

Lake Whatcom Water Quality Model



by

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Table of Contents

<i>List of Figures</i>	<i>i</i>
<i>List of Tables</i>	<i>xviii</i>
<i>Acknowledgements</i>	<i>xix</i>
<i>Introduction</i>	<i>1</i>
<i>Model Selection</i>	<i>4</i>
<i>Model Water Quality Constituents</i>	<i>6</i>
<i>Model Forcing Data and Bathymetry</i>	<i>7</i>
Model Geometry	9
Bathymetry	9
Grid Layout	10
Lake Whatcom outflow.....	12
Tributaries	13
Meteorological Data	18
Groundwater	18
Precipitation	21
Withdrawals	22
<i>Hydrodynamic Calibration</i>	<i>23</i>
<i>Temperature Calibration</i>	<i>24</i>
<i>Water Quality Calibration</i>	<i>25</i>
<i>Scenarios</i>	<i>35</i>
<i>Summary</i>	<i>39</i>
<i>References</i>	<i>40</i>
<i>Appendix A: Model Inputs</i>	<i>41</i>
Tributary Flow Rates.....	41
Tributary Temperatures.....	45
Tributary Constituents	49
Meteorological Inputs	85
Precipitation Constituent Inputs	92
<i>Appendix B: Model Control File</i>	<i>96</i>
<i>Appendix C: Vertical Profiles of Model Predictions and data</i>	<i>118</i>

List of Figures

Figure 1. Lake Whatcom and vicinity.	1
Figure 2. Topography around Lake Whatcom.	3
Figure 3. Coordinate system for CE-QUAL-W2 Version 3.2.	5

Figure 4. Conceptual schematic of river-reservoir connection in CE-QUAL-W2 Version 3. The propellers indicate that a model cell is well-mixed.....	6
Figure 5. Monitoring sites at Lake Whatcom	8
Figure 6. Lake Whatcom bathymetry	10
Figure 7. Plan view of the Lake Whatcom model grid.	11
Figure 8. Layer elevations of Lake Whatcom model. Only layers below the full pool elevation are shown.	12
Figure 9. Lake Whatcom Outflow	13
Figure 10. Watersheds of Lake Whatcom tributaries.	14
Figure 11. Flows and Water Quality Based on Ecology’s “Lake Whatcom TMDL Groundwater Study”, (Pitz, 2005).....	20
Figure 12. Groundwater temperatures.	21
Figure 13. Precipitation rates for water body 1 and water body 2.	22
Figure 14. Lake Whatcom withdrawals.	23
Figure 15. Water level prediction compared with data for Lake Whatcom.	24
Figure 16. Model versus data scatter plot for temperature.	25
Figure 17. Model versus data scatter plot for dissolved oxygen.	34
Figure 18. Model versus data scatter plot for chlorophyll a.	35
Figure 19. Graph showing DO deficit at bottom layer of Segment 60 (segment in basin 1) relative to rollback case for different phosphorus loads. Point corresponding to the rollback with dam scenario, partial rollback D scenario, partial rollback E scenario, and the base scenarios were plotted.	38
Figure 20. Dissolved Oxygen profiles of rollback, base, buildout, and partial rollback run D scenarios in basin 1 (segment 60) on 7/22/02.	39
Figure 21. Tributary flow rates.	41
Figure 22. Tributary flow rates (continued).....	42
Figure 23. Tributary flow rates (continued).....	43
Figure 24. Tributary flow rates (continued).....	44
Figure 25. Tributary temperatures (data gaps correspond to periods of zero flow).	45
Figure 26. Tributary temperatures (data gaps correspond to periods of zero flow).	46
Figure 27. Tributary temperatures (data gaps correspond to periods of zero flow).	47
Figure 28. Tributary temperatures (data gaps correspond to periods of zero flow).	48
Figure 29. Constituent Concentrations used for Anderson Creek.	49
Figure 30. Constituent Concentrations used for Anderson Creek.	50
Figure 31. Constituent Concentrations used for Anderson Creek.	51
Figure 32. Constituent Concentrations used for Anderson Creek.	52
Figure 33. Constituent Concentrations used for Austin Creek.	53
Figure 34. Constituent Concentrations used for Austin Creek.	54
Figure 35. Constituent Concentrations used for Austin Creek.	55
Figure 36. Constituent Concentrations used for Austin Creek.	56
Figure 37. Constituent Concentrations used for Brannian Creek.	57
Figure 38. Constituent Concentrations used for Brannian Creek.	58
Figure 39. Constituent Concentrations used for Brannian Creek.	59
Figure 40. Constituent concentrations used for Brannian Creek.	60
Figure 41. Constituent concentrations used for Carpenter Creek.	61
Figure 42. Constituent concentrations used for Carpenter Creek.	62
Figure 43. Constituent concentrations used for Carpenter Creek.	63
Figure 44. Constituent concentrations used for Carpenter Creek.	64
Figure 45. Constituent concentrations used for Euclid Creek.	65

Figure 46. Constituent concentrations used for Euclid Creek.	66
Figure 47. Constituent concentrations used for Euclid Creek.	67
Figure 48. Constituent concentrations used for Euclid Creek.	68
Figure 49. Constituent concentrations used for Mill Wheel Creek.	69
Figure 50. Constituent concentrations used for Mill Wheel Creek.	70
Figure 51. Constituent concentrations used for Mill Wheel Creek.	71
Figure 52. Constituent concentrations used for Mill Wheel Creek.	72
Figure 53. Constituent concentrations used for Olsen Creek.	73
Figure 54. Constituent concentrations used for Olsen Creek.	74
Figure 55. Constituent concentrations used for Olsen Creek.	75
Figure 56. Constituent concentrations used for Olsen Creek.	76
Figure 57. Constituent concentrations used for Silver Beach Creek.	77
Figure 58. Constituent concentrations used for Silver Beach Creek.	78
Figure 59. Constituent concentrations used for Silver Beach Creek.	79
Figure 60. Constituent concentrations used for Silver Beach Creek.	80
Figure 61. Constituent concentrations used for Smith Creek.	81
Figure 62. Constituent concentrations used for Smith Creek.	82
Figure 63. Constituent concentrations used for Smith Creek.	83
Figure 64. Constituent concentrations used for Smith Creek.	84
Figure 65. Air temperature for water body 1.	85
Figure 66. Air temperature for water body 2.	86
Figure 67. Dew point temperature for water body 1.....	87
Figure 68. Dew point temperature for water body 2.....	87
Figure 69. Wind Speed for water body 1.....	88
Figure 70. Wind Speed for water body 2.....	88
Figure 71. Wind direction used water body 1.....	89
Figure 72. Wind direction used water body 2.....	89
Figure 73. Cloud Cover for water body 1.	90
Figure 74. Cloud Cover for water body 2.	90
Figure 75. Short wave solar radiation for water body 1.	91
Figure 76. Short wave solar radiation for water body 2.	91
Figure 77. Constituent concentrations for precipitation.	92
Figure 78. Constituent concentrations for precipitation (continued).	93
Figure 79. Constituent concentrations for precipitation (continued).	94
Figure 80. Constituent concentrations for precipitation (continued).	95
Figure 81. Vertical profiles of TEMPERATURE compared with data for 2/14/2002.	118
Figure 82. Vertical profiles of TEMPERATURE compared with data for 4/ 2/2002.	119
Figure 83. Vertical profiles of TEMPERATURE compared with data for 4/ 4/2002.	120
Figure 84. Vertical profiles of TEMPERATURE compared with data for 5/ 7/2002.	121
Figure 85. Vertical profiles of TEMPERATURE compared with data for 5/ 9/2002.	122
Figure 86. Vertical profiles of TEMPERATURE compared with data for 6/ 4/2002.	123
Figure 87. Vertical profiles of TEMPERATURE compared with data for 6/14/2002.	124
Figure 88. Vertical profiles of TEMPERATURE compared with data for 7/ 2/2002.	125
Figure 89. Vertical profiles of TEMPERATURE compared with data for 7/10/2002.	126
Figure 90. Vertical profiles of TEMPERATURE compared with data for 7/15/2002.	127
Figure 91. Vertical profiles of TEMPERATURE compared with data for 8/ 6/2002.	128
Figure 92. Vertical profiles of TEMPERATURE compared with data for 8/ 8/2002.	129
Figure 93. Vertical profiles of TEMPERATURE compared with data for 8/10/2002.	130

Figure 94. Vertical profiles of TEMPERATURE compared with data for 8/13/2002.	131
Figure 95. Vertical profiles of TEMPERATURE compared with data for 9/ 3/2002.	132
Figure 96. Vertical profiles of TEMPERATURE compared with data for 9/ 5/2002.	133
Figure 97. Vertical profiles of TEMPERATURE compared with data for 9/16/2002.	134
Figure 98. Vertical profiles of TEMPERATURE compared with data for 10/ 8/2002.	135
Figure 99. Vertical profiles of TEMPERATURE compared with data for 10/10/2002.	136
Figure 100. Vertical profiles of TEMPERATURE compared with data for 11/ 5/2002.	137
Figure 101. Vertical profiles of TEMPERATURE compared with data for 11/ 7/2002.	138
Figure 102. Vertical profiles of TEMPERATURE compared with data for 11/13/2002.	139
Figure 103. Vertical profiles of TEMPERATURE compared with data for 12/ 3/2002.	140
Figure 104. Vertical profiles of TEMPERATURE compared with data for 12/ 5/2002.	141
Figure 105. Vertical profiles of TEMPERATURE compared with data for 2/ 4/2003.	142
Figure 106. Vertical profiles of TEMPERATURE compared with data for 2/ 6/2003.	143
Figure 107. Vertical profiles of TEMPERATURE compared with data for 4/ 1/2003.	144
Figure 108. Vertical profiles of TEMPERATURE compared with data for 4/ 3/2003.	145
Figure 109. Vertical profiles of TEMPERATURE compared with data for 5/ 6/2003.	146
Figure 110. Vertical profiles of TEMPERATURE compared with data for 5/ 8/2003.	147
Figure 111. Vertical profiles of TEMPERATURE compared with data for 5/27/2003.	148
Figure 112. Vertical profiles of TEMPERATURE compared with data for 6/ 3/2003.	149
Figure 113. Vertical profiles of TEMPERATURE compared with data for 6/ 5/2003.	150
Figure 114. Vertical profiles of TEMPERATURE compared with data for 6/10/2003.	151
Figure 115. Vertical profiles of TEMPERATURE compared with data for 7/ 8/2003.	152
Figure 116. Vertical profiles of TEMPERATURE compared with data for 7/10/2003.	153
Figure 117. Vertical profiles of TEMPERATURE compared with data for 7/15/2003.	154
Figure 118. Vertical profiles of TEMPERATURE compared with data for 7/29/2003.	155
Figure 119. Vertical profiles of TEMPERATURE compared with data for 8/ 5/2003.	156
Figure 120. Vertical profiles of TEMPERATURE compared with data for 8/ 7/2003.	157
Figure 121. Vertical profiles of TEMPERATURE compared with data for 8/14/2003.	158
Figure 122. Vertical profiles of TEMPERATURE compared with data for 8/19/2003.	159
Figure 123. Vertical profiles of TEMPERATURE compared with data for 8/26/2003.	160
Figure 124. Vertical profiles of TEMPERATURE compared with data for 9/ 2/2003.	161
Figure 125. Vertical profiles of TEMPERATURE compared with data for 9/ 4/2003.	162
Figure 126. Vertical profiles of TEMPERATURE compared with data for 9/ 9/2003.	163
Figure 127. Vertical profiles of TEMPERATURE compared with data for 9/23/2003.	164
Figure 128. Vertical profiles of TEMPERATURE compared with data for 10/ 7/2003.	165
Figure 129. Vertical profiles of TEMPERATURE compared with data for 10/ 9/2003.	166
Figure 130. Vertical profiles of TEMPERATURE compared with data for 11/ 4/2003.	167
Figure 131. Vertical profiles of TEMPERATURE compared with data for 11/ 6/2003.	168
Figure 132. Vertical profiles of TEMPERATURE compared with data for 12/ 4/2003.	169
Figure 133. Vertical profiles of TEMPERATURE compared with data for 12/ 9/2003.	170
Figure 134. Vertical profiles of TEMPERATURE compared with data for 12/12/2003.	171
Figure 135. Vertical profiles of PO4-P compared with data for 2/14/2002.	172
Figure 136. Vertical profiles of PO4-P compared with data for 4/ 2/2002.	173
Figure 137. Vertical profiles of PO4-P compared with data for 4/ 4/2002.	174
Figure 138. Vertical profiles of PO4-P compared with data for 5/ 7/2002.	175
Figure 139. Vertical profiles of PO4-P compared with data for 5/ 9/2002.	176
Figure 140. Vertical profiles of PO4-P compared with data for 6/ 4/2002.	177
Figure 141. Vertical profiles of PO4-P compared with data for 6/14/2002.	178

Figure 142.	Vertical profiles of PO4-P compared with data for 7/ 2/2002.....	179
Figure 143.	Vertical profiles of PO4-P compared with data for 7/10/2002.....	180
Figure 144.	Vertical profiles of PO4-P compared with data for 7/15/2002.....	181
Figure 145.	Vertical profiles of PO4-P compared with data for 8/ 6/2002.....	182
Figure 146.	Vertical profiles of PO4-P compared with data for 8/ 8/2002.....	183
Figure 147.	Vertical profiles of PO4-P compared with data for 8/10/2002.....	184
Figure 148.	Vertical profiles of PO4-P compared with data for 8/13/2002.....	185
Figure 149.	Vertical profiles of PO4-P compared with data for 9/ 3/2002.....	186
Figure 150.	Vertical profiles of PO4-P compared with data for 9/ 5/2002.....	187
Figure 151.	Vertical profiles of PO4-P compared with data for 9/16/2002.....	188
Figure 152.	Vertical profiles of PO4-P compared with data for 10/ 8/2002.....	189
Figure 153.	Vertical profiles of PO4-P compared with data for 10/10/2002.....	190
Figure 154.	Vertical profiles of PO4-P compared with data for 11/ 5/2002.....	191
Figure 155.	Vertical profiles of PO4-P compared with data for 11/ 7/2002.....	192
Figure 156.	Vertical profiles of PO4-P compared with data for 11/13/2002.....	193
Figure 157.	Vertical profiles of PO4-P compared with data for 12/ 3/2002.....	194
Figure 158.	Vertical profiles of PO4-P compared with data for 12/ 5/2002.....	195
Figure 159.	Vertical profiles of PO4-P compared with data for 2/ 4/2003.....	196
Figure 160.	Vertical profiles of PO4-P compared with data for 2/ 6/2003.....	197
Figure 161.	Vertical profiles of PO4-P compared with data for 4/ 1/2003.....	198
Figure 162.	Vertical profiles of PO4-P compared with data for 4/ 3/2003.....	199
Figure 163.	Vertical profiles of PO4-P compared with data for 5/ 6/2003.....	200
Figure 164.	Vertical profiles of PO4-P compared with data for 5/ 8/2003.....	201
Figure 165.	Vertical profiles of PO4-P compared with data for 5/27/2003.....	202
Figure 166.	Vertical profiles of PO4-P compared with data for 6/ 3/2003.....	203
Figure 167.	Vertical profiles of PO4-P compared with data for 6/ 5/2003.....	204
Figure 168.	Vertical profiles of PO4-P compared with data for 6/10/2003.....	205
Figure 169.	Vertical profiles of PO4-P compared with data for 7/ 8/2003.....	206
Figure 170.	Vertical profiles of PO4-P compared with data for 7/10/2003.....	207
Figure 171.	Vertical profiles of PO4-P compared with data for 7/15/2003.....	208
Figure 172.	Vertical profiles of PO4-P compared with data for 7/29/2003.....	209
Figure 173.	Vertical profiles of PO4-P compared with data for 8/ 5/2003.....	210
Figure 174.	Vertical profiles of PO4-P compared with data for 8/ 7/2003.....	211
Figure 175.	Vertical profiles of PO4-P compared with data for 8/14/2003.....	212
Figure 176.	Vertical profiles of PO4-P compared with data for 8/19/2003.....	213
Figure 177.	Vertical profiles of PO4-P compared with data for 8/26/2003.....	214
Figure 178.	Vertical profiles of PO4-P compared with data for 9/ 2/2003.....	215
Figure 179.	Vertical profiles of PO4-P compared with data for 9/ 4/2003.....	216
Figure 180.	Vertical profiles of PO4-P compared with data for 9/ 9/2003.....	217
Figure 181.	Vertical profiles of PO4-P compared with data for 9/23/2003.....	218
Figure 182.	Vertical profiles of PO4-P compared with data for 10/ 7/2003.....	219
Figure 183.	Vertical profiles of PO4-P compared with data for 10/ 9/2003.....	220
Figure 184.	Vertical profiles of PO4-P compared with data for 11/ 4/2003.....	221
Figure 185.	Vertical profiles of PO4-P compared with data for 11/ 6/2003.....	222
Figure 186.	Vertical profiles of PO4-P compared with data for 12/ 4/2003.....	223
Figure 187.	Vertical profiles of PO4-P compared with data for 12/ 9/2003.....	224
Figure 188.	Vertical profiles of PO4-P compared with data for 12/12/2003.....	225
Figure 189.	Vertical profiles of NH4-N compared with data for 2/14/2002.	226

Figure 190. Vertical profiles of NH ₄ -N compared with data for 4/ 2/2002.	227
Figure 191. Vertical profiles of NH ₄ -N compared with data for 4/ 4/2002.	228
Figure 192. Vertical profiles of NH ₄ -N compared with data for 5/ 7/2002.	229
Figure 193. Vertical profiles of NH ₄ -N compared with data for 5/ 9/2002.	230
Figure 194. Vertical profiles of NH ₄ -N compared with data for 6/ 4/2002.	231
Figure 195. Vertical profiles of NH ₄ -N compared with data for 6/14/2002.	232
Figure 196. Vertical profiles of NH ₄ -N compared with data for 7/ 2/2002.	233
Figure 197. Vertical profiles of NH ₄ -N compared with data for 7/10/2002.	234
Figure 198. Vertical profiles of NH ₄ -N compared with data for 7/15/2002.	235
Figure 199. Vertical profiles of NH ₄ -N compared with data for 8/ 6/2002.	236
Figure 200. Vertical profiles of NH ₄ -N compared with data for 8/ 8/2002.	237
Figure 201. Vertical profiles of NH ₄ -N compared with data for 8/10/2002.	238
Figure 202. Vertical profiles of NH ₄ -N compared with data for 8/13/2002.	239
Figure 203. Vertical profiles of NH ₄ -N compared with data for 9/ 3/2002.	240
Figure 204. Vertical profiles of NH ₄ -N compared with data for 9/ 5/2002.	241
Figure 205. Vertical profiles of NH ₄ -N compared with data for 9/16/2002.	242
Figure 206. Vertical profiles of NH ₄ -N compared with data for 10/ 8/2002.	243
Figure 207. Vertical profiles of NH ₄ -N compared with data for 10/10/2002.	244
Figure 208. Vertical profiles of NH ₄ -N compared with data for 11/ 5/2002.	245
Figure 209. Vertical profiles of NH ₄ -N compared with data for 11/ 7/2002.	246
Figure 210. Vertical profiles of NH ₄ -N compared with data for 11/13/2002.	247
Figure 211. Vertical profiles of NH ₄ -N compared with data for 12/ 3/2002.	248
Figure 212. Vertical profiles of NH ₄ -N compared with data for 12/ 5/2002.	249
Figure 213. Vertical profiles of NH ₄ -N compared with data for 2/ 4/2003.	250
Figure 214. Vertical profiles of NH ₄ -N compared with data for 2/ 6/2003.	251
Figure 215. Vertical profiles of NH ₄ -N compared with data for 4/ 1/2003.	252
Figure 216. Vertical profiles of NH ₄ -N compared with data for 4/ 3/2003.	253
Figure 217. Vertical profiles of NH ₄ -N compared with data for 5/ 6/2003.	254
Figure 218. Vertical profiles of NH ₄ -N compared with data for 5/ 8/2003.	255
Figure 219. Vertical profiles of NH ₄ -N compared with data for 5/27/2003.	256
Figure 220. Vertical profiles of NH ₄ -N compared with data for 6/ 3/2003.	257
Figure 221. Vertical profiles of NH ₄ -N compared with data for 6/ 5/2003.	258
Figure 222. Vertical profiles of NH ₄ -N compared with data for 6/10/2003.	259
Figure 223. Vertical profiles of NH ₄ -N compared with data for 7/ 8/2003.	260
Figure 224. Vertical profiles of NH ₄ -N compared with data for 7/10/2003.	261
Figure 225. Vertical profiles of NH ₄ -N compared with data for 7/15/2003.	262
Figure 226. Vertical profiles of NH ₄ -N compared with data for 7/29/2003.	263
Figure 227. Vertical profiles of NH ₄ -N compared with data for 8/ 5/2003.	264
Figure 228. Vertical profiles of NH ₄ -N compared with data for 8/ 7/2003.	265
Figure 229. Vertical profiles of NH ₄ -N compared with data for 8/14/2003.	266
Figure 230. Vertical profiles of NH ₄ -N compared with data for 8/19/2003.	267
Figure 231. Vertical profiles of NH ₄ -N compared with data for 8/26/2003.	268
Figure 232. Vertical profiles of NH ₄ -N compared with data for 9/ 2/2003.	269
Figure 233. Vertical profiles of NH ₄ -N compared with data for 9/ 4/2003.	270
Figure 234. Vertical profiles of NH ₄ -N compared with data for 9/ 9/2003.	271
Figure 235. Vertical profiles of NH ₄ -N compared with data for 9/23/2003.	272
Figure 236. Vertical profiles of NH ₄ -N compared with data for 10/ 7/2003.	273
Figure 237. Vertical profiles of NH ₄ -N compared with data for 10/ 9/2003.	274

Figure 238.	Vertical profiles of NH ₄ -N compared with data for 11/ 4/2003.	275
Figure 239.	Vertical profiles of NH ₄ -N compared with data for 11/ 6/2003.	276
Figure 240.	Vertical profiles of NH ₄ -N compared with data for 12/ 4/2003.	277
Figure 241.	Vertical profiles of NH ₄ -N compared with data for 12/ 9/2003.	278
Figure 242.	Vertical profiles of NH ₄ -N compared with data for 12/12/2003.	279
Figure 243.	Vertical profiles of NO _x -N compared with data for 2/14/2002.	280
Figure 244.	Vertical profiles of NO _x -N compared with data for 4/ 2/2002.	281
Figure 245.	Vertical profiles of NO _x -N compared with data for 4/ 4/2002.	282
Figure 246.	Vertical profiles of NO _x -N compared with data for 5/ 7/2002.	283
Figure 247.	Vertical profiles of NO _x -N compared with data for 5/ 9/2002.	284
Figure 248.	Vertical profiles of NO _x -N compared with data for 6/ 4/2002.	285
Figure 249.	Vertical profiles of NO _x -N compared with data for 6/14/2002.	286
Figure 250.	Vertical profiles of NO _x -N compared with data for 7/ 2/2002.	287
Figure 251.	Vertical profiles of NO _x -N compared with data for 7/10/2002.	288
Figure 252.	Vertical profiles of NO _x -N compared with data for 7/15/2002.	289
Figure 253.	Vertical profiles of NO _x -N compared with data for 8/ 6/2002.	290
Figure 254.	Vertical profiles of NO _x -N compared with data for 8/ 8/2002.	291
Figure 255.	Vertical profiles of NO _x -N compared with data for 8/10/2002.	292
Figure 256.	Vertical profiles of NO _x -N compared with data for 8/13/2002.	293
Figure 257.	Vertical profiles of NO _x -N compared with data for 9/ 3/2002.	294
Figure 258.	Vertical profiles of NO _x -N compared with data for 9/ 5/2002.	295
Figure 259.	Vertical profiles of NO _x -N compared with data for 9/16/2002.	296
Figure 260.	Vertical profiles of NO _x -N compared with data for 10/ 8/2002.	297
Figure 261.	Vertical profiles of NO _x -N compared with data for 10/10/2002.	298
Figure 262.	Vertical profiles of NO _x -N compared with data for 11/ 5/2002.	299
Figure 263.	Vertical profiles of NO _x -N compared with data for 11/ 7/2002.	300
Figure 264.	Vertical profiles of NO _x -N compared with data for 11/13/2002.	301
Figure 265.	Vertical profiles of NO _x -N compared with data for 12/ 3/2002.	302
Figure 266.	Vertical profiles of NO _x -N compared with data for 12/ 5/2002.	303
Figure 267.	Vertical profiles of NO _x -N compared with data for 2/ 4/2003.	304
Figure 268.	Vertical profiles of NO _x -N compared with data for 2/ 6/2003.	305
Figure 269.	Vertical profiles of NO _x -N compared with data for 4/ 1/2003.	306
Figure 270.	Vertical profiles of NO _x -N compared with data for 4/ 3/2003.	307
Figure 271.	Vertical profiles of NO _x -N compared with data for 5/ 6/2003.	308
Figure 272.	Vertical profiles of NO _x -N compared with data for 5/ 8/2003.	309
Figure 273.	Vertical profiles of NO _x -N compared with data for 5/27/2003.	310
Figure 274.	Vertical profiles of NO _x -N compared with data for 6/ 3/2003.	311
Figure 275.	Vertical profiles of NO _x -N compared with data for 6/ 5/2003.	312
Figure 276.	Vertical profiles of NO _x -N compared with data for 6/10/2003.	313
Figure 277.	Vertical profiles of NO _x -N compared with data for 7/ 8/2003.	314
Figure 278.	Vertical profiles of NO _x -N compared with data for 7/10/2003.	315
Figure 279.	Vertical profiles of NO _x -N compared with data for 7/15/2003.	316
Figure 280.	Vertical profiles of NO _x -N compared with data for 7/29/2003.	317
Figure 281.	Vertical profiles of NO _x -N compared with data for 8/ 5/2003.	318
Figure 282.	Vertical profiles of NO _x -N compared with data for 8/ 7/2003.	319
Figure 283.	Vertical profiles of NO _x -N compared with data for 8/14/2003.	320
Figure 284.	Vertical profiles of NO _x -N compared with data for 8/19/2003.	321
Figure 285.	Vertical profiles of NO _x -N compared with data for 8/26/2003.	322

Figure 286.	Vertical profiles of NO _x -N compared with data for 9/ 2/2003.	323
Figure 287.	Vertical profiles of NO _x -N compared with data for 9/ 4/2003.	324
Figure 288.	Vertical profiles of NO _x -N compared with data for 9/ 9/2003.	325
Figure 289.	Vertical profiles of NO _x -N compared with data for 9/23/2003.	326
Figure 290.	Vertical profiles of NO _x -N compared with data for 10/ 7/2003.	327
Figure 291.	Vertical profiles of NO _x -N compared with data for 10/ 9/2003.	328
Figure 292.	Vertical profiles of NO _x -N compared with data for 11/ 4/2003.	329
Figure 293.	Vertical profiles of NO _x -N compared with data for 11/ 6/2003.	330
Figure 294.	Vertical profiles of NO _x -N compared with data for 12/ 4/2003.	331
Figure 295.	Vertical profiles of NO _x -N compared with data for 12/ 9/2003.	332
Figure 296.	Vertical profiles of NO _x -N compared with data for 12/12/2003.	333
Figure 297.	Vertical profiles of DISSOLVED OXYGEN compared with data for 2/14/2002.	334
Figure 298.	Vertical profiles of DISSOLVED OXYGEN compared with data for 4/ 2/2002.	335
Figure 299.	Vertical profiles of DISSOLVED OXYGEN compared with data for 4/ 4/2002.	336
Figure 300.	Vertical profiles of DISSOLVED OXYGEN compared with data for 5/ 7/2002.	337
Figure 301.	Vertical profiles of DISSOLVED OXYGEN compared with data for 5/ 9/2002.	338
Figure 302.	Vertical profiles of DISSOLVED OXYGEN compared with data for 6/ 4/2002.	339
Figure 303.	Vertical profiles of DISSOLVED OXYGEN compared with data for 6/14/2002.	340
Figure 304.	Vertical profiles of DISSOLVED OXYGEN compared with data for 7/ 2/2002.	341
Figure 305.	Vertical profiles of DISSOLVED OXYGEN compared with data for 7/10/2002.	342
Figure 306.	Vertical profiles of DISSOLVED OXYGEN compared with data for 7/15/2002.	343
Figure 307.	Vertical profiles of DISSOLVED OXYGEN compared with data for 8/ 6/2002.	344
Figure 308.	Vertical profiles of DISSOLVED OXYGEN compared with data for 8/ 8/2002.	345
Figure 309.	Vertical profiles of DISSOLVED OXYGEN compared with data for 8/10/2002.	346
Figure 310.	Vertical profiles of DISSOLVED OXYGEN compared with data for 8/13/2002.	347
Figure 311.	Vertical profiles of DISSOLVED OXYGEN compared with data for 9/ 3/2002.	348
Figure 312.	Vertical profiles of DISSOLVED OXYGEN compared with data for 9/ 5/2002.	349
Figure 313.	Vertical profiles of DISSOLVED OXYGEN compared with data for 9/16/2002.	350
Figure 314.	Vertical profiles of DISSOLVED OXYGEN compared with data for 10/ 8/2002.	351
Figure 315.	Vertical profiles of DISSOLVED OXYGEN compared with data for 10/10/2002.	352
Figure 316.	Vertical profiles of DISSOLVED OXYGEN compared with data for 11/ 5/2002.	353
Figure 317.	Vertical profiles of DISSOLVED OXYGEN compared with data for 11/ 7/2002.	354
Figure 318.	Vertical profiles of DISSOLVED OXYGEN compared with data for 11/13/2002.	355
Figure 319.	Vertical profiles of DISSOLVED OXYGEN compared with data for 12/ 3/2002.	356
Figure 320.	Vertical profiles of DISSOLVED OXYGEN compared with data for 12/ 5/2002.	357
Figure 321.	Vertical profiles of DISSOLVED OXYGEN compared with data for 2/ 4/2003.	358
Figure 322.	Vertical profiles of DISSOLVED OXYGEN compared with data for 2/ 6/2003.	359
Figure 323.	Vertical profiles of DISSOLVED OXYGEN compared with data for 4/ 1/2003.	360
Figure 324.	Vertical profiles of DISSOLVED OXYGEN compared with data for 4/ 3/2003.	361
Figure 325.	Vertical profiles of DISSOLVED OXYGEN compared with data for 5/ 6/2003.	362
Figure 326.	Vertical profiles of DISSOLVED OXYGEN compared with data for 5/ 8/2003.	363
Figure 327.	Vertical profiles of DISSOLVED OXYGEN compared with data for 5/27/2003.	364
Figure 328.	Vertical profiles of DISSOLVED OXYGEN compared with data for 6/ 3/2003.	365
Figure 329.	Vertical profiles of DISSOLVED OXYGEN compared with data for 6/ 5/2003.	366
Figure 330.	Vertical profiles of DISSOLVED OXYGEN compared with data for 6/10/2003.	367
Figure 331.	Vertical profiles of DISSOLVED OXYGEN compared with data for 7/ 8/2003.	368
Figure 332.	Vertical profiles of DISSOLVED OXYGEN compared with data for 7/10/2003.	369
Figure 333.	Vertical profiles of DISSOLVED OXYGEN compared with data for 7/15/2003.	370

Figure 334.	Vertical profiles of DISSOLVED OXYGEN compared with data for 7/29/2003.	371
Figure 335.	Vertical profiles of DISSOLVED OXYGEN compared with data for 8/ 5/2003.	372
Figure 336.	Vertical profiles of DISSOLVED OXYGEN compared with data for 8/ 7/2003.	373
Figure 337.	Vertical profiles of DISSOLVED OXYGEN compared with data for 8/14/2003.	374
Figure 338.	Vertical profiles of DISSOLVED OXYGEN compared with data for 8/19/2003.	375
Figure 339.	Vertical profiles of DISSOLVED OXYGEN compared with data for 8/26/2003.	376
Figure 340.	Vertical profiles of DISSOLVED OXYGEN compared with data for 9/ 2/2003.	377
Figure 341.	Vertical profiles of DISSOLVED OXYGEN compared with data for 9/ 4/2003.	378
Figure 342.	Vertical profiles of DISSOLVED OXYGEN compared with data for 9/ 9/2003.	379
Figure 343.	Vertical profiles of DISSOLVED OXYGEN compared with data for 9/23/2003.	380
Figure 344.	Vertical profiles of DISSOLVED OXYGEN compared with data for 10/ 7/2003.	381
Figure 345.	Vertical profiles of DISSOLVED OXYGEN compared with data for 10/ 9/2003.	382
Figure 346.	Vertical profiles of DISSOLVED OXYGEN compared with data for 11/ 4/2003.	383
Figure 347.	Vertical profiles of DISSOLVED OXYGEN compared with data for 11/ 6/2003.	384
Figure 348.	Vertical profiles of DISSOLVED OXYGEN compared with data for 12/ 4/2003.	385
Figure 349.	Vertical profiles of DISSOLVED OXYGEN compared with data for 12/ 9/2003.	386
Figure 350.	Vertical profiles of DISSOLVED OXYGEN compared with data for 12/12/2003.	387
Figure 351.	Vertical profiles of Alkalinity compared with data for 2/14/2002.	388
Figure 352.	Vertical profiles of Alkalinity compared with data for 4/ 2/2002.	389
Figure 353.	Vertical profiles of Alkalinity compared with data for 4/ 4/2002.	390
Figure 354.	Vertical profiles of Alkalinity compared with data for 5/ 7/2002.	391
Figure 355.	Vertical profiles of Alkalinity compared with data for 5/ 9/2002.	392
Figure 356.	Vertical profiles of Alkalinity compared with data for 6/ 4/2002.	393
Figure 357.	Vertical profiles of Alkalinity compared with data for 6/14/2002.	394
Figure 358.	Vertical profiles of Alkalinity compared with data for 7/ 2/2002.	395
Figure 359.	Vertical profiles of Alkalinity compared with data for 7/10/2002.	396
Figure 360.	Vertical profiles of Alkalinity compared with data for 7/15/2002.	397
Figure 361.	Vertical profiles of Alkalinity compared with data for 8/ 6/2002.	398
Figure 362.	Vertical profiles of Alkalinity compared with data for 8/ 8/2002.	399
Figure 363.	Vertical profiles of Alkalinity compared with data for 8/10/2002.	400
Figure 364.	Vertical profiles of Alkalinity compared with data for 8/13/2002.	401
Figure 365.	Vertical profiles of Alkalinity compared with data for 9/ 3/2002.	402
Figure 366.	Vertical profiles of Alkalinity compared with data for 9/ 5/2002.	403
Figure 367.	Vertical profiles of Alkalinity compared with data for 9/16/2002.	404
Figure 368.	Vertical profiles of Alkalinity compared with data for 10/ 8/2002.	405
Figure 369.	Vertical profiles of Alkalinity compared with data for 10/10/2002.	406
Figure 370.	Vertical profiles of Alkalinity compared with data for 11/ 5/2002.	407
Figure 371.	Vertical profiles of Alkalinity compared with data for 11/ 7/2002.	408
Figure 372.	Vertical profiles of Alkalinity compared with data for 11/13/2002.	409
Figure 373.	Vertical profiles of Alkalinity compared with data for 12/ 3/2002.	410
Figure 374.	Vertical profiles of Alkalinity compared with data for 12/ 5/2002.	411
Figure 375.	Vertical profiles of Alkalinity compared with data for 2/ 4/2003.	412
Figure 376.	Vertical profiles of Alkalinity compared with data for 2/ 6/2003.	413
Figure 377.	Vertical profiles of Alkalinity compared with data for 4/ 1/2003.	414
Figure 378.	Vertical profiles of Alkalinity compared with data for 4/ 3/2003.	415
Figure 379.	Vertical profiles of Alkalinity compared with data for 5/ 6/2003.	416
Figure 380.	Vertical profiles of Alkalinity compared with data for 5/ 8/2003.	417
Figure 381.	Vertical profiles of Alkalinity compared with data for 5/27/2003.	418

Figure 382. Vertical profiles of Alkalinity compared with data for 6/ 3/2003.	419
Figure 383. Vertical profiles of Alkalinity compared with data for 6/ 5/2003.	420
Figure 384. Vertical profiles of Alkalinity compared with data for 6/10/2003.	421
Figure 385. Vertical profiles of Alkalinity compared with data for 7/ 8/2003.	422
Figure 386. Vertical profiles of Alkalinity compared with data for 7/10/2003.	423
Figure 387. Vertical profiles of Alkalinity compared with data for 7/15/2003.	424
Figure 388. Vertical profiles of Alkalinity compared with data for 7/29/2003.	425
Figure 389. Vertical profiles of Alkalinity compared with data for 8/ 5/2003.	426
Figure 390. Vertical profiles of Alkalinity compared with data for 8/ 7/2003.	427
Figure 391. Vertical profiles of Alkalinity compared with data for 8/14/2003.	428
Figure 392. Vertical profiles of Alkalinity compared with data for 8/19/2003.	429
Figure 393. Vertical profiles of Alkalinity compared with data for 8/26/2003.	430
Figure 394. Vertical profiles of Alkalinity compared with data for 9/ 2/2003.	431
Figure 395. Vertical profiles of Alkalinity compared with data for 9/ 4/2003.	432
Figure 396. Vertical profiles of Alkalinity compared with data for 9/ 9/2003.	433
Figure 397. Vertical profiles of Alkalinity compared with data for 9/23/2003.	434
Figure 398. Vertical profiles of Alkalinity compared with data for 10/ 7/2003.	435
Figure 399. Vertical profiles of Alkalinity compared with data for 10/ 9/2003.	436
Figure 400. Vertical profiles of Alkalinity compared with data for 11/ 4/2003.	437
Figure 401. Vertical profiles of Alkalinity compared with data for 11/ 6/2003.	438
Figure 402. Vertical profiles of Alkalinity compared with data for 12/ 4/2003.	439
Figure 403. Vertical profiles of Alkalinity compared with data for 12/ 9/2003.	440
Figure 404. Vertical profiles of Alkalinity compared with data for 12/12/2003.	441
Figure 405. Vertical profiles of TOTAL NITROGEN compared with data for 2/14/2002.....	442
Figure 406. Vertical profiles of TOTAL NITROGEN compared with data for 4/ 2/2002.....	443
Figure 407. Vertical profiles of TOTAL NITROGEN compared with data for 4/ 4/2002.....	444
Figure 408. Vertical profiles of TOTAL NITROGEN compared with data for 5/ 7/2002.....	445
Figure 409. Vertical profiles of TOTAL NITROGEN compared with data for 5/ 9/2002.....	446
Figure 410. Vertical profiles of TOTAL NITROGEN compared with data for 6/ 4/2002.....	447
Figure 411. Vertical profiles of TOTAL NITROGEN compared with data for 6/14/2002.....	448
Figure 412. Vertical profiles of TOTAL NITROGEN compared with data for 7/ 2/2002.....	449
Figure 413. Vertical profiles of TOTAL NITROGEN compared with data for 7/10/2002.....	450
Figure 414. Vertical profiles of TOTAL NITROGEN compared with data for 7/15/2002.....	451
Figure 415. Vertical profiles of TOTAL NITROGEN compared with data for 8/ 6/2002.....	452
Figure 416. Vertical profiles of TOTAL NITROGEN compared with data for 8/ 8/2002.....	453
Figure 417. Vertical profiles of TOTAL NITROGEN compared with data for 8/10/2002.....	454
Figure 418. Vertical profiles of TOTAL NITROGEN compared with data for 8/13/2002.....	455
Figure 419. Vertical profiles of TOTAL NITROGEN compared with data for 9/ 3/2002.....	456
Figure 420. Vertical profiles of TOTAL NITROGEN compared with data for 9/ 5/2002.....	457
Figure 421. Vertical profiles of TOTAL NITROGEN compared with data for 9/16/2002.....	458
Figure 422. Vertical profiles of TOTAL NITROGEN compared with data for 10/ 8/2002.....	459
Figure 423. Vertical profiles of TOTAL NITROGEN compared with data for 10/10/2002.....	460
Figure 424. Vertical profiles of TOTAL NITROGEN compared with data for 11/ 5/2002.....	461
Figure 425. Vertical profiles of TOTAL NITROGEN compared with data for 11/ 7/2002.....	462
Figure 426. Vertical profiles of TOTAL NITROGEN compared with data for 11/13/2002.....	463
Figure 427. Vertical profiles of TOTAL NITROGEN compared with data for 12/ 3/2002.....	464
Figure 428. Vertical profiles of TOTAL NITROGEN compared with data for 12/ 5/2002.....	465
Figure 429. Vertical profiles of TOTAL NITROGEN compared with data for 2/ 4/2003.....	466

Figure 430.	Vertical profiles of TOTAL NITROGEN compared with data for 2/ 6/2003.....	467
Figure 431.	Vertical profiles of TOTAL NITROGEN compared with data for 4/ 1/2003.....	468
Figure 432.	Vertical profiles of TOTAL NITROGEN compared with data for 4/ 3/2003.....	469
Figure 433.	Vertical profiles of TOTAL NITROGEN compared with data for 5/ 6/2003.....	470
Figure 434.	Vertical profiles of TOTAL NITROGEN compared with data for 5/ 8/2003.....	471
Figure 435.	Vertical profiles of TOTAL NITROGEN compared with data for 5/27/2003.....	472
Figure 436.	Vertical profiles of TOTAL NITROGEN compared with data for 6/ 3/2003.....	473
Figure 437.	Vertical profiles of TOTAL NITROGEN compared with data for 6/ 5/2003.....	474
Figure 438.	Vertical profiles of TOTAL NITROGEN compared with data for 6/10/2003.....	475
Figure 439.	Vertical profiles of TOTAL NITROGEN compared with data for 7/ 8/2003.....	476
Figure 440.	Vertical profiles of TOTAL NITROGEN compared with data for 7/10/2003.....	477
Figure 441.	Vertical profiles of TOTAL NITROGEN compared with data for 7/15/2003.....	478
Figure 442.	Vertical profiles of TOTAL NITROGEN compared with data for 7/29/2003.....	479
Figure 443.	Vertical profiles of TOTAL NITROGEN compared with data for 8/ 5/2003.....	480
Figure 444.	Vertical profiles of TOTAL NITROGEN compared with data for 8/ 7/2003.....	481
Figure 445.	Vertical profiles of TOTAL NITROGEN compared with data for 8/14/2003.....	482
Figure 446.	Vertical profiles of TOTAL NITROGEN compared with data for 8/19/2003.....	483
Figure 447.	Vertical profiles of TOTAL NITROGEN compared with data for 8/26/2003.....	484
Figure 448.	Vertical profiles of TOTAL NITROGEN compared with data for 9/ 2/2003.....	485
Figure 449.	Vertical profiles of TOTAL NITROGEN compared with data for 9/ 4/2003.....	486
Figure 450.	Vertical profiles of TOTAL NITROGEN compared with data for 9/ 9/2003.....	487
Figure 451.	Vertical profiles of TOTAL NITROGEN compared with data for 9/23/2003.....	488
Figure 452.	Vertical profiles of TOTAL NITROGEN compared with data for 10/ 7/2003.....	489
Figure 453.	Vertical profiles of TOTAL NITROGEN compared with data for 10/ 9/2003.....	490
Figure 454.	Vertical profiles of TOTAL NITROGEN compared with data for 11/ 4/2003.....	491
Figure 455.	Vertical profiles of TOTAL NITROGEN compared with data for 11/ 6/2003.....	492
Figure 456.	Vertical profiles of TOTAL NITROGEN compared with data for 12/ 4/2003.....	493
Figure 457.	Vertical profiles of TOTAL NITROGEN compared with data for 12/ 9/2003.....	494
Figure 458.	Vertical profiles of TOTAL NITROGEN compared with data for 12/12/2003.....	495
Figure 459.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 2/14/2002.	496
Figure 460.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 4/ 2/2002.	497
Figure 461.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 4/ 4/2002.	498
Figure 462.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 5/ 7/2002.	499
Figure 463.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 5/ 9/2002.	500
Figure 464.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 6/ 4/2002.	501
Figure 465.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 6/14/2002.	502
Figure 466.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 7/ 2/2002.	503
Figure 467.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 7/10/2002.	504
Figure 468.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 7/15/2002.	505
Figure 469.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 8/ 6/2002.	506
Figure 470.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 8/ 8/2002.	507
Figure 471.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 8/10/2002.	508
Figure 472.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 8/13/2002.	509
Figure 473.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 9/ 3/2002.	510
Figure 474.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 9/ 5/2002.	511
Figure 475.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 9/16/2002.	512
Figure 476.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 10/ 8/2002.	513
Figure 477.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 10/10/2002.	514

Figure 478.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 11/ 5/2002.	515
Figure 479.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 11/ 7/2002.	516
Figure 480.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 11/13/2002.	517
Figure 481.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 12/ 3/2002.	518
Figure 482.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 12/ 5/2002.	519
Figure 483.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 2/ 4/2003.	520
Figure 484.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 2/ 6/2003.	521
Figure 485.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 4/ 1/2003.	522
Figure 486.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 4/ 3/2003.	523
Figure 487.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 5/ 6/2003.	524
Figure 488.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 5/ 8/2003.	525
Figure 489.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 5/27/2003.	526
Figure 490.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 6/ 3/2003.	527
Figure 491.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 6/ 5/2003.	528
Figure 492.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 6/10/2003.	529
Figure 493.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 7/ 8/2003.	530
Figure 494.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 7/10/2003.	531
Figure 495.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 7/15/2003.	532
Figure 496.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 7/29/2003.	533
Figure 497.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 8/ 5/2003.	534
Figure 498.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 8/ 7/2003.	535
Figure 499.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 8/14/2003.	536
Figure 500.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 8/19/2003.	537
Figure 501.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 8/26/2003.	538
Figure 502.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 9/ 2/2003.	539
Figure 503.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 9/ 4/2003.	540
Figure 504.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 9/ 9/2003.	541
Figure 505.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 9/23/2003.	542
Figure 506.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 10/ 7/2003.	543
Figure 507.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 10/ 9/2003.	544
Figure 508.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 11/ 4/2003.	545
Figure 509.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 11/ 6/2003.	546
Figure 510.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 12/ 4/2003.	547
Figure 511.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 12/ 9/2003.	548
Figure 512.	Vertical profiles of TOTAL PHOSPHORUS compared with data for 12/12/2003.	549
Figure 513.	Vertical profiles of Chlorophyll compared with data for 2/14/2002.	550
Figure 514.	Vertical profiles of Chlorophyll compared with data for 4/ 2/2002.	551
Figure 515.	Vertical profiles of Chlorophyll compared with data for 4/ 4/2002.	552
Figure 516.	Vertical profiles of Chlorophyll compared with data for 5/ 7/2002.	553
Figure 517.	Vertical profiles of Chlorophyll compared with data for 5/ 9/2002.	554
Figure 518.	Vertical profiles of Chlorophyll compared with data for 6/ 4/2002.	555
Figure 519.	Vertical profiles of Chlorophyll compared with data for 6/14/2002.	556
Figure 520.	Vertical profiles of Chlorophyll compared with data for 7/ 2/2002.	557
Figure 521.	Vertical profiles of Chlorophyll compared with data for 7/10/2002.	558
Figure 522.	Vertical profiles of Chlorophyll compared with data for 7/15/2002.	559
Figure 523.	Vertical profiles of Chlorophyll compared with data for 8/ 6/2002.	560
Figure 524.	Vertical profiles of Chlorophyll compared with data for 8/ 8/2002.	561
Figure 525.	Vertical profiles of Chlorophyll compared with data for 8/10/2002.	562

Figure 526.	Vertical profiles of Chlorophyll compared with data for 8/13/2002.	563
Figure 527.	Vertical profiles of Chlorophyll compared with data for 9/ 3/2002.	564
Figure 528.	Vertical profiles of Chlorophyll compared with data for 9/ 5/2002.	565
Figure 529.	Vertical profiles of Chlorophyll compared with data for 9/16/2002.	566
Figure 530.	Vertical profiles of Chlorophyll compared with data for 10/ 8/2002.	567
Figure 531.	Vertical profiles of Chlorophyll compared with data for 10/10/2002.	568
Figure 532.	Vertical profiles of Chlorophyll compared with data for 11/ 5/2002.	569
Figure 533.	Vertical profiles of Chlorophyll compared with data for 11/ 7/2002.	570
Figure 534.	Vertical profiles of Chlorophyll compared with data for 11/13/2002.	571
Figure 535.	Vertical profiles of Chlorophyll compared with data for 12/ 3/2002.	572
Figure 536.	Vertical profiles of Chlorophyll compared with data for 12/ 5/2002.	573
Figure 537.	Vertical profiles of Chlorophyll compared with data for 2/ 4/2003.	574
Figure 538.	Vertical profiles of Chlorophyll compared with data for 2/ 6/2003.	575
Figure 539.	Vertical profiles of Chlorophyll compared with data for 4/ 1/2003.	576
Figure 540.	Vertical profiles of Chlorophyll compared with data for 4/ 3/2003.	577
Figure 541.	Vertical profiles of Chlorophyll compared with data for 5/ 6/2003.	578
Figure 542.	Vertical profiles of Chlorophyll compared with data for 5/ 8/2003.	579
Figure 543.	Vertical profiles of Chlorophyll compared with data for 5/27/2003.	580
Figure 544.	Vertical profiles of Chlorophyll compared with data for 6/ 3/2003.	581
Figure 545.	Vertical profiles of Chlorophyll compared with data for 6/ 5/2003.	582
Figure 546.	Vertical profiles of Chlorophyll compared with data for 6/10/2003.	583
Figure 547.	Vertical profiles of Chlorophyll compared with data for 7/ 8/2003.	584
Figure 548.	Vertical profiles of Chlorophyll compared with data for 7/10/2003.	585
Figure 549.	Vertical profiles of Chlorophyll compared with data for 7/15/2003.	586
Figure 550.	Vertical profiles of Chlorophyll compared with data for 7/29/2003.	587
Figure 551.	Vertical profiles of Chlorophyll compared with data for 8/ 5/2003.	588
Figure 552.	Vertical profiles of Chlorophyll compared with data for 8/ 7/2003.	589
Figure 553.	Vertical profiles of Chlorophyll compared with data for 8/14/2003.	590
Figure 554.	Vertical profiles of Chlorophyll compared with data for 8/19/2003.	591
Figure 555.	Vertical profiles of Chlorophyll compared with data for 8/26/2003.	592
Figure 556.	Vertical profiles of Chlorophyll compared with data for 9/ 2/2003.	593
Figure 557.	Vertical profiles of Chlorophyll compared with data for 9/ 4/2003.	594
Figure 558.	Vertical profiles of Chlorophyll compared with data for 9/ 9/2003.	595
Figure 559.	Vertical profiles of Chlorophyll compared with data for 9/23/2003.	596
Figure 560.	Vertical profiles of Chlorophyll compared with data for 10/ 7/2003.	597
Figure 561.	Vertical profiles of Chlorophyll compared with data for 10/ 9/2003.	598
Figure 562.	Vertical profiles of Chlorophyll compared with data for 11/ 4/2003.	599
Figure 563.	Vertical profiles of Chlorophyll compared with data for 11/ 6/2003.	600
Figure 564.	Vertical profiles of Chlorophyll compared with data for 12/ 4/2003.	601
Figure 565.	Vertical profiles of Chlorophyll compared with data for 12/ 9/2003.	602
Figure 566.	Vertical profiles of Chlorophyll compared with data for 12/12/2003.	603
Figure 567.	Vertical profiles of pH compared with data for 2/14/2002.	604
Figure 568.	Vertical profiles of pH compared with data for 4/ 2/2002.	605
Figure 569.	Vertical profiles of pH compared with data for 4/ 4/2002.	606
Figure 570.	Vertical profiles of pH compared with data for 5/ 7/2002.	607
Figure 571.	Vertical profiles of pH compared with data for 5/ 9/2002.	608
Figure 572.	Vertical profiles of pH compared with data for 6/ 4/2002.	609
Figure 573.	Vertical profiles of pH compared with data for 6/14/2002.	610

Figure 574. Vertical profiles of pH compared with data for 7/ 2/2002.	611
Figure 575. Vertical profiles of pH compared with data for 7/10/2002.	612
Figure 576. Vertical profiles of pH compared with data for 7/15/2002.	613
Figure 577. Vertical profiles of pH compared with data for 8/ 6/2002.	614
Figure 578. Vertical profiles of pH compared with data for 8/ 8/2002.	615
Figure 579. Vertical profiles of pH compared with data for 8/10/2002.	616
Figure 580. Vertical profiles of pH compared with data for 8/13/2002.	617
Figure 581. Vertical profiles of pH compared with data for 9/ 3/2002.	618
Figure 582. Vertical profiles of pH compared with data for 9/ 5/2002.	619
Figure 583. Vertical profiles of pH compared with data for 9/16/2002.	620
Figure 584. Vertical profiles of pH compared with data for 10/ 8/2002.	621
Figure 585. Vertical profiles of pH compared with data for 10/10/2002.	622
Figure 586. Vertical profiles of pH compared with data for 11/ 5/2002.	623
Figure 587. Vertical profiles of pH compared with data for 11/ 7/2002.	624
Figure 588. Vertical profiles of pH compared with data for 11/13/2002.	625
Figure 589. Vertical profiles of pH compared with data for 12/ 3/2002.	626
Figure 590. Vertical profiles of pH compared with data for 12/ 5/2002.	627
Figure 591. Vertical profiles of pH compared with data for 2/ 4/2003.	628
Figure 592. Vertical profiles of pH compared with data for 2/ 6/2003.	629
Figure 593. Vertical profiles of pH compared with data for 4/ 1/2003.	630
Figure 594. Vertical profiles of pH compared with data for 4/ 3/2003.	631
Figure 595. Vertical profiles of pH compared with data for 5/ 6/2003.	632
Figure 596. Vertical profiles of pH compared with data for 5/ 8/2003.	633
Figure 597. Vertical profiles of pH compared with data for 5/27/2003.	634
Figure 598. Vertical profiles of pH compared with data for 6/ 3/2003.	635
Figure 599. Vertical profiles of pH compared with data for 6/ 5/2003.	636
Figure 600. Vertical profiles of pH compared with data for 6/10/2003.	637
Figure 601. Vertical profiles of pH compared with data for 7/ 8/2003.	638
Figure 602. Vertical profiles of pH compared with data for 7/10/2003.	639
Figure 603. Vertical profiles of pH compared with data for 7/15/2003.	640
Figure 604. Vertical profiles of pH compared with data for 7/29/2003.	641
Figure 605. Vertical profiles of pH compared with data for 8/ 5/2003.	642
Figure 606. Vertical profiles of pH compared with data for 8/ 7/2003.	643
Figure 607. Vertical profiles of pH compared with data for 8/14/2003.	644
Figure 608. Vertical profiles of pH compared with data for 8/19/2003.	645
Figure 609. Vertical profiles of pH compared with data for 8/26/2003.	646
Figure 610. Vertical profiles of pH compared with data for 9/ 2/2003.	647
Figure 611. Vertical profiles of pH compared with data for 9/ 4/2003.	648
Figure 612. Vertical profiles of pH compared with data for 9/ 9/2003.	649
Figure 613. Vertical profiles of pH compared with data for 9/23/2003.	650
Figure 614. Vertical profiles of pH compared with data for 10/ 7/2003.	651
Figure 615. Vertical profiles of pH compared with data for 10/ 9/2003.	652
Figure 616. Vertical profiles of pH compared with data for 11/ 4/2003.	653
Figure 617. Vertical profiles of pH compared with data for 11/ 6/2003.	654
Figure 618. Vertical profiles of pH compared with data for 12/ 4/2003.	655
Figure 619. Vertical profiles of pH compared with data for 12/ 9/2003.	656
Figure 620. Vertical profiles of pH compared with data for 12/12/2003.	657
Figure 621. Vertical profiles of ALGAE 1 compared with data for 2/14/2002.	658

Figure 622.	Vertical profiles of ALGAE 1 compared with data for 4/ 2/2002.....	659
Figure 623.	Vertical profiles of ALGAE 1 compared with data for 4/ 4/2002.....	660
Figure 624.	Vertical profiles of ALGAE 1 compared with data for 5/ 7/2002.....	661
Figure 625.	Vertical profiles of ALGAE 1 compared with data for 5/ 9/2002.....	662
Figure 626.	Vertical profiles of ALGAE 1 compared with data for 6/ 4/2002.....	663
Figure 627.	Vertical profiles of ALGAE 1 compared with data for 6/14/2002.....	664
Figure 628.	Vertical profiles of ALGAE 1 compared with data for 7/ 2/2002.....	665
Figure 629.	Vertical profiles of ALGAE 1 compared with data for 7/10/2002.....	666
Figure 630.	Vertical profiles of ALGAE 1 compared with data for 7/15/2002.....	667
Figure 631.	Vertical profiles of ALGAE 1 compared with data for 8/ 6/2002.....	668
Figure 632.	Vertical profiles of ALGAE 1 compared with data for 8/ 8/2002.....	669
Figure 633.	Vertical profiles of ALGAE 1 compared with data for 8/10/2002.....	670
Figure 634.	Vertical profiles of ALGAE 1 compared with data for 8/13/2002.....	671
Figure 635.	Vertical profiles of ALGAE 1 compared with data for 9/ 3/2002.....	672
Figure 636.	Vertical profiles of ALGAE 1 compared with data for 9/ 5/2002.....	673
Figure 637.	Vertical profiles of ALGAE 1 compared with data for 9/16/2002.....	674
Figure 638.	Vertical profiles of ALGAE 1 compared with data for 10/ 8/2002.....	675
Figure 639.	Vertical profiles of ALGAE 1 compared with data for 10/10/2002.....	676
Figure 640.	Vertical profiles of ALGAE 1 compared with data for 11/ 5/2002.....	677
Figure 641.	Vertical profiles of ALGAE 1 compared with data for 11/ 7/2002.....	678
Figure 642.	Vertical profiles of ALGAE 1 compared with data for 11/13/2002.....	679
Figure 643.	Vertical profiles of ALGAE 1 compared with data for 12/ 3/2002.....	680
Figure 644.	Vertical profiles of ALGAE 1 compared with data for 12/ 5/2002.....	681
Figure 645.	Vertical profiles of ALGAE 1 compared with data for 2/ 4/2003.....	682
Figure 646.	Vertical profiles of ALGAE 1 compared with data for 2/ 6/2003.....	683
Figure 647.	Vertical profiles of ALGAE 1 compared with data for 4/ 1/2003.....	684
Figure 648.	Vertical profiles of ALGAE 1 compared with data for 4/ 3/2003.....	685
Figure 649.	Vertical profiles of ALGAE 1 compared with data for 5/ 6/2003.....	686
Figure 650.	Vertical profiles of ALGAE 1 compared with data for 5/ 8/2003.....	687
Figure 651.	Vertical profiles of ALGAE 1 compared with data for 5/27/2003.....	688
Figure 652.	Vertical profiles of ALGAE 1 compared with data for 6/ 3/2003.....	689
Figure 653.	Vertical profiles of ALGAE 1 compared with data for 6/ 5/2003.....	690
Figure 654.	Vertical profiles of ALGAE 1 compared with data for 6/10/2003.....	691
Figure 655.	Vertical profiles of ALGAE 1 compared with data for 7/ 8/2003.....	692
Figure 656.	Vertical profiles of ALGAE 1 compared with data for 7/10/2003.....	693
Figure 657.	Vertical profiles of ALGAE 1 compared with data for 7/15/2003.....	694
Figure 658.	Vertical profiles of ALGAE 1 compared with data for 7/29/2003.....	695
Figure 659.	Vertical profiles of ALGAE 1 compared with data for 8/ 5/2003.....	696
Figure 660.	Vertical profiles of ALGAE 1 compared with data for 8/ 7/2003.....	697
Figure 661.	Vertical profiles of ALGAE 1 compared with data for 8/14/2003.....	698
Figure 662.	Vertical profiles of ALGAE 1 compared with data for 8/19/2003.....	699
Figure 663.	Vertical profiles of ALGAE 1 compared with data for 8/26/2003.....	700
Figure 664.	Vertical profiles of ALGAE 1 compared with data for 9/ 2/2003.....	701
Figure 665.	Vertical profiles of ALGAE 1 compared with data for 9/ 4/2003.....	702
Figure 666.	Vertical profiles of ALGAE 1 compared with data for 9/ 9/2003.....	703
Figure 667.	Vertical profiles of ALGAE 1 compared with data for 9/23/2003.....	704
Figure 668.	Vertical profiles of ALGAE 1 compared with data for 10/ 7/2003.....	705
Figure 669.	Vertical profiles of ALGAE 1 compared with data for 10/ 9/2003.....	706

Figure 670.	Vertical profiles of ALGAE 1 compared with data for 11/ 4/2003.....	707
Figure 671.	Vertical profiles of ALGAE 1 compared with data for 11/ 6/2003.....	708
Figure 672.	Vertical profiles of ALGAE 1 compared with data for 12/ 4/2003.....	709
Figure 673.	Vertical profiles of ALGAE 1 compared with data for 12/ 9/2003.....	710
Figure 674.	Vertical profiles of ALGAE 1 compared with data for 12/12/2003.....	711
Figure 675.	Vertical profiles of ALGAE 2 compared with data for 2/14/2002.....	712
Figure 676.	Vertical profiles of ALGAE 2 compared with data for 4/ 2/2002.....	713
Figure 677.	Vertical profiles of ALGAE 2 compared with data for 4/ 4/2002.....	714
Figure 678.	Vertical profiles of ALGAE 2 compared with data for 5/ 7/2002.....	715
Figure 679.	Vertical profiles of ALGAE 2 compared with data for 5/ 9/2002.....	716
Figure 680.	Vertical profiles of ALGAE 2 compared with data for 6/ 4/2002.....	717
Figure 681.	Vertical profiles of ALGAE 2 compared with data for 6/14/2002.....	718
Figure 682.	Vertical profiles of ALGAE 2 compared with data for 7/ 2/2002.....	719
Figure 683.	Vertical profiles of ALGAE 2 compared with data for 7/10/2002.....	720
Figure 684.	Vertical profiles of ALGAE 2 compared with data for 7/15/2002.....	721
Figure 685.	Vertical profiles of ALGAE 2 compared with data for 8/ 6/2002.....	722
Figure 686.	Vertical profiles of ALGAE 2 compared with data for 8/ 8/2002.....	723
Figure 687.	Vertical profiles of ALGAE 2 compared with data for 8/10/2002.....	724
Figure 688.	Vertical profiles of ALGAE 2 compared with data for 8/13/2002.....	725
Figure 689.	Vertical profiles of ALGAE 2 compared with data for 9/ 3/2002.....	726
Figure 690.	Vertical profiles of ALGAE 2 compared with data for 9/ 5/2002.....	727
Figure 691.	Vertical profiles of ALGAE 2 compared with data for 9/16/2002.....	728
Figure 692.	Vertical profiles of ALGAE 2 compared with data for 10/ 8/2002.....	729
Figure 693.	Vertical profiles of ALGAE 2 compared with data for 10/10/2002.....	730
Figure 694.	Vertical profiles of ALGAE 2 compared with data for 11/ 5/2002.....	731
Figure 695.	Vertical profiles of ALGAE 2 compared with data for 11/ 7/2002.....	732
Figure 696.	Vertical profiles of ALGAE 2 compared with data for 11/13/2002.....	733
Figure 697.	Vertical profiles of ALGAE 2 compared with data for 12/ 3/2002.....	734
Figure 698.	Vertical profiles of ALGAE 2 compared with data for 12/ 5/2002.....	735
Figure 699.	Vertical profiles of ALGAE 2 compared with data for 2/ 4/2003.....	736
Figure 700.	Vertical profiles of ALGAE 2 compared with data for 2/ 6/2003.....	737
Figure 701.	Vertical profiles of ALGAE 2 compared with data for 4/ 1/2003.....	738
Figure 702.	Vertical profiles of ALGAE 2 compared with data for 4/ 3/2003.....	739
Figure 703.	Vertical profiles of ALGAE 2 compared with data for 5/ 6/2003.....	740
Figure 704.	Vertical profiles of ALGAE 2 compared with data for 5/ 8/2003.....	741
Figure 705.	Vertical profiles of ALGAE 2 compared with data for 5/27/2003.....	742
Figure 706.	Vertical profiles of ALGAE 2 compared with data for 6/ 3/2003.....	743
Figure 707.	Vertical profiles of ALGAE 2 compared with data for 6/ 5/2003.....	744
Figure 708.	Vertical profiles of ALGAE 2 compared with data for 6/10/2003.....	745
Figure 709.	Vertical profiles of ALGAE 2 compared with data for 7/ 8/2003.....	746
Figure 710.	Vertical profiles of ALGAE 2 compared with data for 7/10/2003.....	747
Figure 711.	Vertical profiles of ALGAE 2 compared with data for 7/15/2003.....	748
Figure 712.	Vertical profiles of ALGAE 2 compared with data for 7/29/2003.....	749
Figure 713.	Vertical profiles of ALGAE 2 compared with data for 8/ 5/2003.....	750
Figure 714.	Vertical profiles of ALGAE 2 compared with data for 8/ 7/2003.....	751
Figure 715.	Vertical profiles of ALGAE 2 compared with data for 8/14/2003.....	752
Figure 716.	Vertical profiles of ALGAE 2 compared with data for 8/19/2003.....	753
Figure 717.	Vertical profiles of ALGAE 2 compared with data for 8/26/2003.....	754

Figure 718.	Vertical profiles of ALGAE 2 compared with data for 9/ 2/2003.....	755
Figure 719.	Vertical profiles of ALGAE 2 compared with data for 9/ 4/2003.....	756
Figure 720.	Vertical profiles of ALGAE 2 compared with data for 9/ 9/2003.....	757
Figure 721.	Vertical profiles of ALGAE 2 compared with data for 9/23/2003.....	758
Figure 722.	Vertical profiles of ALGAE 2 compared with data for 10/ 7/2003.....	759
Figure 723.	Vertical profiles of ALGAE 2 compared with data for 10/ 9/2003.....	760
Figure 724.	Vertical profiles of ALGAE 2 compared with data for 11/ 4/2003.....	761
Figure 725.	Vertical profiles of ALGAE 2 compared with data for 11/ 6/2003.....	762
Figure 726.	Vertical profiles of ALGAE 2 compared with data for 12/ 4/2003.....	763
Figure 727.	Vertical profiles of ALGAE 2 compared with data for 12/ 9/2003.....	764
Figure 728.	Vertical profiles of ALGAE 2 compared with data for 12/12/2003.....	765
Figure 729.	Vertical profiles of ALGAE 3 compared with data for 2/14/2002.....	766
Figure 730.	Vertical profiles of ALGAE 3 compared with data for 4/ 2/2002.....	767
Figure 731.	Vertical profiles of ALGAE 3 compared with data for 4/ 4/2002.....	768
Figure 732.	Vertical profiles of ALGAE 3 compared with data for 5/ 7/2002.....	769
Figure 733.	Vertical profiles of ALGAE 3 compared with data for 5/ 9/2002.....	770
Figure 734.	Vertical profiles of ALGAE 3 compared with data for 6/ 4/2002.....	771
Figure 735.	Vertical profiles of ALGAE 3 compared with data for 6/14/2002.....	772
Figure 736.	Vertical profiles of ALGAE 3 compared with data for 7/ 2/2002.....	773
Figure 737.	Vertical profiles of ALGAE 3 compared with data for 7/10/2002.....	774
Figure 738.	Vertical profiles of ALGAE 3 compared with data for 7/15/2002.....	775
Figure 739.	Vertical profiles of ALGAE 3 compared with data for 8/ 6/2002.....	776
Figure 740.	Vertical profiles of ALGAE 3 compared with data for 8/ 8/2002.....	777
Figure 741.	Vertical profiles of ALGAE 3 compared with data for 8/10/2002.....	778
Figure 742.	Vertical profiles of ALGAE 3 compared with data for 8/13/2002.....	779
Figure 743.	Vertical profiles of ALGAE 3 compared with data for 9/ 3/2002.....	780
Figure 744.	Vertical profiles of ALGAE 3 compared with data for 9/ 5/2002.....	781
Figure 745.	Vertical profiles of ALGAE 3 compared with data for 9/16/2002.....	782
Figure 746.	Vertical profiles of ALGAE 3 compared with data for 10/ 8/2002.....	783
Figure 747.	Vertical profiles of ALGAE 3 compared with data for 10/10/2002.....	784
Figure 748.	Vertical profiles of ALGAE 3 compared with data for 11/ 5/2002.....	785
Figure 749.	Vertical profiles of ALGAE 3 compared with data for 11/ 7/2002.....	786
Figure 750.	Vertical profiles of ALGAE 3 compared with data for 11/13/2002.....	787
Figure 751.	Vertical profiles of ALGAE 3 compared with data for 12/ 3/2002.....	788
Figure 752.	Vertical profiles of ALGAE 3 compared with data for 12/ 5/2002.....	789
Figure 753.	Vertical profiles of ALGAE 3 compared with data for 2/ 4/2003.....	790
Figure 754.	Vertical profiles of ALGAE 3 compared with data for 2/ 6/2003.....	791
Figure 755.	Vertical profiles of ALGAE 3 compared with data for 4/ 1/2003.....	792
Figure 756.	Vertical profiles of ALGAE 3 compared with data for 4/ 3/2003.....	793
Figure 757.	Vertical profiles of ALGAE 3 compared with data for 5/ 6/2003.....	794
Figure 758.	Vertical profiles of ALGAE 3 compared with data for 5/ 8/2003.....	795
Figure 759.	Vertical profiles of ALGAE 3 compared with data for 5/27/2003.....	796
Figure 760.	Vertical profiles of ALGAE 3 compared with data for 6/ 3/2003.....	797
Figure 761.	Vertical profiles of ALGAE 3 compared with data for 6/ 5/2003.....	798
Figure 762.	Vertical profiles of ALGAE 3 compared with data for 6/10/2003.....	799
Figure 763.	Vertical profiles of ALGAE 3 compared with data for 7/ 8/2003.....	800
Figure 764.	Vertical profiles of ALGAE 3 compared with data for 7/10/2003.....	801
Figure 765.	Vertical profiles of ALGAE 3 compared with data for 7/15/2003.....	802

Figure 766. Vertical profiles of ALGAE 3 compared with data for 7/29/2003.....	803
Figure 767. Vertical profiles of ALGAE 3 compared with data for 8/ 5/2003.....	804
Figure 768. Vertical profiles of ALGAE 3 compared with data for 8/ 7/2003.....	805
Figure 769. Vertical profiles of ALGAE 3 compared with data for 8/14/2003.....	806
Figure 770. Vertical profiles of ALGAE 3 compared with data for 8/19/2003.....	807
Figure 771. Vertical profiles of ALGAE 3 compared with data for 8/26/2003.....	808
Figure 772. Vertical profiles of ALGAE 3 compared with data for 9/ 2/2003.....	809
Figure 773. Vertical profiles of ALGAE 3 compared with data for 9/ 4/2003.....	810
Figure 774. Vertical profiles of ALGAE 3 compared with data for 9/ 9/2003.....	811
Figure 775. Vertical profiles of ALGAE 3 compared with data for 9/23/2003.....	812
Figure 776. Vertical profiles of ALGAE 3 compared with data for 10/ 7/2003.....	813
Figure 777. Vertical profiles of ALGAE 3 compared with data for 10/ 9/2003.....	814
Figure 778. Vertical profiles of ALGAE 3 compared with data for 11/ 4/2003.....	815
Figure 779. Vertical profiles of ALGAE 3 compared with data for 11/ 6/2003.....	816
Figure 780. Vertical profiles of ALGAE 3 compared with data for 12/ 4/2003.....	817
Figure 781. Vertical profiles of ALGAE 3 compared with data for 12/ 9/2003.....	818
Figure 782. Vertical profiles of ALGAE 3 compared with data for 12/12/2003.....	819

List of Tables

Table 1. Monitoring sites	8
Table 2. Lake Whatcom model point tributaries and inflow segments.	14
Table 3. Method to fill in the watersheds without data.....	15
Table 4. Data sources for meteorological input files.	18
Table 5. Groundwater flow rates of shoreline areas.	18
Table 6. Point source tributaries and distributed tributaries used to characterize groundwater inflows.	19
Table 7. Constituent concentrations used for groundwater inflows	19
Table 8. Steps taken in creating precipitation rate files.	21
Table 9. List of Lake Whatcom withdrawals.	22
Table 10. Water level error statistics.	23
Table 11. Temperature profile error statistics.	25
Table 12. W2 Model Water Quality Parameters.....	26
Table 13. Constituent error statistics for site LW1.	32
Table 14. Constituent error statistics for site LW2.	32
Table 15. Constituent model-error statistics for site LW3.....	32
Table 16. Constituent model-error statistics for site LW4.....	32
Table 17. Constituent model-error statistics for the intake site.	33
Table 18. Constituent model-error statistics for all sites.	33
Table 19. Lake Whatcom scenario descriptions.	37
Table 20. Phosphorus loading from tributaries, groundwater, and precipitation for the scenarios.	37
Table 21. Dissolved oxygen difference for scenarios (relative to rollback scenario) at bottom of basin 1 (7/22/02), bottom of basin 2 (7/30/02) and bottom 3 (8/14/02).....	38

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Introduction

A water quality model of Lake Whatcom, Washington (see Figure 1 and Figure 2) was developed as part of a Total Maximum Daily Load Study for the Washington Department of Ecology. Lake Whatcom is a large natural lake which is listed on the 1998 Washington State 303(d) list of waterbodies which do not meet the criterion for dissolved oxygen. Located next to the city of Bellingham, it is approximately 10 miles long and has a surface area of approximately 5000 acres and a maximum depth of over 100 meters. Eutrophication processes in the lake have been accelerated in recent years perhaps by the availability of nutrients from tributary discharges to the basin. Many of these tributaries have accelerated their nutrient loading to the system as a result of development in the watershed. The lake is being modeled using the Corps of Engineer's model CE-QUAL-W2, which is a two-dimensional, hydrodynamic and water quality model. The project is managed by the Washington Department of Ecology which plans to make recommendations for reduction and allocation of pollutant loads.

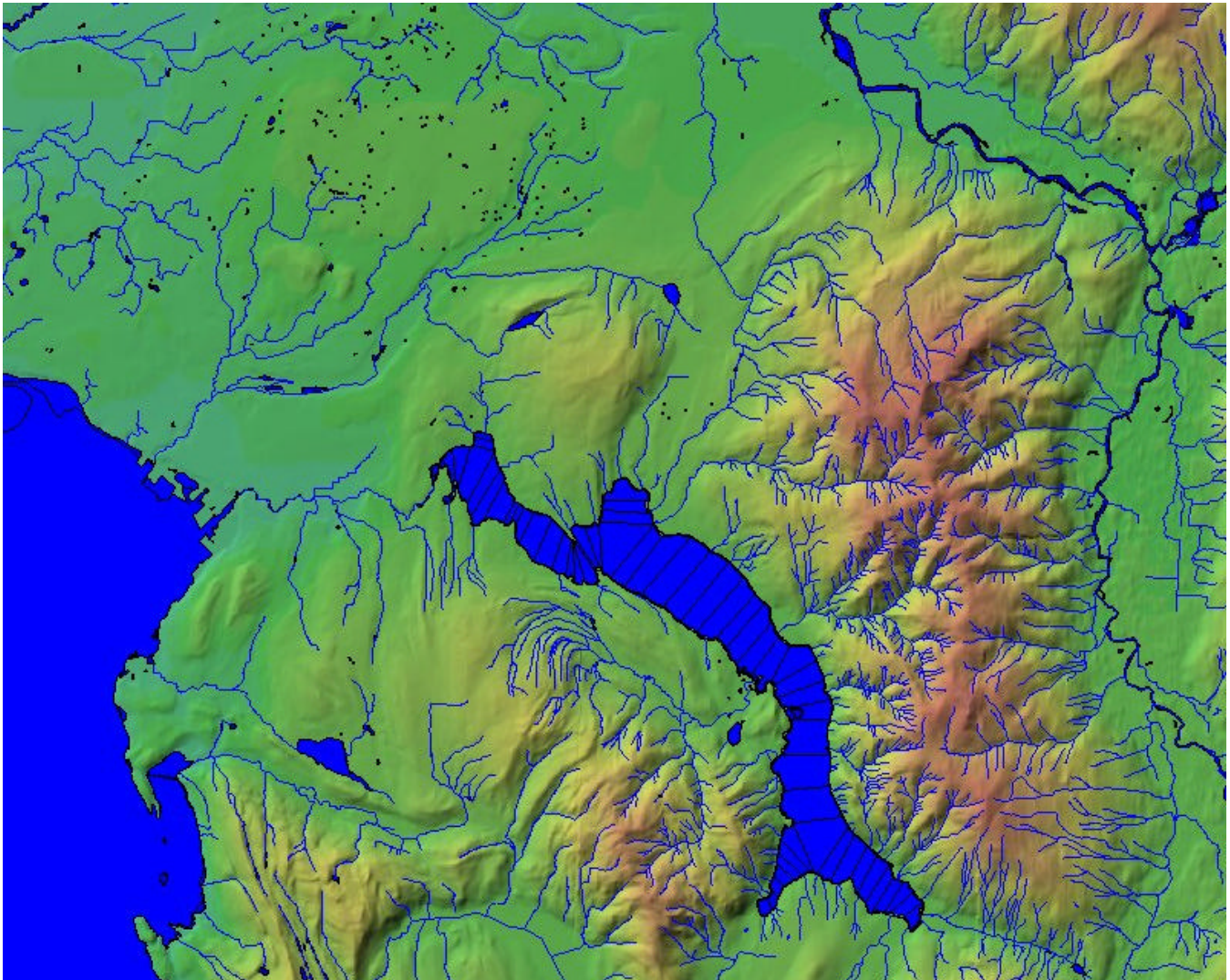


Figure 1. Lake Whatcom and vicinity.

The objectives of this study were then to

- ❑ Develop a hydrodynamic and water quality model of Lake Whatcom
- ❑ Calibrate the model to field data collected from February 2002 through December 2003
- ❑ Use the model to evaluate strategies for water quality improvement

The model chosen for development was CE-QUAL-W2 Version 3.2 (Cole and Wells, 2004). This is a two-dimensional unsteady hydrodynamic, temperature and water quality model that includes typical eutrophication parameters (algae, nutrients, temperature, organic matter, dissolved oxygen, pH). PSU, under the support of the Corps of Engineers Waterways Experiment Station, is a center for development of this modeling tool.

In order to model the system, the following data were required:

- Lake Whatcom outflow rates
- Tributary inflows, temperatures, and water quality
- Groundwater inflows, temperatures, and water quality
- Precipitation rates, temperatures, and water quality
- Meteorological conditions
- Bathymetry

This report summarizes model development. Information provided in this report was organized in the following sections:

- Model Selection
- Model Forcing Data
- Hydrodynamic Calibration
- Temperature Calibration
- Water Quality Calibration
- Scenarios
- Summary

Also discussed are issues relative to the calibration effort. Calibration focused on model predictions of hydrodynamics (flow and water level), temperature, and water quality. The model calibration period was from February 14, 2002 to December 31, 2003.

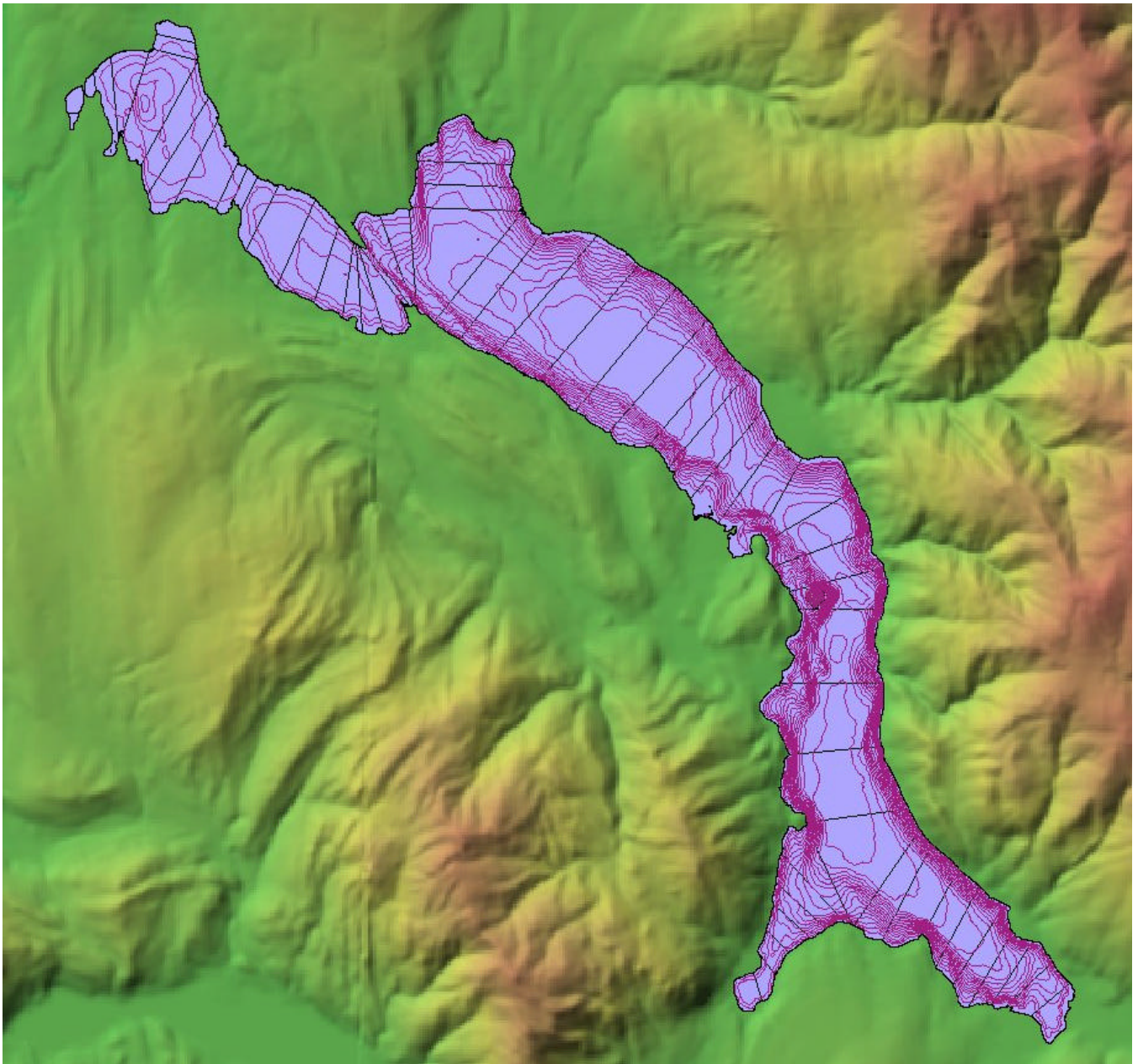


Figure 2. Topography around Lake Whatcom.

Model Selection

Selection of the appropriate water quality model is a function of properly identifying the water quality problem ("conceptualization") and selecting a model which appropriately describes the water quality changes in the water body, is theoretically valid, and can be easily adapted to site-specific physical characteristics of the water body.

The performance of a mathematical model in predicting the existing and future water quality dynamics of a system is dependent on the following steps:

- (i) identification of the problem
- (ii) selection of model type and relationship of model to the problem
- (iii) computational representation
- (iv) model response studies or model sensitivity analyses
- (v) model calibration
- (vi) application of model to evaluate management strategies

Because there are many water quality models available, a choice of the appropriate model would be made after considering the following questions: What physical processes are represented in the model and which are ignored? How are physical processes included in the model? What processes are represented by model coefficients? For example in defining the problem, the following questions could be asked:

- (i) What are the dominant physical processes at work and can the chosen model represent those processes? (such as, how does the water move? Is there stratification, wind-driven currents, and/or selective withdrawal?)
- (ii) What are the spatial and temporal scales of these processes and can the model represent them? (such as, is steady-state representation adequate, is 1-D, 2-D, or 3-D spatial discretization necessary?)

The choice of the proper model is also based on answering

- (1) site specific questions (physical characteristics of the each system component - river or reservoir reach, water quality cycles, algal types),
- (2) management objectives (required accuracy, use for future studies),
- (3) project resources (data availability, staff constraints, time limitations).

The model chosen for Lake Whatcom was the Corps of Engineers model CE-QUAL-W2 Version 3.2. CE-QUAL-W2 Version 3.2 is a dynamic 2-d (x-z) model developed for stratified water-bodies (Cole and Wells, 2004). This is a Corps of Engineers modification of the Laterally Averaged Reservoir Model (Edinger and Buchak 1978). CE-QUAL-W2, whose grid is shown in Figure 3, consists of directly coupled hydrodynamic and water quality transport models. Hydrodynamic computations are influenced by variable water density caused by temperature, salinity, and dissolved and suspended solids. Developed for reservoirs and narrow, stratified estuaries, CE-QUAL-W2 can handle a branched and/or looped system with flow and/or head boundary conditions. With two dimensions depicted, point and non-point loading can be spatially distributed. Relative to other 2-D models, CE-QUAL-W2 is efficient and cost effective to use. This model allows the user to use the ultimate quickest Numerical Scheme for improved numerical accuracy.

In addition to temperature, CE-QUAL-W2 Version 3.2 can simulate many water quality variables. Primary physical processes included are surface heat transfer, short-wave and long-wave radiation and penetration, convective mixing, wind and flow induced mixing, entrainment of ambient water by pumped-storage inflows, inflow density stratification as impacted by temperature and dissolved and suspended solids. Major chemical and biological processes in CE-QUAL-W2 include: the effects of DO of atmospheric exchange, photosynthesis, respiration, organic matter decomposition, nitrification, and chemical oxidation of reduced substances; uptake, excretion, and regeneration of phosphorus and nitrogen and nitrification-denitrification under aerobic and anaerobic conditions; carbon cycling and alkalinity-pH-CO₂ interactions; trophic relationships for total phytoplankton; accumulation and decomposition of detritus and organic sediment; and coliform bacteria mortality.

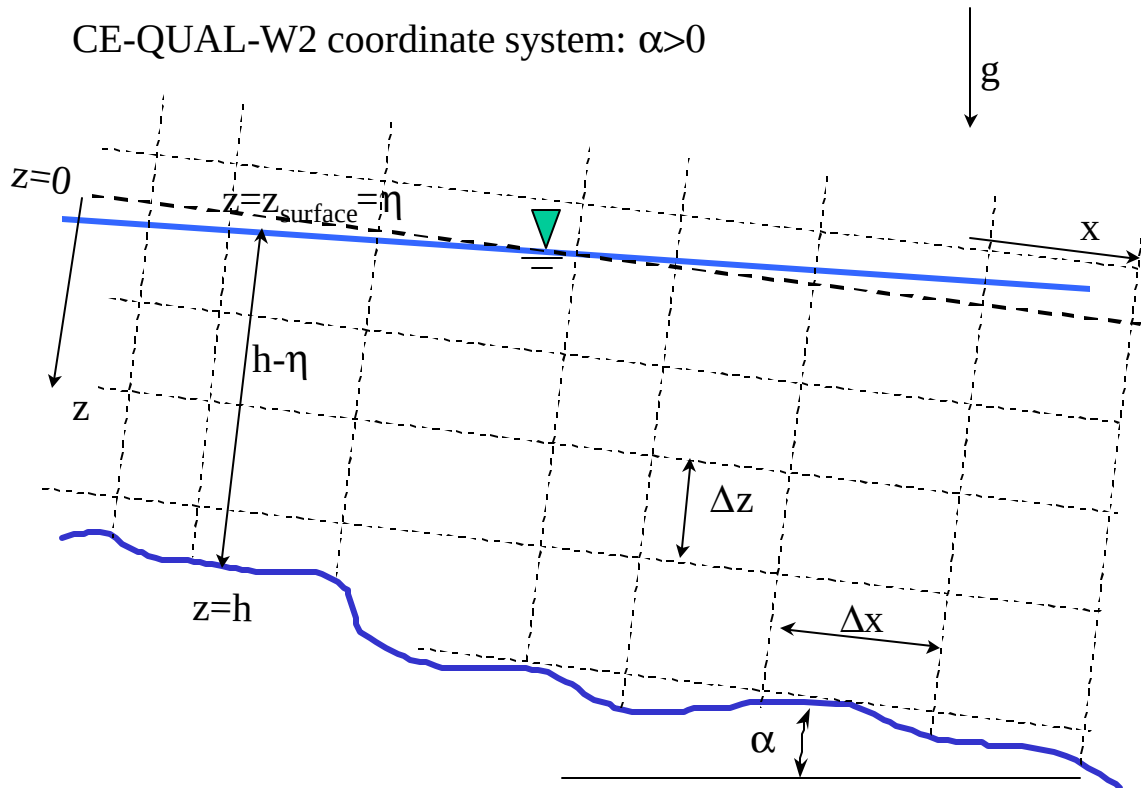


Figure 3. Coordinate system for CE-QUAL-W2 Version 3.2.

Models, such as WQRSS (Smith 1978), HEC-5Q (Corps of Engineers 1986), and HSPF (Donigian, et al. 1984), have been developed for river basin modeling but have serious limitations. One issue is that the HEC-5Q (similar to WQRSS) and HSPF models incorporate a one-dimensional, longitudinal river model with a one-dimensional, vertical reservoir model (one-dimensional for temperature and water quality and zero dimensional for hydrodynamics). The modeler must choose the location of the transition from 1-D longitudinal to 1-D vertical. Besides the limitation of not solving for the velocity field in the stratified, reservoir system, any point source inputs to the reservoir section are spread over the entire longitudinal distribution of the reservoir layer.

Also, other one-dimensional reservoir models, such as the HEC WQRRS (Water Quality River-Reservoir Simulation) model and the Corps's CE-QUAL-R1, are also not adequate to compute 2-D circulation within pool areas. These models conceptualize a pool as well mixed in each horizontal slab,

i.e., over the length and the width of the system. By making this assumption, the vertical and longitudinal circulation patterns within a pool cannot be resolved.

Based on the depth Lake Whatcom, a one-dimensional reservoir model would not be adequate because of possible longitudinal and vertical gradients in water quality.

For this project, the CE-QUAL-W2 River Basin Model Version 3.2 (as schematized in Figure 4) was the most appropriate for modeling Lake Whatcom since it contains the following elements:

- Two-dimensional, dynamic hydrodynamics and water quality capable of replicating any density stratified environment.
- The model is a state-of-the-art tool with features not found in other models

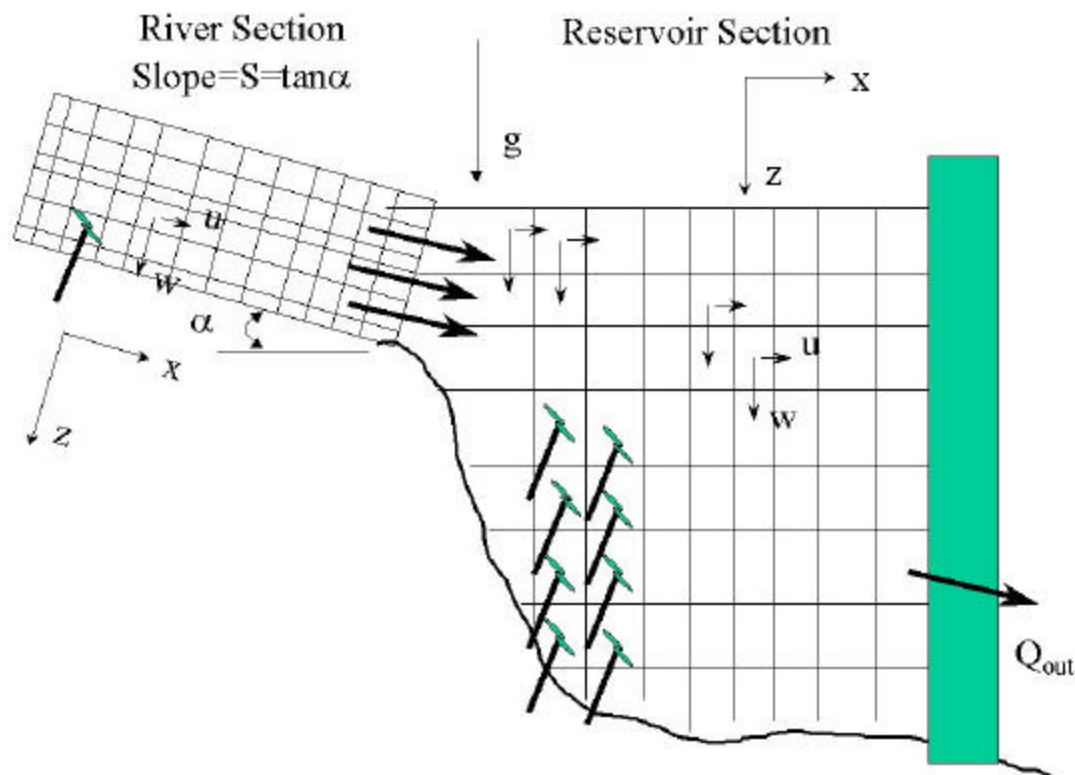


Figure 4. Conceptual schematic of river-reservoir connection in CE-QUAL-W2 Version 3. The propellers indicate that a model cell is well-mixed.

This model has been under development for many years and is a public-domain code maintained by the Corps of Engineers, Waterways Experiments Station (WES), located in Vicksburg, Mississippi. Version 3.2 has and is undergoing rigorous testing and has been successfully applied to many river basin systems. Further information about CE-QUAL-W2 Version 3 is shown at <http://www.ce.pdx.edu/w2>.

Model Water Quality Constituents

The following water quality constituents were simulated in the Lake Whatcom model:

- Inorganic Suspended Solids (ISS)

- Dissolved Inorganic Phosphorus (PO₄-P)
- Ammonia Nitrogen (NH₄-N)
- Nitrate-nitrite Nitrogen (NO_x-N)
- Labile Dissolved Organic Matter (LDOM)
- Refractory Dissolved Organic Matter (RDOM)
- Labile Particulate Organic Matter (LPOM)
- Refractory Particulate Organic Matter (RPOM)
- 3 Algae Compartments
- Dissolved Oxygen
- Total Inorganic Carbon (TIC)
- Alkalinity
- Labile Dissolved Organic Matter Phosphorus (LDOM-P)
- Refractory Dissolved Organic Matter Phosphorus (RDOM-P)
- Labile Particulate Organic Matter Phosphorus (LPOM-P)
- Refractory Particulate Organic Matter Phosphorus (RPOM-P)
- Labile Dissolved Organic Matter Nitrogen (LDOM-N)
- Refractory Dissolved Organic Matter Nitrogen (RDOM-N)
- Labile Particulate Organic Matter Nitrogen (LPOM-N)
- Refractory Particulate Organic Matter Nitrogen (RPOM-N)

Water quality cycles are described in the user's manual (Cole and Wells, 2004). However, the phosphorus and nitrogen organic matter compartments (LDOM-P, RDOM-P, LPOM-P, RPOM-P, LDOM-N, RDOM-N, LPOM-N, RPOM-N) were added specially to the Lake Whatcom model and represent the phosphorus and nitrogen mass contained in LDOM, RDOM, LPOM and RPOM. This allowed the model user to set dynamic values of N and P in all tributaries associated with organic matter and to track these quantities within the domain of the CE-QUAL-W2.

The 3 algae compartments correspond to 3 groups of algae species. Algae group 1 represents Chrysophyta (mostly diatoms), algae group 2 represents Chlorophyta (greens), and algae group 3 are Cyanobacteria (blue-greens).

Model Forcing Data and Bathymetry

The model forcing data consists of the boundary conditions for all inflows (flow rate, temperature and water quality data) and the system meteorology. The model bathymetry is also required to develop a model grid for the numerical simulation.

Water quality monitoring sites from which data were used for model development were identified in Figure 5 and were described in Table 1.

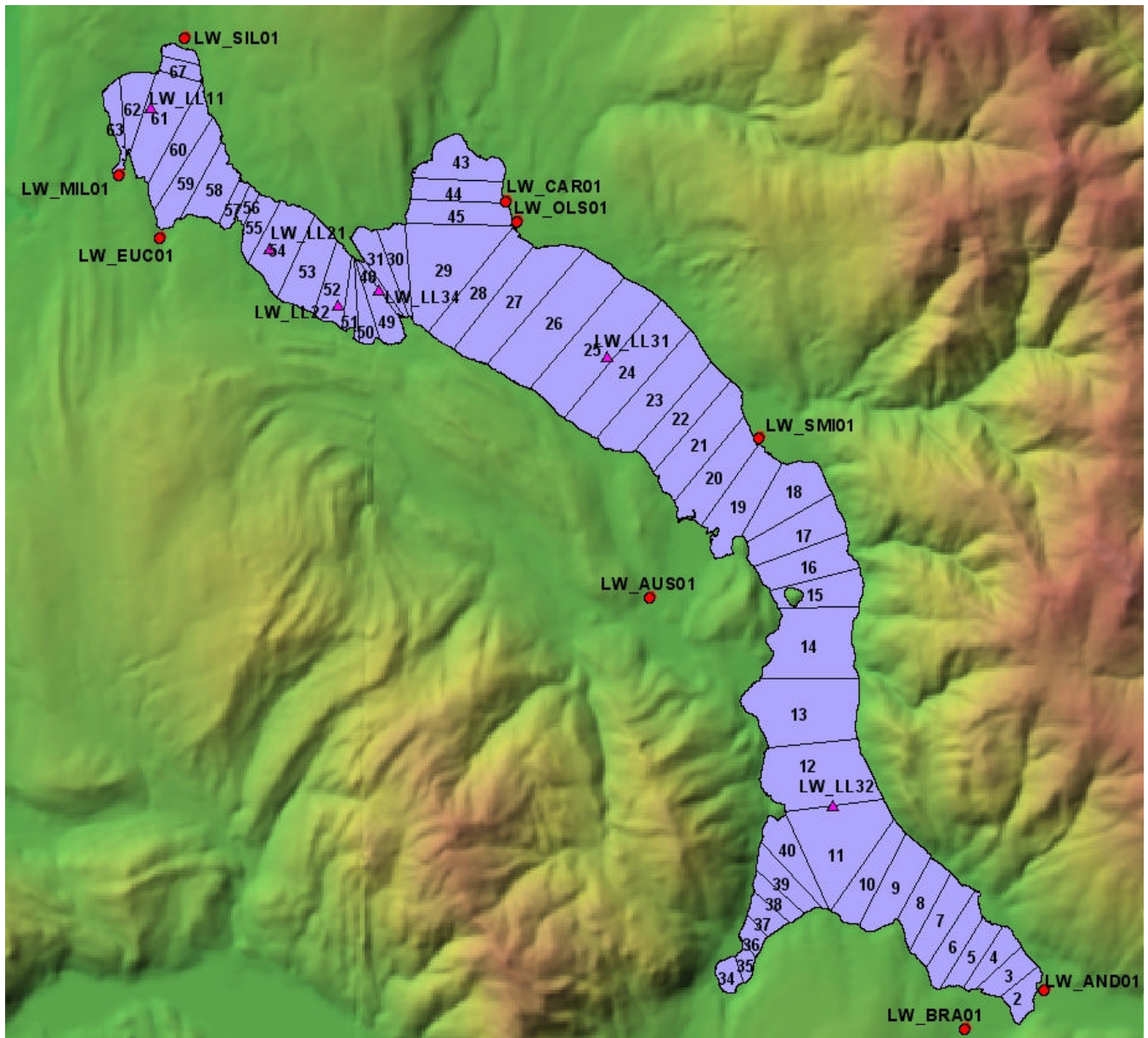


Figure 5. Monitoring sites at Lake Whatcom

Table 1. Monitoring sites		
Site ID	Description	Parameters
LW_AND01	Anderson Creek	Flow, Temperature, Water Quality
LW_AUS01	Austin Creek	Flow, Temperature, Water Quality
LW_BRA01	Brannian Creek	Flow, Temperature, Water Quality
LW_CAR01	Carpenter Creek	Flow, Temperature, Water Quality
LW_EUC01	Euclid Creek	Flow, Temperature, Water Quality
LW_MIL01	Mill Wheel	Flow, Temperature, Water Quality
LW_OLS01	Olsen Creek	Flow, Temperature, Water Quality
LW_SIL01	Silver Beach Creek	Flow, Temperature, Water Quality
LW_SMI01	Smith Creek	Flow, Temperature, Water Quality

Table 1. Monitoring sites		
Site ID	Description	Parameters
LW1 (LW_LL11)	Basin 1	Temperature, Water Quality
LW2 (LW_LL22)	Basin 2	Temperature, Water Quality
LW3 (LW_LL31)	Basin 3, north	Temperature, Water Quality
LW4 (LW_LL32)	Basin 3, south	Temperature, Water Quality
Intake (LW_LL21)	Basin 2, near water intake	Temperature, Water Quality

Model Geometry

Bathymetry

The Lake Whatcom bathymetry, as shown in Figure 6, was developed by the Washington Department of Ecology. The following was quoted from documentation obtained from the Washington Department of Ecology:

“The bathymetry data file was developed based on the data from the Lake Whatcom 1999-2000 Area and Capacity Survey conducted by Bureau of Reclamation, US Department of the Interior. The data from this survey contains 1m interval contour polygons from elevation of -5m to 97m (City of Bellingham datum). The data was then imported to Arcview 3.2. Polygons outside the lake boundary, polygons of islands, and those tiny ones less than 1000 square feet were deleted by using a query in ArcView, and the cleaned up contour polygons were later merged into one big shape file and used for calculating segment length and cell width.”

“The lake has been divided into 72 segments manually by drawing lines across the cleaned contour polygons at elevation of 97 m. There are 62 physical segments and 10 virtual ones. There is a virtual segment both at the beginning and end of each branch. The virtual ones are just used by the model to separate each branch.”

“The shapefile for the centerline of the main branch was obtained from Ecology’s GIS server, and for all of the other small branches, centerlines were drawn manually. Each of the four centerlines was intersected with the segmentation shapefile, the four created attribute tables were then exported to excel and the length of each segment was then retrieved from the excel spreadsheet based on segment number.”

“The merged contour polygons were intersected with the segmentation shapefile. The attribute table was exported to excel and the area of each layer by segments was then retrieved from the excel spreadsheet. The volume of each cell was calculated by using the formula:

$$1/3*(D1+D2+SQRT(D1*D2))$$

D1 is the area of the upper layer cell

D2 is the area of the lower layer cell

The width of each cell was calculated by using the volume divided by cell depth (1m in our case) and the segment length.”

“TTools was used to calculate the aspects of each centerline, which created a series of points. The points coverage was then intersected with the segmentation shapefile. The attribute table was exported to excel and then the aspect for each segment was obtained by averaging all of the aspect values based on the segment number.”

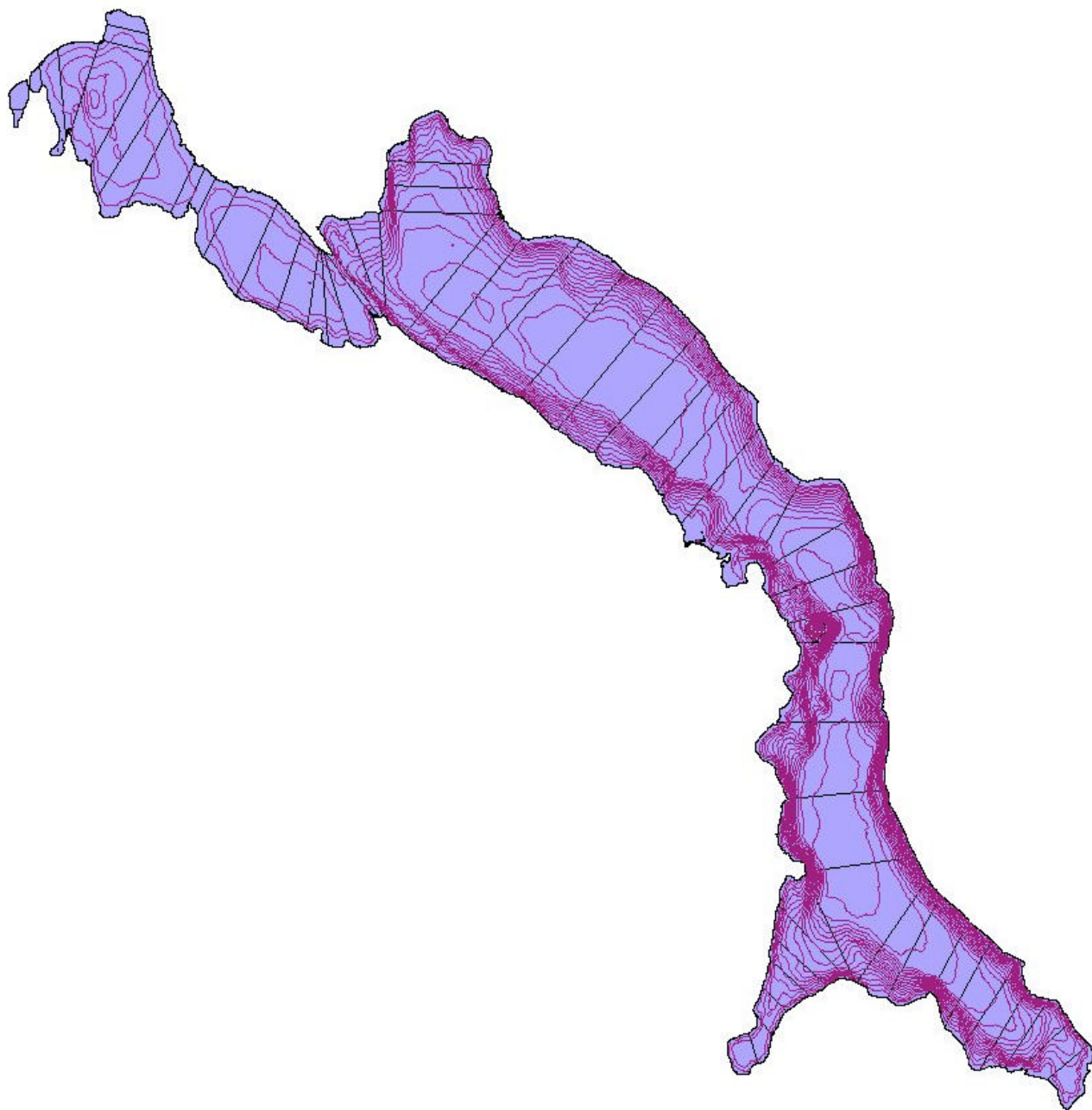


Figure 6. Lake Whatcom bathymetry

Grid Layout

A plan view of the CE-QUAL-W2 grid layout, shown in Figure 7, was also developed from the model bathymetry by Washington Ecology.

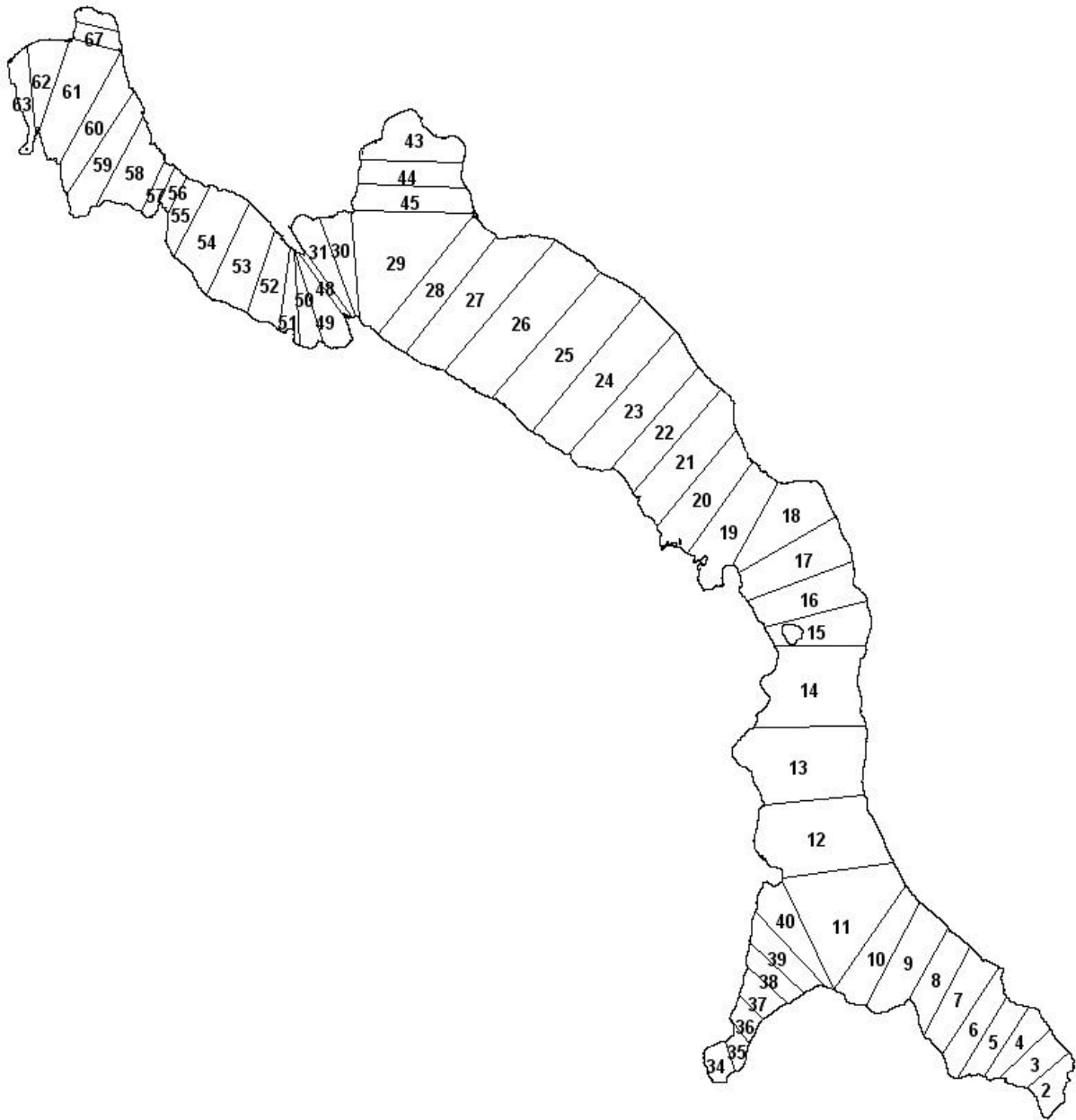


Figure 7. Plan view of the Lake Whatcom model grid.

The model was divided into five branches and two water bodies. Branches 1 through 3 simulated basin 3 and branches 4 and 5 represented basins 1 and 2. The length of the model segments ranged from 16 meters to 821 meters. Model layers have a thickness of 1 or 3 meters. 3 meter layer thicknesses were used only in the deeper sections of Basin 3. Model layers were shown in Figure 8.

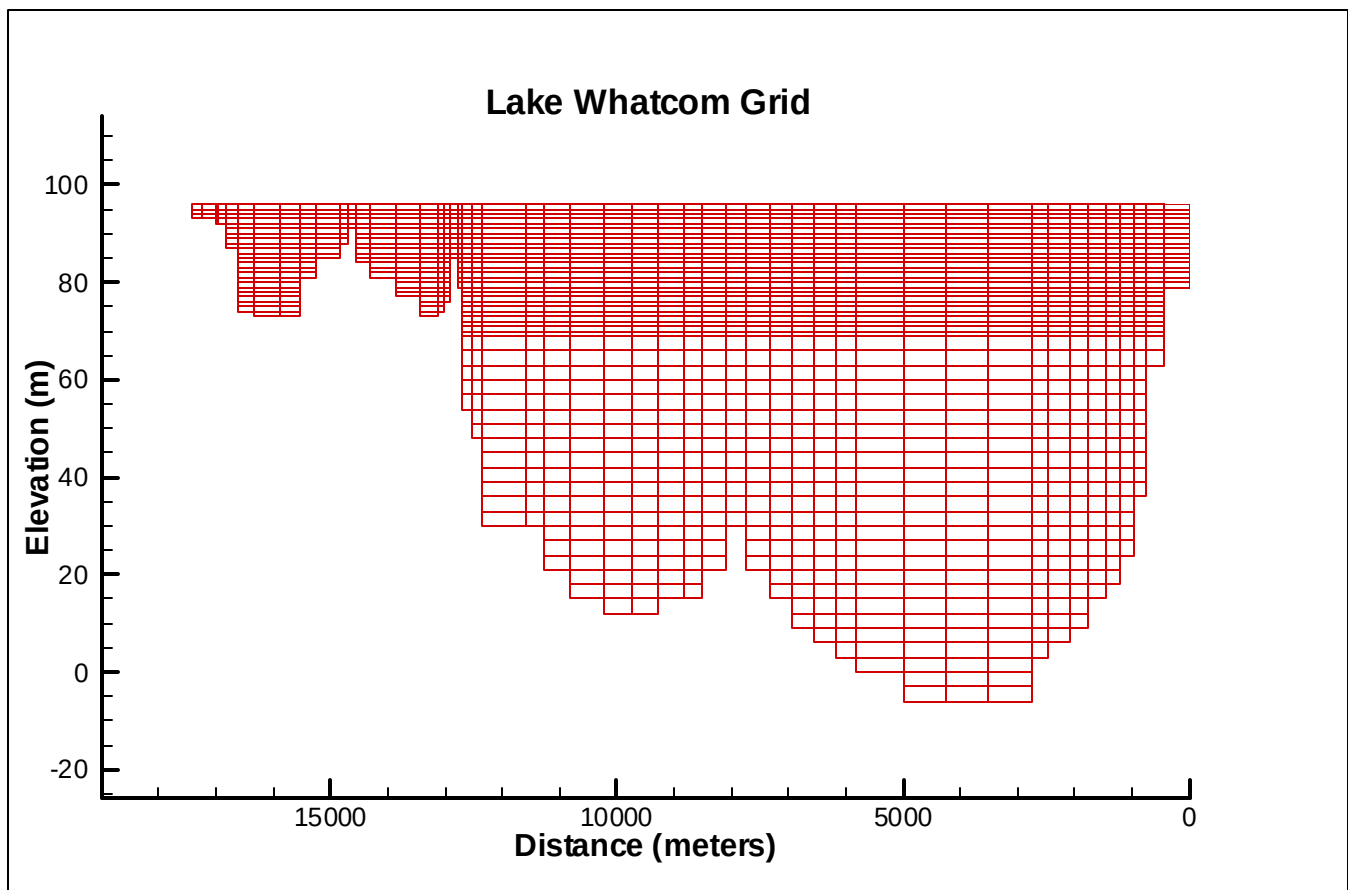


Figure 8. Layer elevations of Lake Whatcom model. Only layers below the full pool elevation are shown.

In the CE-QUAL-W2 model, the model user must specify the characteristics and connectivity of the model grid. The following parameters were used in the Lake Whatcom model (see Cole and Wells, 2004, for detailed explanation of model grid characteristics):

IMP (# of segments): 68
 KMP (# of vertical layers): 105
 NWB (# of water-bodies): 2
 NBR (# of branches): 5

The branch layout was specified by these parameters for each branch (as specified in the w2_con.npt control file – see Cole and Wells, 2004).

Lake Whatcom outflow

The downstream boundary condition was the outflow from Lake Whatcom (Figure 9). Outflow data were obtained from the City of Bellingham.

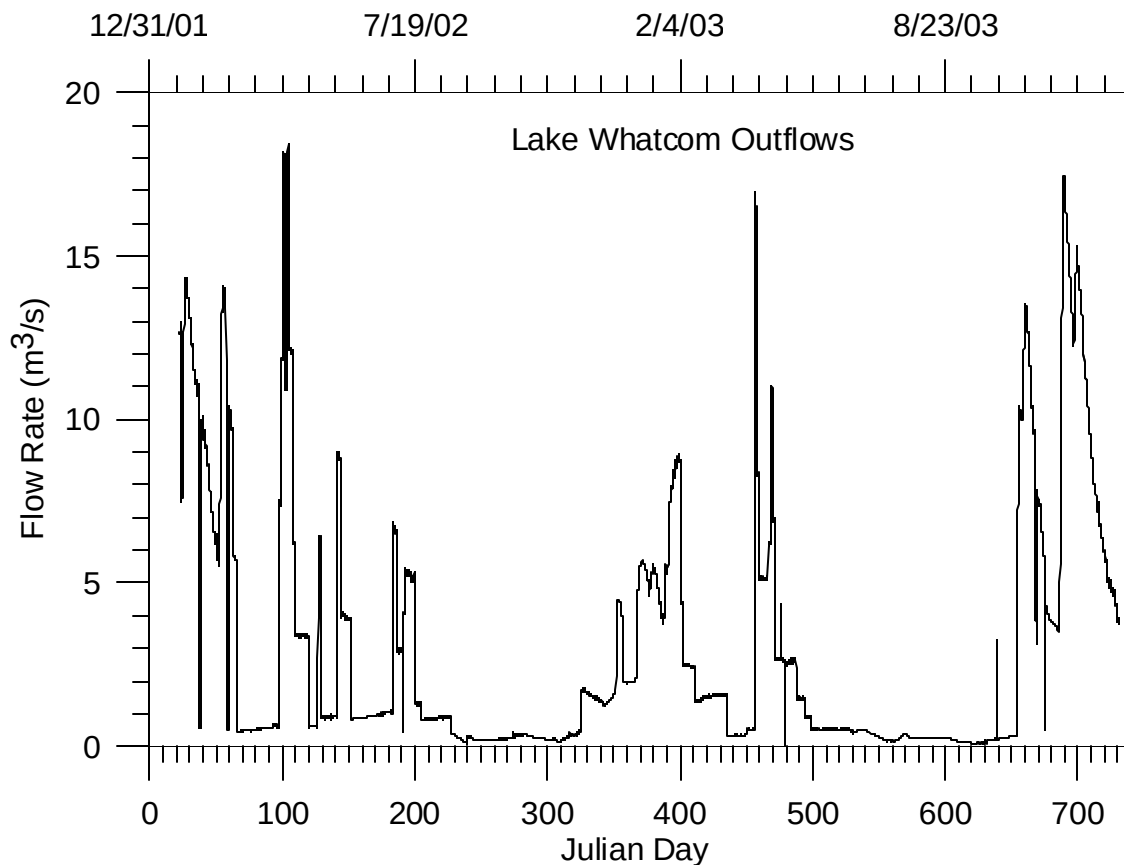


Figure 9. Lake Whatcom Outflow

Tributaries

A total of 22 point tributaries of Lake Whatcom were simulated in the model. Table 2 lists these tributaries and their model inflow segment. The watersheds of the tributaries were shown in Figure 10. Continuous flow and temperature data were available for the following creeks: Austin, Anderson, Brannian, Carpenter, Euclid, Mill Wheel, Olsen, Silver Beach, and Smith. Flows for un-gauged watersheds were estimated by calculating the area proportional flow based on a nearby gauged creek. Figure 21 through Figure 24 in Appendix A: Model Inputs show the tributary flow rates.

Temperature files were developed using measured data and a simple response temperature model. For those creeks or watersheds without measured data, the data from an adjacent watershed were used (Table 3). All temperature probes were removed the first week of November 2003, and afterwards the tributary temperatures were estimated using a simple response temperature model developed by the Department of Ecology. October 2003 temperature data were used to calibrate this model and model absolute mean errors were all less than 1 degree Celsius. Figure 25 through Figure 28 in Appendix A: Model Inputs show the tributary temperatures.

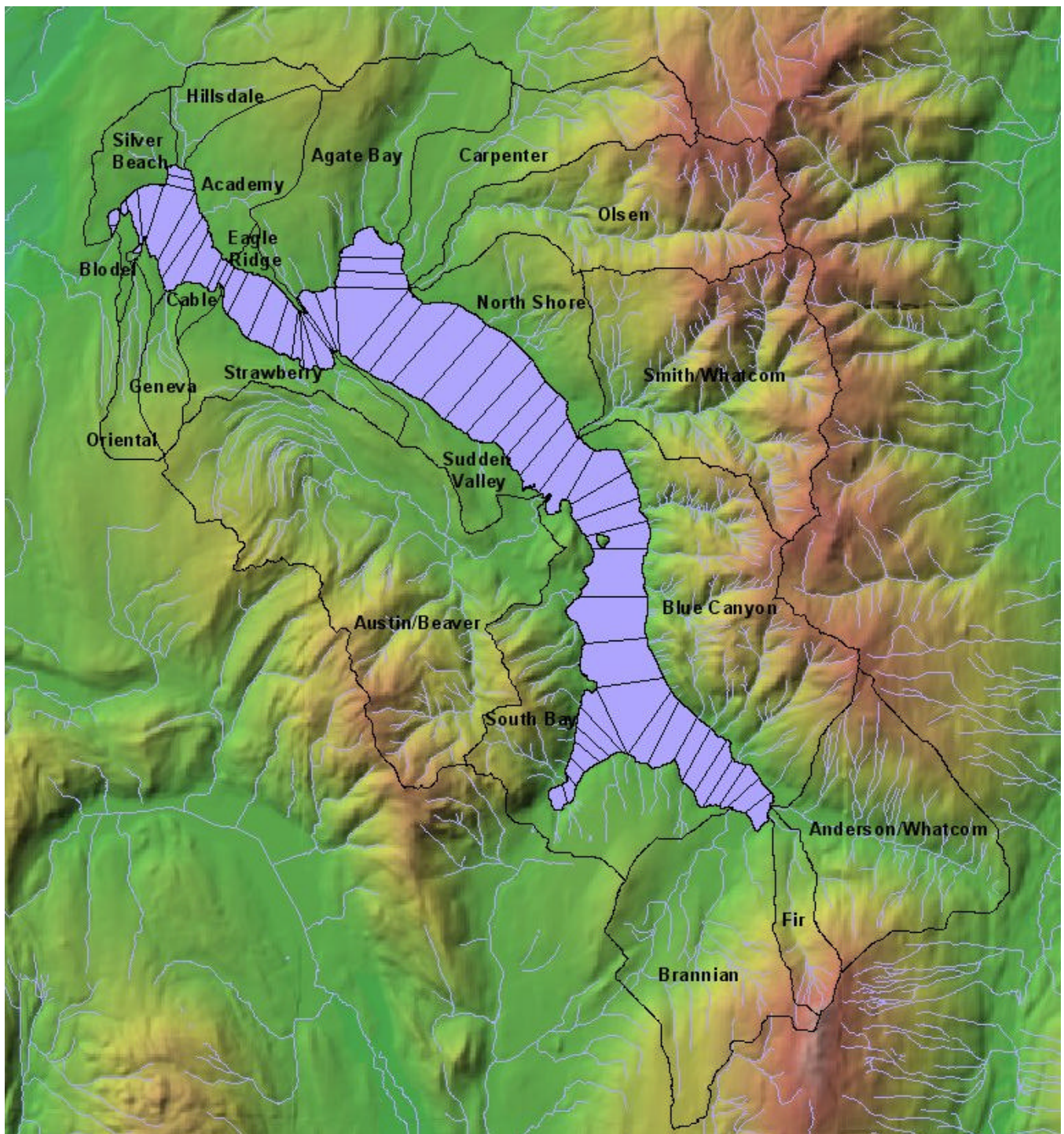


Figure 10. Watersheds of Lake Whatcom tributaries.

Table 2. Lake Whatcom model point tributaries and inflow segments.

Tributary #	Inflow Segment #	Watershed
1	29	Agate Bay
2	45	Carpenter
3	66	Hillsdale
4	60	Academy

Tributary #	Inflow Segment #	Watershed
5	66	Silver Beach
6	28	Olsen
7	63	Blodel
8	55	Eagle Ridge
9	25	North Shore
10	20	Smith
11	60	Donavan
12	62	Mill Wheel
13	57	Cable
14	49	Strawberry
15	59	Euclid
16	23	Sudden Valley
17	19	Austin
18	5	Blue Canyon
19	11	South Bay
20	2	Anderson
21	2	Fir
22	4	Brannian

Table 3. Method to fill in the watersheds without data

No data watershed	Corresponding data watershed
Academy	Euclid
Agate Bay	Carpenter
South Bay	Brannian
Blodel	Mill Wheel
Blue Canyon	Smith
Cable	Euclid
Donavan	Euclid
Eagle Ridge	Euclid
Fir	Brannian
Hillsdale	Silver Beach
North Shore	Carpenter
Strawberry	Euclid
Sudden Valley	Euclid

Constituent data were available for the Anderson, Austin, Brannian, Carpenter, Euclid, Mill Wheel, Olsen, Silver Beach and Smith watersheds. Constituent files were developed from data and using regressions fitted to the data. These regressions were developed by the Department of Ecology. For watersheds that lacked data, the constituent file of a similar watershed was used (Table 3). Constituent concentrations for the tributaries were shown in Figure 29 through Figure 64 of Appendix A: Model Inputs.

The equations used in developing the constituent files for the tributaries were shown below:

Algae:

$$\sum \Phi_{algae} = \Phi_{algae(total)} = \Phi_{Chl_a(total)} \times \text{Algae_to_Chla_ratio} \times \text{species_fraction} \quad (1)$$

Algae_to_Chla_Ratio = 100, this is the ratio between algae biomass and chlorophyll a mass

Species_fraction = 0.6 for species 1 (diatoms), 0.3 for species group 2(greens), 0.1 for species group 3 (blue-greens)

Total Organic Matter (TOM)

$$\Phi_{TOM} = \frac{\Phi_{TOC}}{d_C} - \sum \Phi_{algae} \quad (2)$$

$d_C = 0.45$, carbon-biomass ratio

Φ_{TOC} : Total Organic Carbon, from regression

Dissolved Organic Matter (DOM)

$$\Phi_{DOM} = \frac{\Phi_{DOC}}{d_C} \quad (3)$$

Φ_{DOC} : Dissolved Organic Carbon

POM (particulate organic matter) or Detritus:

$$\Phi_{POM} = \Phi_{TOM} - \Phi_{DOM} \quad (4)$$

LDOM (Labile Dissolved Organic Matter)

$$\Phi_{LDOM} = f_{LDOM} \Phi_{DOM} \quad (5)$$

$f_{LDOM} = 0.50$

RDOM (Refractory Dissolved Organic matter)

$$\Phi_{RDOM} = (1 - f_{LDOM}) \Phi_{DOM} \quad (6)$$

LPOM (labile particulate organic matter)

$$\Phi_{LPOM} = f_{LPOM} \Phi_{POM} \quad (7)$$

$f_{LPOM} = 0.5$

RPOM (refractory particulate organic matter)

$$\Phi_{RPOM} = (1 - f_{LPOM}) \Phi_{POM} \quad (8)$$

ISS (inorganic suspended solids):

$$\Phi_{ISS} = \Phi_{TNVSS} \quad (9)$$

Φ_{TNVSS} : Total non-volatile suspended solids, from data

Total Inorganic Carbon:

$$\Phi_{TIC} = function(\Phi_{alk} + pH + Temp) \quad (10)$$

Φ_{alk} : alkalinity, used regression developed from data

LDOM-P (labile dissolved organic matter – phosphorus):

$$\Phi_{LDOM-P} = (\Phi_{TP} - \Phi_{PO4P} - \sum \Phi_{algae} \times orgp) / \Phi_{TOM} \times \Phi_{LDOM} \quad (11)$$

$orgp$: phosphorus fraction of algae, assumed to be 0.005

Φ_{TP} : Total Phosphorus, used regression developed from data

Φ_{PO4P} : soluble reactive phosphorus, used regression developed from data

RDOM-P (refractory dissolved organic matter – phosphorus):

$$\Phi_{RDOM-P} = (\Phi_{TP} - \Phi_{PO4P} - \sum \Phi_{algae} \times orgp) / \Phi_{TOM} \times \Phi_{RDOM} \quad (12)$$

LPOM-P (labile particulate organic matter – phosphorus):

$$\Phi_{LPOM-P} = (\Phi_{TP} - \Phi_{PO4P} - \sum \Phi_{algae} \times orgp) / \Phi_{TOM} \times \Phi_{LPOM} \quad (13)$$

RPOM-P (refractory particulate organic matter – phosphorus):

$$\Phi_{RPOM-P} = (\Phi_{TP} - \Phi_{PO4P} - \sum \Phi_{algae} \times orgp) / \Phi_{TOM} \times \Phi_{RPOM} \quad (14)$$

LDOM-N (labile dissolved organic matter – nitrogen):

$$\Phi_{LDOM-N} = (\Phi_{TPN} - \Phi_{NH3} - \Phi_{NO3+NO2} - \sum \Phi_{algae} \times orgn) / \Phi_{TOM} \times \Phi_{LDOM} \quad (15)$$

$orgn$: phosphorus fraction of algae, assumed to be 0.08

Φ_{TPN} : Total Persulfate Nitrogen, used regression developed from data

$\Phi_{NO3+NO2}$: nitrite-nitrate, regression developed from data

Φ_{NH3} : ammonia, from data

RDOM-N (refractory dissolved organic matter – nitrogen):

$$\Phi_{RDOM-N} = (\Phi_{TPN} - \Phi_{NH3} - \Phi_{NO3+NO2} - \sum \Phi_{algae} \times orgn) / \Phi_{TOM} \times \Phi_{RDOM} \quad (16)$$

LPOM-N (labile particulate organic matter – nitrogen):

$$\Phi_{LPOM-N} = (\Phi_{TPN} - \Phi_{NH3} - \Phi_{NO3+NO2} - \sum \Phi_{algae} \times orgn) / \Phi_{TOM} \times \Phi_{LPOM} \quad (17)$$

RPOM-N (refractory particulate organic matter – nitrogen):

$$\Phi_{RPOM-N} = (\Phi_{TPN} - \Phi_{NH3} - \Phi_{NO3+NO2} - \sum \Phi_{algae} \times orgn) / \Phi_{TOM} \times \Phi_{RPOM} \quad (18)$$

Meteorological Data

Meteorological data for the CE-QUAL-W2 model were measured near Smith Creek and near Brannian Creek. The model utilizes air and dew point temperature, wind speed and direction, and cloud cover and/or solar radiation. The Washington Department of Ecology developed the meteorological data. Meteorological input files were created for water body 1 (basin 3) and water body 2 (basins 1 and 2). Table 4 summarizes the data sources of the meteorological inputs.

Table 4. Data sources for meteorological input files.

Meteorological Input	Water Body 1 (file 'met_1.npt')	Water Body 2 (file 'met_2.npt')
Air Temperature	used the average of the two stations [*]	Used data at Smith
Dew Point Temperature	used the average of the two stations [*]	Used data at Smith
Wind direction	Used data at Smith	Used data at Smith
Wind speed	Used data at Smith	Used data at Smith
Cloud Cover	Cloud cover data were from National Weather Service Data measured at Bellingham Airport	Cloud cover data were from National Weather Service Data measured at Bellingham Airport
Short Wave Solar Radiation	used the bigger value of the two stations [*]	used the bigger value of the two stations [*]

^{*}For the time period 10/1/2002 -- 11/10/2002 there was no data at Brannian, so data at Smith were used.

Plots of the meteorological inputs were shown in Appendix A: Model Inputs. A time series model input of air temperature, dew point temperature, wind speed, wind direction, cloud cover and short wave solar radiation were necessary for each water body and these were shown in Figure 65 to Figure 76. Air temperature for water body 1 and water body 2 were shown in Figure 65 and Figure 66, respectively. Dew point temperatures were shown in Figure 67 and Figure 68. Figure 69 and Figure 70 show wind speed for these 2 waterbodies, respectively. Figure 71 shows wind direction data. Cloud cover data were shown in Figure 73 and Figure 74, and short wave radiation were shown in Figure 75 and Figure 76 for water body 1 and 2, respectively.

Groundwater

Groundwater flow rates and water quality were based on the Department of Ecology report "Lake Whatcom Total Maximum Daily Load Groundwater Study" (Pitz, 2005). Groundwater inflows were characterized in 3 shoreline sections: Agate Bay shoreline, South Bay/Anderson Creek shoreline, and the bedrock terrain shoreline which represented all the remaining shoreline area (Figure 11). The groundwater flow rates of these shoreline areas were listed in Table 5.

Table 5. Groundwater flow rates of shoreline areas.

Shoreline Area	Flow Rate (m ³ /s)
Agate Bay Shoreline	0.073
South Bay/Anderson Creek Shoreline	0.169
Bedrock Terrane (remain shoreline)	0.147
Total	0.388

The groundwater inflows were characterized using point source tributaries and distributed tributaries in the model. For the Agate Bay shoreline area, a distributed tributary in branch 3 was applied. A distributed tributary in branch 2 and a single tributary into segment 2 were used for the South Bay/Anderson groundwater inflow. The bedrock terrane inflows were described using a distributed inflow into branch 4 and 7 point source tributaries in branch 1. Point source tributaries in branch 1 were used to describe the bedrock terrane inflows because the distributed tributary had been used for the water balance flow. Table 6 lists the point source tributaries and distributed tributaries which were used to characterize the groundwater inflows.

Table 6. Point source tributaries and distributed tributaries used to characterize groundwater inflows.

Type	Shoreline	Segment or Branch #	Flow rate (m ³ /s)
Distributed Tributary	Agate Bay	Branch 3	0.0729
Distributed Tributary	South Bay/Anderson	Branch 2	0.0843
Point Source Tributary	South Bay/Anderson	Segment 2	0.0843
Point Source Tributary	Bedrock Terrane	Segment 4	0.0153
Point Source Tributary	Bedrock Terrane	Segment 8	0.0153
Point Source Tributary	Bedrock Terrane	Segment 12	0.0153
Point Source Tributary	Bedrock Terrane	Segment 16	0.0153
Point Source Tributary	Bedrock Terrane	Segment 20	0.0153
Point Source Tributary	Bedrock Terrane	Segment 24	0.0153
Point Source Tributary	Bedrock Terrane	Segment 28	0.0153
Distributed Tributary	Bedrock Terrane	Branch 4	0.0396

Groundwater constituent concentrations were based on geomeans of data measured in each shoreline area (Pitz, 2005). Table 7 list the constituent concentrations used for each shoreline area.

Table 7. Constituent concentrations used for groundwater inflows

Constituent	Unit of Measure	Agate Bay	South Bay/Anderson	Bedrock Terrane
DO	mg/L	0.9	0.9	0.9
TDS	mg/L	149	86	214
Chloride	mg/L	2.89	1.95	7.56
Conductivity	uS/cm	204	116	328
Ammonia-N	mg/L	0.347	0.259	0.183
Nitrate-N	mg/L	0.005	0.005	0.005
OP	mg/L	0.082	0.095	0.038
Alkalinity	mg/L	20	20	20
Inorganic C	mg/L	6.63	6.63	5.72
LDOM P	mg/L	0.0465	0.031	0.05
RDOM P	mg/L	0.0465	0.031	0.05
LDOM	mg/L	9.3	6.2	10
RDOM	mg/L	9.3	6.2	10

Groundwater temperatures were estimated using Whatcom remediation site temperatures (Figure 12).

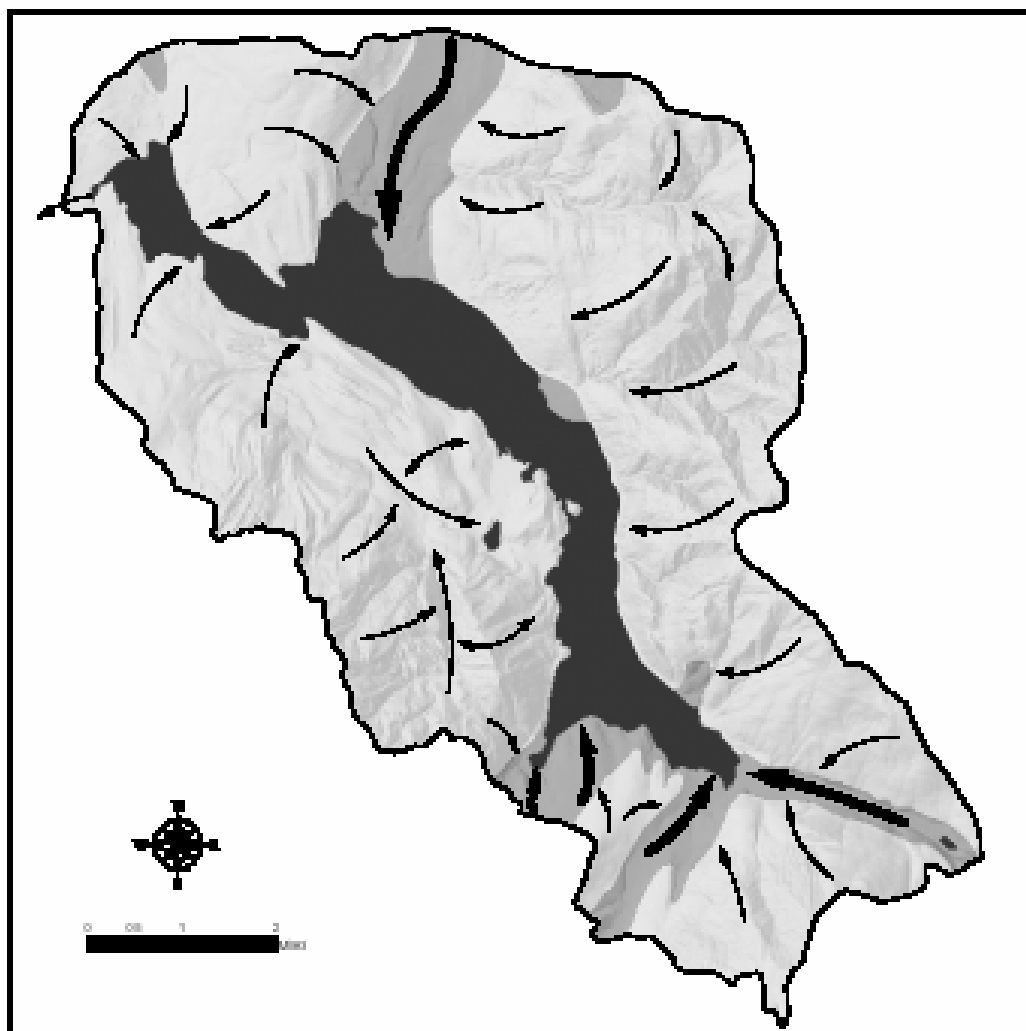


Figure 11. Flows and Water Quality Based on Ecology’s “Lake Whatcom TMDL Groundwater Study”, (Pitz, 2005)

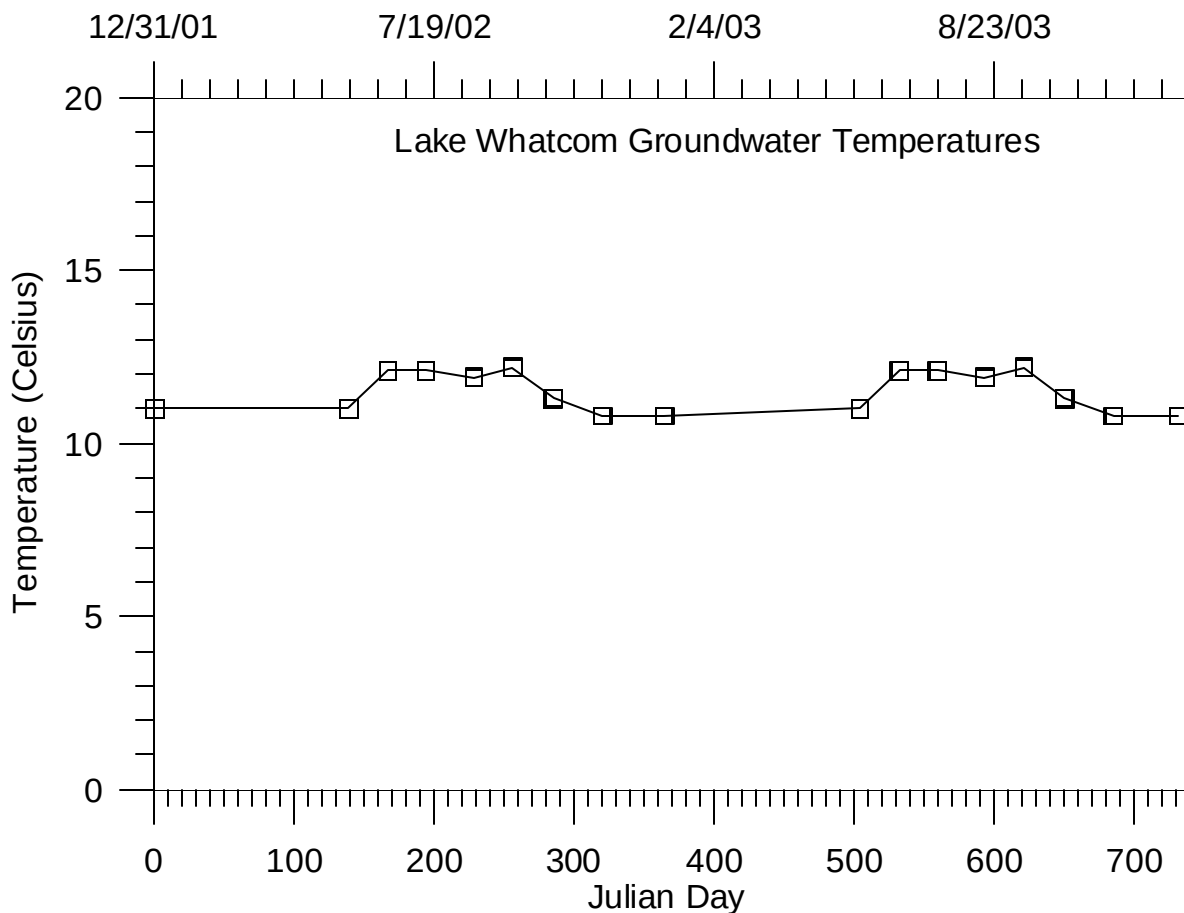


Figure 12. Groundwater temperatures.

Precipitation

Precipitation rates were developed from data collected at the Geneva Gate House, Smith, and Brannian gauges. Although the precipitation rate files were created for each water body, CE-QUAL-W2 requires precipitation files for every branch. Table 8 summarizes the steps taken in creating a precipitation rate file for each water body. The precipitation rates for each water body were shown in Figure 13.

Table 8. Steps taken in creating precipitation rate files.

Water Body	Inflow file
1 (branches 1, 2, and 3)	Used the following weighting factors provided by Western Washington University to calculate precipitation: Smith gage: 0.4610 Brannian gage: 0.3146
2 (branches 4 and 5)	Used data collected at Geneva Gate House, except for period from 5/2/02 to 5/8/02 when data at Geneva were missing and a regression between Geneva and Smith was used to fill in the data

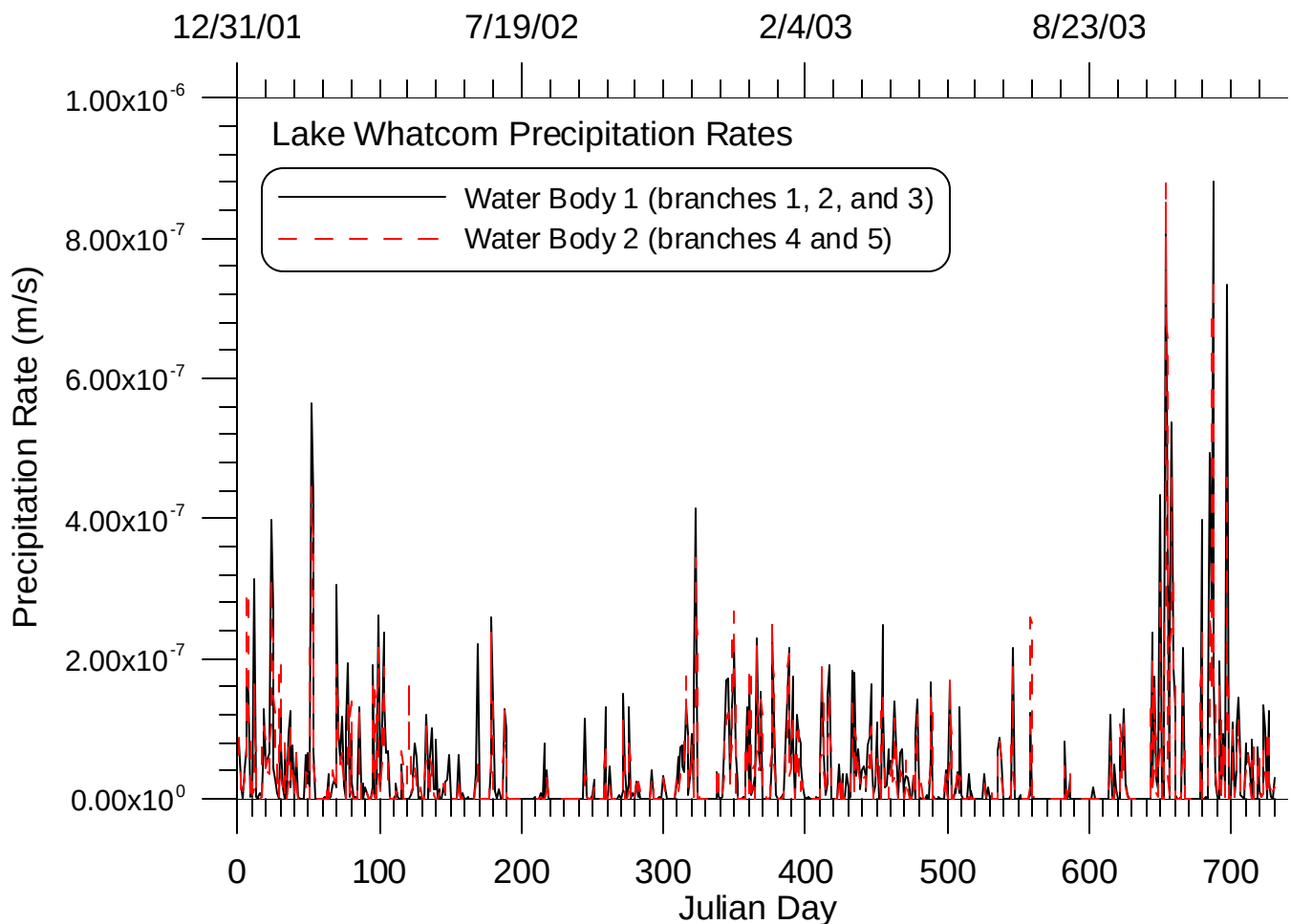


Figure 13. Precipitation rates for water body 1 and water body 2.

The precipitation temperature was assumed to be equal to air temperature. The precipitation temperature for branches 1, 3, 4 and 5 was assumed to be the average of the air temperatures at the Smith and Brannian meteorological stations. For branch 2 the precipitation was assumed to be equal to the air temperature measured at Brannian.

Precipitation constituent concentrations varied seasonally and data collected by the USGS National Atmospheric Deposition Program were used to create the time series input file. Figure 77 through Figure 80 in Appendix A: Model Inputs show the constituent concentrations for precipitation.

Withdrawals

Withdrawals simulating the water district 10 intake, the combined City and Georgia Pacific intake, and the fish hatchery intake were simulated. These withdrawals are listed in Table 9 and their flow rates were plotted in Figure 14. Flow rate data were obtained from the City of Bellingham.

Table 9. List of Lake Whatcom withdrawals.

Withdrawal #	Description	Model Segment	Intake elevation (m)
1	Water District 10	17	74.5
2	City and Georgia Pacific	54	83.5
3	Fish Hatchery	63	94.5

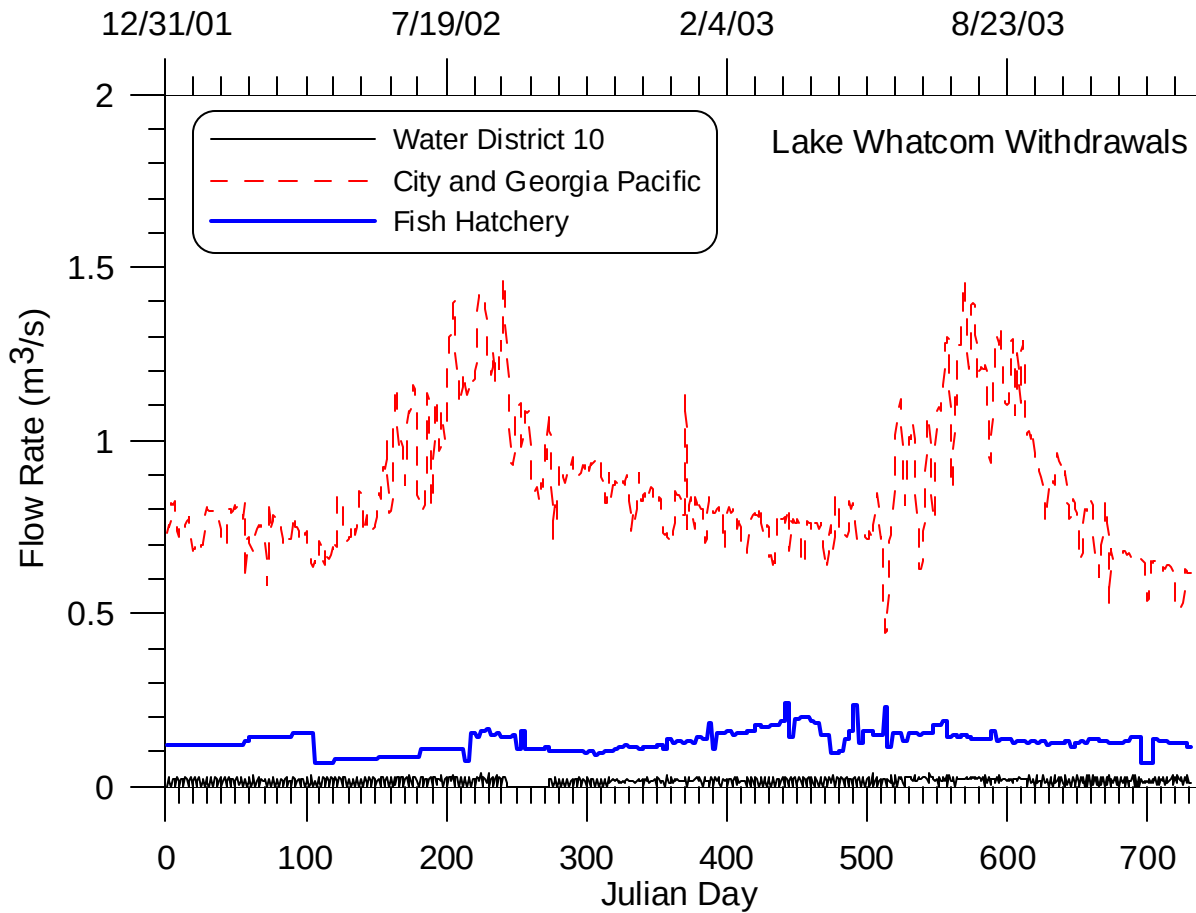


Figure 14. Lake Whatcom withdrawals.

Hydrodynamic Calibration

Water level data provided by the City of Bellingham were compared with model results were shown in Figure 15. Table 10 shows water level statistics. Water levels were calibrated by adding a distributed flow file for branch 1 to compensate for the error in inflow/outflow measurements and to also account for inflows and/or losses directly into the lake.

Table 10. Water level error statistics.

n, # of data comparisons	Mean Error M	Absolute Mean Error m	Root Mean Square Error m
685	-0.014	0.017	0.021

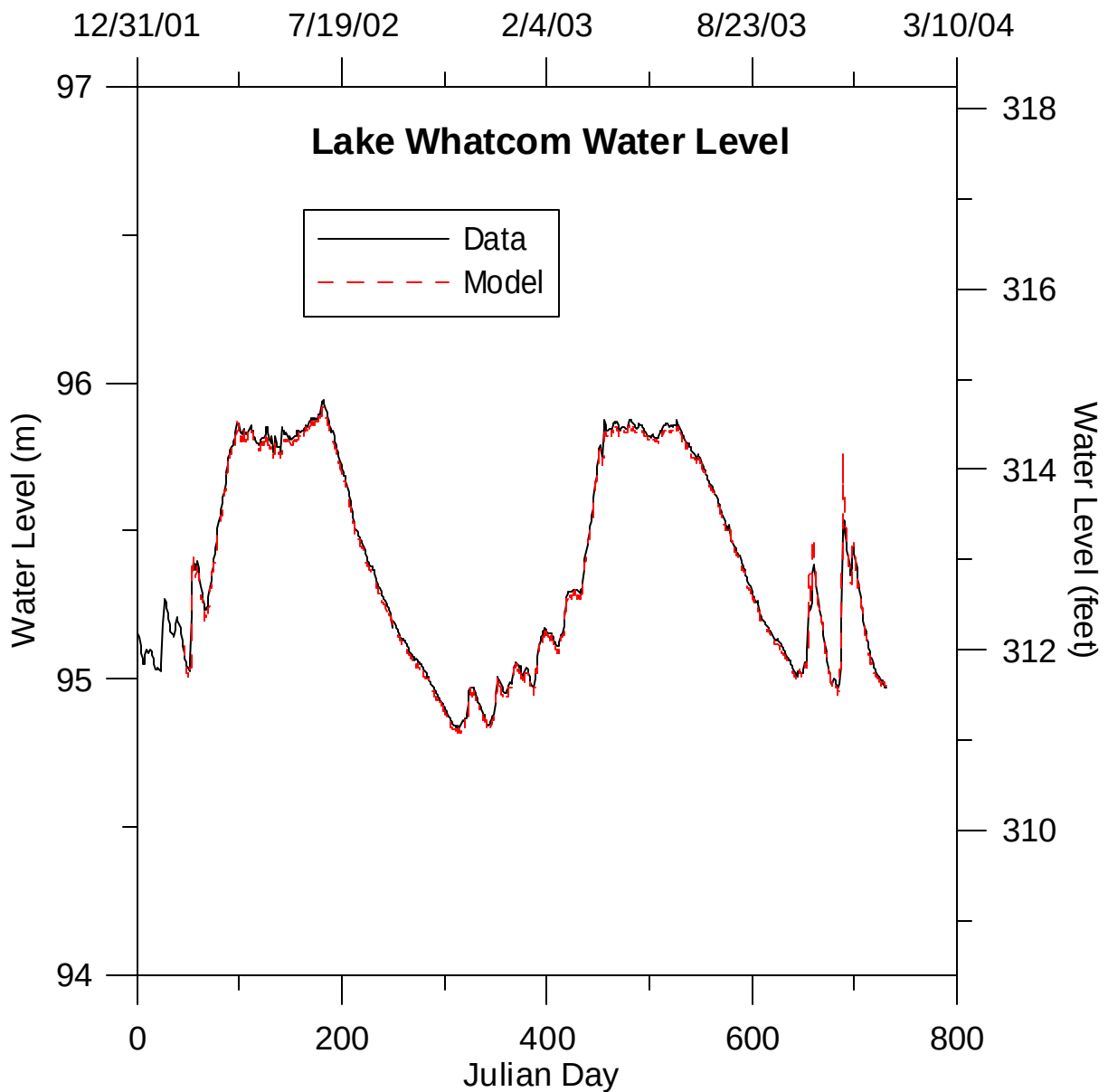


Figure 15. Water level prediction compared with data for Lake Whatcom.

Temperature Calibration

The primary model parameters affecting temperature calibration was wind sheltering coefficients. Comparisons between model predictions and temperatures were shown in Appendix B Table 11 list error statistics between model predictions and data for all the sampling locations in the lake. Error statistics were calculated by comparing measured data at a particular depth with the model prediction (interpolated between layers) at that depth. The root mean square error average was less than 1 degrees Celsius for all sites. Figure 16 shows the correlation between model predictions and data. The r -squared value for model versus data was 0.995.

Table 11. Temperature profile error statistics.

Site	Mean Error (Celsius)	Absolute Mean Error (Celsius)	Root Mean Square Error (Celsius)
LW1	-0.10	0.67	0.78
LW2	0.03	0.55	0.67
LW3	-0.20	0.47	0.60
LW4	-0.22	0.58	0.69
Intake	-0.19	0.44	0.49
Average	-0.14	0.54	0.64

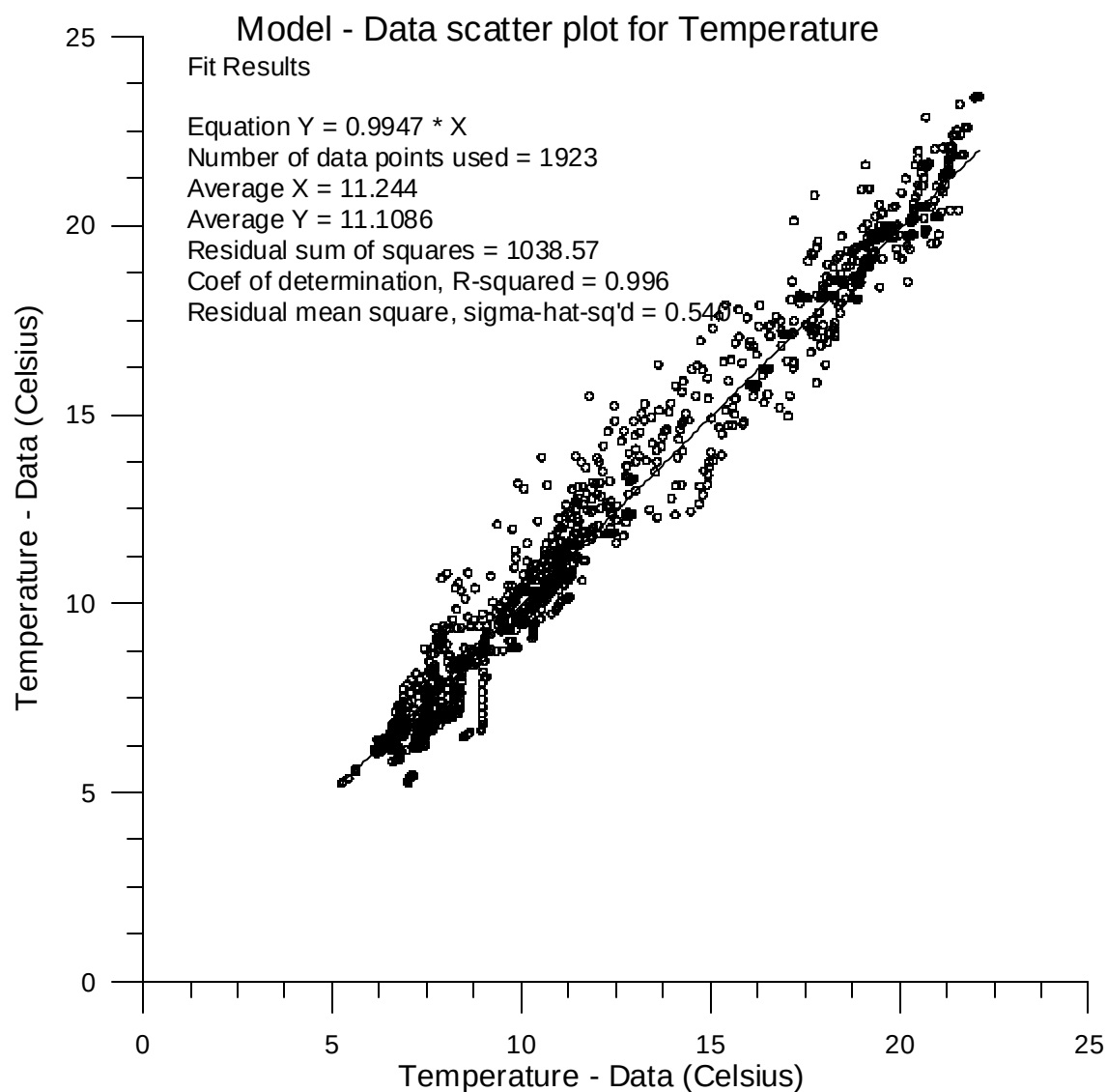


Figure 16. Model versus data scatter plot for temperature.

Water Quality Calibration

The calibrated water quality coefficients were shown in Table 12. These are variables that can be adjusted to calibrate a CE-QUAL-W2 model.

Table 12. W2 Model Water Quality Parameters

Variable	Description	Units	Typical values*	Calibration Values
Hydrodynamics and Longitudinal Transport				
AX	Longitudinal eddy viscosity (for momentum dispersion)	m ² /sec	1	1
DX	Longitudinal eddy diffusivity (for dispersion of heat and constituents)	m ² /sec	1	1
Temperature				
CBHE	Coefficient of bottom heat exchange	Wm ² /sec	0.30	0.30
TSED	Sediment (ground) temperature	°C	12.8	11.5
WSC	Wind sheltering coefficient		0.85	0.8-3.3
BETA	Fraction of incident solar radiation absorbed at the water surface		0.45	0.45
Water Quality				
EXH20	Extinction for water	/m	0.25	0.25
EXSS	Extinction due to inorganic suspended solids	m ³ /m/g	0.01	0.1
EXOM	Extinction due to organic suspended solids	m ³ /m/g	0.17	0.1
EXA	Extinction due to organic algal type 1	m ³ /m/g	0.1	0.1
SSS	Suspended solids settling rate	m/day	2	1.5
AG1	Algal growth rate for algal type 1	/day	1.1	1.65
AM1	Algal mortality rate for algal type 1	/day	0.01	0.04
AE1	Algal excretion rate for algal type 1	/day	0.01	0.04
AR1	Algal dark respiration rate for algal type 1	/day	0.02	0.04
AS1	Algal settling rate for algal type 1	/day	0.14	0.1
ASAT1	Saturation intensity at maximum photosynthetic	W/m ²	150	50

Variable	Description	Units	Typical values*	Calibration Values
	rate for algal type 1			
APOM1	Fraction of algal biomass lost by mortality to detritus for algal type 1		0.8	0.8
AT11	Lower temperature for algal growth for algal type 1	°C	10	1
AT21	Lower temperature for maximum algal growth for algal type 1	°C	30	3
AT31	Upper temperature for maximum algal growth for algal type 1	°C	35	12
AT41	Upper temperature for algal growth for algal type 1	°C	40	25
AK11	Fraction of algal growth rate at ALGT1 for algal type 1		0.1	0.5
AK21	Fraction of maximum algal growth rate at ALGT2 for algal type 1		0.99	0.99
AK31	Fraction of maximum algal growth rate at ALGT3 for algal type 1		0.99	0.99
AK41	Fraction of algal growth rate at ALGT4 for algal type 1		0.1	0.1
ALGP-A1	Stoichiometric equivalent between organic matter and phosphorus for algal type 1		0.011	0.003
ALGN-A1	Stoichiometric equivalent between organic matter and nitrogen for algal type 1		0.08	0.06
ALGC-A1	Stoichiometric equivalent between organic matter and carbon for algal type 1		0.45	0.60
AG2	Algal growth rate for algal type 2	/day	1.1	1.9
AM2	Algal mortality rate for algal type 2	/day	0.01	0.04
AE2	Algal excretion rate for algal type 2	/day	0.01	0.04
AR2	Algal dark respiration rate for algal type 2	/day	0.02	0.04
AS2	Algal settling rate for algal	/day	0.14	0.1

Variable	Description	Units	Typical values*	Calibration Values
	type 2			
ASAT2	Saturation intensity at maximum photosynthetic rate for algal type 2	W/m ²	150	75
APOM2	Fraction of algal biomass lost by mortality to detritus for algal type 2		0.8	0.8
AT12	Lower temperature for algal growth for algal type 2	°C	10	8
AT22	Lower temperature for maximum algal growth for algal type 2	°C	30	12
AT32	Upper temperature for maximum algal growth for algal type 2	°C	35	16
AT42	Upper temperature for algal growth for algal type 2	°C	40	30
AK12	Fraction of algal growth rate at ALGT1 for algal type 2		0.1	0.1
AK22	Fraction of maximum algal growth rate at ALGT2 for algal type 2		0.99	0.6
AK32	Fraction of maximum algal growth rate at ALGT3 for algal type 2		0.99	0.99
AK42	Fraction of algal growth rate at ALGT4 for algal type 2		0.1	0.1
ALGP-A2	Stoichiometric equivalent between organic matter and phosphorus for algal type 2		0.011	0.0025
ALGN-A2	Stoichiometric equivalent between organic matter and nitrogen for algal type 2		0.08	0.06
ALGC-A2	Stoichiometric equivalent between organic matter and carbon for algal type 2		0.45	0.60
AG3	Algal growth rate for algal type 2	/day	1.1	2.0
AM3	Algal mortality rate for algal type 2	/day	0.01	0.04
AE3	Algal excretion rate for algal type 2	/day	0.01	0.04

Variable	Description	Units	Typical values*	Calibration Values
AR3	Algal dark respiration rate for algal type 2	/day	0.02	0.04
AS3	Algal settling rate for algal type 2	/day	0.14	0.01
ASAT3	Saturation intensity at maximum photosynthetic rate for algal type 2	W/m ²	150	130
APOM3	Fraction of algal biomass lost by mortality to detritus for algal type 2		0.8	0.8
AT13	Lower temperature for algal growth for algal type 2	°C	10	8
AT23	Lower temperature for maximum algal growth for algal type 2	°C	30	16
AT33	Upper temperature for maximum algal growth for algal type 2	°C	35	20
AT43	Upper temperature for algal growth for algal type 2	°C	40	30
AK13	Fraction of algal growth rate at ALGT1 for algal type 2		0.1	0.1
AK23	Fraction of maximum algal growth rate at ALGT2 for algal type 2		0.99	0.60
AK33	Fraction of maximum algal growth rate at ALGT3 for algal type 2		0.99	0.99
AK43	Fraction of algal growth rate at ALGT4 for algal type 2		0.1	0.1
ALGP-A3	Stoichiometric equivalent between organic matter and phosphorus for algal type 2		0.011	0.002
ALGN-A3	Stoichiometric equivalent between organic matter and nitrogen for algal type 2		0.08	0.06
ALGC-A2	Stoichiometric equivalent between organic matter and carbon for algal type 2		0.45	0.60
LDOMDK	Labile DOM decay rate	/day	0.12	WB1:0.060 WB2:0.120
LRDDK	Labile to refractory decay rate	/day	0.001	0.01

Variable	Description	Units	Typical values*	Calibration Values
RDOMDK	Maximum refractory decay rate	/day	0.001	0.001
LPOMDK	Labile Detritus decay rate	/day	0.06	WB1:0.020 WB2:0.040
POMS	Detritus settling rate	m/day	0.35	WB1:1.0 WB2:0.5
RPOMDK	Refractory Detritus decay rate	/day		0.001
OMT1	Lower temperature for organic matter decay	°C	4	2
OMT2	Lower temperature for maximum organic matter decay	°C	20	20
OMK1	Fraction of organic matter decay rate at OMT1		0.1	0.4
OMK2	Fraction of organic matter decay rate at OMT2		0.99	0.99
SEDK	Sediment decay rate	/day	0.06	WB1:0.001 WB2:0.004
PARTP	Phosphorous partitioning coefficient for suspended solids		1.2	0
AHSP1	Algal half-saturation constant for phosphorous – algae 1	g/m	0.009	0.002
AHSP2	Algal half-saturation constant for phosphorous – algae 2	g/m	0.009	0.0025
AHSP3	Algal half-saturation constant for phosphorous – algae 3	g/m	0.009	0.002
NH4DK	Ammonia decay rate (nitrification rate)	/day	0.12	0.3
AHSN	Algal half-saturation constant for ammonia	g/m ³	0.014	0.014
NH4T1	Lower temperature for ammonia decay	°C	5	5
NH4T2	Lower temperature for maximum ammonia decay	°C	20	25
NH4K1	Fraction of nitrification rate at NH4T1		0.1	0.1
NH4K2	Fraction of nitrification rate at NH4T2		0.99	0.99
NO3DK	Nitrate decay rate (denitrification rate)	/day	0.102	0.05

Variable	Description	Units	Typical values*	Calibration Values
NO3T1	Lower temperature for nitrate decay	°C	5	5
NO3T2	Lower temperature for maximum nitrate decay	°C	20	25
NO3K1	Fraction of denitrification rate at NO3T1		0.1	0.1
NO3K2	Fraction of denitrification rate at NO3T2		0.99	0.99
O2NH4	Oxygen stoichiometric equivalent for ammonia decay		4.57	4.57
O2OM	Oxygen stoichiometric equivalent for organic matter decay		1.4	1.4
O2AR	Oxygen stoichiometric equivalent for dark respiration		1.4	1.1
O2AG	Oxygen stoichiometric equivalent for algal growth		1.4	1.8
ORGP	Stoichiometric equivalent between organic matter and phosphorus		0.011	WB1:0.0002 WB2:0.004
ORGN	Stoichiometric equivalent between organic matter and nitrogen		0.08	0.08
ORGC	Stoichiometric equivalent between organic matter and carbon		0.45	0.45
O2LIM	Dissolved oxygen concentration at which anaerobic processes begin	g/m ³	0.05	0.1
* Cole and Wells (2000)				

The constituent model-error statistics for all sites were included in Table 13 through Table 17. Statistics calculated include mean error (ME), absolute mean error (AME), and root mean square error (RMS). The statistics for all the sites were summarized in Table 18. Error statistics were calculated by comparing measured data at a particular depth with the model prediction (interpolated between layers) at that depth. “Appendix C: Vertical Profiles of Model Predictions and data” contains the vertical profile model versus data comparisons. Scatter plots showing the model versus data comparisons were shown for dissolved oxygen and chlorophyll a in Figure 17 and Figure 18.

The percentage bio-volumes of the 3 algae groups were also compared with vertical profile data. Figure 621 through Figure 782 in “Appendix C: Vertical Profiles of Model Predictions and data” show the model predicted bio-volumes and data. The algae 1 compartment simulates Chrysophyta (mostly

diatoms), the algae 2 compartment simulates Chlorophyta (greens), and the algae 3 compartment represents cyanobacteria (blue-greens). Algae data were obtained from the Washington Department of Ecology and Western Washington University (Deluna, 2004).

Table 13. Constituent error statistics for site LW1.

parameter	LW1 Mean Error (segment 61)	LW1 Absolute Mean Error (segment 61)	LW1 Root Mean Square Error (segment 61)
PO4-P (mg/l)	-0.0004	0.0028	0.0032
NH4-N (mg/l)	-0.0187	0.0337	0.0437
NOx-N (mg/l)	0.018	0.049	0.052
D. O. (mg/l)	0.307	1.01	1.27
Alkalinity (mg/l)	-1.86	1.86	2
TPN (mg/l)	-0.065	0.069	0.076
TP (mg/l)	-0.0049	0.0064	0.0080
Chlorophyll a	0.46	1.22	1.44
pH	-0.03	0.26	0.32

Table 14. Constituent error statistics for site LW2.

parameter	LW2 ME (segment 52)	LW2 AME (segment 52)	LW2 RMS (segment 52)
PO4-P (mg/l)	-0.0009	0.0022	0.0024
NH4-N (mg/l)	-0.0069	0.0163	0.0242
NOx-N (mg/l)	-0.025	0.049	0.053
D. O. (mg/l)	0.203	0.538	0.624
Alkalinity (mg/l)	-1.02	1.09	1.29
TPN (mg/l)	-0.085	0.085	0.098
TP (mg/l)	-0.0020	0.0037	0.0047
Chlorophyll a	0.21	0.86	1.01
pH	-0.01	0.18	0.21

Table 15. Constituent model-error statistics for site LW3.

Parameter	LW3 ME (segment 25)	LW3 AME (segment 25)	LW3 RMS (segment 25)
PO4-P (mg/l)	-0.0012	0.0016	0.0018
NH4-N (mg/l)	0.0003	0.0044	0.0055
NOx-N (mg/l)	-0.017	0.044	0.050
D. O. (mg/l)	0.409	0.602	0.706
Alkalinity (mg/l)	-0.451	0.545	0.616
TPN (mg/l)	-0.054	0.063	0.068
TP (mg/l)	-0.0016	0.0036	0.0041
Chlorophyll a	-0.16	0.91	0.99
pH	0.03	0.14	0.17

Table 16. Constituent model-error statistics for site LW4.

Parameter	LW4 ME (segment 11)	LW4 AME (segment 11)	LW4 RMS (segment 11)
PO4-P (mg/l)	-0.0011	0.0016	0.0019
NH4-N (mg/l)	-0.0004	0.0039	0.0050
NOx-N (mg/l)	-0.022	0.043	0.050
D. O. (mg/l)	0.51	0.71	0.782
Alkalinity (mg/l)	-0.39	0.506	0.597

Parameter	LW4 ME (segment 11)	LW4 AME (segment 11)	LW4 RMS (segment 11)
TPN (mg/l)	-0.066	0.072	0.076
TP (mg/l)	-0.0002	0.0029	0.0033
Chlorophyll a	0.07	0.80	0.89
pH	0.06	0.12	0.14

Table 17. Constituent model-error statistics for the intake site.

Parameter	INTAKE (segment 54)	INTAKE AME (segment 54)	INTAKE RMS (segment 54)
PO4-P (mg/l)	-0.0019	0.0019	0.0019
NH4-N (mg/l)	0.0036	0.0056	0.0058
NOx-N (mg/l)	-0.013	0.040	0.041
D. O. (mg/l)	0.203	0.57	0.598
Alkalinity (mg/l)	-0.7	0.788	0.794
TPN (mg/l)	-0.061	0.061	0.061
TP (mg/l)	-0.0007	0.0028	0.0028
Chlorophyll a	0.73	1.04	1.06
pH	-0.09	0.25	0.26

Table 18. Constituent model-error statistics for all sites.

Parameter	Average ME	Average AME	average RMS
PO4-P (mg/l)	-0.0011	0.0020	0.0023
NH4-N (mg/l)	-0.0044	0.0128	0.0168
NOx-N (mg/l)	-0.012	0.045	0.049
D. O. (mg/l)	0.326	0.685	0.797
Alkalinity (mg/l)	-0.883	0.958	1.06
TPN (mg/l)	-0.066	0.070	0.076
TP (mg/l)	-0.0019	0.0039	0.0046
Chlorophyll a	0.26	0.97	1.08
pH	-0.01	0.19	0.22

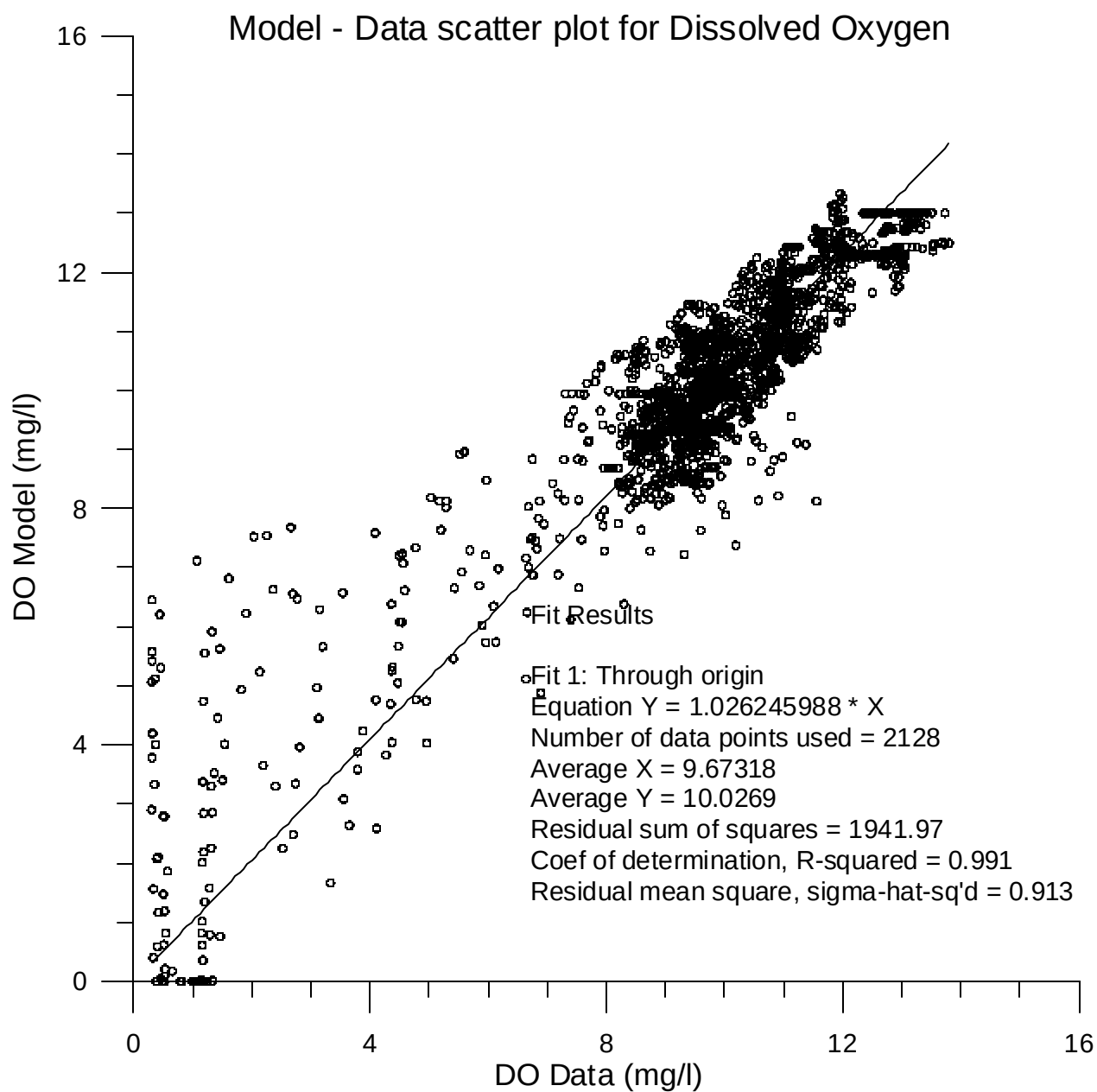


Figure 17. Model versus data scatter plot for dissolved oxygen.

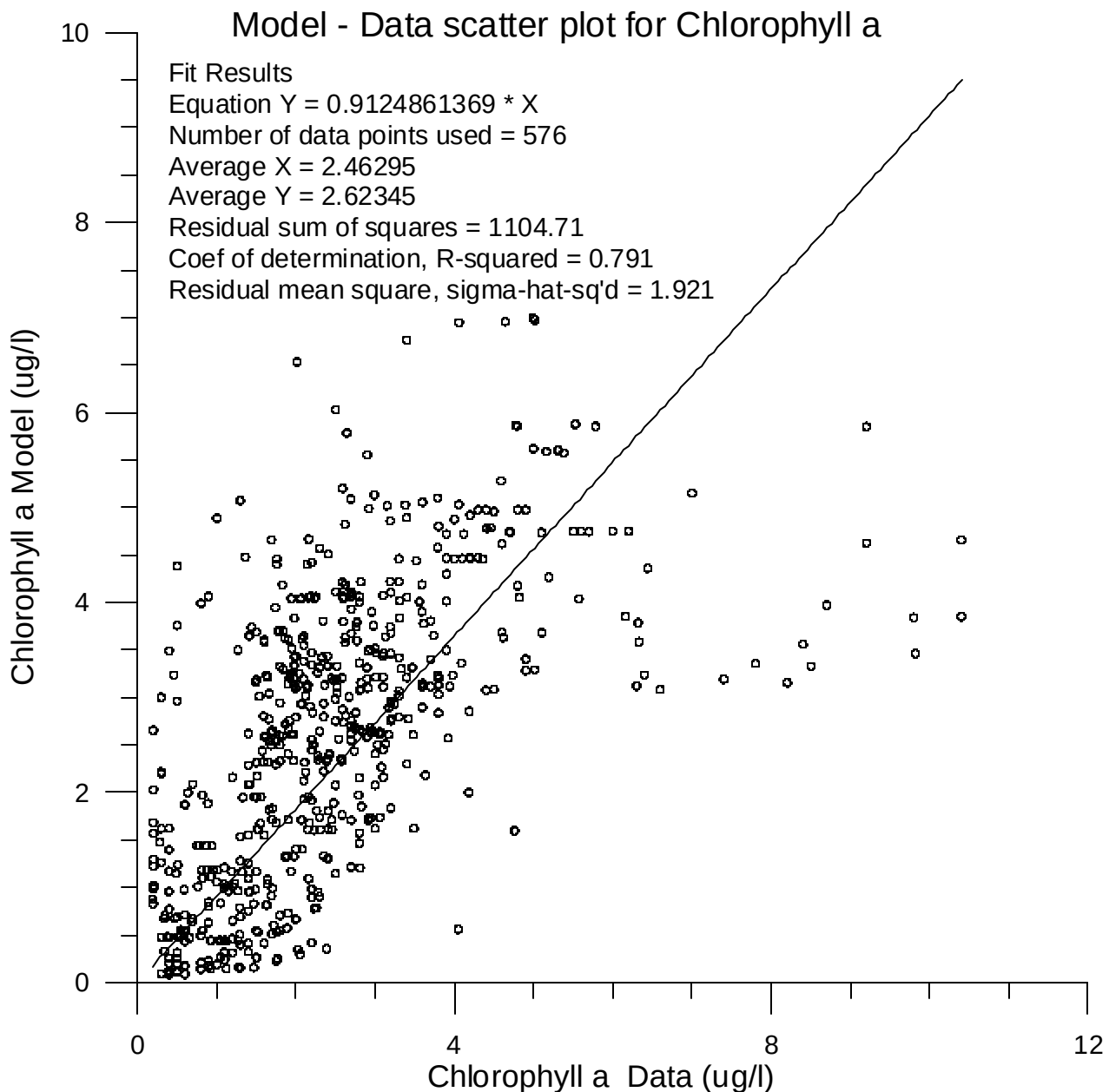


Figure 18. Model versus data scatter plot for chlorophyll a.

Preliminary Management Scenarios

In order to demonstrate how the model could be used to evaluate changes in phosphorus loading, several model scenarios were performed to determine the phosphorus loading needed to impact dissolved oxygen by 0.2 mg/l relative to natural conditions. These model evaluations are preliminary and are not intended to show how the Washington Department of Ecology will perform a TMDL assessment of Lake Whatcom. The model scenarios used are listed in Table 19. Further analysis is required to explore how various nutrient loading strategies affect dissolved oxygen concentrations in the lake. Tributary inputs for water quality, temperature, and flow were developed by the Washington Department of Ecology. The simulated model time period was approximately 5 years from October 1, 1998 to

December 31, 2003. The full rollback scenario represented natural conditions and the full buildout scenario corresponded to the loading that would occur if the Lake Whatcom watershed was developed. Partial rollback scenarios were simulated to determine the phosphorus loading necessary to reduce dissolved oxygen concentration by 0.2 mg/l at a critical time and point in the reservoir. The partial rollback scenarios were created by proportionally increasing the phosphorus loading ($\text{PO}_4\text{-P}$ and organic matter P) of the tributary loadings in rollback scenario. All the scenarios except for the rollback scenario and rollback scenario without dam include the diversion from the Nooksack River.

The bottom of basin 1 (segment 60) on 7/22/02 was selected as being the critical point or the time and location when dissolved oxygen concentration was decreased by a maximum amount relative to the rollback scenario. This time and location was selected by plotting the difference in dissolved oxygen concentrations between the rollback scenario and the base case and determining the time and location where this difference was greatest.

Additional critical points were chosen for basins 2 and 3. The bottom of basin 2 (segment 52) was selected as being a critical point on 7/30/2002 and the bottom of basin 3 (segment 11) was chosen as a critical point on 8/14/2003.

The selection of these critical points is one approach for evaluating changes in dissolved oxygen as a result of differences in phosphorus loading. Since oxygen changes at the bottom of the lake may represent only a small volume of the water column, a time and vertical volume-weighted average over the water column (where there is no credit given for super-saturation - if dissolved oxygen is above saturation, then that value is set equal to saturation) or over the hypolimnion may also provide a method for comparison of varying P loading effects on dissolved oxygen. Other statistical approaches for assessing changes in dissolved oxygen in the lake could also be explored. Since the intent of this section is to explore how the model can be used, this type of comparison was not included in this preliminary review of model scenarios.

The phosphorus loading due to tributaries, groundwater inflows, and precipitation for the scenarios are shown in Table 20. Groundwater and precipitation phosphorus loading was the same for all scenarios. The tributary loadings were varied to help determine the phosphorus load at which dissolved oxygen concentration was affected by 0.2 mg/l at the bottom of basin 1 on 7/22/02.

Figure 19 shows the absolute value of dissolved oxygen difference at the selected control point and time for basin 1, plotted versus phosphorus loading of the scenarios. At a phosphorus loading of approximately 19000 kg (3617 kg/yr), the dissolved oxygen concentration at the bottom of basin 1 will be affected by 0.2 mg/l. Table 21 shows the dissolved oxygen difference at the bottom of basin 1, basin 2, and basin 3 for all the scenarios. A plot of the dissolved oxygen profile in basin 1 (segment 60) on 7/22/02 for the base case, full rollback, full buildout, and partial rollback run D was shown in Figure 20.

The full rollback scenario without dam scenario actually predicted decreased dissolved oxygen concentrations at the control points in Table 21 relative to the rollback with dam scenario. Since the hydrodynamic conditions were different for this scenario (water levels were lower), and because dissolved oxygen concentrations at the bottom of a basin can vary daily, care must be taken in comparing a particular time/location between scenarios when water levels are different. For instance, seicheing can affect dissolved oxygen concentrations at the bottom of a basin and the seicheing period can vary due to differing water levels. Consequently, these results are being subjected to additional review and analysis.

A partial rollback from buildout scenario was also included. Dissolved oxygen concentrations for this scenario differed significantly from the other partial rollback scenario because of the difference in loading distribution of the tributaries.

These results, even though only illustrative, show that Whatcom Lake does respond to increased nutrient loading. Further analysis is required to explore how various nutrient loading strategies affect dissolved oxygen concentrations in the lake.

Table 19. Lake Whatcom scenario descriptions.

Scenario #	Name	Description	Phosphorus Load over simulation period (kg)
1	Base Case	5 year model simulation from October 1, 1998 to December 31, 2003.	22966
2	Full Rollback	Tributary loads “rolled back” to natural conditions, with dam	17719
3	Full Buildout	Tributary loads increased to build out conditions	26350
4	Partial Rollback D	P Load reduced to 19115 kg	19115
5	Partial Rollback E	P Load reduced to 18961 kg	18961
6	Full Rollback w/o dam	Tributary loads “rolled back” to natural conditions, with dam	17719
7	Partial Rollback from full buildout	P Load reduced to 18979 kg	18979

Table 20. Phosphorus loading from tributaries, groundwater, and precipitation for the scenarios.

Scenario	Tributaries (kg)	Groundwater (kg)	Precipitation (kg)	Total (kg)
Full Rollback w/o dam	6730.6	9699.4	1288.7	17718.7
Full Rollback with dam	6730.6	9699.4	1288.7	17718.7
Partial Rollback D	8126.5	9699.4	1288.7	19114.6
Partial Rollback E	7972.6	9699.4	1288.7	18960.7
Partial rollback from full Buildout	7990.41	9699.4	1288.7	18978.5
Base	11978.1	9699.4	1288.7	22966.2
Full Buildout	15361.7	9699.4	1288.7	26349.8

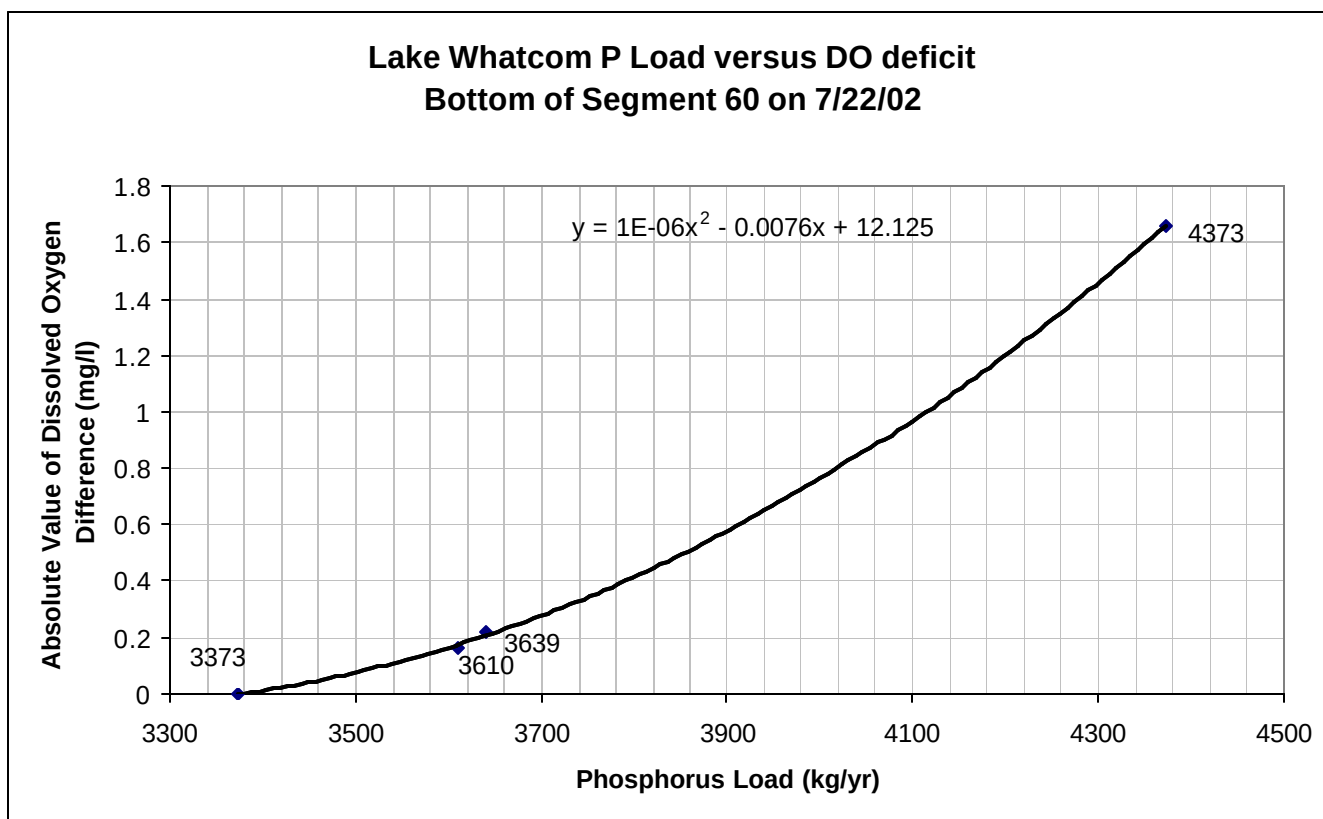


Figure 19. Graph showing DO deficit at bottom layer of Segment 60 (segment in basin 1) relative to roll back case for different phosphorus loads. Point corresponding to the rollback with dam scenario, partial rollback D scenario, partial rollback E scenario, and the base scenarios were plotted.

Table 21. Dissolved oxygen difference for scenarios (relative to rollback scenario) at bottom of basin 1 (7/22/02), bottom of basin 2 (7/30/02) and bottom 3 (8/14/02).

Alternative	P load (kg)	P Load (kg/yr)	DO Difference Basin 1 (mg/l) on 7/22/02	DO Difference Basin 2 (mg/l) on 7/30/02	DO Difference Basin 3 (mg/l) on 8/14/03
Full Rollback with dam	17718.7	3373	0	0	0
Partial Rollback D	19114.6	3639	-0.22	-0.13	0.07
Partial Rollback E	18960.7	3610	-0.16	-0.09	-0.02
Partial rollback from full Buildout	18978.5	3613	-2.13	-0.64	-0.13
Base	22966.2	4373	-1.66	-0.40	-0.06
Full Buildout	26349.8	5017	-3.10	-1.24	-0.27

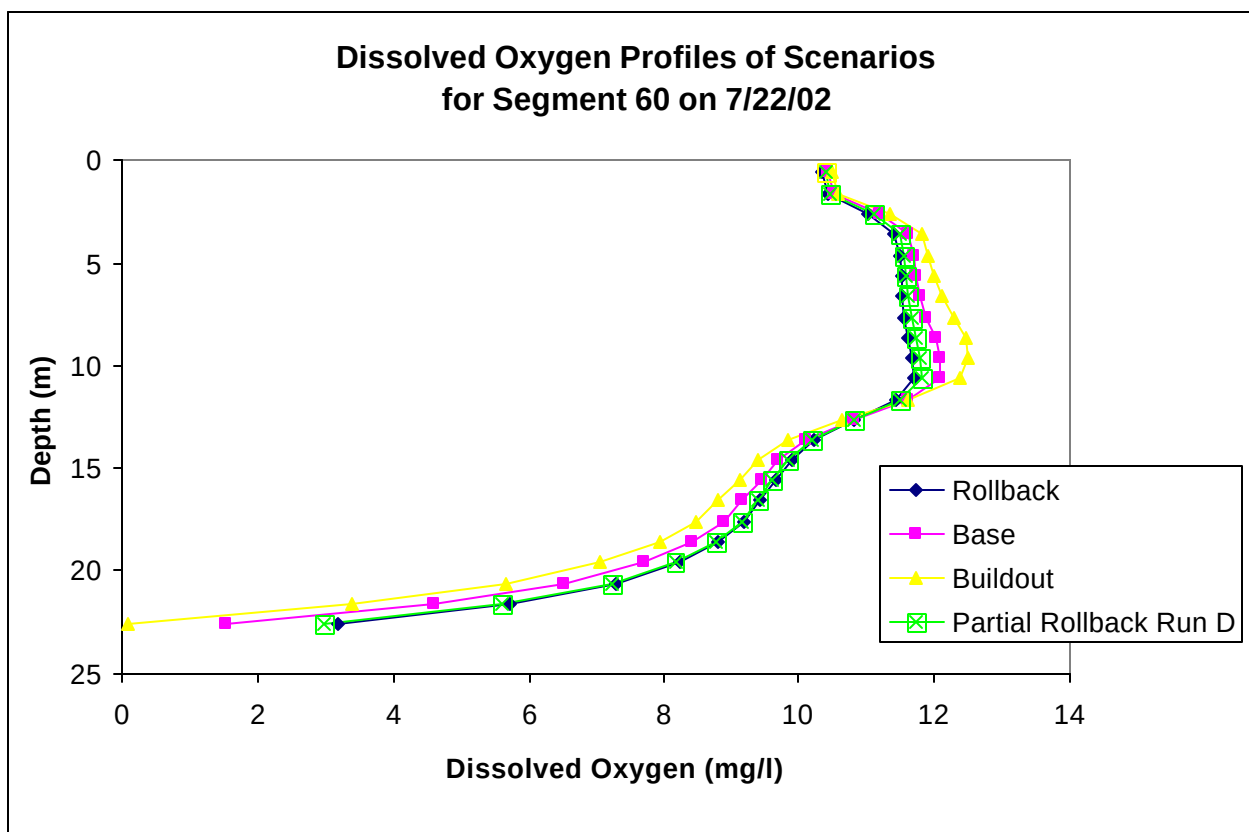


Figure 20. Dissolved Oxygen profiles of rollback, base, buildout, and partial rollback run D scenarios in basin 1 (segment 60) on 7/22/02.

Summary and Recommendations

A water quality and hydrodynamic model, CE-QUAL-W2 Version 3.2 (Cole and Wells, 2001; <http://www.cee.pdx.edu/w2>), was applied to Lake Whatcom Washington. This report summarizes model development and calibration of the CE-QUAL-W2 Version 3.2 model of Lake Whatcom.

The system model required that boundary conditions and the topography be determined. Data in support of this modeling effort were shown in this report. This includes data such as:

- Dynamic inflow/discharge rates
- Dynamic inflow/discharge temperatures
- Dynamic inflow/discharge water quality constituents
- Dynamic meteorological data (air temperature, dew point temperature, wind speed, wind direction and cloud cover or short wave solar radiation)
- Model bathymetry

In general, the model reproduces the lake responses to the known boundary conditions. The average absolute mean error of model predictions was 0.64 degrees Celsius for temperature, 0.69 mg/l for dissolved oxygen, 0.97 ug/l for chlorophyll a, 0.22 for pH and 0.004 mg/l for total phosphorus.

Model scenarios were performed in order to understand the dissolved oxygen response of the lake. There were 5 scenarios simulated including the following:

- Base case
- Roll back
- Build out
- Partial Roll back D
- Partial Roll back E
- Partial Roll back from Buildout
- Roll back without dam

As a preliminary exercise, the phosphorus loading necessary to reduce dissolved oxygen concentration by 0.2 mg/l at a critical location and time was determined. A more thorough analysis of the lake's response to nutrient loading should be performed. This would include more than just a response of the lake at one segment, at one depth, and at one time. Suggested methods for evaluating the lake's response include:

- Statistical frequency analysis of predicted levels of dissolved oxygen for all time (either at one location or a spatial volume weighted average)
- Temporal and volume weighted averages of dissolved oxygen over different spatial ranges (such as the entire lake, vertically over a segment, at a segment but only below the photic zone)

Also, the scenario for the no-dam case needs to be explored in more detail to understand how best to compare this scenario with others, and why the preliminary analysis appeared to show dissolved oxygen to be worse with the dam case at the 3 control points.

References

Cole, T.M., and S.A. Wells (2004) "CE-QUAL-W2: A two-dimensional, laterally averaged, Hydrodynamic and Water Quality Model, Version 3.2," Instruction Report EL-2004-, US Army Engineering and Research Development Center, Vicksburg, MS.

Deluna, E. (2004), Water Quality and algae data provided by Elise Deluna, Western Washington University

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Mathews, R. A., M. Hilles, J. Vandersypen, R. J. Mitchell, G. B. Mathews (2004). "Lake Whatcom Monitoring Project 2002/2003 Final Report", Western Washington University.

Pitz, C. F. (2005). "Lake Whatcom Total Maximum Daily Load Groundwater Study," Publication No. 05-03-001, Washington State Department of Ecology, Olympia, WA.

Wells, S. A. (1997) "Theoretical Basis for the CE-QUAL-W2 River Basin Model," Dept. of Civil Engr., Tech. Rpt. EWR-6-97, Portland St. Univ., Portland, OR, 1997.

Appendix A: Model Inputs

Tributary Flow Rates

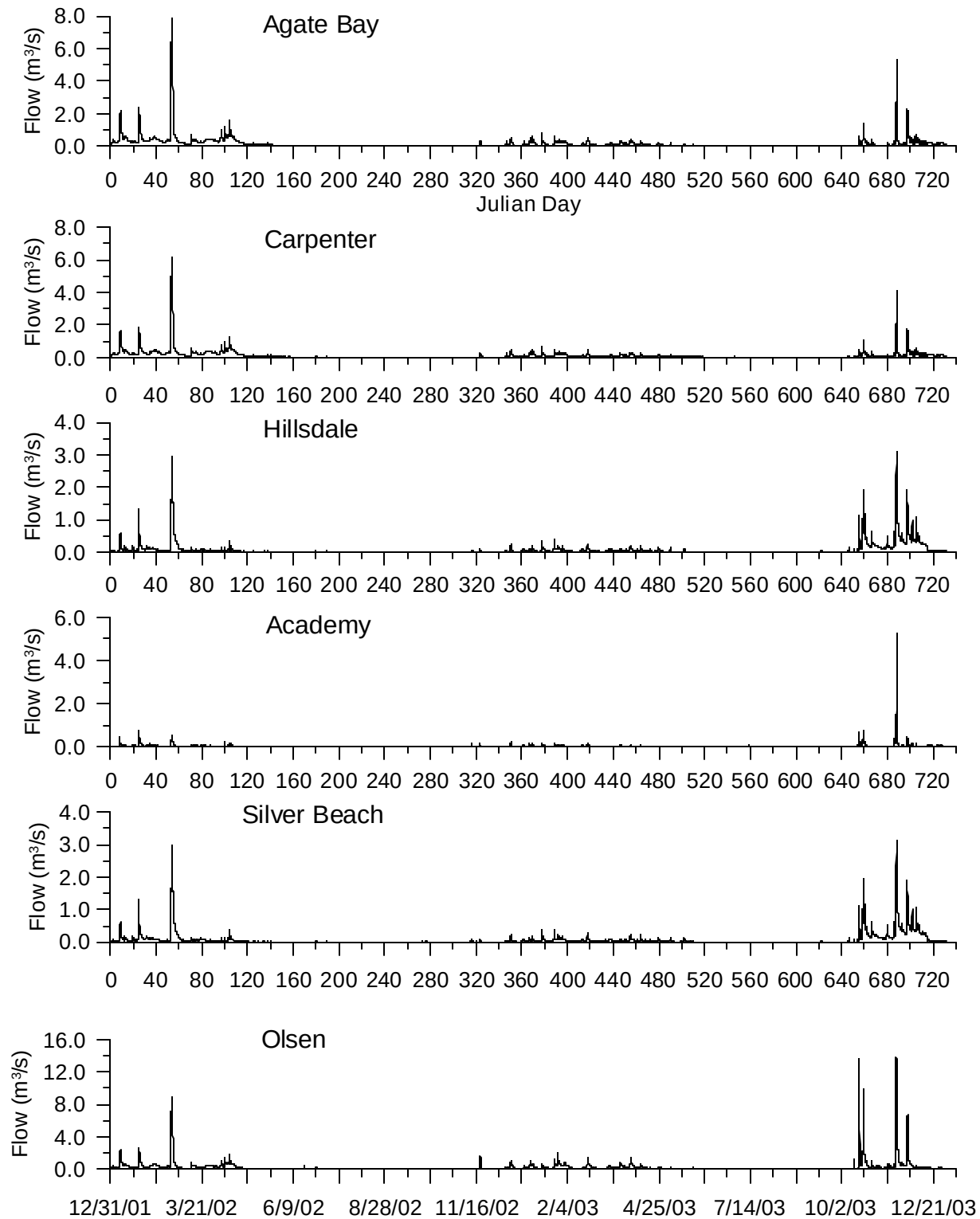


Figure 21. Tributary flow rates.

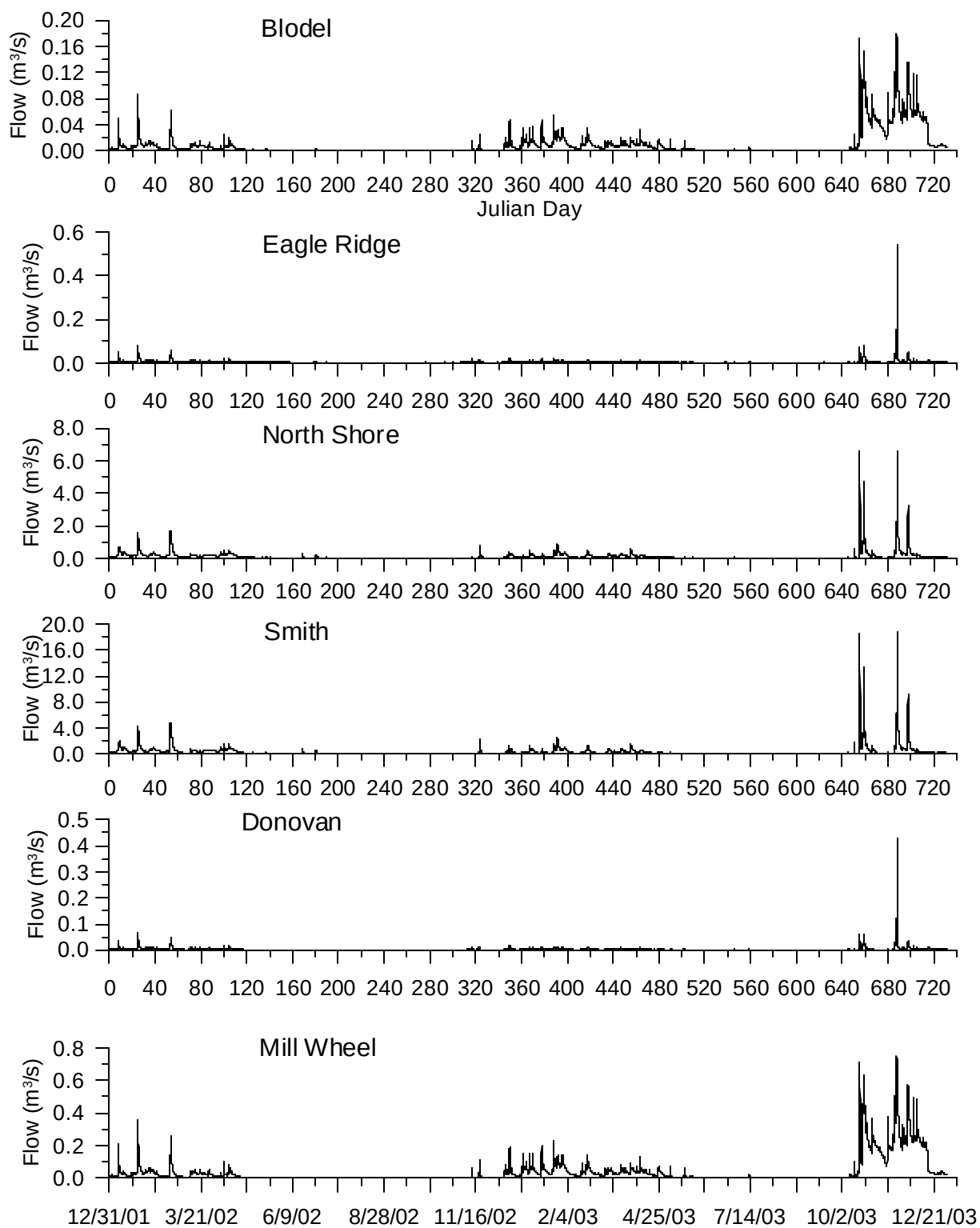


Figure 22. Tributary flow rates (continued).

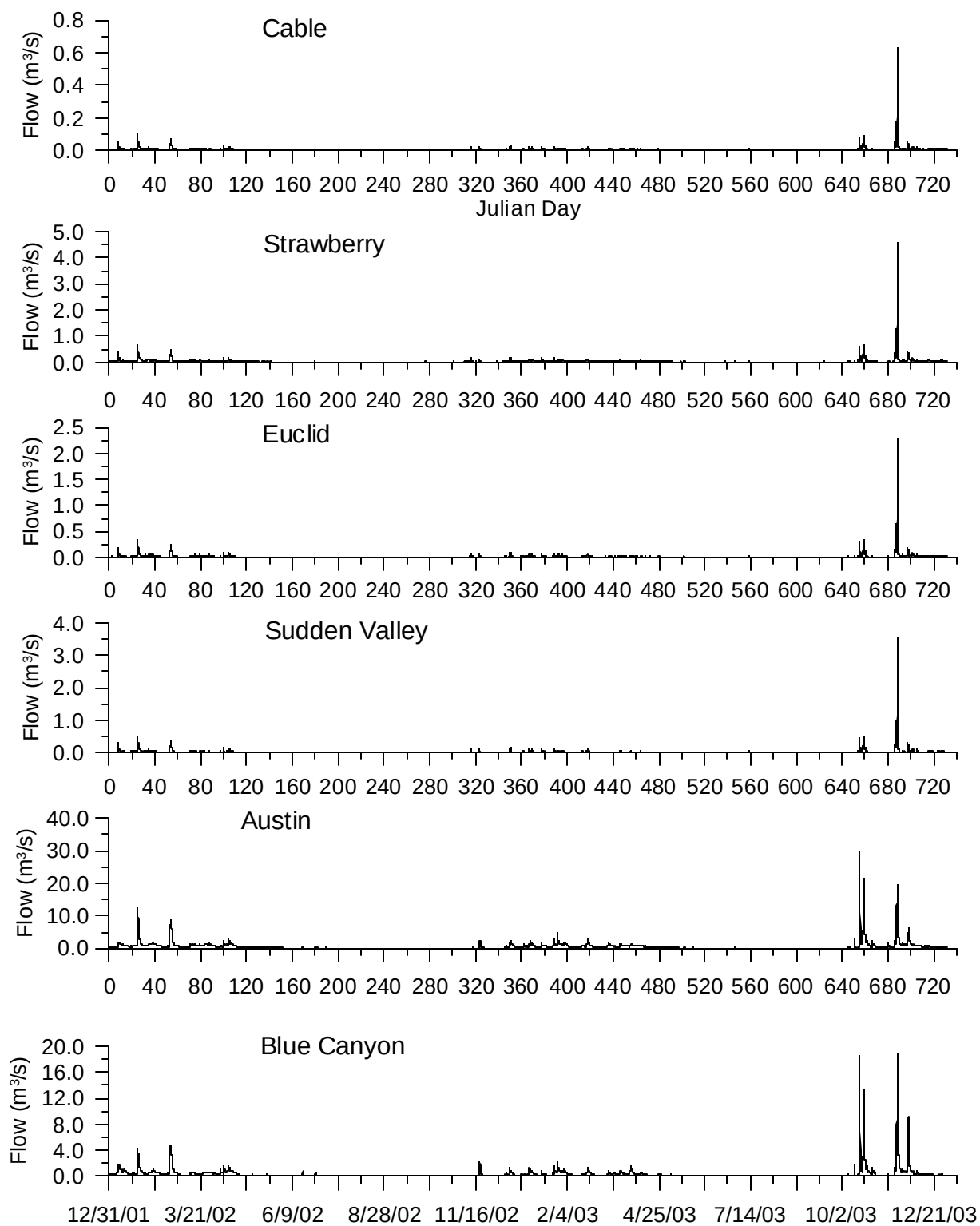


Figure 23. Tributary flow rates (continued).

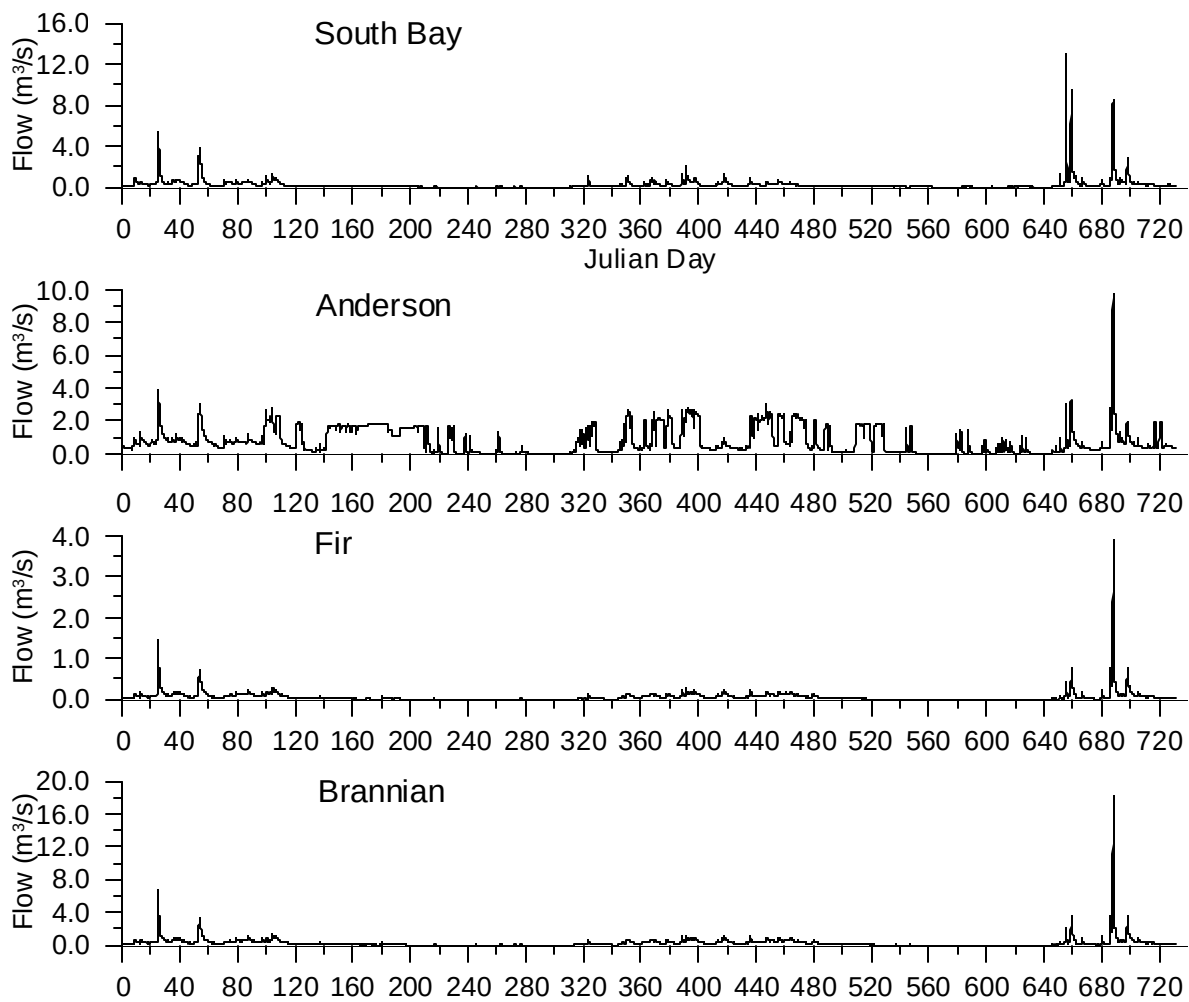


Figure 24. Tributary flow rates (continued).

Tributary Temperatures

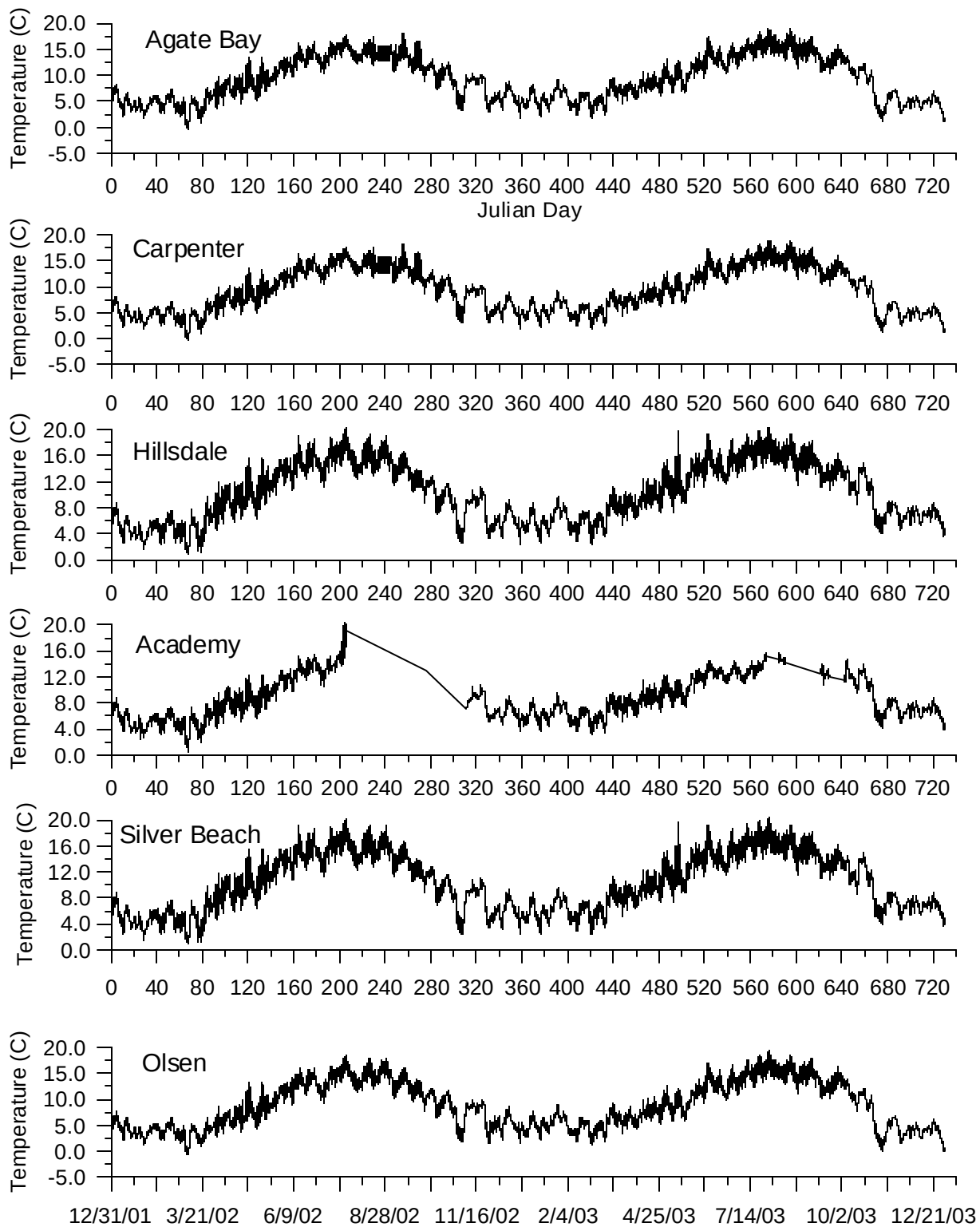


Figure 25. Tributary temperatures (data gaps correspond to periods of zero flow).

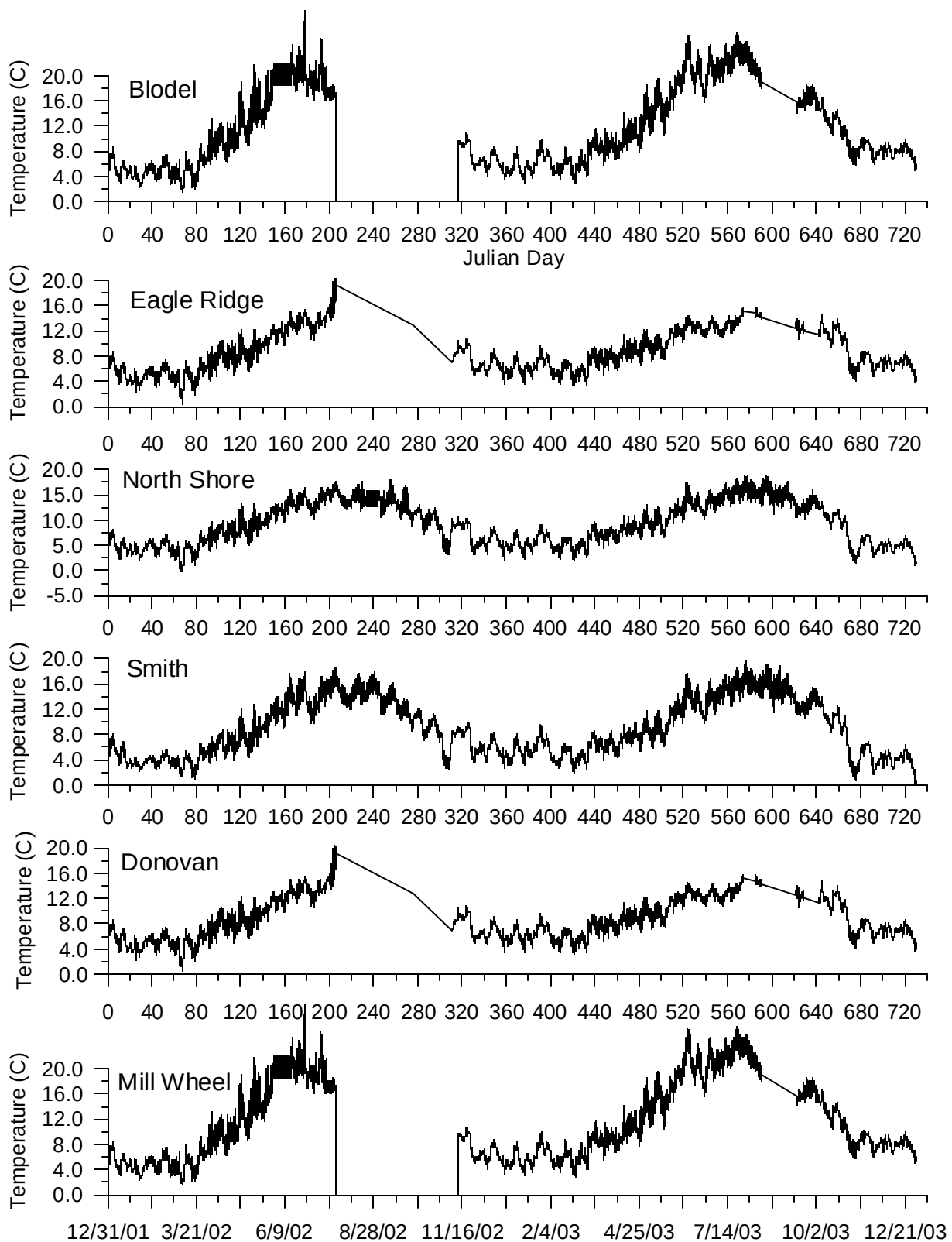


Figure 26. Tributary temperatures (data gaps correspond to periods of zero flow).

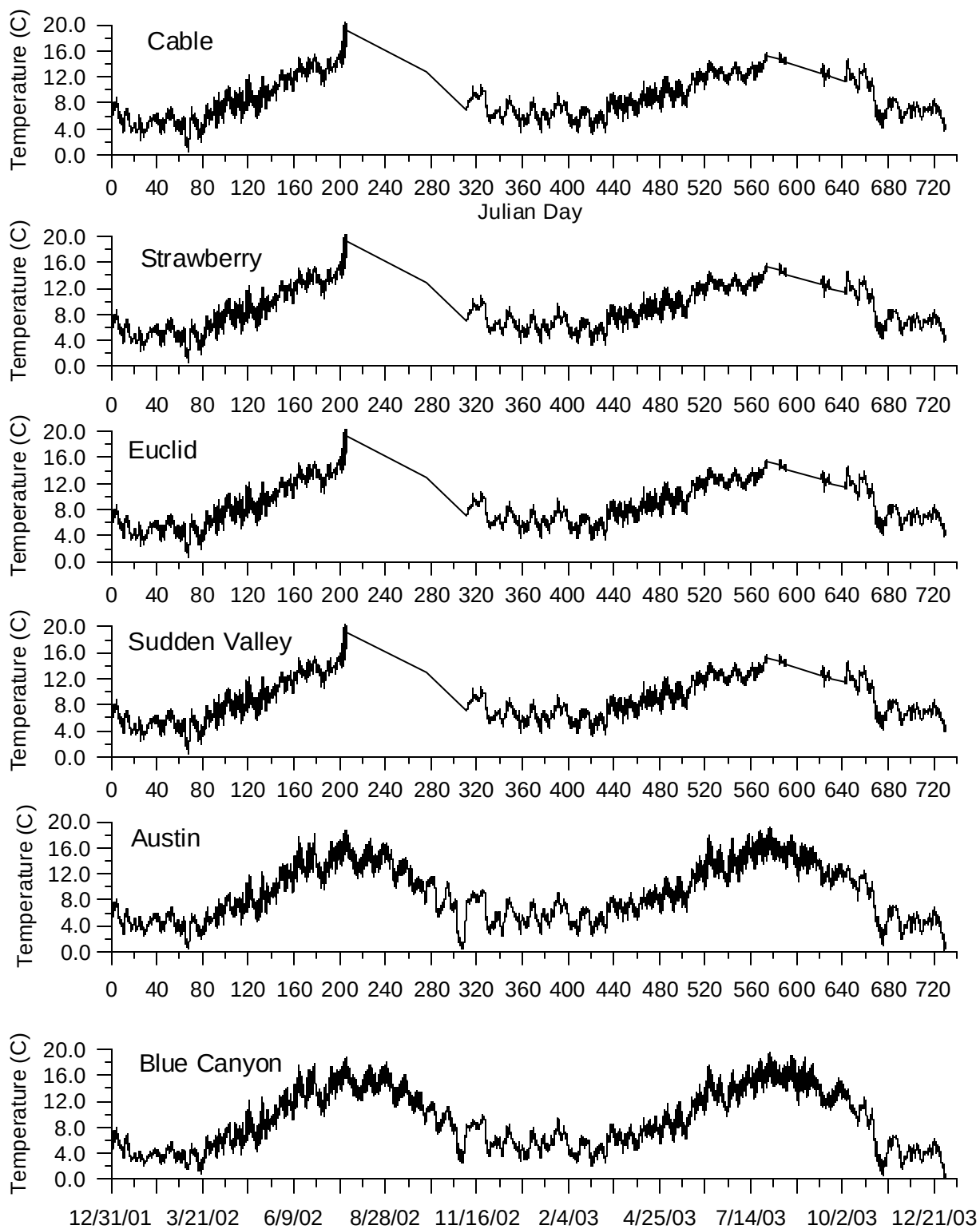


Figure 27. Tributary temperatures (data gaps correspond to periods of zero flow).

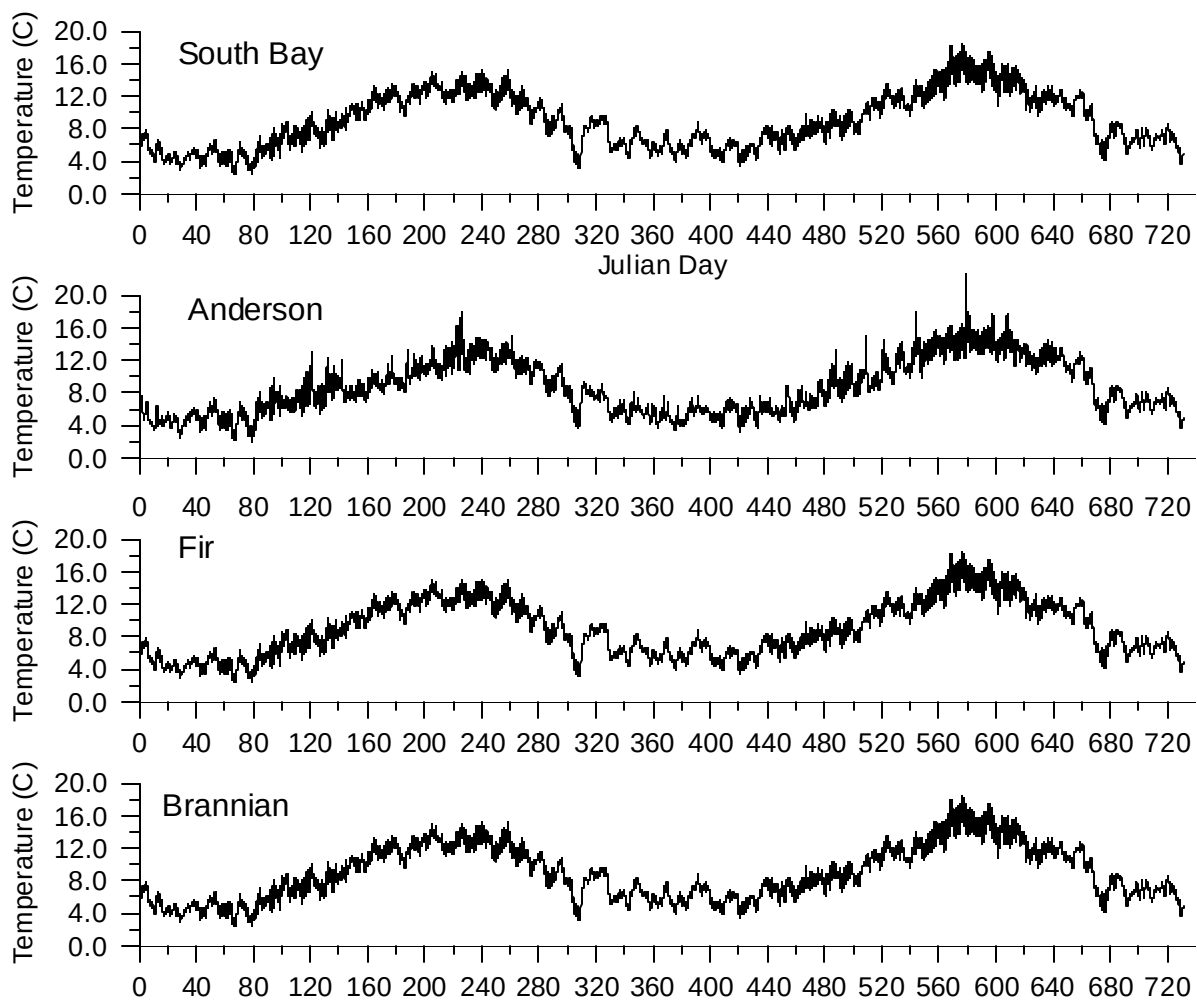


Figure 28. Tributary temperatures (data gaps correspond to periods of zero flow).

Tributary Constituents

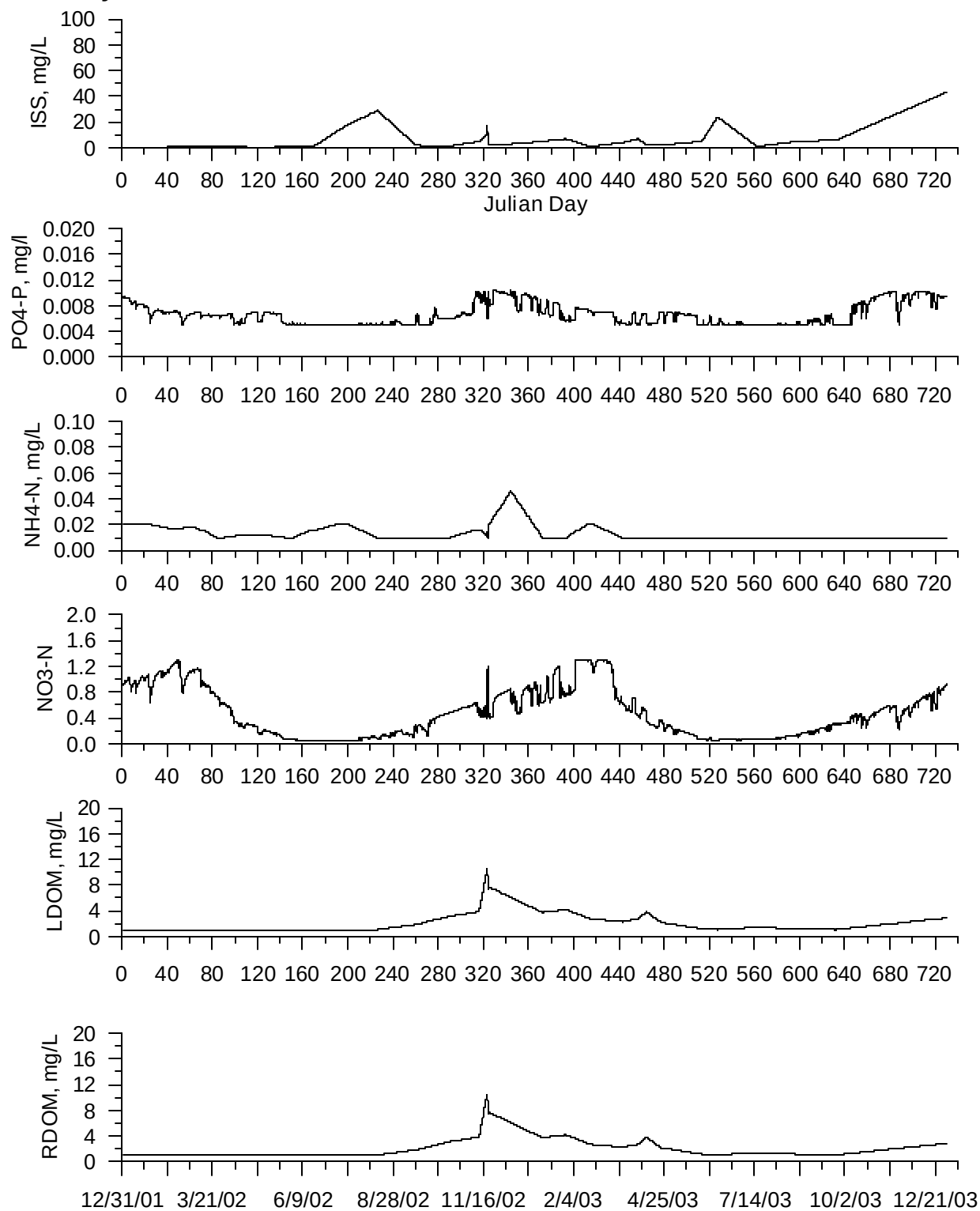


Figure 29. Constituent Concentrations used for Anderson Creek.

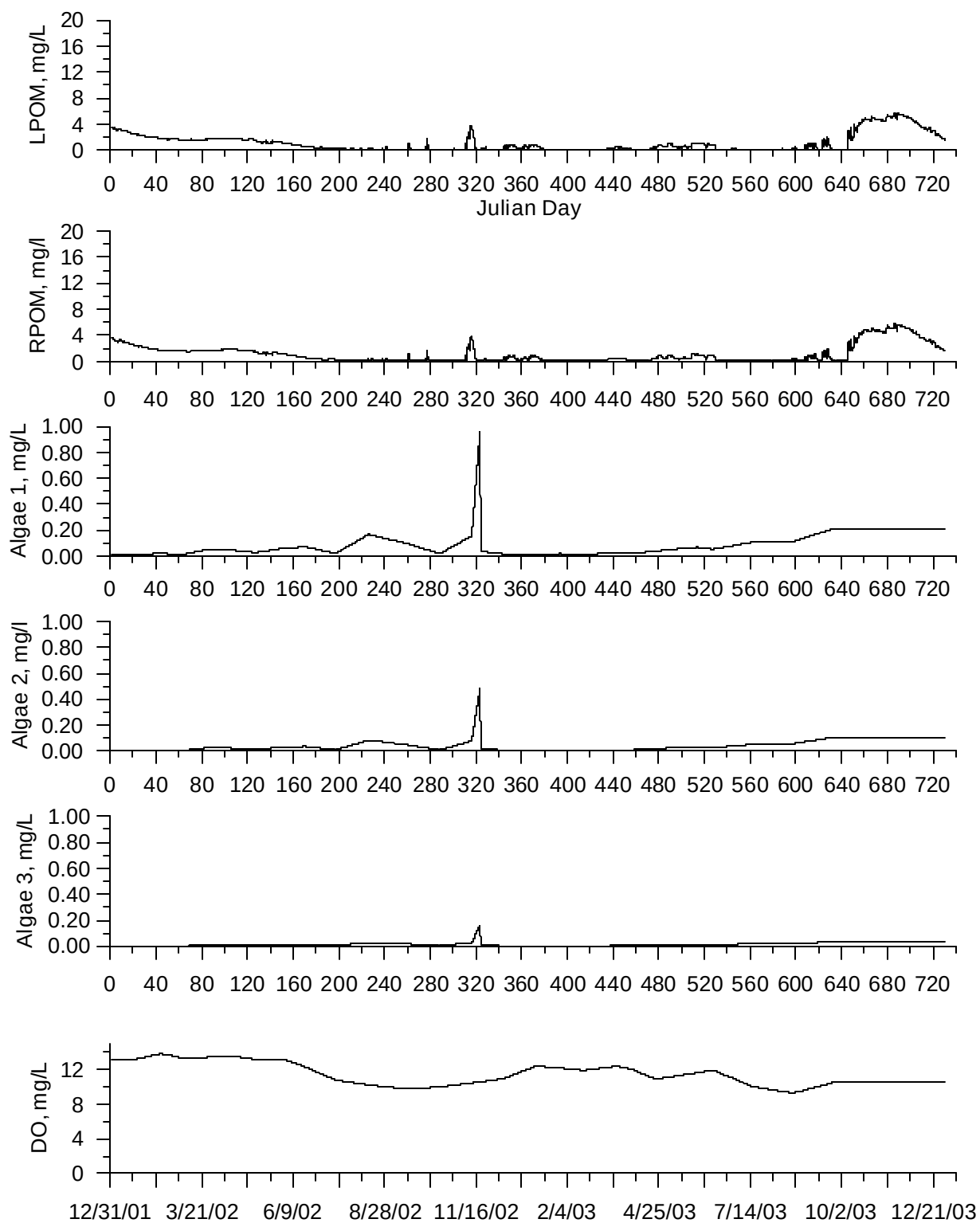


Figure 30. Constituent Concentrations used for Anderson Creek.

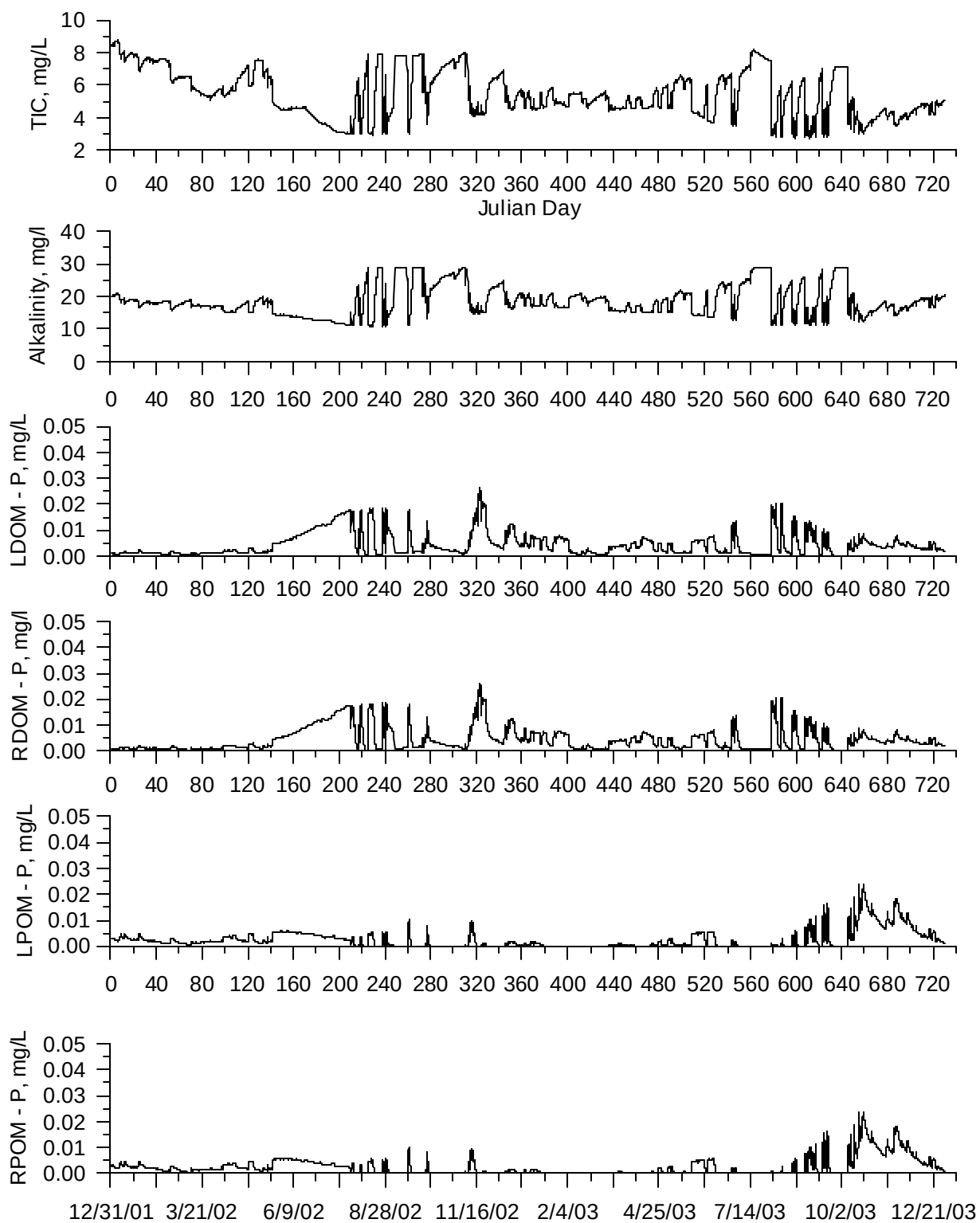


Figure 31. Constituent Concentrations used for Anderson Creek.

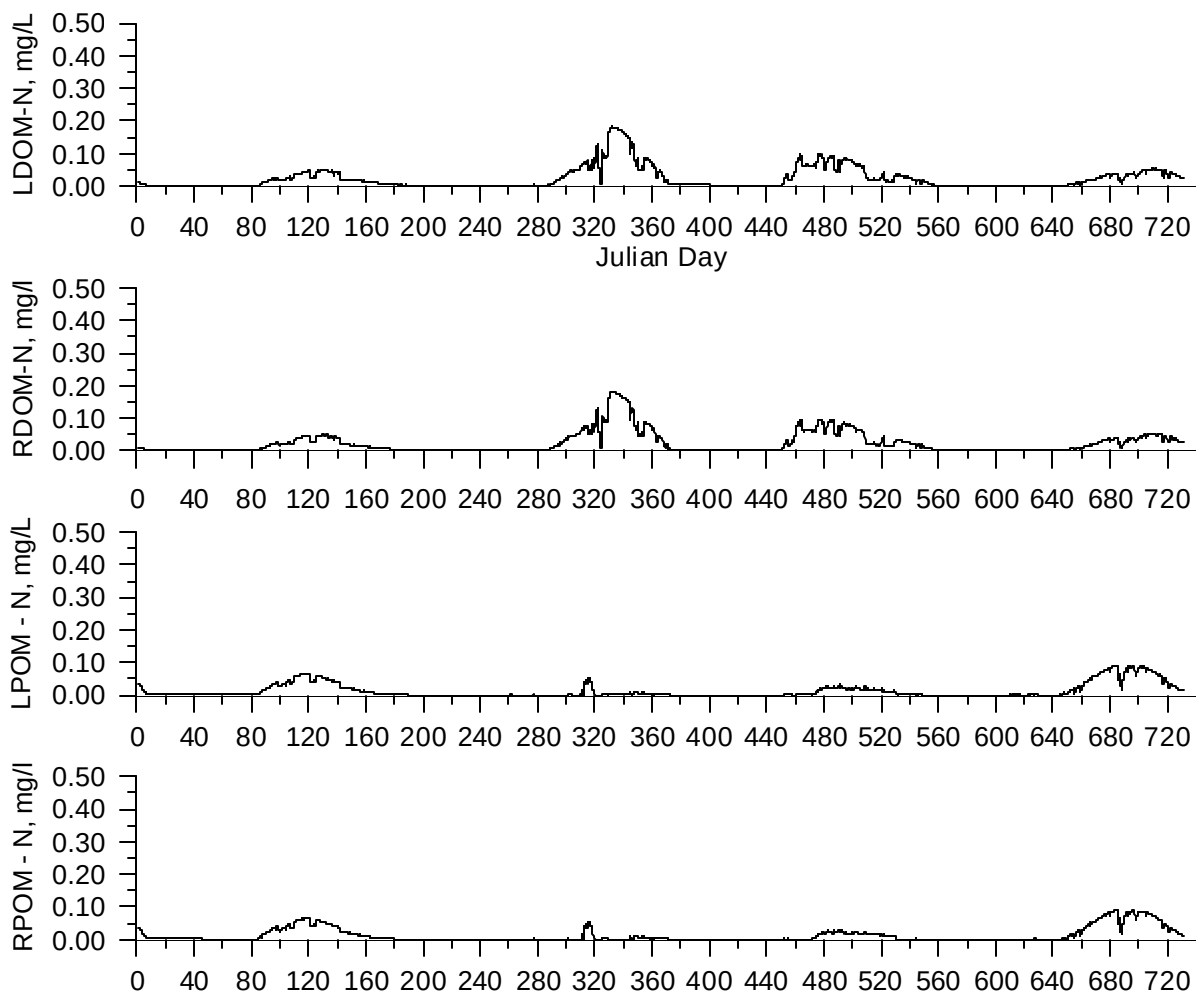


Figure 32. Constituent Concentrations used for Anderson Creek.

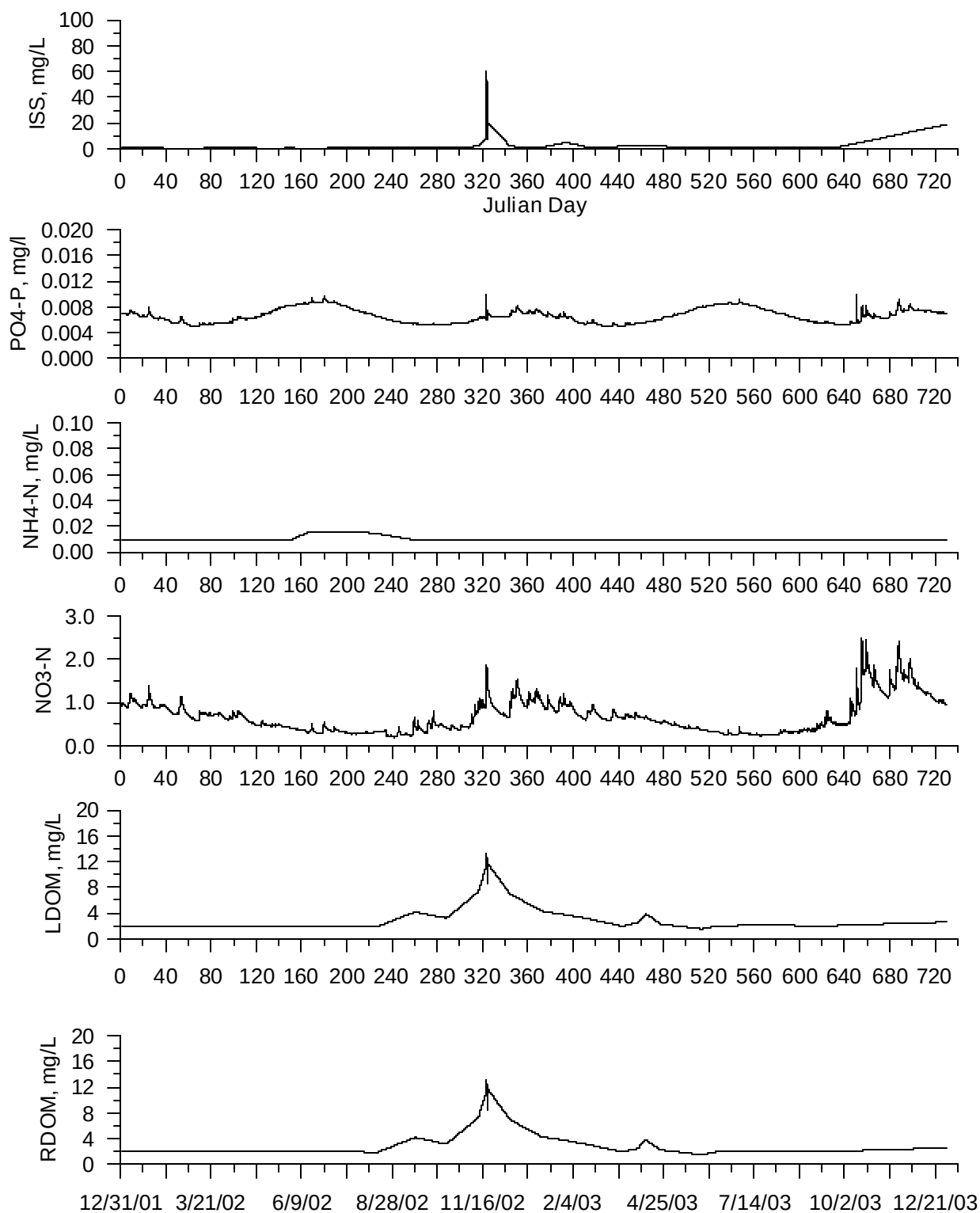


Figure 33. Constituent Concentrations used for Austin Creek.

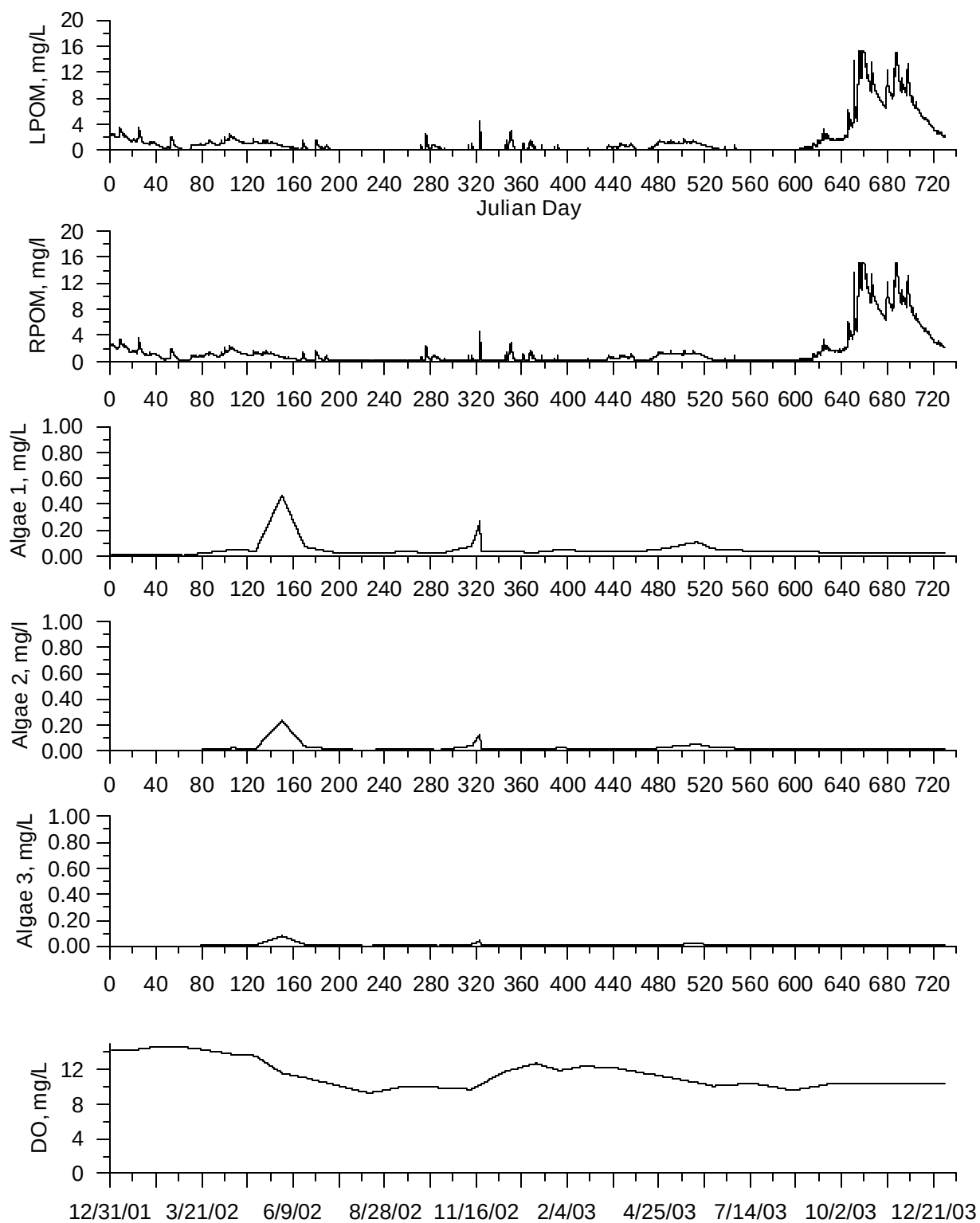


Figure 34. Constituent Concentrations used for Austin Creek.

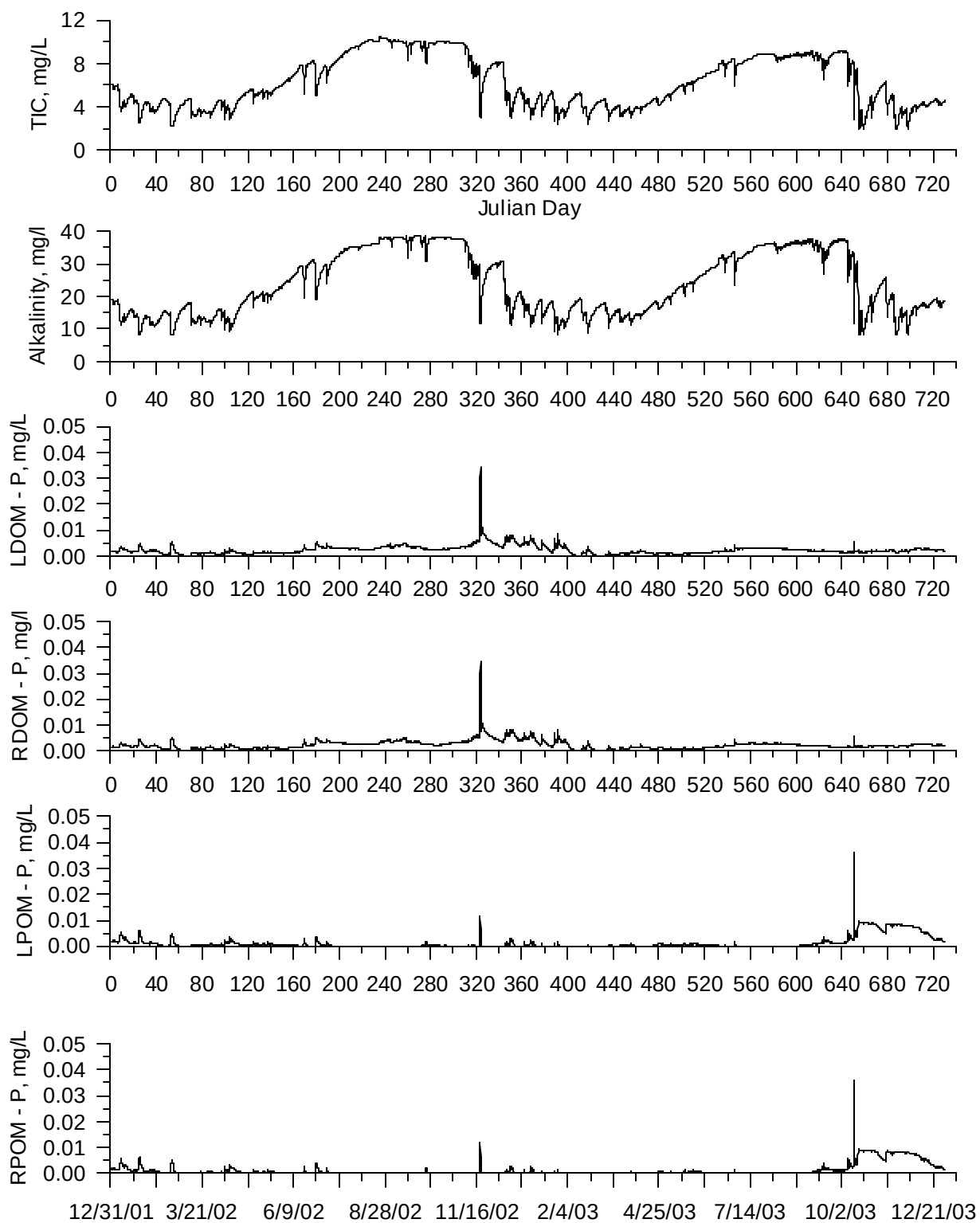


Figure 35. Constituent Concentrations used for Austin Creek.

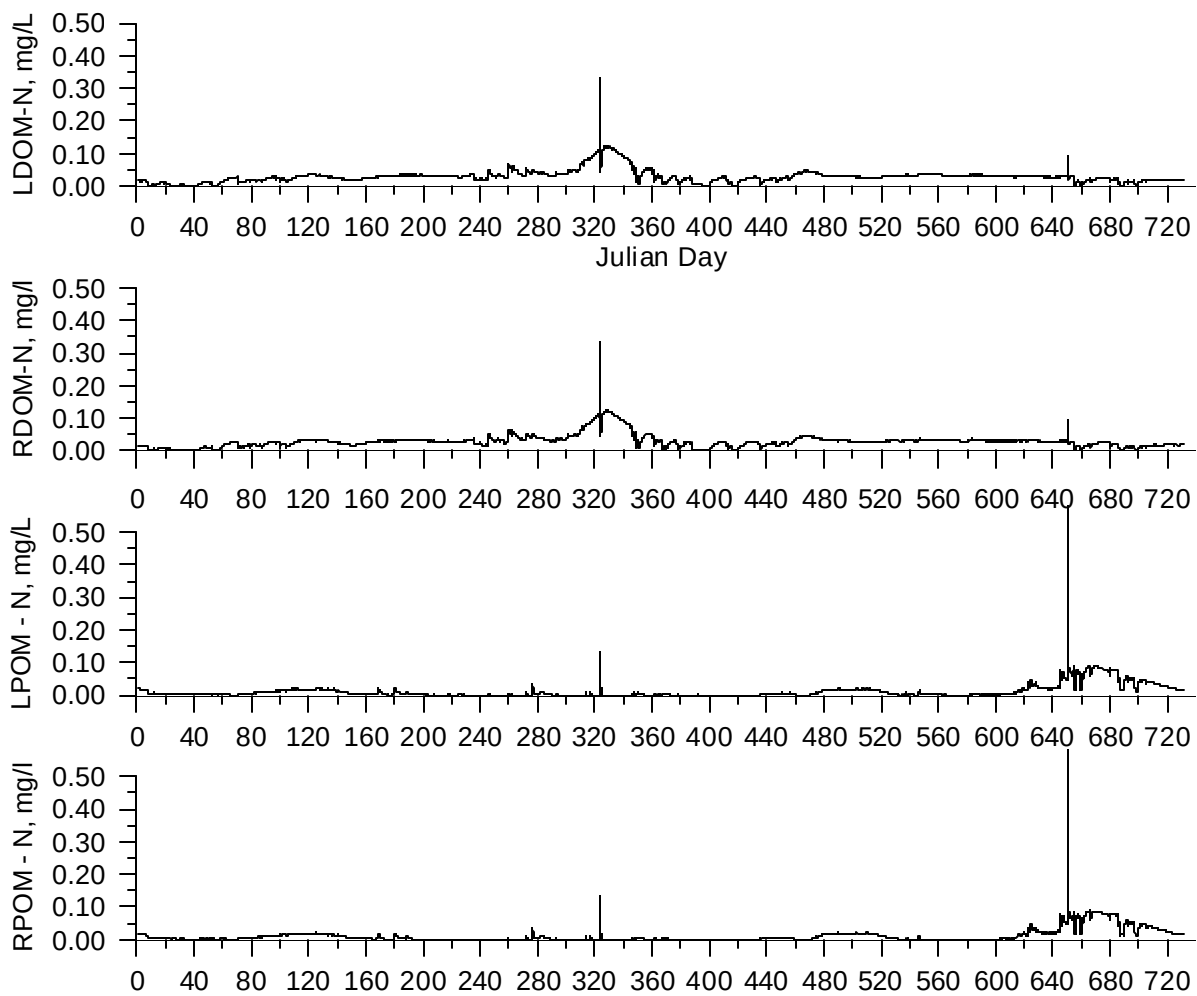


Figure 36. Constituent Concentrations used for Austin Creek.

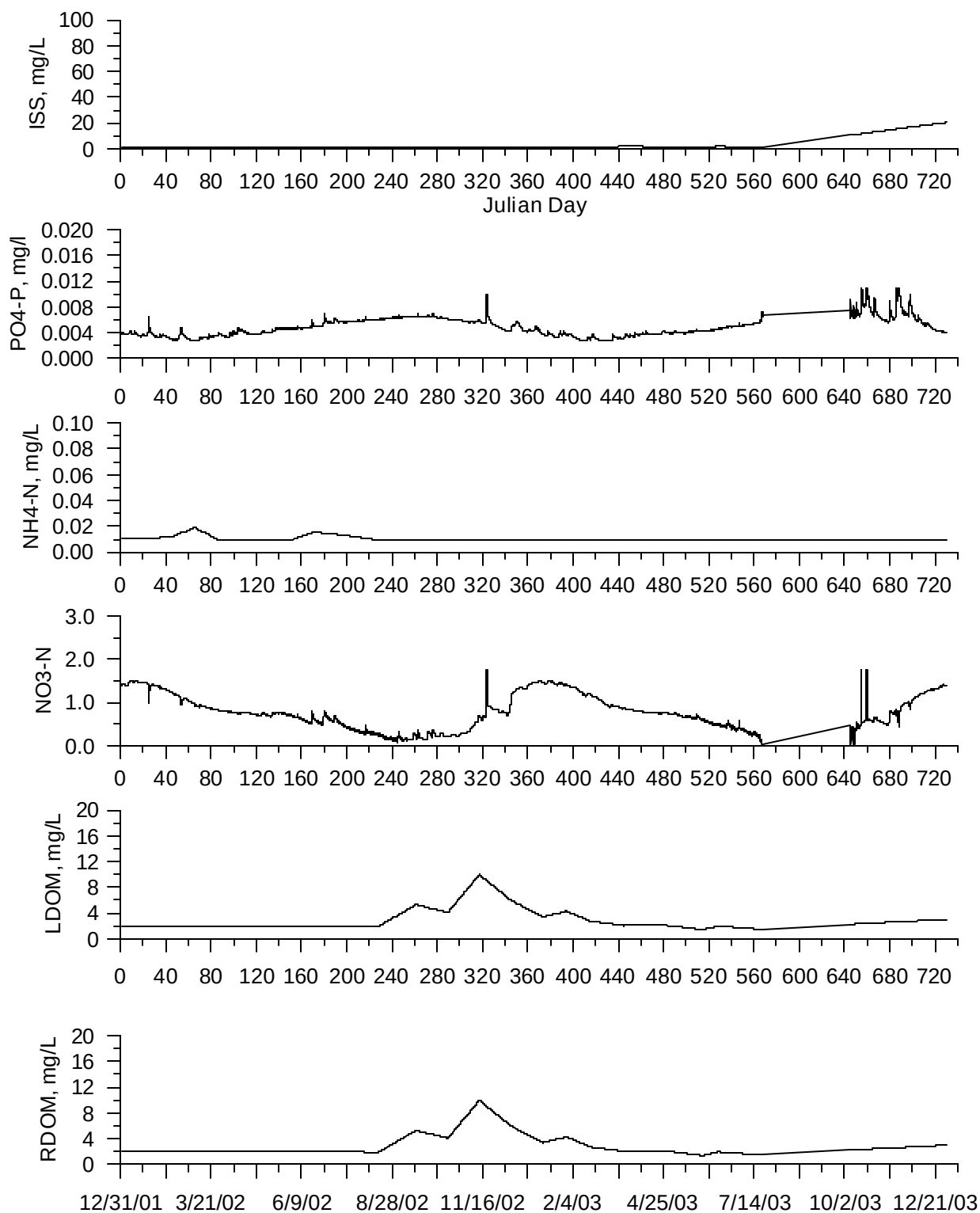


Figure 37. Constituent Concentrations used for Brannian Creek.

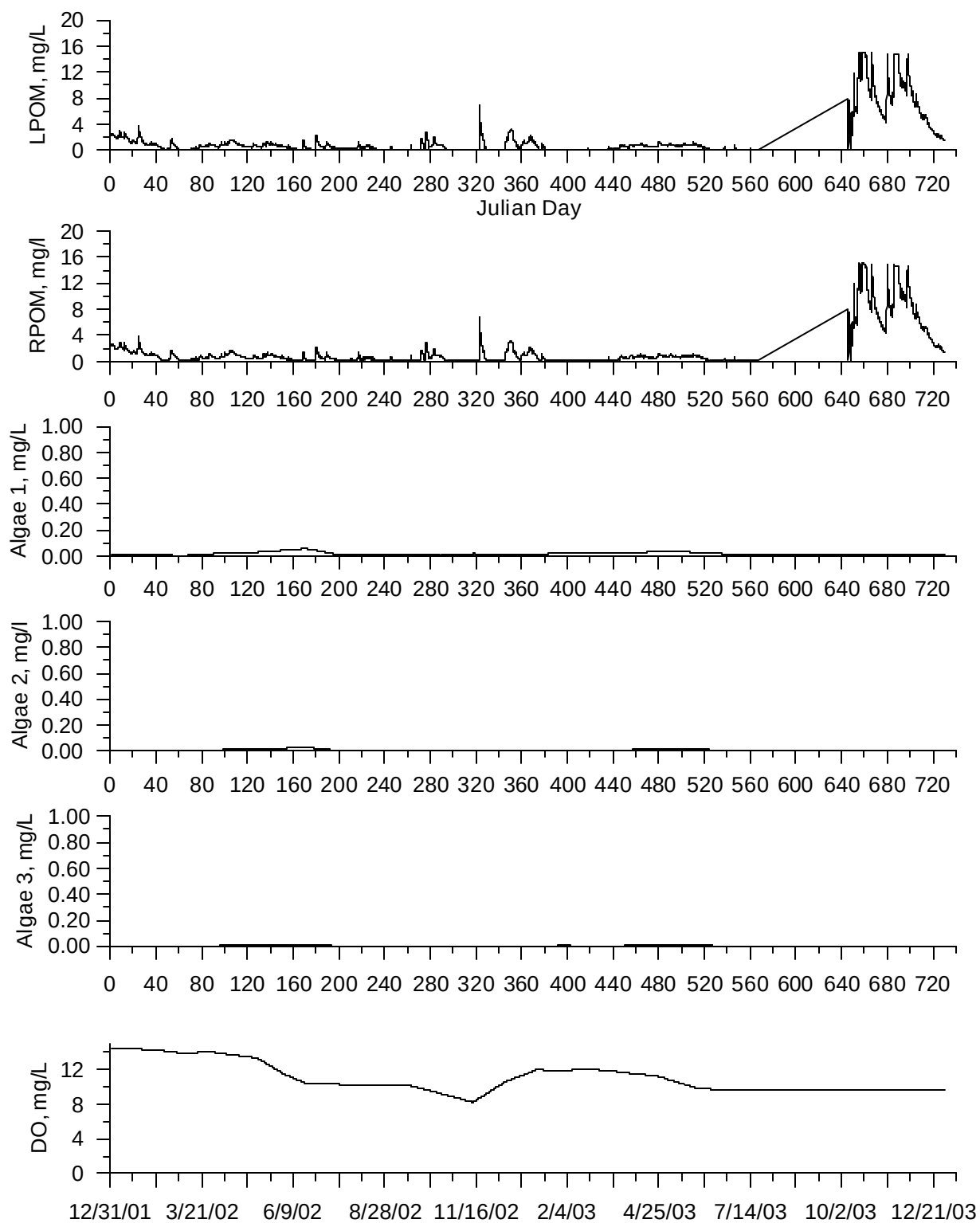


Figure 38. Constituent Concentrations used for Brannian Creek.

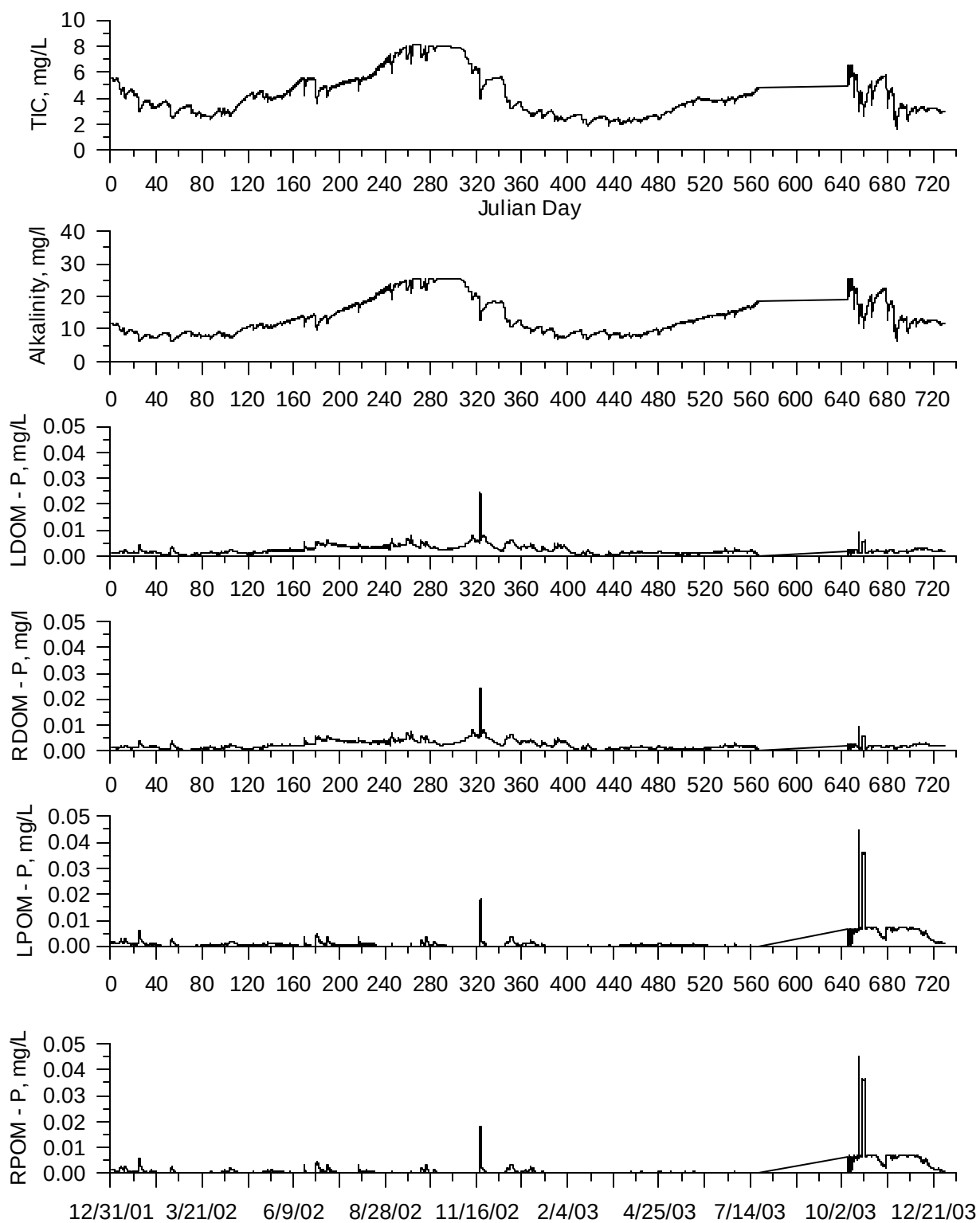


Figure 39. Constituent Concentrations used for Brannian Creek.

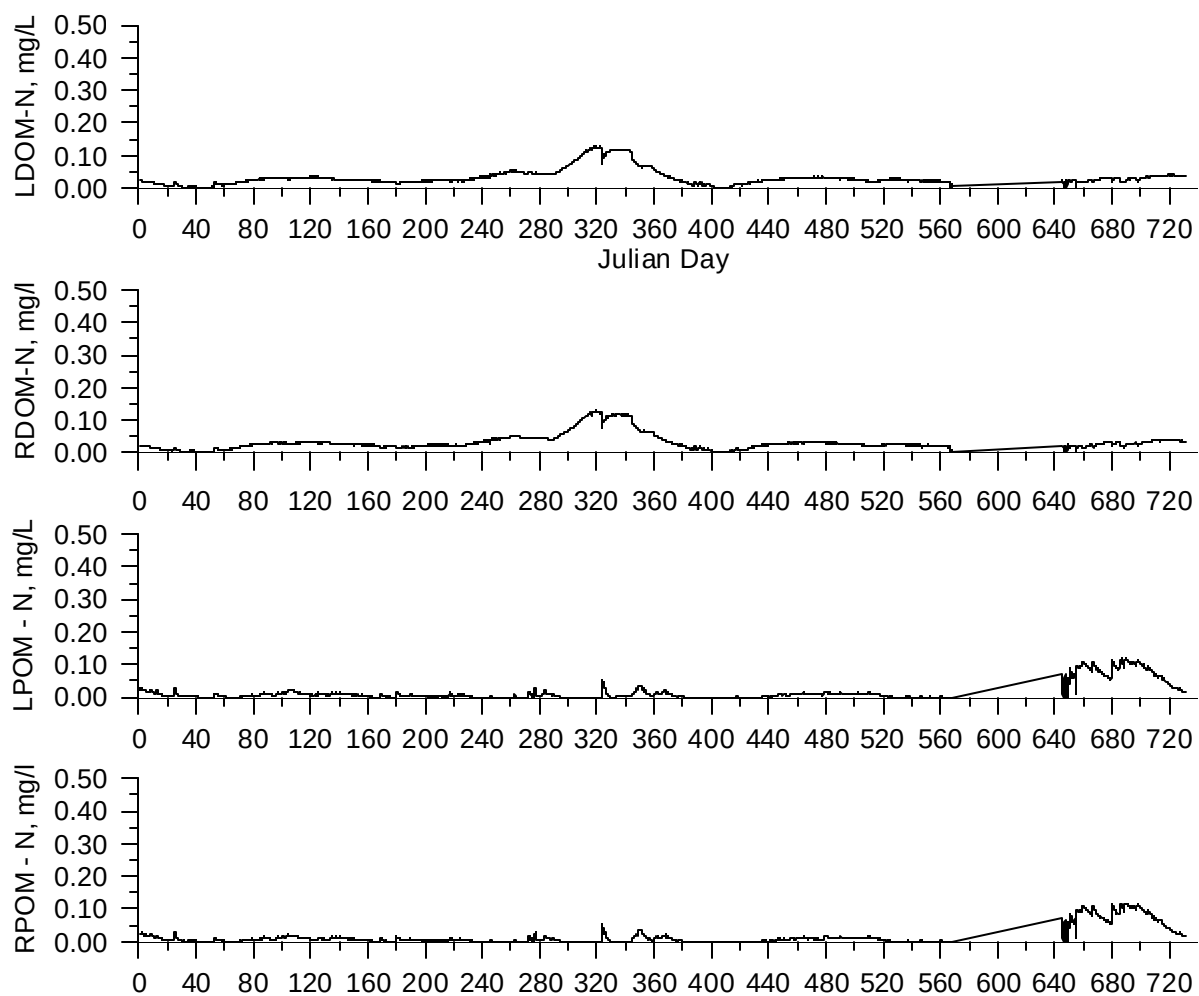


Figure 40. Constituent concentrations used for Brannian Creek.

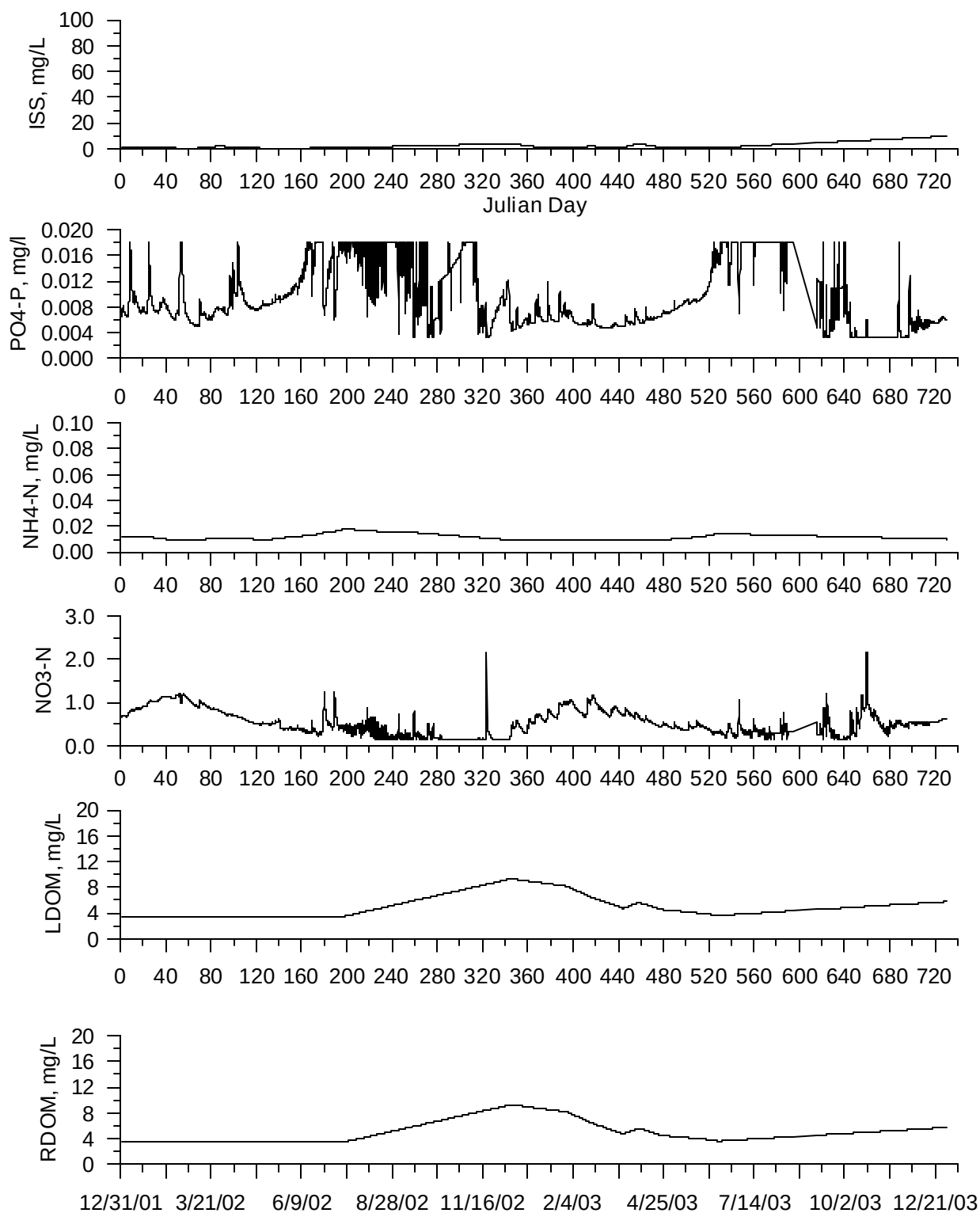


Figure 41. Constituent concentrations used for Carpenter Creek.

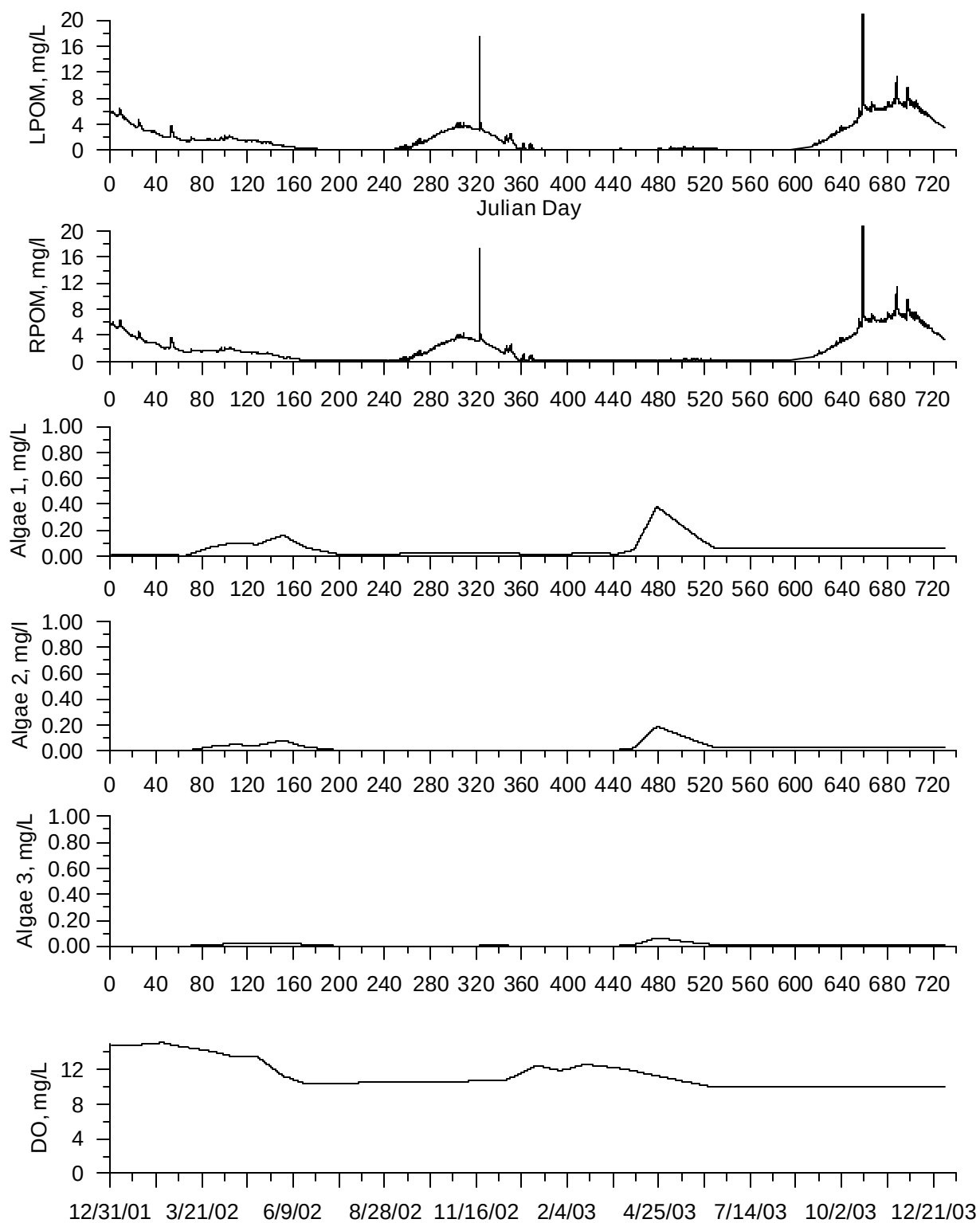


Figure 42. Constituent concentrations used for Carpenter Creek.

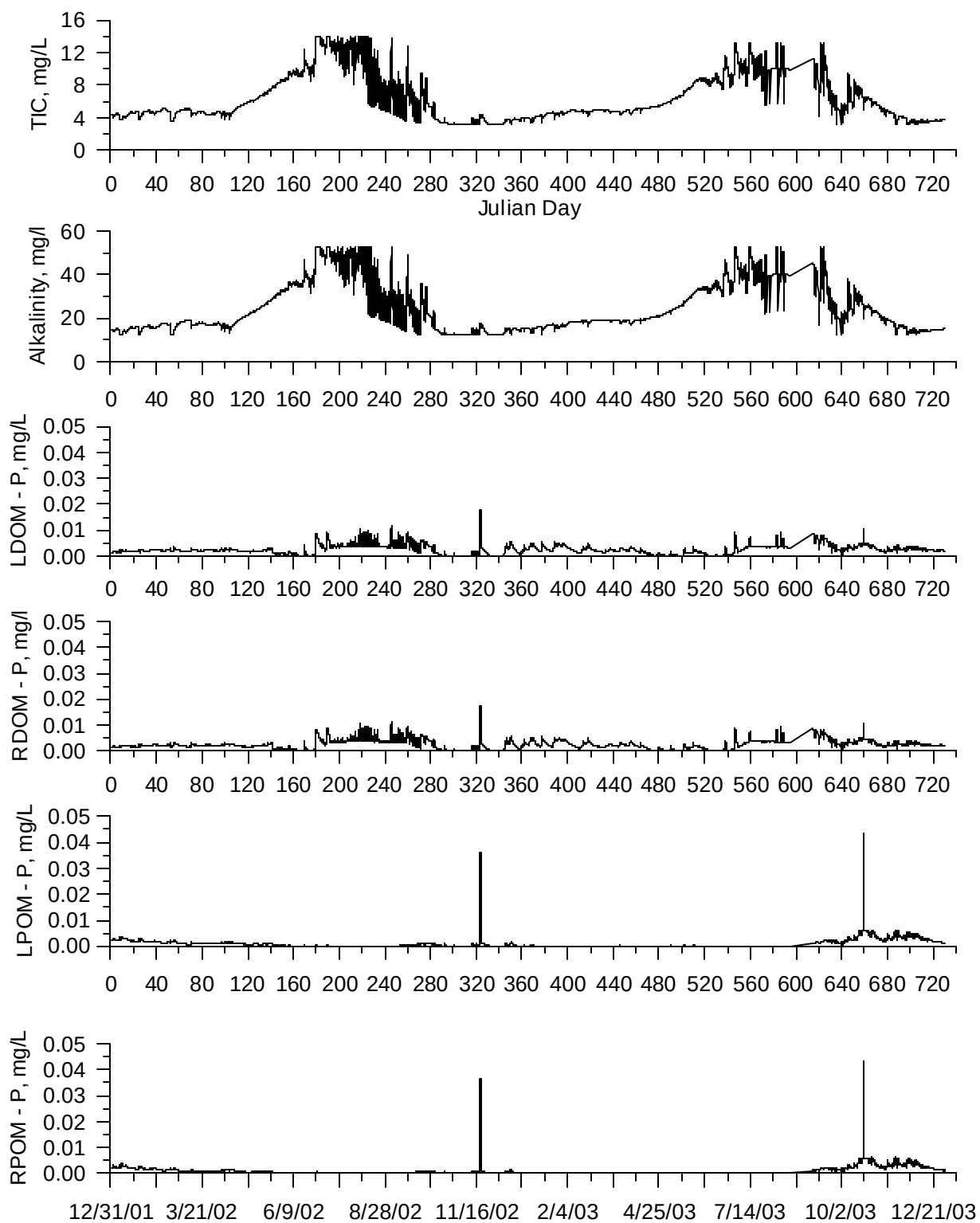


Figure 43. Constituent concentrations used for Carpenter Creek.

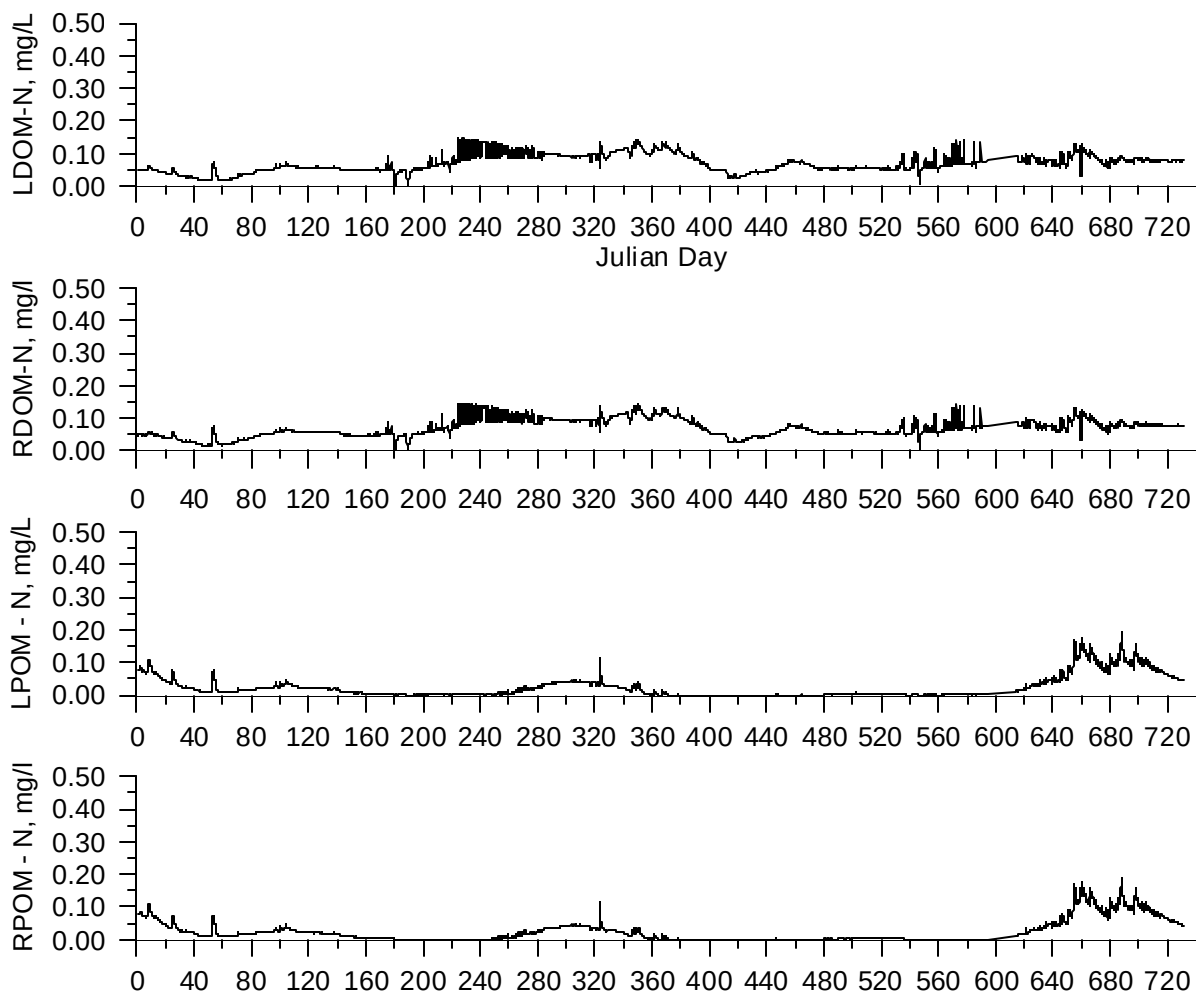


Figure 44. Constituent concentrations used for Carpenter Creek.

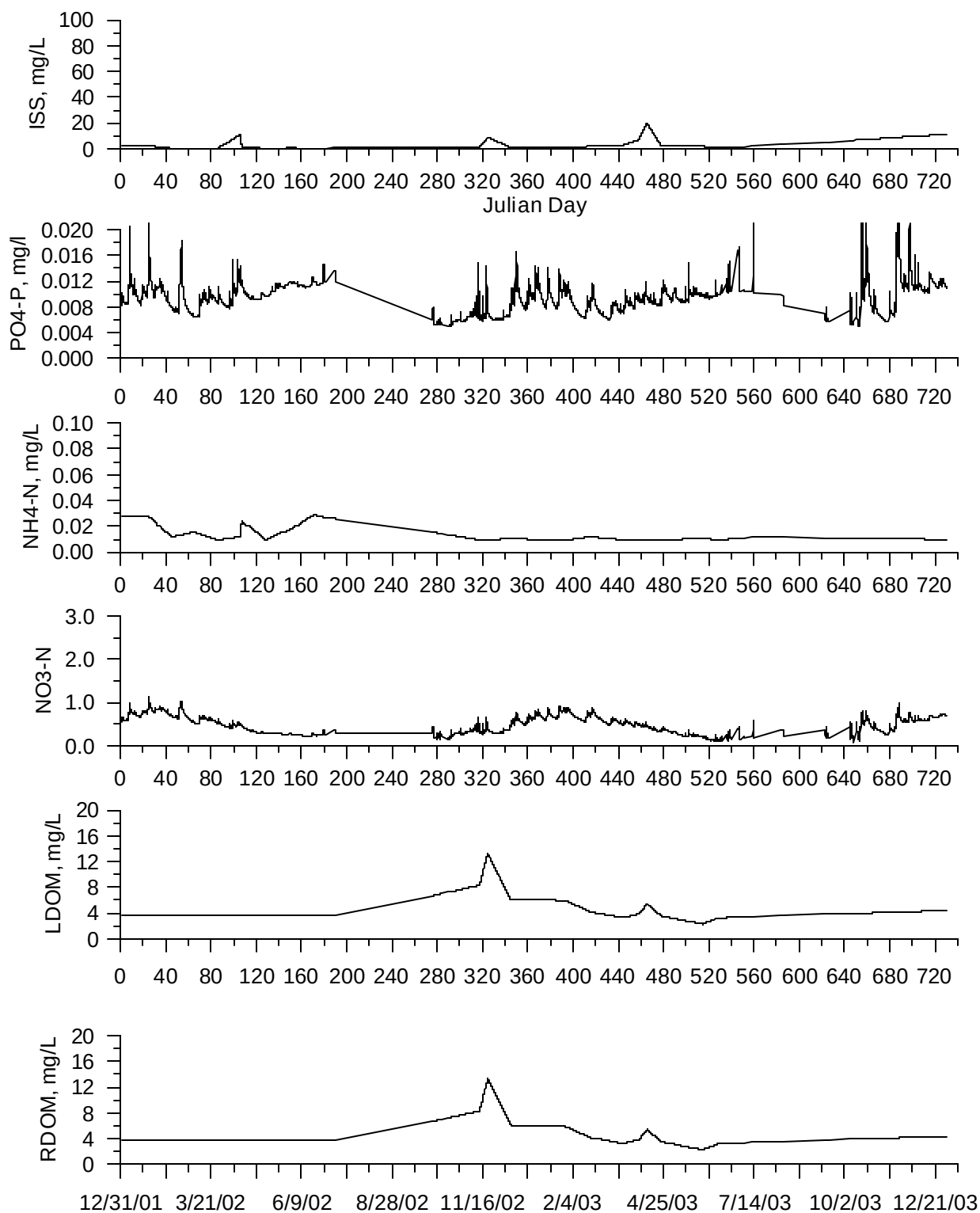


Figure 45. Constituent concentrations used for Euclid Creek.

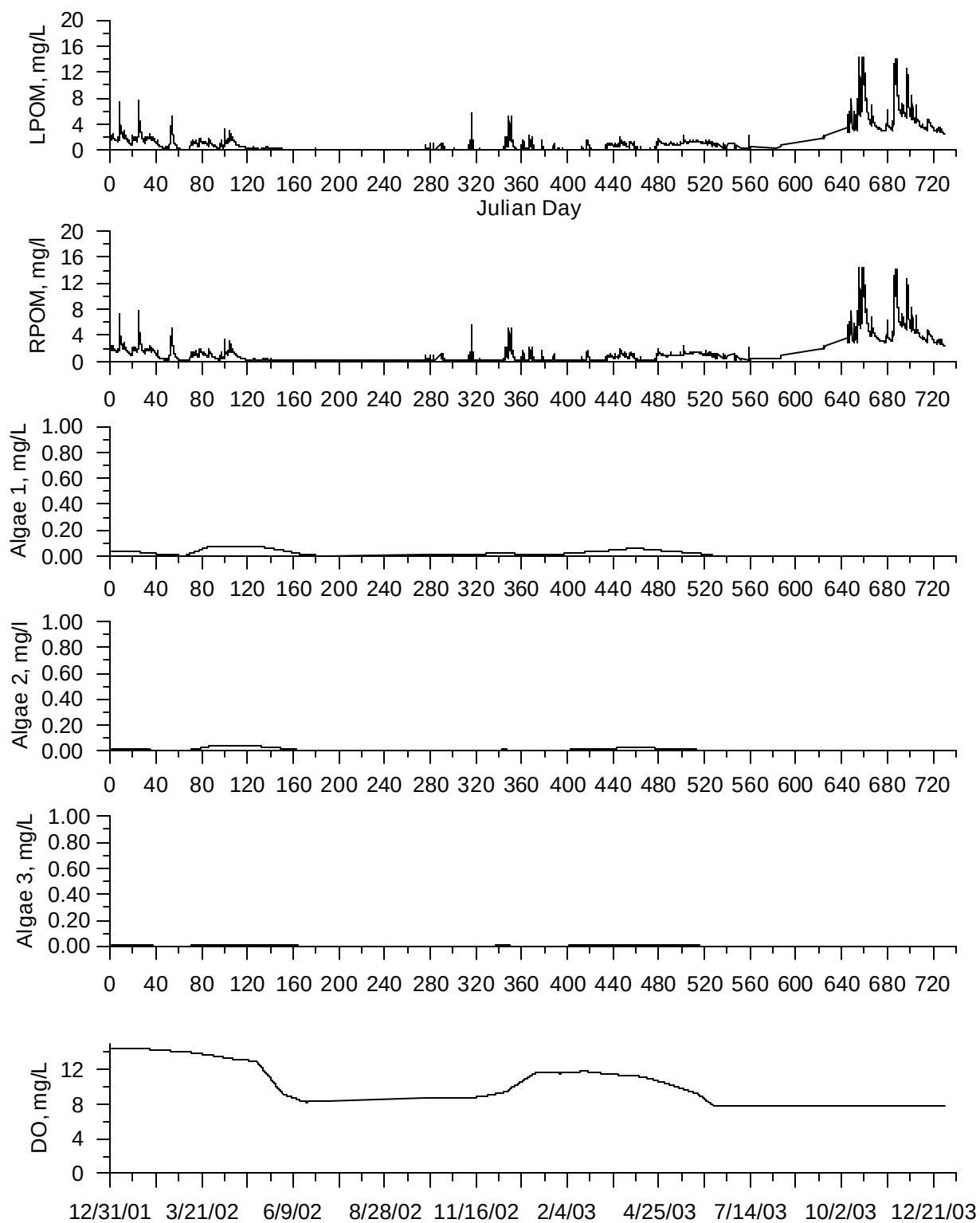


Figure 46. Constituent concentrations used for Euclid Creek.

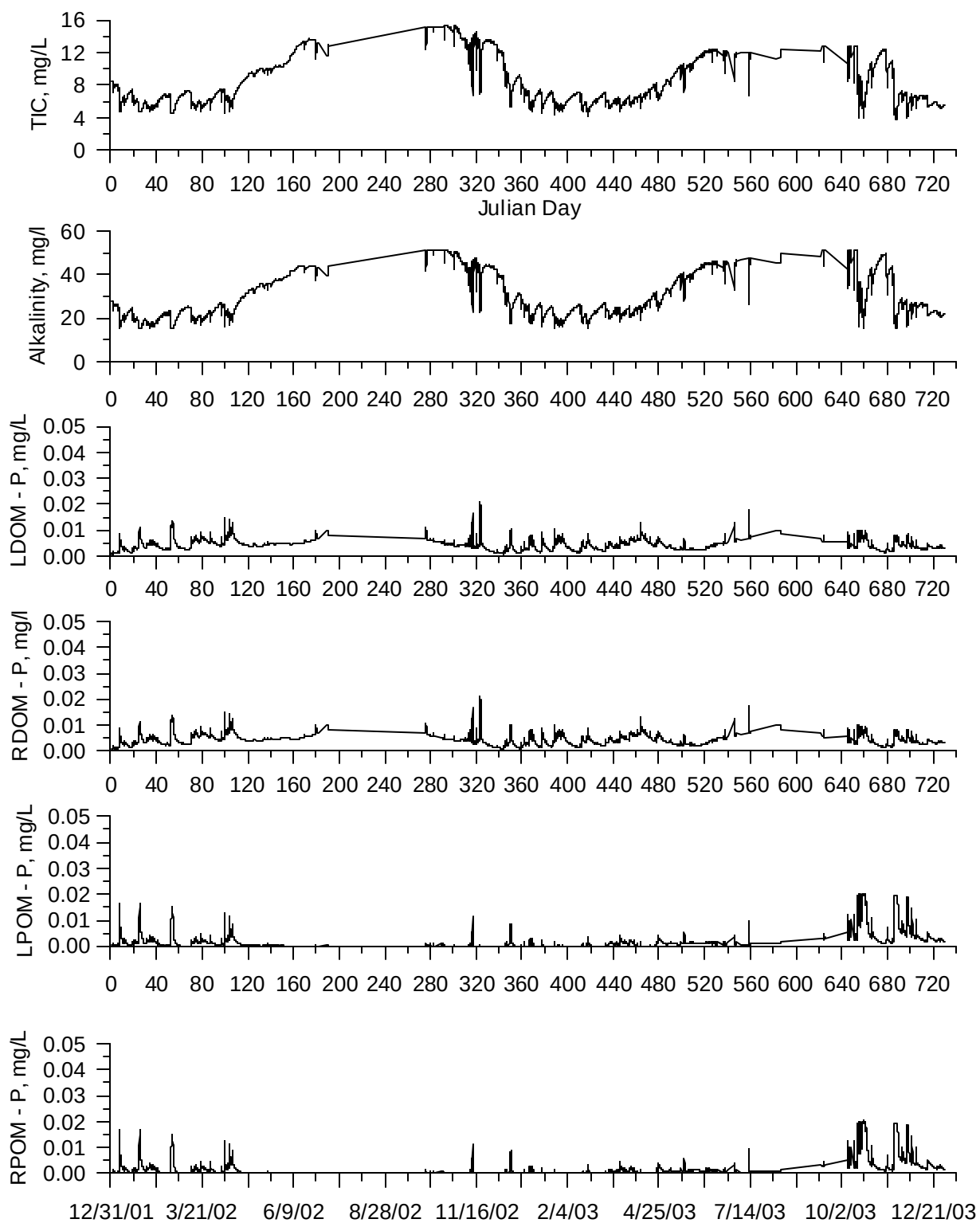


Figure 47. Constituent concentrations used for Euclid Creek.

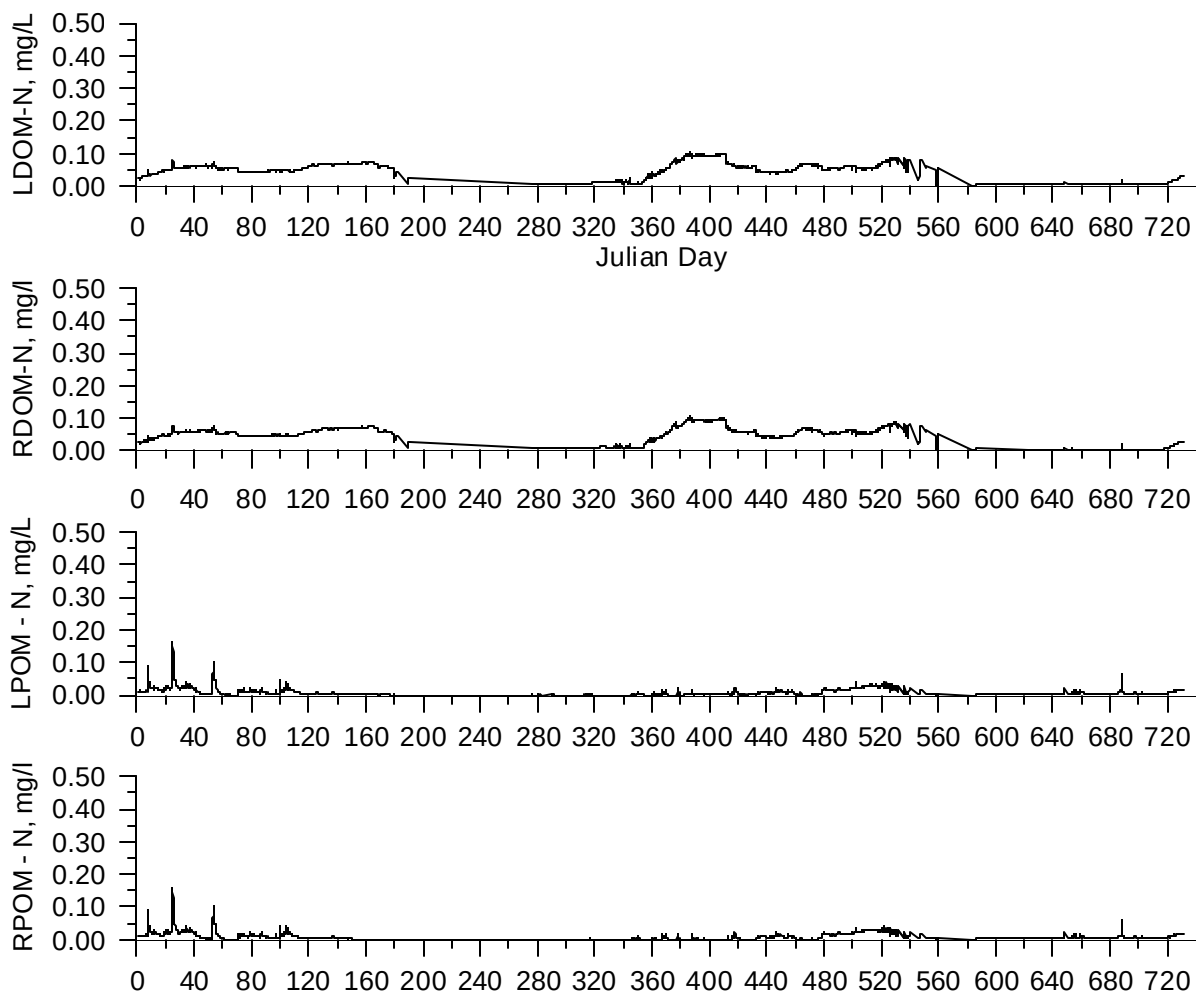


Figure 48. Constituent concentrations used for Euclid Creek.

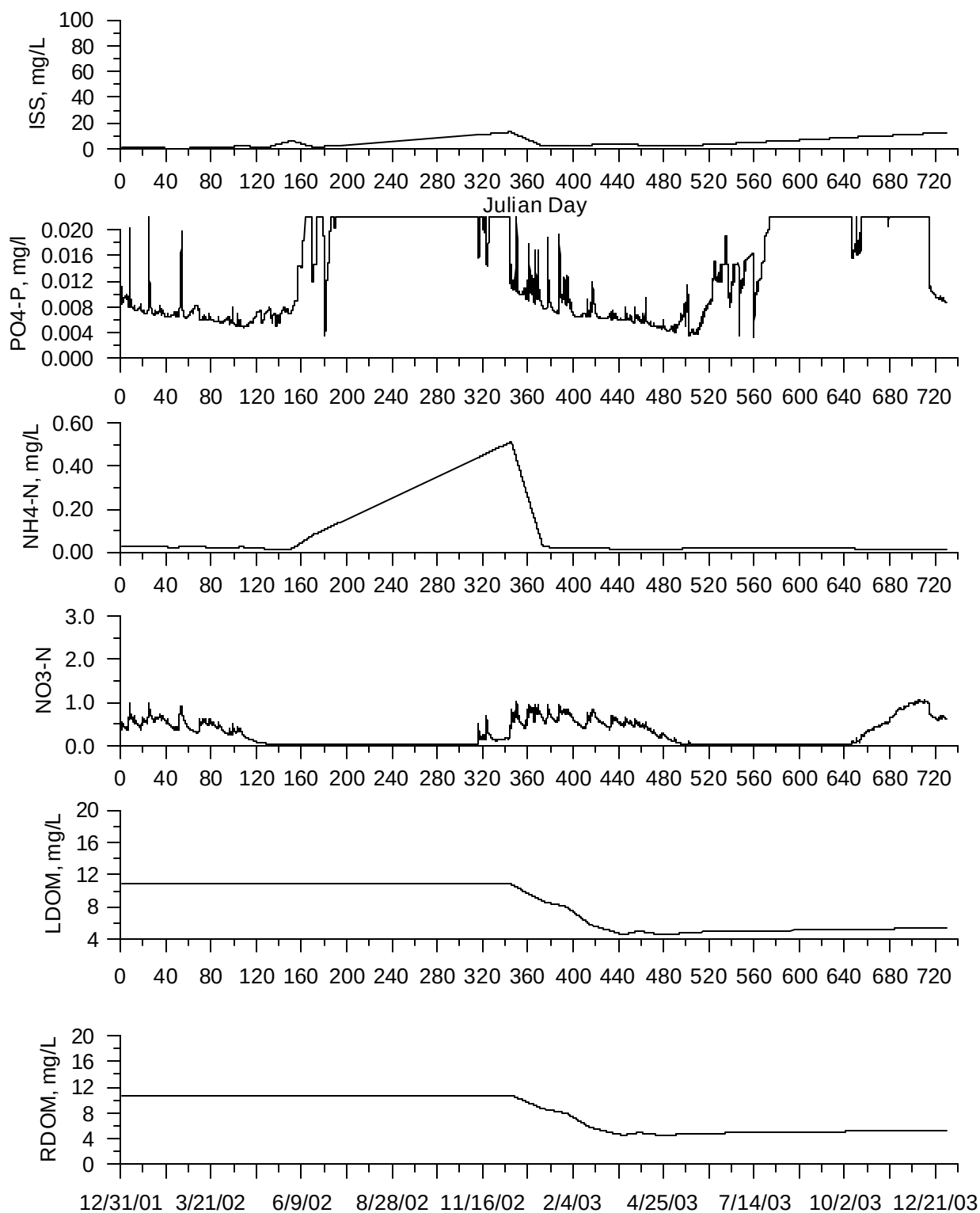


Figure 49. Constituent concentrations used for Mill Wheel Creek.

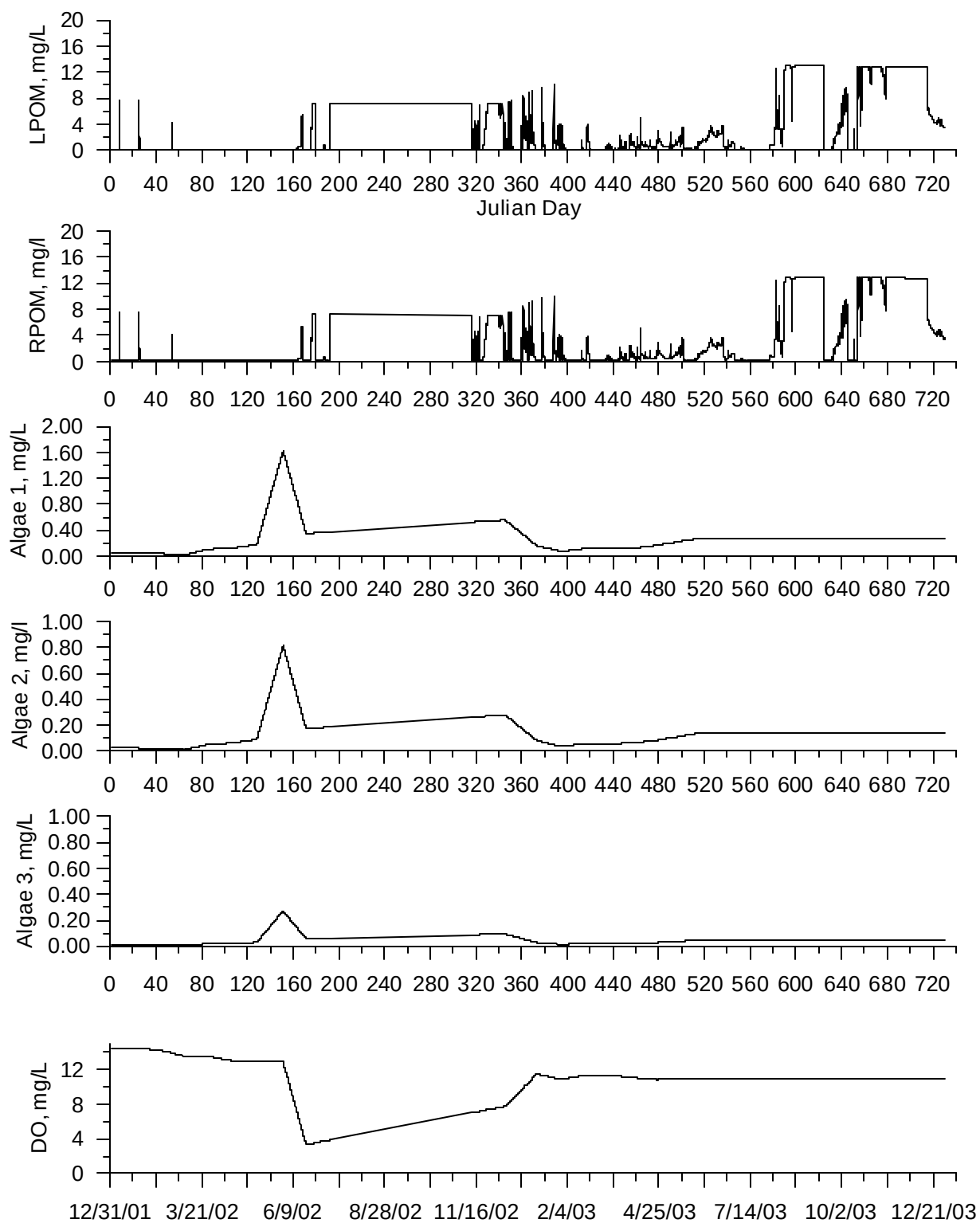


Figure 50. Constituent concentrations used for Mill Wheel Creek.

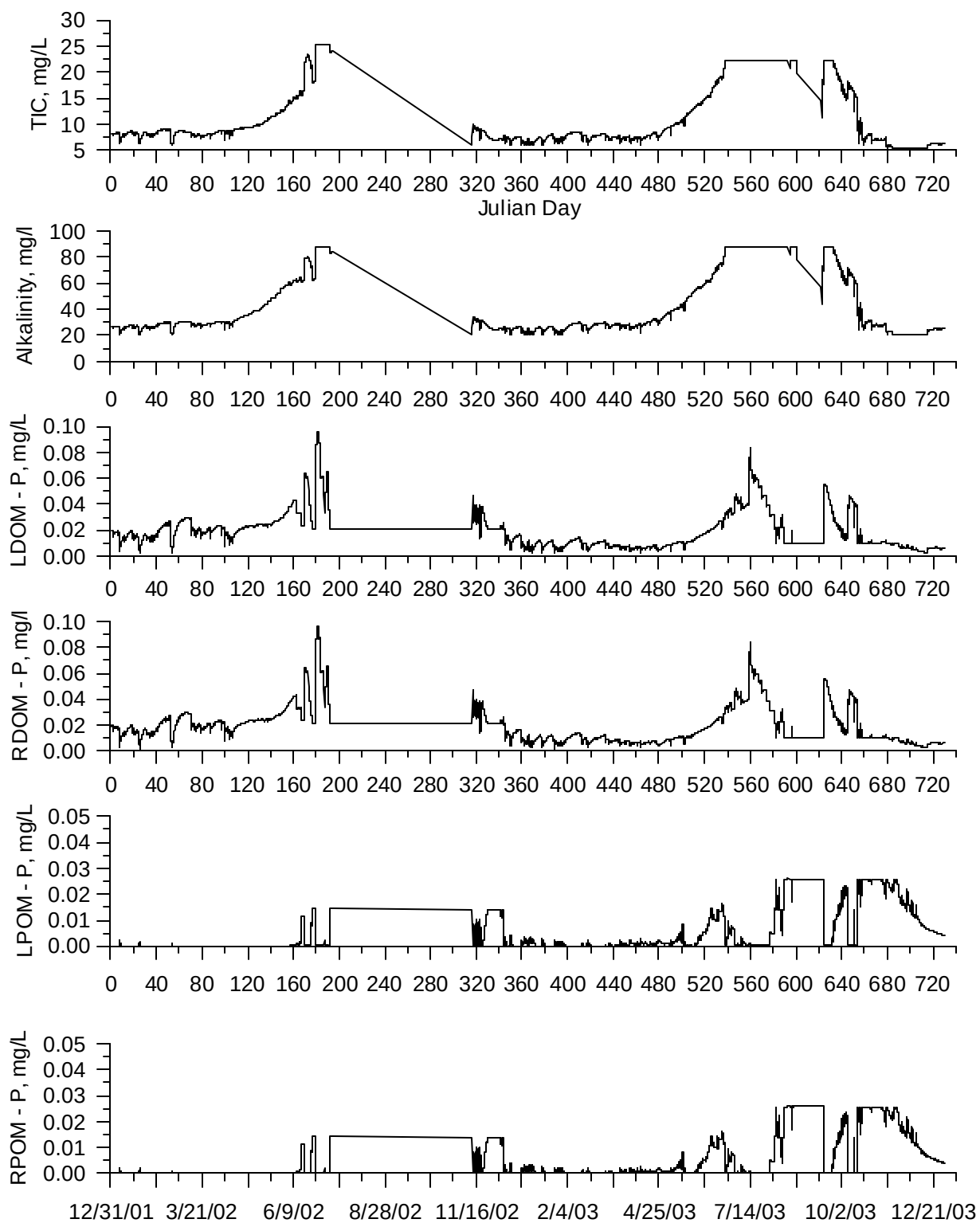


Figure 51. Constituent concentrations used for Mill Wheel Creek.

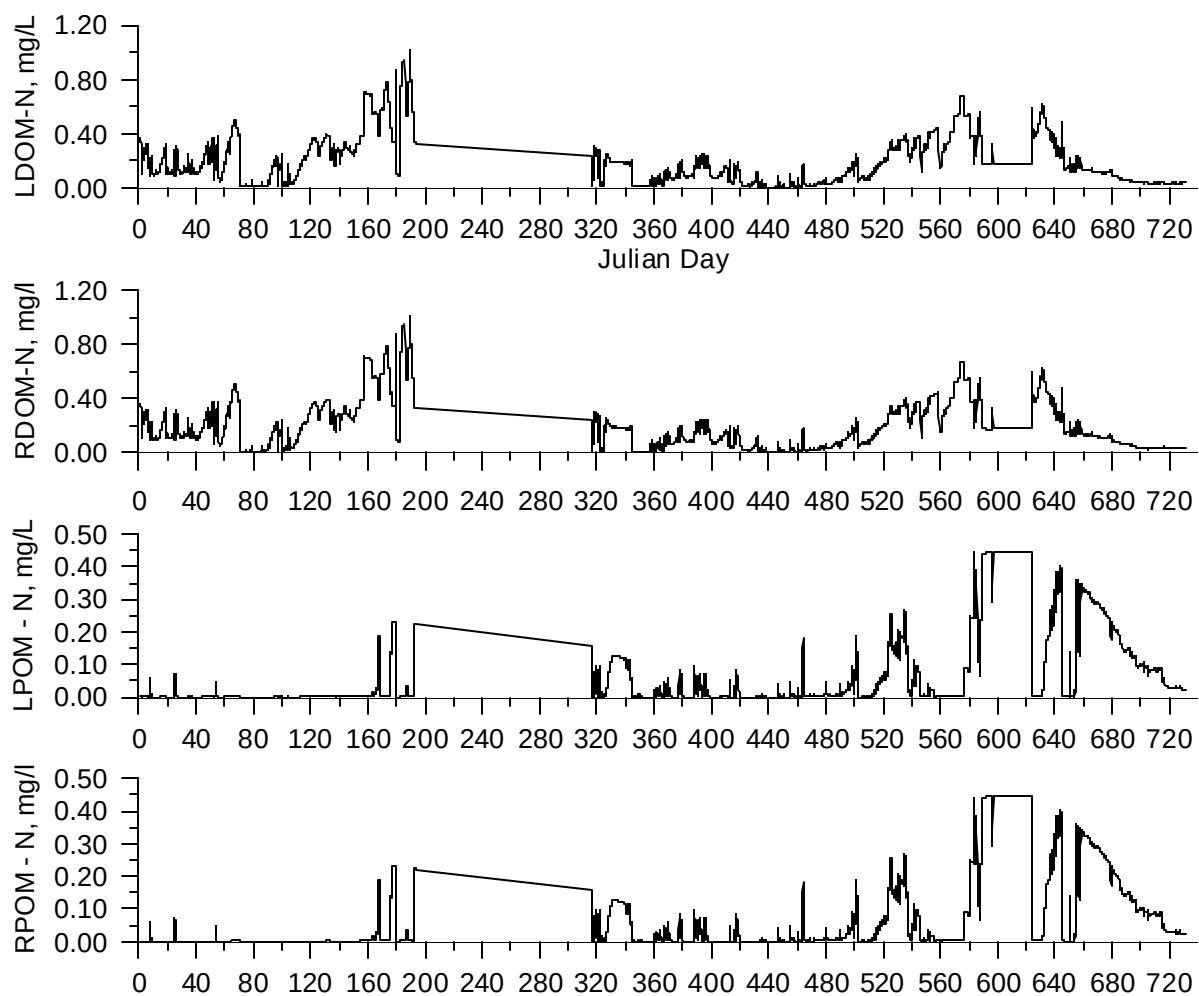


Figure 52. Constituent concentrations used for Mill Wheel Creek.

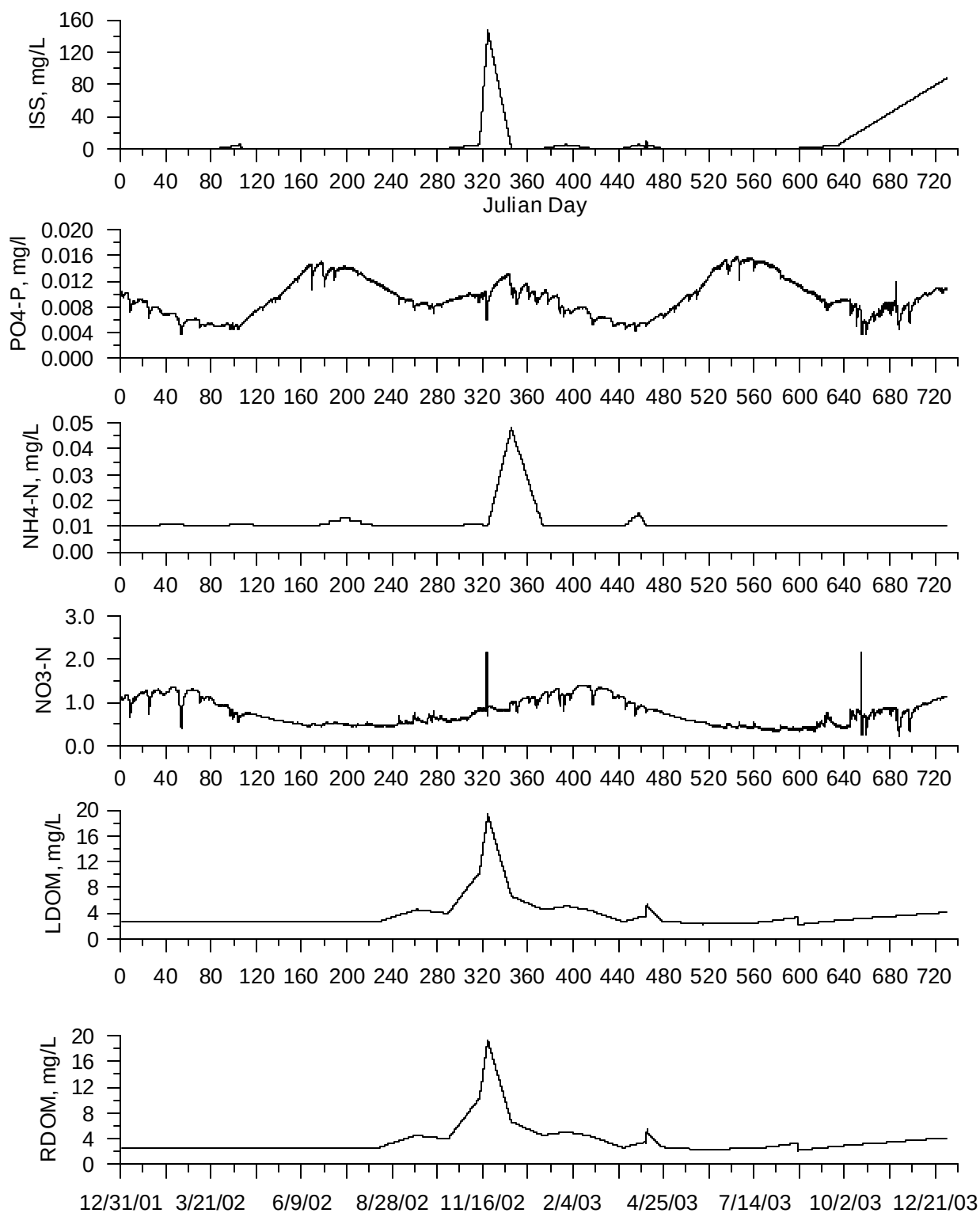


Figure 53. Constituent concentrations used for Olsen Creek.

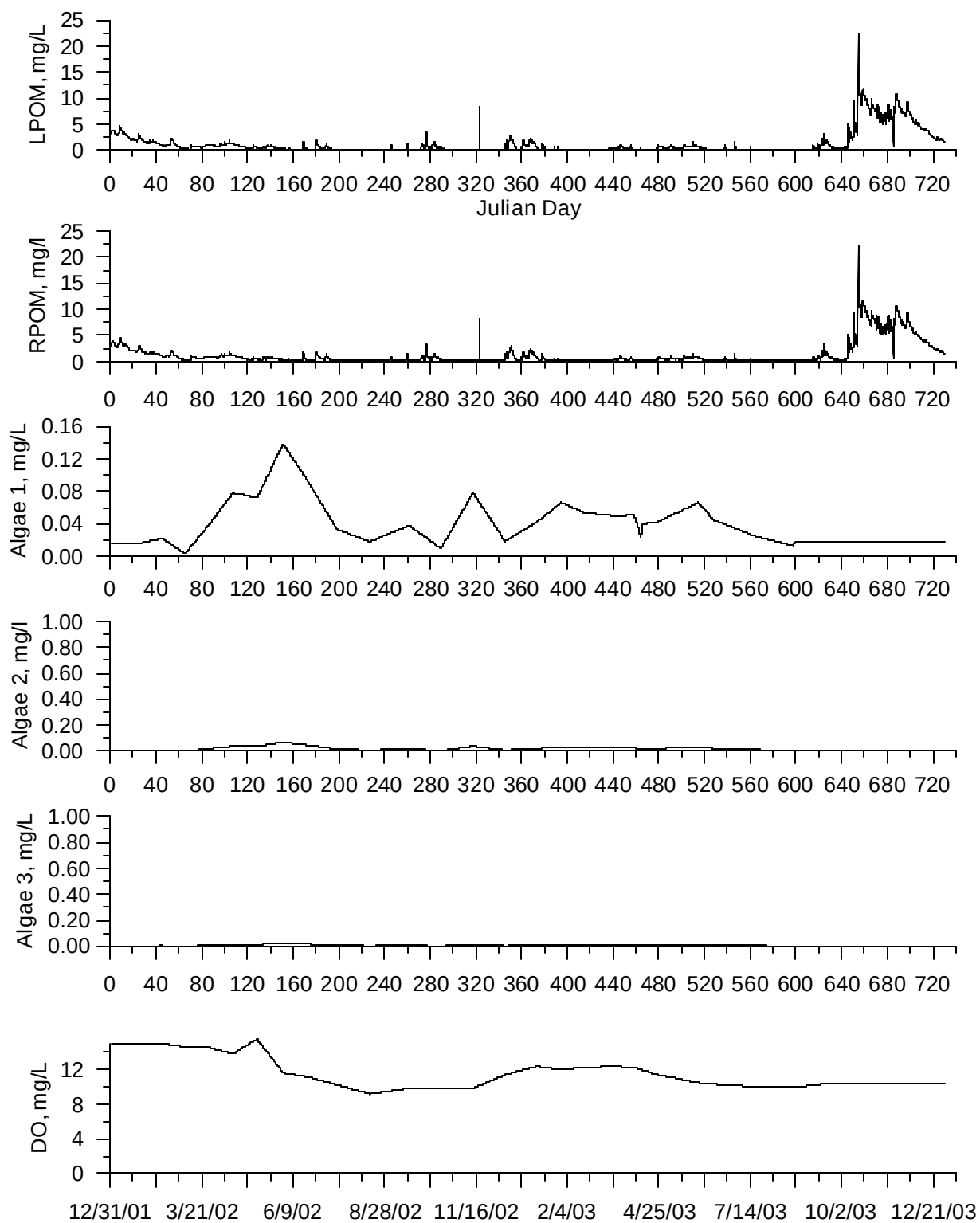


Figure 54. Constituent concentrations used for Olsen Creek.

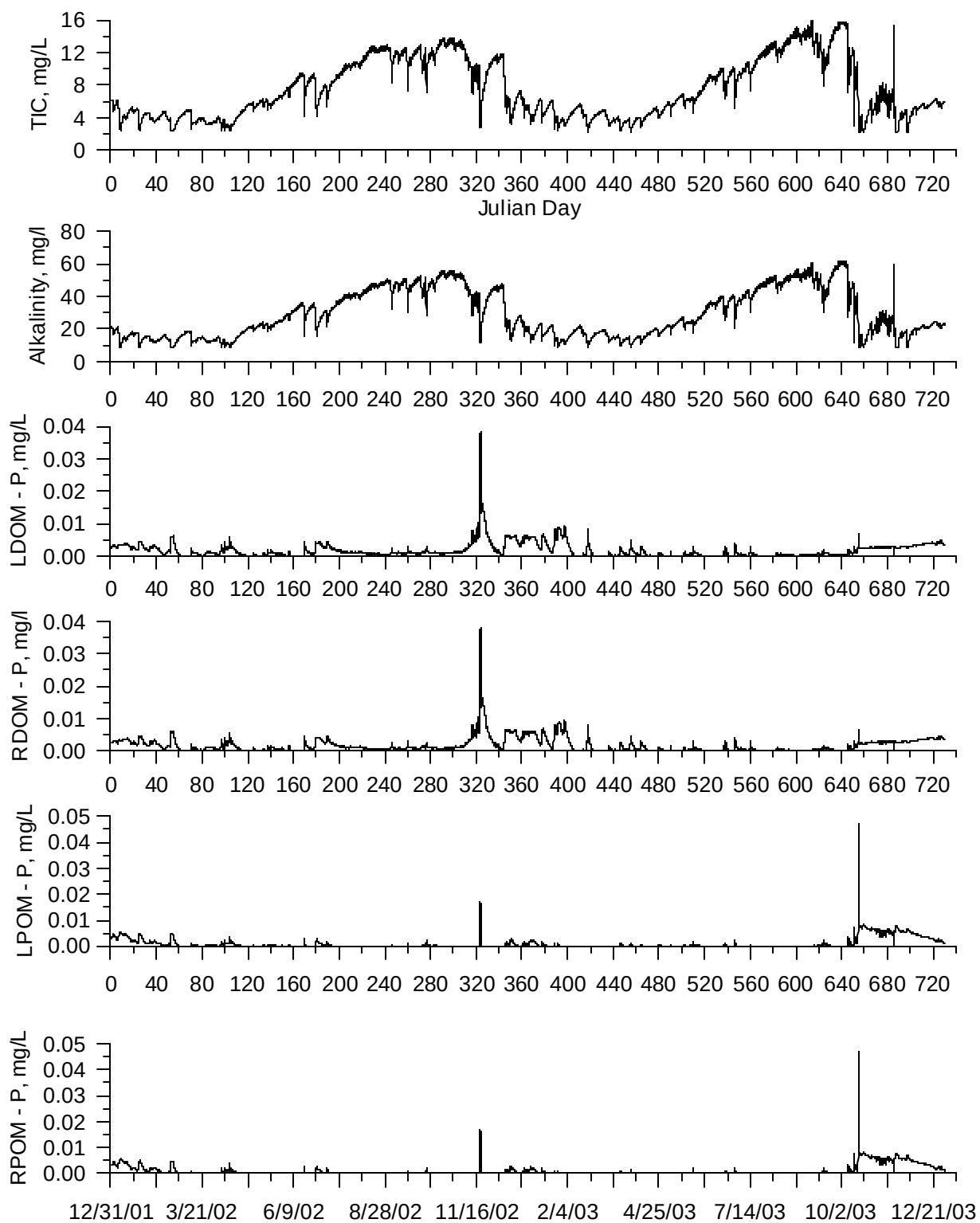


Figure 55. Constituent concentrations used for Olsen Creek.

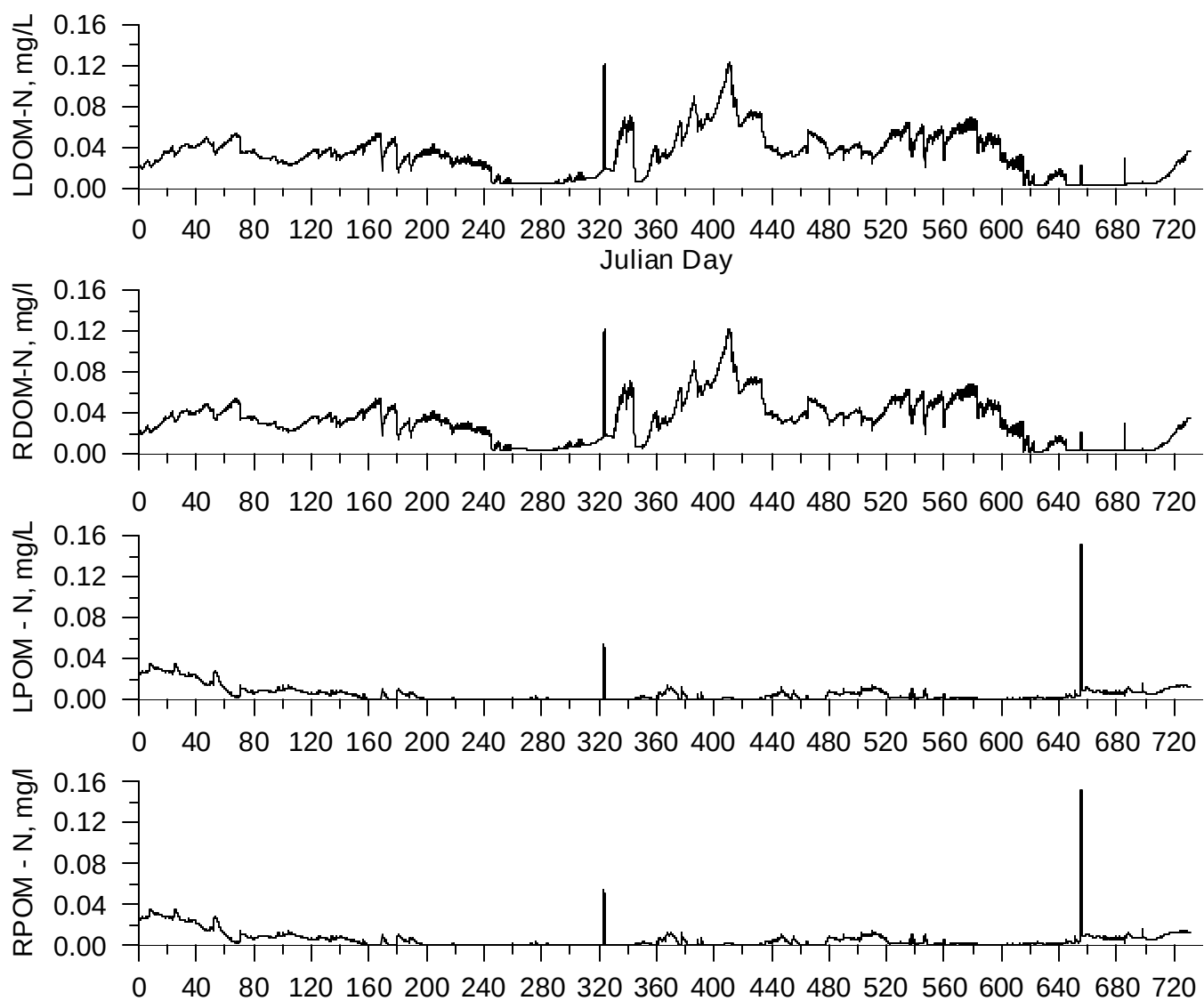


Figure 56. Constituent concentrations used for Olsen Creek.

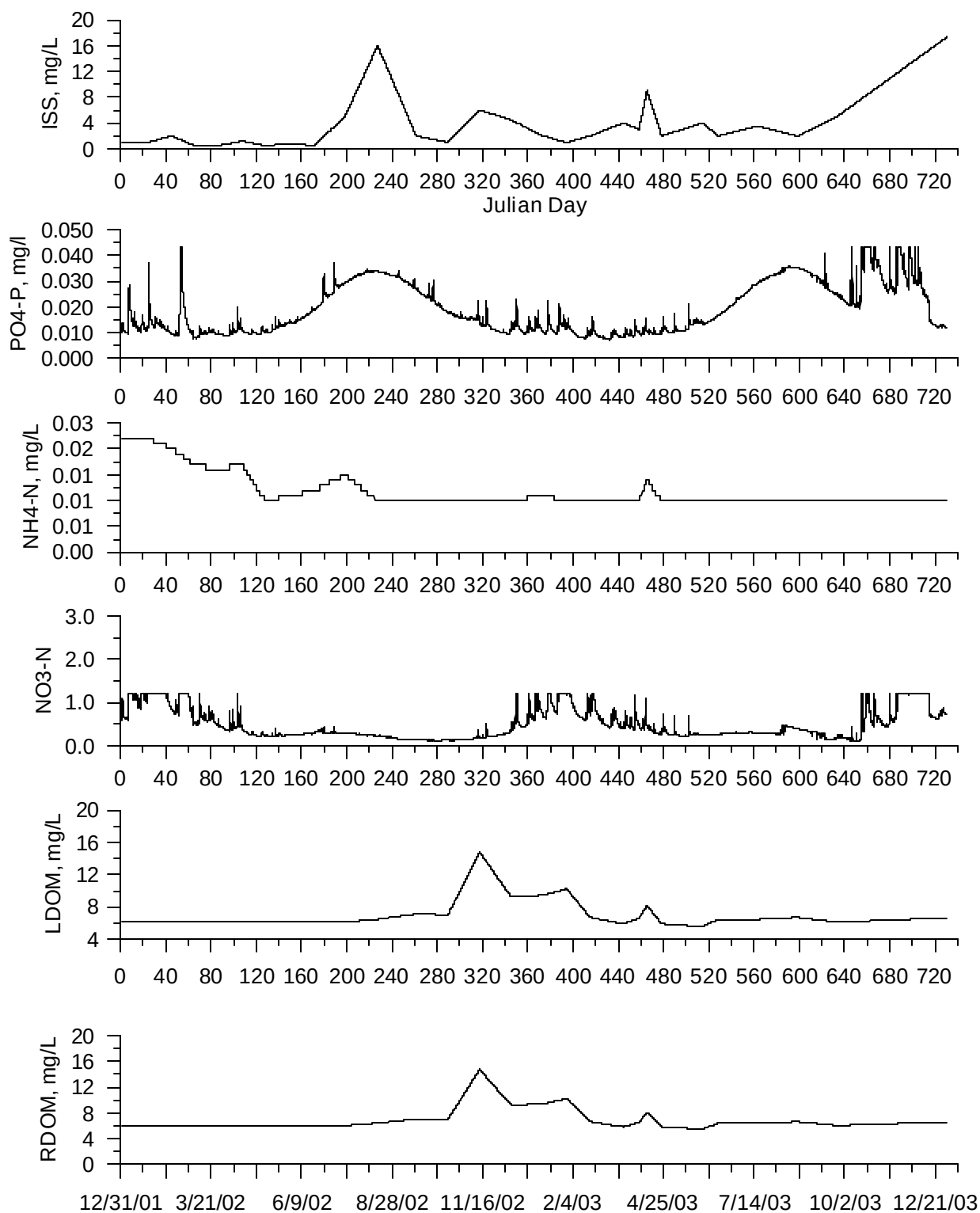


Figure 57. Constituent concentrations used for Silver Beach Creek.

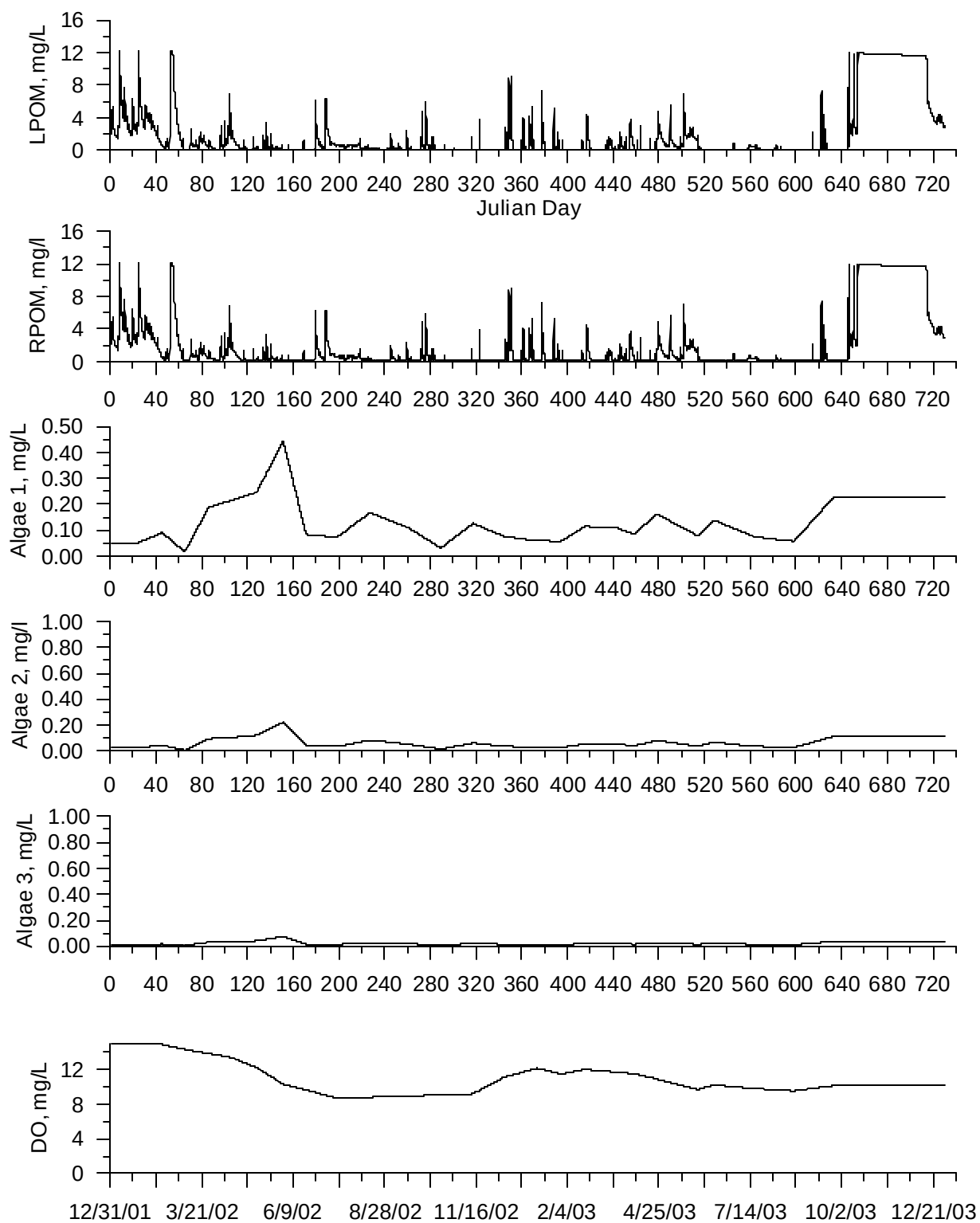


Figure 58. Constituent concentrations used for Silver Beach Creek.

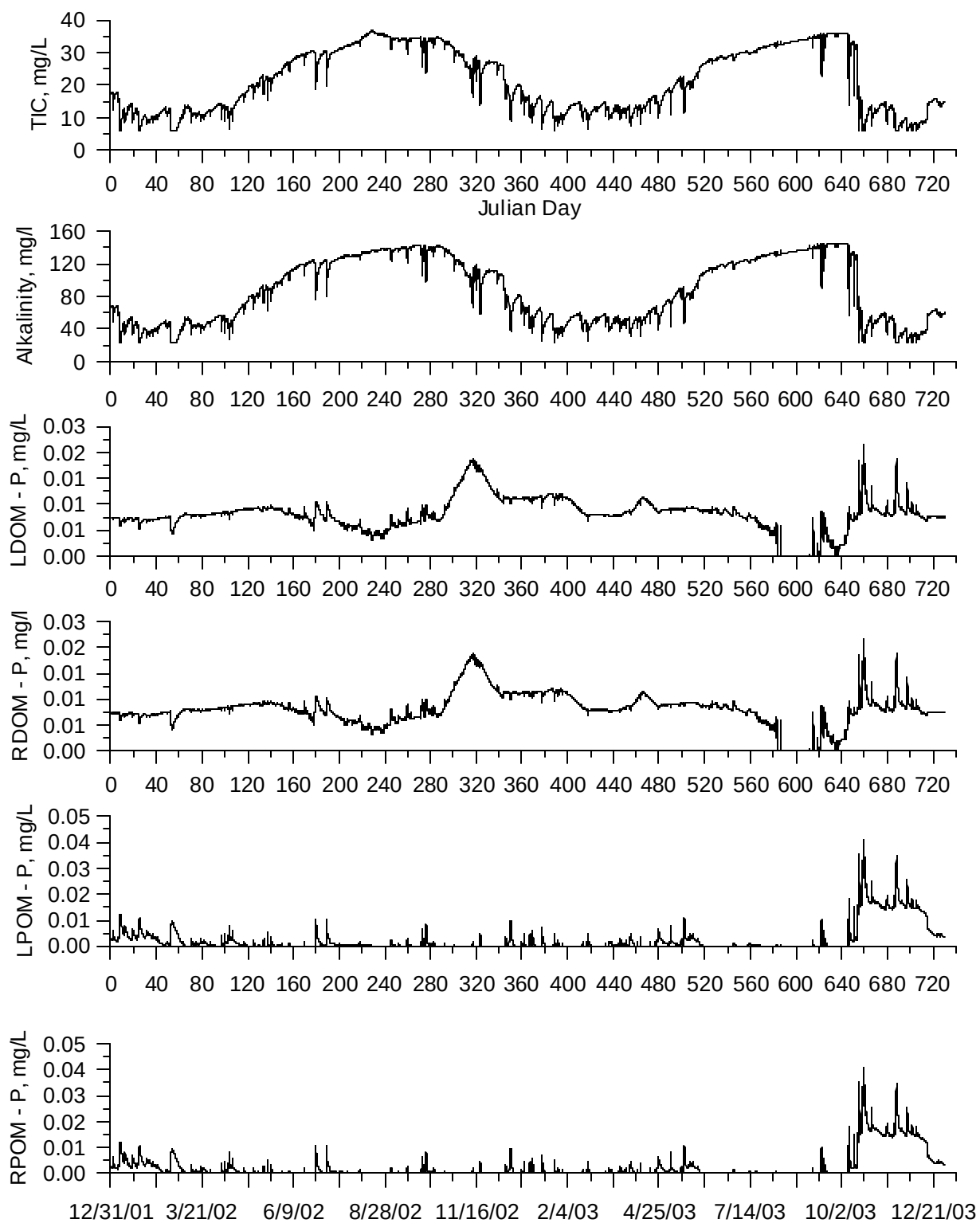


Figure 59. Constituent concentrations used for Silver Beach Creek.

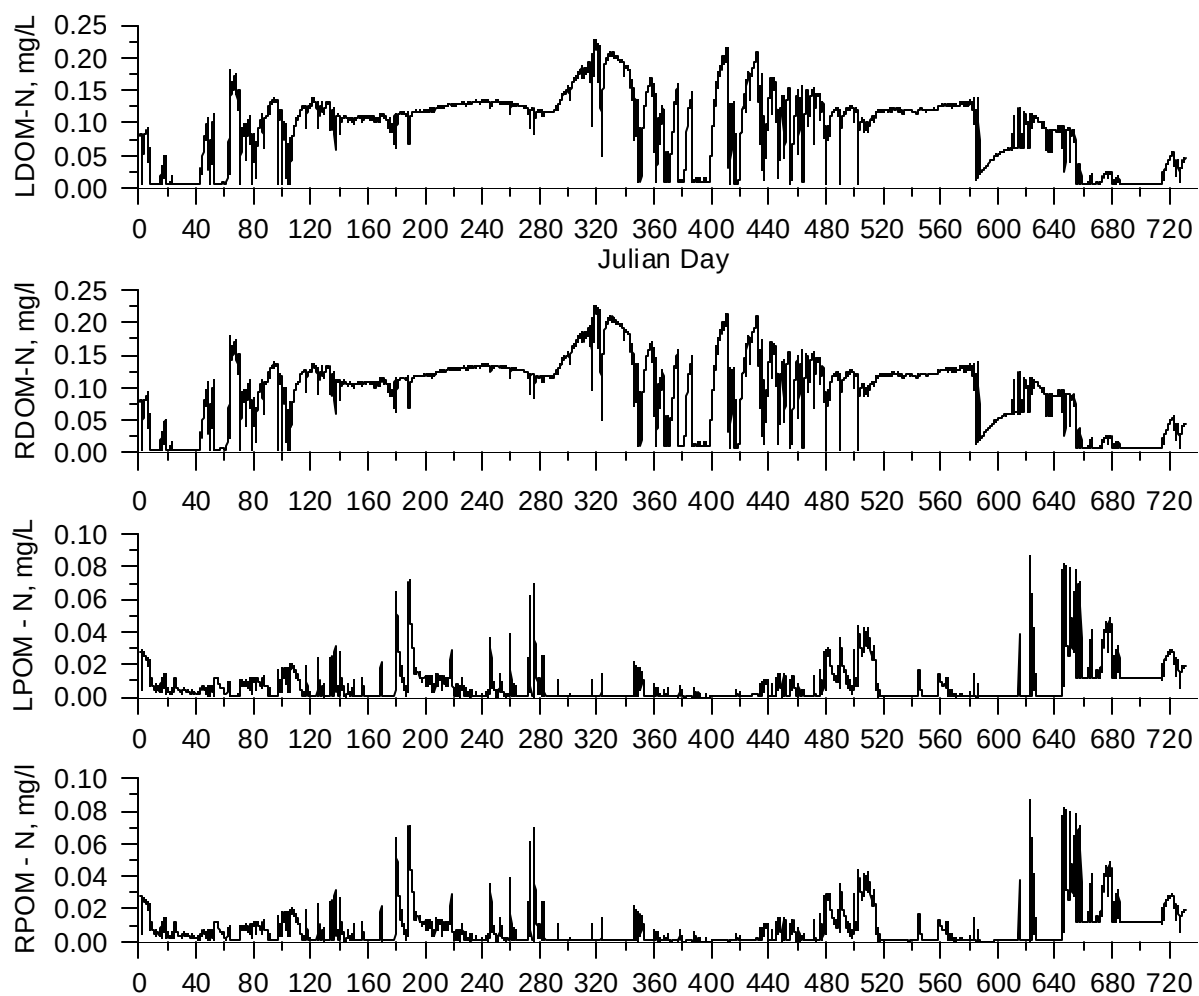


Figure 60. Constituent concentrations used for Silver Beach Creek.

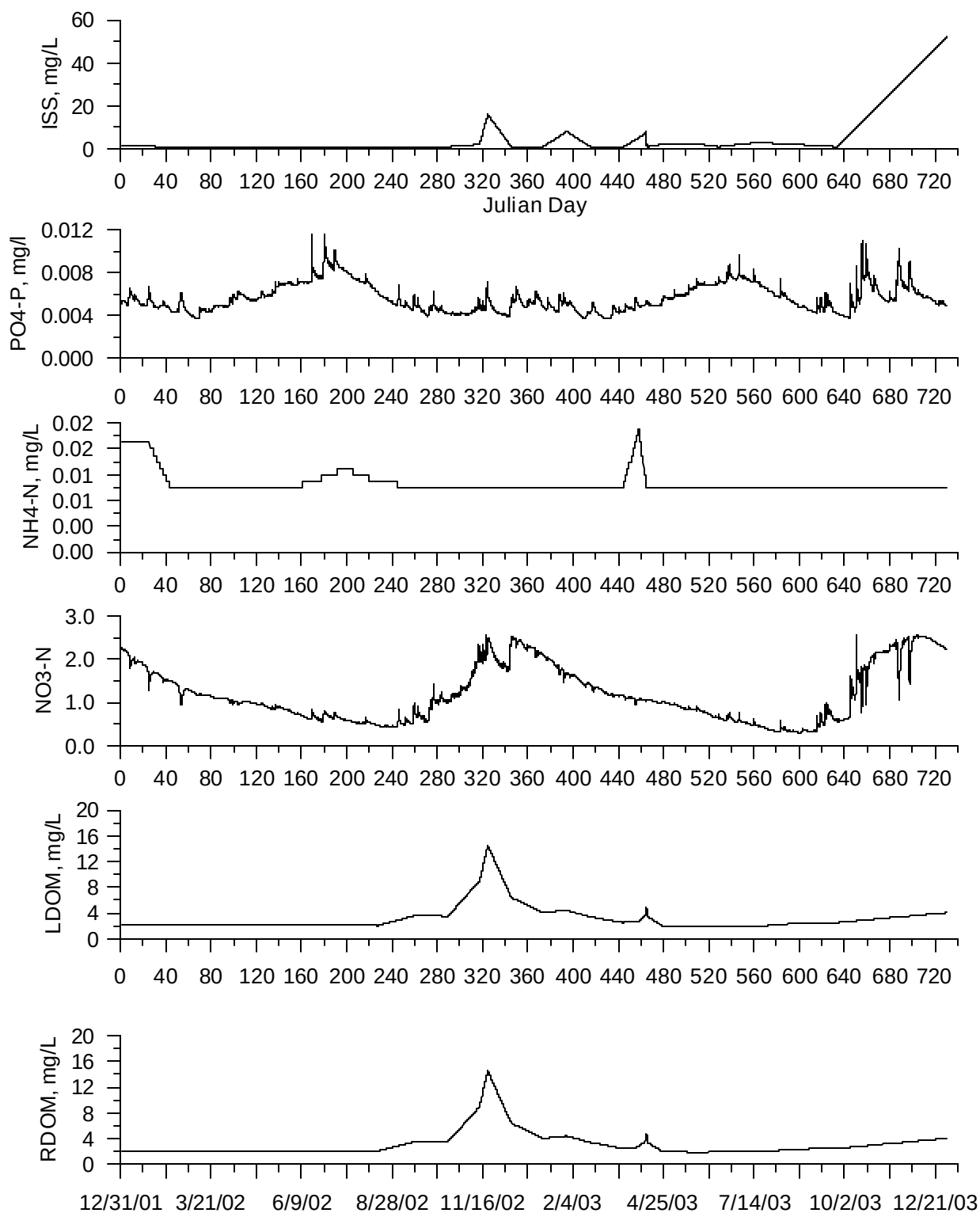


Figure 61. Constituent concentrations used for Smith Creek.

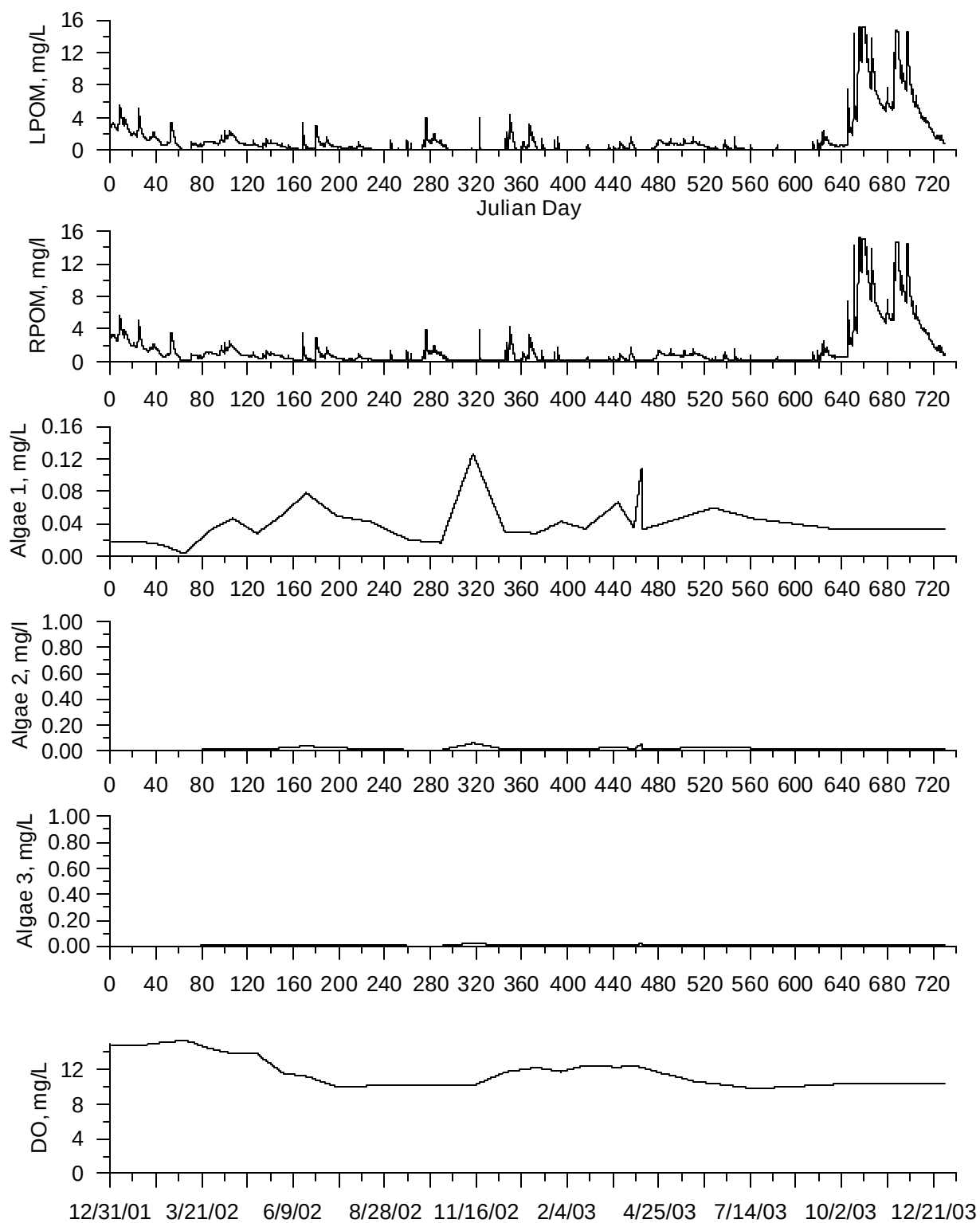


Figure 62. Constituent concentrations used for Smith Creek.

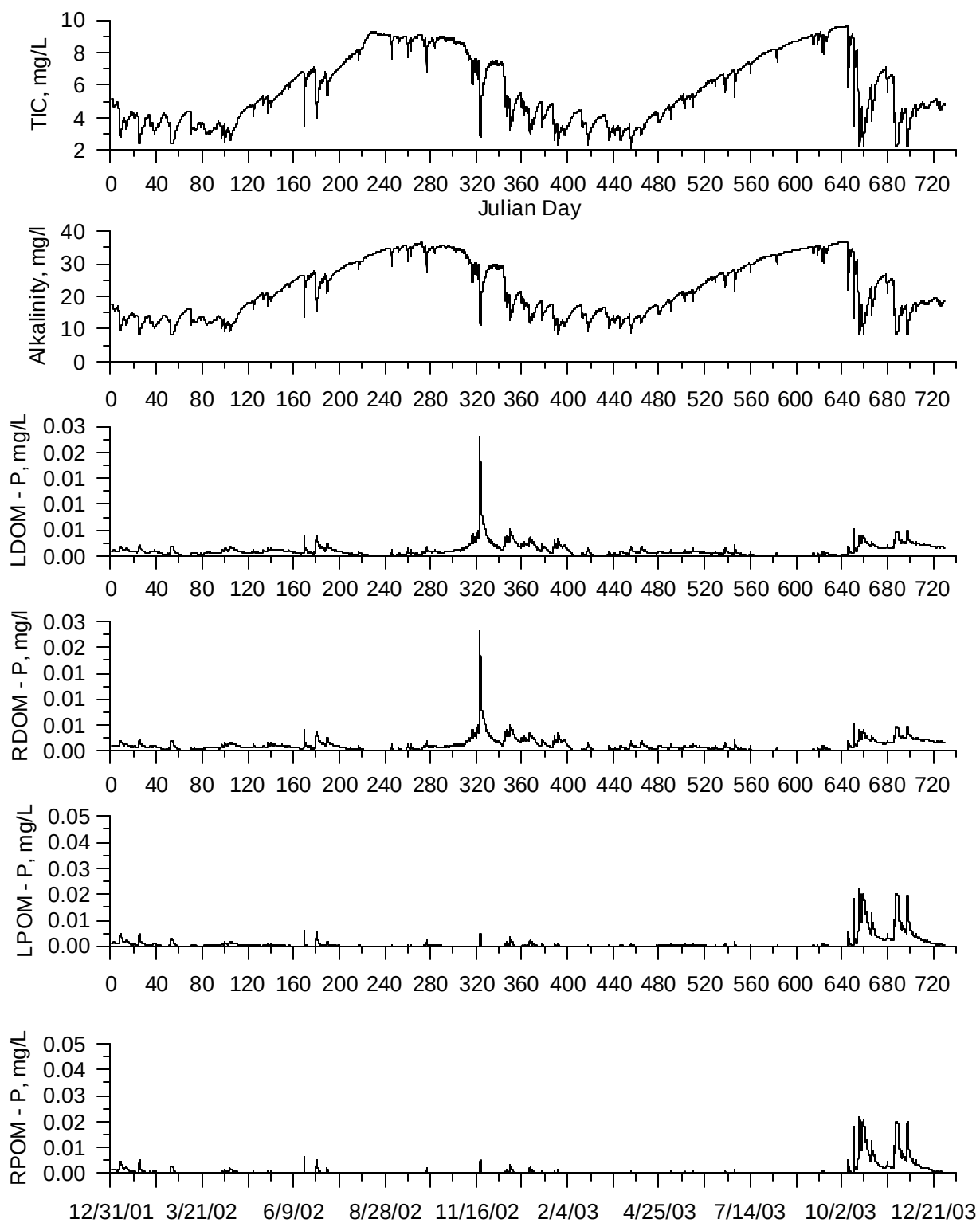


Figure 63. Constituent concentrations used for Smith Creek.

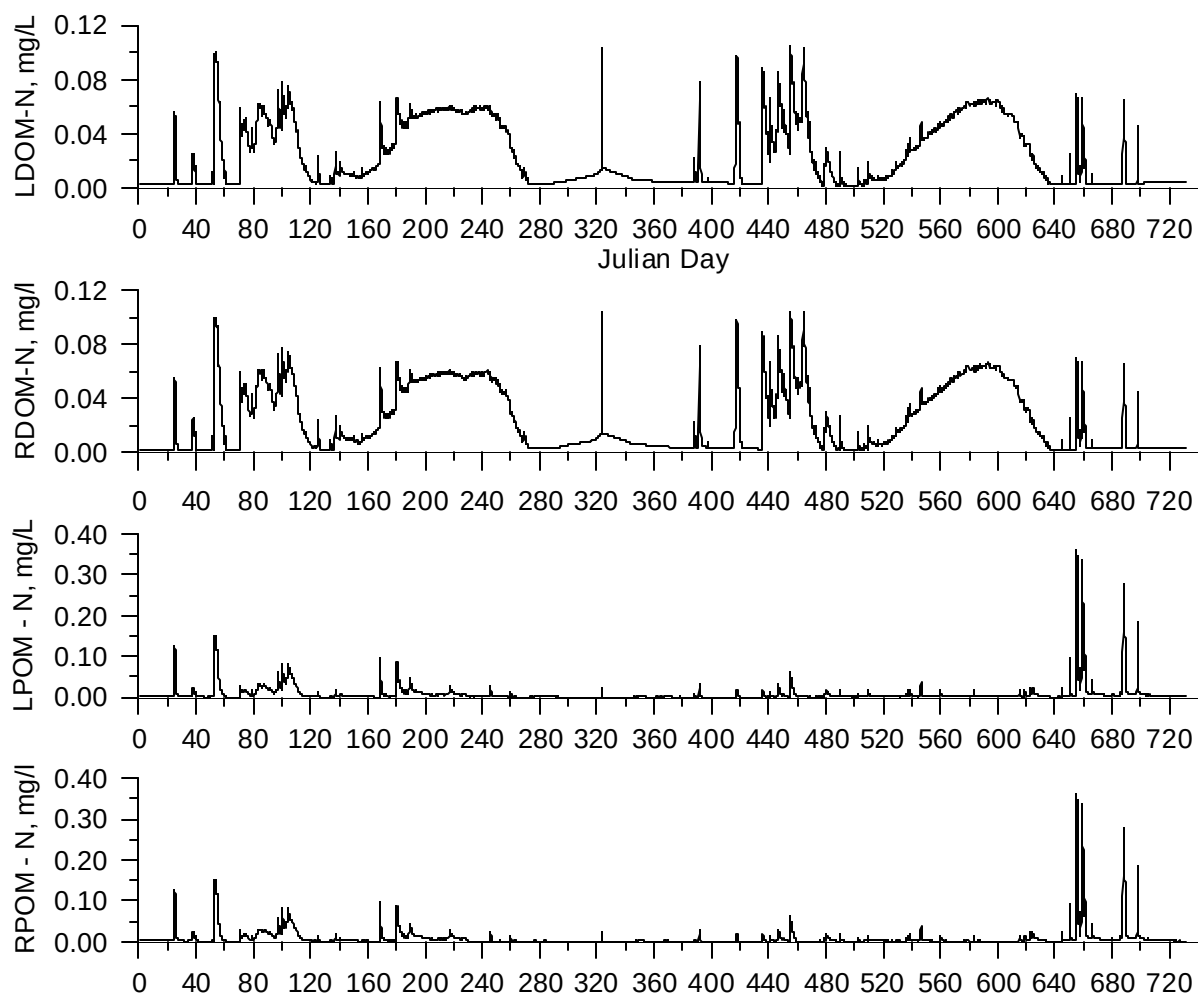


Figure 64. Constituent concentrations used for Smith Creek.

Meteorological Inputs

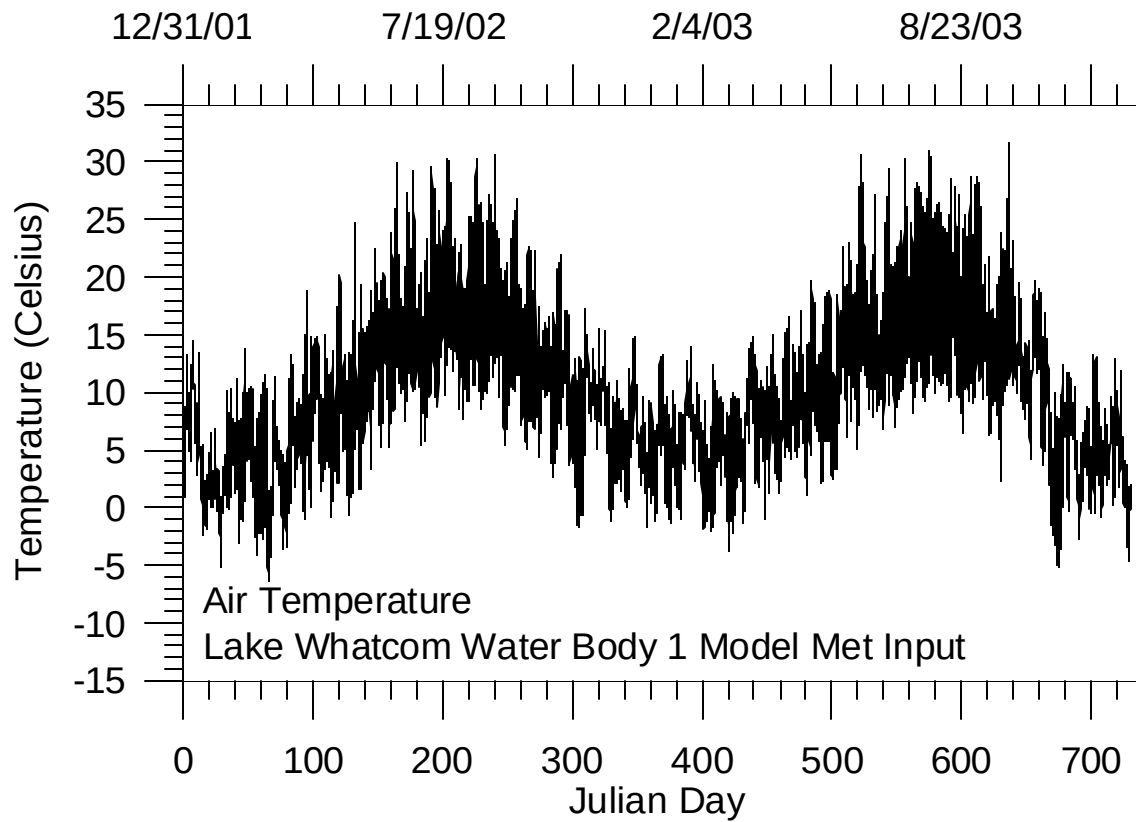


Figure 65. Air temperature for water body 1.

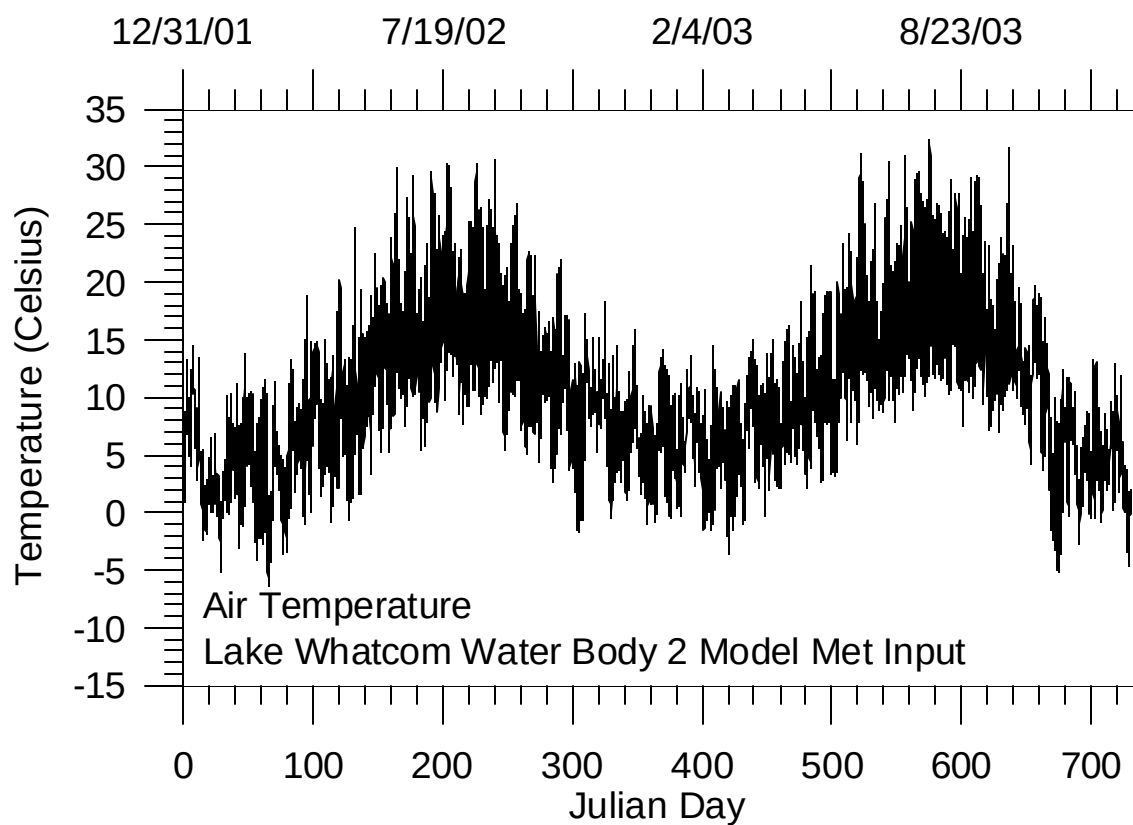


Figure 66. Air temperature for water body 2.

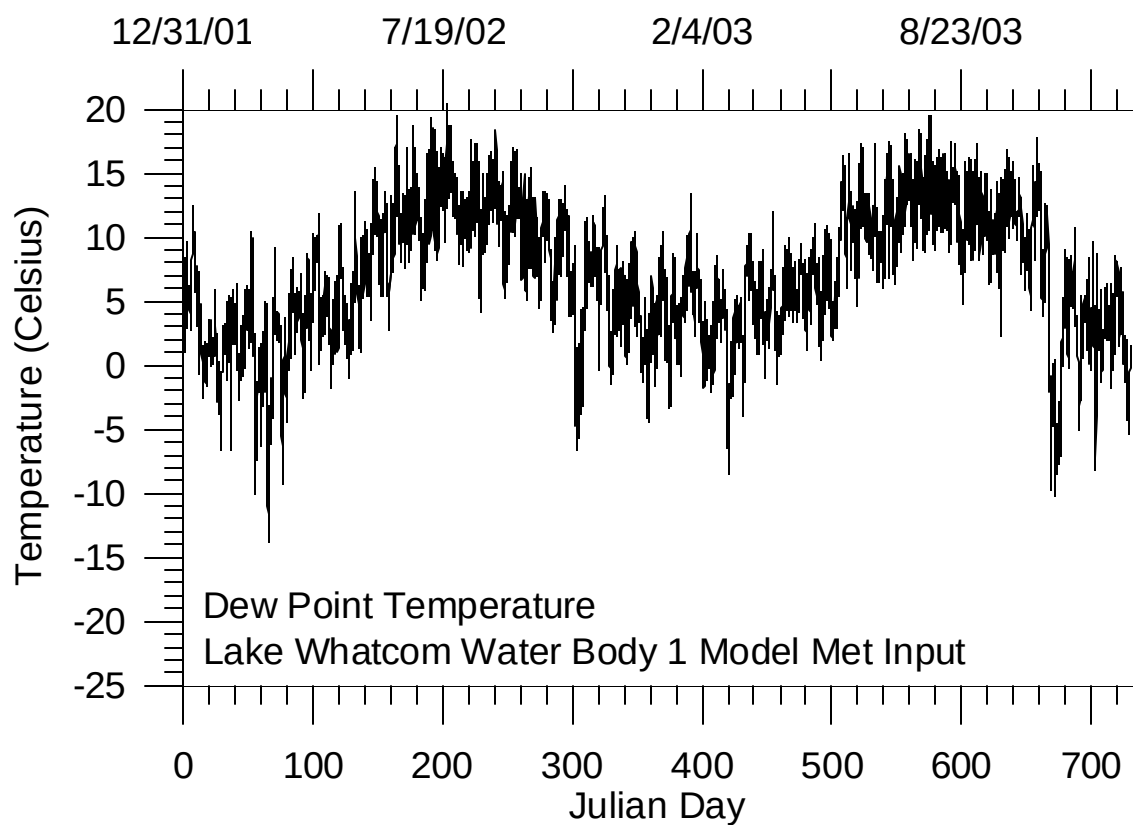


Figure 67. Dew point temperature for water body 1.

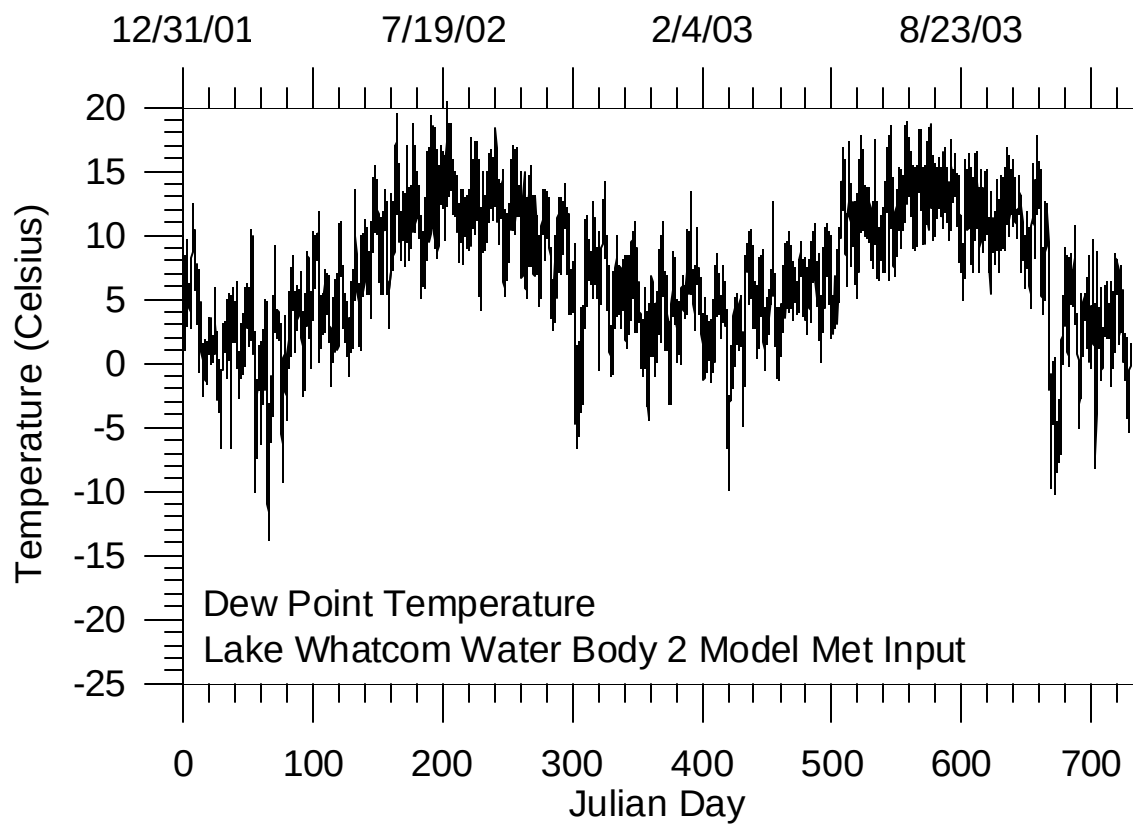


Figure 68. Dew point temperature for water body 2.

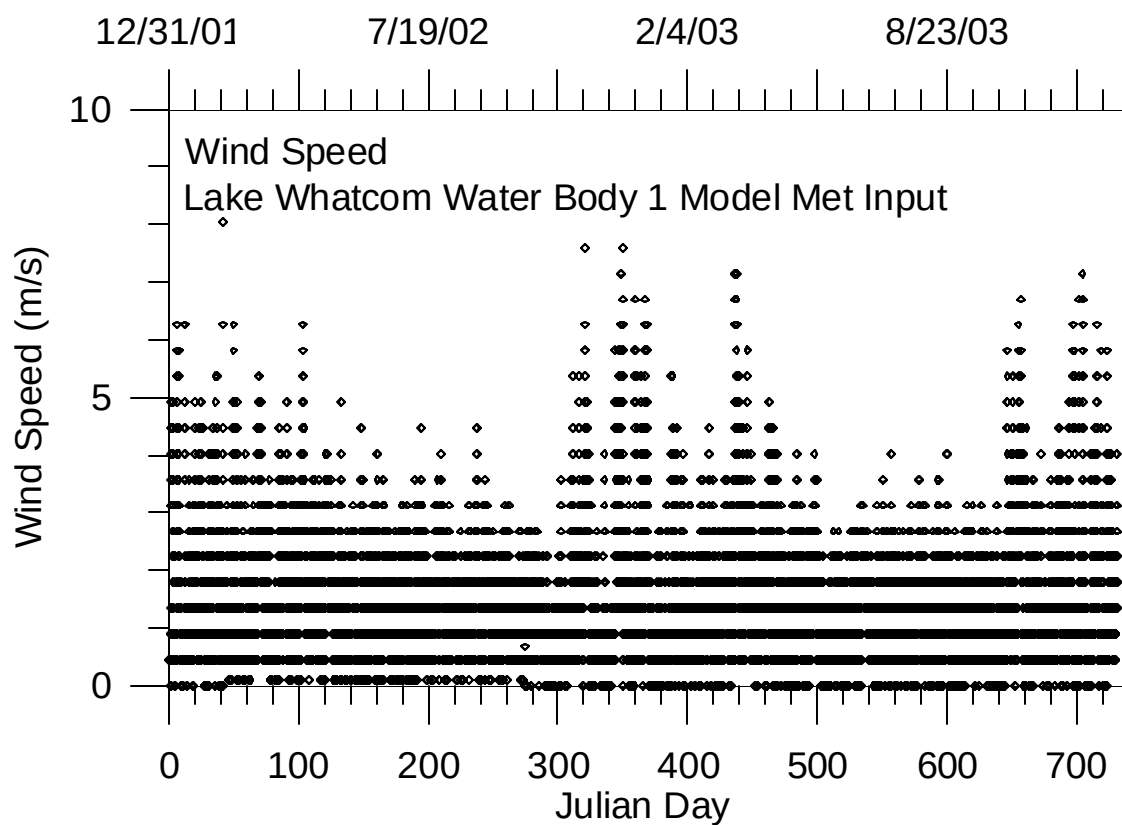


Figure 69. Wind Speed for water body 1.

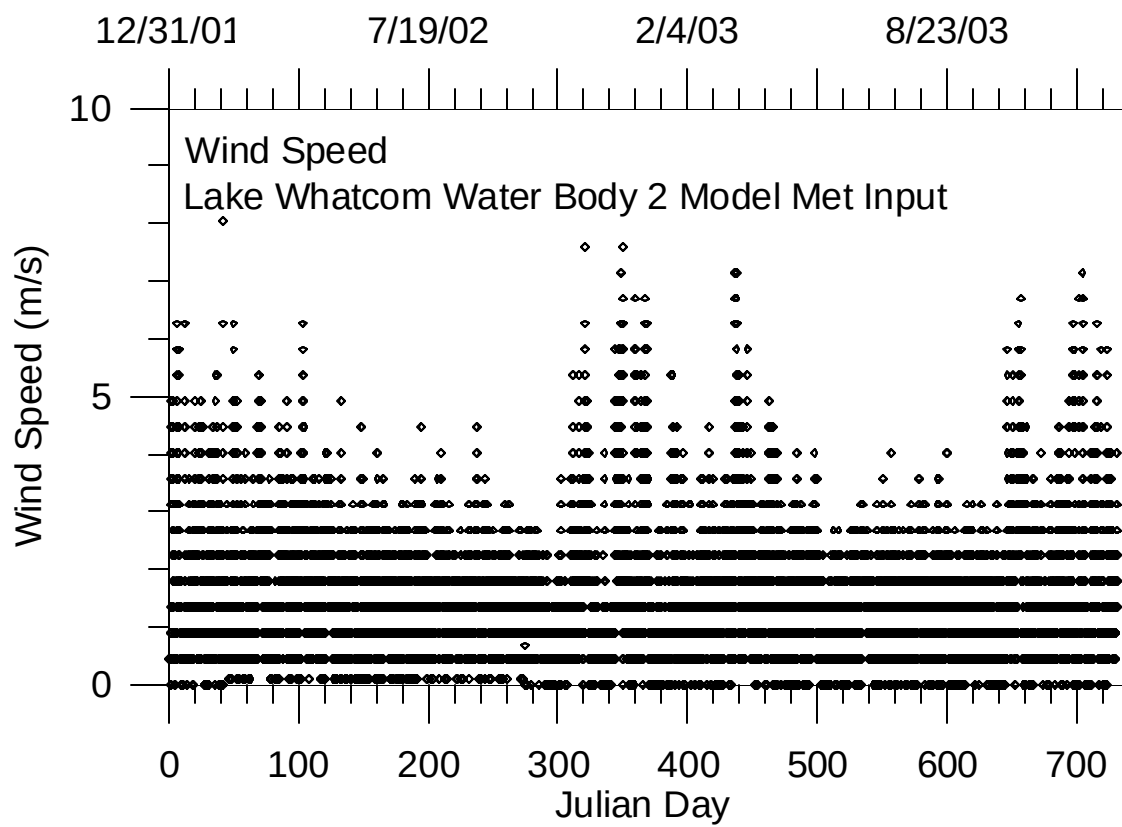


Figure 70. Wind Speed for water body 2.

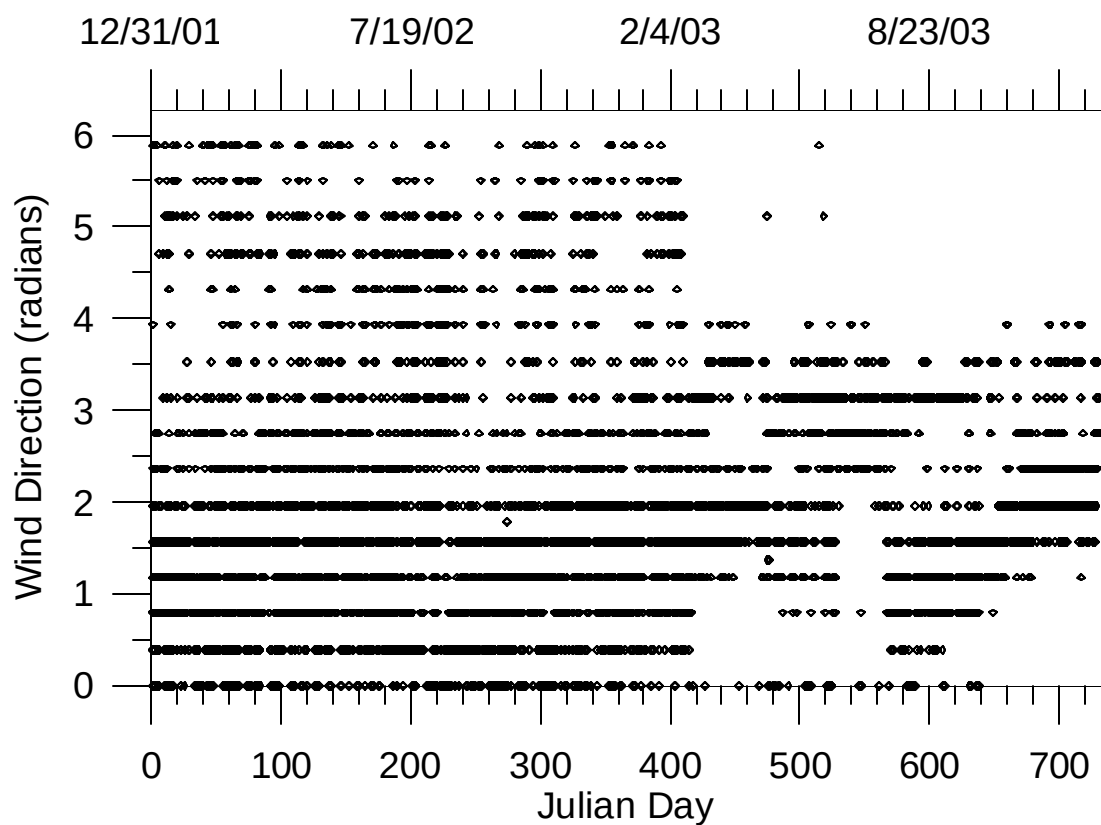


Figure 71. Wind direction used water body 1.

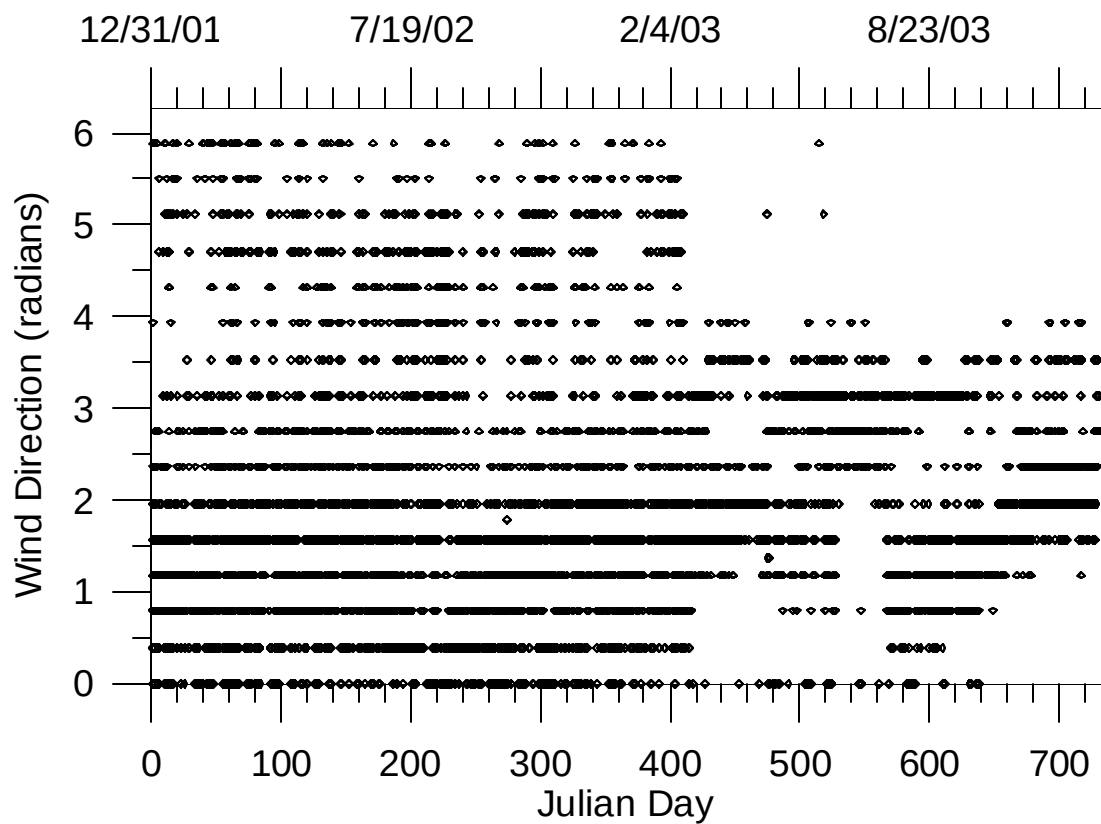
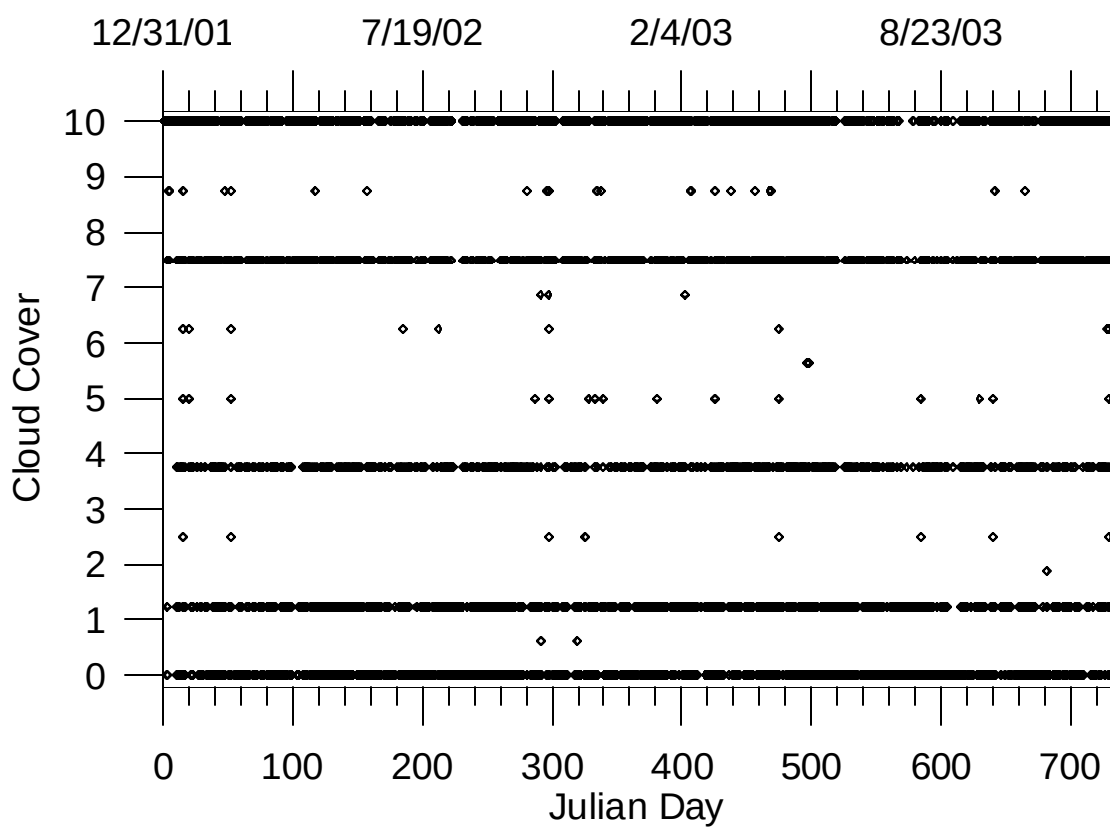
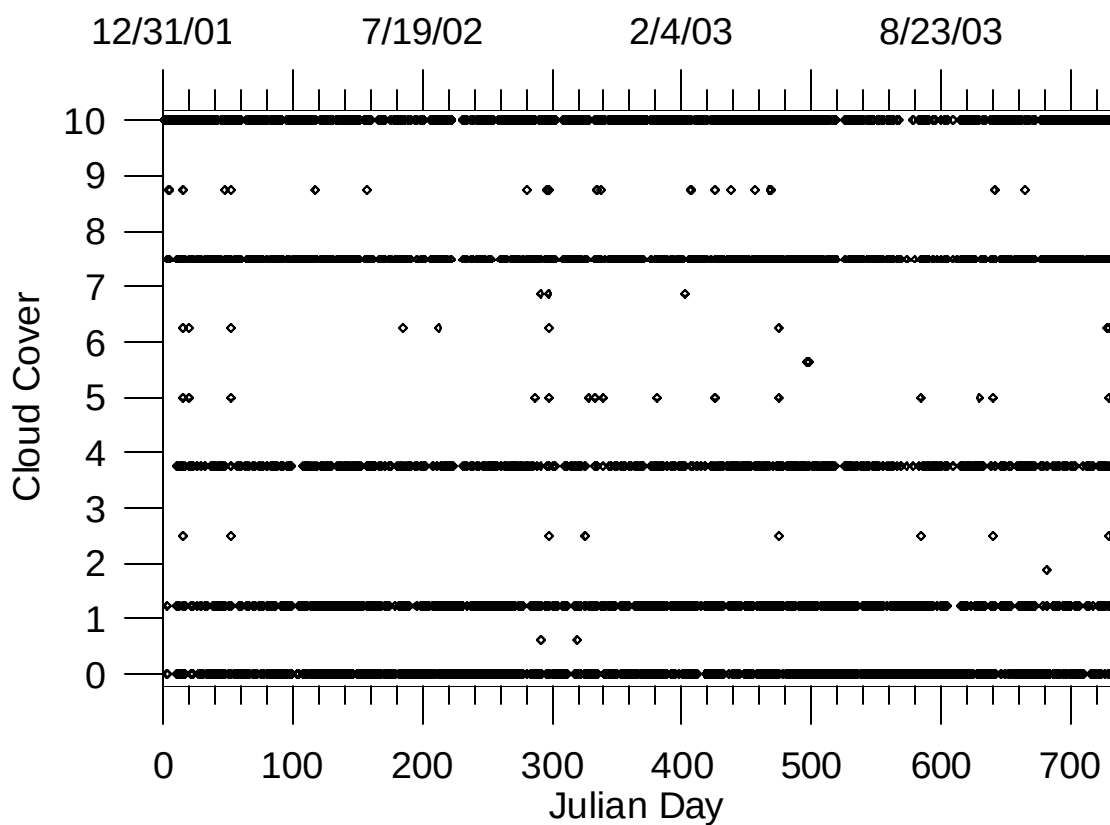


Figure 72. Wind direction used water body 2.



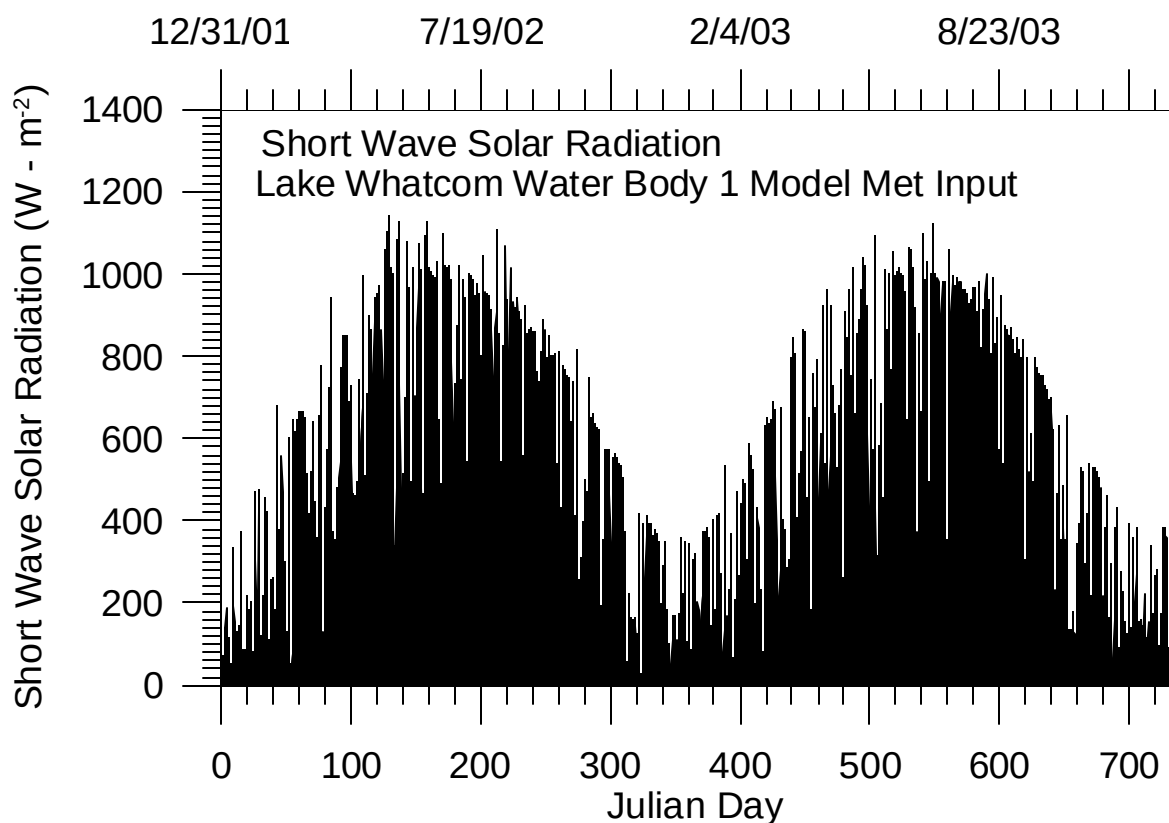


Figure 75. Short wave solar radiation for water body 1.

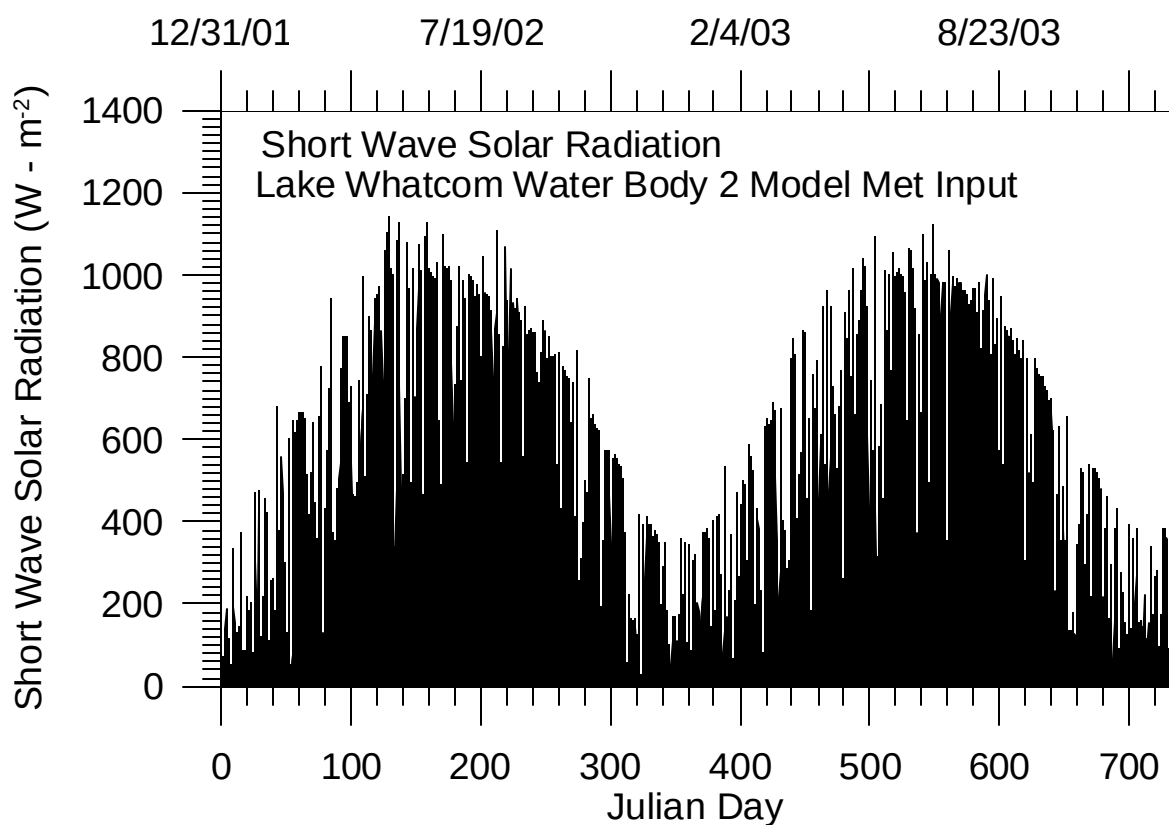


Figure 76. Short wave solar radiation for water body 2.

Precipitation Constituent Inputs

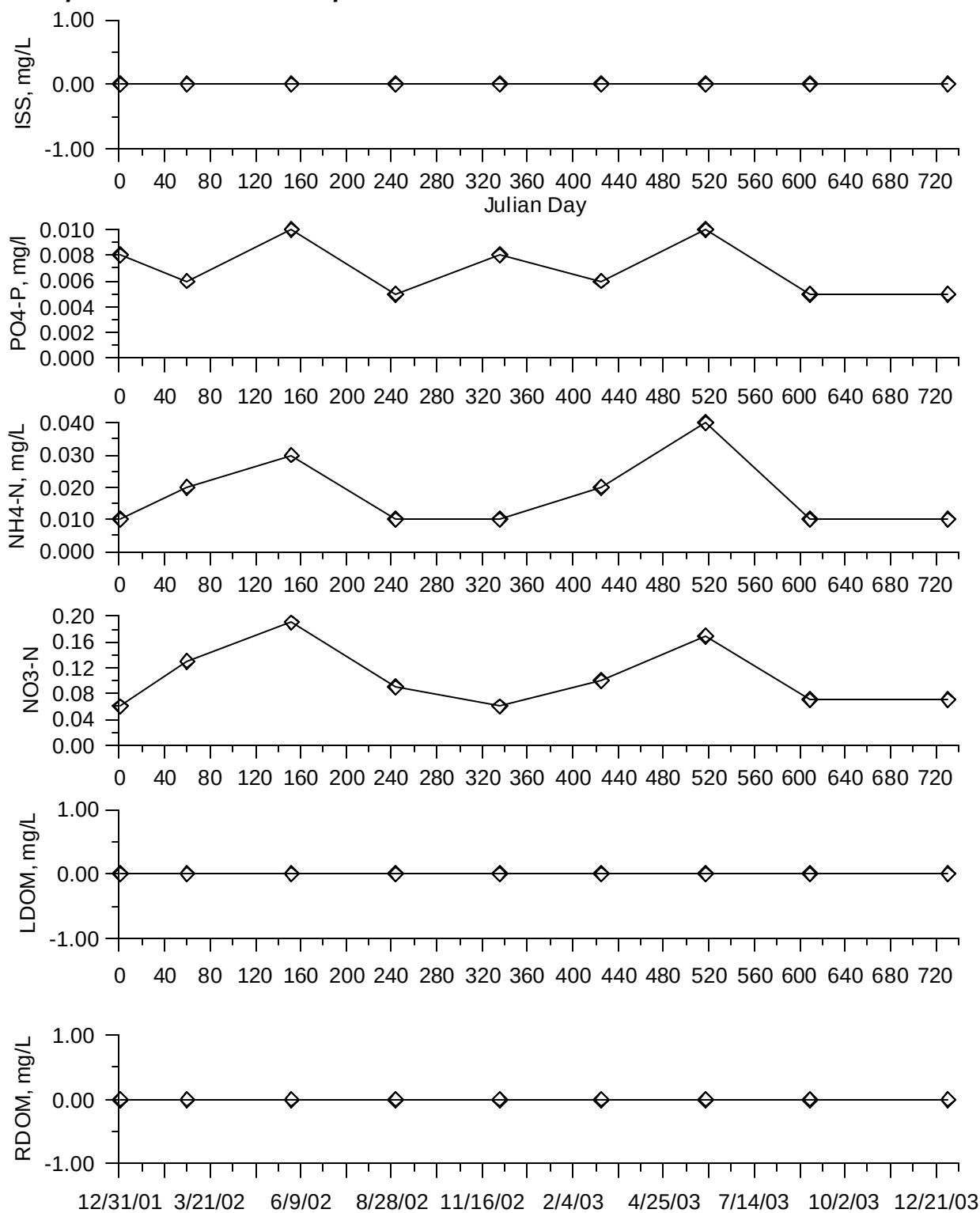


Figure 77. Constituent concentrations for precipitation.

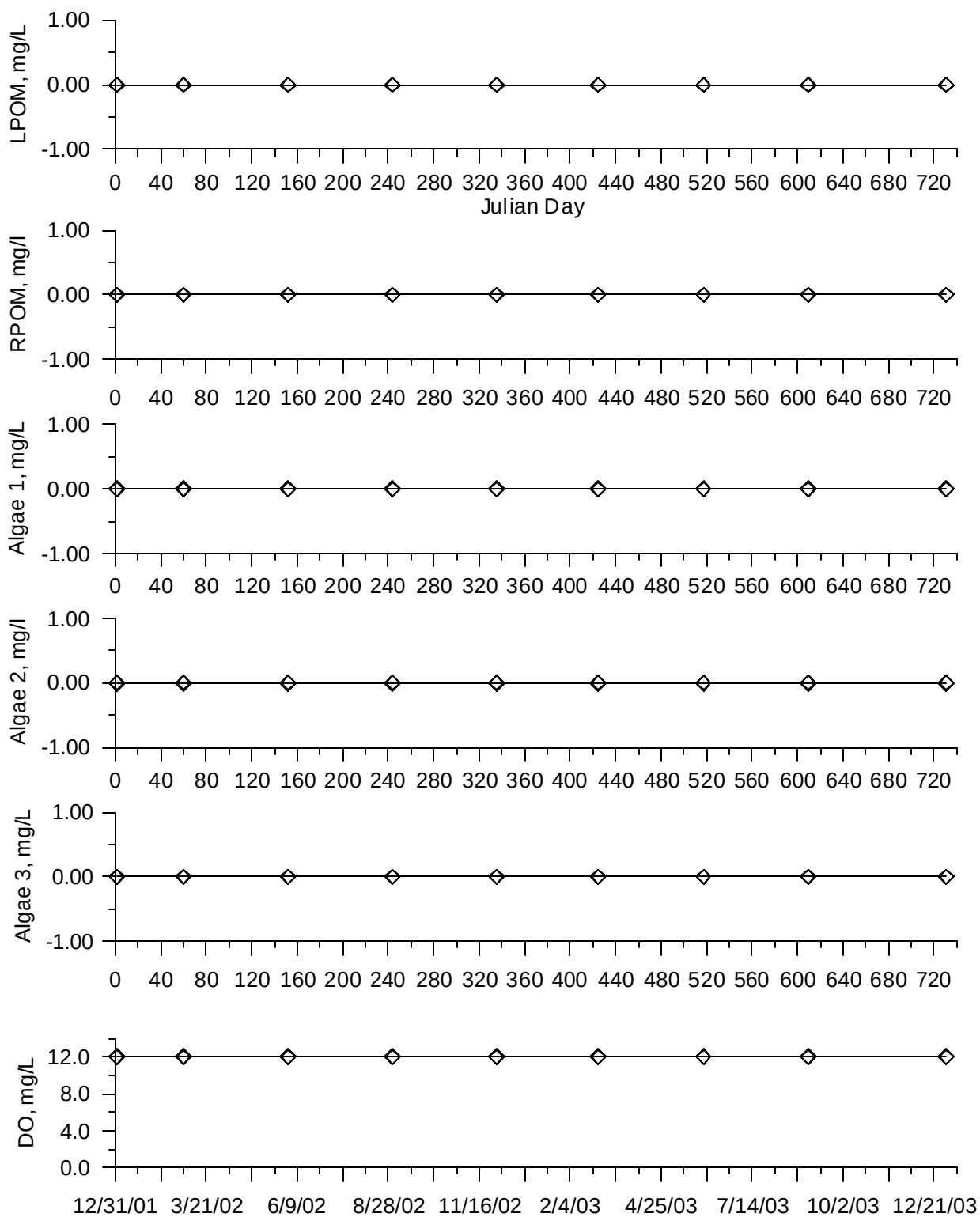


Figure 78. Constituent concentrations for precipitation (continued).

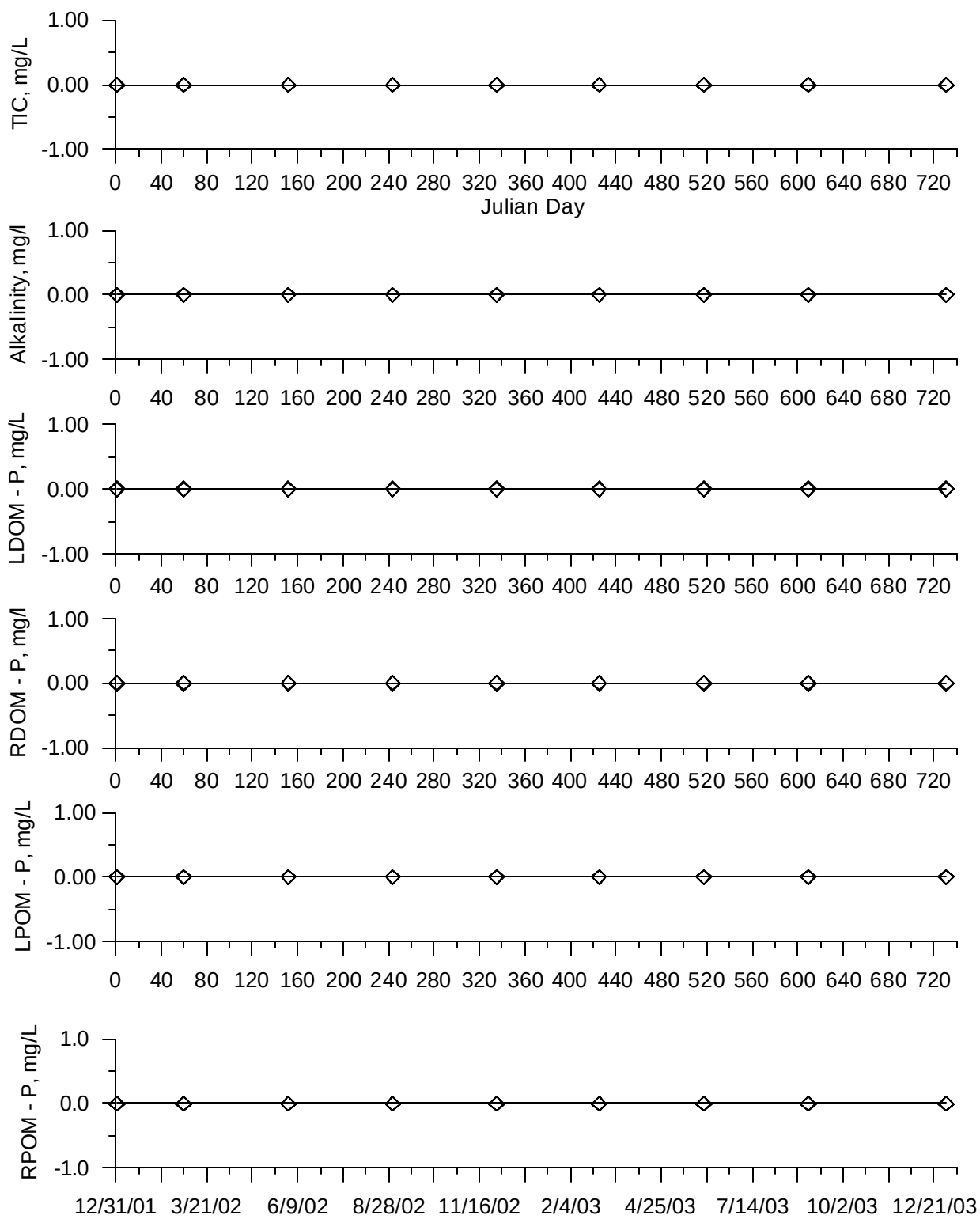


Figure 79. Constituent concentrations for precipitation (continued).

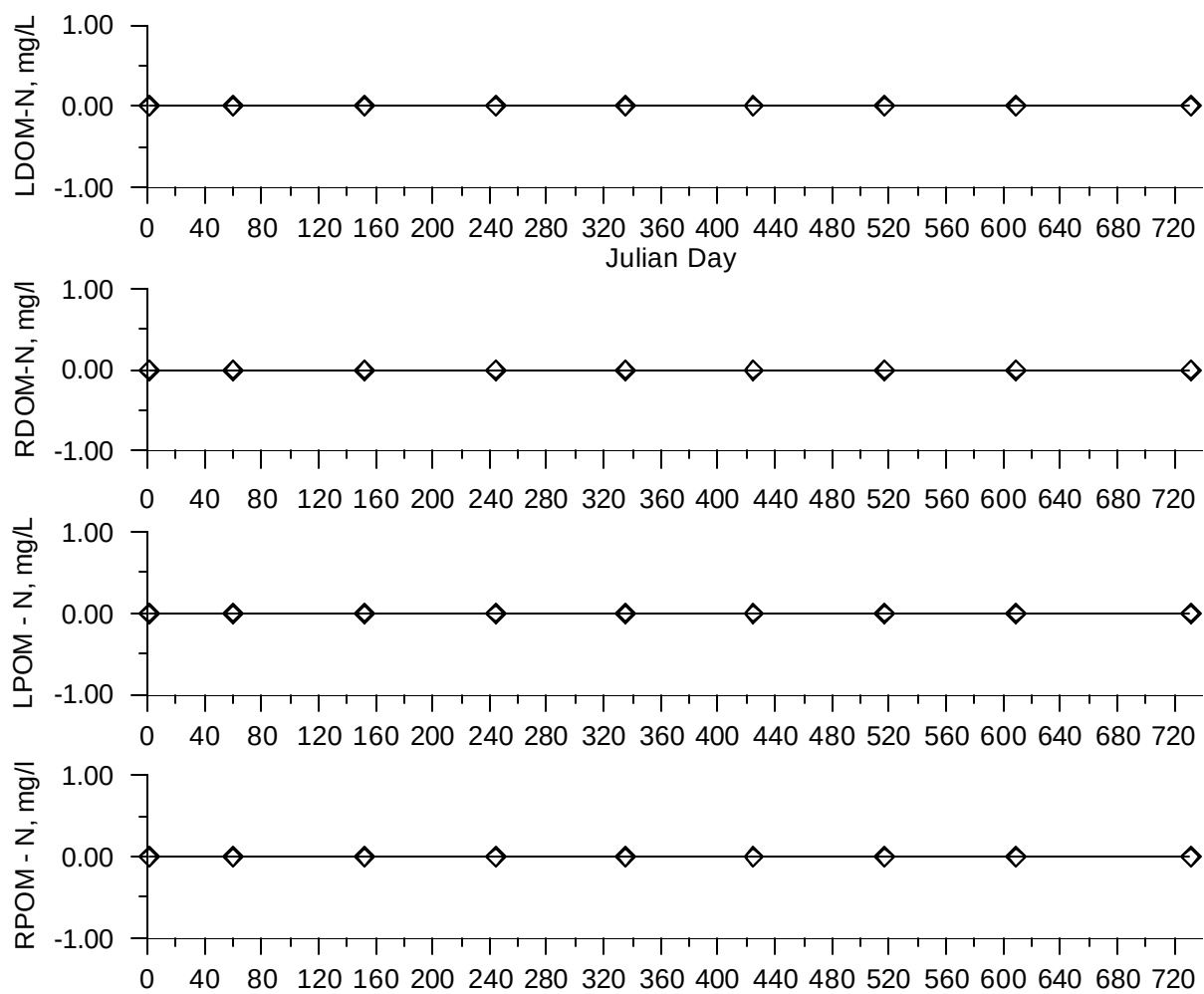


Figure 80. Constituent concentrations for precipitation (continued).

Appendix B: Model Control File

W2 Model Version 3.2

TITLE CTITLE.....
 Version 3.2 Whatcom L. Model
 WB 1 : Basin III
 WB 2 : Basin I & II

Jing Liu & Bob Cusinamo, Department of Ecology
 Chris Berger and Scott Wells, Portland State University

GRID	NWB 2	NBR 5	IMX 68	KMX 105					
IN/OUTFL	NTR 30	NST 1	NIW 0	NWD 3	NGT 0	NSP 0	NPI 0	NPU 0	
CONSTITU	NGC 5	NSS 1	NAL 4	NEP 1	NBOD 1	VSTCH ON			
MISCELL	NDAY 100								
TIME CON	TMSTRT 45.6000	TMEND 730.600	YEAR 2002						
DLT CON	NDT 3	DLTMIN 0.10000							
DLT DATE	DLTD 45.6000	DLTD 370.0	DLTD 390.0	DLTD	DLTD	DLTD	DLTD	DLTD	DLTD
DLT MAX	DLTMAX 300.000	DLTMAX 300.00	DLTMAX 300.00	DLTMAX	DLTMAX	DLTMAX	DLTMAX	DLTMAX	DLTMAX
DLT FRN	DLTF 0.20000	DLTF 0.2	DLTF 0.2	DLTF	DLTF	DLTF	DLTF	DLTF	DLTF
DLT LIM1	VISC	CELC							
WB 1	ON	ON							
WB 2	ON	ON							
BRANCH G	US	DS	UHS	DHS	UQB	DQB	NLMIN	SLOPE	
BR1	2	31	0	48	0	0	1	0.00000	
BR2	34	40	0	11	0	0	1	0.00000	
BR3	43	45	0	29	0	0	1	0.00000	
BR4	48	63	31	0	0	0	1	0.00000	
BR5	66	67	0	61	0	0	1	0.00000	
LOCATION	LAT	LONG	EBOT	BS	BE	JBDN			
WB 1	48.6921	122.300	-6.0000	1	3	1			
WB 2	48.6921	122.300	-6.0000	4	5	4			

INIT CND	T2I	ICEI	WTYPEC
WB 1	6.60000	0.00000	FRESH
WB 2	-2.00000	0.00000	FRESH

CALCULAT	VBC	EBC	MBC	PQC	EVC	PRC
WB 1	ON	ON	ON	ON	ON	ON
WB 2	ON	ON	ON	ON	ON	ON

DEAD SEA	WINDC	QINC	QOUTC	HEATC
WB 1	ON	ON	ON	ON
WB 2	ON	ON	ON	ON

INTERPOL	QINIC	DTRIC	HDIC
BR1	ON	OFF	ON
BR2	ON	OFF	ON
BR3	ON	OFF	ON
BR4	ON	OFF	ON
BR5	ON	OFF	ON

HEAT EXCH	SLHTC	SROC	RHEVAP	METIC	FETCHC	AFW	BFW	CFW	WINDH
WB 1	TERM	ON	OFF	ON	OFF	9.20000	0.46000	2.00000	2.27000
WB 2	TERM	ON	OFF	ON	OFF	9.20000	0.46000	2.00000	2.27000

ICE COVE	ICEC	SLICEC	ALBEDO	HWICE	BICE	GICE	ICEMIN	ICET2
WB 1	OFF	DETAIL	0.25000	10.0000	0.60000	0.07000	0.05000	3.00000
WB 2	OFF	DETAIL	0.25000	10.0000	0.60000	0.07000	0.05000	3.00000

TRANSPOR	SLTRC	THETA
WB 1	ULTIMATE	0.55000
WB 2	ULTIMATE	0.55000

HYD COEF	AX	DX	CBHE	TSED	FI	TSEDF	FRICC
WB 1	1.00000	1.00000	7E-08	11.5000	0.01000	1.00000	MANN
WB 2	1.00000	1.00000	7E-08	11.5000	0.01000	1.00000	MANN

EDDY VISC	AZC	AZSLC	AZMAX	PHISET
WB 1	W2N	IMP	1.00000	0.0
WB 2	W2N	IMP	1.00000	0.0

N STRUC	NSTR
BR1	0
BR2	0
BR3	0
BR4	1
BR5	0

STR INT	STRIC	STRIC	STRIC	STRIC	STRIC	STRIC	STRIC	STRIC	STRIC
BR 1									
BR 2									
BR 3									
BR 4	ON								
BR 5									

STR TOP	KTSTR	KTSTR	KTSTR	KTSTR	KTSTR	KTSTR	KTSTR	KTSTR	KTSTR
BR1									
BR2									
BR3									
BR4	2								

BR5

STR BOT	KBSTR	KBSTR	KBSTR	KBSTR	KBSTR	KBSTR	KBSTR	KBSTR	KBSTR	KBSTR
BR1										
BR2										
BR3										
BR4	55									
BR5										

STR SINK	SINKC	SINKC	SINKC	SINKC	SINKC	SINKC	SINKC	SINKC	SINKC	SINKC
BR1										
BR2										
BR3										
BR4	POINT									
BR5										

STR ELEV	ESTR	ESTR	ESTR	ESTR	ESTR	ESTR	ESTR	ESTR	ESTR	ESTR
BR1										
BR2										
BR3										
BR4	94.5000									
BR5										

STR WIDT	WSTR	WSTR	WSTR	WSTR	WSTR	WSTR	WSTR	WSTR	WSTR	WSTR
BR1										
BR2										
BR3										
BR4	0.00000									
BR5										

PIPES	IUPI	IDPI	EUPI	EDPI	WPI	DLXPI	FPI	FMINPI	WTHLC
-------	------	------	------	------	-----	-------	-----	--------	-------

PIPE UP	PUPIC	ETUPI	EBUPI	KTUPI	KBUPI
---------	-------	-------	-------	-------	-------

PIPE DOWN	PDPIC	ETDPI	EBDPI	KTDPI	KBDPI
-----------	-------	-------	-------	-------	-------

SPILLWAY	IUSP	IDSP	ESP	A1SP	B1SP	A2SP	B2SP	WTHLC
----------	------	------	-----	------	------	------	------	-------

SPILL UP	PUSPC	ETUSP	EBUSP	KTUSP	KBUSP
----------	-------	-------	-------	-------	-------

SPILL DOWN	PDSPC	ETUSP	EBUSP	KTDSP	KBDSP
------------	-------	-------	-------	-------	-------

SPILL GAS	GASSPC	EQSP	AGASSP	BGASSP	CGASSP
-----------	--------	------	--------	--------	--------

GATES WTHLC	IUGT	IDGT	EGT	A1GT	B1GT	G1GT	A2GT	B2GT	G2GT
----------------	------	------	-----	------	------	------	------	------	------

GATE WEIR	GTA1	GTB1	GTA2	GTB2	DYNVAR
-----------	------	------	------	------	--------

GATE UP	PUGTC	ETUGT	EBUGT	KTUGT	KBUGT
---------	-------	-------	-------	-------	-------

GATE DOWN	PDGTC	ETDGT	EBDGT	KTDGT	KBDGT					
GATE GAS	GASGTC	EQGT	AGASGT	BGASGT	CGASGT					
PUMPS 1	IUPU	IDPU	EPU	STRTPU	ENDPU	EONPU	EOFFPU	QPU	WTHLC	
PUMPS 2	PPUC	ETPU	EBPU	KTPU	KBPU					
WEIR SEG	IWR	IWR	IWR	IWR	IWR	IWR	IWR	IWR	IWR	
WEIR TOP	KTWR	KTWR	KTWR	KTWR	KTWR	KTWR	KTWR	KTWR	KTWR	
WEIR BOT	KBWR	KBWR	KBWR	KBWR	KBWR	KBWR	KBWR	KBWR	KBWR	
WD INT	WDIC ON	WDIC ON	WDIC ON	WDIC	WDIC	WDIC	WDIC	WDIC	WDIC	
WD SEG	IWD 17	IWD 54	IWD 63	IWD	IWD	IWD	IWD	IWD	IWD	
WD ELEV	EWD 74.5000	EWD 83.5000	EWD 94.5000	EWD	EWD	EWD	EWD	EWD	EWD	
WD TOP	KTWD 2	KTWD 2	KTWD 2	KTWD	KTWD	KTWD	KTWD	KTWD	KTWD	
WD BOT	KBWD 74	KBWD 67	KBWD 61	KBWD	KBWD	KBWD	KBWD	KBWD	KBWD	
TRIB PLA	PTRC DISTR DISTR DISTR DISTR	PTRC DENSITY DISTR DISTR DISTR	PTRC DISTR DISTR DISTR DISTR	PTRC DISTR DISTR DISTR	PTRC DISTR DISTR DISTR	PTRC DISTR DISTR DISTR	PTRC DISTR DISTR DISTR	PTRC DISTR DISTR DISTR	PTRC DISTR DISTR DISTR	
TRIB INT	TRIC OFF OFF OFF OFF	TRIC OFF OFF OFF OFF	TRIC OFF OFF OFF OFF	TRIC OFF OFF OFF	TRIC OFF OFF OFF	TRIC OFF OFF OFF	TRIC OFF OFF OFF	TRIC OFF OFF OFF	TRIC OFF OFF OFF	
TRIB SEG	ITR 29 20 11 20	ITR 45 60 2 24	ITR 66 62 2 28	ITR 60 57 4	ITR 66 49 2	ITR 28 59 4	ITR 63 23 8	ITR 55 19 12	ITR 25 5 16	
TRIB TOP	ELTRT 0.00000 0.00000	ELTRT 0.00000 0.00000	ELTRT 0.00000 0.00000	ELTRT 0.00000 0.00000	ELTRT 0.00000 0.00000	ELTRT 0.00000 0.00000	ELTRT 0.00000 0.00000	ELTRT 0.00000 0.00000	ELTRT 0.00000 0.00000	

0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000							

TRIB BOT	ELTRB	ELTRB	ELTRB	ELTRB	ELTRB	ELTRB	ELTRB	ELTRB	ELTRB
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	0.00000	0.00000	0.00000						

DST TRIB	DTRC	DTRC	DTRC	DTRC	DTRC	DTRC	DTRC	DTRC	DTRC
BR 1	ON								
BR 2	ON								
BR 3	ON								
BR 4	ON								
BR 5	ON								

PUMPBACK	JBG	KTG	KBG	JBP	KTP	KBP			
	0	0	0	0	0	0			

PRINTER	LJC								
	IV								

HYD PRIN	HPRWBC	HPRWBC	HPRWBC	HPRWBC	HPRWBC	HPRWBC	HPRWBC	HPRWBC	HPRWBC
NVIOL	ON	ON							
U	ON	ON							
W	ON	ON							
T	ON	ON							
RHO	OFF	OFF							
AZ	OFF	OFF							
SHEAR	OFF	OFF							
ST	OFF	OFF							
SB	OFF	OFF							
ADMX	OFF	OFF							
DM	OFF	OFF							
HDG	OFF	OFF							
ADMZ	OFF	OFF							
HPG	OFF	OFF							
GRAV	OFF	OFF							

SNP PRINT	SNPC	NSNP	NISNP						
WB 1	ON	3	9						
WB 2	ON	3	15						

SNP DATE	SNPD	SNPD	SNPD	SNPD	SNPD	SNPD	SNPD	SNPD	SNPD
WB 1	45.6000	53.6000	54.6000						
WB 2	45.6000	53.6000	54.6000						

SNP FREQ	SNPF	SNPF	SNPF	SNPF	SNPF	SNPF	SNPF	SNPF	SNPF
WB 1	1.00000	0.10000	3.00000						
WB 2	1.00000	0.10000	3.00000						

SNP SEG	ISNP	ISNP	ISNP	ISNP	ISNP	ISNP	ISNP	ISNP	ISNP
WB 1	2	5	11	15	20	24	25	26	31
WB 2	48	49	50	51	52	53	54	55	56
	60	61	62	63	66	67			

SCR PRINT	SCRC	NSCR							
WB 1	OFF	1							
WB 2	ON	1							

SCR DATE	SCRD	SCRD	SCRD	SCRD	SCRD	SCRD	SCRD	SCRD	SCRD
WB 1	1.00000								
WB 2	1.00000								

SCR FREQ	SCRF	SCRF	SCRF	SCRF	SCRF	SCRF	SCRF	SCRF	SCRF
WB 1	0.50000								
WB 2	0.50000								

PRF PLOT	PRFC	NPRF	NIPRF						
WB 1	ON	55	5						
WB 2	ON	55	7						

PRF DATE	PRFD	PRFD	PRFD	PRFD	PRFD	PRFD	PRFD	PRFD	PRFD
WB 1	43.4000	45.4000	92.4000	94.4000	127.400	129.400	155.400	165.400	183.400
	191.400	196.400	218.400	220.400	222.400	225.400	246.400	248.400	259.400
	281.400	283.400	309.400	311.400	317.400	337.400	339.400	400.400	402.400
	456.400	458.400	491.400	493.400	512.400	519.400	521.400	526.400	554.400
	556.400	561.400	575.600	582.400	584.400	591.400	596.400	603.600	610.400
	612.400	617.600	631.400	645.400	647.400	673.400	675.400	703.400	708.400
	711.400								
WB 2	43.4000	45.4000	92.4000	94.4000	127.400	129.400	155.400	165.400	183.400
	191.400	196.400	218.400	220.400	222.400	225.400	246.400	248.400	259.400
	281.400	283.400	309.400	311.400	317.400	337.400	339.400	400.400	402.400
	456.400	458.400	491.400	493.400	512.400	519.400	521.400	526.400	554.400
	556.400	561.400	575.600	582.400	584.400	591.400	596.400	603.600	610.400
	612.400	617.600	631.400	645.400	647.400	673.400	675.400	703.400	708.400
	711.400								

PRF FREQ	PRFF	PRFF	PRFF	PRFF	PRFF	PRFF	PRFF	PRFF	PRFF
WB 1	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000
	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000
	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000
	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000
	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000
	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000
	900.000								
WB 2	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000
	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000
	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000
	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000
	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000
	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000
	900.000								

PRF SEG	IPRF	IPRF	IPRF	IPRF	IPRF	IPRF	IPRF	IPRF	IPRF
WB 1	11	24	25	26	31				
WB 2	48	52	54	56	60	61	62		

SPR PLOT	SPRC	NSPR	NISPR						
WB 1	OFF	59	5						
WB 2	OFF	59	6						

SPR DATE	SPRD	SPRD	SPRD	SPRD	SPRD	SPRD	SPRD	SPRD	SPRD
WB 1	43.6000	45.6000	92.6000	94.6000	127.600	129.600	155.600	165.600	183.600
	191.600	196.540	196.660	218.600	220.600	222.600	225.490	225.580	246.600
	248.600	259.470	259.530	281.600	283.600	309.600	311.600	317.600	337.600
	339.600	400.600	402.600	456.600	458.600	491.600	493.600	512.490	512.550
	519.600	521.600	526.470	526.540	554.600	556.600	561.470	561.530	582.600

	584.600	596.460	596.600	610.600	612.600	631.470	631.540	645.600	647.600
	673.600	675.600	703.600	708.600	711.600				
WB 2	43.6000	45.6000	92.6000	94.6000	127.600	129.600	155.600	165.600	183.600
	191.600	196.540	196.660	218.600	220.600	222.600	225.490	225.580	246.600
	248.600	259.470	259.530	281.600	283.600	309.600	311.600	317.600	337.600
	339.600	400.600	402.600	456.600	458.600	491.600	493.600	512.490	512.550
	519.600	521.600	526.470	526.540	554.600	556.600	561.470	561.530	582.600
	584.600	596.460	596.600	610.600	612.600	631.470	631.540	645.600	647.600
	673.600	675.600	703.600	708.600	711.600				
SPR FREQ	SPRF	SPRF	SPRF	SPRF	SPRF	SPRF	SPRF	SPRF	SPRF
WB 1	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000
	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000
	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000
	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000
	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000
	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000
	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000
WB 2	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000
	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000
	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000
	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000
	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000
	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000
	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000	900.000
SPR SEG	ISPR	ISPR	ISPR	ISPR	ISPR	ISPR	ISPR	ISPR	ISPR
WB 1	11	24	25	26	31				
WB 2	48	52	56	60	61	62			
VPL PLOT	VPLC	NVPL							
WB 1	OFF	1							
WB 2	OFF	1							
VPL DATE	VPLD	VPLD	VPLD	VPLD	VPLD	VPLD	VPLD	VPLD	VPLD
WB 1	63.5000								
WB 2	63.5000								
VPL FREQ	VPLF	VPLF	VPLF	VPLF	VPLF	VPLF	VPLF	VPLF	VPLF
WB 1	1.00000								
WB 2	1.00000								
CPL PLOT	CPLC	NCPL							
WB 1	ON	1							
WB 2	ON	1							
CPL DATE	CPLD	CPLD	CPLD	CPLD	CPLD	CPLD	CPLD	CPLD	CPLD
WB 1	45.5000								
WB 2	45.5000								
CPL FREQ	CPLF	CPLF	CPLF	CPLF	CPLF	CPLF	CPLF	CPLF	CPLF
WB 1	1.00000								
WB 2	1.00000								
FLUXES	FLXC	NFLX							
WB 1	ON	1							
WB 2	ON	1							
FLX DATE	FLXD	FLXD	FLXD	FLXD	FLXD	FLXD	FLXD	FLXD	FLXD

WB 1	45.6								
WB 2	45.6								
FLX FREQ	FLXF	FLXF	FLXF	FLXF	FLXF	FLXF	FLXF	FLXF	FLXF
WB 1	30.0								
WB 2	30.0								
TSR PLOT	TSRC ON	NISR 1	NISR 5						
TSR DATE	TSRD 45.0000	TSRD	TSRD	TSRD	TSRD	TSRD	TSRD	TSRD	TSRD
TSR FREQ	TSRF 0.10000	TSRF	TSRF	TSRF	TSRF	TSRF	TSRF	TSRF	TSRF
TSR SEG	ITSR 2	ITSR 54	ITSR 61	ITSR 63	ITSR 63	ITSR	ITSR	ITSR	ITSR
TSR LAYE	ETSR 1.00000	ETSR 3.00000	ETSR 0.00000	ETSR 0.00000	ETSR 0.000	ETSR	ETSR	ETSR	ETSR
WITH OUT	WDOC OFF	NWDO 1	NIWDO 3						
WITH DAT	WDOD 1.00000	WDOD	WDOD	WDOD	WDOD	WDOD	WDOD	WDOD	WDOD
WITH FRE	WDOF 1.00000	WDOF	WDOF	WDOF	WDOF	WDOF	WDOF	WDOF	WDOF
WITH SEG	IWDO 4	IWDO 6	IWDO 15	IWDO	IWDO	IWDO	IWDO	IWDO	IWDO
RESTART	RSOC ON	NRSO 1	RSIC OFF						
RSO DATE	RSOD 45.600	RSOD	RSOD	RSOD	RSOD	RSOD	RSOD	RSOD	RSOD
RSO FREQ	RSOF 30.000	RSOF	RSOF	RSOF	RSOF	RSOF	RSOF	RSOF	RSOF
CST COMP	CCC ON	LIMC ON	CUF 10						
CST ACTIVE	CAC								
TDS	OFF								
Gen1	OFF								
Gen2	OFF								
Gen3	OFF								
Gen4	OFF								
Gen5	ON								
ISS1	ON								
P04	ON								
NH4	ON								
N03	ON								
DSI	OFF								
PSI	OFF								

FE	OFF
LDOM	ON
RDOM	ON
LPOM	ON
RPOM	ON
BOD1	OFF
ALG1	ON
ALG2	ON
ALG3	ON
ALG4	OFF
DO	ON
TIC	ON
ALK	ON

CST	DERI	CDWBC	CDWBC	CDWBC	CDWBC	CDWBC	CDWBC	CDWBC	CDWBC	CDWBC
DOC		ON	ON							
POC		OFF	OFF							
TOC		ON	ON							
DON		OFF	OFF							
PON		OFF	OFF							
TON		OFF	OFF							
TKN		ON	ON							
TN		ON	ON							
DOP		OFF	OFF							
POP		OFF	OFF							
TOP		OFF	OFF							
TP		ON	ON							
APR		OFF	OFF							
CHLA		ON	ON							
ATOT		OFF	OFF							
%DO		OFF	OFF							
TSS		ON	ON							
TISS		OFF	OFF							
CBOD		OFF	OFF							
pH		ON	ON							
CO2		OFF	OFF							
HCO3		OFF	OFF							
CO3		OFF	OFF							

CST	FLUX	CFWBC	CFWBC	CFWBC	CFWBC	CFWBC	CFWBC	CFWBC	CFWBC	CFWBC
TISSIN		OFF	OFF							
TISSOUT		OFF	OFF							
P04AR		OFF	OFF							
P04AG		OFF	OFF							
P04AP		OFF	OFF							
P04ER		OFF	OFF							
P04EG		OFF	OFF							
P04EP		OFF	OFF							
P04POM		OFF	OFF							
P04DOM		OFF	OFF							
P04OM		OFF	OFF							
P04SED		OFF	OFF							
P04SOD		OFF	OFF							
P04SET		OFF	OFF							
NH4NITR		OFF	OFF							
NH4AR		OFF	OFF							
NH4AG		OFF	OFF							
NH4AP		OFF	OFF							
NH4ER		OFF	OFF							

NH4EG	OFF	OFF
NH4EP	OFF	OFF
NH4POM	OFF	OFF
NH4DOM	OFF	OFF
NH4OM	OFF	OFF
NH4SED	OFF	OFF
NH4SOD	OFF	OFF
N03DEN	OFF	OFF
N03AG	OFF	OFF
N03EG	OFF	OFF
N03SED	OFF	OFF
DSIAG	OFF	OFF
DSIEG	OFF	OFF
DSIPIS	OFF	OFF
DSISED	OFF	OFF
DSISOD	OFF	OFF
DSISET	OFF	OFF
PSIAM	OFF	OFF
PSINET	OFF	OFF
PSIDK	OFF	OFF
FESET	OFF	OFF
FESED	OFF	OFF
LDOMDK	OFF	OFF
LRDOM	OFF	OFF
RDOMDK	OFF	OFF
LDOMAP	OFF	OFF
LDOMEF	OFF	OFF
LPOMDK	OFF	OFF
LRPOM	OFF	OFF
RPOMDK	OFF	OFF
LPOMAP	OFF	OFF
LPOMEF	OFF	OFF
LPOMSET	OFF	OFF
RPOMSET	OFF	OFF
CBODDK	OFF	OFF
DOAP	OFF	OFF
DOAR	OFF	OFF
DOEP	OFF	OFF
DOER	OFF	OFF
DOPOM	OFF	OFF
DODOM	OFF	OFF
DOOM	OFF	OFF
DONITR	OFF	OFF
DOCBOD	OFF	OFF
DOREAR	OFF	OFF
DOSED	OFF	OFF
DOSOD	OFF	OFF
TICAG	OFF	OFF
TICEG	OFF	OFF
SEDDK	OFF	OFF
SEDAS	OFF	OFF
SEDLPOM	OFF	OFF
SEDSET	OFF	OFF
SODDK	OFF	OFF

CST ICON	C2IWB	C2IWB	C2IWB	C2IWB	C2IWB	C2IWB	C2IWB	C2IWB	C2IWB
TDS	0.00000	0.00000							
Gen1	0.00000	0.00000							
Gen2	0.00000	0.00000							

Gen3	0.00000	0.00000
Gen4	0.00000	0.00000
Gen5	0.00000	0.00000
ISS1	0.00000	0.00000
P04	0.00050	0.00150
NH4	0.00300	0.00300
NO3	0.40000	0.40000
DSI	0.00000	0.00000
PSI	0.00000	0.00000
FE	0.00000	0.00000
LDOM	0.10000	0.10000
RDOM	0.40000	0.40000
LPOM	0.20000	0.20000
RPOM	0.50000	0.50000
BOD1	0.00000	0.00000
ALG1	0.05000	0.05000
ALG2	0.01000	0.01000
ALG3	0.00000	0.00000
ALG4	0.00000	0.00000
DO	13.0000	13.0000
TIC	5.03000	4.77000
ALK	18.0000	18.5000

CST	PRIN	CPRWBC	CPRWBC	CPRWBC	CPRWBC	CPRWBC	CPRWBC	CPRWBC	CPRWBC	CPRWBC	CPRWBC
TDS		OFF	OFF								
Gen1		OFF	OFF								
Gen2		OFF	OFF								
Gen3		OFF	OFF								
Gen4		OFF	OFF								
Gen5		OFF	OFF								
ISS1		ON	ON								
P04		ON	ON								
NH4		ON	ON								
NO3		ON	ON								
DSI		OFF	OFF								
PSI		OFF	OFF								
FE		OFF	OFF								
LDOM		ON	ON								
RDOM		ON	ON								
LPOM		ON	ON								
RPOM		ON	ON								
BOD1		ON	ON								
ALG1		ON	ON								
ALG2		ON	ON								
ALG3		ON	ON								
ALG4		ON	ON								
DO		ON	ON								
TIC		ON	ON								
ALK		ON	ON								

CIN	CON	CINBRC	CINBRC	CINBRC	CINBRC	CINBRC	CINBRC	CINBRC	CINBRC	CINBRC	CINBRC
TDS		ON	ON	ON	ON	ON					
Gen1		ON	ON	ON	ON	ON					
Gen2		OFF	OFF	OFF	OFF	OFF					
Gen3		ON	ON	ON	ON	ON					
Gen4		ON	ON	ON	ON	ON					
Gen5		ON	ON	ON	ON	ON					
ISS1		ON	ON	ON	ON	ON					
P04		ON	ON	ON	ON	ON					

NH4	ON	ON	ON	ON	ON
NO3	ON	ON	ON	ON	ON
DSI	OFF	OFF	OFF	OFF	OFF
PSI	OFF	OFF	OFF	OFF	OFF
FE	OFF	OFF	OFF	OFF	OFF
LDOM	ON	ON	ON	ON	ON
RDOM	ON	ON	ON	ON	ON
LPOM	ON	ON	ON	ON	ON
RPOM	ON	ON	ON	ON	ON
BOD1	OFF	OFF	OFF	OFF	OFF
ALG1	ON	ON	ON	ON	ON
ALG2	ON	ON	ON	ON	ON
ALG3	ON	ON	ON	ON	ON
ALG4	ON	ON	ON	ON	ON
DO	ON	ON	ON	ON	ON
TIC	ON	ON	ON	ON	ON
ALK	ON	ON	ON	ON	ON

CTR	CON	CTRTRC	CTRTRC	CTRTRC	CTRTRC	CTRTRC	CTRTRC	CTRTRC	CTRTRC	CTRTRC
TDS		ON	ON	ON	ON	ON	ON	ON	ON	ON
		ON	ON	ON	ON	ON	ON	ON	ON	ON
		ON	ON	ON	ON	ON	ON	ON	ON	ON
		ON	ON	ON						
Gen1		ON	ON	ON	ON	ON	ON	ON	ON	ON
		ON	ON	ON	ON	ON	ON	ON	ON	ON
		ON	ON	ON	ON	ON	ON	ON	ON	ON
		ON	ON	ON						
Gen2		OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
		OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
		OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
		OFF	OFF	OFF						
Gen3		ON	ON	ON	ON	ON	ON	ON	ON	ON
		ON	ON	ON	ON	ON	ON	ON	ON	ON
		ON	ON	ON	ON	ON	ON	ON	ON	ON
		ON	ON	ON						
Gen4		ON	ON	ON	ON	ON	ON	ON	ON	ON
		ON	ON	ON	ON	ON	ON	ON	ON	ON
		ON	ON	ON	ON	ON	ON	ON	ON	ON
		ON	ON	ON						
Gen5		ON	ON	ON	ON	ON	ON	ON	ON	ON
		ON	ON	ON	ON	ON	ON	ON	ON	ON
		ON	ON	ON	ON	ON	ON	ON	ON	ON
		ON	ON	ON						
ISS1		ON	ON	ON	ON	ON	ON	ON	ON	ON
		ON	ON	ON	ON	ON	ON	ON	ON	ON
		ON	ON	ON	ON	ON	ON	ON	ON	ON
		ON	ON	ON						
P04		ON	ON	ON	ON	ON	ON	ON	ON	ON
		ON	ON	ON	ON	ON	ON	ON	ON	ON
		ON	ON	ON	ON	ON	ON	ON	ON	ON
		ON	ON	ON						
NH4		ON	ON	ON	ON	ON	ON	ON	ON	ON
		ON	ON	ON	ON	ON	ON	ON	ON	ON
		ON	ON	ON	ON	ON	ON	ON	ON	ON
		ON	ON	ON						
NO3		ON	ON	ON	ON	ON	ON	ON	ON	ON
		ON	ON	ON	ON	ON	ON	ON	ON	ON
		ON	ON	ON	ON	ON	ON	ON	ON	ON
		ON	ON	ON						

DSI	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	OFF	OFF	OFF						
PSI	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	OFF	OFF	OFF						
FE	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	OFF	OFF	OFF						
LDOM	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON						
RDOM	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON						
LPOM	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON						
RPOM	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON						
BOD1	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	OFF	OFF	OFF						
ALG1	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON						
ALG2	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON						
ALG3	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON						
ALG4	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON						
DO	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON						
TIC	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON						
ALK	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON	ON	ON	ON	ON	ON	ON
	ON	ON	ON	ON	ON	ON	ON	ON	ON

	ON	ON	ON						
CDT CON	CDTBRC	CDTBRC	CDTBRC	CDTBRC	CDTBRC	CDTBRC	CDTBRC	CDTBRC	CDTBRC
TDS	ON	ON	ON	ON	ON				
Gen1	ON	ON	ON	ON	ON				
Gen2	OFF	OFF	OFF	OFF	OFF				
Gen3	ON	ON	ON	ON	ON				
Gen4	ON	ON	ON	ON	ON				
Gen5	ON	ON	ON	ON	ON				
ISS1	ON	ON	ON	ON	ON				
P04	ON	ON	ON	ON	ON				
NH4	ON	ON	ON	ON	ON				
N03	ON	ON	ON	ON	ON				
DSI	OFF	OFF	OFF	OFF	OFF				
PSI	OFF	OFF	OFF	OFF	OFF				
FE	OFF	OFF	OFF	OFF	OFF				
LDOM	ON	ON	ON	ON	ON				
RDOM	ON	ON	ON	ON	ON				
LPOM	ON	ON	ON	ON	ON				
RPOM	ON	ON	ON	ON	ON				
BOD1	OFF	OFF	OFF	OFF	OFF				
ALG1	ON	ON	ON	ON	ON				
ALG2	ON	ON	ON	ON	ON				
ALG3	ON	ON	ON	ON	ON				
ALG4	ON	ON	ON	ON	ON				
DO	ON	ON	ON	ON	ON				
TIC	ON	ON	ON	ON	ON				
ALK	ON	ON	ON	ON	ON				

CPR CON	CPRBRC	CPRBRC	CPRBRC	CPRBRC	CPRBRC	CPRBRC	CPRBRC	CPRBRC	CPRBRC
TDS	ON	ON	ON	ON	ON				
Gen1	ON	ON	ON	ON	ON				
Gen2	OFF	OFF	OFF	OFF	OFF				
Gen3	ON	ON	ON	ON	ON				
Gen4	ON	ON	ON	ON	ON				
Gen5	ON	ON	ON	ON	ON				
ISS1	ON	ON	ON	ON	ON				
P04	ON	ON	ON	ON	ON				
NH4	ON	ON	ON	ON	ON				
N03	ON	ON	ON	ON	ON				
DSI	OFF	OFF	OFF	OFF	OFF				
PSI	OFF	OFF	OFF	OFF	OFF				
FE	OFF	OFF	OFF	OFF	OFF				
LDOM	ON	ON	ON	ON	ON				
RDOM	ON	ON	ON	ON	ON				
LPOM	ON	ON	ON	ON	ON				
RPOM	ON	ON	ON	ON	ON				
BOD1	OFF	OFF	OFF	OFF	OFF				
ALG1	ON	ON	ON	ON	ON				
ALG2	ON	ON	ON	ON	ON				
ALG3	ON	ON	ON	ON	ON				
ALG4	ON	ON	ON	ON	ON				
DO	ON	ON	ON	ON	ON				
TIC	ON	ON	ON	ON	ON				
ALK	ON	ON	ON	ON	ON				

EX COEF	EXH2O	EXSS	EXOM	BETA	EXC	EXIC
WB 1	0.25000	0.10000	0.10000	0.45000	OFF	OFF
WB 2	0.28000	0.10000	0.08000	0.45000	OFF	OFF

ALG EX	EXA	EXA	EXA	EXA	EXA	EXA
	0.10000	0.10000	0.10000	0.10000		

GENERIC	CGQ10	CG0DK	CG1DK	CGS
CG 1	0.00000	0.00000	0.00000	0.00000
CG 2	0.00000	0.00000	0.00000	0.00000
CG 3	0.00000	-1.0000	0.00000	0.00000
CG 4	1.04000	0.00000	0.50000	0.00000
CG 5	0.00000	0.00000	0.00000	0.00000

S SOLIDS	SSS	SEDRC	TAUCR
SS# 1	1.50000	OFF	.15E-04

ALGAL RATE	AG	AR	AE	AM	AS	AHSP	AHSN	AHSSI	ASAT
ALG1	1.65000	0.04000	0.04000	0.04000	0.10000	0.00200	0.01400	0.00000	50.0000
ALG2	1.90000	0.04000	0.04000	0.04000	0.10000	0.00250	0.01400	0.00000	75.0000
ALG3	2.00000	0.04000	0.04000	0.04000	0.01000	0.00200	0.01400	0.00000	130.000
ALG4	0.00000	0.10000	0.04000	0.10000	0.10000	0.00200	0.01400	0.00000	30.0000

ALGAL TEMP	AT1	AT2	AT3	AT4	AK1	AK2	AK3	AK4
ALG1	1.00000	3.0000	12.0000	25.0000	0.50000	0.99000	0.99000	0.10000
ALG2	8.00000	12.0000	16.0000	30.0000	0.10000	0.60000	0.99000	0.10000
ALG3	8.00000	16.0000	20.0000	30.0000	0.10000	0.60000	0.99000	0.10000
ALG1	1.00000	3.0000	12.0000	25.0000	0.50000	0.99000	0.99000	0.10000

ALG STOI	ALGP	ALGN	ALGC	ALGSI	ACHLA	ALPOM	ANEQN	ANPR
ALG1	0.00300	0.06000	0.60000	0.00000	150.000	0.80000	1	0.00100
ALG2	0.00250	0.06000	0.60000	0.00000	90.000	0.80000	1	0.00100
ALG3	0.00200	0.06000	0.60000	0.00000	120.000	0.80000	1	0.00100
ALG1	0.00500	0.08000	0.60000	0.00000	130.000	0.80000	1	0.00100

EPIPHYTE	EPIC	EPIC	EPIC	EPIC	EPIC	EPIC	EPIC	EPIC	EPIC
EPI1	OFF	OFF							

EPI PRIN	EPRC	EPRC	EPRC	EPRC	EPRC	EPRC	EPRC	EPRC	EPRC
EPI1	OFF	OFF							

EPI INIT	EPICI	EPICI	EPICI	EPICI	EPICI	EPICI	EPICI	EPICI	EPICI
EPI1	20.0000	20.0000							

EPI RATE	EG	ER	EE	EM	EB	EHSP	EHSN	EHSSI
EPI1	1.50000	0.04000	0.04000	0.10000	0.00100	0.00300	0.01400	0.00000

EPI HALF	ESAT	EHS	ENEQN	ENPR
EPI1	150.000	15.0000	2	0.00100

EPI TEMP	ET1	ET2	ET3	ET4	EK1	EK2	EK3	EK4
EPI1	1.00000	3.00000	20.0000	30.0000	0.10000	0.99000	0.99000	0.10000

EPI STOI	EP	EN	EC	ESI	ECHLA	EPOM
EPI1	0.00500	0.08000	0.45000	0.00000	65.0000	0.80000

DOM	LDOMDK	RDOMDK	LRDDK
WB 1	0.06000	0.00100	0.01000
WB 2	0.12000	0.00100	0.01000

POM	LPOMDK	RPOMDK	LRPDK	POMS
WB 1	0.02000	0.00100	0.01000	1.00000

WB 2	0.04000	0.00100	0.01000	0.50000
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OM STOIC	ORGP	ORGN	ORGC	ORGS
WB 1	0.00020	0.08000	0.45000	0.18000
WB 2	0.00400	0.08000	0.45000	0.18000

OM RATE	OMT1	OMT2	OMK1	OMK2
WB 1	2.00000	20.0000	0.40000	0.99000
WB 2	2.00000	20.0000	0.40000	0.99000

CBOD	KBOD	TBOD	RBOD
BOD 1	0.04180	1.01470	1.00000

CBOD STOIC	BODP	BODN	BODC
BOD 1	0.00500	0.08000	0.45000

PHOSPHOR	P04R	PARTP
WB 1	.10E-05	0.00000
WB 2	.50E-03	0.00000

AMMONIUM	NH4R	NH4DK
WB 1	0.04000	0.30000
WB 2	0.04000	0.30000

NH4 RATE	NH4T1	NH4T2	NH4K1	NH4K2
WB 1	5.00000	25.0000	0.10000	0.99000
WB 2	5.00000	25.0000	0.10000	0.99000

NITRATE	N03DK	N03S
WB 1	0.05000	0.10000
WB 2	0.05000	0.10000

N03 RATE	N03T1	N03T2	N03K1	N03K2
WB 1	5.00000	25.0000	0.10000	0.99000
WB 2	5.00000	25.0000	0.10000	0.99000

SILICA	DSIR	PSIS	PSIDK	PARTSI
WB 1	0.10000	0.00000	0.30000	0.20000
WB 2	0.10000	0.00000	0.30000	0.20000

IRON	FER	FES
WB 1	0.10000	0.00000
WB 2	0.10000	0.00000

SED C02	C02R
WB 1	0.70000
WB 2	0.40000

STOICH 1	02NH4	02OM
WB 1	4.57000	1.40000
WB 2	4.57000	1.40000

STOICH 2	02AR	02AG
ALG1	1.10000	1.80000
ALG2	1.10000	1.80000
ALG3	1.10000	1.80000
ALG4	1.10000	1.80000

STOICH 3	02ER	02EG
----------	------	------

EPI1 1.10000 1.40000

O2 LIMIT 02LIM
0.10000

SEDIMENT	SEDC	SEDPRC	SEDCI	SEDK	FSOD	FSED
WB 1	ON	ON-2.00000	0.00100	1.00000	1.00000	1.00000
WB 2	ON	ON-2.00000	0.00400	1.00000	1.00000	1.00000

SOD RATE	SODT1	SODT2	SODK1	SODK2
WB 1	5.00000	20.0000	0.10000	0.99000
WB 2	5.00000	20.0000	0.10000	0.99000

S DEMAND	SOD	SOD	SOD	SOD	SOD	SOD	SOD	SOD	SOD
	0.80000	0.80000	0.80000	0.80000	0.80000	0.80000	0.80000	0.80000	0.80000
	0.80000	0.80000	0.80000	0.80000	0.80000	0.80000	0.80000	0.80000	0.80000
	0.80000	0.80000	0.80000	0.80000	0.80000	0.80000	0.80000	0.80000	0.80000
	0.80000	0.80000	0.80000	0.80000	0.70000	0.70000	0.70000	0.70000	0.70000
	0.70000	0.70000	0.70000	0.70000	0.70000	0.70000	0.70000	0.70000	0.70000
	0.45000	0.45000	0.45000	0.45000	0.45000	0.45000	0.45000	0.45000	0.45000
	0.45000	0.45000	0.45000	0.60000	0.60000	0.60000	0.60000	0.60000	0.60000
	0.60000	0.60000	0.60000	0.60000	0.60000				

REAERATION	TYPE	EQN#	COEF1	COEF2	COEF3	COEF4
WB 1	LAKE	3	0.00000	0.00000	0.00000	0.00000
WB 2	LAKE	3	0.00000	0.00000	0.00000	0.00000

RSI FILE.....RSIFN.....
rsi.npt

QWD FILE.....QWDFN.....
qwd.npt

QGT FILE.....QGTFN.....
qgt.npt

WSC FILE.....WSCFN.....
wsc.npt

SHD FILE.....SHDFN.....
shade.npt

BTH FILE.....BTHFN.....
WB 1 bth_1_coarse.npt
WB 2 bth_2_coarsed.npt

MET FILE.....METFN.....
WB 1 met_1.npt
WB 2 met_2.npt

EXT FILE.....EXTFN.....
WB 1 ext_1.npt
WB 2 ext_2.npt

VPR FILE.....VPRFN.....
WB 1 vpr_1.npt
WB 2 vpr_2.npt

LPR FILE.....LPRFN.....

WB 1 lpr_1.npt
WB 2 lpr_2.npt

QIN FILE.....QINFN.....
BR1 qin_br1.npt
BR2 qin_br2.npt
BR3 qin_br3.npt
BR4 qin_br4.npt
BR5 qin_br5.npt

TIN FILE.....TINFN.....
BR1 tin_br1.npt
BR2 tin_br2.npt
BR3 tin_br3.npt
BR4 tin_br4.npt
BR5 tin_br5.npt

CIN FILE.....CINFN.....
BR1 cin_br1.npt
BR2 cin_br2.npt
BR3 cin_br3.npt
BR4 cin_br4.npt
BR5 cin_br5.npt

QOT FILE.....QOTFN.....
BR1 qot_br1.npt
BR2 qot_br2.npt
BR3 qot_br3.npt
BR4 whatcom-creek-q_hourly.npt
BR5 qot_br5.npt

QTR FILE.....QTRFN.....
TR1 qtr_aga.npt
TR2 qtr_car.npt
TR3 qtr_hil.npt
TR4 qtr_aca.npt
TR5 qtr_sil.npt
TR6 qtr_ols.npt
TR7 qtr_blo.npt
TR8 qtr_eag.npt
TR9 qtr_nsh.npt
TR10 qtr_smi.npt
TR11 qtr_don.npt
TR12 qtr_mil.npt
TR13 qtr_cab.npt
TR14 qtr_str.npt
TR15 qtr_euc.npt
TR16 qtr_sud.npt
TR17 qtr_aus.npt
TR18 qtr_blu.npt
TR19 qtr_bay.npt
TR20 qtr_and.npt
TR21 qtr_fir.npt
TR22 qtr_bra.npt
tr23 qtr_gw2.npt
tr24 qtr_gw4.npt
tr25 qtr_gw8.npt
tr26 qtr_gw12.npt
tr27 qtr_gw16.npt

tr28 qtr_gw20.npt
tr29 qtr_gw24.npt
tr30 qtr_gw28.npt

TTR FILE.....TTRFN.....

TR1 ttr_aga.npt
TR2 ttr_car.npt
TR3 ttr_hil.npt
TR4 ttr_aca.npt
TR5 ttr_sil.npt
TR6 ttr_ols.npt
TR7 ttr_blo.npt
TR8 ttr_eag.npt
TR9 ttr_nsh.npt
TR10 ttr_smi.npt
TR11 ttr_don.npt
TR12 ttr_mil.npt
TR13 ttr_cab.npt
TR14 ttr_str.npt
TR15 ttr_euc.npt
TR16 ttr_sud.npt
TR17 ttr_aus.npt
TR18 ttr_blu.npt
TR19 ttr_bay.npt
TR20 ttr_and.npt
TR21 ttr_fir.npt
TR22 ttr_bra.npt
tr23 ttr_gw2.npt
tr24 ttr_gw4.npt
tr25 ttr_gw8.npt
tr26 ttr_gw12.npt
tr27 ttr_gw16.npt
tr28 ttr_gw20.npt
tr29 ttr_gw24.npt
tr30 ttr_gw28.npt

CTR FILE.....CTRFN.....

TR1 ctr_aga.npt
TR2 ctr_car.npt
TR3 ctr_hil.npt
TR4 ctr_aca.npt
TR5 ctr_sil.npt
TR6 ctr_ols.npt
TR7 ctr_blo.npt
TR8 ctr_eag.npt
TR9 ctr_nsh.npt
TR10 ctr_smi.npt
TR11 ctr_don.npt
TR12 ctr_mil.npt
TR13 ctr_cab.npt
TR14 ctr_str.npt
TR15 ctr_euc.npt
TR16 ctr_sud.npt
TR17 ctr_aus.npt
TR18 ctr_blu.npt
TR19 ctr_bay.npt
TR20 ctr_and.npt
TR21 ctr_fir.npt
TR22 ctr_bra.npt

tr23 ctr_gw2.npt
tr24 ctr_gw4.npt
tr25 ctr_gw8.npt
tr26 ctr_gw12.npt
tr27 ctr_gw16.npt
tr28 ctr_gw20.npt
tr29 ctr_gw24.npt
tr30 ctr_gw28.npt

QDT FILE.....QDTFN..
BR1 qdt_br1.npt
BR2 qdt_br2.npt
BR3 qdt_br3.npt
BR4 qdt_br4.npt
BR5 qdt_br5.npt

TDT FILE.....TDTFN..
BR1 tdt_br1.npt
BR2 tdt_br2.npt
BR3 tdt_br3.npt
BR4 tdt_br4.npt
BR5 tdt_br5.npt

CDT FILE.....CDTFN..
BR1 cdt_br1.npt
BR2 cdt_br2.npt
BR3 cdt_br3.npt
BR4 cdt_br4.npt
BR5 cdt_br5.npt

PRE FILE.....PREFN..
BR1 pre_br1.npt
BR2 pre_br2.npt
BR3 pre_br3.npt
BR4 pre_br4.npt
BR5 pre_br5.npt

TPR FILE.....TPRFN..
BR1 tpr_br1.npt
BR2 tpr_br2.npt
BR3 tpr_br3.npt
BR4 tpr_br4.npt
BR5 tpr_br5.npt

CPR FILE.....CPRFN..
BR1 cpr_br1.npt
BR2 cpr_br2.npt
BR3 cpr_br3.npt
BR4 cpr_br4.npt
BR5 cpr_br5.npt

EUH FILE.....EUHFN..
BR1 euh_br1.npt
BR2 euh_br2.npt
BR3 euh_br3.npt
BR4 euh_br4.npt
BR5 euh_br5.npt

TUH FILE.....TUHFN..

```

BR1      tuh_br1.npt
BR2      tuh_br2.npt
BR3      tuh_br3.npt
BR4      tuh_br4.npt
BR5      tuh_br5.npt

CUH FILE.....CUHFN.....
BR1      cuh_br1.npt
BR2      cuh_br2.npt
BR3      cuh_br3.npt
BR4      cuh_br4.npt
BR5      cuh_br5.npt

EDH FILE.....EDHFN.....
BR1      edh_br1.npt
BR2      edh_br2.npt
BR3      edh_br3.npt
BR4      edh_br4.npt
BR5      edh_br5.npt

TDH FILE.....TDHFN.....
BR1      tdh_br1.npt
BR2      tdh_br2.npt
BR3      tdh_br3.npt
BR4      tdh_br4.npt
BR5      tdh_br5.npt

CDH FILE.....CDHFN.....
BR1      cdh_br1.npt
BR2      cdh_br2.npt
BR3      cdh_br3.npt
BR4      cdh_br4.npt
BR5      cdh_br5.npt

SNP FILE.....SNPFN.....
WB 1     snp1.opt
WB 2     snp2.opt

PRF FILE.....PRFFN.....
WB 1     prf1.opt
WB 2     prf2.opt

VPL FILE.....VPLFN.....
WB 1     vpl1.opt
WB 2     vpl2.opt

CPL FILE.....CPLFN.....
WB 1     cpl1.opt
WB 2     cpl2.opt

SPR FILE.....SPRFN.....
WB 1     spr1.opt
WB 2     spr2.opt

FLX FILE.....FLXFN.....
WB 1     flx1.opt
WB 2     flx2.opt

TSR FILE.....TSRFN.....

```

tsr.opt

WDO FILE.....WDOFN.....
wdo.opt

Appendix C: Vertical Profiles of Model Predictions and data

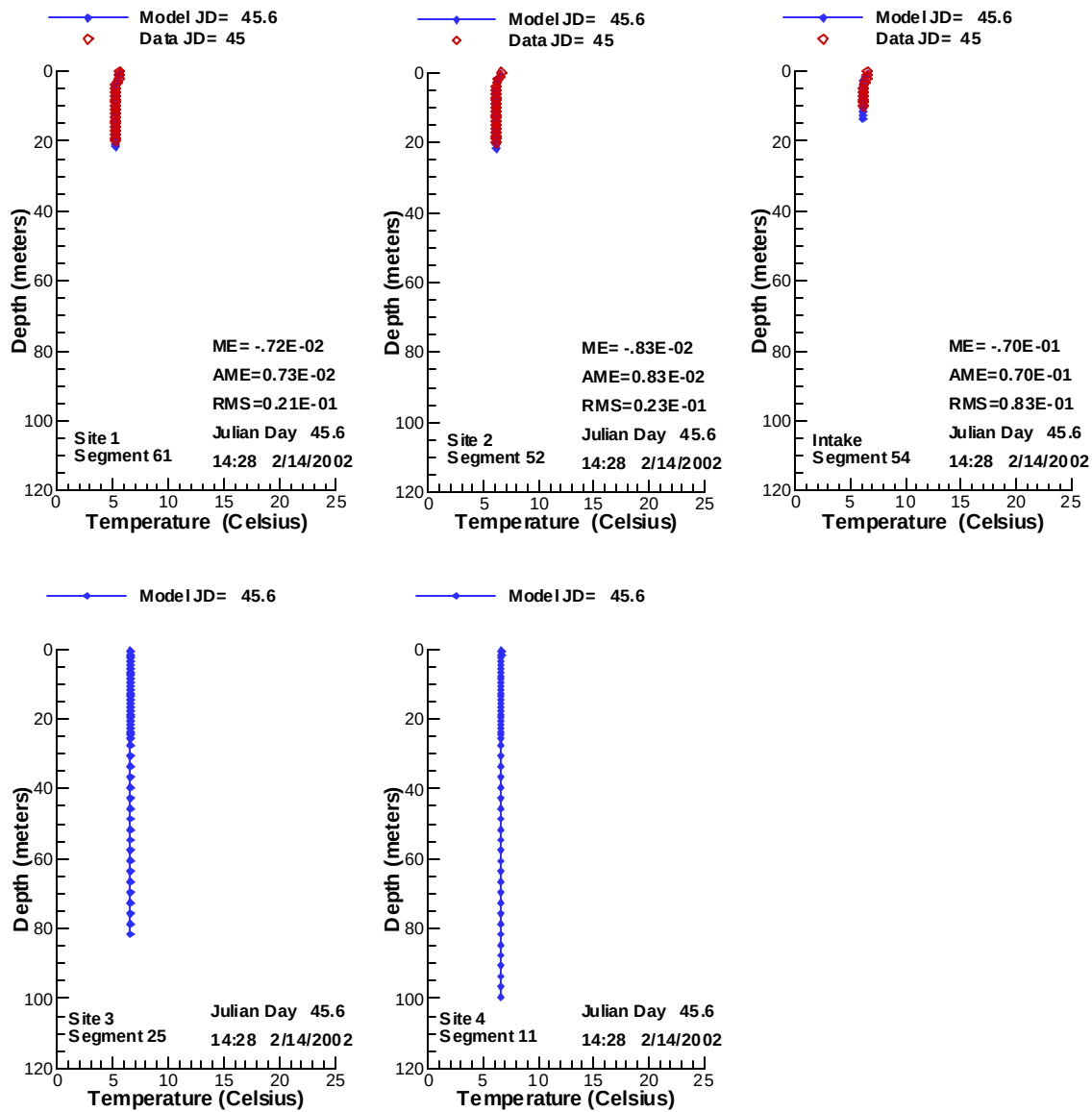


Figure 81. Vertical profiles of TEMPERATURE compared with data for 2/14/2002.

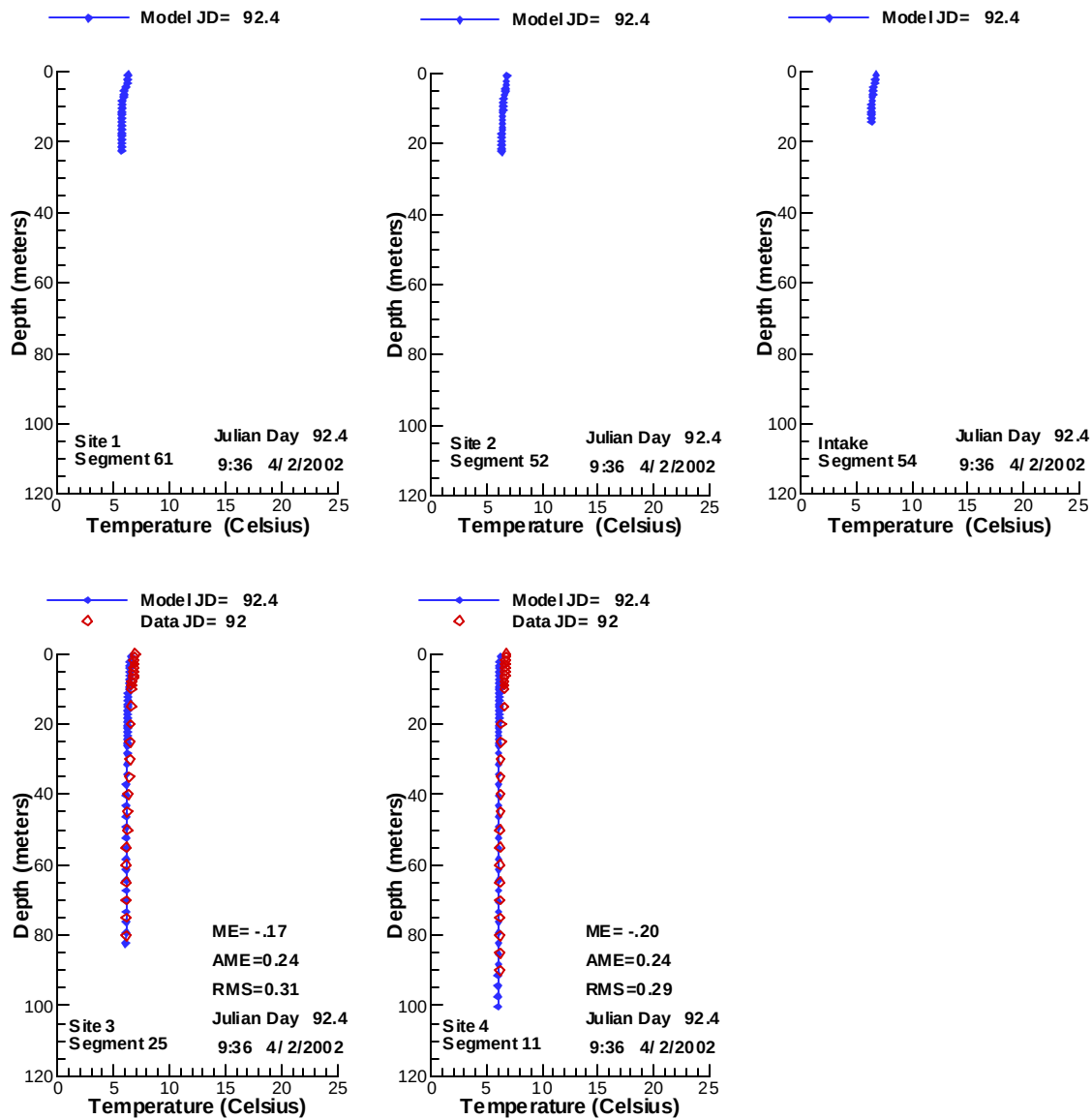


Figure 82. Vertical profiles of TEMPERATURE compared with data for 4/ 2/2002.

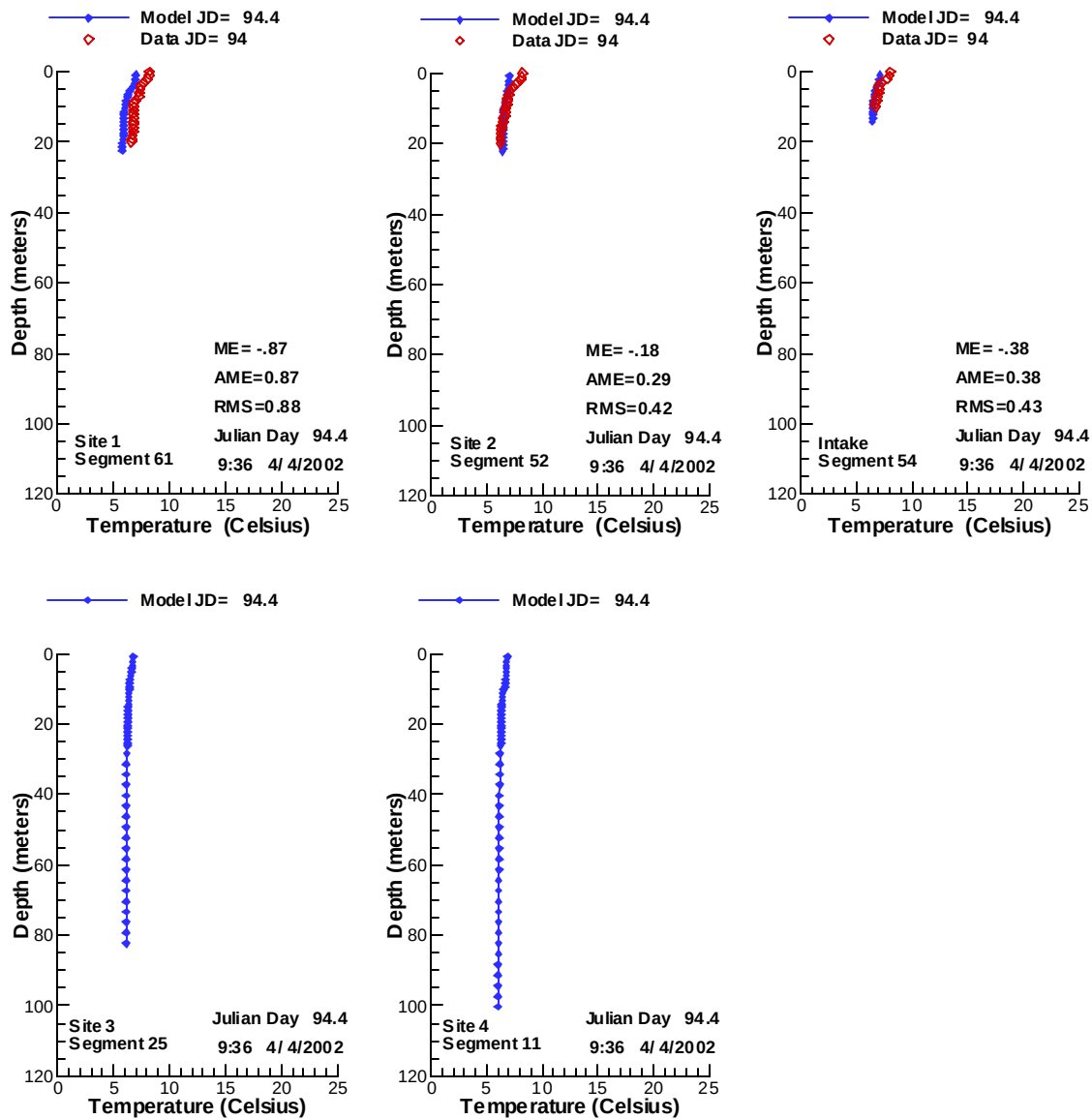


Figure 83. Vertical profiles of TEMPERATURE compared with data for 4/ 4/2002.

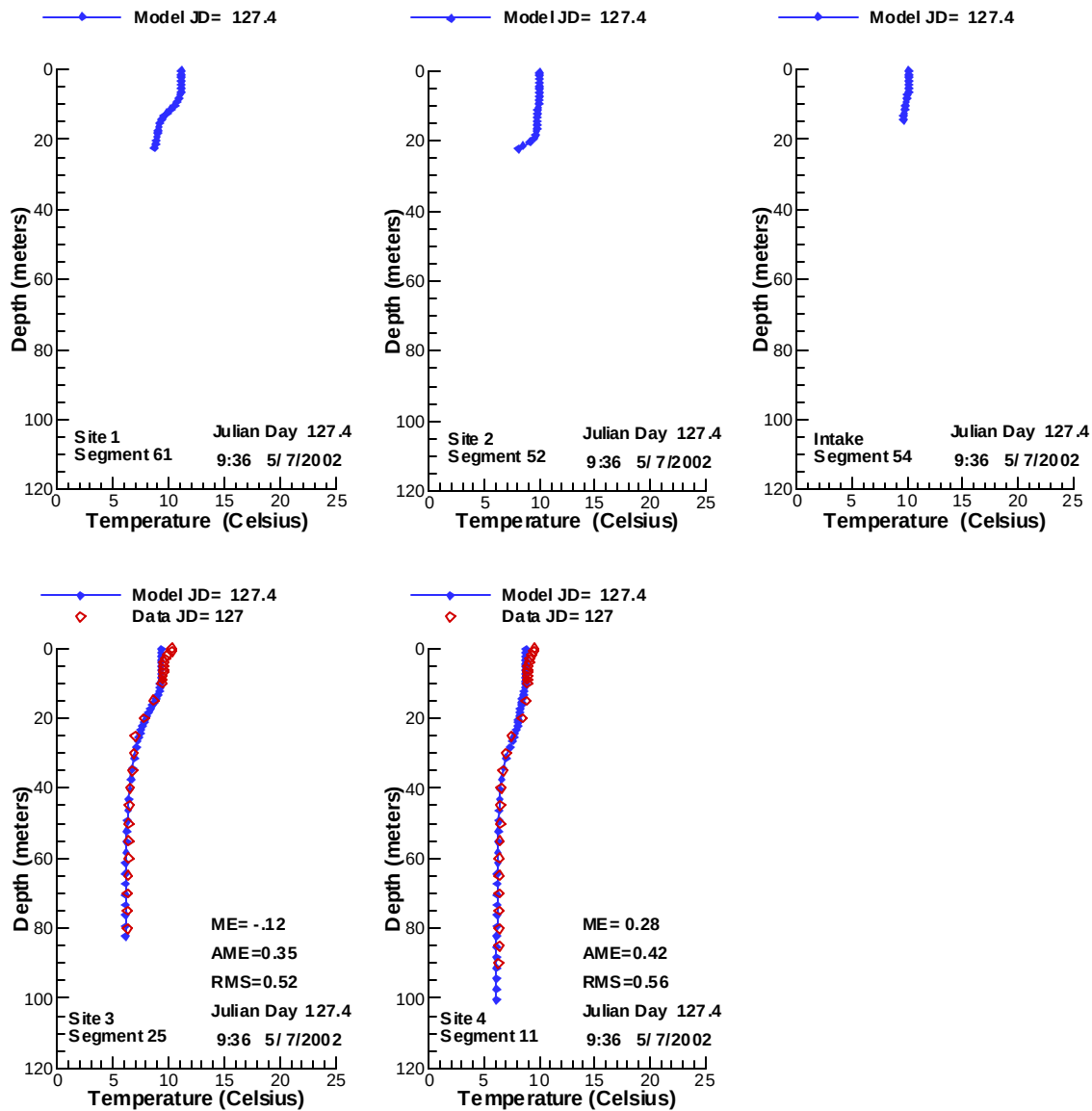


Figure 84. Vertical profiles of TEMPERATURE compared with data for 5/ 7/2002.

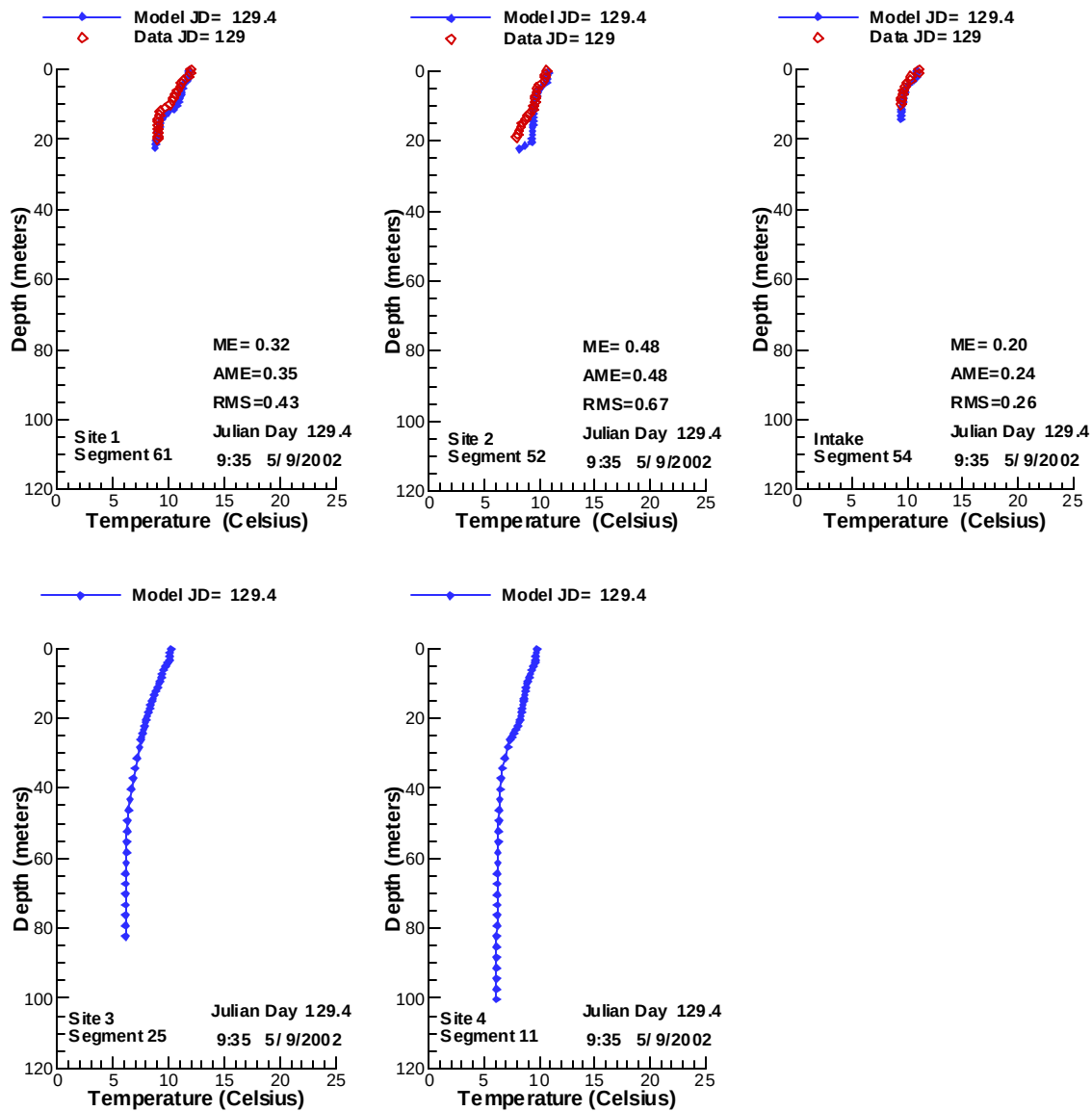


Figure 85. Vertical profiles of TEMPERATURE compared with data for 5/ 9/2002.

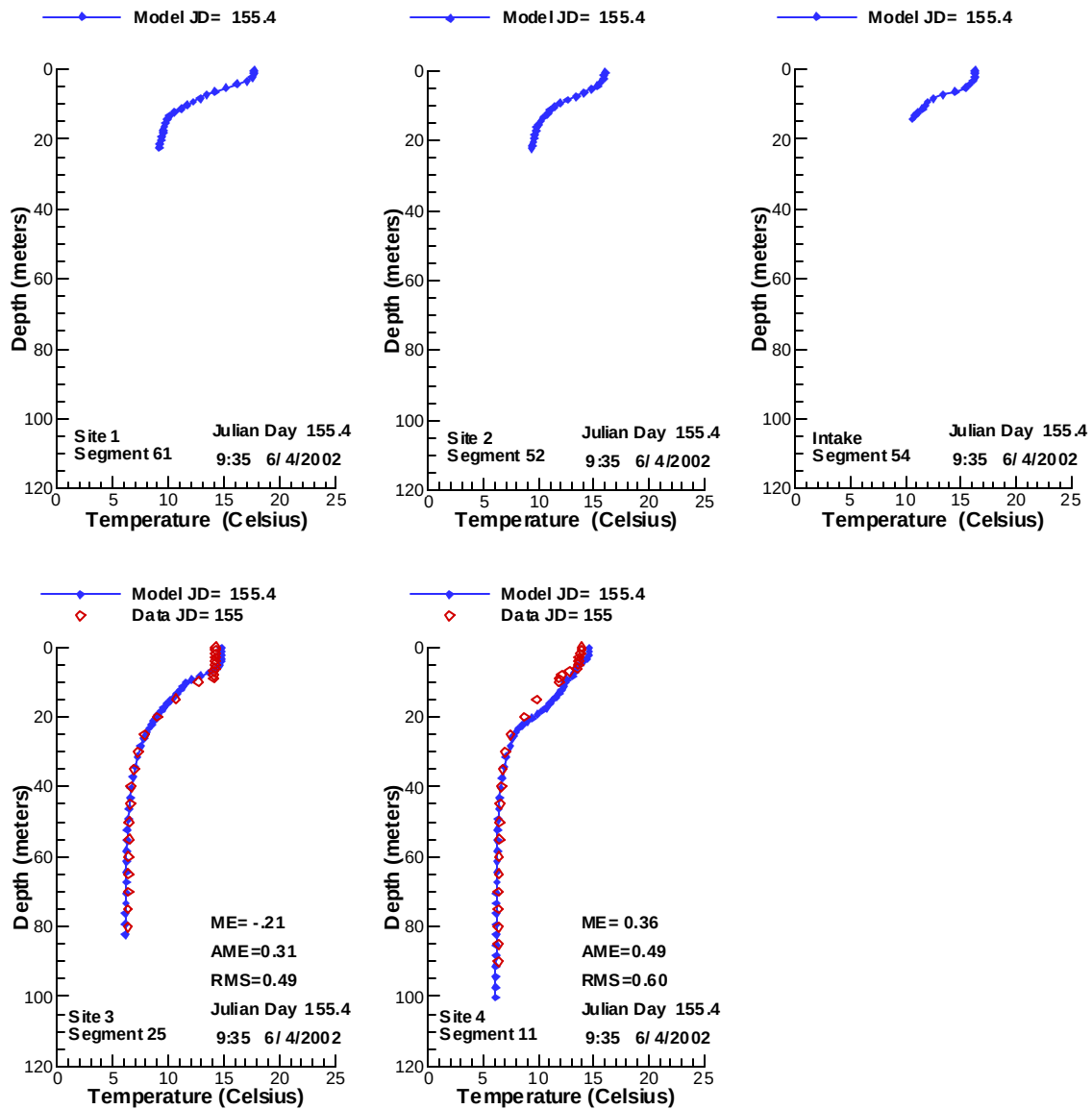


Figure 86. Vertical profiles of TEMPERATURE compared with data for 6/ 4/2002.

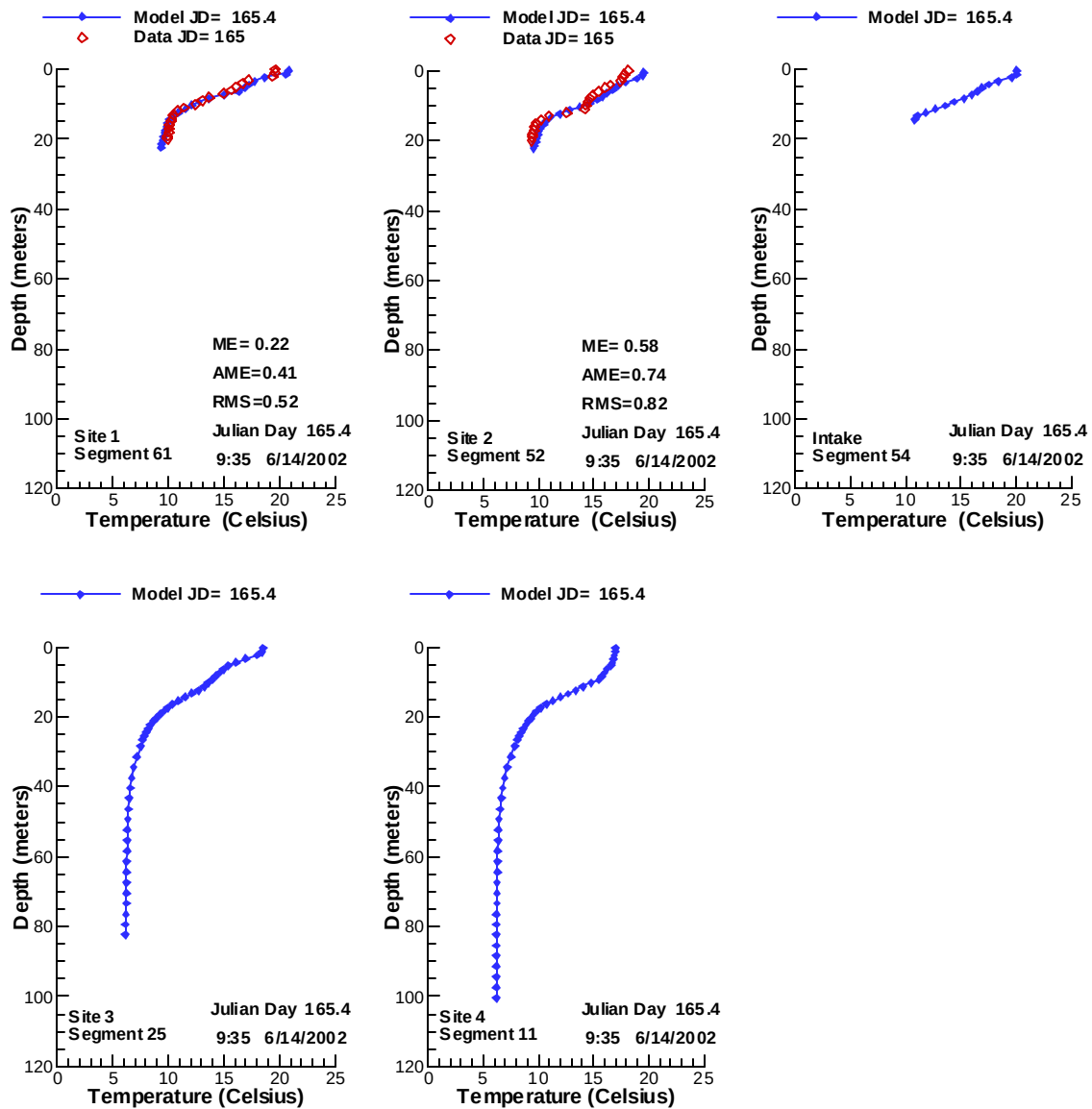


Figure 87. Vertical profiles of TEMPERATURE compared with data for 6/14/2002.

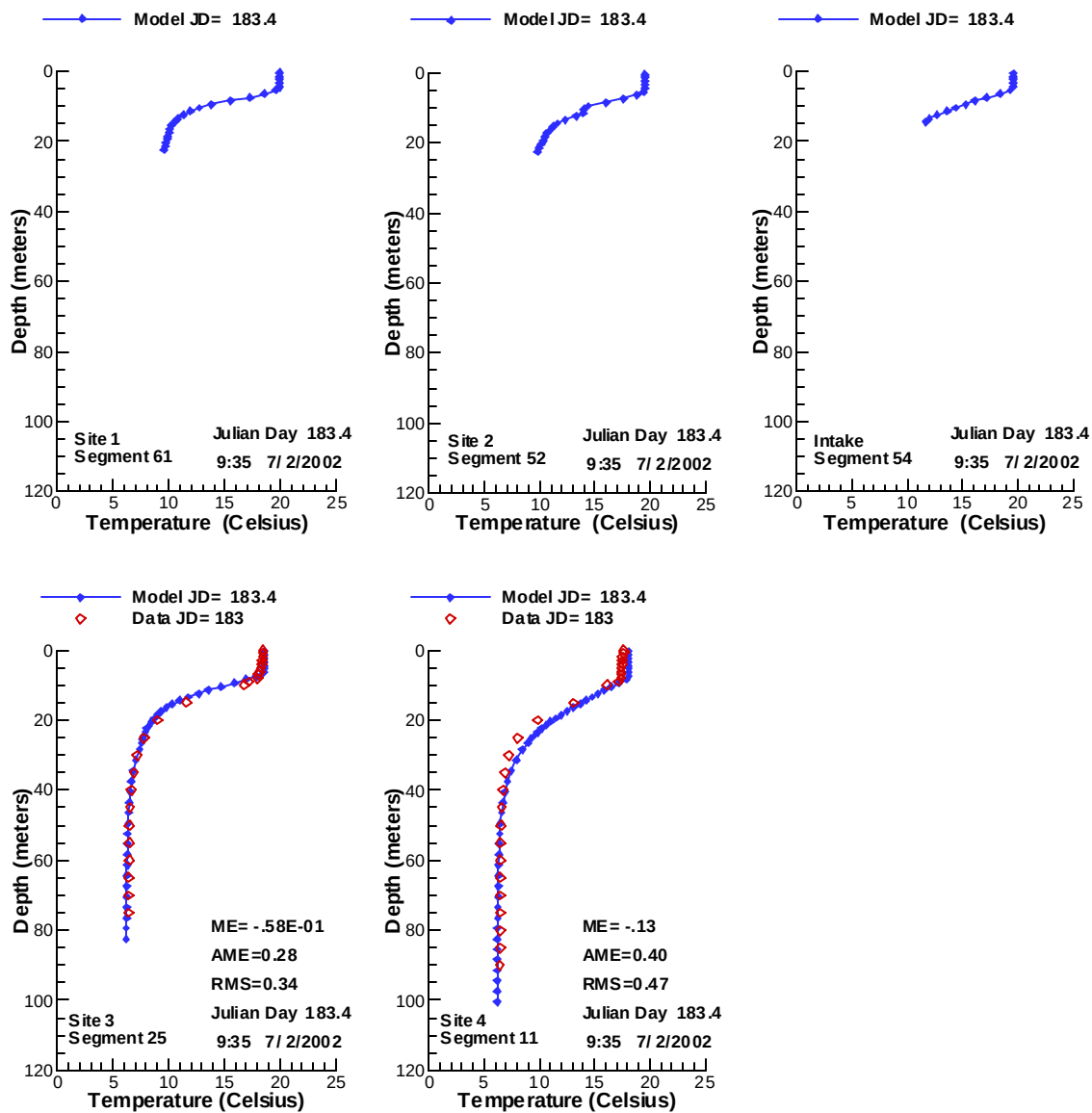


Figure 88. Vertical profiles of TEMPERATURE compared with data for 7/ 2/2002.

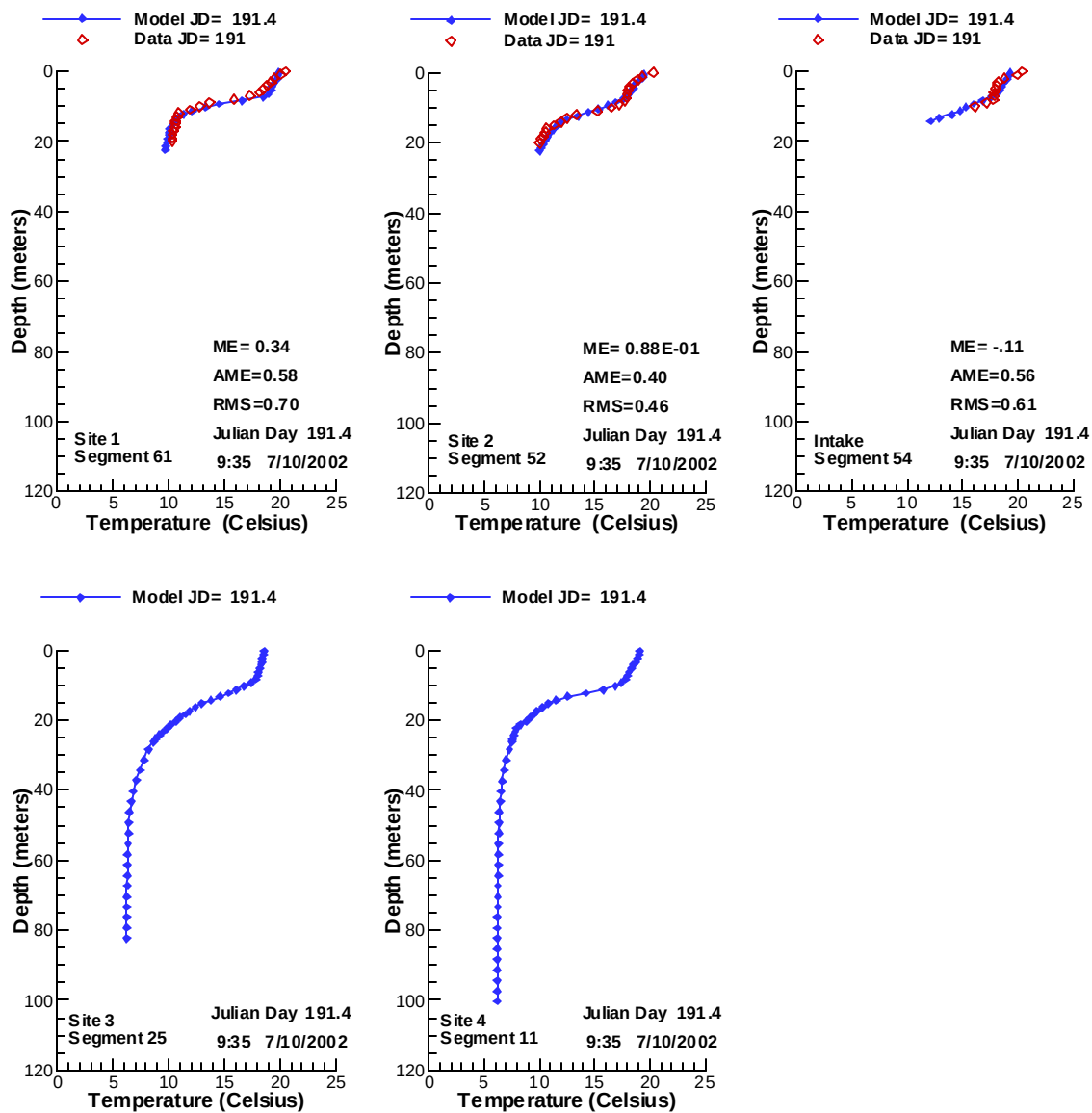


Figure 89. Vertical profiles of TEMPERATURE compared with data for 7/10/2002.

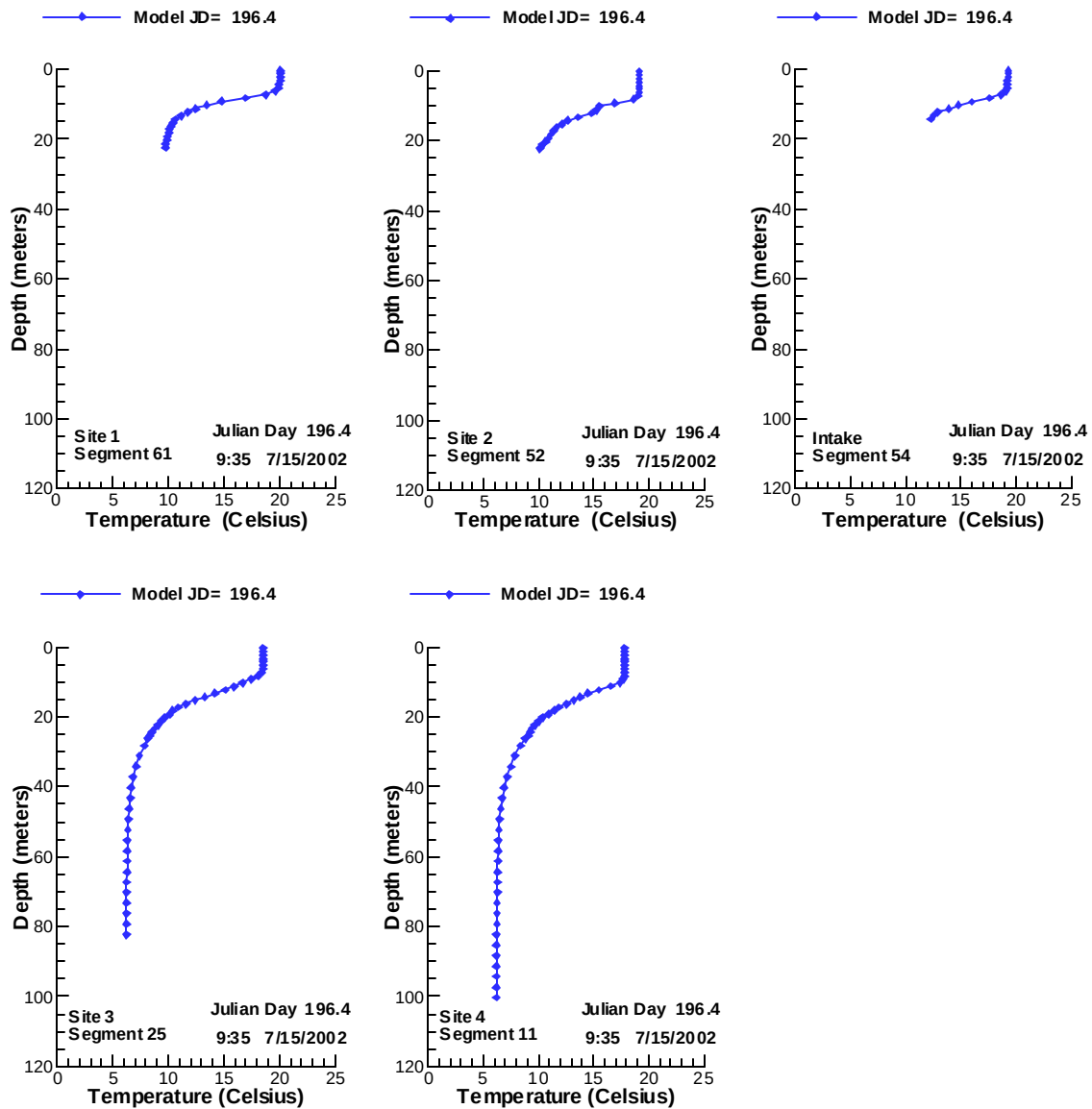


Figure 90. Vertical profiles of TEMPERATURE compared with data for 7/15/2002.

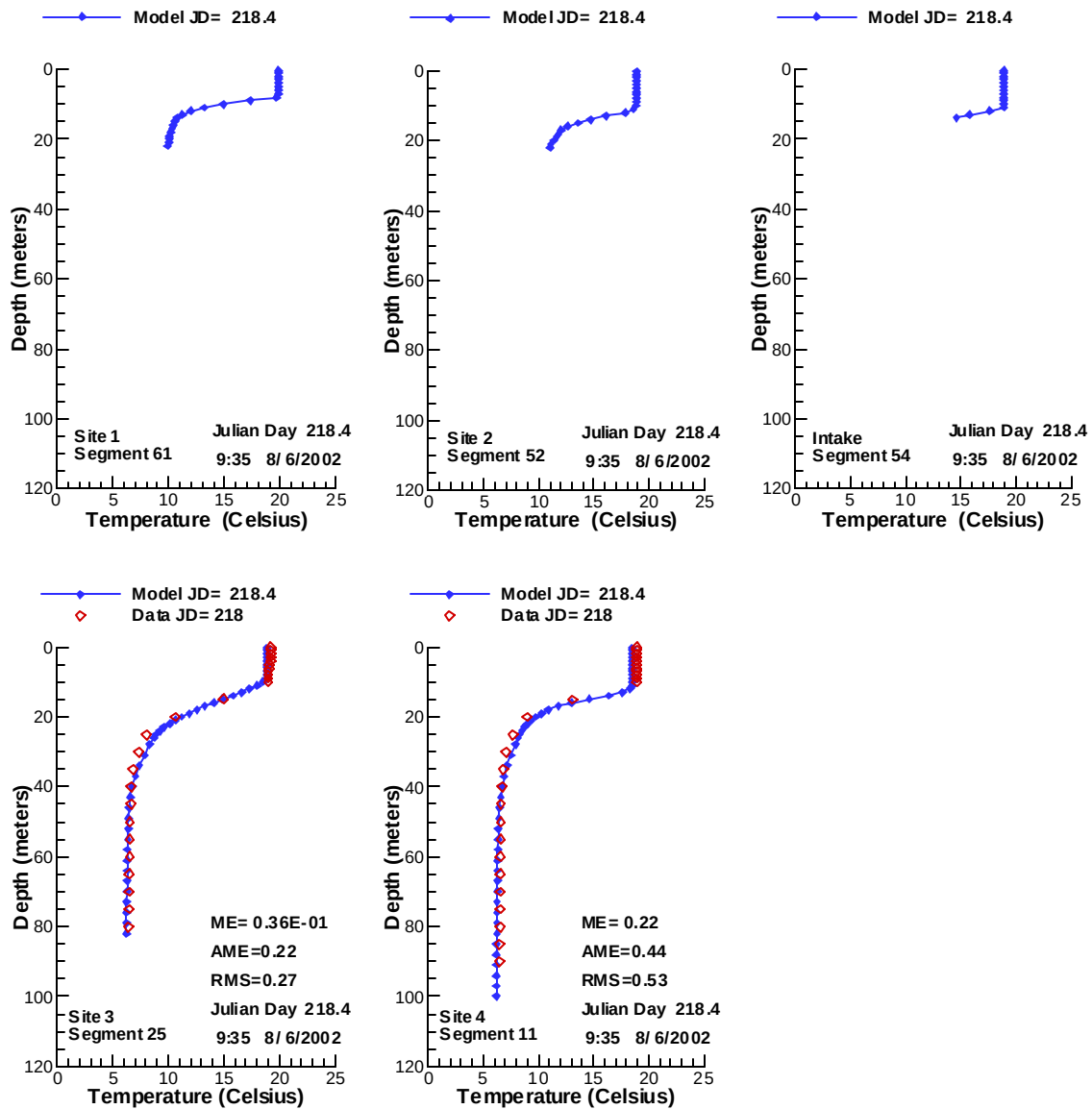


Figure 91. Vertical profiles of TEMPERATURE compared with data for 8/ 6/2002.

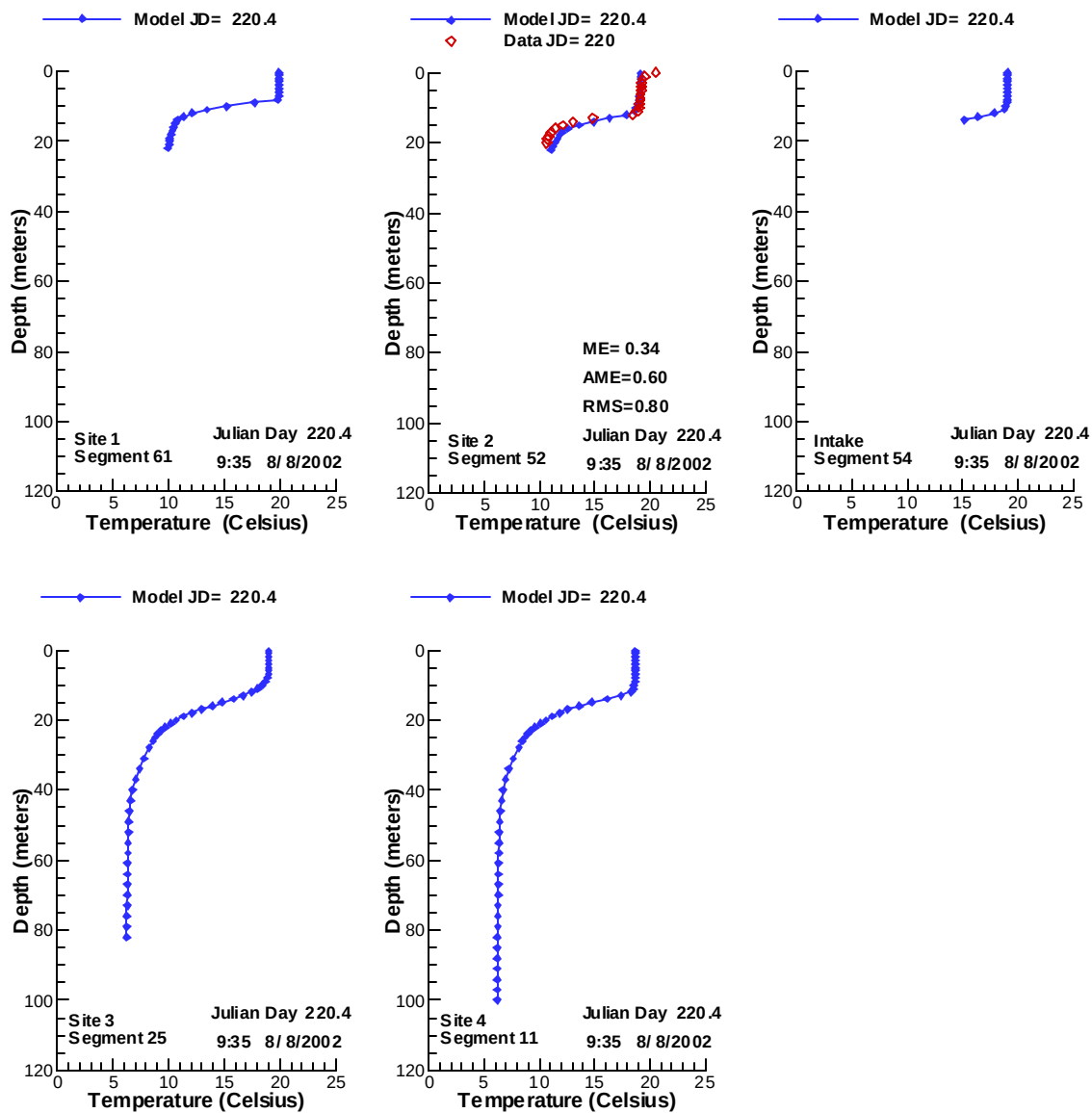


Figure 92. Vertical profiles of TEMPERATURE compared with data for 8/ 8/2002.

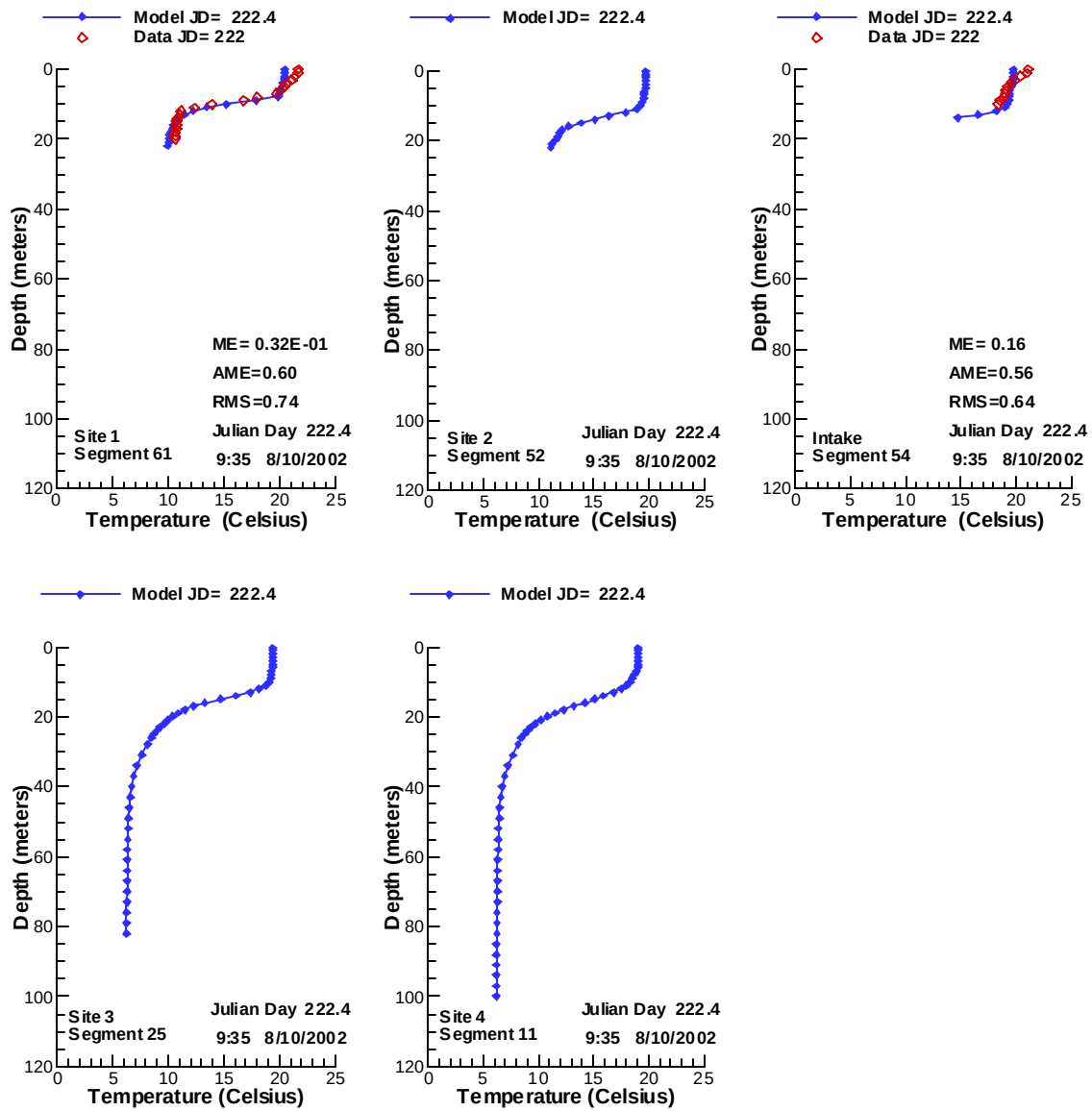


Figure 93. Vertical profiles of TEMPERATURE compared with data for 8/10/2002.

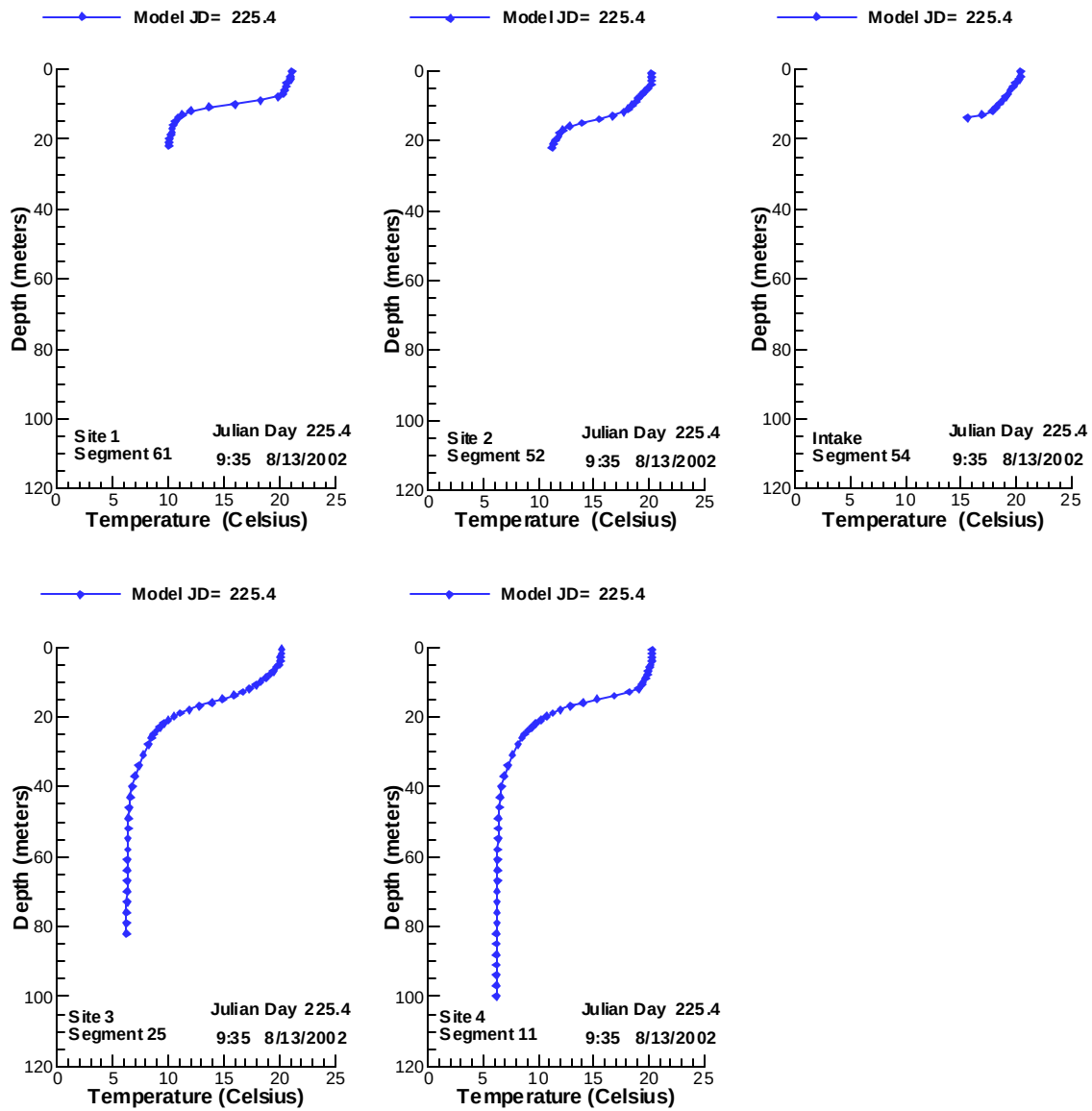


Figure 94. Vertical profiles of TEMPERATURE compared with data for 8/13/2002.

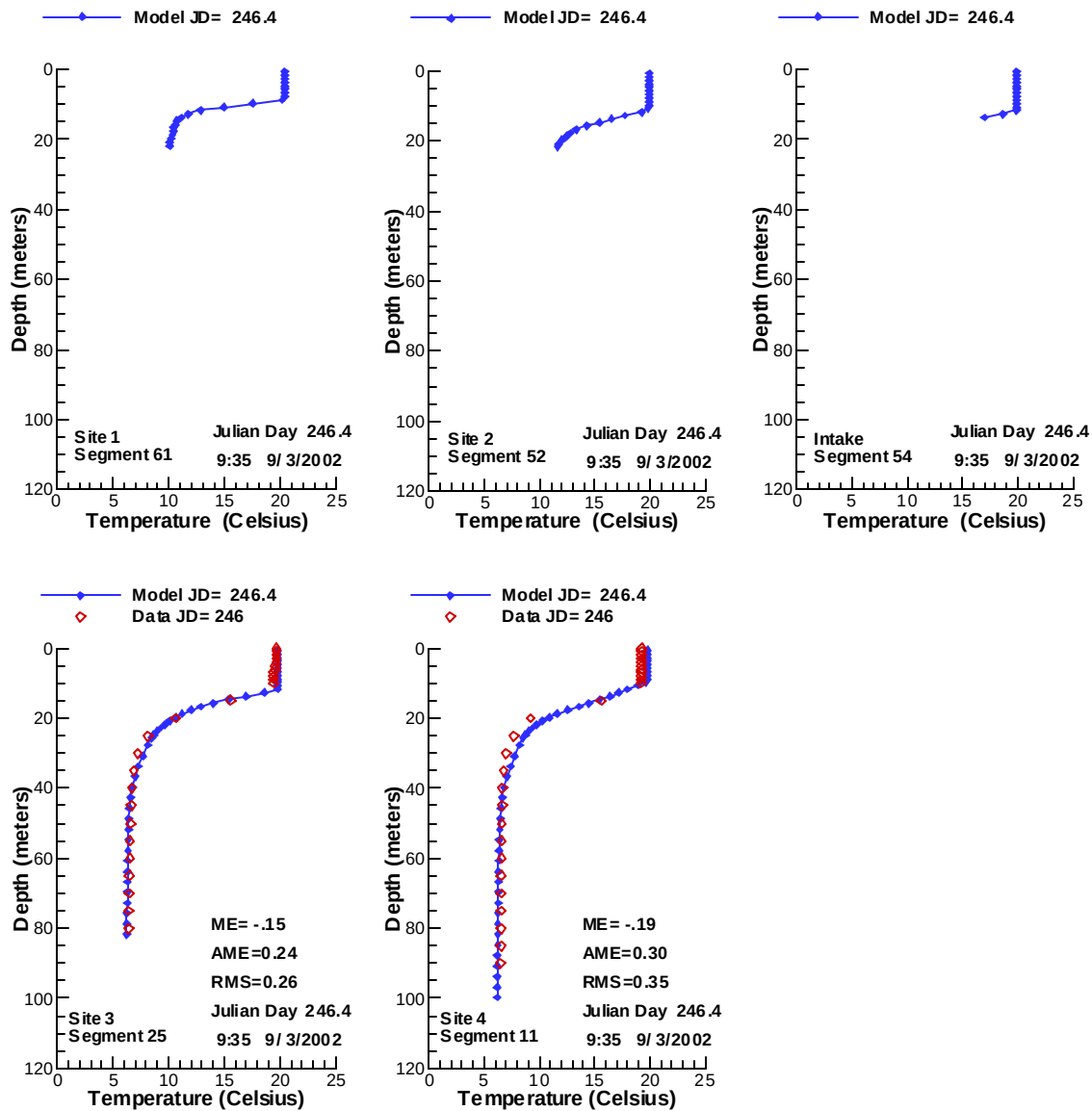


Figure 95. Vertical profiles of TEMPERATURE compared with data for 9/ 3/2002.

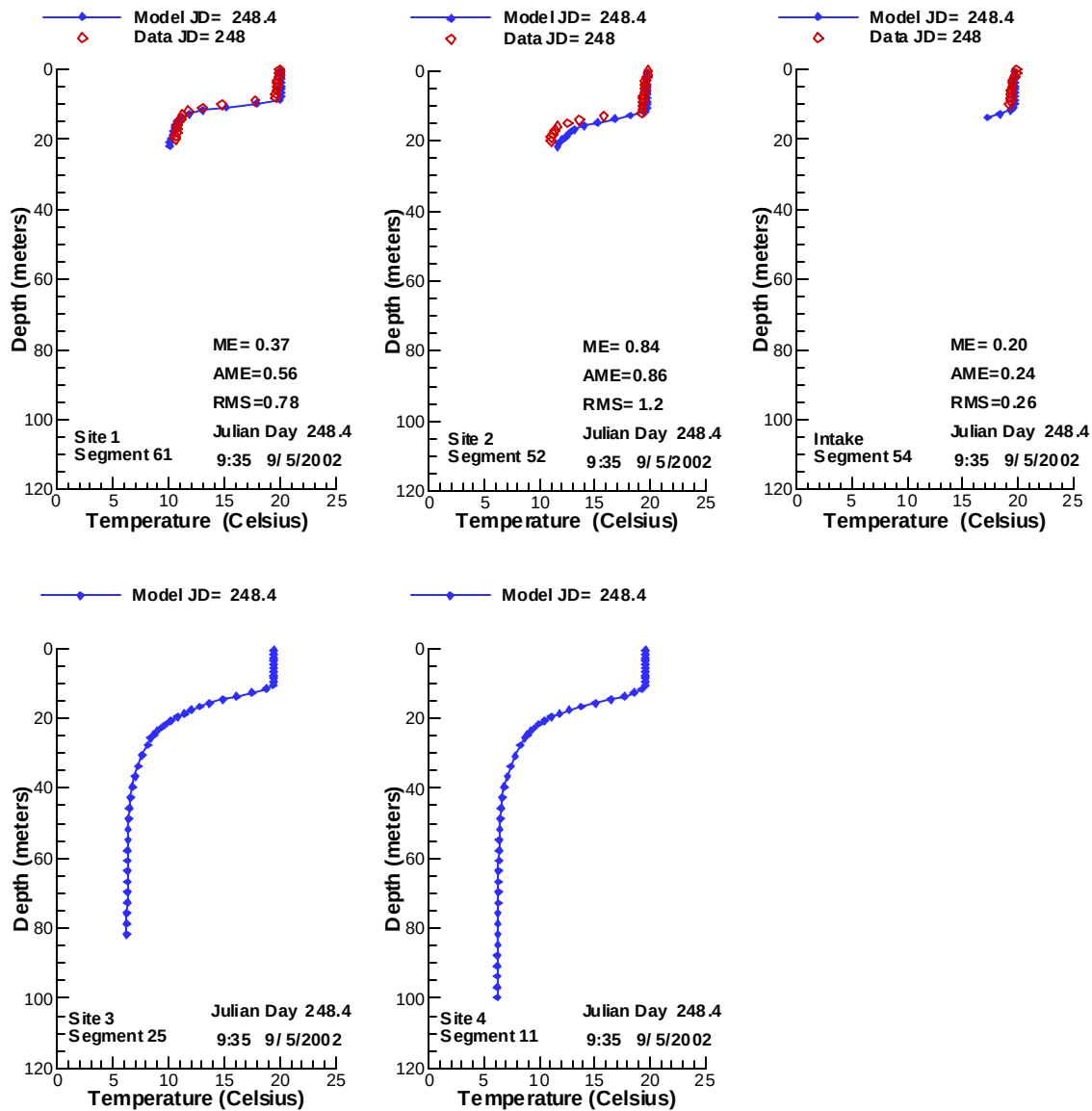


Figure 96. Vertical profiles of TEMPERATURE compared with data for 9/ 5/2002.

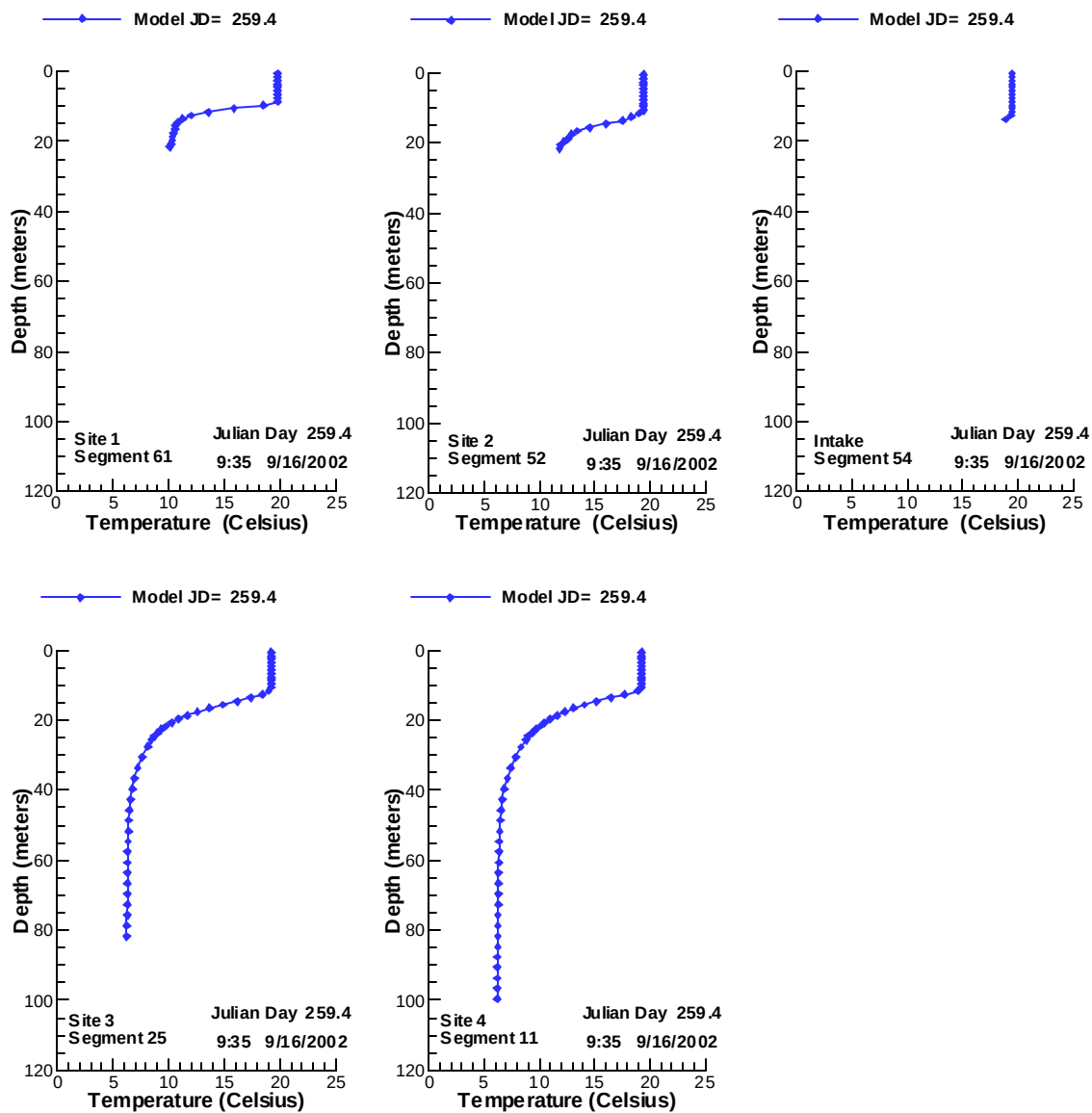


Figure 97. Vertical profiles of TEMPERATURE compared with data for 9/16/2002.

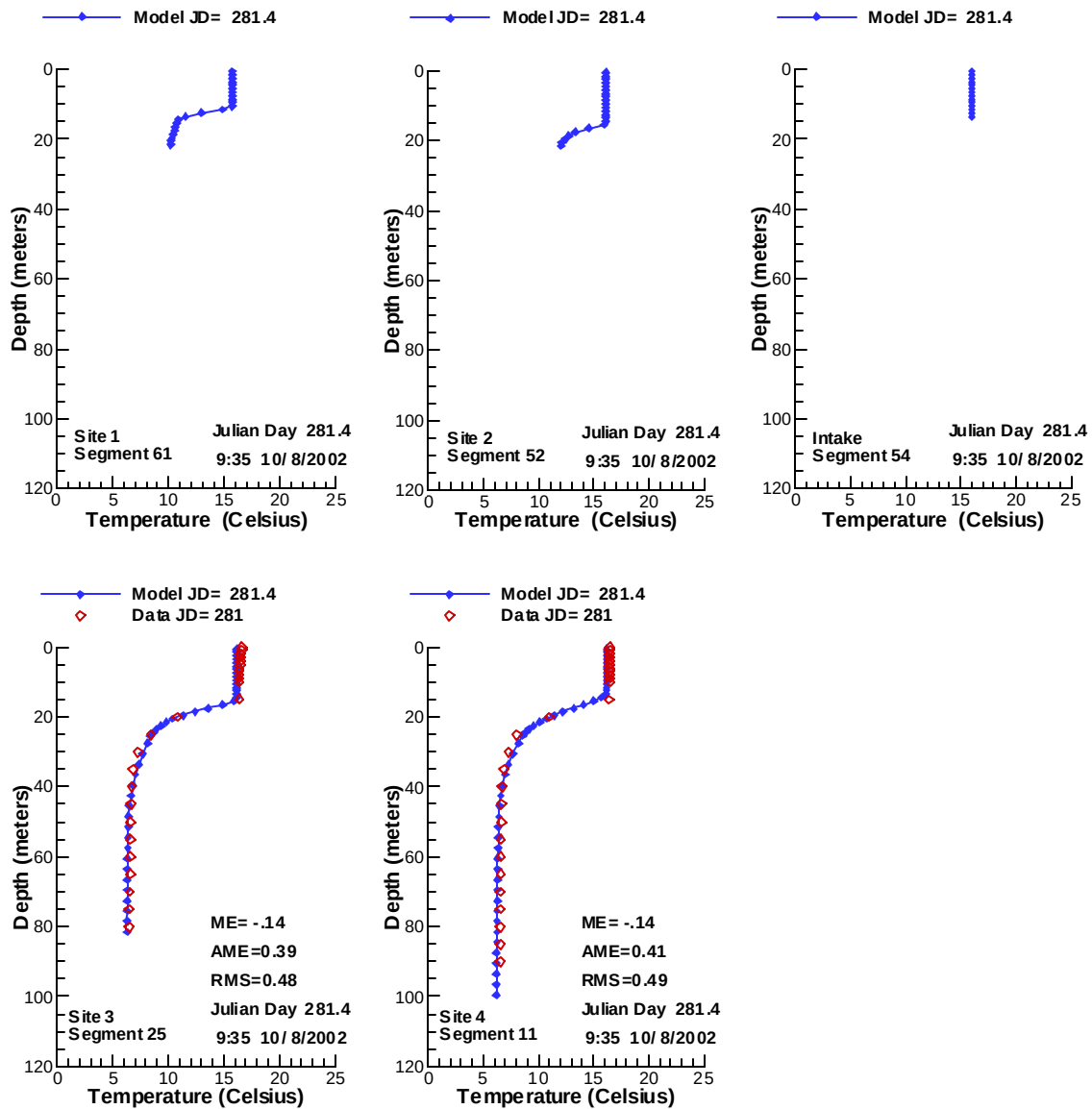


Figure 98. Vertical profiles of TEMPERATURE compared with data for 10/ 8/2002.

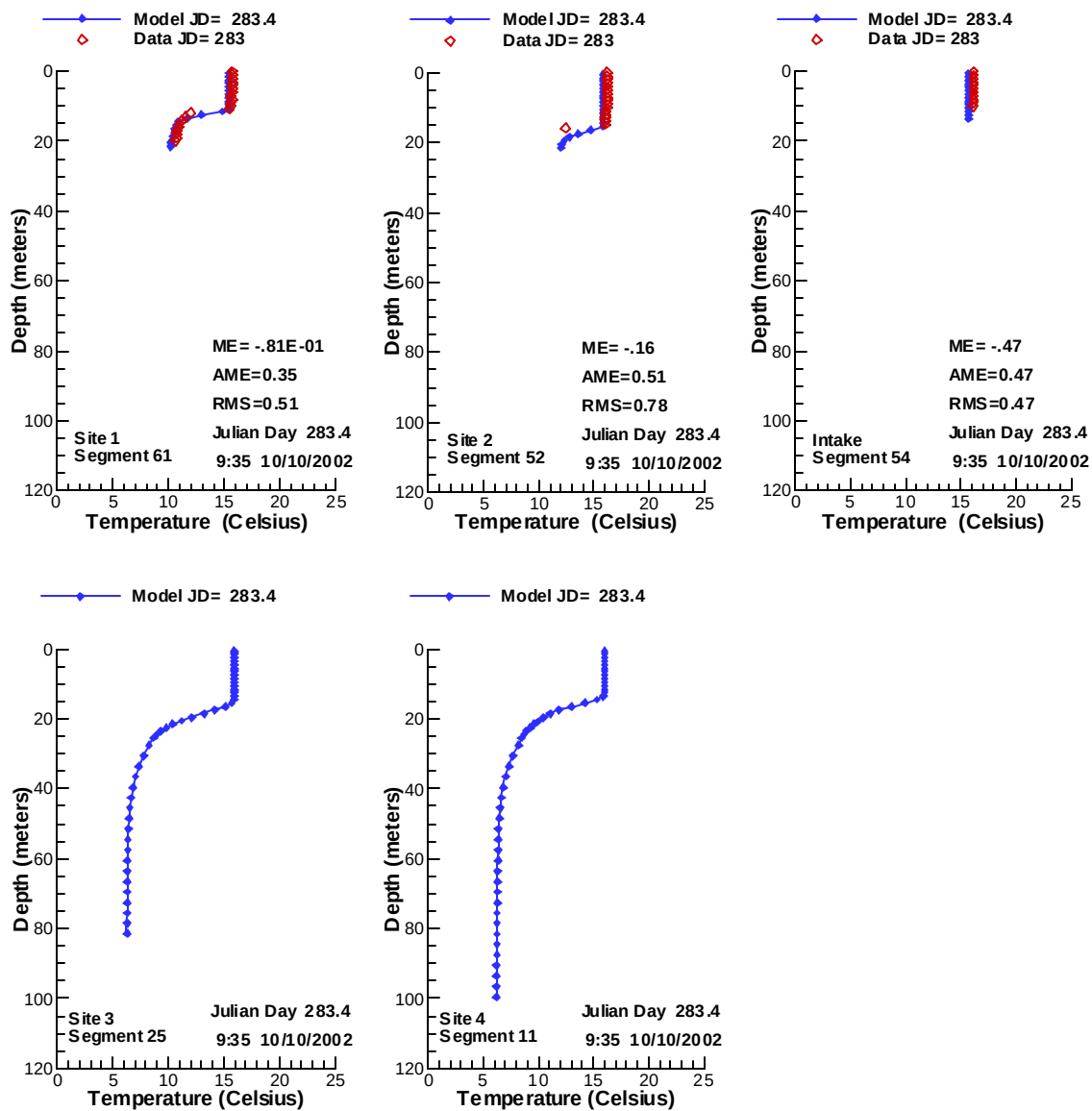


Figure 99. Vertical profiles of TEMPERATURE compared with data for 10/10/2002.

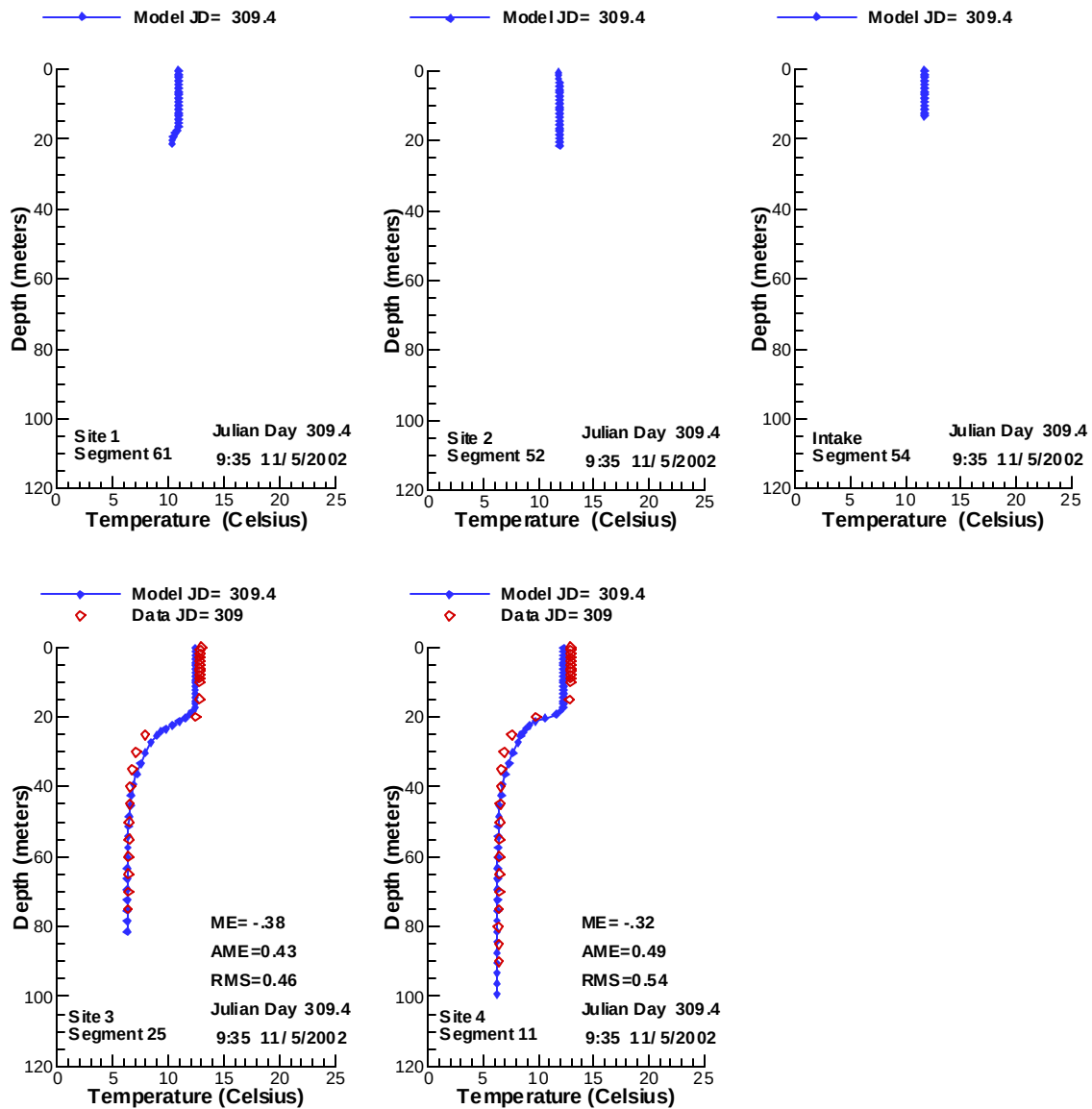


Figure 100. Vertical profiles of TEMPERATURE compared with data for 11/ 5/2002.

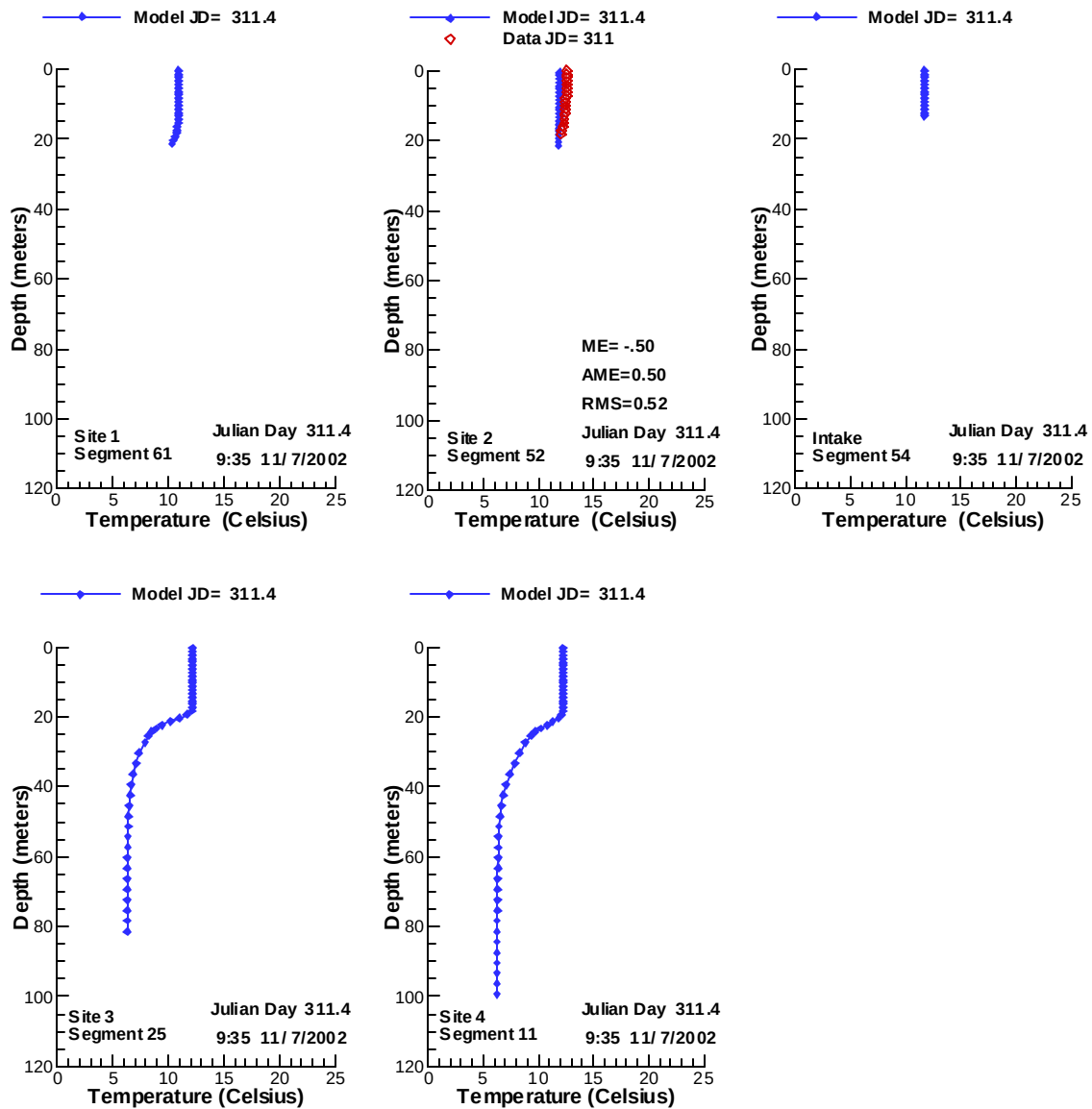


Figure 101. Vertical profiles of TEMPERATURE compared with data for 11/ 7/2002.

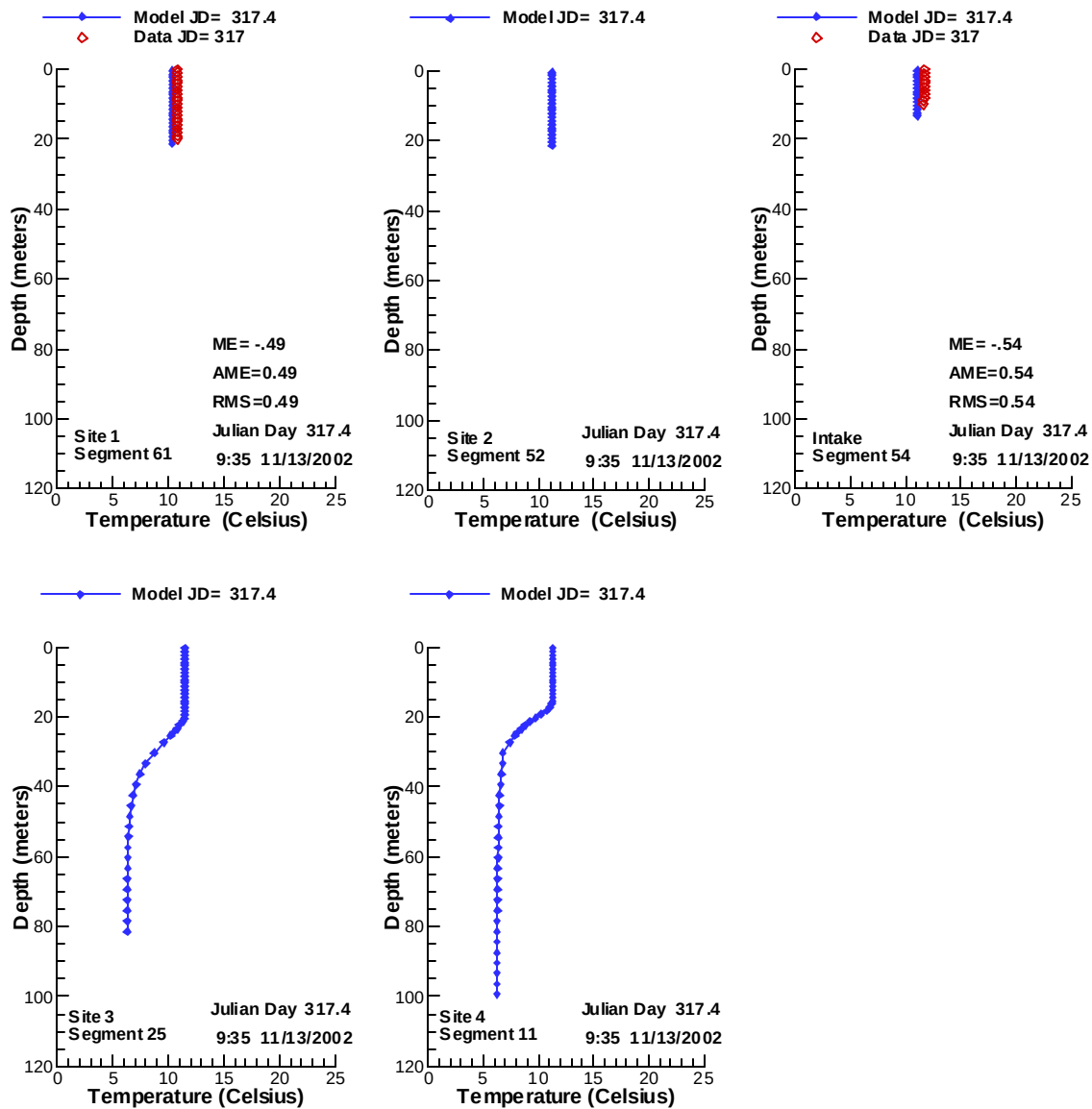


Figure 102. Vertical profiles of TEMPERATURE compared with data for 11/13/2002.

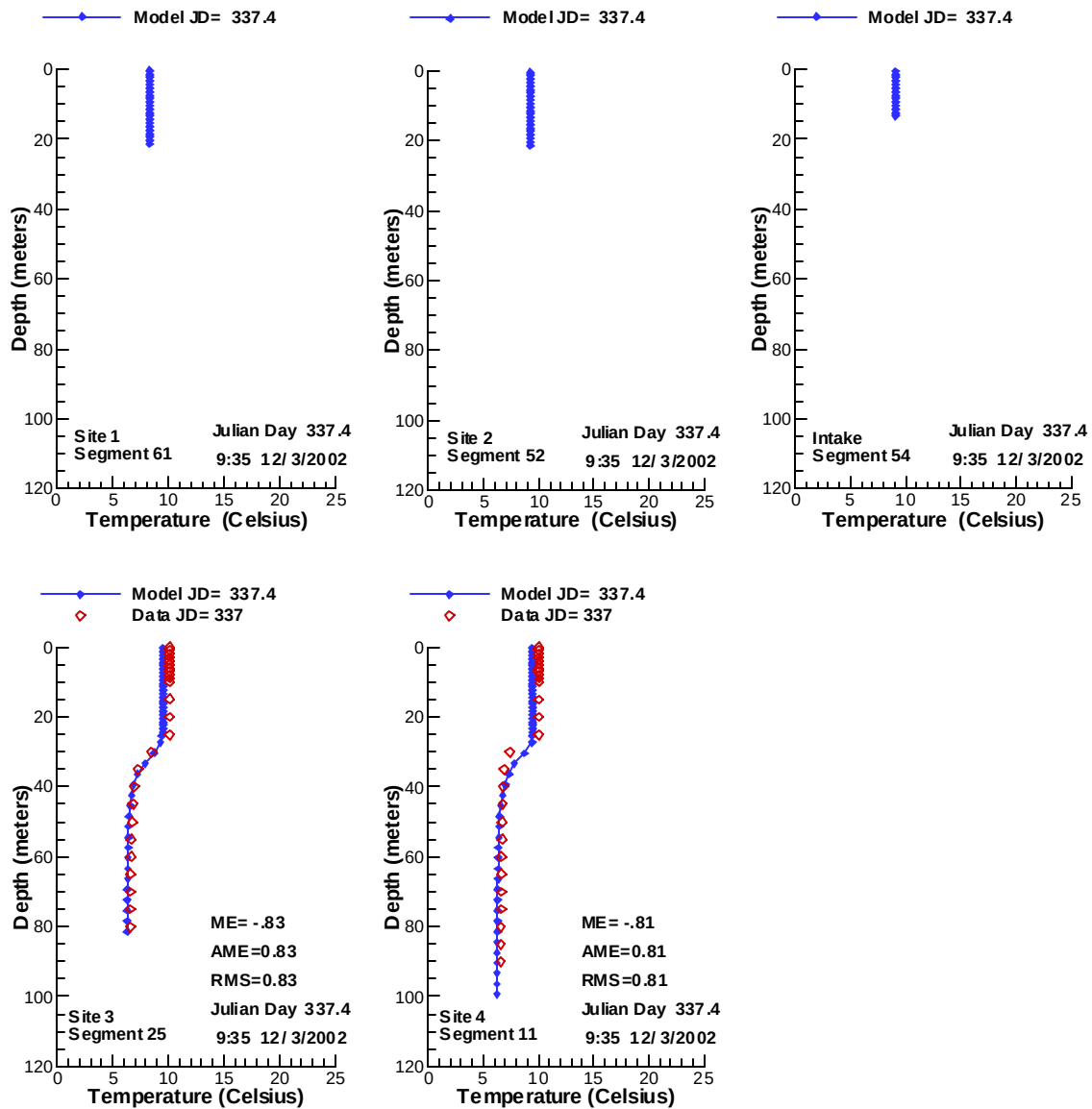


Figure 103. Vertical profiles of TEMPERATURE compared with data for 12/ 3/2002.

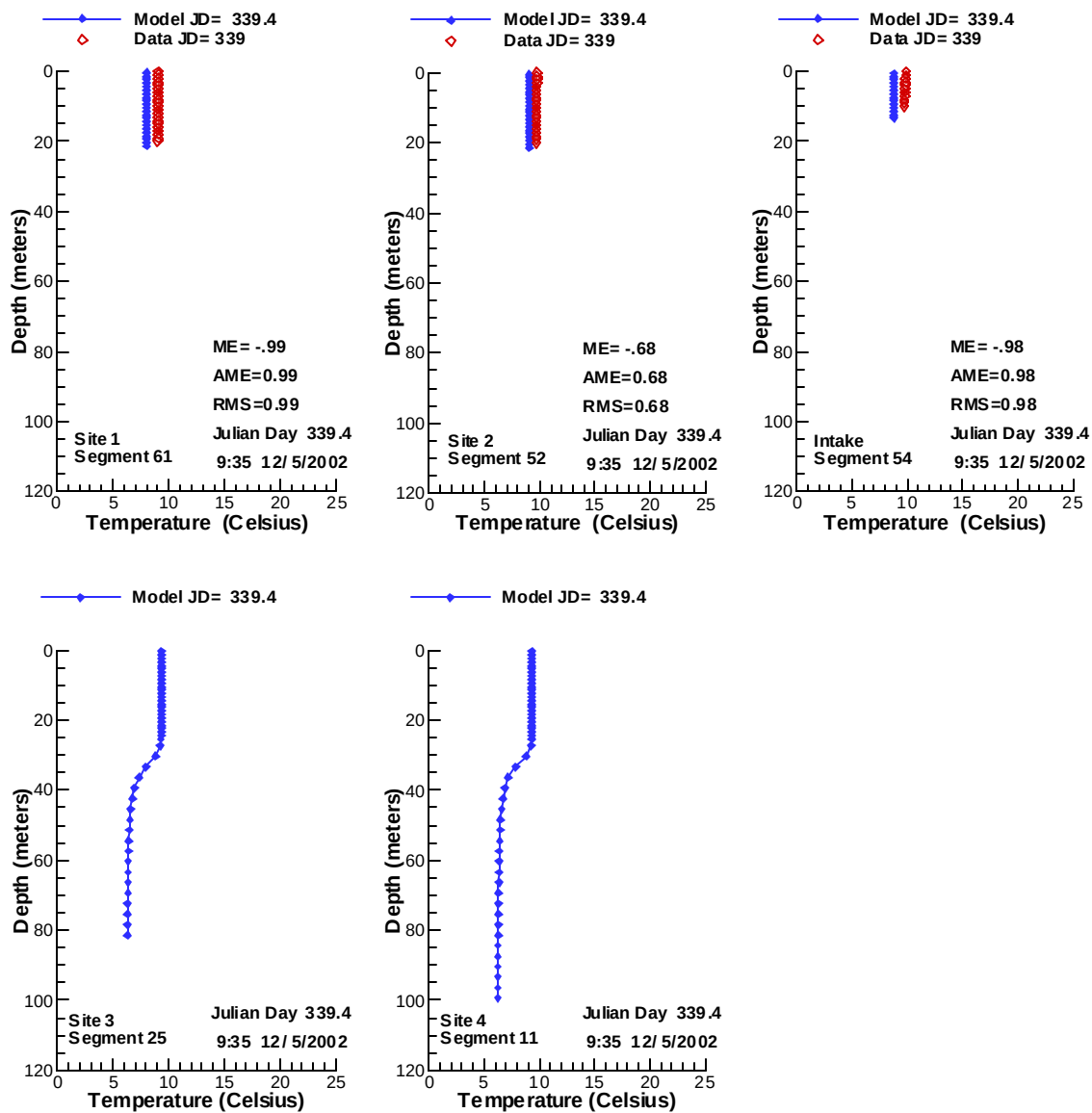


Figure 104. Vertical profiles of TEMPERATURE compared with data for 12/ 5/2002.

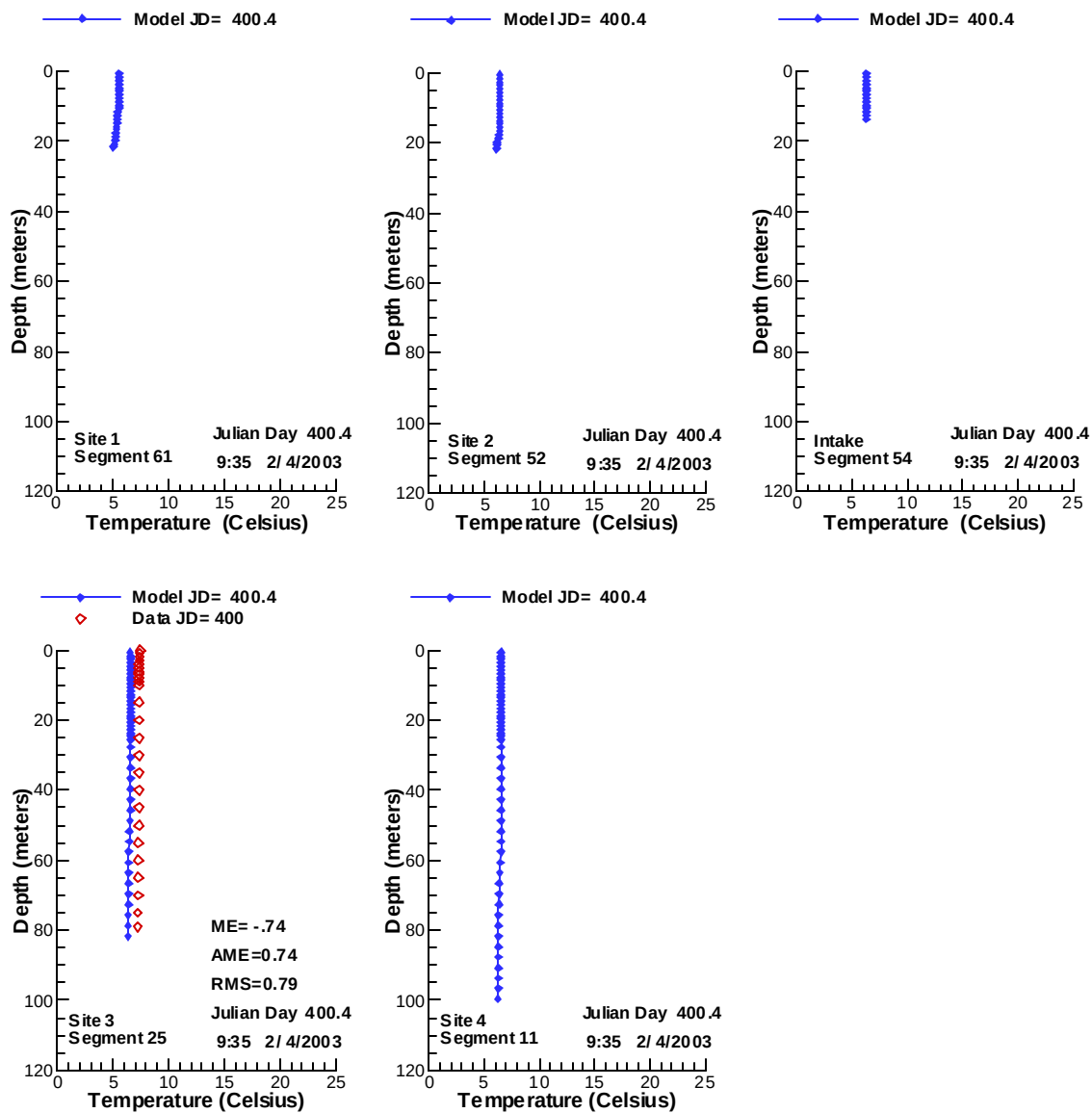


Figure 105. Vertical profiles of TEMPERATURE compared with data for 2/ 4/2003.

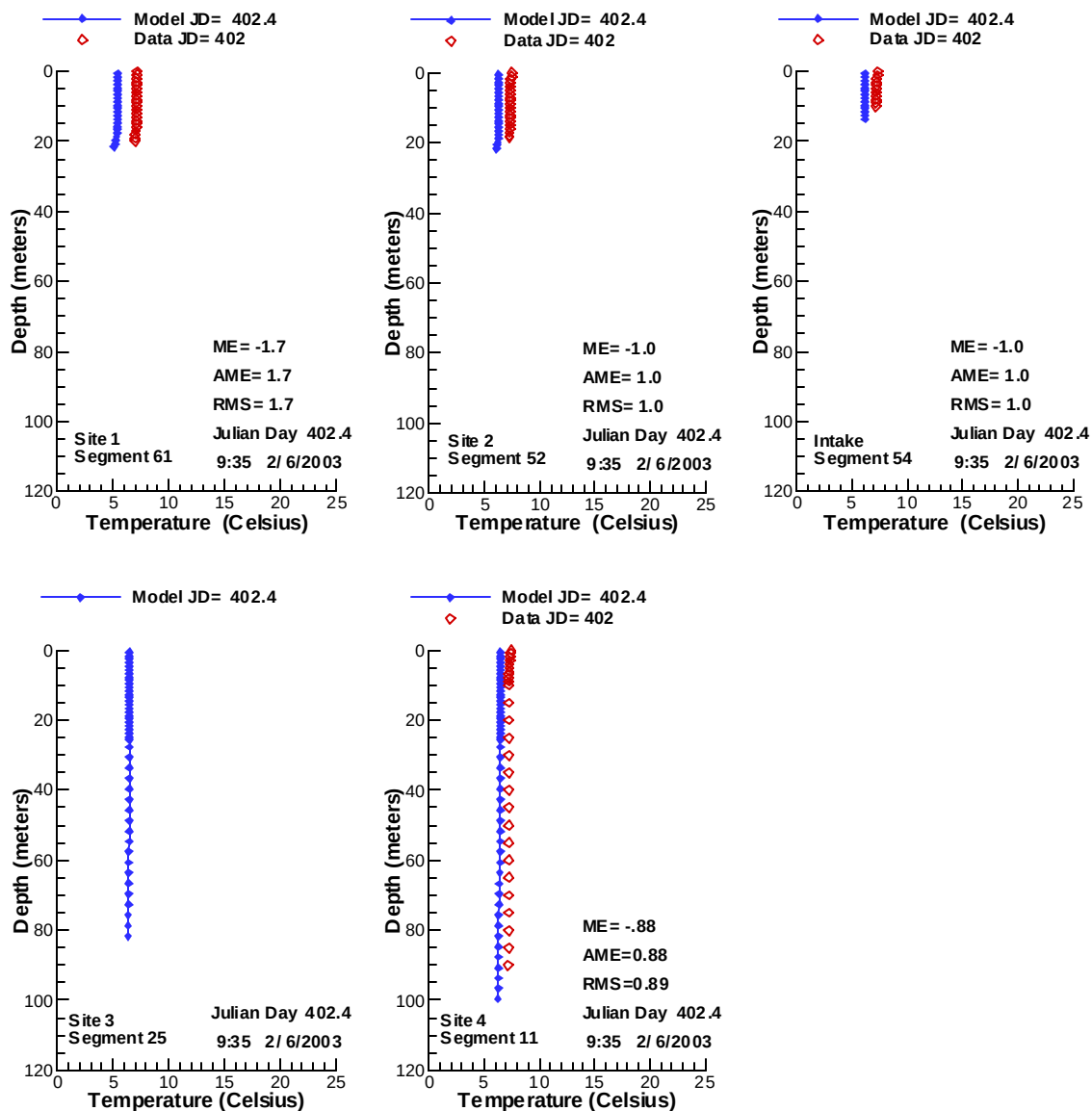


Figure 106. Vertical profiles of TEMPERATURE compared with data for 2/ 6/2003.

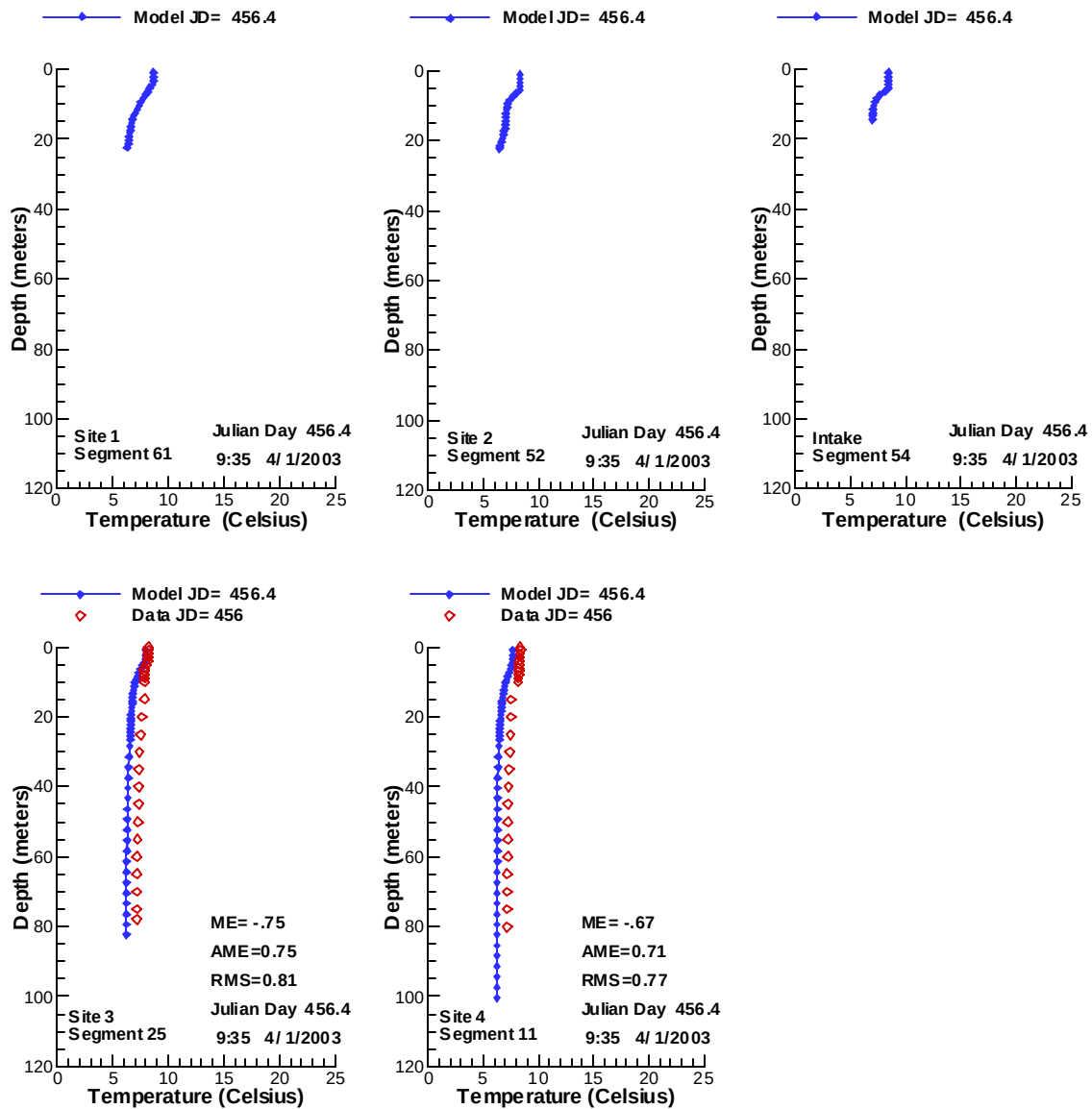


Figure 107. Vertical profiles of TEMPERATURE compared with data for 4/ 1/2003.

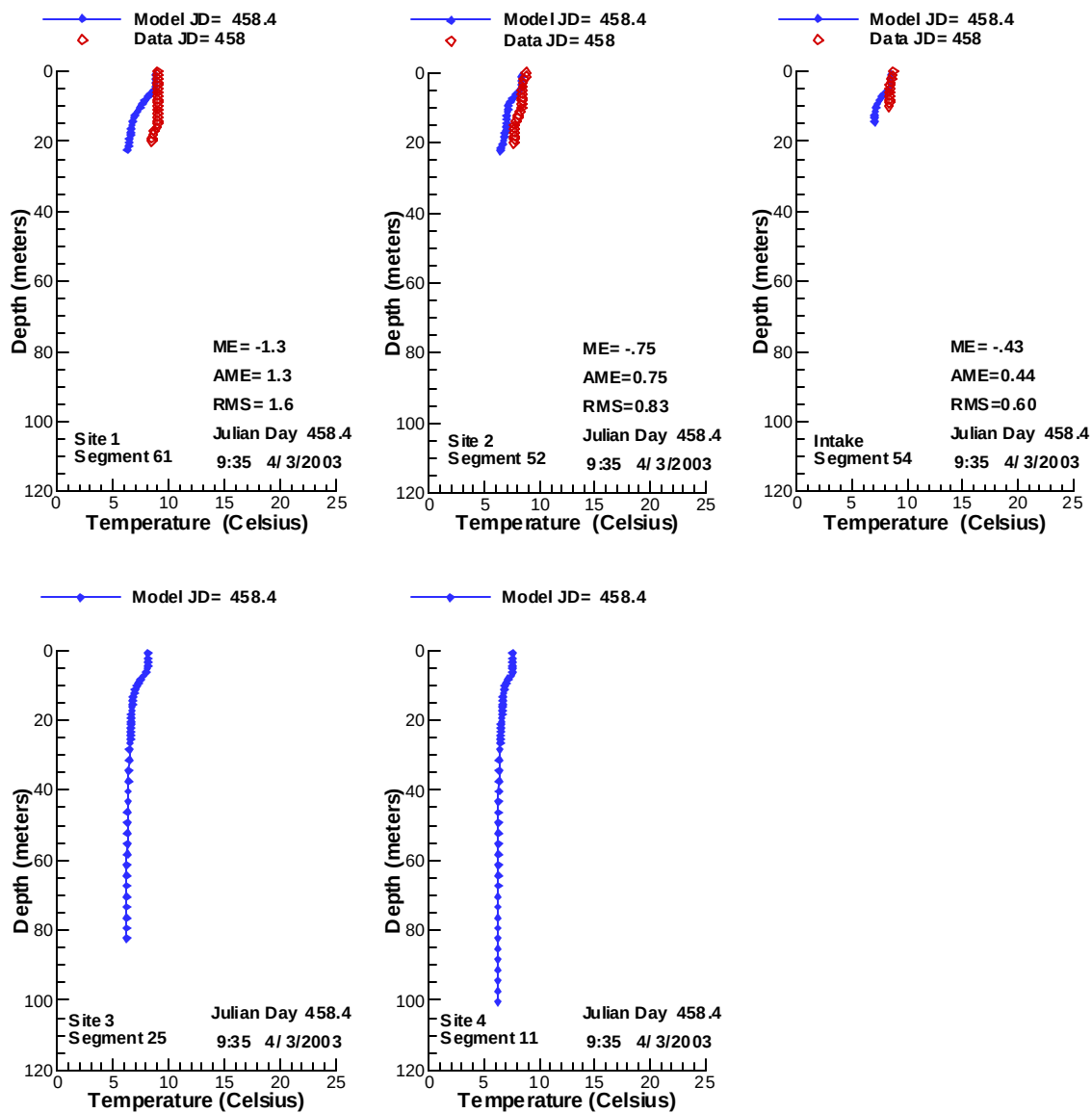


Figure 108. Vertical profiles of TEMPERATURE compared with data for 4/ 3/2003.

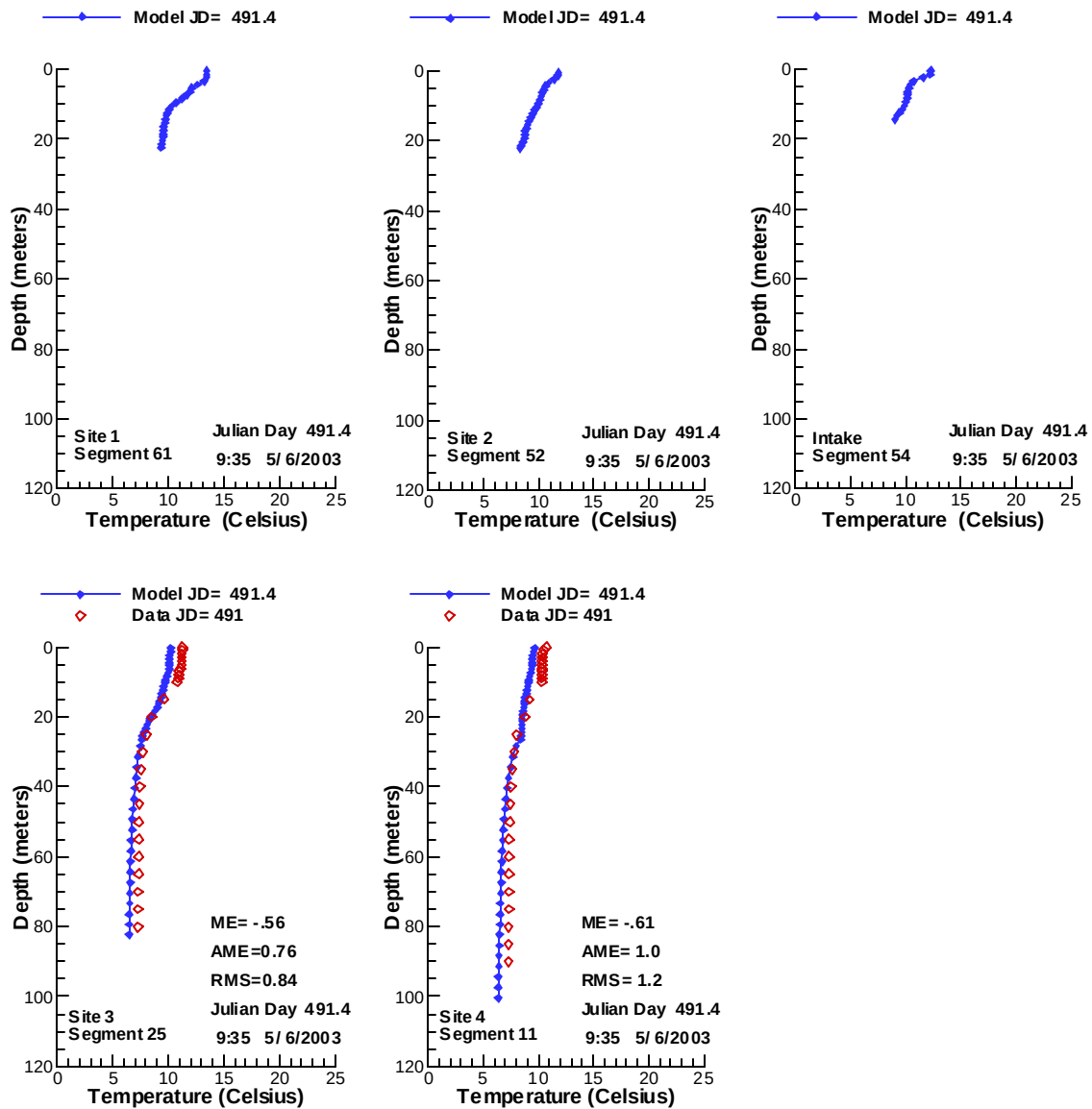


Figure 109. Vertical profiles of TEMPERATURE compared with data for 5/ 6/2003.

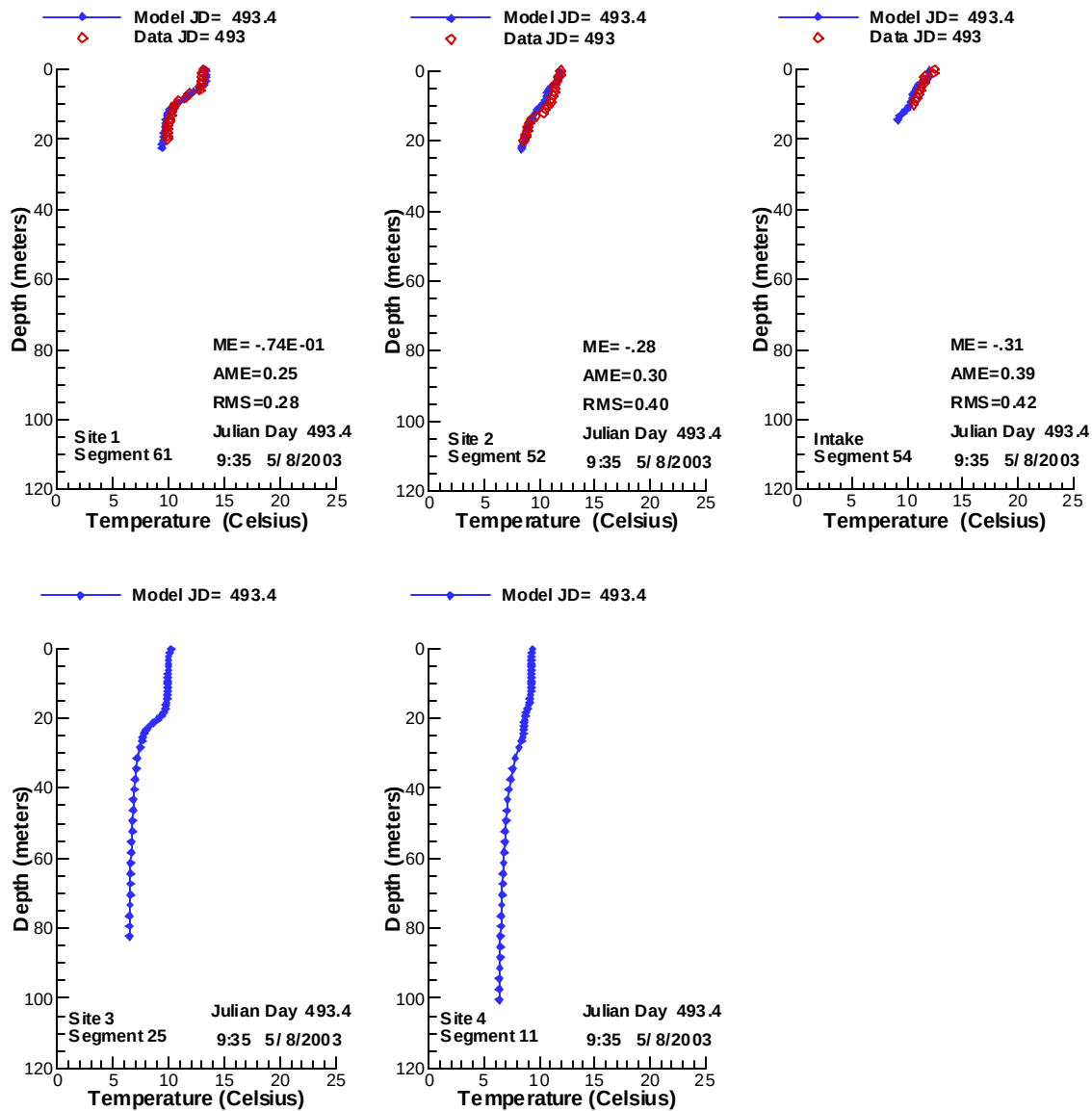


Figure 110. Vertical profiles of TEMPERATURE compared with data for 5/ 8/2003.

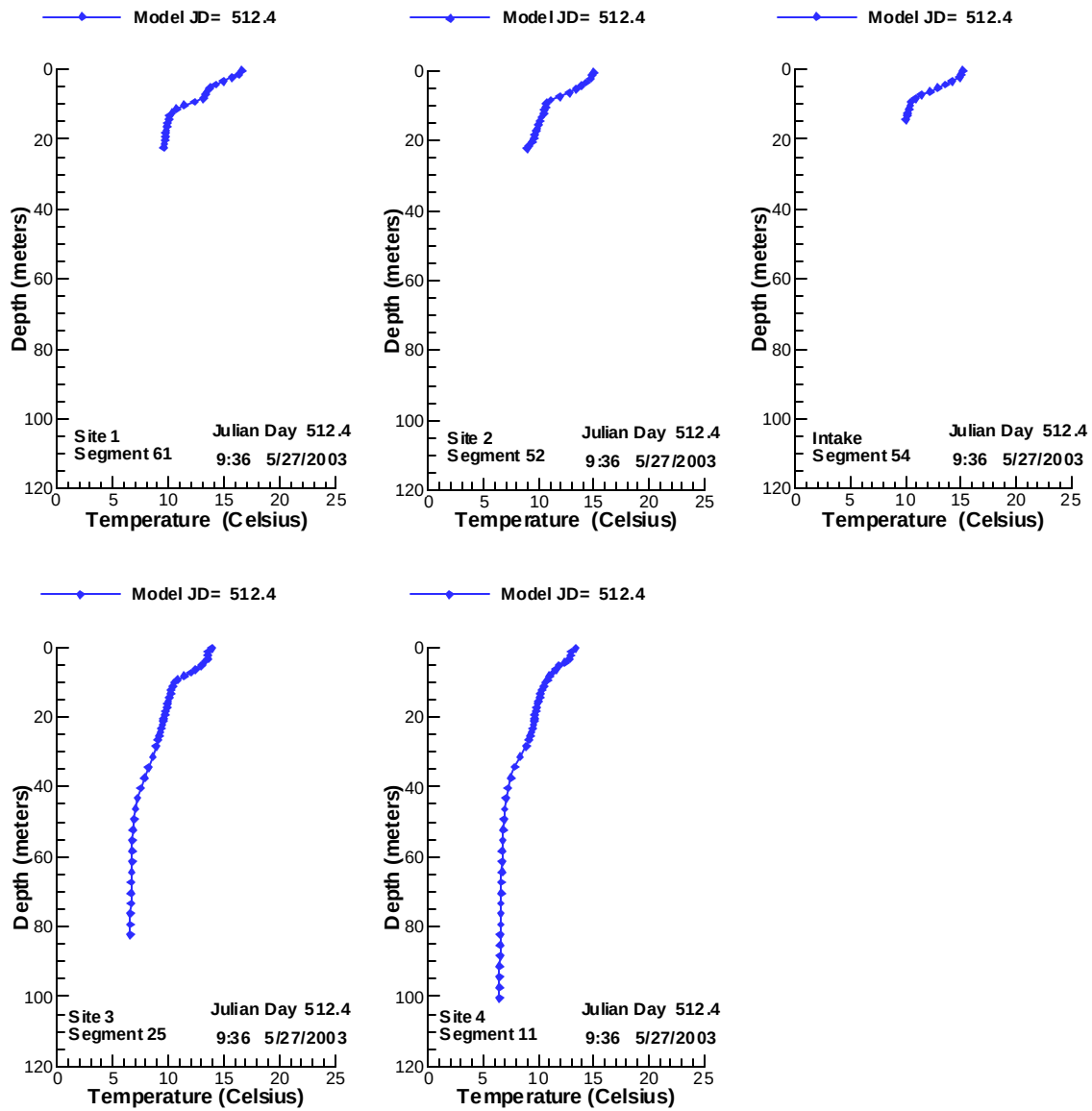


Figure 111. Vertical profiles of TEMPERATURE compared with data for 5/27/2003.

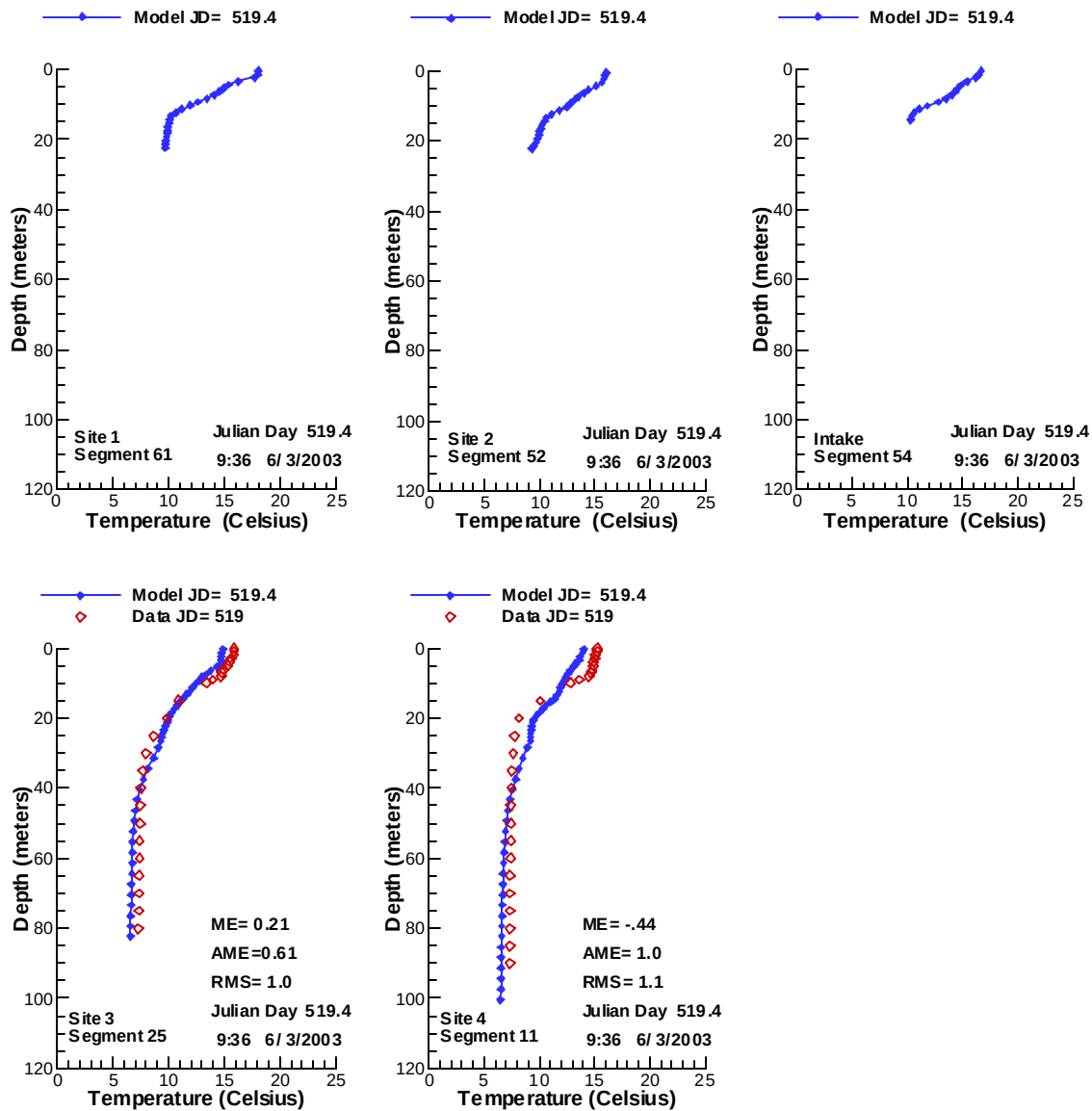


Figure 112. Vertical profiles of TEMPERATURE compared with data for 6/ 3/2003.

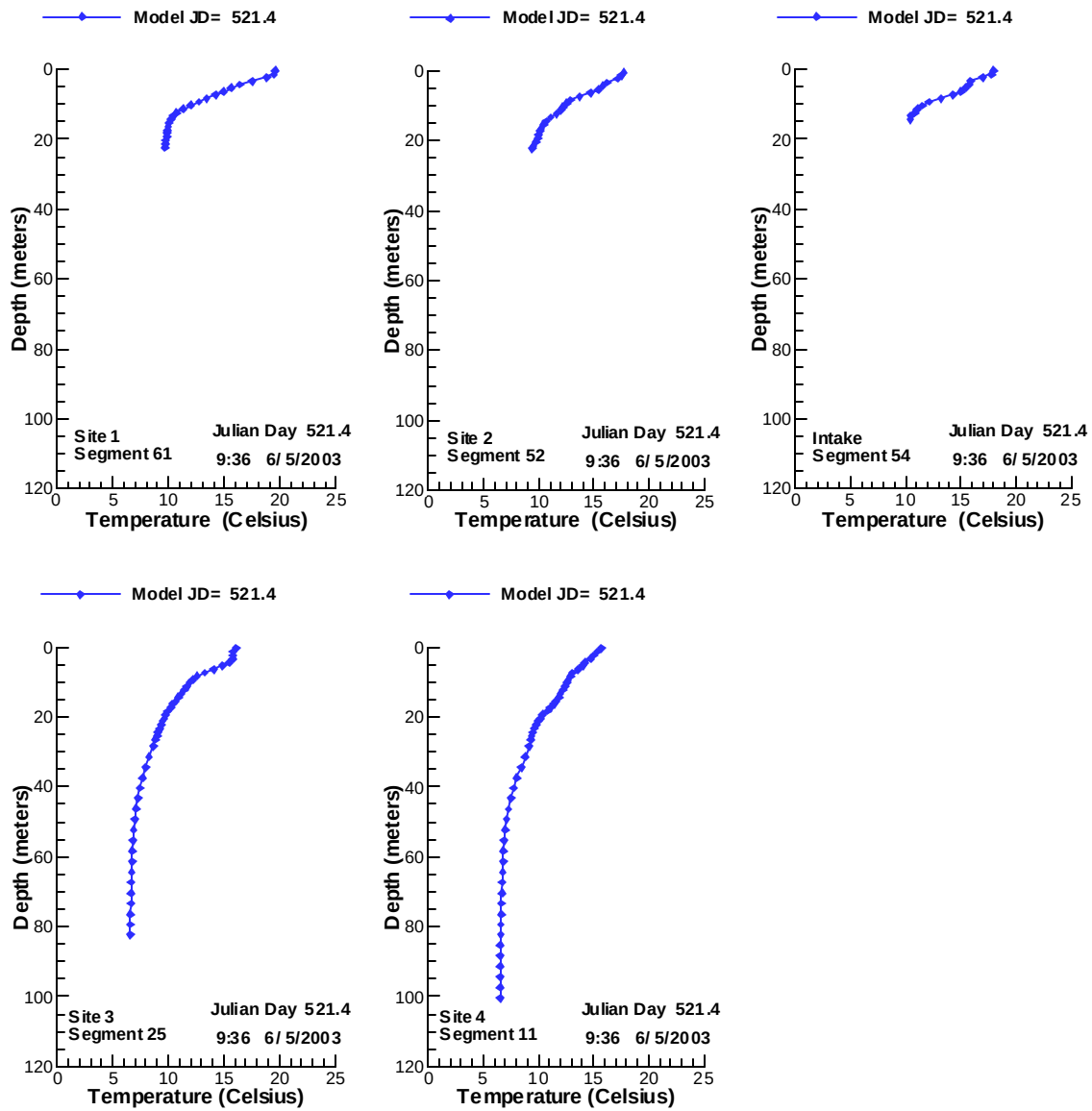


Figure 113. Vertical profiles of TEMPERATURE compared with data for 6/ 5/2003.

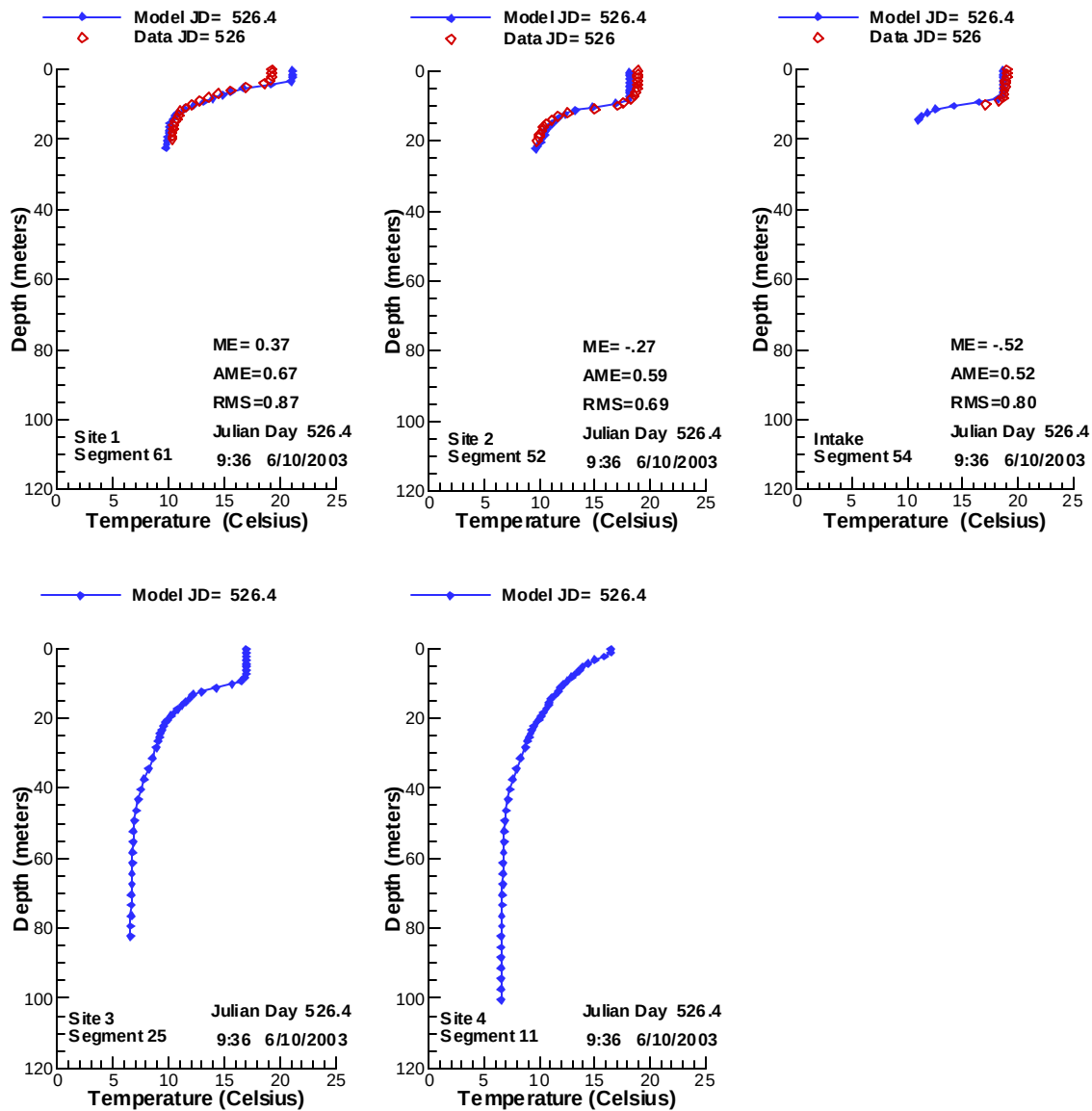


Figure 114. Vertical profiles of TEMPERATURE compared with data for 6/10/2003.

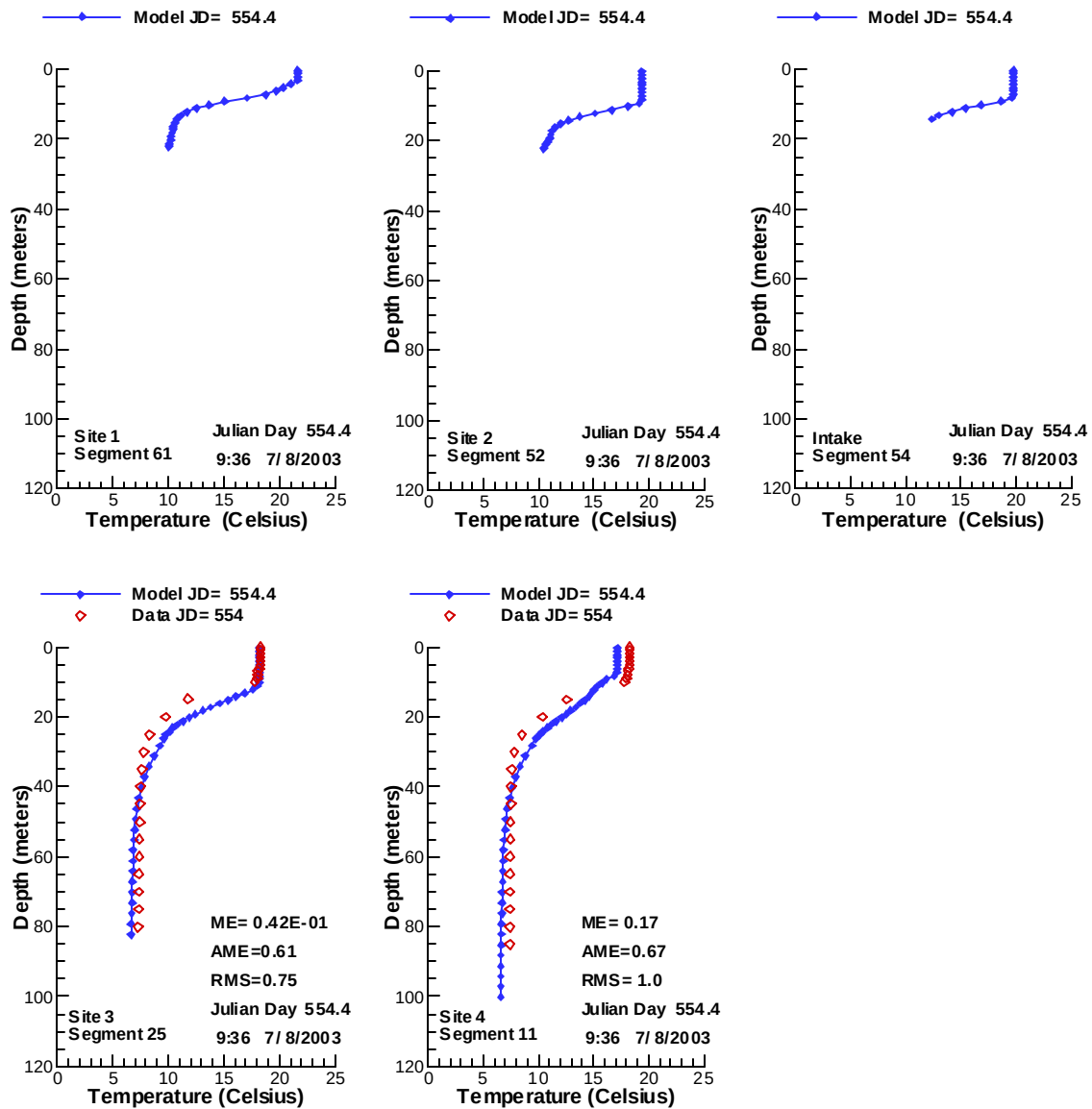


Figure 115. Vertical profiles of TEMPERATURE compared with data for 7/ 8/2003.

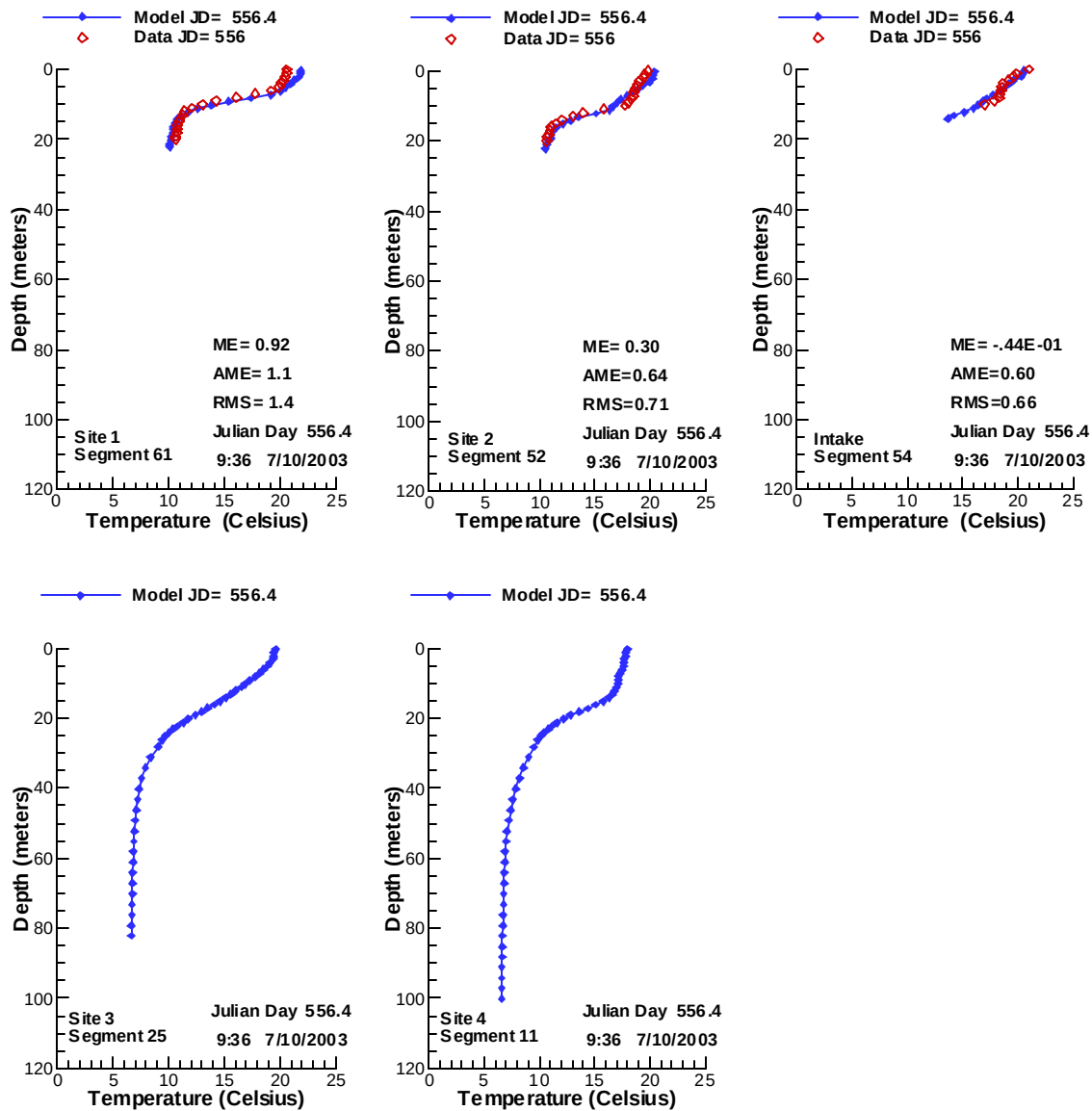


Figure 116. Vertical profiles of TEMPERATURE compared with data for 7/10/2003.

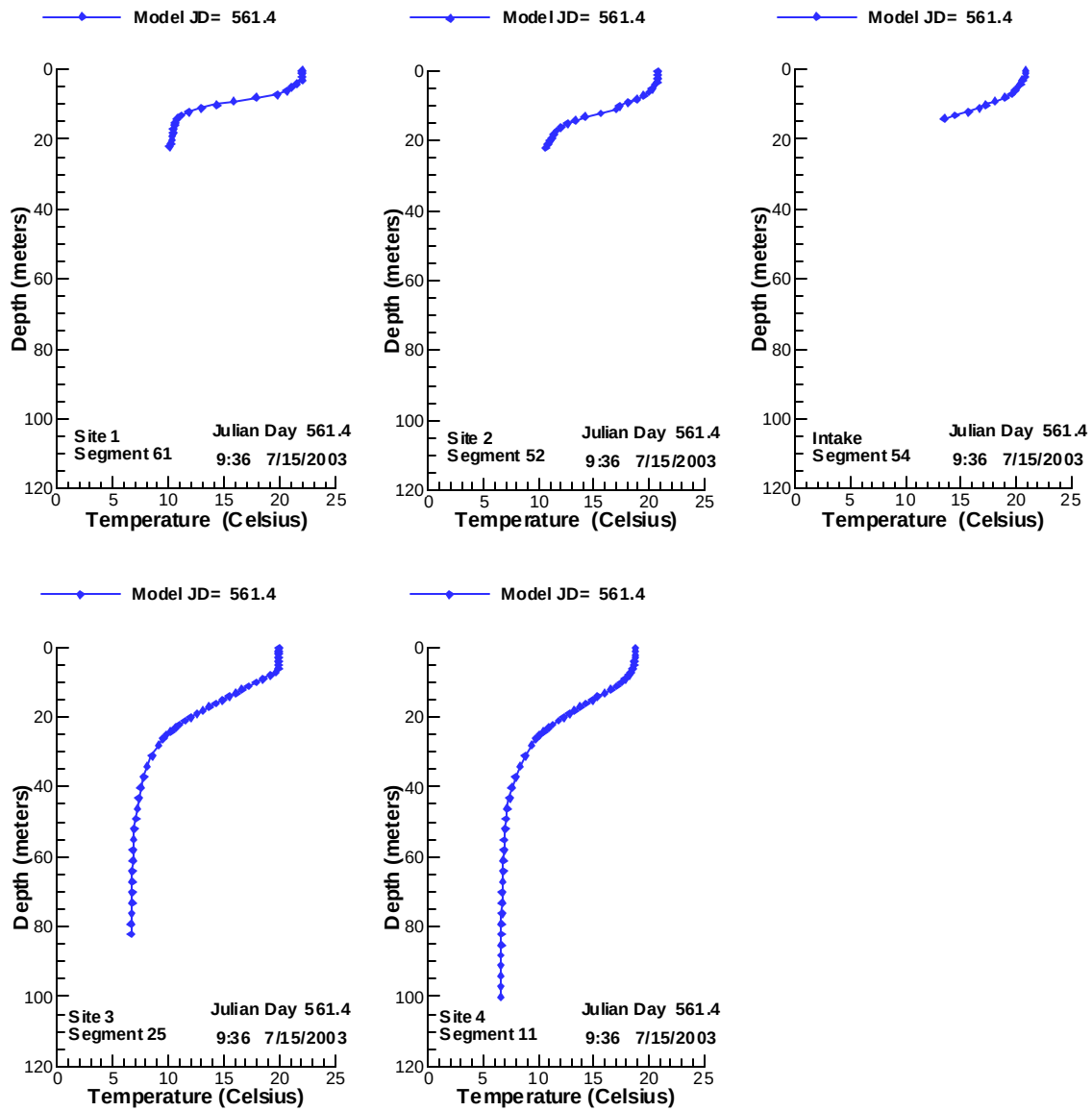


Figure 117. Vertical profiles of TEMPERATURE compared with data for 7/15/2003.

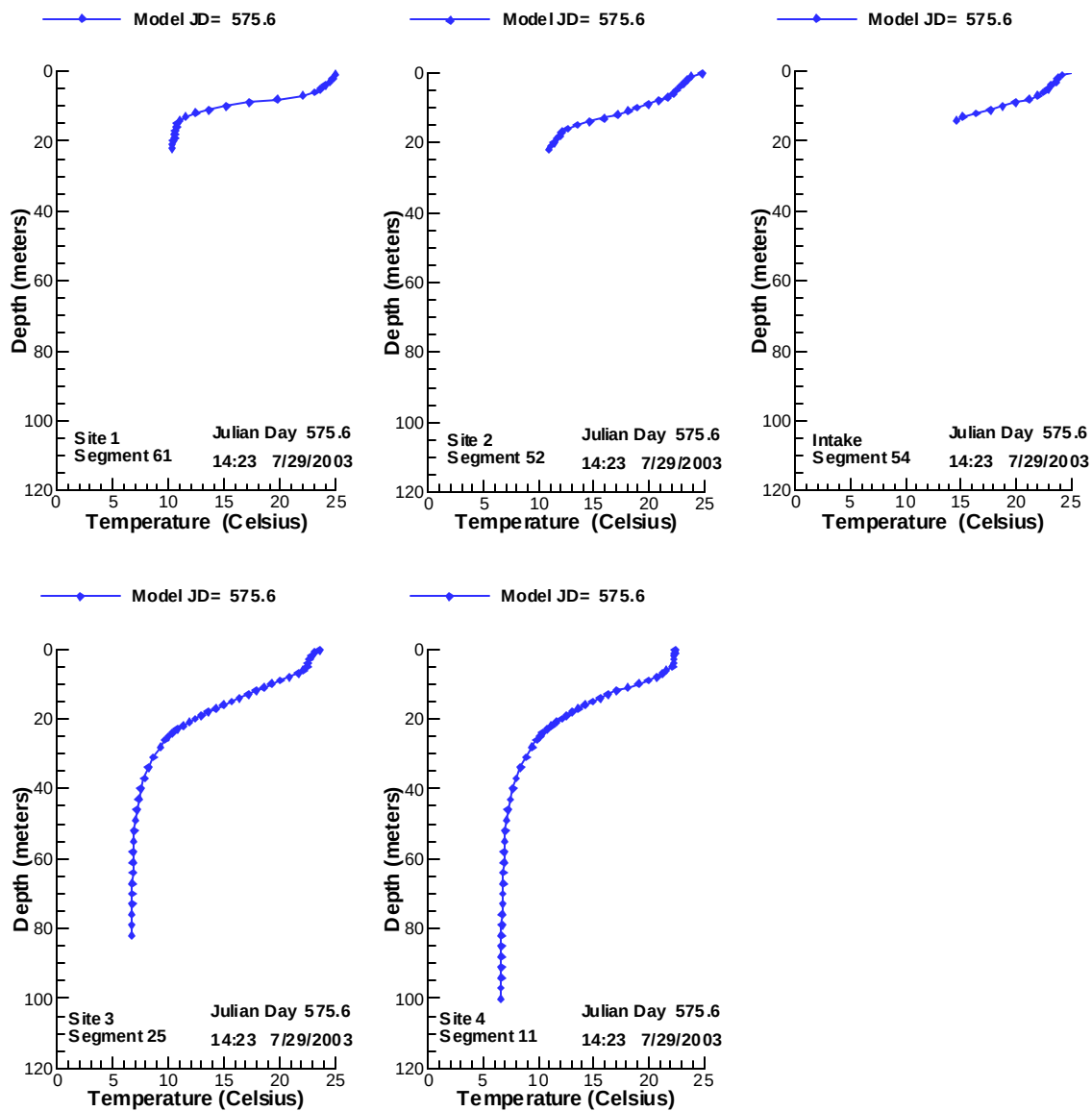


Figure 118. Vertical profiles of TEMPERATURE compared with data for 7/29/2003.

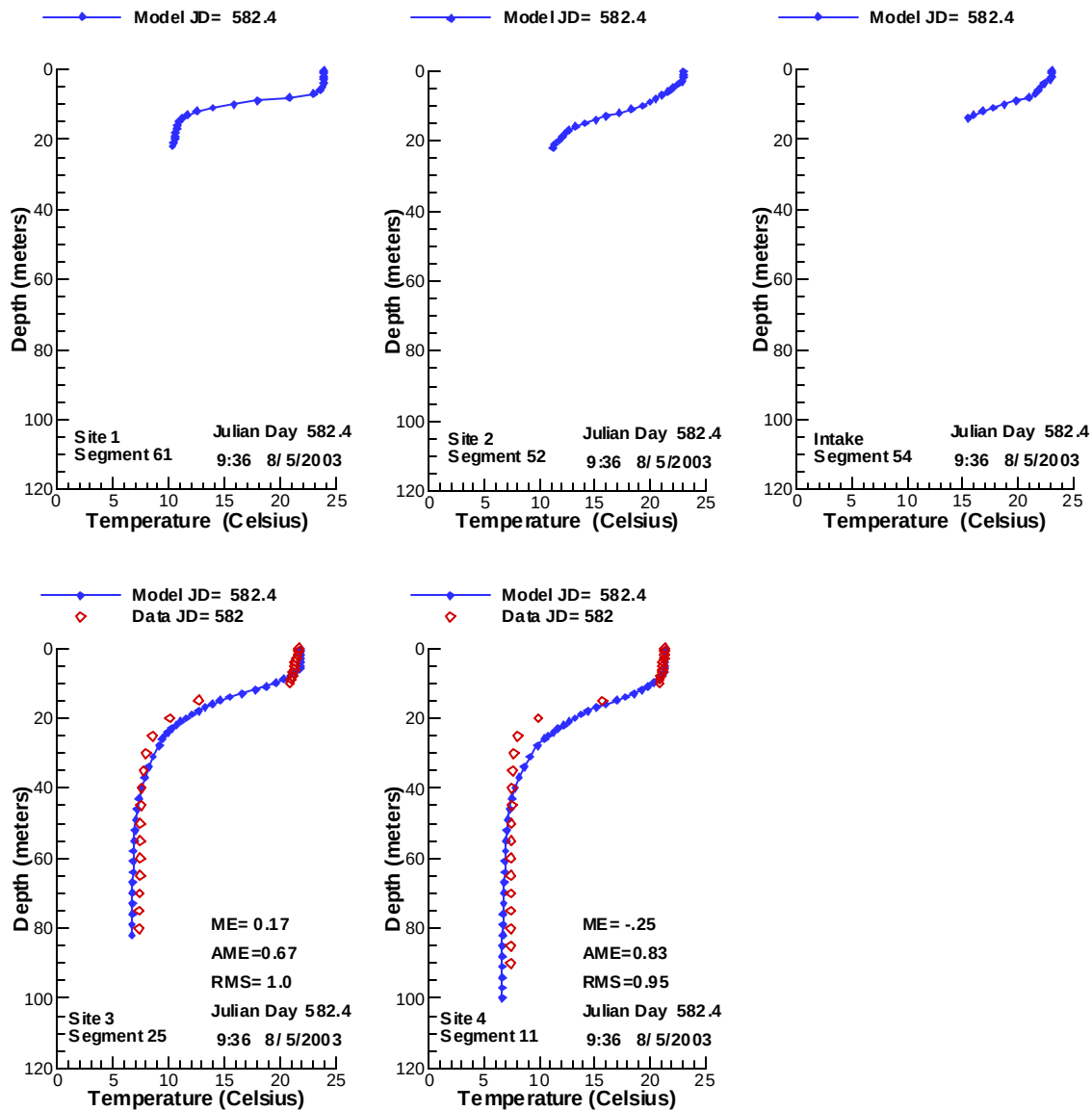


Figure 119. Vertical profiles of TEMPERATURE compared with data for 8/ 5/2003.

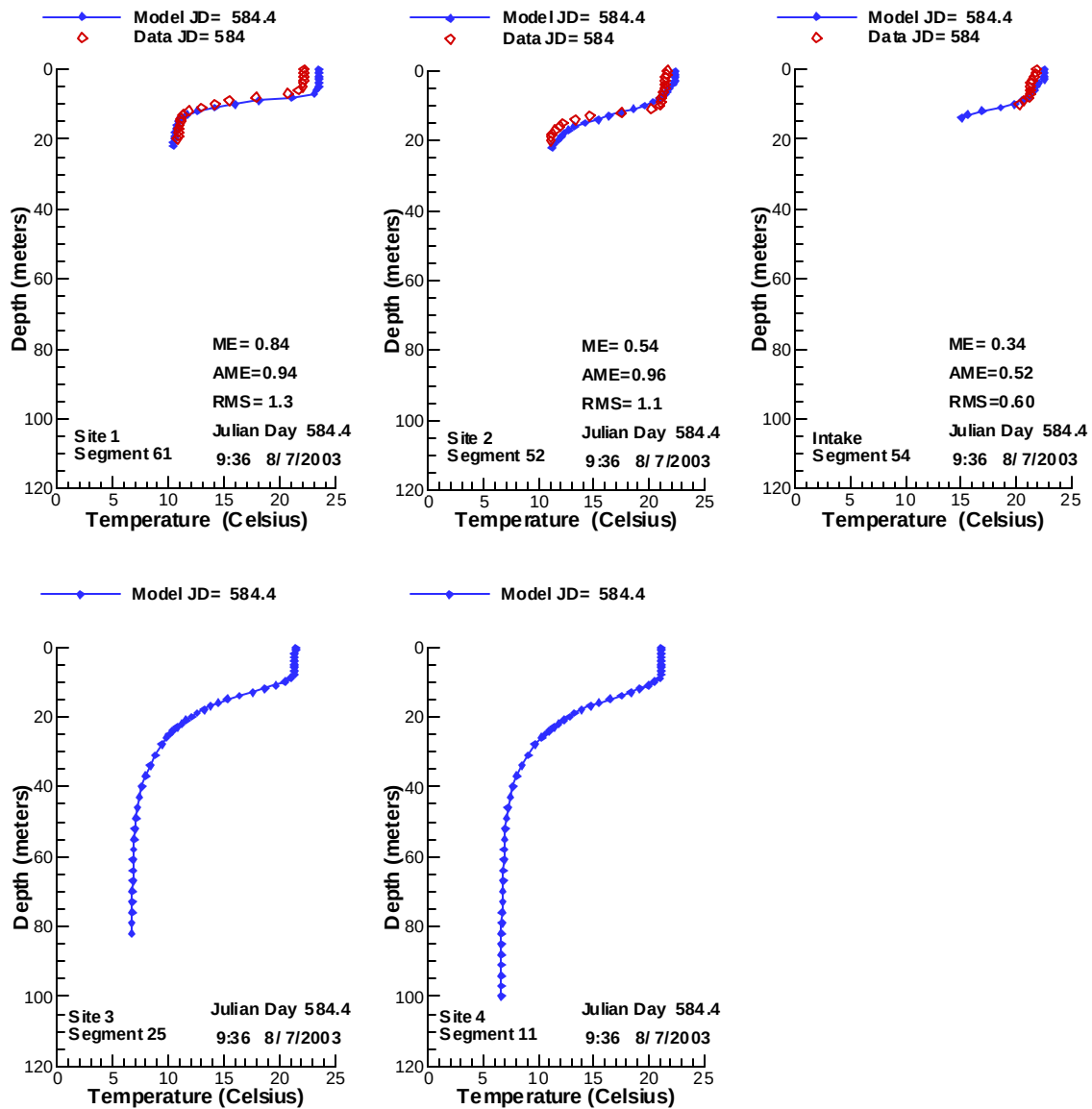


Figure 120. Vertical profiles of TEMPERATURE compared with data for 8/ 7/2003.

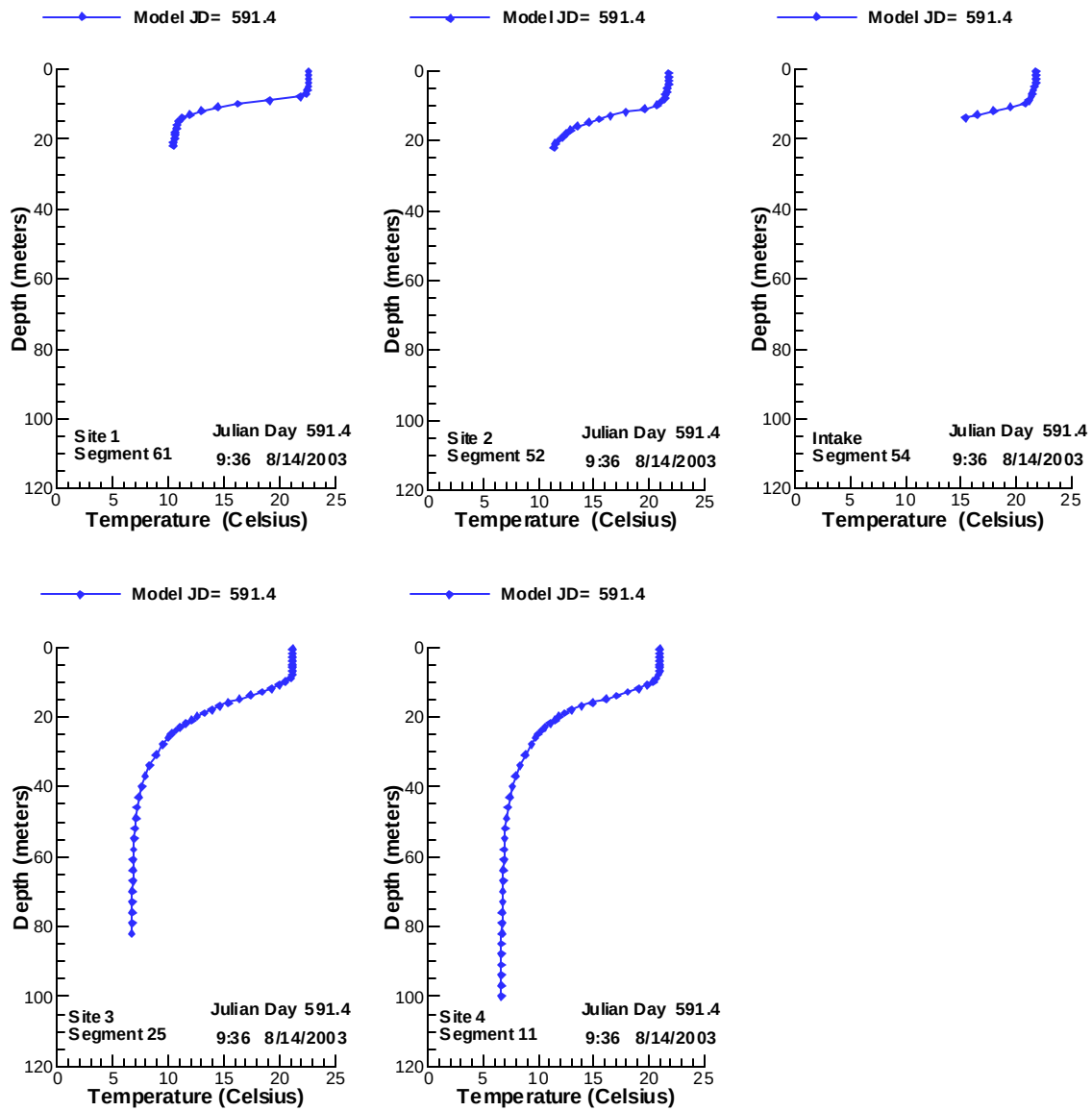


Figure 121. Vertical profiles of TEMPERATURE compared with data for 8/14/2003.

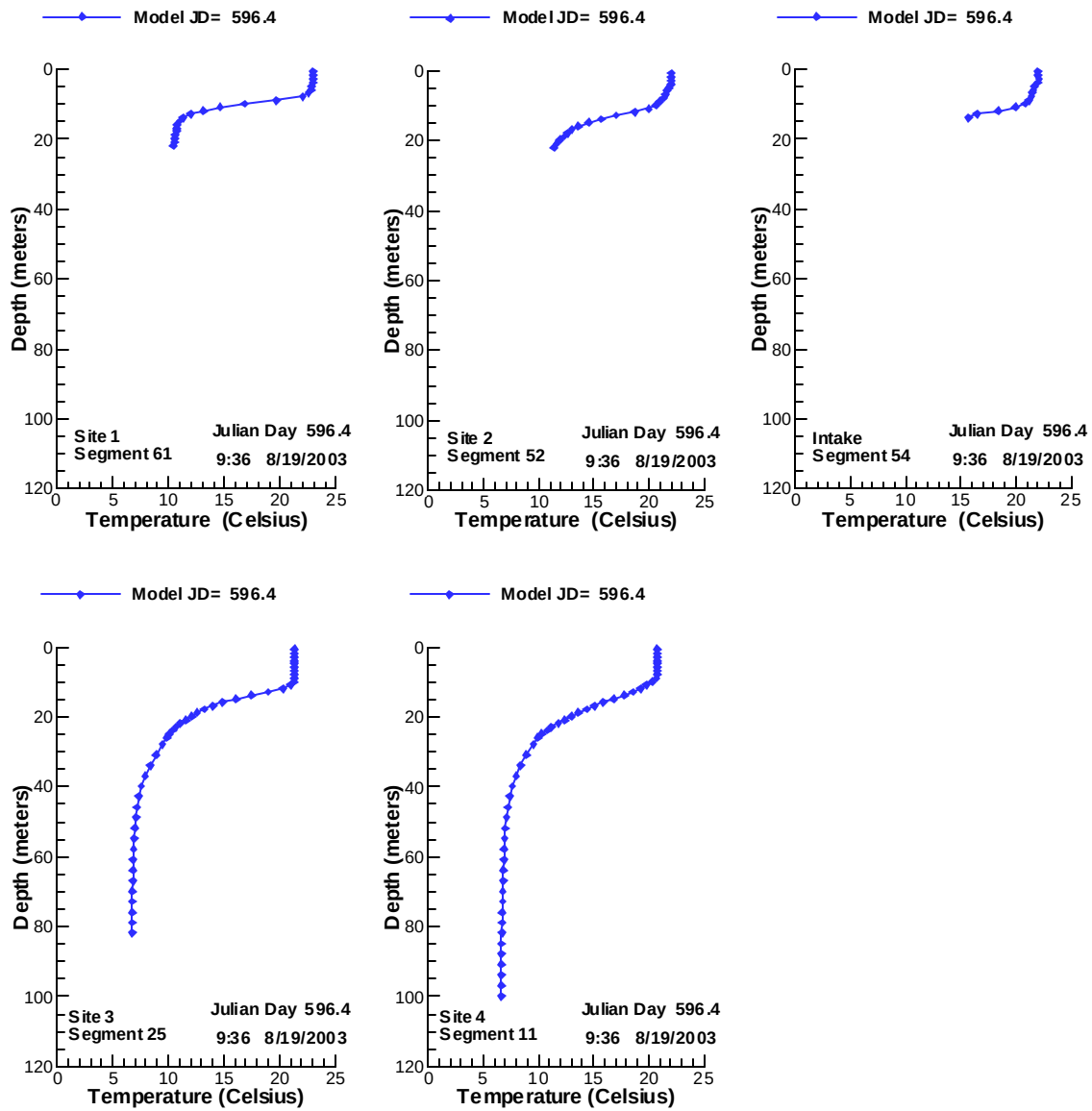


Figure 122. Vertical profiles of TEMPERATURE compared with data for 8/19/2003.

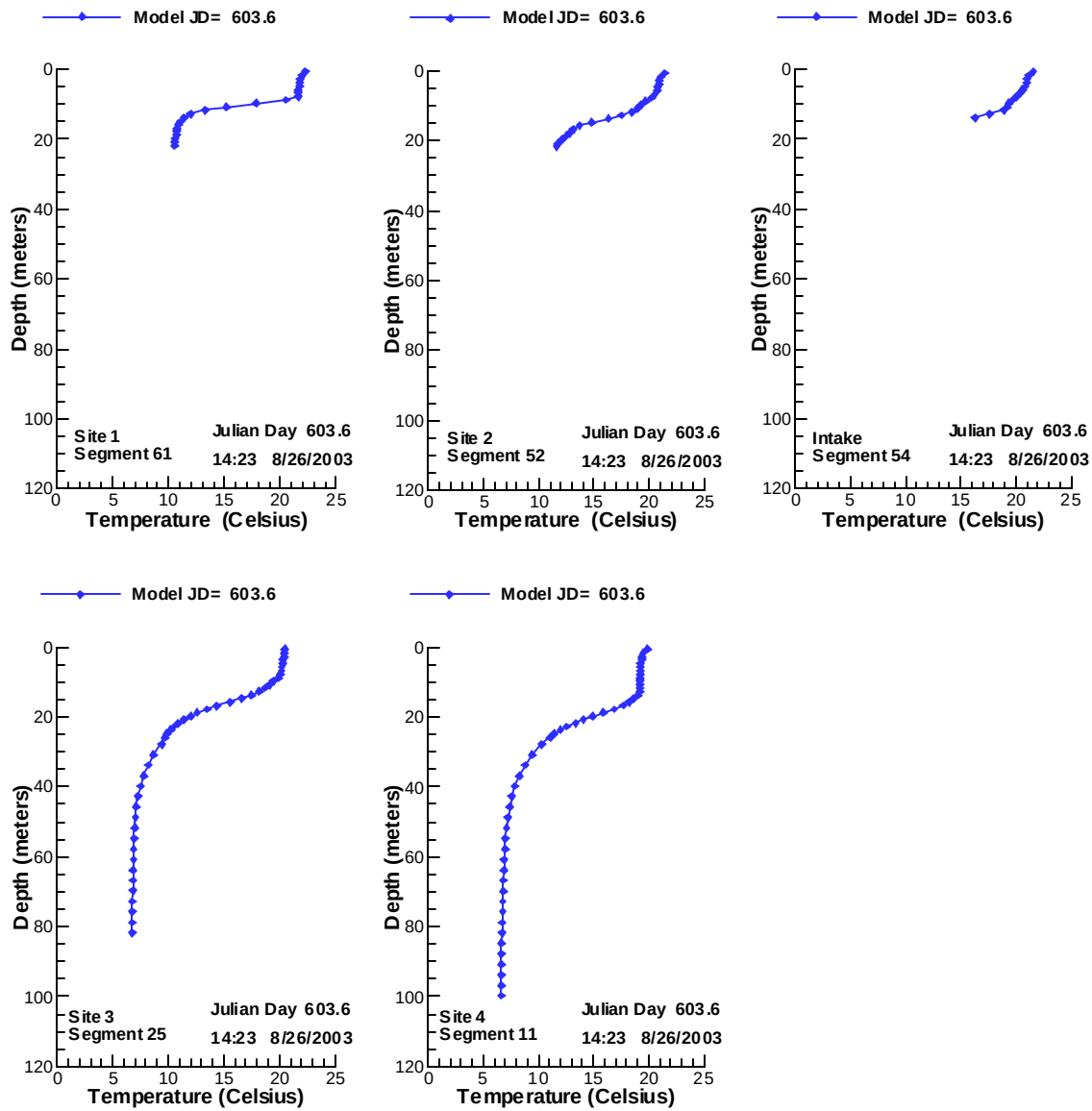


Figure 123. Vertical profiles of TEMPERATURE compared with data for 8/26/2003.

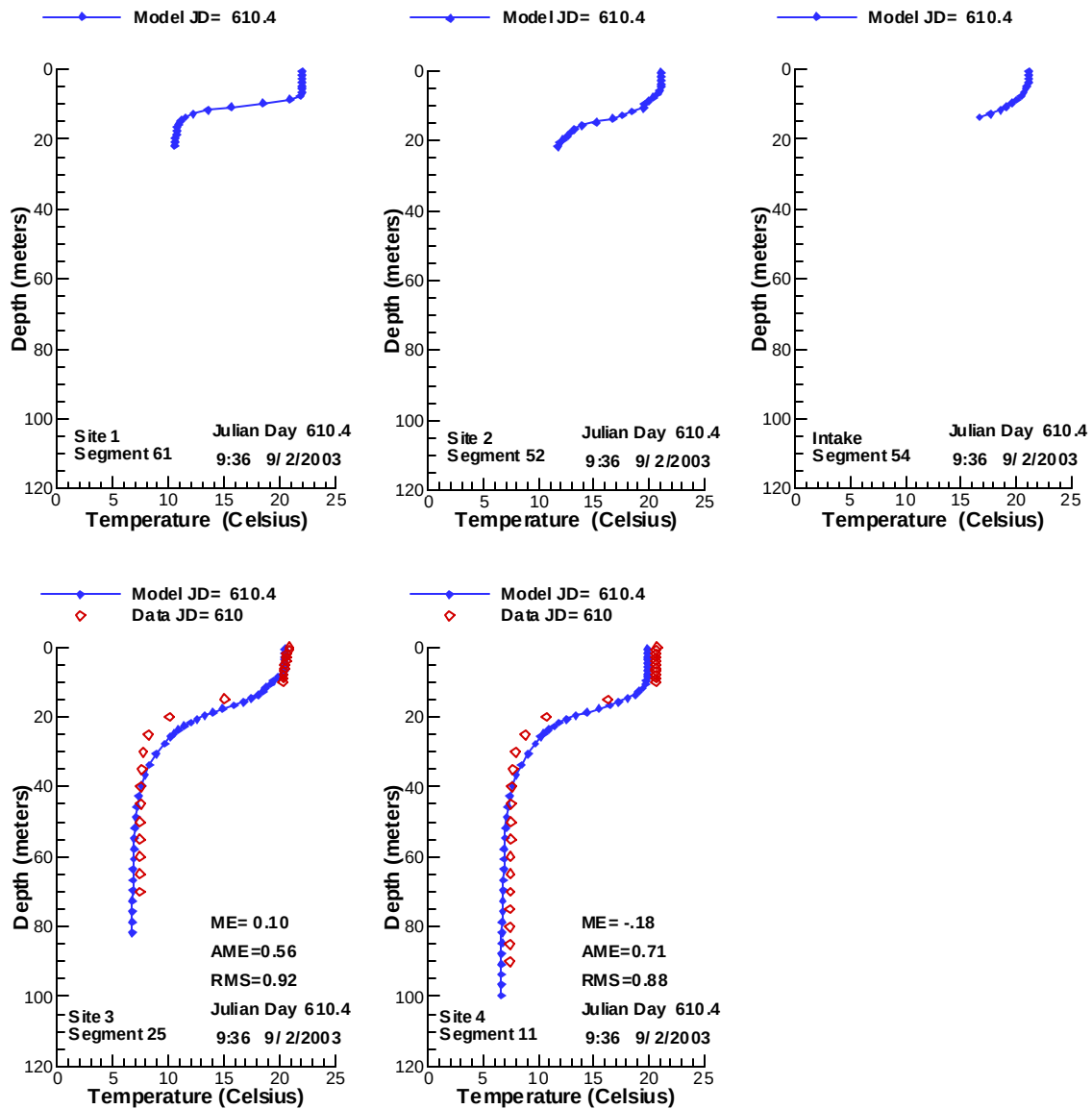


Figure 124. Vertical profiles of TEMPERATURE compared with data for 9/ 2/2003.

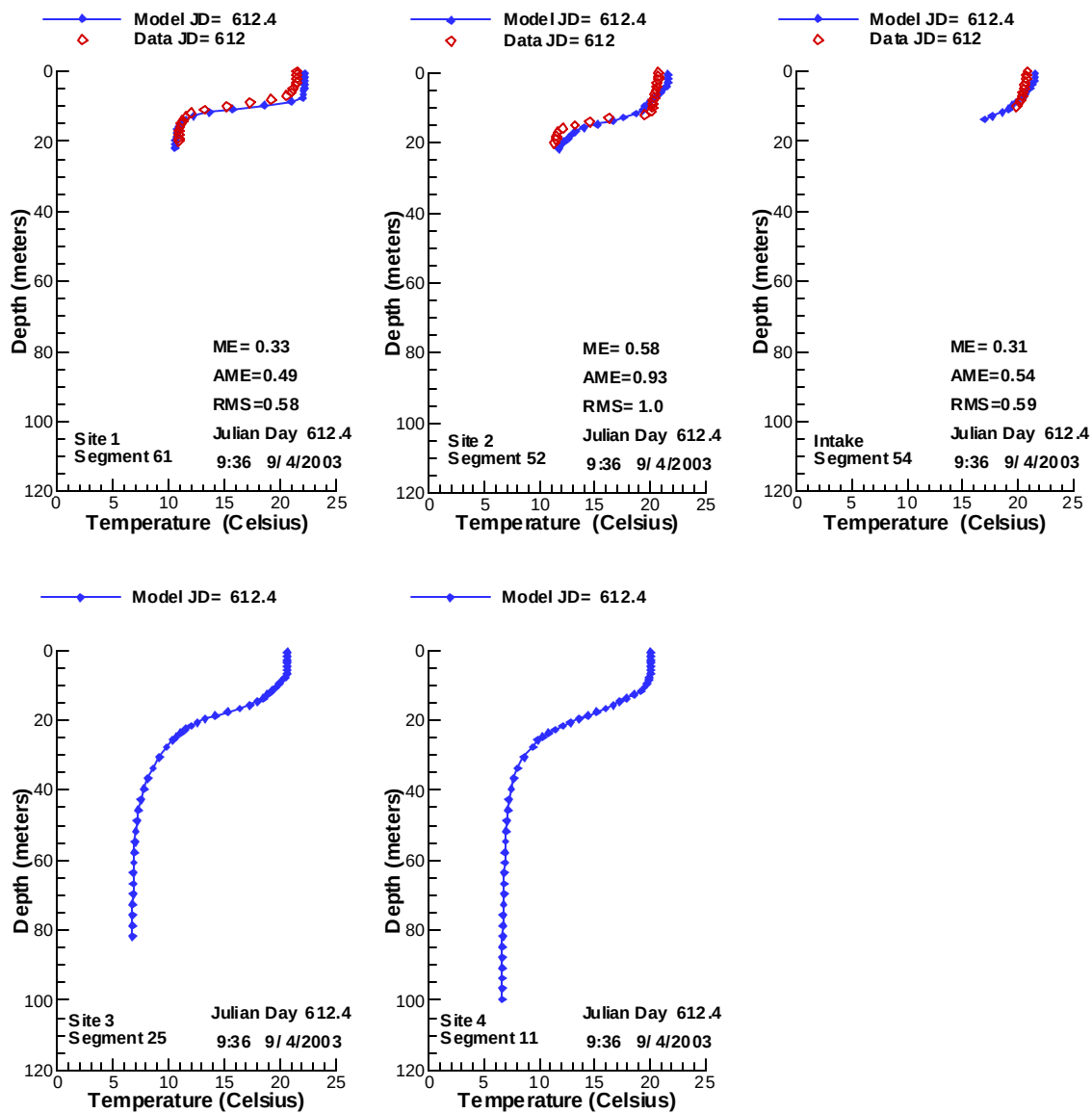


Figure 125. Vertical profiles of TEMPERATURE compared with data for 9/ 4/2003.

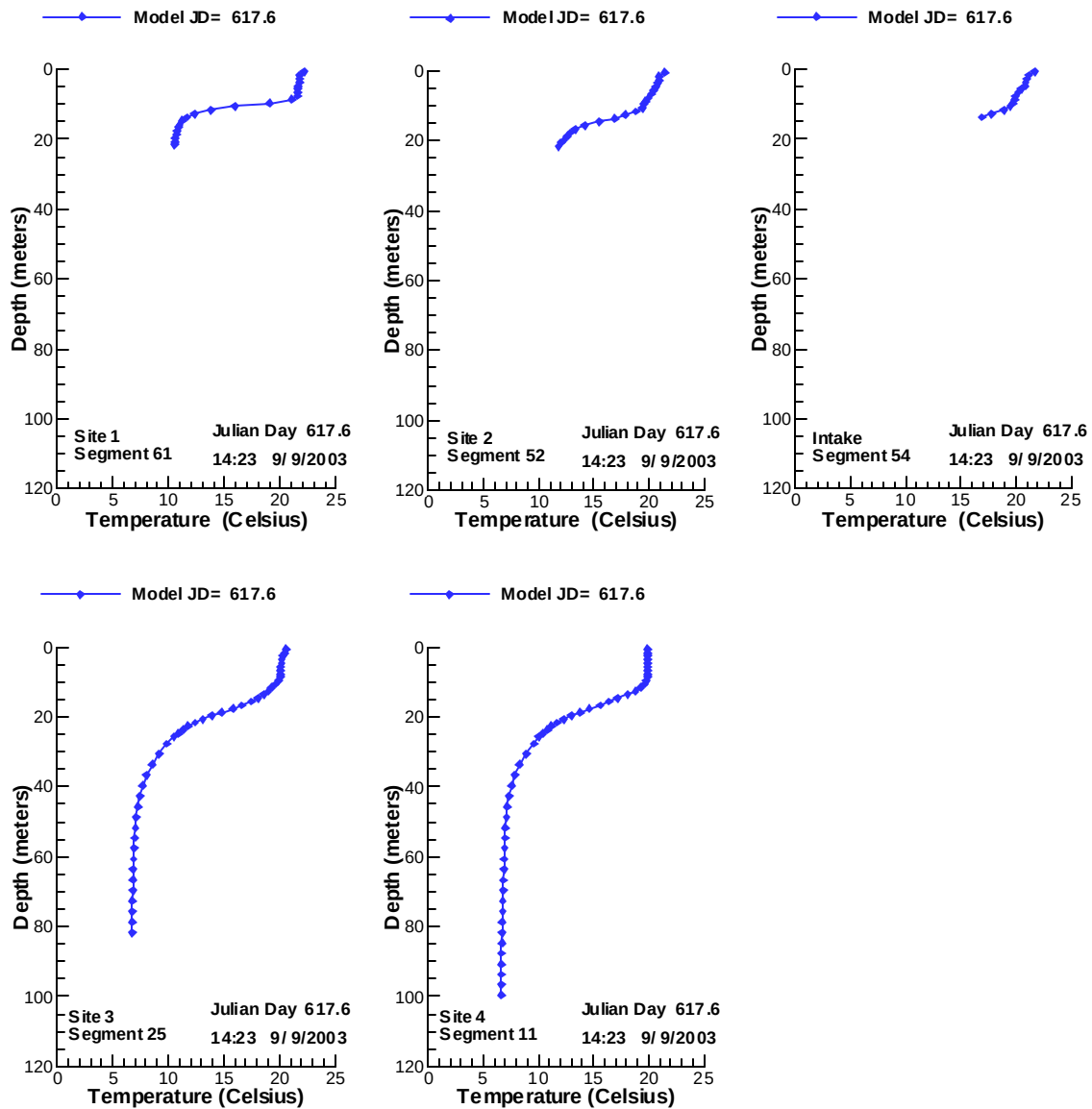


Figure 126. Vertical profiles of TEMPERATURE compared with data for 9/ 9/2003.

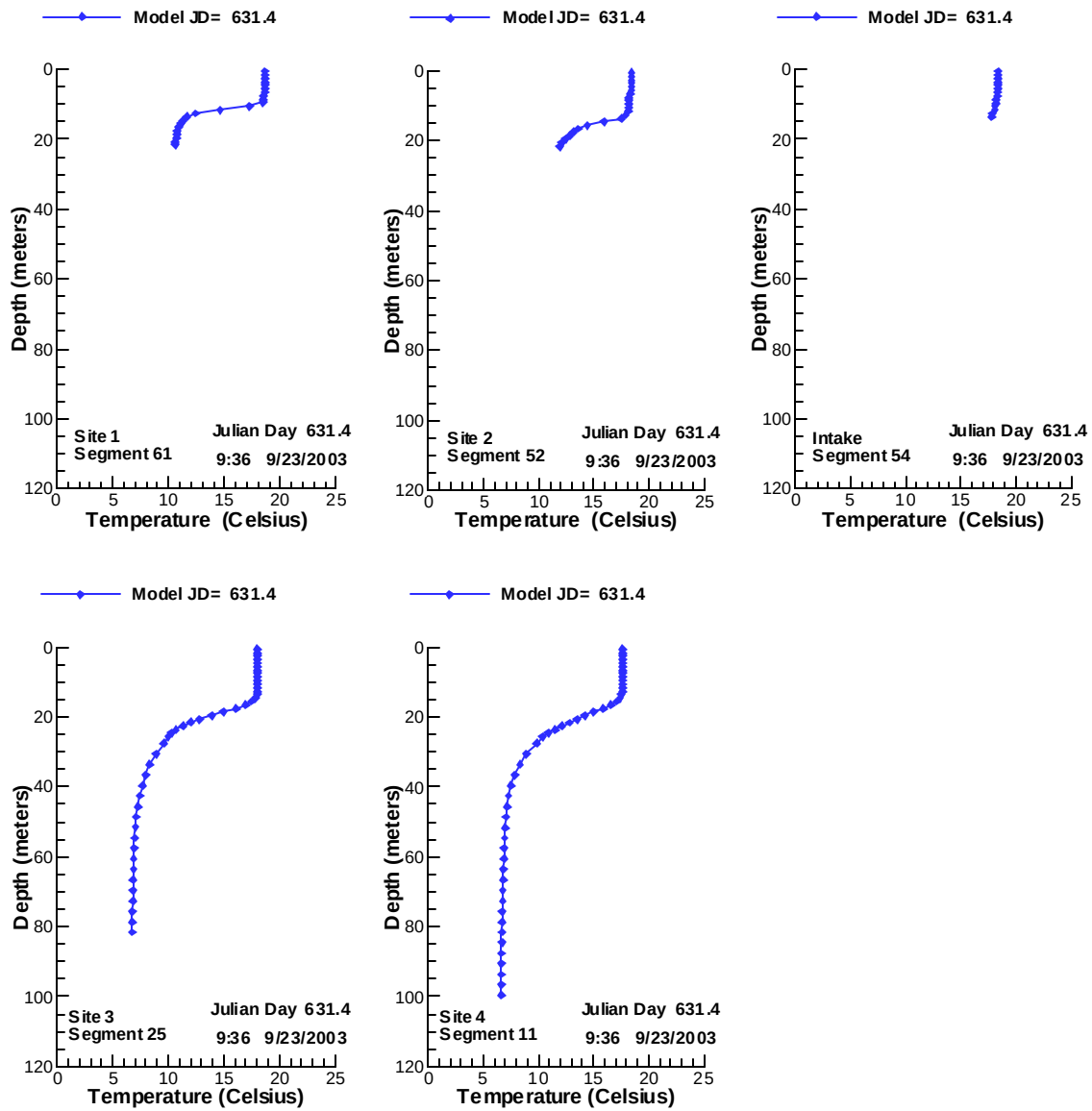


Figure 127. Vertical profiles of TEMPERATURE compared with data for 9/23/2003.

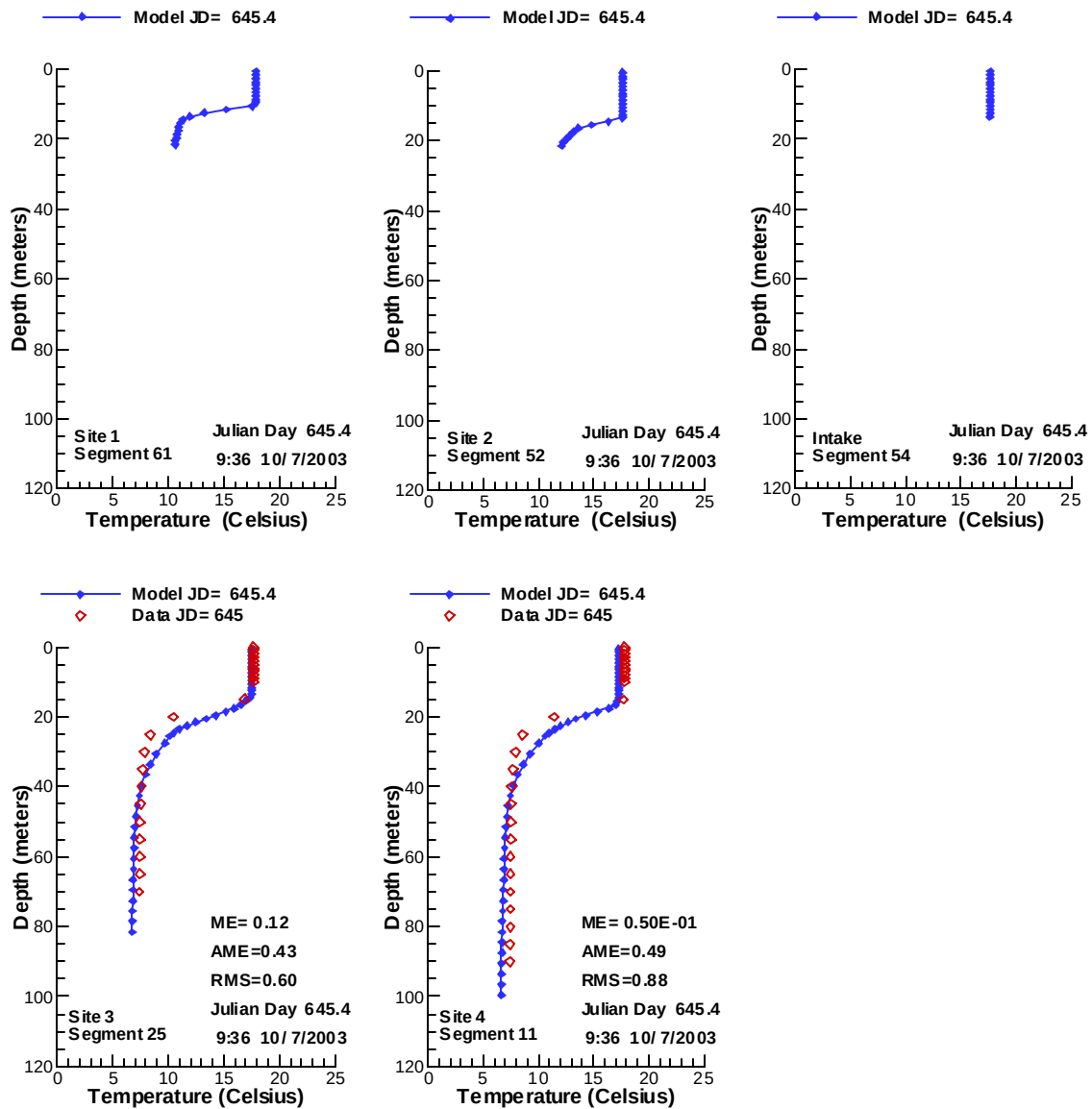


Figure 128. Vertical profiles of TEMPERATURE compared with data for 10/ 7/2003.

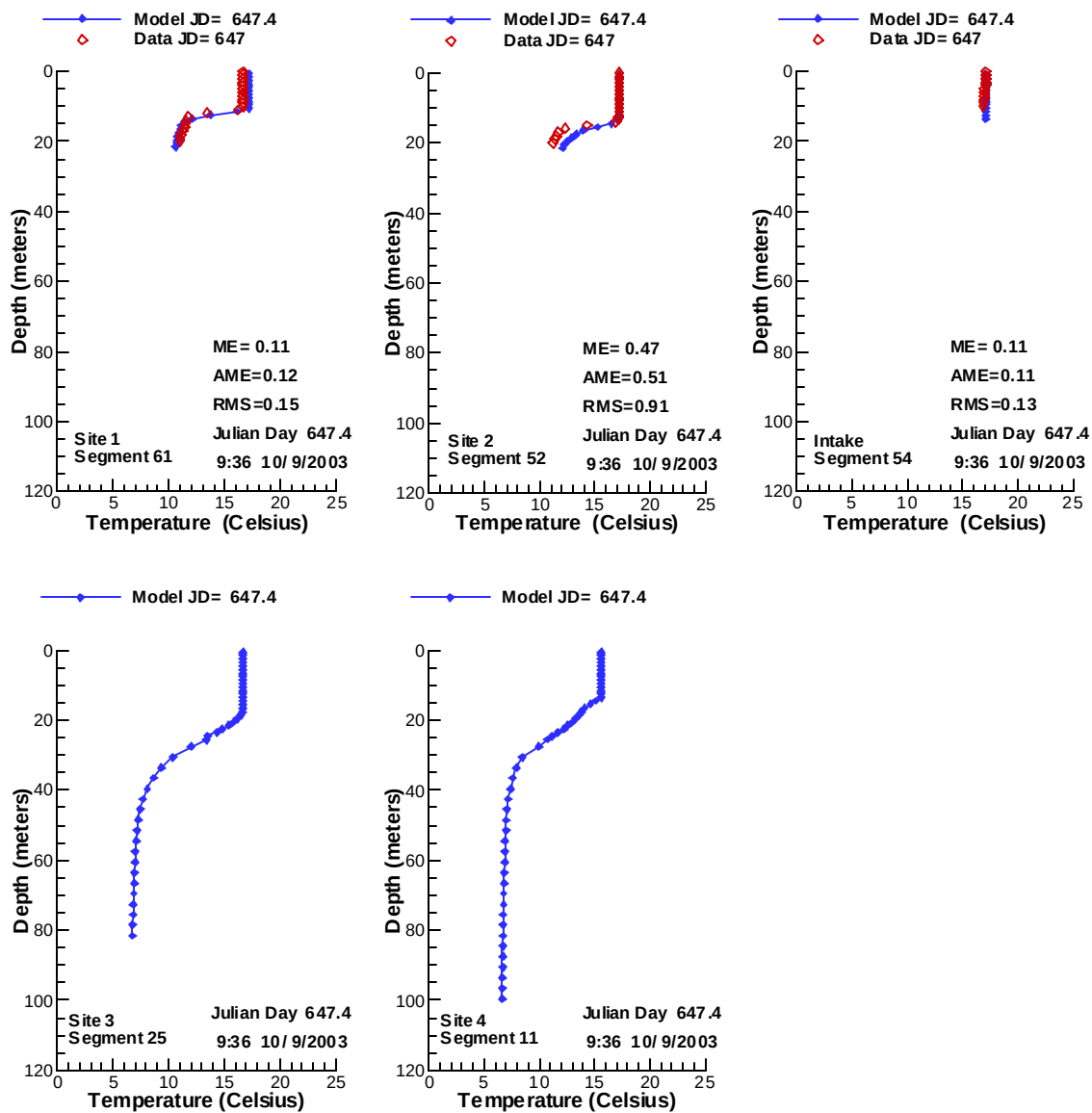


Figure 129. Vertical profiles of TEMPERATURE compared with data for 10/ 9/2003.

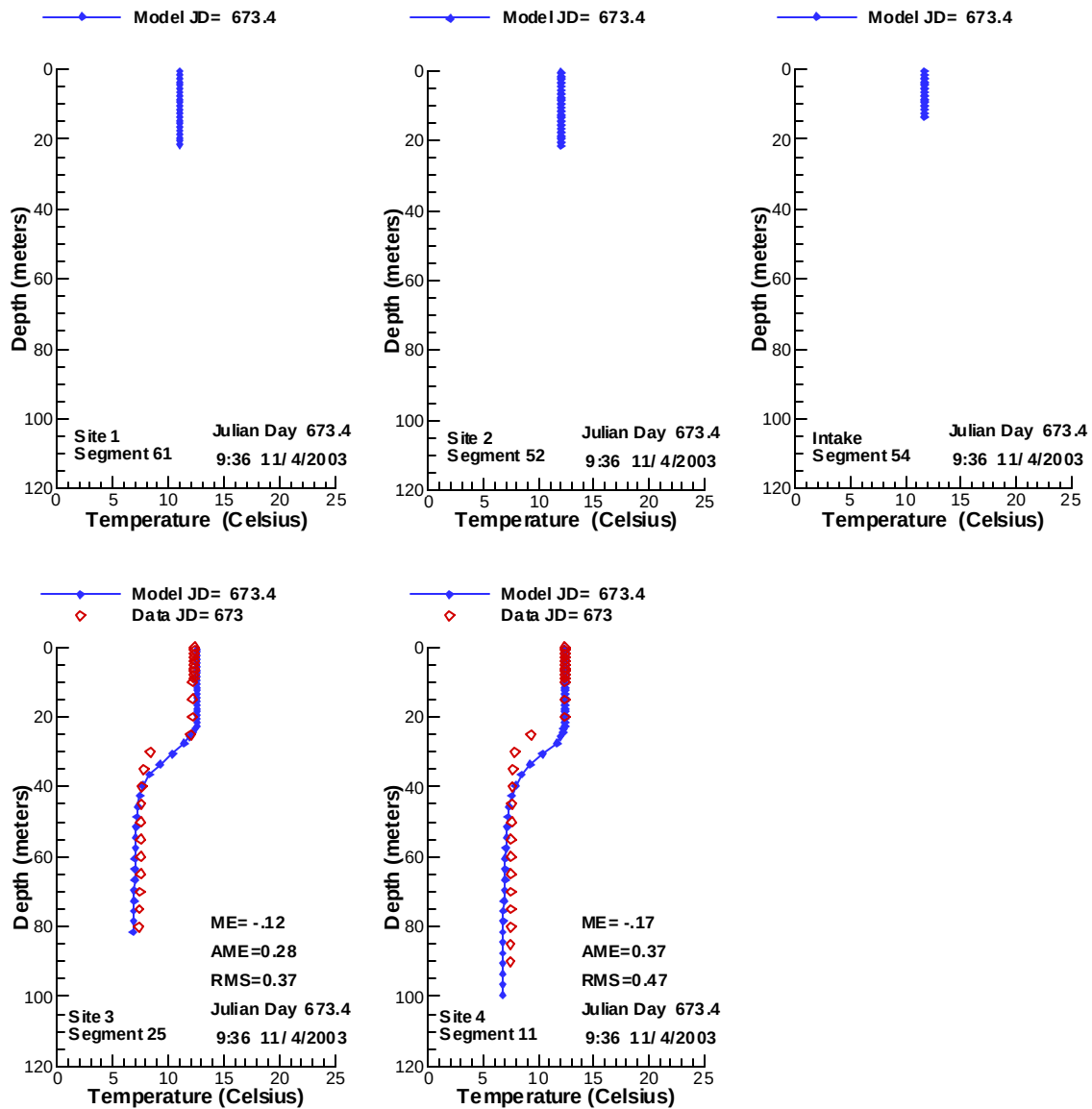


Figure 130. Vertical profiles of TEMPERATURE compared with data for 11/ 4/2003.

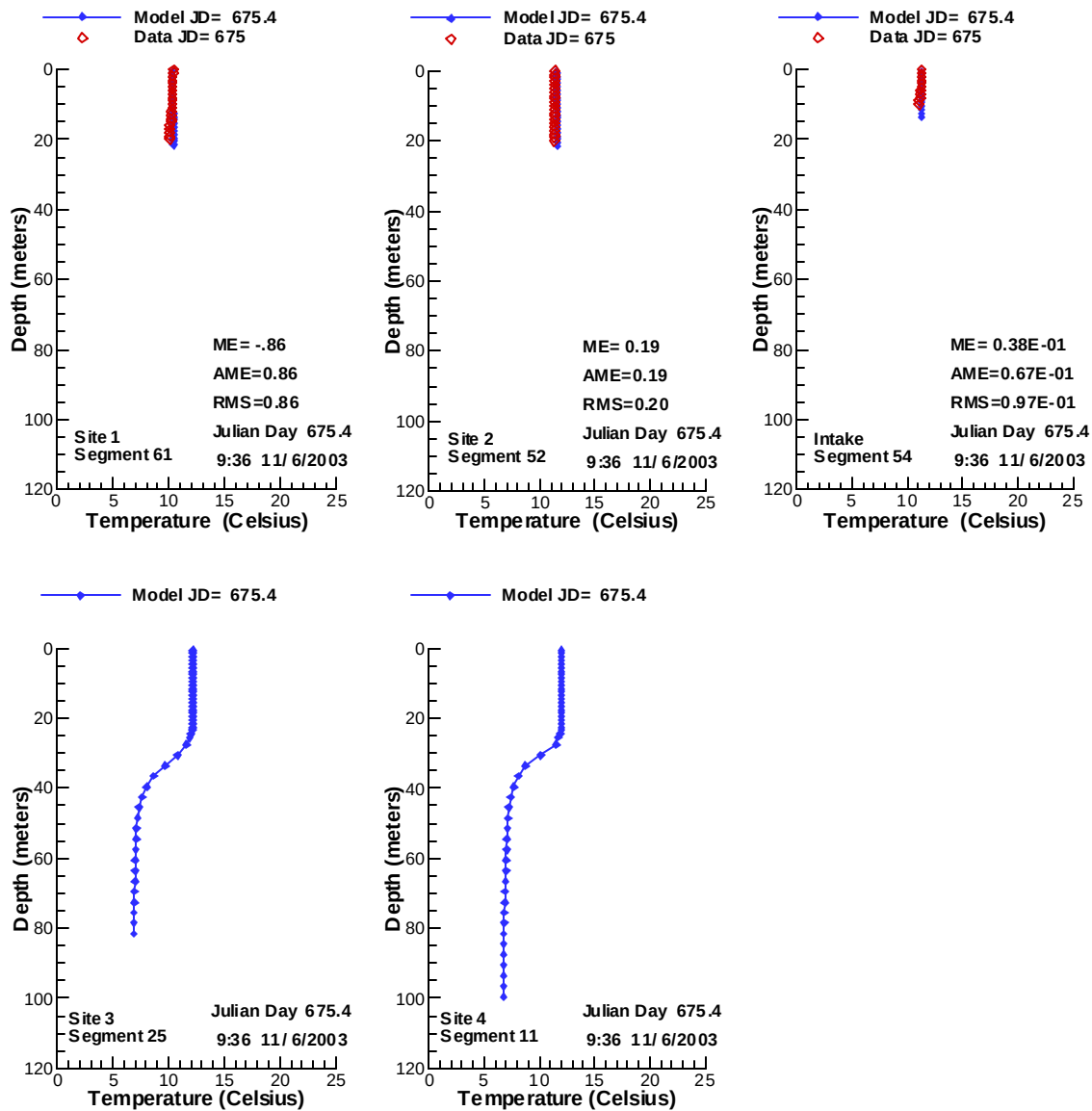


Figure 131. Vertical profiles of TEMPERATURE compared with data for 11/ 6/2003.

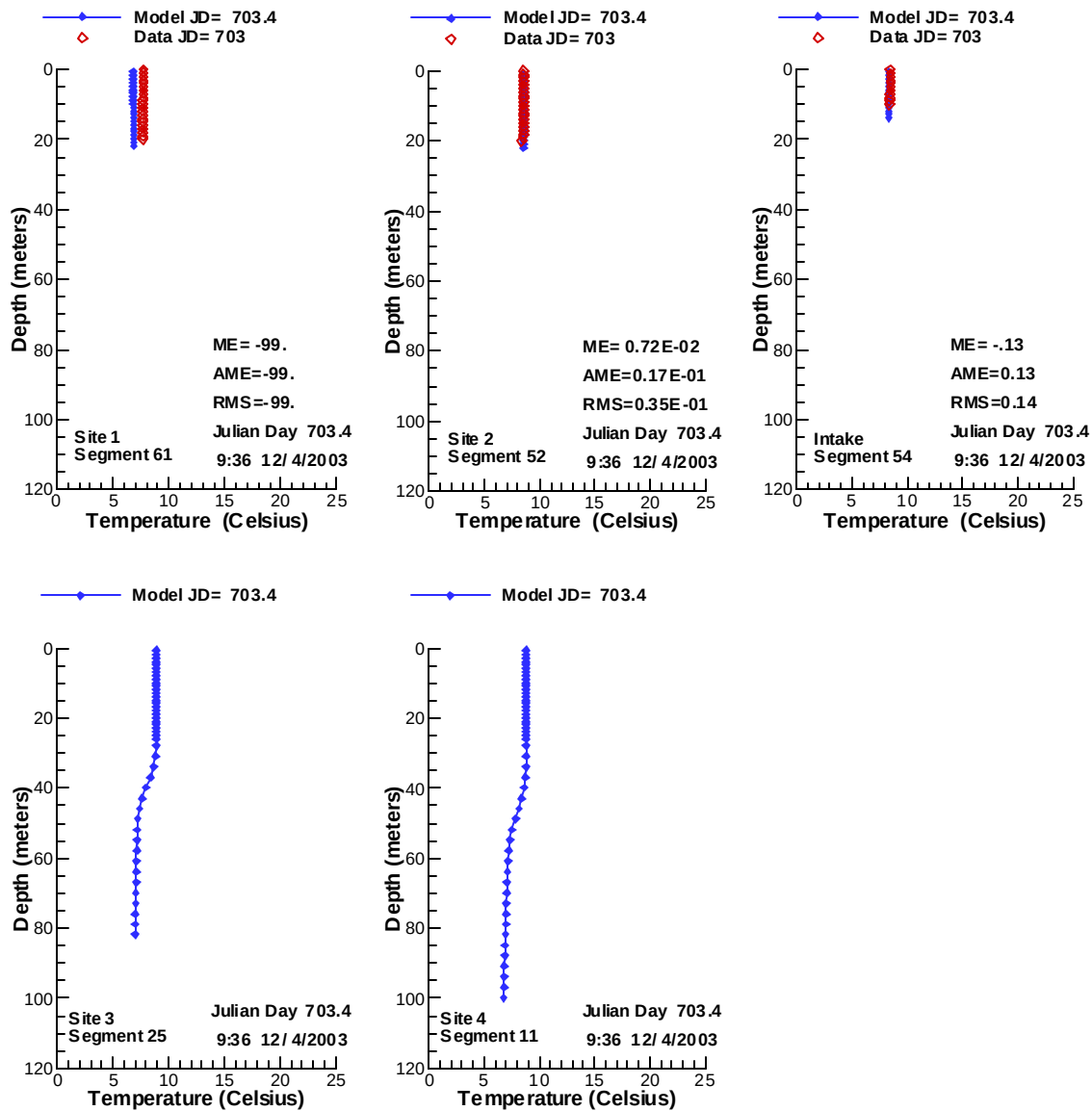


Figure 132. Vertical profiles of TEMPERATURE compared with data for 12/ 4/2003.

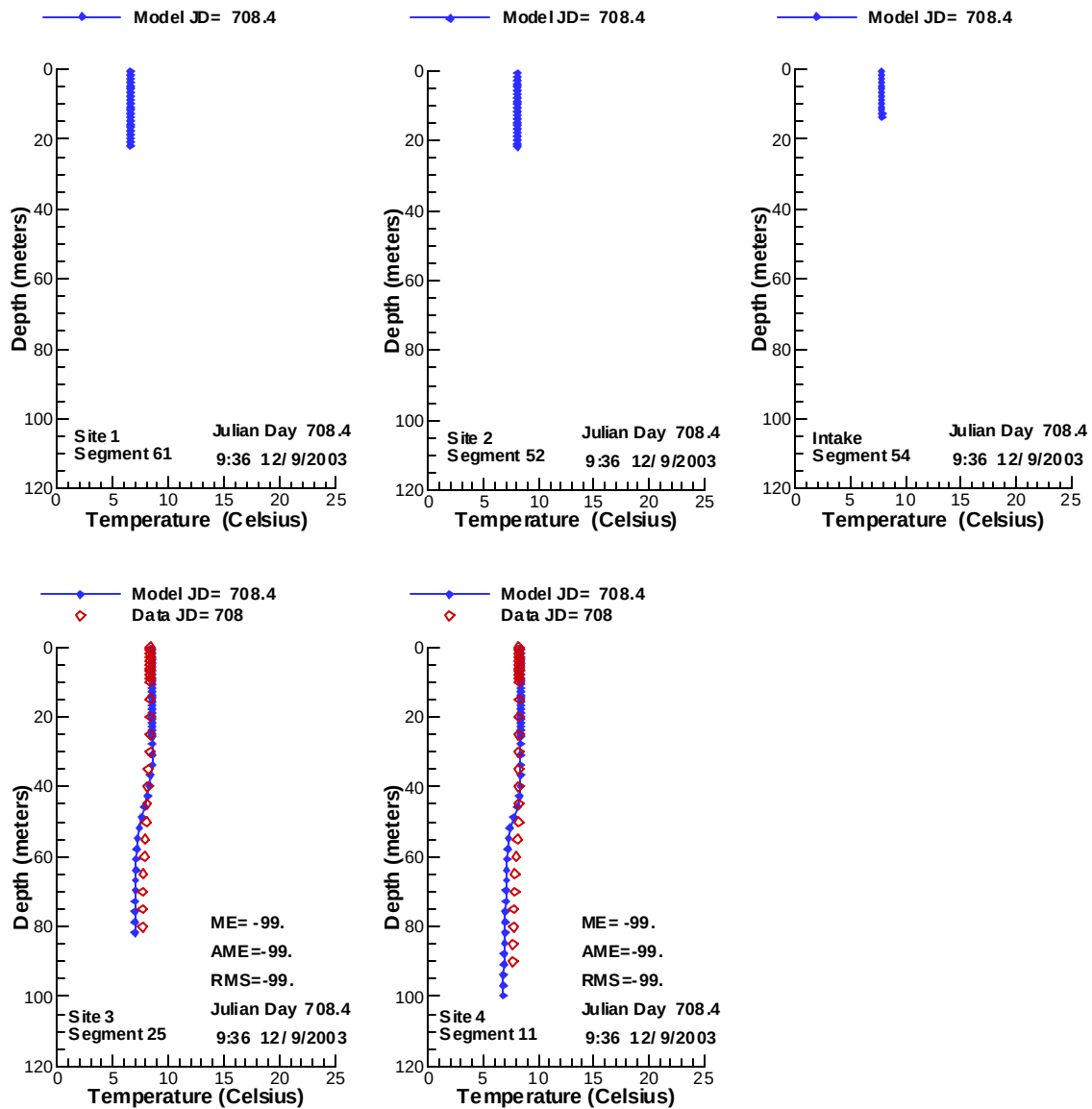


Figure 133. Vertical profiles of TEMPERATURE compared with data for 12/ 9/2003.

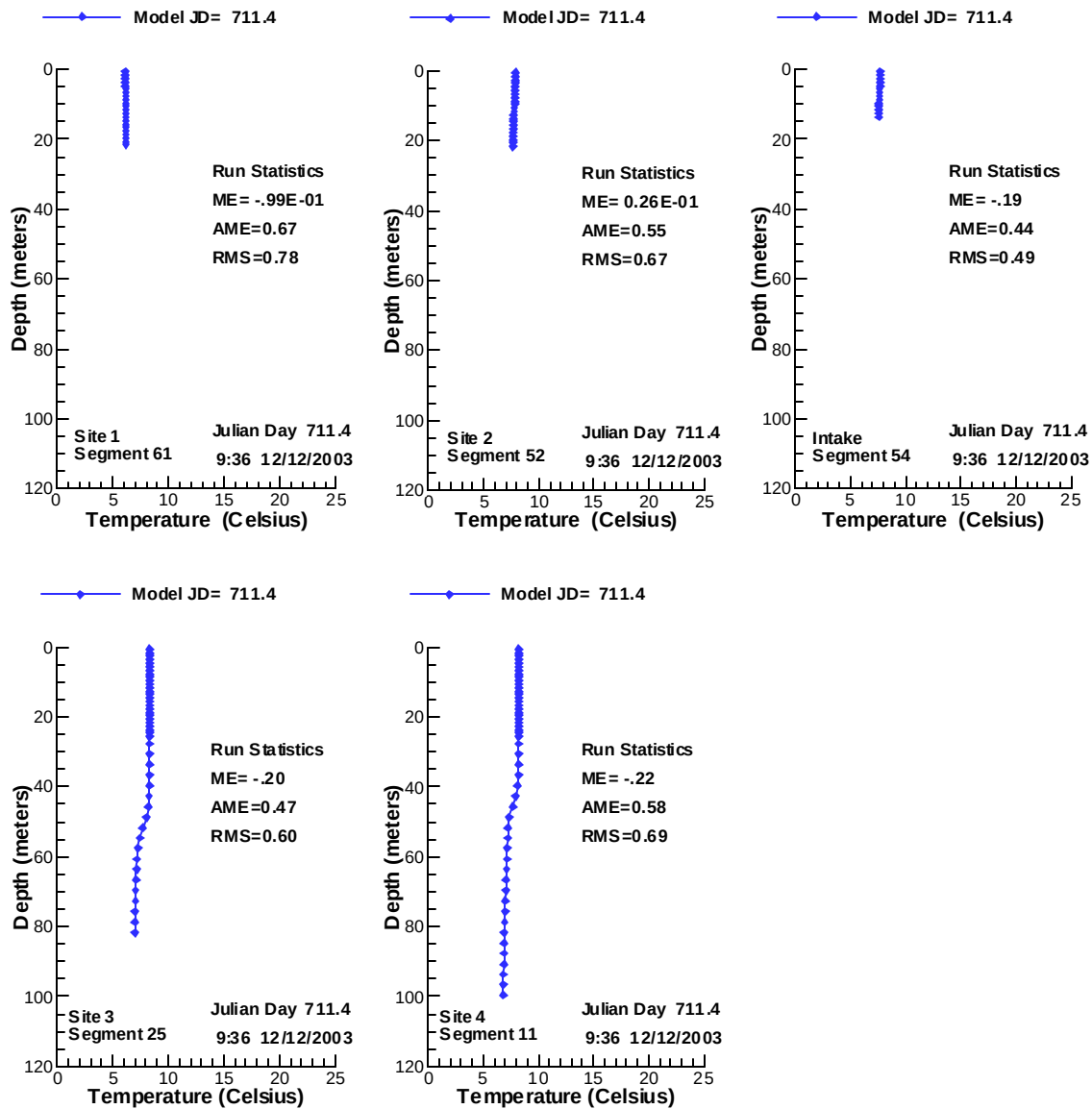


Figure 134. Vertical profiles of TEMPERATURE compared with data for 12/12/2003.

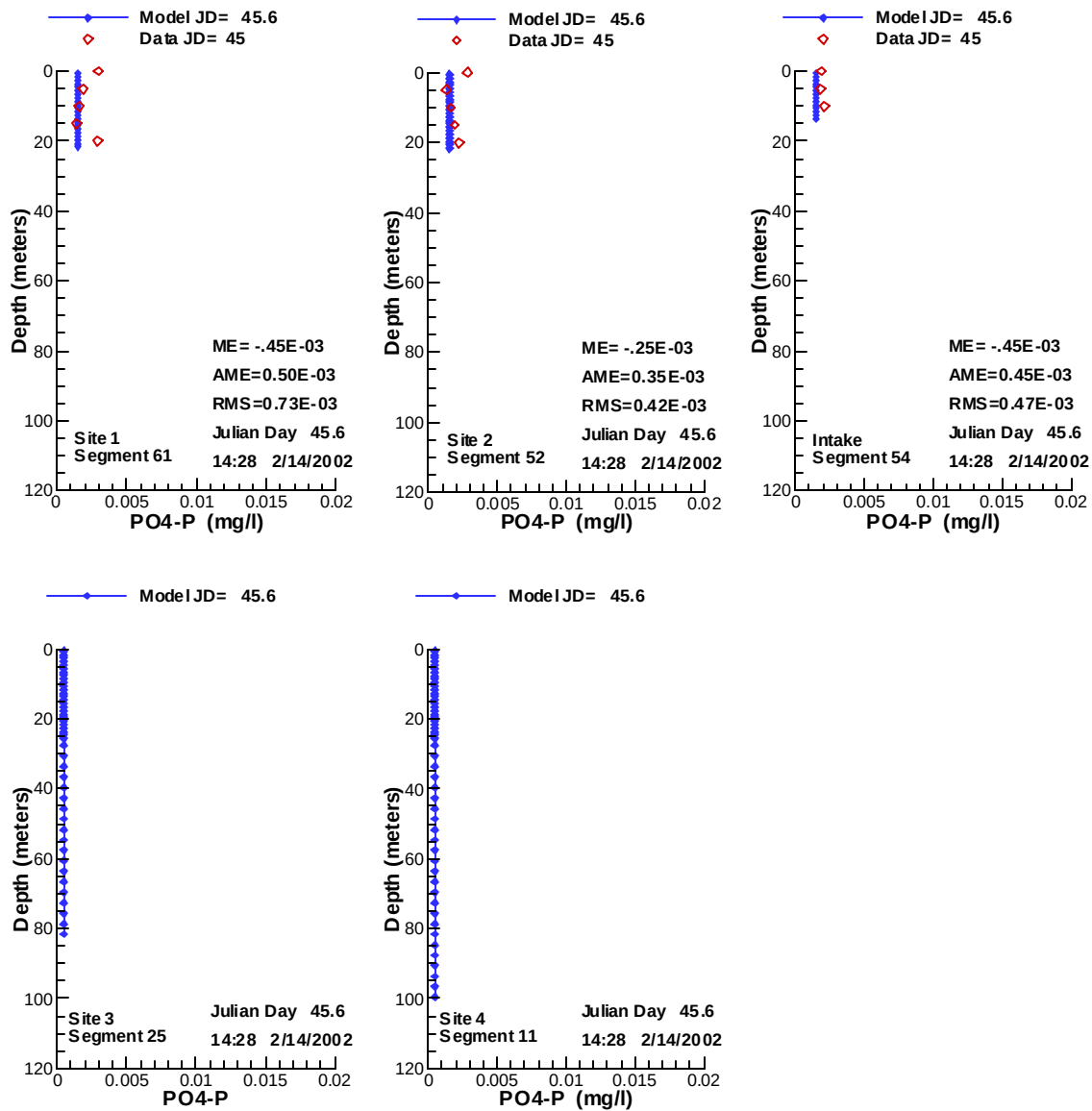


Figure 135. Vertical profiles of PO4-P compared with data for 2/14/2002.

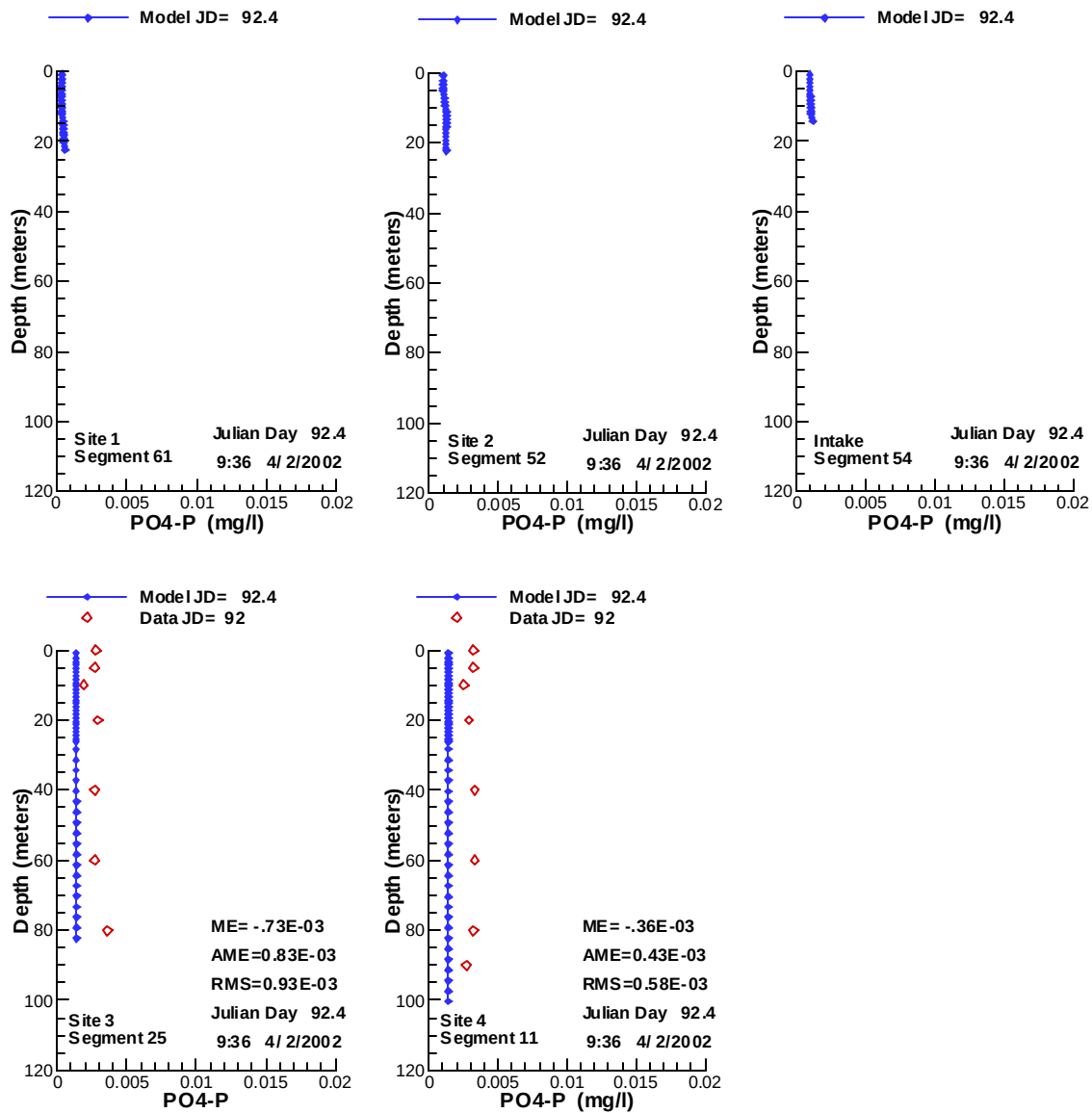


Figure 136. Vertical profiles of PO4-P compared with data for 4/ 2/2002.

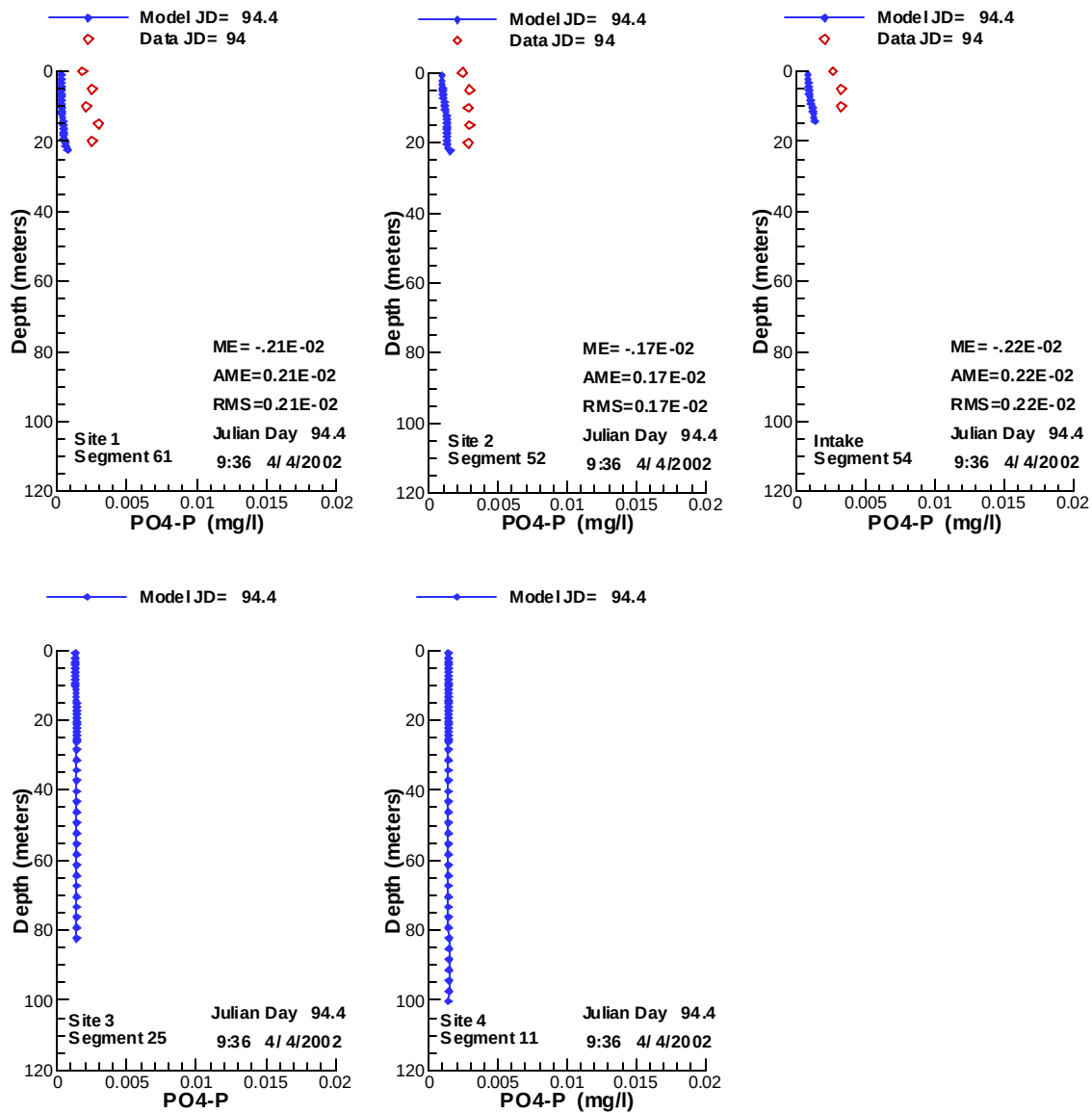


Figure 137. Vertical profiles of PO4-P compared with data for 4/ 4/2002.

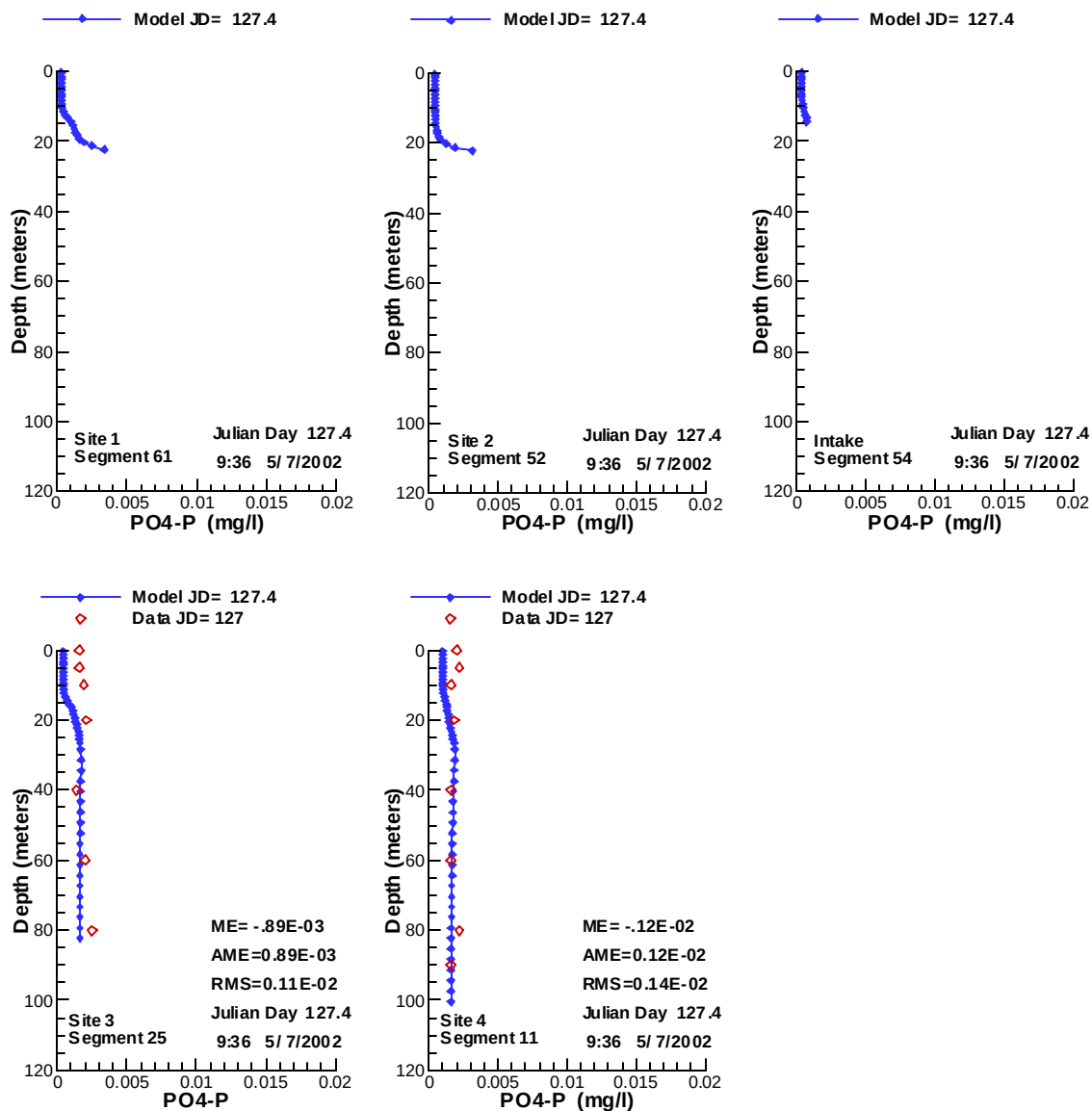


Figure 138. Vertical profiles of PO4-P compared with data for 5/ 7/2002.

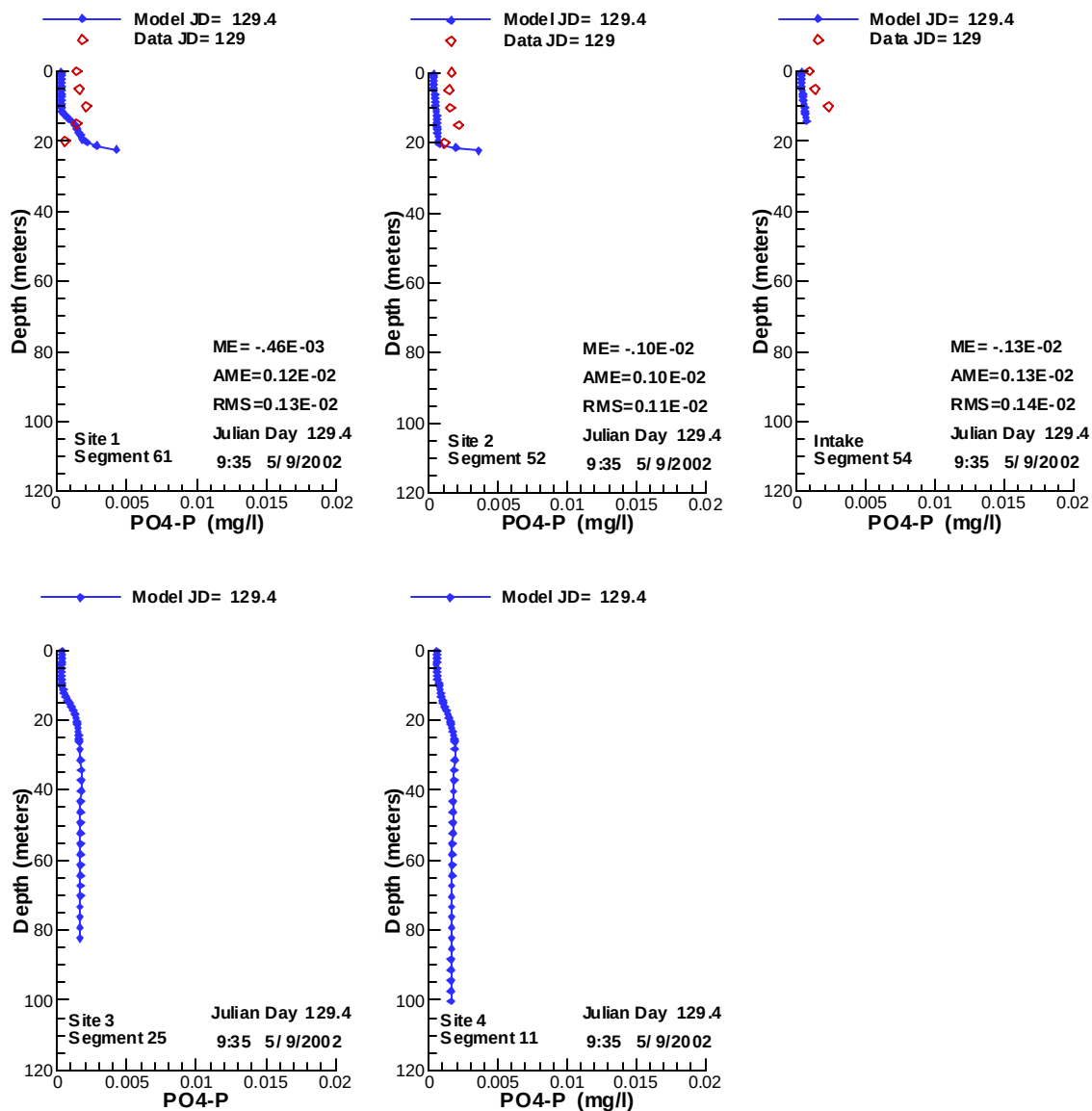


Figure 139. Vertical profiles of PO4-P compared with data for 5/ 9/2002.

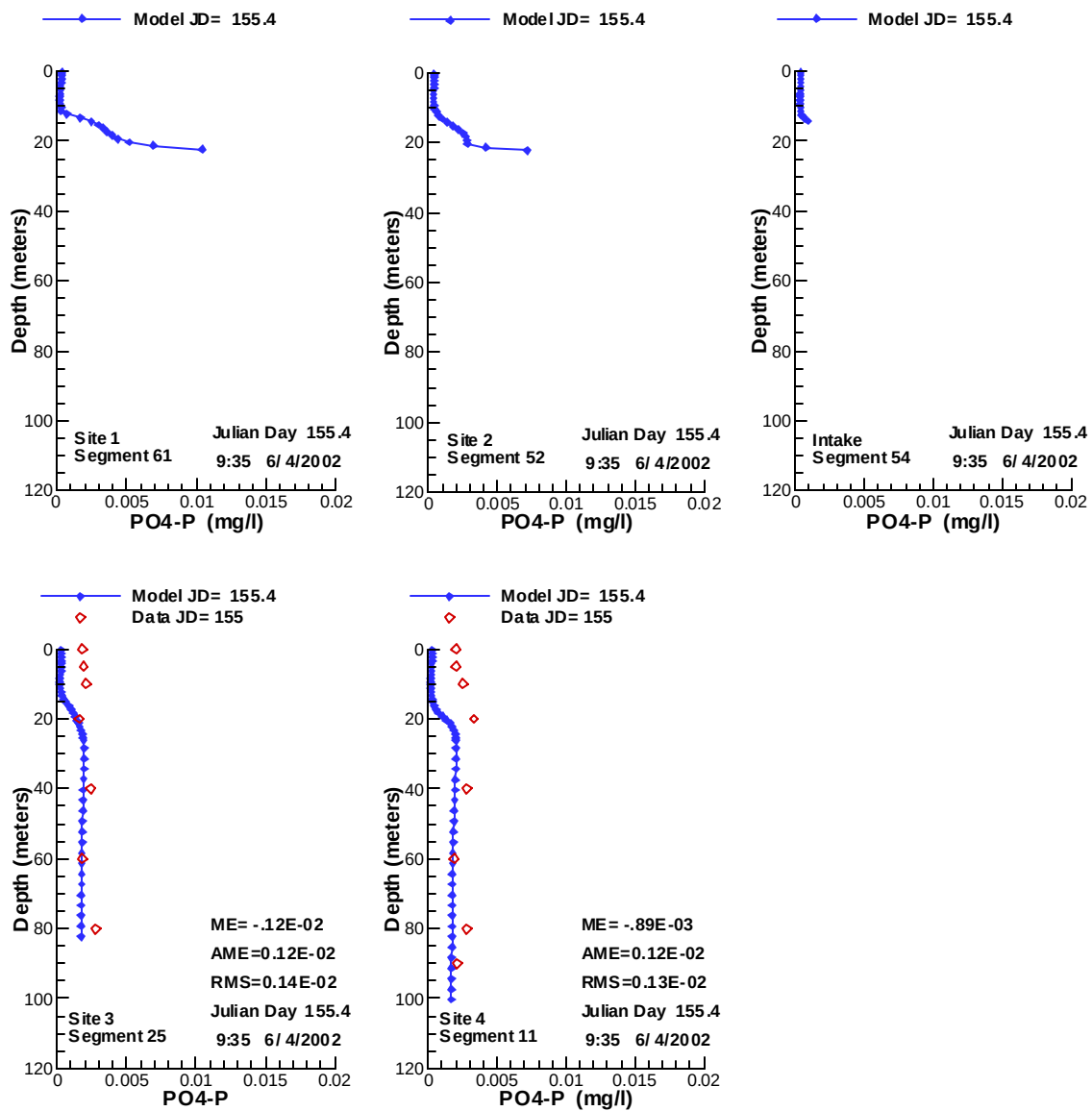


Figure 140. Vertical profiles of PO4-P compared with data for 6/ 4/2002.

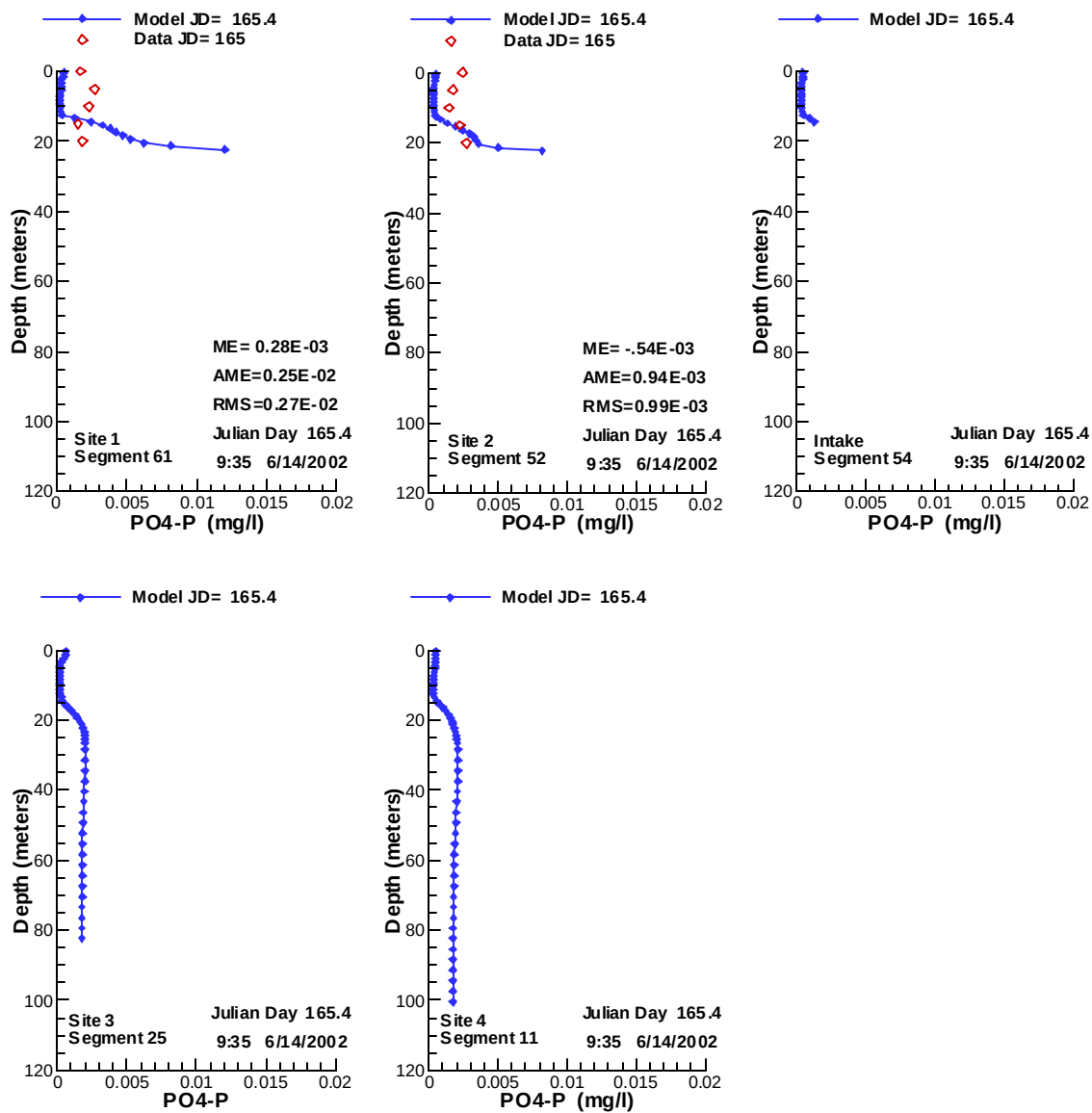


Figure 141. Vertical profiles of PO4-P compared with data for 6/14/2002.

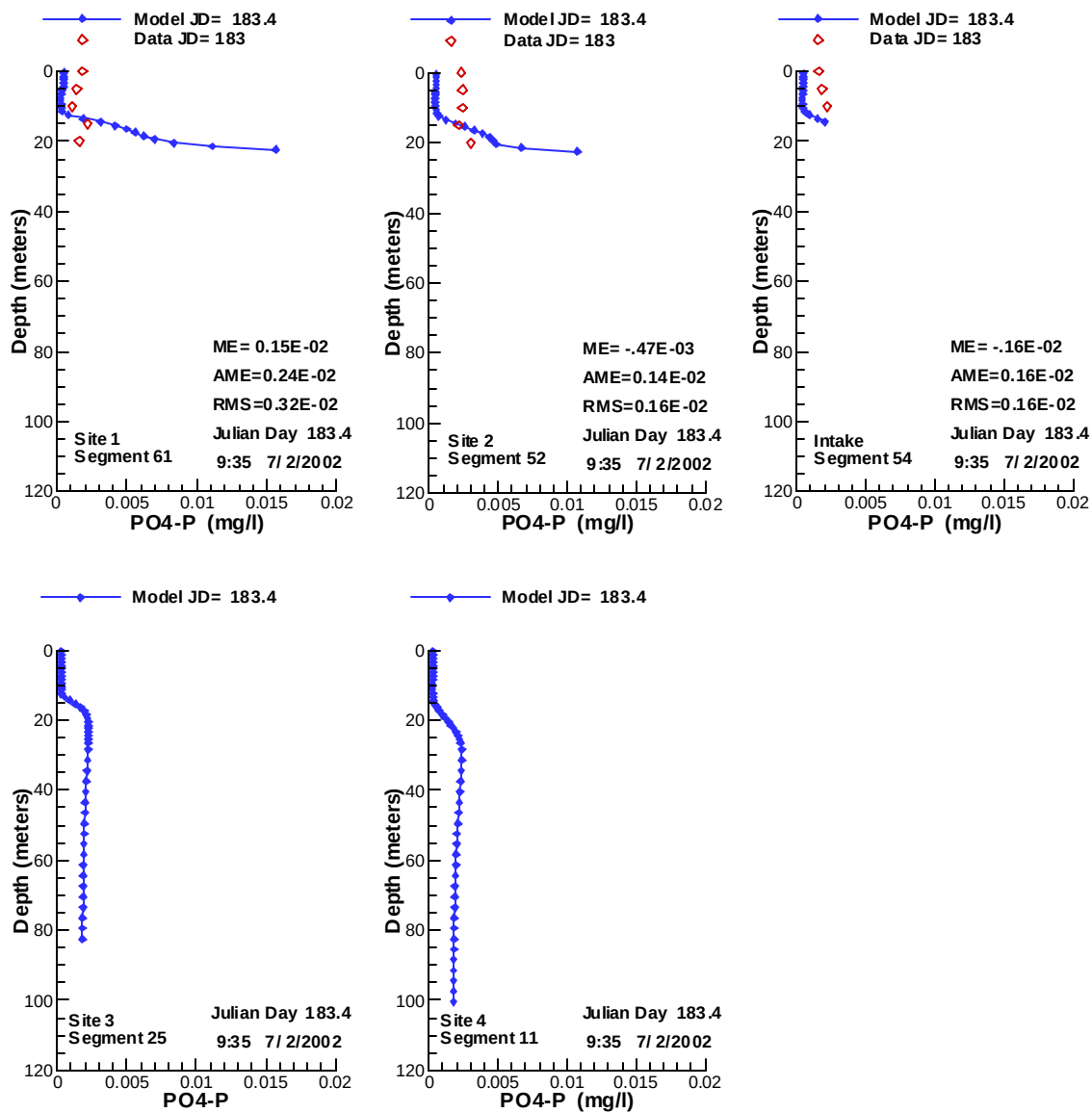


Figure 142. Vertical profiles of PO4-P compared with data for 7/ 2/2002.

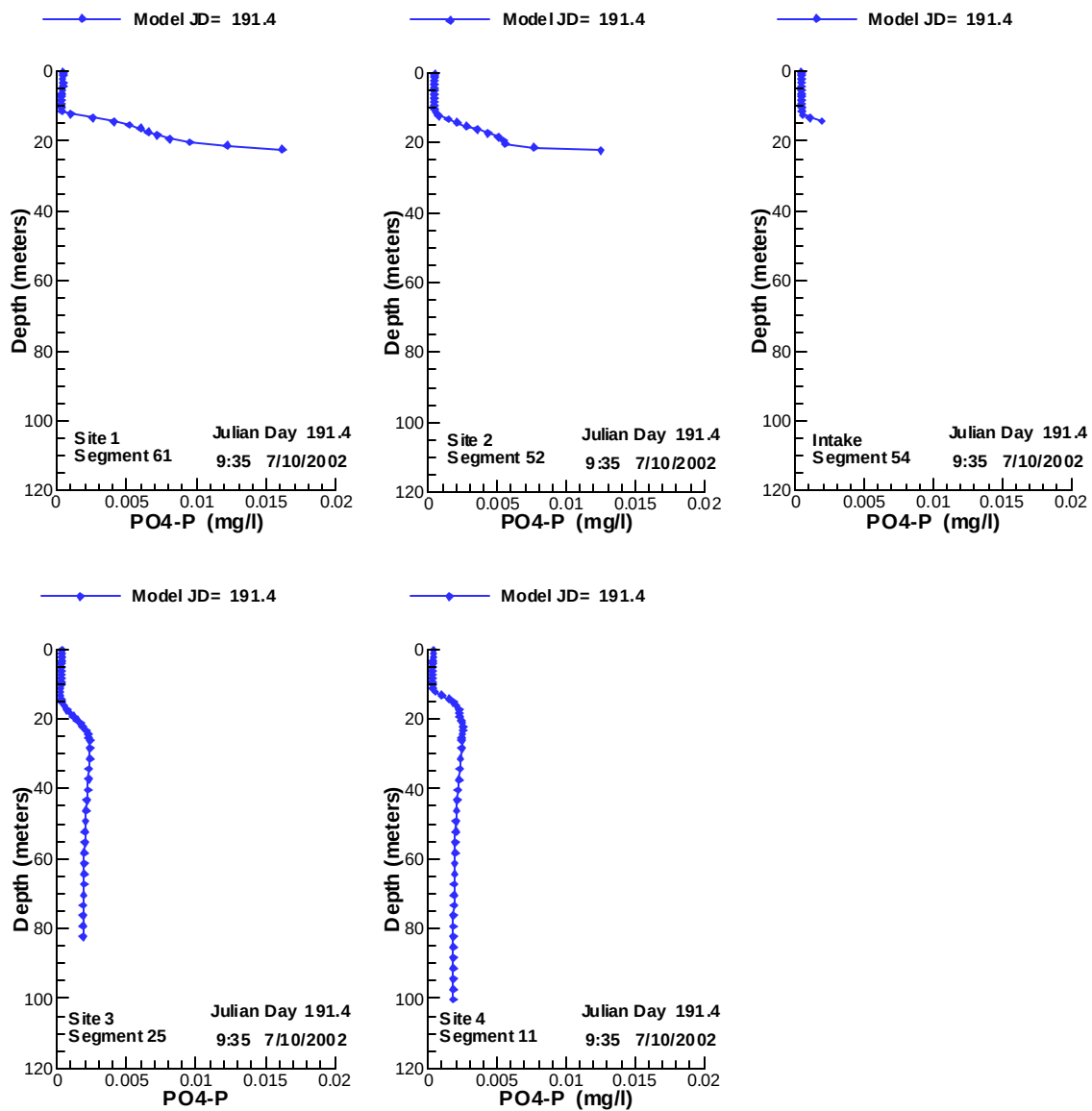


Figure 143. Vertical profiles of PO4-P compared with data for 7/10/2002.

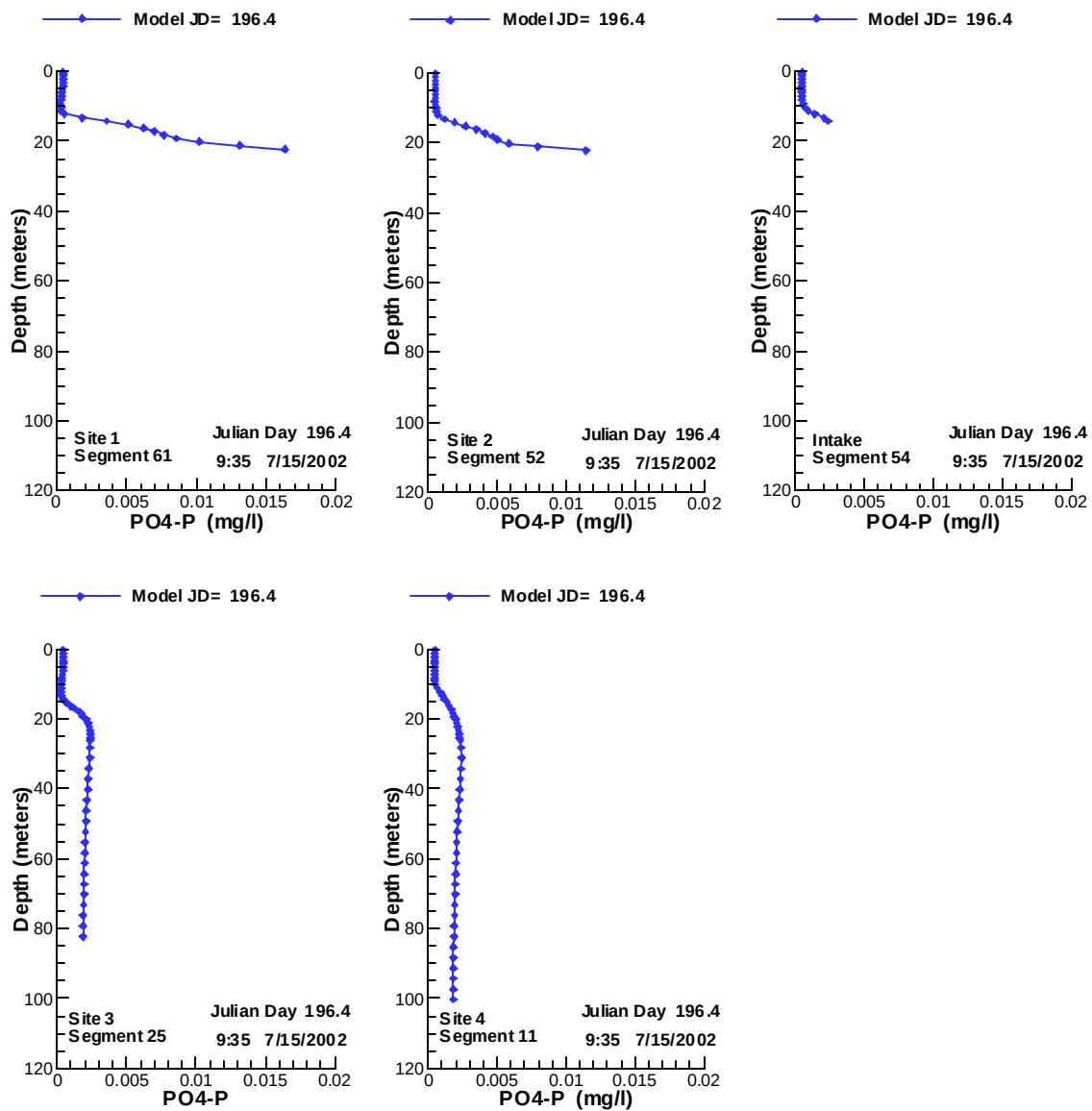


Figure 144. Vertical profiles of PO4-P compared with data for 7/15/2002.

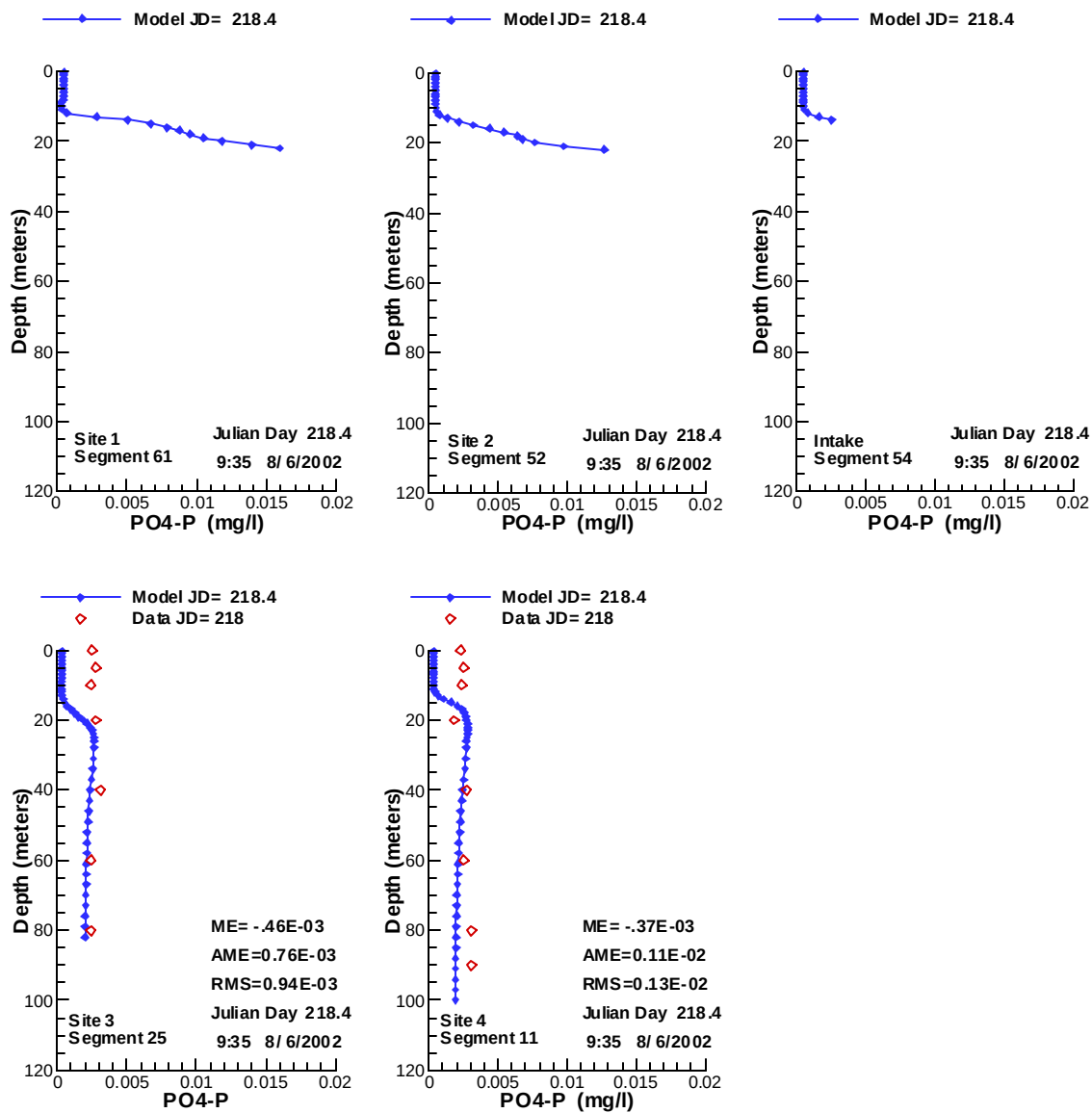


Figure 145. Vertical profiles of PO4-P compared with data for 8/ 6/2002.

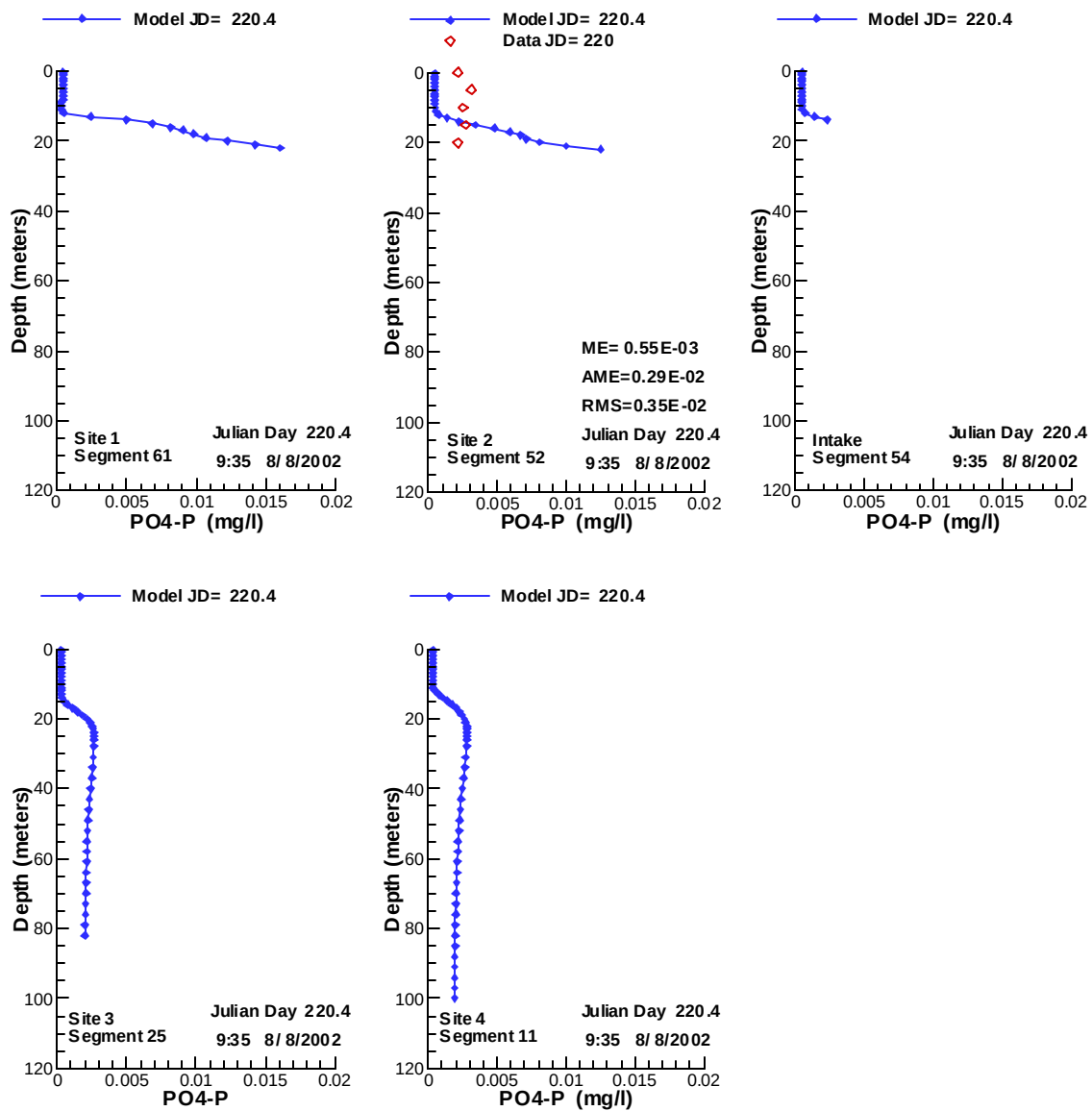


Figure 146. Vertical profiles of PO4-P compared with data for 8/ 8/2002.

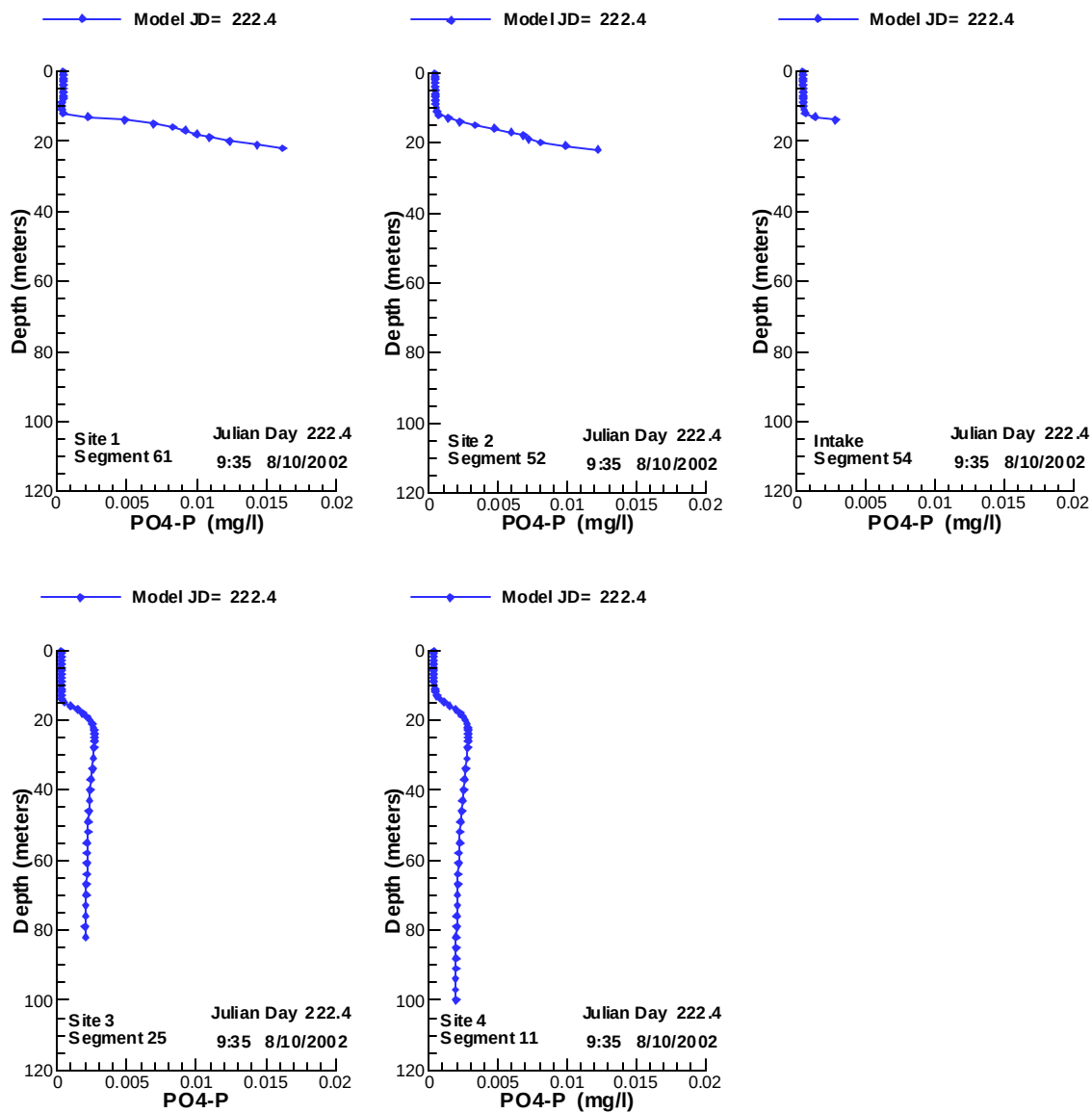


Figure 147. Vertical profiles of PO4-P compared with data for 8/10/2002.

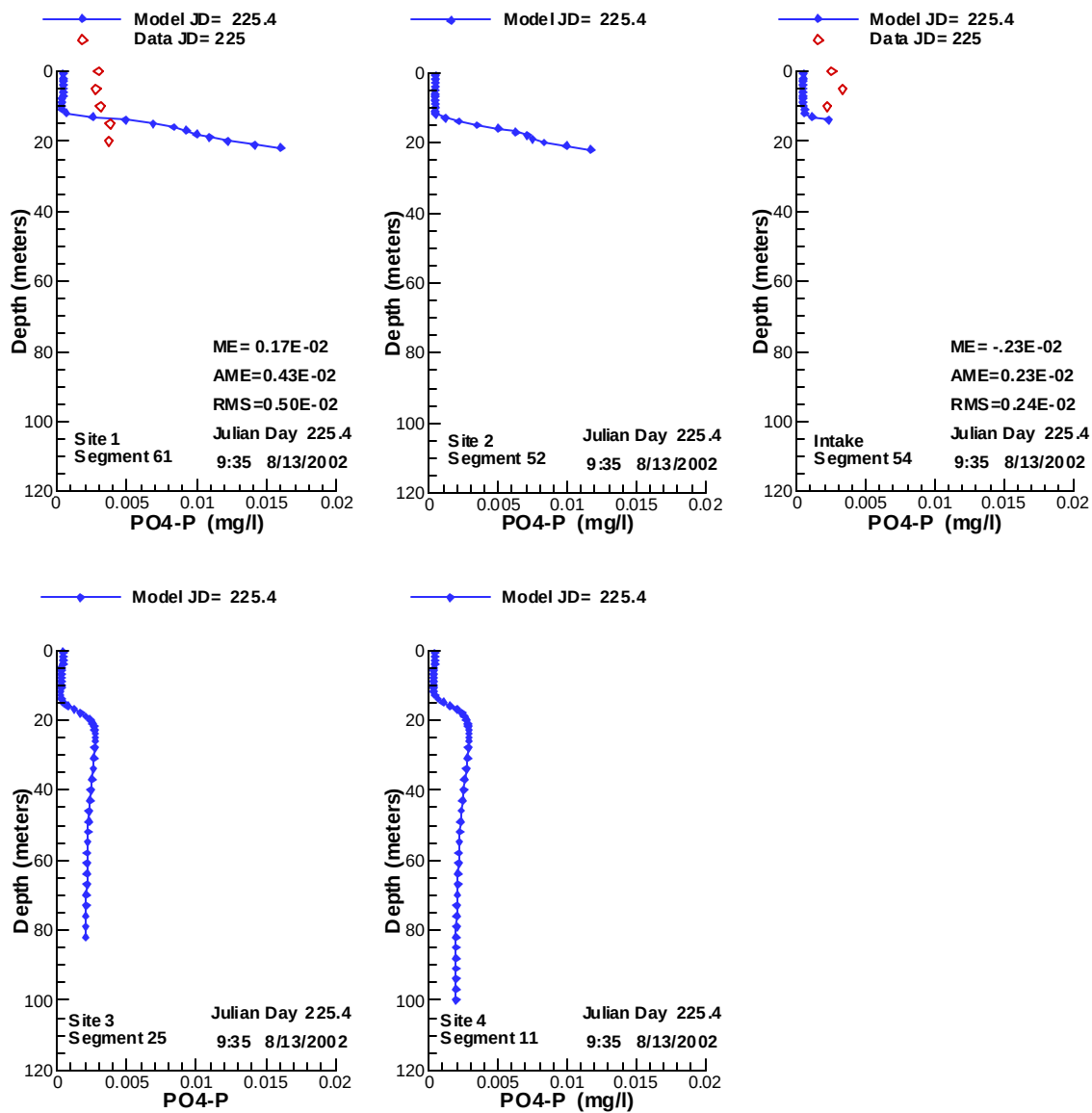


Figure 148. Vertical profiles of PO4-P compared with data for 8/13/2002.

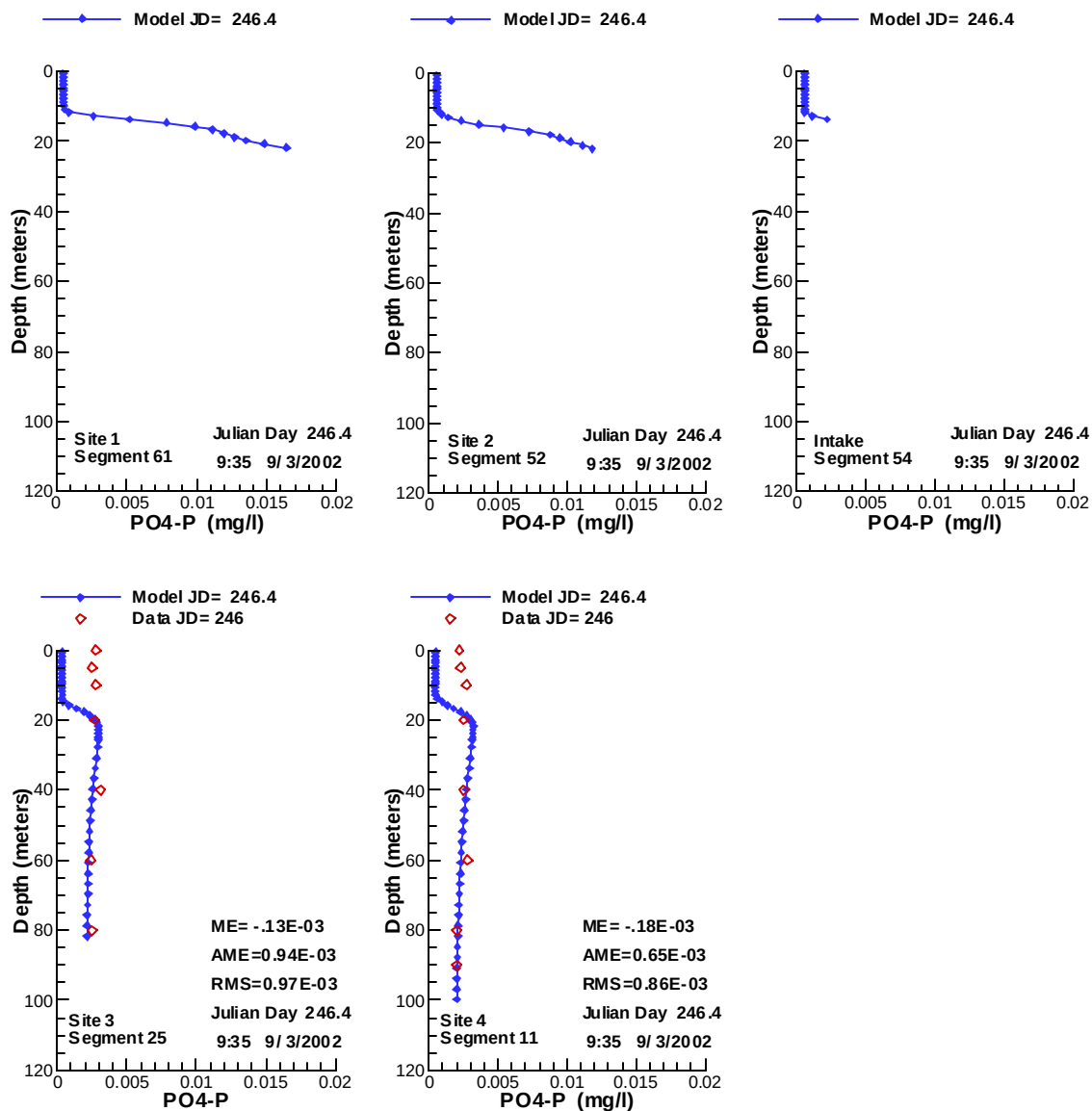


Figure 149. Vertical profiles of PO4-P compared with data for 9/ 3/2002.

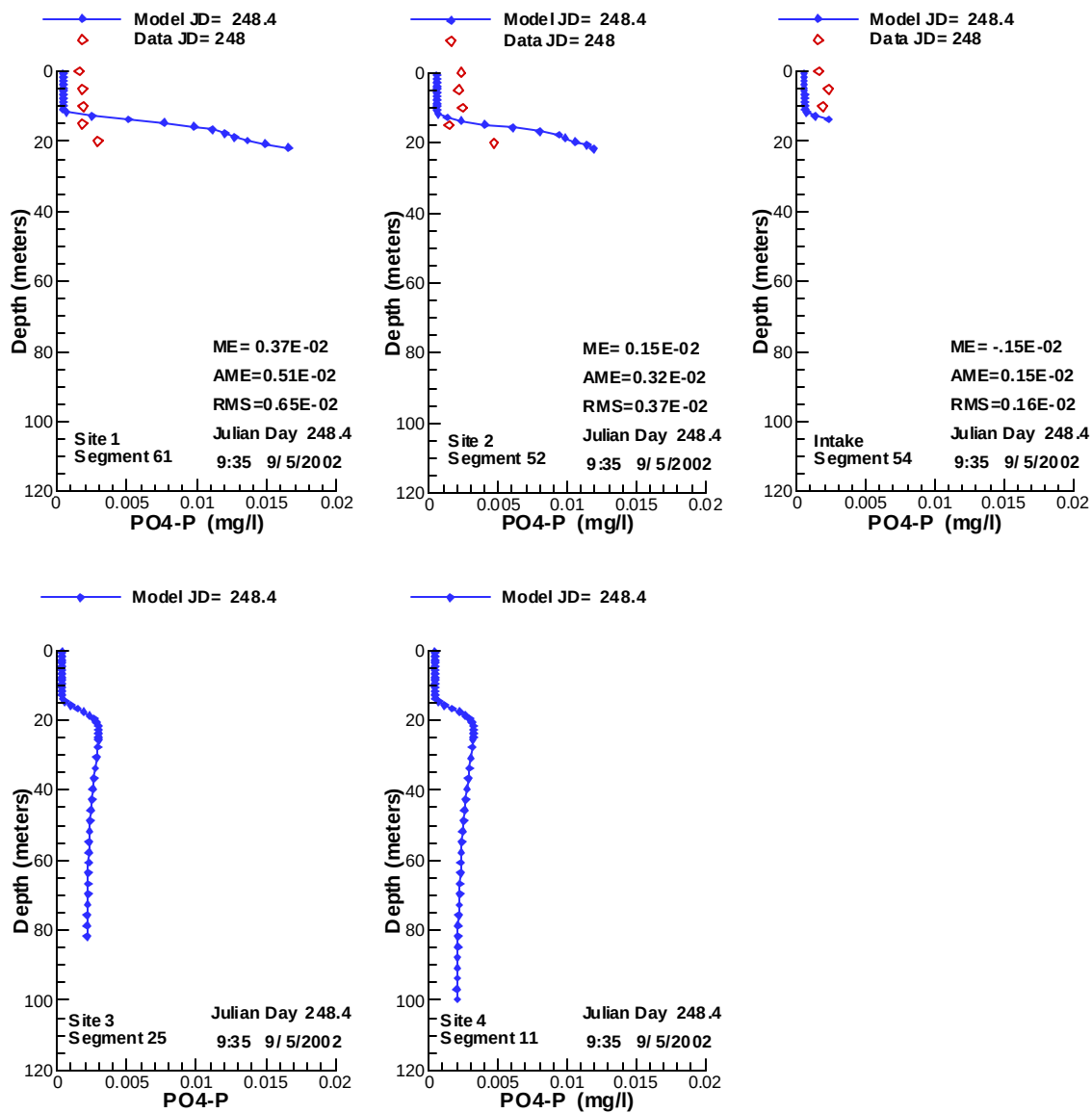


Figure 150. Vertical profiles of PO4-P compared with data for 9/ 5/2002.

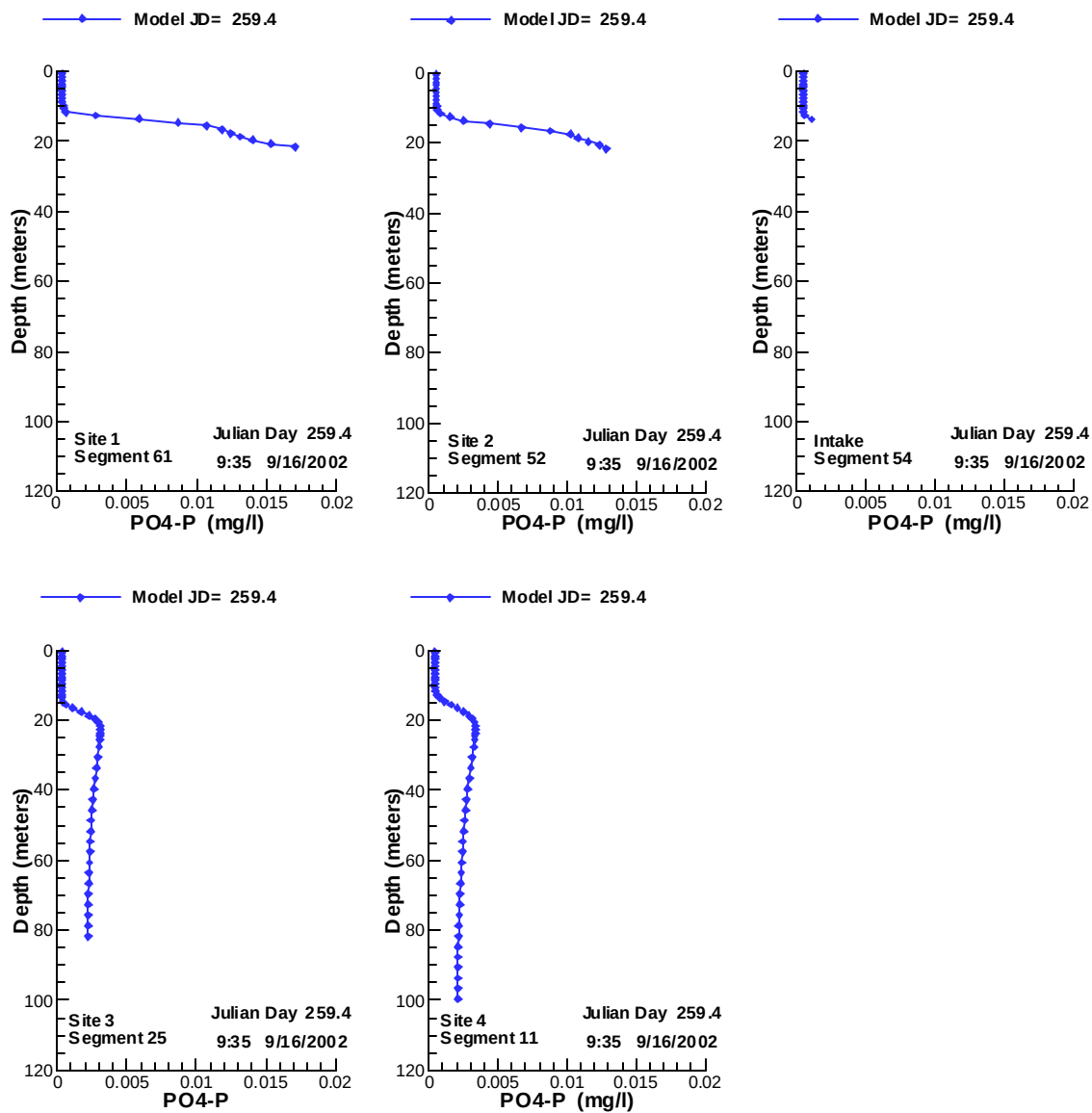


Figure 151. Vertical profiles of PO4-P compared with data for 9/16/2002.

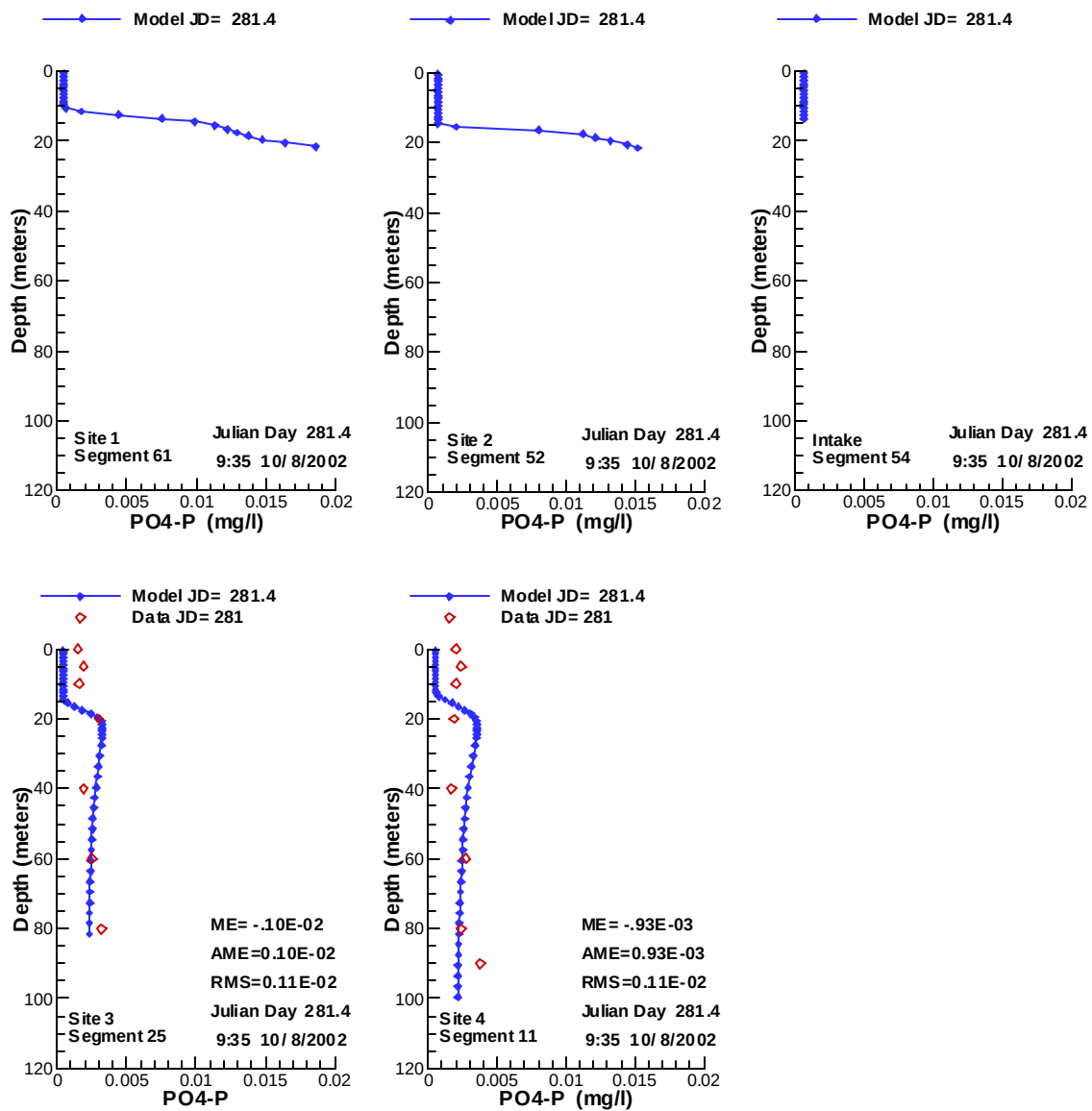


Figure 152. Vertical profiles of PO4-P compared with data for 10/ 8/2002.

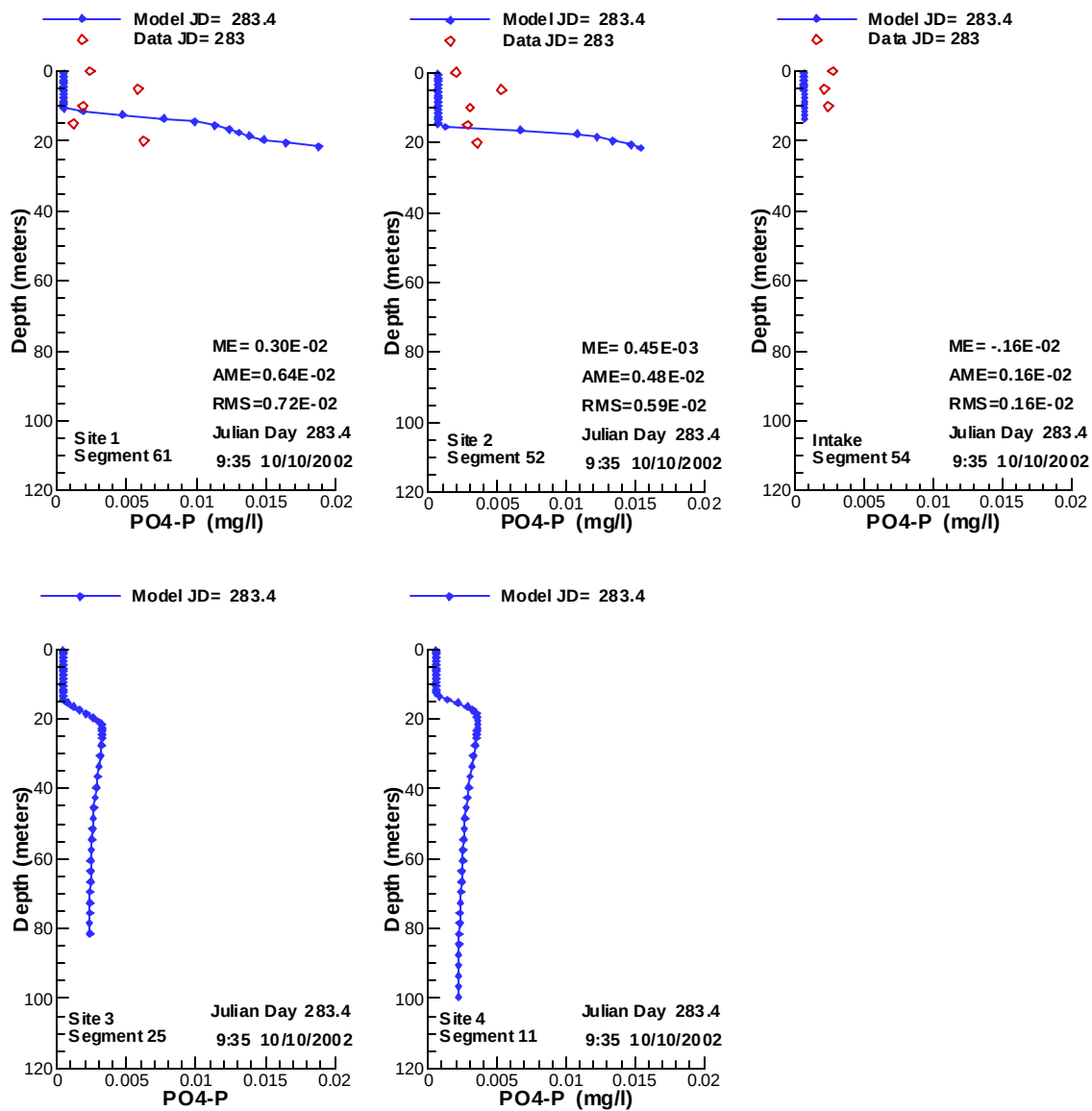


Figure 153. Vertical profiles of PO4-P compared with data for 10/10/2002.

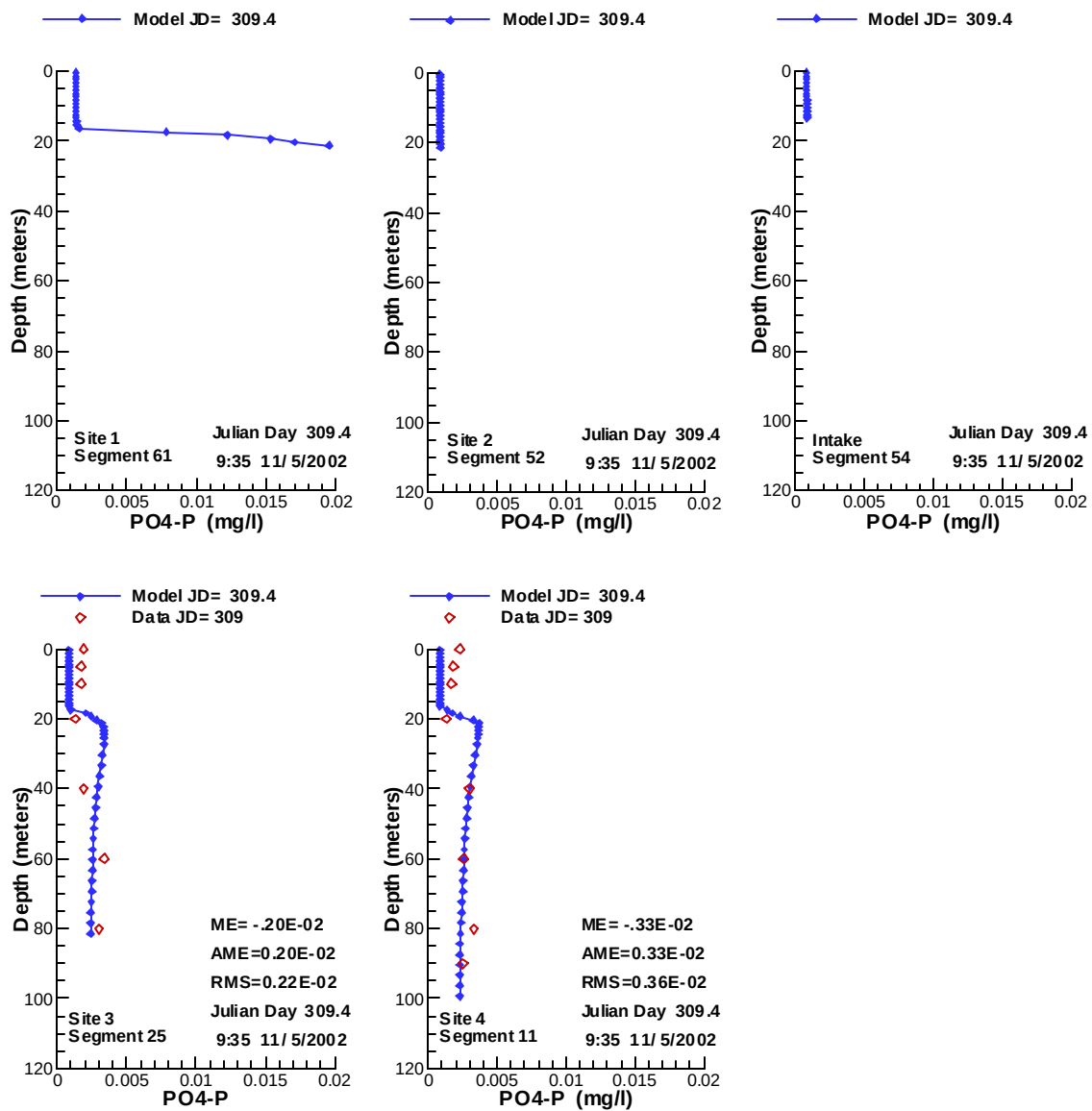


Figure 154. Vertical profiles of PO4-P compared with data for 11/ 5/2002.

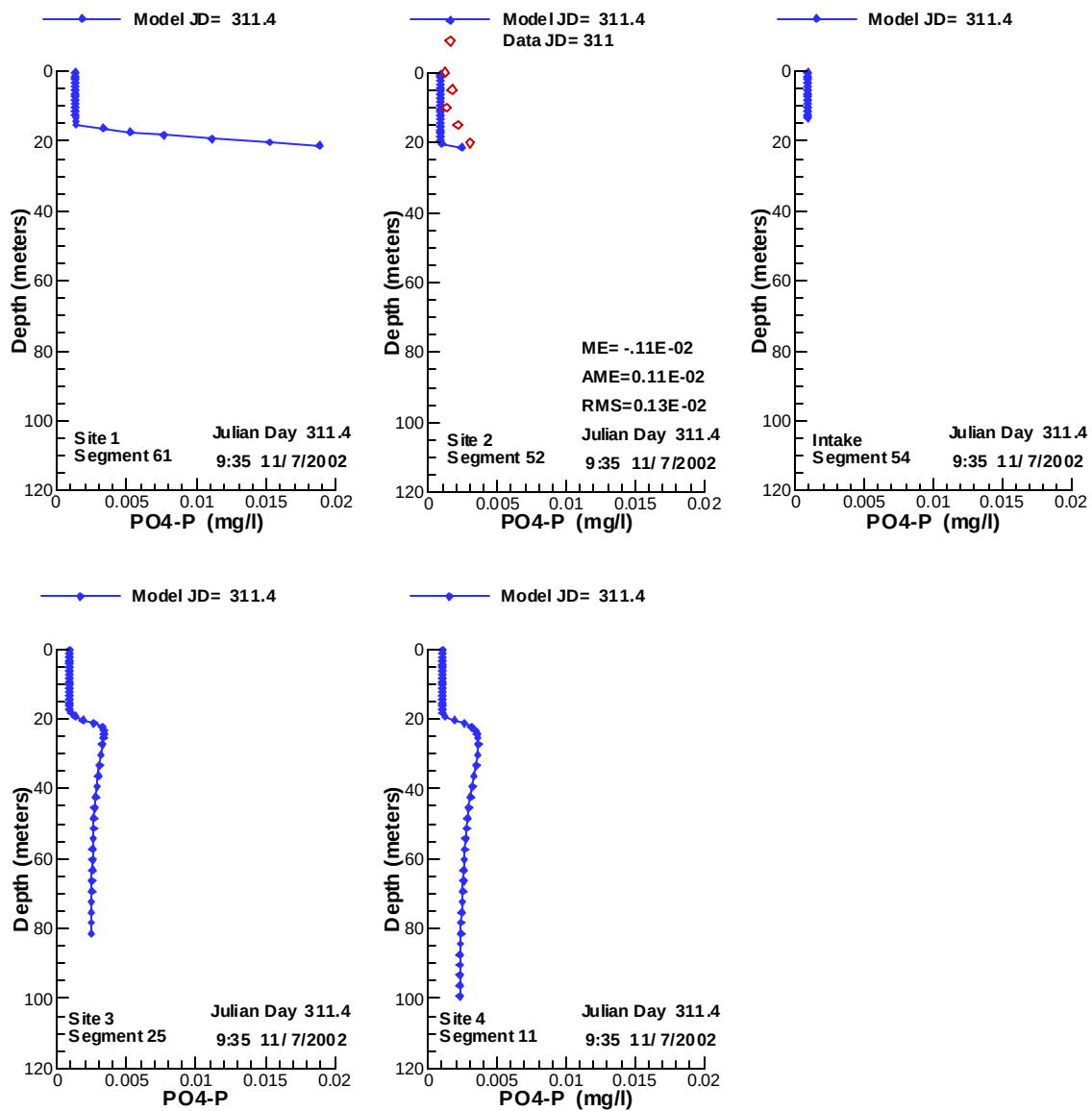


Figure 155. Vertical profiles of PO4-P compared with data for 11/ 7/2002.

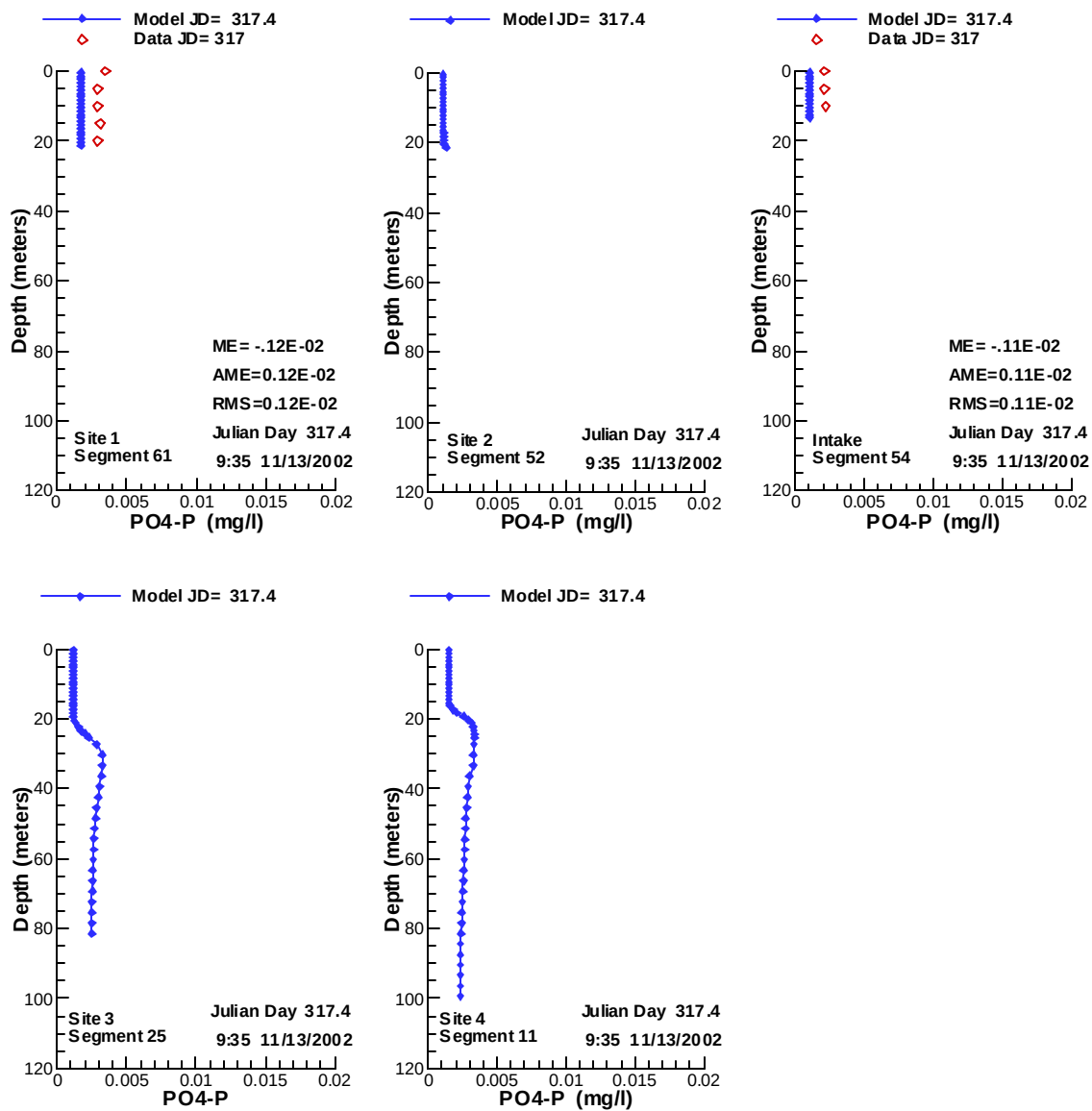


Figure 156. Vertical profiles of PO4-P compared with data for 11/13/2002.

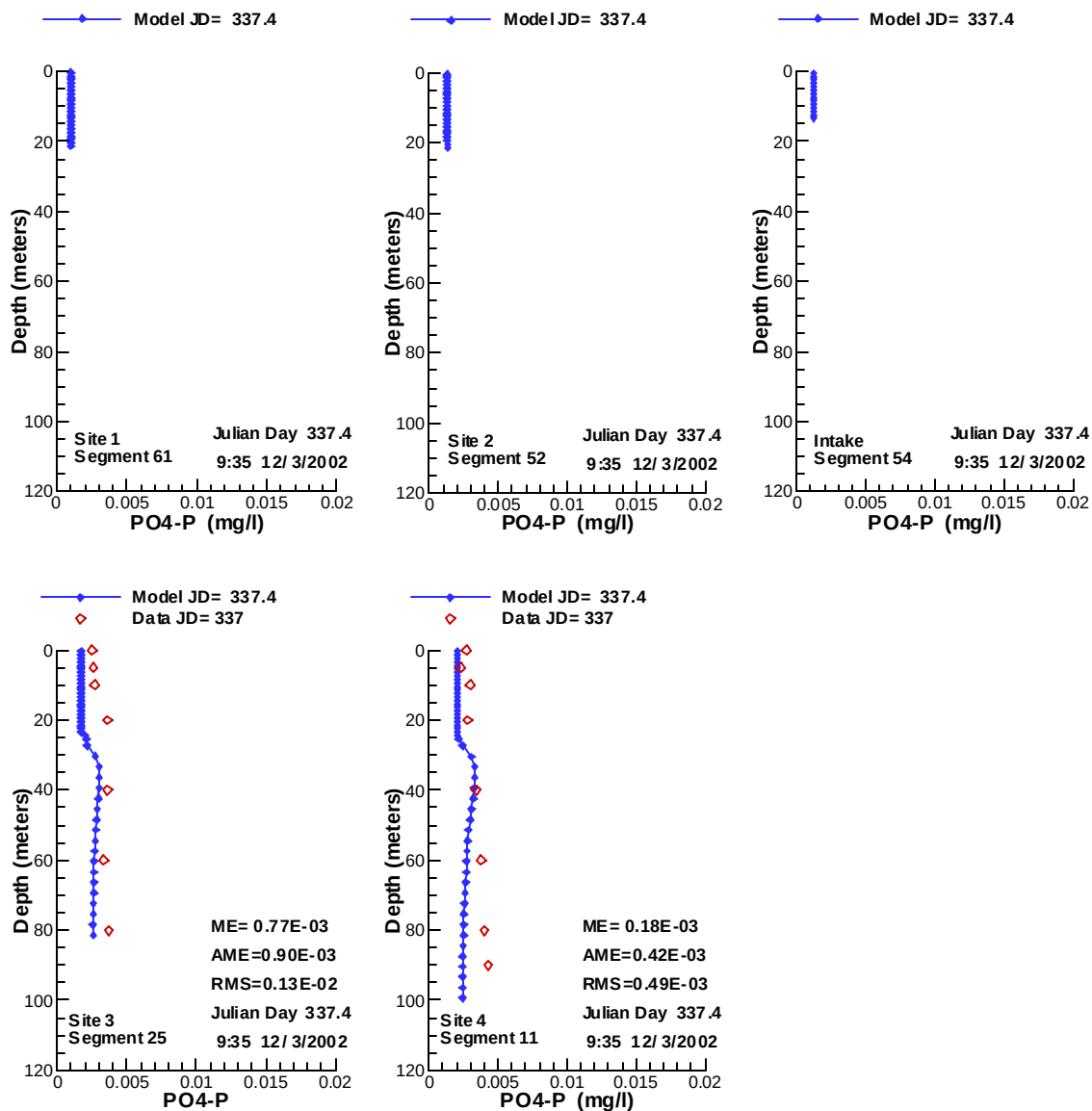


Figure 157. Vertical profiles of PO4-P compared with data for 12/ 3/2002.

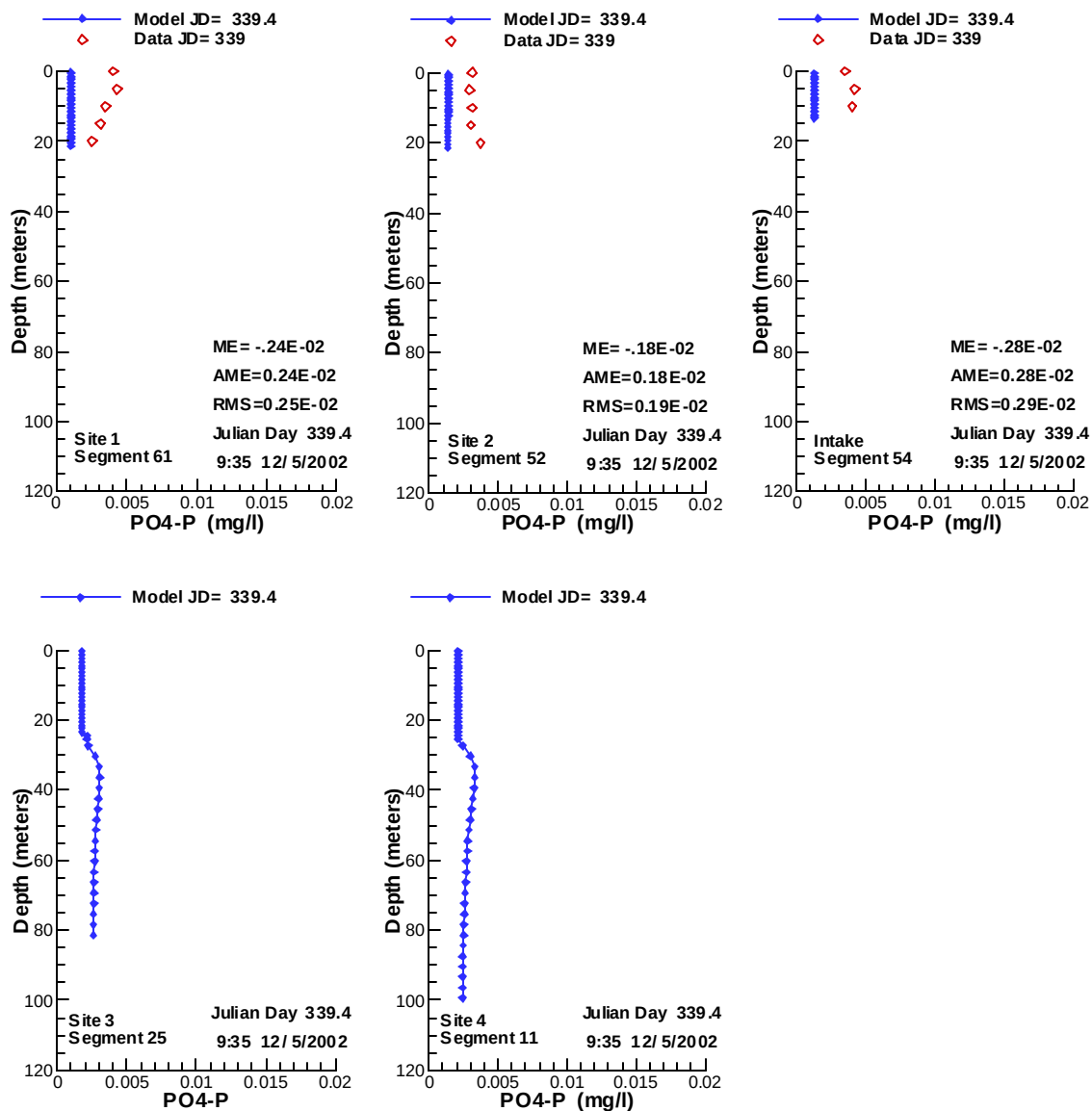


Figure 158. Vertical profiles of PO4-P compared with data for 12/ 5/2002.

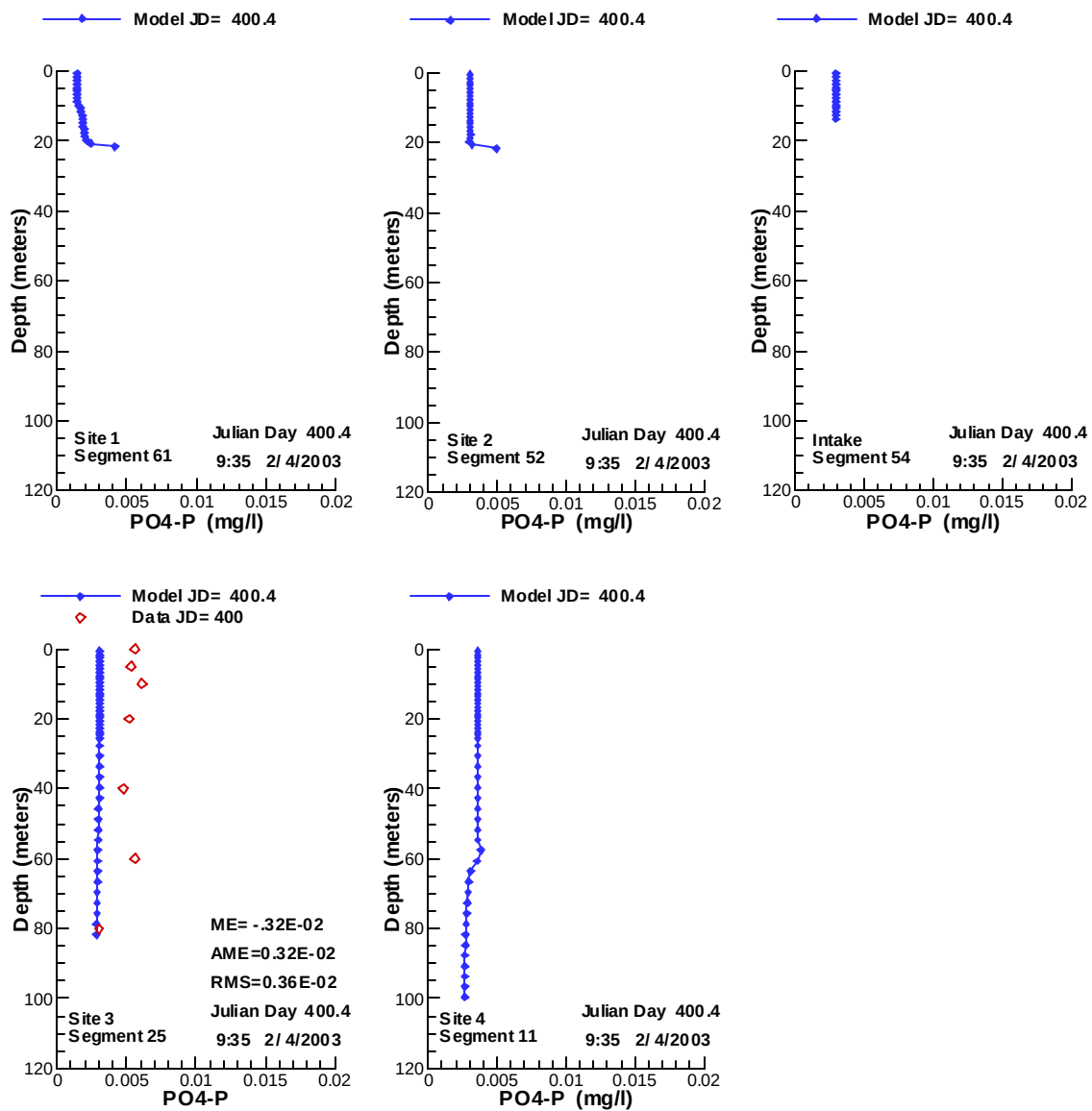


Figure 159. Vertical profiles of PO4-P compared with data for 2/ 4/2003.

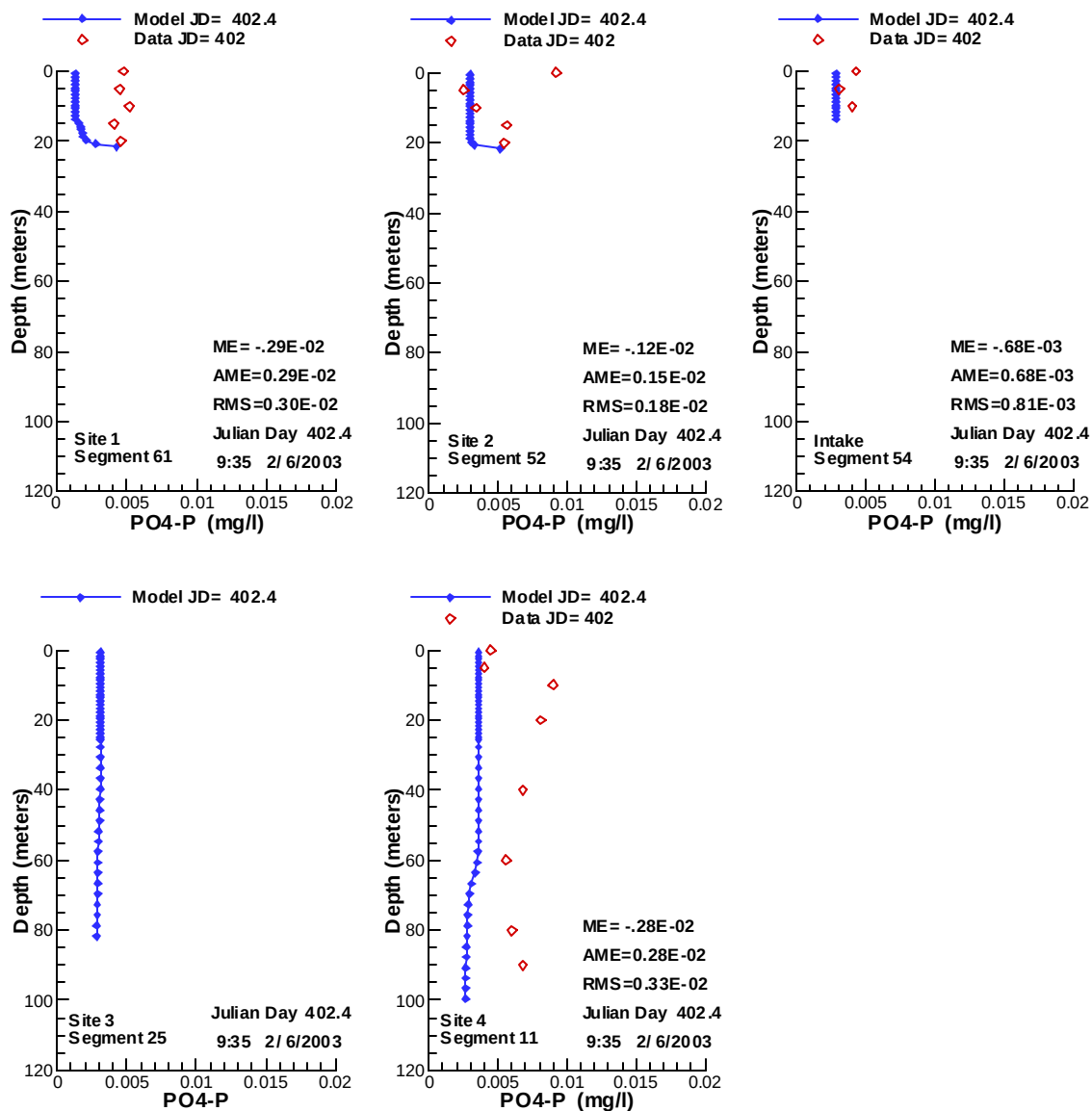


Figure 160. Vertical profiles of PO4-P compared with data for 2/ 6/2003.

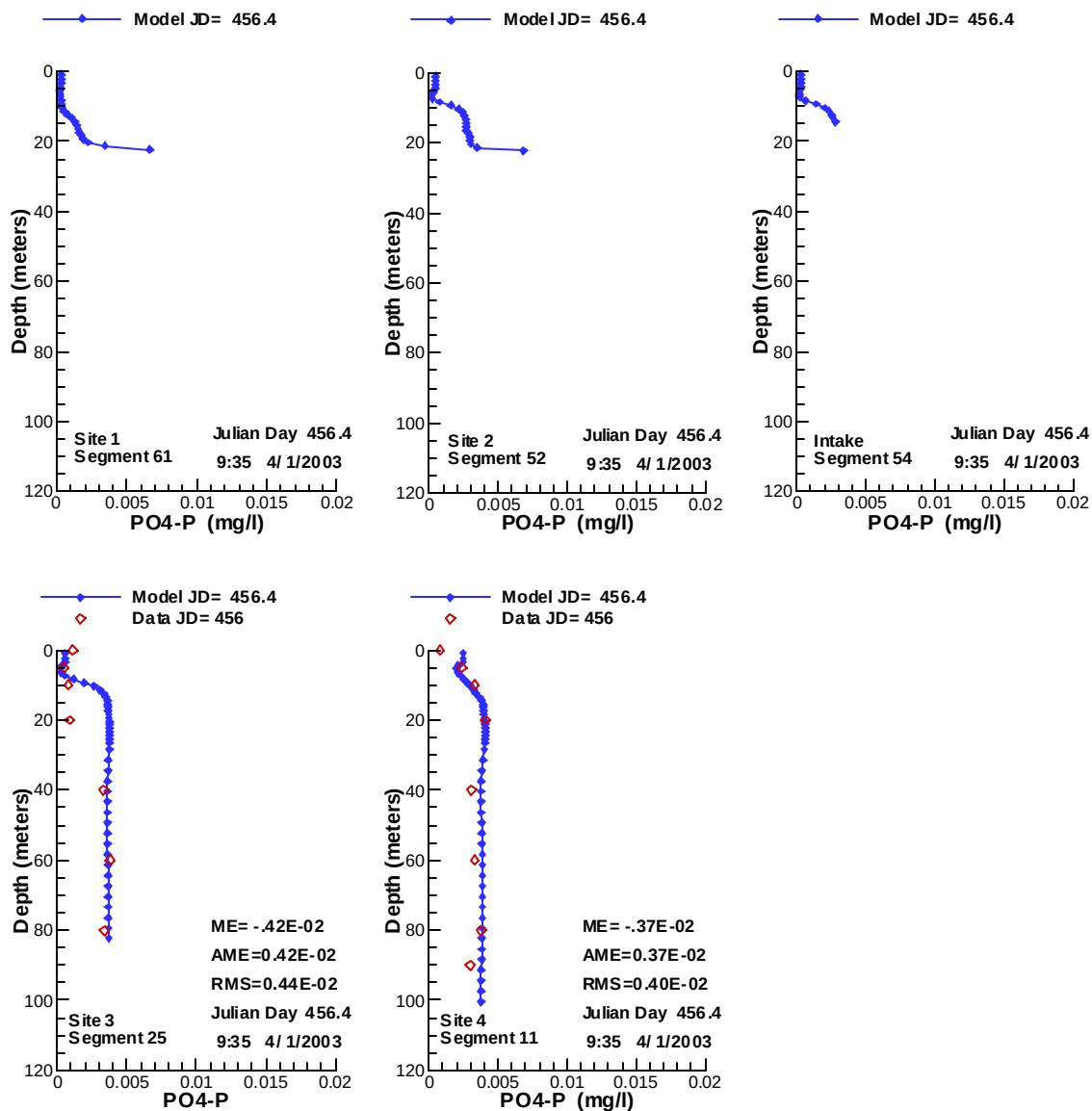


Figure 161. Vertical profiles of PO4-P compared with data for 4/ 1/2003.

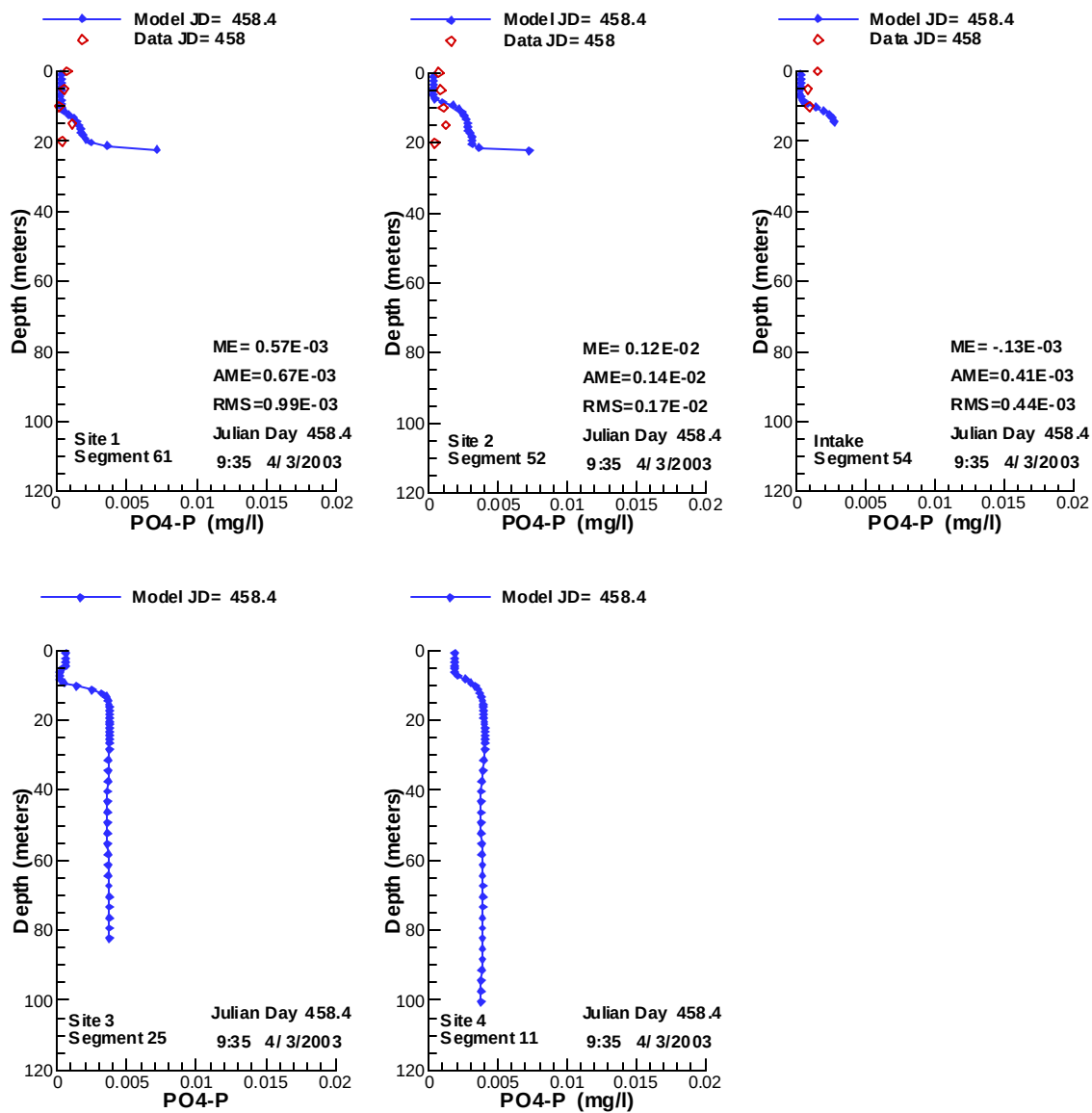


Figure 162. Vertical profiles of PO4-P compared with data for 4/ 3/2003.

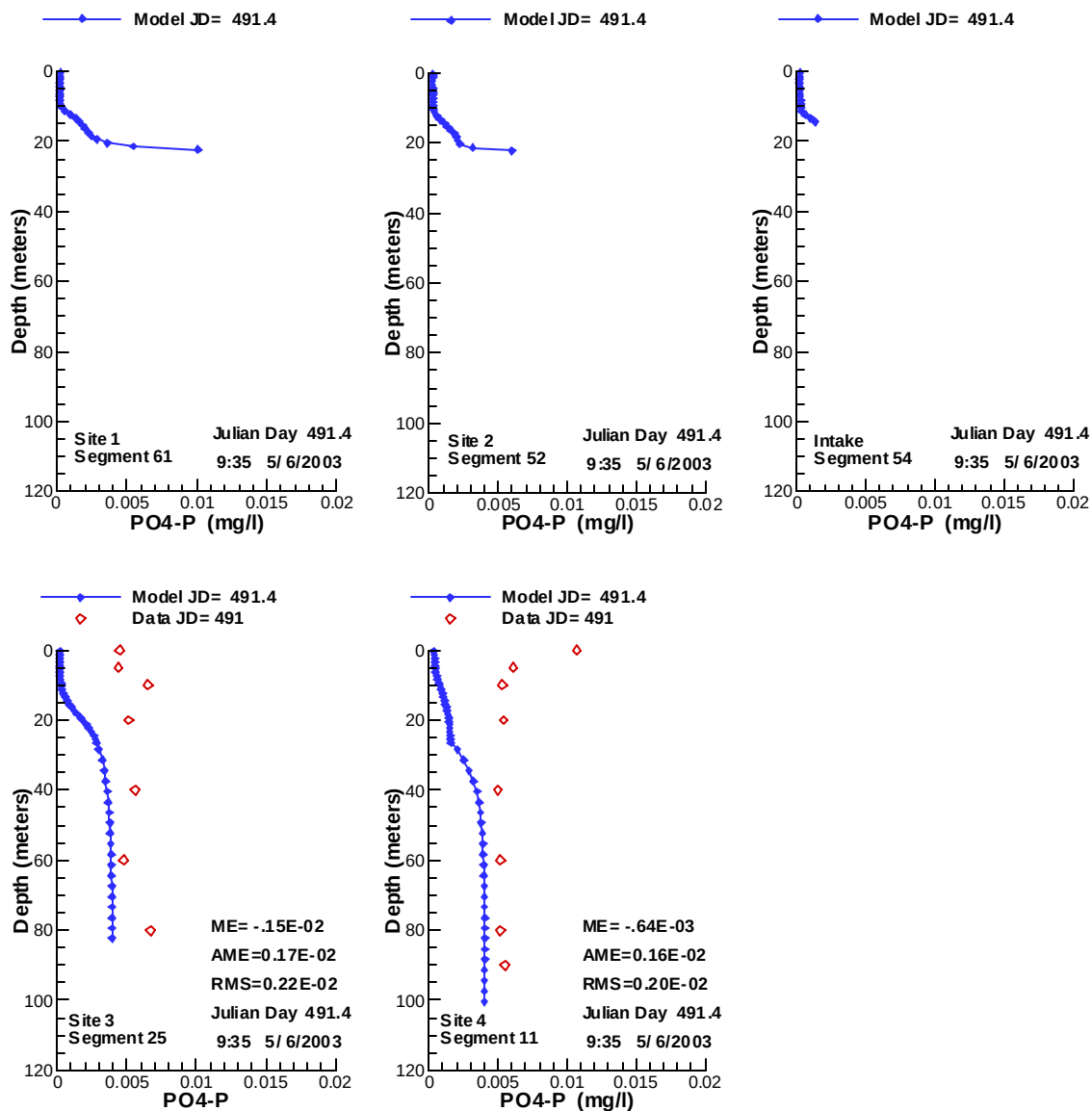


Figure 163. Vertical profiles of PO4-P compared with data for 5/ 6/2003.

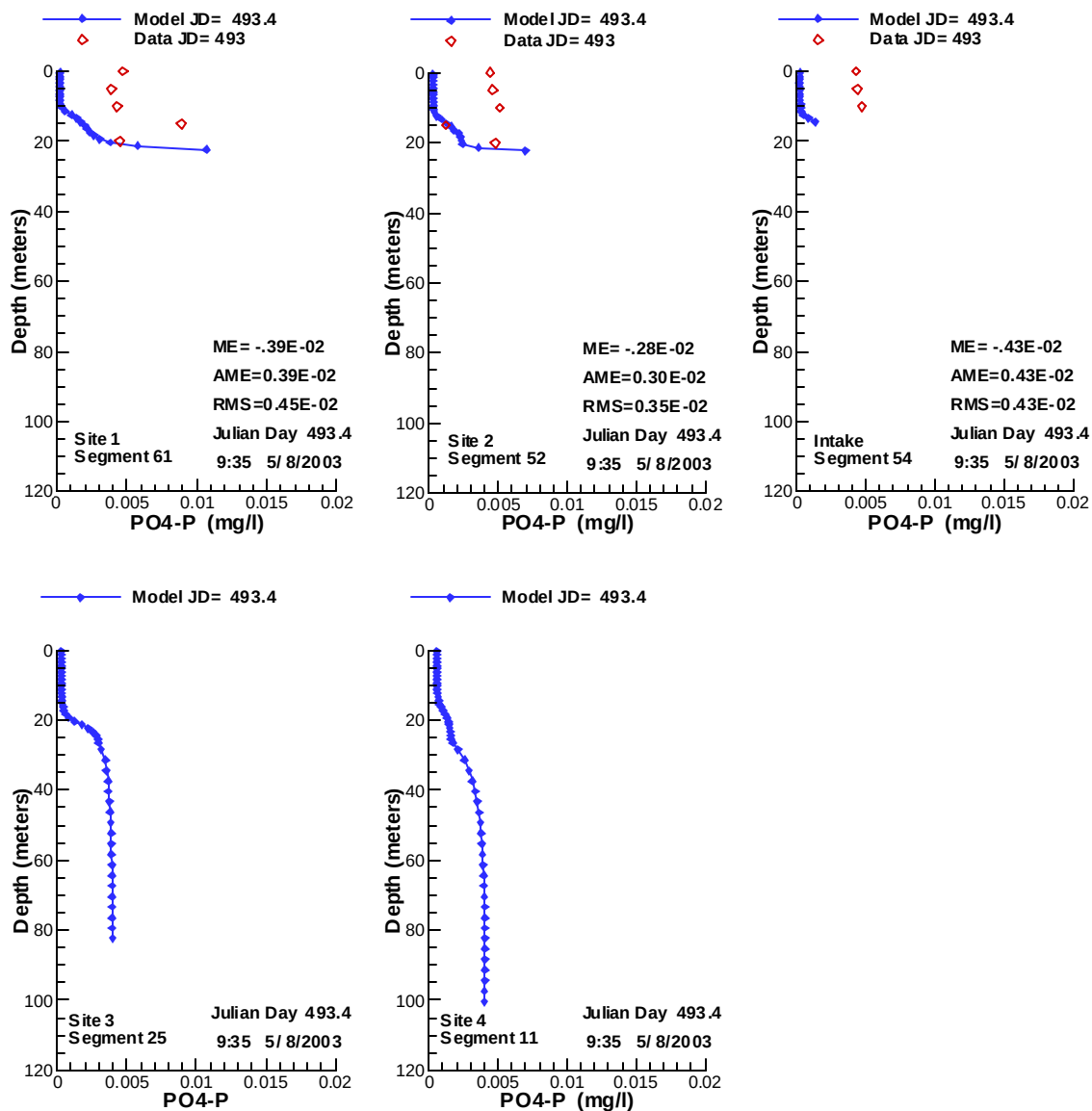


Figure 164. Vertical profiles of PO4-P compared with data for 5/ 8/2003.

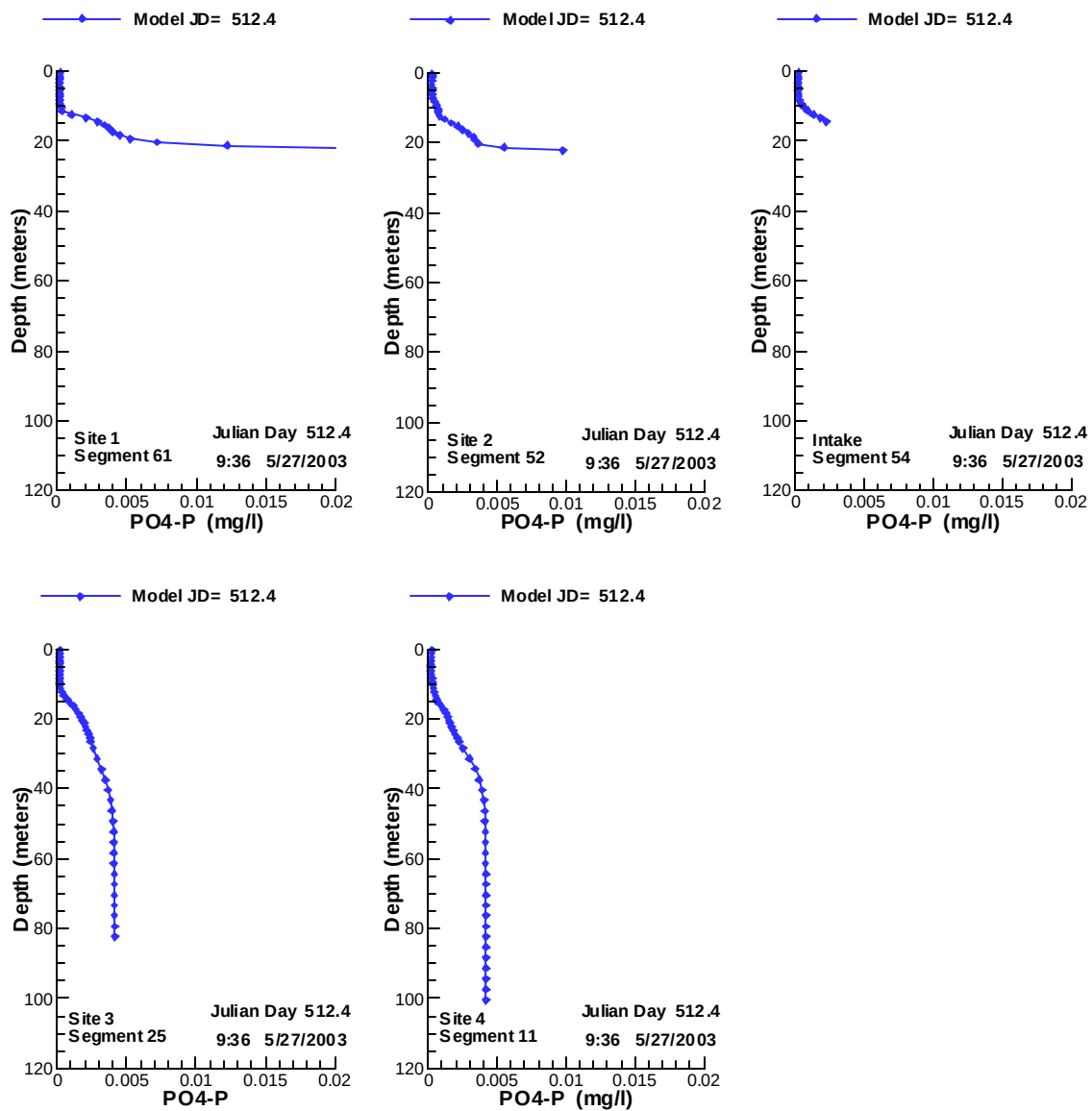


Figure 165. Vertical profiles of PO4-P compared with data for 5/27/2003.

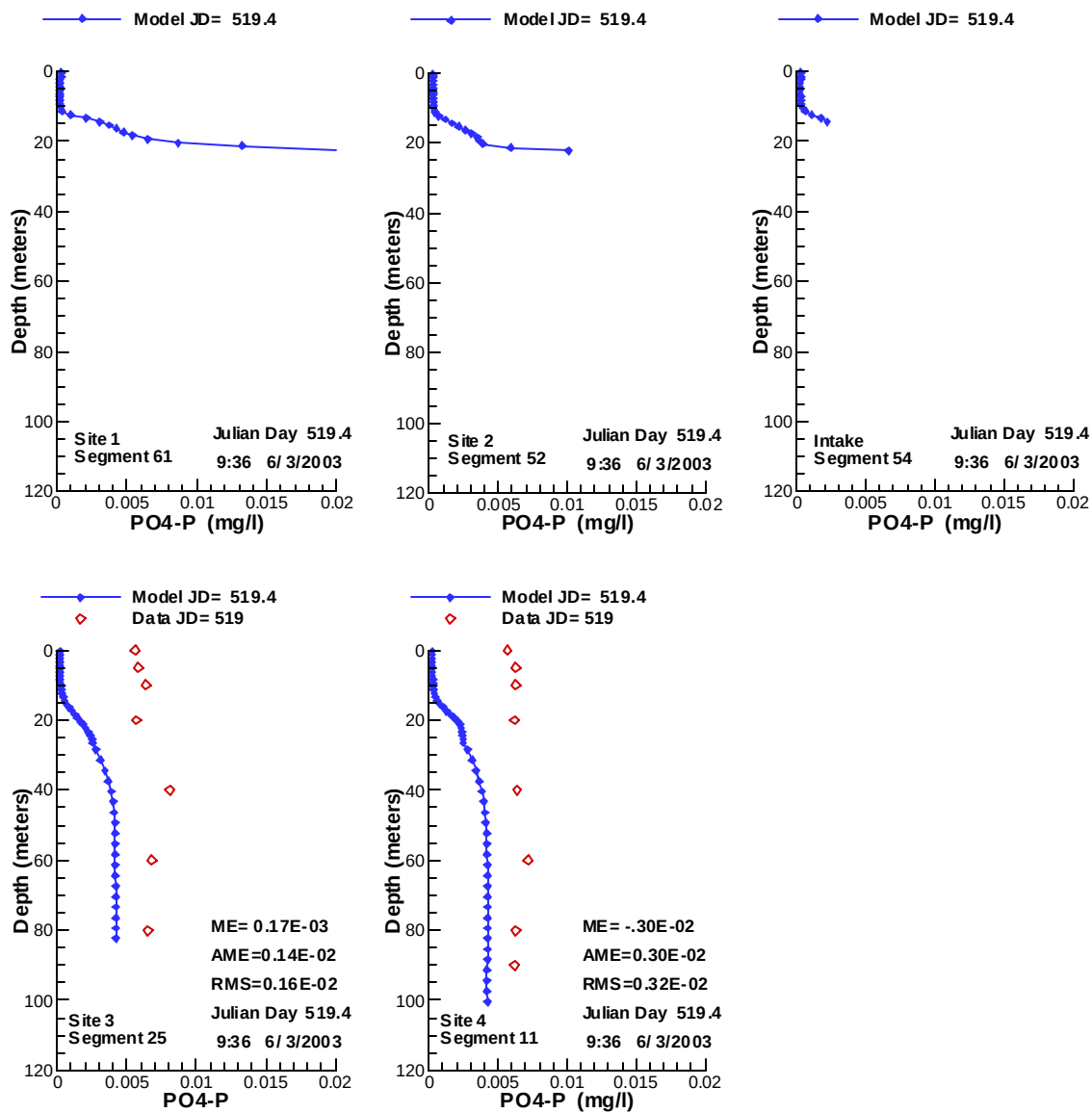


Figure 166. Vertical profiles of PO4-P compared with data for 6/ 3/2003.

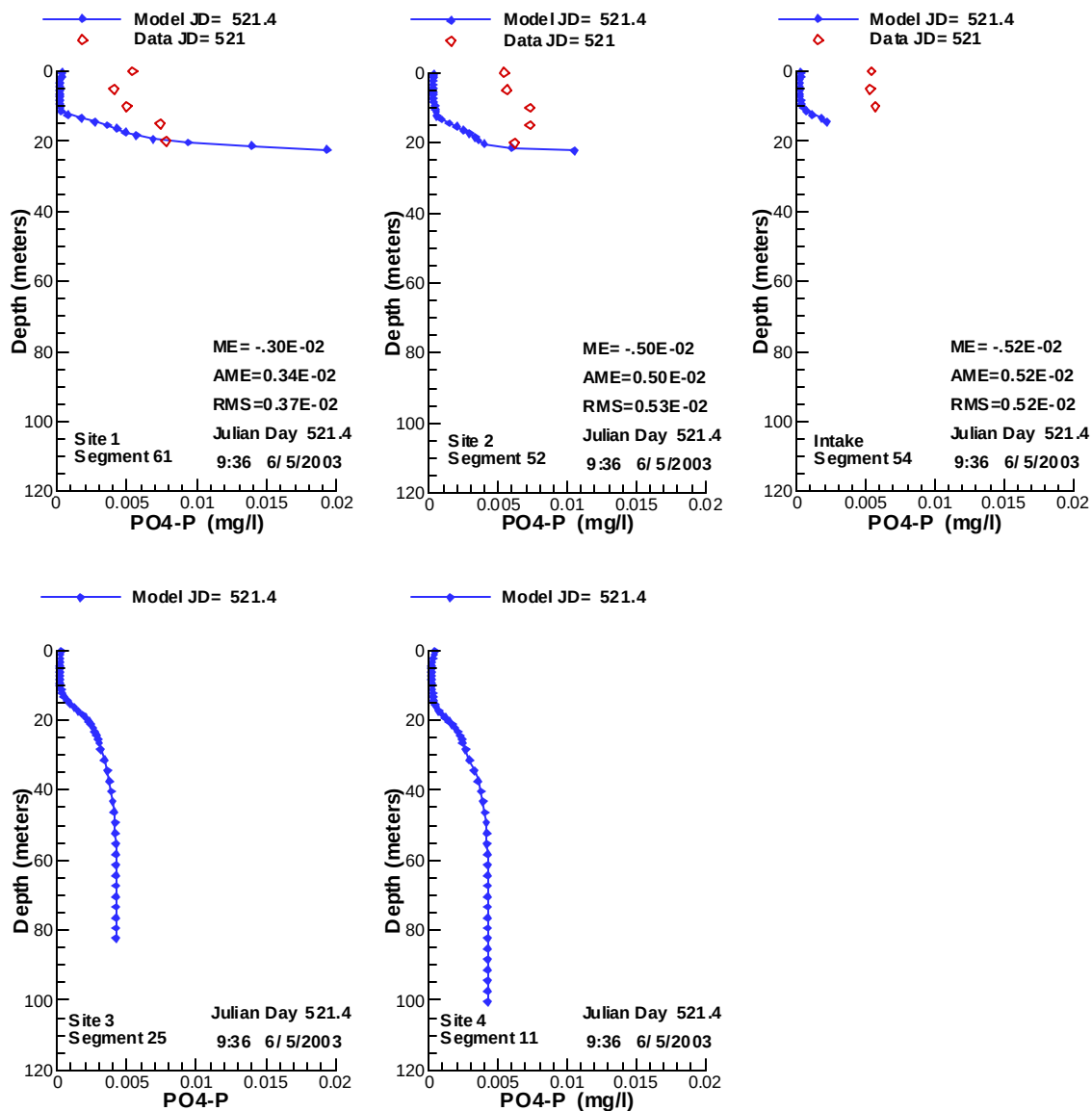


Figure 167. Vertical profiles of PO4-P compared with data for 6/ 5/2003.

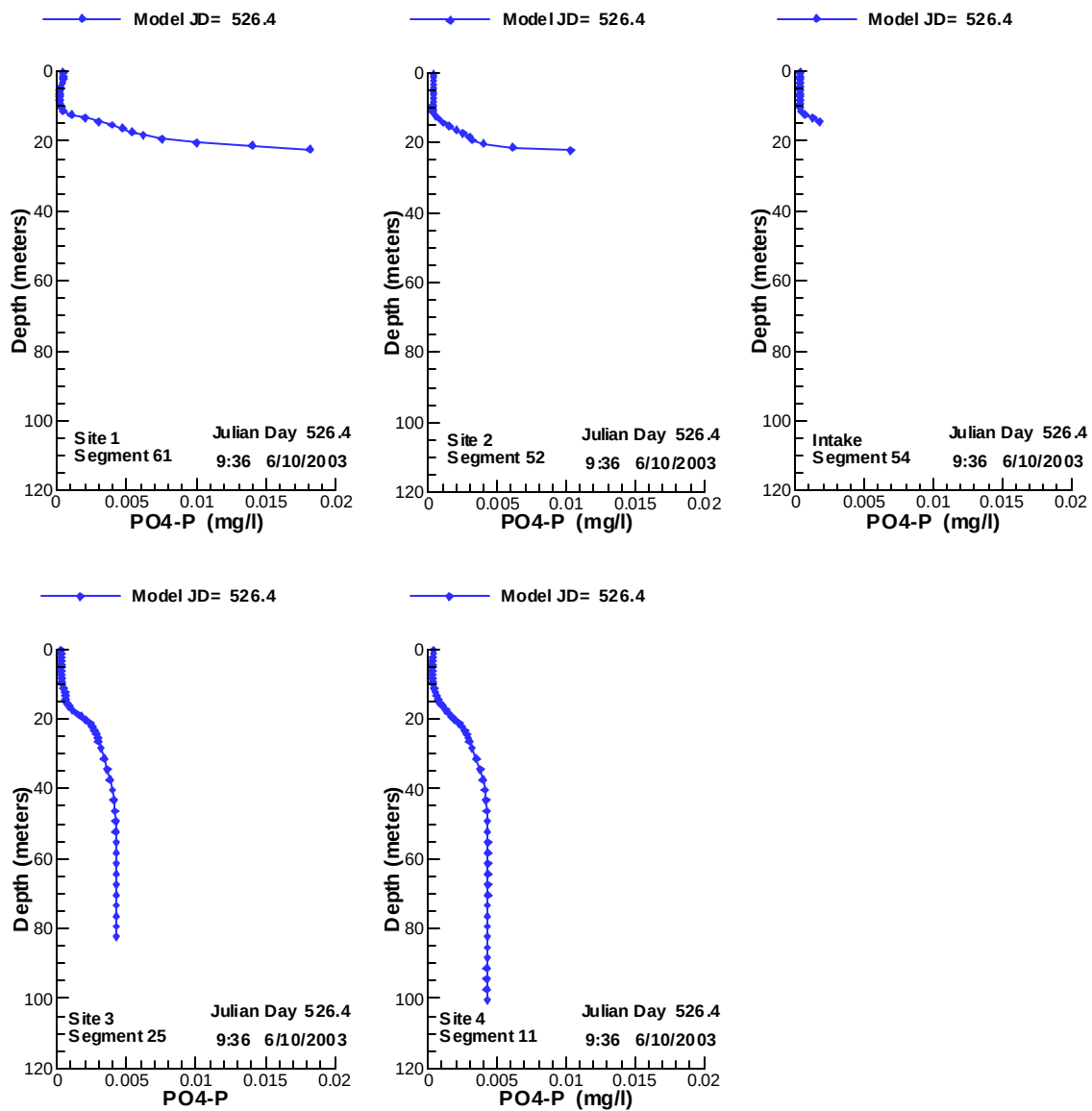


Figure 168. Vertical profiles of PO4-P compared with data for 6/10/2003.

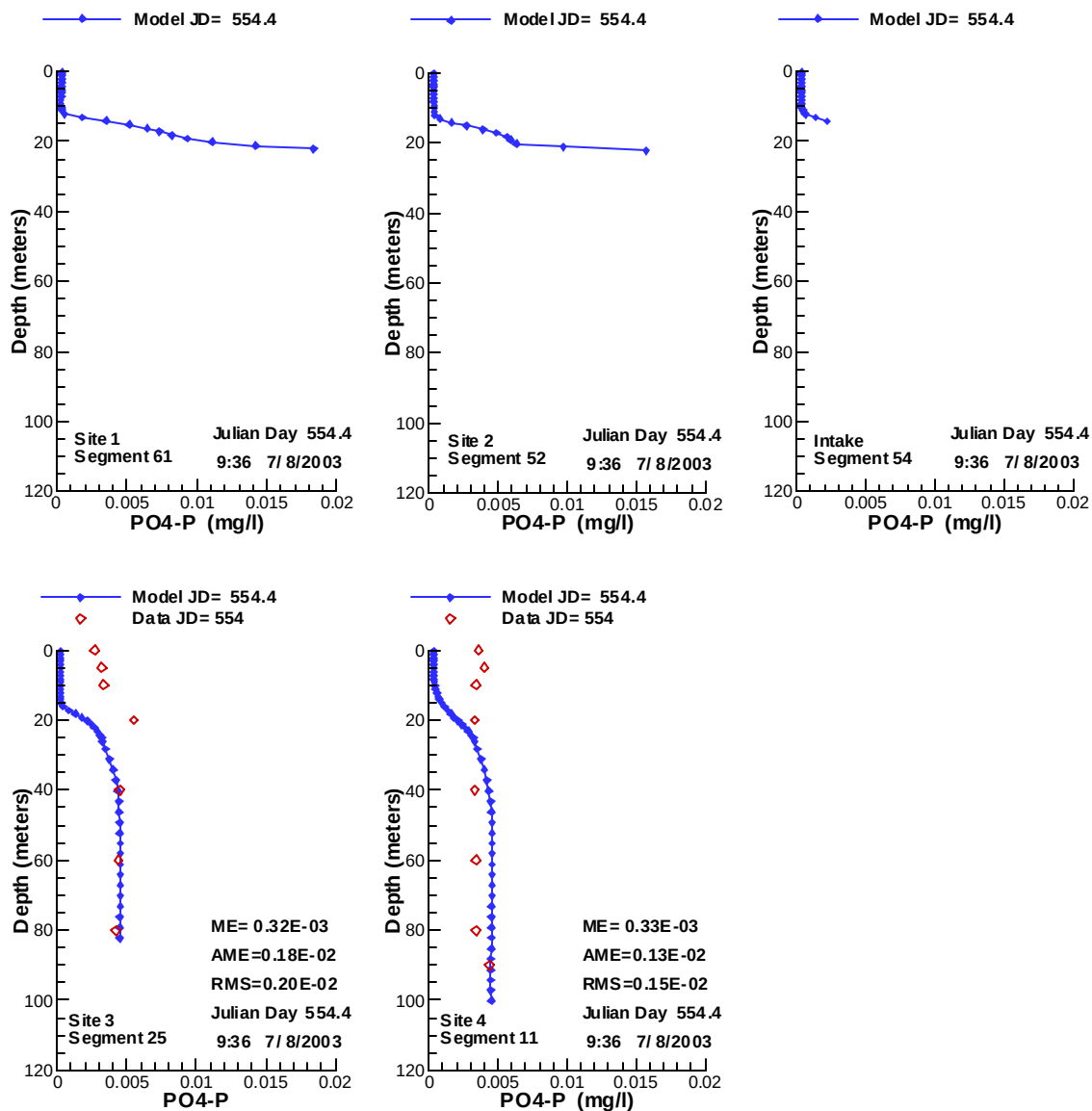


Figure 169. Vertical profiles of PO4-P compared with data for 7/ 8/2003.

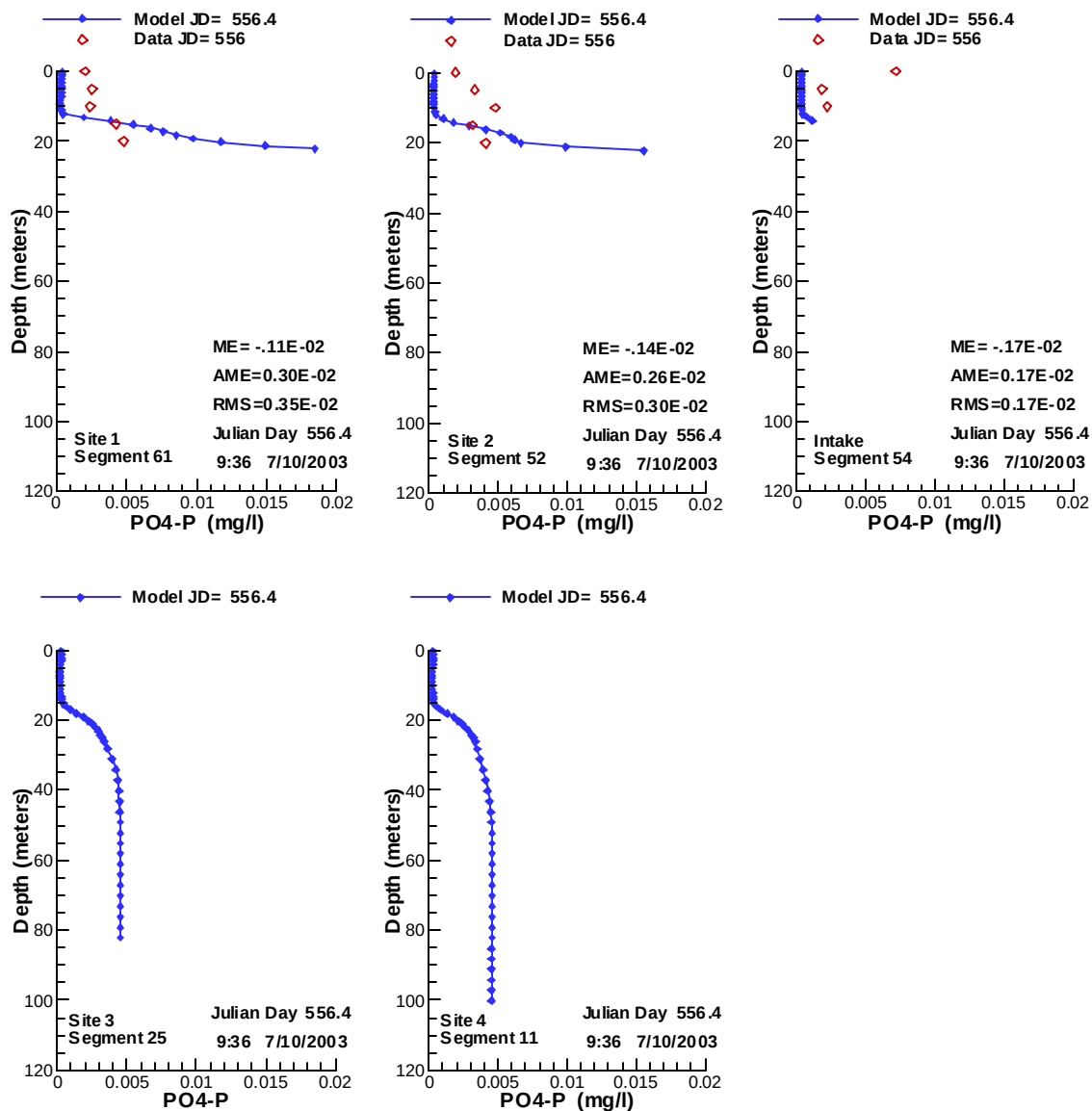


Figure 170. Vertical profiles of PO4-P compared with data for 7/10/2003.

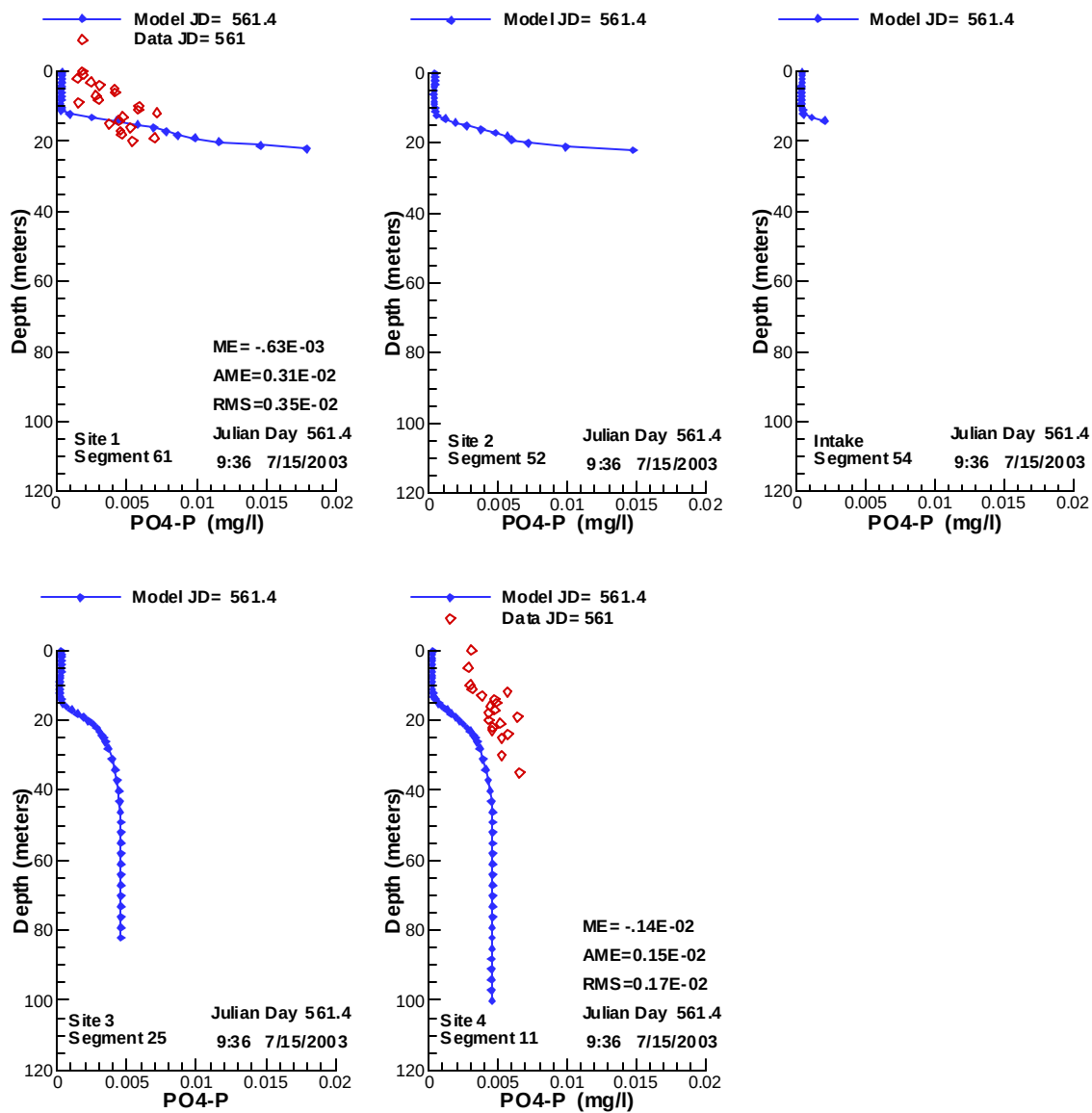


Figure 171. Vertical profiles of PO4-P compared with data for 7/15/2003.

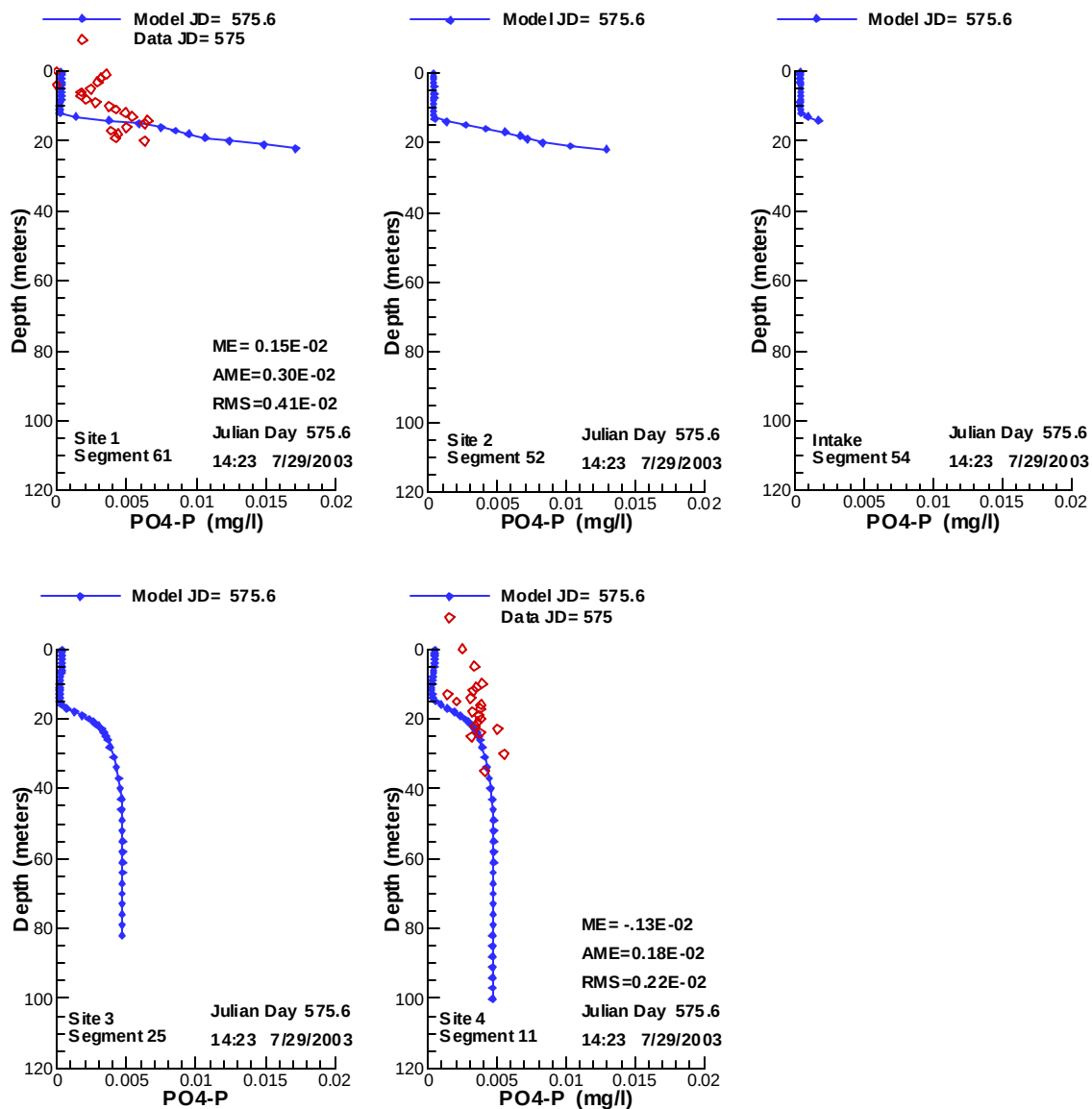


Figure 172. Vertical profiles of PO4-P compared with data for 7/29/2003.

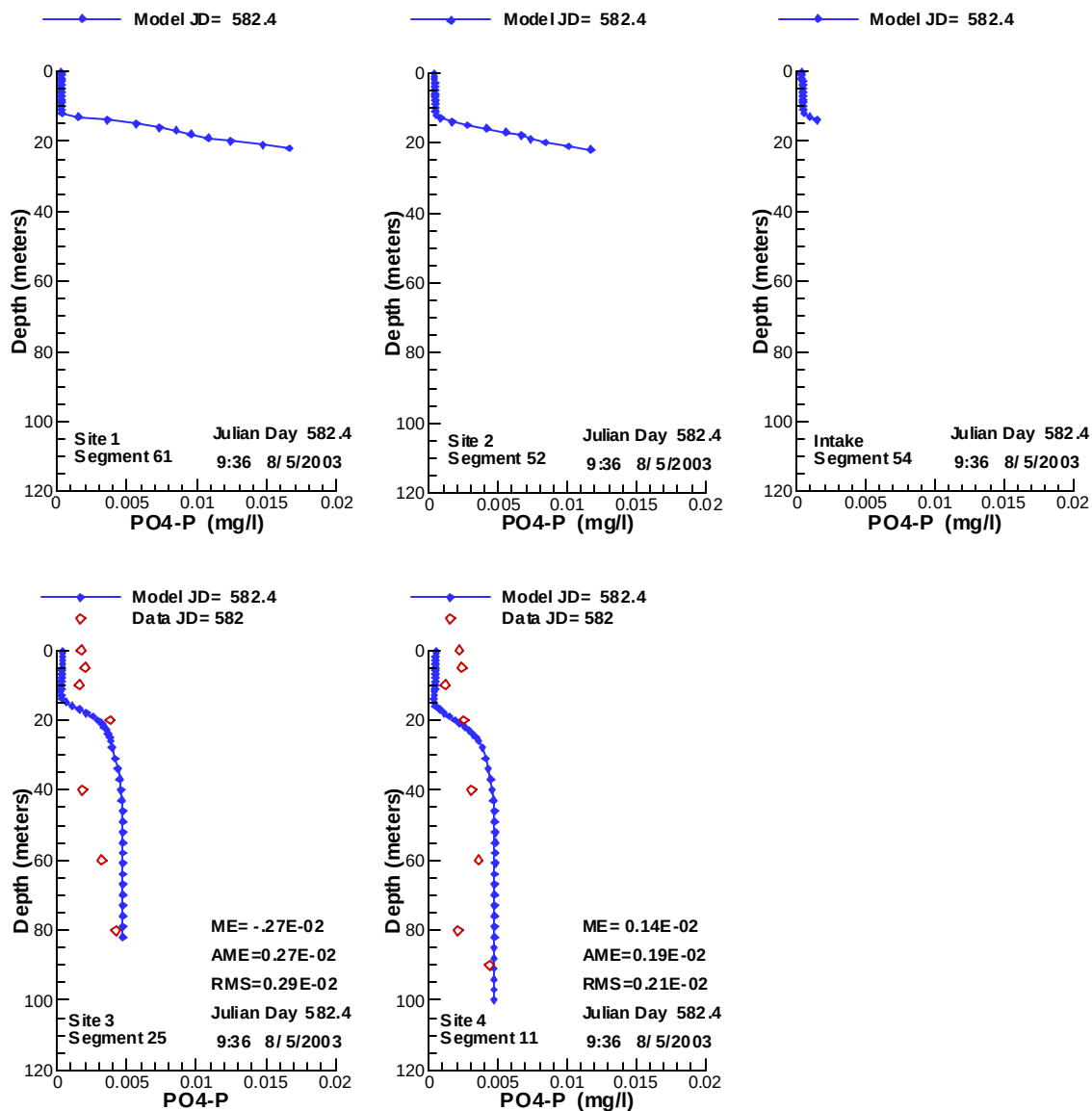


Figure 173. Vertical profiles of PO4-P compared with data for 8/ 5/2003.

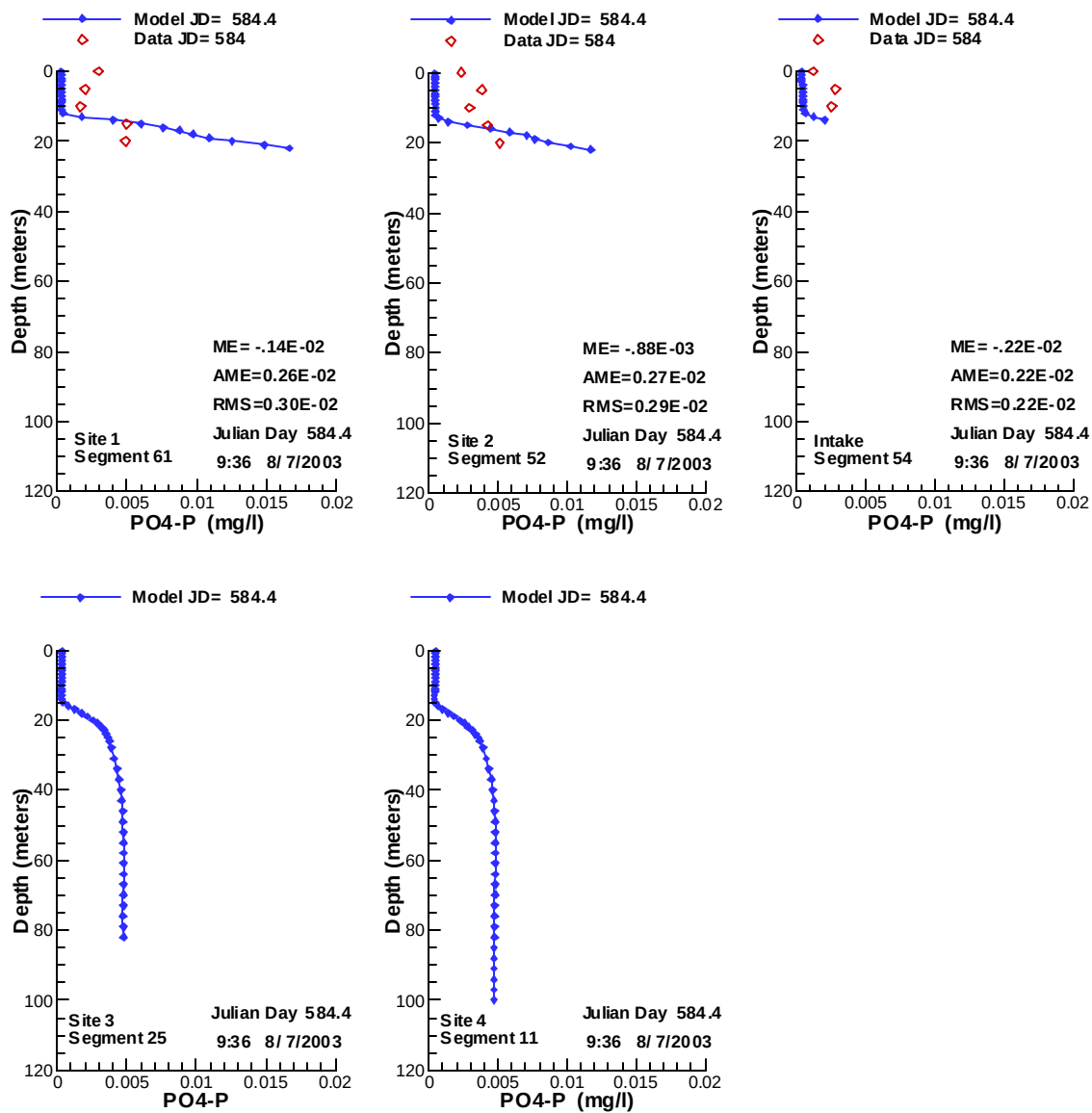


Figure 174. Vertical profiles of PO4-P compared with data for 8/ 7/2003.

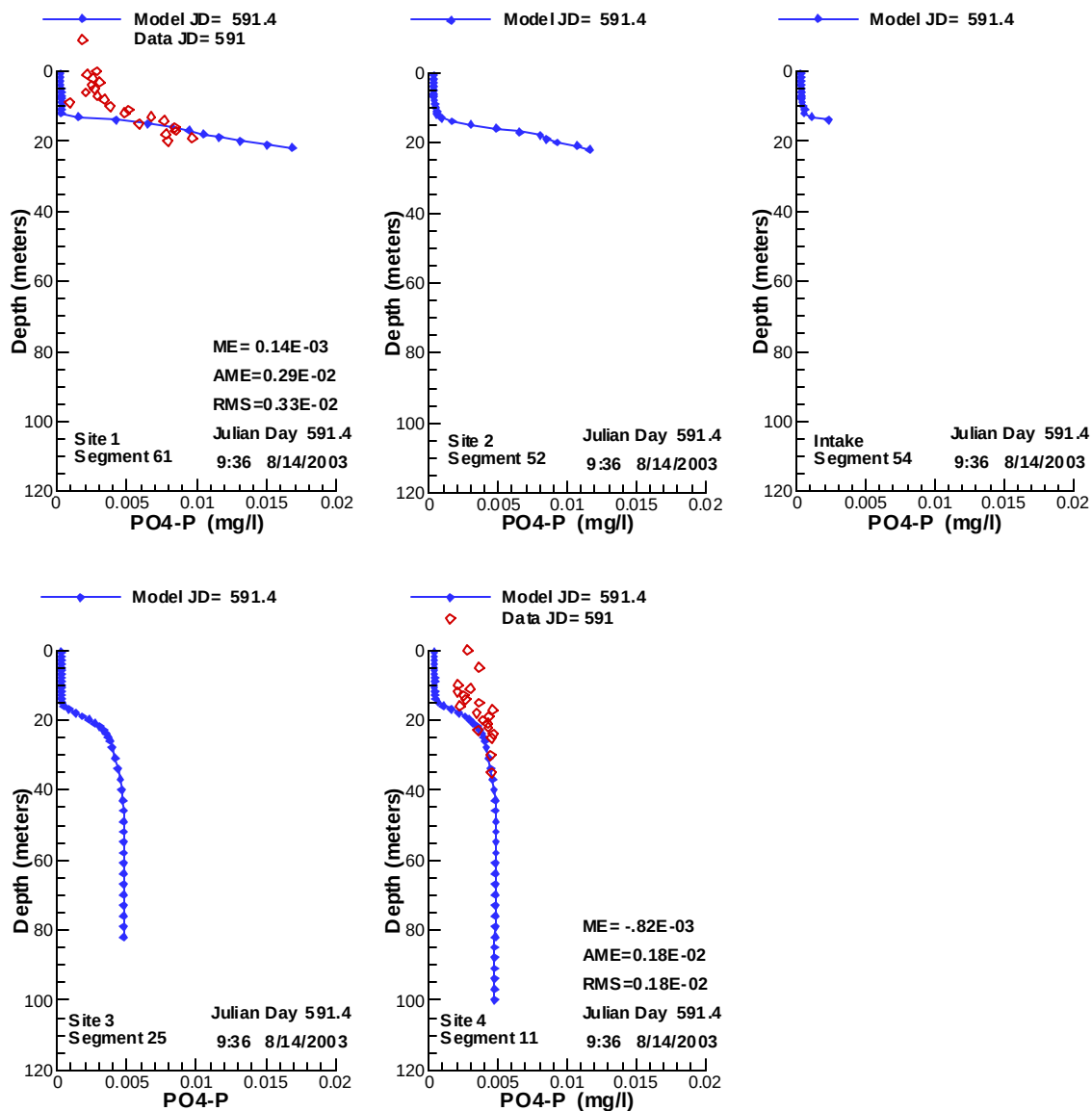


Figure 175. Vertical profiles of PO4-P compared with data for 8/14/2003.

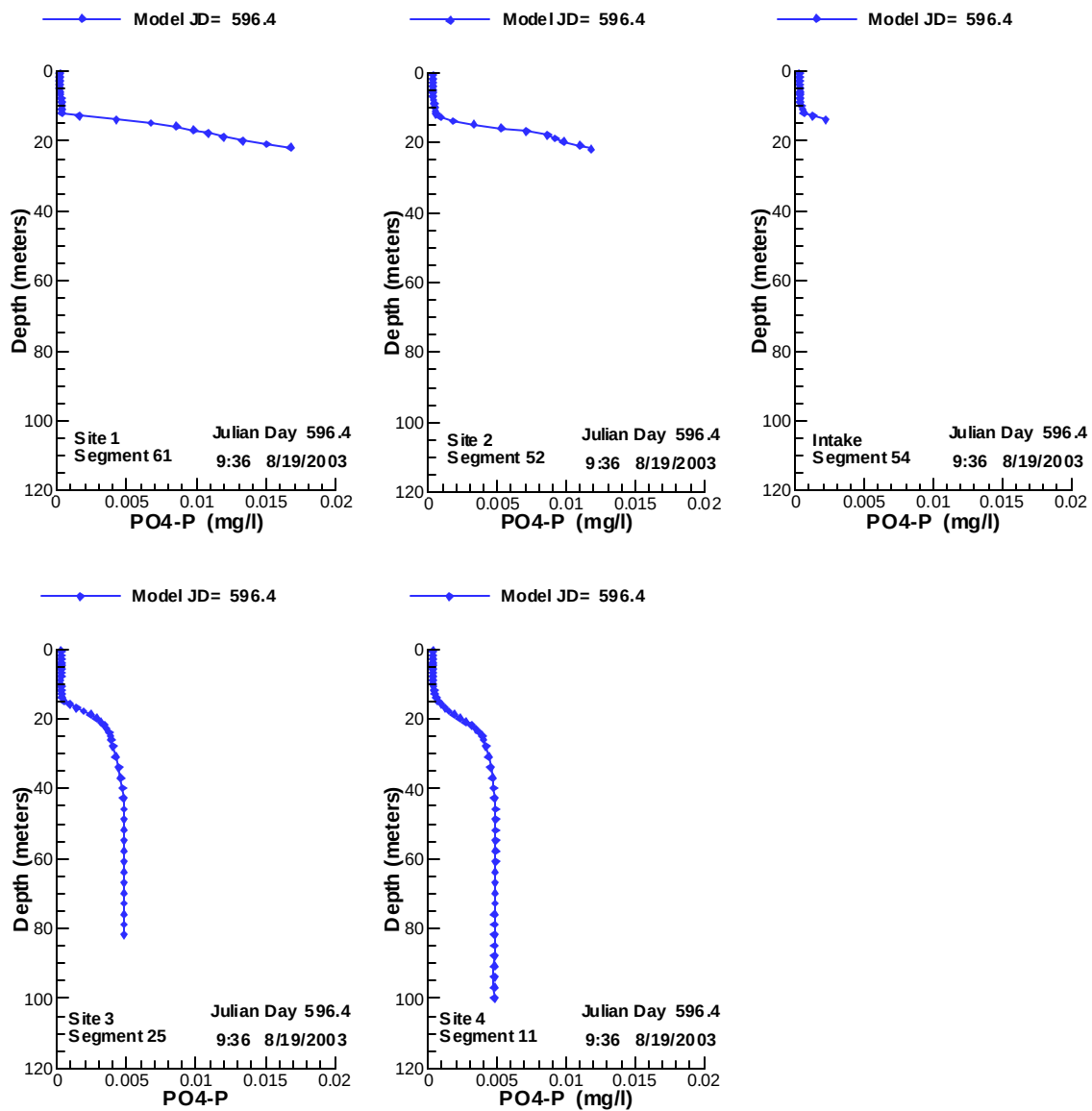


Figure 176. Vertical profiles of PO4-P compared with data for 8/19/2003.

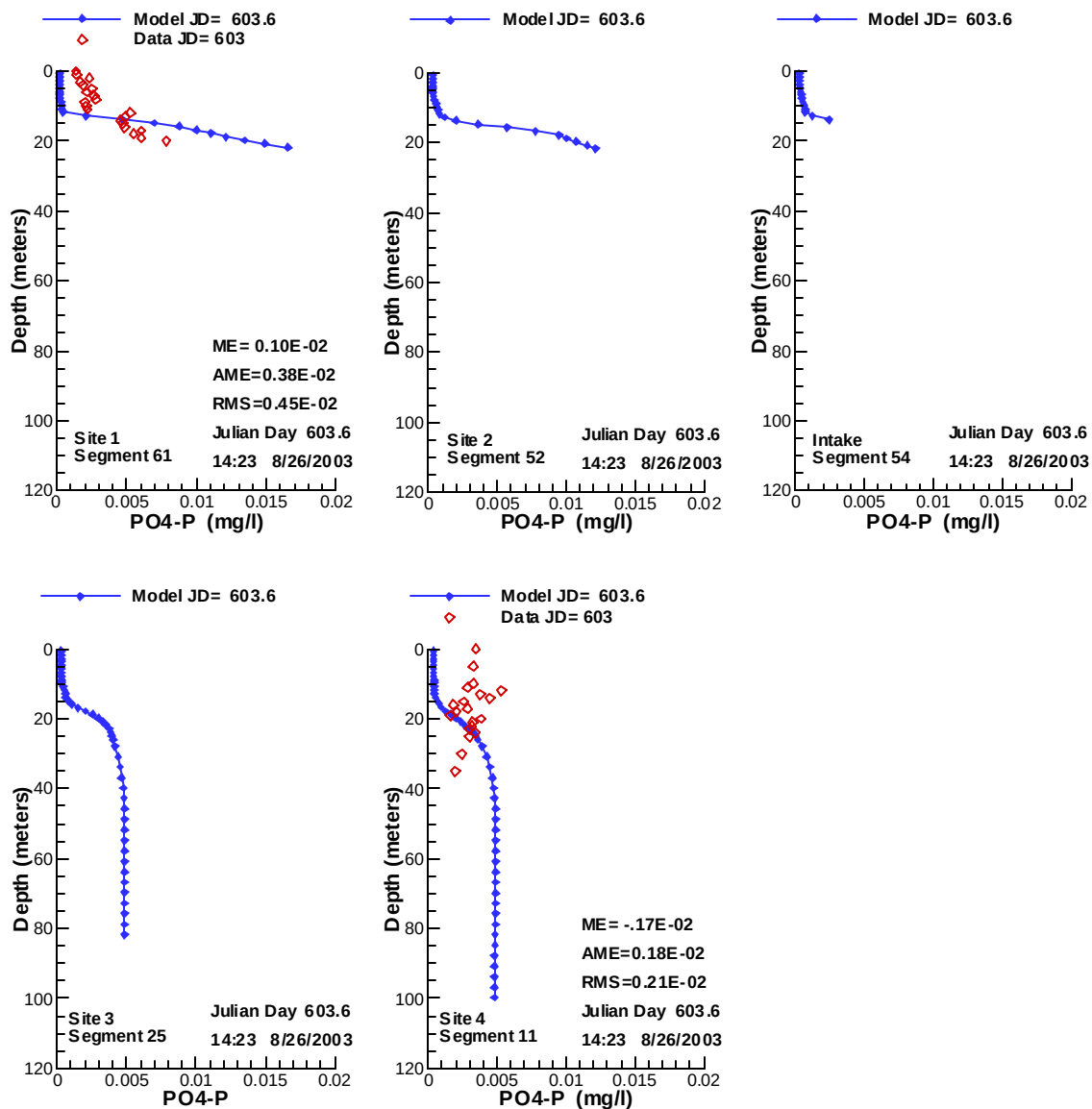


Figure 177. Vertical profiles of PO4-P compared with data for 8/26/2003.

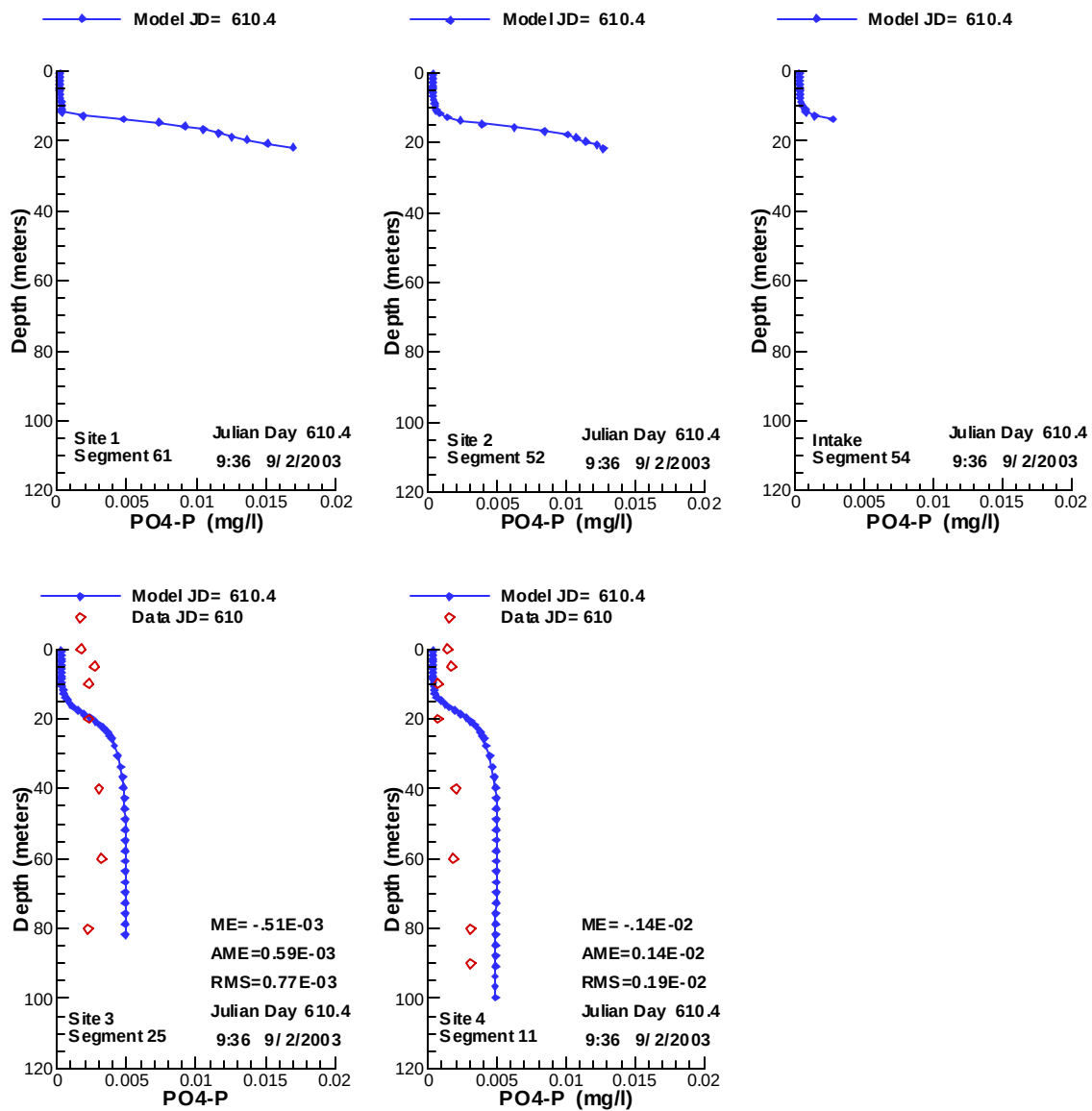


Figure 178. Vertical profiles of PO4-P compared with data for 9/ 2/2003.

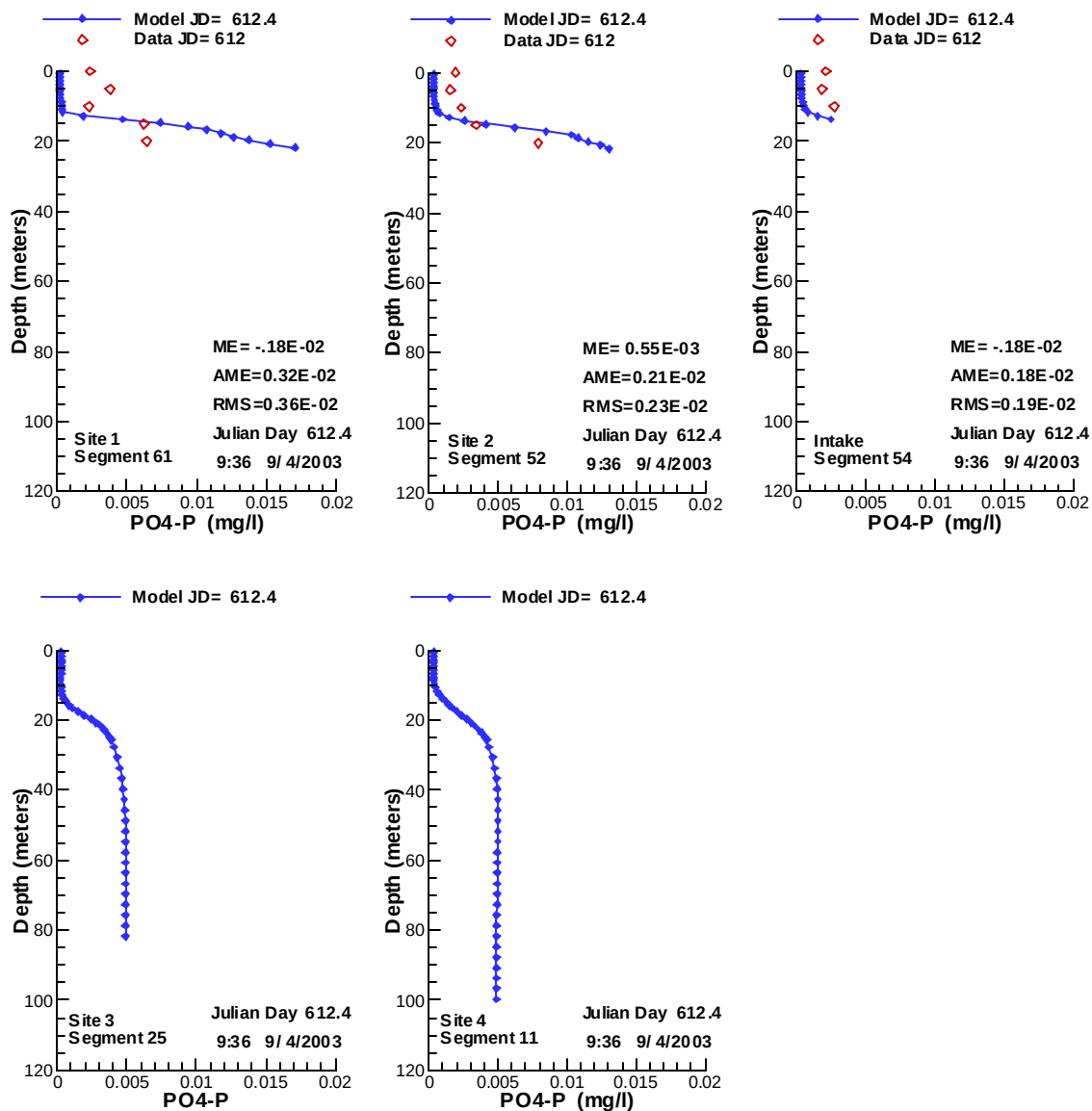


Figure 179. Vertical profiles of PO4-P compared with data for 9/ 4/2003.

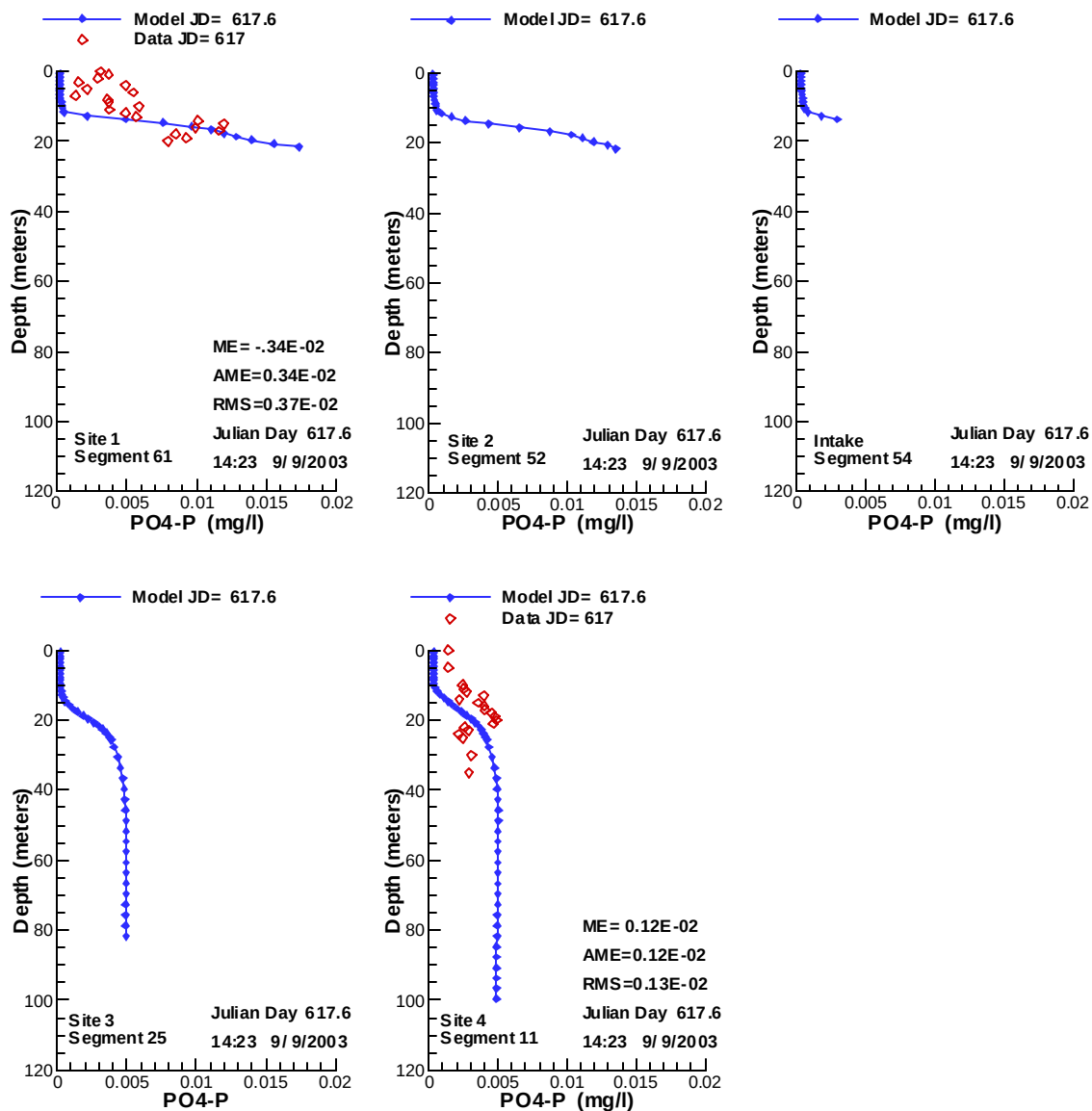


Figure 180. Vertical profiles of PO4-P compared with data for 9/ 9/2003.

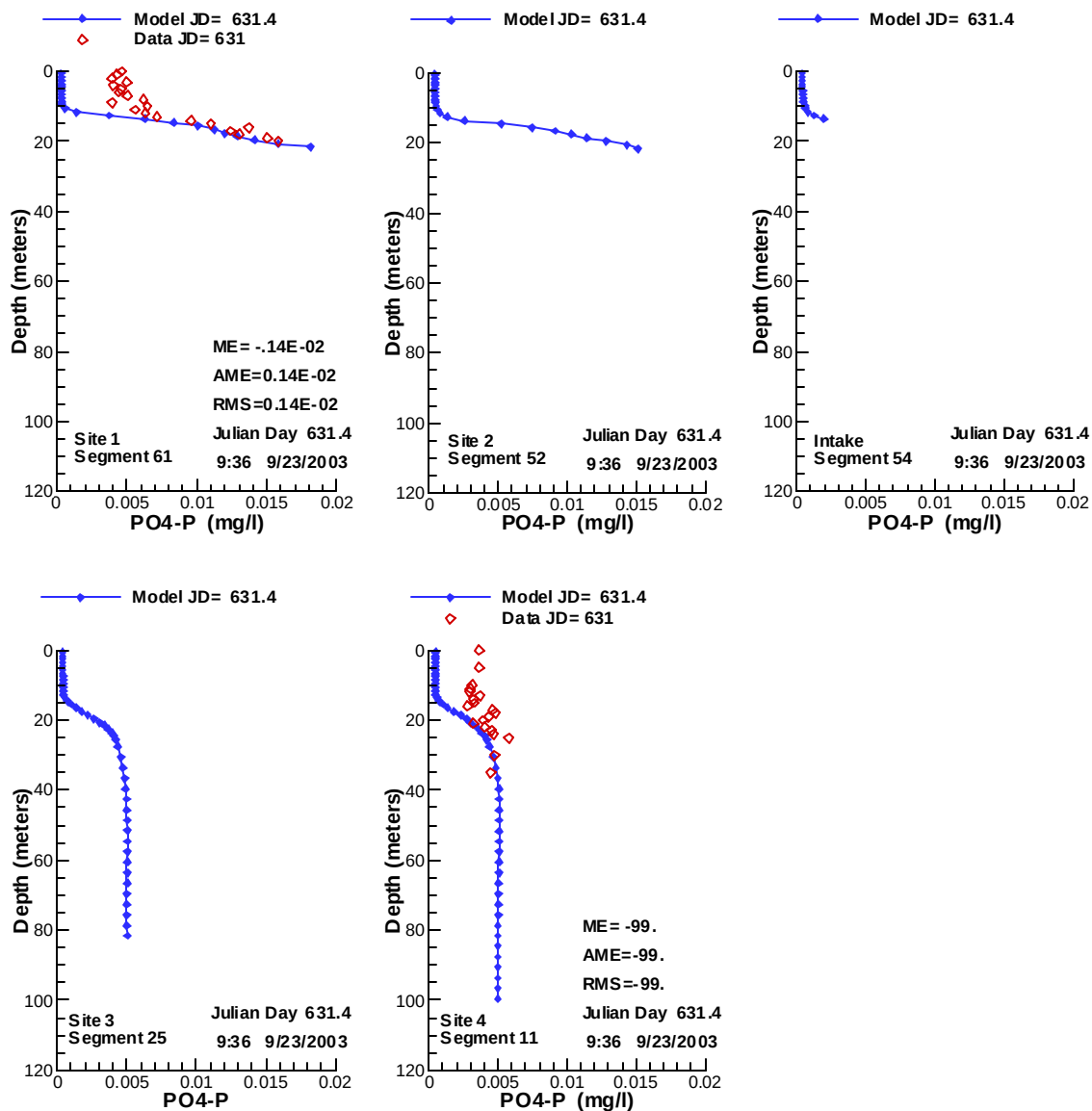


Figure 181. Vertical profiles of PO4-P compared with data for 9/23/2003.

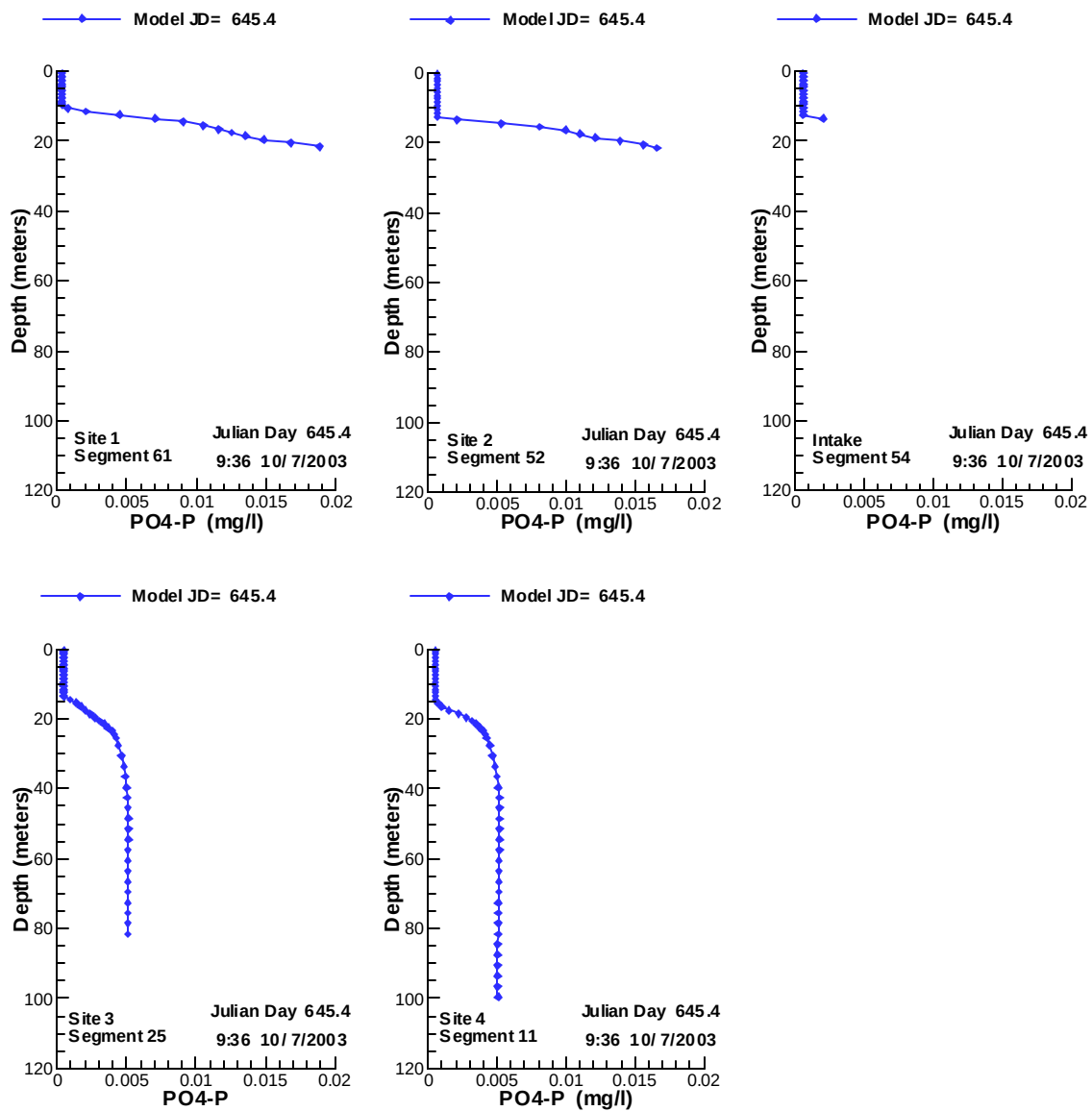


Figure 182. Vertical profiles of PO4-P compared with data for 10/ 7/2003.

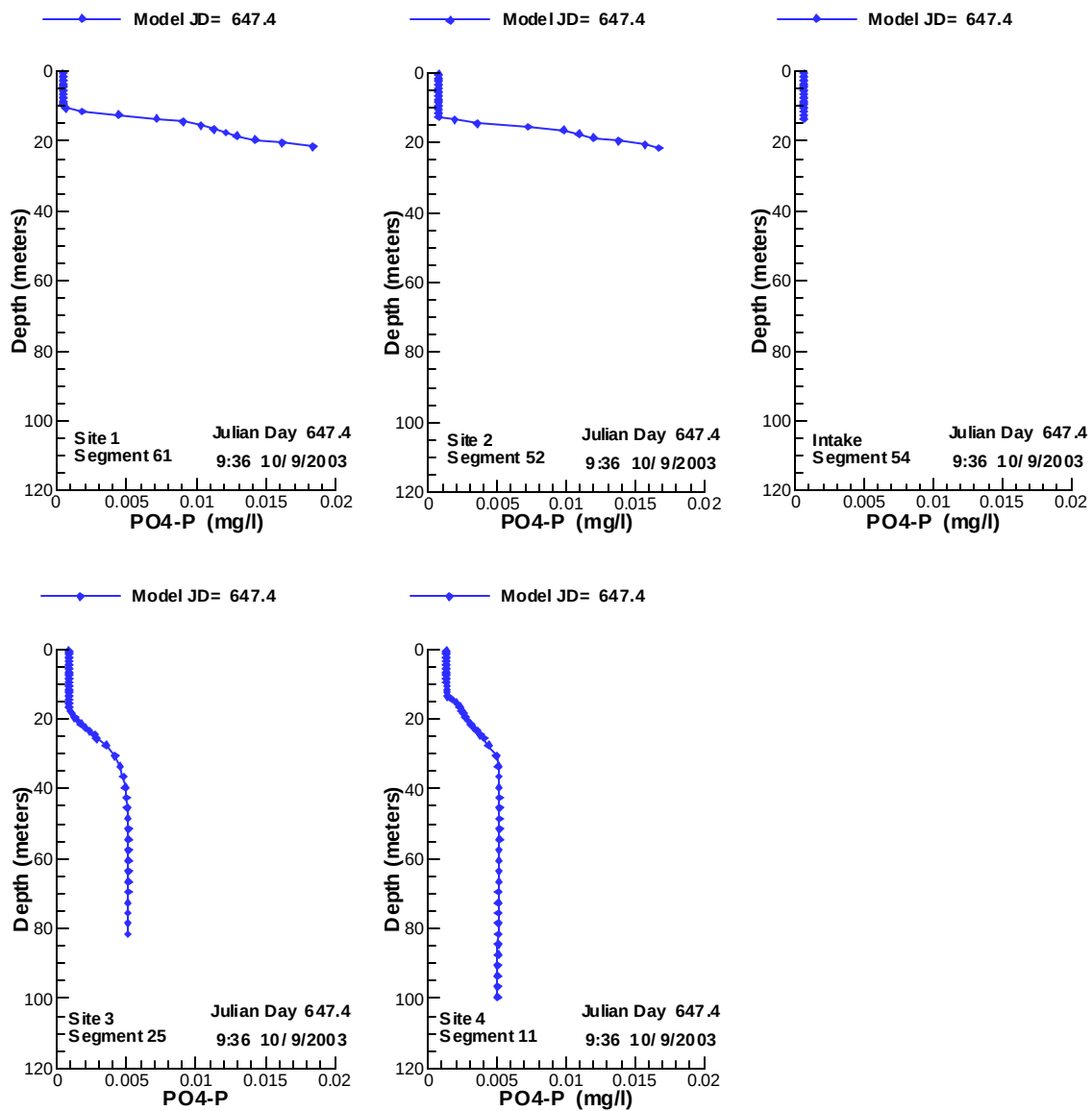


Figure 183. Vertical profiles of PO4-P compared with data for 10/ 9/2003.

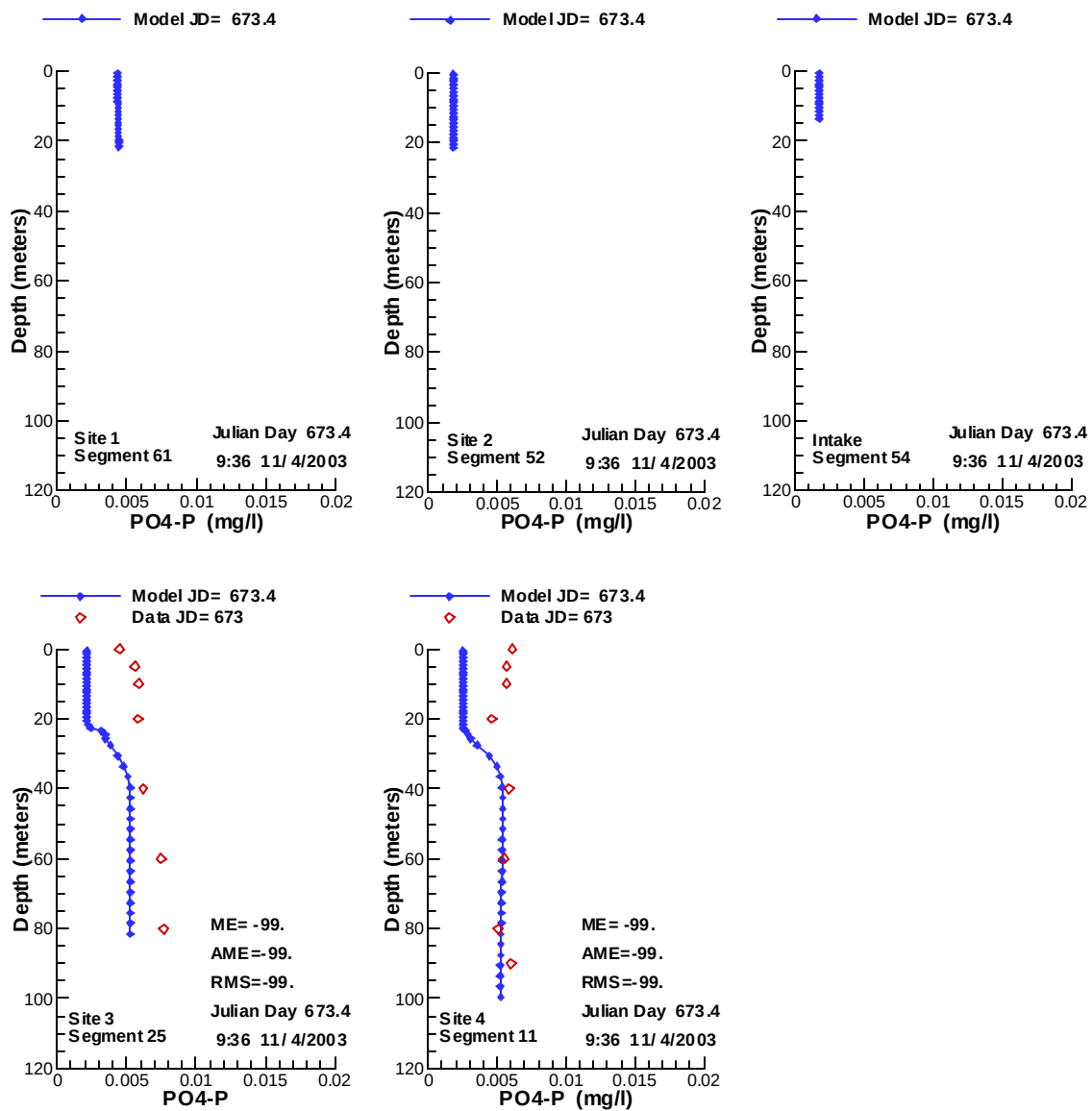


Figure 184. Vertical profiles of PO4-P compared with data for 11/ 4/2003.

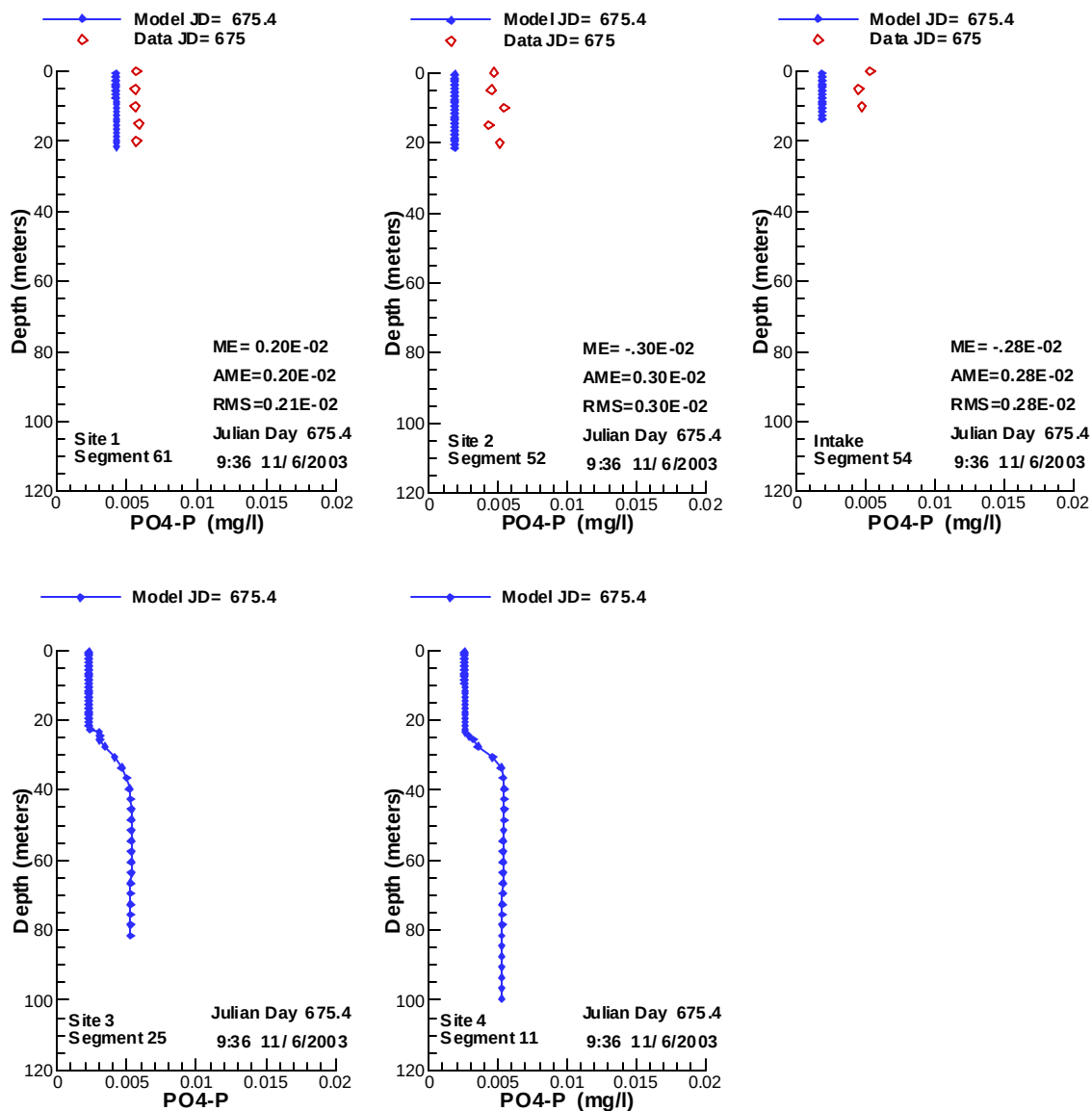


Figure 185. Vertical profiles of PO4-P compared with data for 11/ 6/2003.

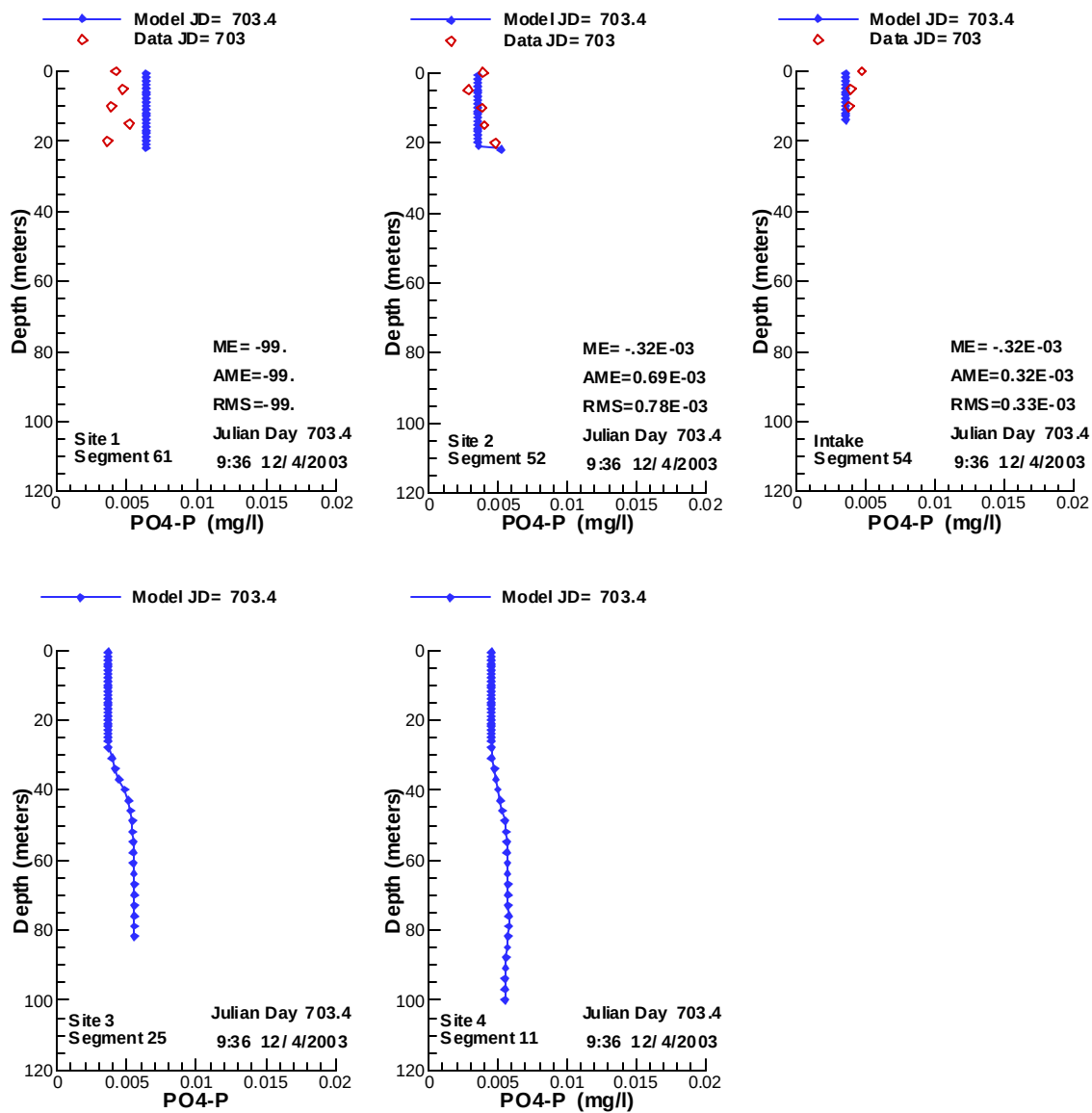


Figure 186. Vertical profiles of PO4-P compared with data for 12/ 4/2003.

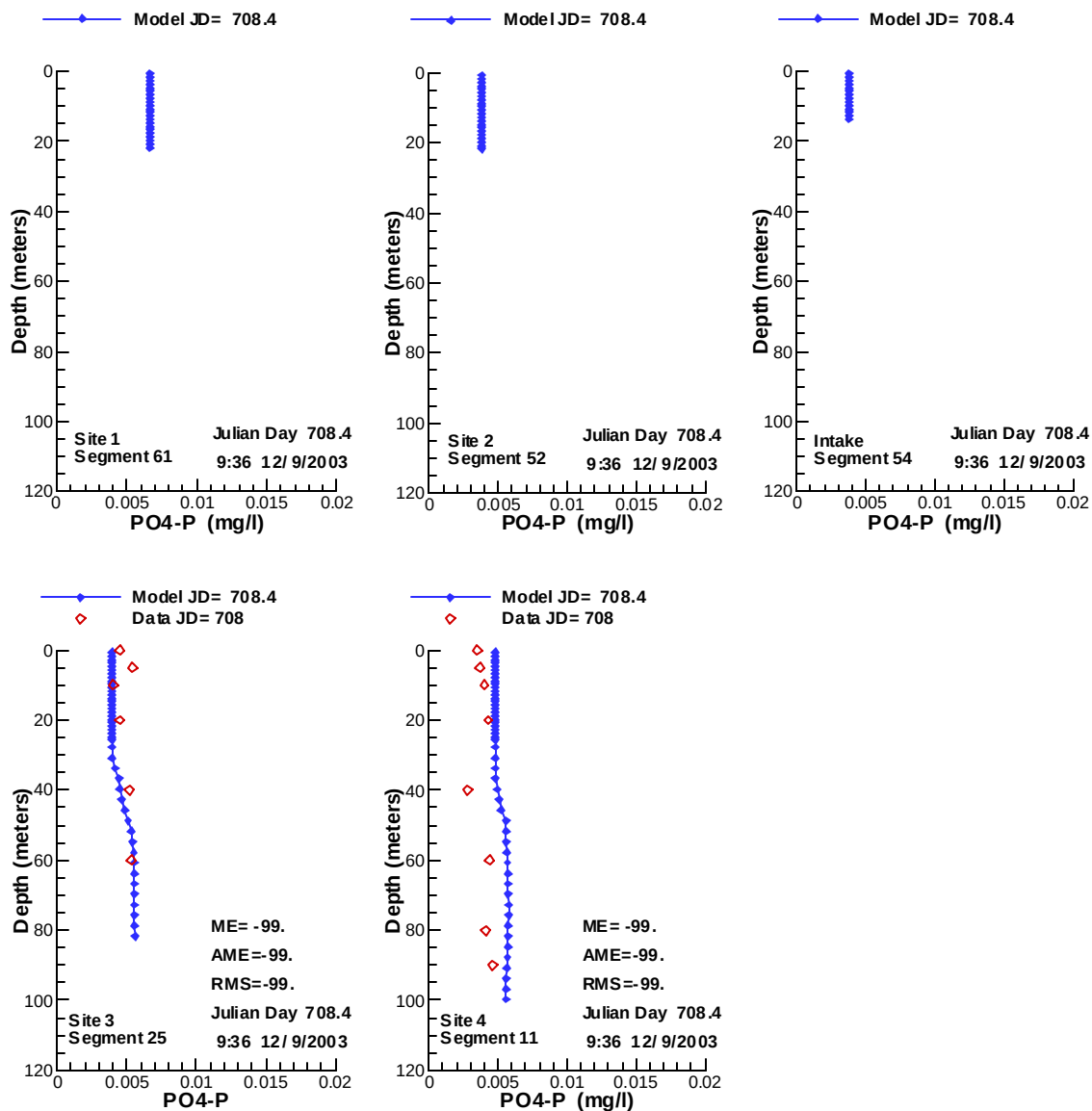


Figure 187. Vertical profiles of PO4-P compared with data for 12/ 9/2003.

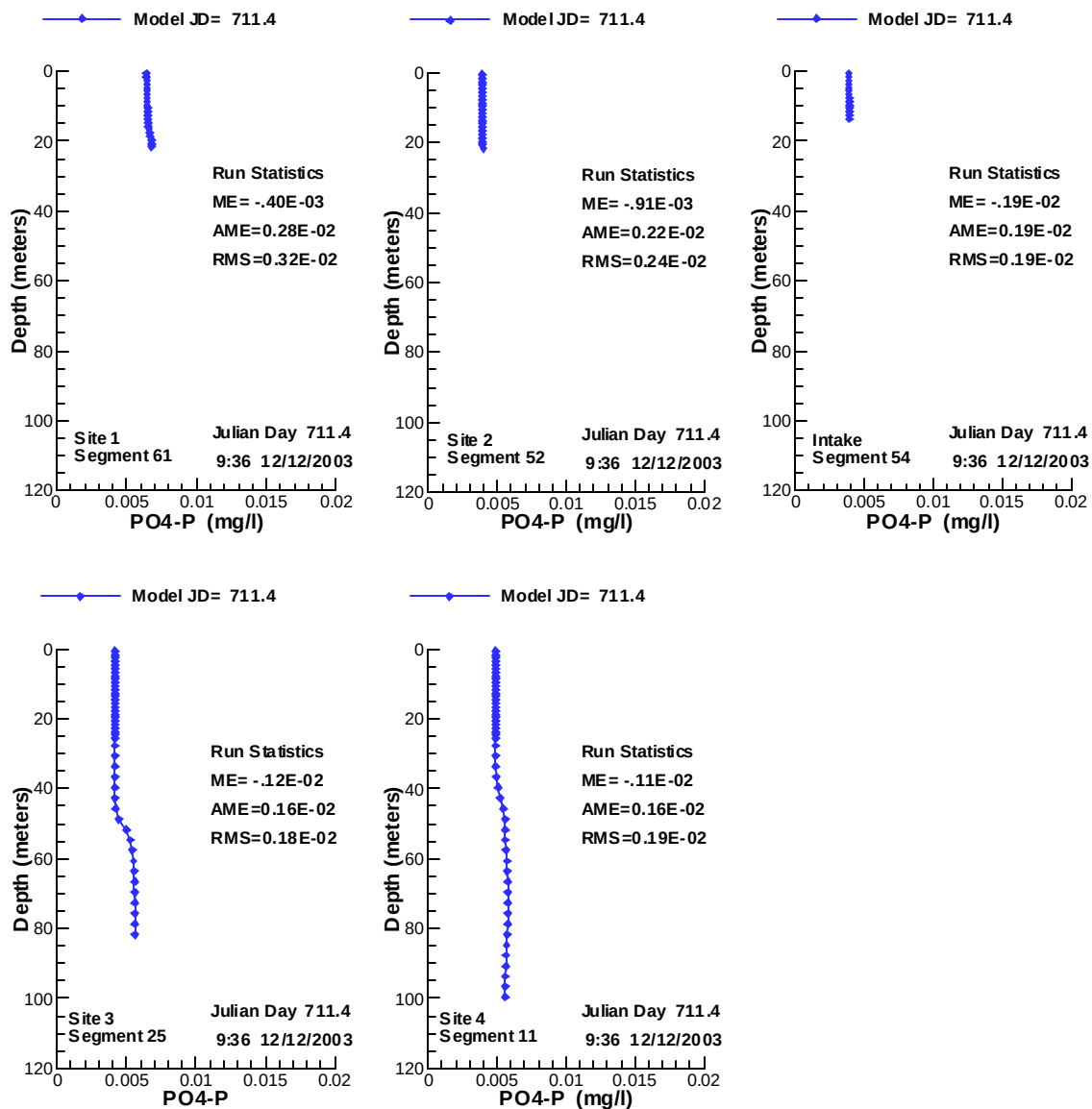


Figure 188. Vertical profiles of PO4-P compared with data for 12/12/2003.

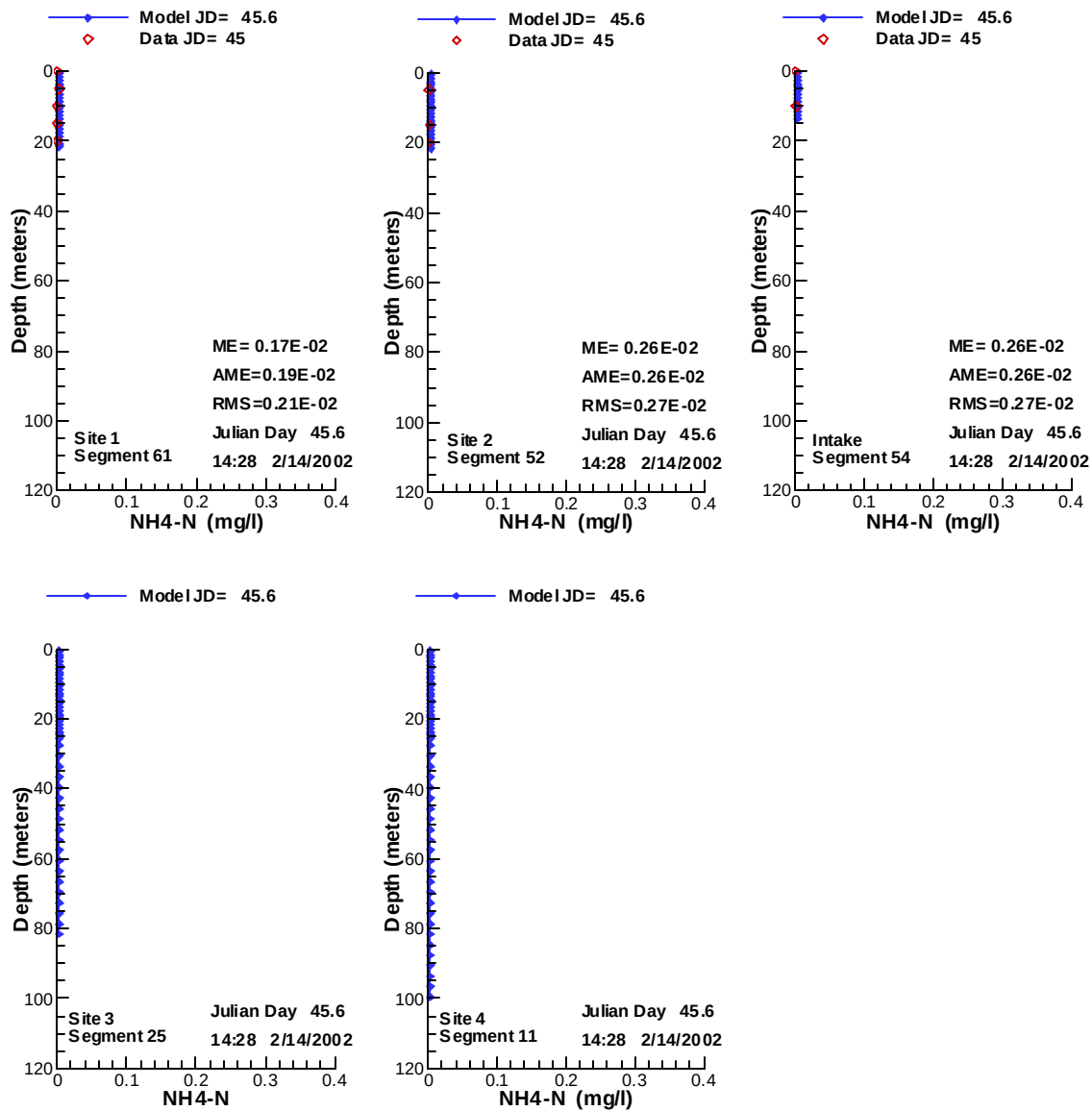


Figure 189. Vertical profiles of NH₄-N compared with data for 2/14/2002.

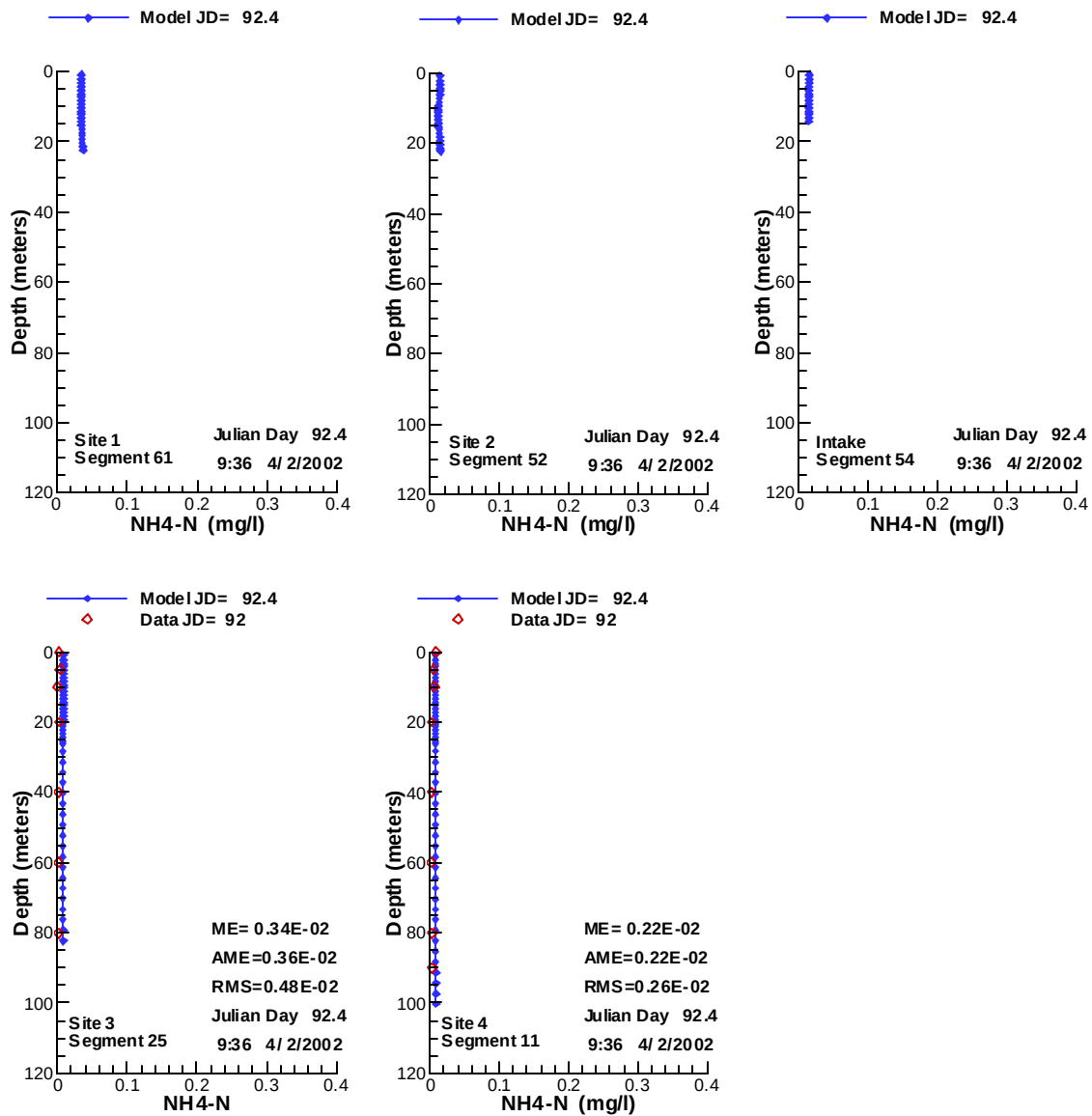


Figure 190. Vertical profiles of NH₄-N compared with data for 4/ 2/2002.

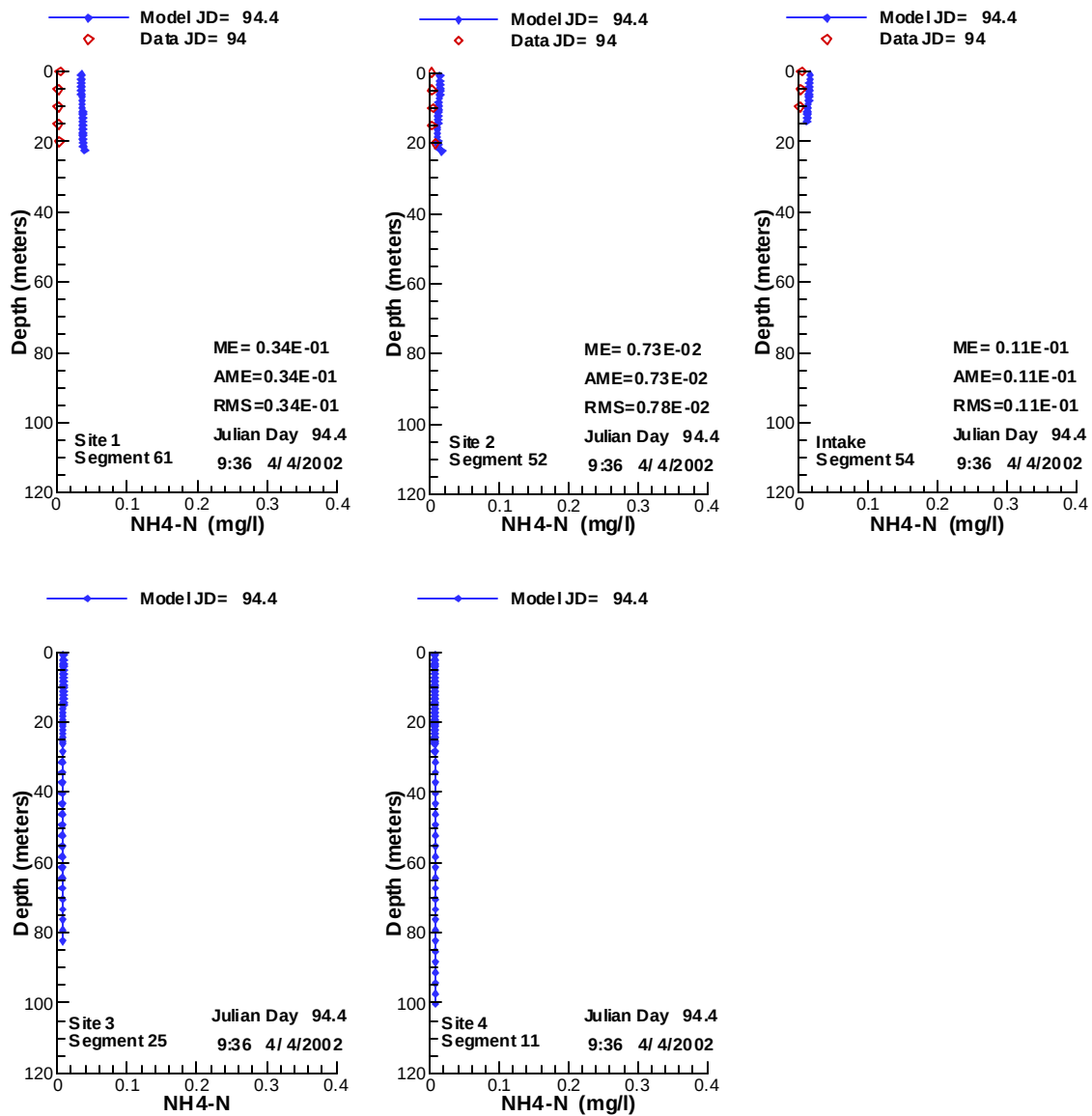


Figure 191. Vertical profiles of NH₄-N compared with data for 4/ 4/2002.

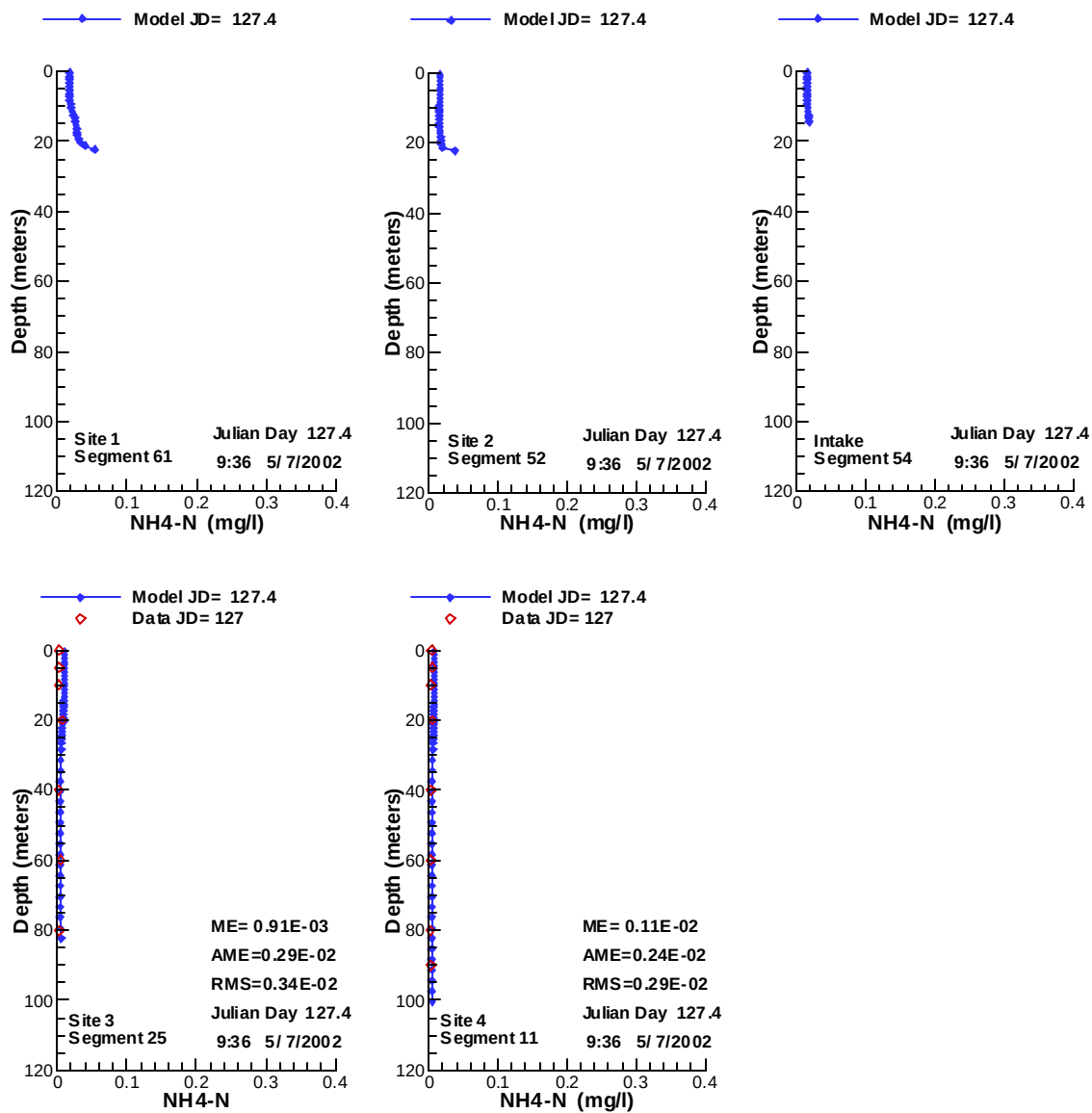


Figure 192. Vertical profiles of NH4-N compared with data for 5/ 7/2002.

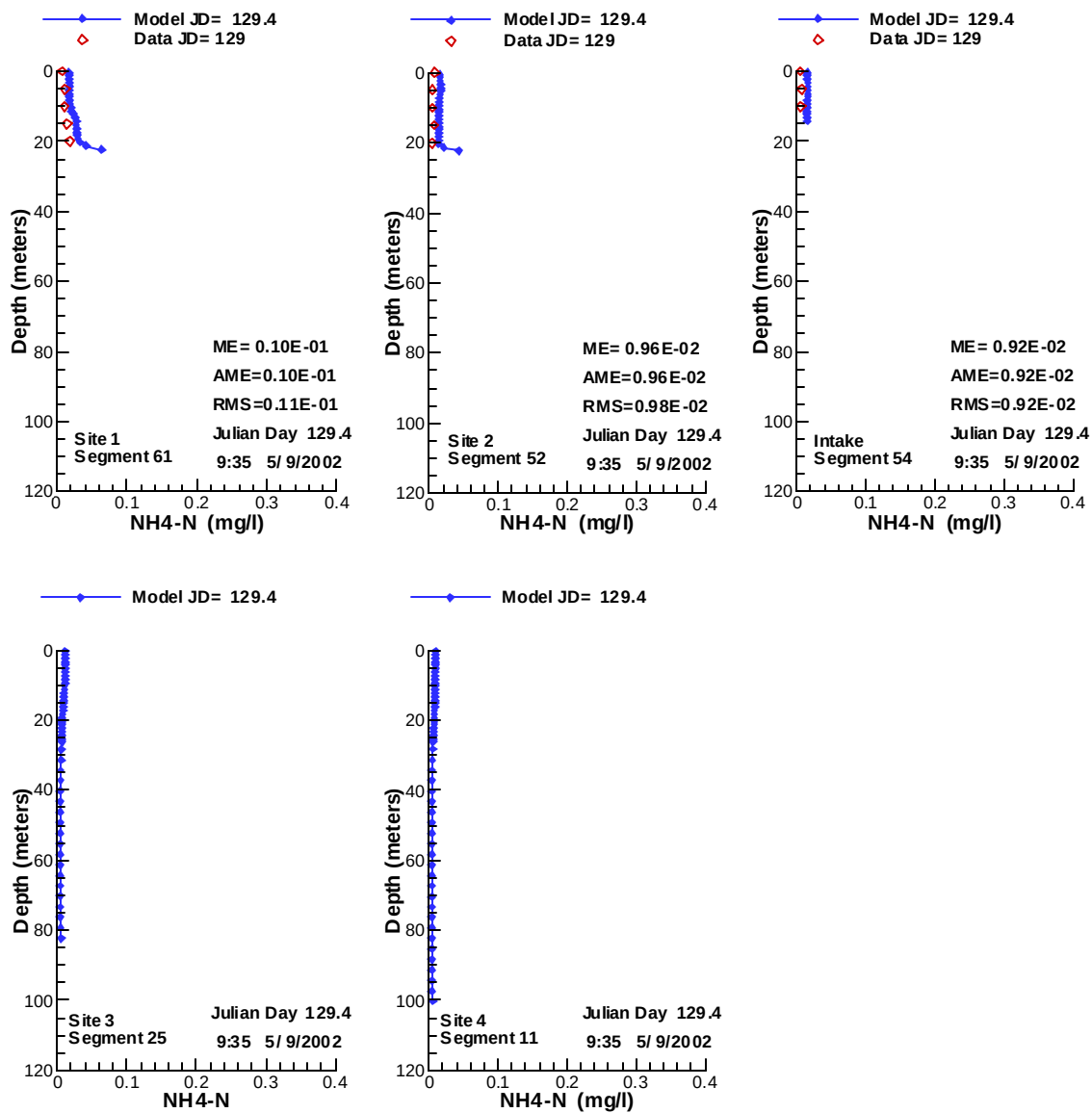


Figure 193. Vertical profiles of $\text{NH}_4\text{-N}$ compared with data for 5/ 9/2002.

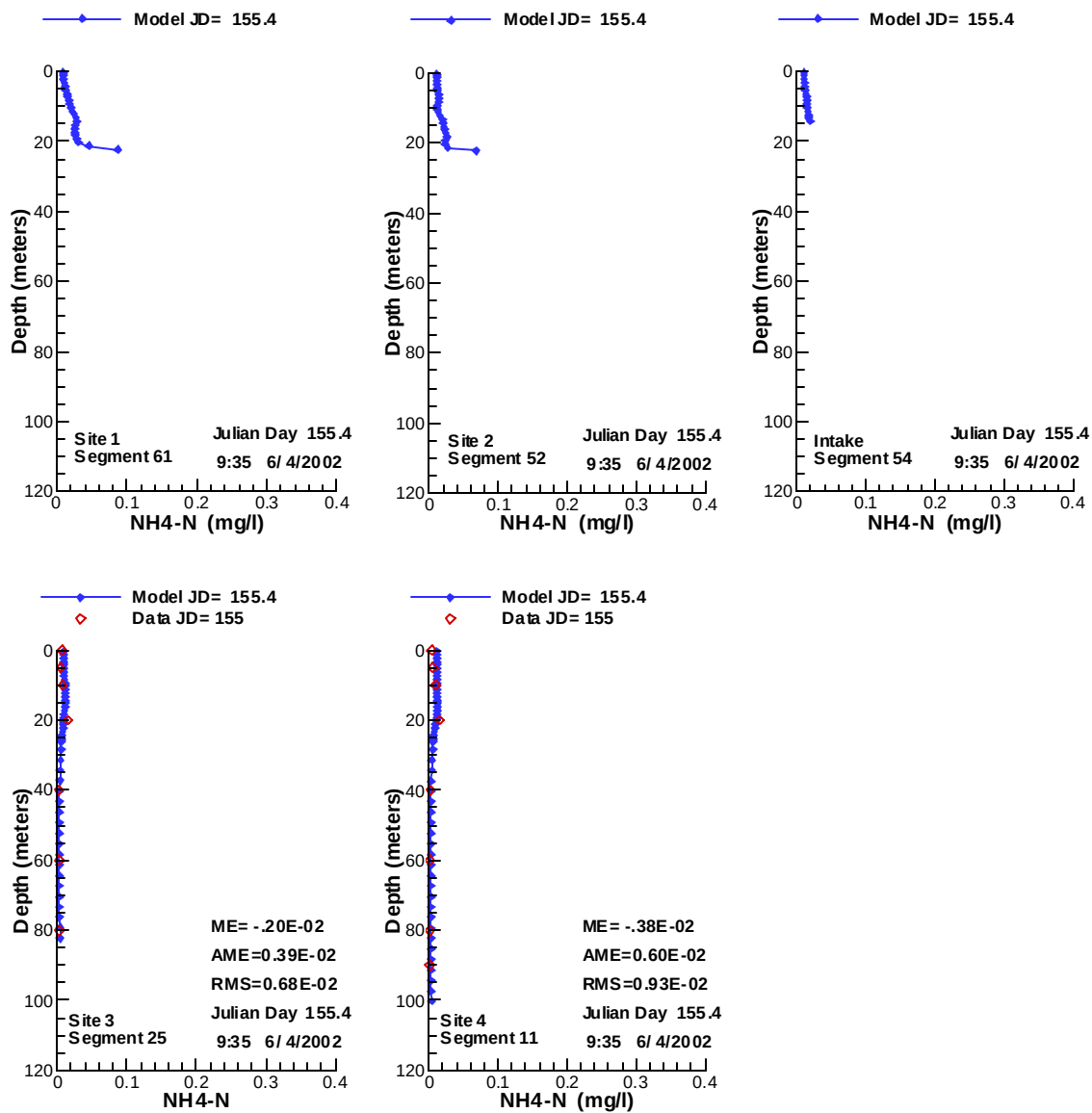


Figure 194. Vertical profiles of NH4-N compared with data for 6/ 4/2002.

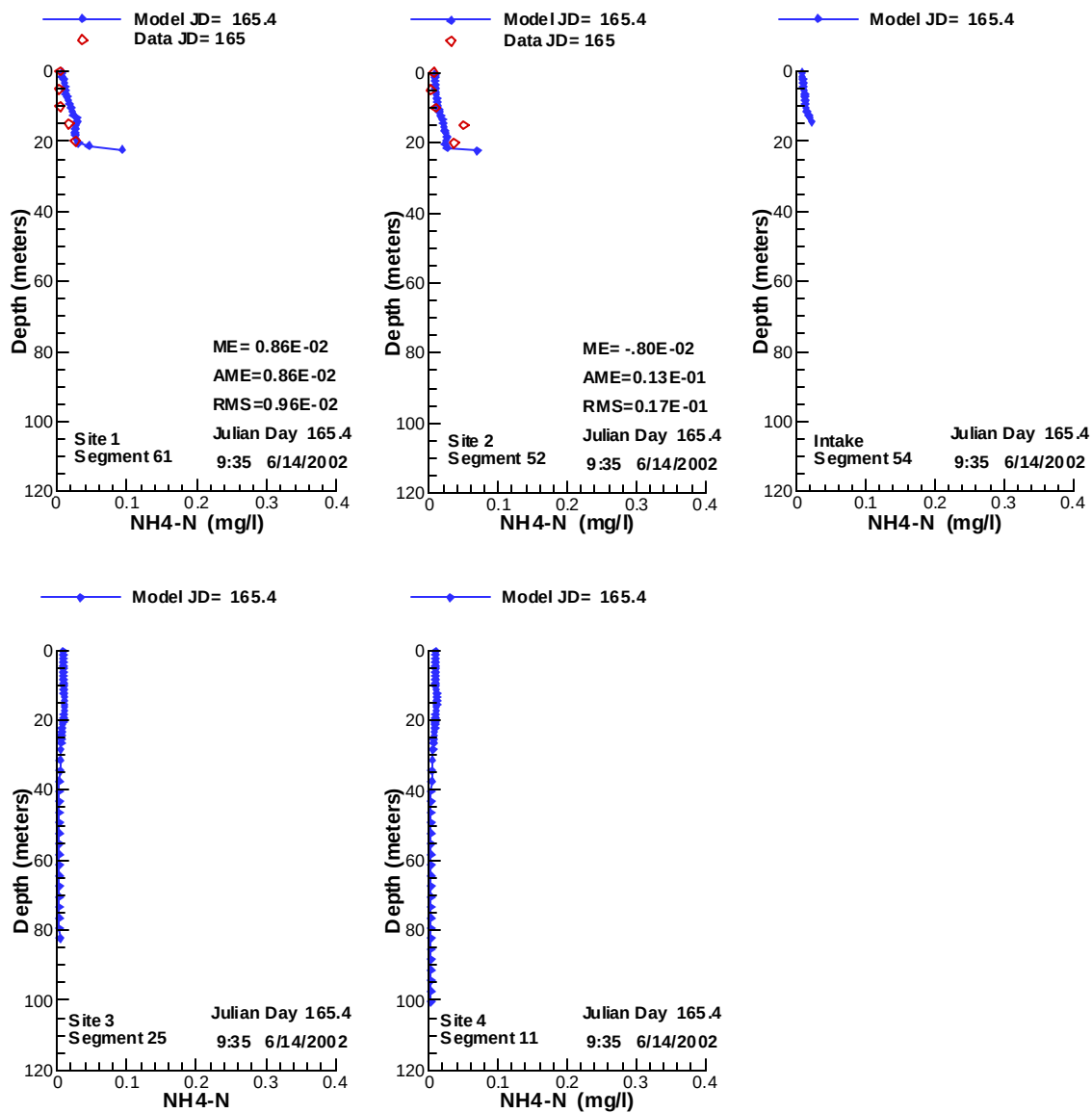


Figure 195. Vertical profiles of NH₄-N compared with data for 6/14/2002.

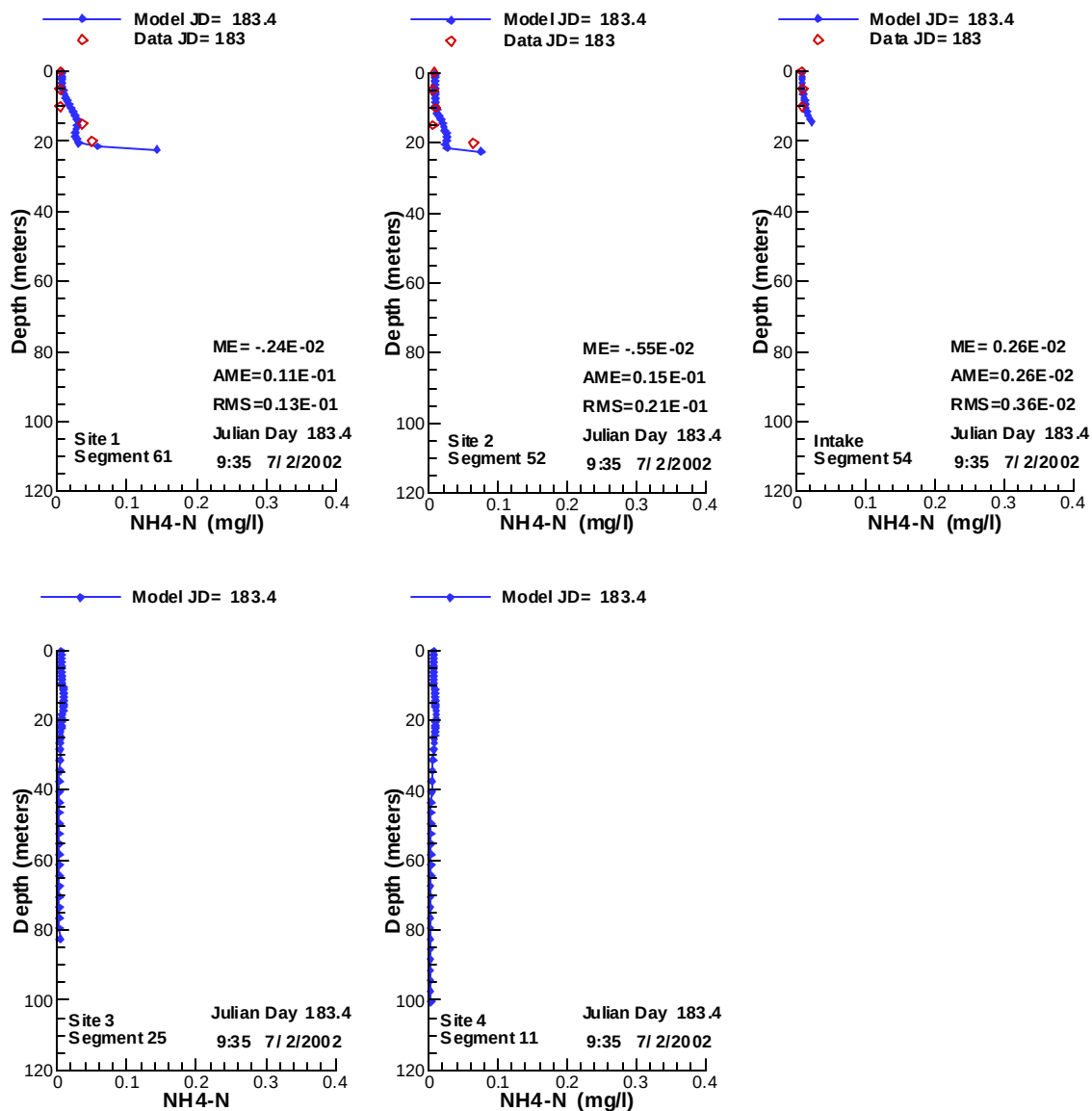


Figure 196. Vertical profiles of $\text{NH}_4\text{-N}$ compared with data for 7/ 2/2002.

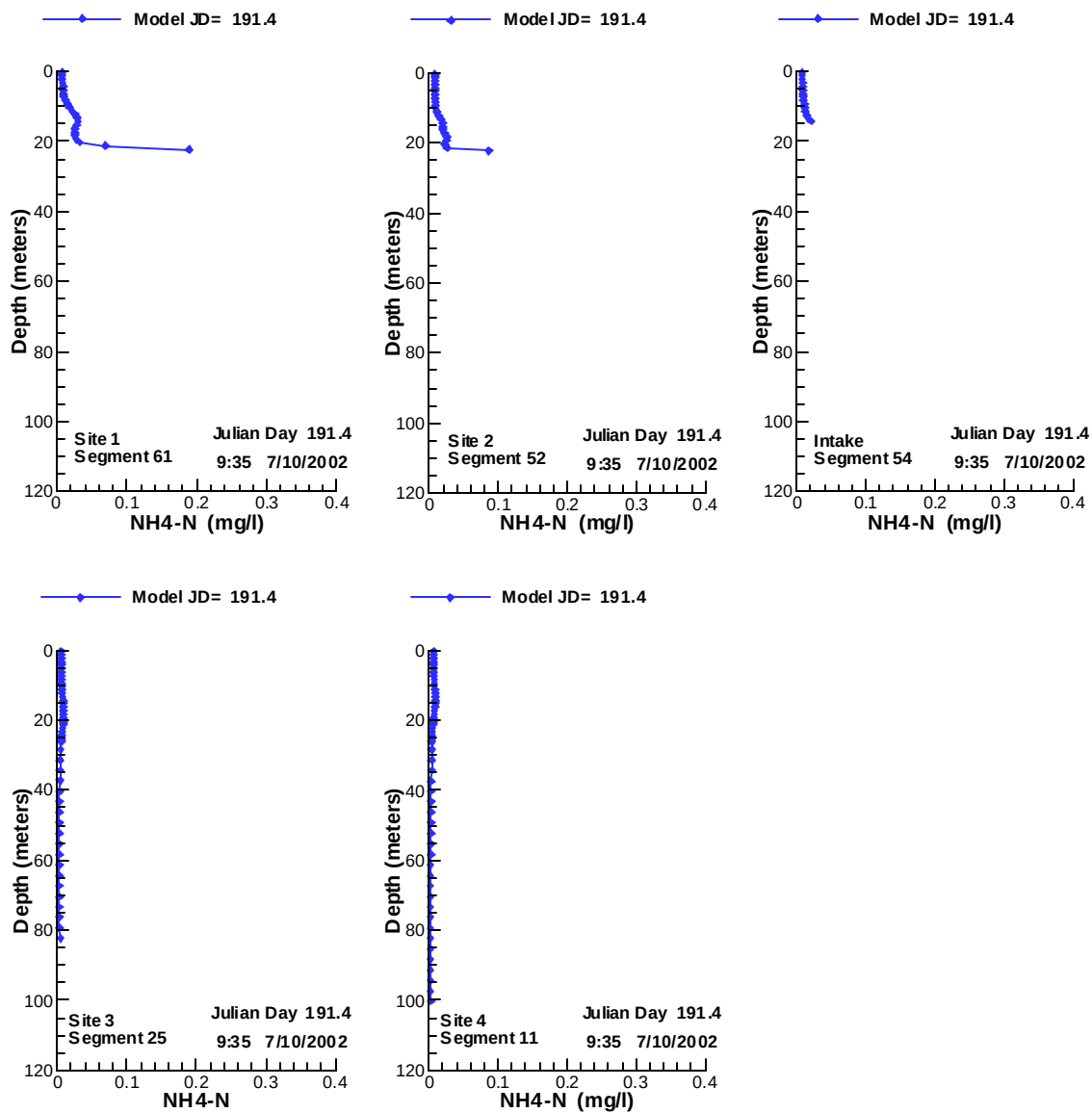


Figure 197. Vertical profiles of NH4-N compared with data for 7/10/2002.

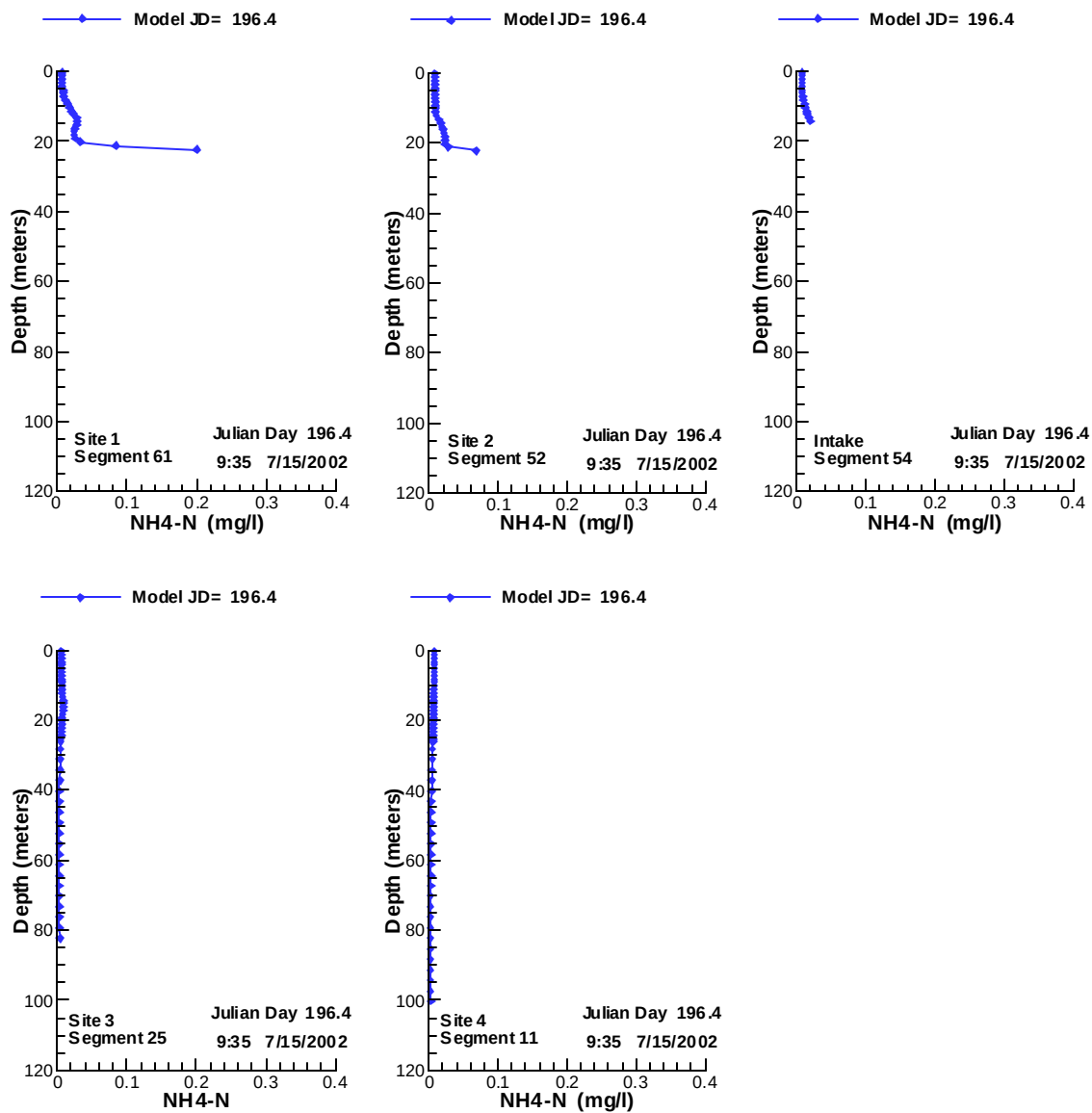


Figure 198. Vertical profiles of NH4-N compared with data for 7/15/2002.

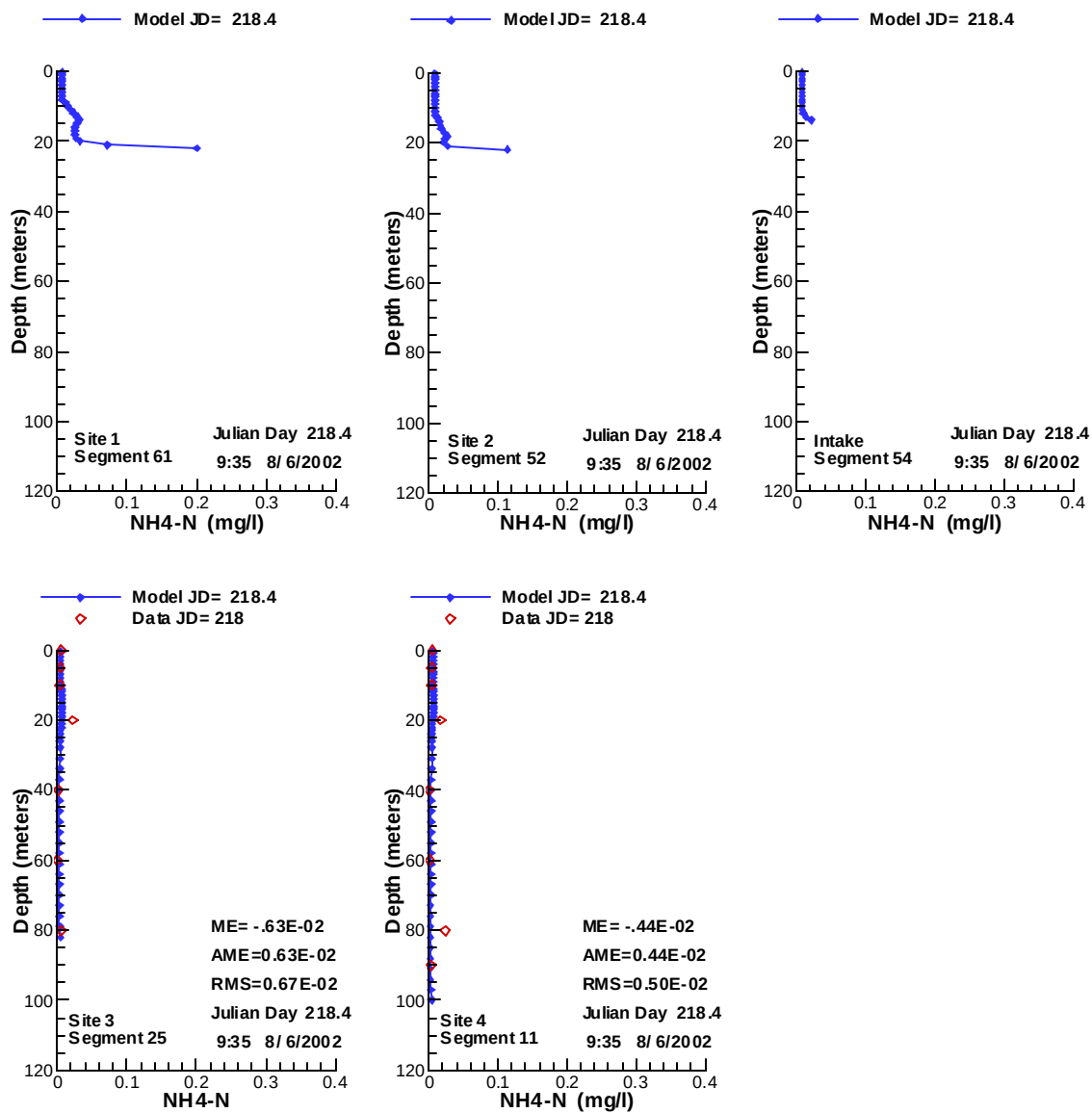


Figure 199. Vertical profiles of NH4-N compared with data for 8/ 6/2002.

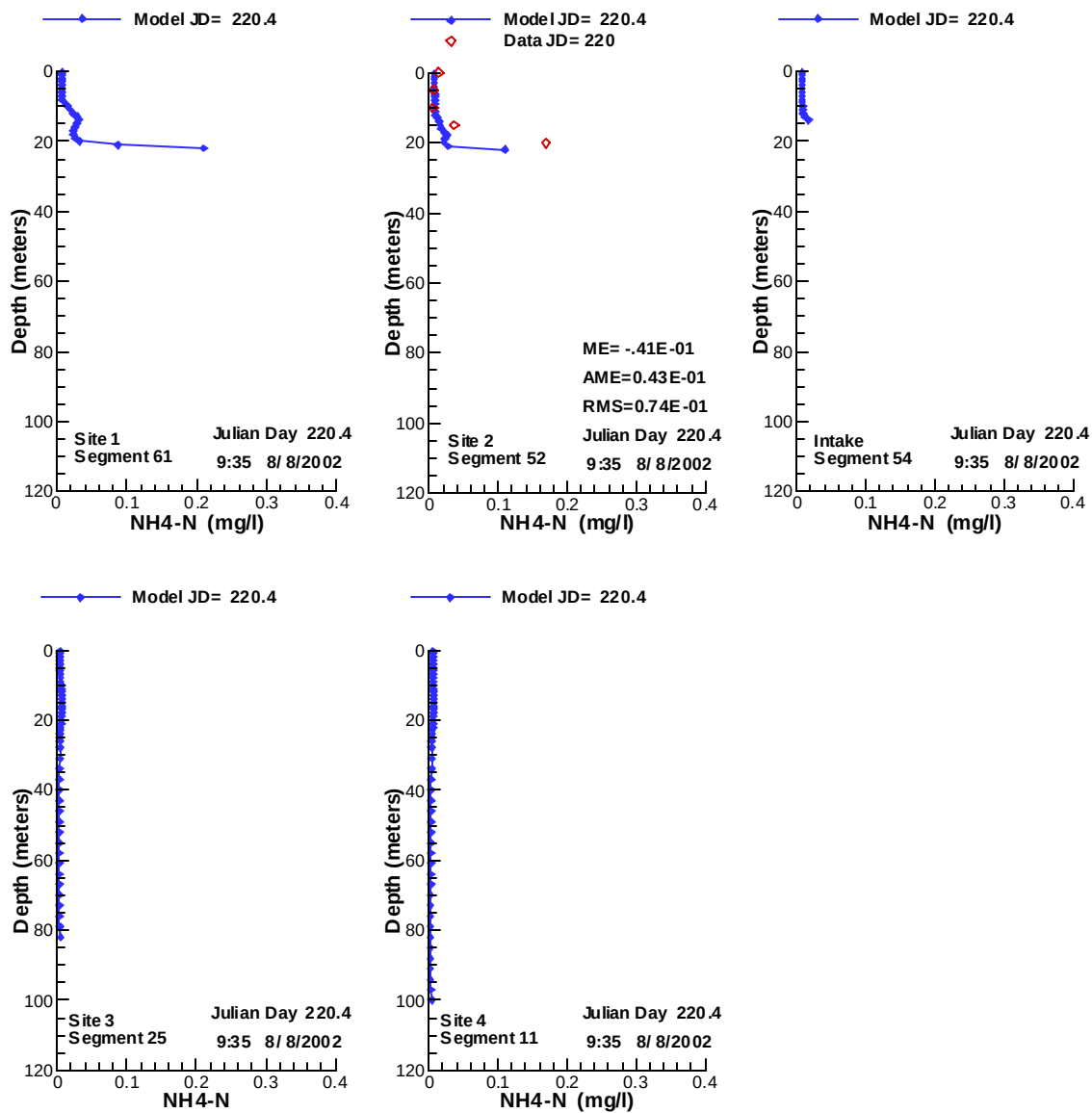


Figure 200. Vertical profiles of NH4-N compared with data for 8/ 8/2002.

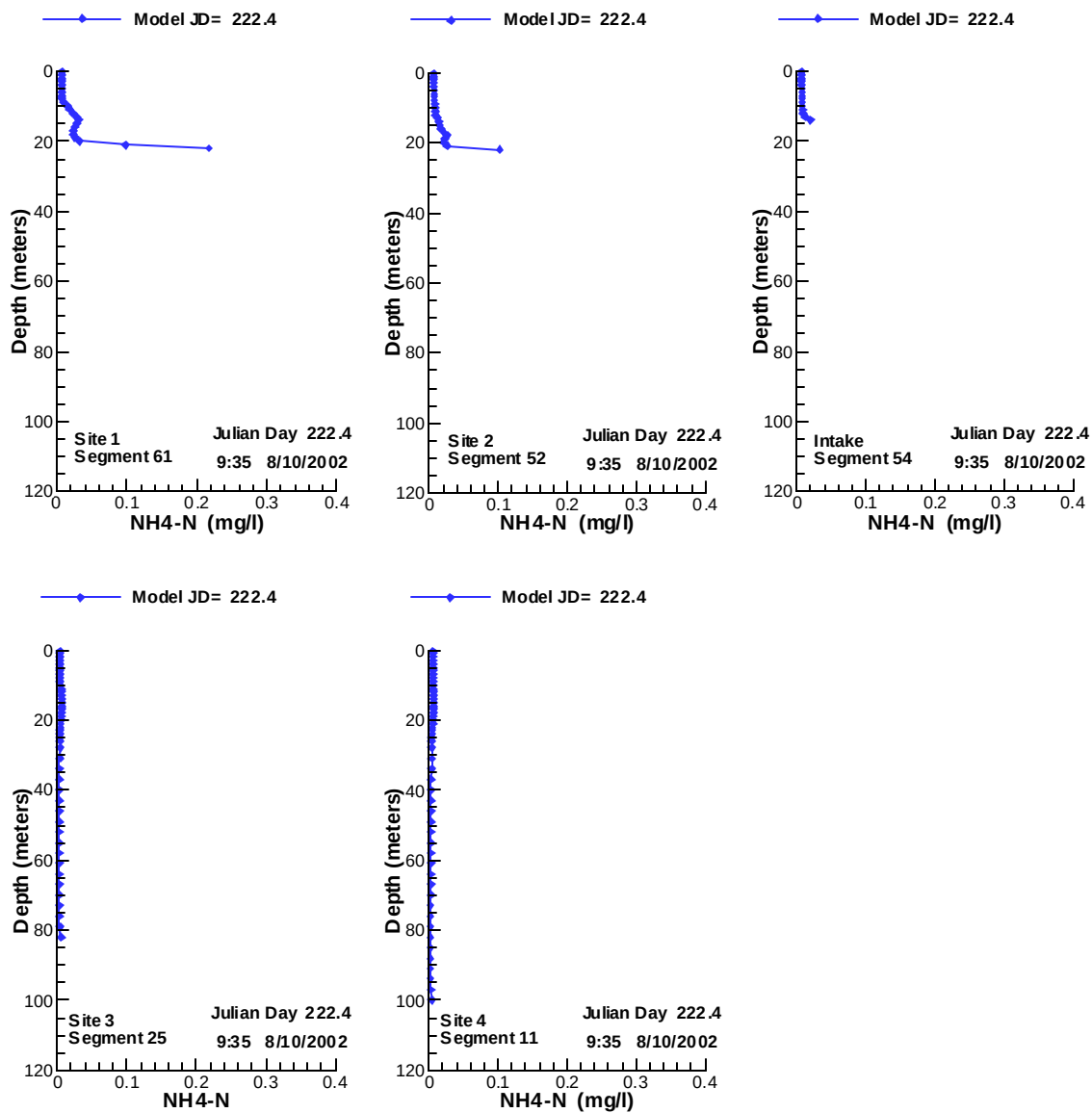


Figure 201. Vertical profiles of NH₄-N compared with data for 8/10/2002.

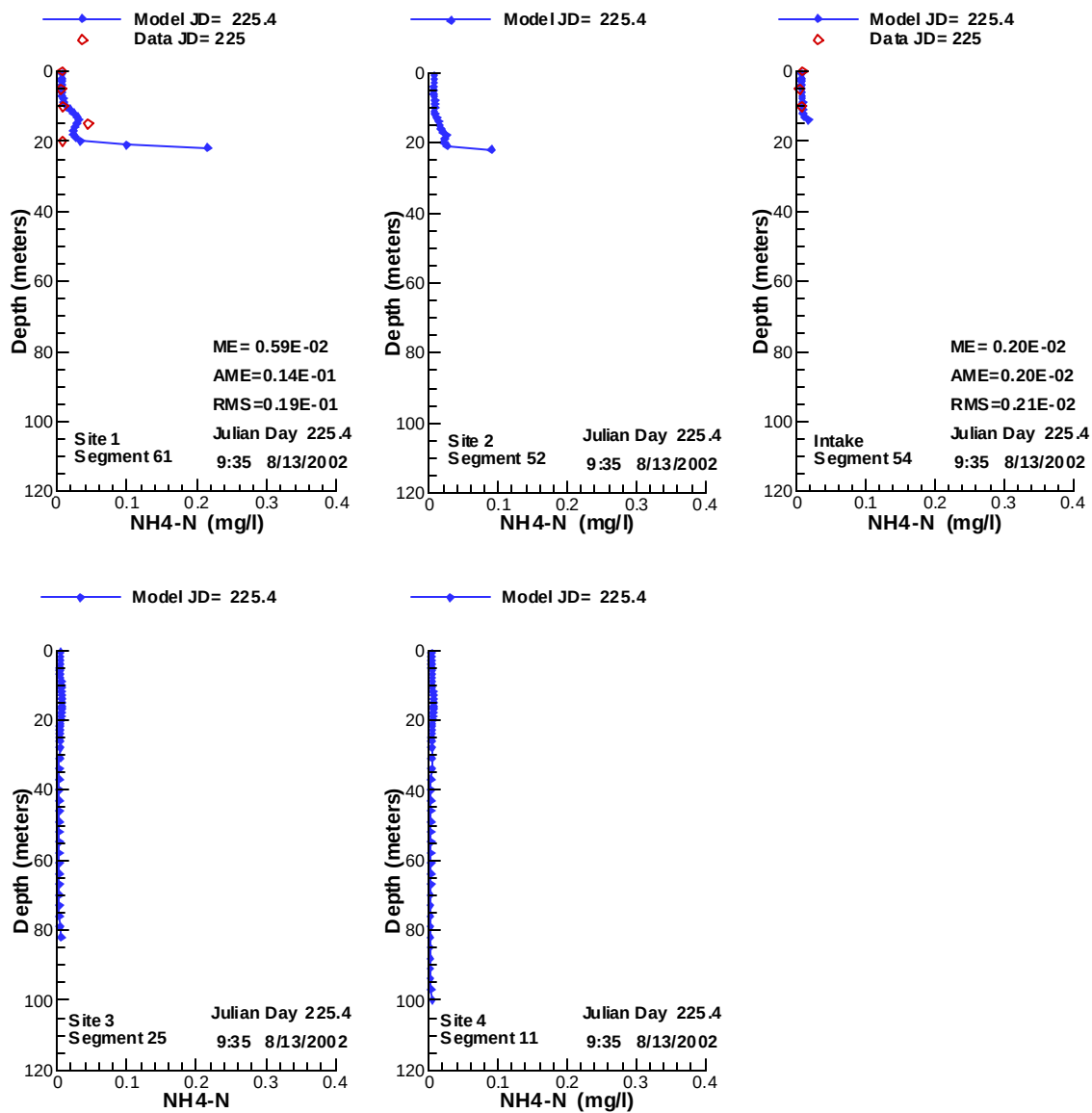


Figure 202. Vertical profiles of $\text{NH}_4\text{-N}$ compared with data for 8/13/2002.

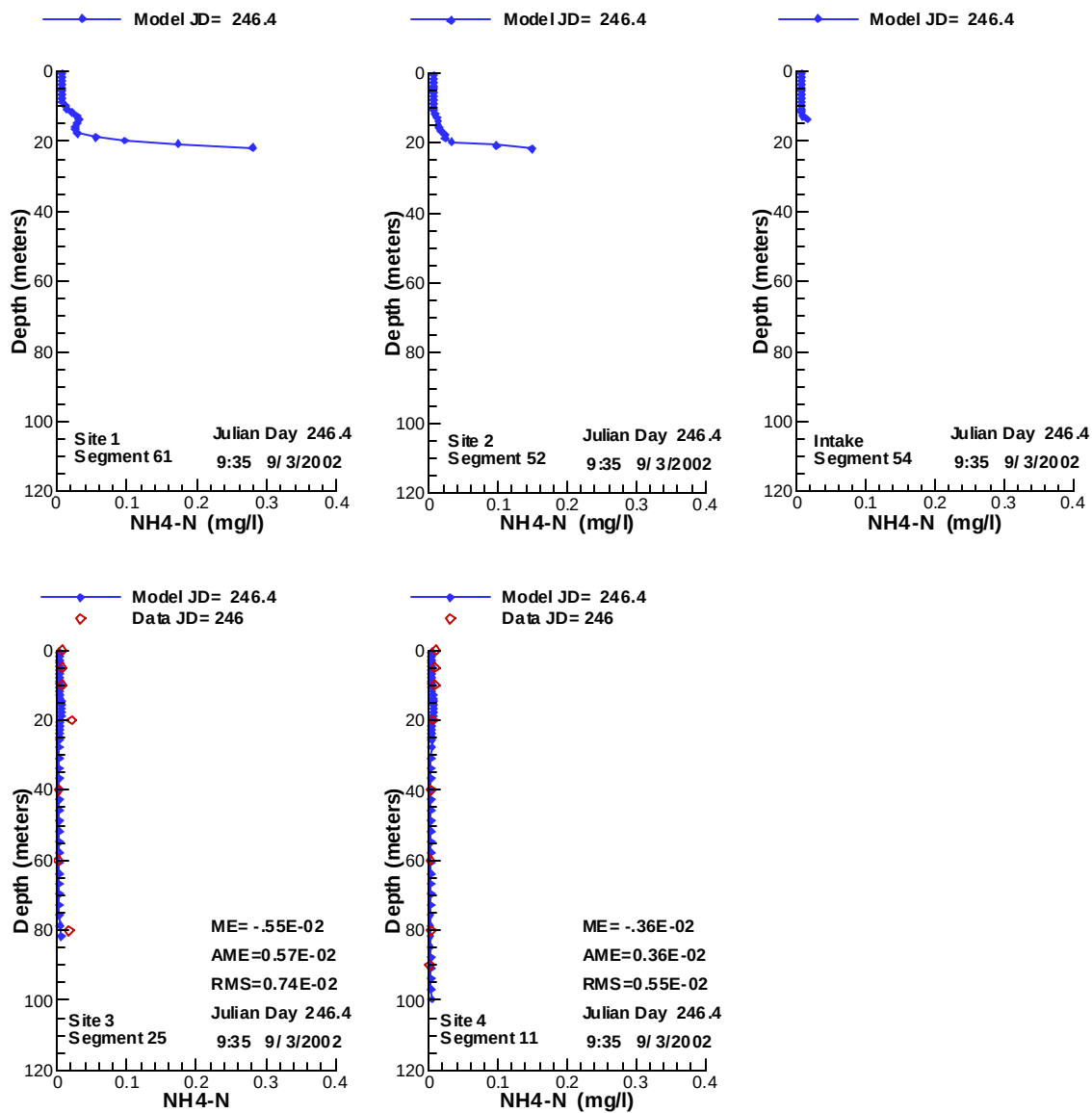


Figure 203. Vertical profiles of NH4-N compared with data for 9/ 3/2002.

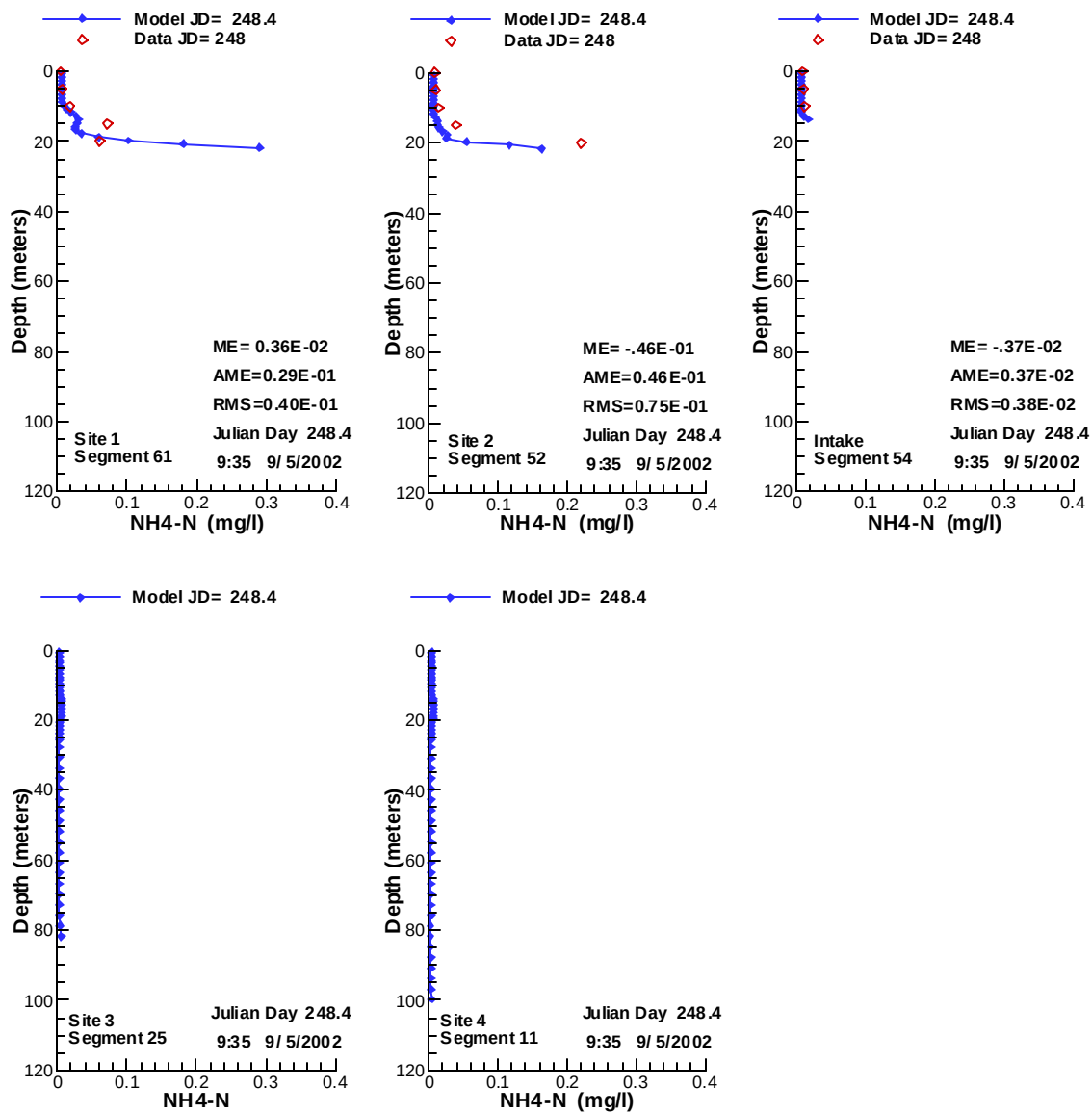


Figure 204. Vertical profiles of $\text{NH}_4\text{-N}$ compared with data for 9/ 5/2002.

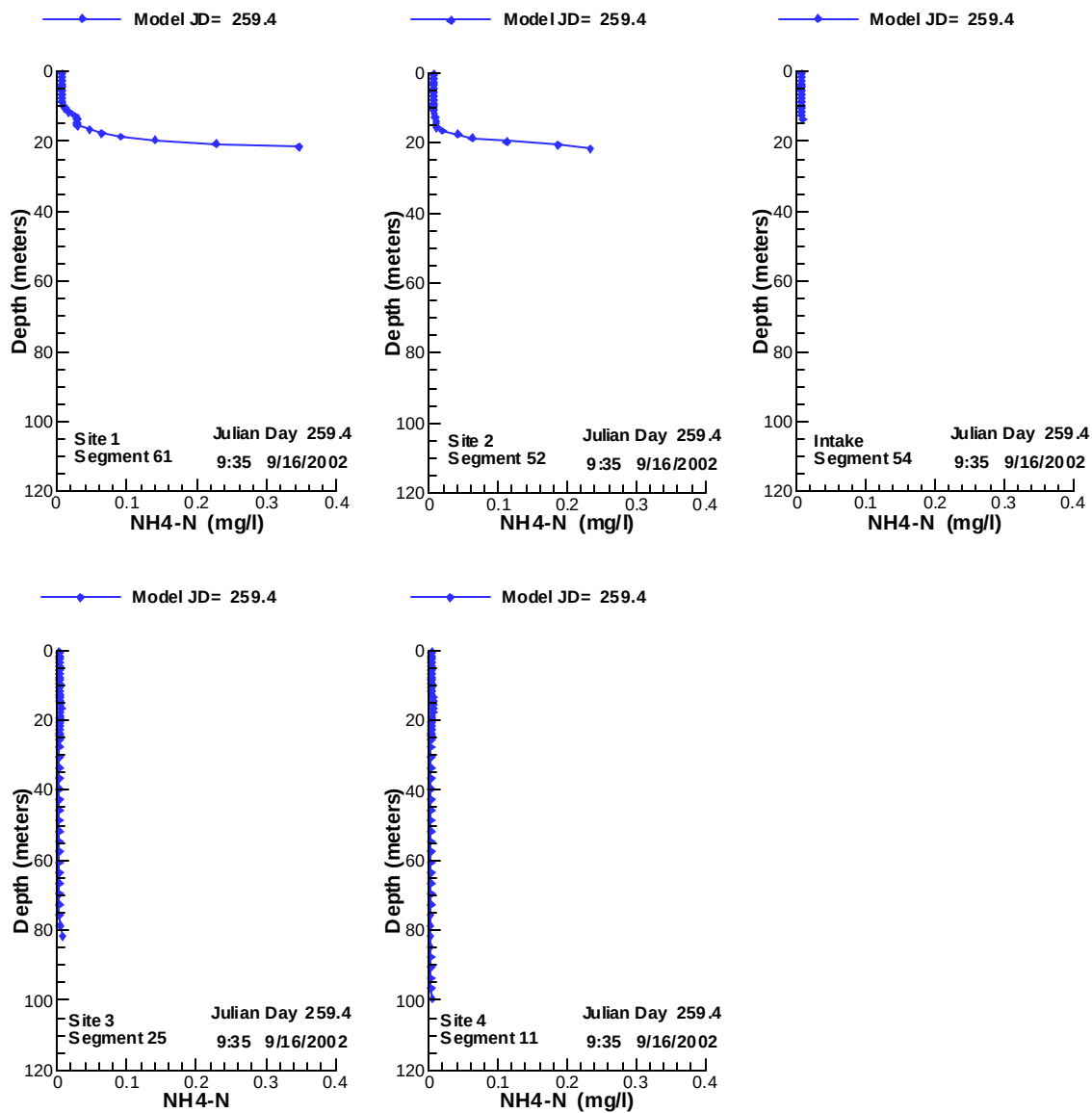


Figure 205. Vertical profiles of NH₄-N compared with data for 9/16/2002.

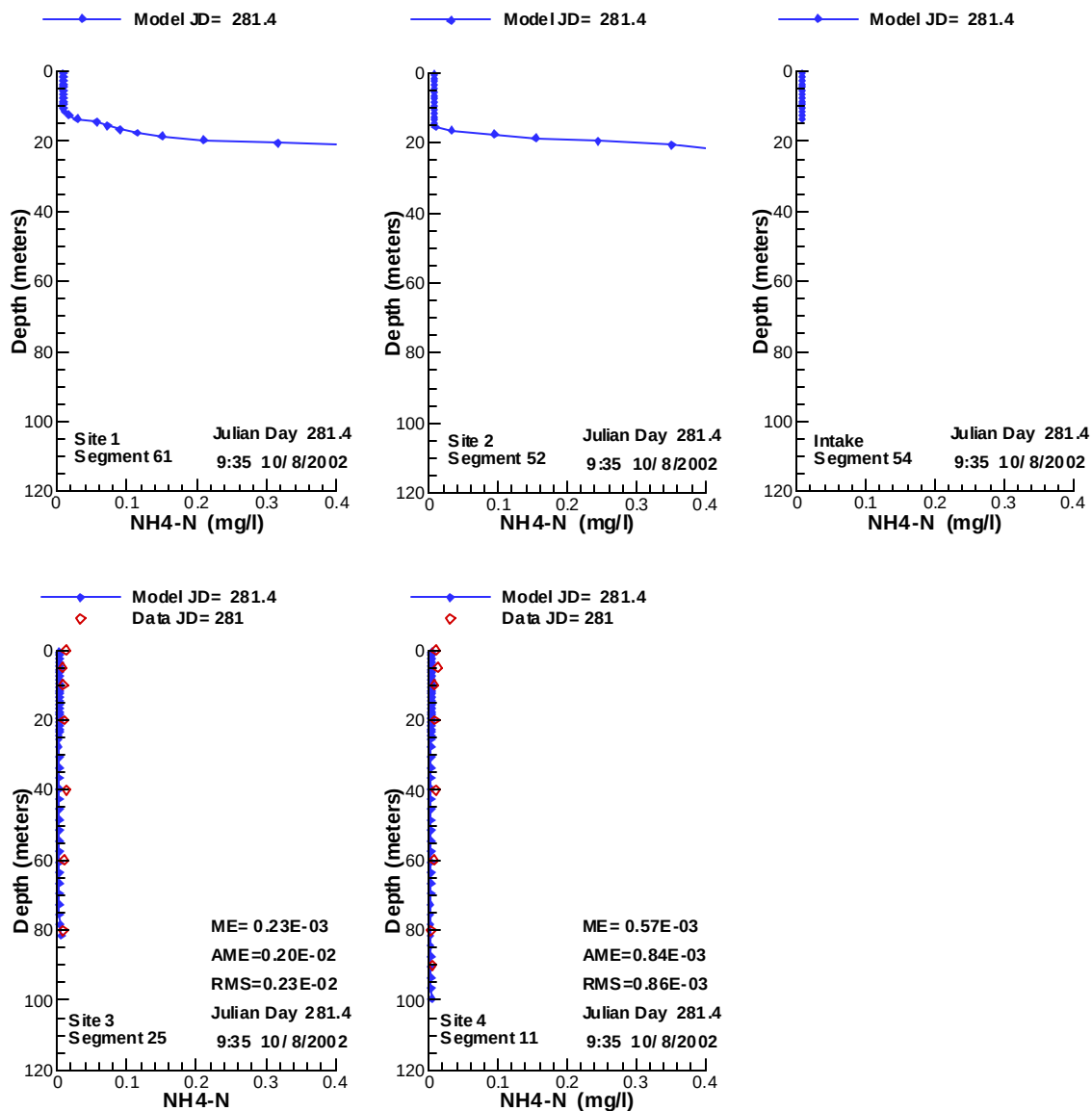


Figure 206. Vertical profiles of $\text{NH}_4\text{-N}$ compared with data for 10/ 8/2002.

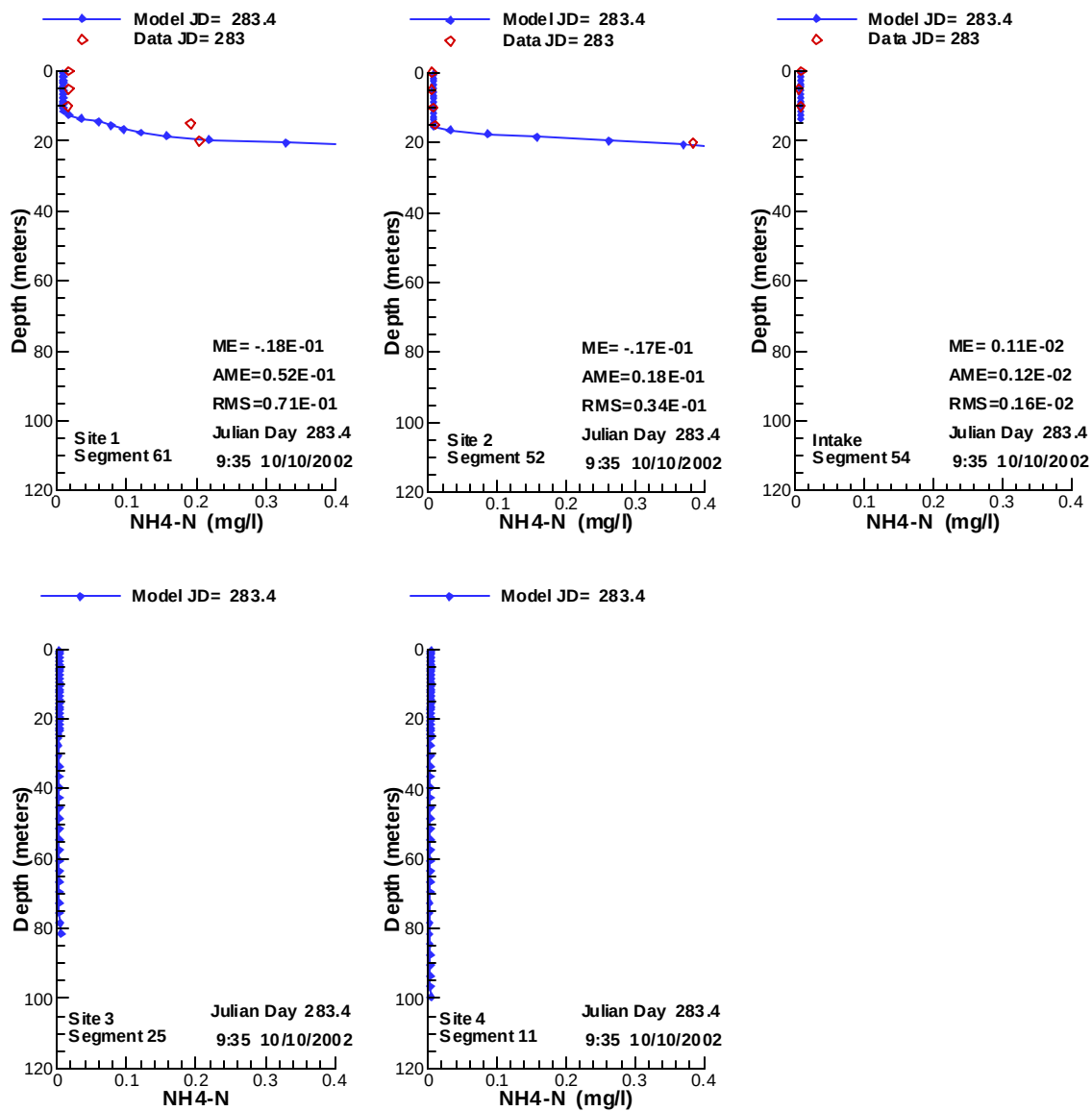


Figure 207. Vertical profiles of NH₄-N compared with data for 10/10/2002.

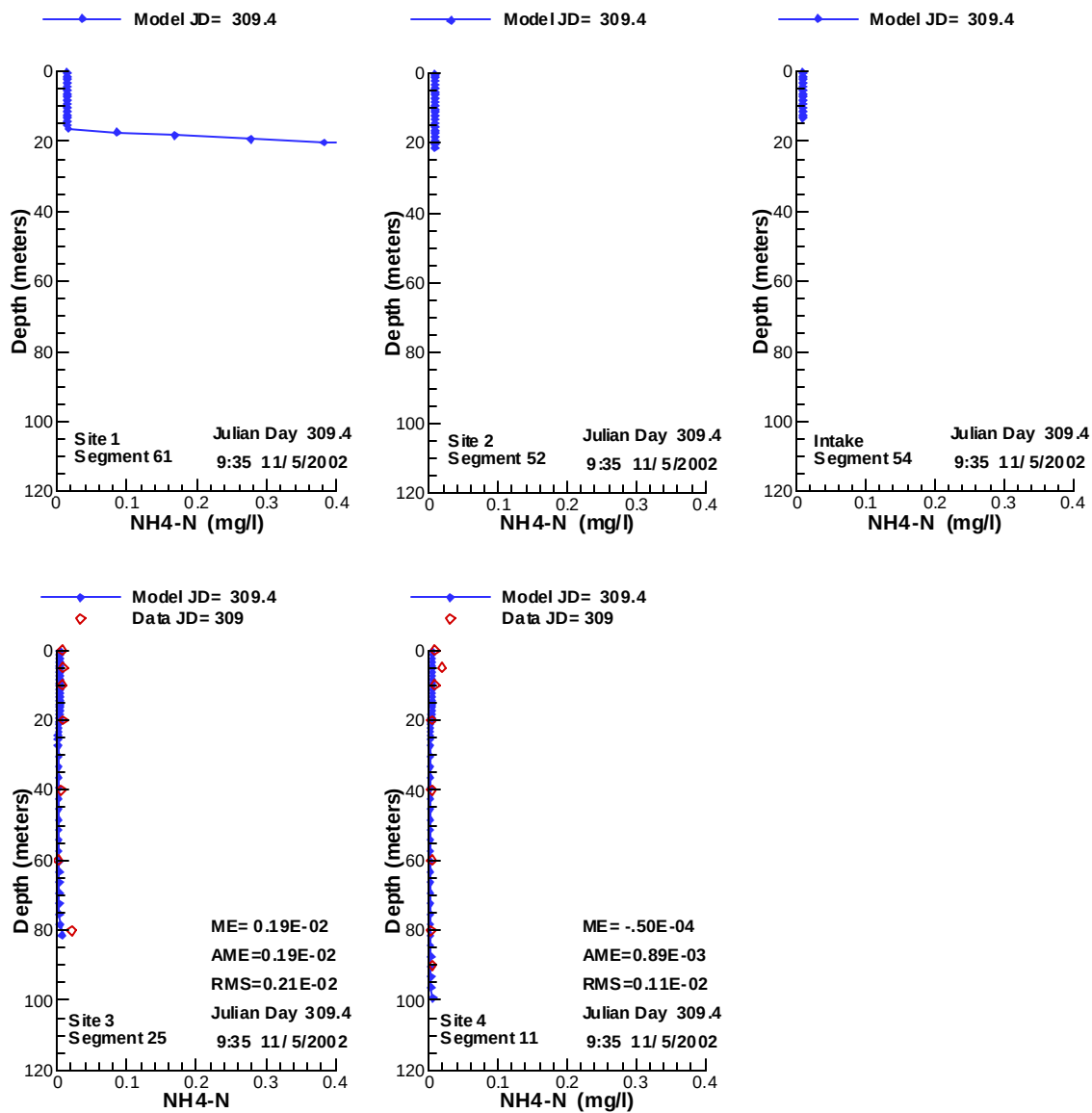


Figure 208. Vertical profiles of $\text{NH}_4\text{-N}$ compared with data for 11/ 5/2002.

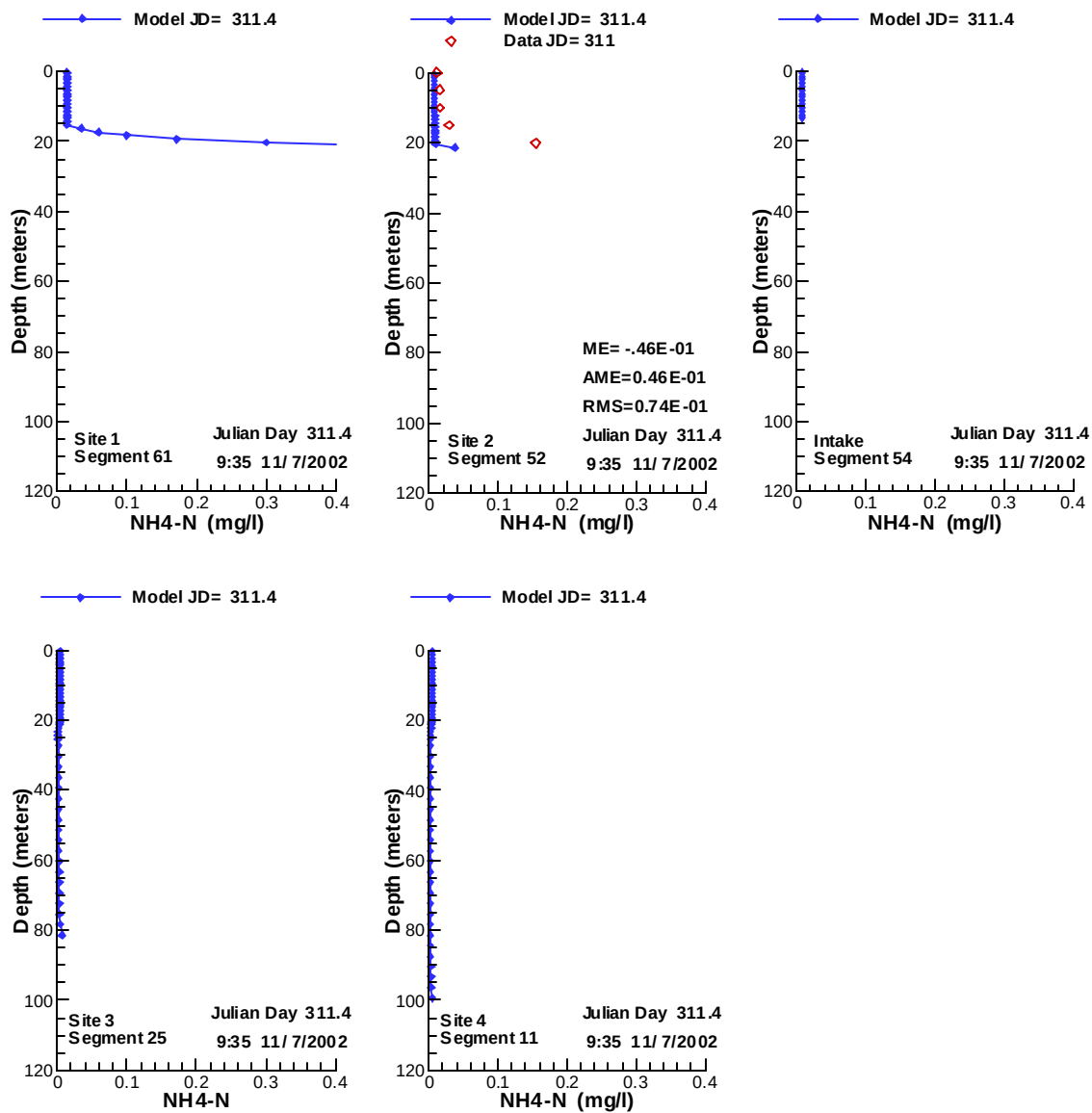


Figure 209. Vertical profiles of NH₄-N compared with data for 11/ 7/2002.

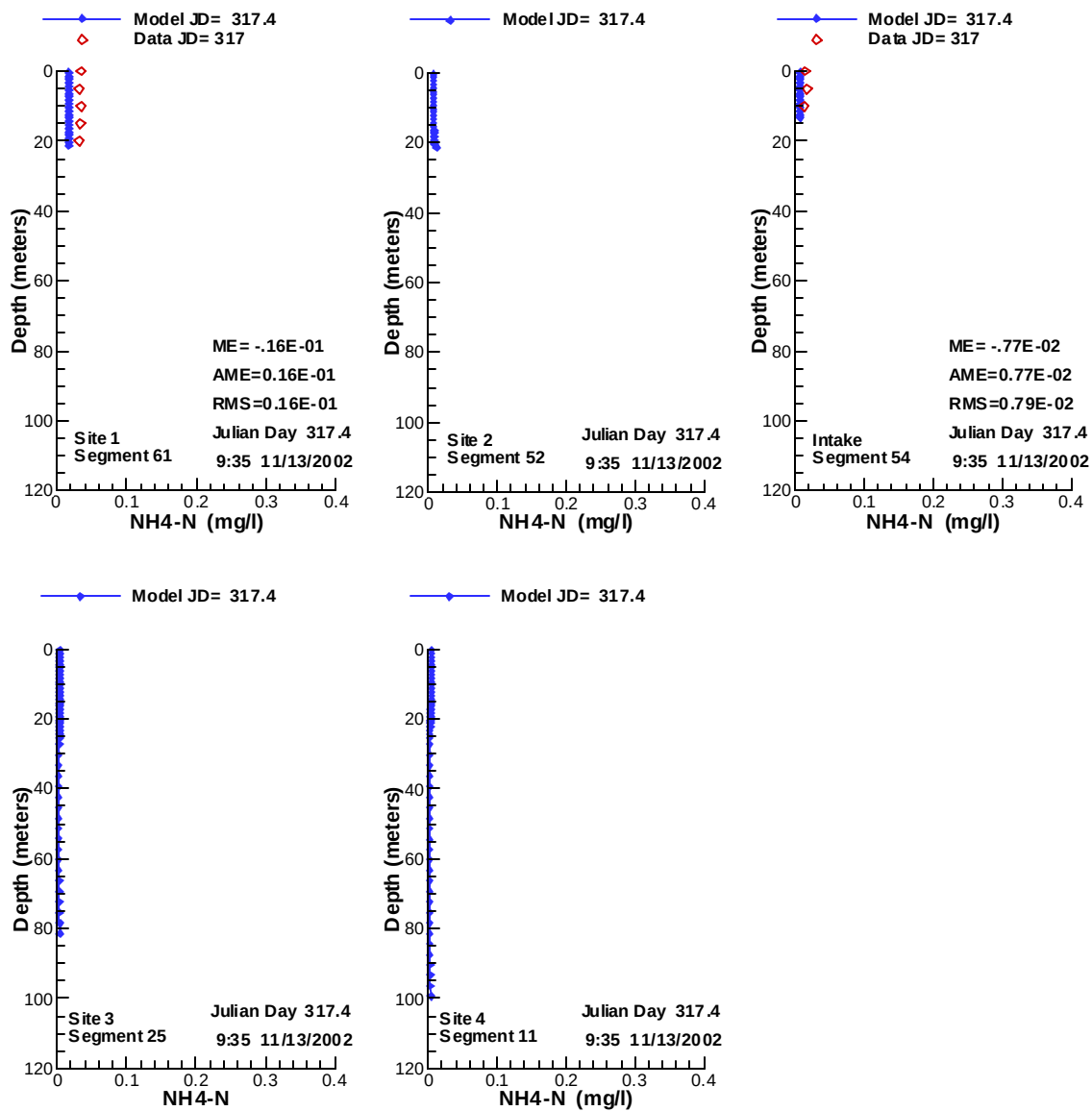


Figure 210. Vertical profiles of $\text{NH}_4\text{-N}$ compared with data for 11/13/2002.

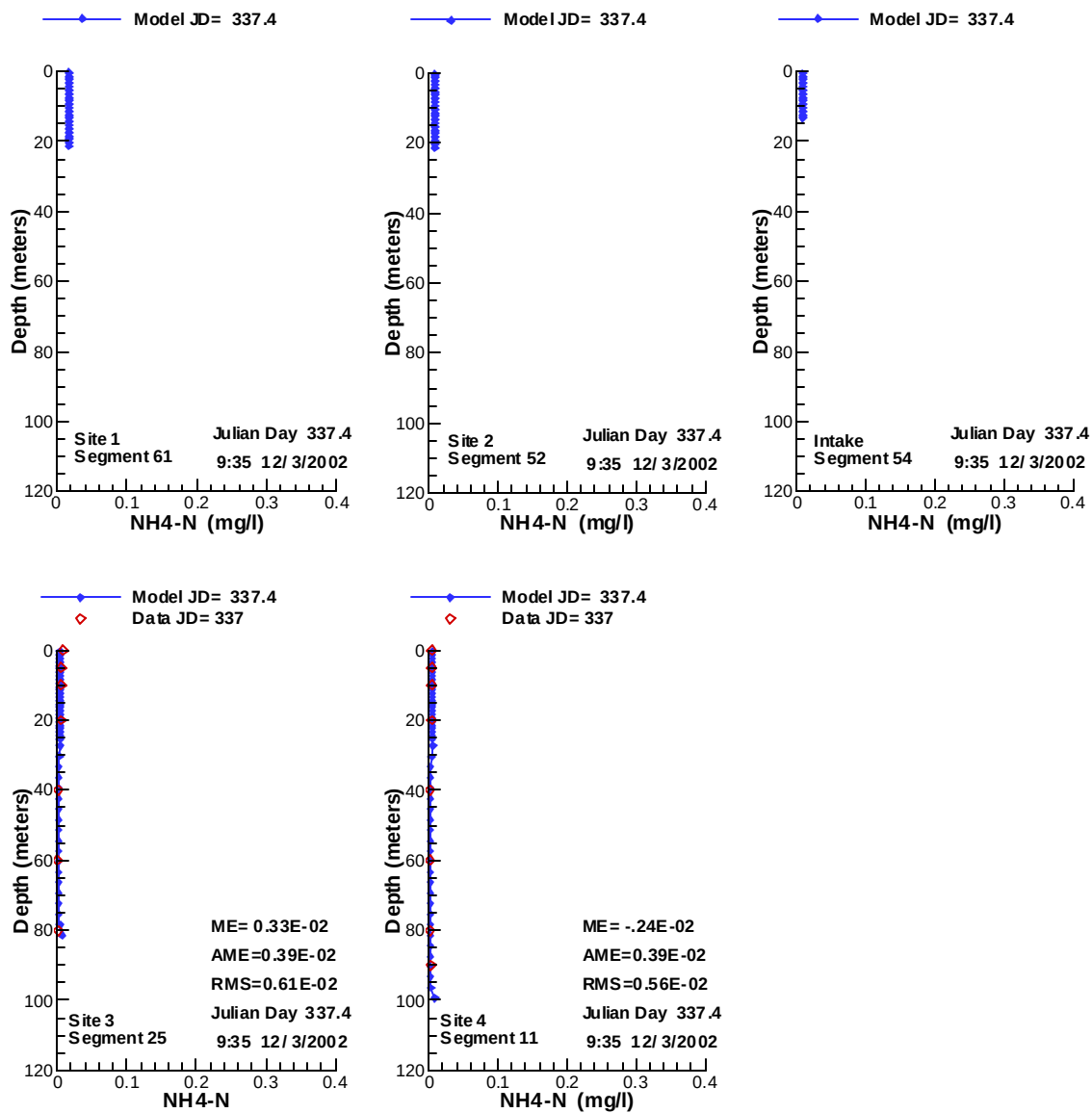


Figure 211. Vertical profiles of NH4-N compared with data for 12/ 3/2002.

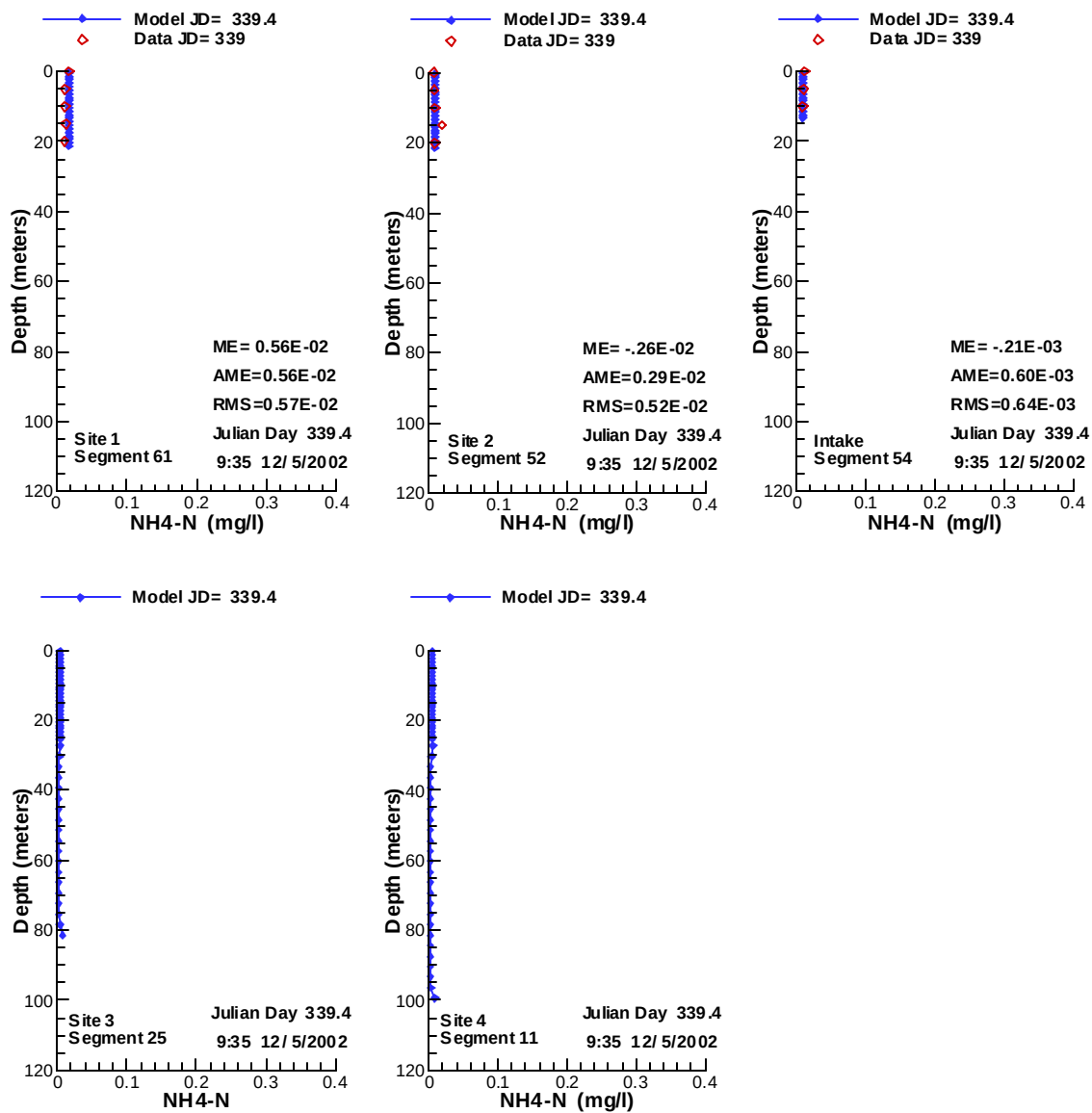


Figure 212. Vertical profiles of NH4-N compared with data for 12/ 5/2002.

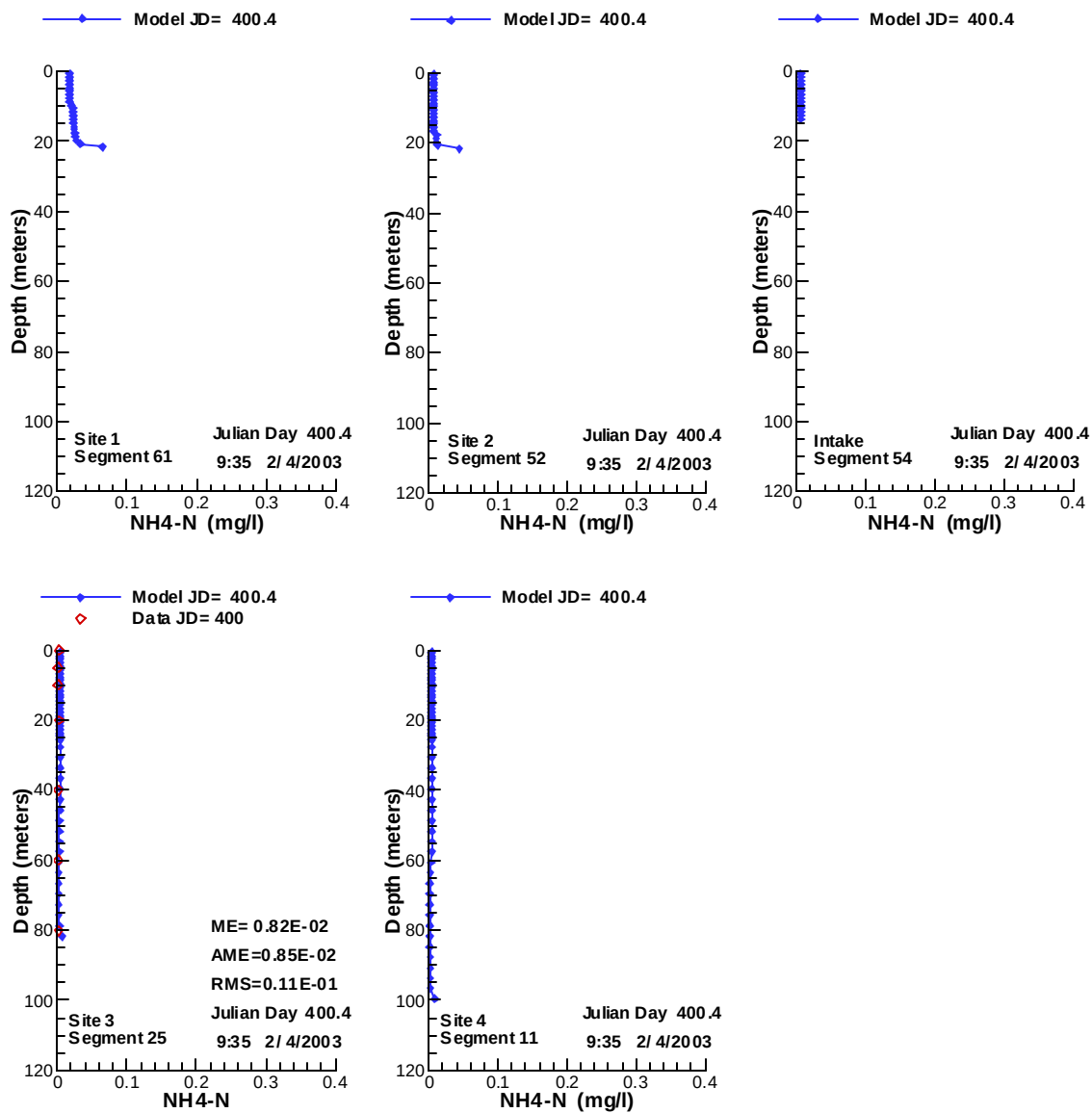


Figure 213. Vertical profiles of NH4-N compared with data for 2/ 4/2003.

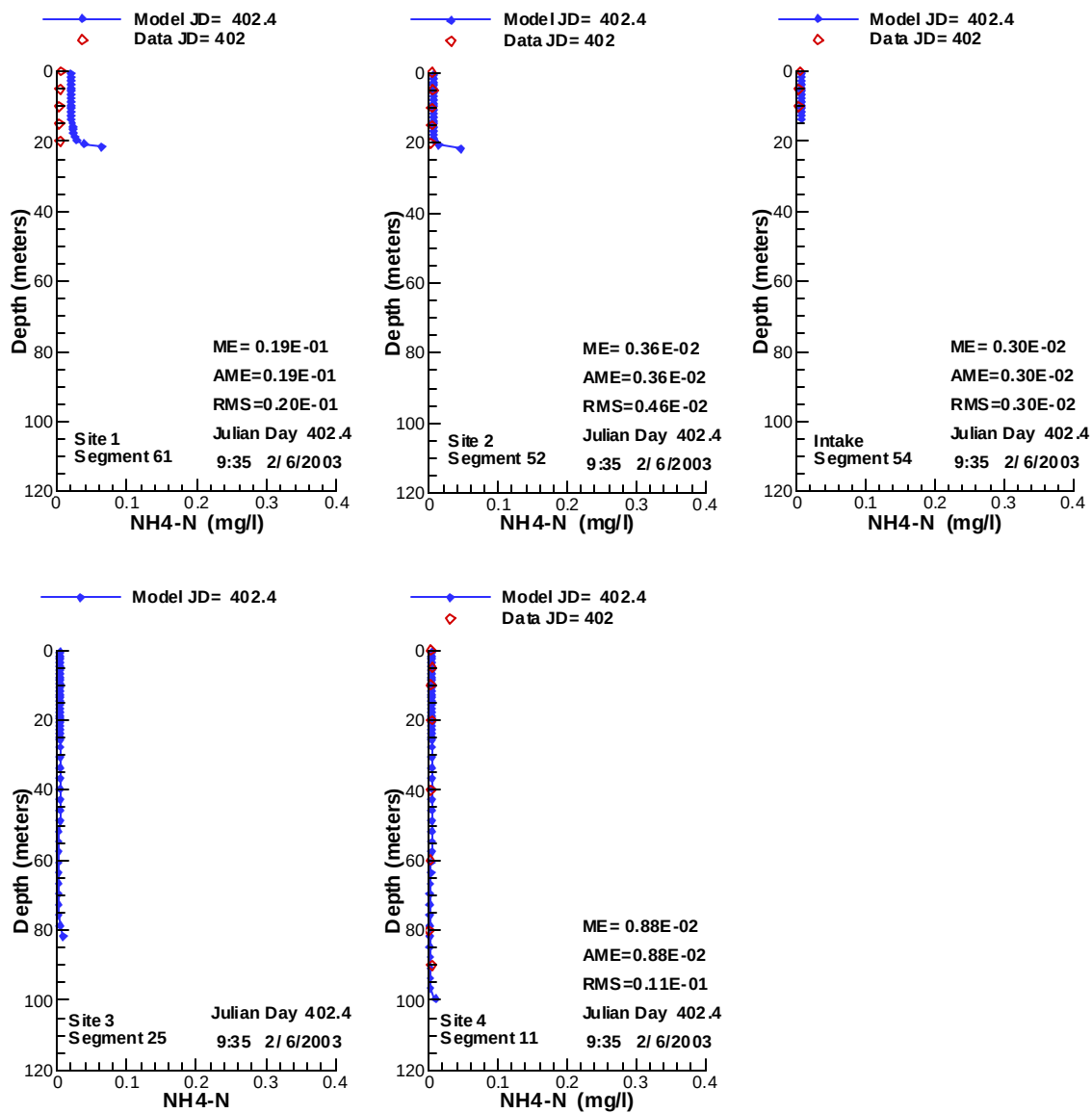


Figure 214. Vertical profiles of $\text{NH}_4\text{-N}$ compared with data for 2/ 6/2003.

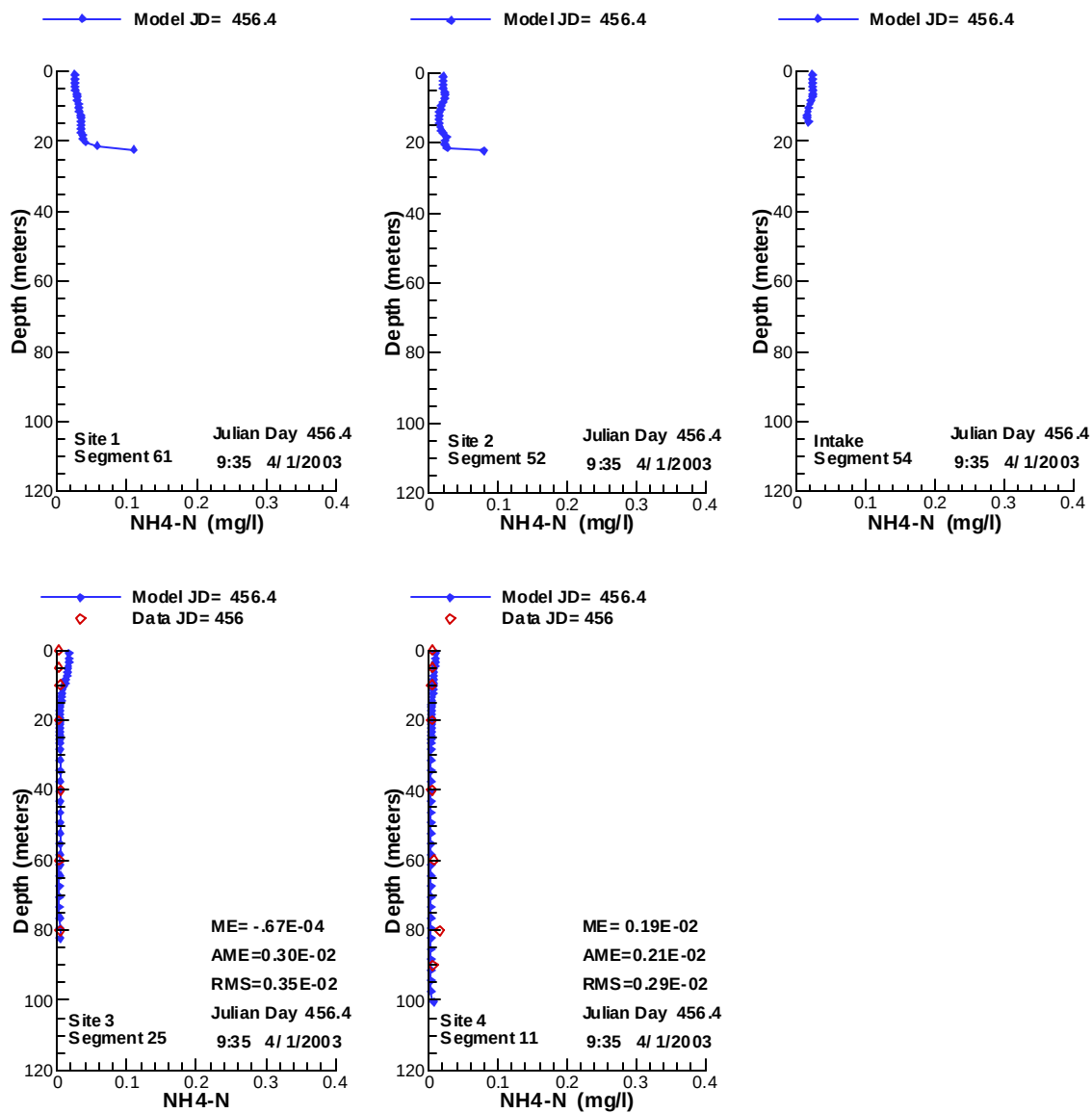


Figure 215. Vertical profiles of NH4-N compared with data for 4/ 1/2003.

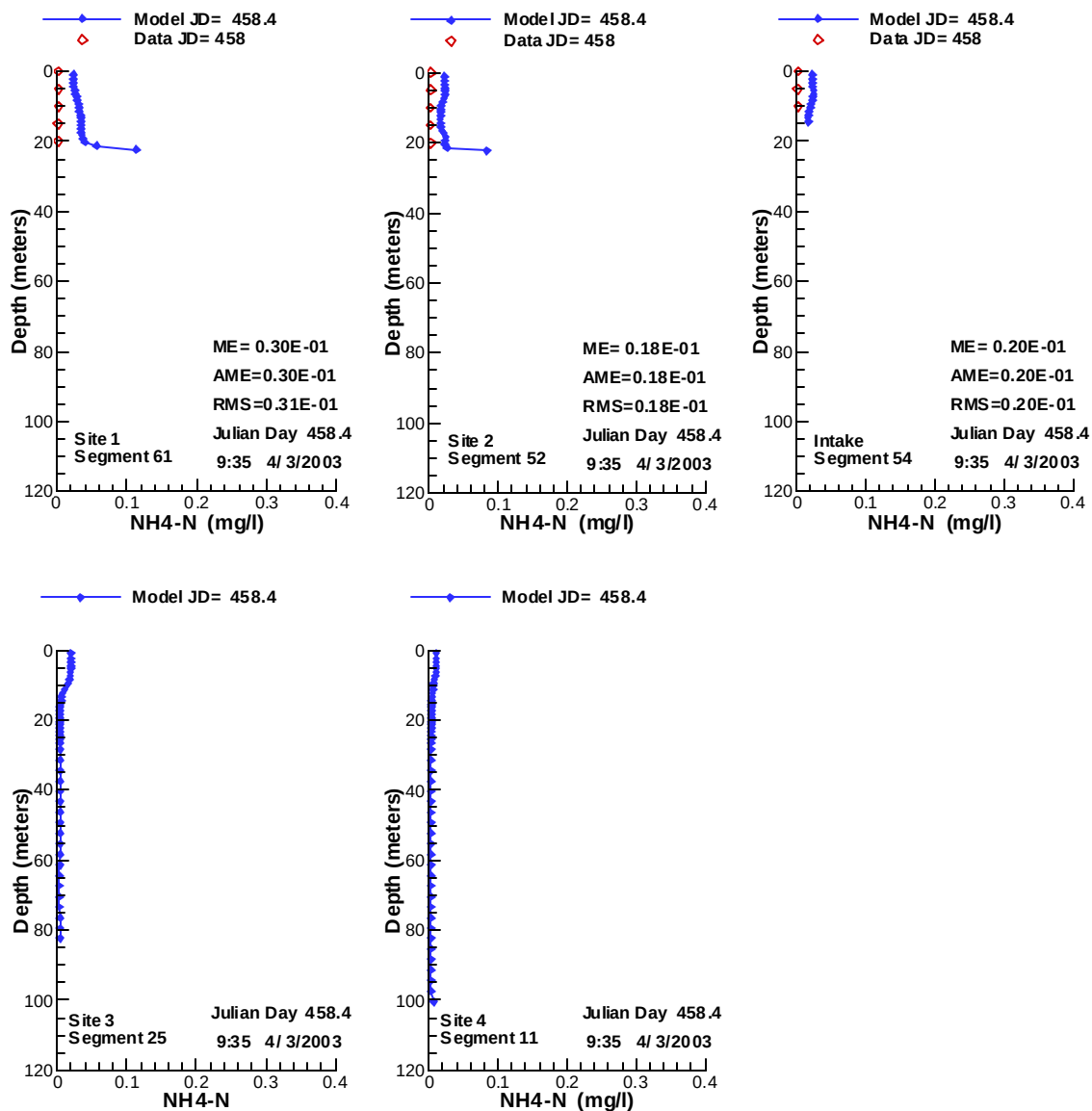


Figure 216. Vertical profiles of NH₄-N compared with data for 4/ 3/2003.

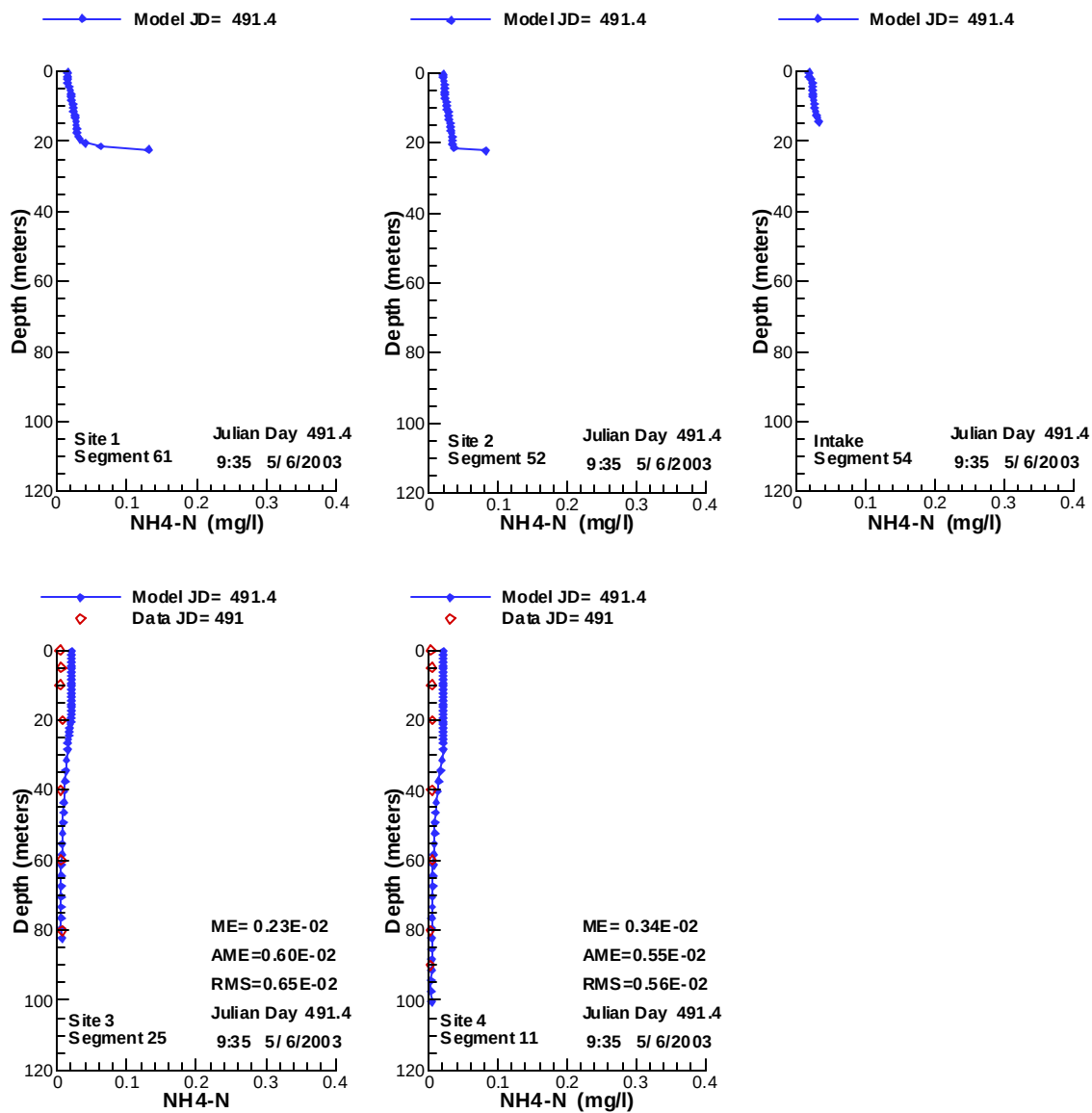


Figure 217. Vertical profiles of NH4-N compared with data for 5/ 6/2003.

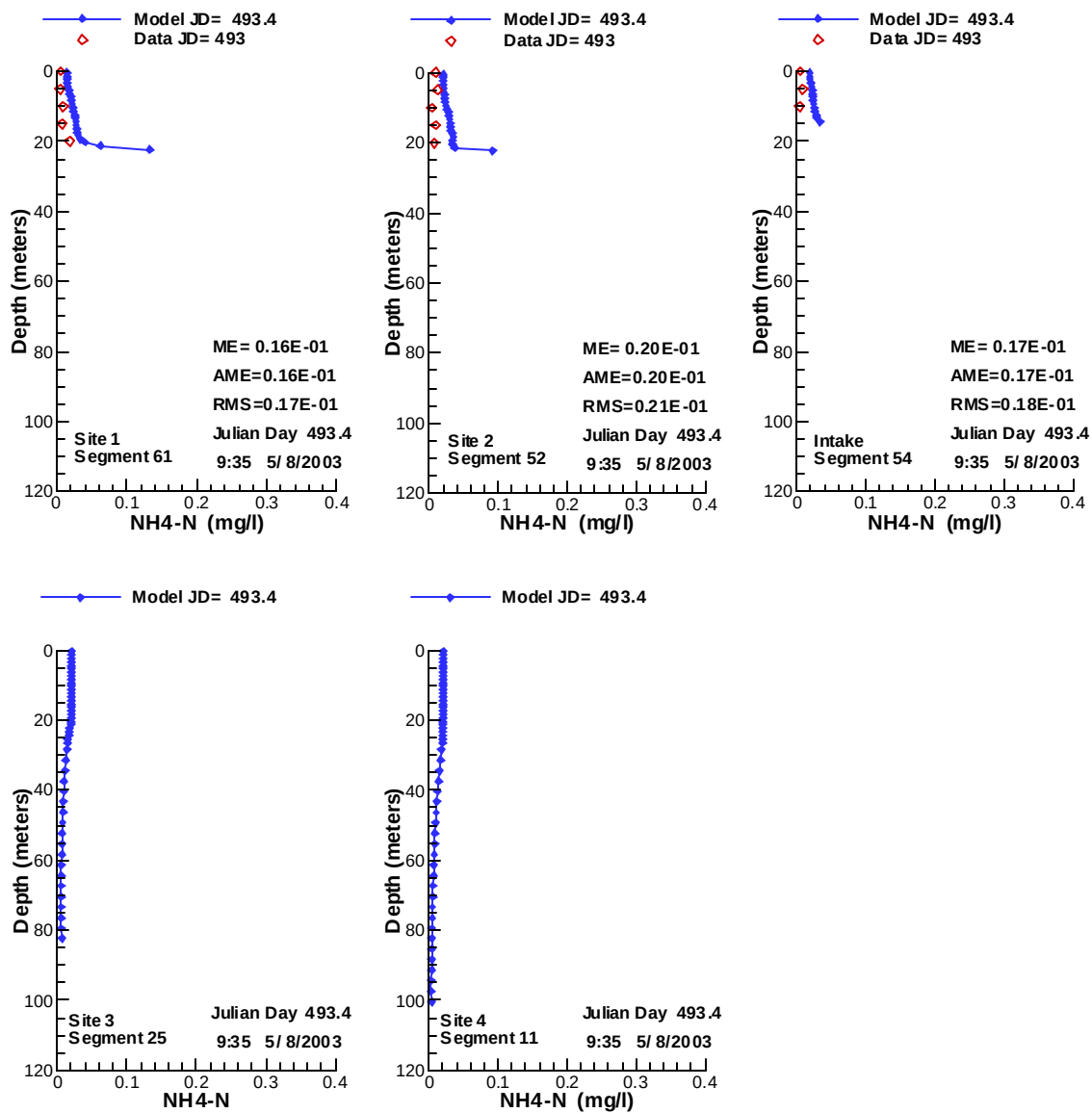


Figure 218. Vertical profiles of NH₄-N compared with data for 5/ 8/2003.

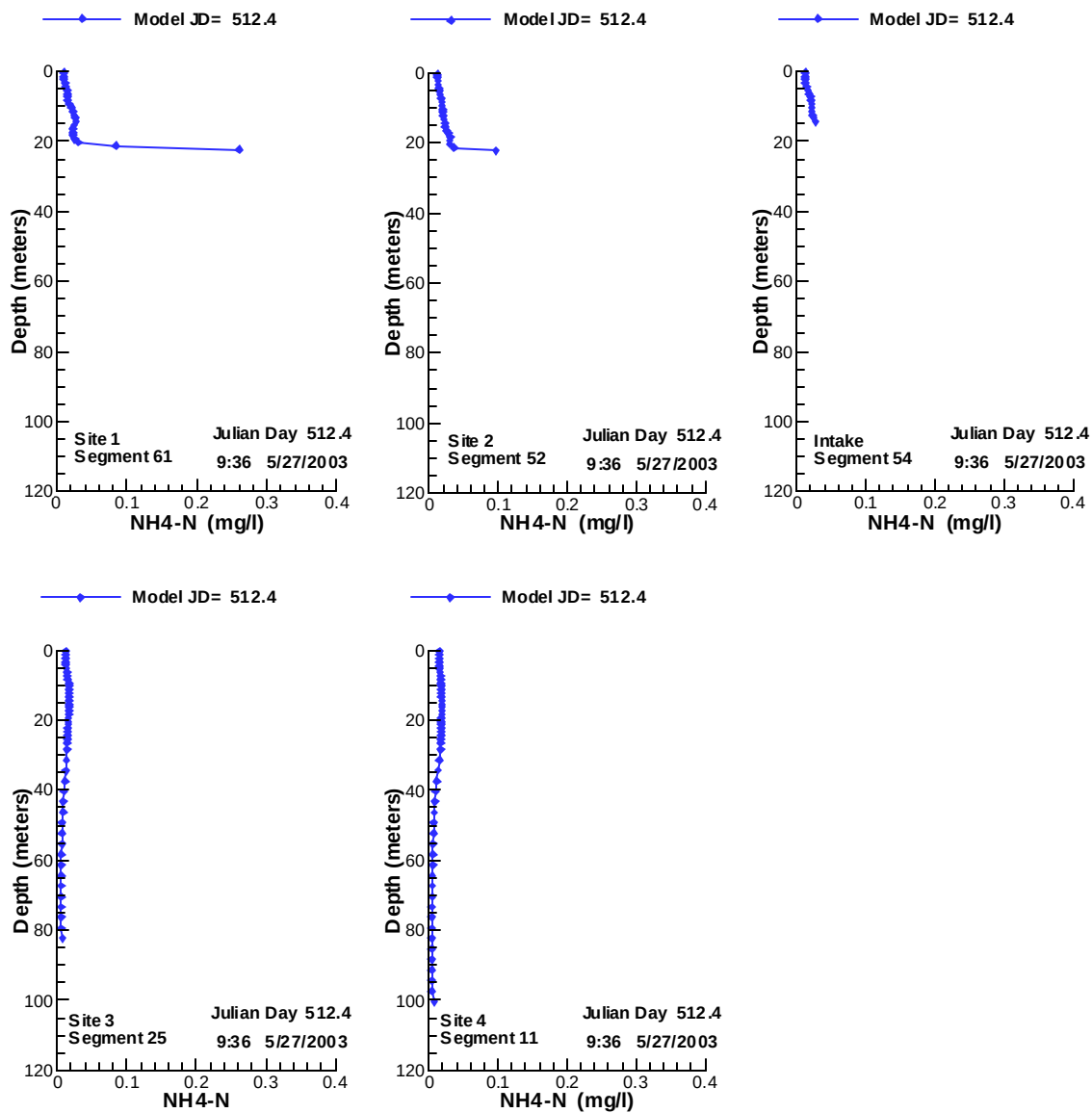


Figure 219. Vertical profiles of NH₄-N compared with data for 5/27/2003.

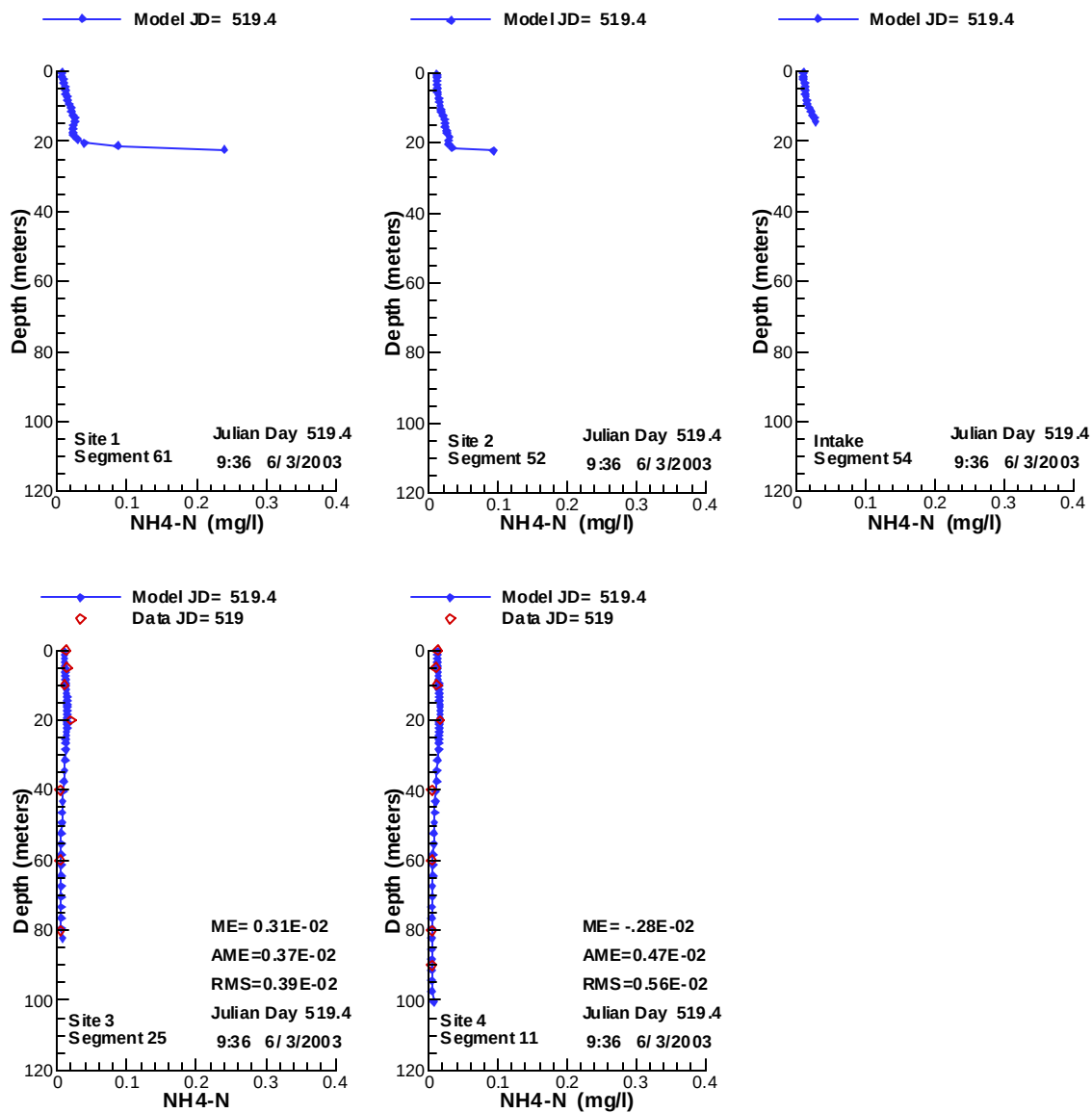


Figure 220. Vertical profiles of NH4-N compared with data for 6/ 3/2003.

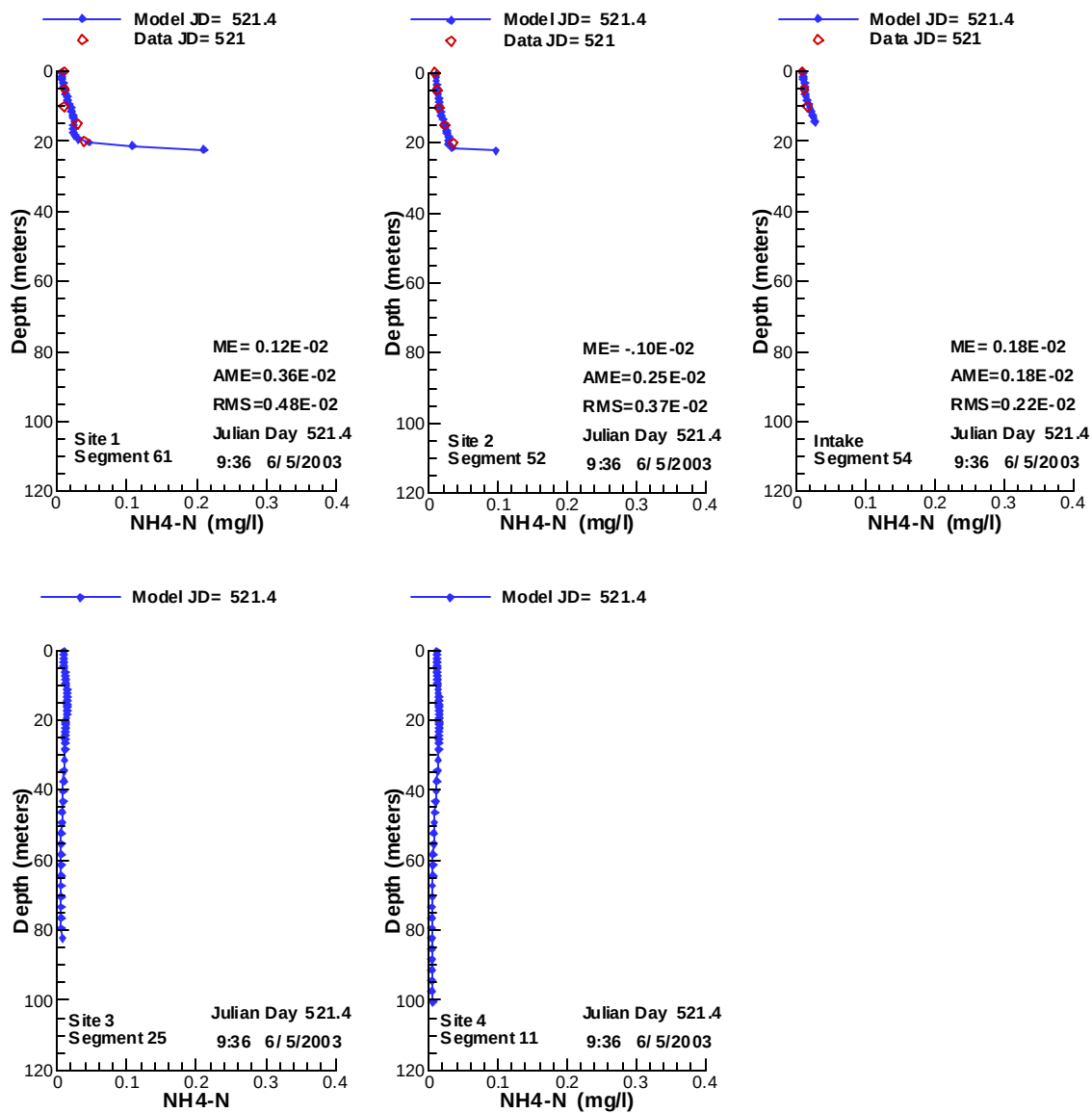


Figure 221. Vertical profiles of $\text{NH}_4\text{-N}$ compared with data for 6/ 5/2003.

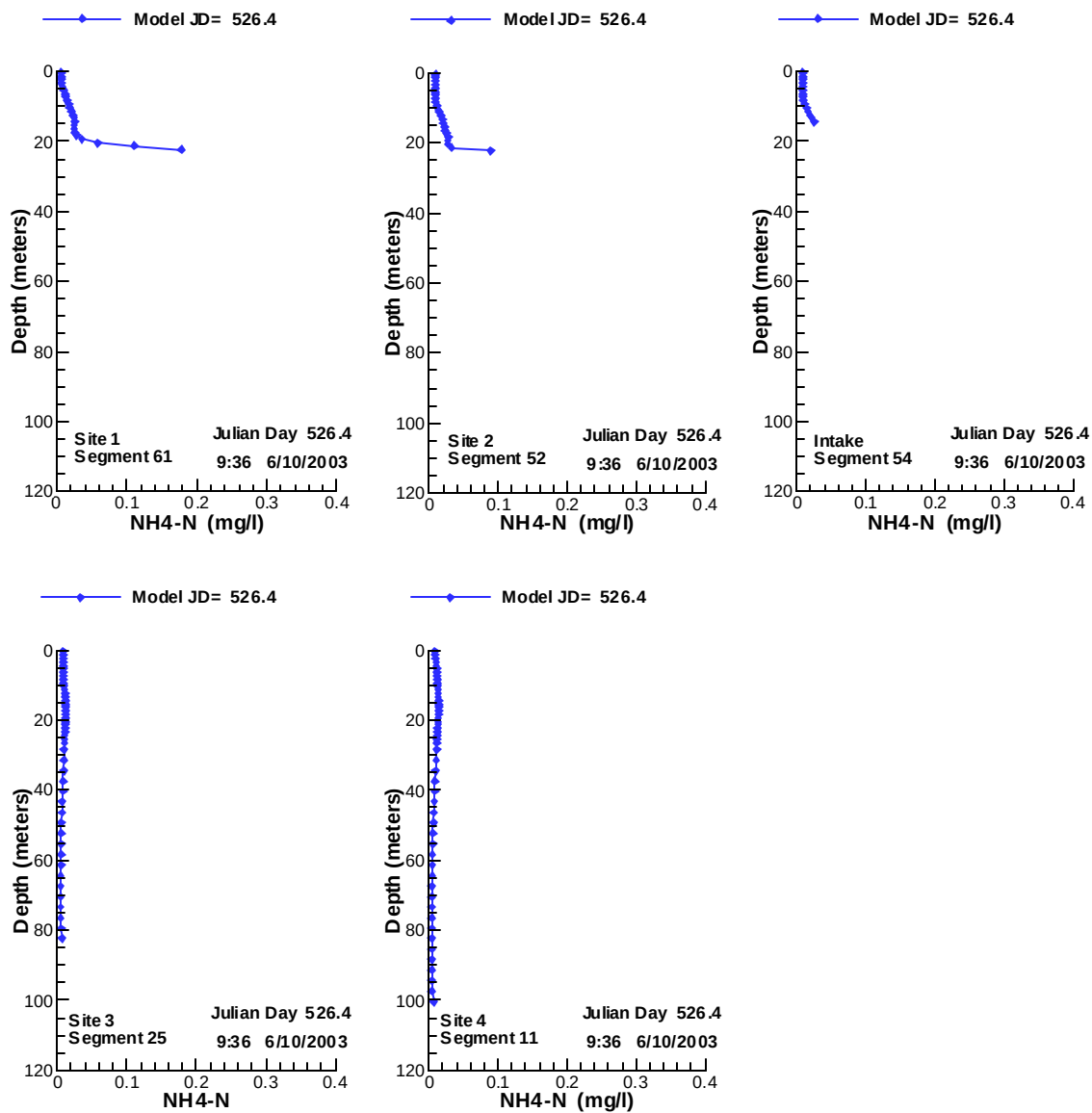


Figure 222. Vertical profiles of $\text{NH}_4\text{-N}$ compared with data for 6/10/2003.

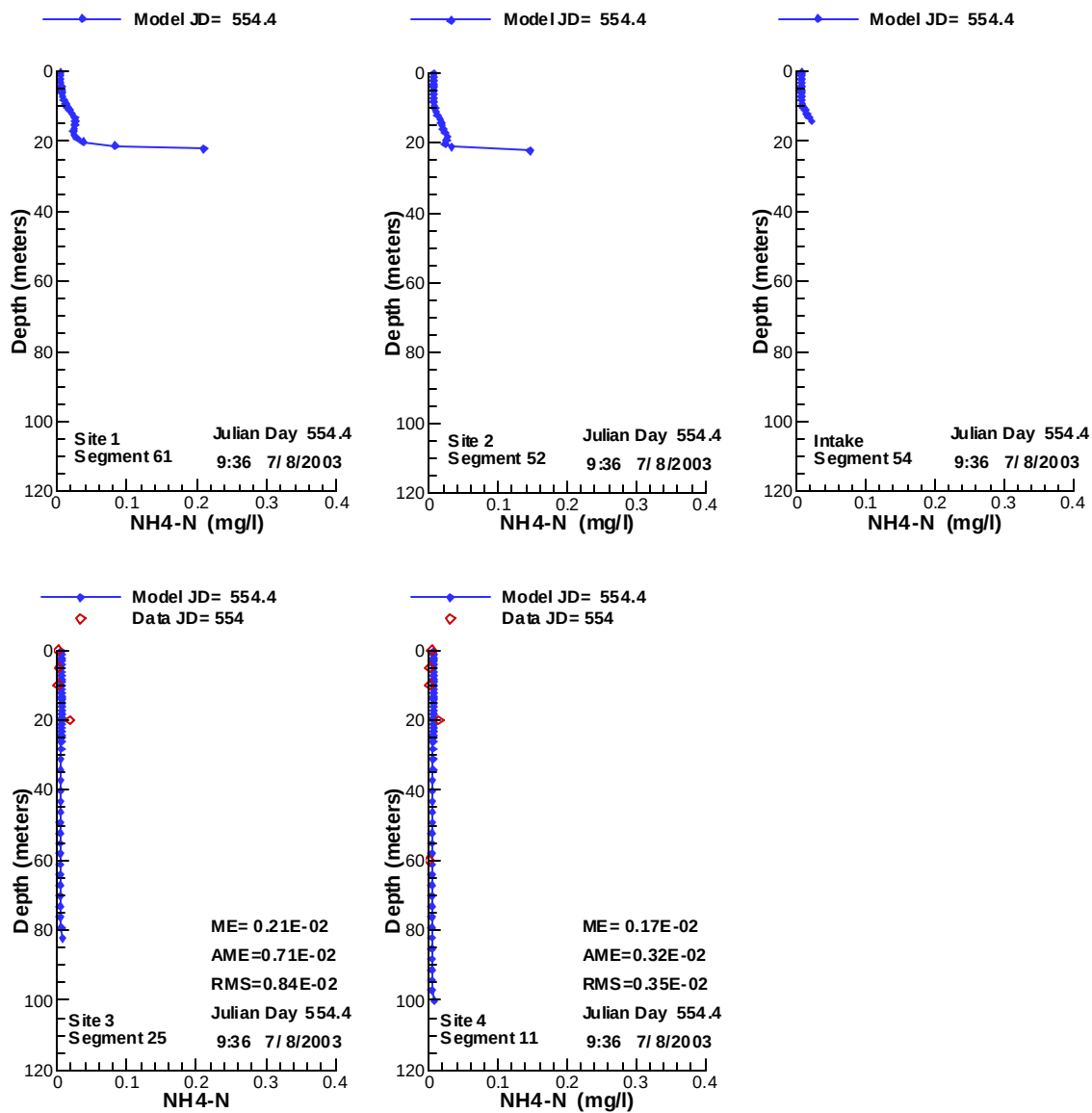


Figure 223. Vertical profiles of NH4-N compared with data for 7/ 8/2003.

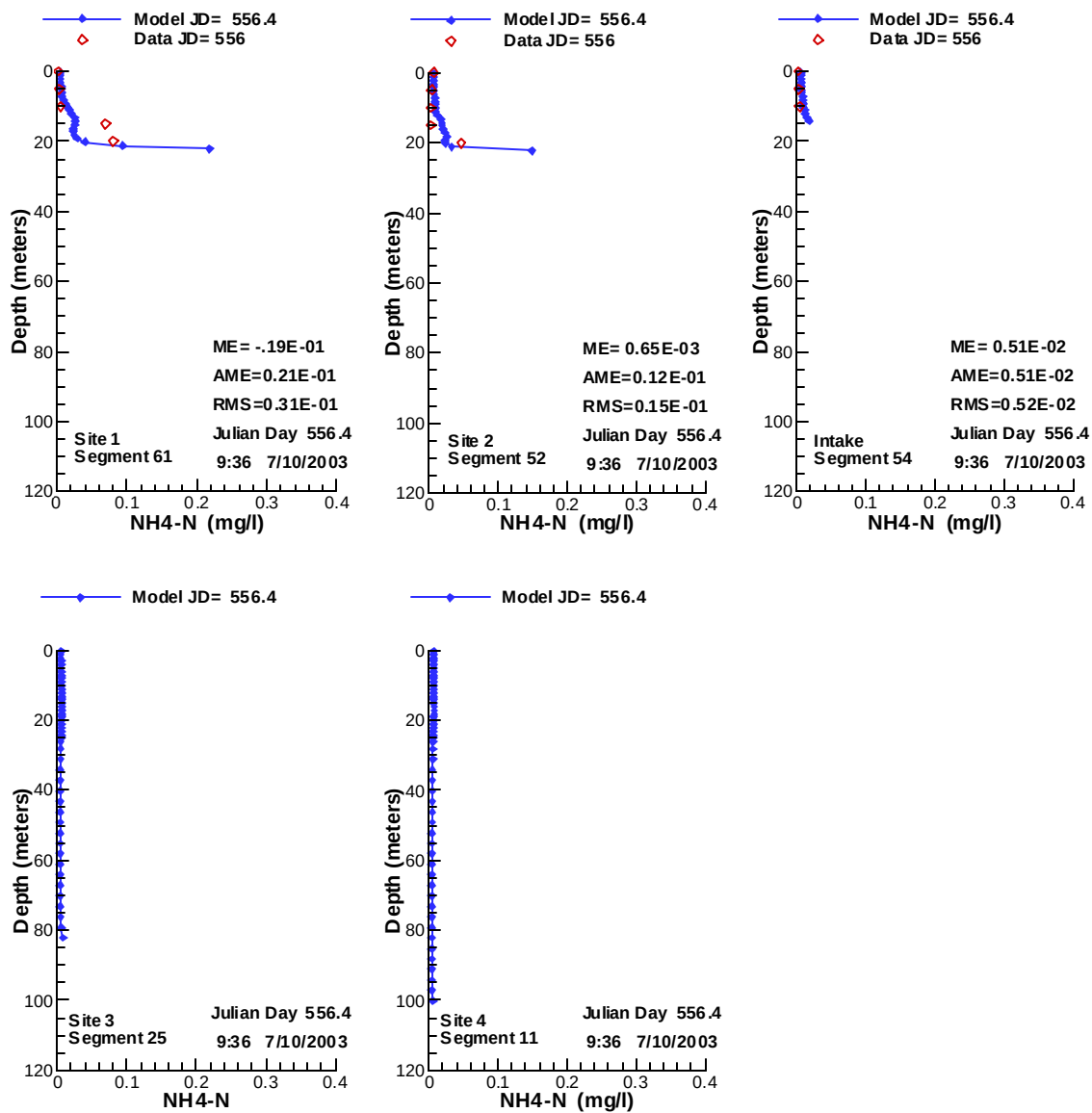


Figure 224. Vertical profiles of $\text{NH}_4\text{-N}$ compared with data for 7/10/2003.

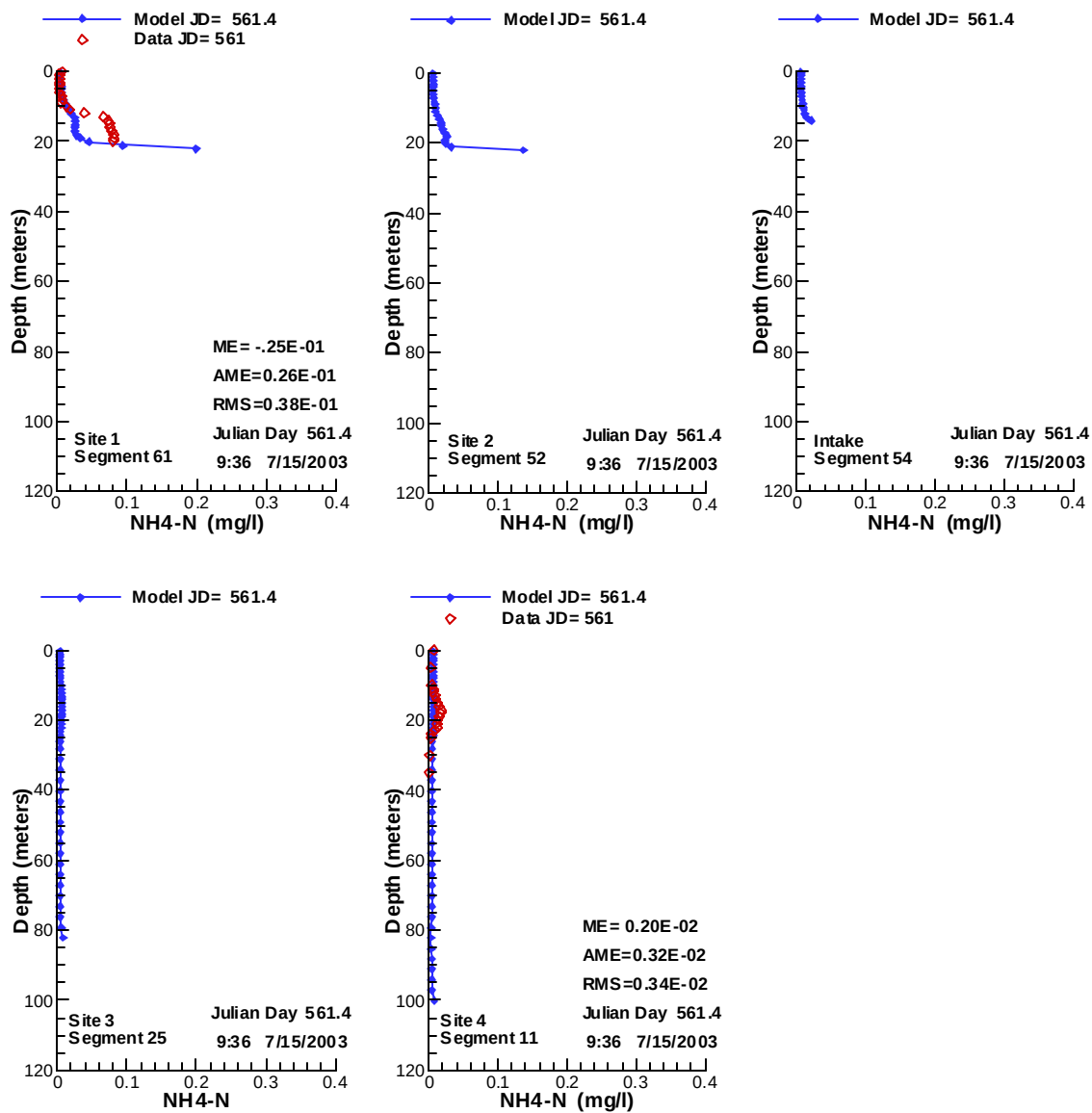


Figure 225. Vertical profiles of $\text{NH}_4\text{-N}$ compared with data for 7/15/2003.

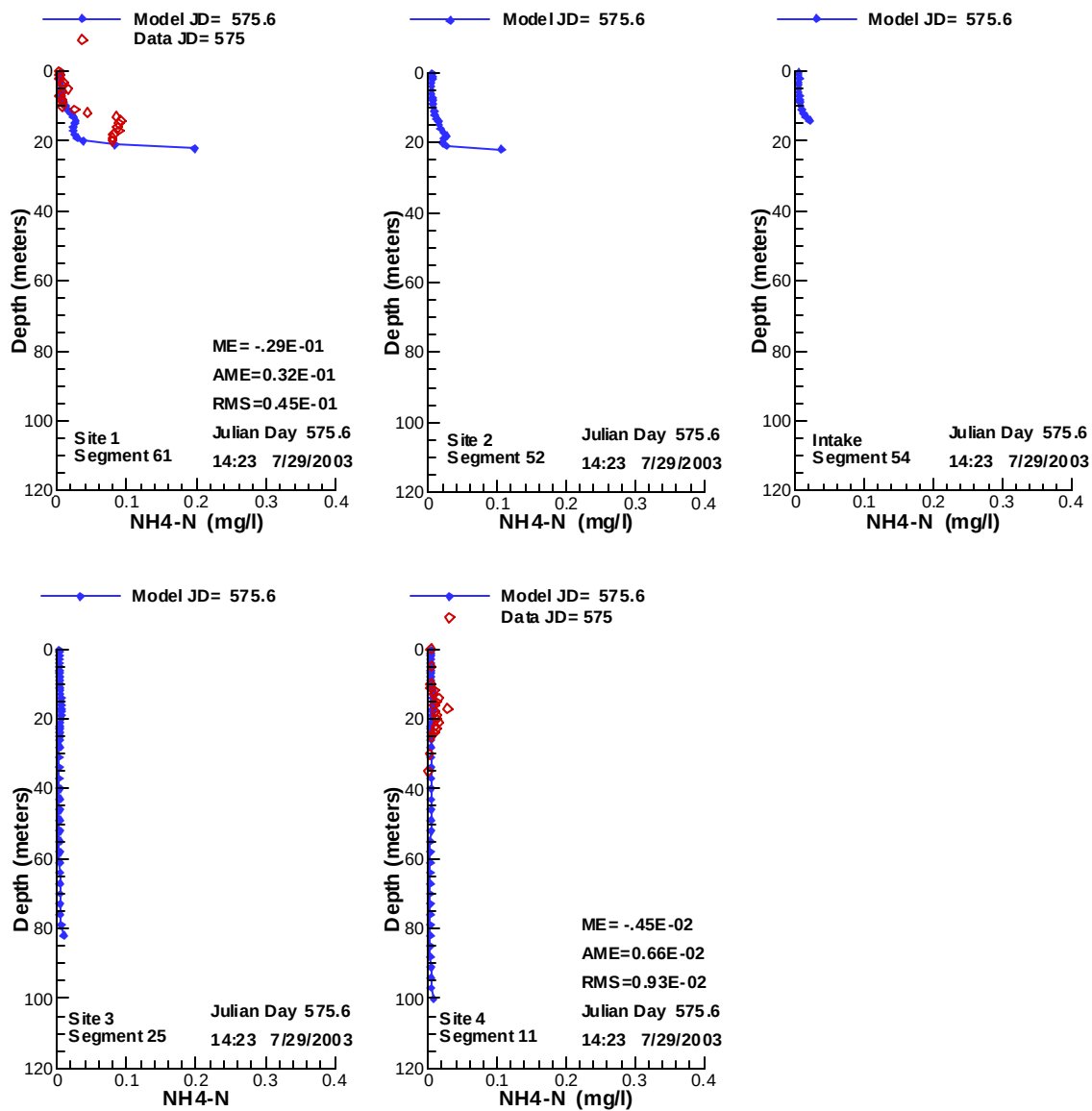


Figure 226. Vertical profiles of $\text{NH}_4\text{-N}$ compared with data for 7/29/2003.

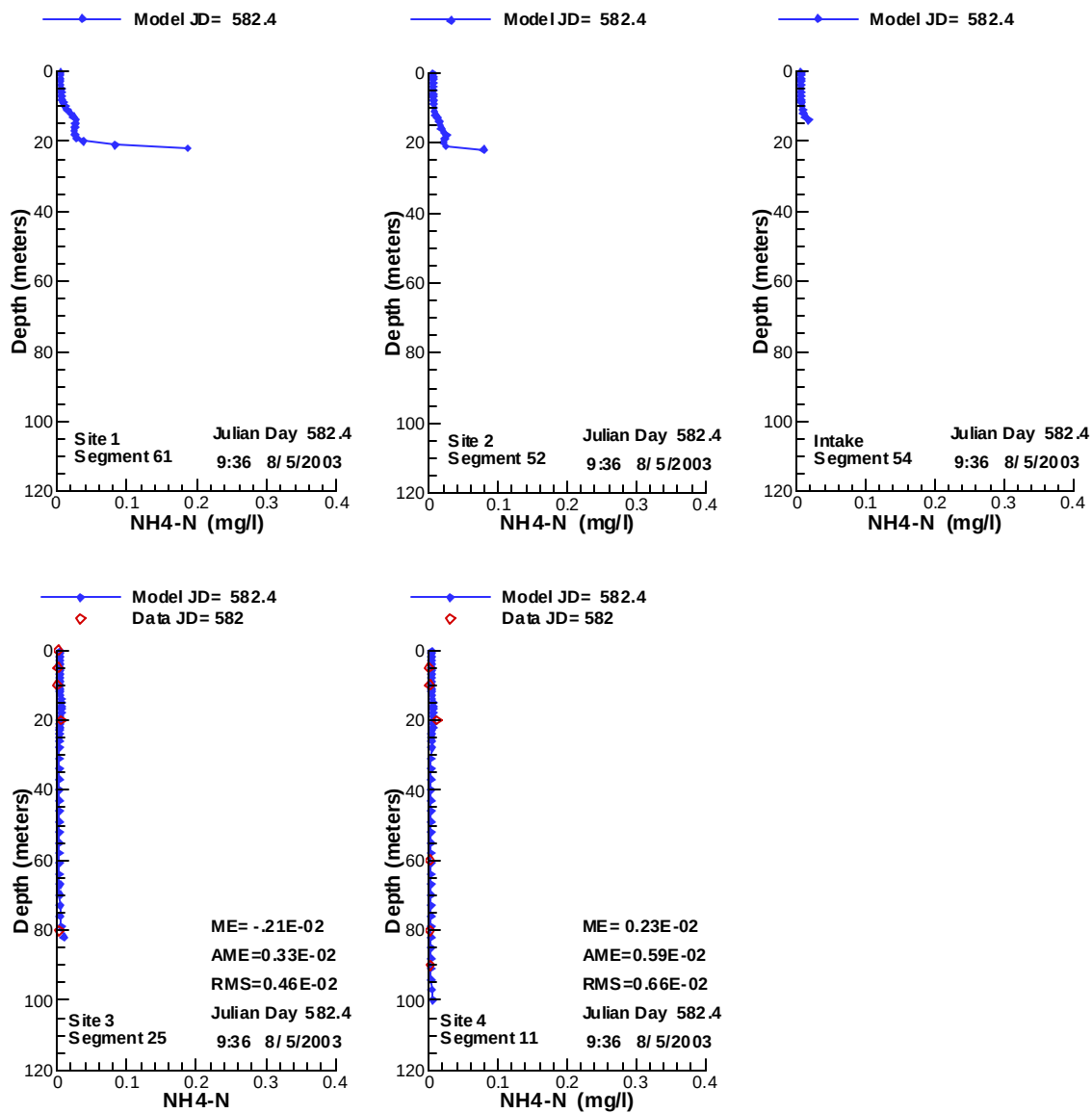


Figure 227. Vertical profiles of NH4-N compared with data for 8/ 5/2003.

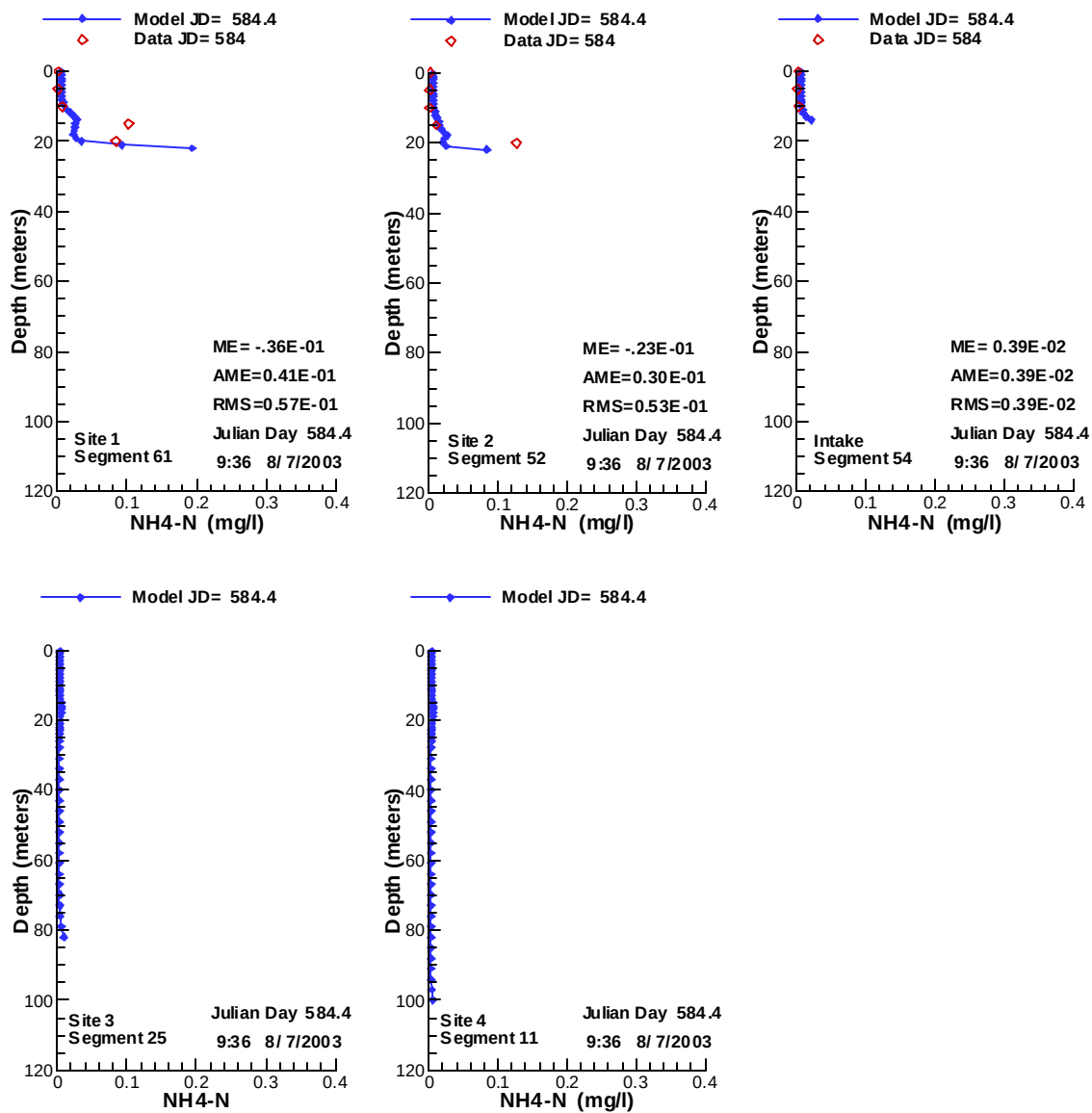


Figure 228. Vertical profiles of $\text{NH}_4\text{-N}$ compared with data for 8/7/2003.

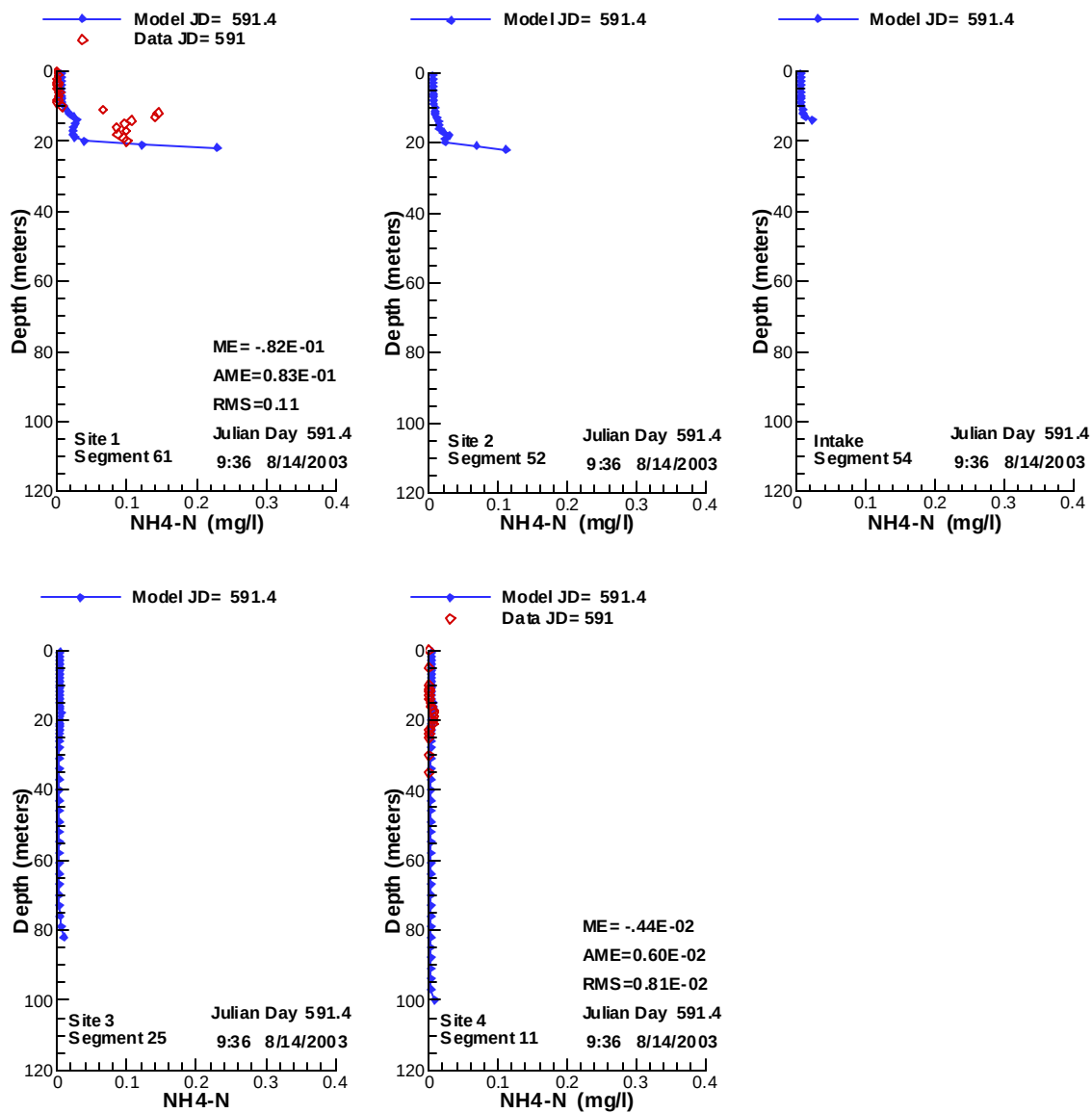


Figure 229. Vertical profiles of $\text{NH}_4\text{-N}$ compared with data for 8/14/2003.

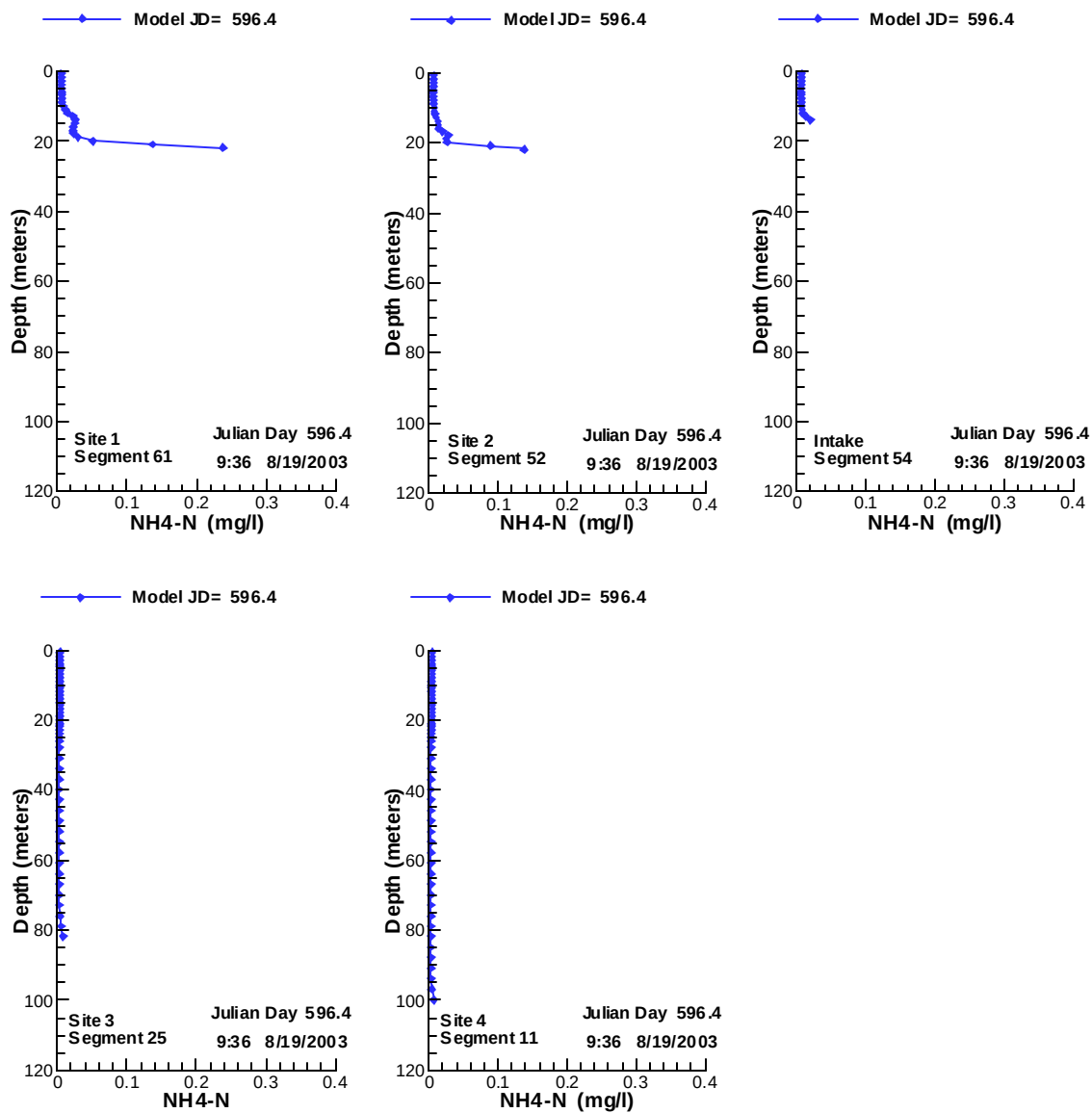


Figure 230. Vertical profiles of $\text{NH}_4\text{-N}$ compared with data for 8/19/2003.

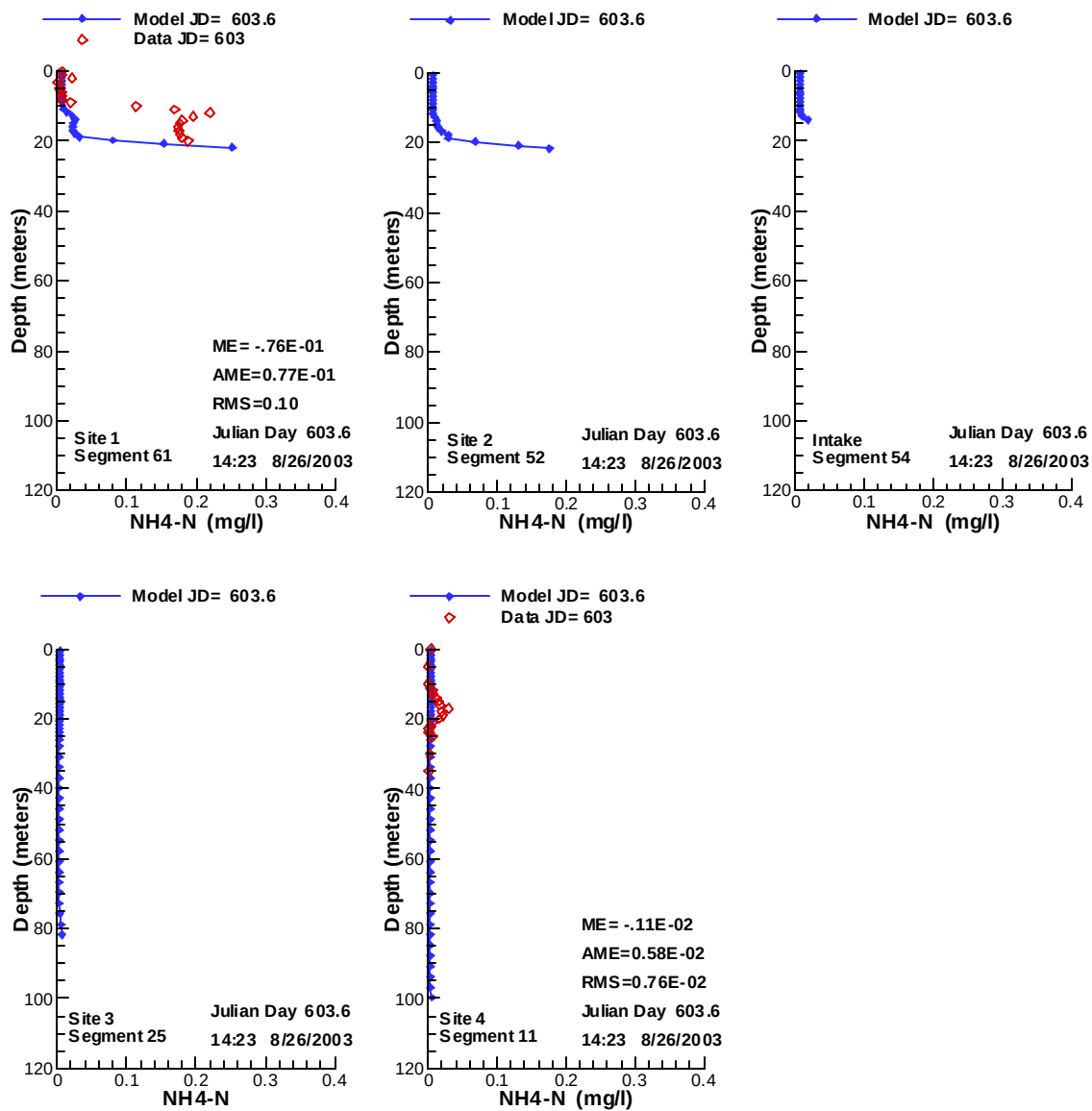


Figure 231. Vertical profiles of $\text{NH}_4\text{-N}$ compared with data for 8/26/2003.

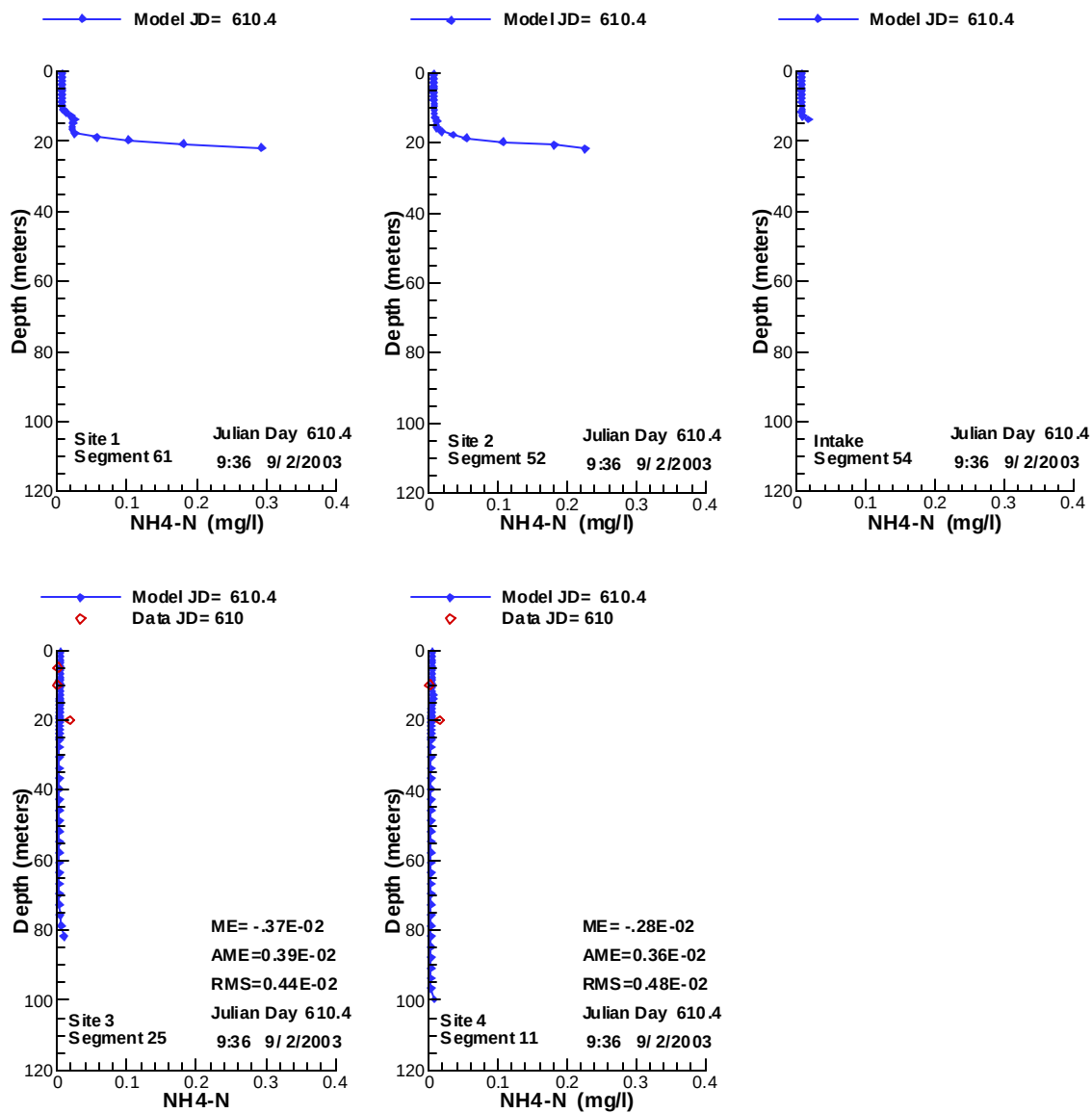


Figure 232. Vertical profiles of NH4-N compared with data for 9/ 2/2003.

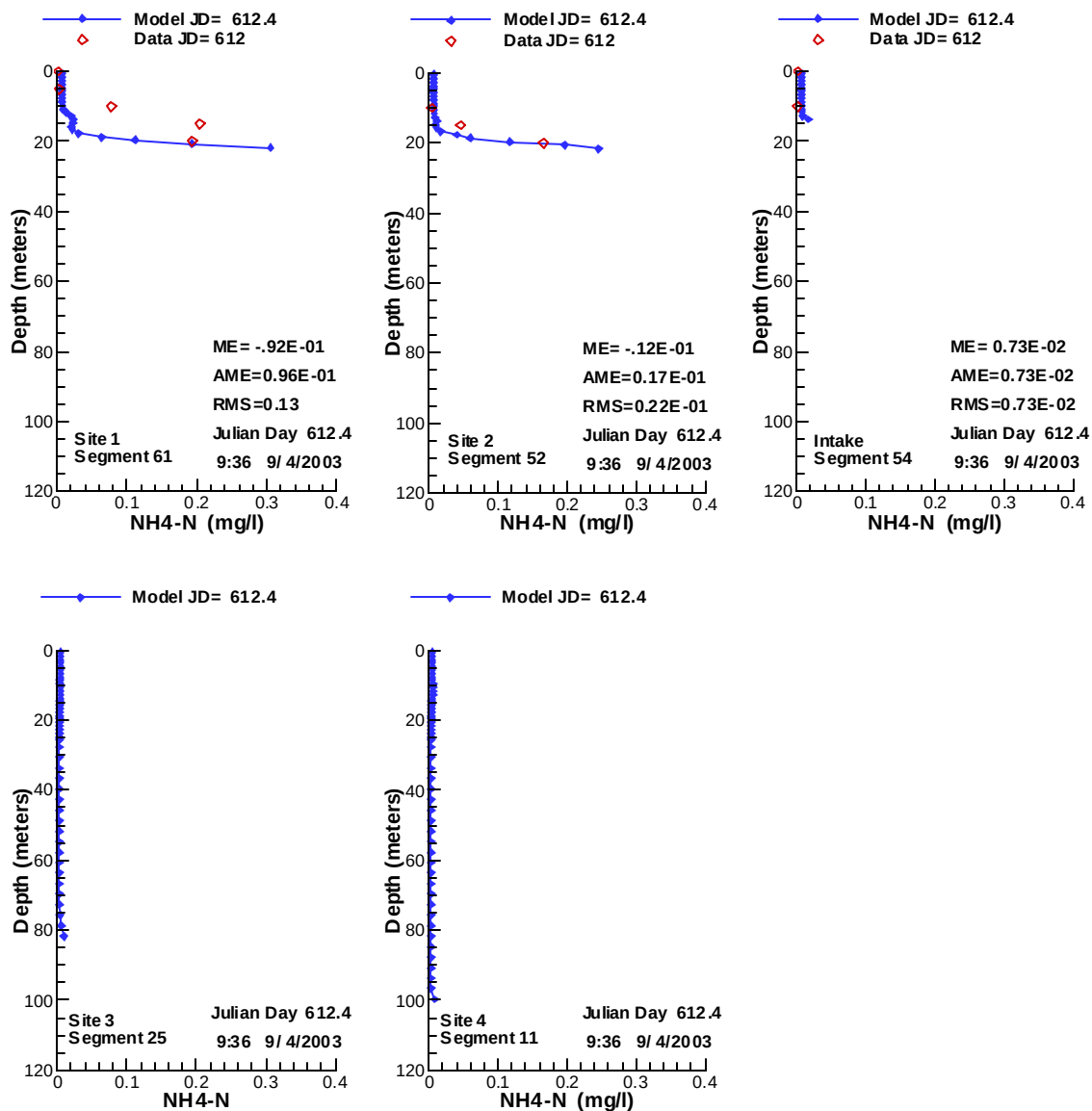


Figure 233. Vertical profiles of $\text{NH}_4\text{-N}$ compared with data for 9/ 4/2003.

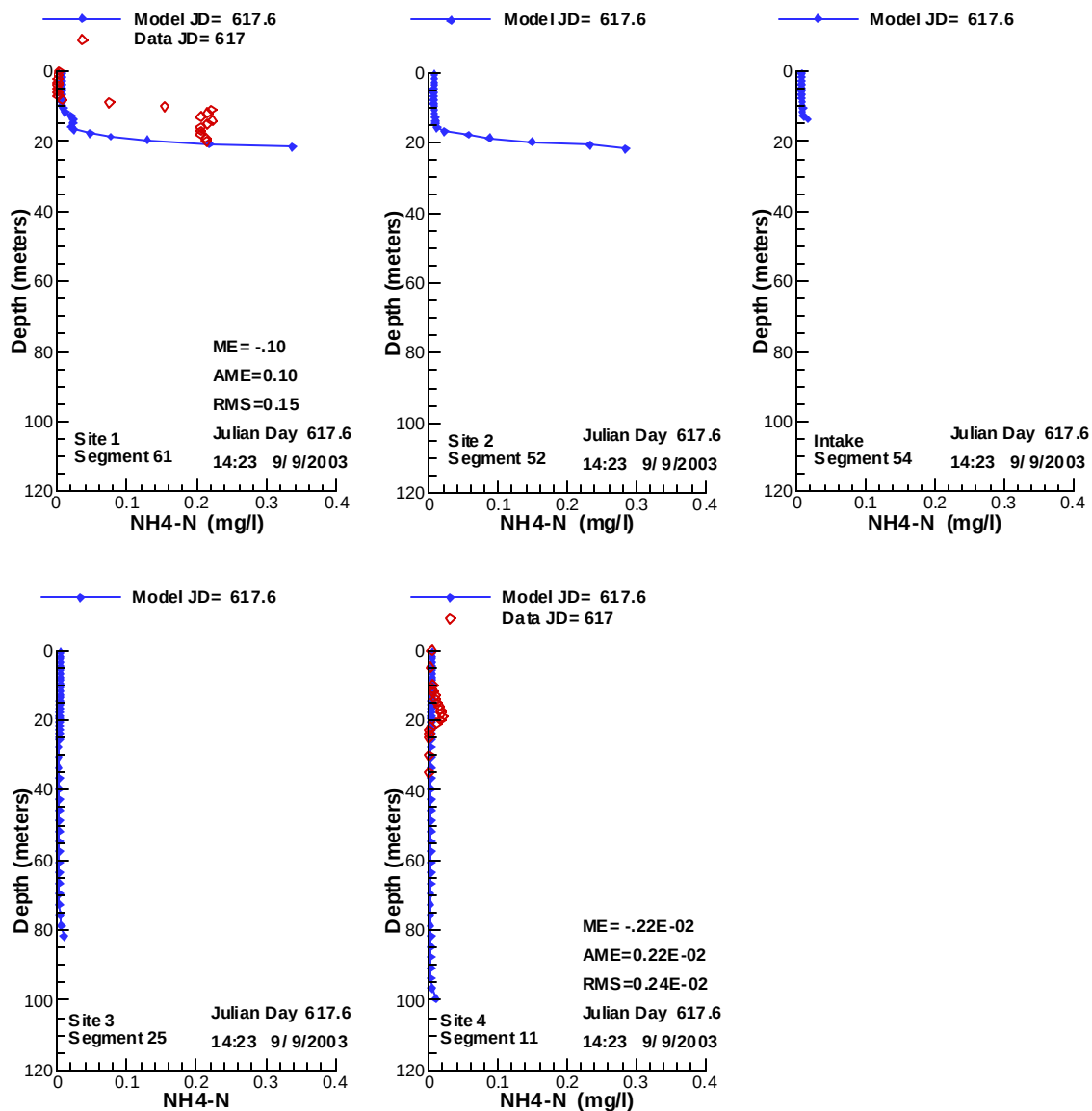


Figure 234. Vertical profiles of $\text{NH}_4\text{-N}$ compared with data for 9/ 9/2003.

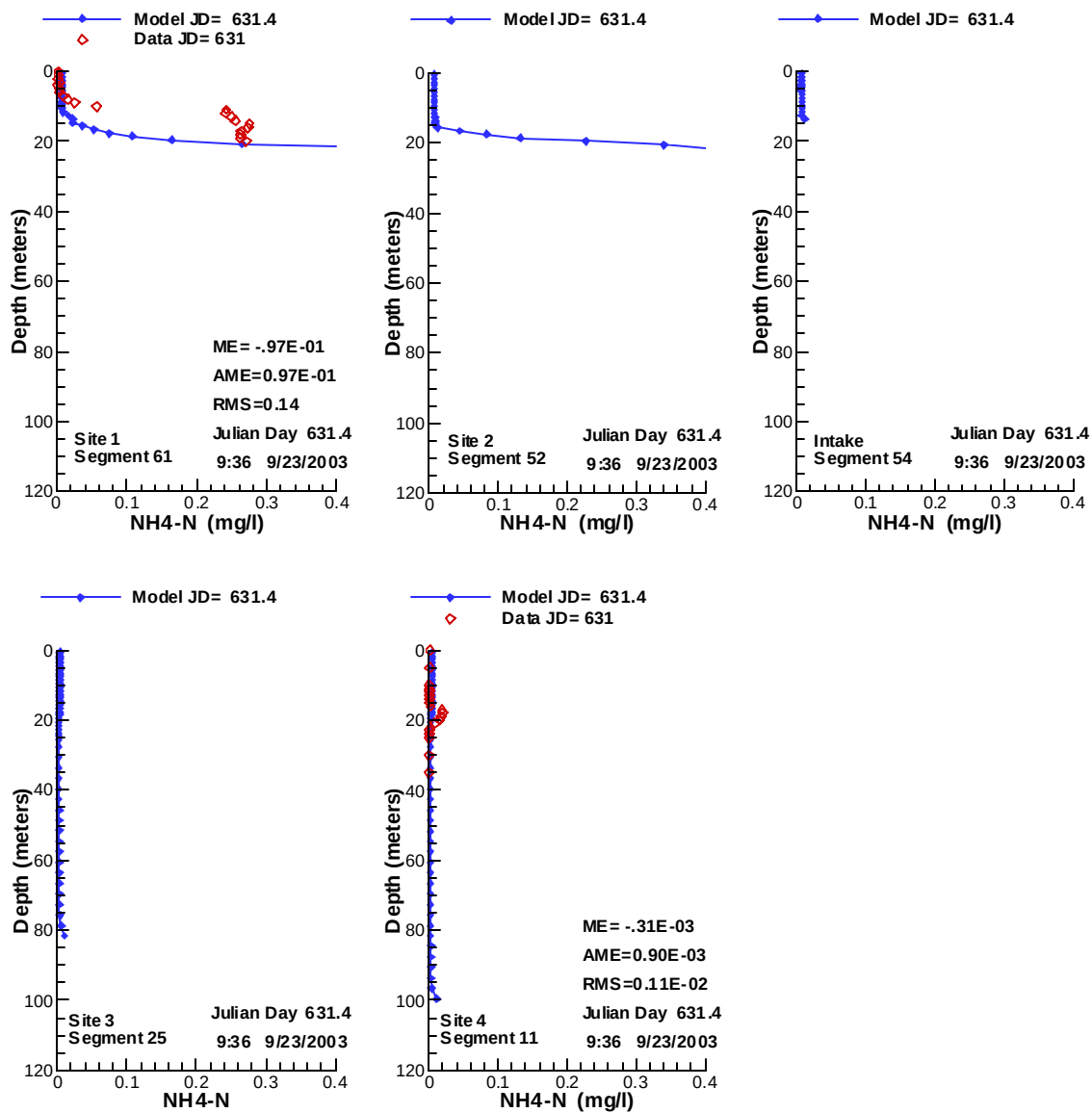


Figure 235. Vertical profiles of $\text{NH}_4\text{-N}$ compared with data for 9/23/2003.

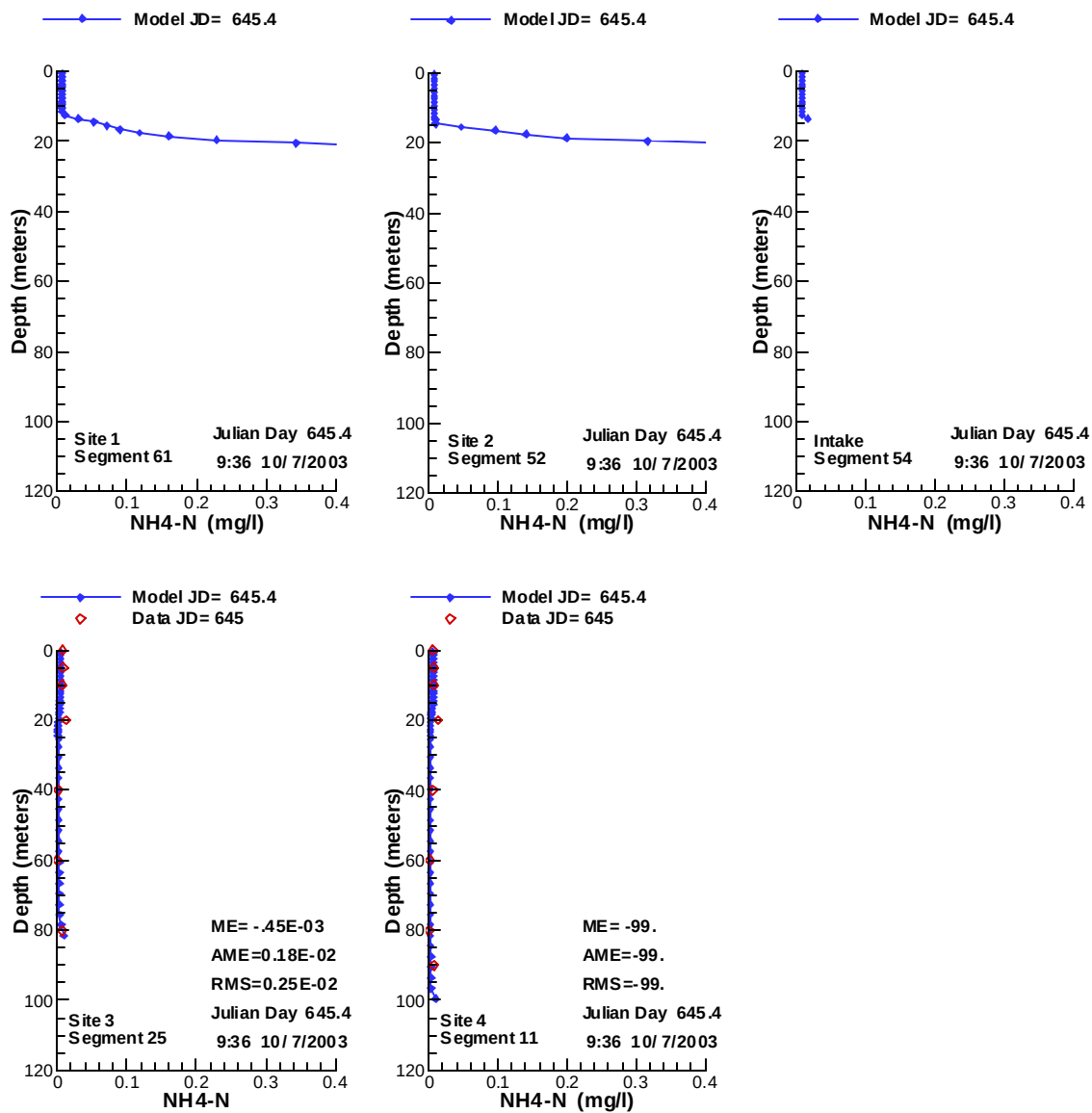


Figure 236. Vertical profiles of $\text{NH}_4\text{-N}$ compared with data for 10/ 7/2003.

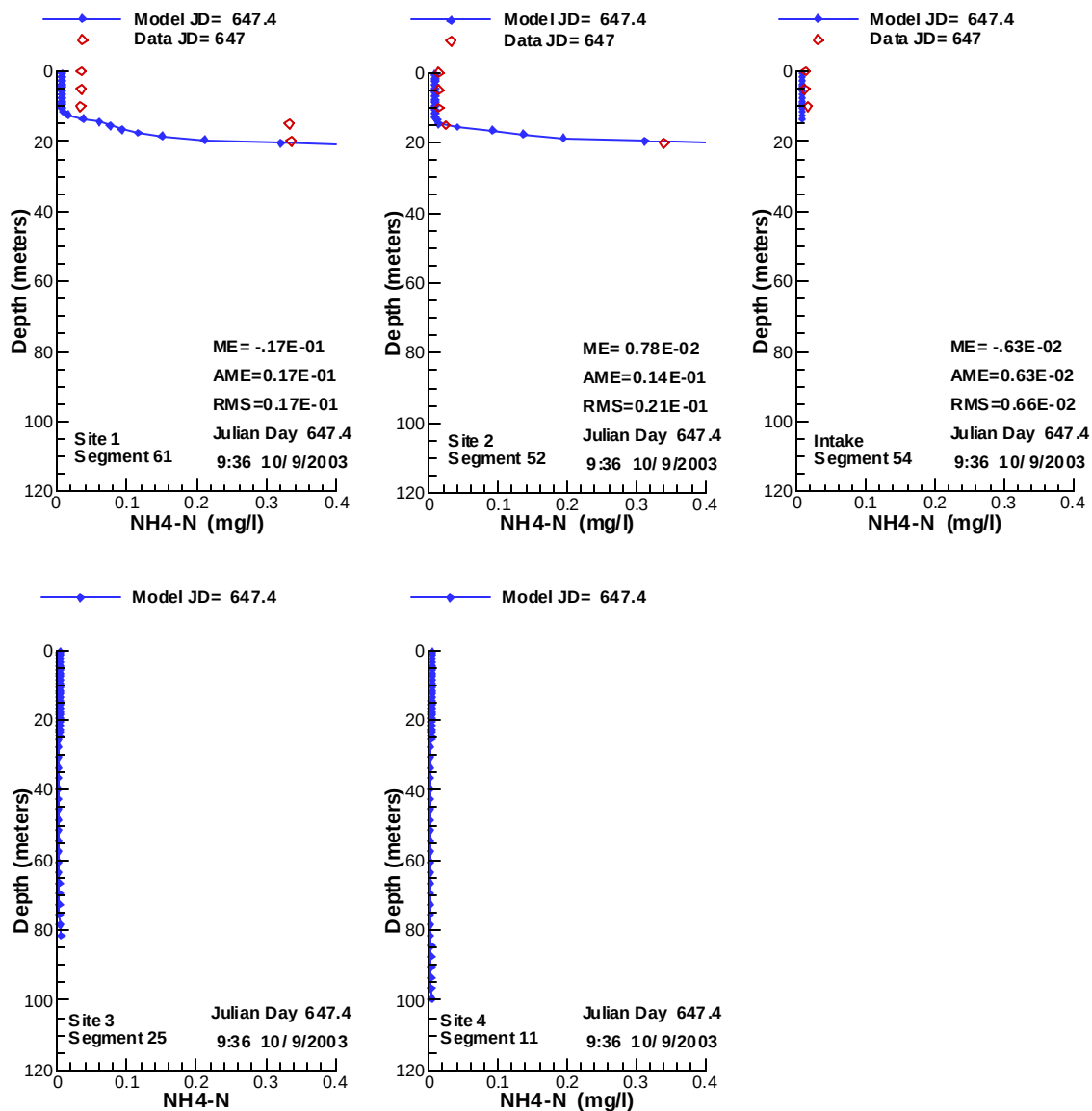


Figure 237. Vertical profiles of $\text{NH}_4\text{-N}$ compared with data for 10/ 9/2003.

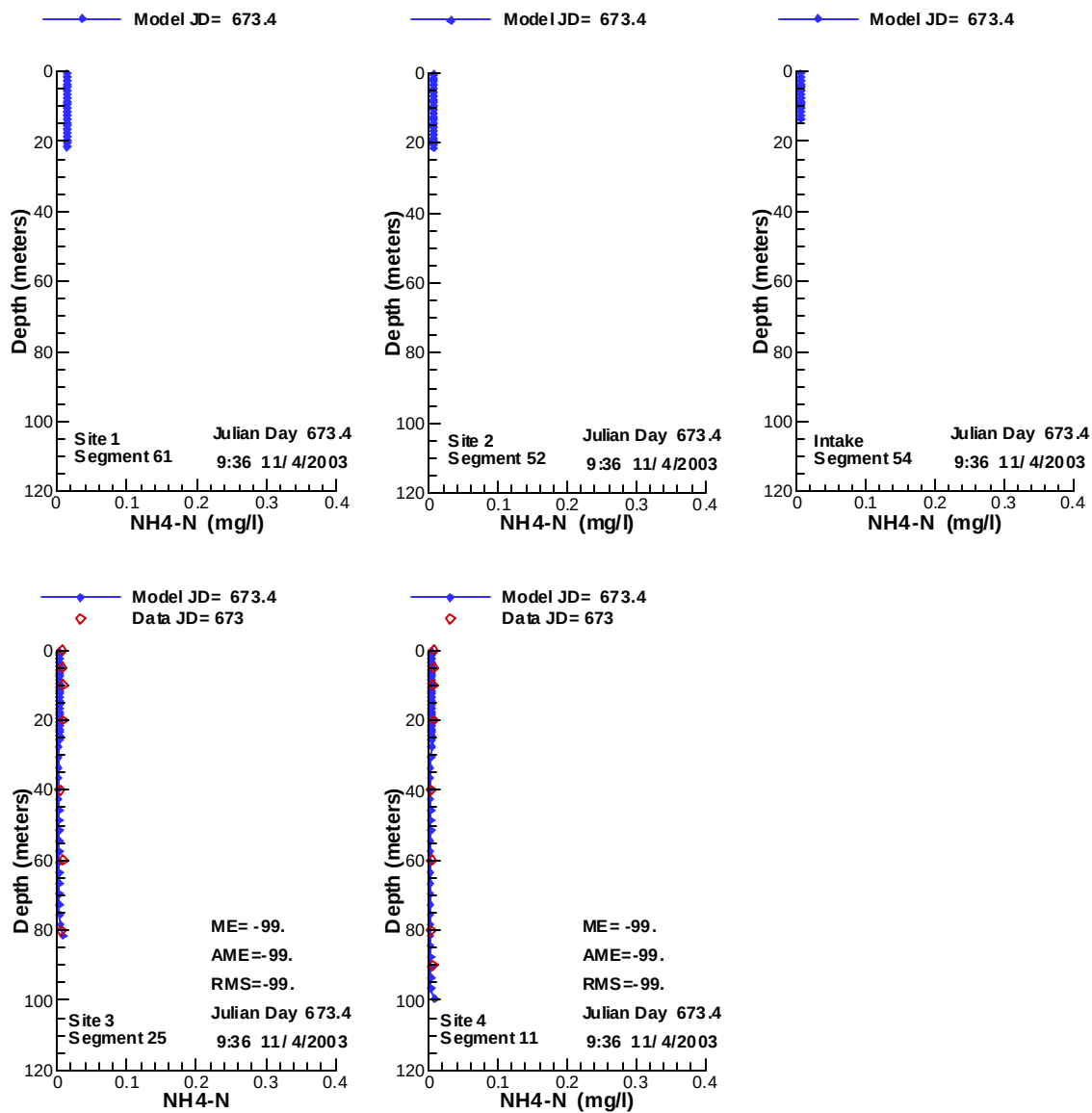


Figure 238. Vertical profiles of NH4-N compared with data for 11/ 4/2003.

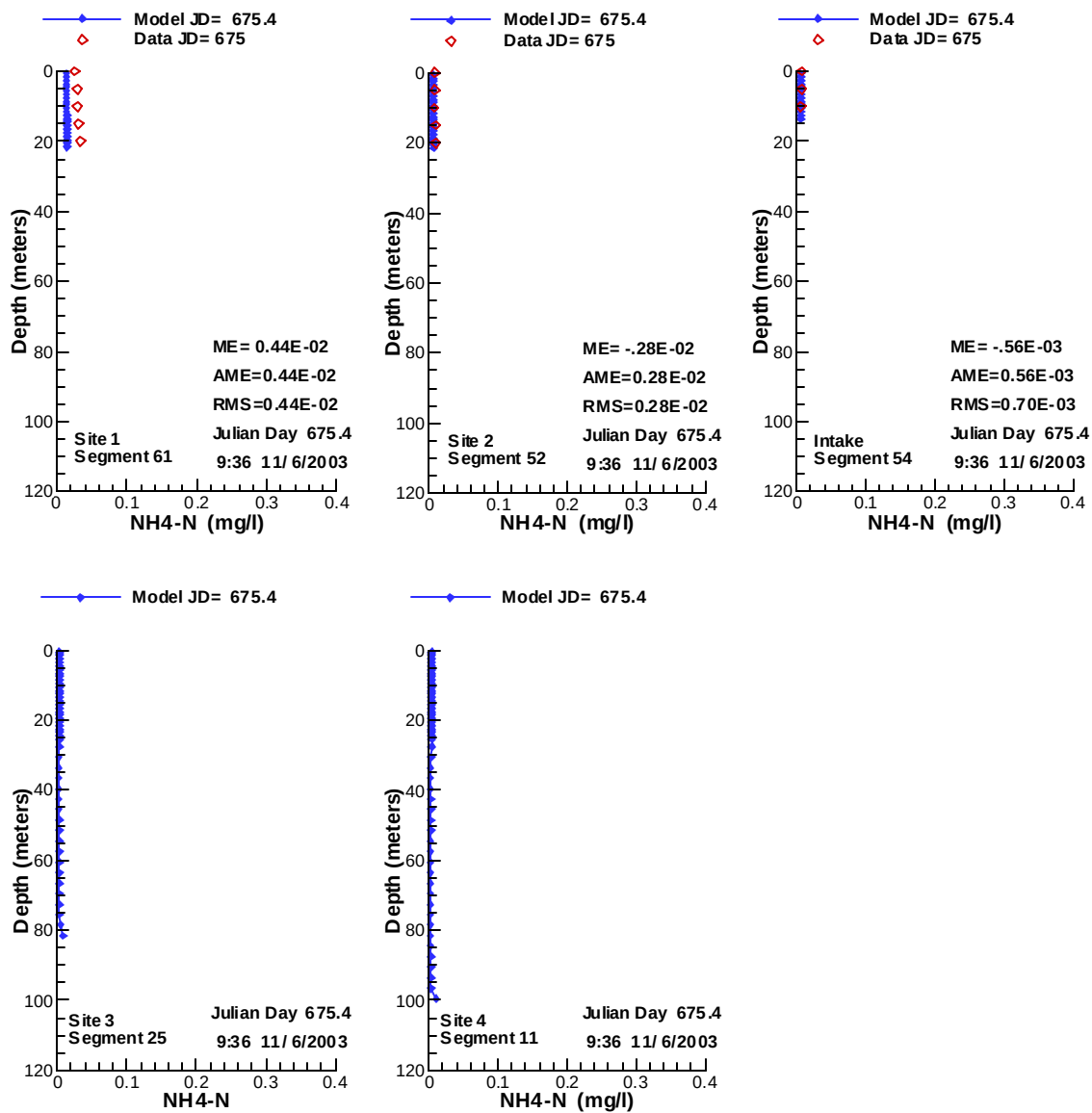


Figure 239. Vertical profiles of $\text{NH}_4\text{-N}$ compared with data for 11/ 6/2003.

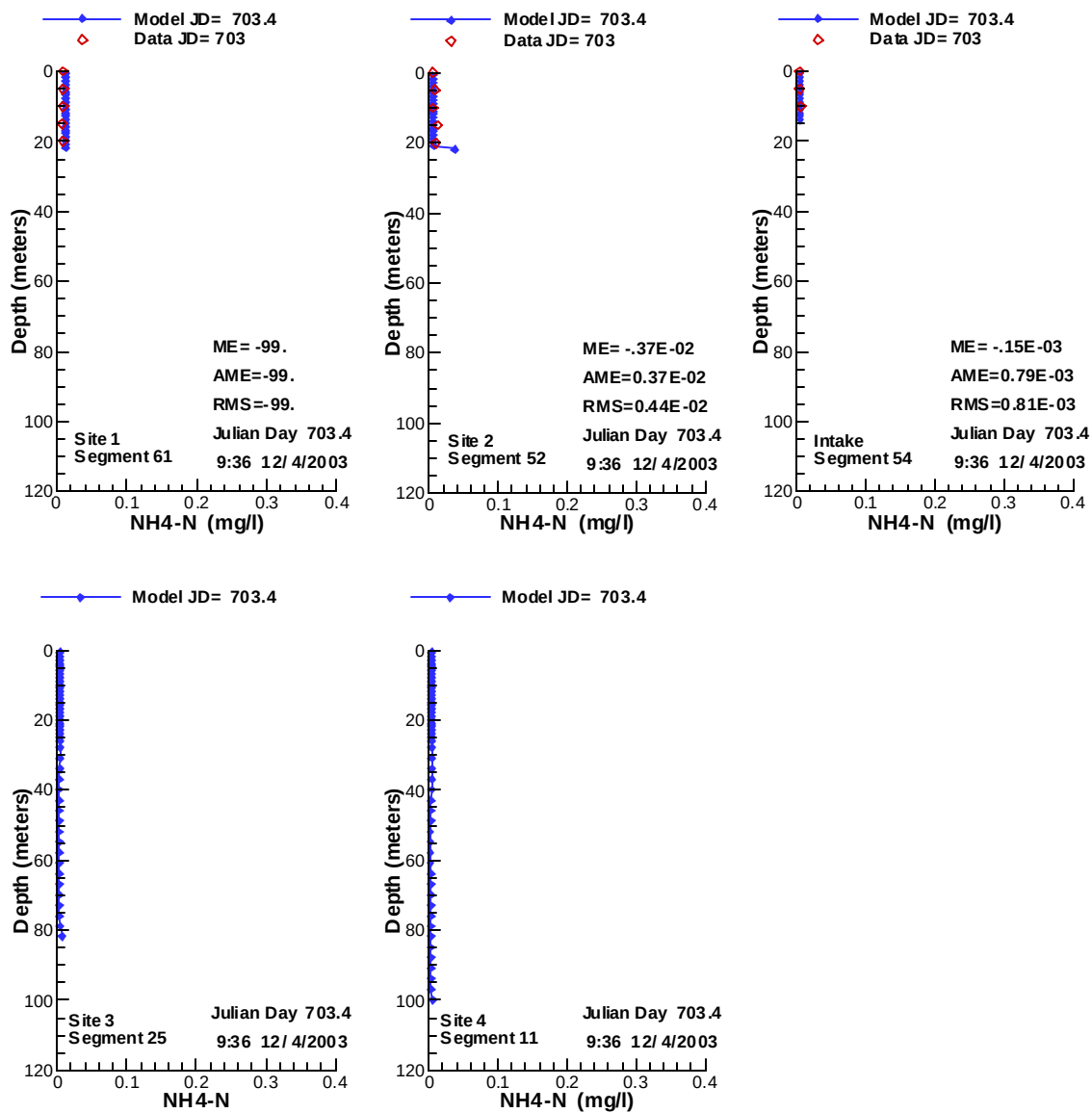


Figure 240. Vertical profiles of $\text{NH}_4\text{-N}$ compared with data for 12/ 4/2003.

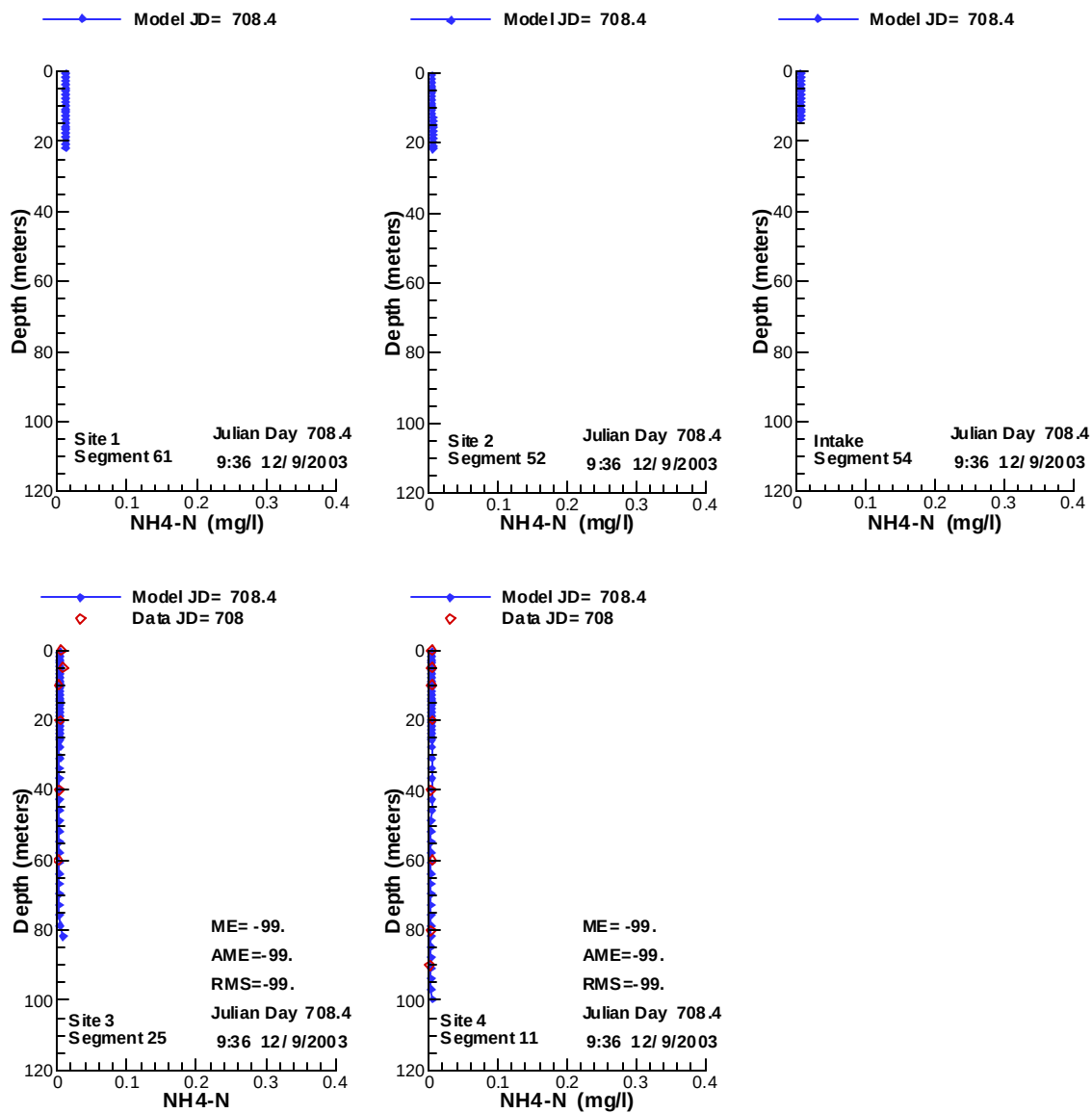


Figure 241. Vertical profiles of NH4-N compared with data for 12/ 9/2003.

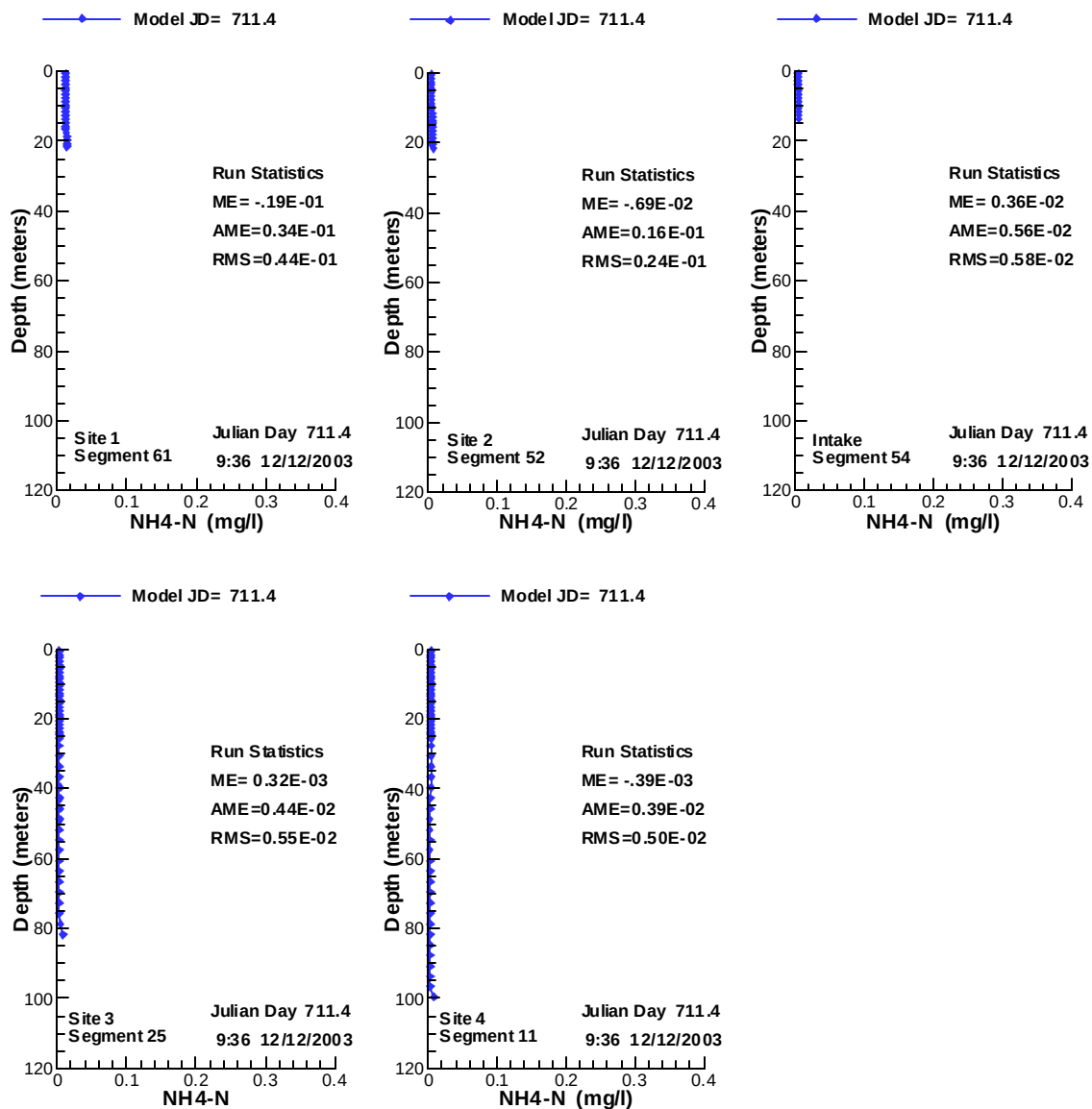


Figure 242. Vertical profiles of NH4-N compared with data for 12/12/2003.

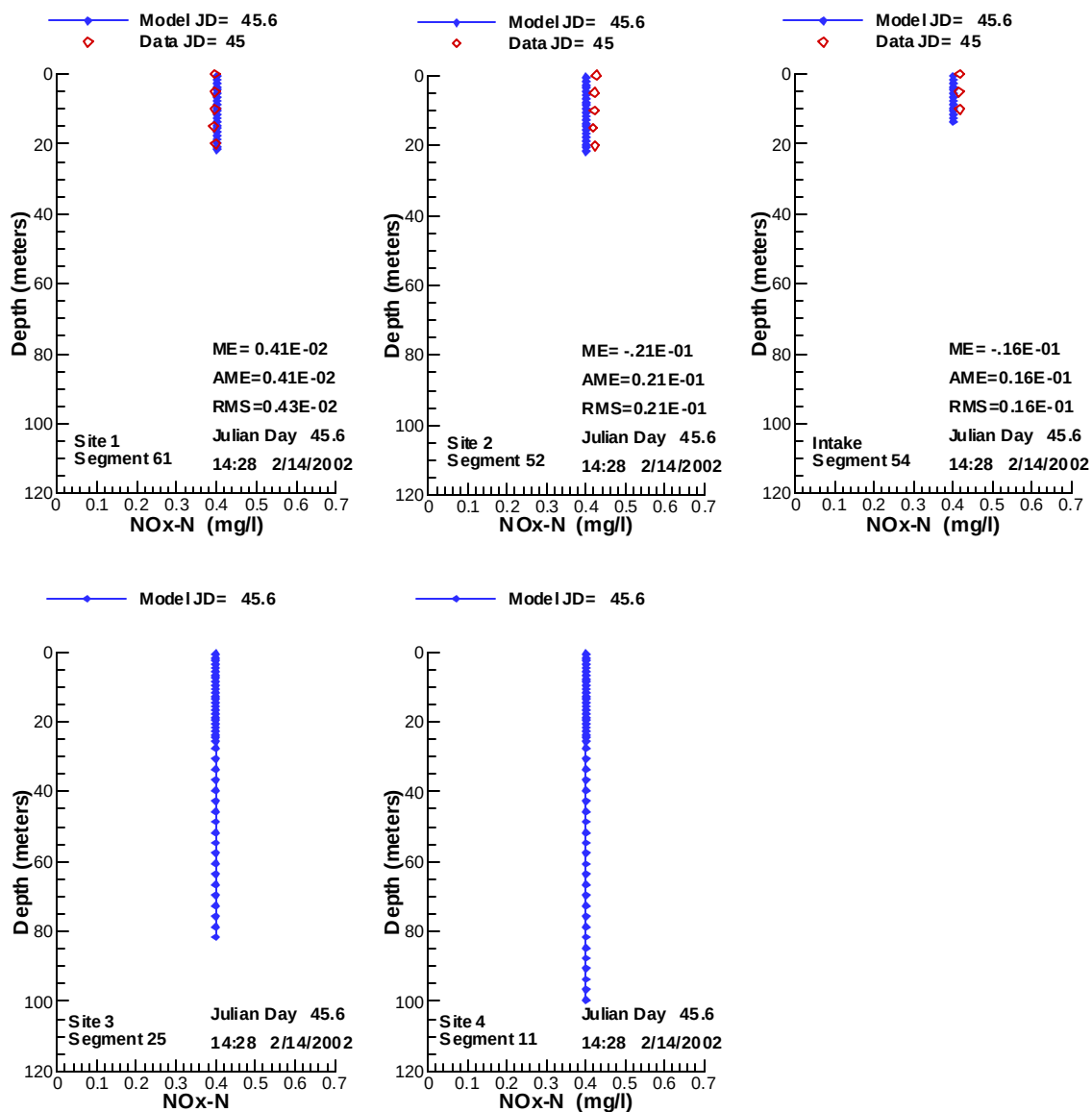


Figure 243. Vertical profiles of NOx-N compared with data for 2/14/2002.

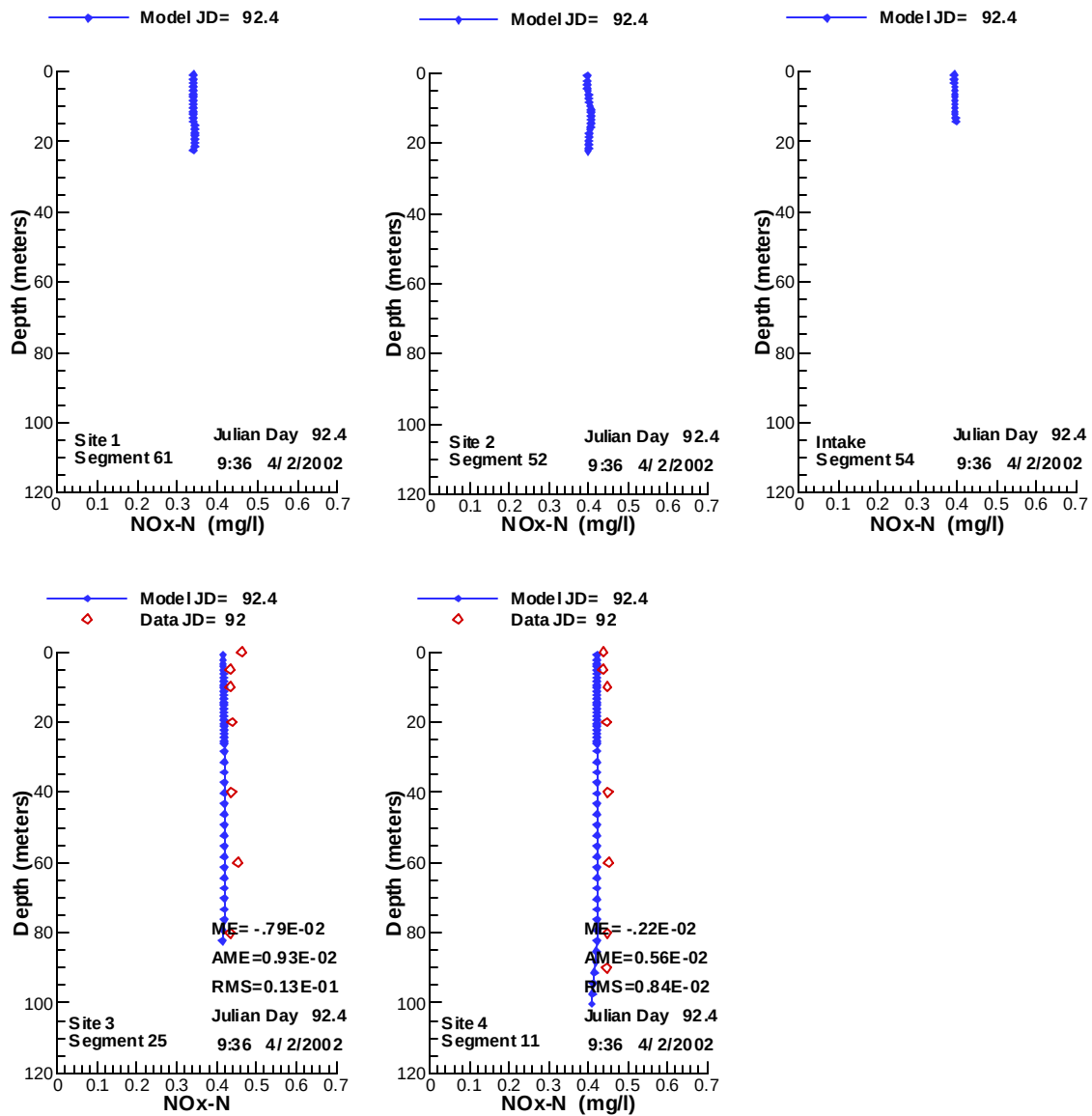


Figure 244. Vertical profiles of NOx-N compared with data for 4/ 2/2002.

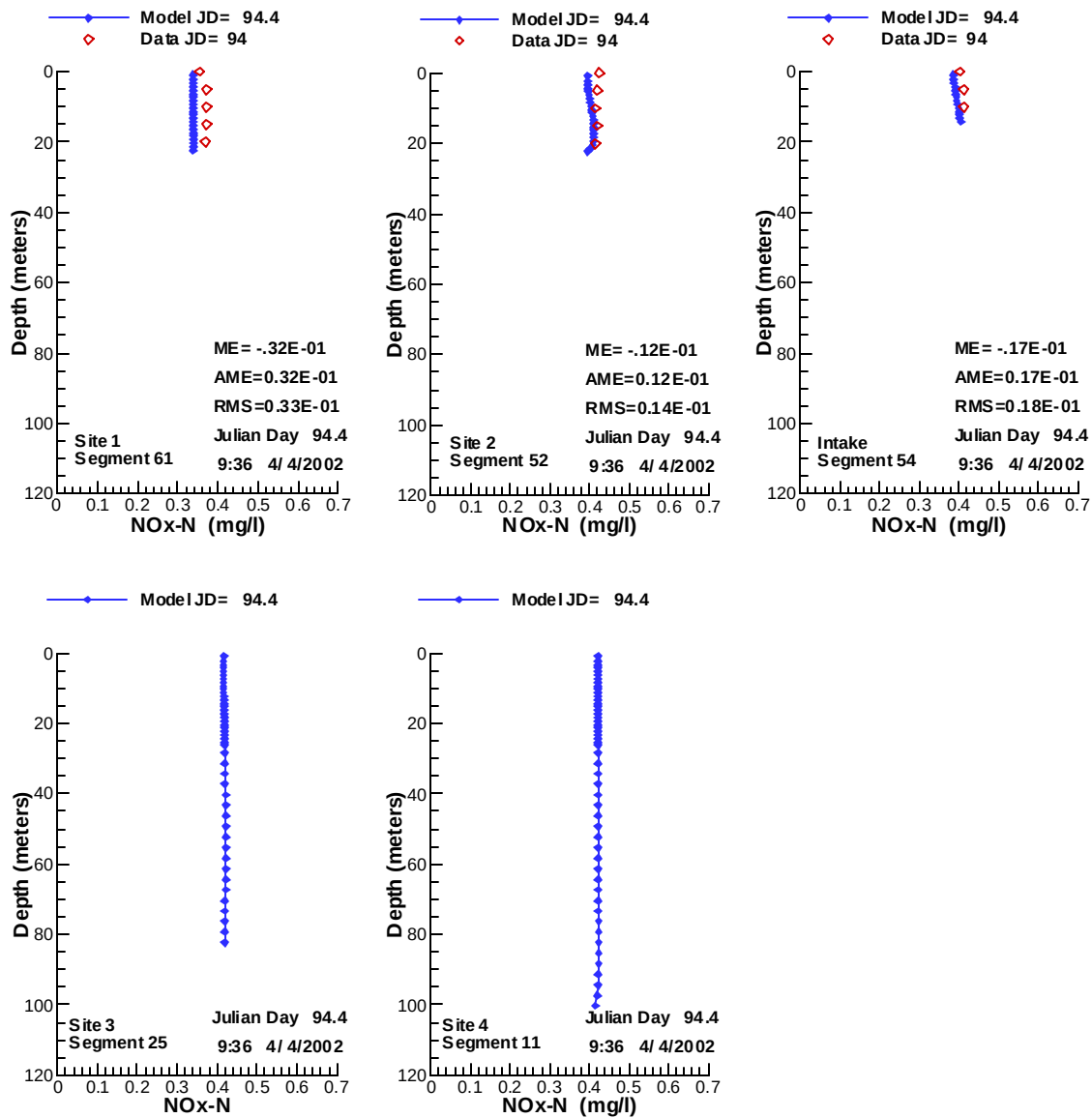


Figure 245. Vertical profiles of NOx-N compared with data for 4/ 4/2002.

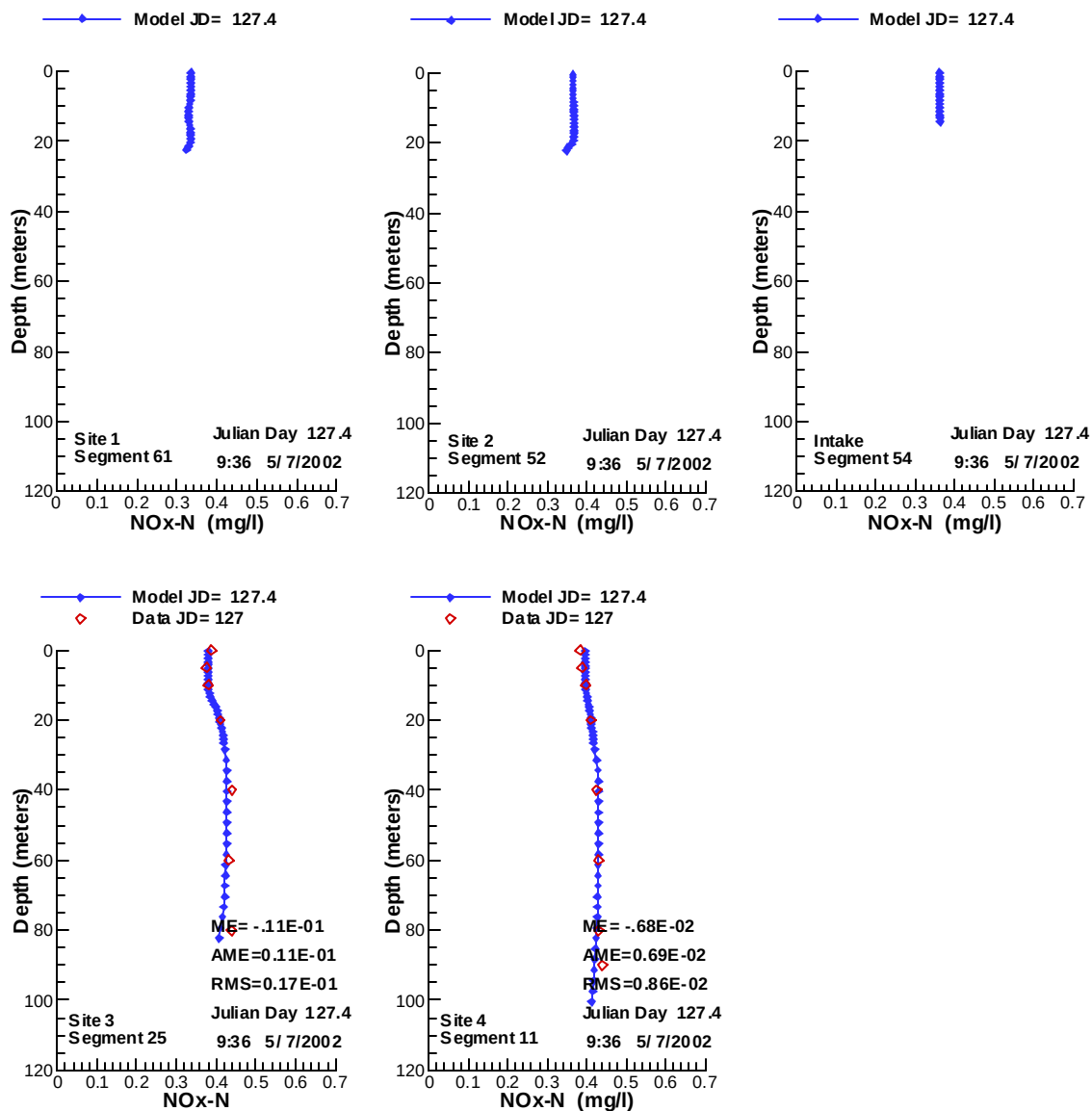


Figure 246. Vertical profiles of NOx-N compared with data for 5/ 7/2002.

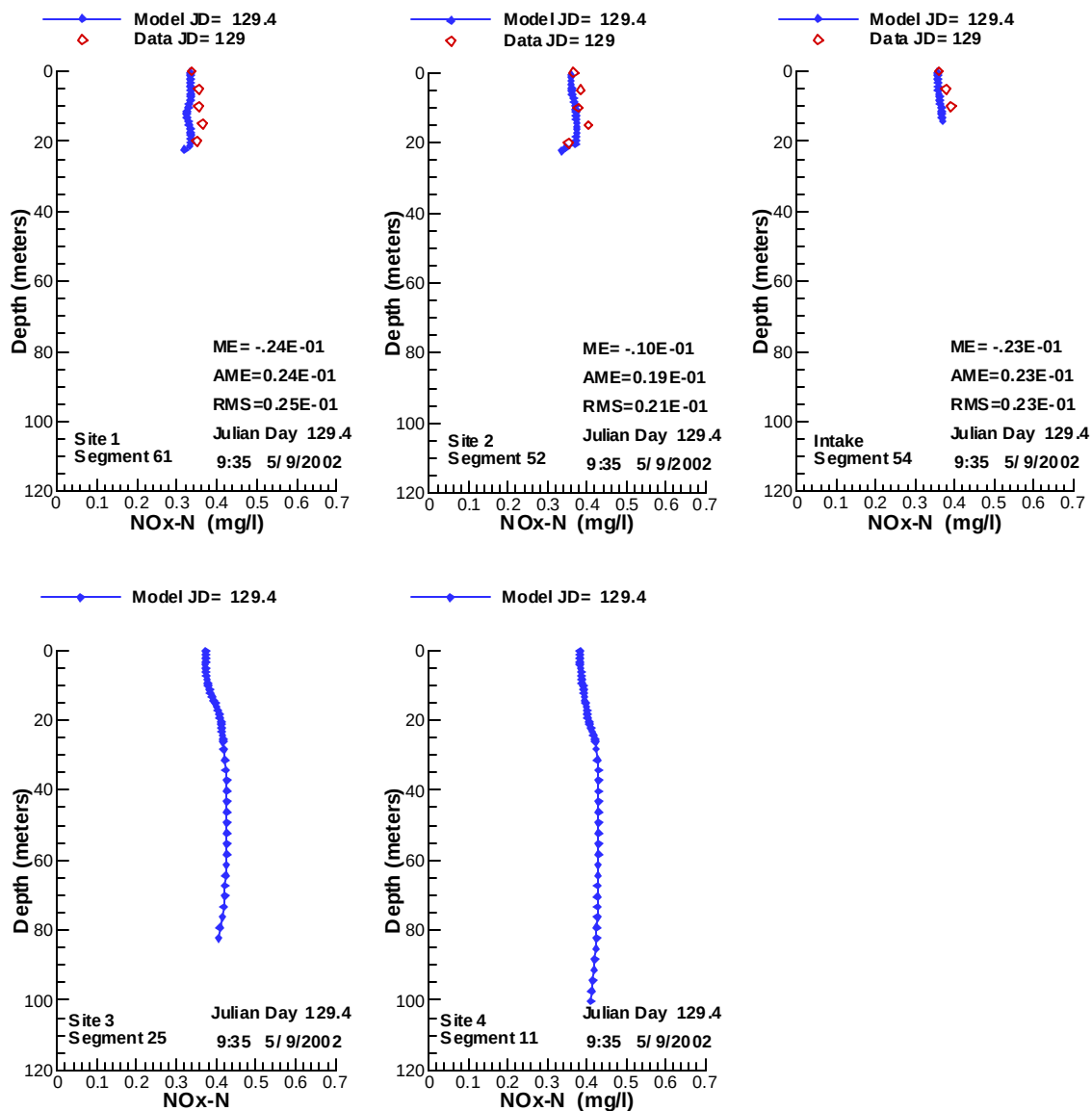


Figure 247. Vertical profiles of NOx-N compared with data for 5/ 9/2002.

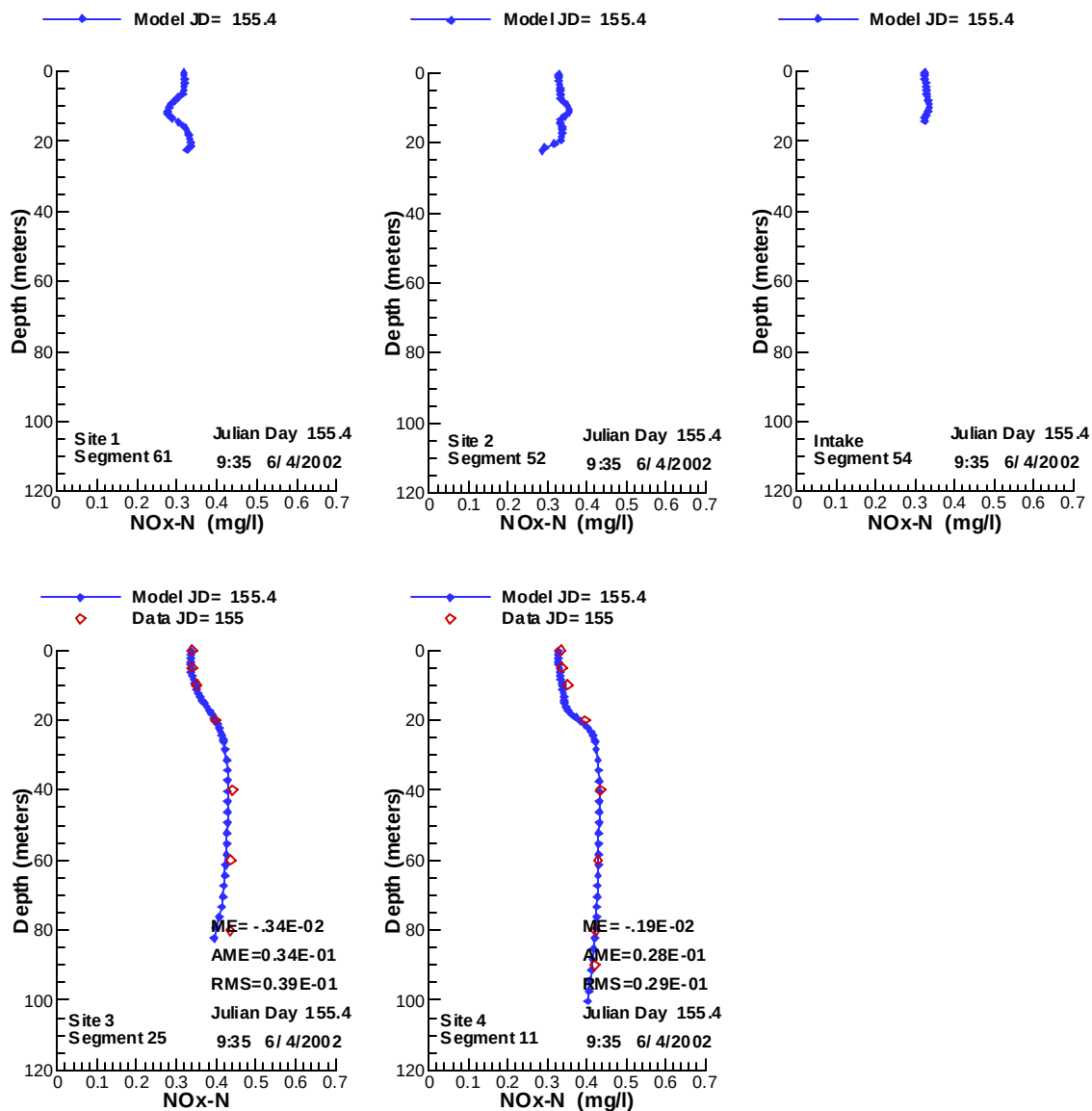


Figure 248. Vertical profiles of NOx-N compared with data for 6/ 4/2002.

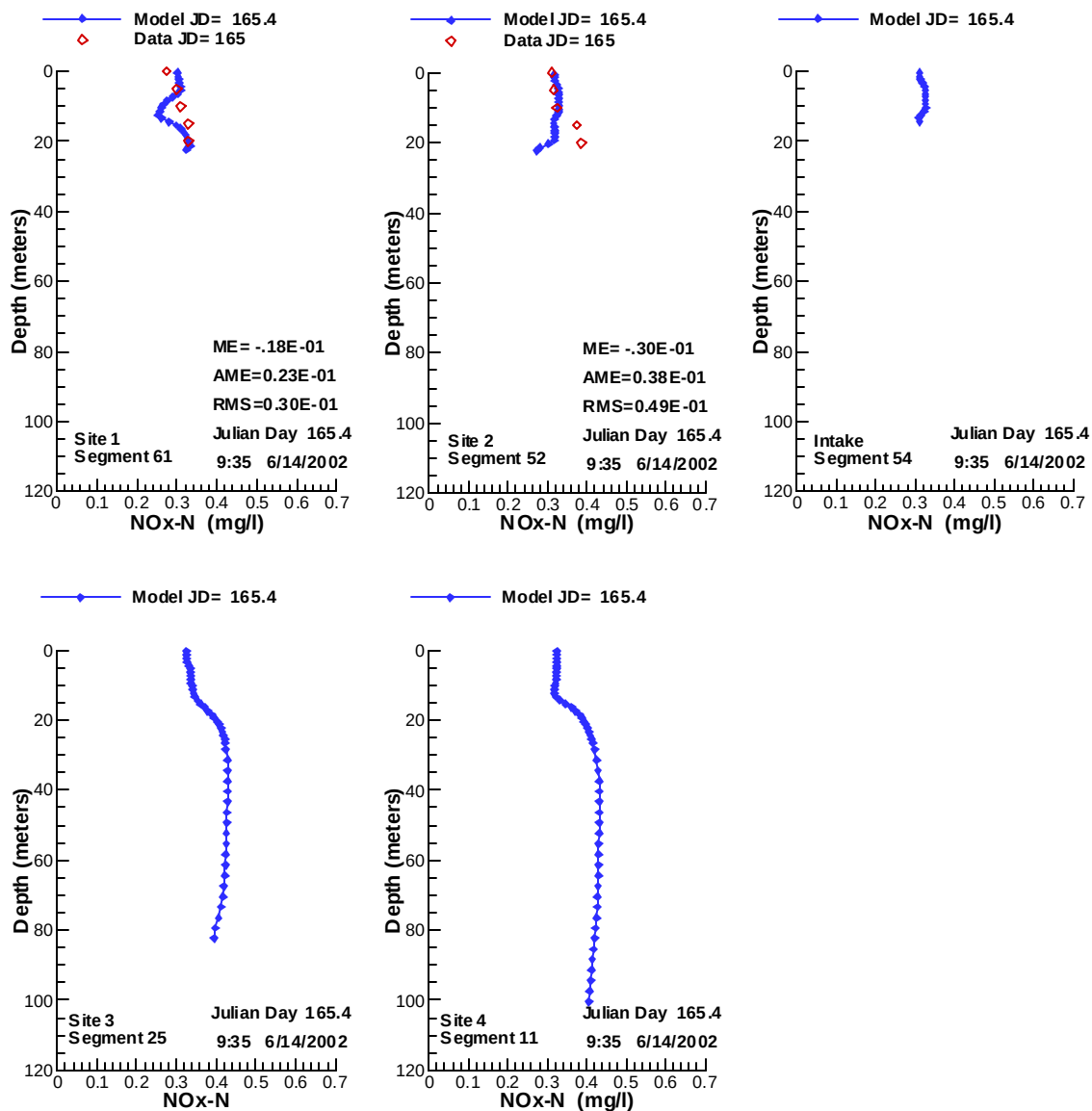


Figure 249. Vertical profiles of NOx-N compared with data for 6/14/2002.

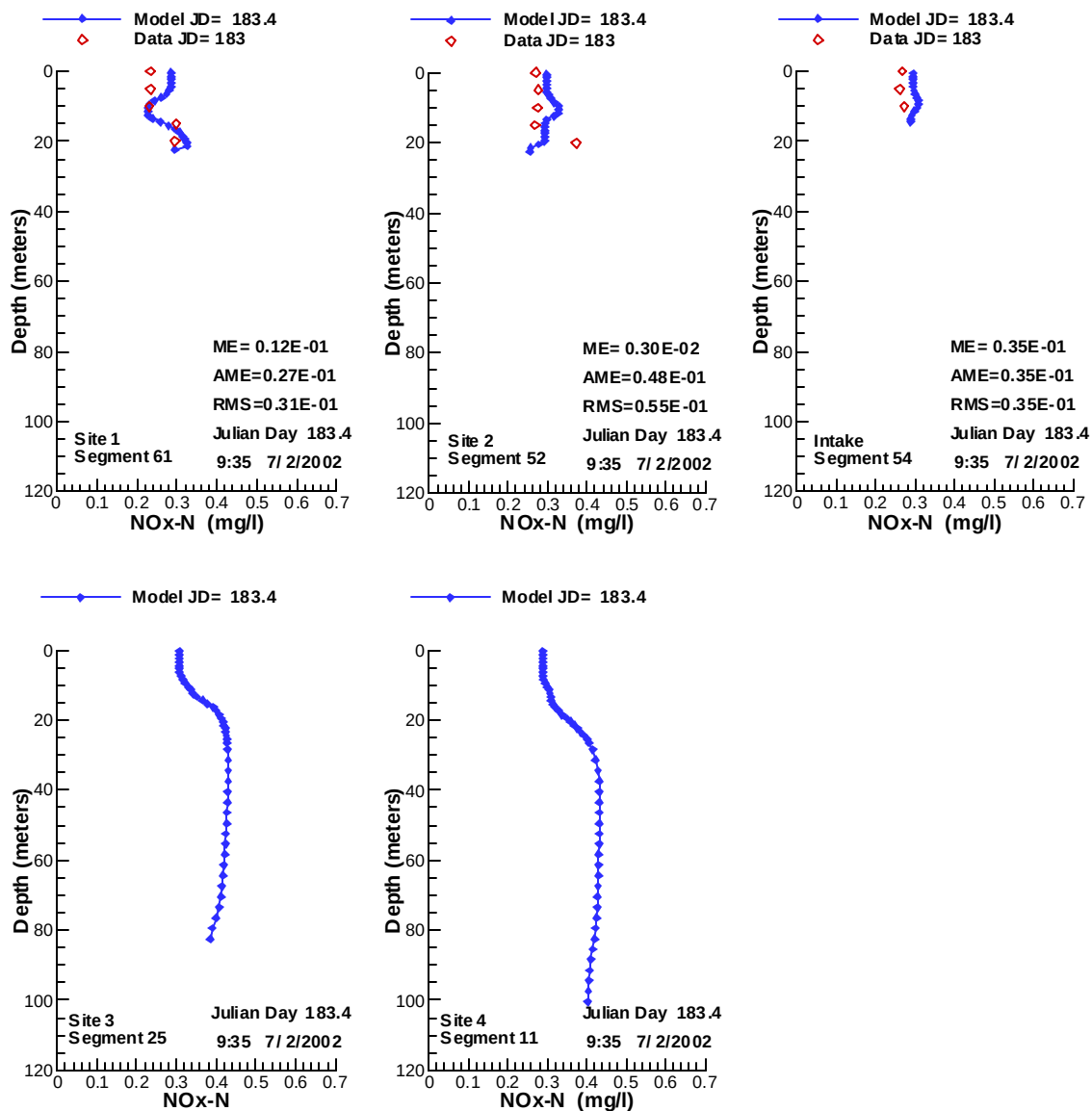


Figure 250. Vertical profiles of NOx-N compared with data for 7/ 2/2002.

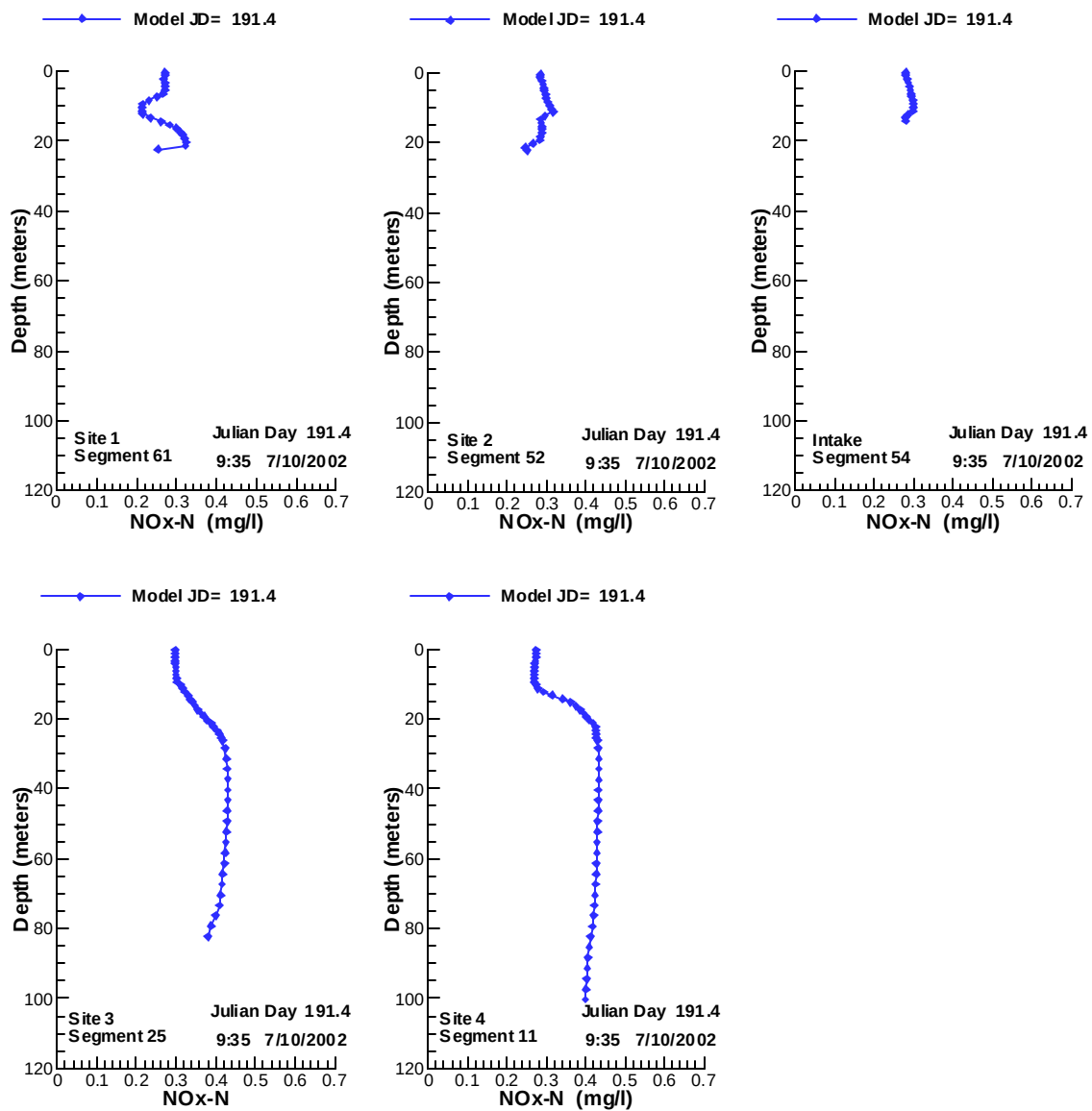


Figure 251. Vertical profiles of NOx-N compared with data for 7/10/2002.

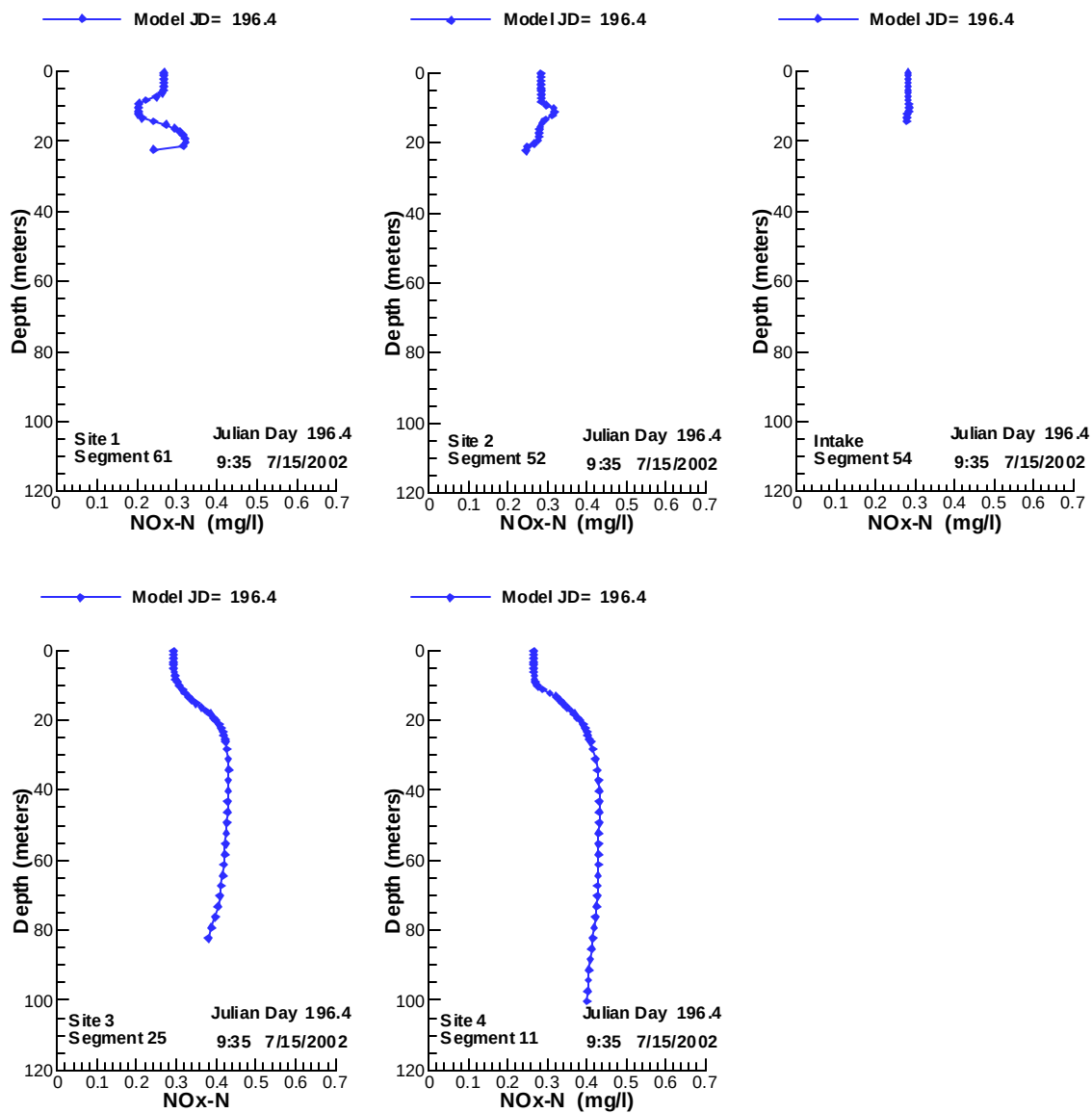


Figure 252. Vertical profiles of NOx-N compared with data for 7/15/2002.

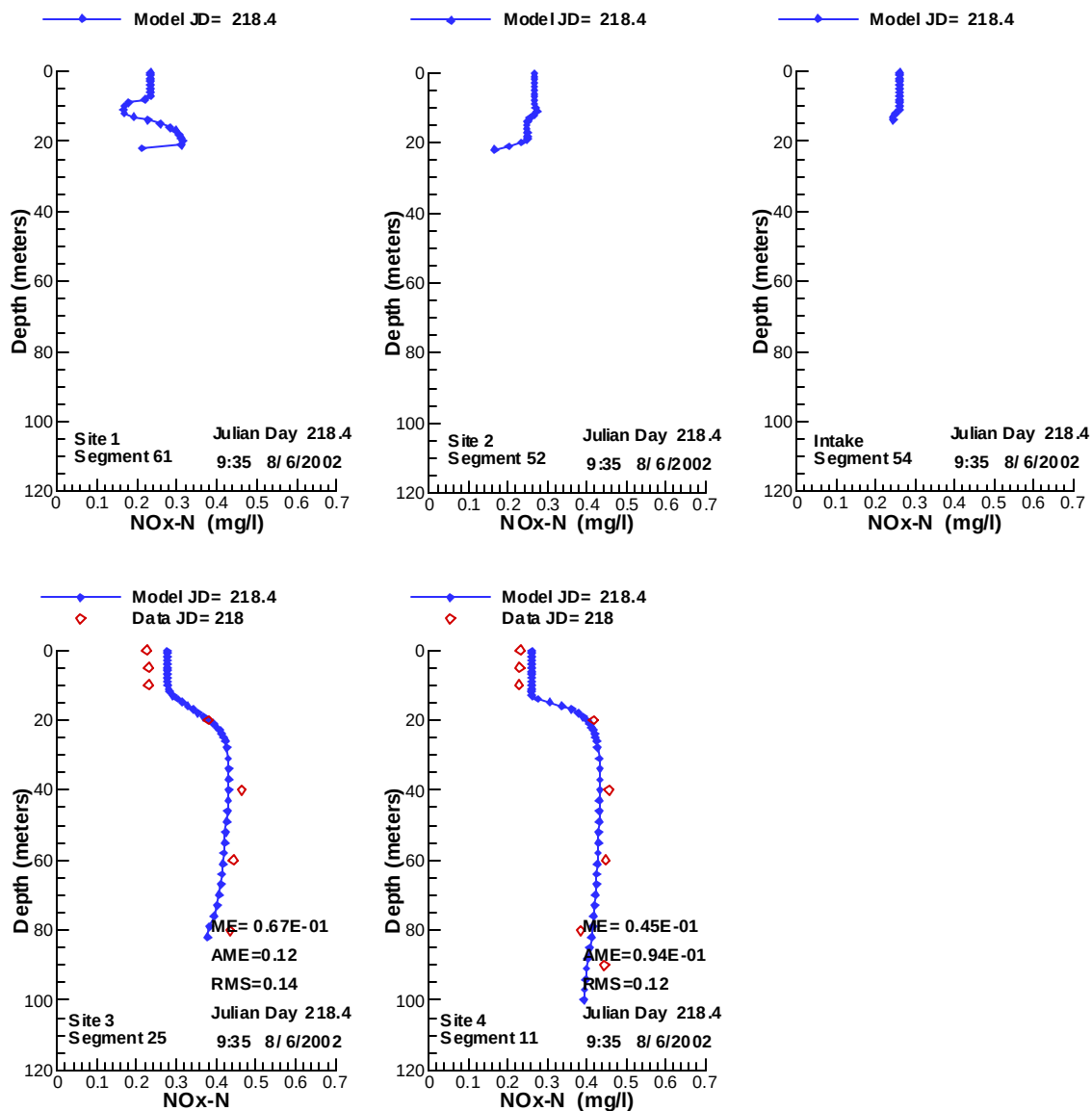


Figure 253. Vertical profiles of NOx-N compared with data for 8/ 6/2002.

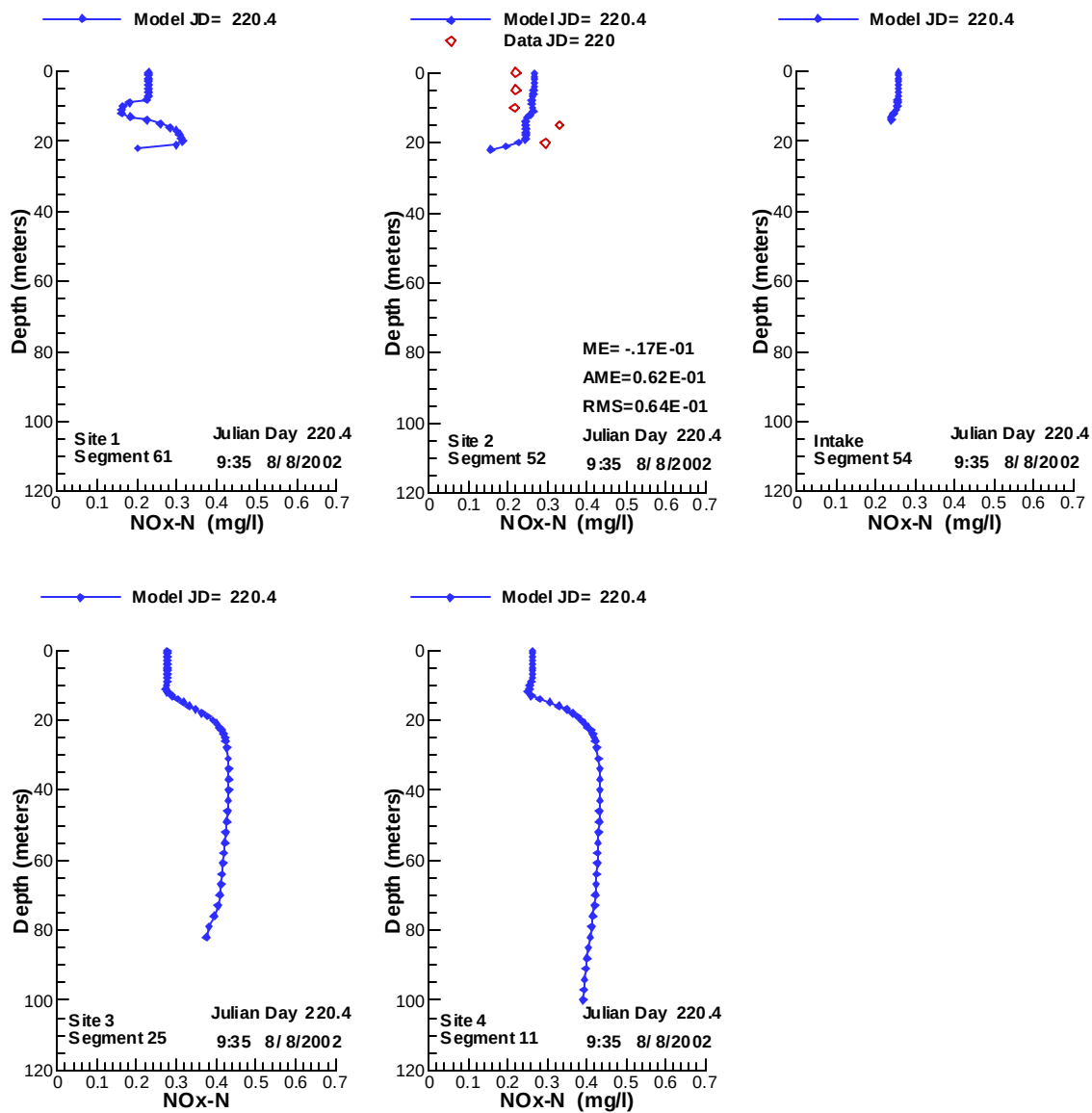


Figure 254. Vertical profiles of NOx-N compared with data for 8/ 8/2002.

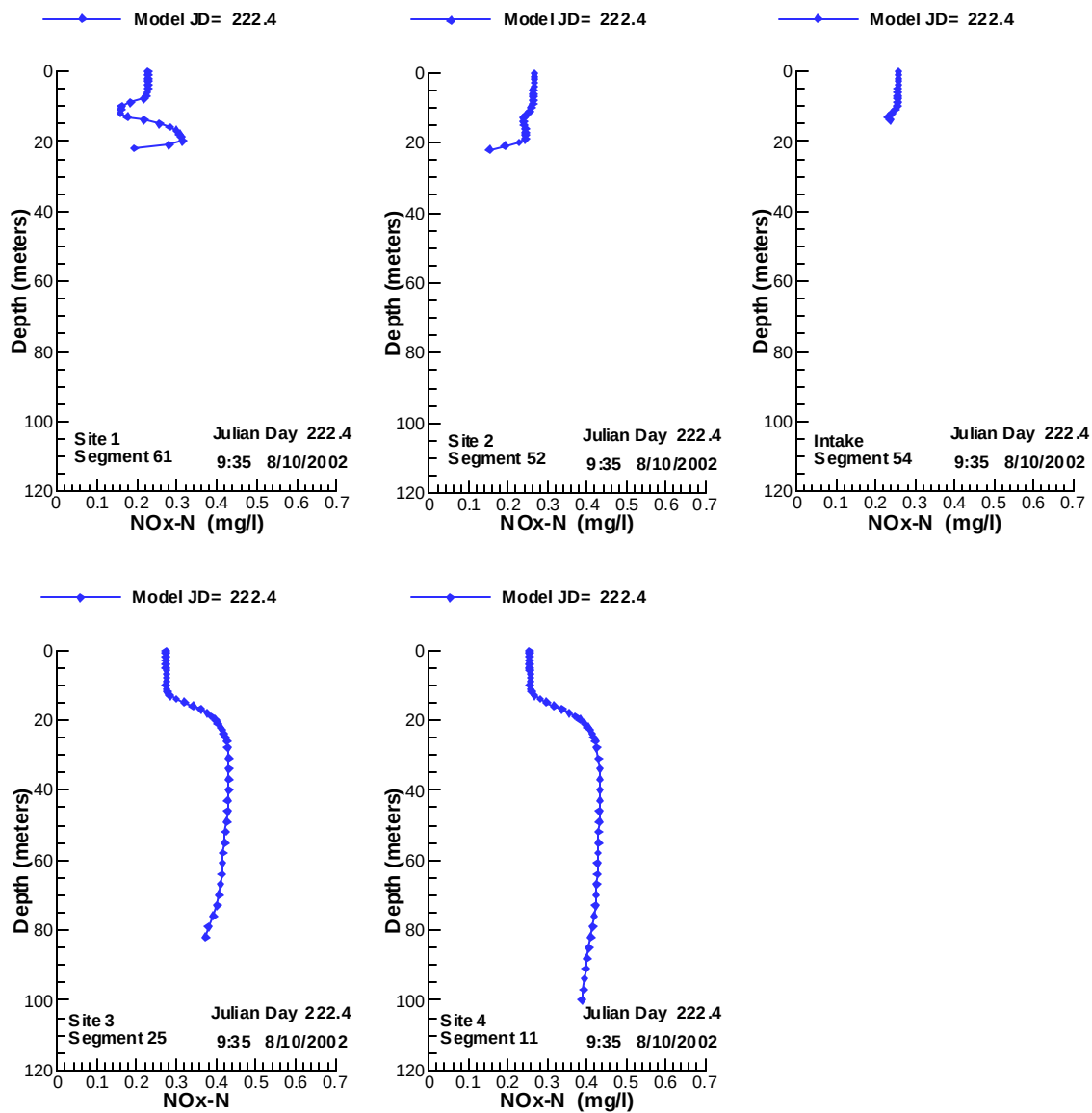


Figure 255. Vertical profiles of NOx-N compared with data for 8/10/2002.

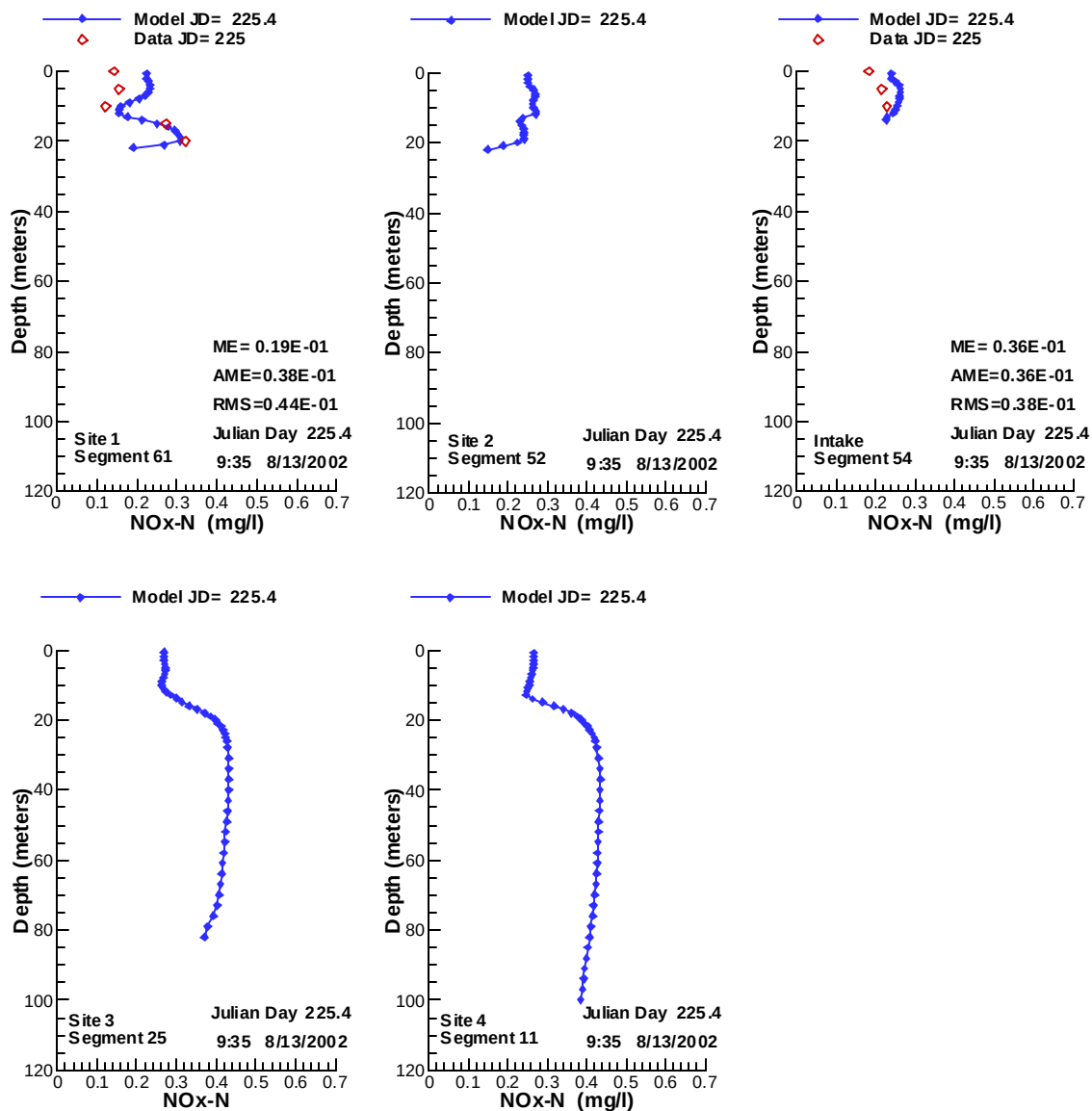


Figure 256. Vertical profiles of NOx-N compared with data for 8/13/2002.

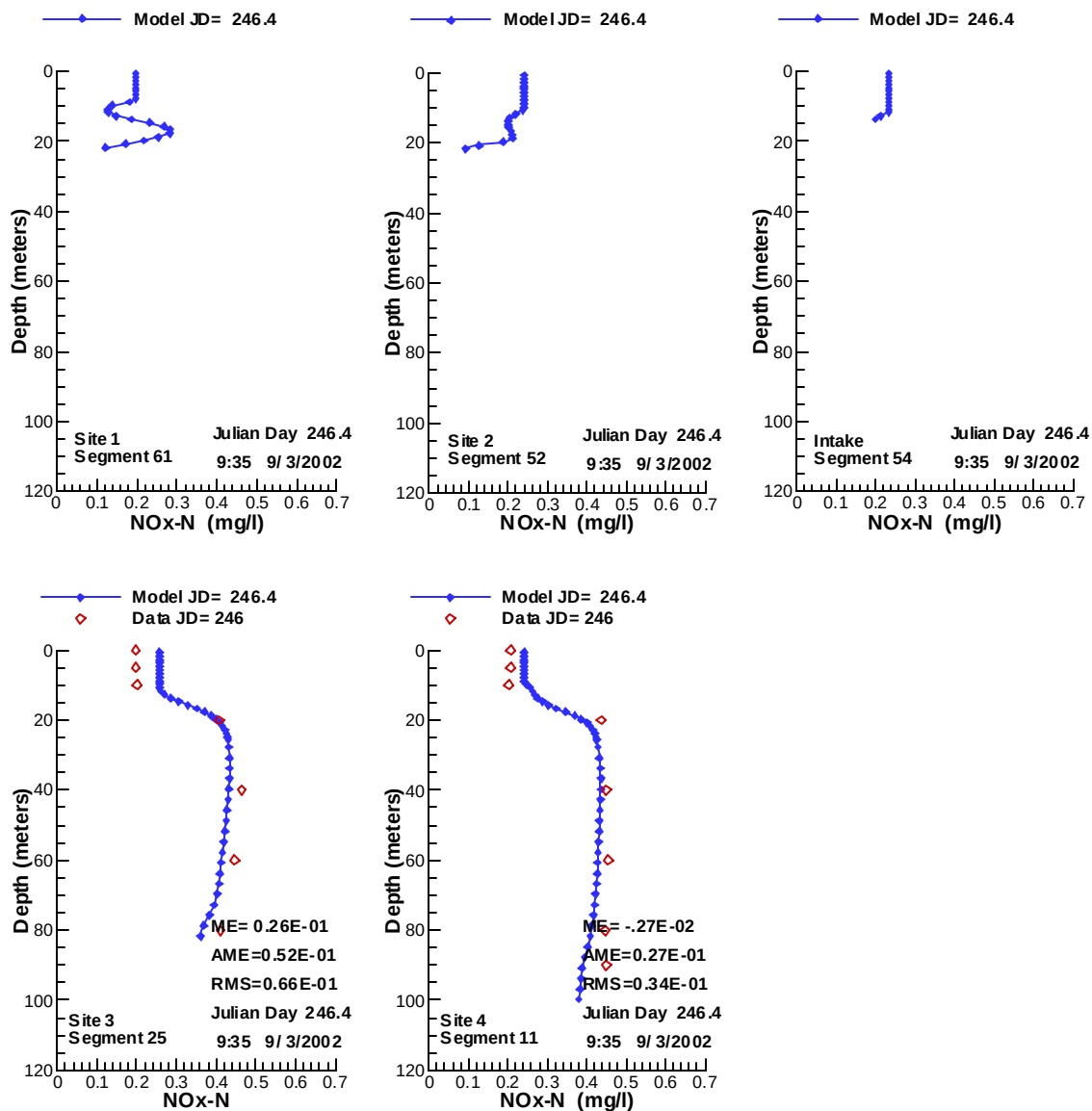


Figure 257. Vertical profiles of NOx-N compared with data for 9/ 3/2002.

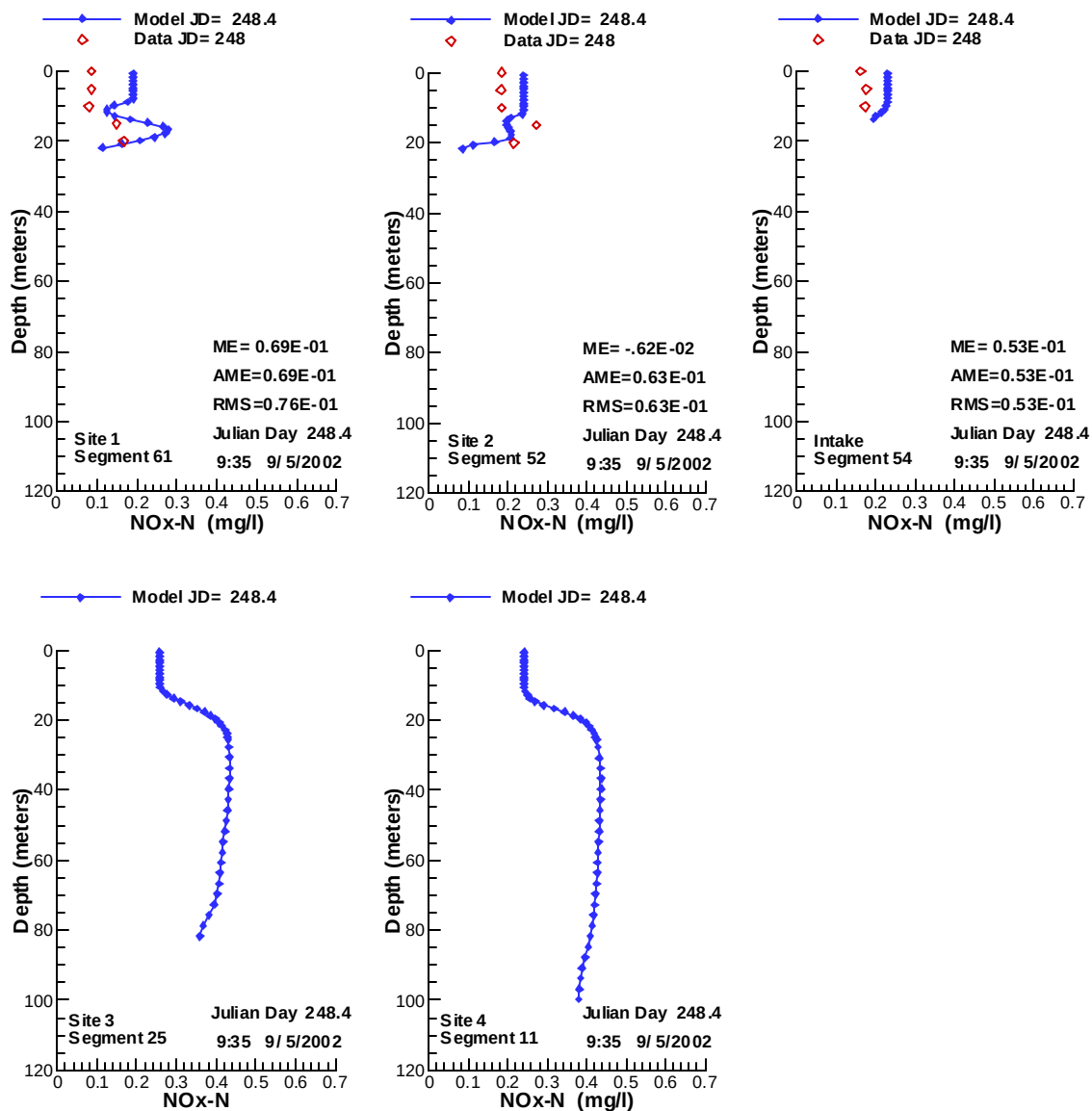


Figure 258. Vertical profiles of NOx-N compared with data for 9/ 5/2002.

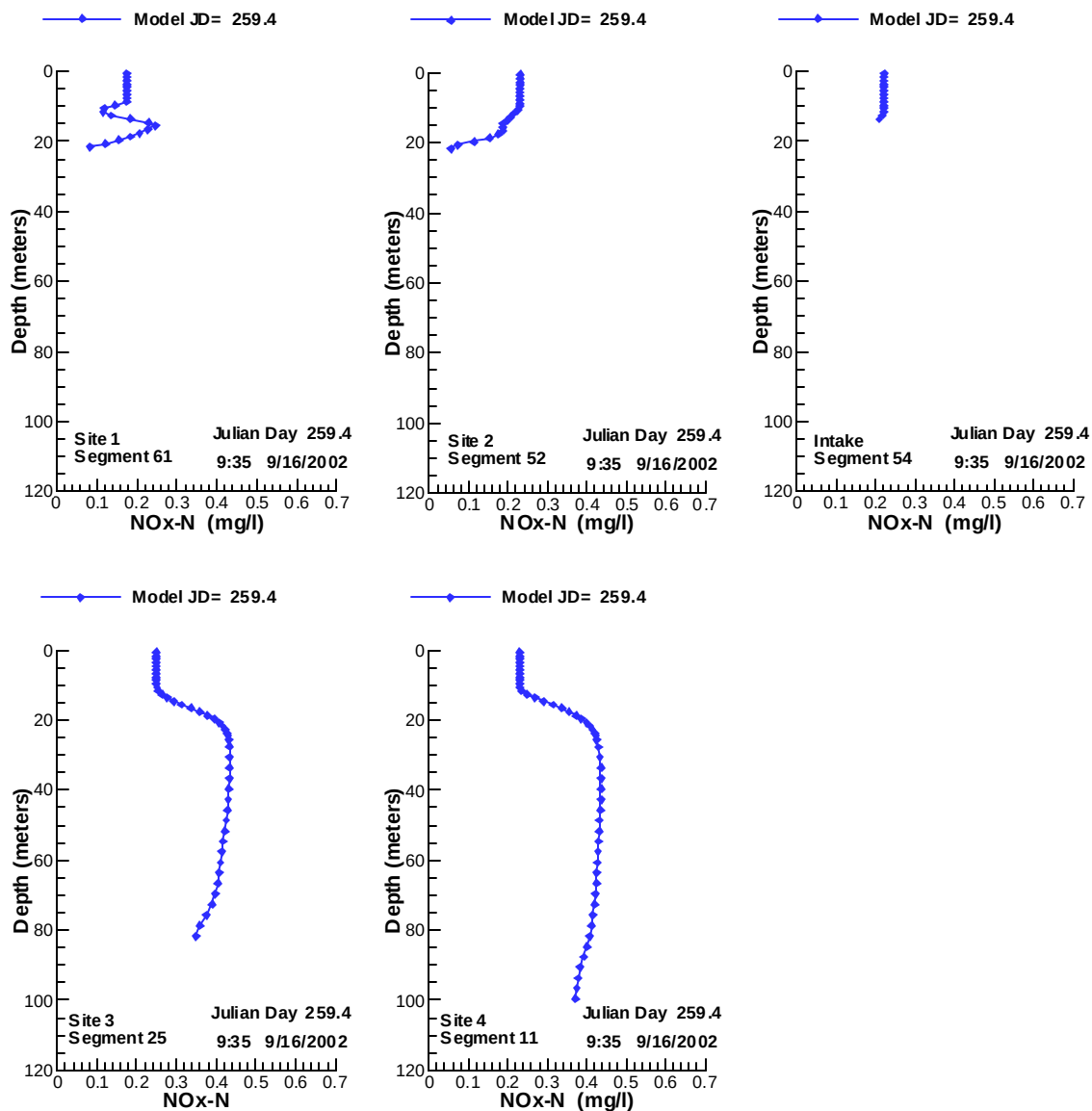


Figure 259. Vertical profiles of NOx-N compared with data for 9/16/2002.

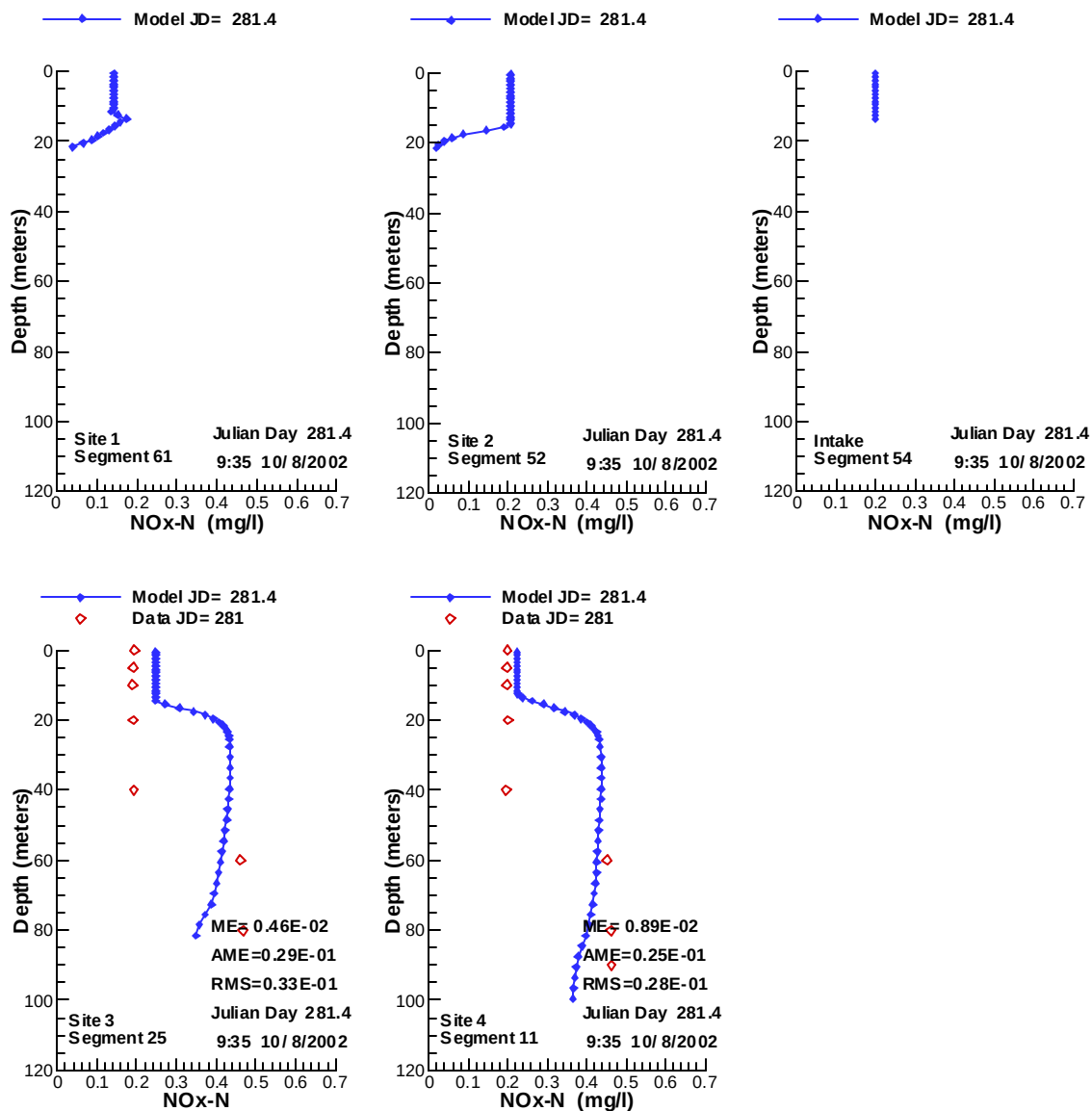


Figure 260. Vertical profiles of NOx-N compared with data for 10/ 8/2002.

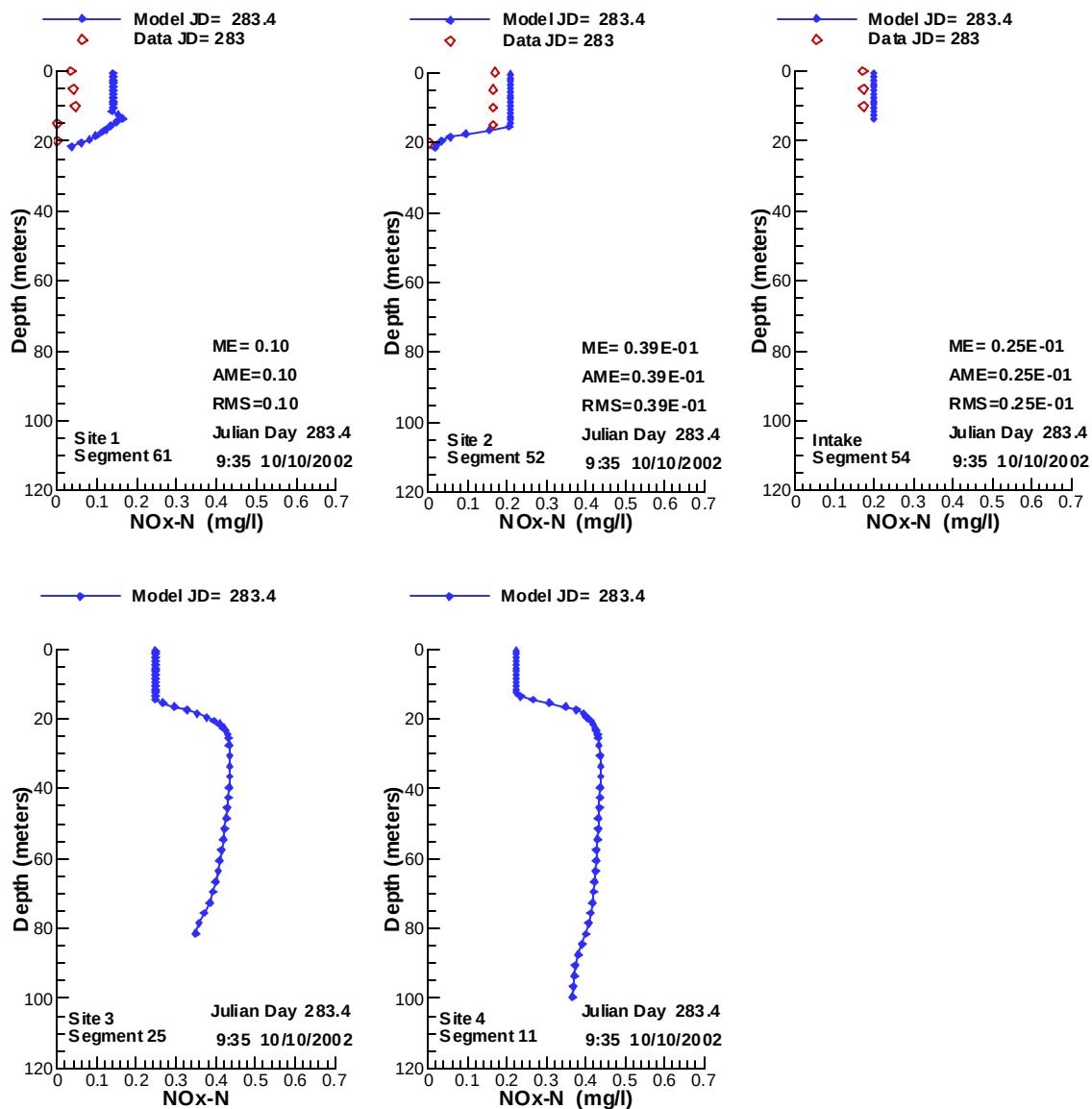


Figure 261. Vertical profiles of NOx-N compared with data for 10/10/2002.

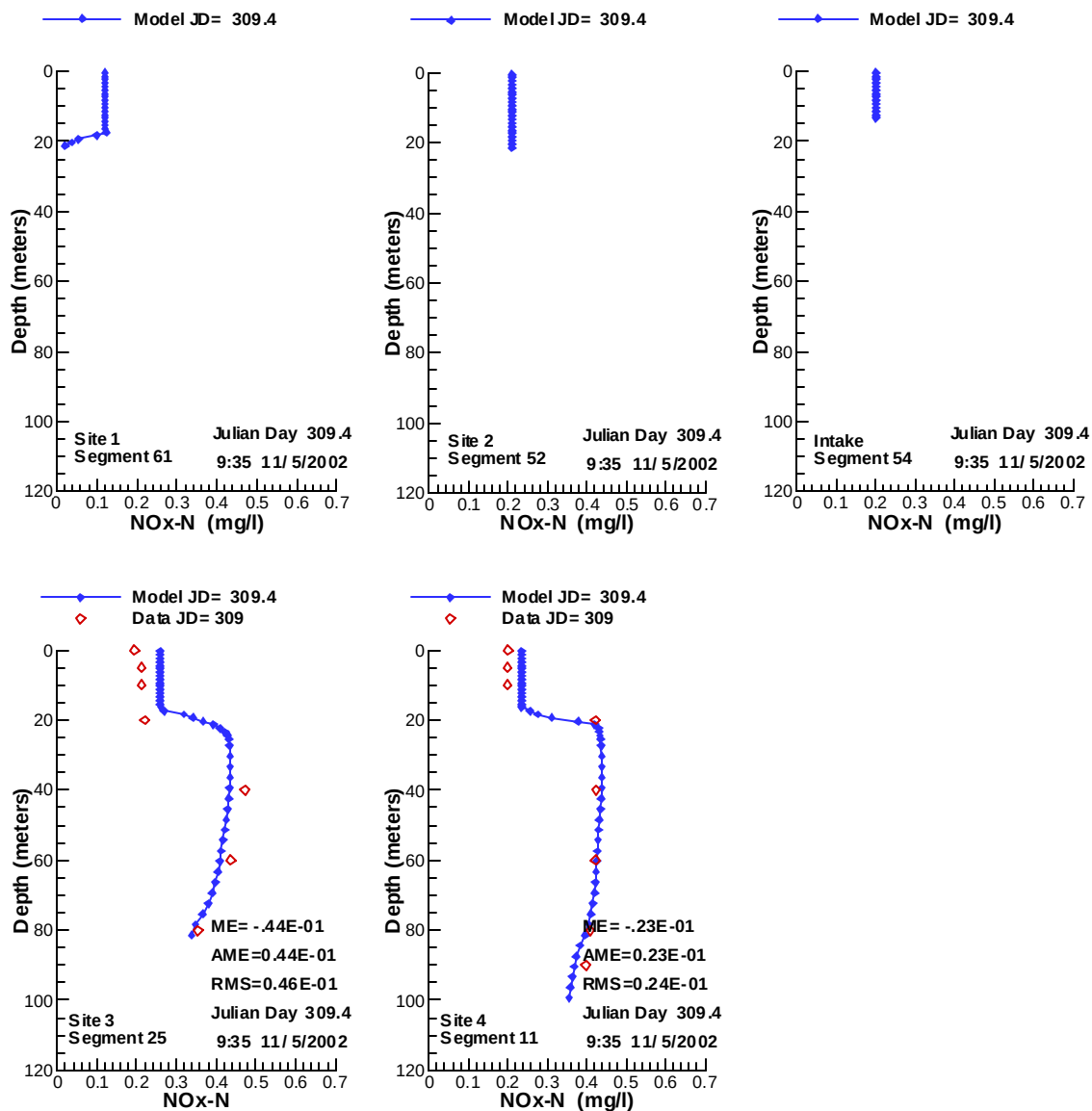


Figure 262. Vertical profiles of NOx-N compared with data for 11/ 5/2002.

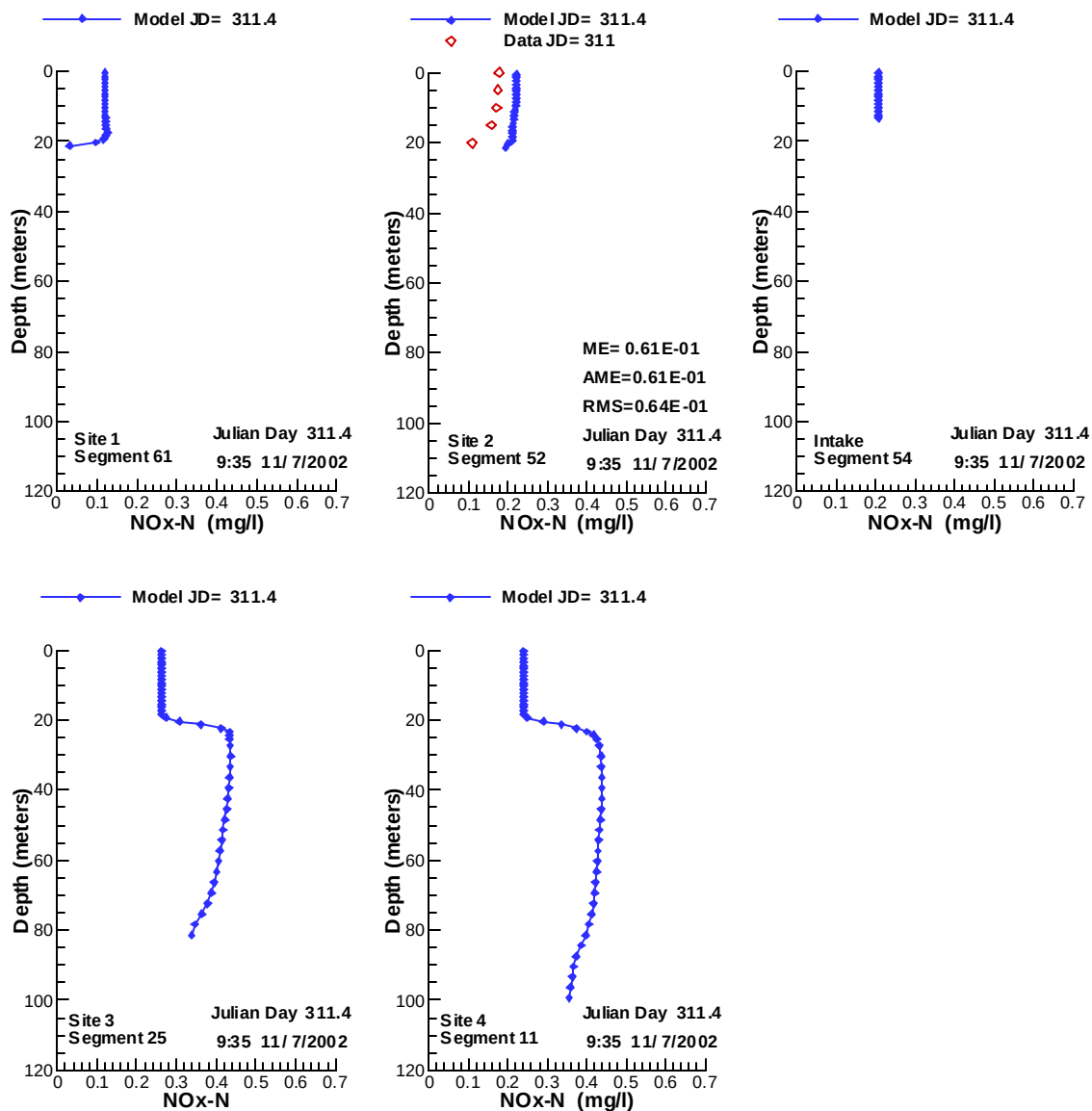


Figure 263. Vertical profiles of NOx-N compared with data for 11/ 7/2002.

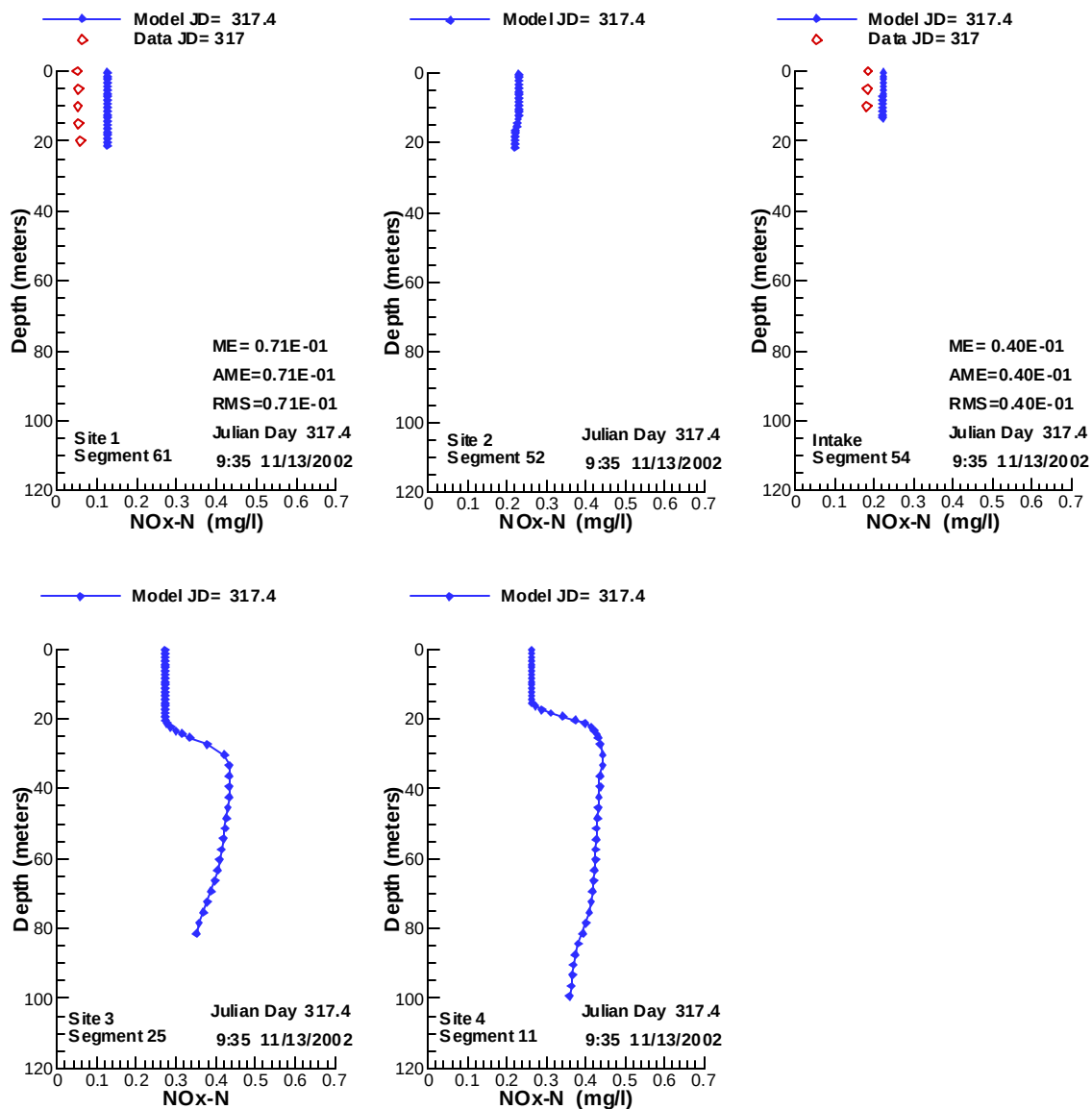


Figure 264. Vertical profiles of NOx-N compared with data for 11/13/2002.

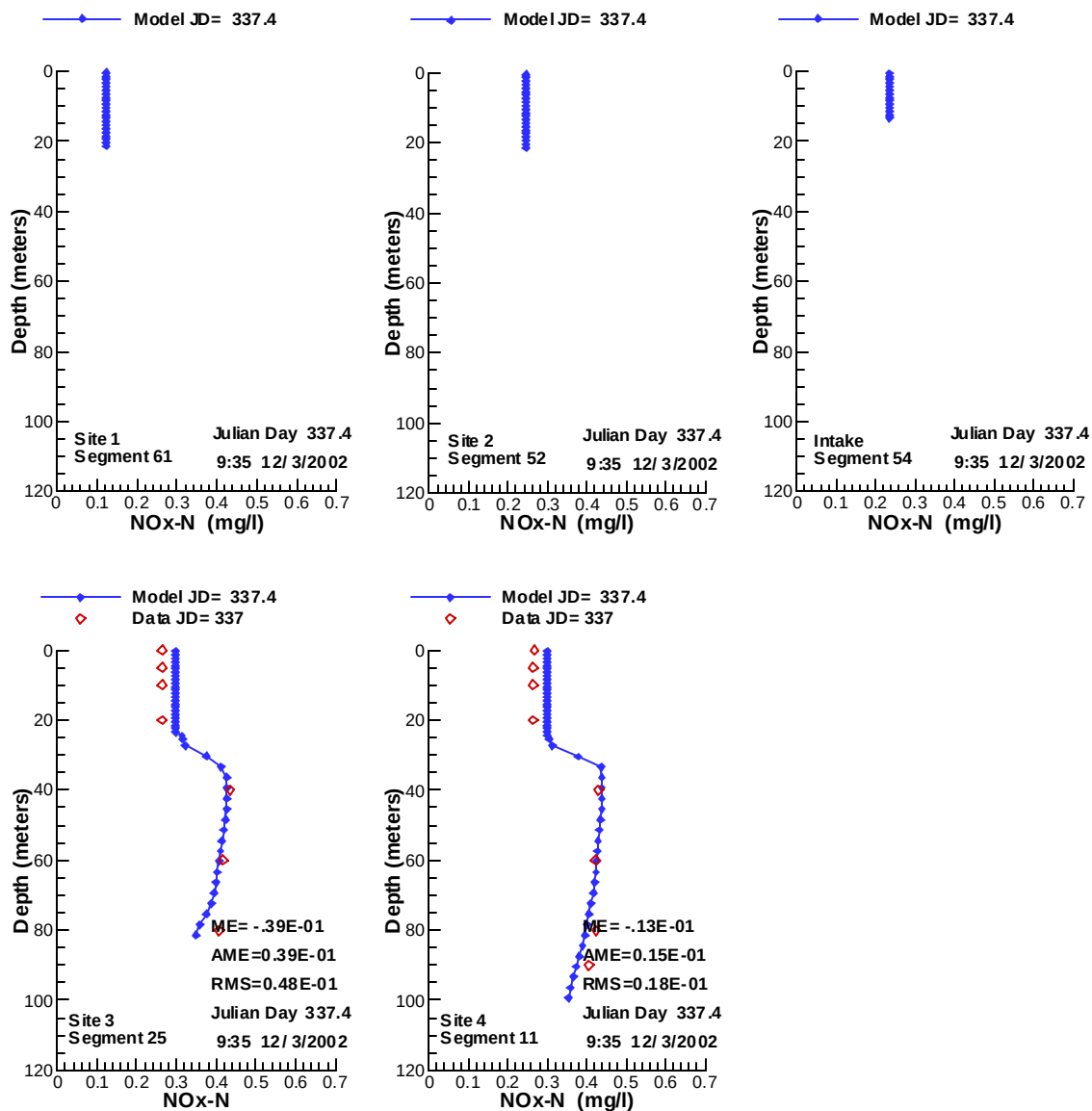


Figure 265. Vertical profiles of NOx-N compared with data for 12/ 3/2002.

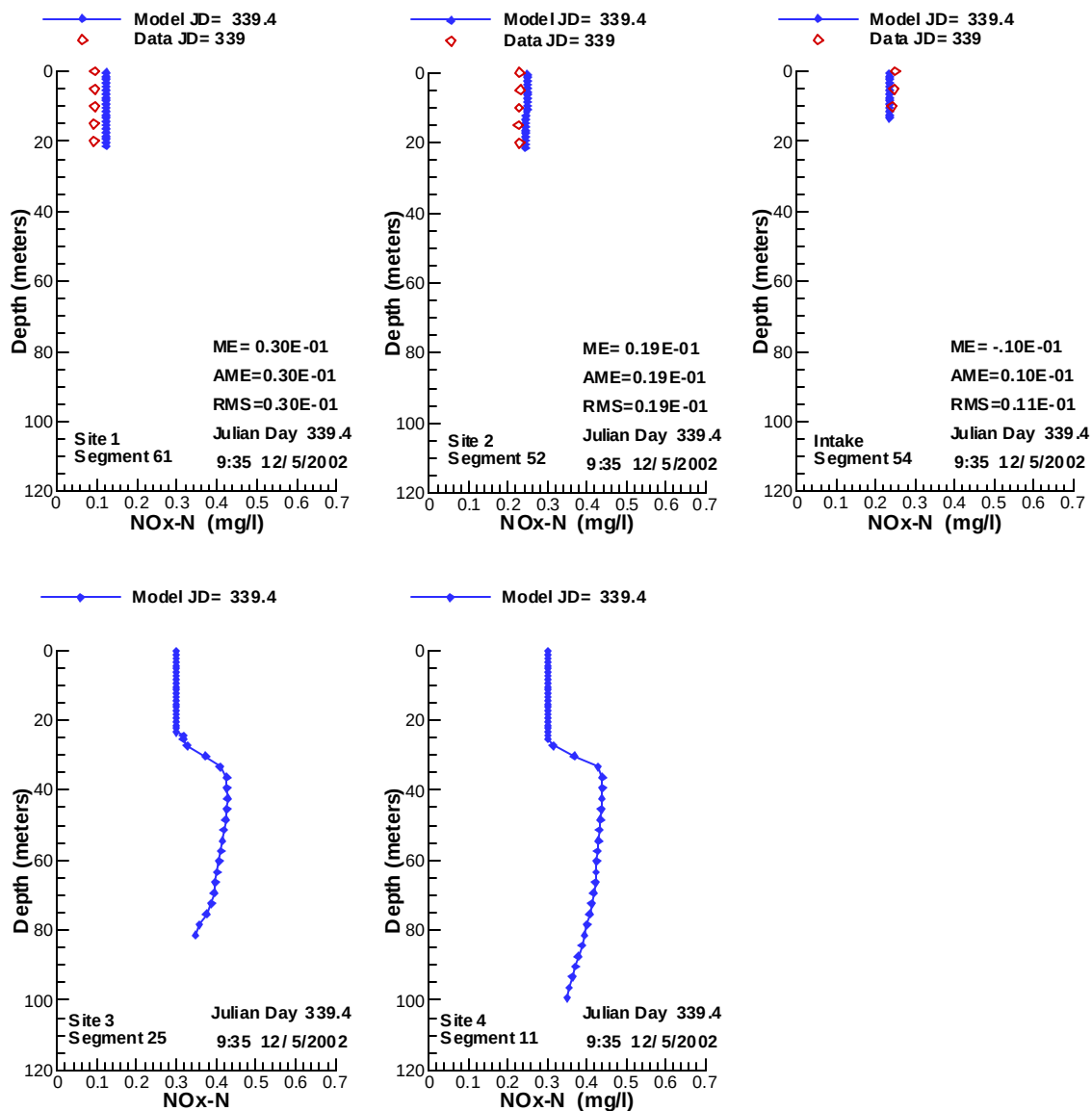


Figure 266. Vertical profiles of NOx-N compared with data for 12/ 5/2002.

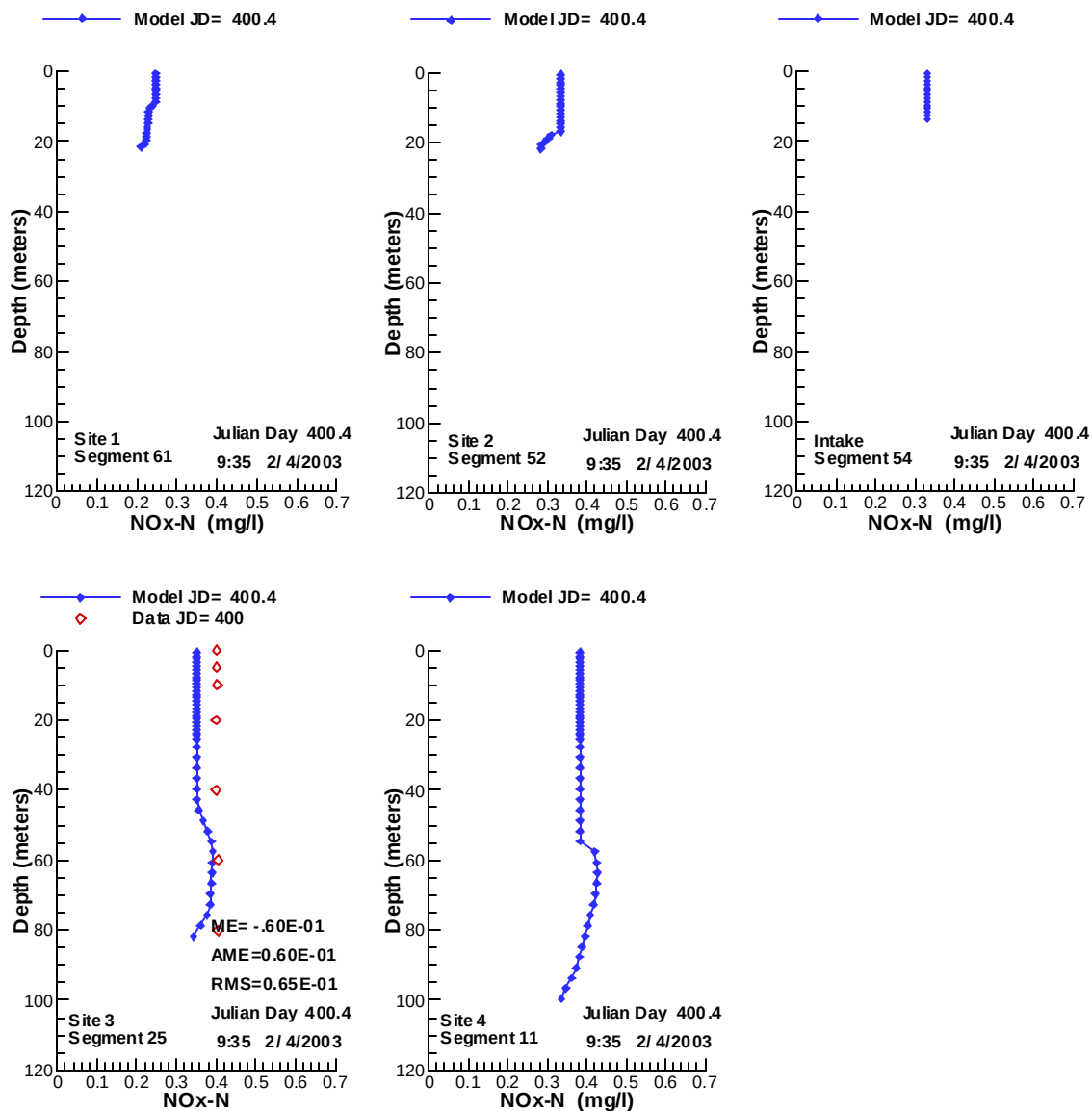


Figure 267. Vertical profiles of NOx-N compared with data for 2/ 4/2003.

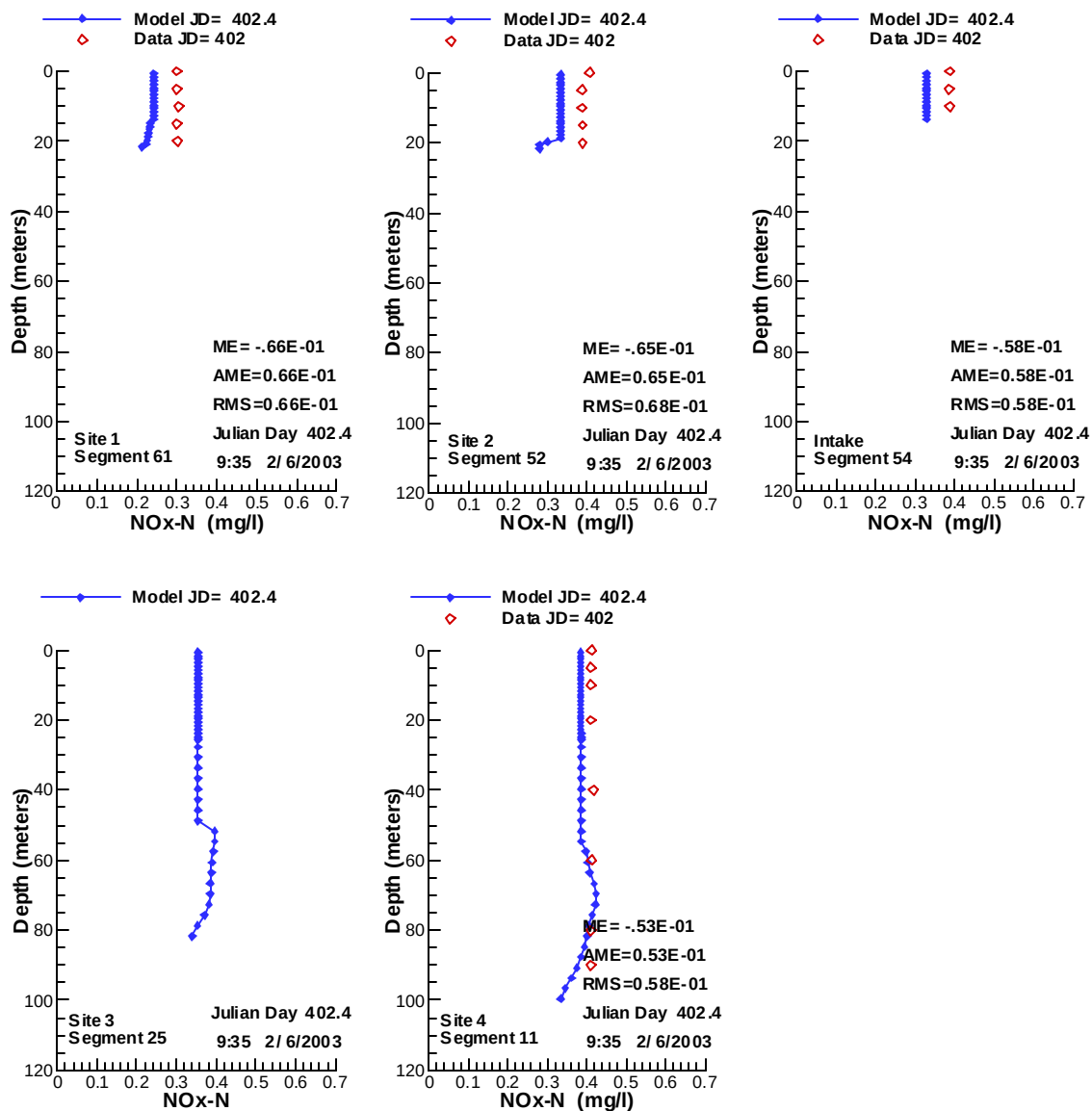


Figure 268. Vertical profiles of NOx-N compared with data for 2/ 6/2003.

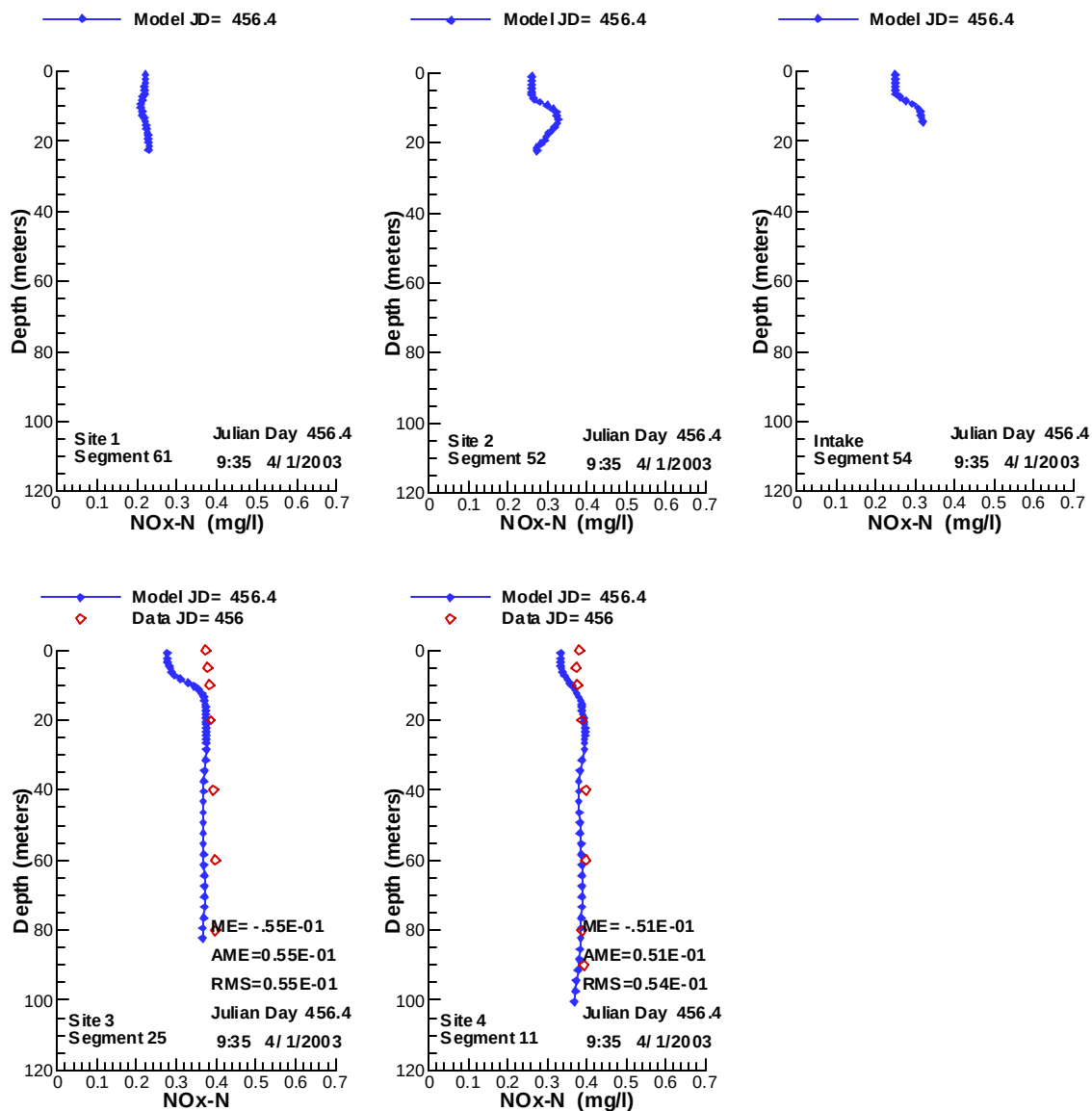


Figure 269. Vertical profiles of NOx-N compared with data for 4/ 1/2003.

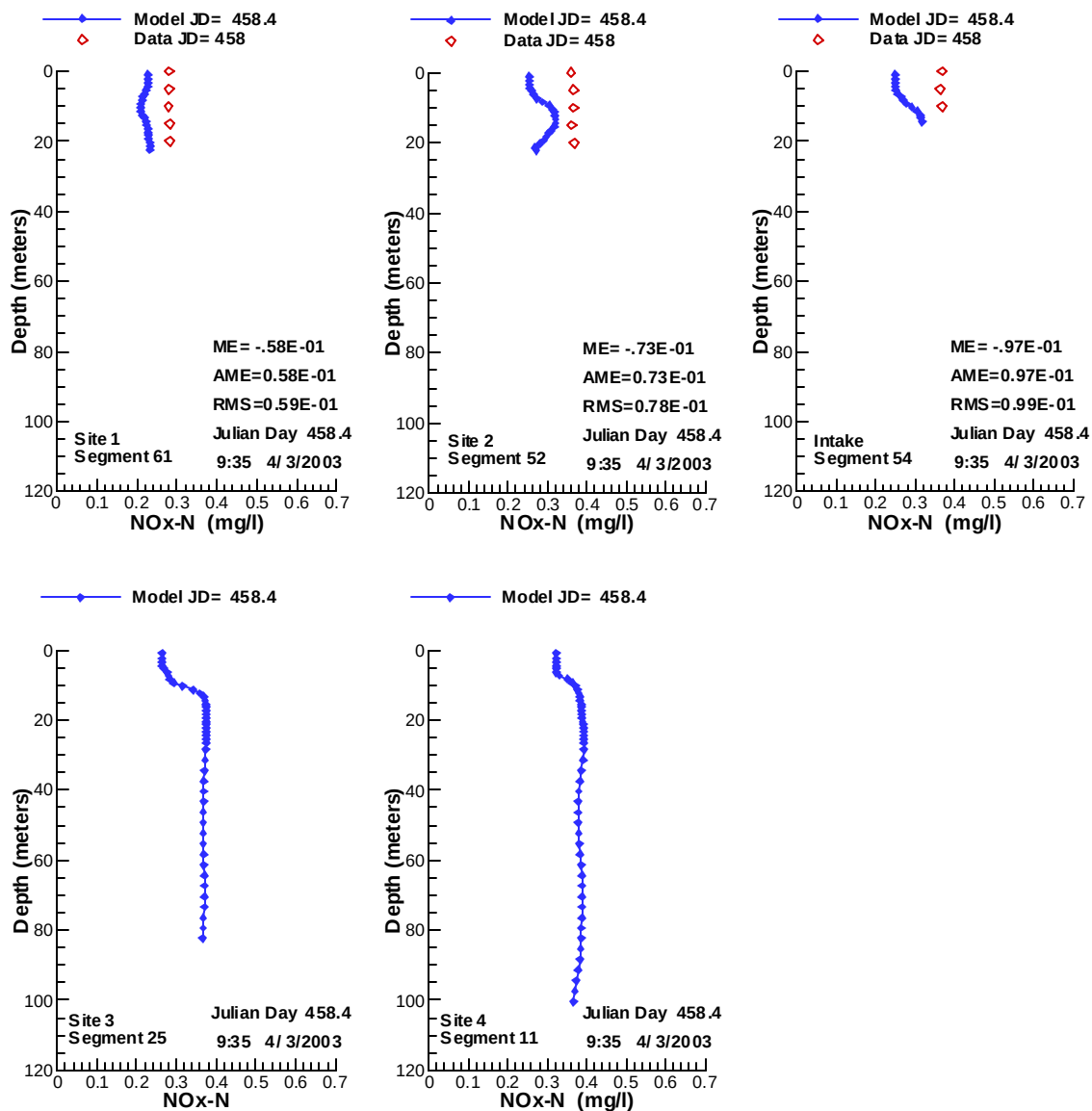


Figure 270. Vertical profiles of NOx-N compared with data for 4/ 3/2003.

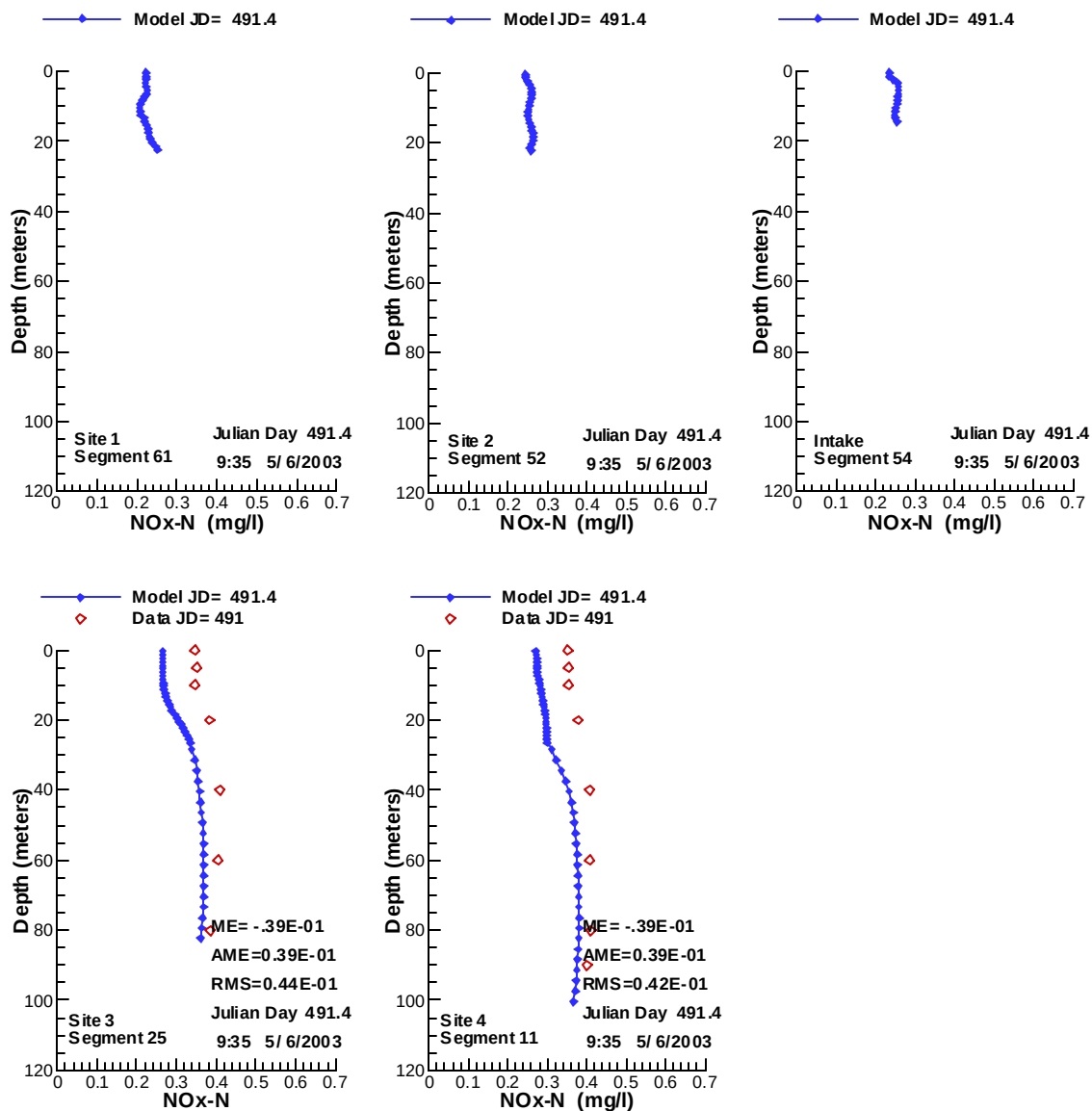


Figure 271. Vertical profiles of NOx-N compared with data for 5/ 6/2003.

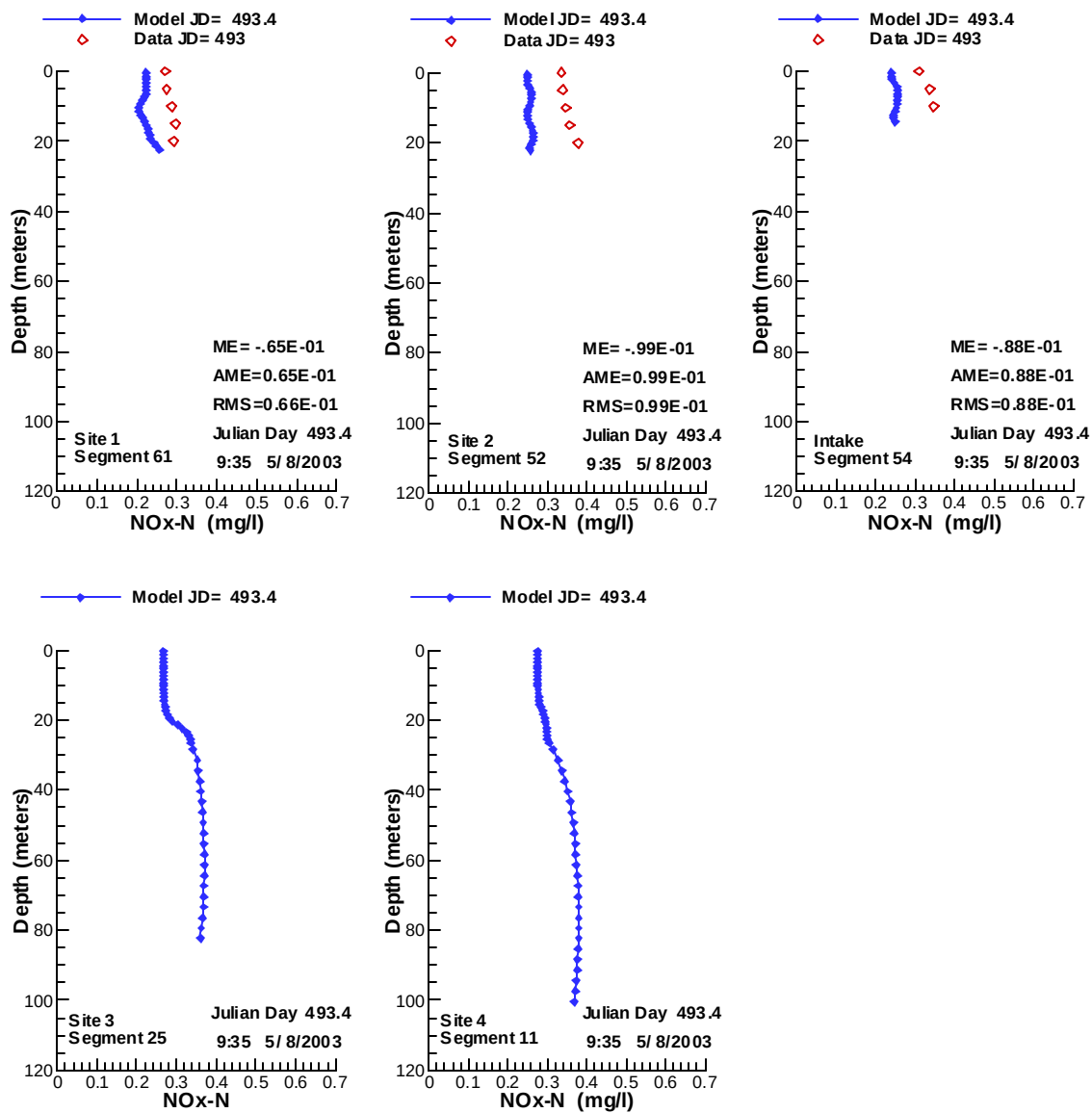


Figure 272. Vertical profiles of NOx-N compared with data for 5/ 8/2003.

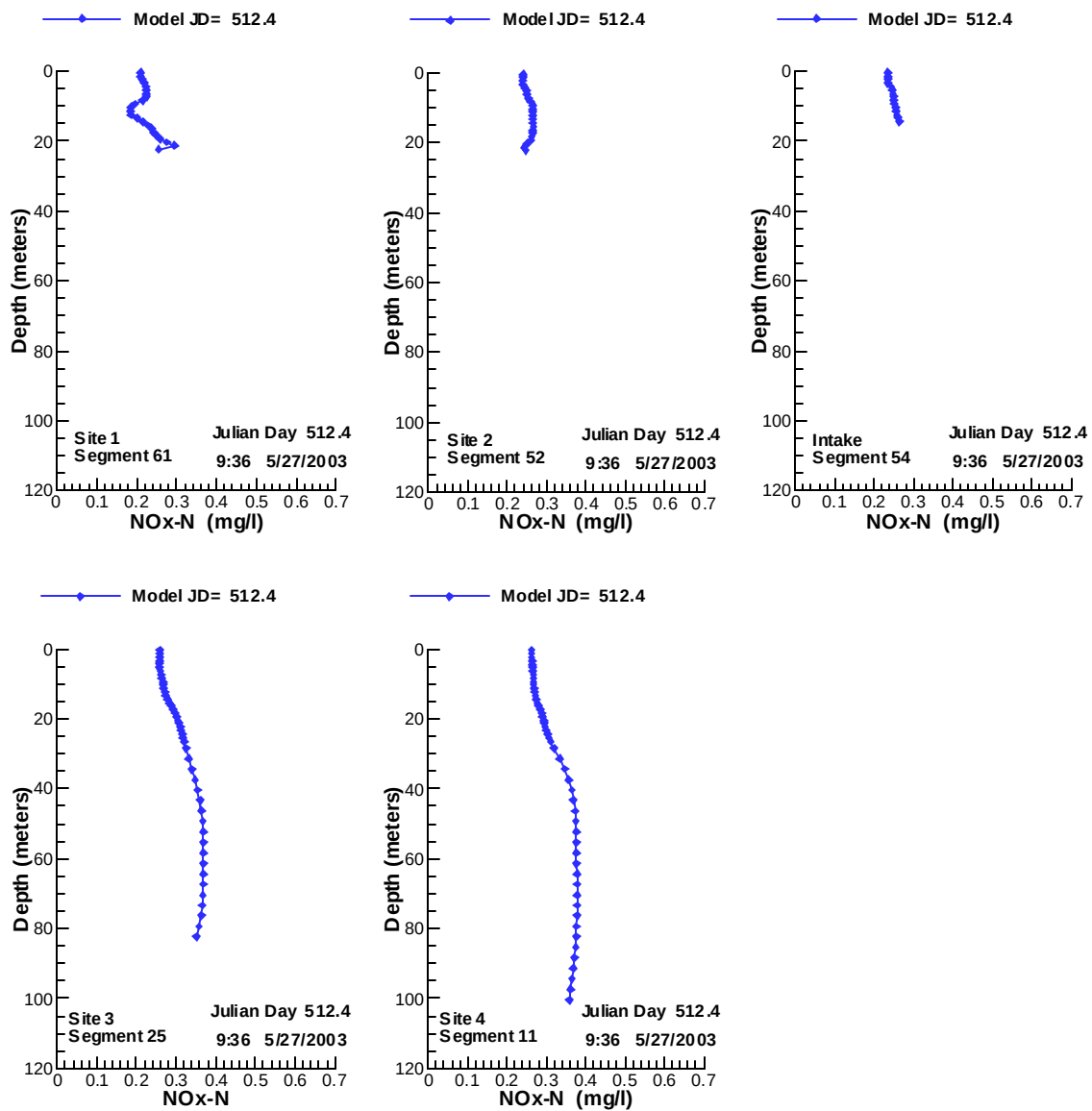


Figure 273. Vertical profiles of NOx-N compared with data for 5/27/2003.

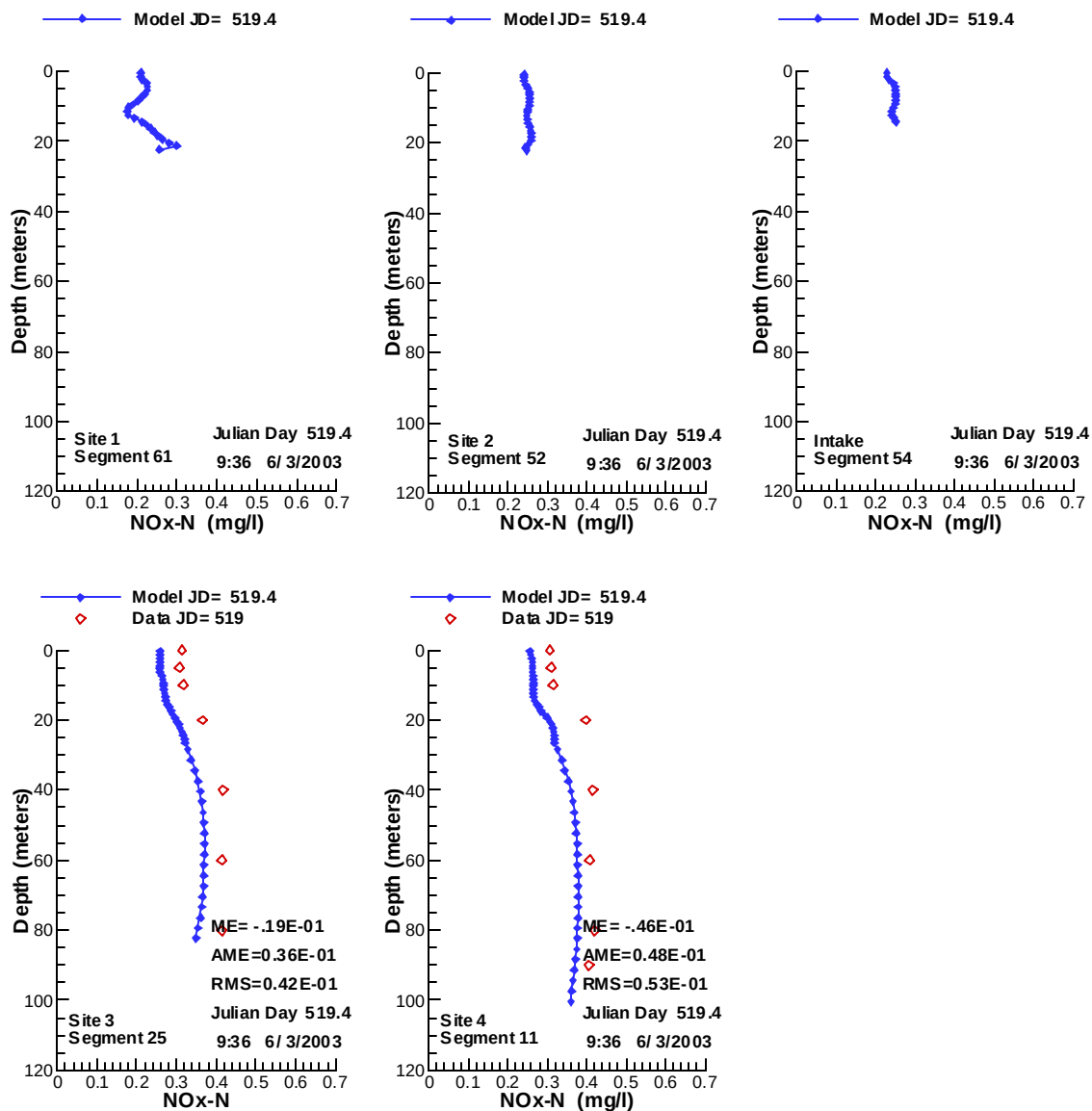


Figure 274. Vertical profiles of NOx-N compared with data for 6/ 3/2003.

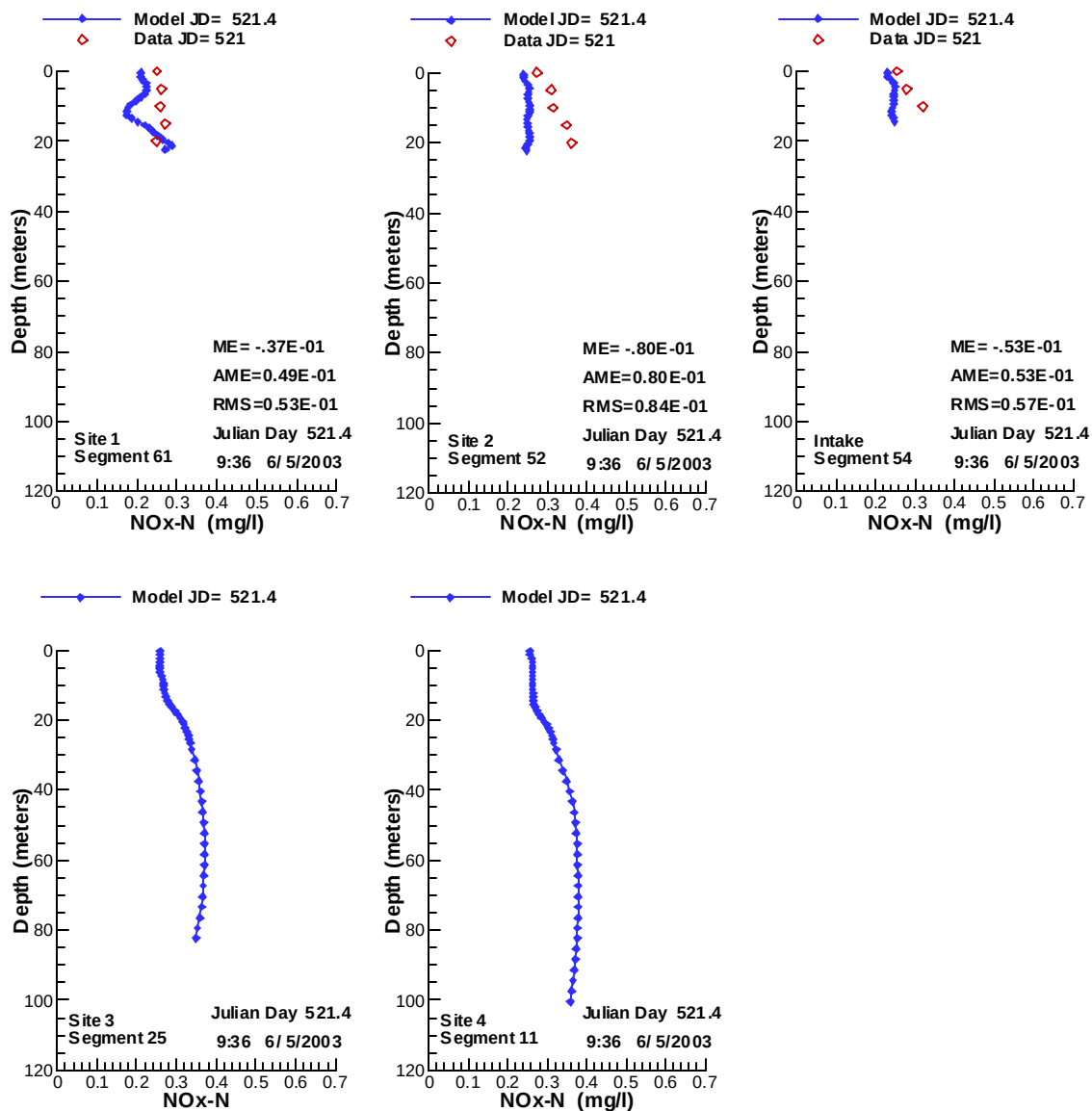


Figure 275. Vertical profiles of NOx-N compared with data for 6/ 5/2003.

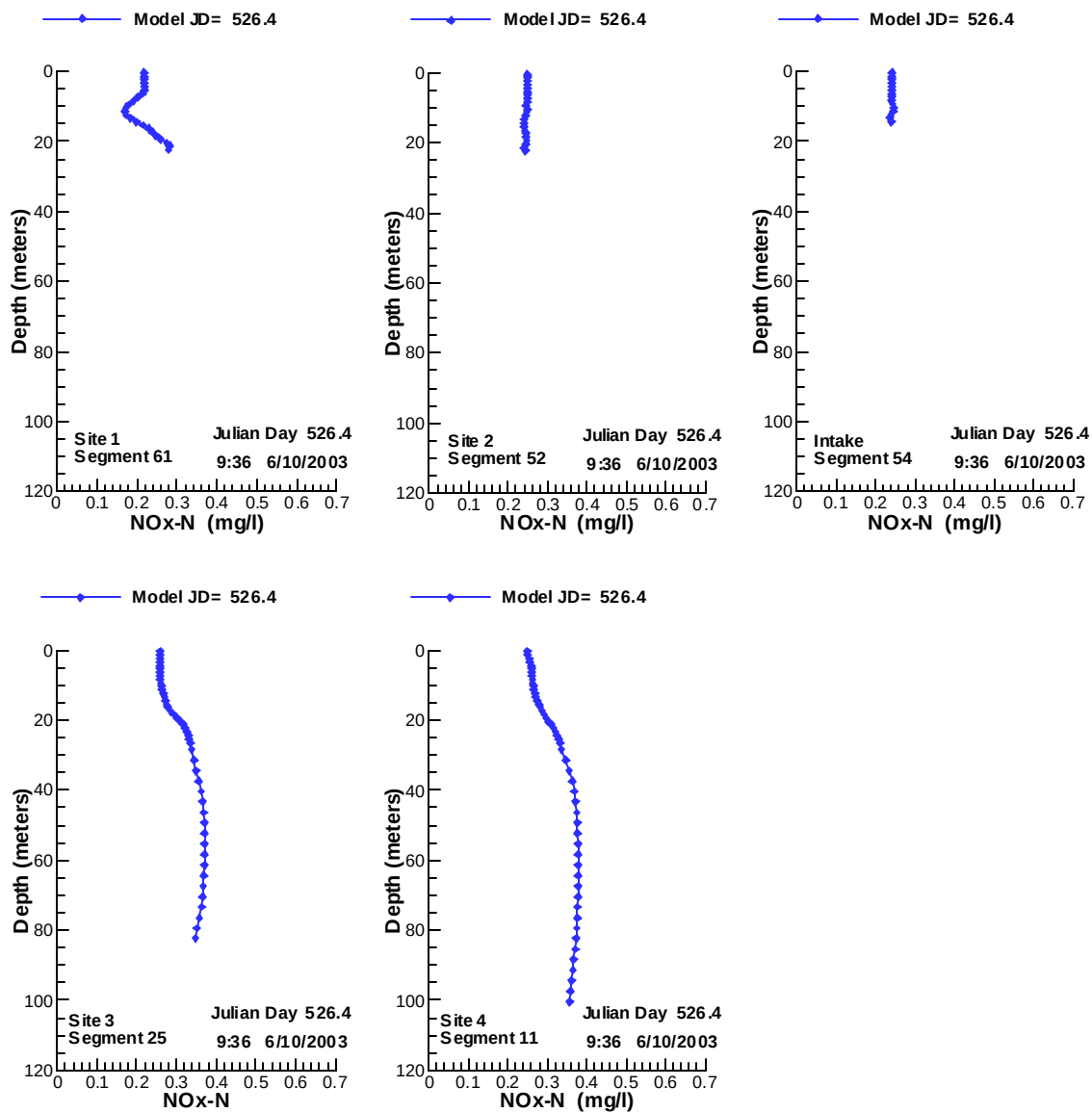


Figure 276. Vertical profiles of NOx-N compared with data for 6/10/2003.

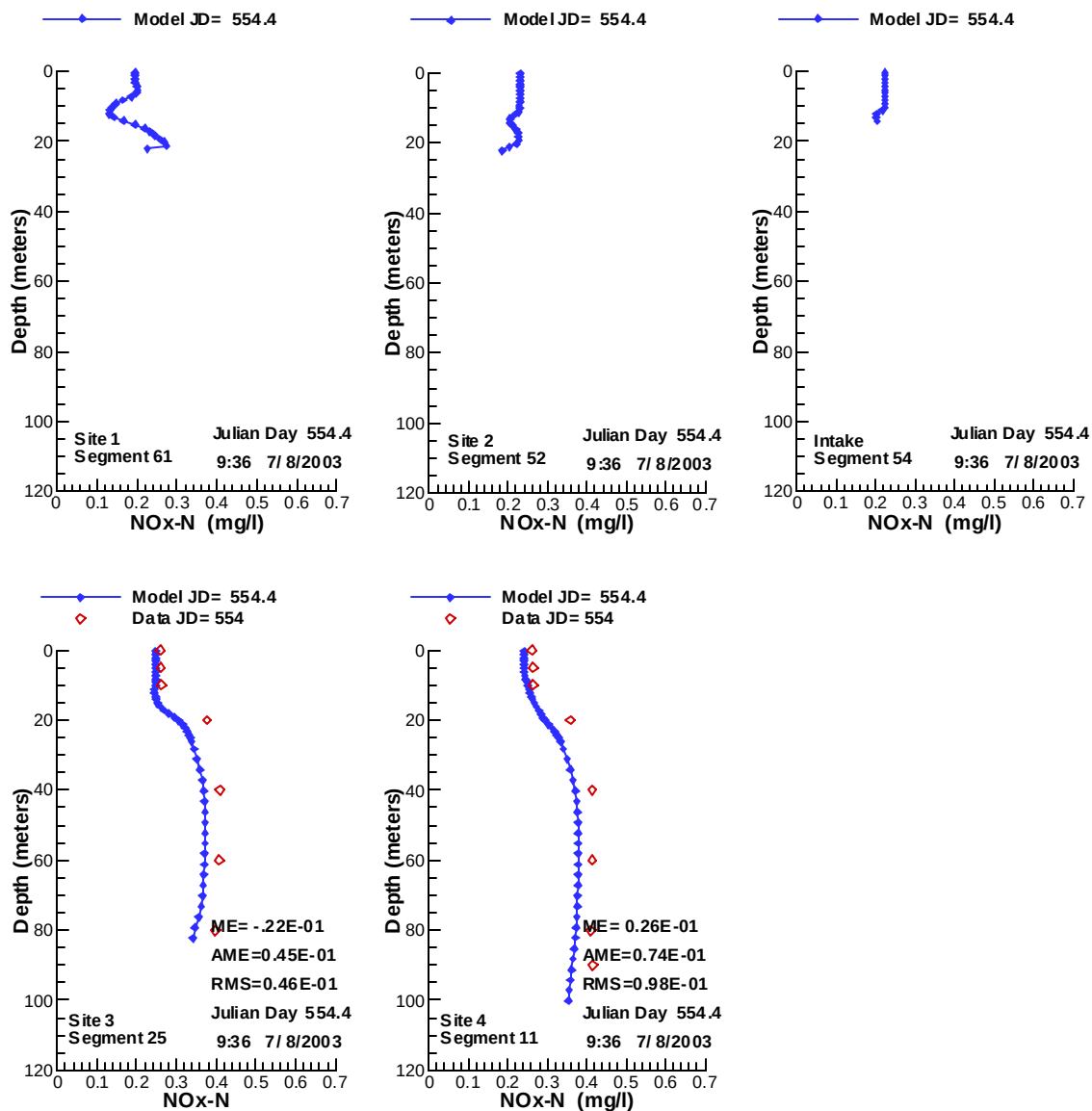


Figure 277. Vertical profiles of NOx-N compared with data for 7/ 8/2003.

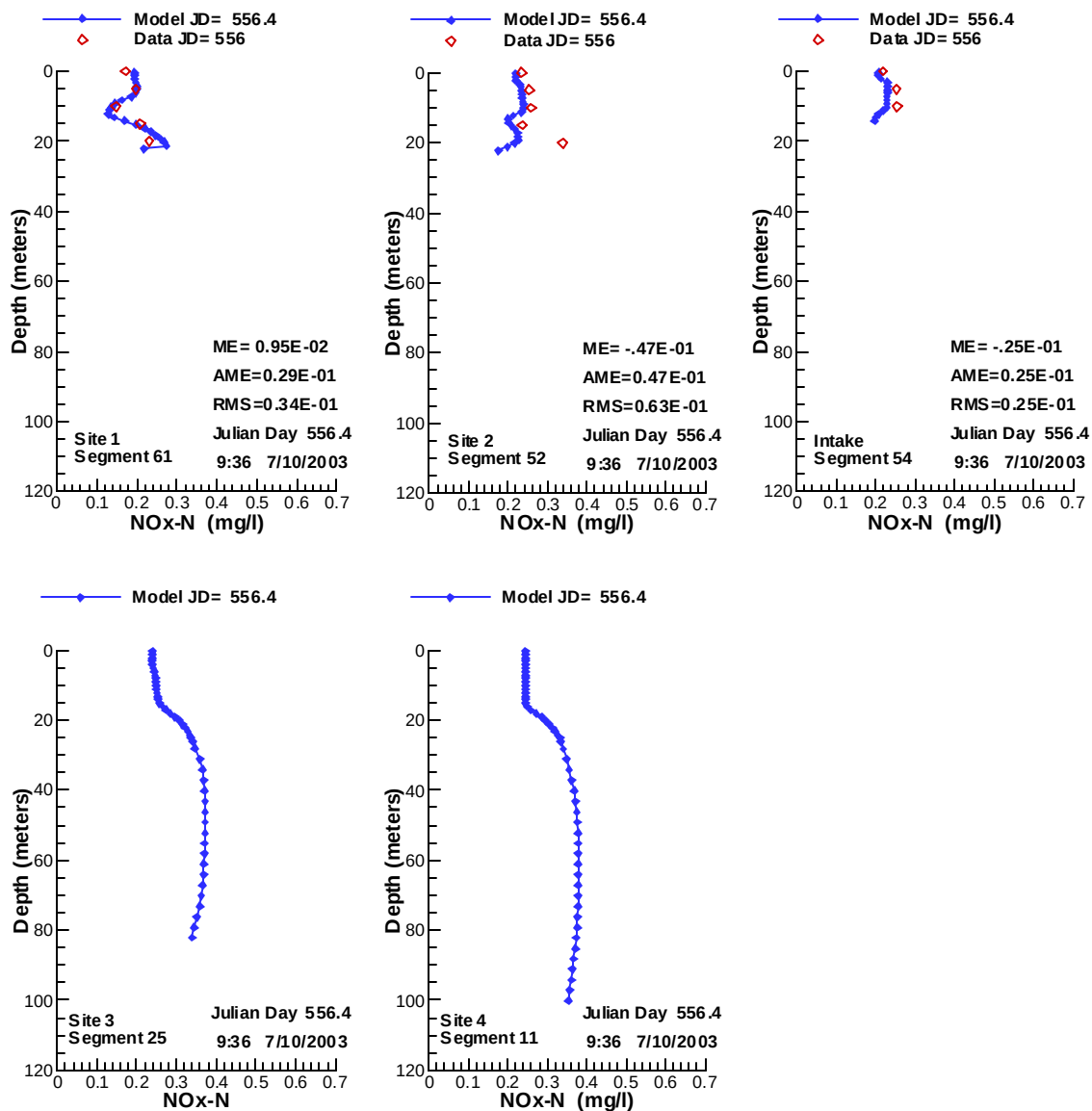


Figure 278. Vertical profiles of NOx-N compared with data for 7/10/2003.

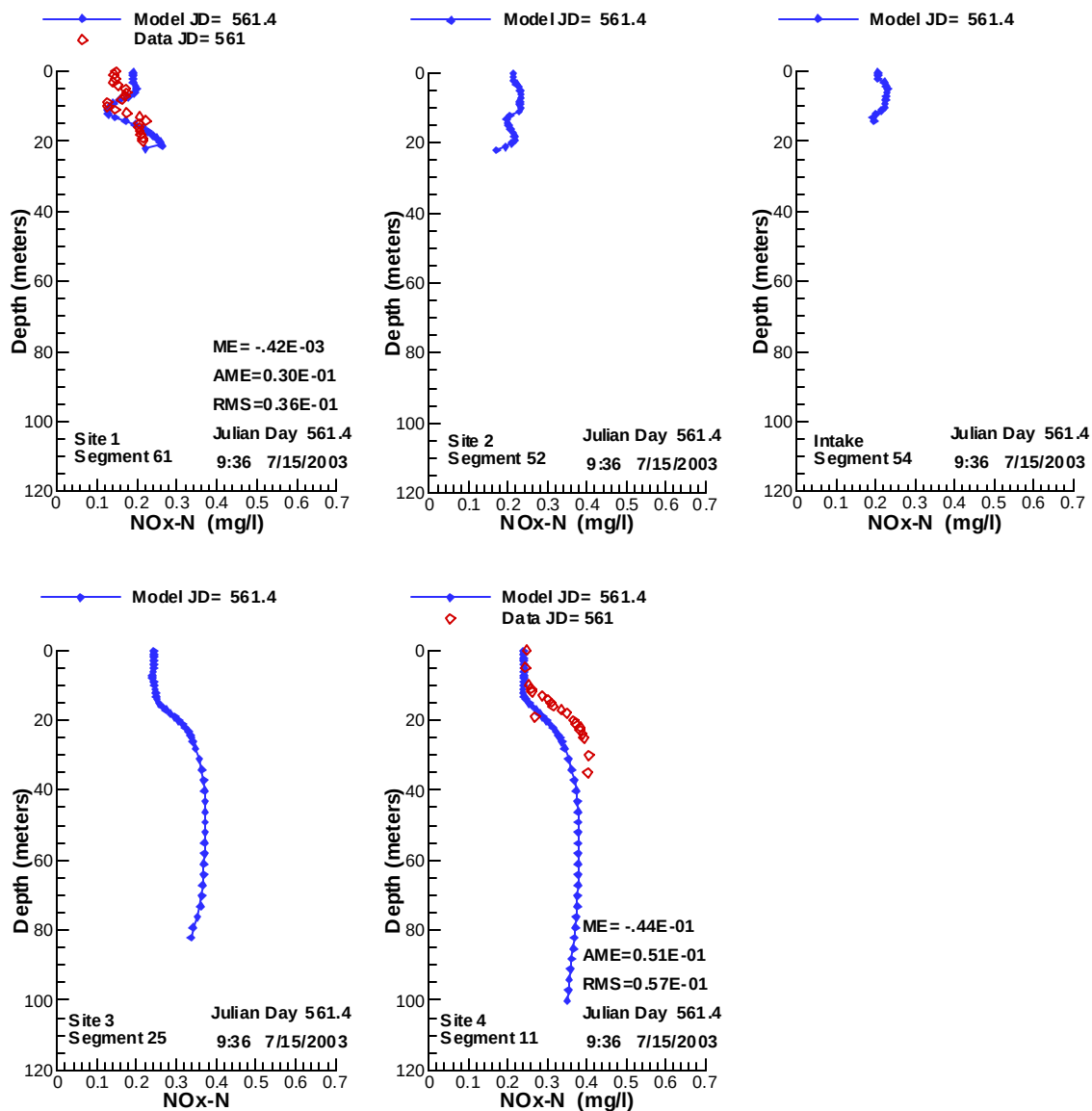


Figure 279. Vertical profiles of NOx-N compared with data for 7/15/2003.

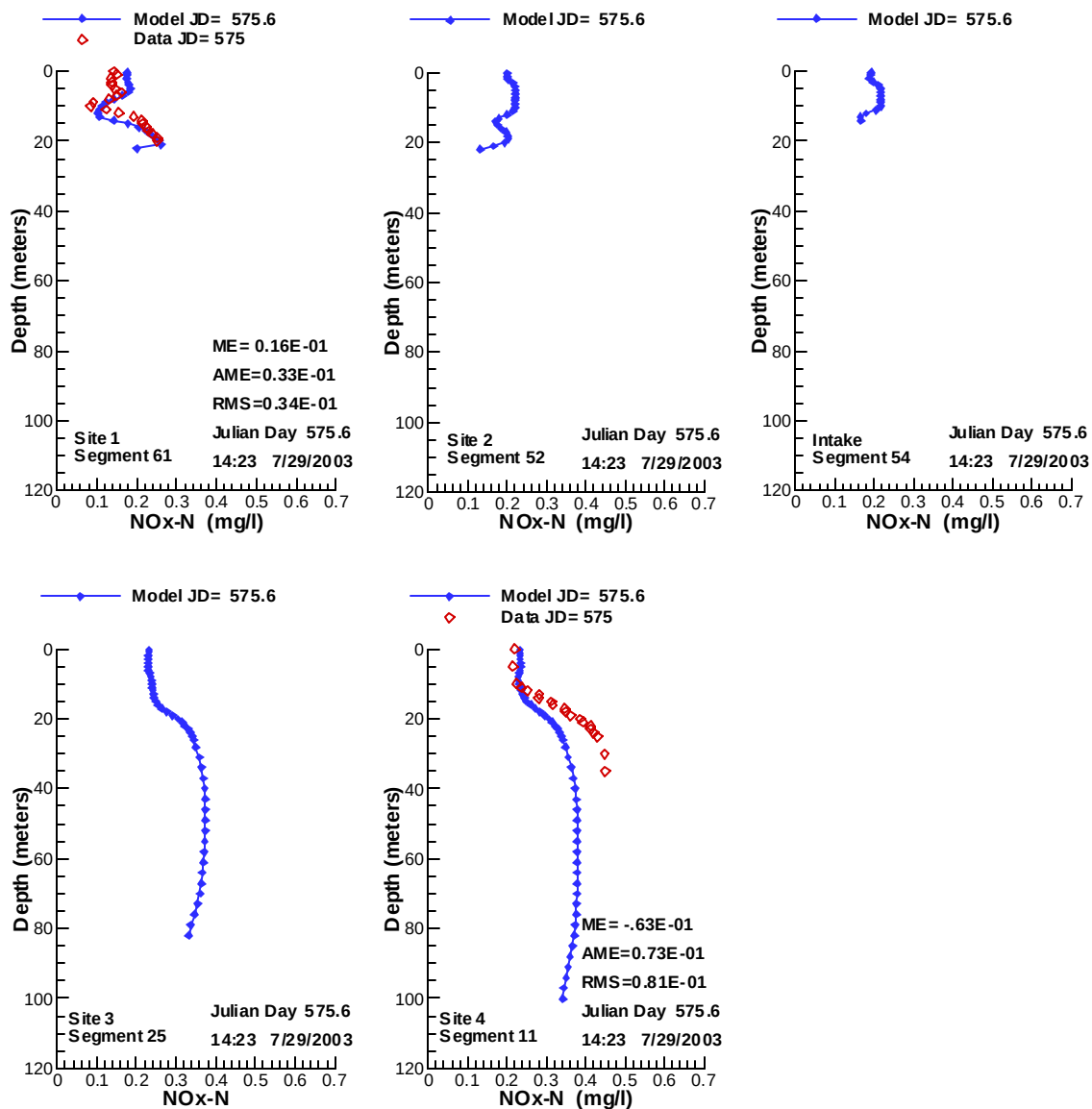


Figure 280. Vertical profiles of NOx-N compared with data for 7/29/2003.

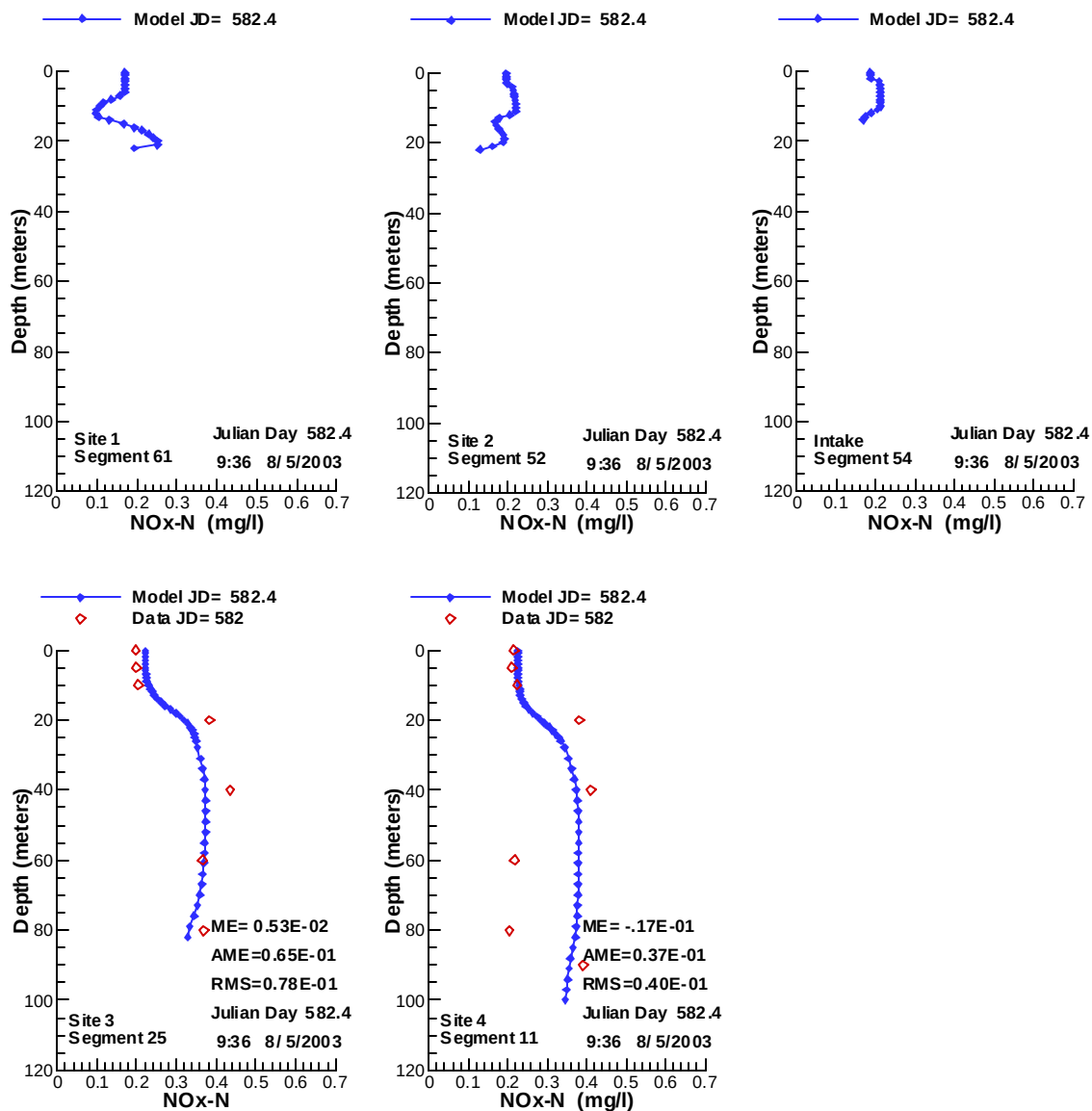


Figure 281. Vertical profiles of NOx-N compared with data for 8/ 5/2003.

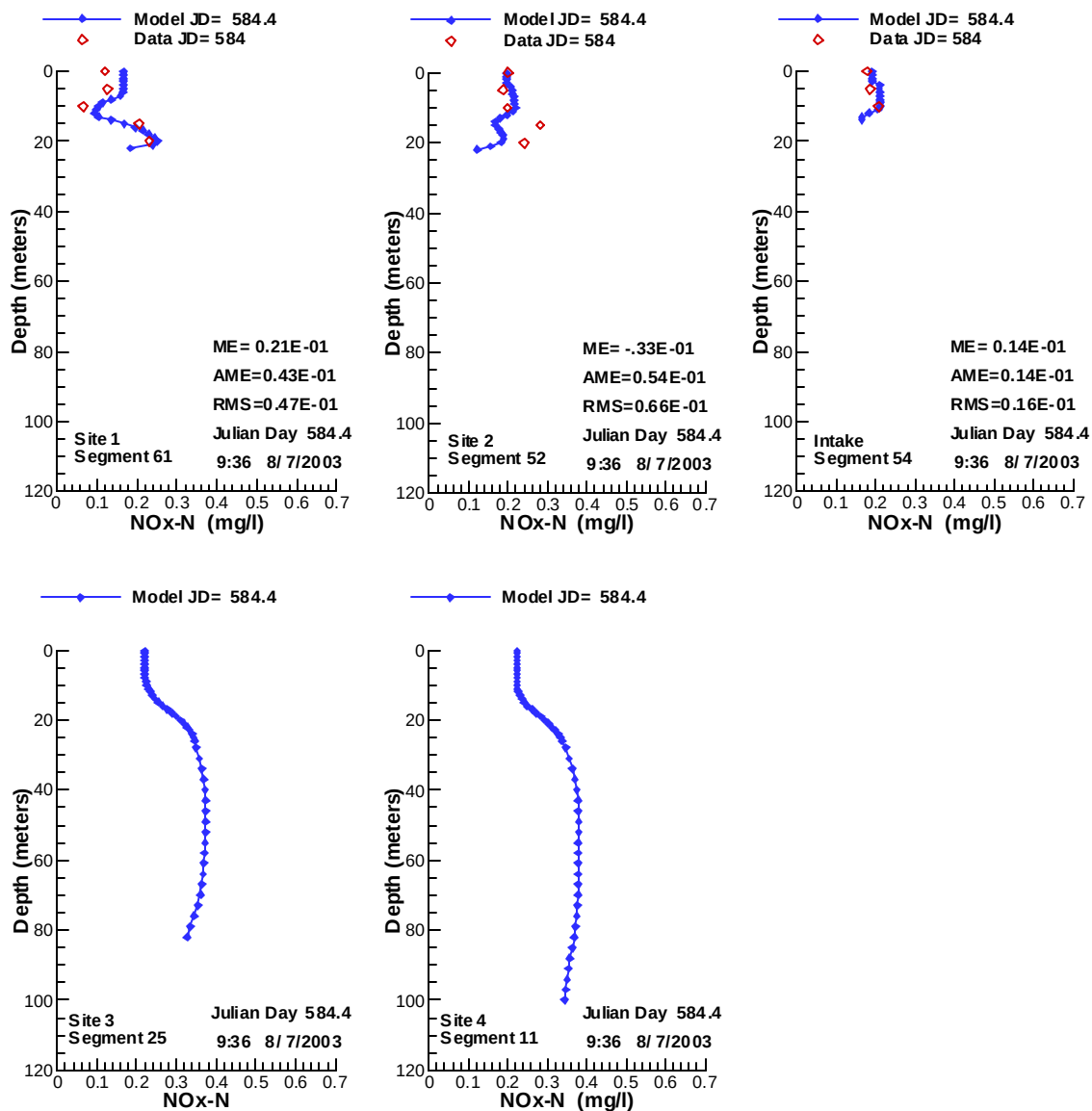


Figure 282. Vertical profiles of NOx-N compared with data for 8/ 7/2003.

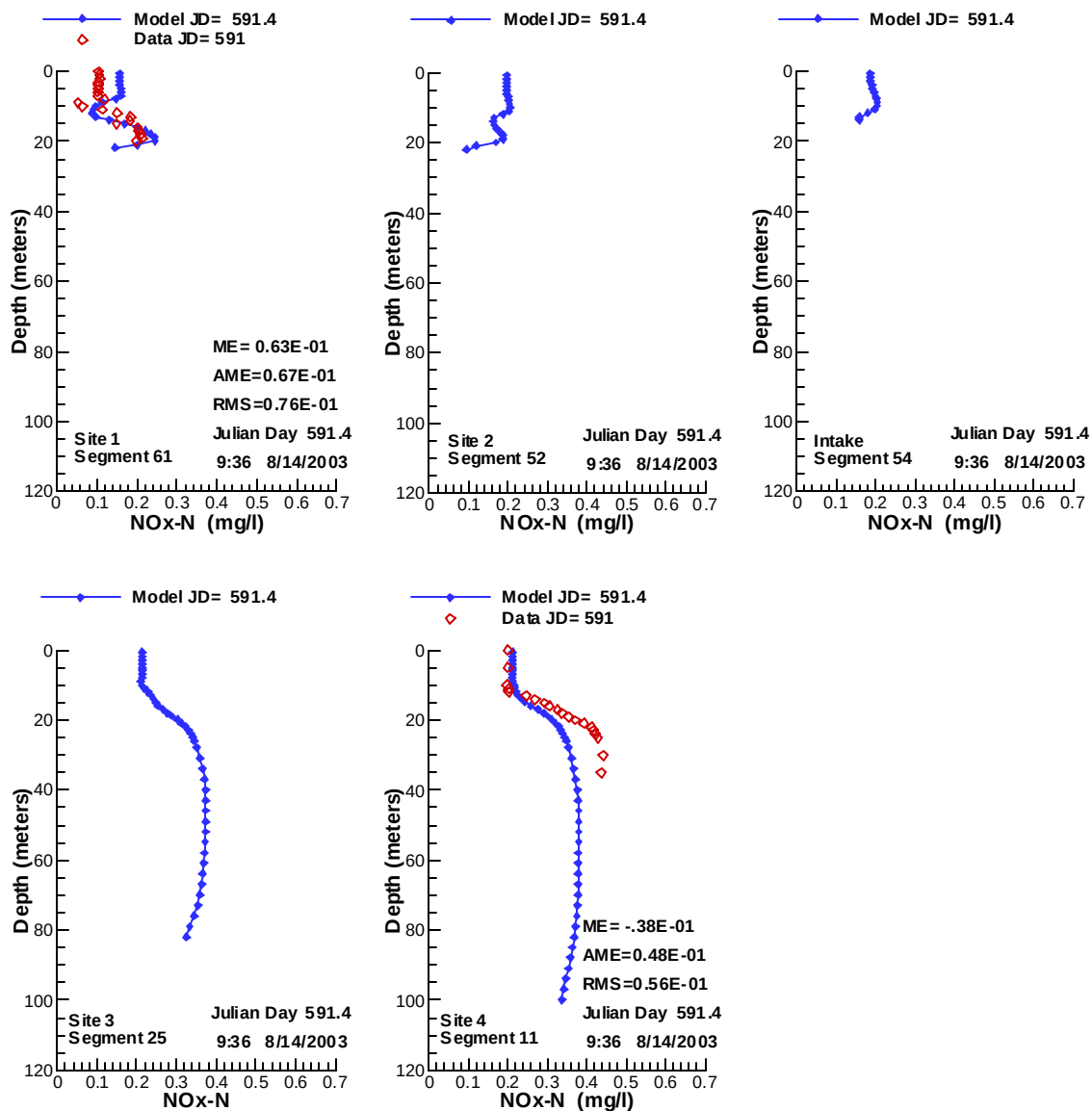


Figure 283. Vertical profiles of NOx-N compared with data for 8/14/2003.

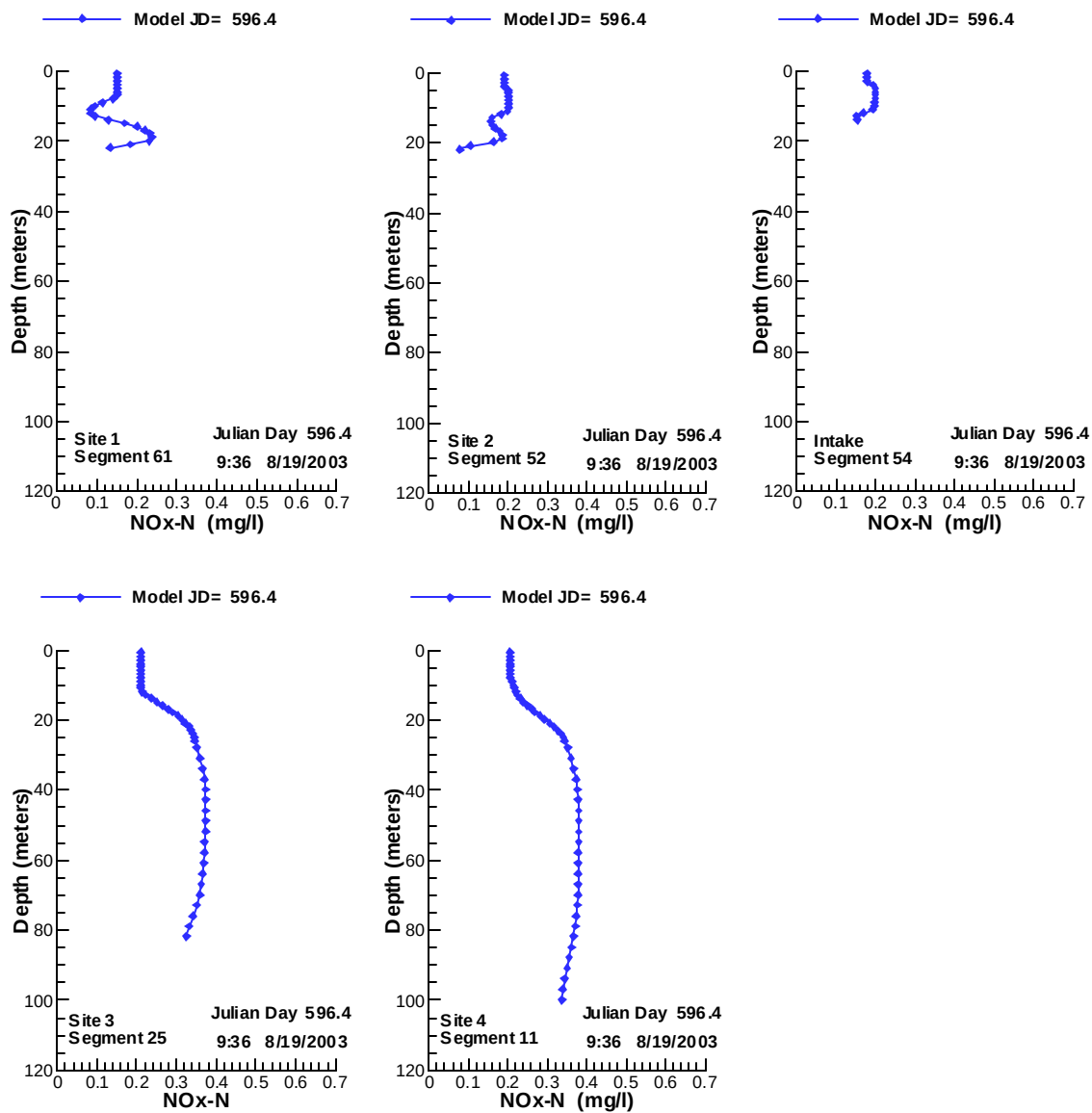


Figure 284. Vertical profiles of NOx-N compared with data for 8/19/2003.

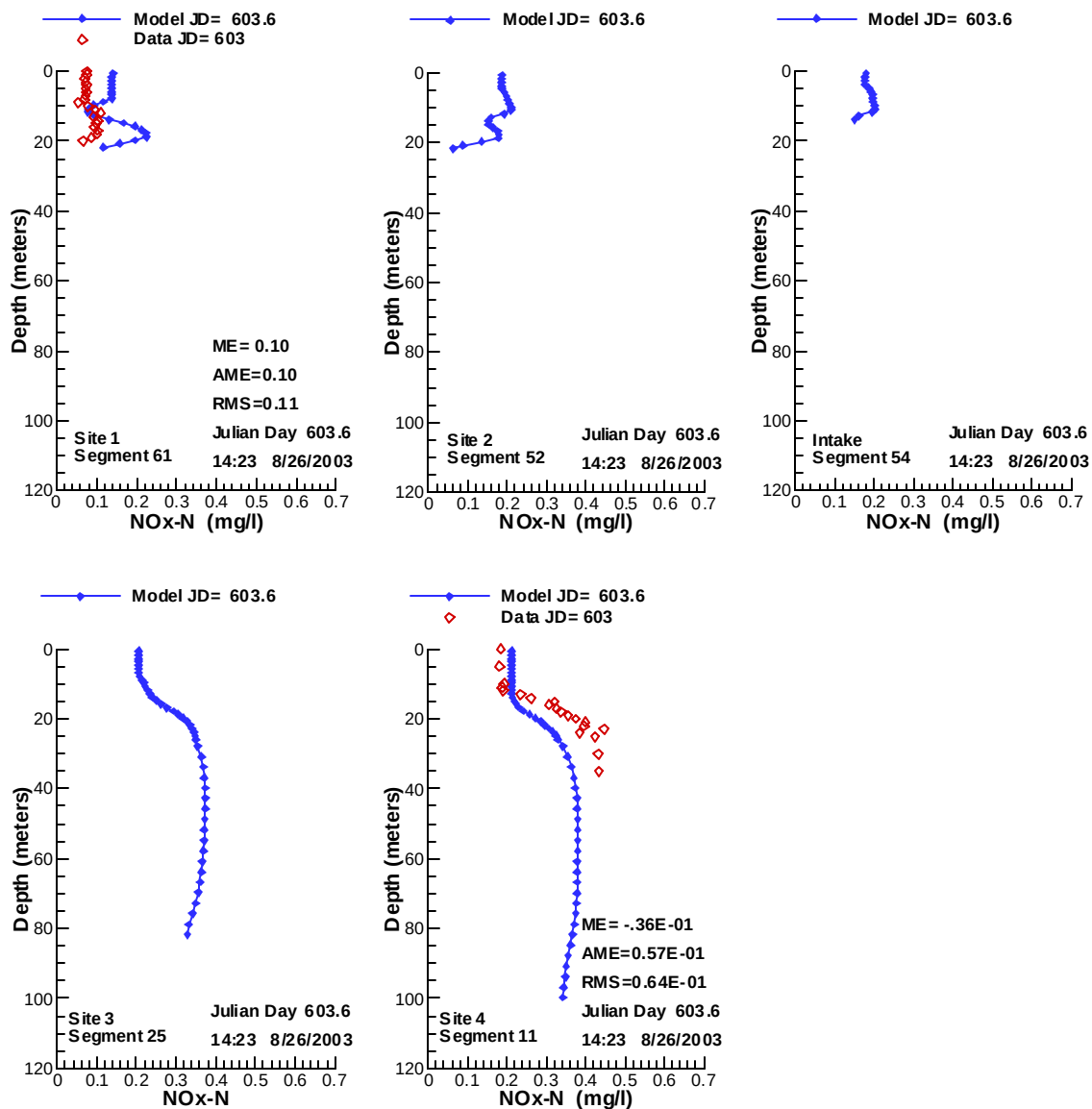


Figure 285. Vertical profiles of NO_x-N compared with data for 8/26/2003.

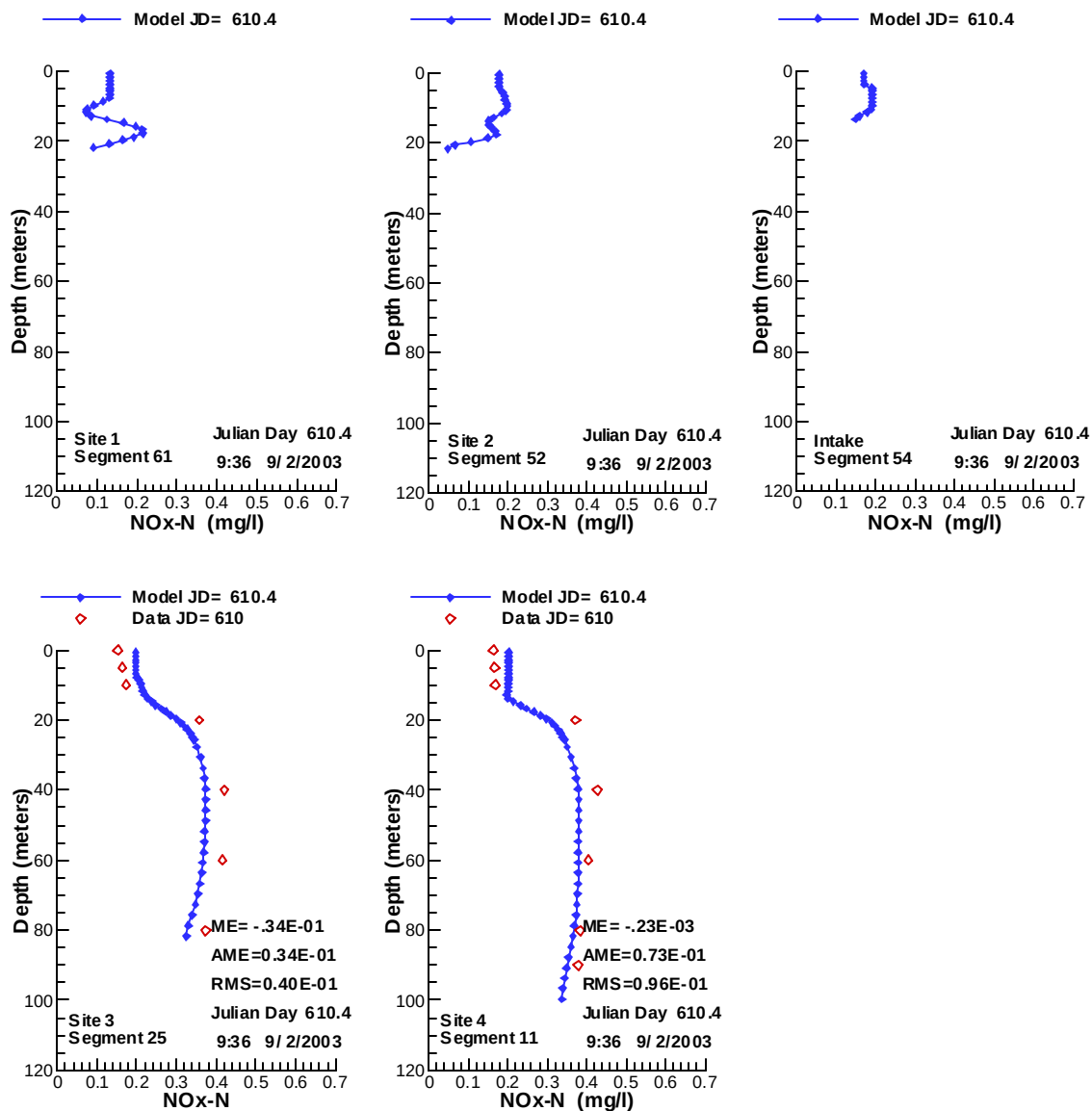


Figure 286. Vertical profiles of NOx-N compared with data for 9/ 2/2003.

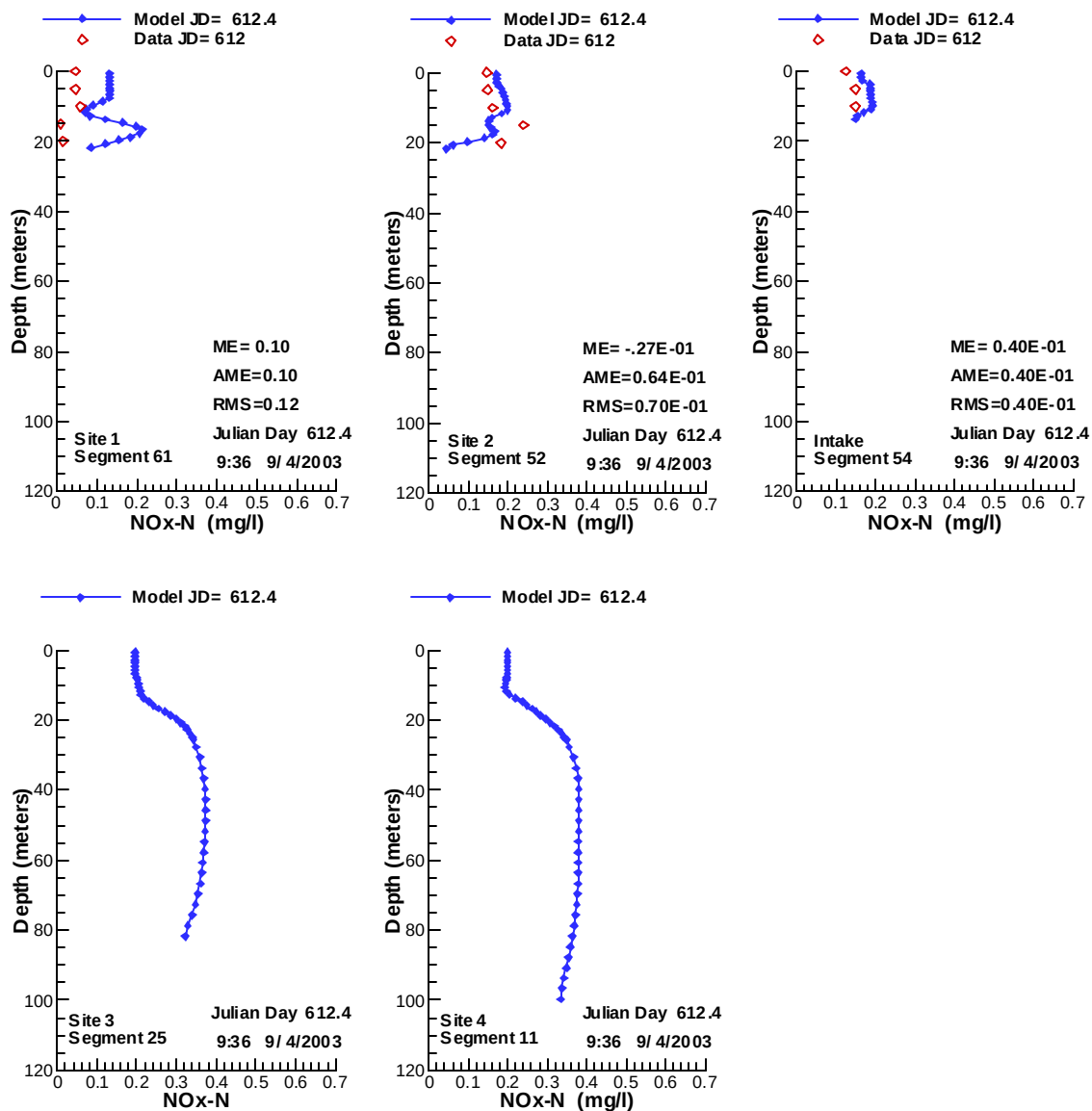


Figure 287. Vertical profiles of NO_x-N compared with data for 9/ 4/2003.

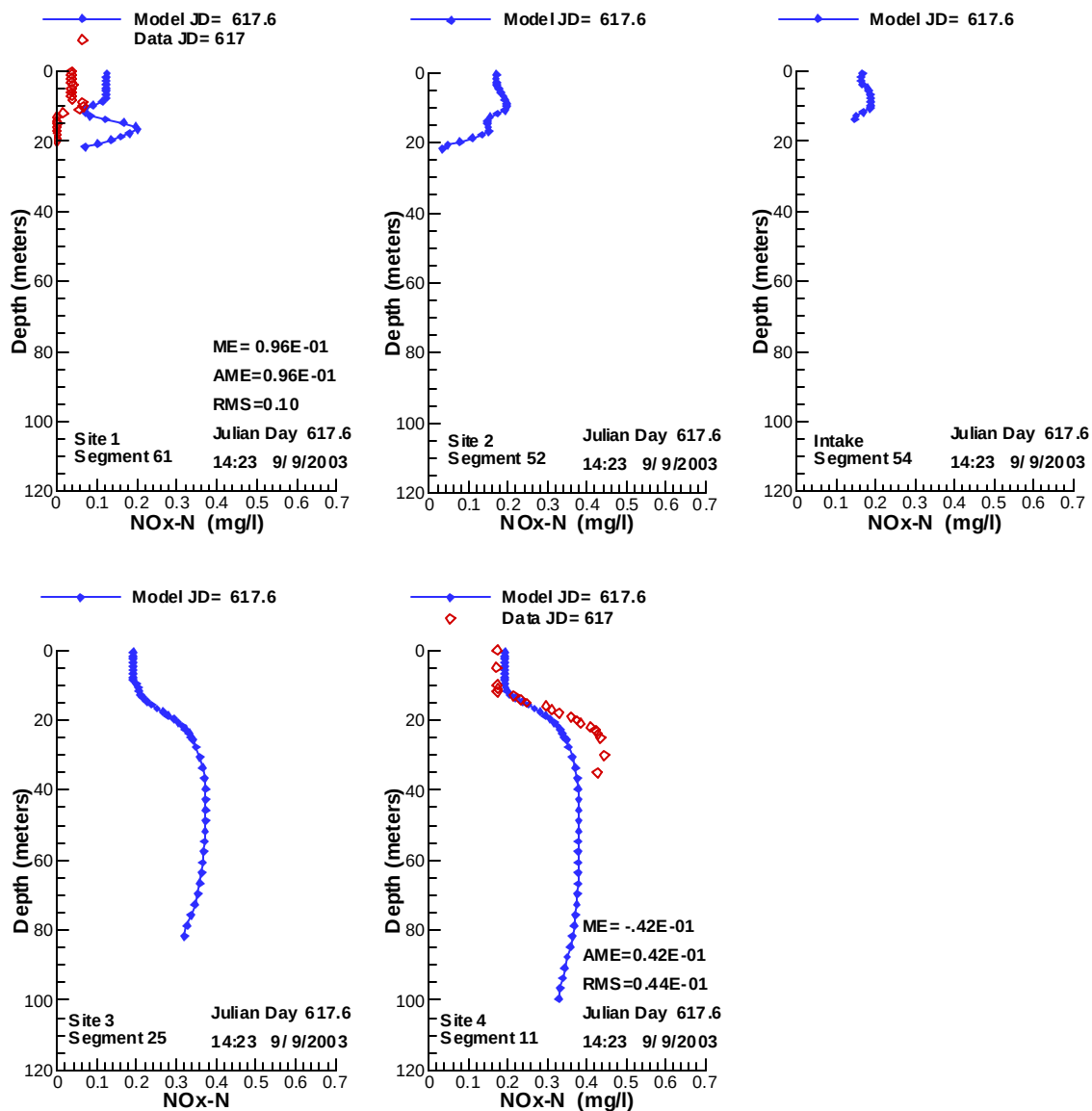


Figure 288. Vertical profiles of NOx-N compared with data for 9/ 9/2003.

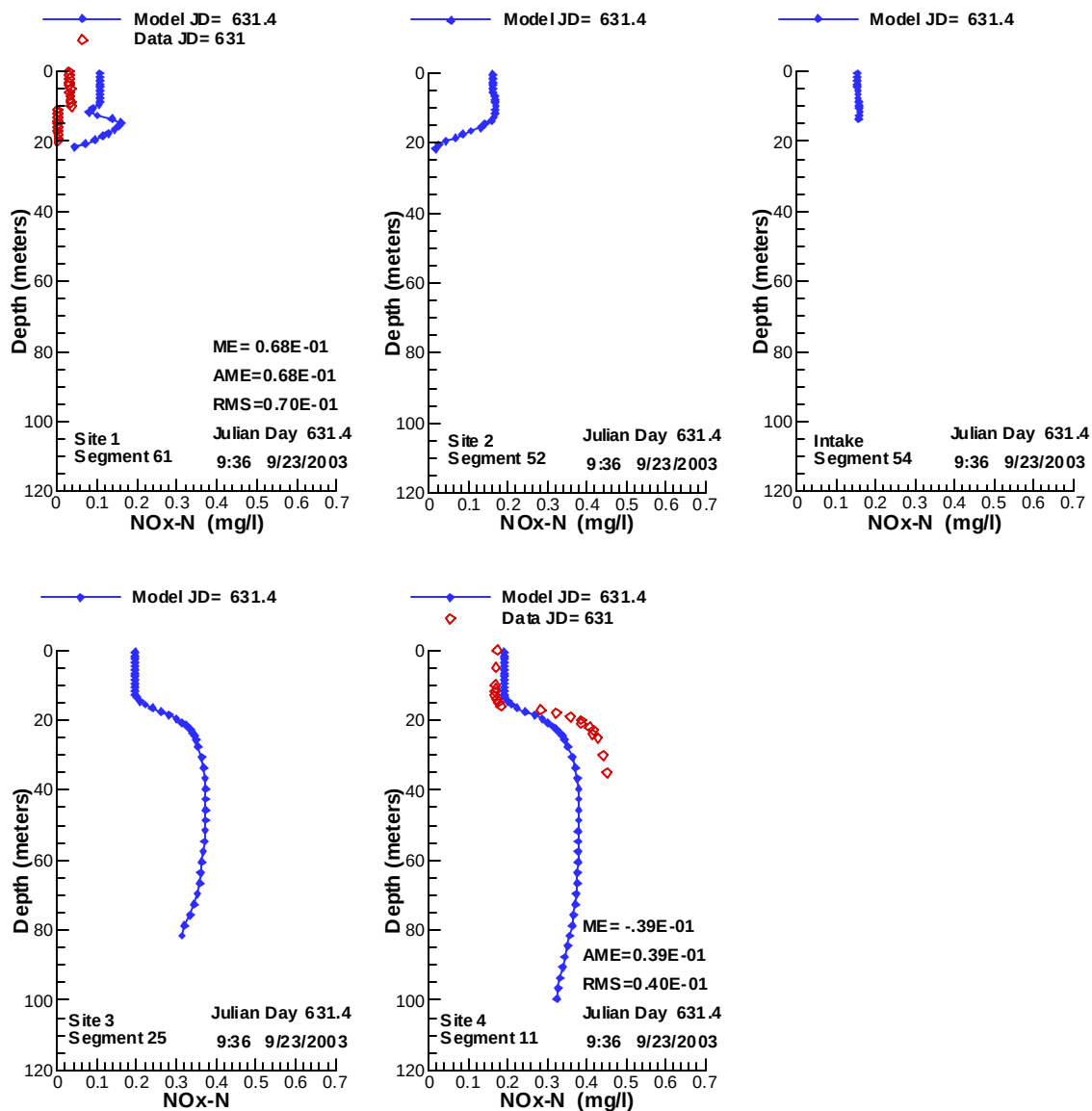


Figure 289. Vertical profiles of NOx-N compared with data for 9/23/2003.

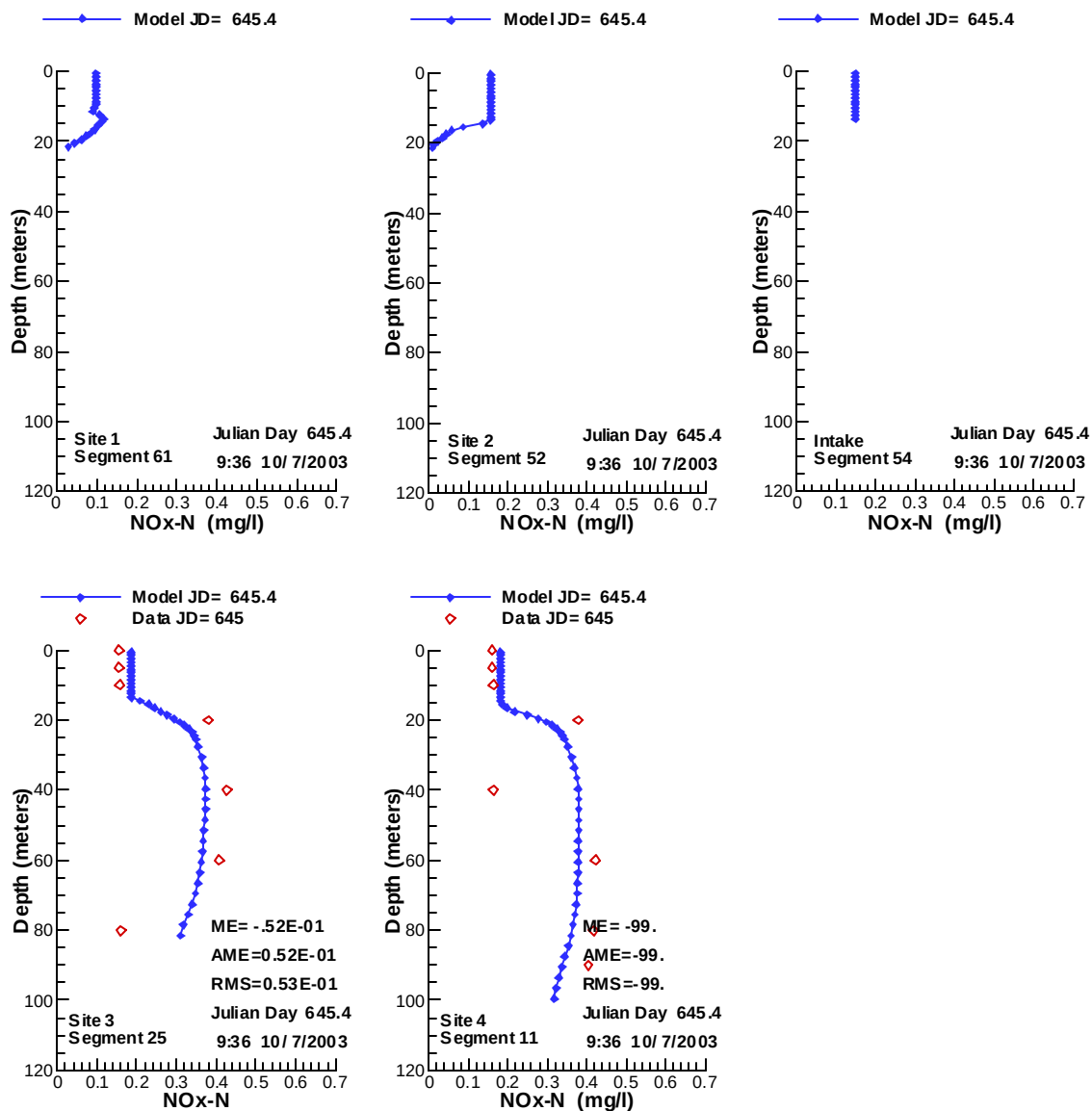


Figure 290. Vertical profiles of NOx-N compared with data for 10/ 7/2003.

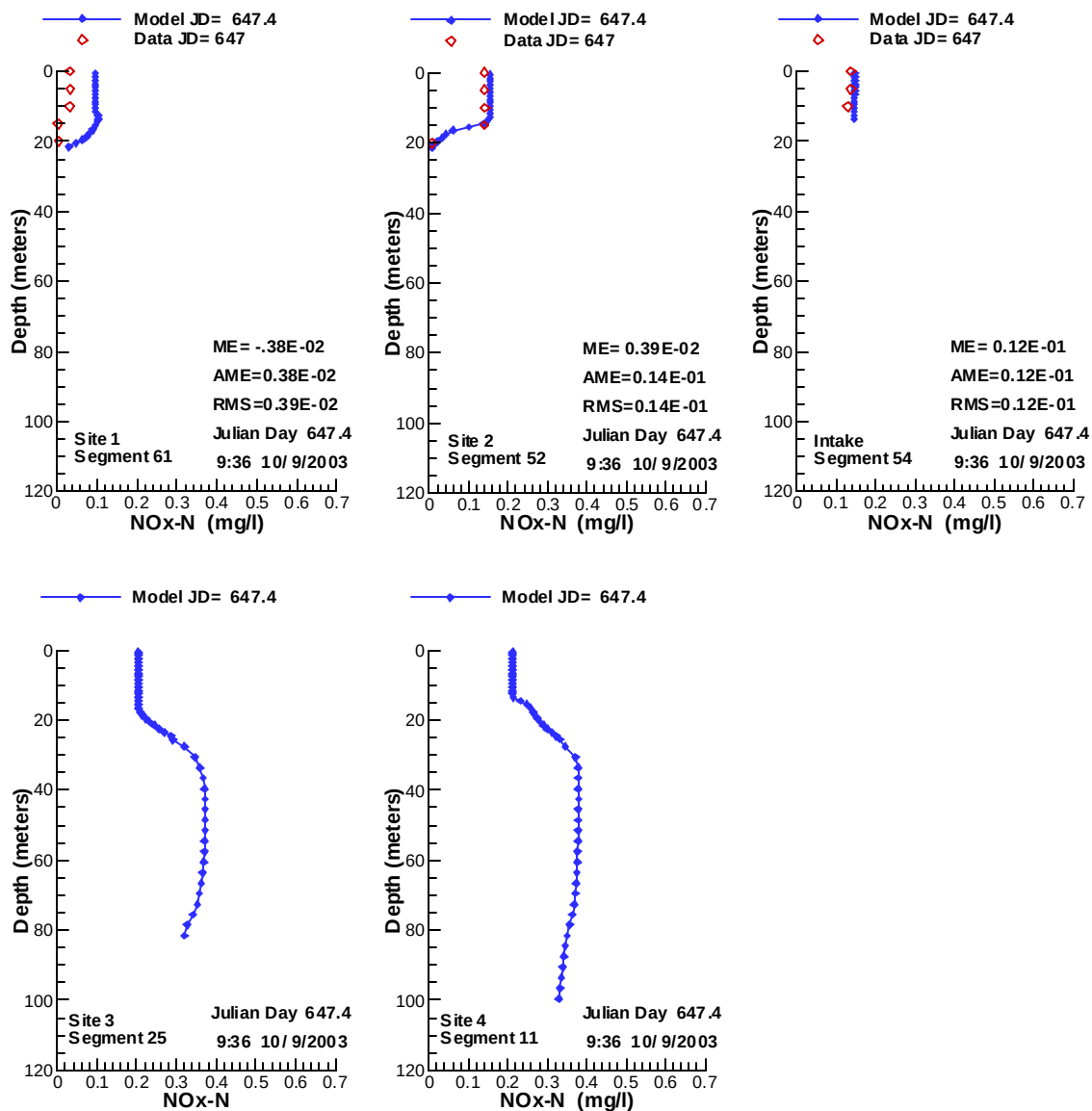


Figure 291. Vertical profiles of NOx-N compared with data for 10/ 9/2003.

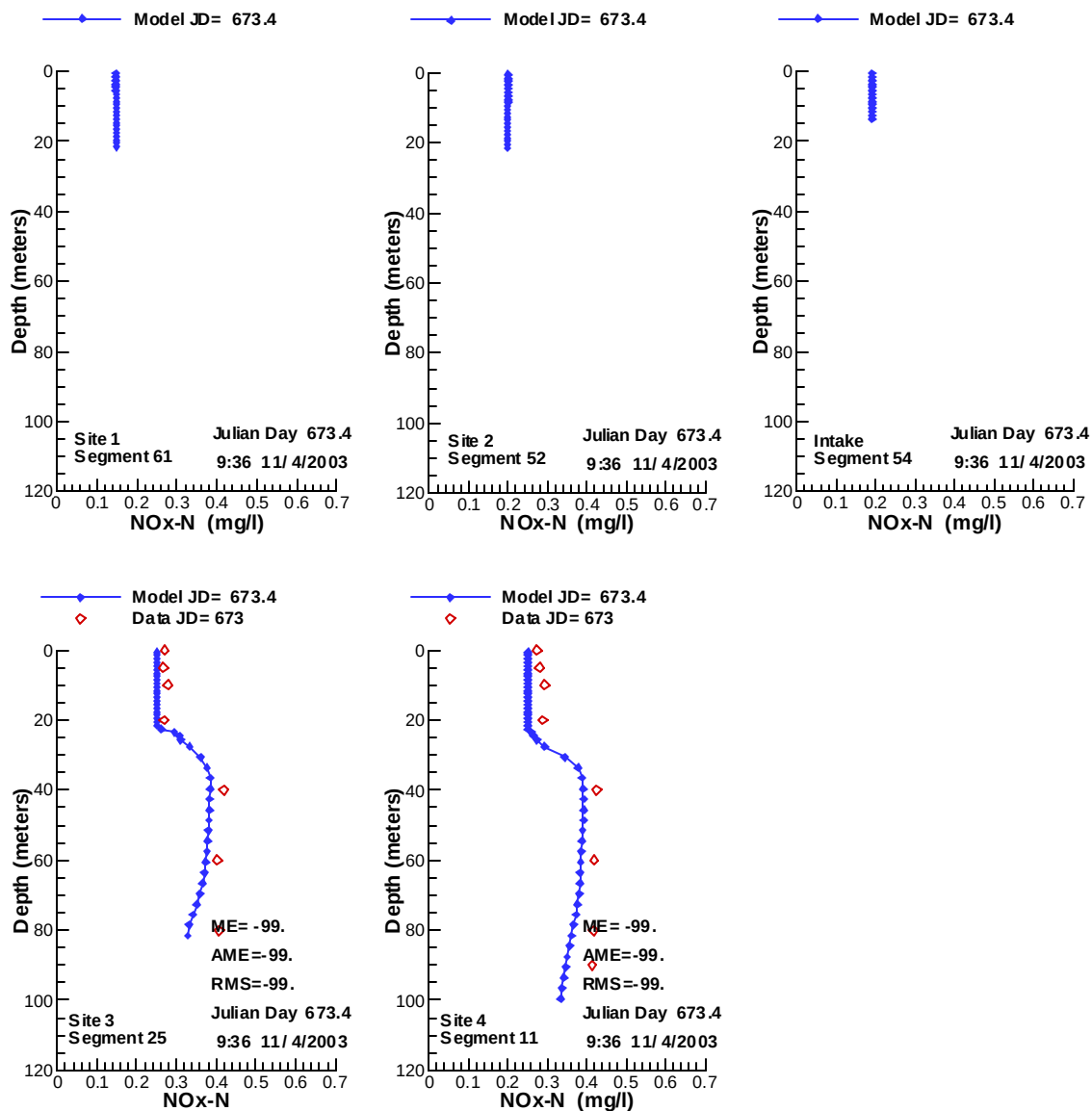


Figure 292. Vertical profiles of NOx-N compared with data for 11/ 4/2003.

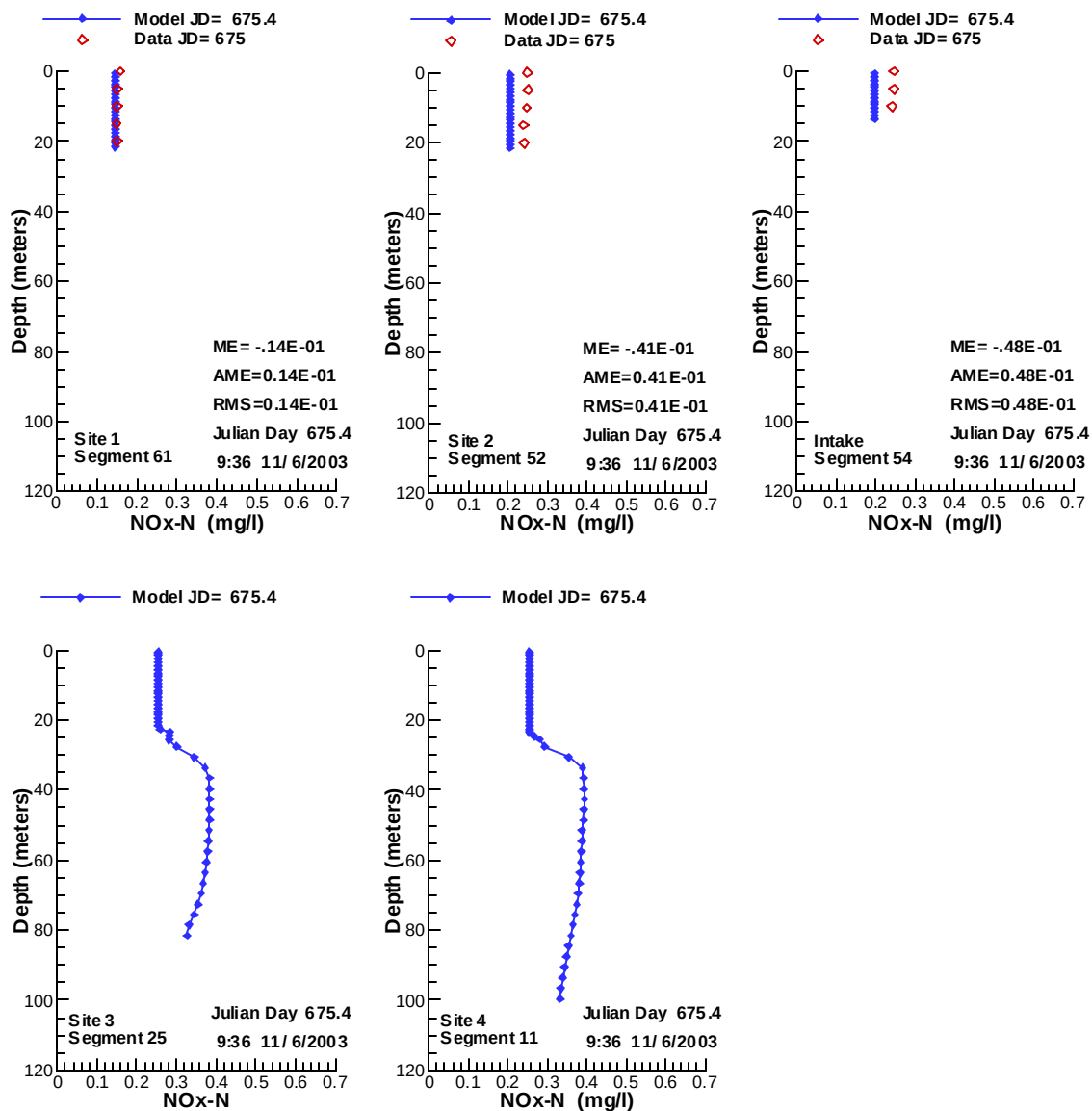


Figure 293. Vertical profiles of NOx-N compared with data for 11/ 6/2003.

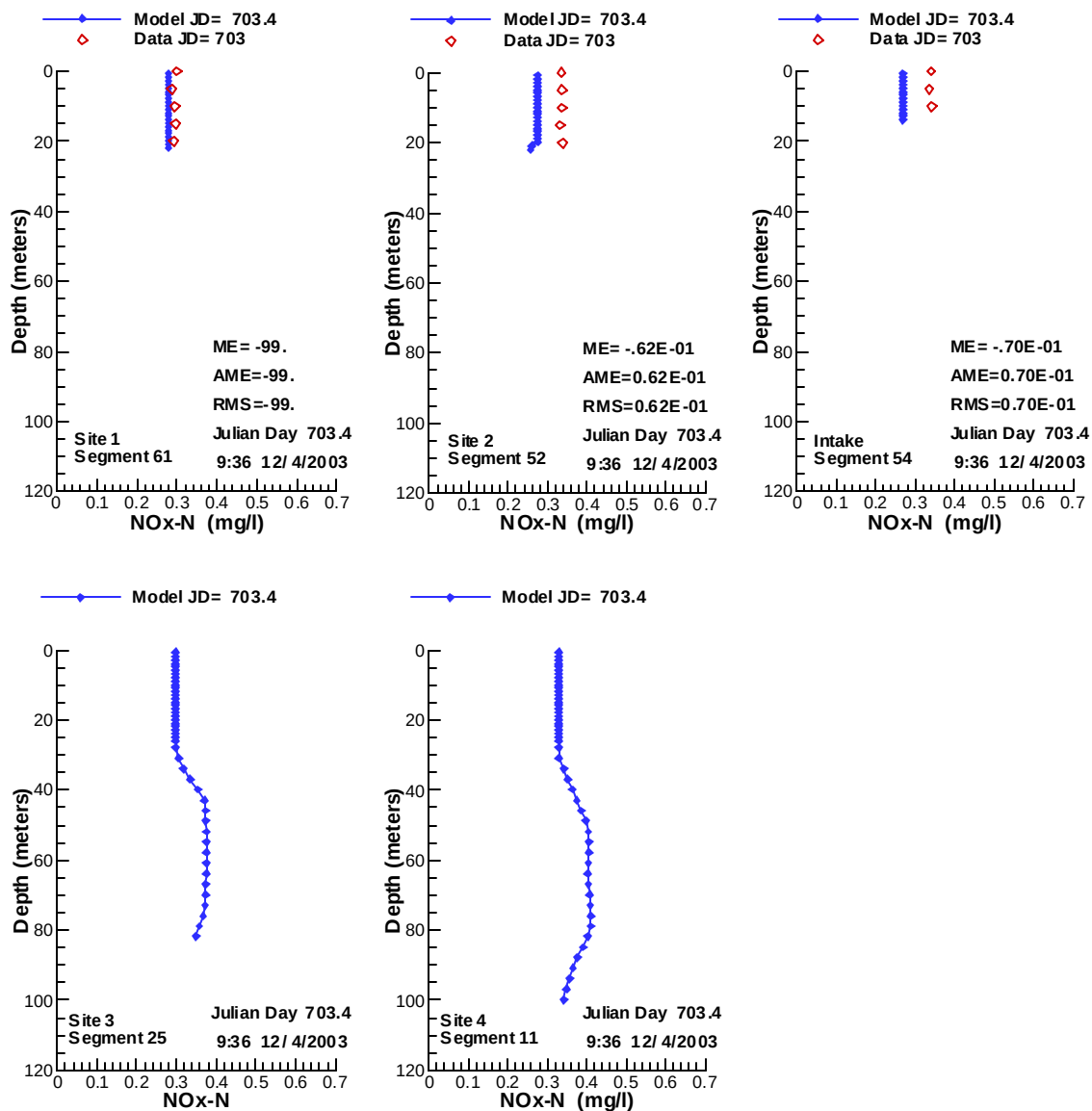


Figure 294. Vertical profiles of NOx-N compared with data for 12/ 4/2003.

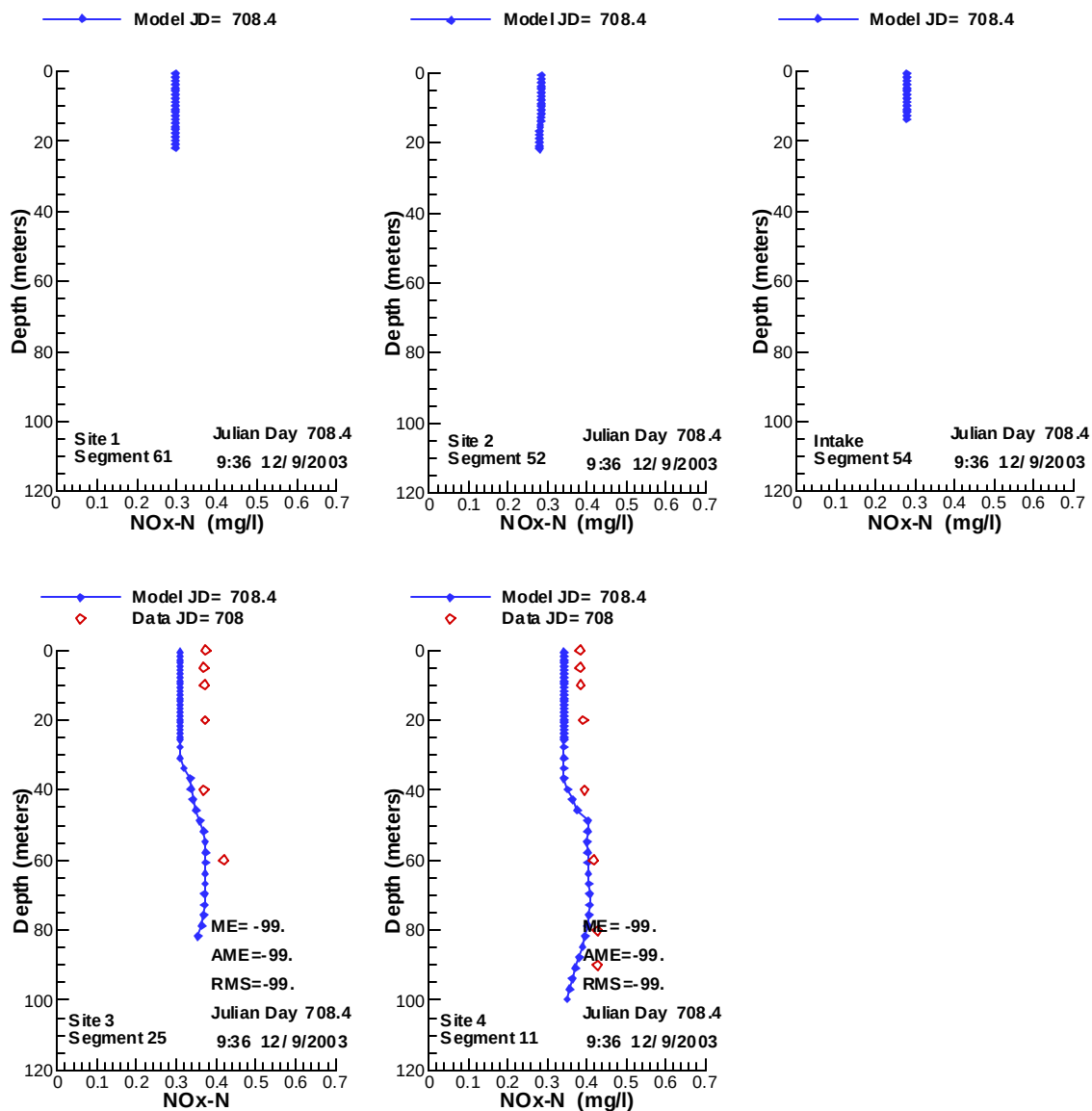


Figure 295. Vertical profiles of NOx-N compared with data for 12/ 9/2003.

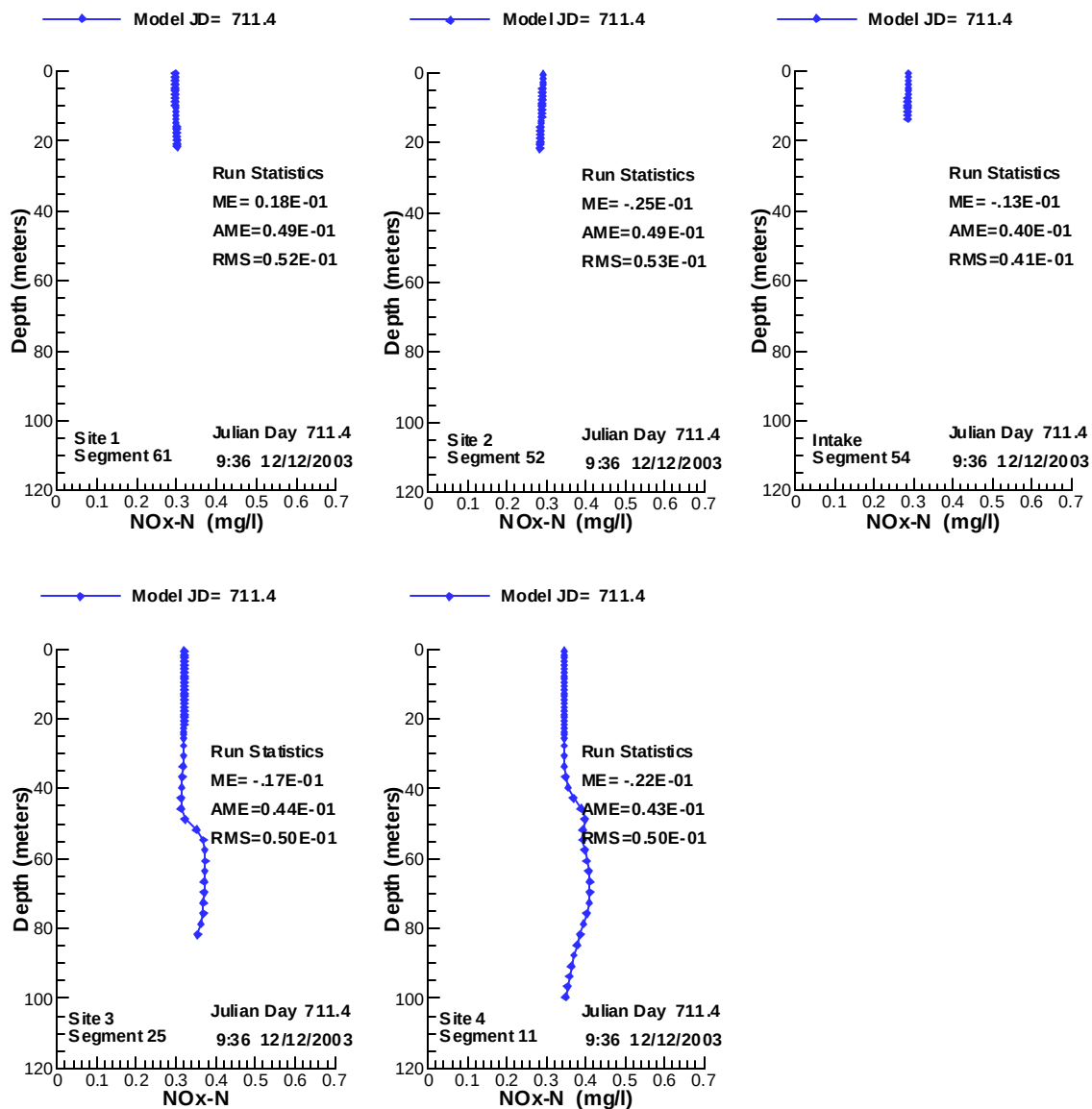


Figure 296. Vertical profiles of NOx-N compared with data for 12/12/2003.

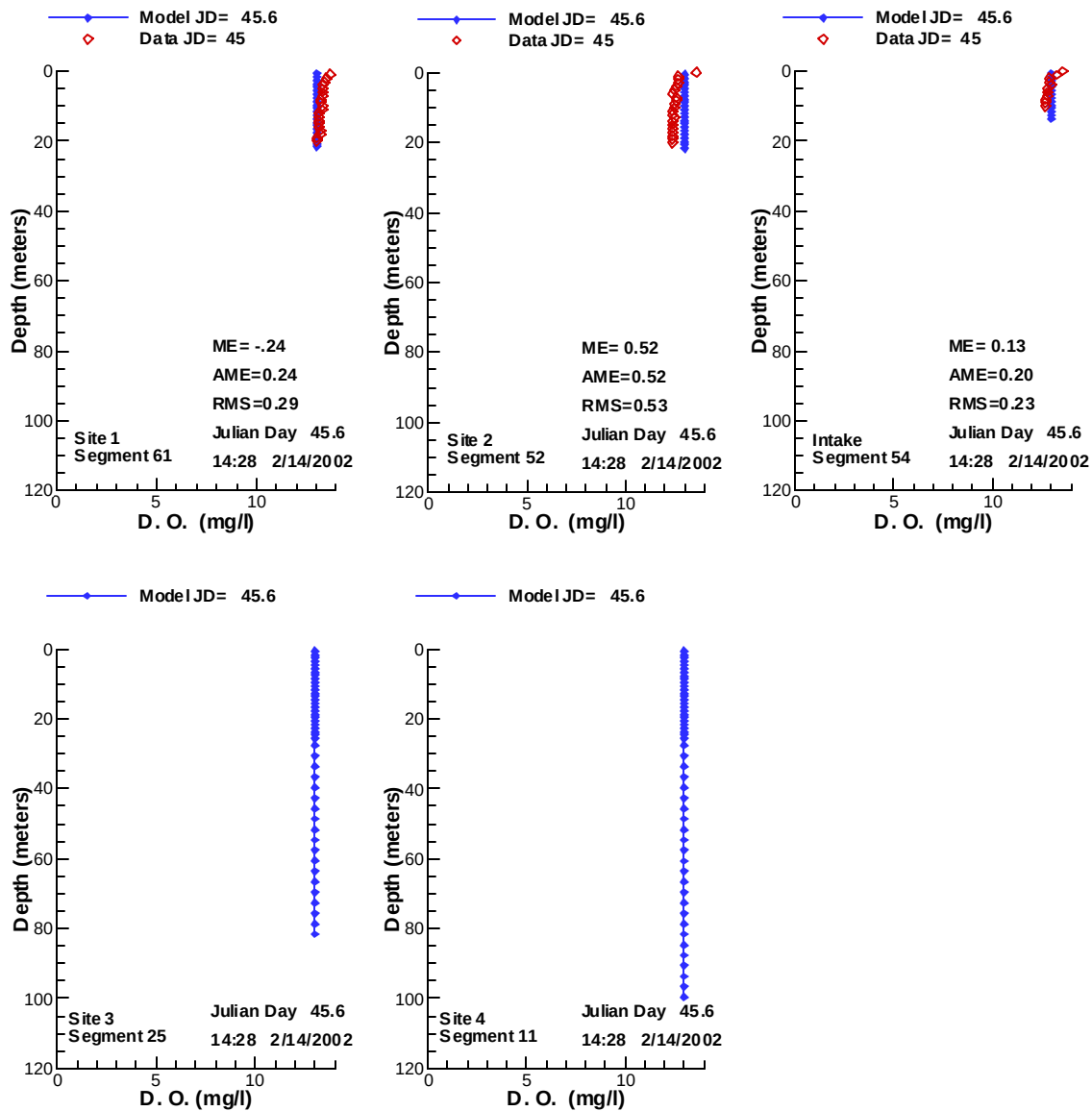


Figure 297. Vertical profiles of DISSOLVED OXYGEN compared with data for 2/14/2002.

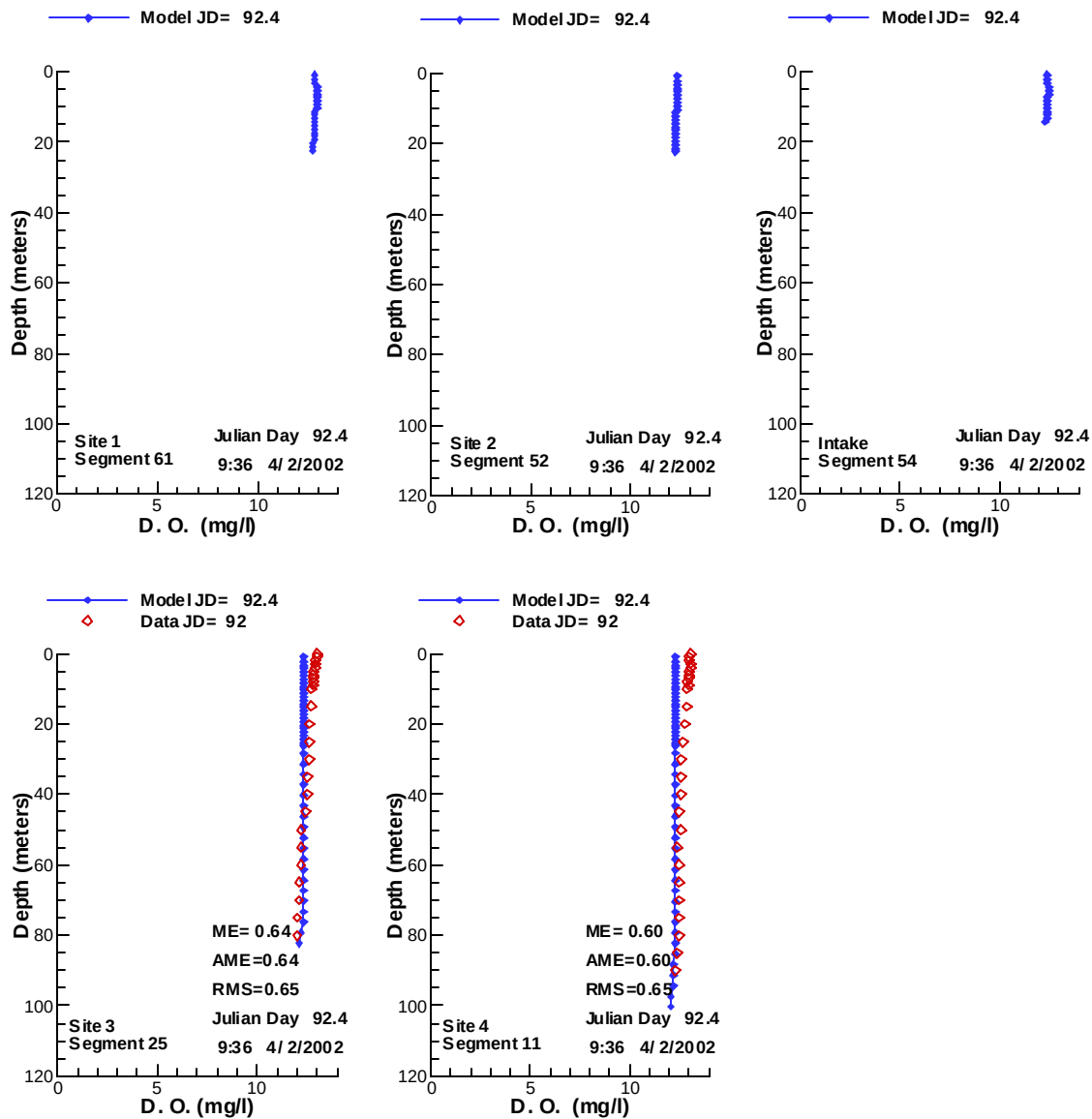


Figure 298. Vertical profiles of DISSOLVED OXYGEN compared with data for 4/ 2/2002.

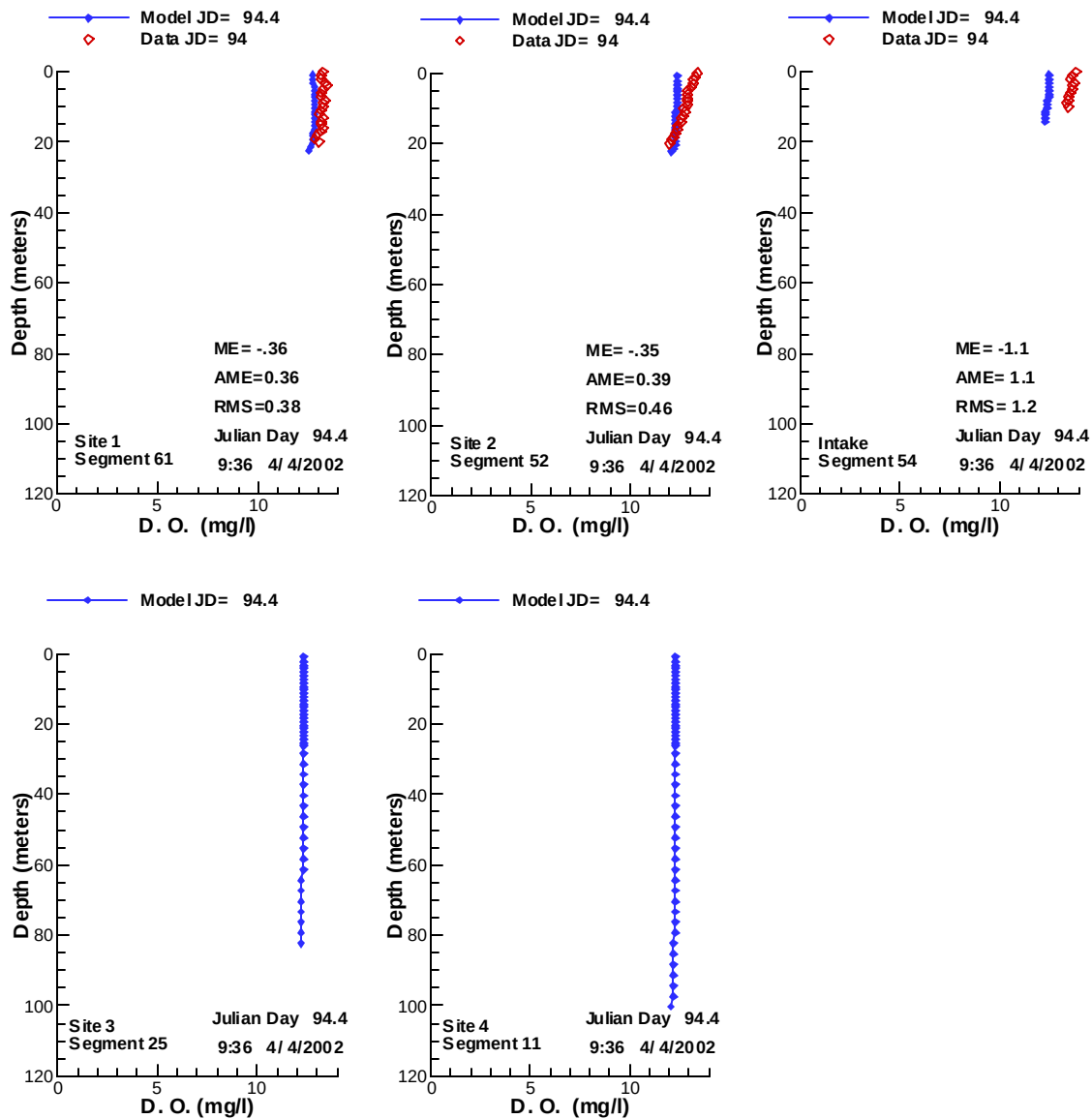


Figure 299. Vertical profiles of DISSOLVED OXYGEN compared with data for 4/ 4/2002.

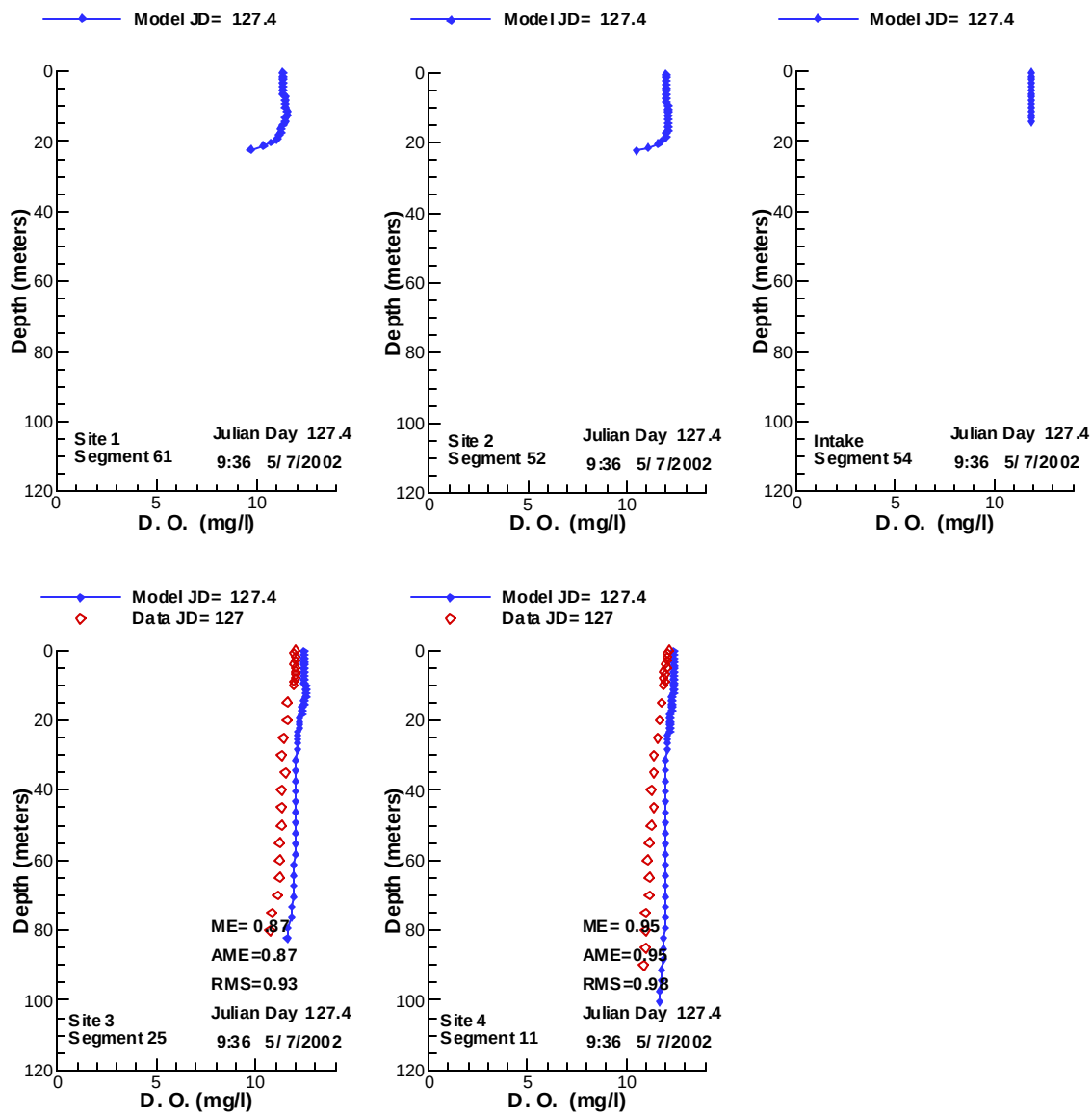


Figure 300. Vertical profiles of DISSOLVED OXYGEN compared with data for 5/ 7/2002.

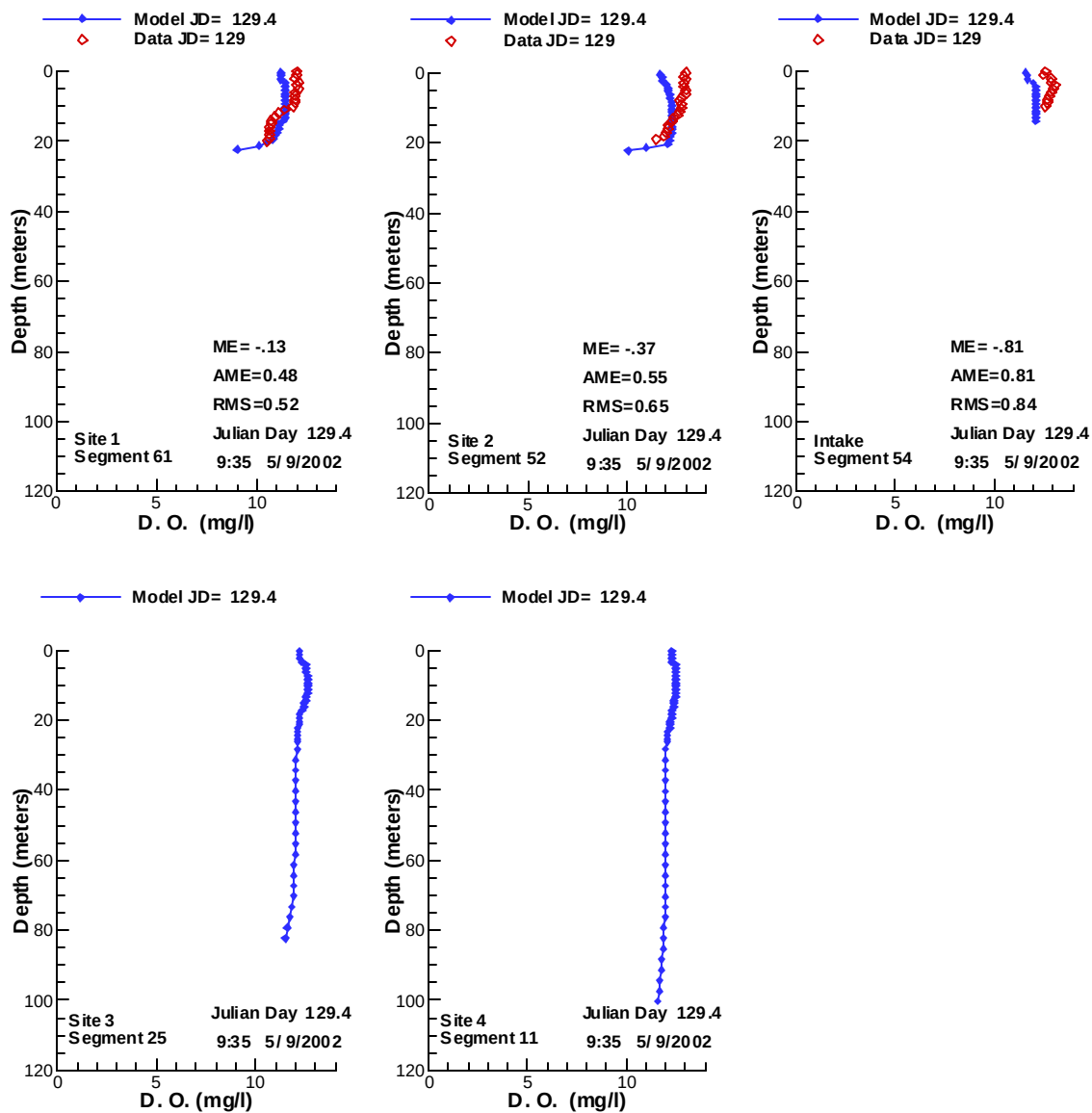


Figure 301. Vertical profiles of DISSOLVED OXYGEN compared with data for 5/ 9/2002.

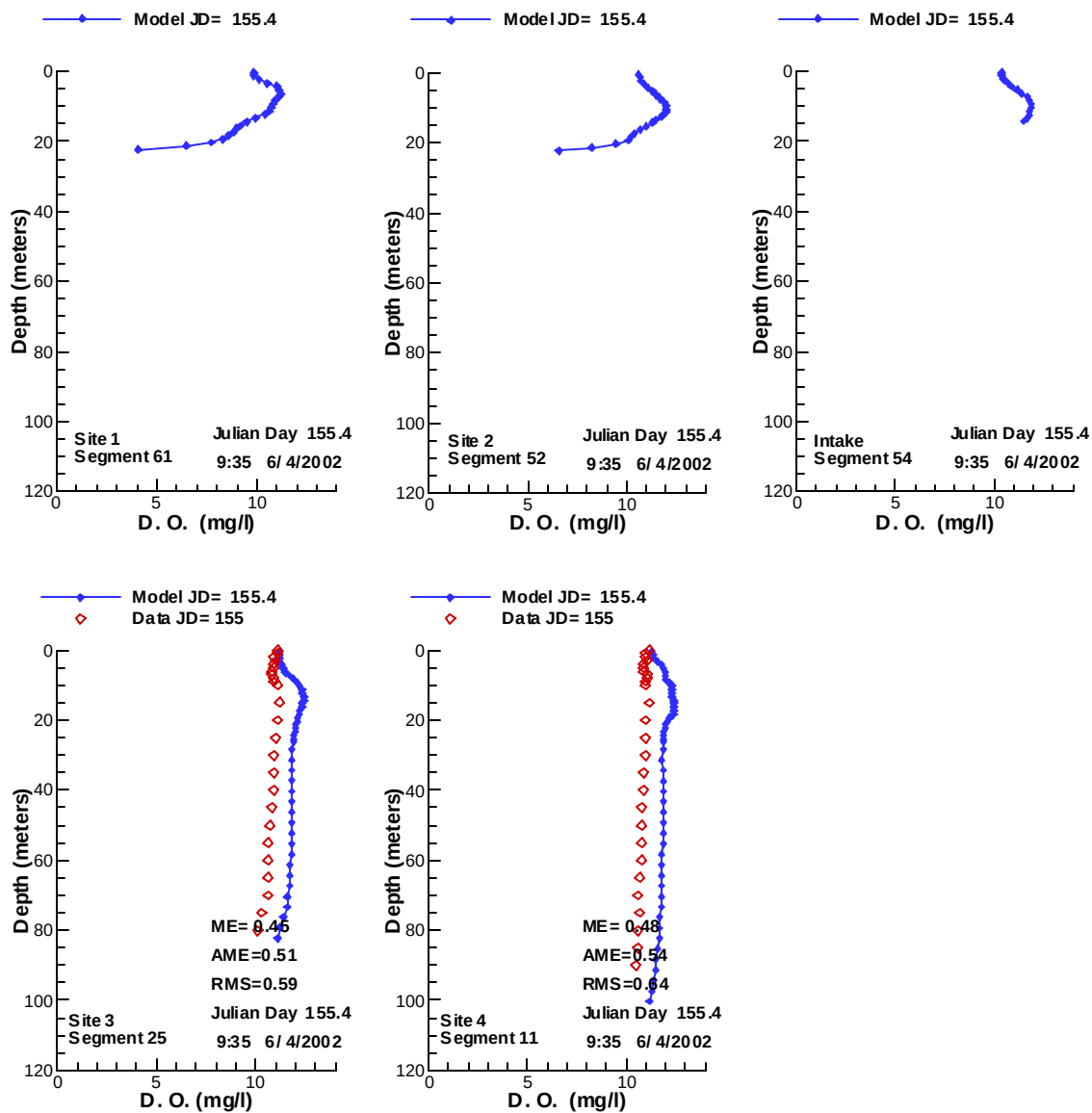


Figure 302. Vertical profiles of DISSOLVED OXYGEN compared with data for 6/ 4/2002.

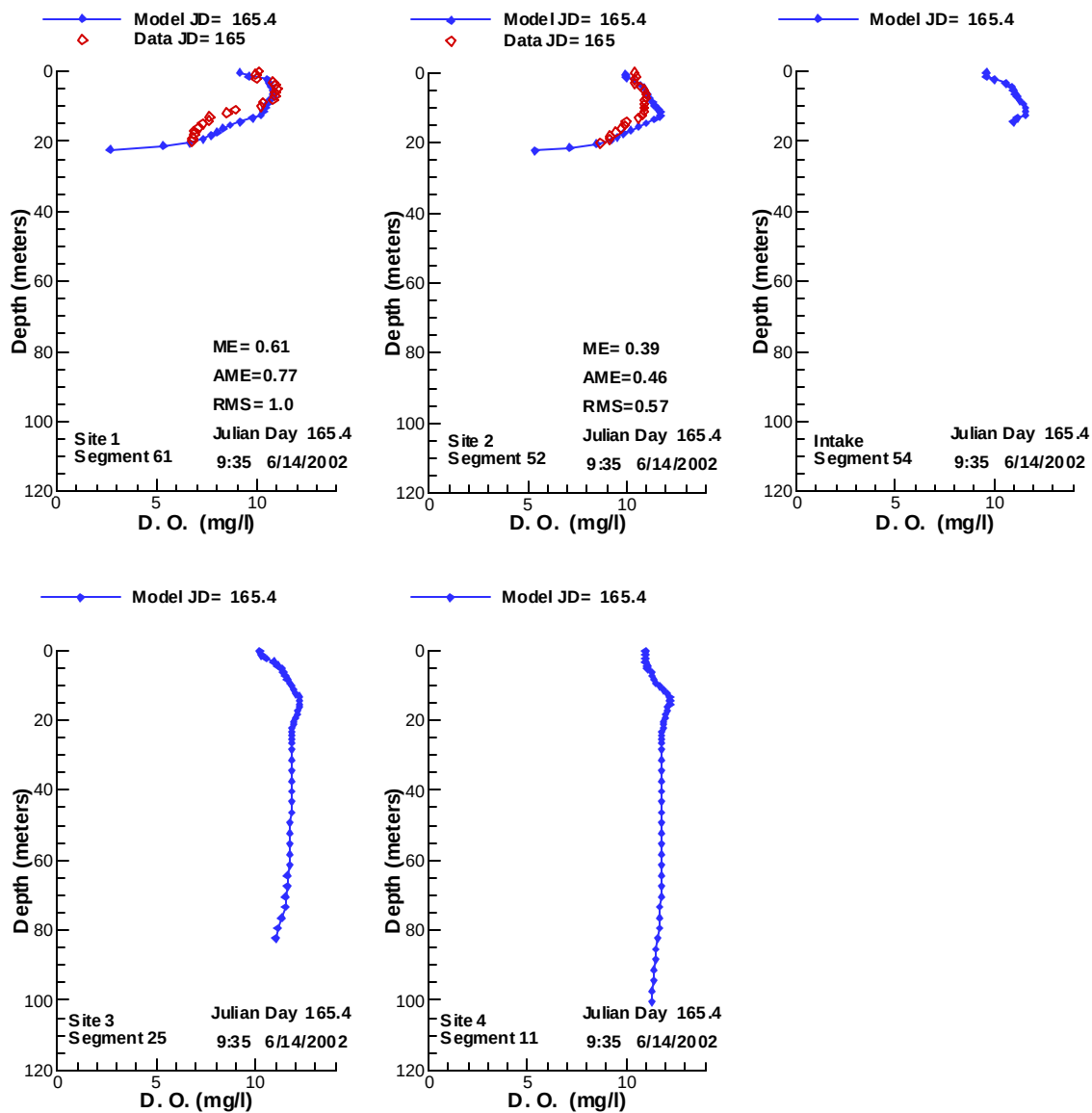


Figure 303. Vertical profiles of DISSOLVED OXYGEN compared with data for 6/14/2002.

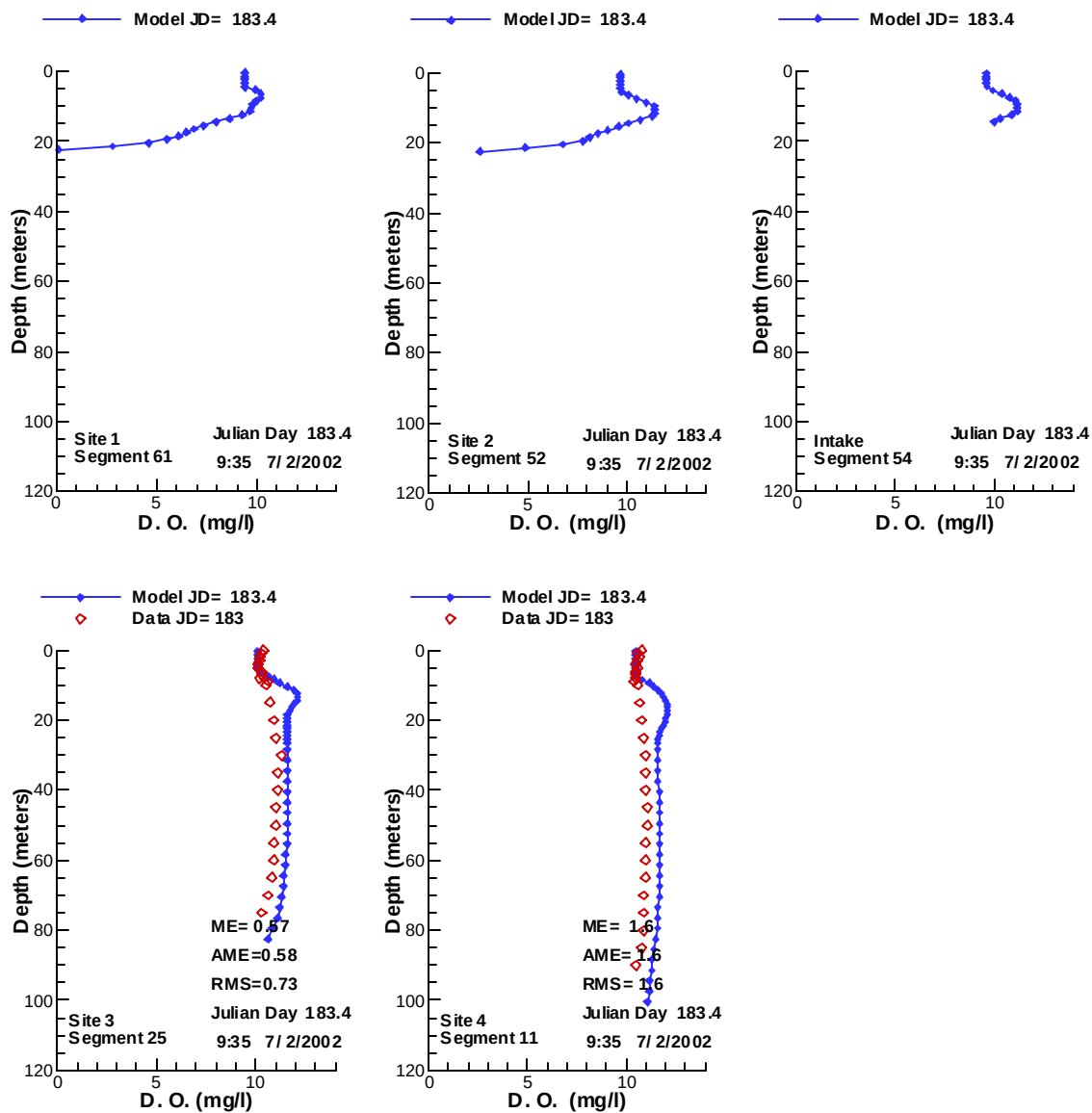


Figure 304. Vertical profiles of DISSOLVED OXYGEN compared with data for 7/ 2/2002.

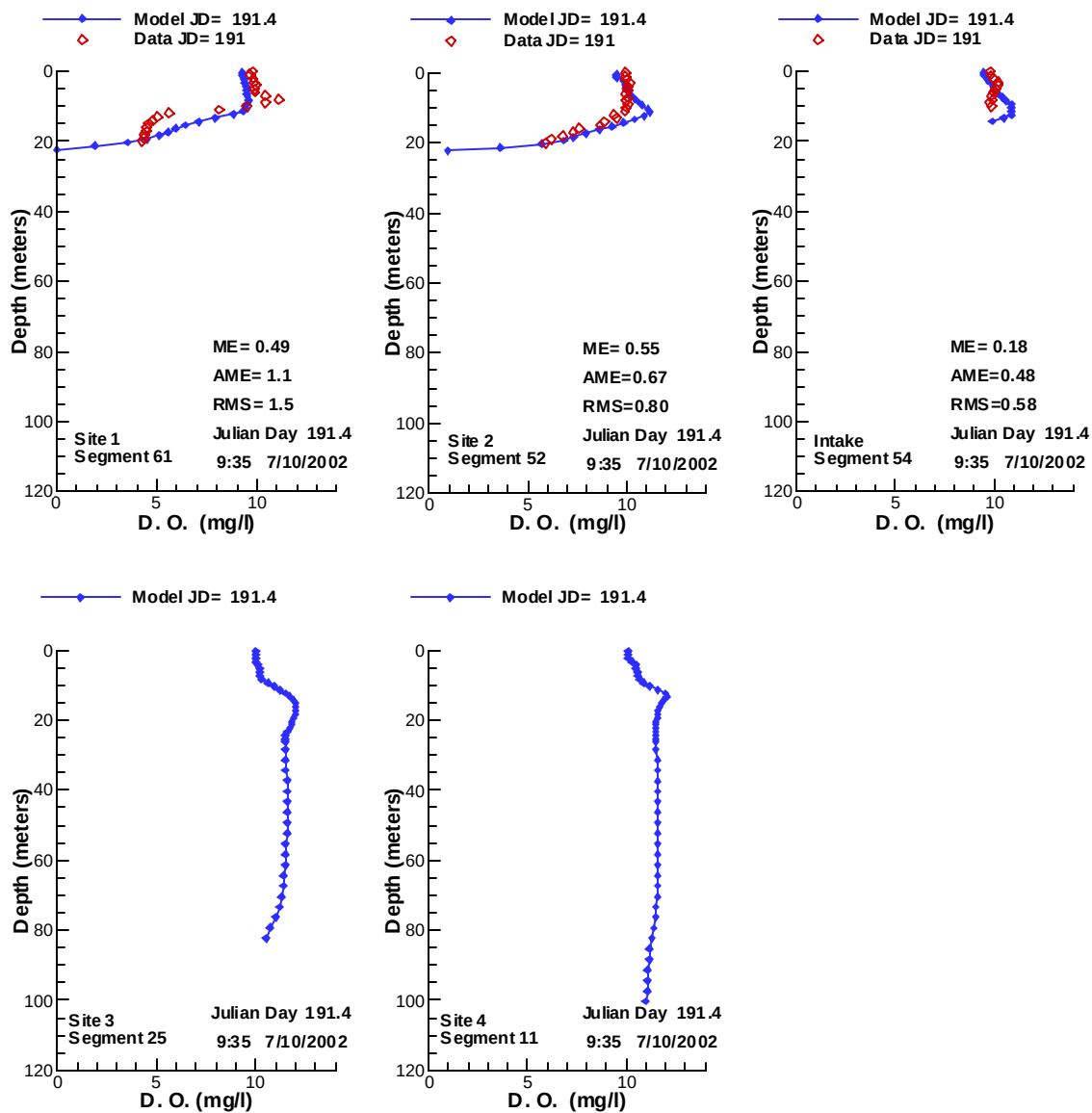


Figure 305. Vertical profiles of DISSOLVED OXYGEN compared with data for 7/10/2002.

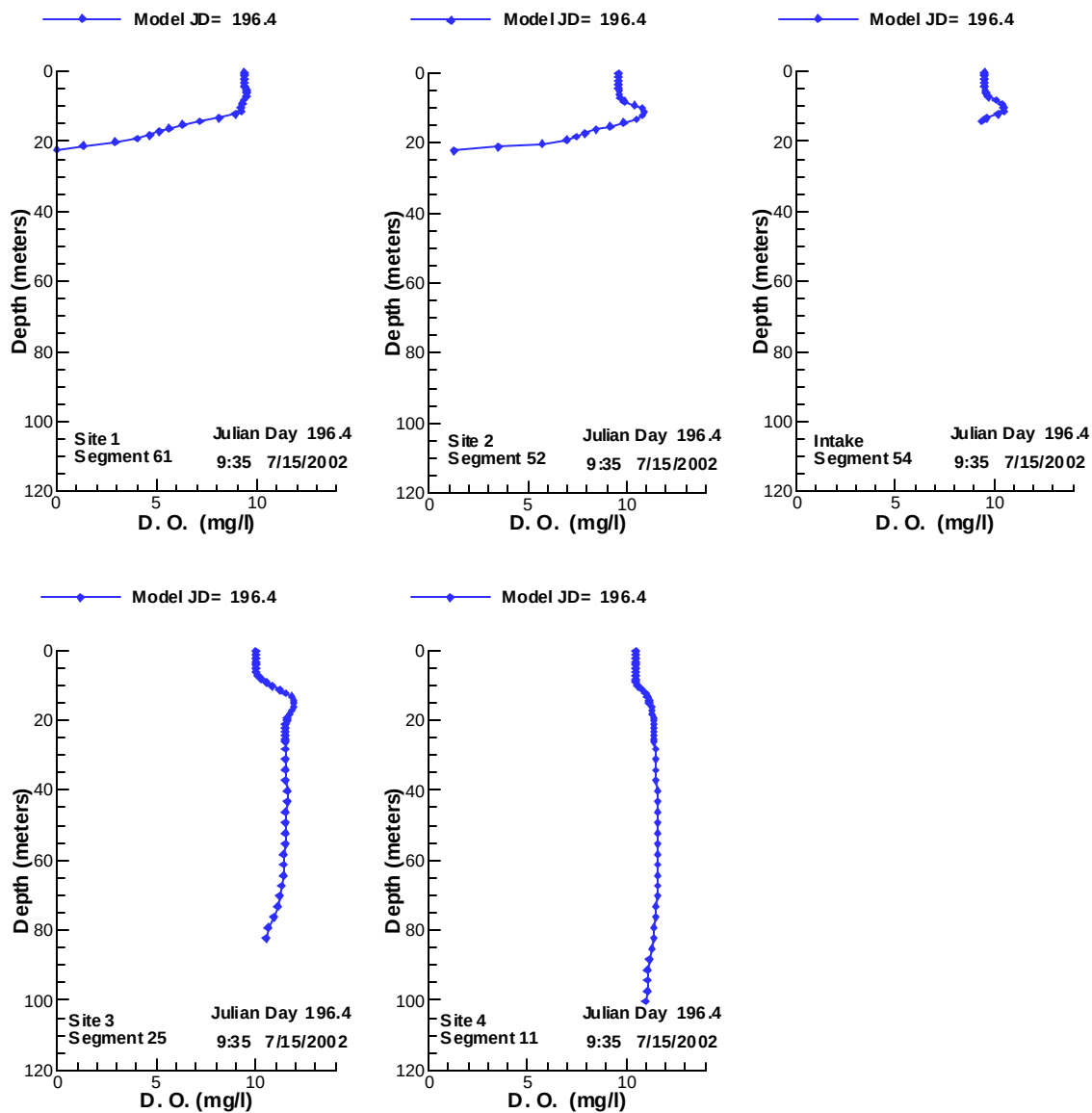


Figure 306. Vertical profiles of DISSOLVED OXYGEN compared with data for 7/15/2002.

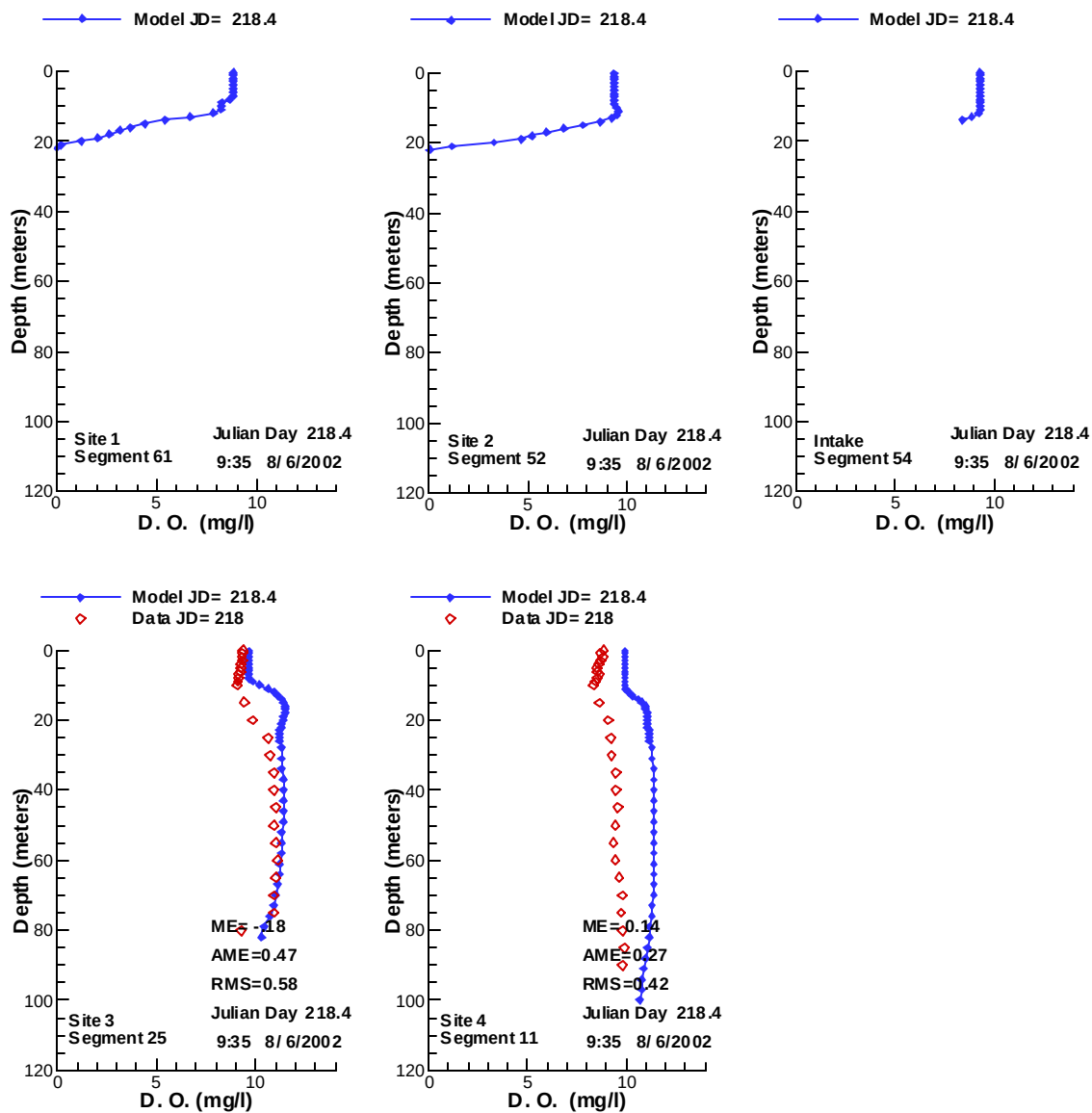


Figure 307. Vertical profiles of DISSOLVED OXYGEN compared with data for 8/ 6/2002.

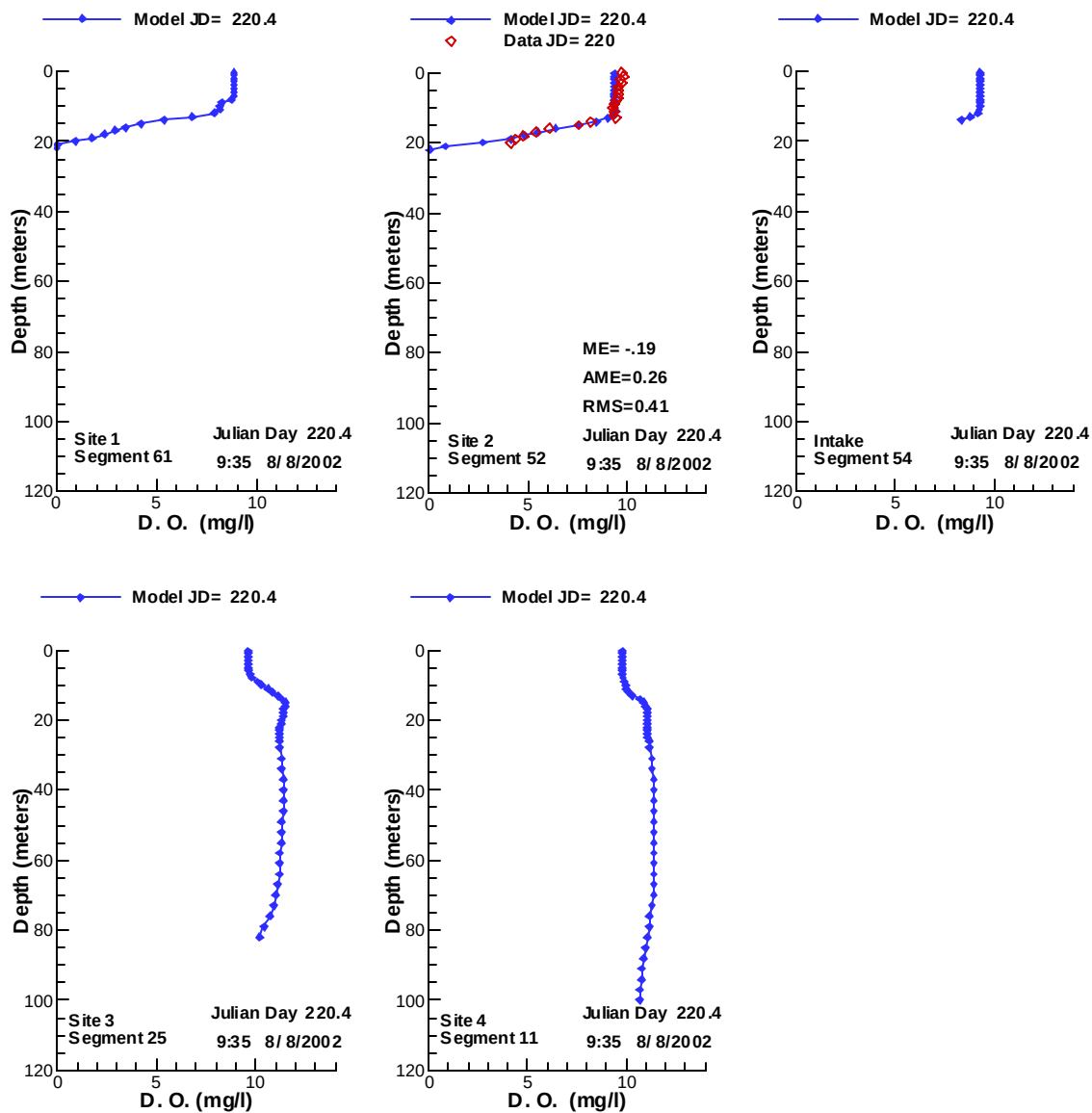


Figure 308. Vertical profiles of DISSOLVED OXYGEN compared with data for 8/ 8/2002.

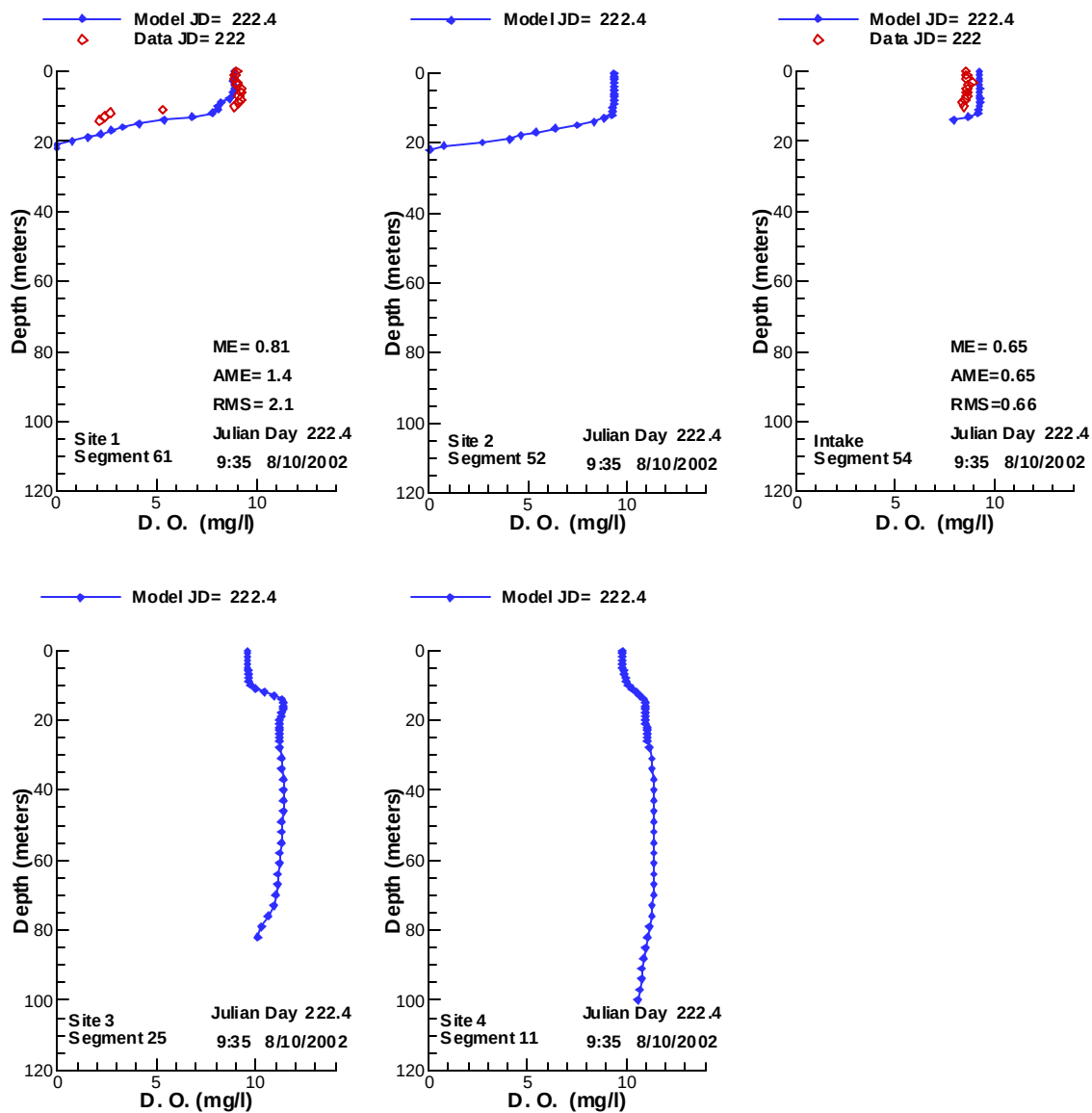


Figure 309. Vertical profiles of DISSOLVED OXYGEN compared with data for 8/10/2002.

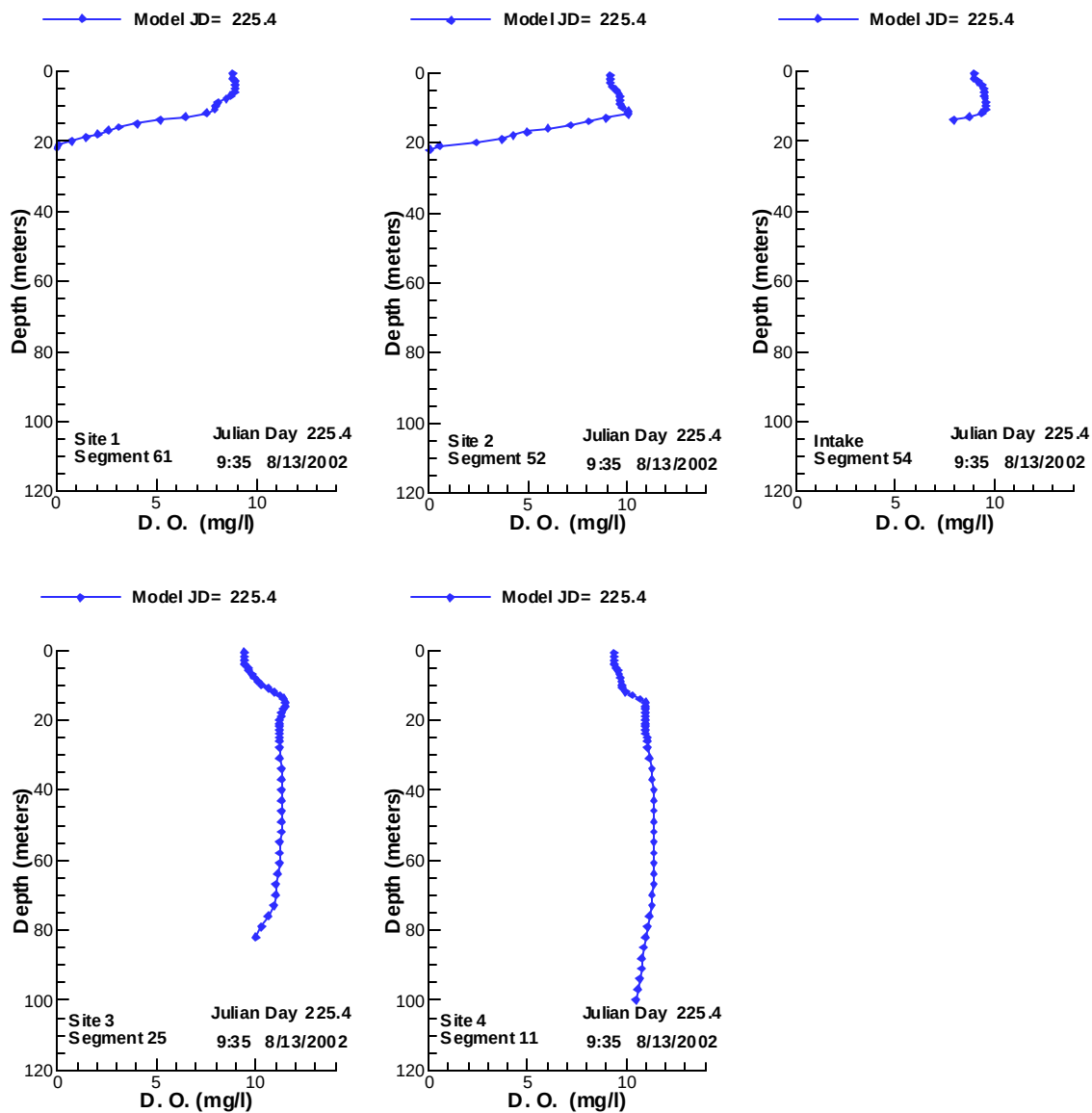


Figure 310. Vertical profiles of DISSOLVED OXYGEN compared with data for 8/13/2002.

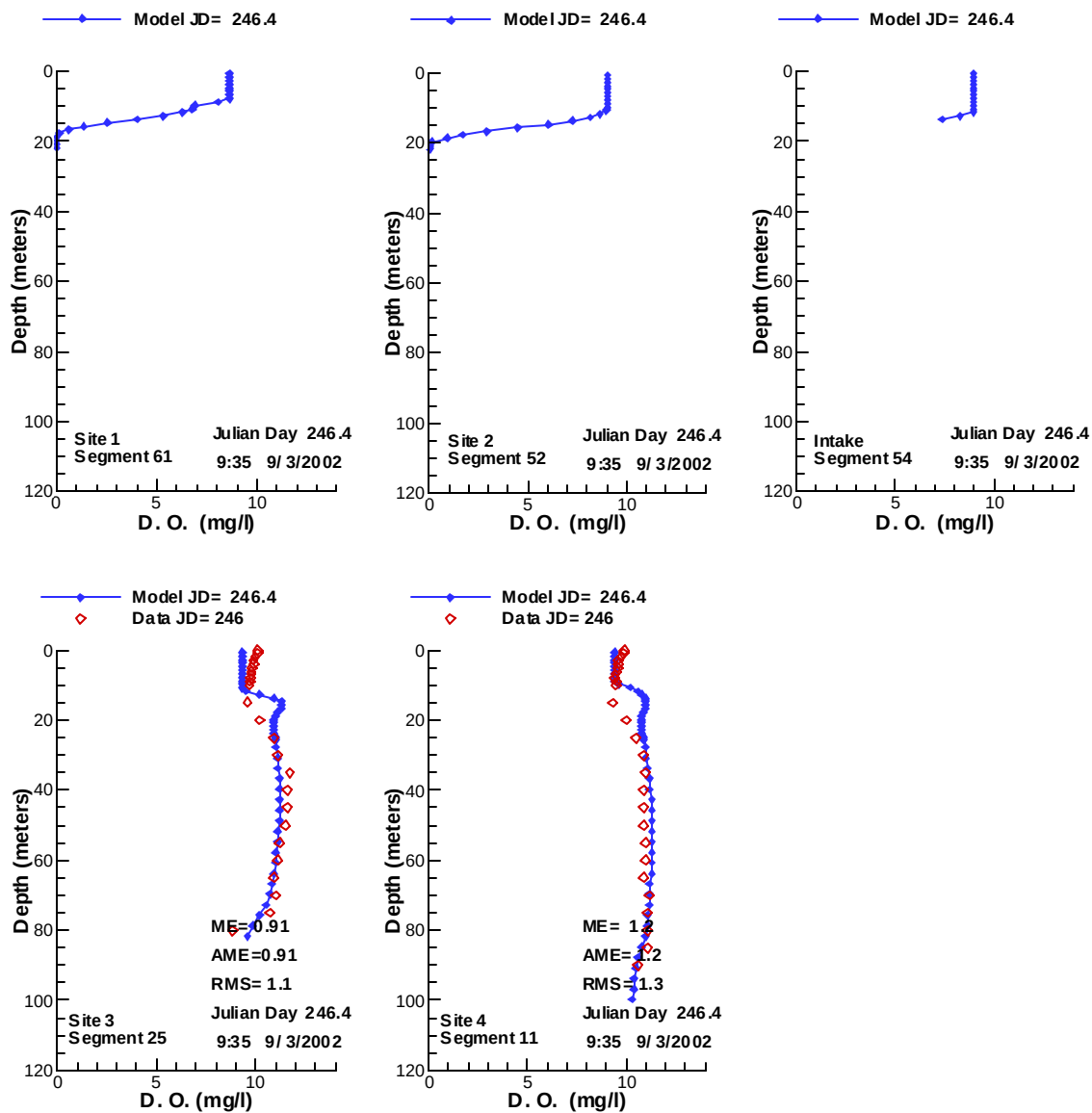


Figure 311. Vertical profiles of DISSOLVED OXYGEN compared with data for 9/ 3/2002.

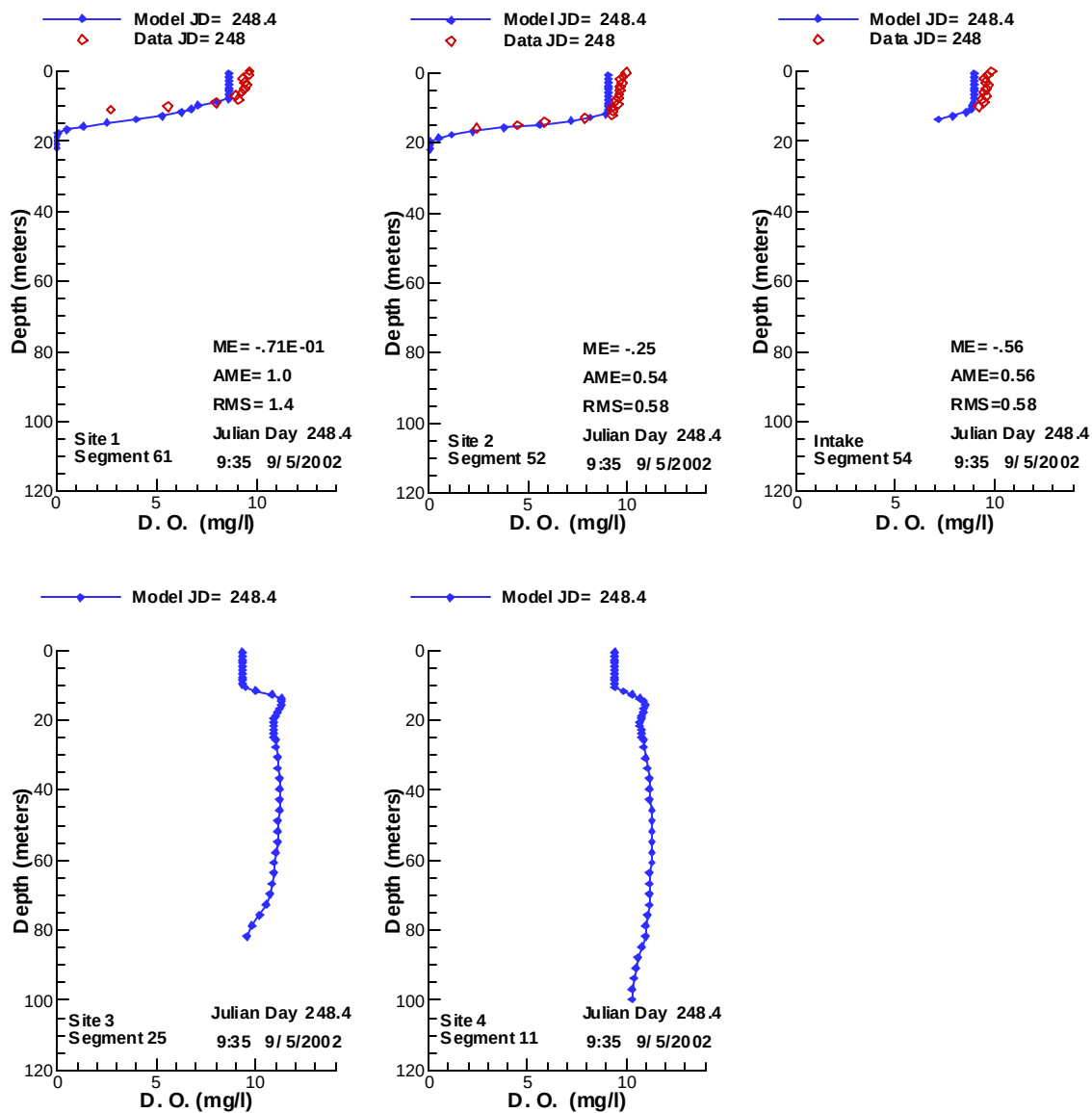


Figure 312. Vertical profiles of DISSOLVED OXYGEN compared with data for 9/ 5/2002.

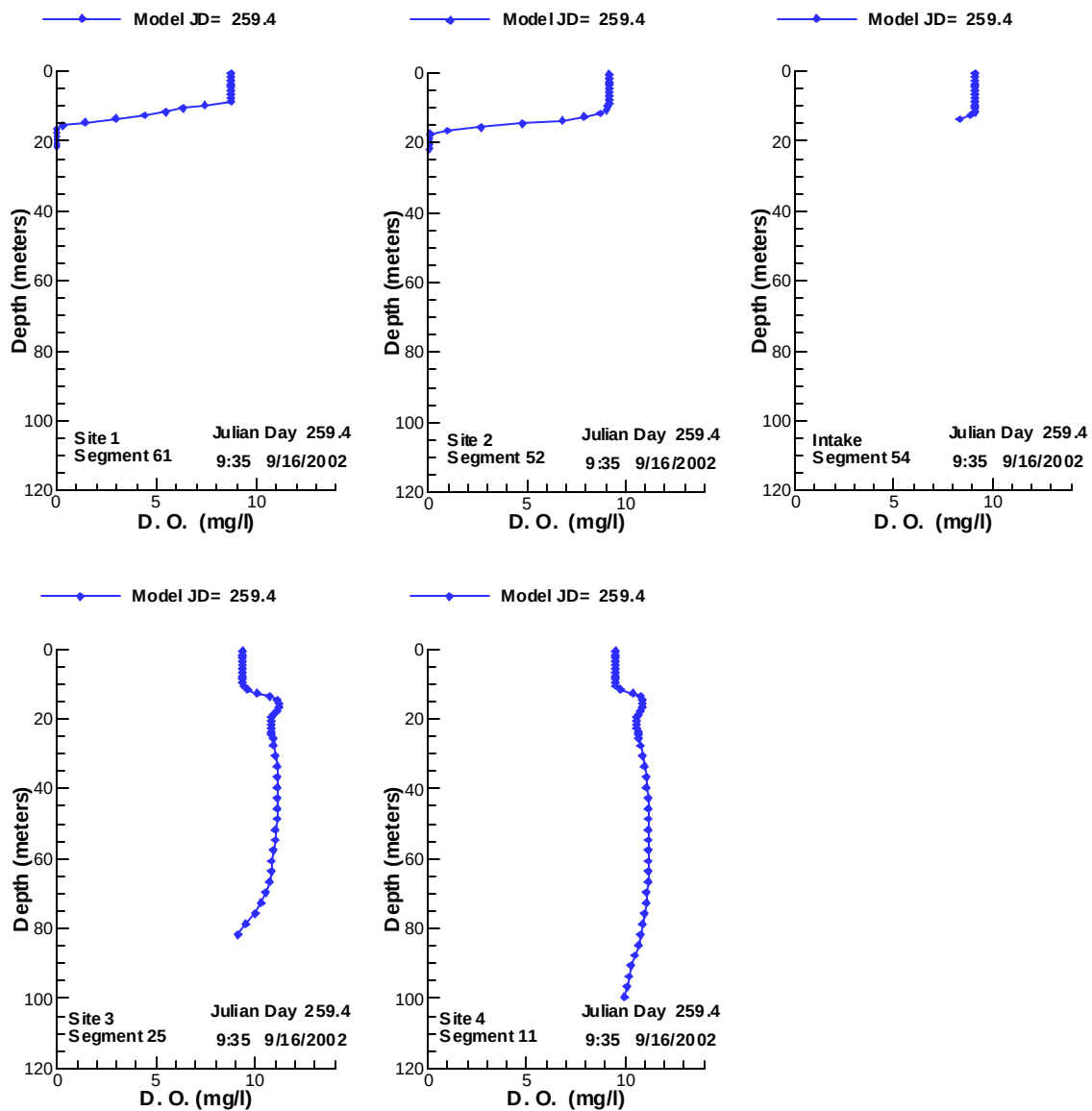


Figure 313. Vertical profiles of DISSOLVED OXYGEN compared with data for 9/16/2002.

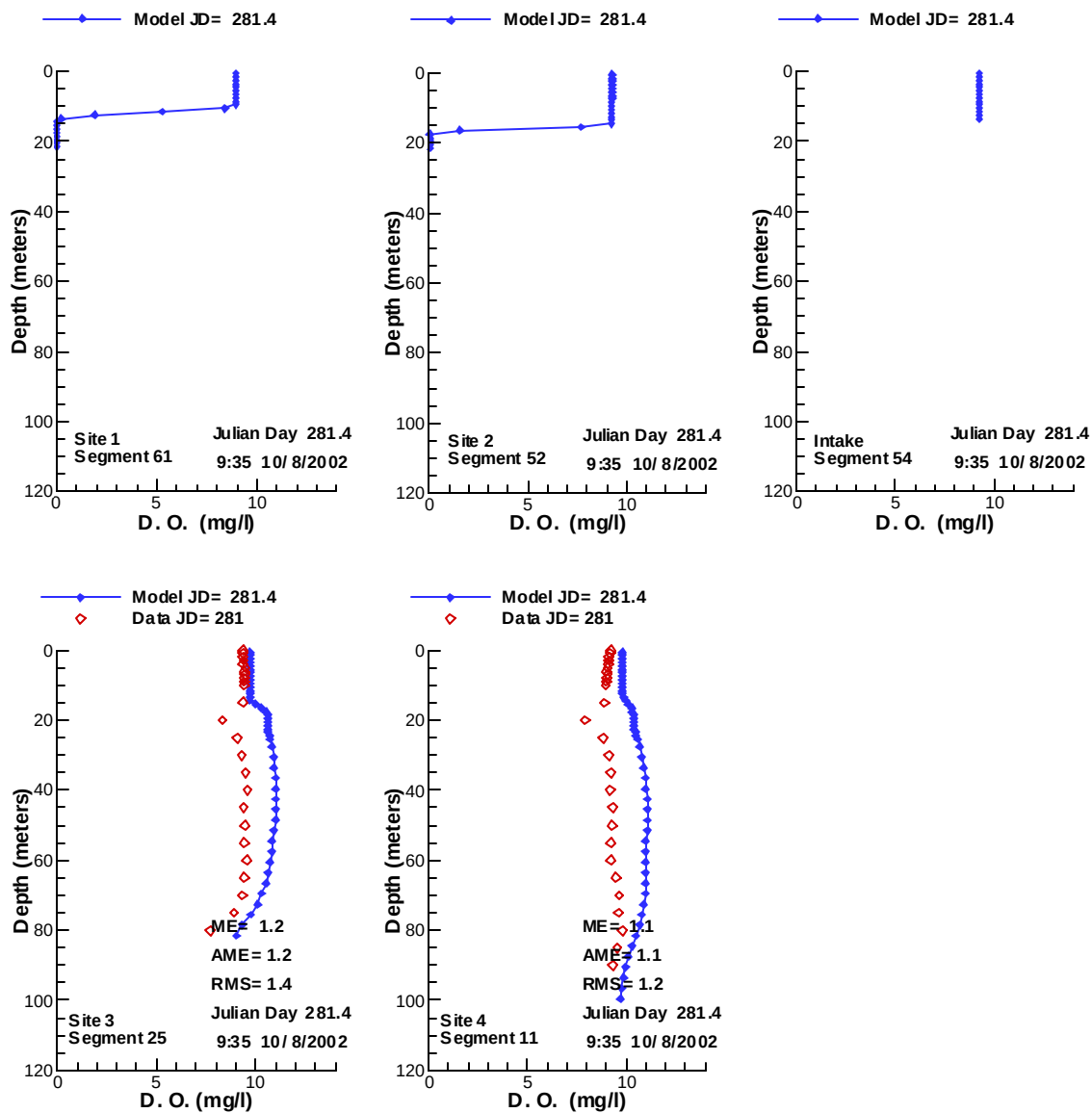


Figure 314. Vertical profiles of DISSOLVED OXYGEN compared with data for 10/ 8/2002.

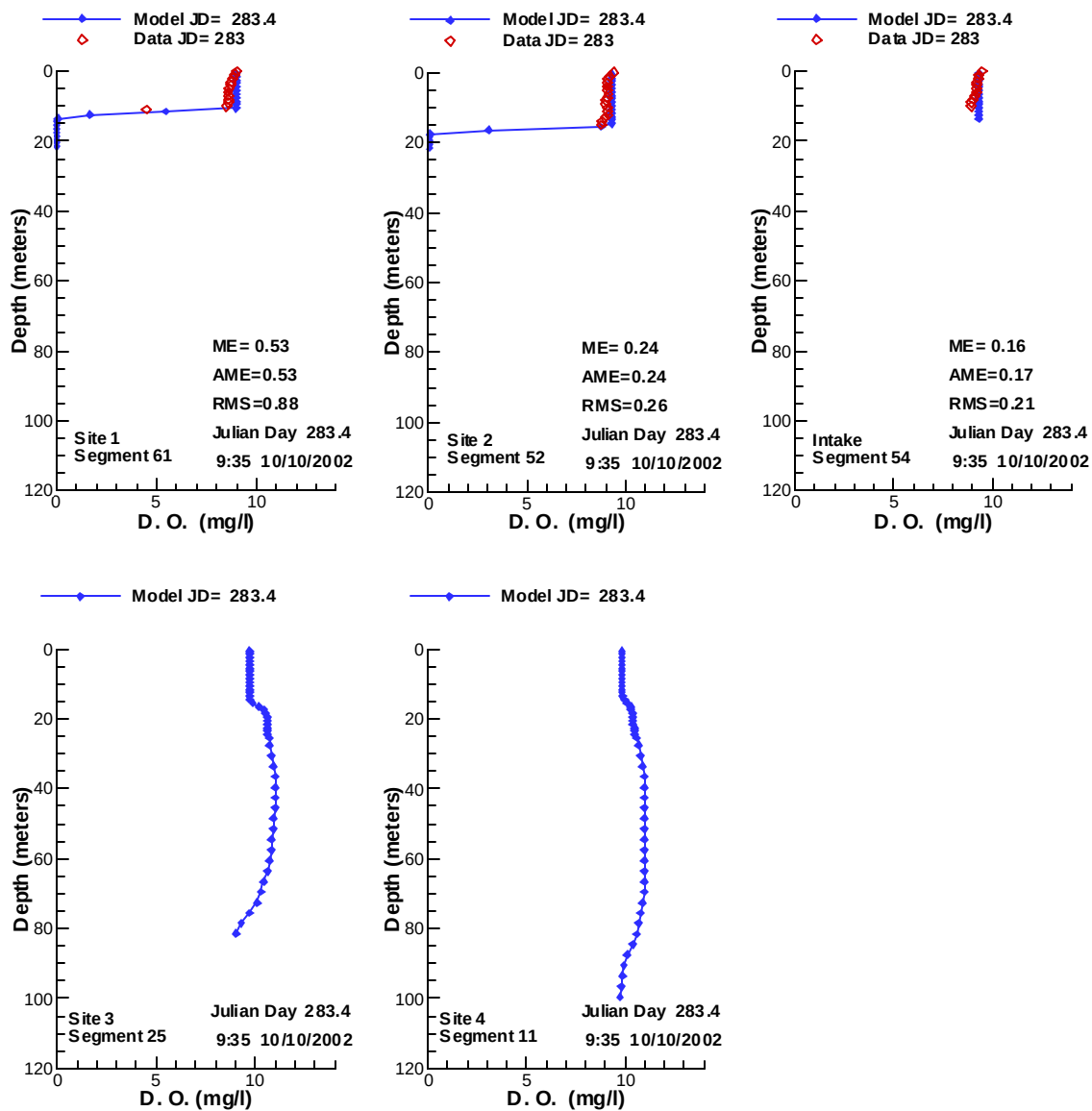


Figure 315. Vertical profiles of DISSOLVED OXYGEN compared with data for 10/10/2002.

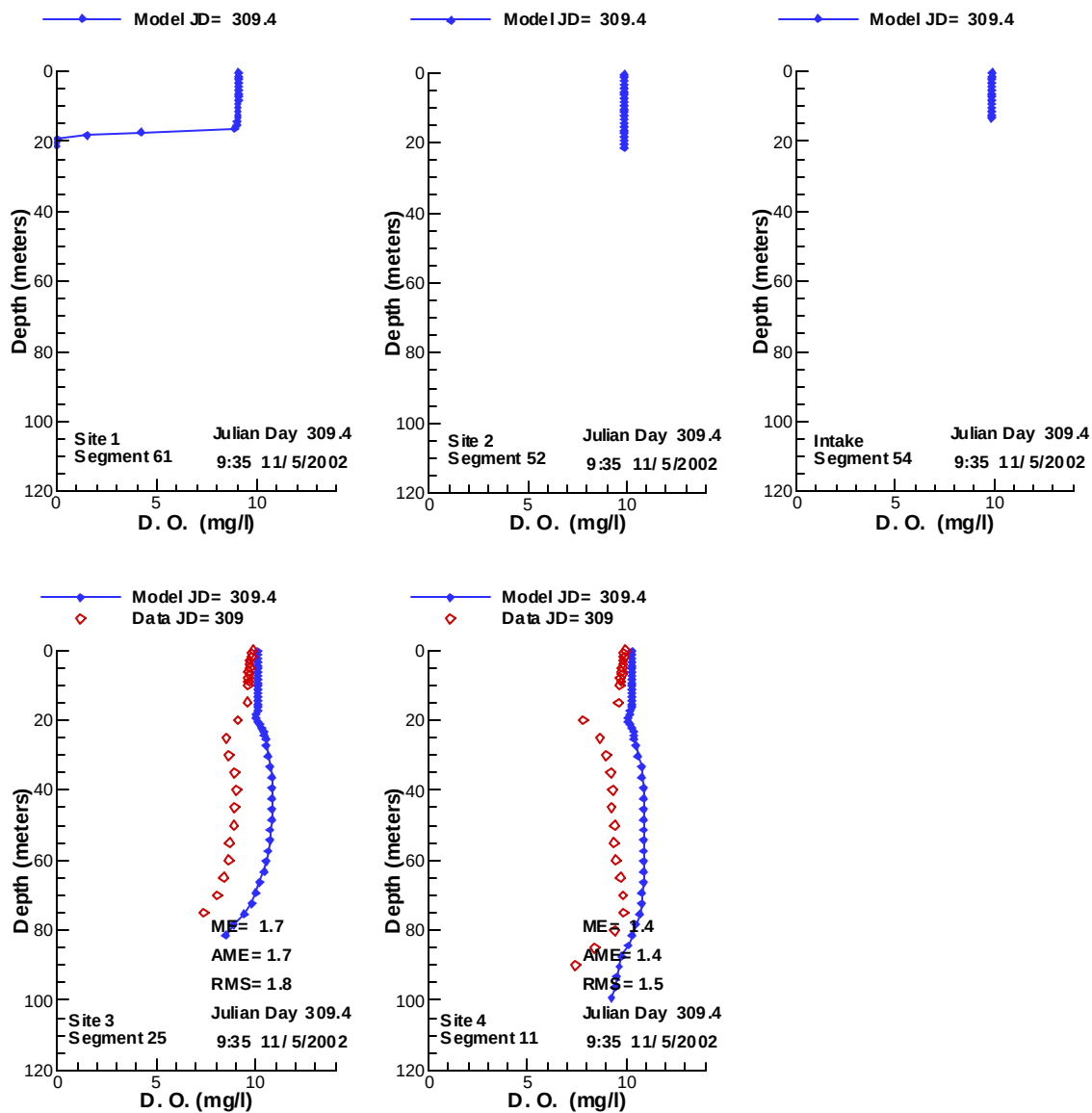


Figure 316. Vertical profiles of DISSOLVED OXYGEN compared with data for 11/ 5/2002.

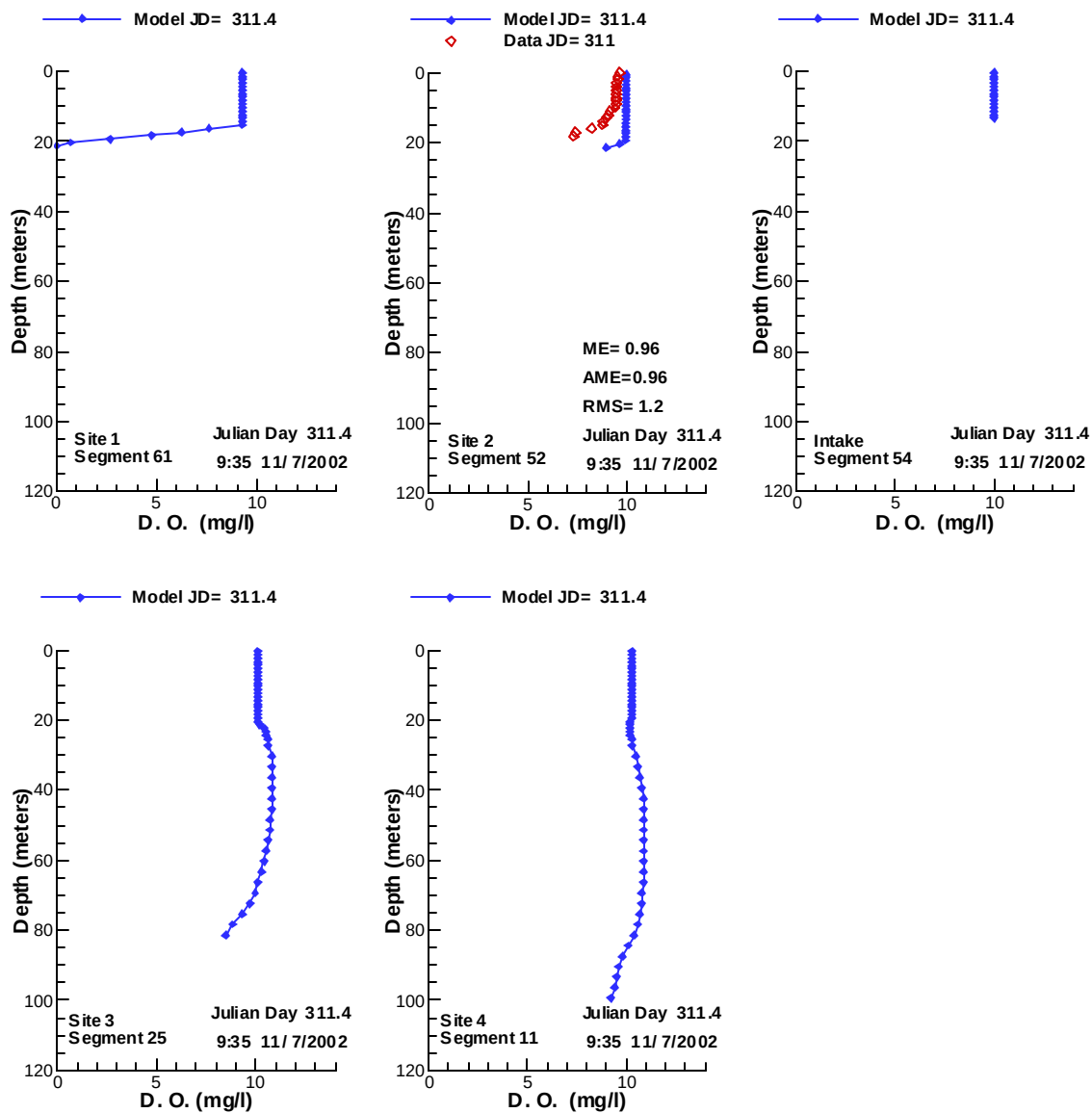


Figure 317. Vertical profiles of DISSOLVED OXYGEN compared with data for 11/ 7/2002.

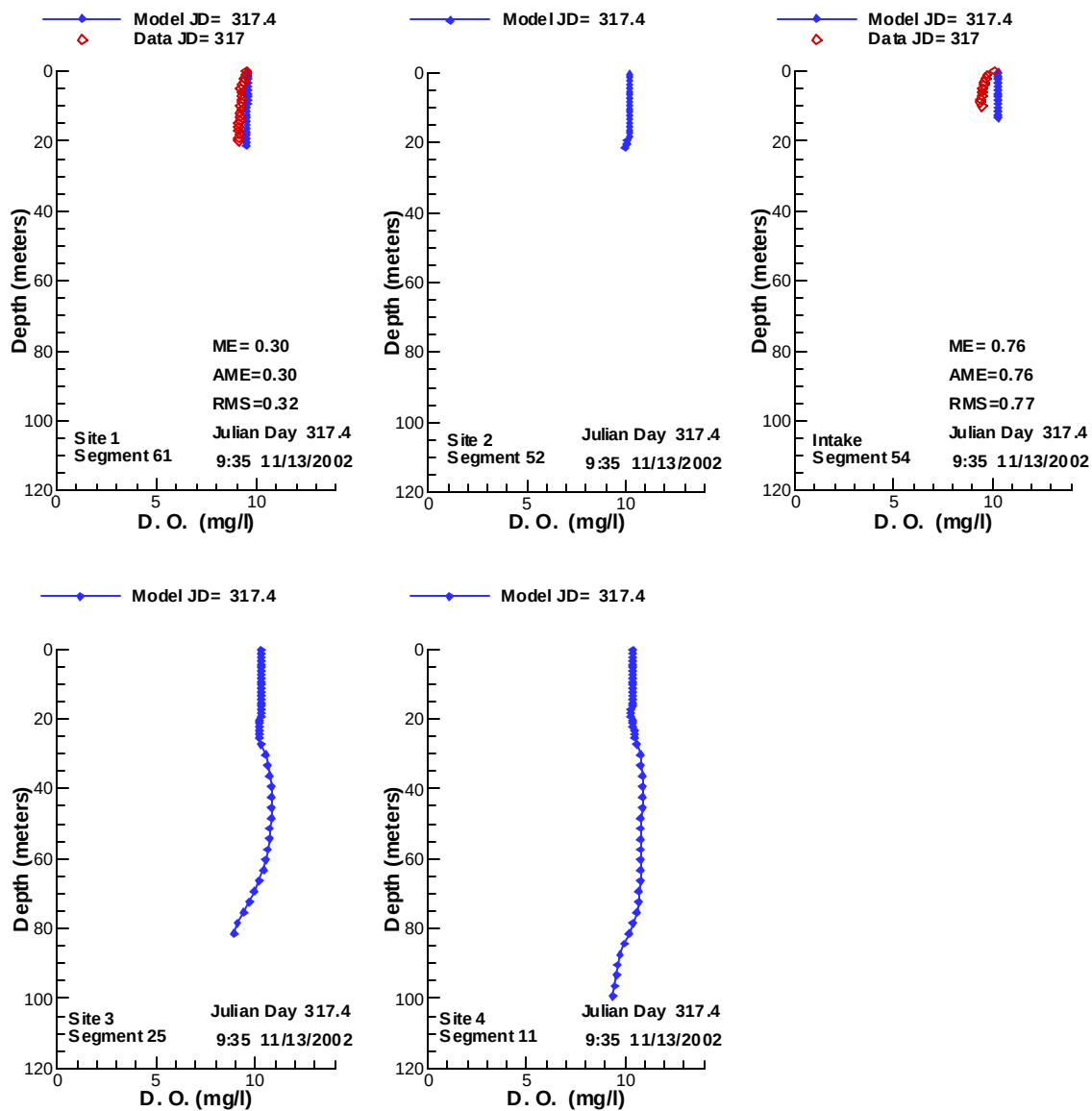


Figure 318. Vertical profiles of DISSOLVED OXYGEN compared with data for 11/13/2002.

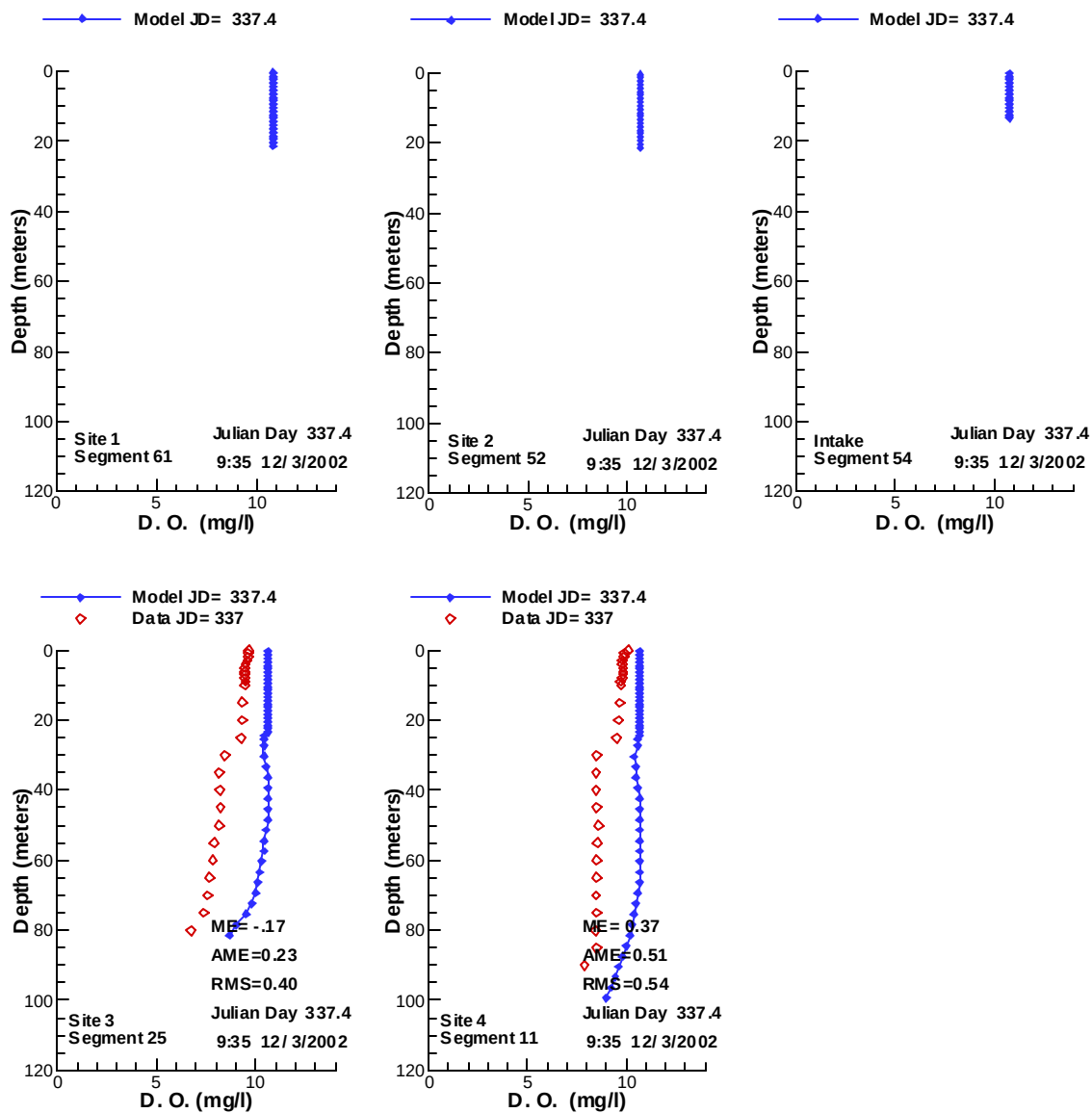


Figure 319. Vertical profiles of DISSOLVED OXYGEN compared with data for 12/ 3/2002.

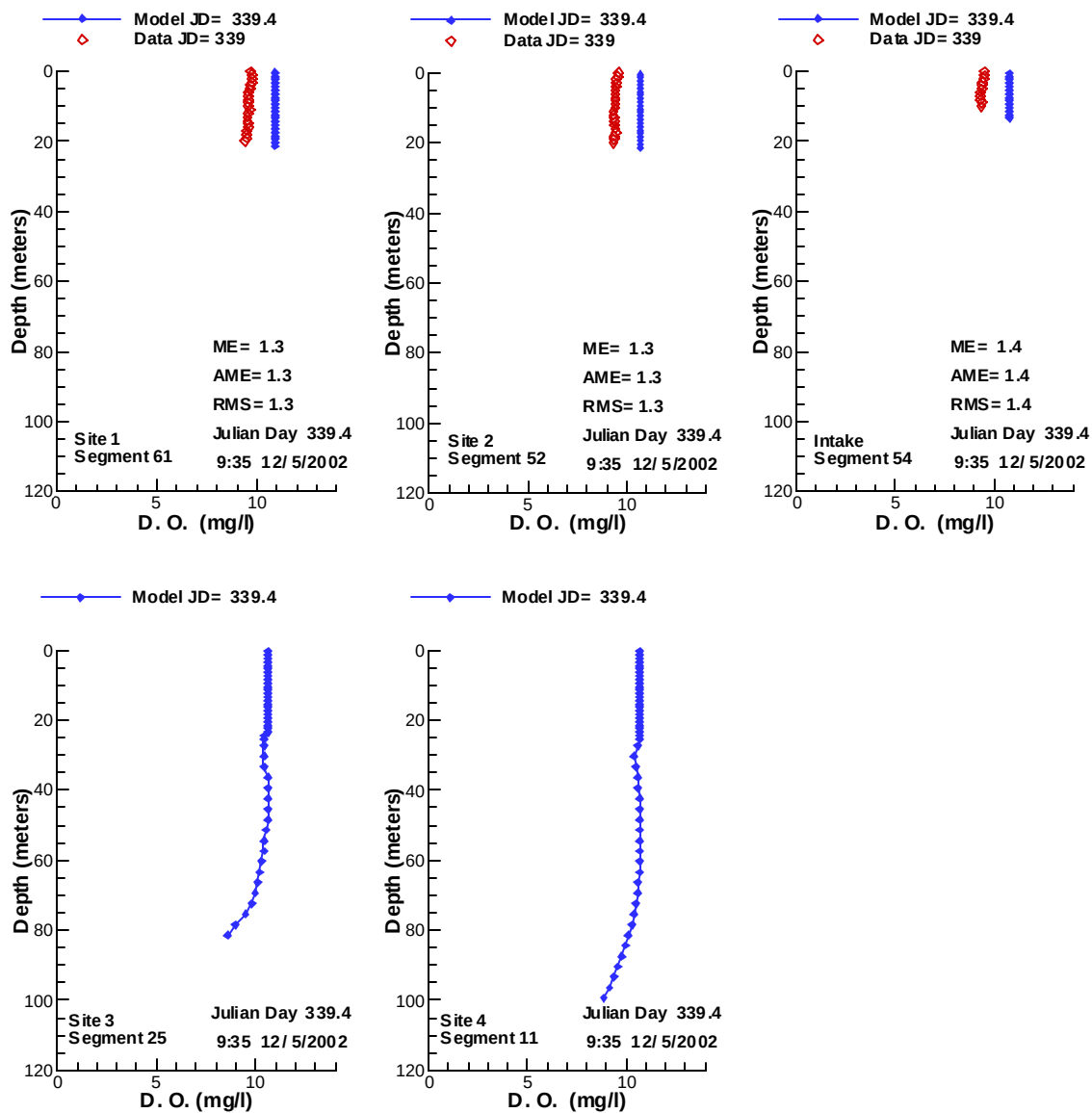


Figure 320. Vertical profiles of DISSOLVED OXYGEN compared with data for 12/ 5/2002.

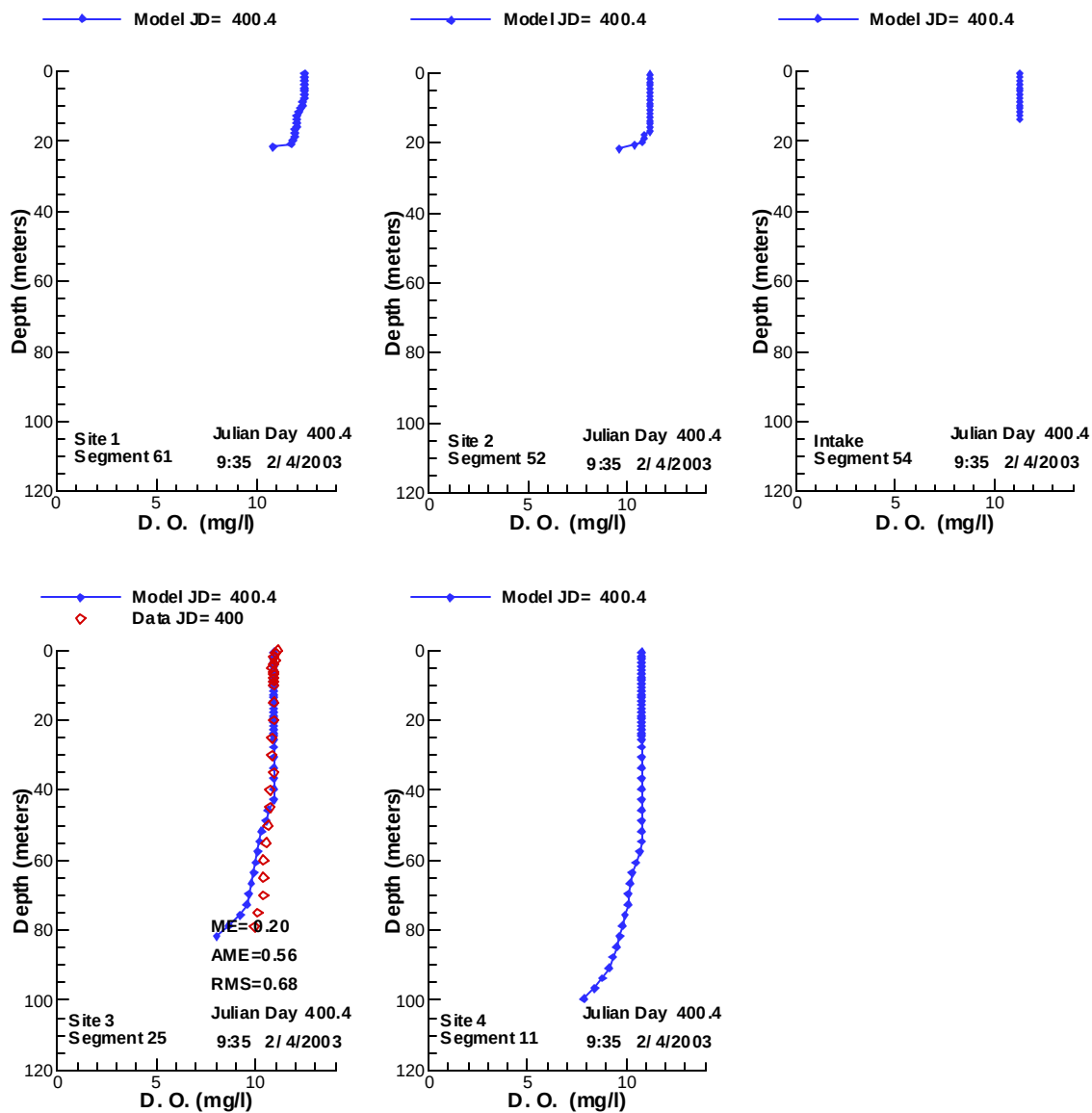


Figure 321. Vertical profiles of DISSOLVED OXYGEN compared with data for 2/ 4/2003.

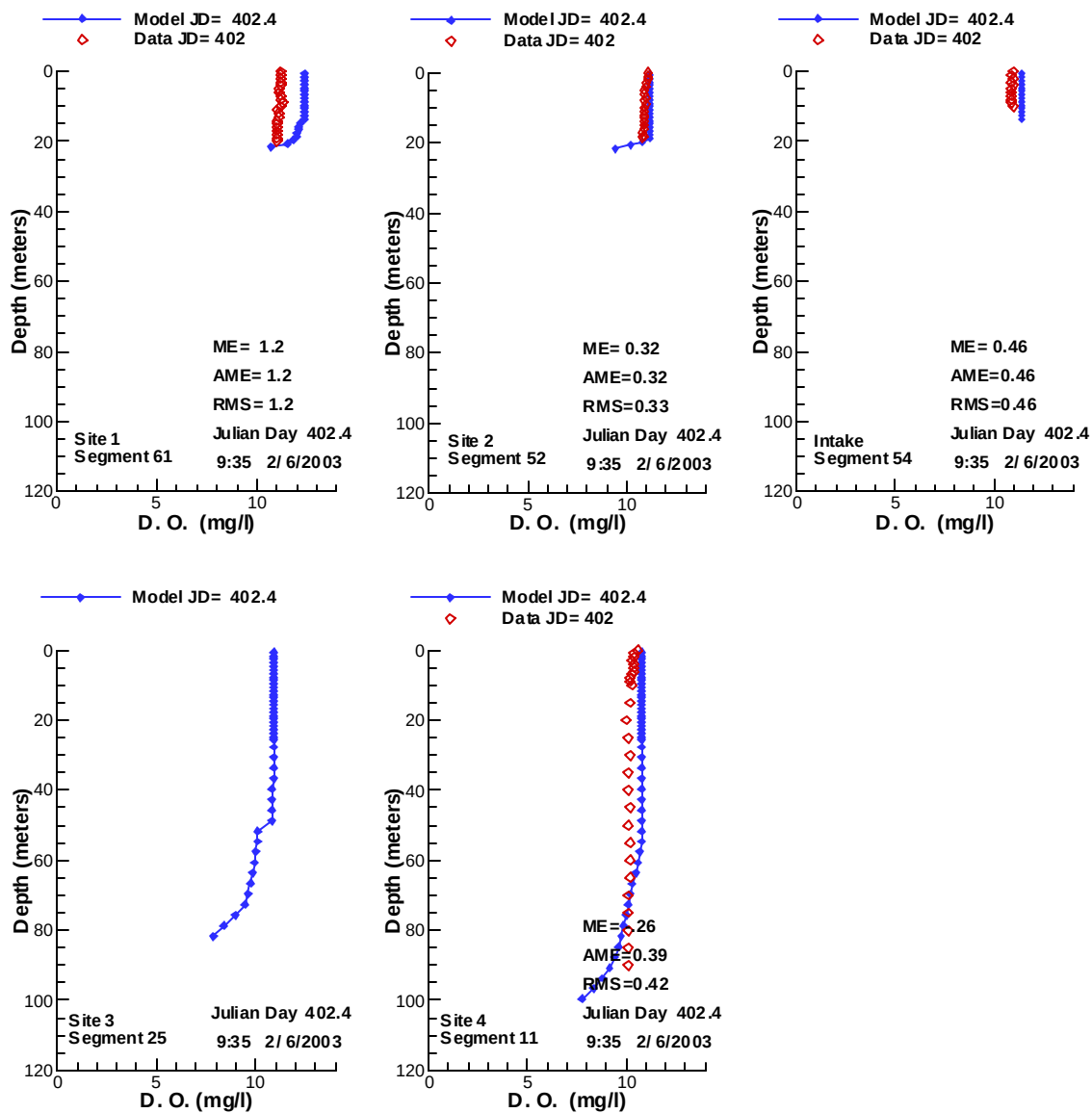


Figure 322. Vertical profiles of DISSOLVED OXYGEN compared with data for 2/ 6/2003.

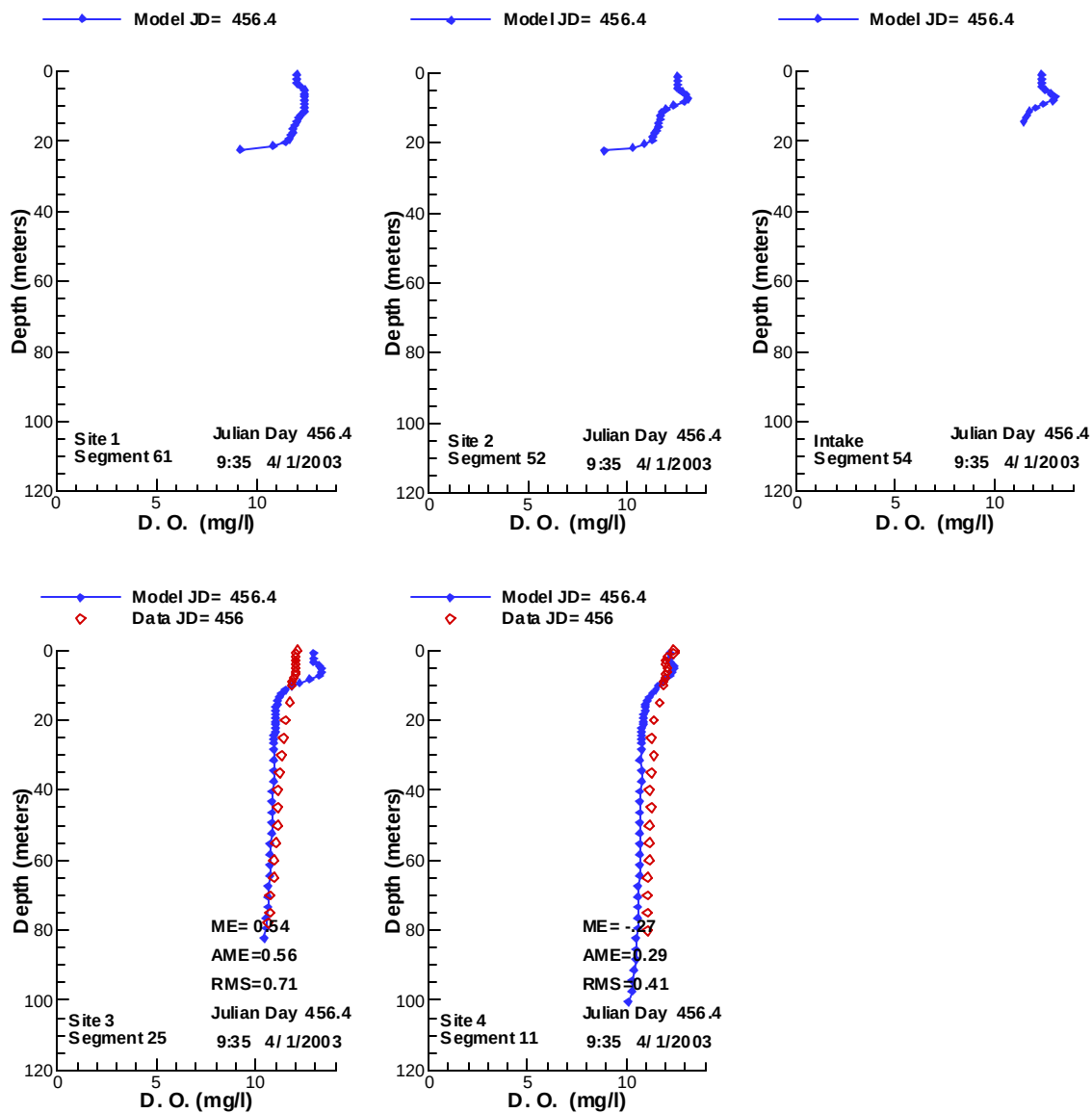


Figure 323. Vertical profiles of DISSOLVED OXYGEN compared with data for 4/ 1/2003.

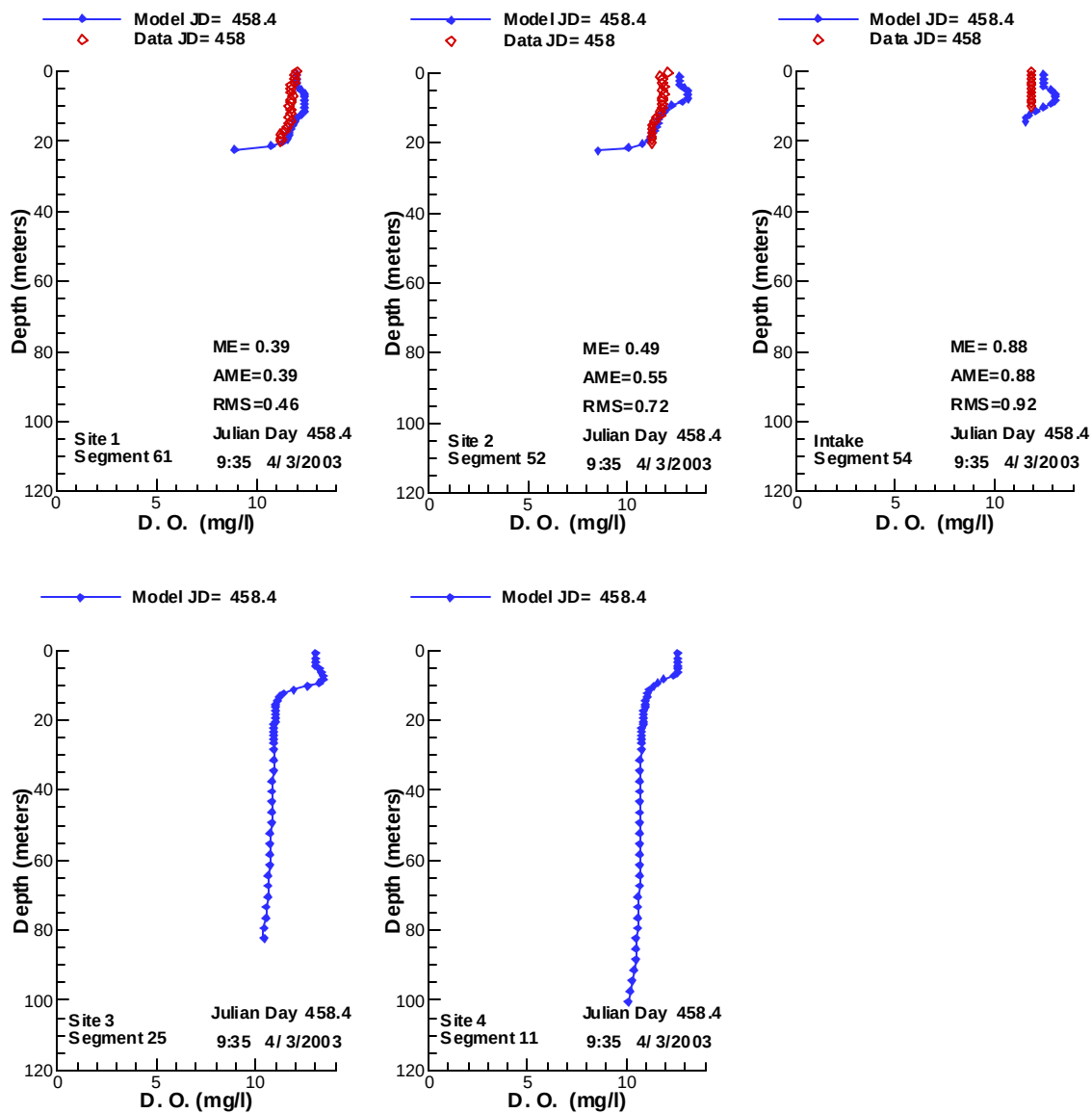


Figure 324. Vertical profiles of DISSOLVED OXYGEN compared with data for 4/ 3/2003.

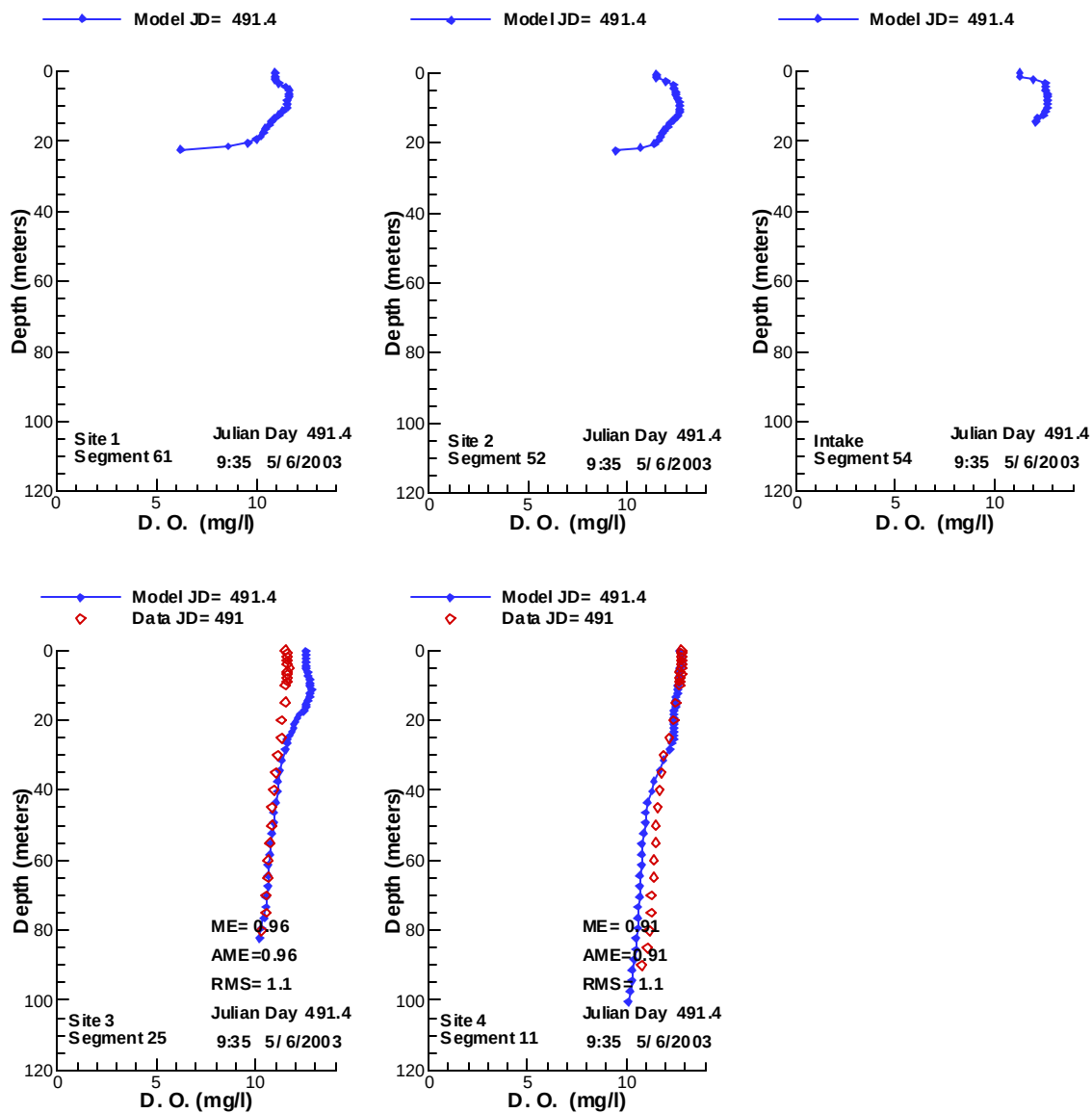


Figure 325. Vertical profiles of DISSOLVED OXYGEN compared with data for 5/ 6/2003.

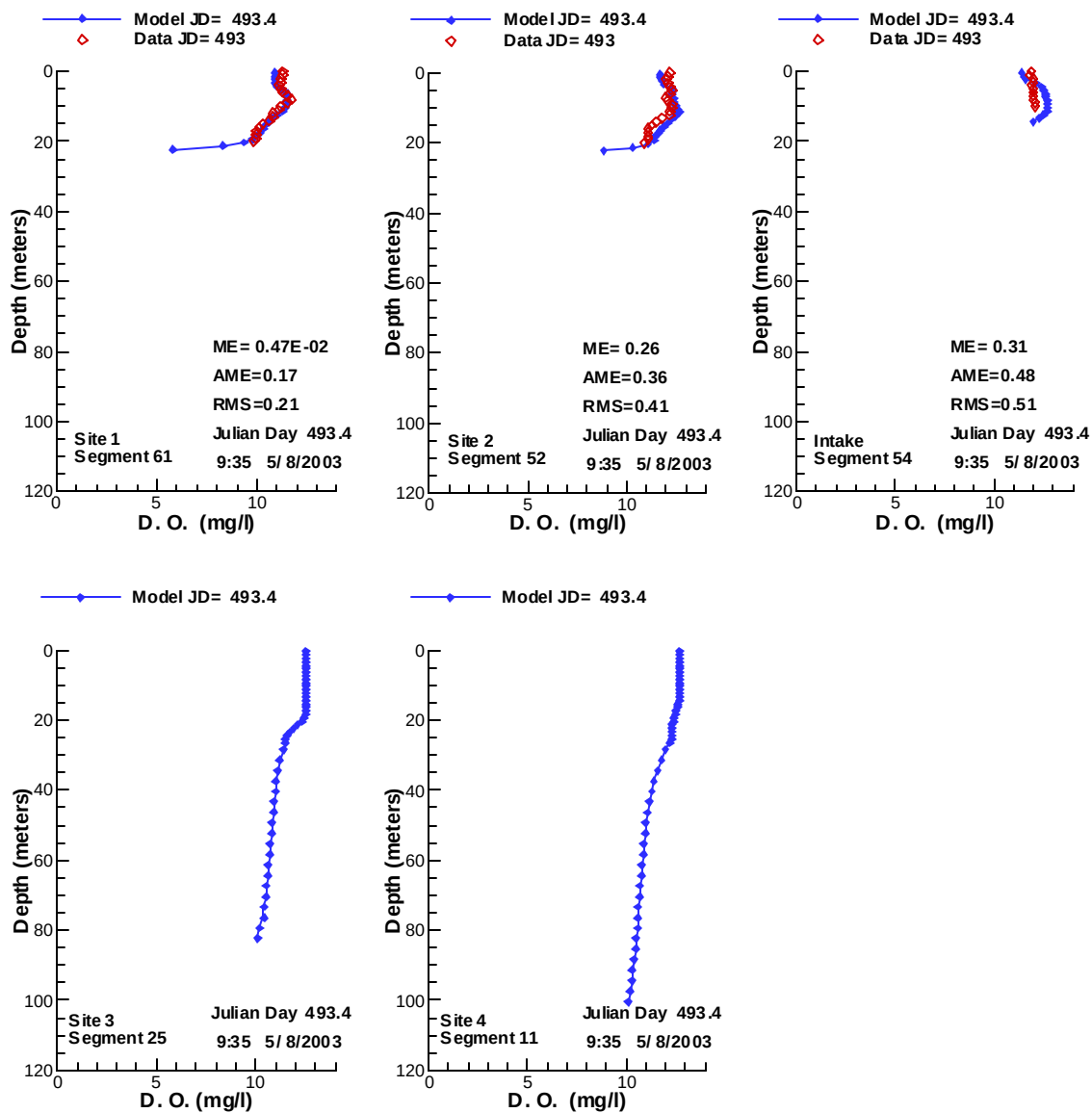


Figure 326. Vertical profiles of DISSOLVED OXYGEN compared with data for 5/ 8/2003.

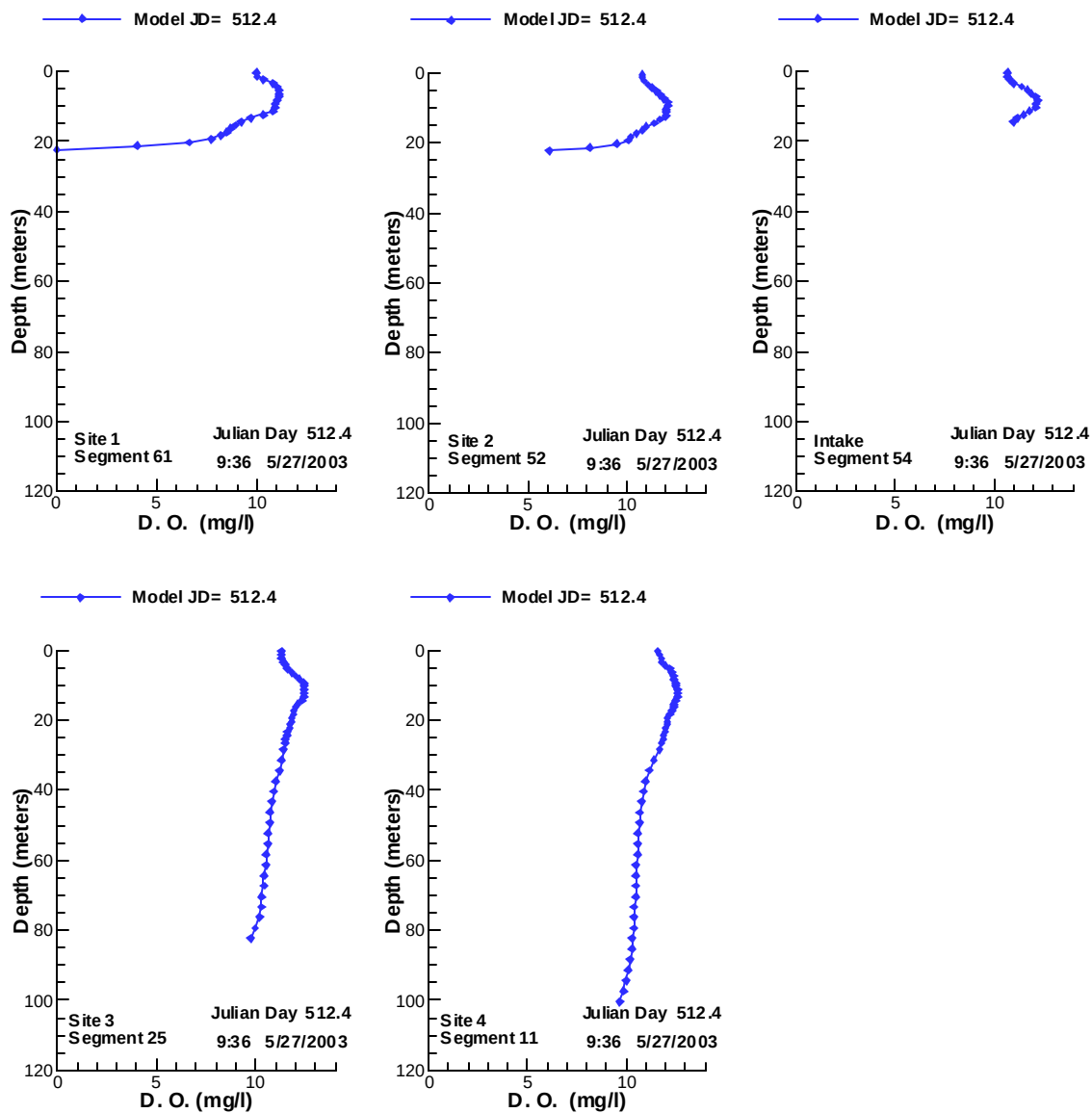


Figure 327. Vertical profiles of DISSOLVED OXYGEN compared with data for 5/27/2003.

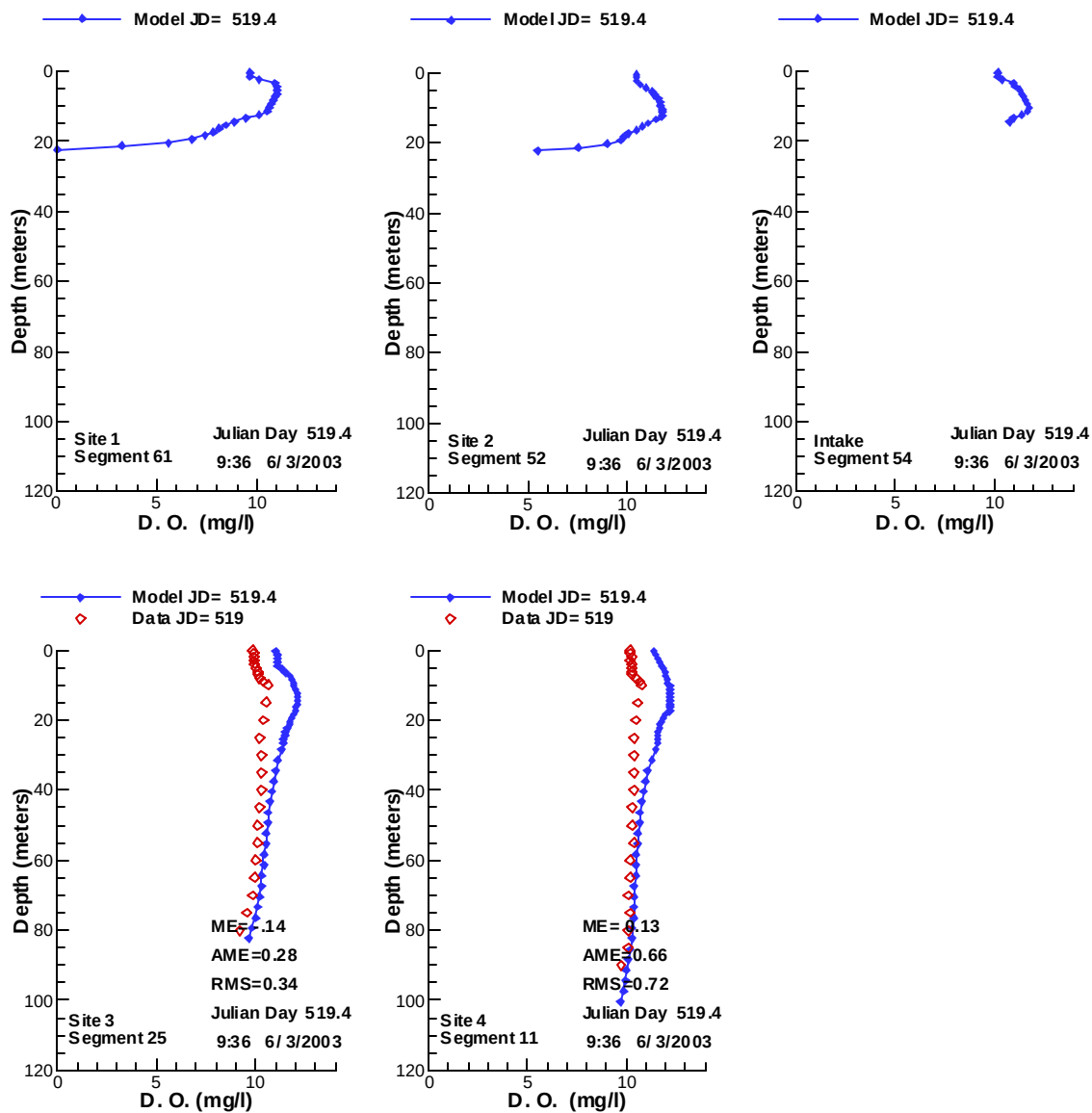


Figure 328. Vertical profiles of DISSOLVED OXYGEN compared with data for 6/ 3/2003.

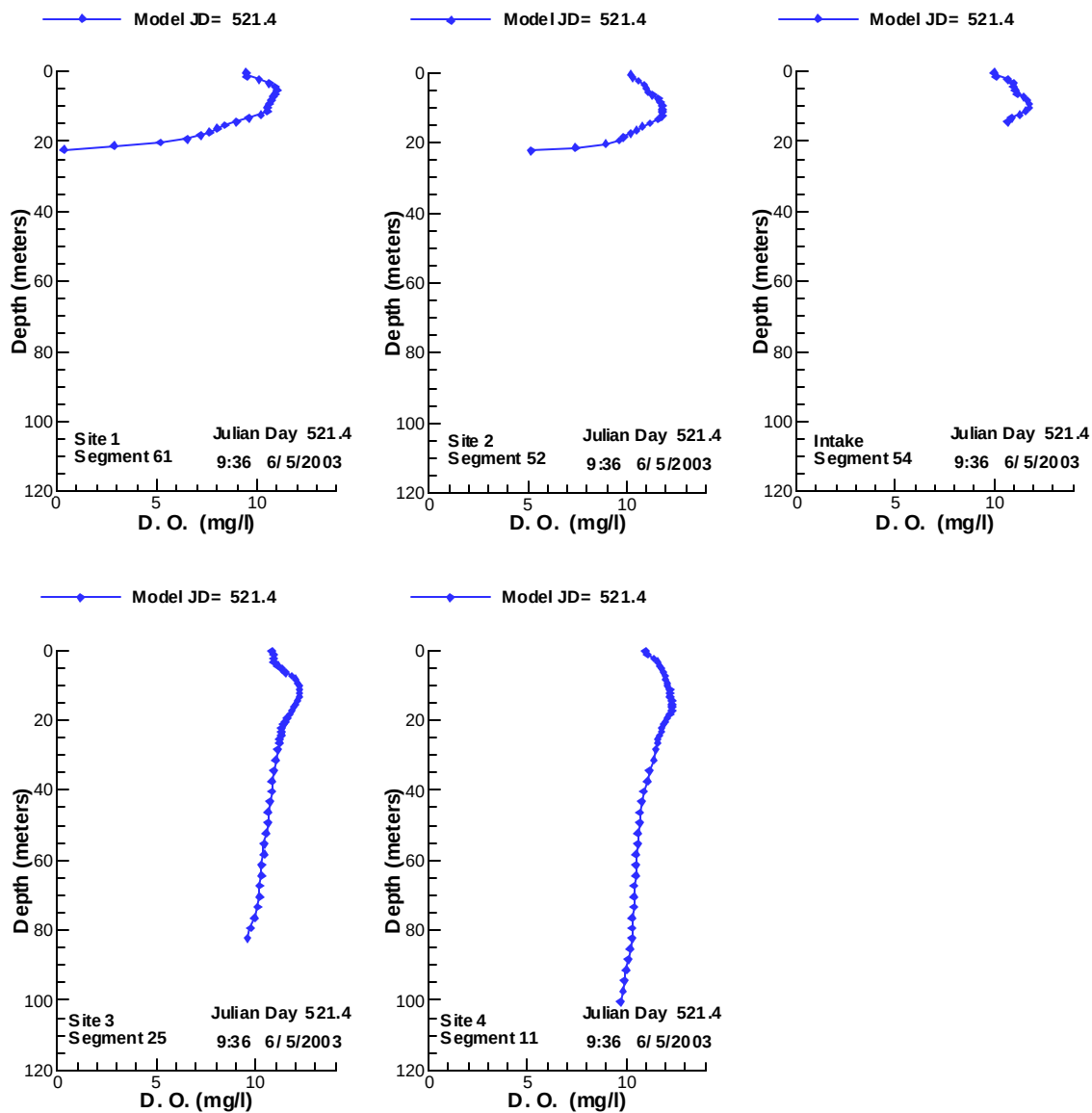


Figure 329. Vertical profiles of DISSOLVED OXYGEN compared with data for 6/ 5/2003.

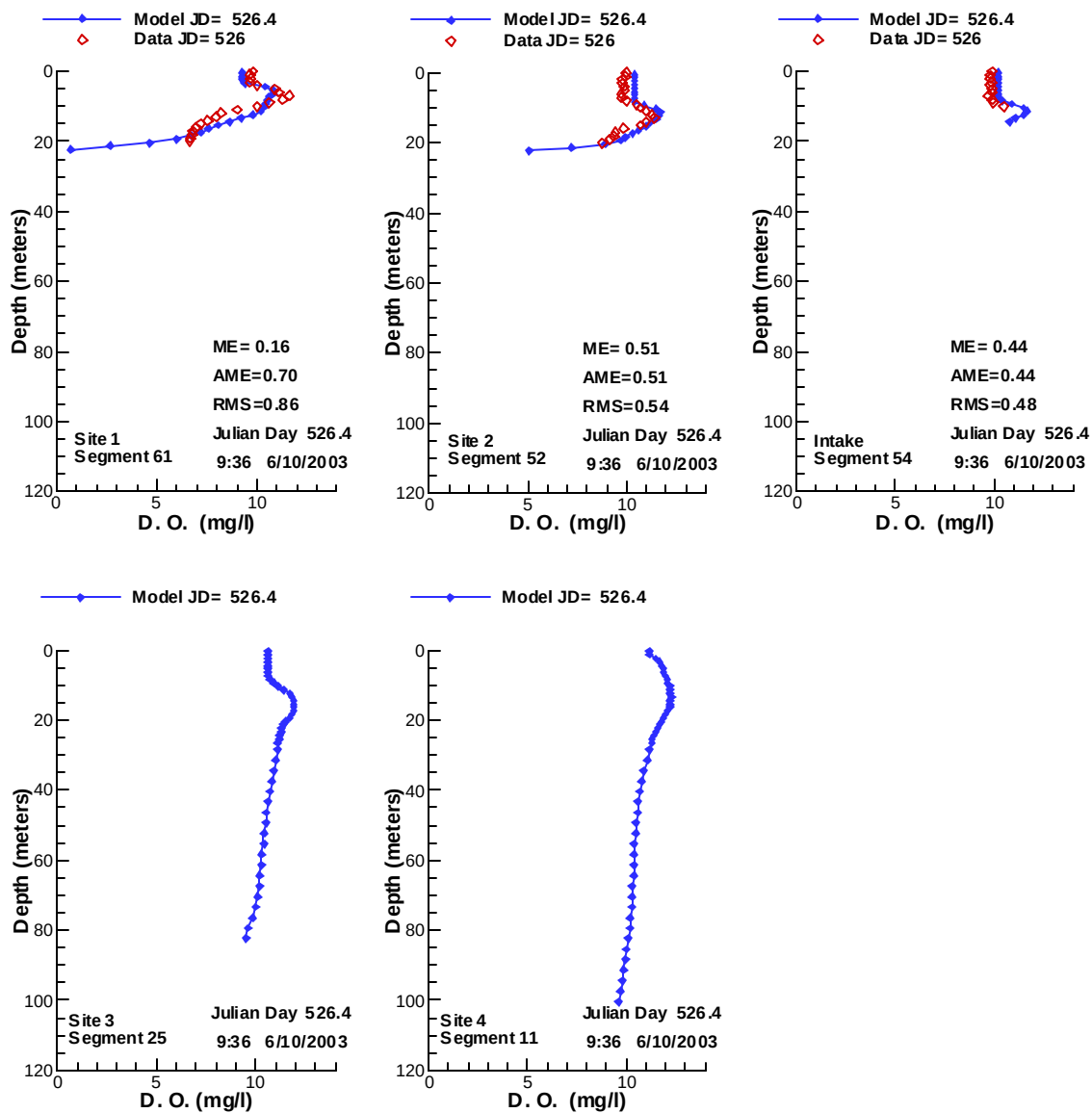


Figure 330. Vertical profiles of DISSOLVED OXYGEN compared with data for 6/10/2003.

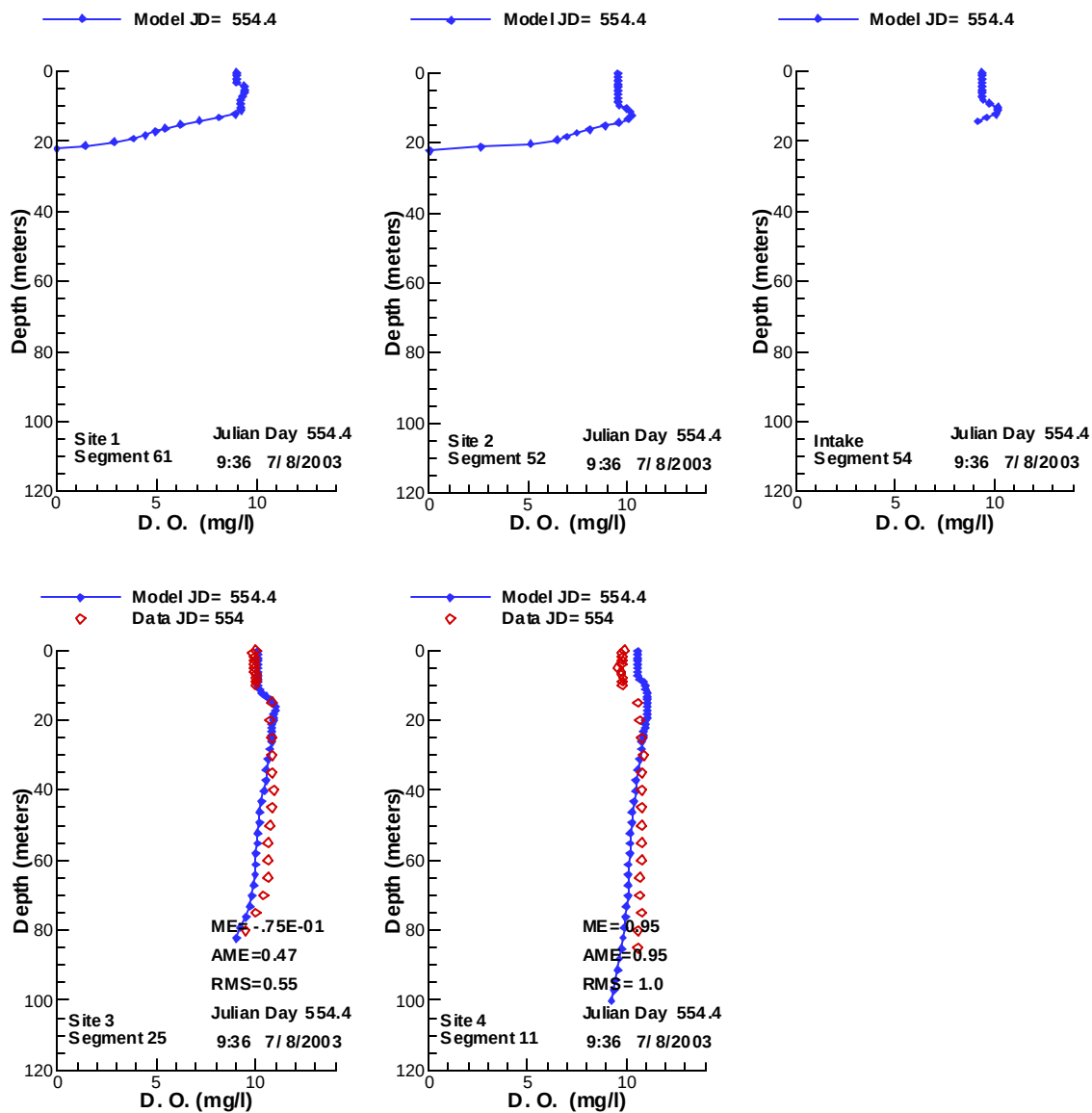


Figure 331. Vertical profiles of DISSOLVED OXYGEN compared with data for 7/ 8/2003.

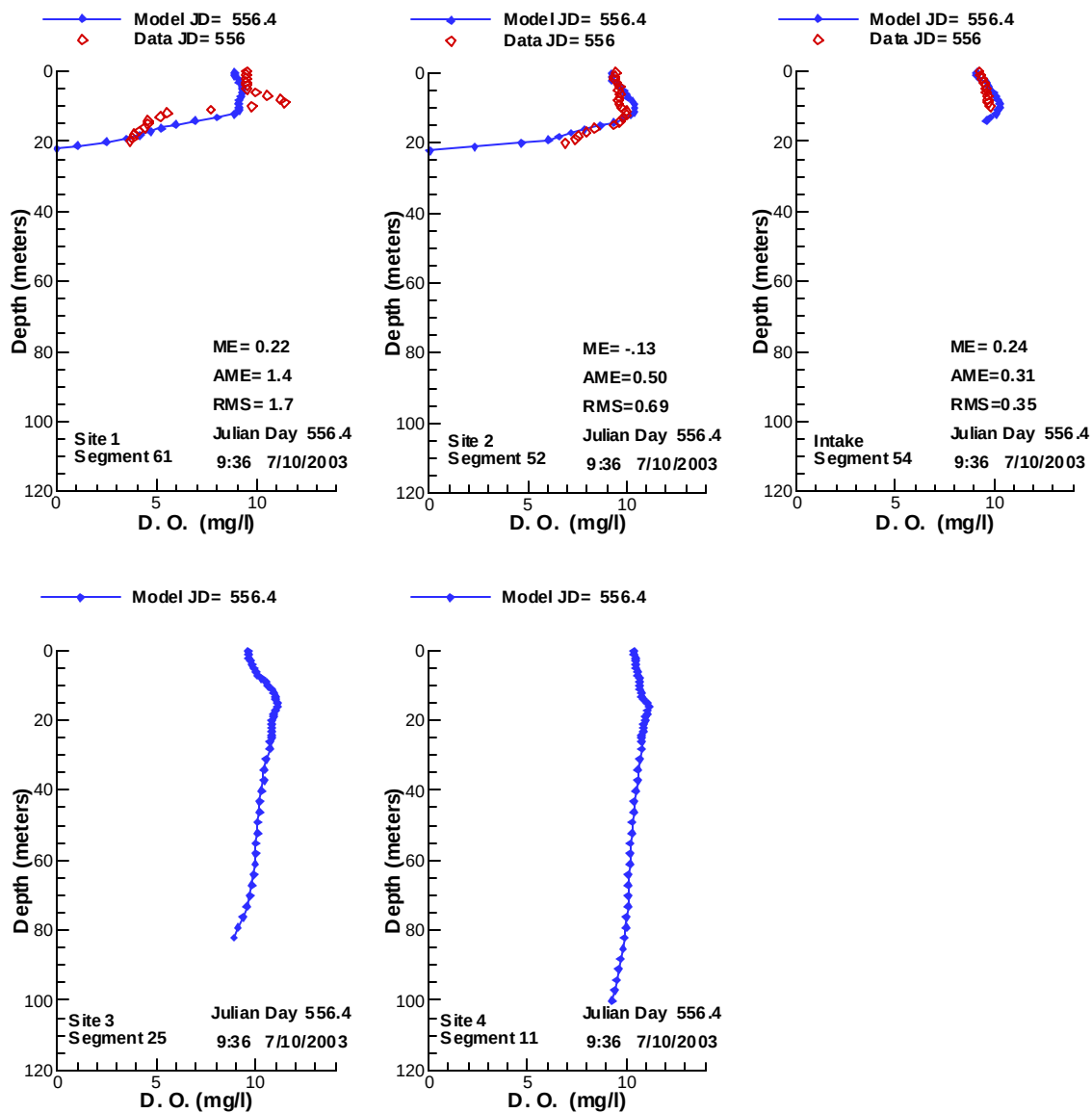


Figure 332. Vertical profiles of DISSOLVED OXYGEN compared with data for 7/10/2003.

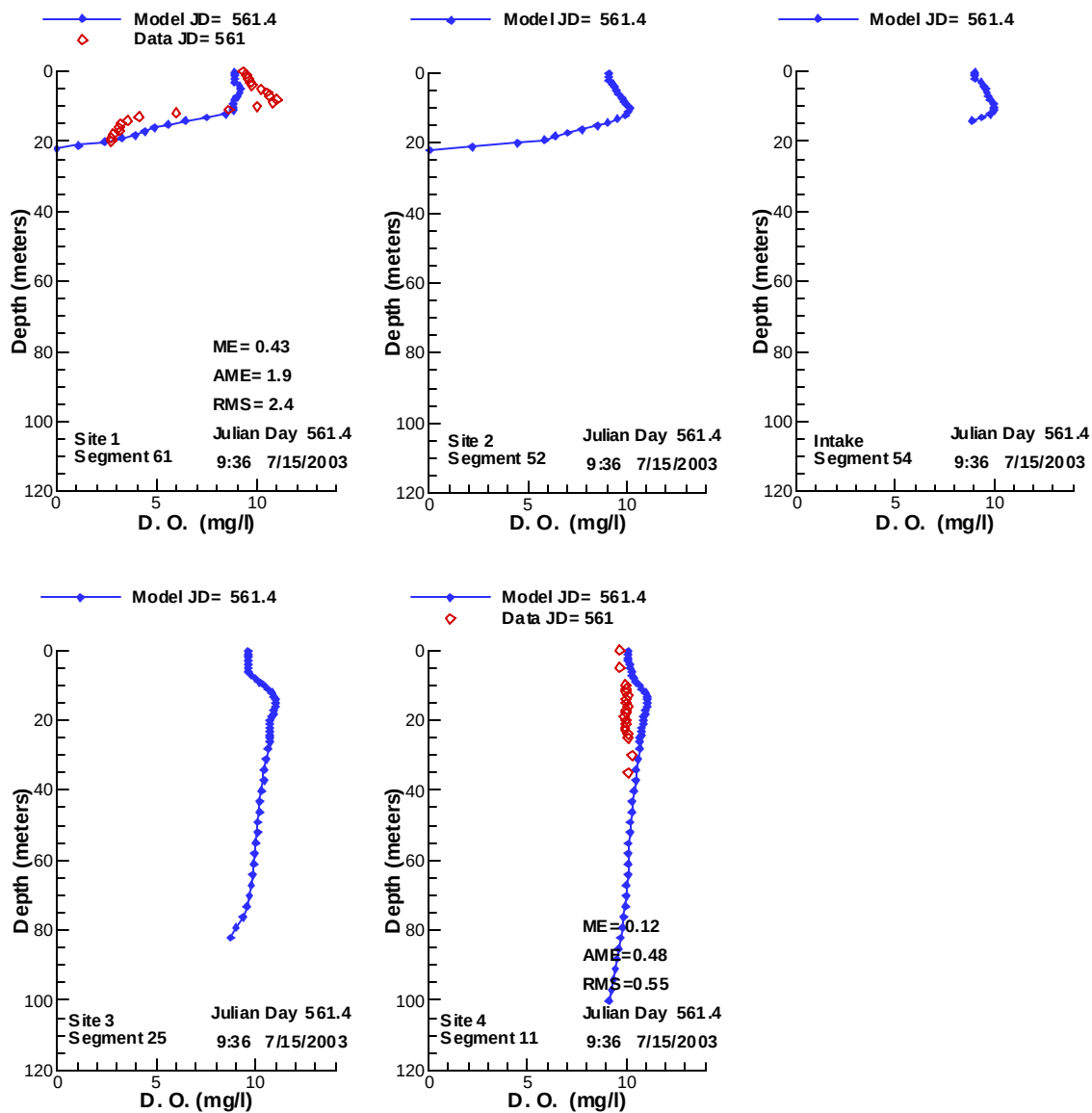


Figure 333. Vertical profiles of DISSOLVED OXYGEN compared with data for 7/15/2003.

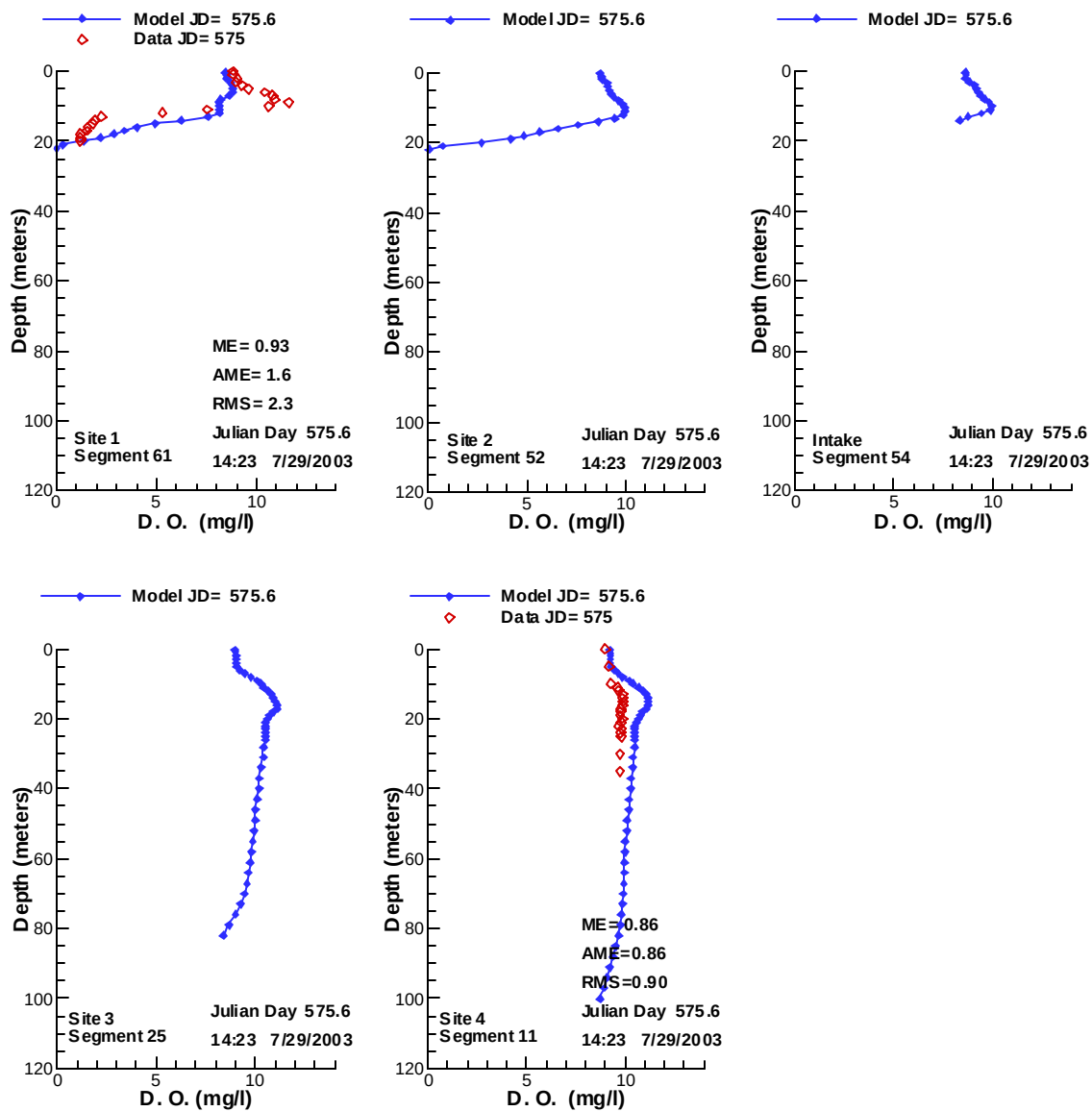


Figure 334. Vertical profiles of DISSOLVED OXYGEN compared with data for 7/29/2003.

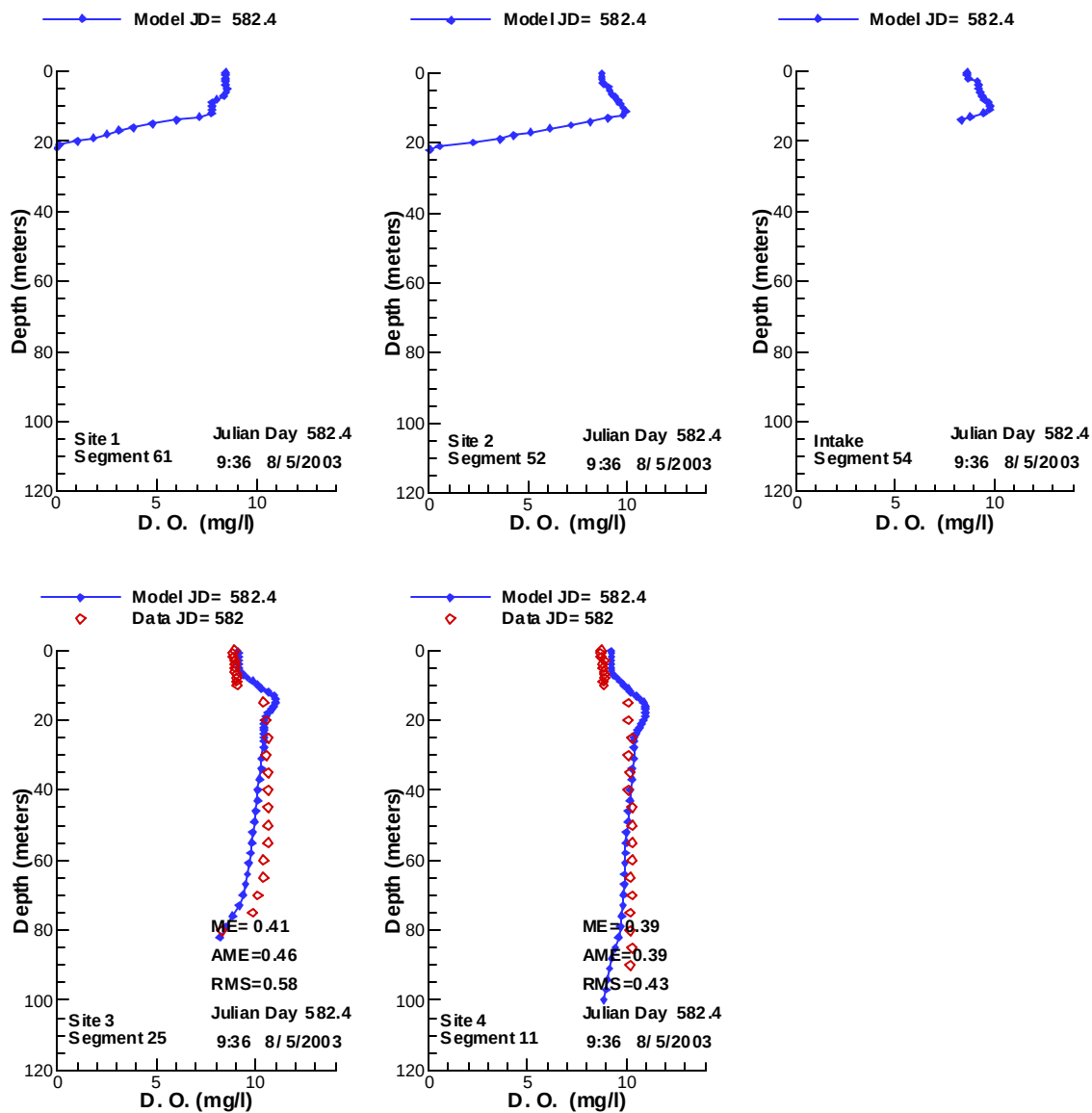


Figure 335. Vertical profiles of DISSOLVED OXYGEN compared with data for 8/ 5/2003.

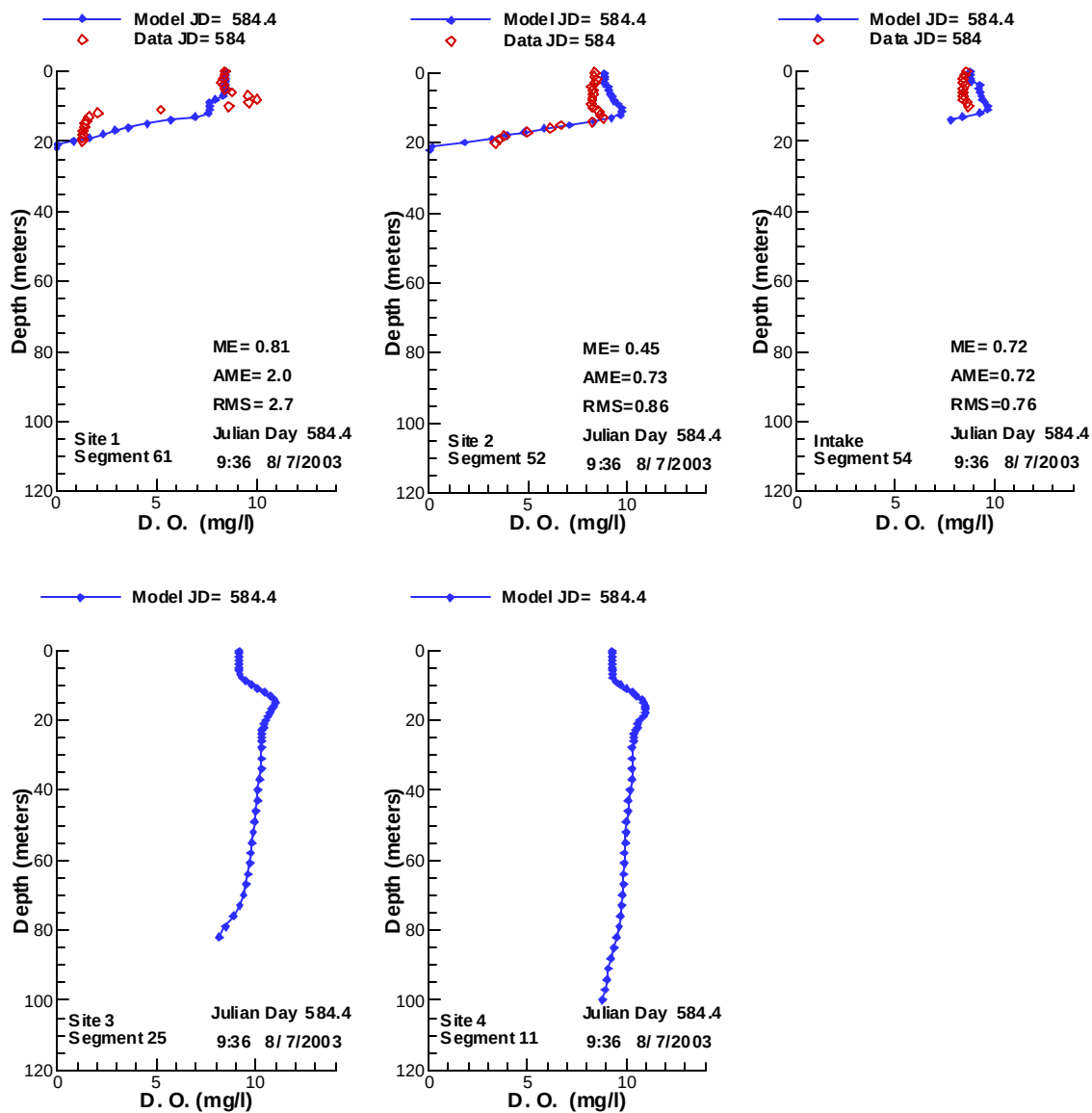


Figure 336. Vertical profiles of DISSOLVED OXYGEN compared with data for 8/ 7/2003.

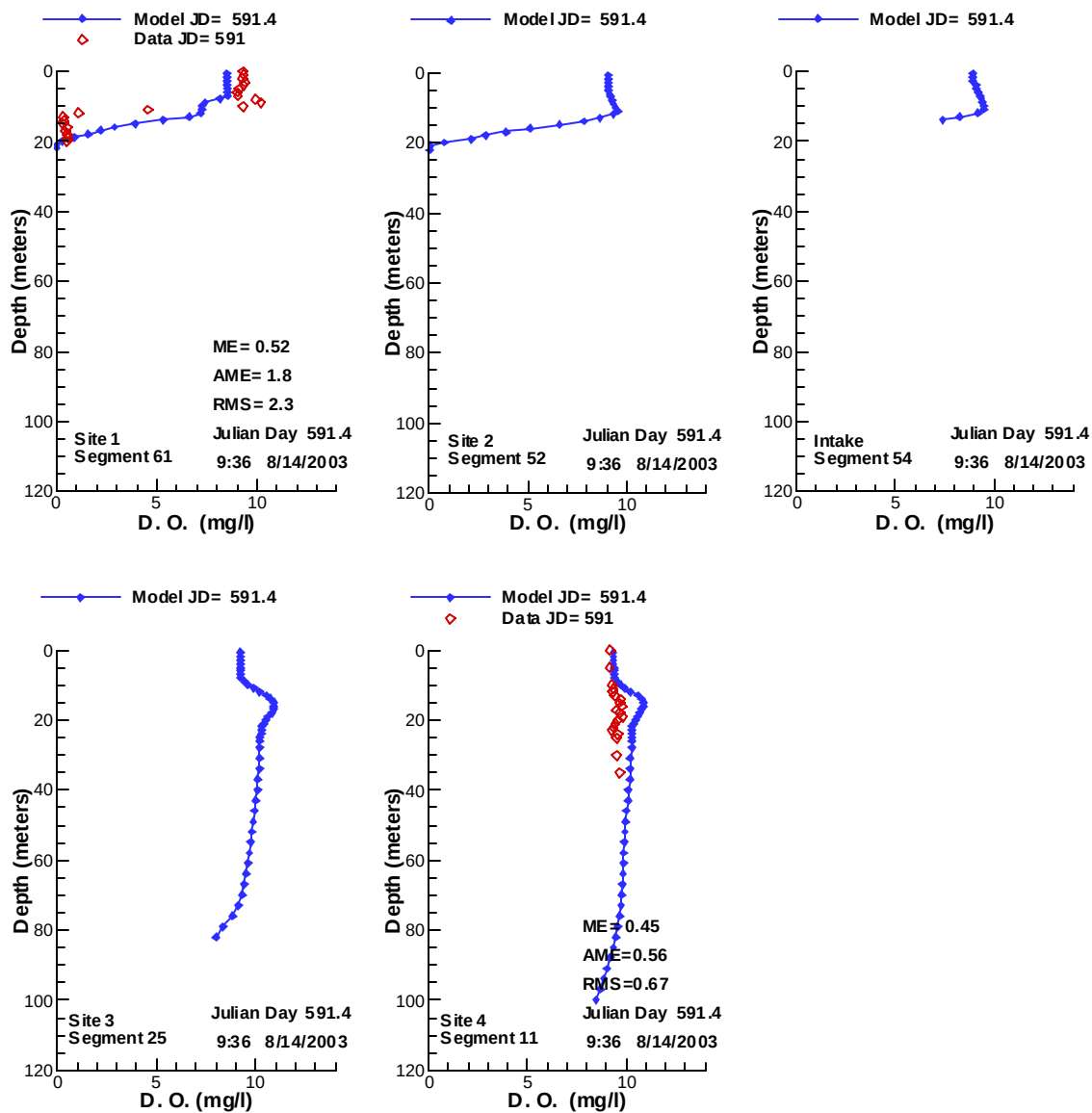


Figure 337. Vertical profiles of DISSOLVED OXYGEN compared with data for 8/14/2003.

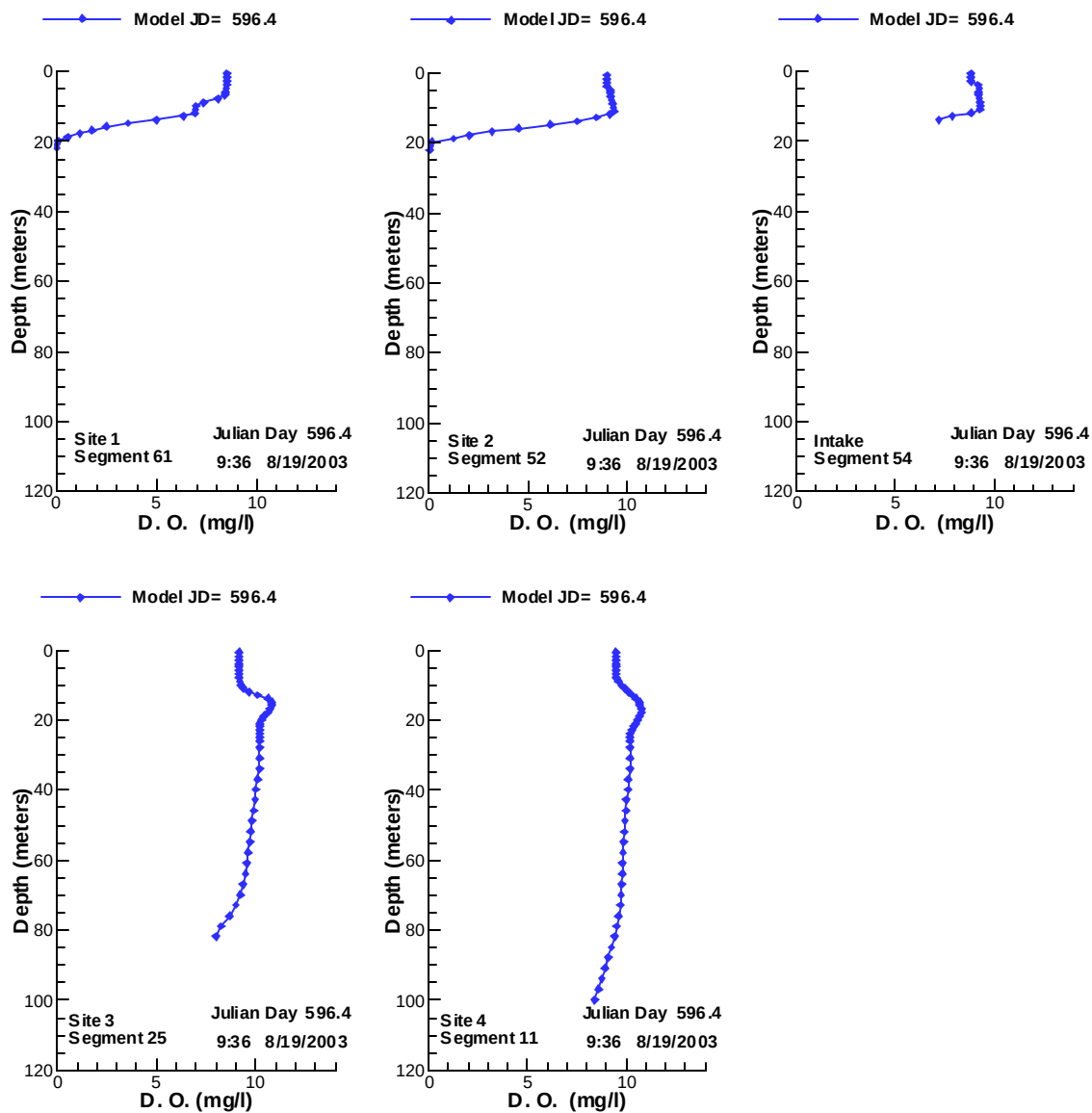


Figure 338. Vertical profiles of DISSOLVED OXYGEN compared with data for 8/19/2003.

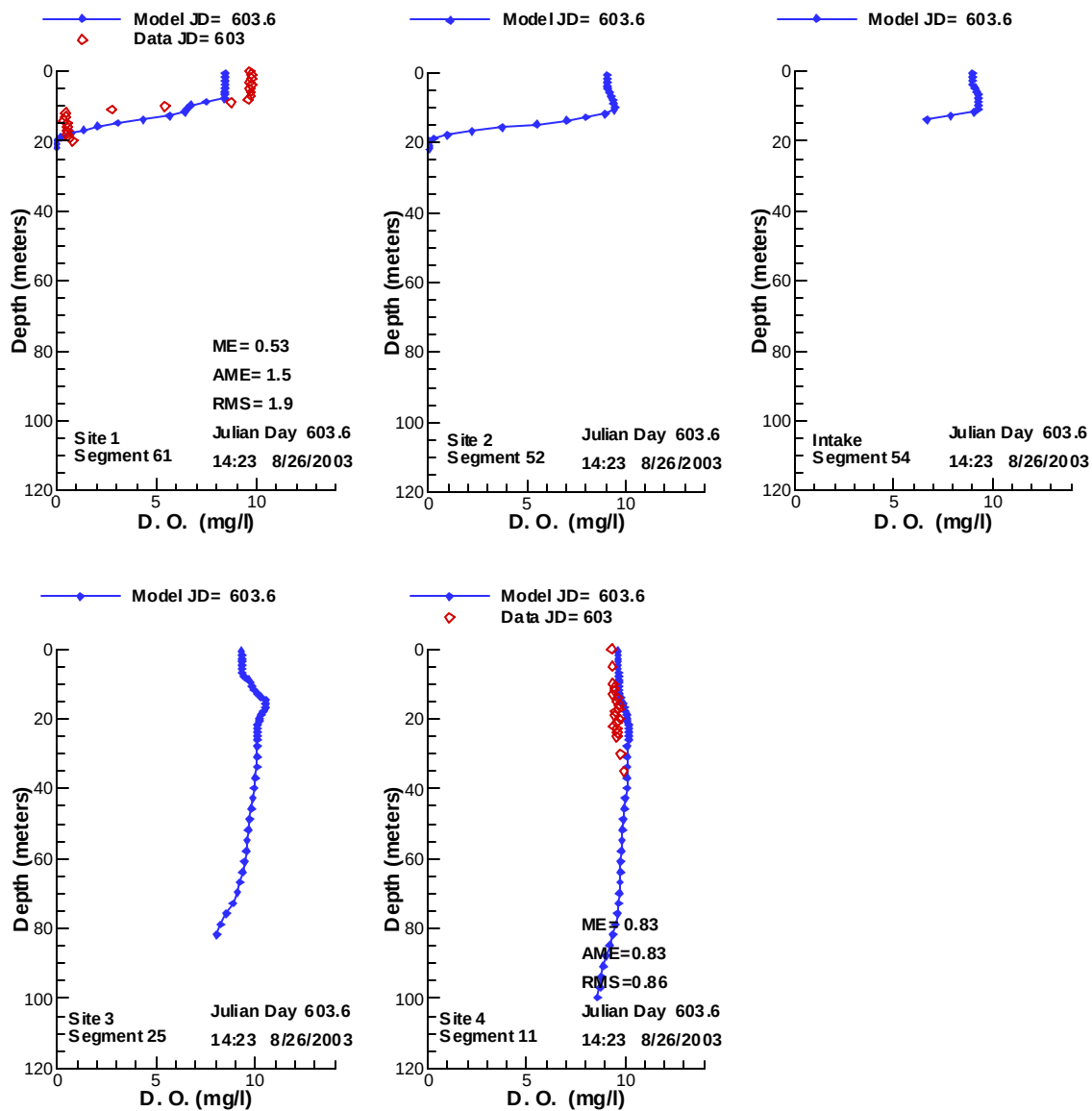


Figure 339. Vertical profiles of DISSOLVED OXYGEN compared with data for 8/26/2003.

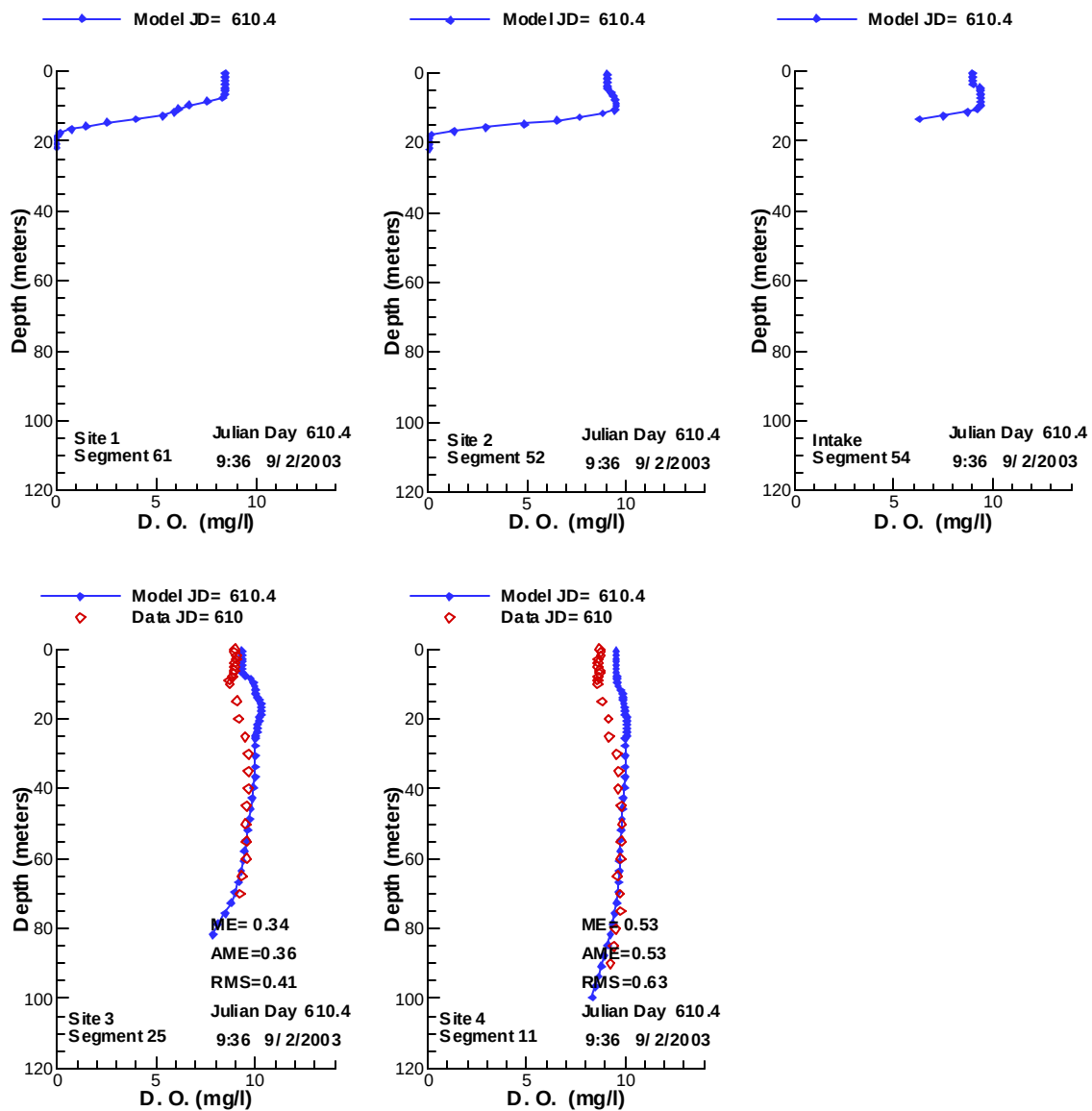


Figure 340. Vertical profiles of DISSOLVED OXYGEN compared with data for 9/ 2/2003.

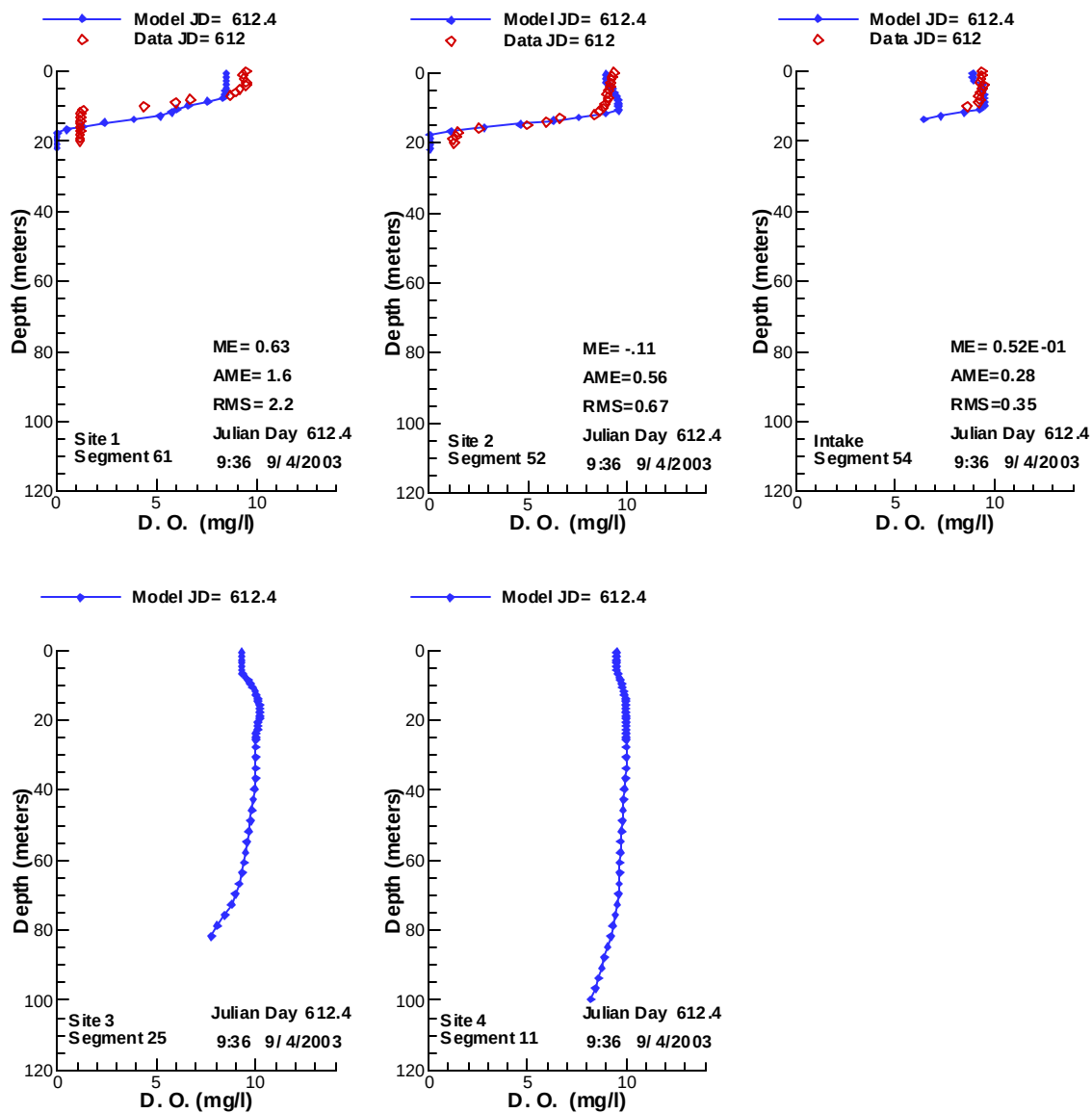


Figure 341. Vertical profiles of DISSOLVED OXYGEN compared with data for 9/ 4/2003.

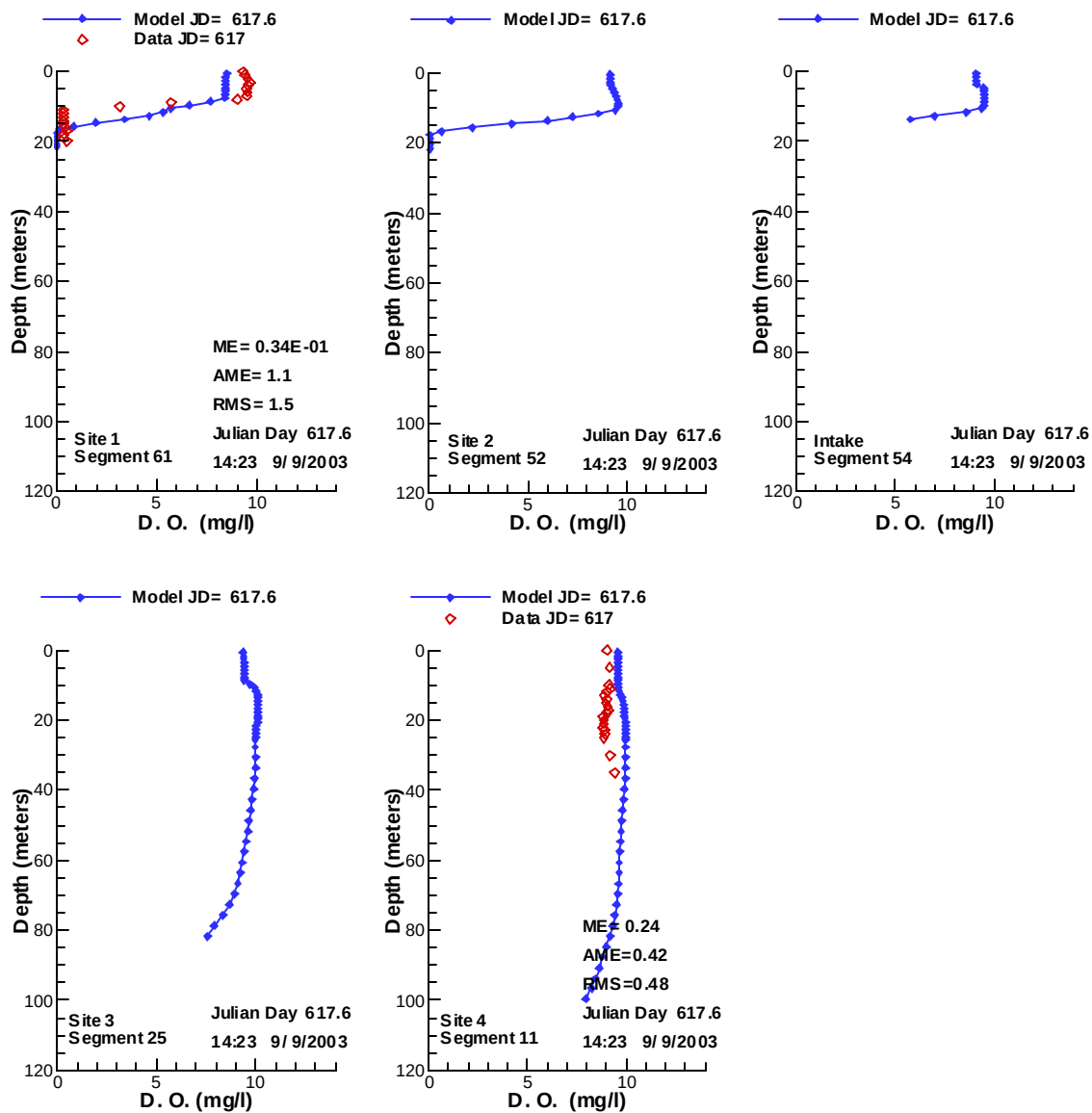


Figure 342. Vertical profiles of DISSOLVED OXYGEN compared with data for 9/ 9/2003.

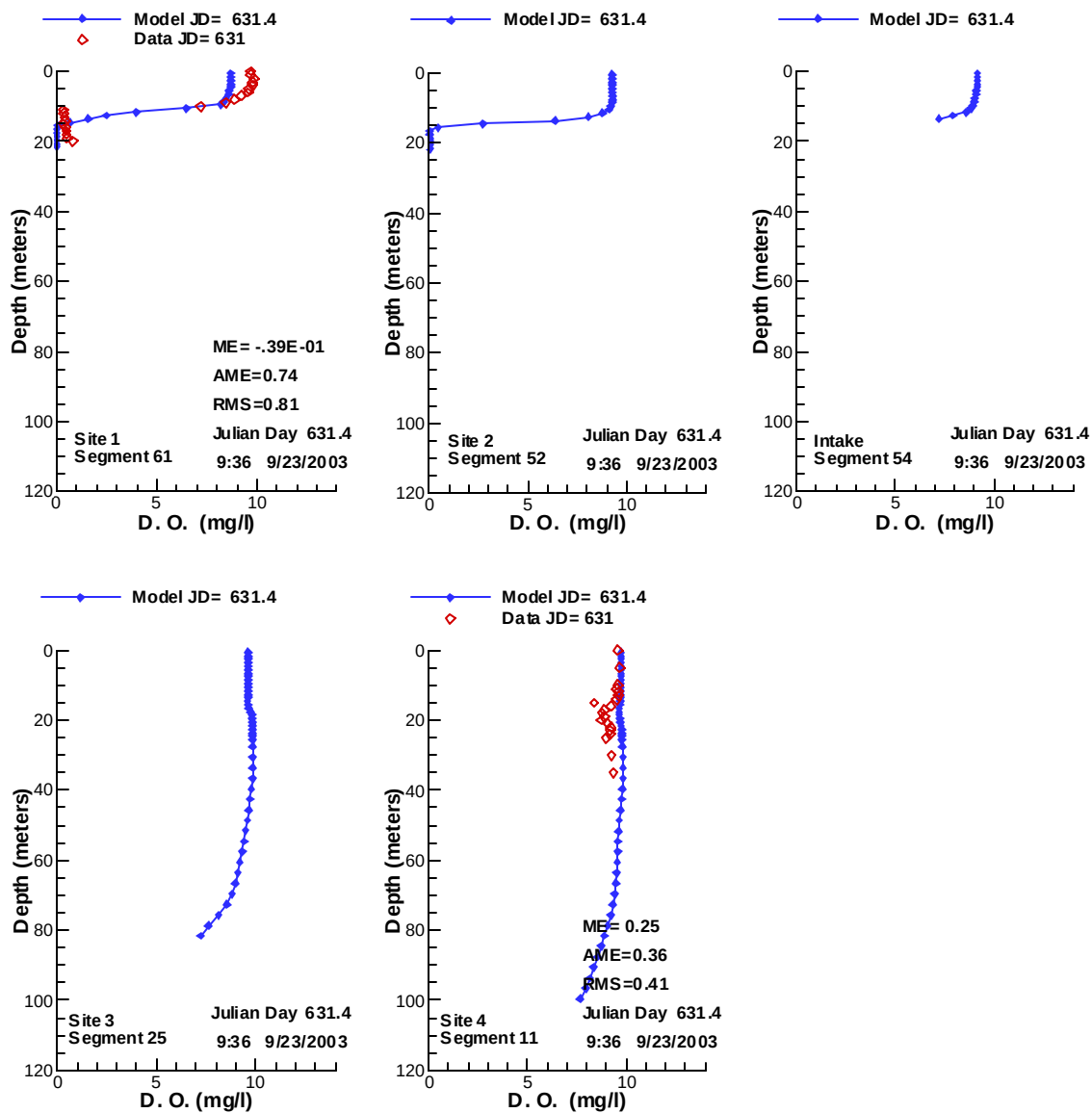


Figure 343. Vertical profiles of DISSOLVED OXYGEN compared with data for 9/23/2003.

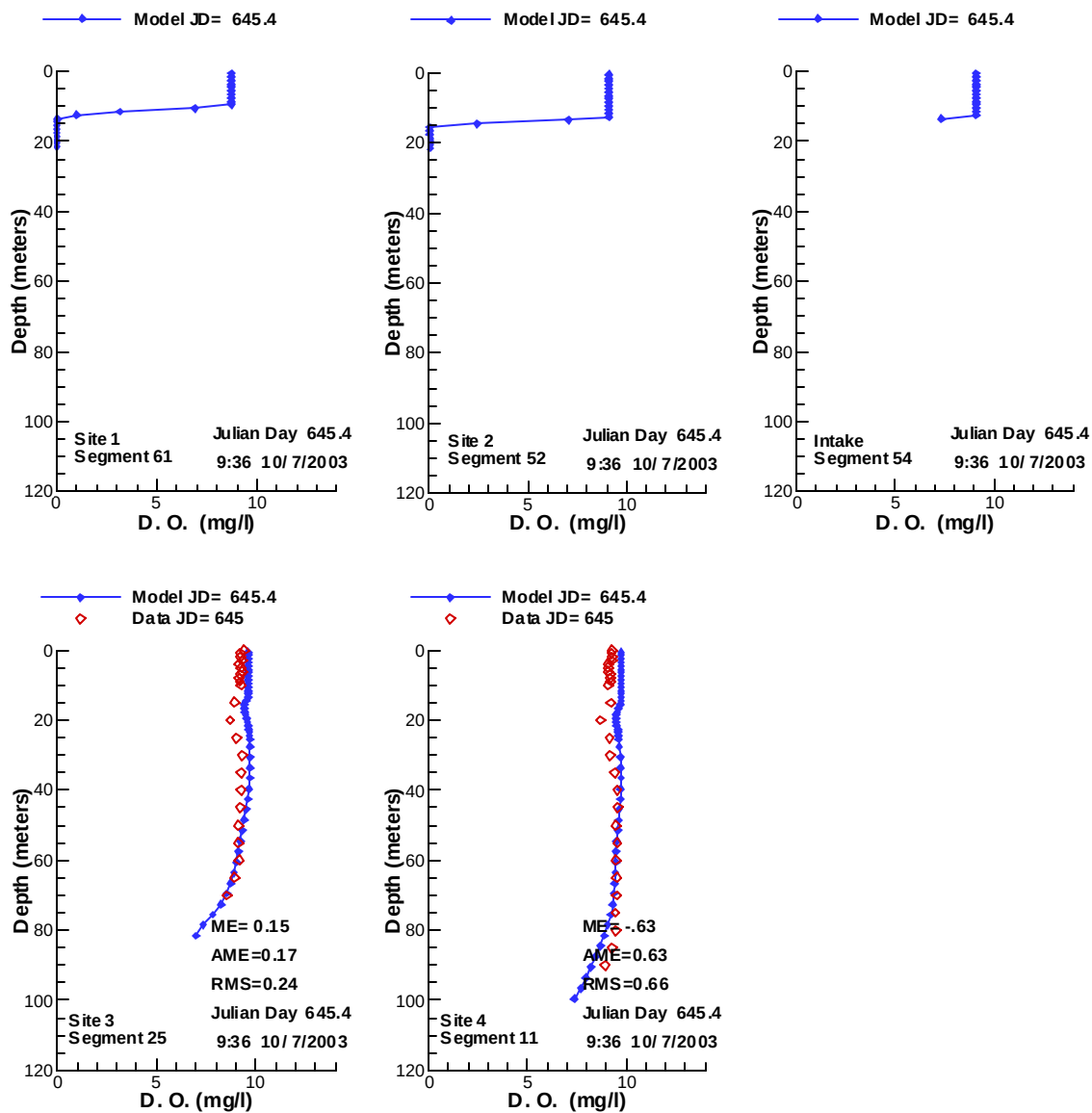


Figure 344. Vertical profiles of DISSOLVED OXYGEN compared with data for 10/ 7/2003.

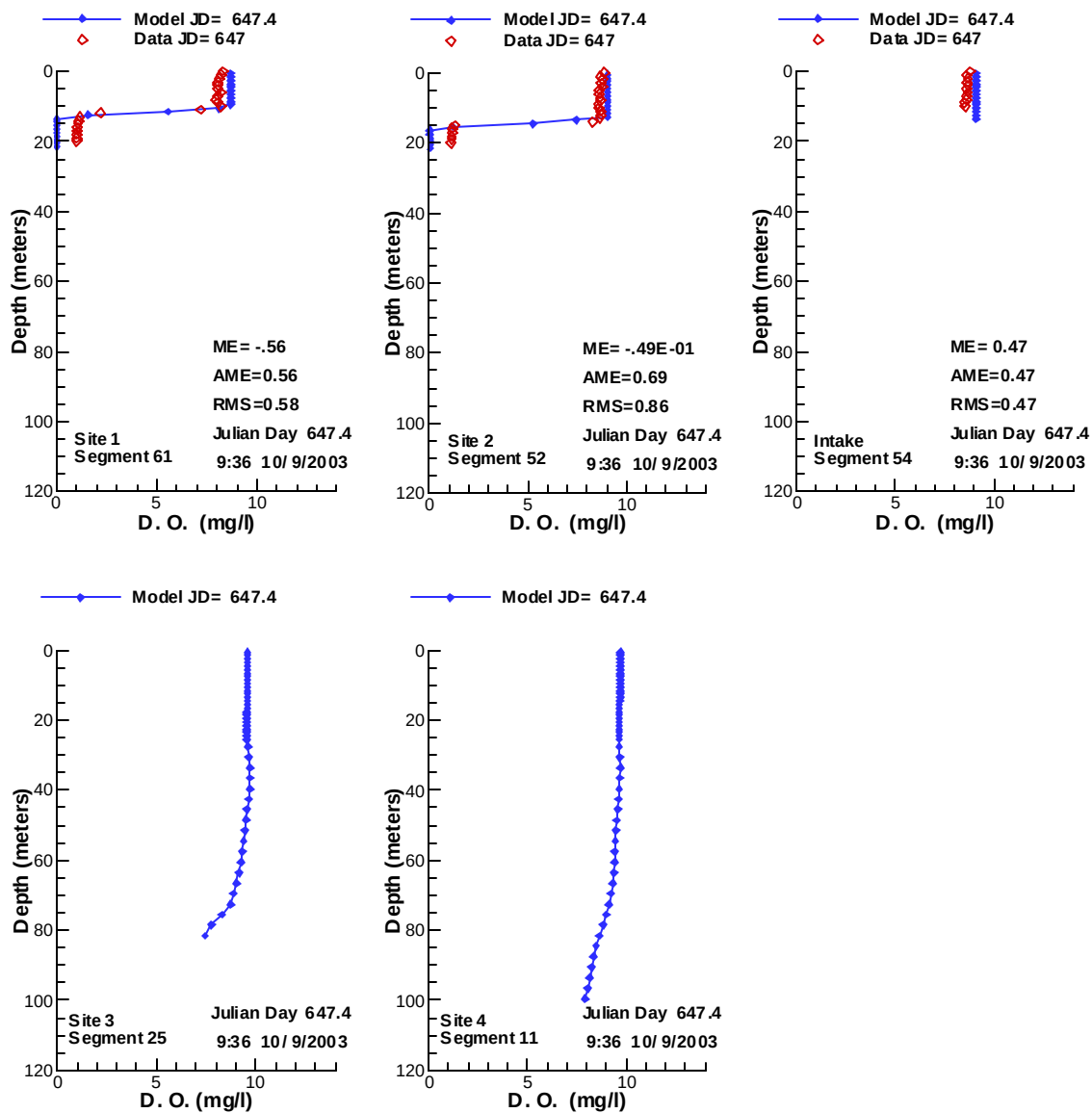


Figure 345. Vertical profiles of DISSOLVED OXYGEN compared with data for 10/ 9/2003.

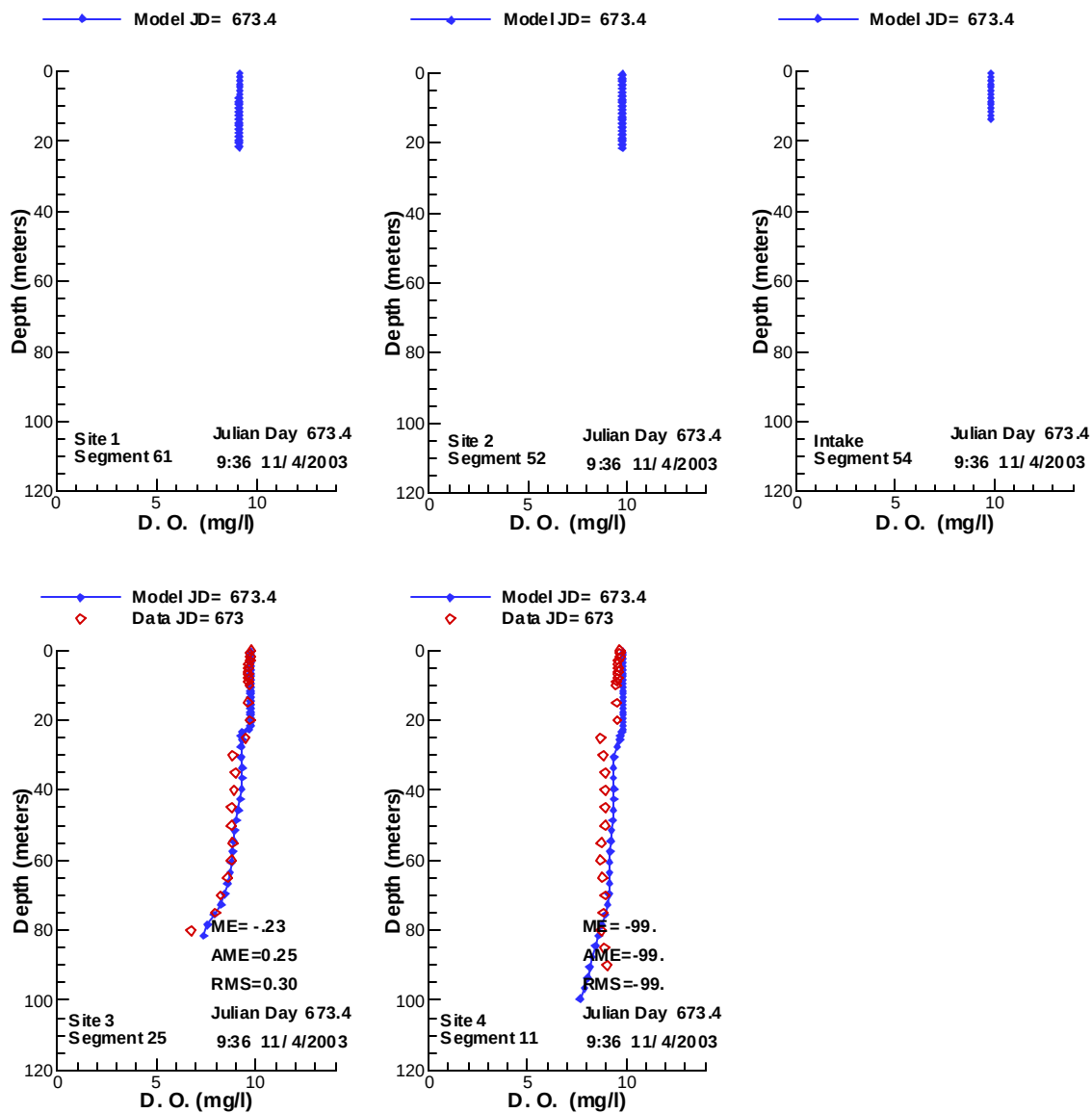


Figure 346. Vertical profiles of DISSOLVED OXYGEN compared with data for 11/ 4/2003.

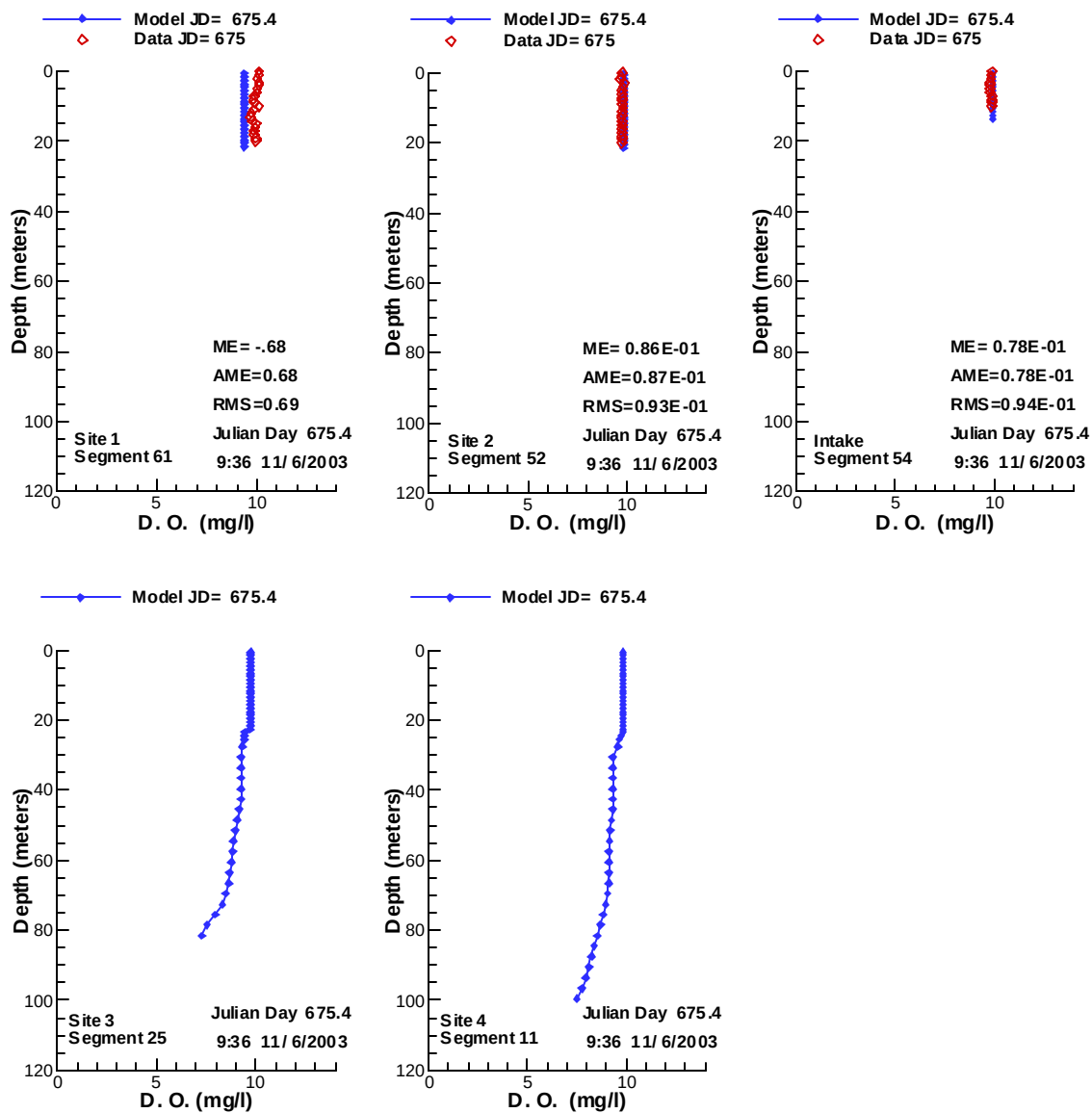


Figure 347. Vertical profiles of DISSOLVED OXYGEN compared with data for 11/ 6/2003.

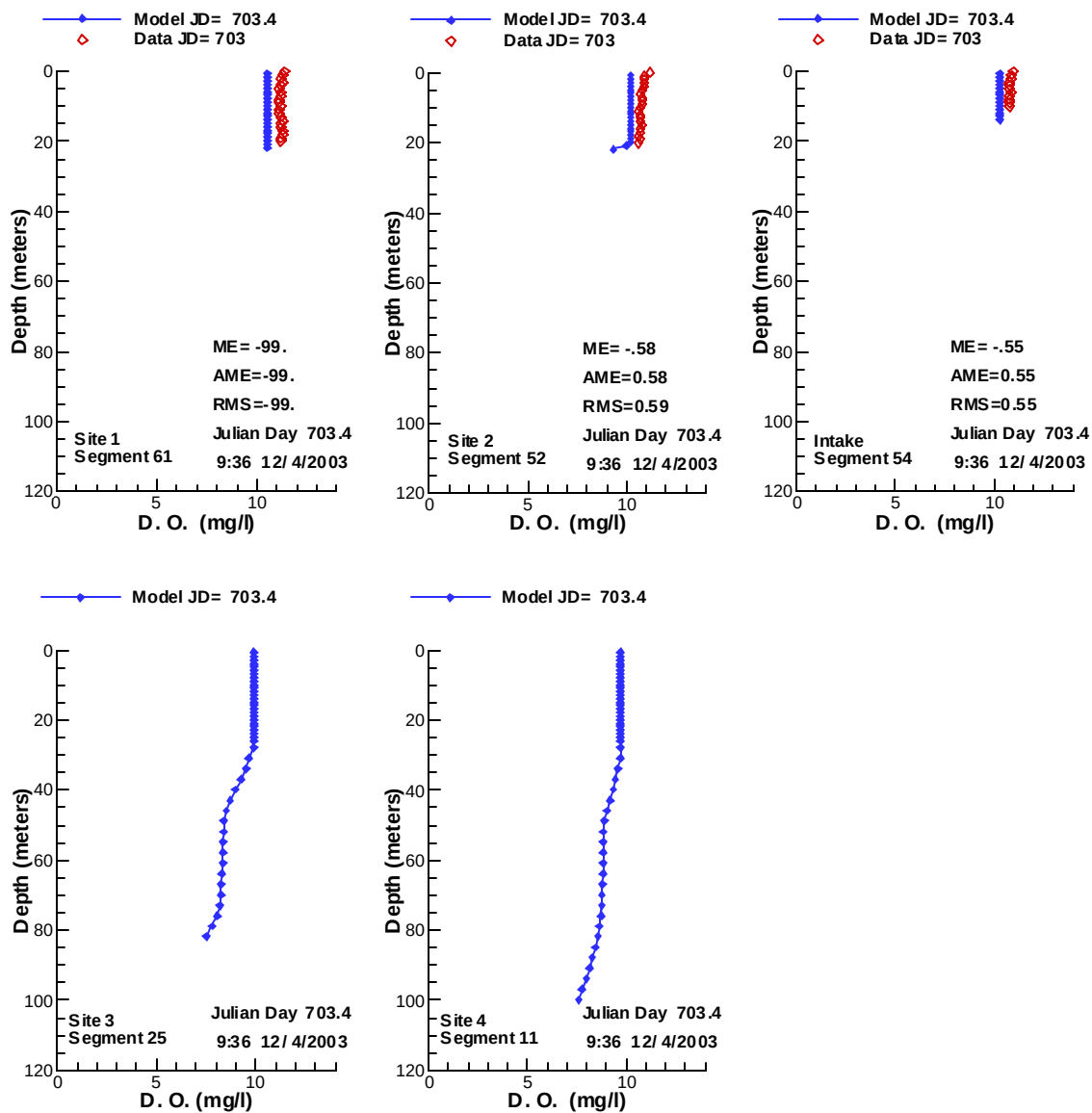


Figure 348. Vertical profiles of DISSOLVED OXYGEN compared with data for 12/ 4/2003.

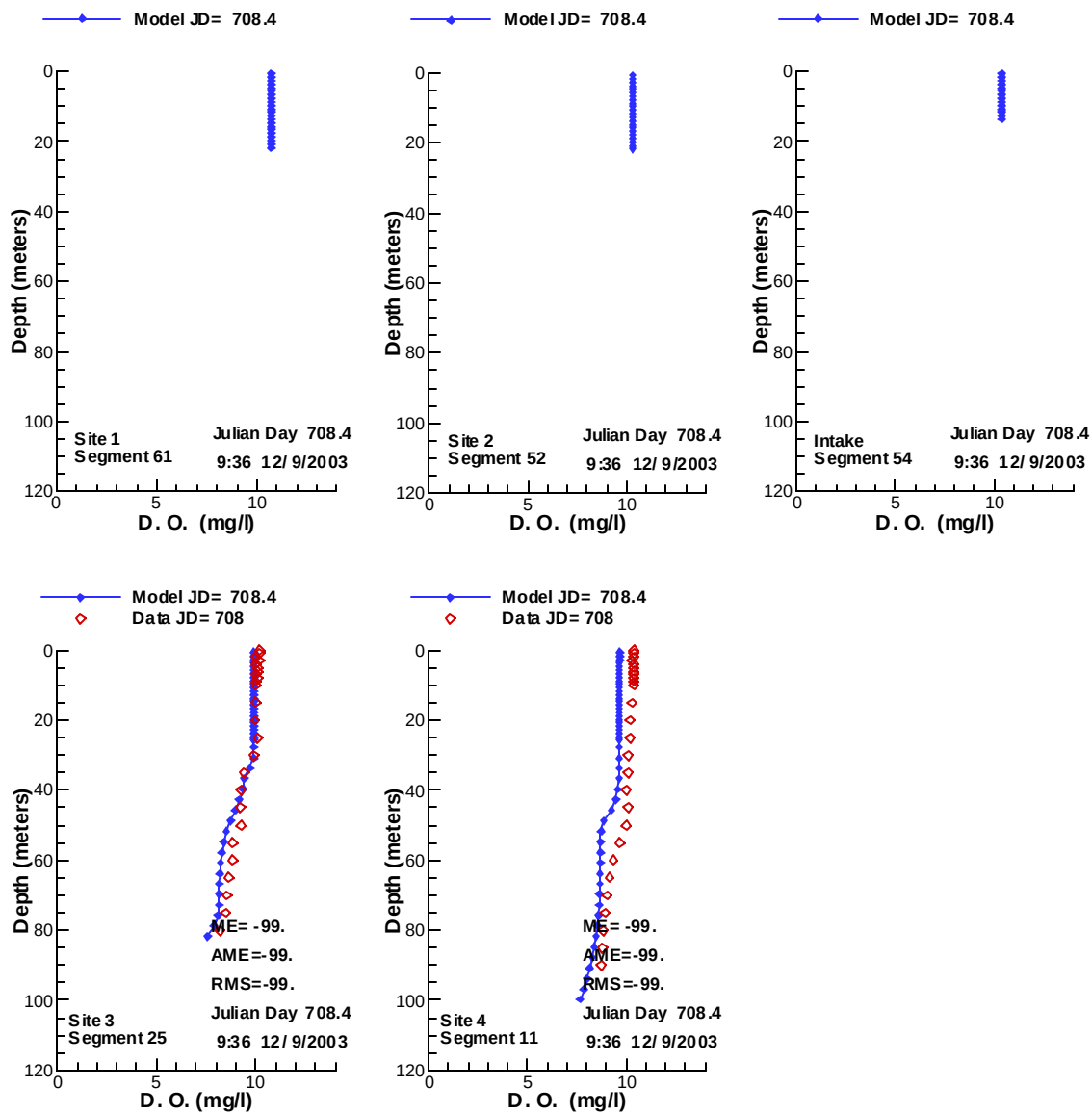


Figure 349. Vertical profiles of DISSOLVED OXYGEN compared with data for 12/ 9/2003.

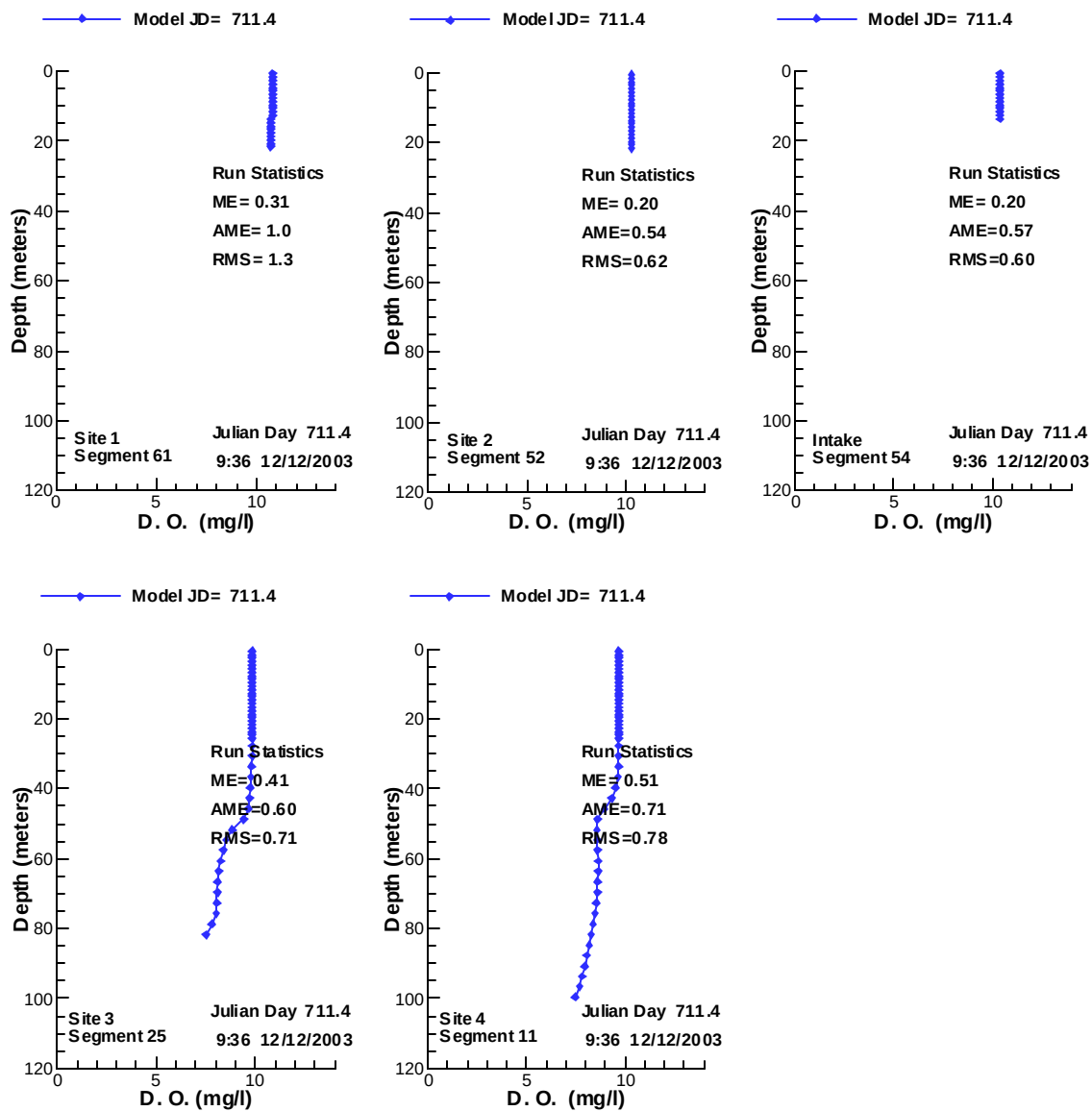


Figure 350. Vertical profiles of DISSOLVED OXYGEN compared with data for 12/12/2003.

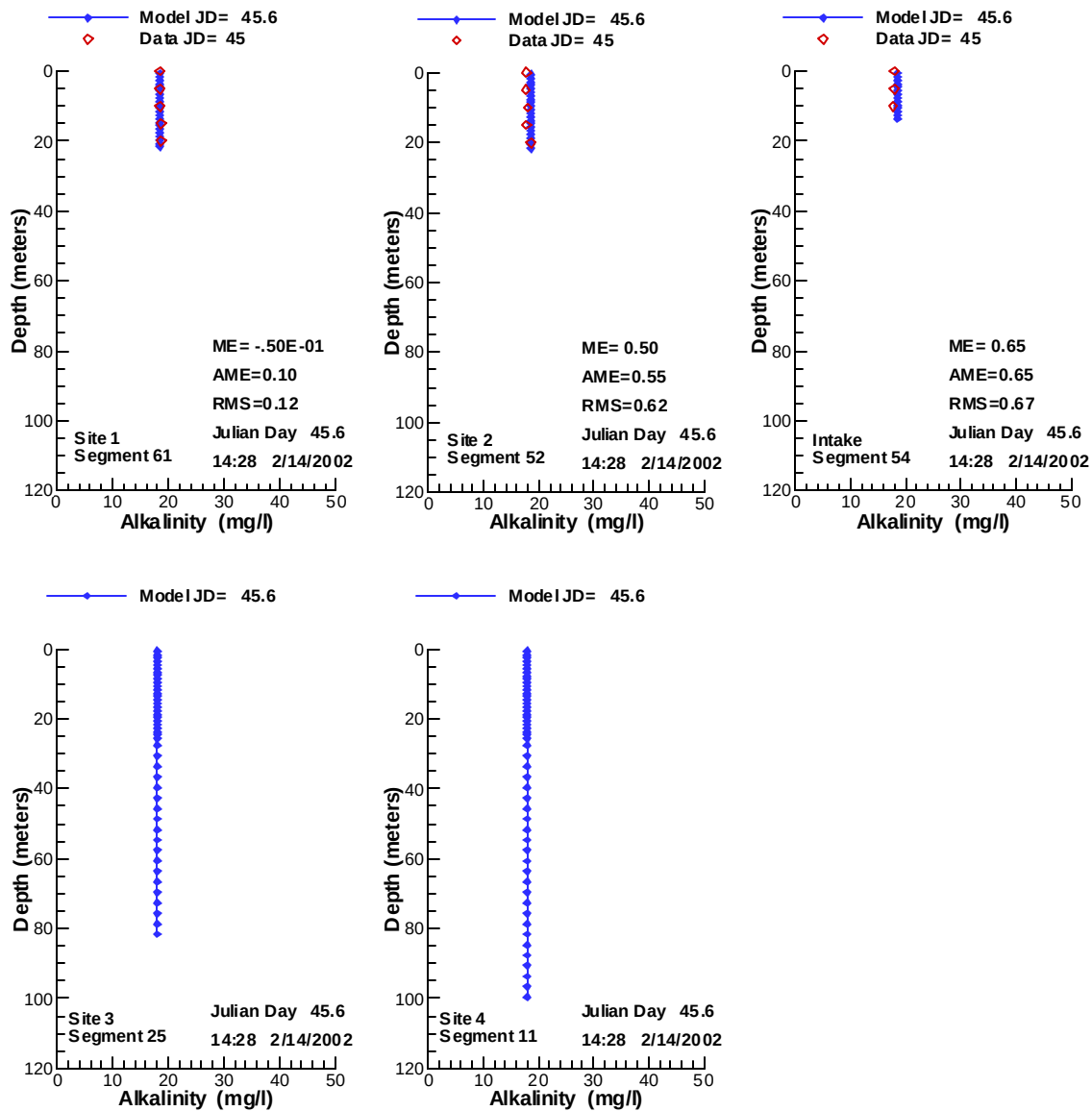


Figure 351. Vertical profiles of Alkalinity compared with data for 2/14/2002.

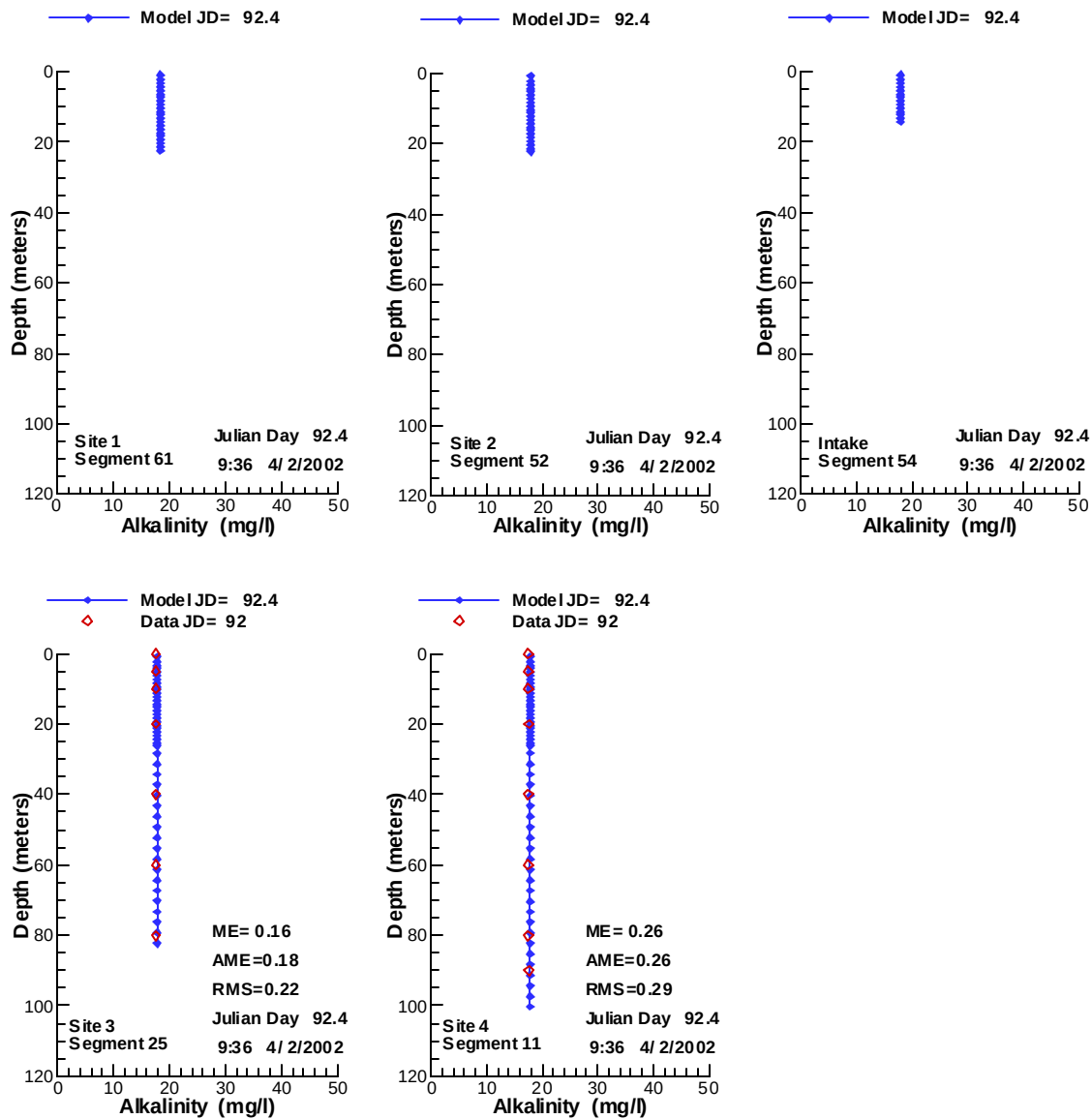


Figure 352. Vertical profiles of Alkalinity compared with data for 4/ 2/2002.

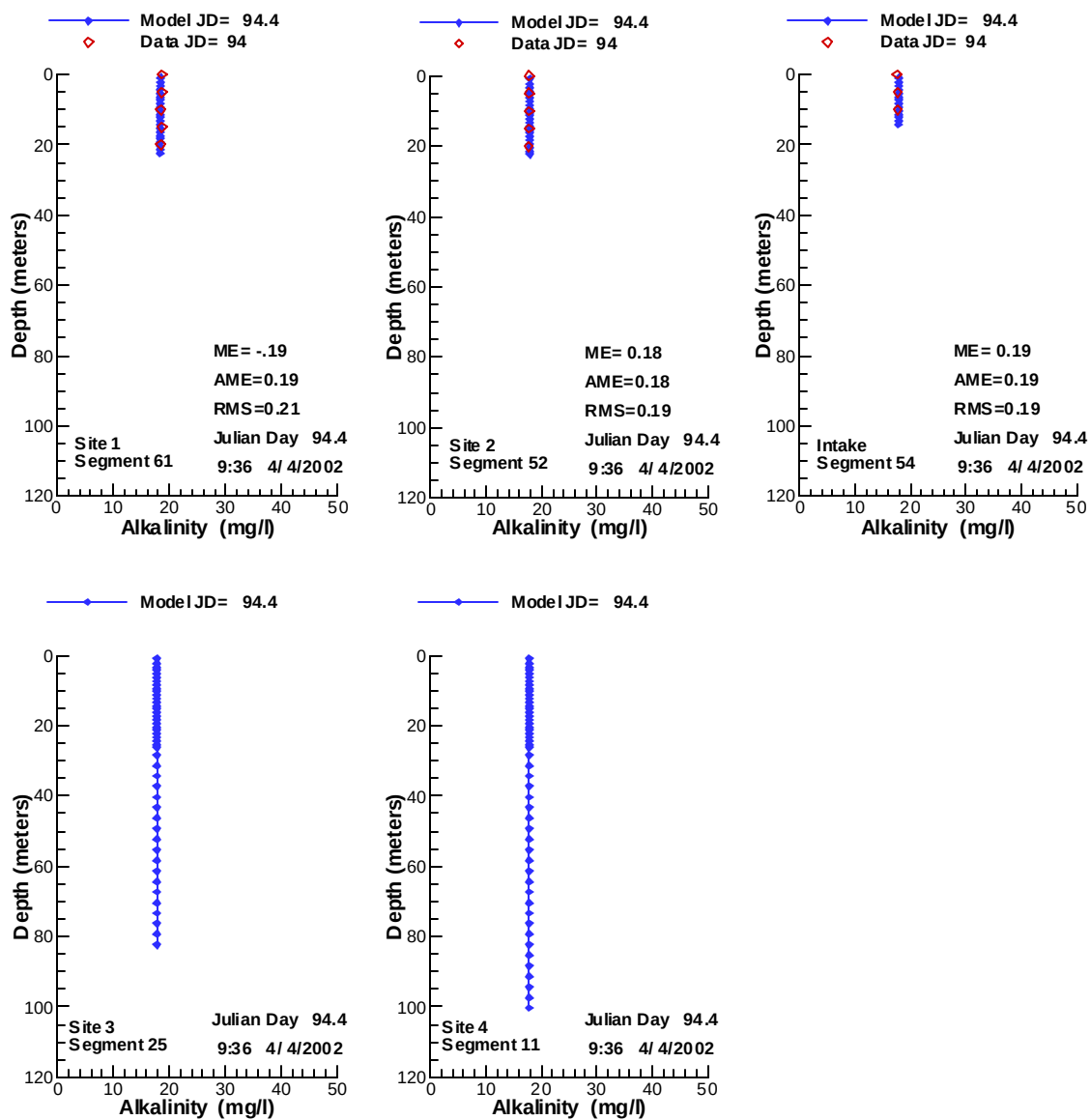


Figure 353. Vertical profiles of Alkalinity compared with data for 4/ 4/2002.

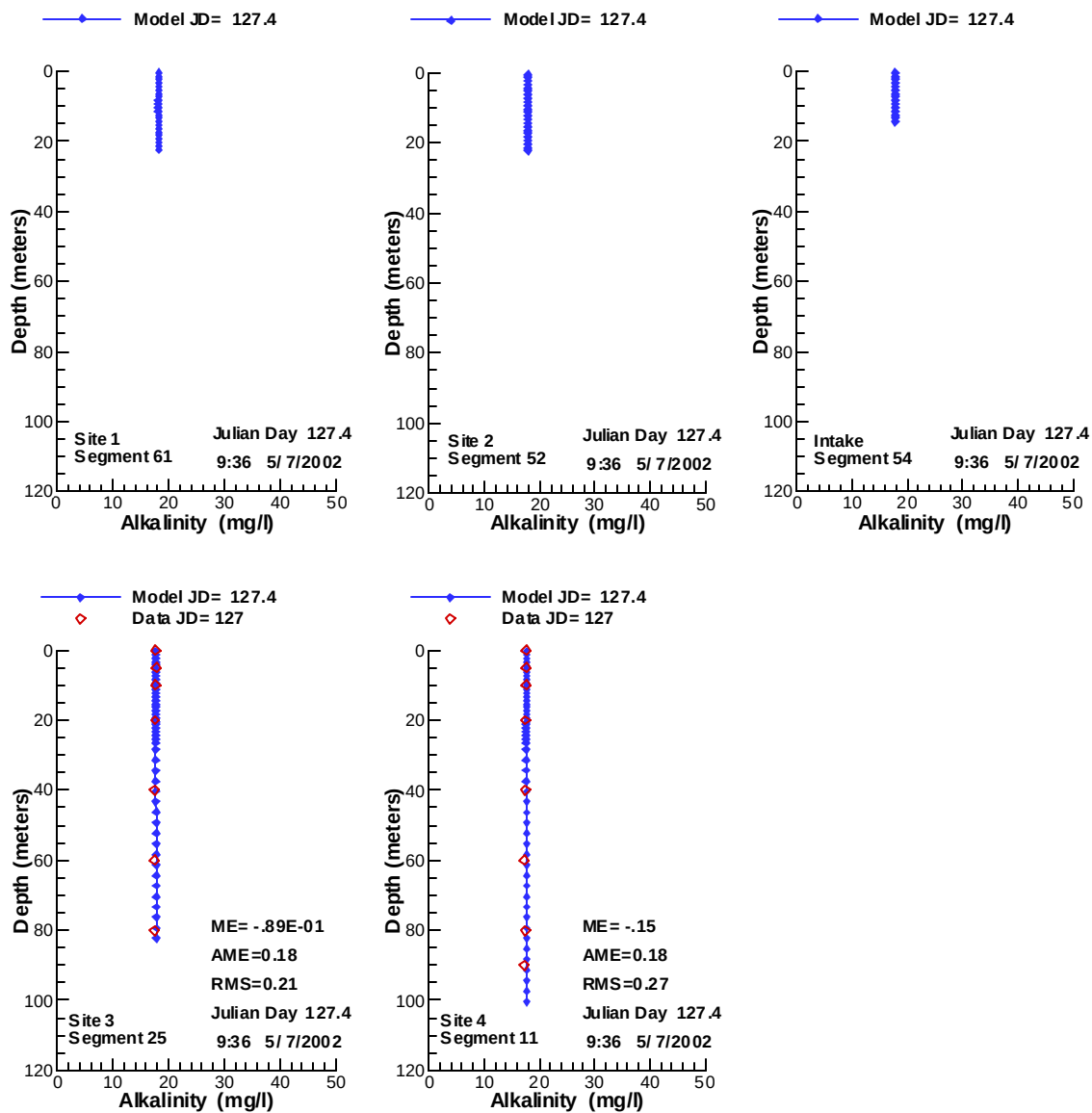


Figure 354. Vertical profiles of Alkalinity compared with data for 5/ 7/2002.

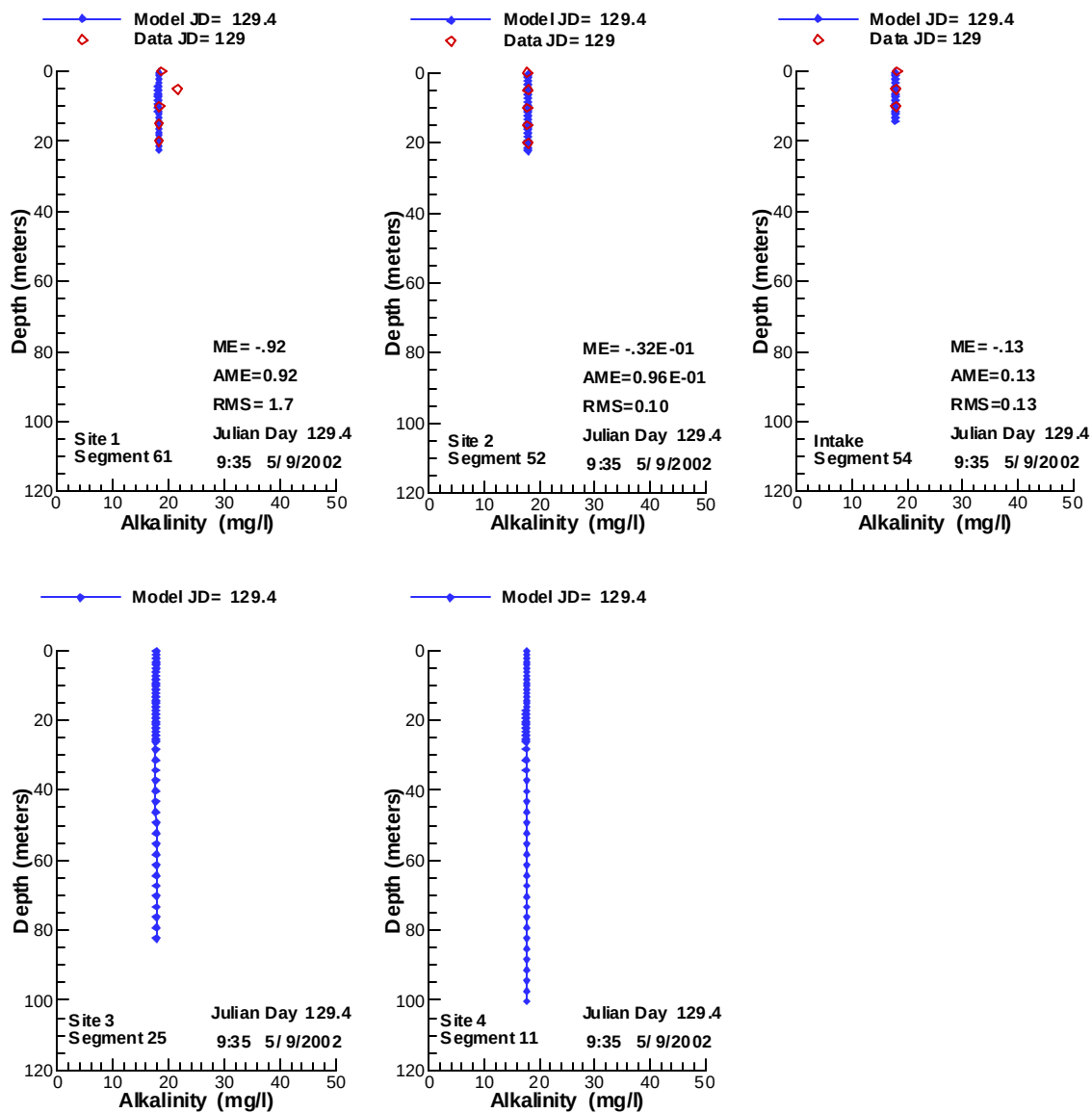


Figure 355. Vertical profiles of Alkalinity compared with data for 5/ 9/2002.

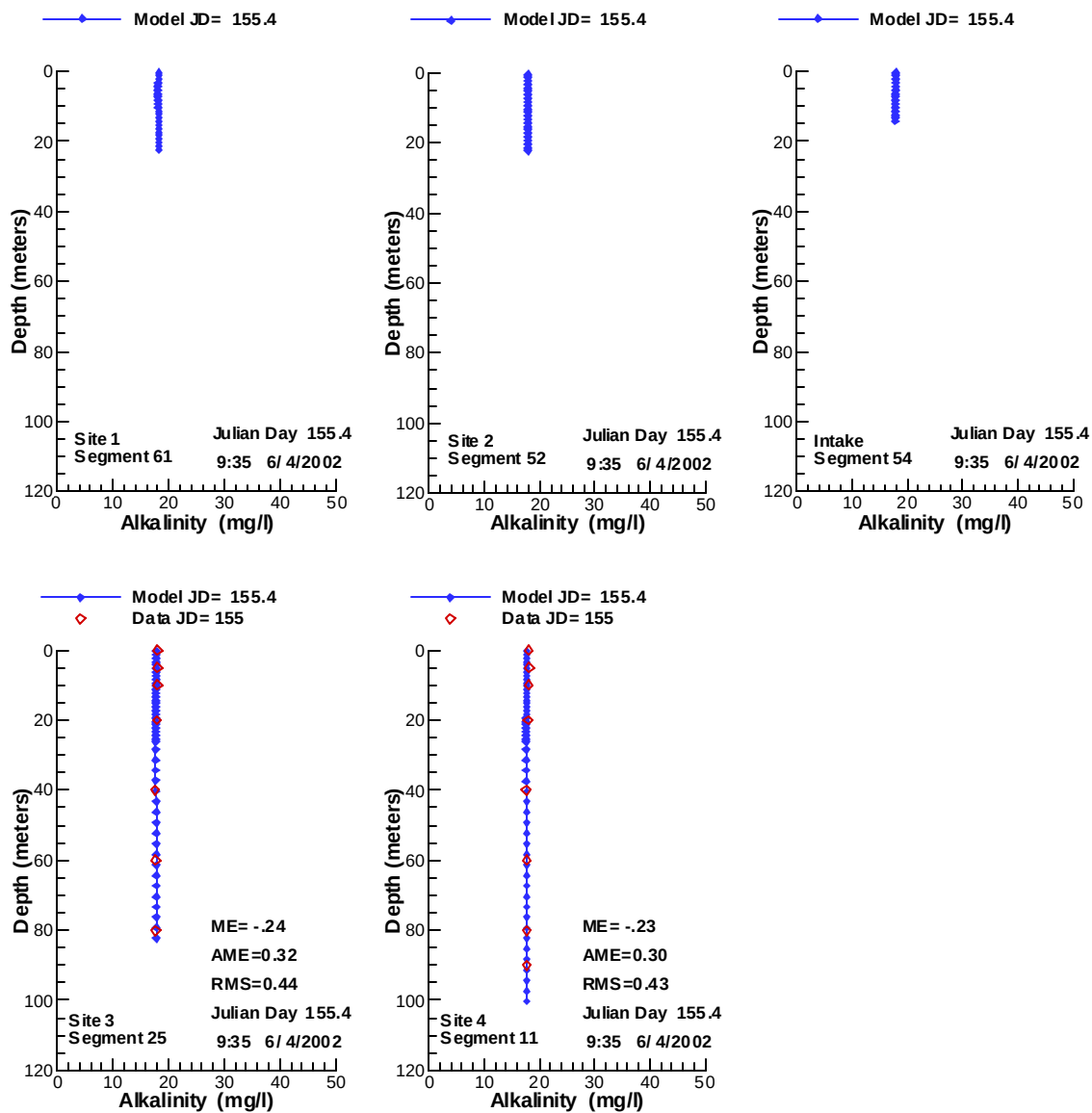


Figure 356. Vertical profiles of Alkalinity compared with data for 6/ 4/2002.

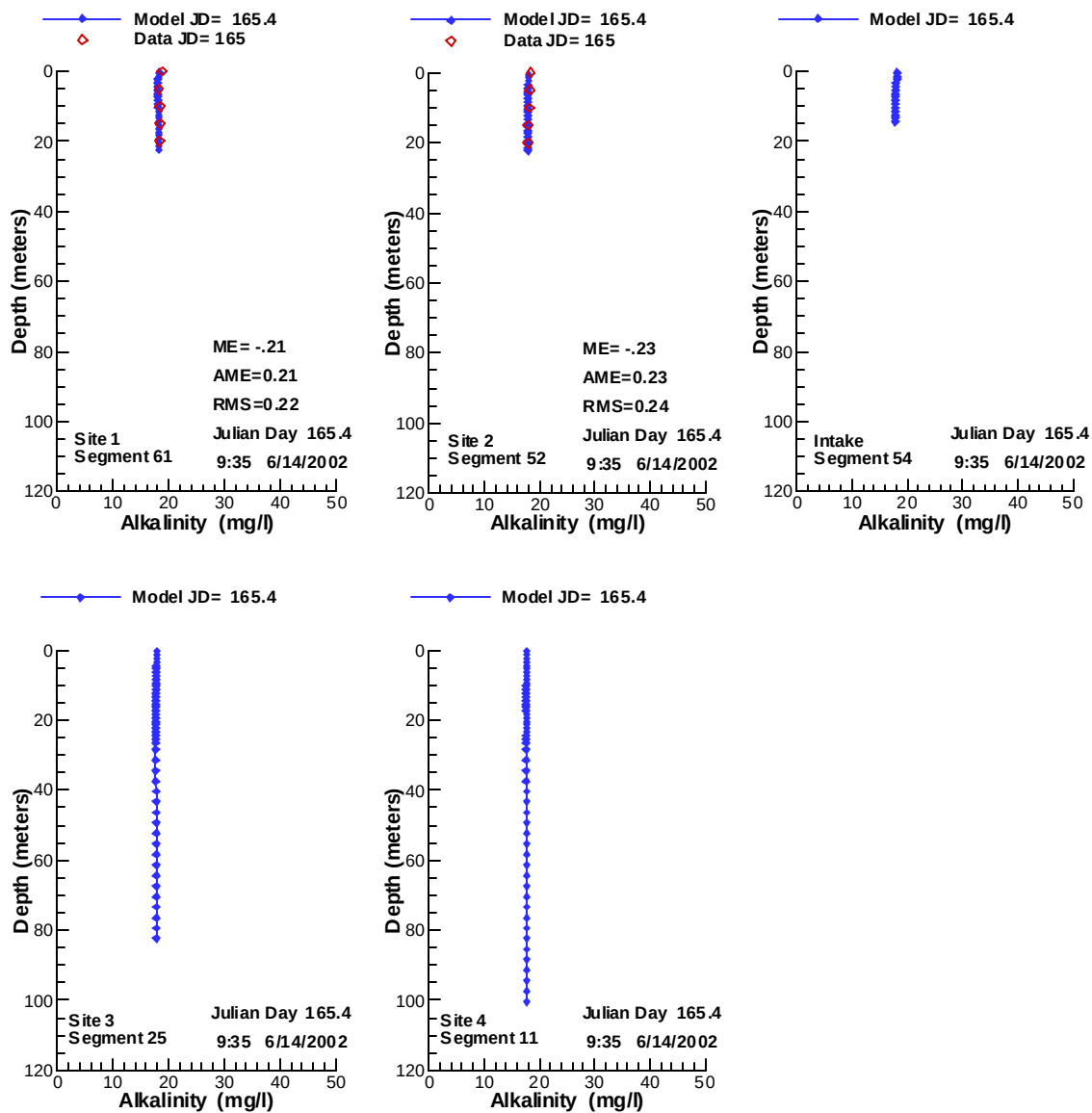


Figure 357. Vertical profiles of Alkalinity compared with data for 6/14/2002.

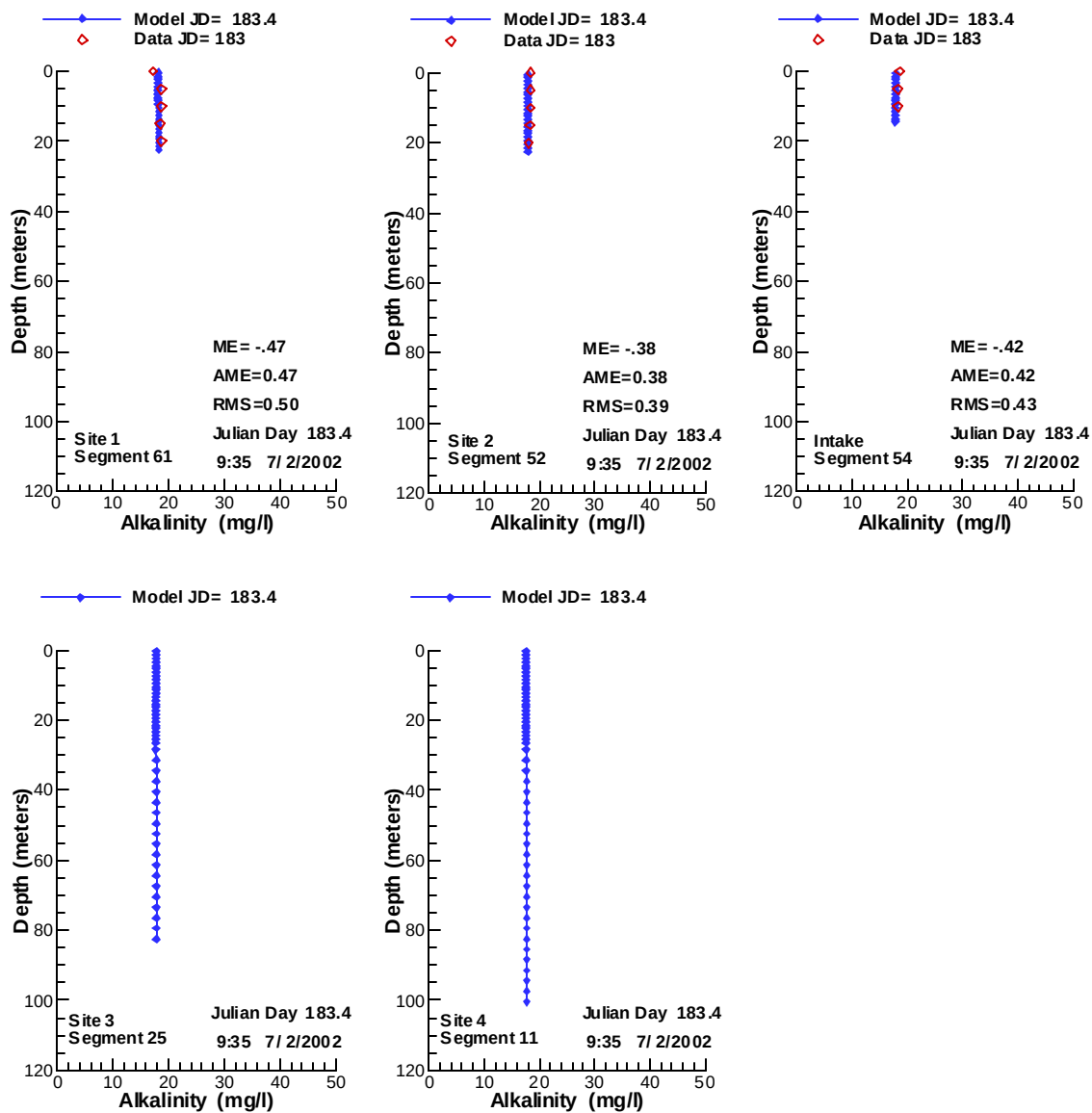


Figure 358. Vertical profiles of Alkalinity compared with data for 7/ 2/2002.

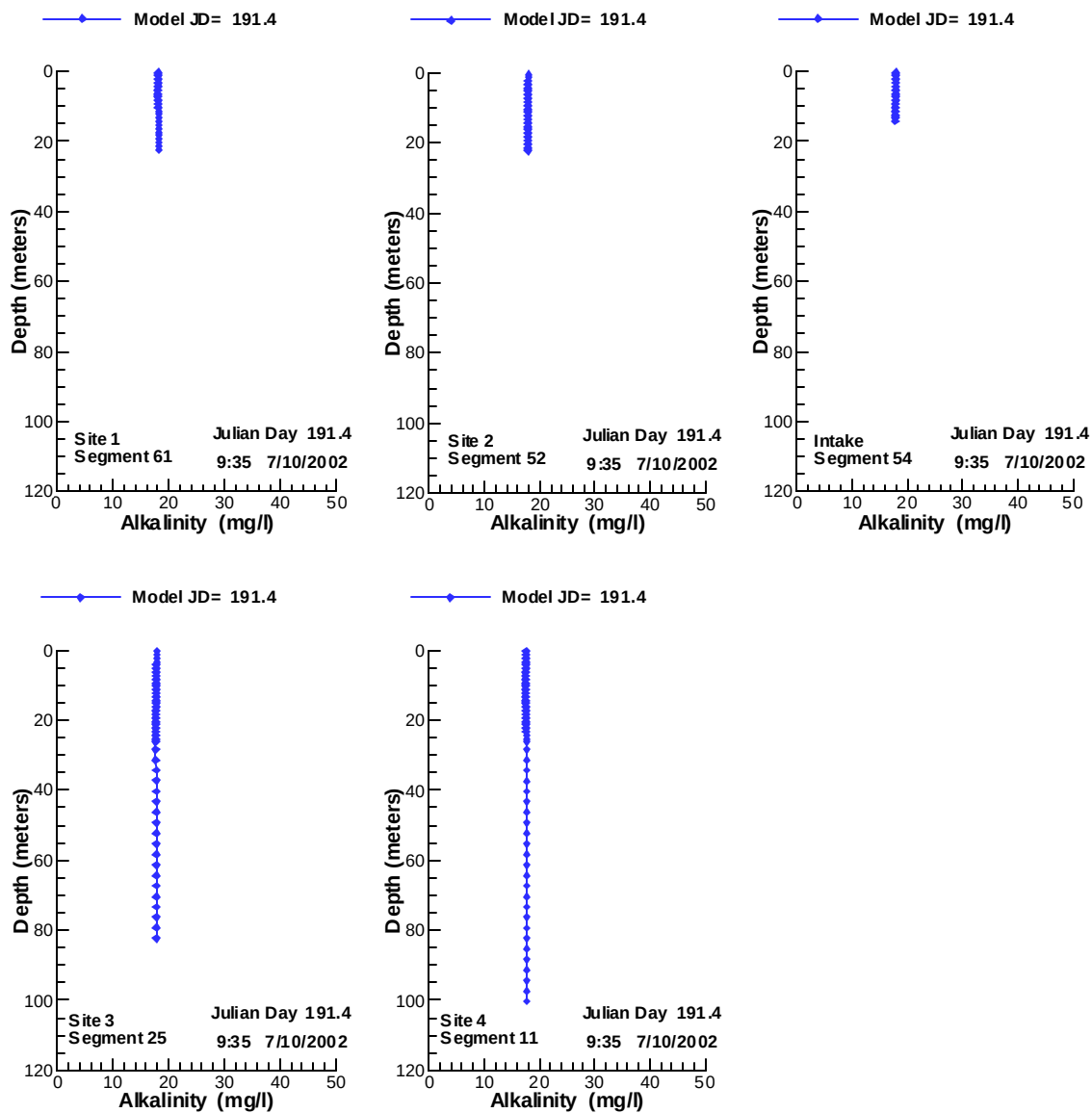


Figure 359. Vertical profiles of Alkalinity compared with data for 7/10/2002.

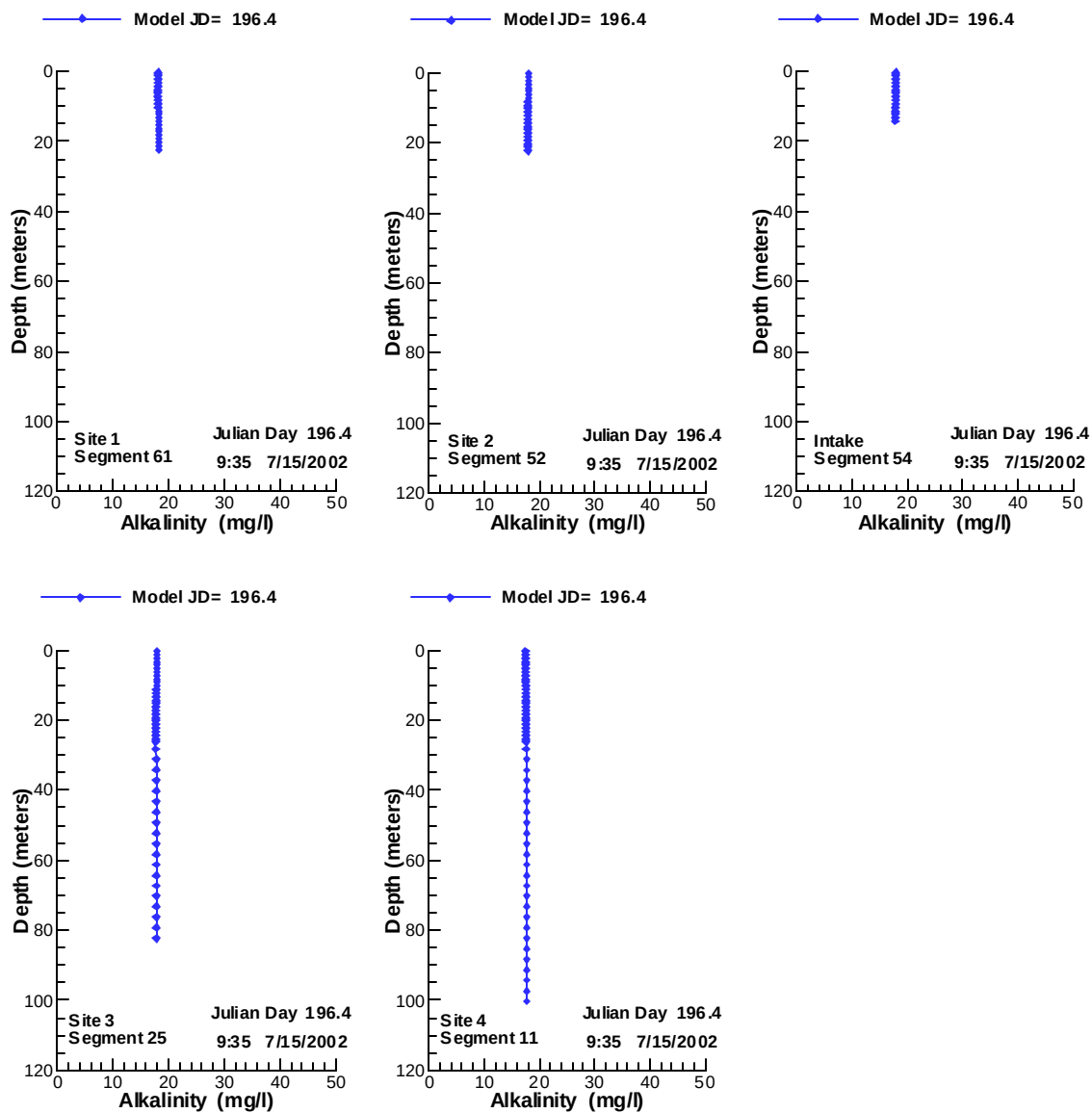


Figure 360. Vertical profiles of Alkalinity compared with data for 7/15/2002.

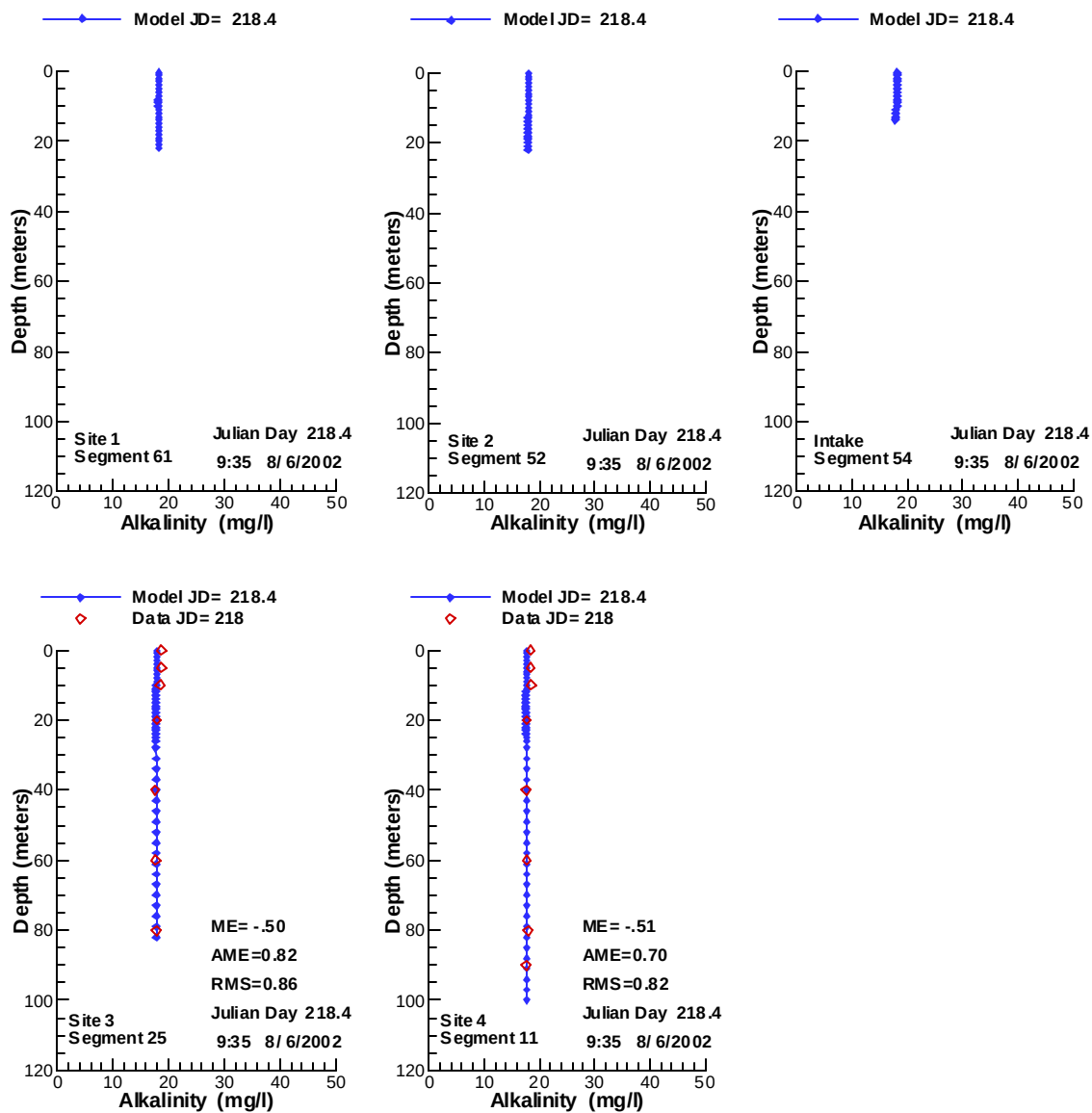


Figure 361. Vertical profiles of Alkalinity compared with data for 8/ 6/2002.

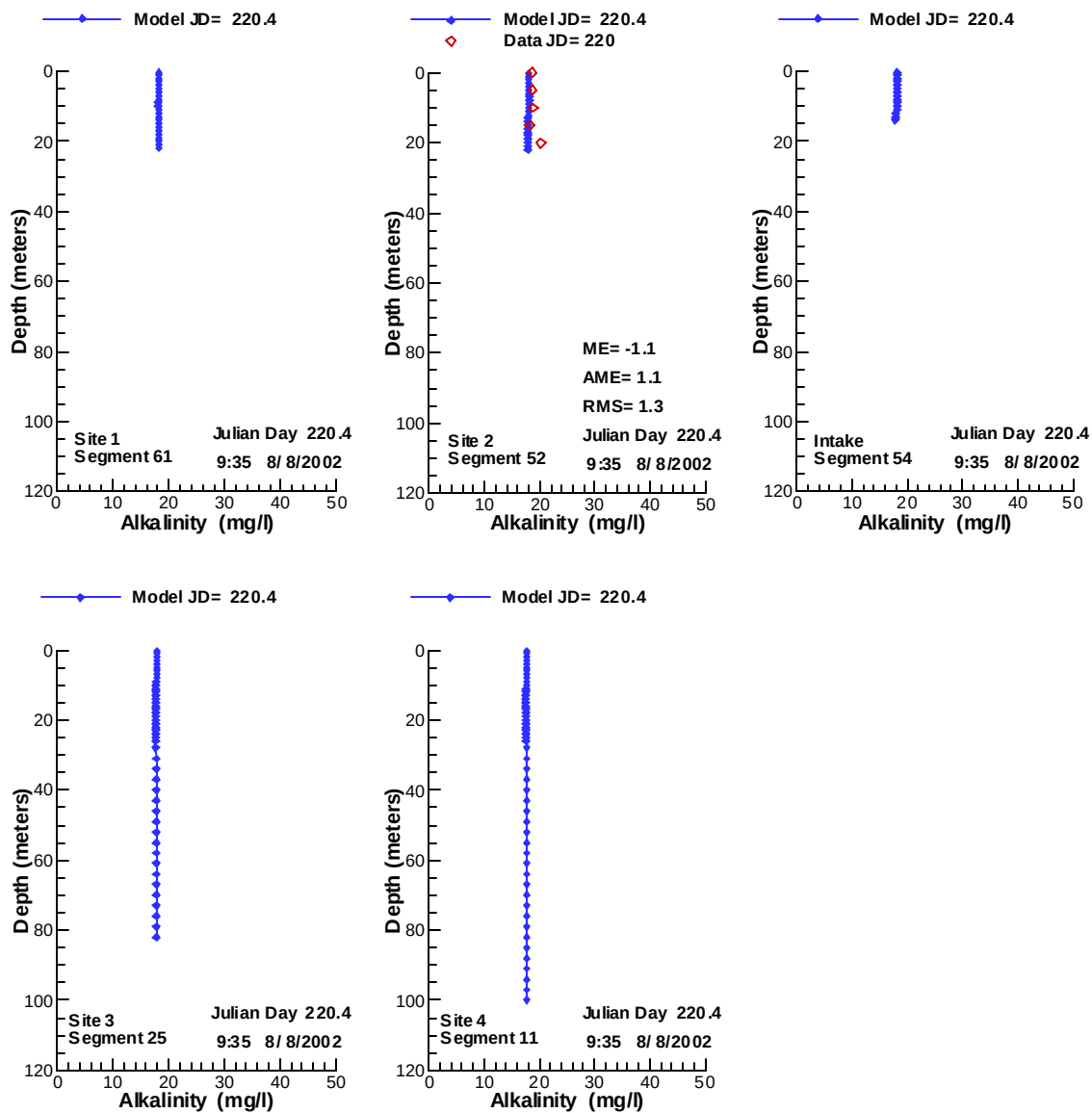


Figure 362. Vertical profiles of Alkalinity compared with data for 8/ 8/2002.

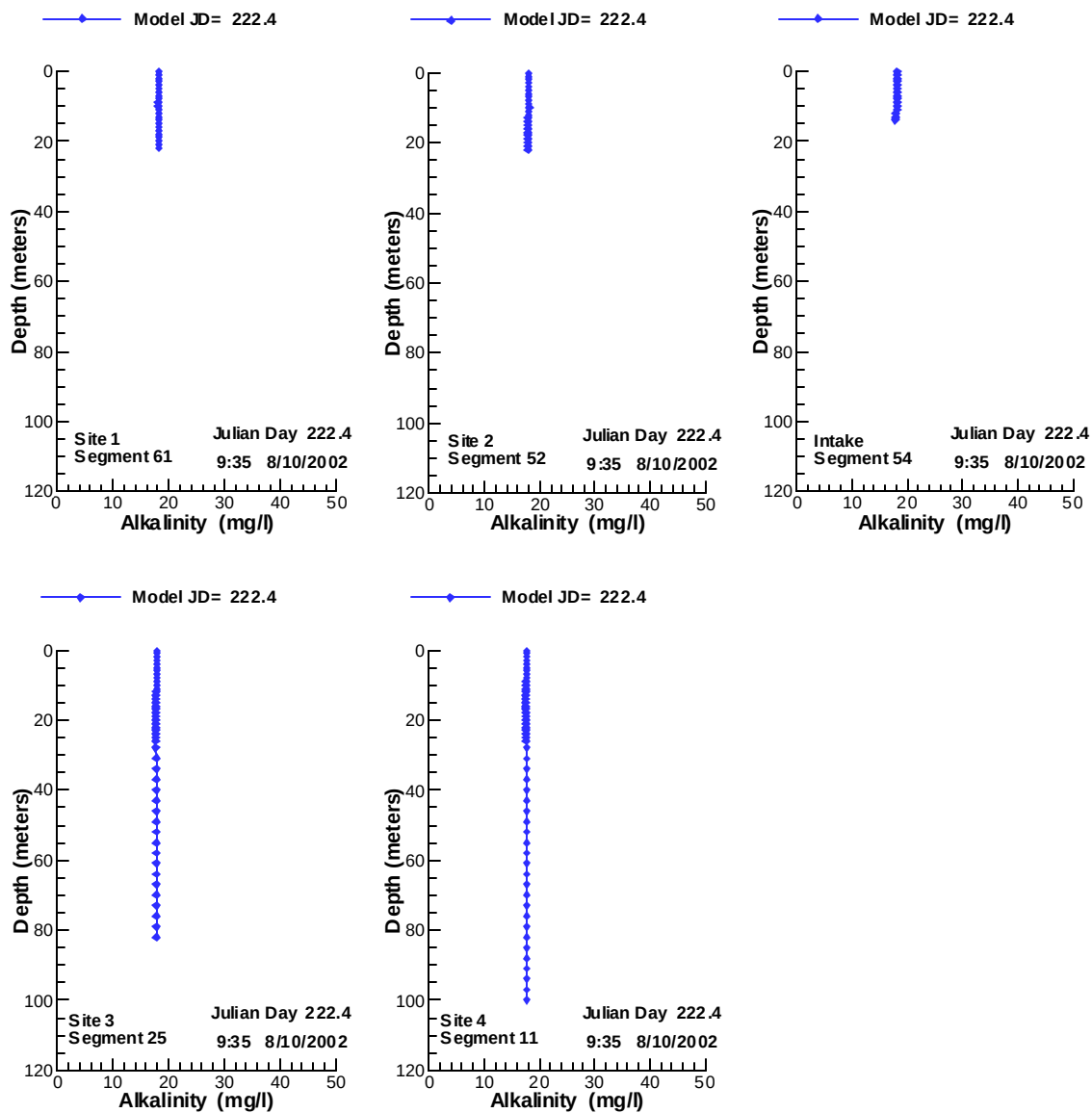


Figure 363. Vertical profiles of Alkalinity compared with data for 8/10/2002.

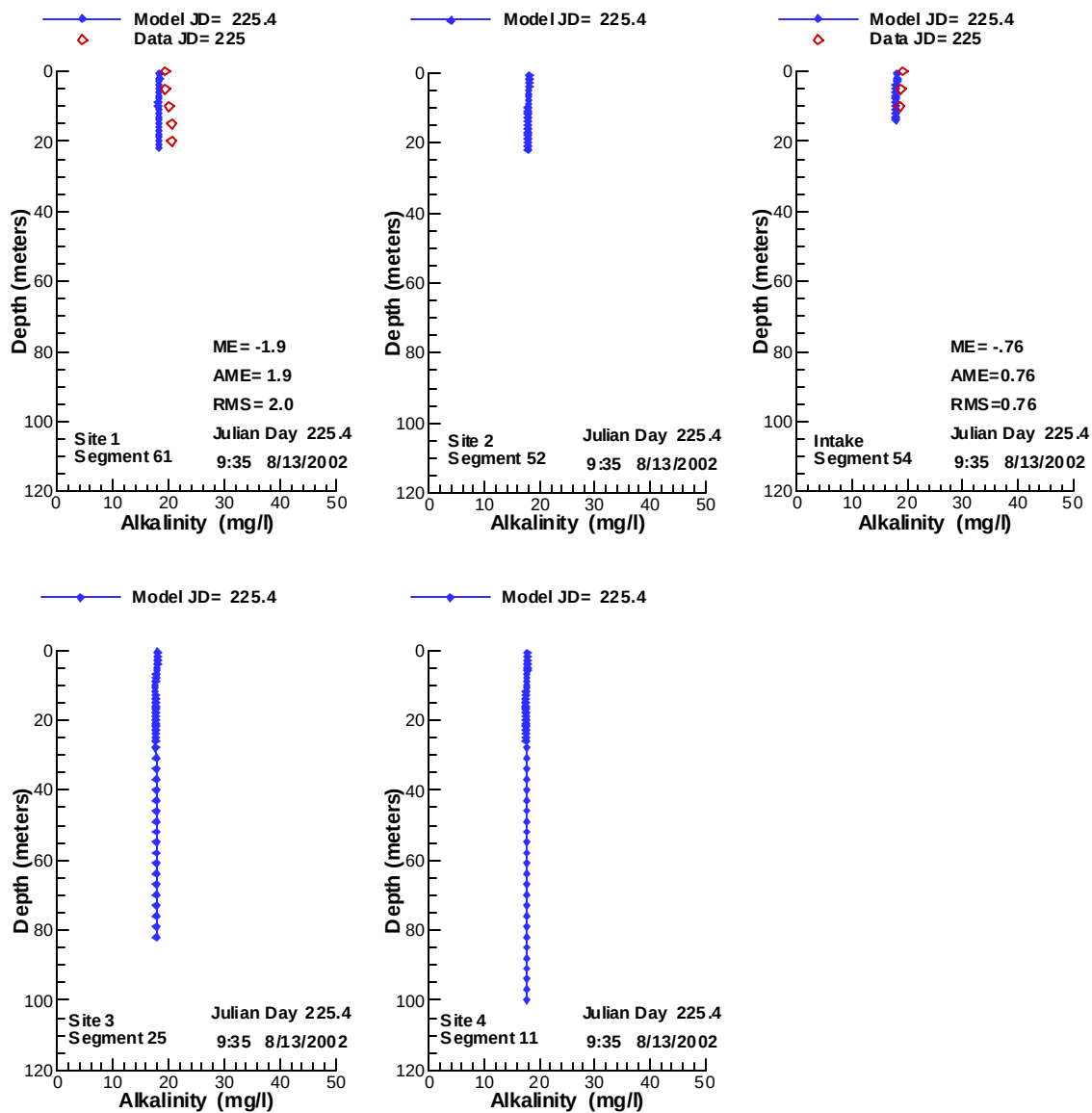


Figure 364. Vertical profiles of Alkalinity compared with data for 8/13/2002.

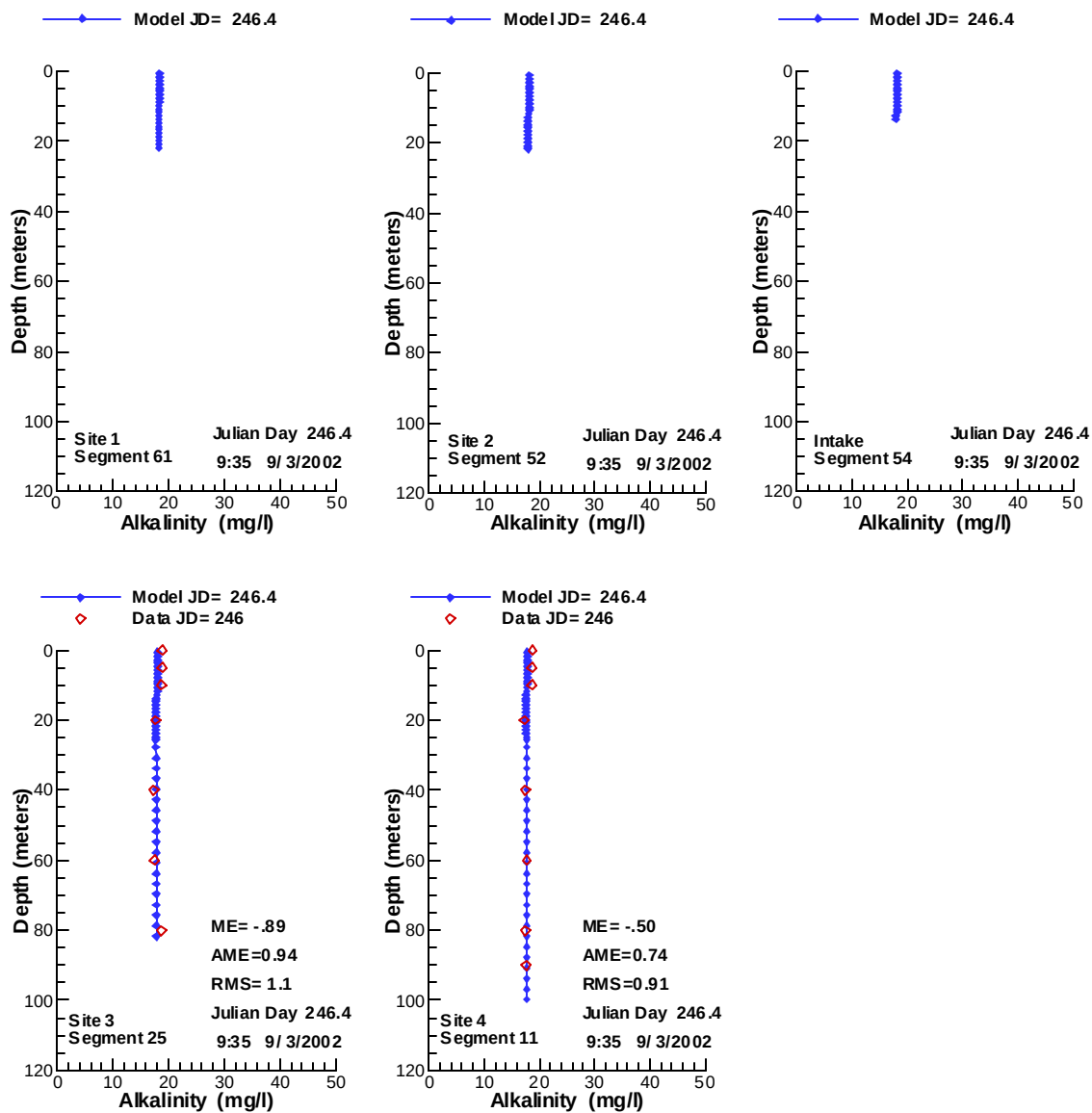


Figure 365. Vertical profiles of Alkalinity compared with data for 9/ 3/2002.

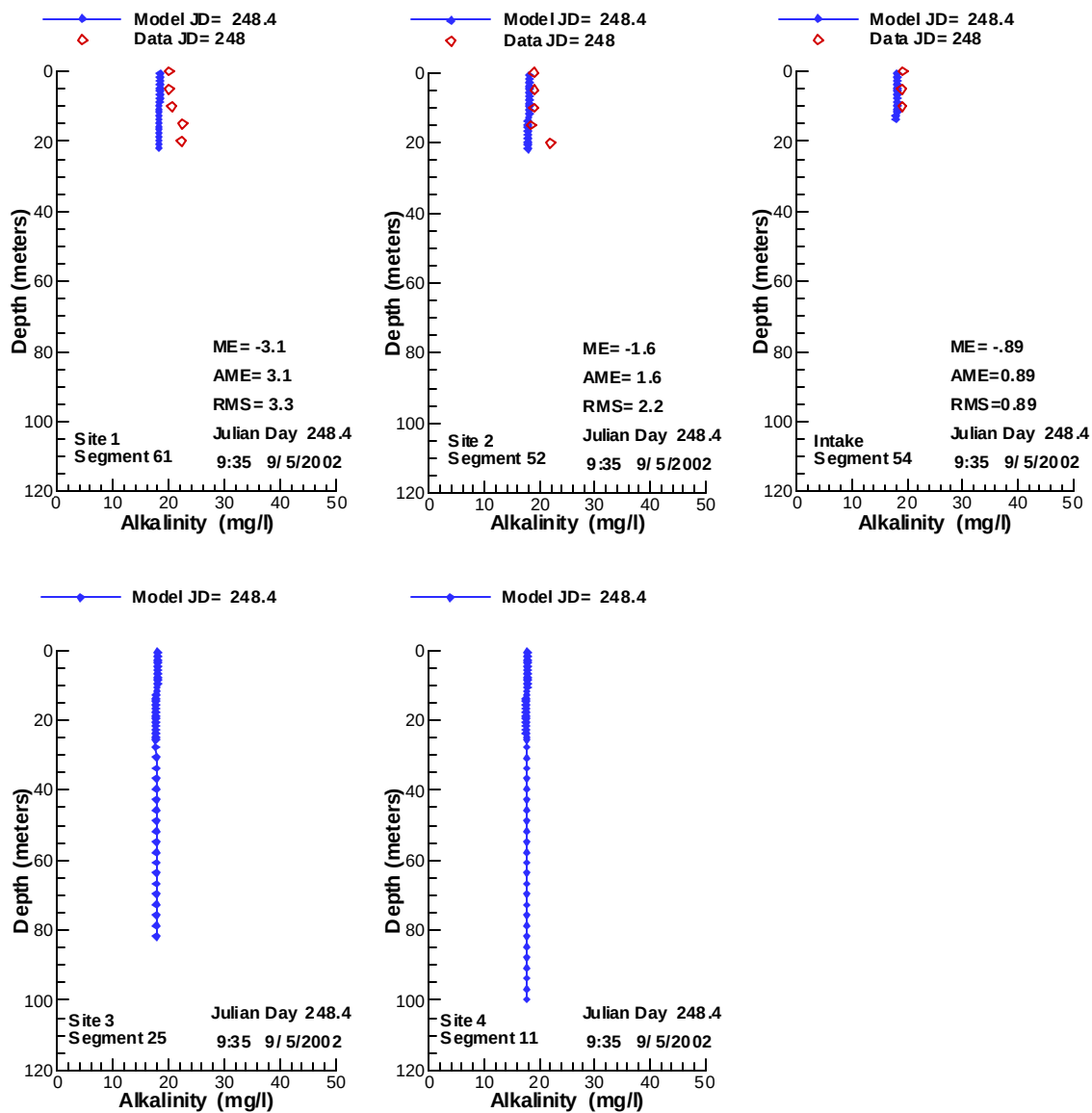


Figure 366. Vertical profiles of Alkalinity compared with data for 9/ 5/2002.

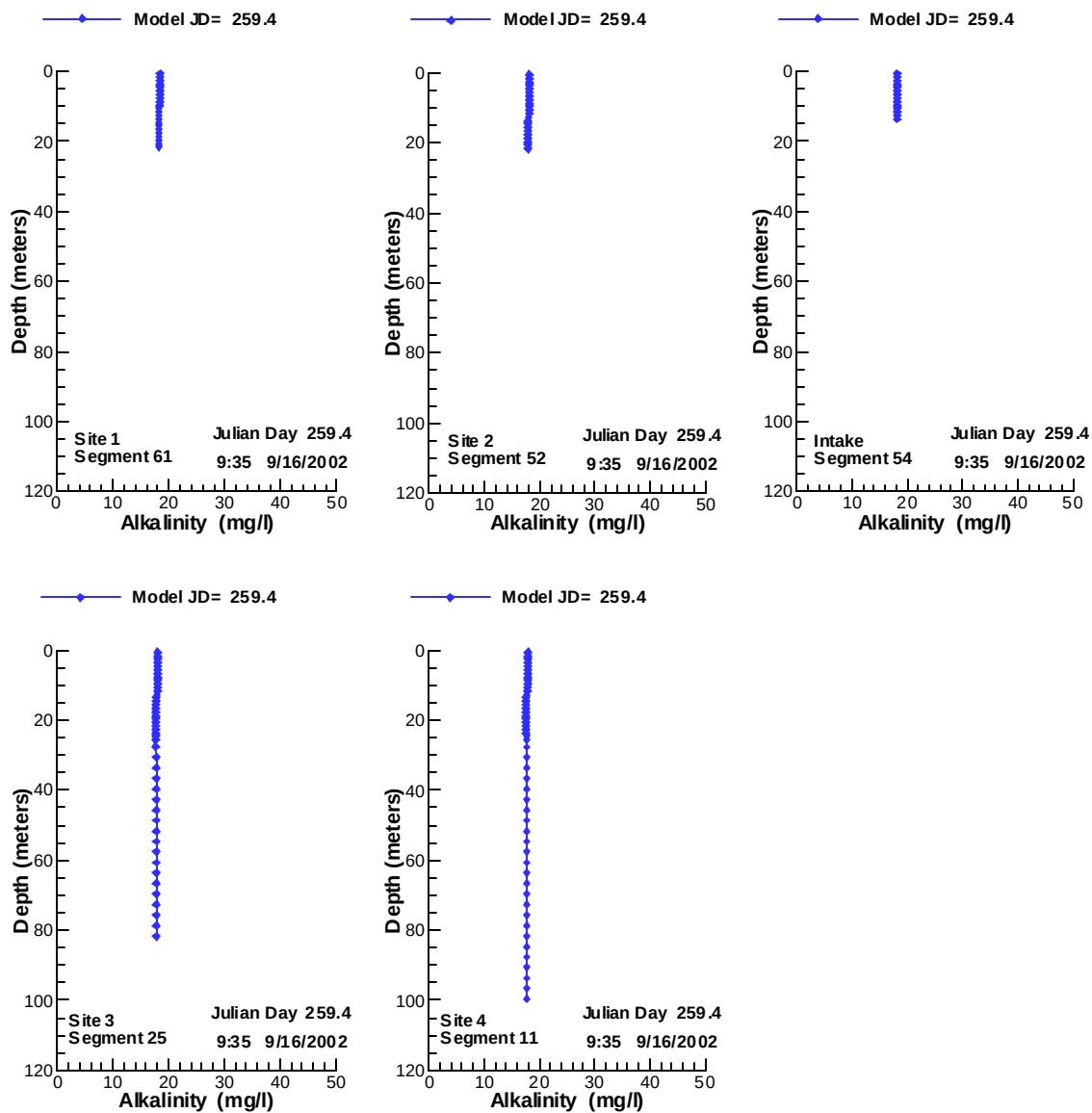


Figure 367. Vertical profiles of Alkalinity compared with data for 9/16/2002.

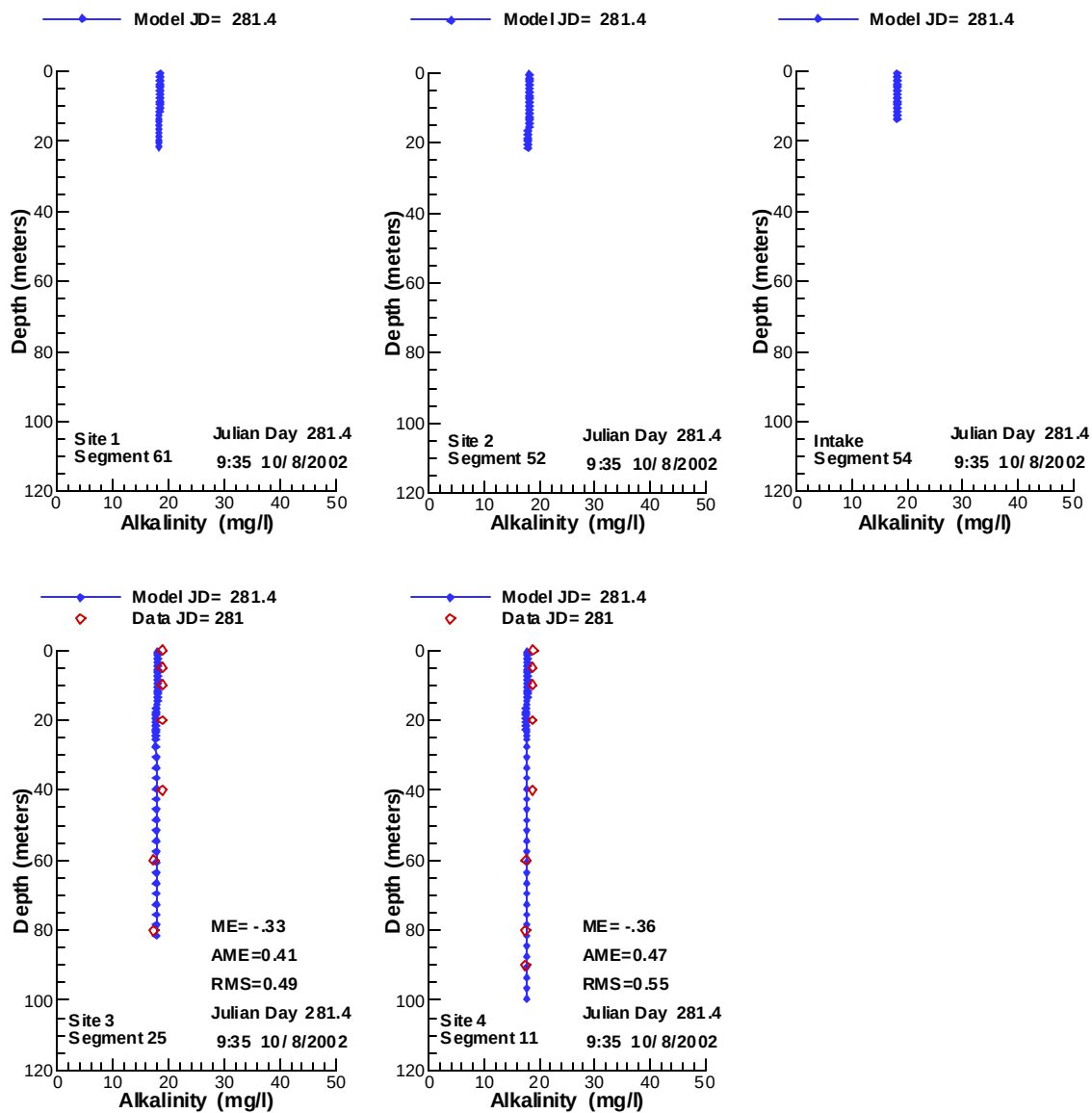


Figure 368. Vertical profiles of Alkalinity compared with data for 10/ 8/2002.

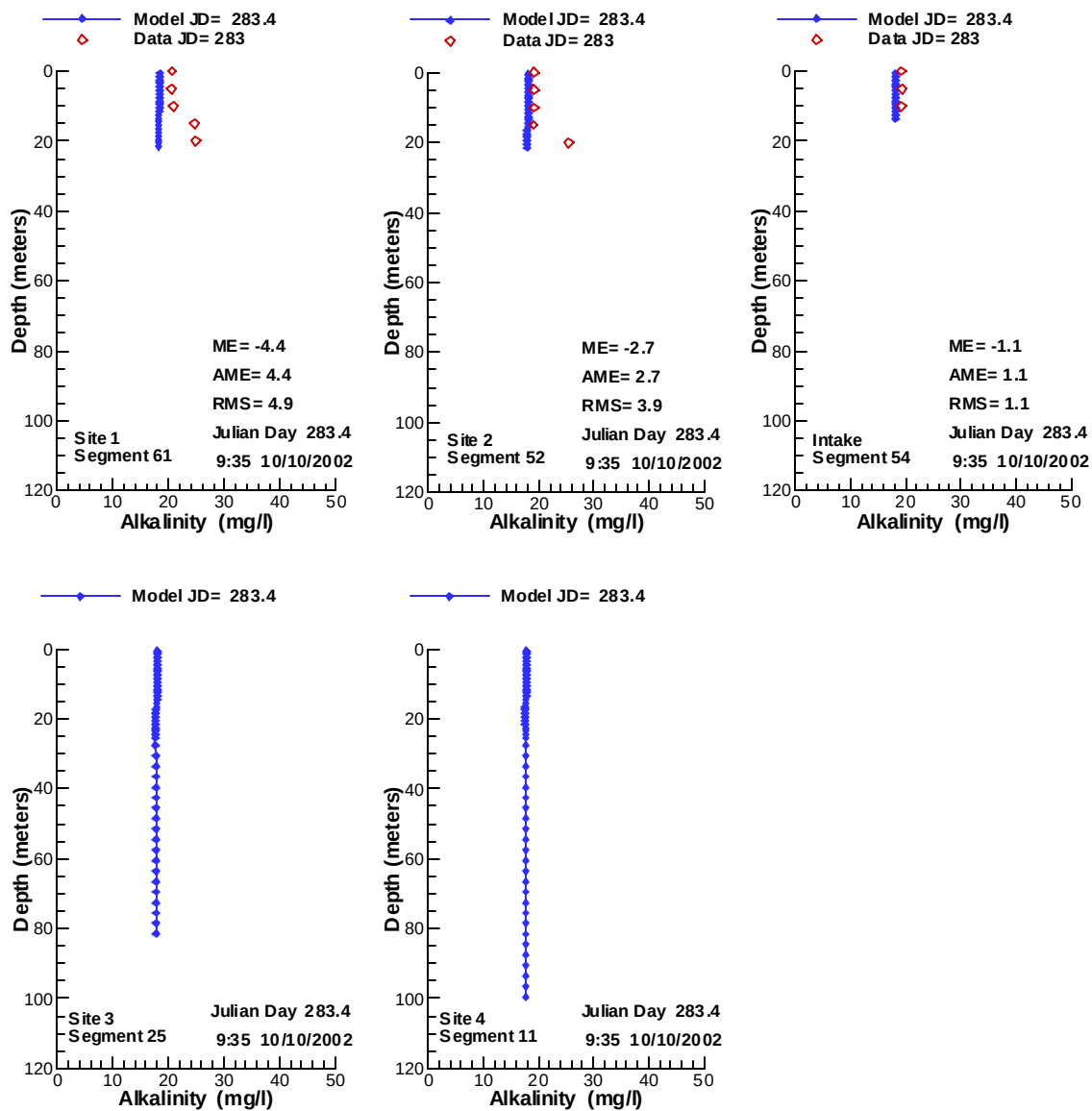


Figure 369. Vertical profiles of Alkalinity compared with data for 10/10/2002.

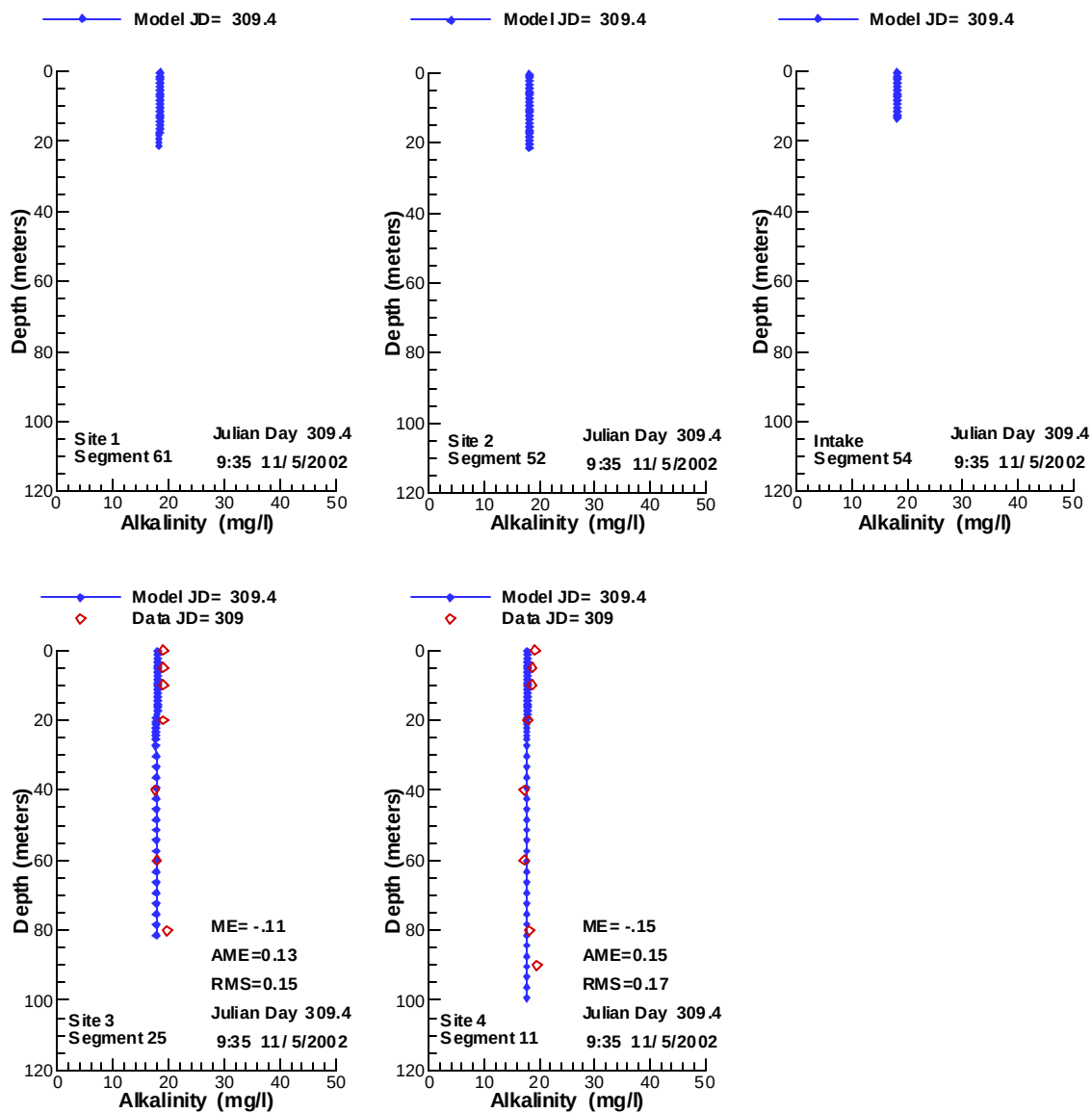


Figure 370. Vertical profiles of Alkalinity compared with data for 11/ 5/2002.

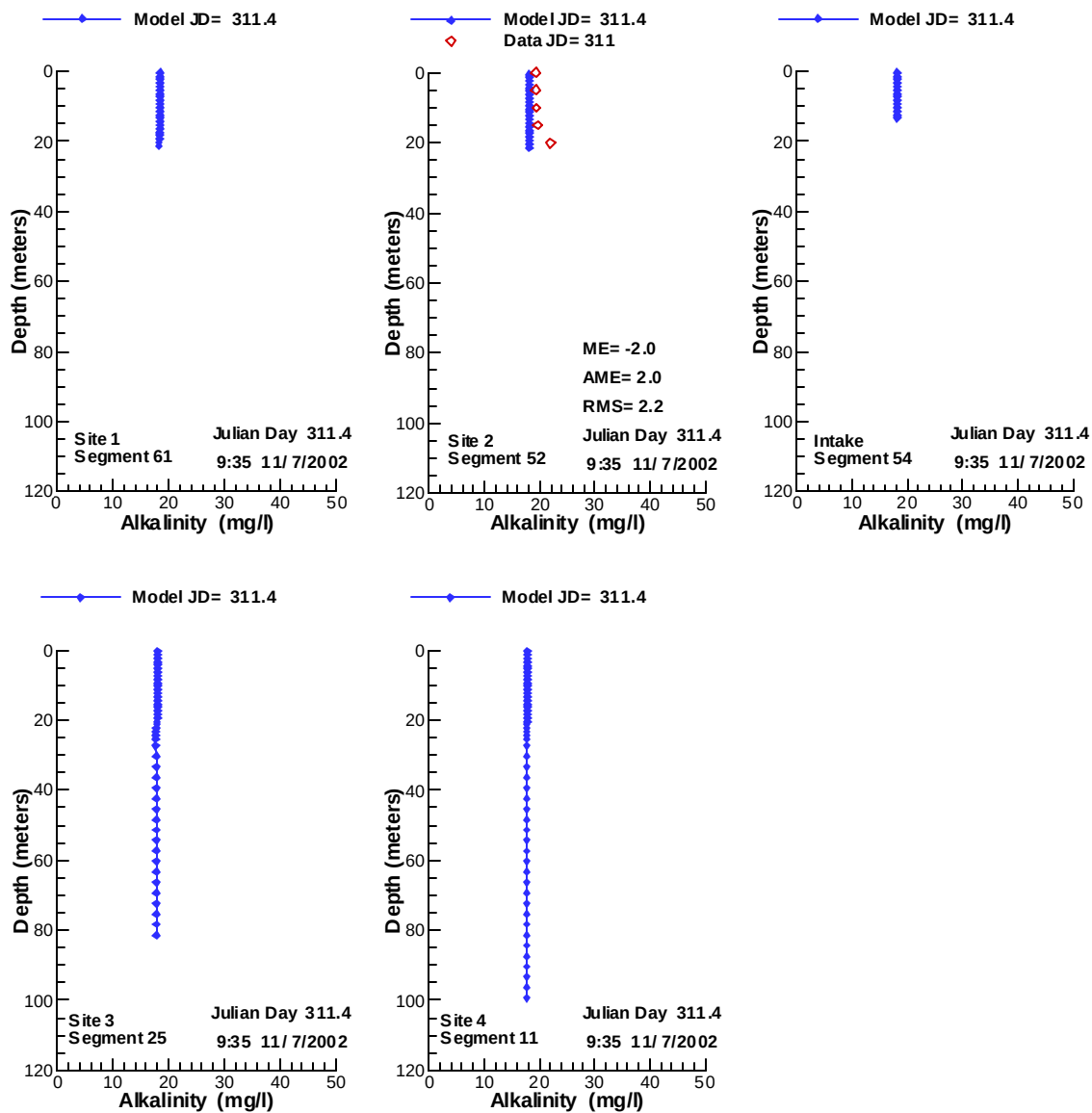


Figure 371. Vertical profiles of Alkalinity compared with data for 11/ 7/2002.

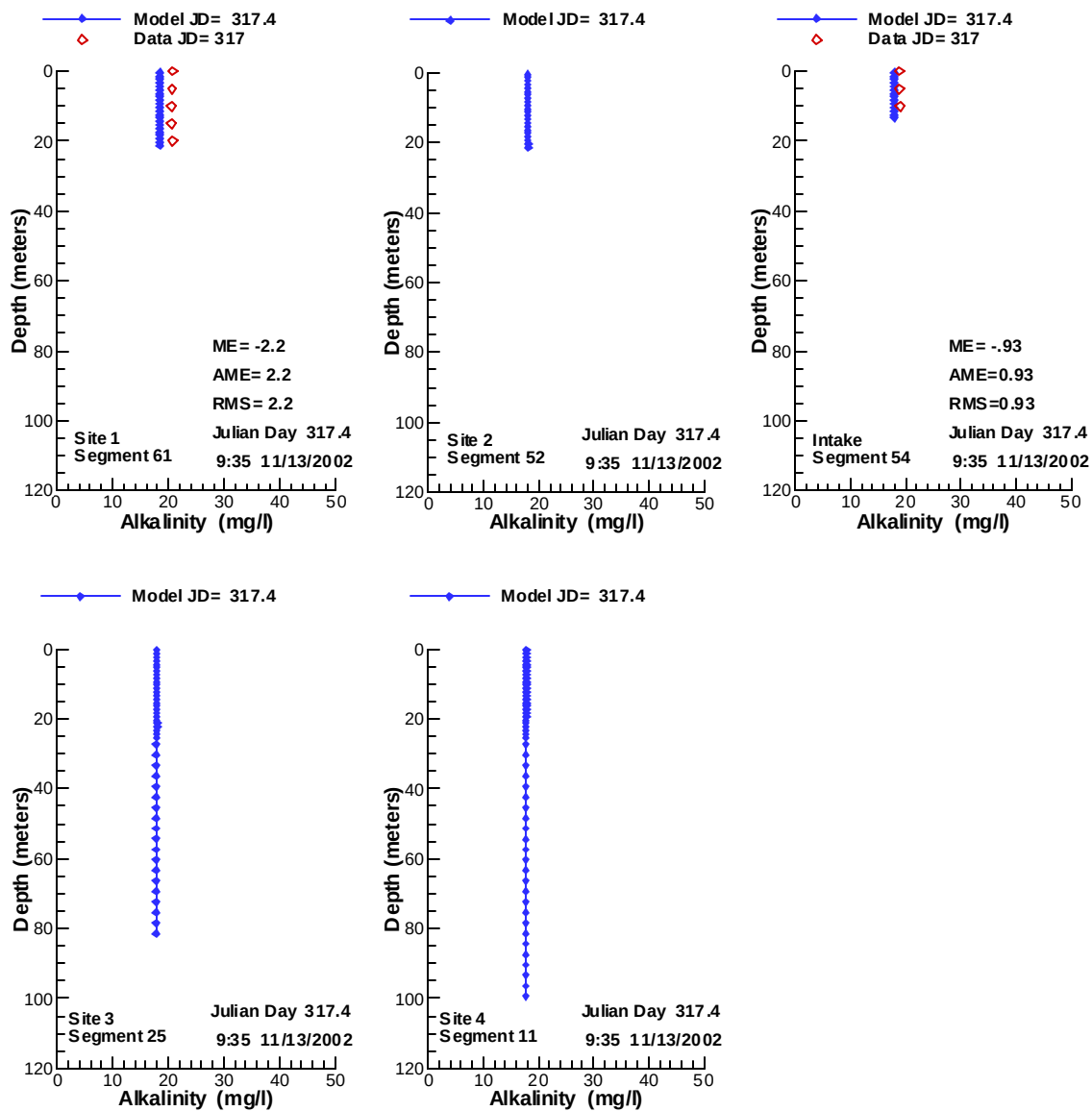


Figure 372. Vertical profiles of Alkalinity compared with data for 11/13/2002.

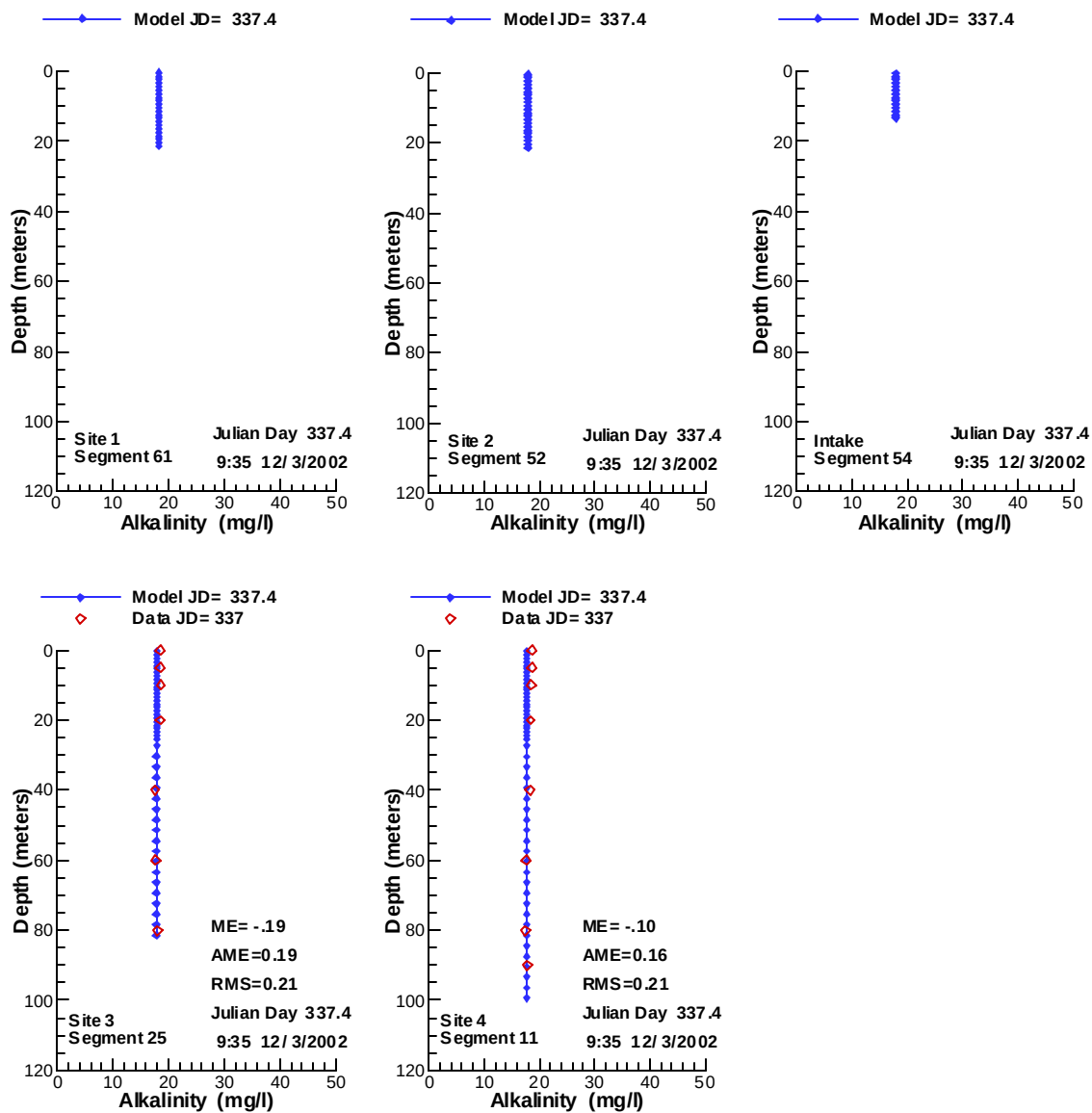


Figure 373. Vertical profiles of Alkalinity compared with data for 12/ 3/2002.

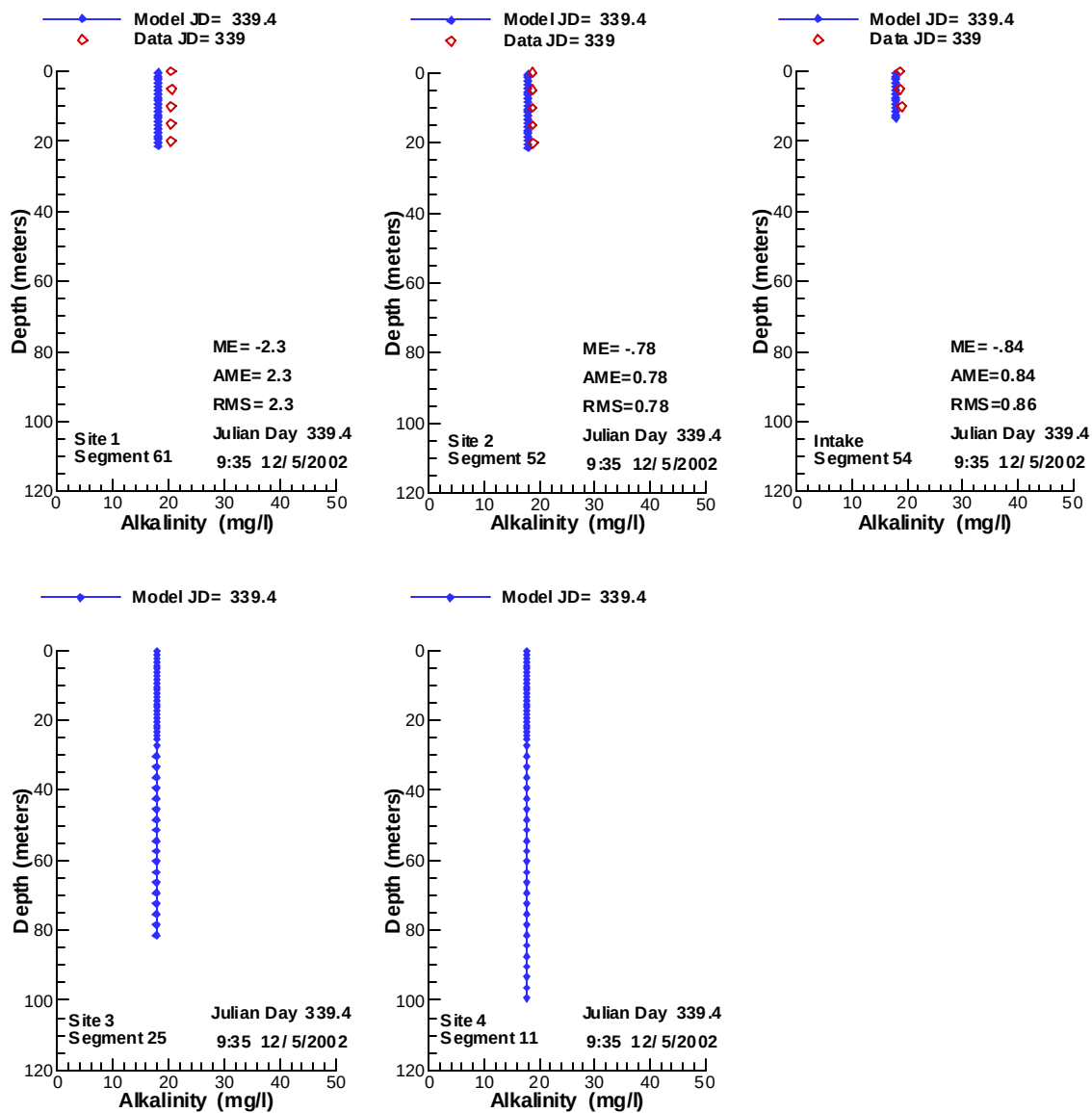


Figure 374. Vertical profiles of Alkalinity compared with data for 12/ 5/2002.

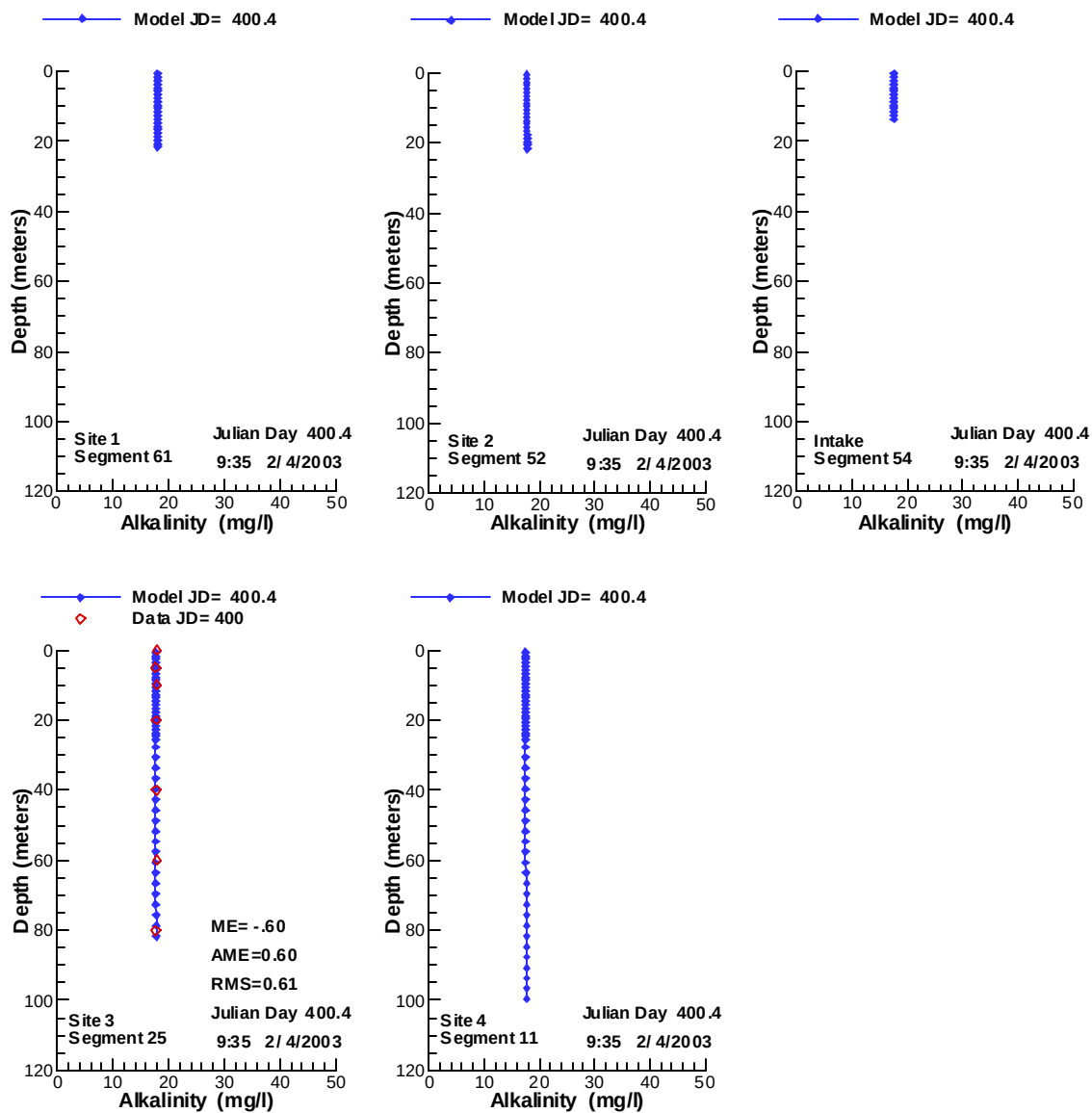


Figure 375. Vertical profiles of Alkalinity compared with data for 2/ 4/2003.

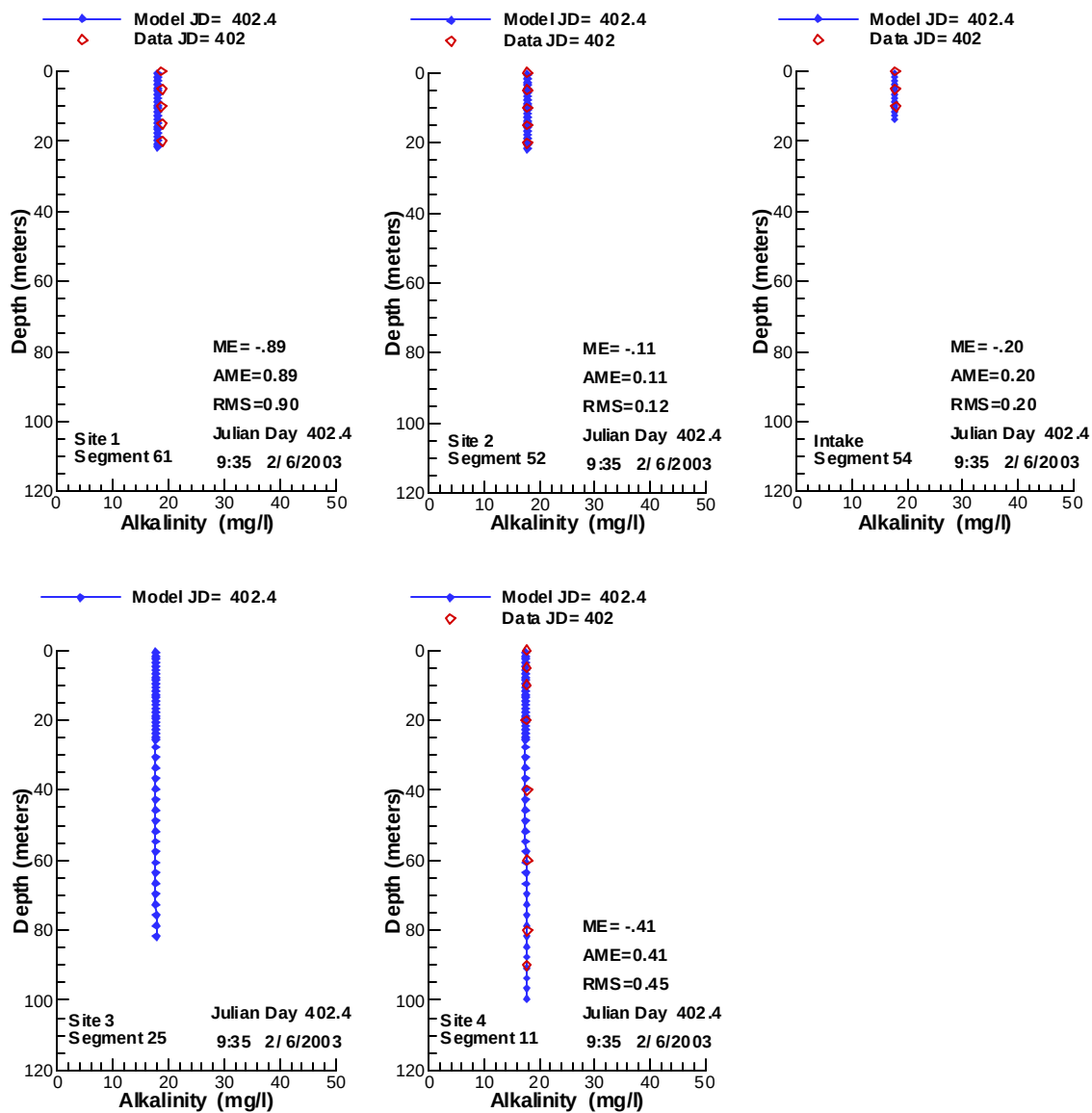


Figure 376. Vertical profiles of Alkalinity compared with data for 2/ 6/2003.

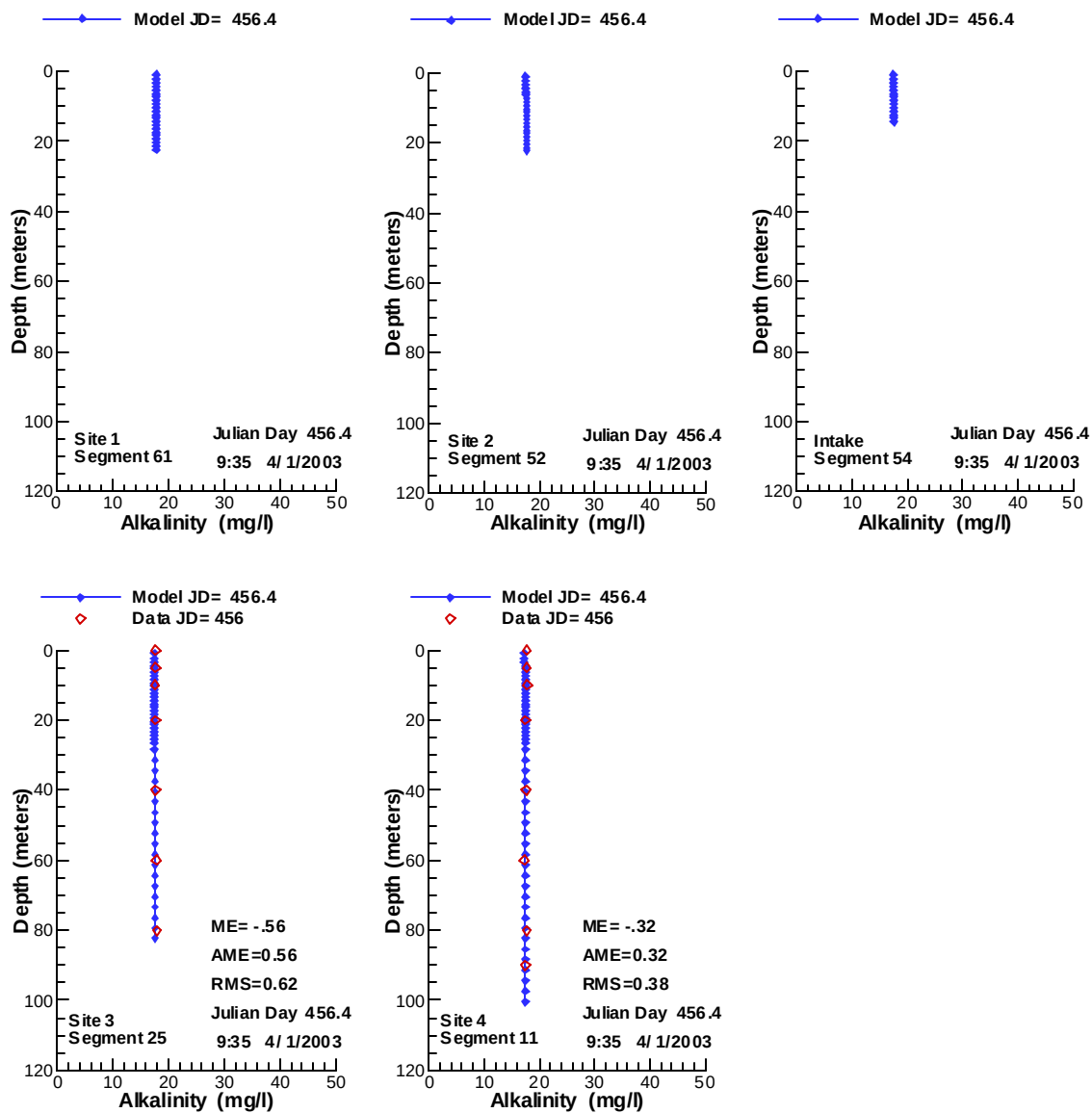


Figure 377. Vertical profiles of Alkalinity compared with data for 4/ 1/2003.

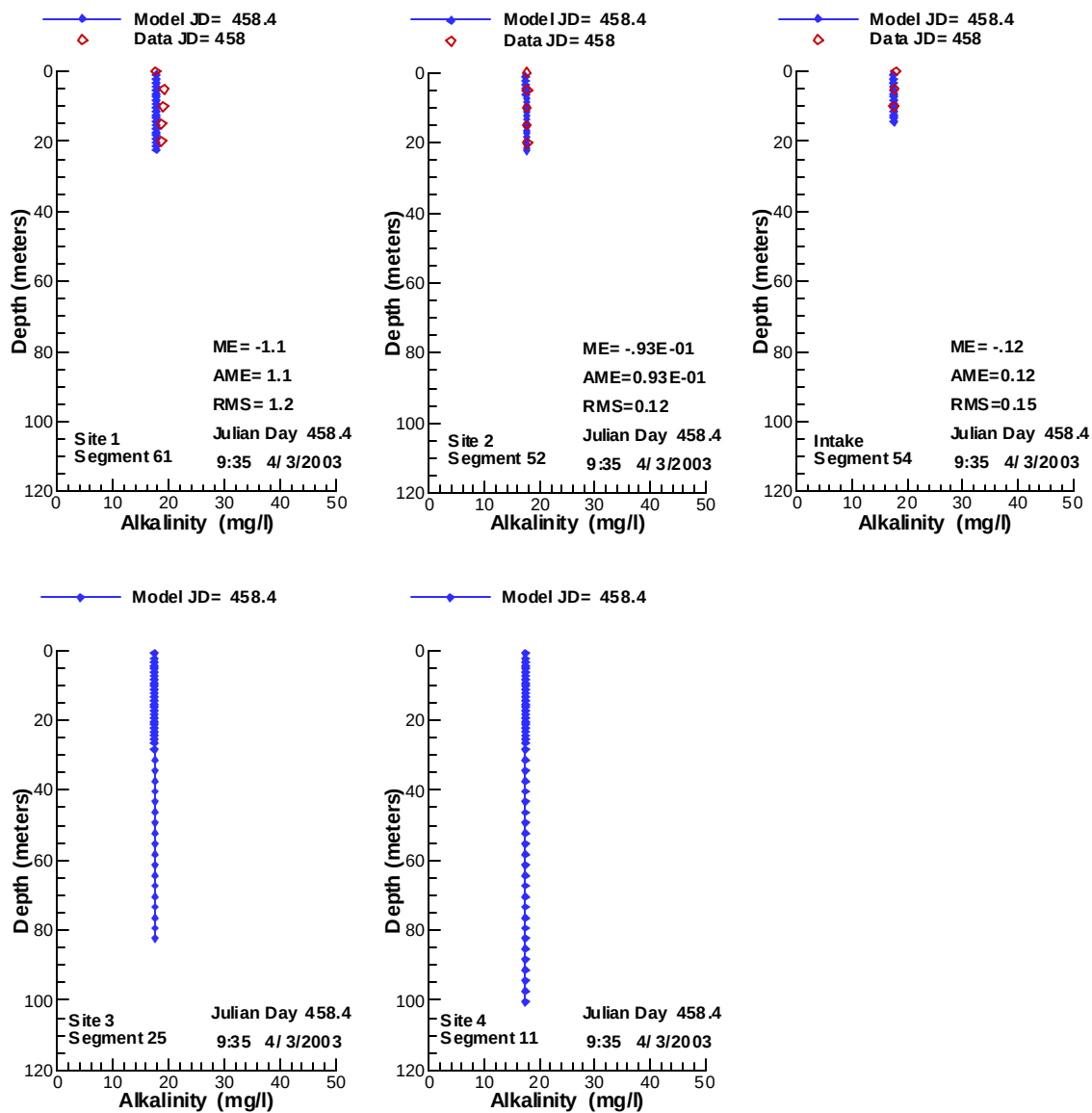


Figure 378. Vertical profiles of Alkalinity compared with data for 4/ 3/2003.

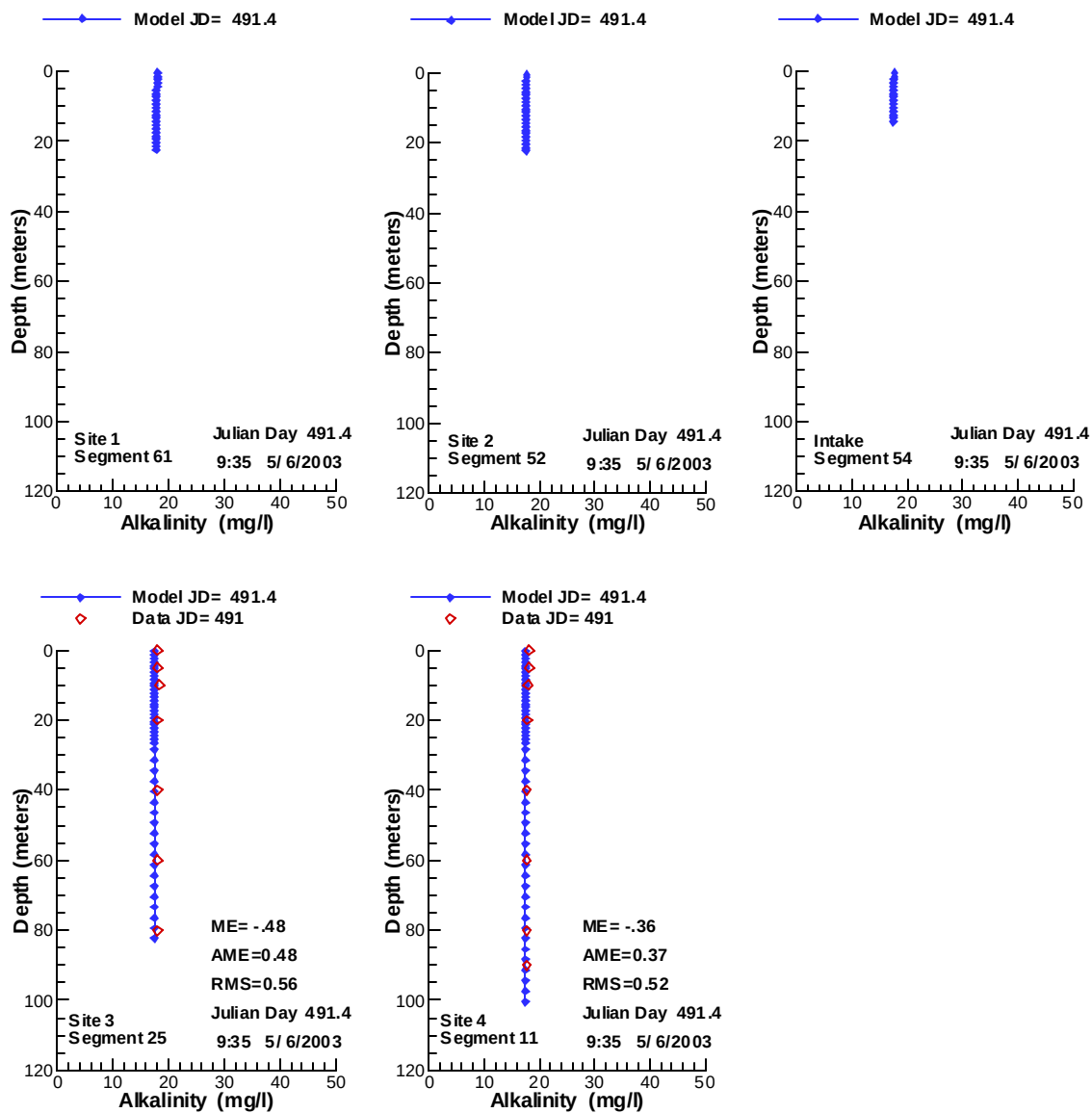


Figure 379. Vertical profiles of Alkalinity compared with data for 5/ 6/2003.

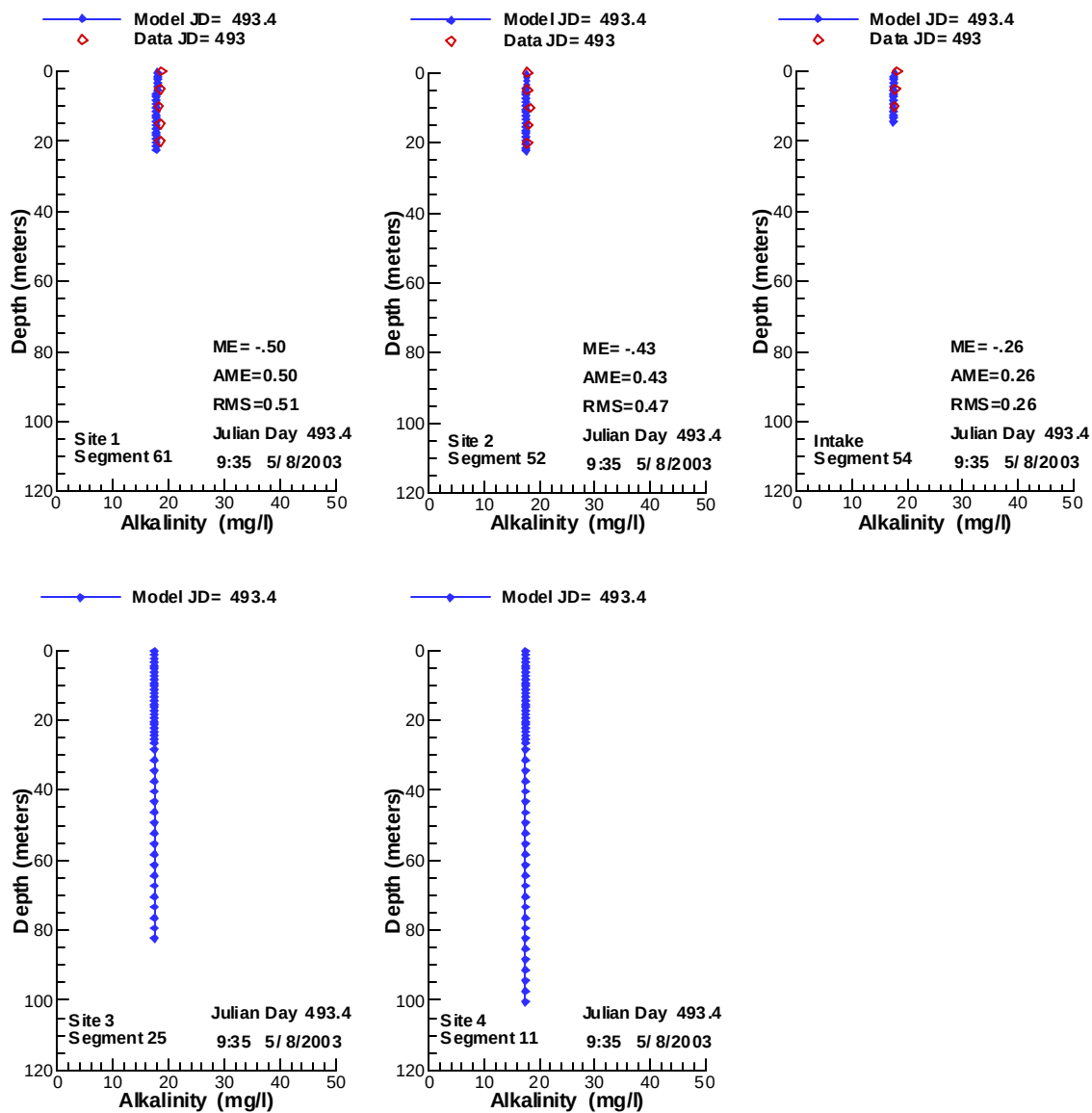


Figure 380. Vertical profiles of Alkalinity compared with data for 5/ 8/2003.

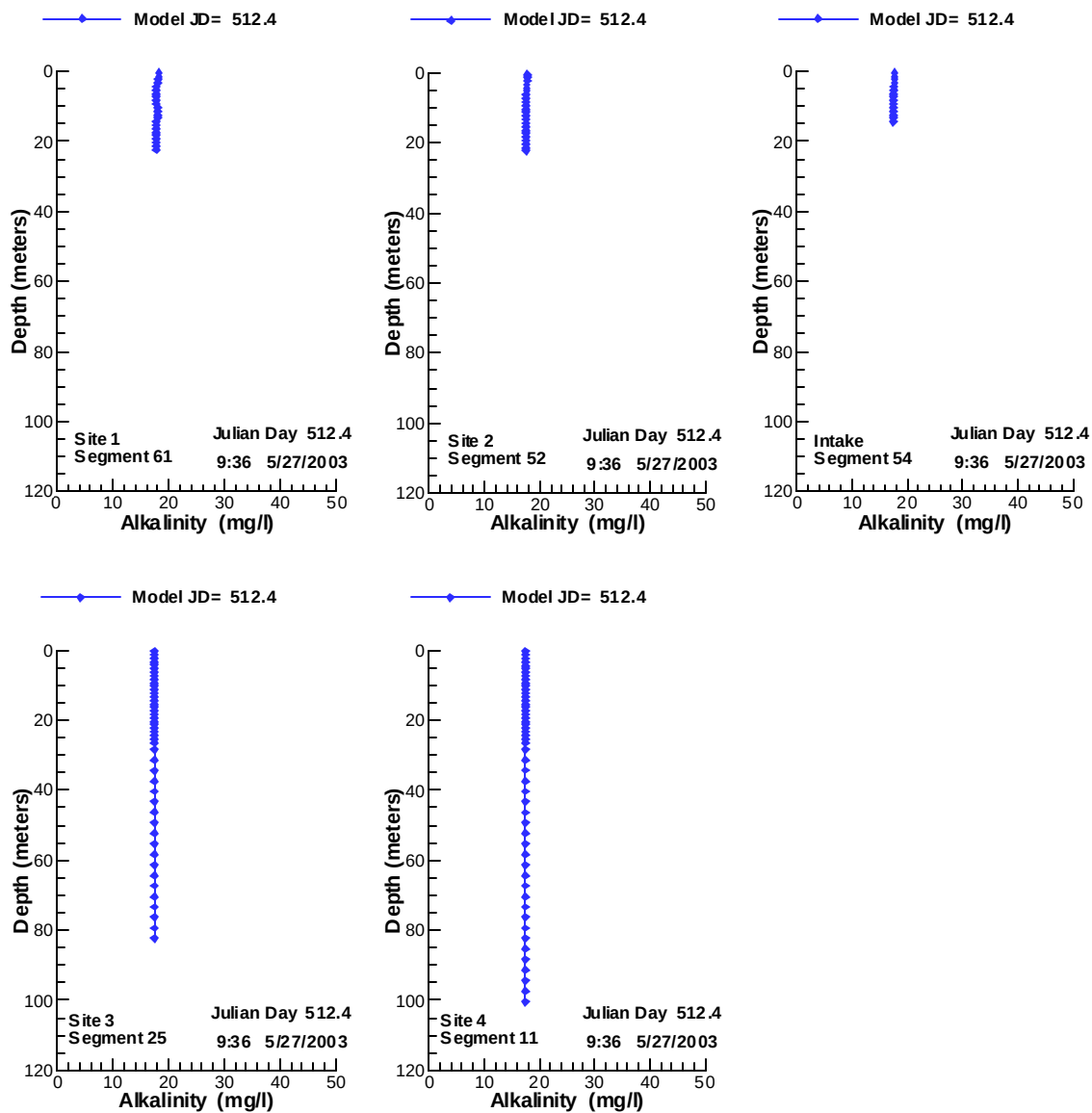


Figure 381. Vertical profiles of Alkalinity compared with data for 5/27/2003.

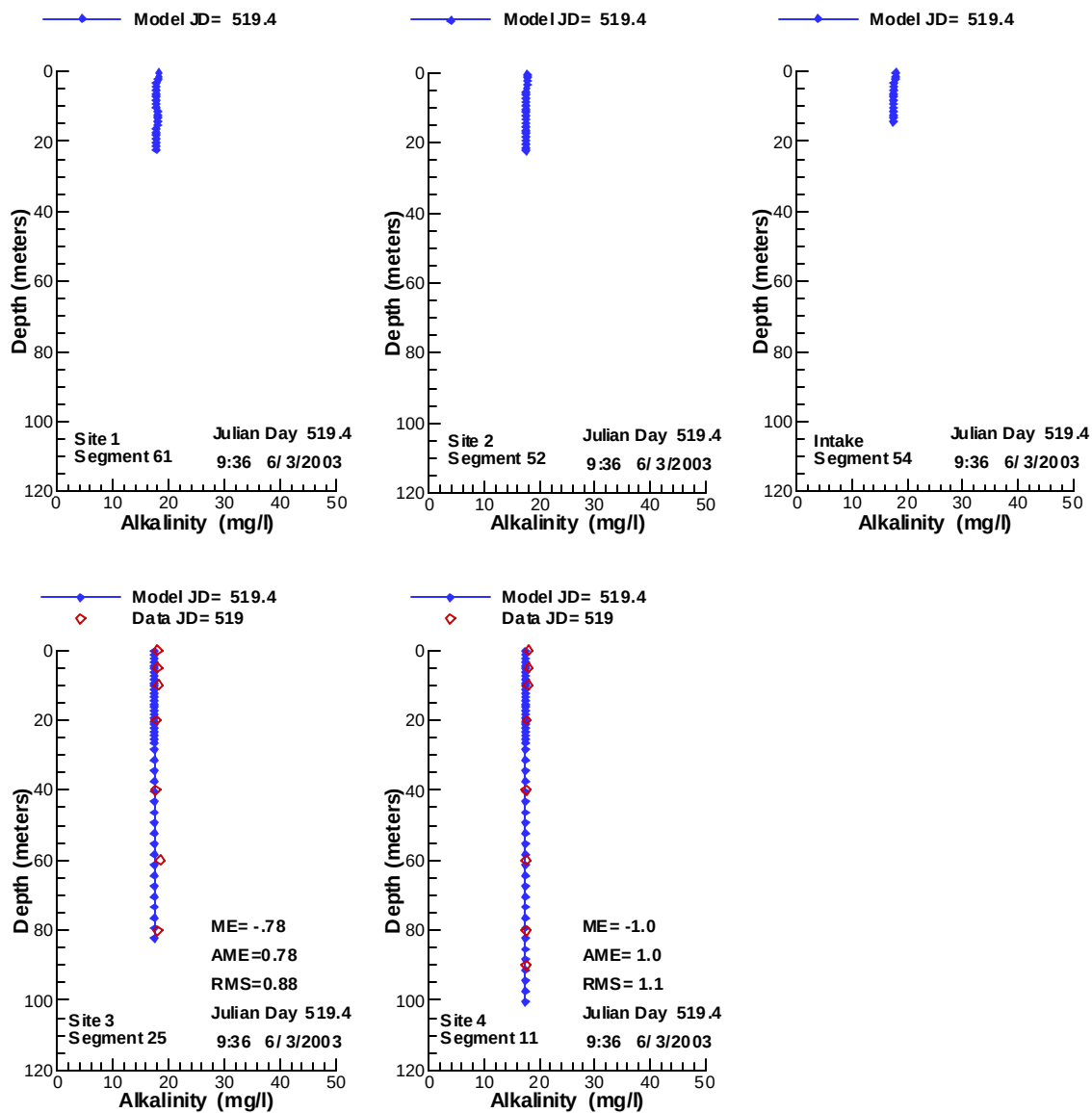


Figure 382. Vertical profiles of Alkalinity compared with data for 6/ 3/2003.

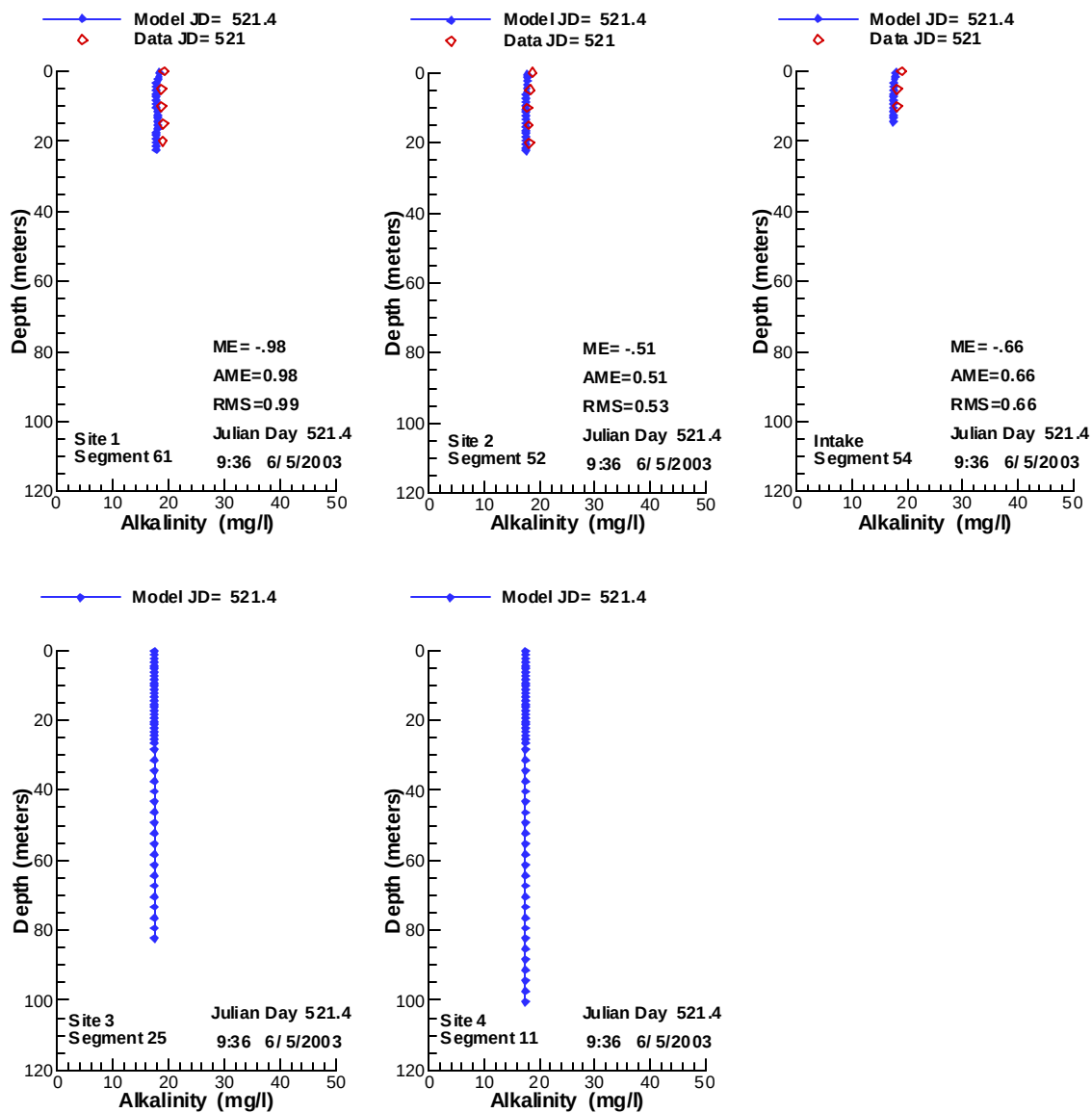


Figure 383. Vertical profiles of Alkalinity compared with data for 6/ 5/2003.

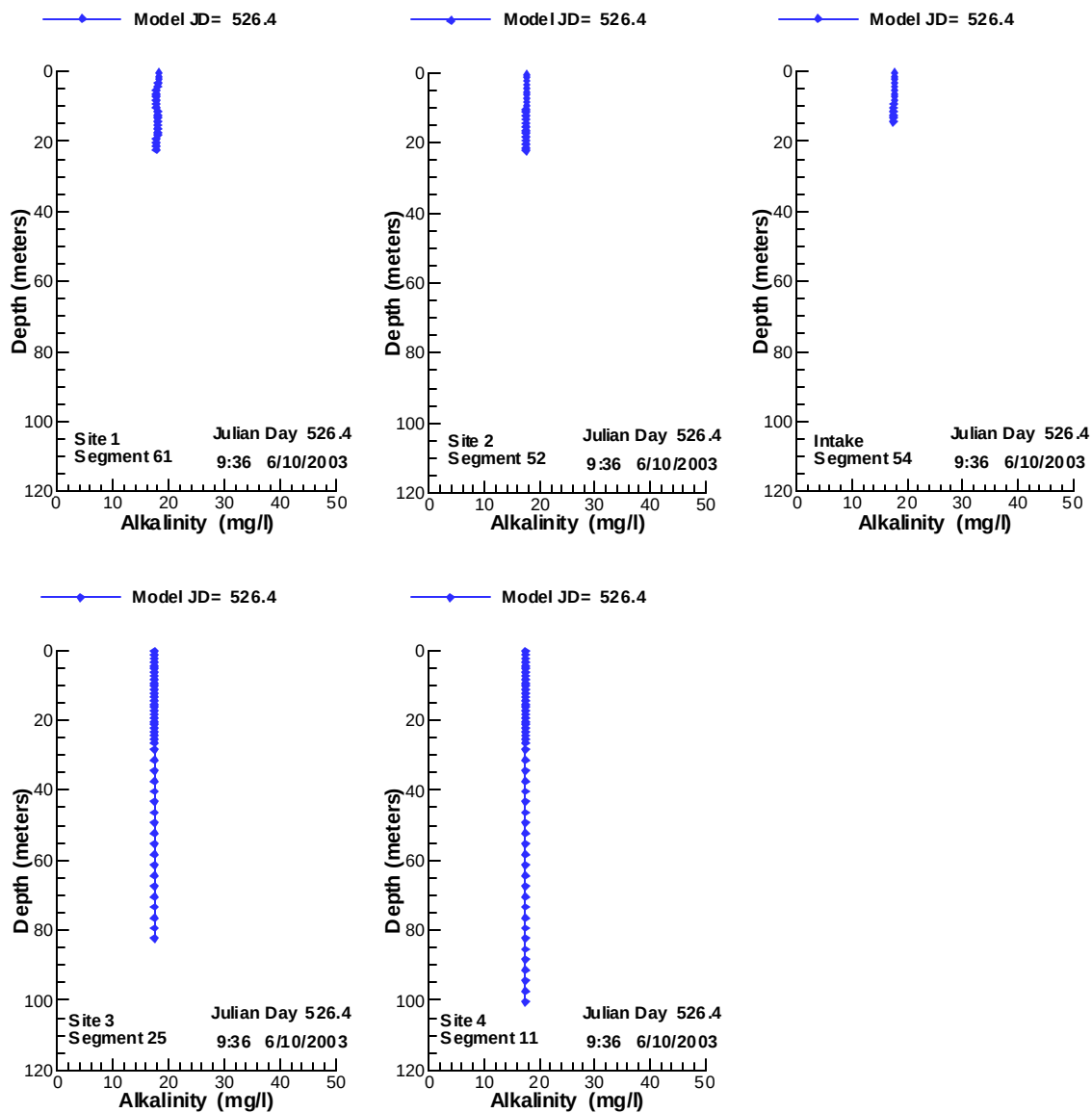


Figure 384. Vertical profiles of Alkalinity compared with data for 6/10/2003.

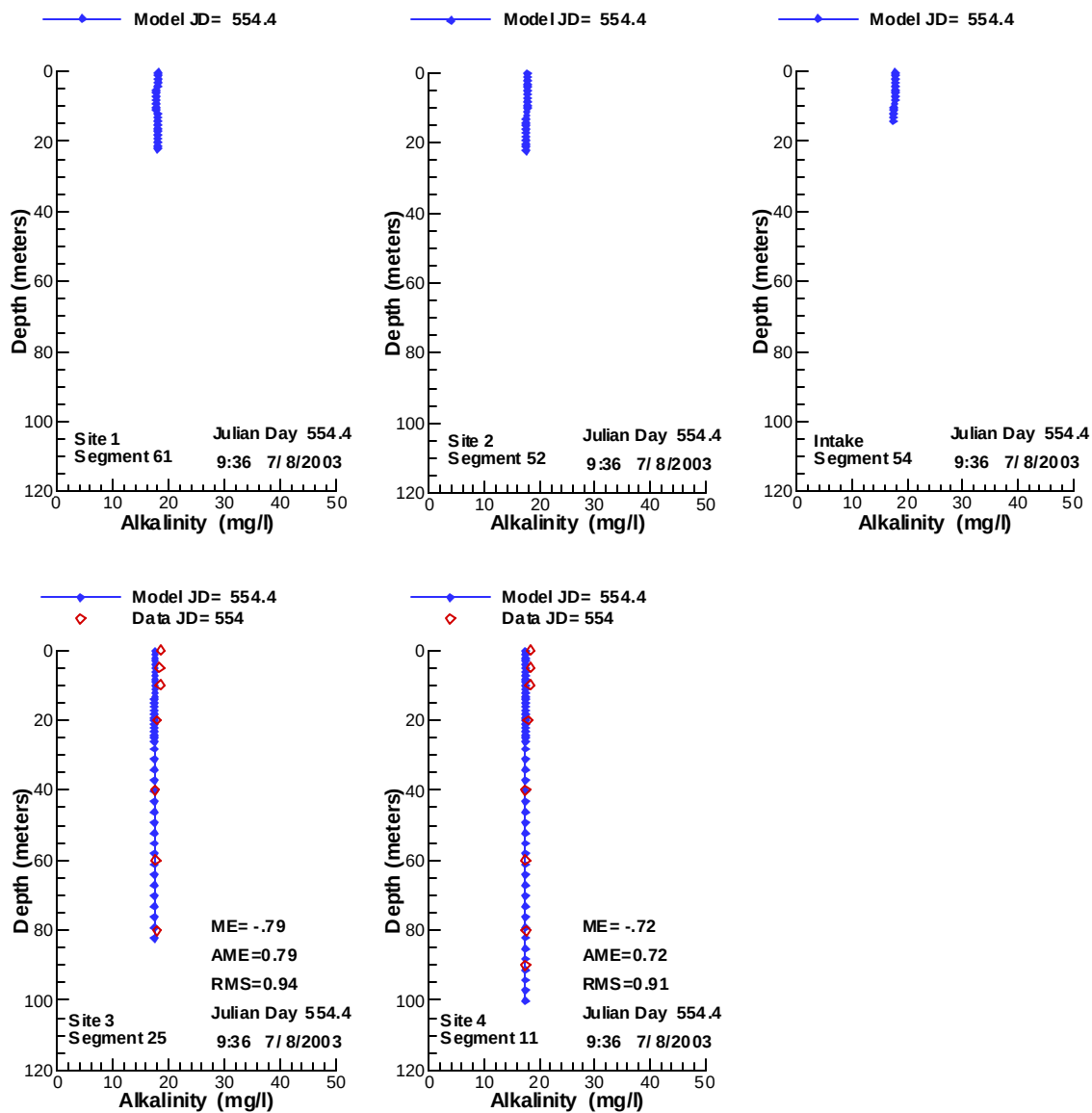


Figure 385. Vertical profiles of Alkalinity compared with data for 7/ 8/2003.

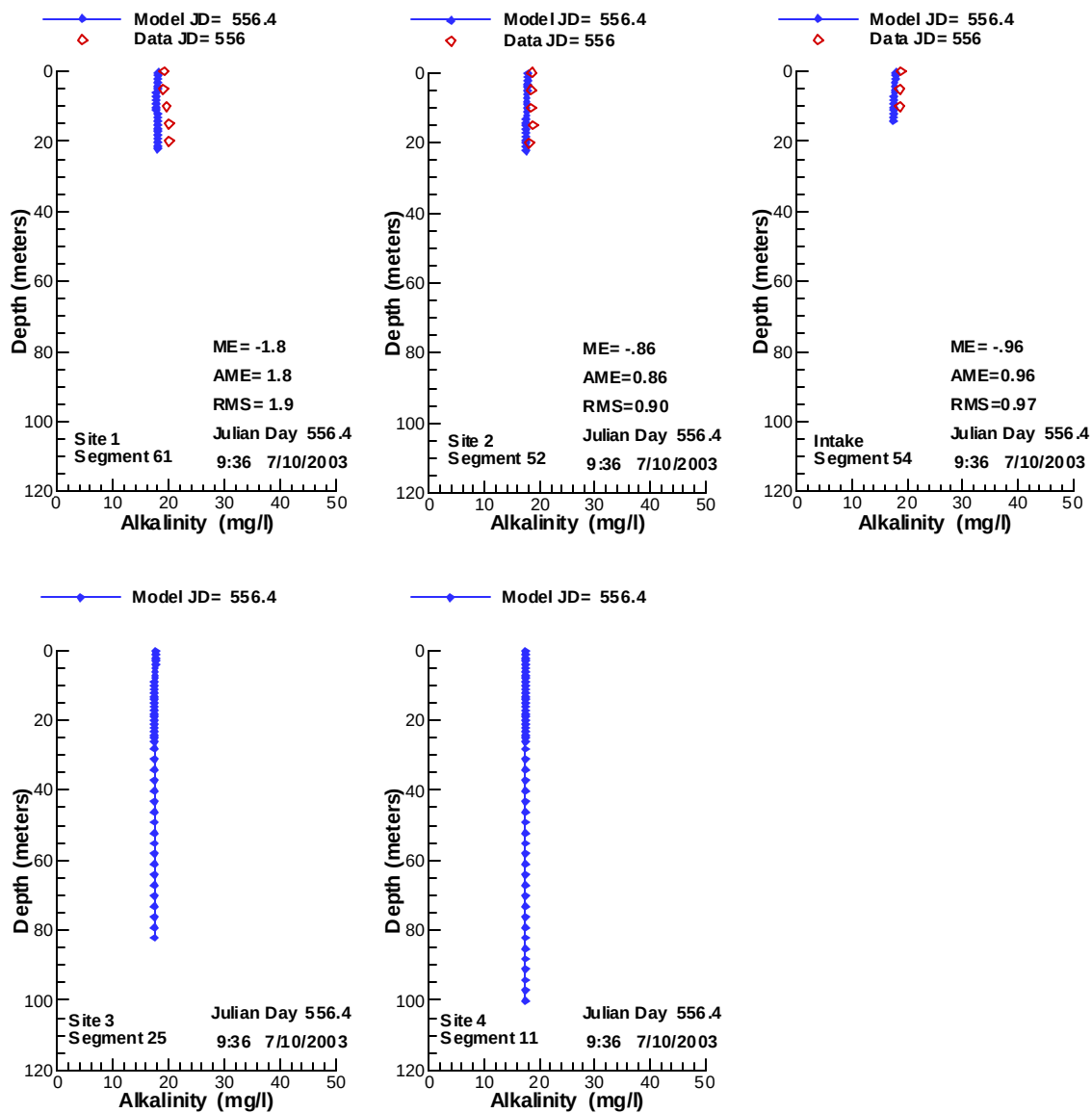


Figure 386. Vertical profiles of Alkalinity compared with data for 7/10/2003.

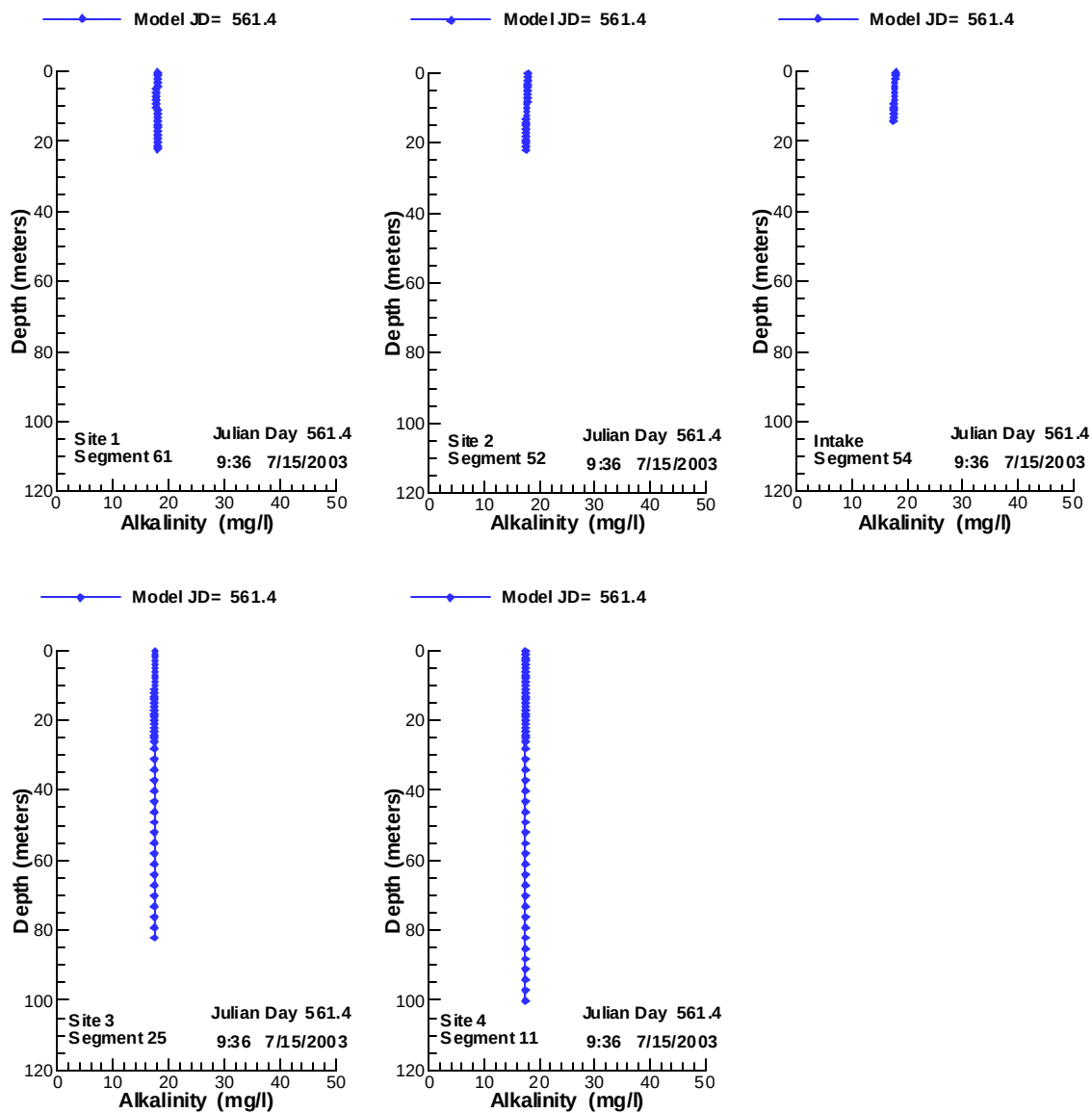


Figure 387. Vertical profiles of Alkalinity compared with data for 7/15/2003.

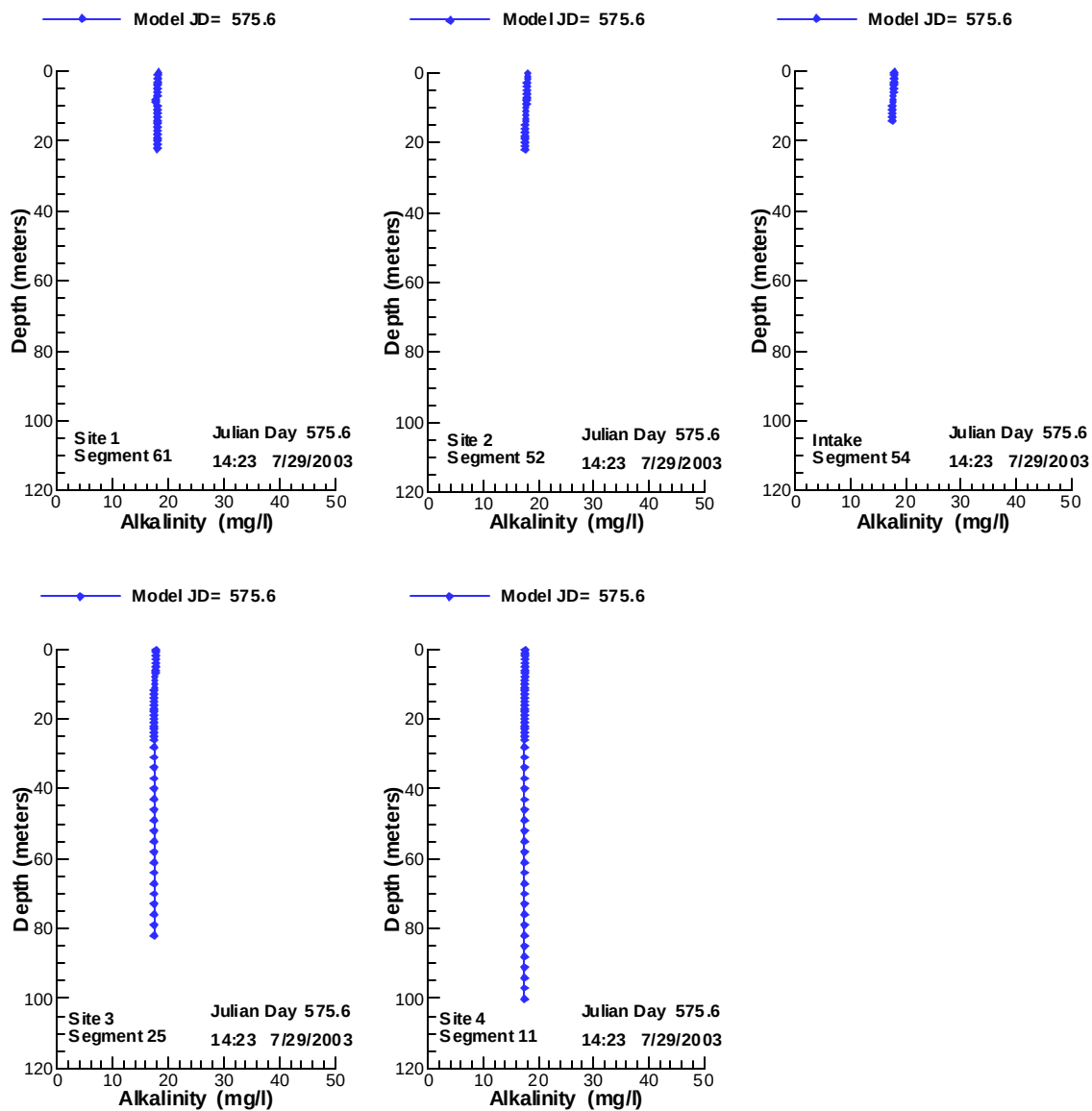


Figure 388. Vertical profiles of Alkalinity compared with data for 7/29/2003.

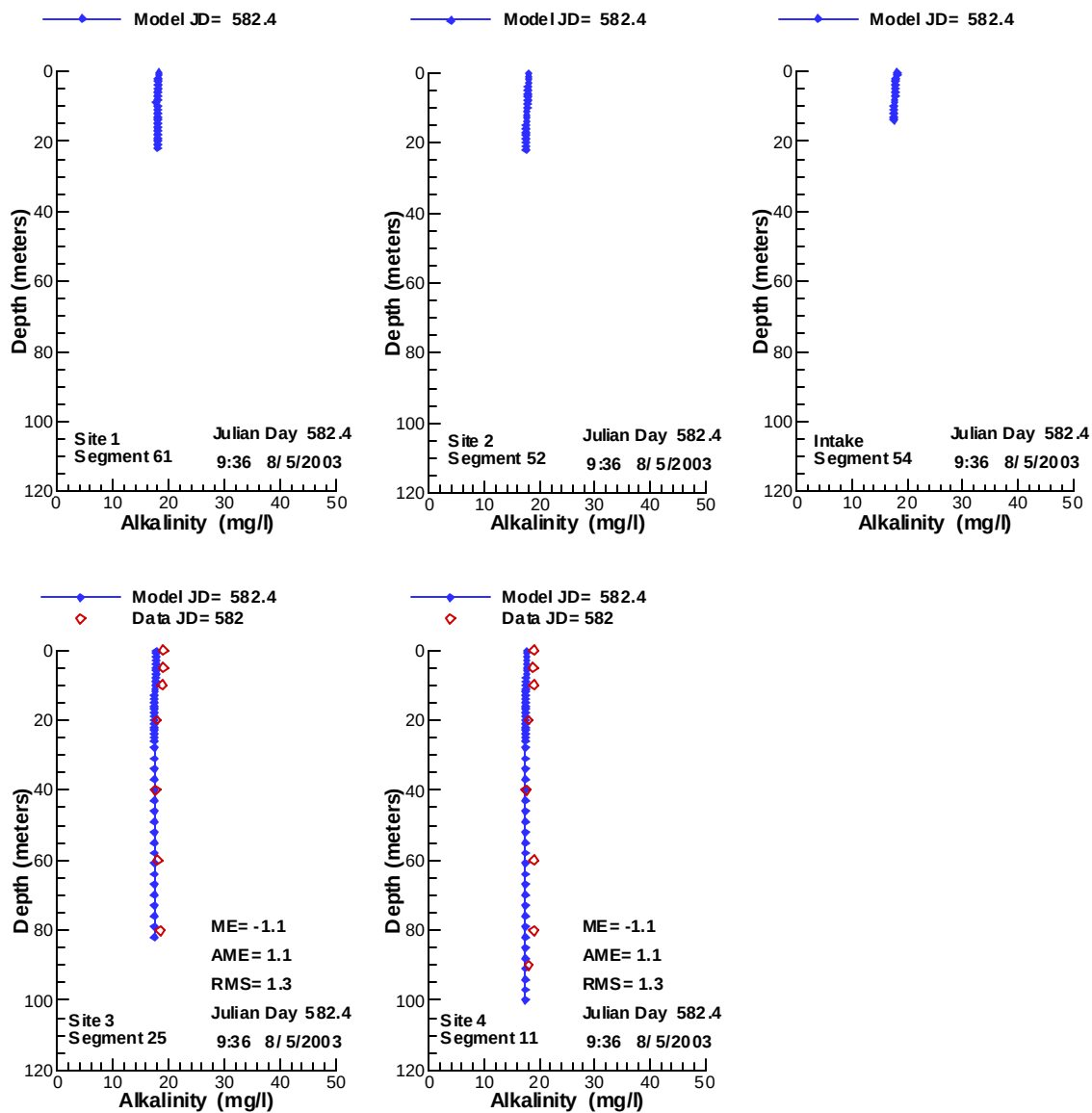


Figure 389. Vertical profiles of Alkalinity compared with data for 8/ 5/2003.

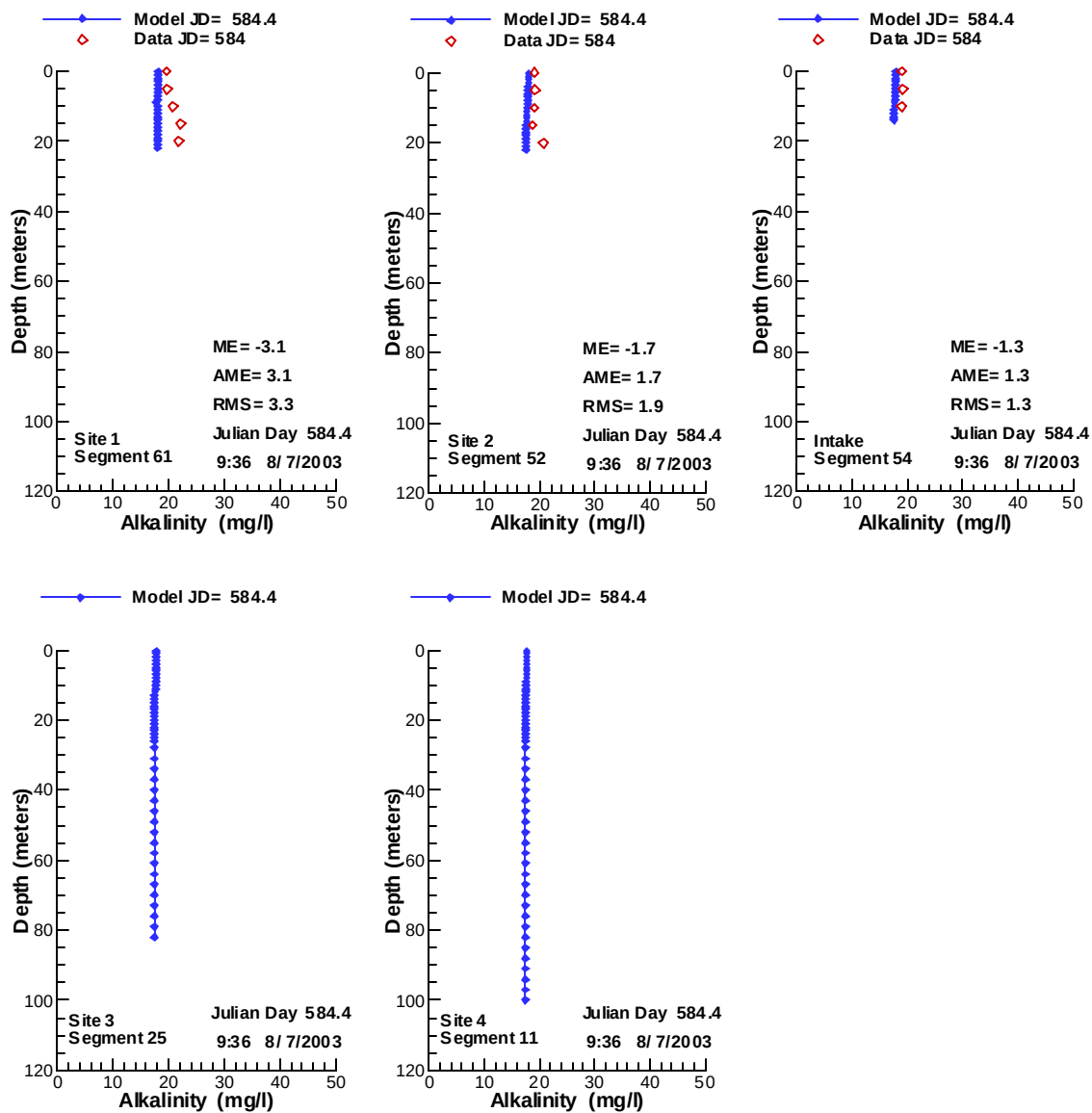


Figure 390. Vertical profiles of Alkalinity compared with data for 8/ 7/2003.

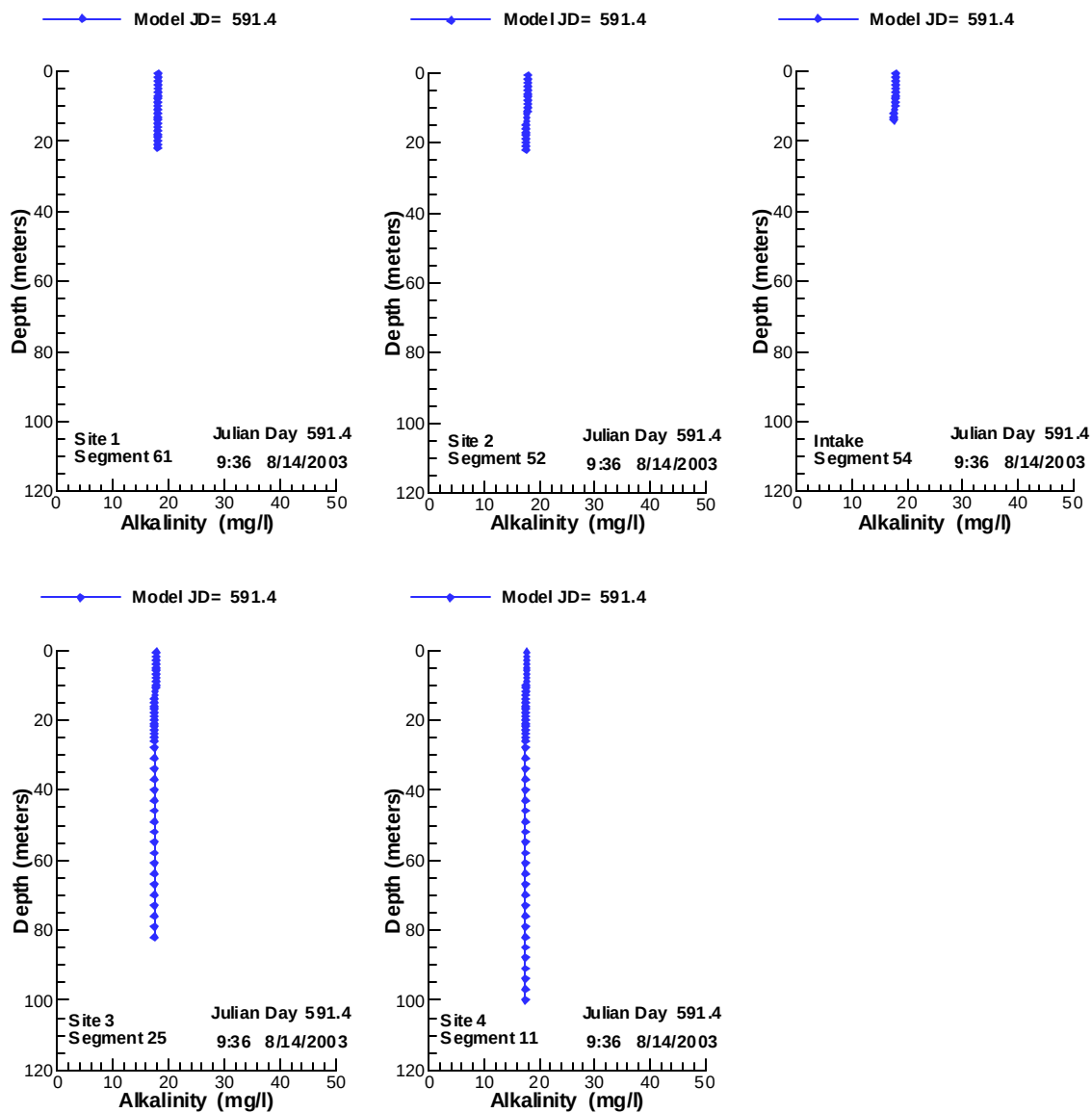


Figure 391. Vertical profiles of Alkalinity compared with data for 8/14/2003.

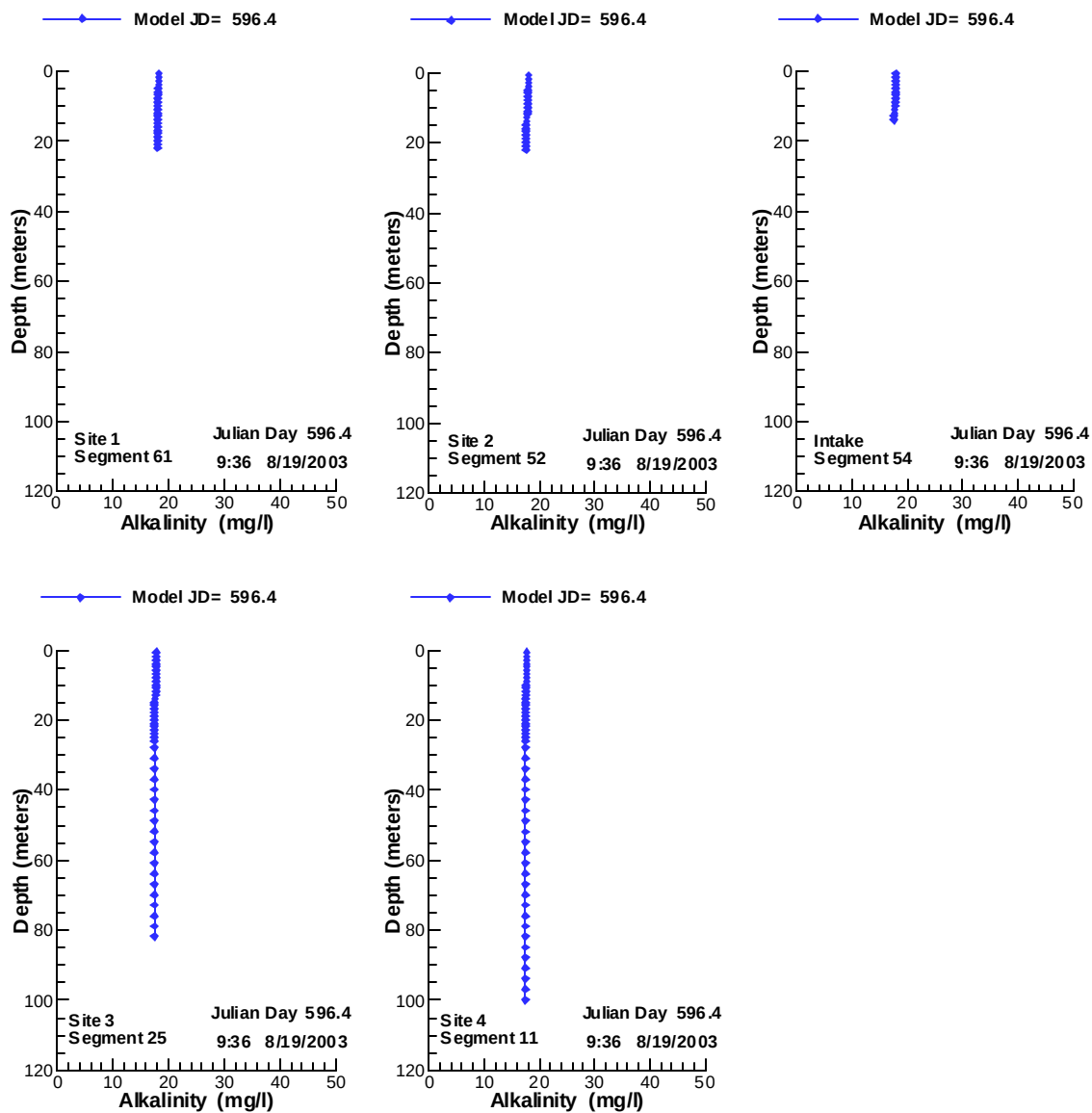


Figure 392. Vertical profiles of Alkalinity compared with data for 8/19/2003.

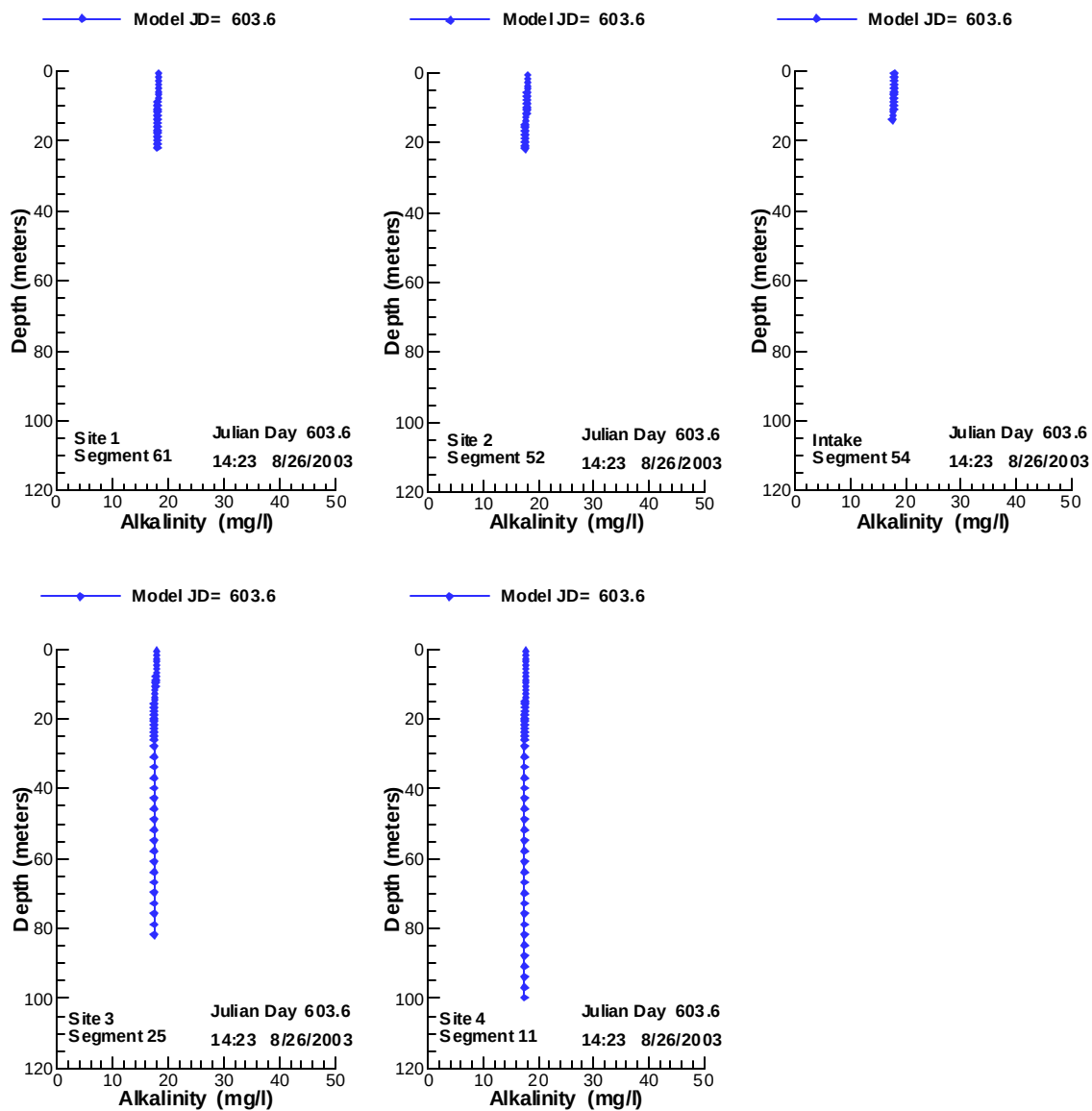


Figure 393. Vertical profiles of Alkalinity compared with data for 8/26/2003.

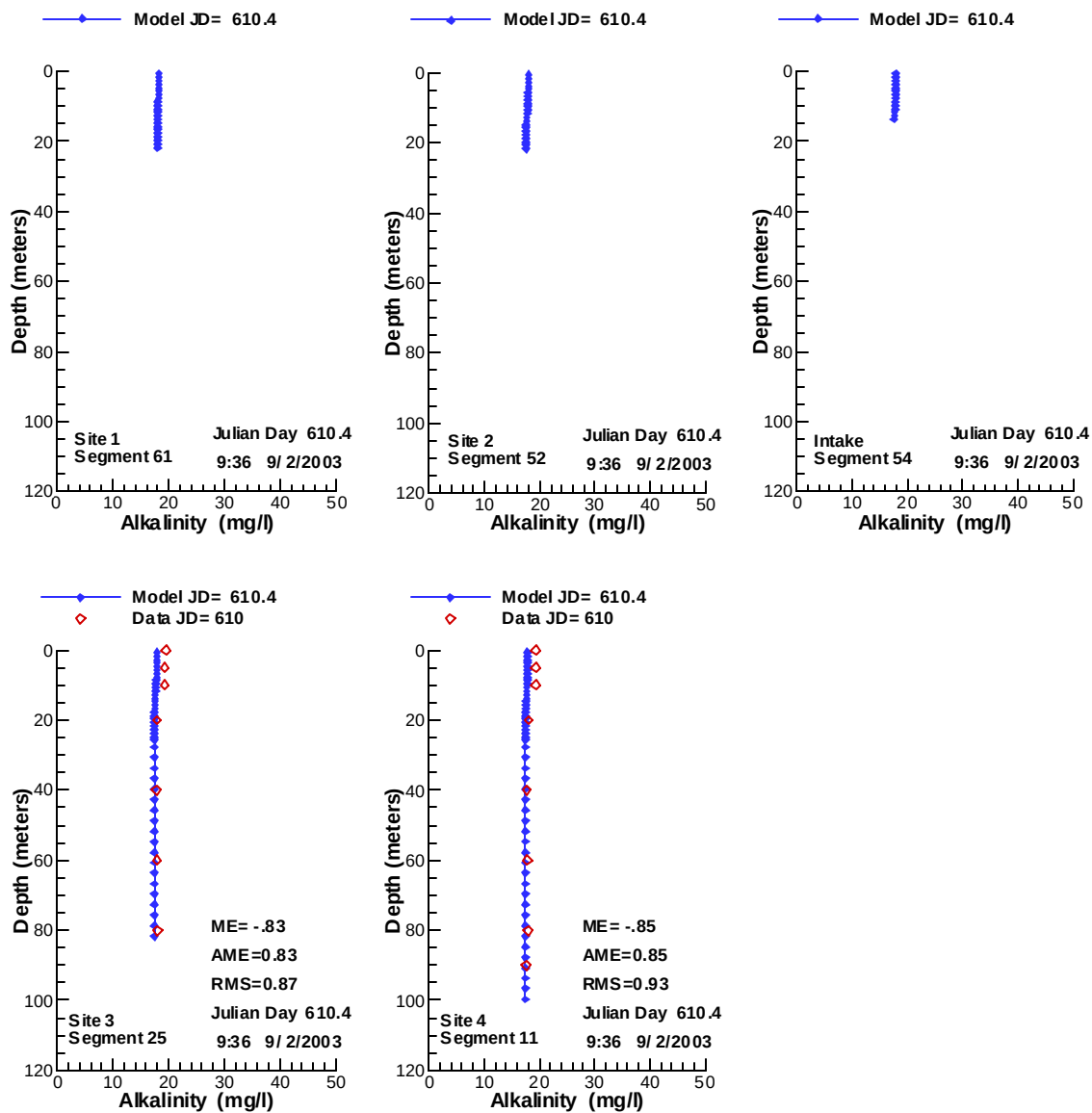


Figure 394. Vertical profiles of Alkalinity compared with data for 9/ 2/2003.

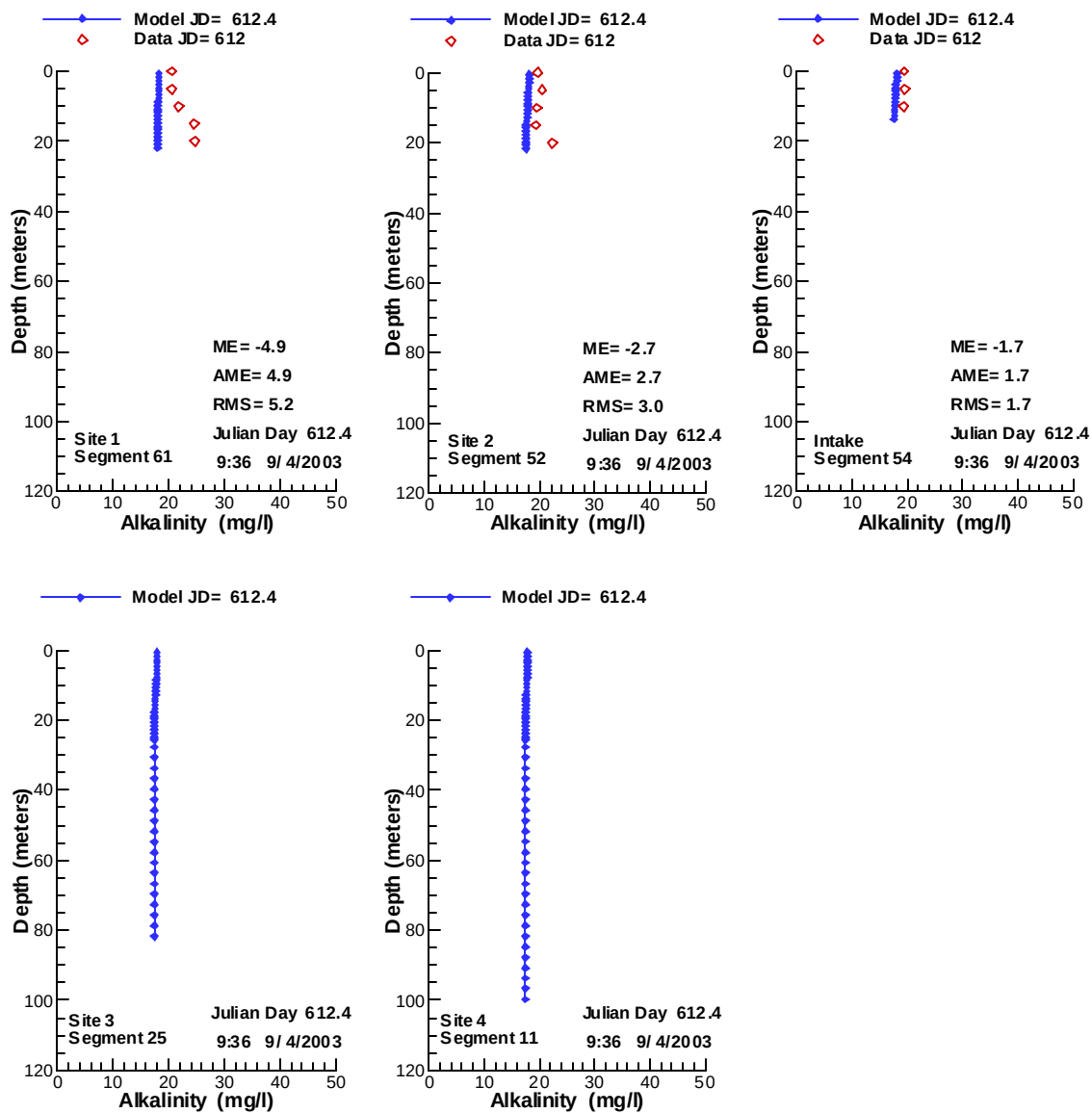


Figure 395. Vertical profiles of Alkalinity compared with data for 9/ 4/2003.

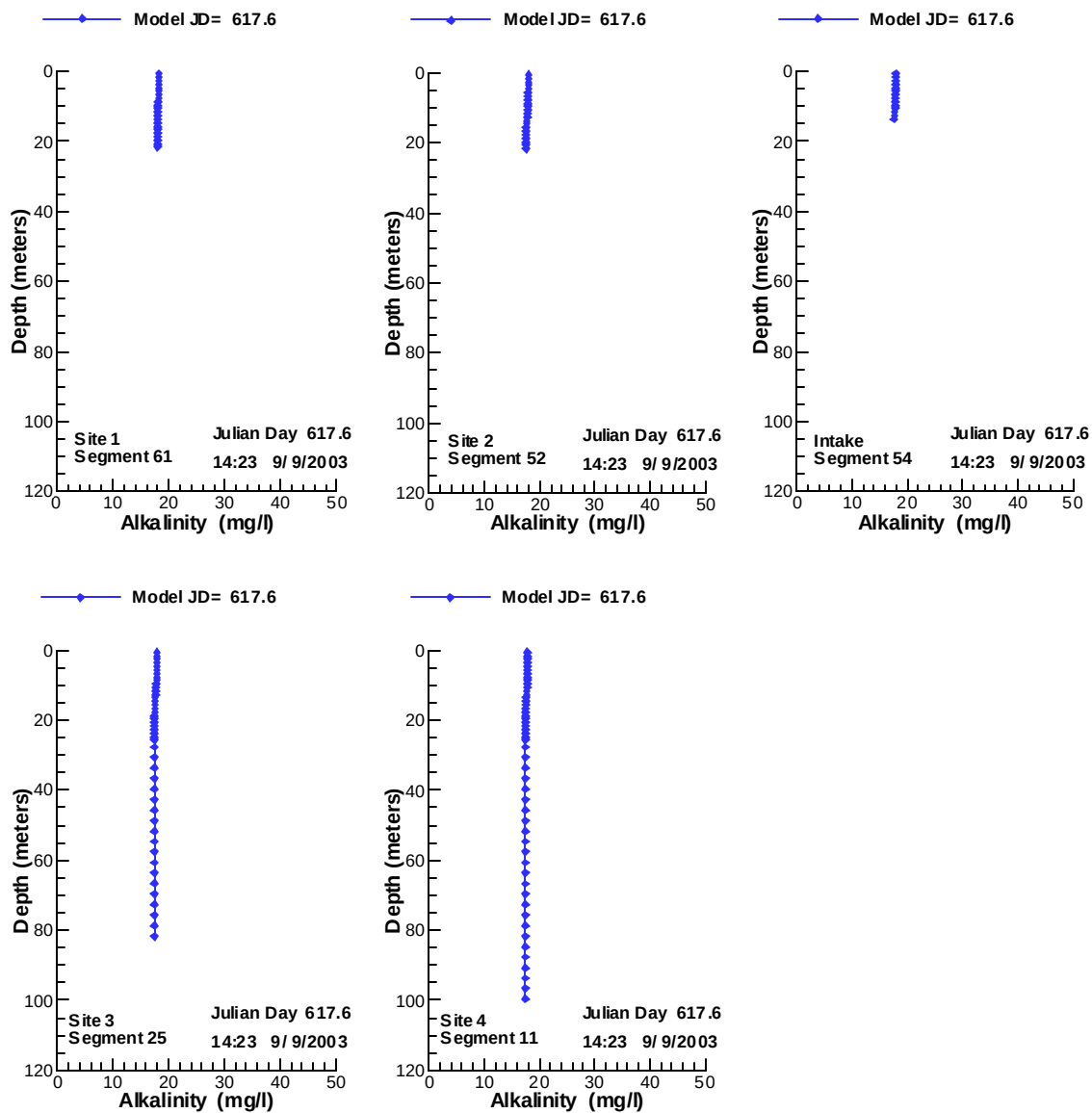


Figure 396. Vertical profiles of Alkalinity compared with data for 9/ 9/2003.

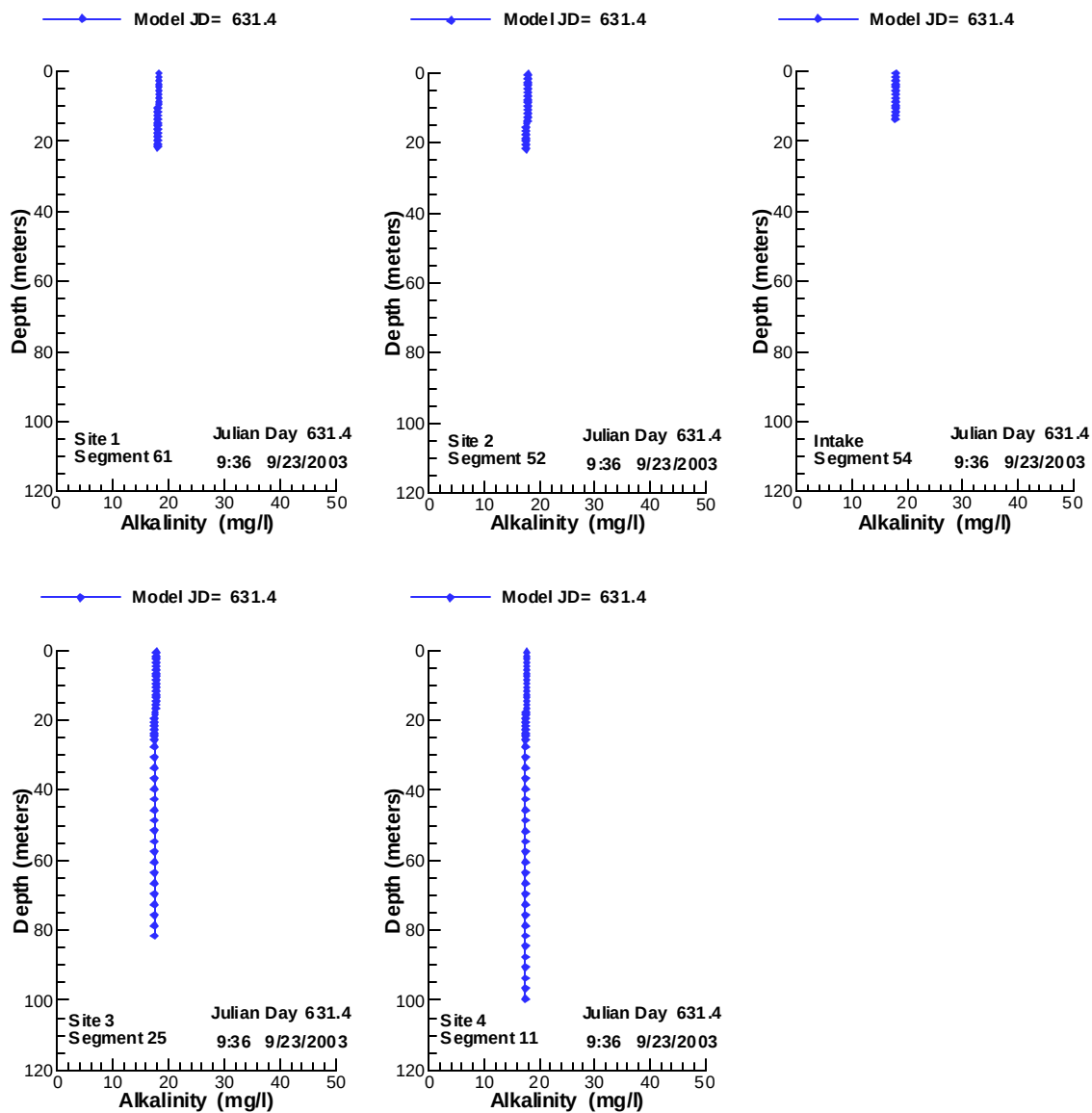


Figure 397. Vertical profiles of Alkalinity compared with data for 9/23/2003.

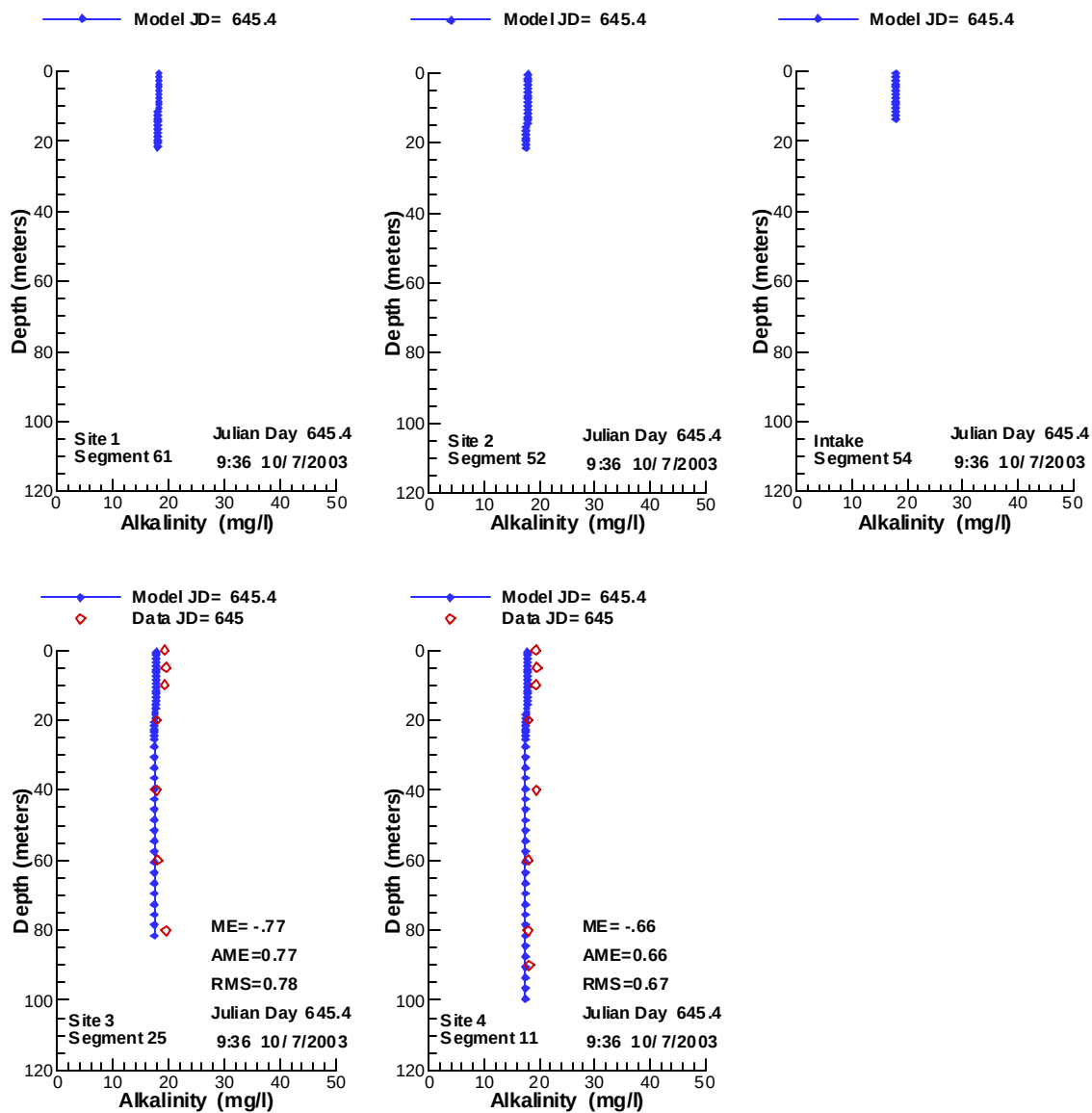


Figure 398. Vertical profiles of Alkalinity compared with data for 10/ 7/2003.

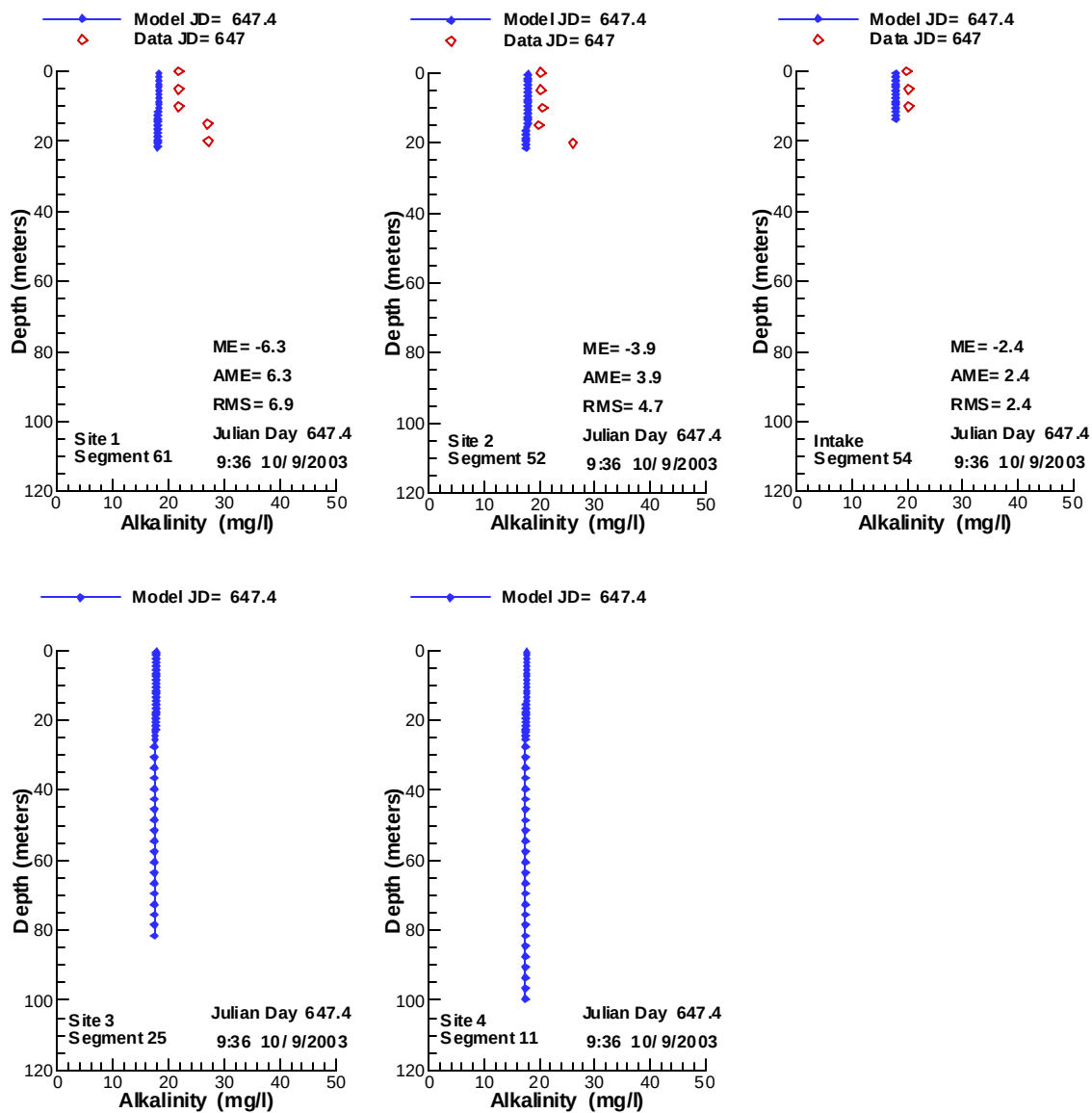


Figure 399. Vertical profiles of Alkalinity compared with data for 10/ 9/2003.

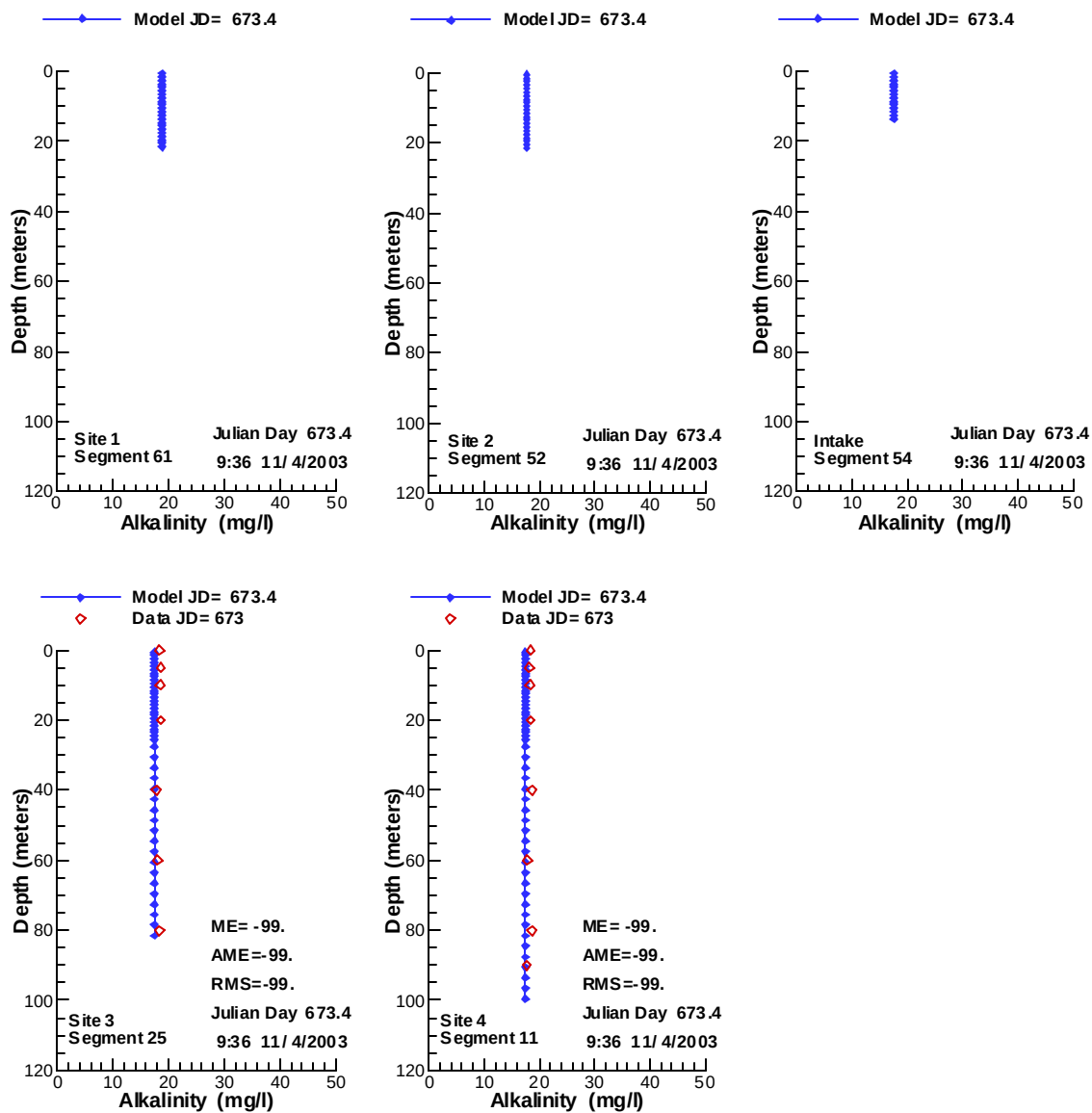


Figure 400. Vertical profiles of Alkalinity compared with data for 11/ 4/2003.

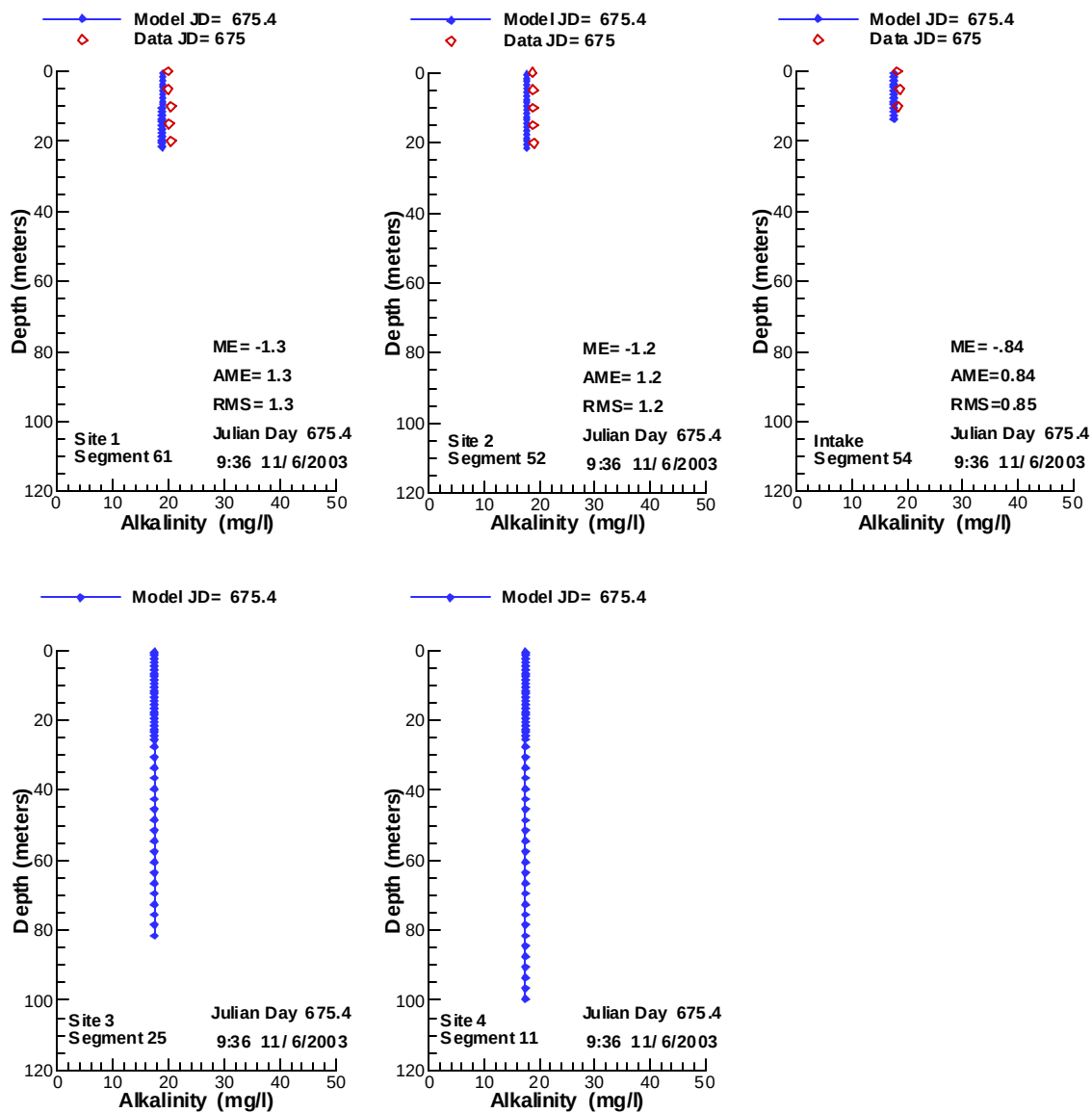


Figure 401. Vertical profiles of Alkalinity compared with data for 11/ 6/2003.

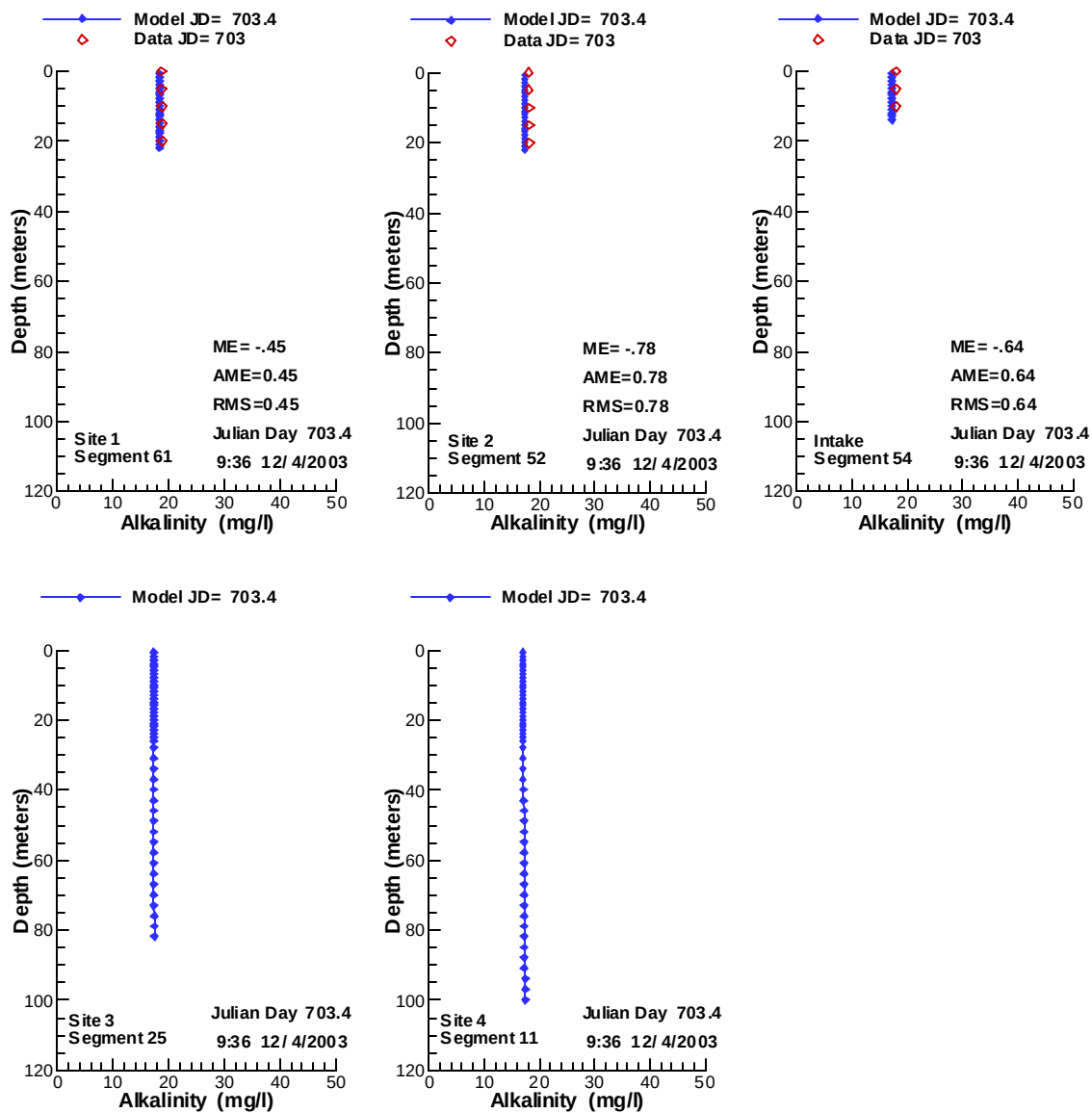


Figure 402. Vertical profiles of Alkalinity compared with data for 12/ 4/2003.

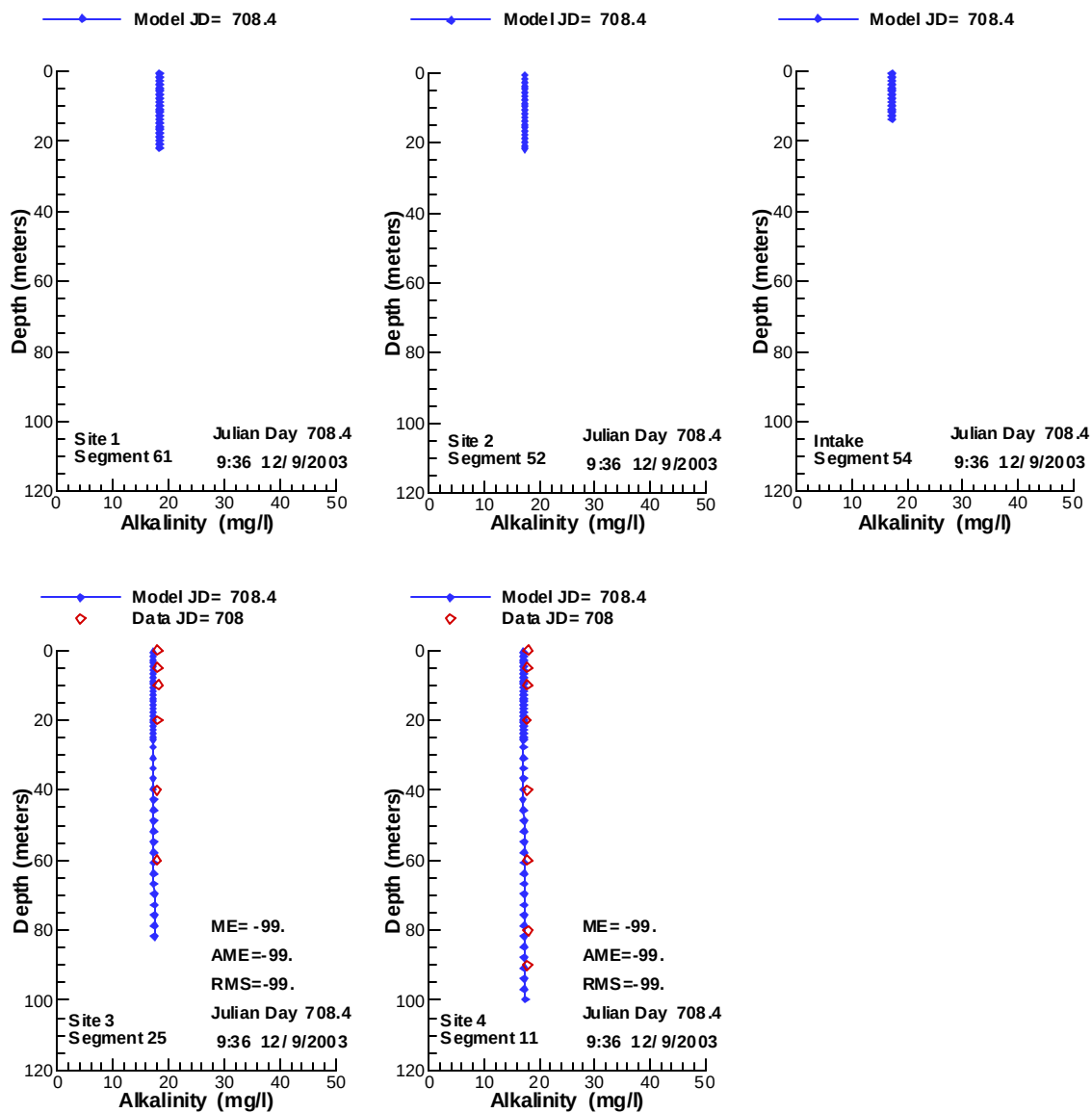


Figure 403. Vertical profiles of Alkalinity compared with data for 12/ 9/2003.

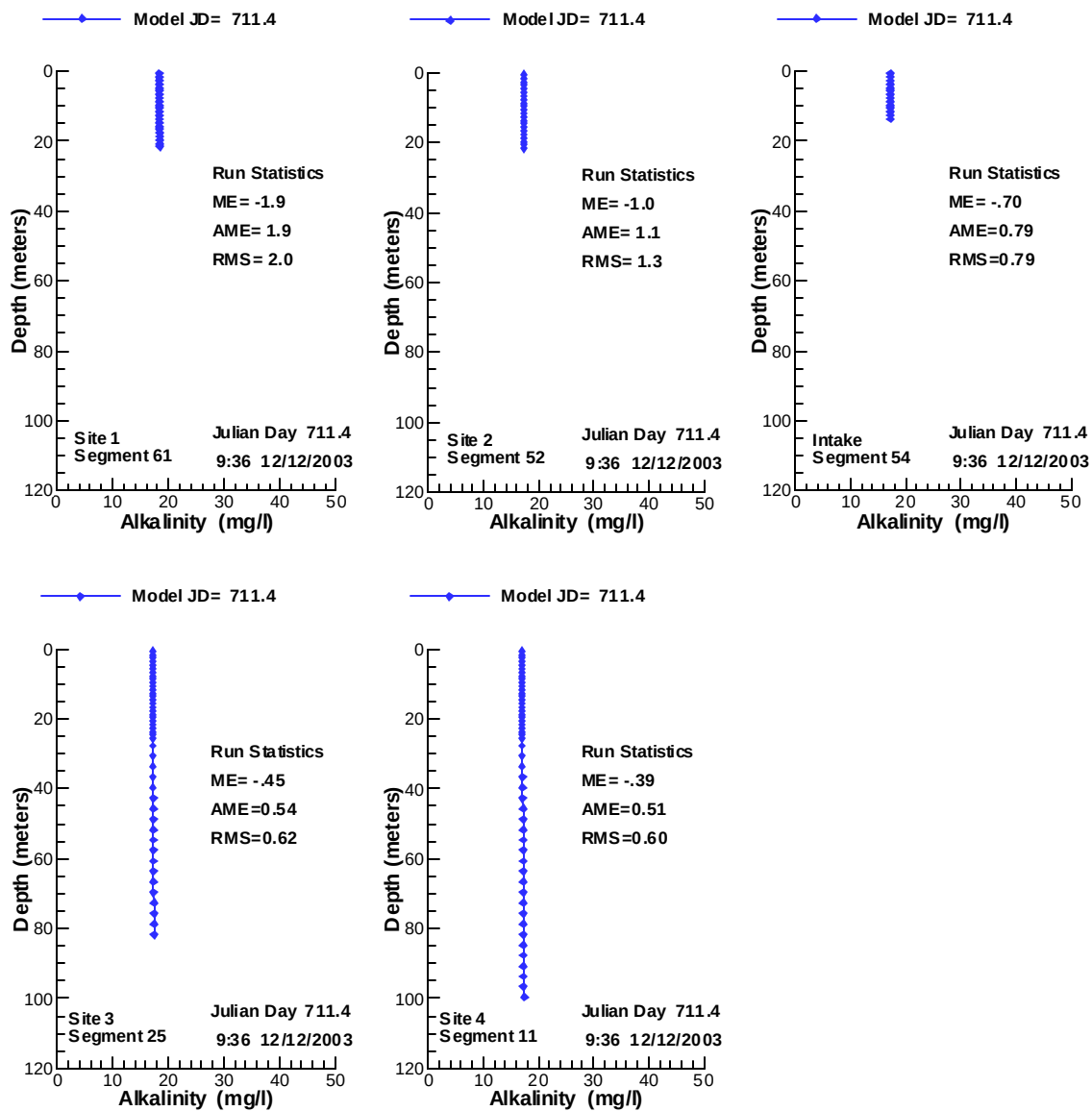


Figure 404. Vertical profiles of Alkalinity compared with data for 12/12/2003.

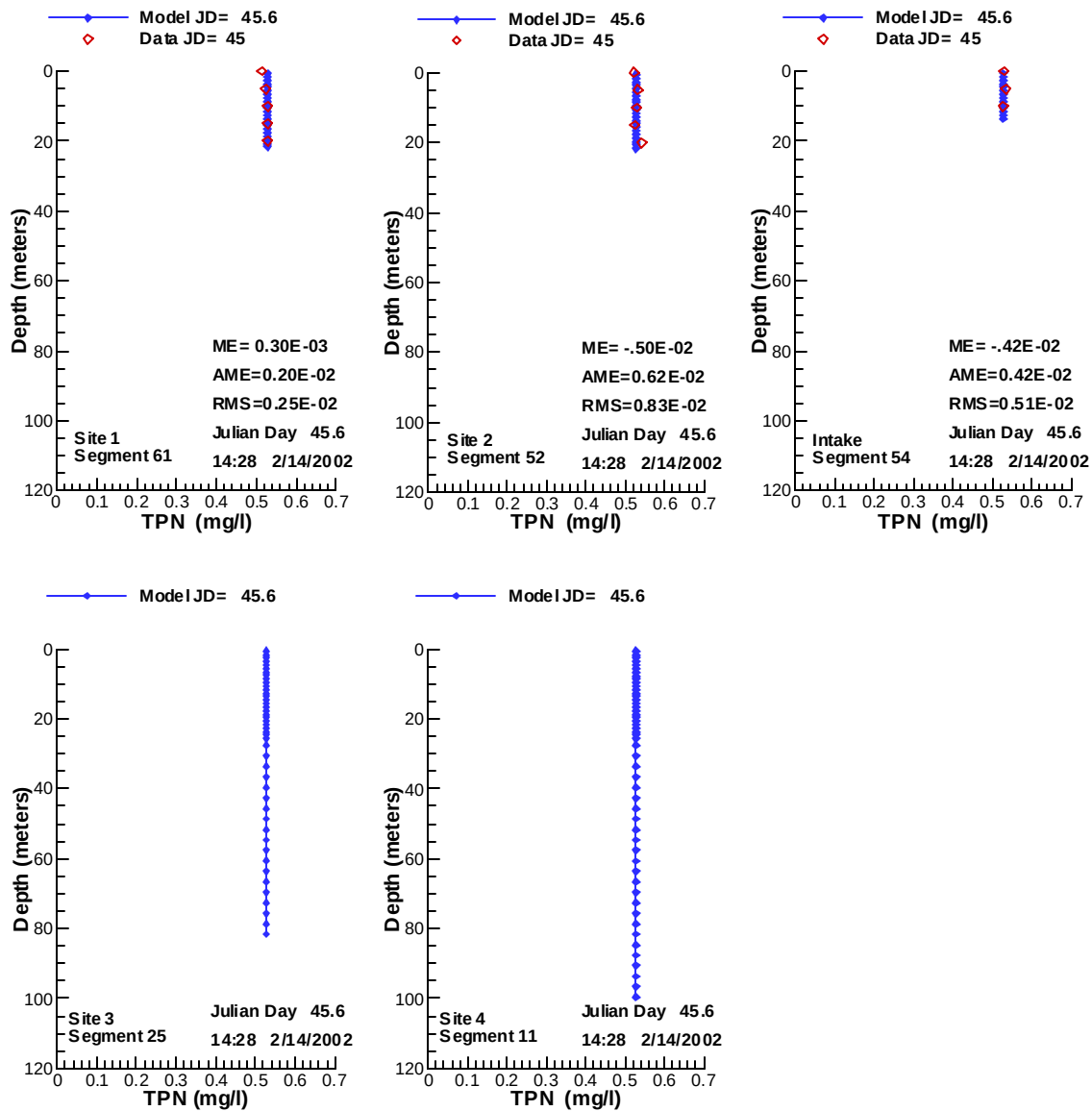


Figure 405. Vertical profiles of TOTAL NITROGEN compared with data for 2/14/2002.

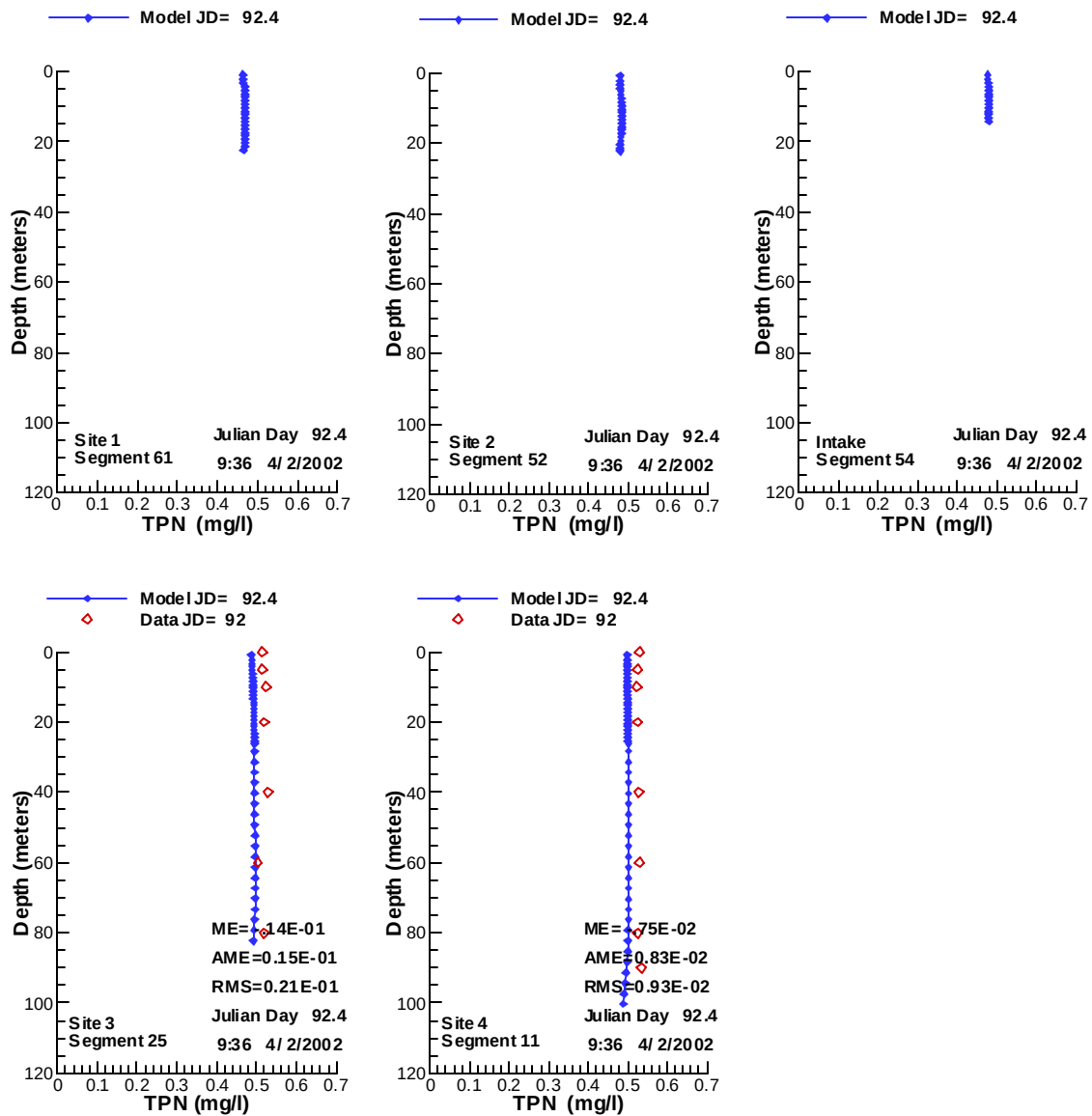


Figure 406. Vertical profiles of TOTAL NITROGEN compared with data for 4/ 2/2002.

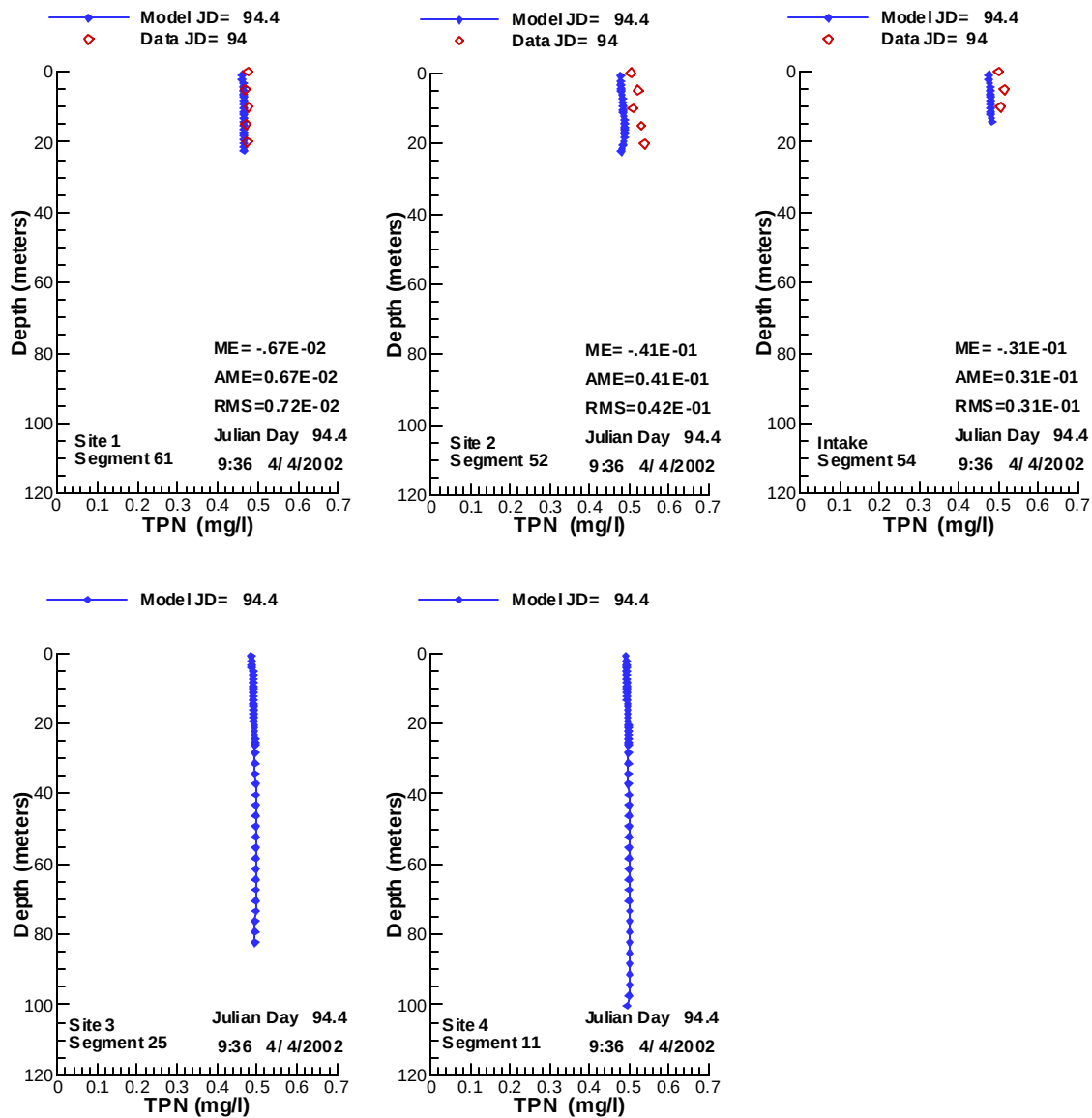


Figure 407. Vertical profiles of TOTAL NITROGEN compared with data for 4/ 4/2002.

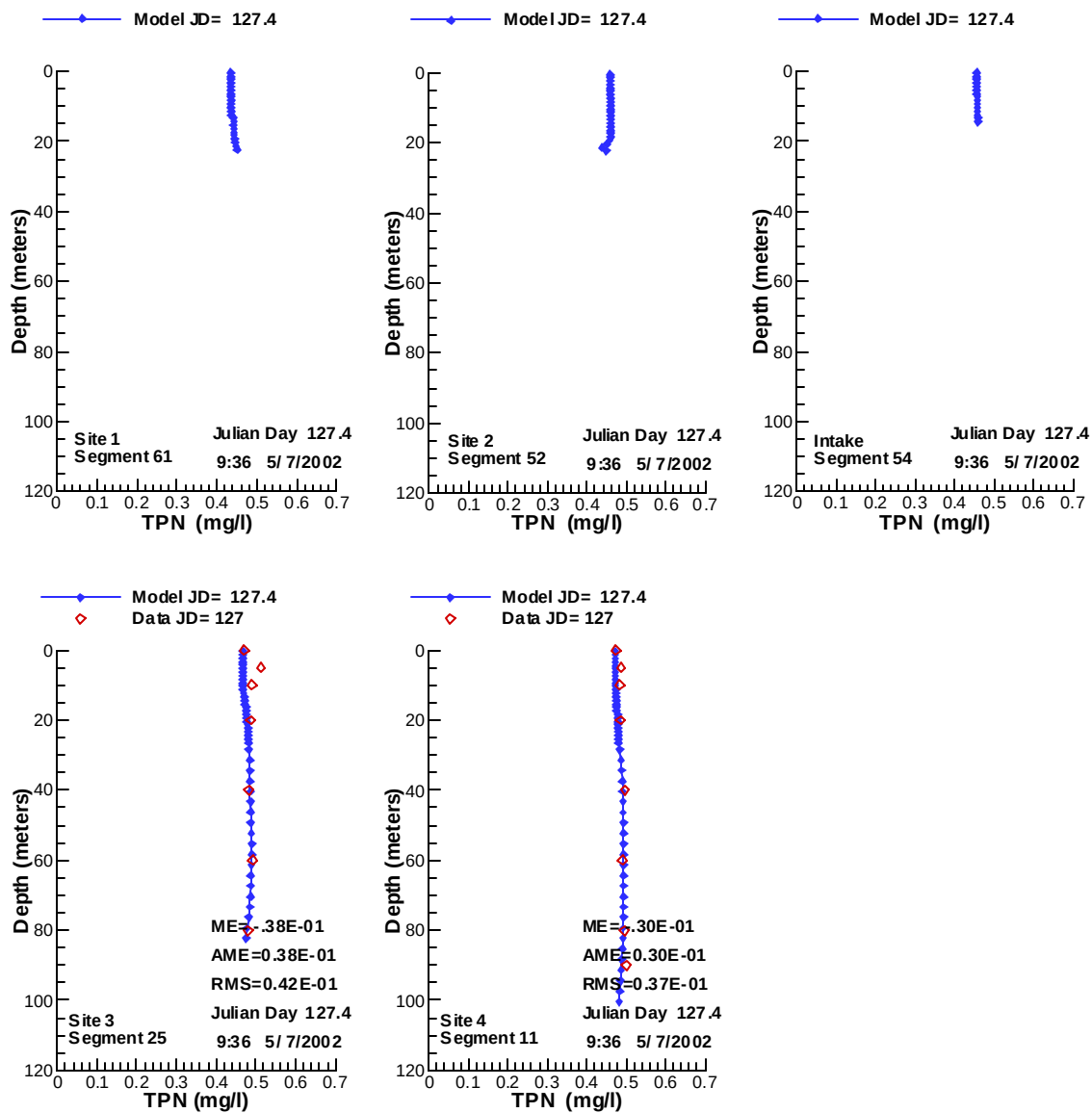


Figure 408. Vertical profiles of TOTAL NITROGEN compared with data for 5/ 7/2002.

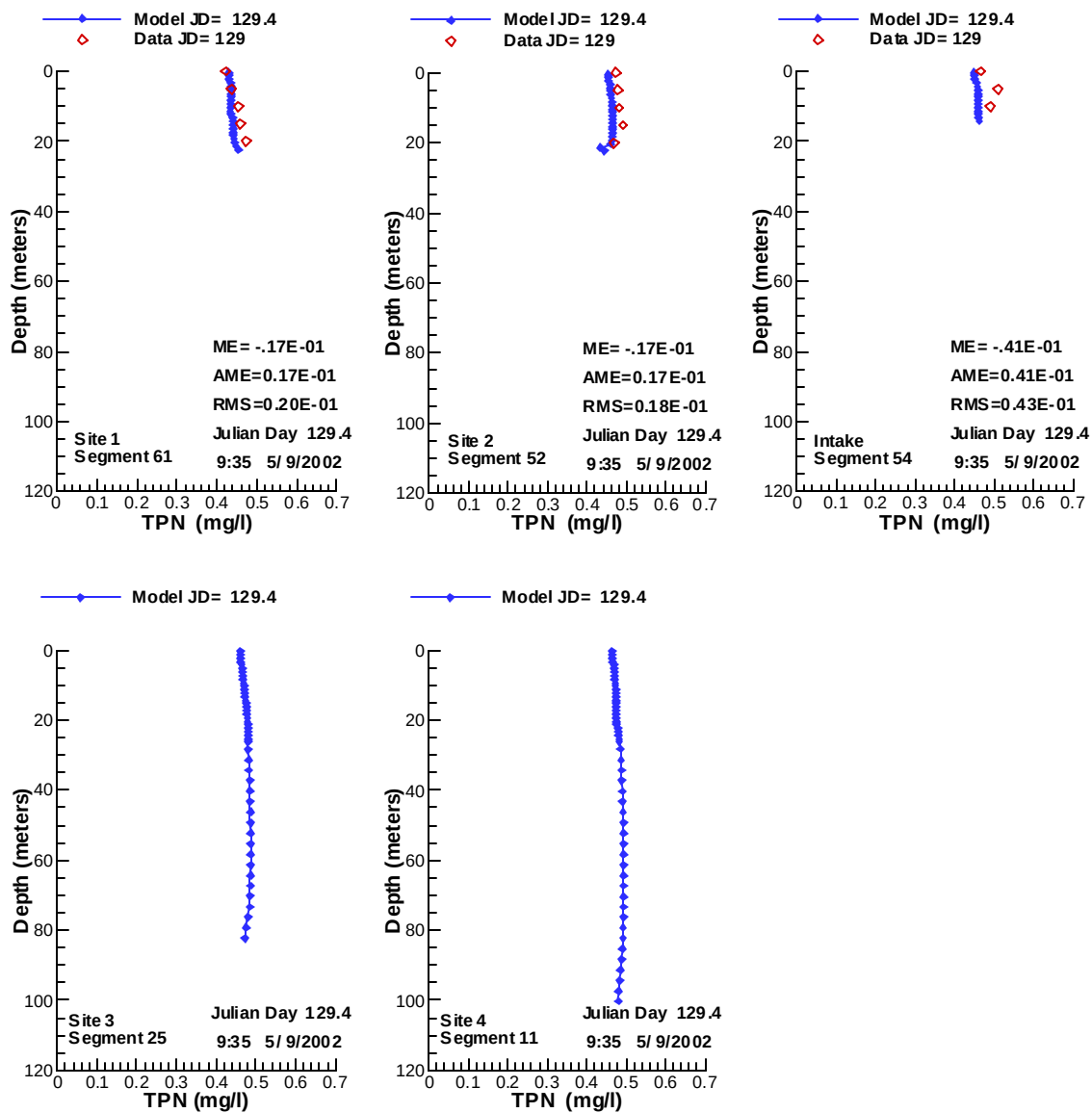


Figure 409. Vertical profiles of TOTAL NITROGEN compared with data for 5/ 9/2002.

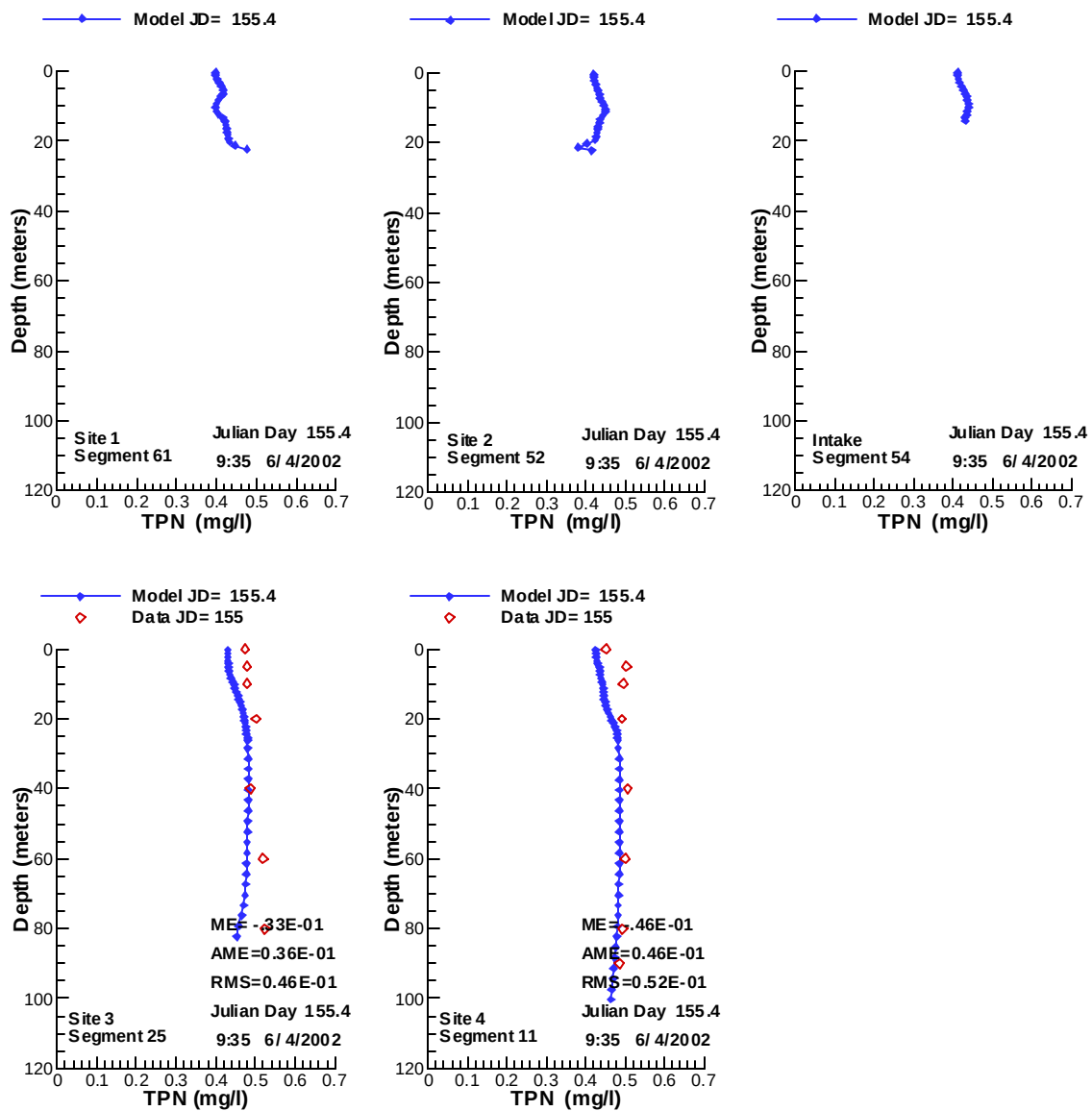


Figure 410. Vertical profiles of TOTAL NITROGEN compared with data for 6/ 4/2002.

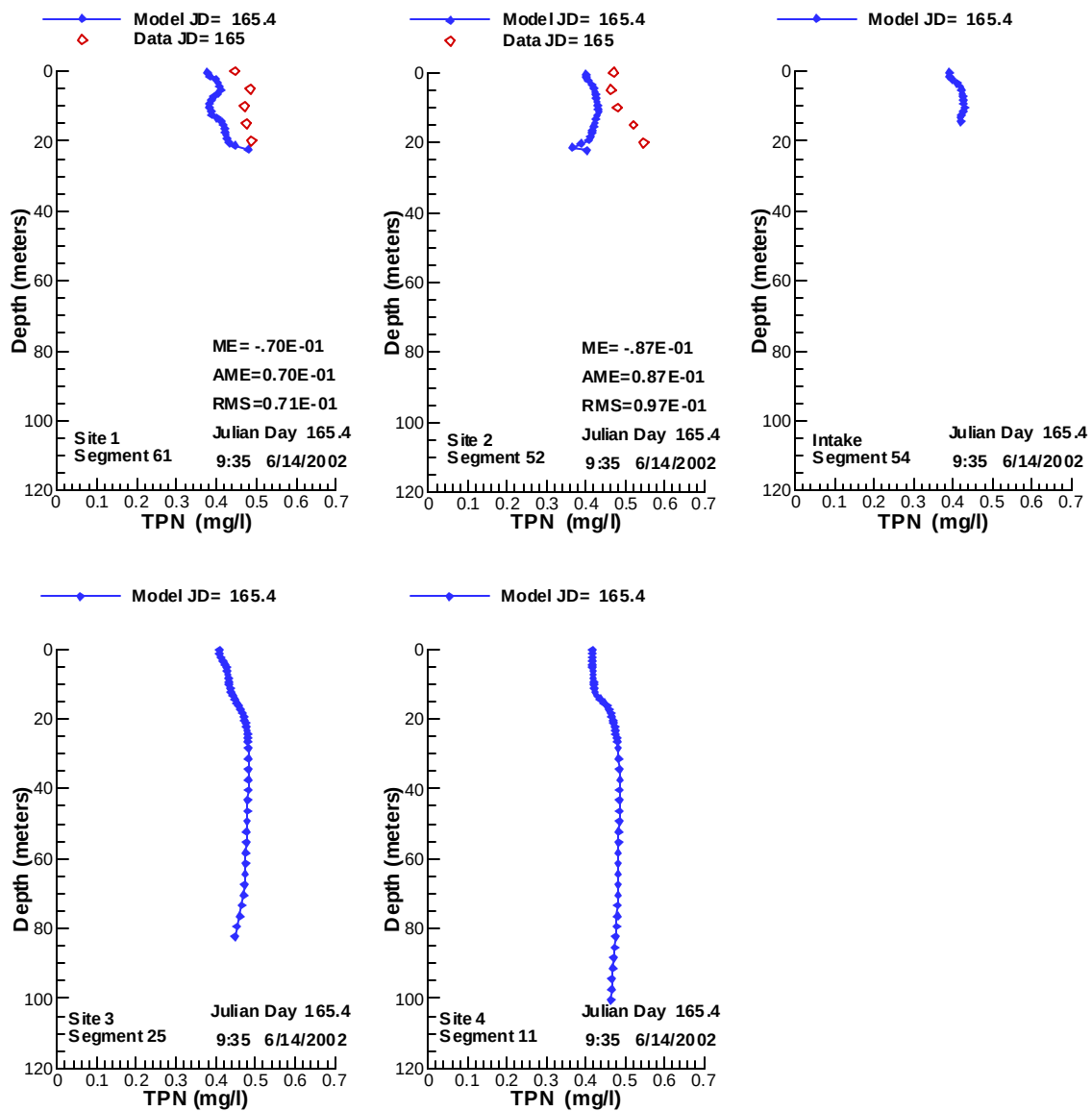


Figure 411. Vertical profiles of TOTAL NITROGEN compared with data for 6/14/2002.

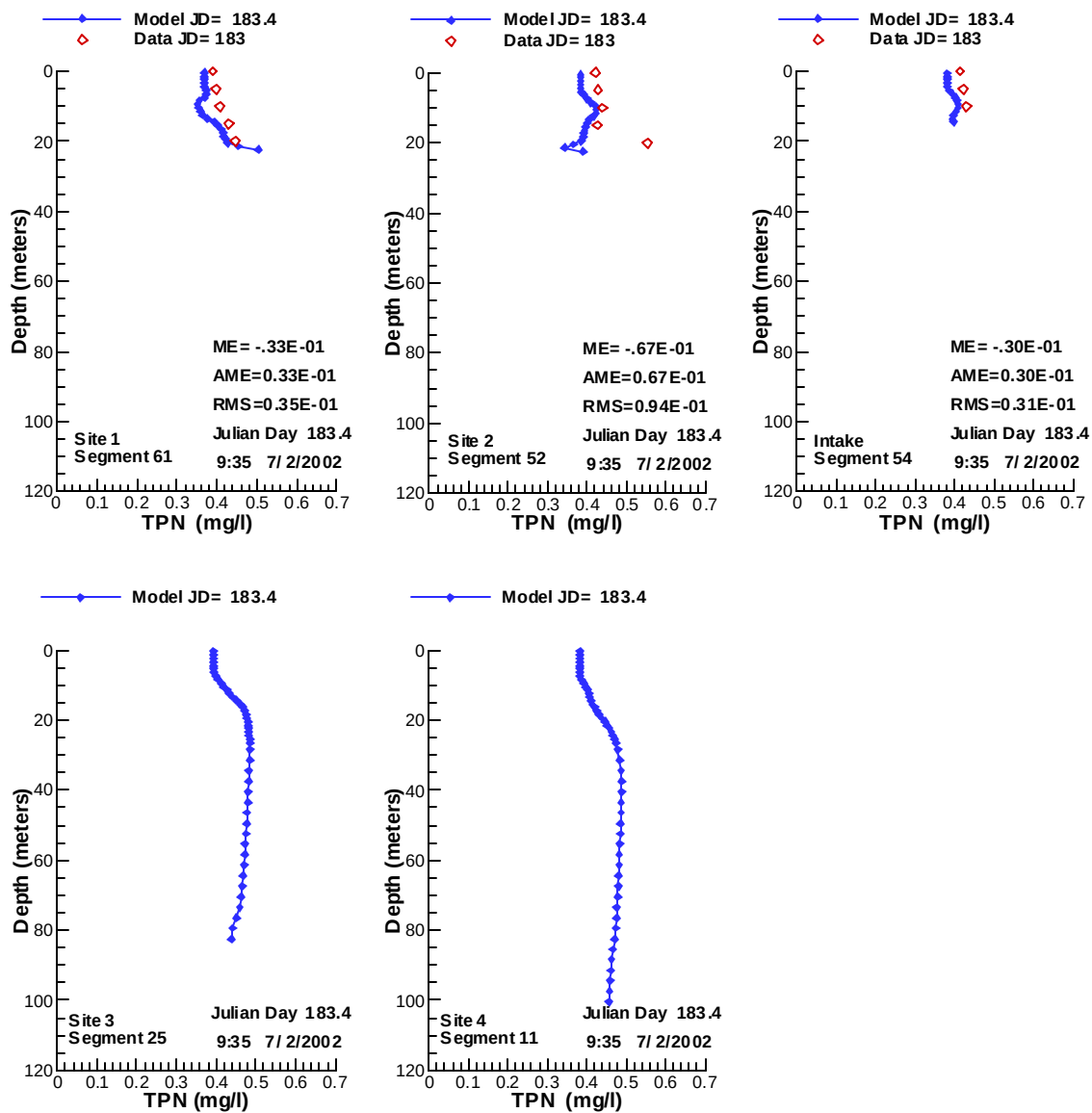


Figure 412. Vertical profiles of TOTAL NITROGEN compared with data for 7/ 2/2002.

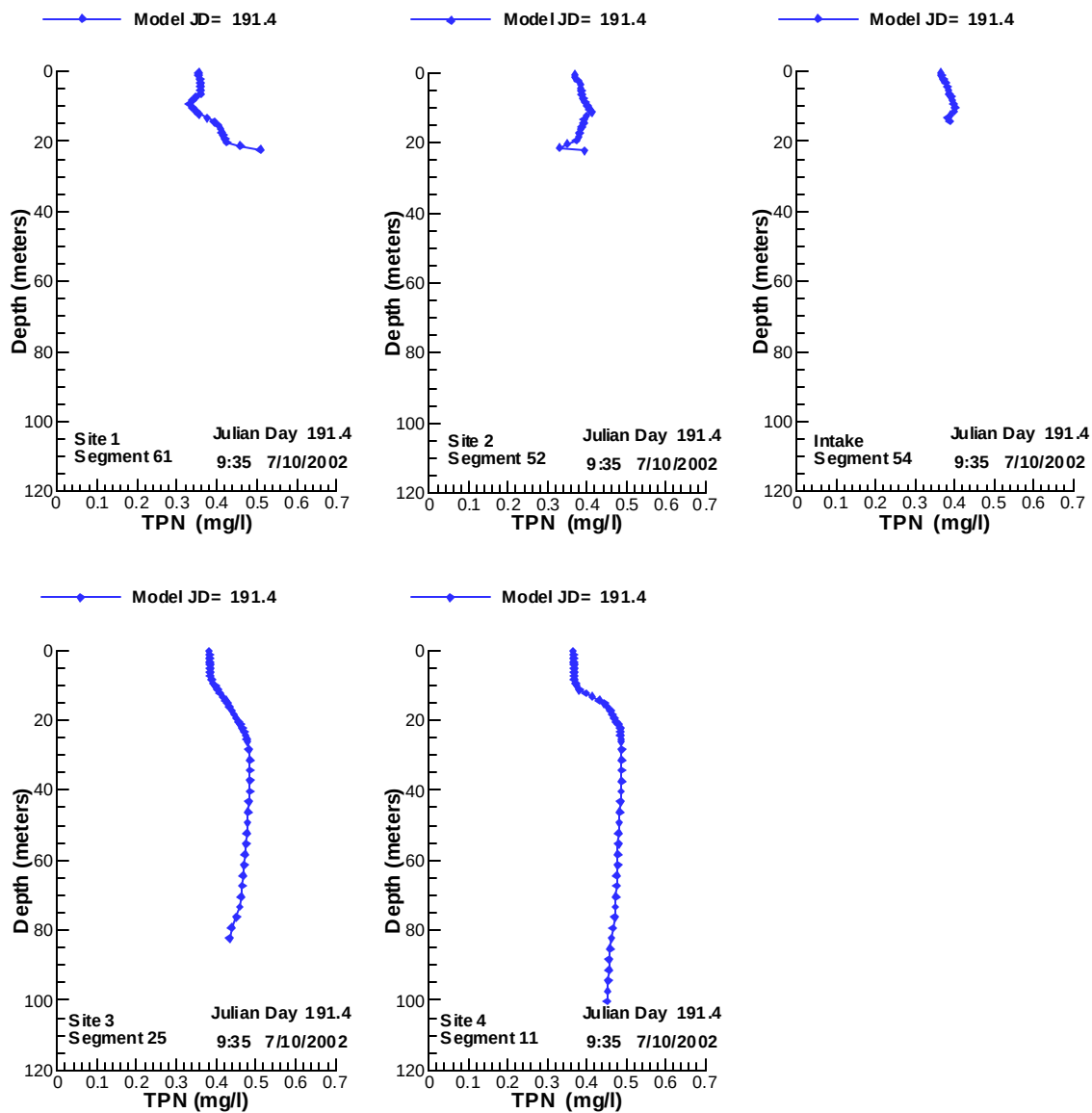


Figure 413. Vertical profiles of TOTAL NITROGEN compared with data for 7/10/2002.

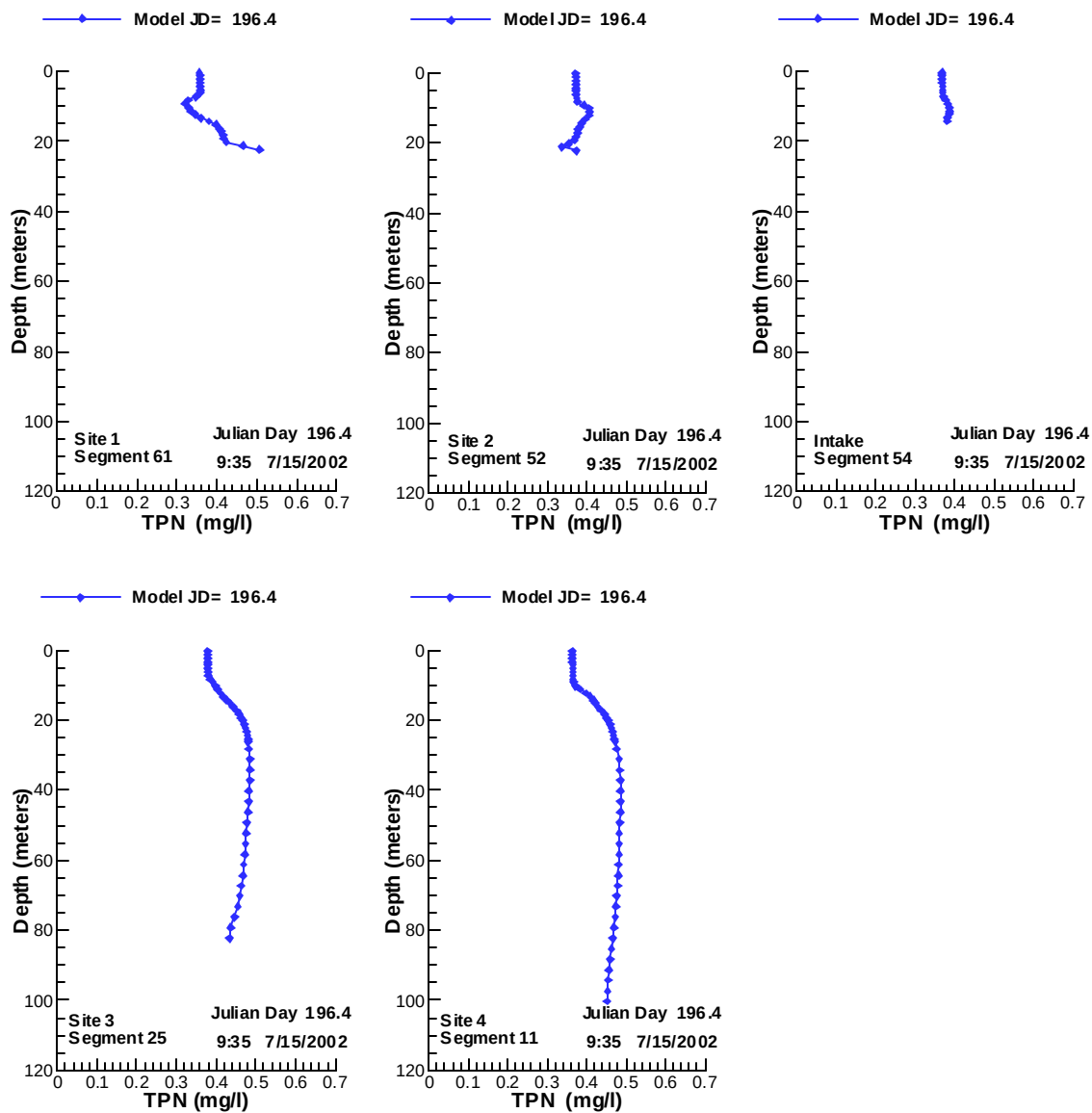


Figure 414. Vertical profiles of TOTAL NITROGEN compared with data for 7/15/2002.

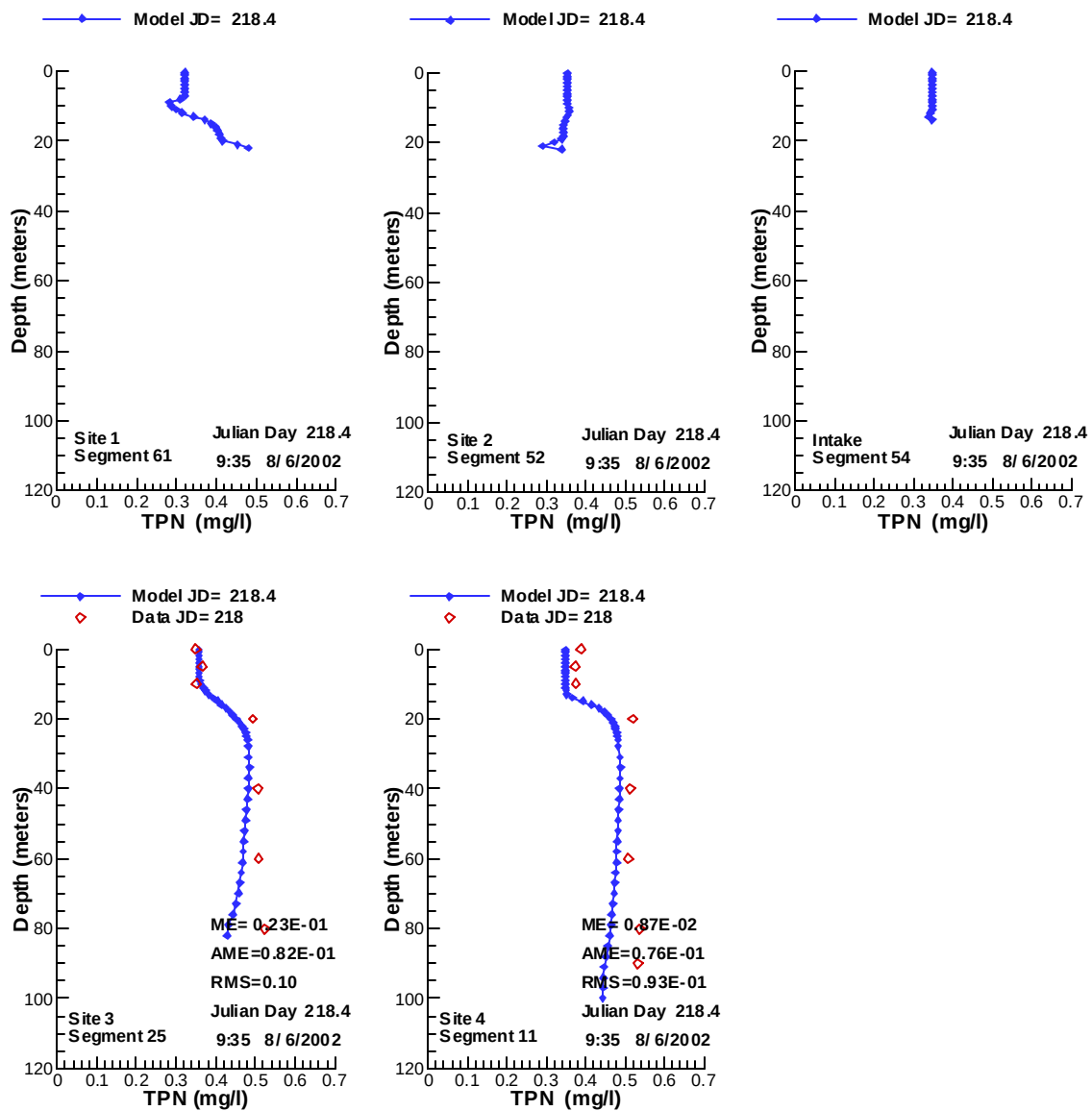


Figure 415. Vertical profiles of TOTAL NITROGEN compared with data for 8/ 6/2002.

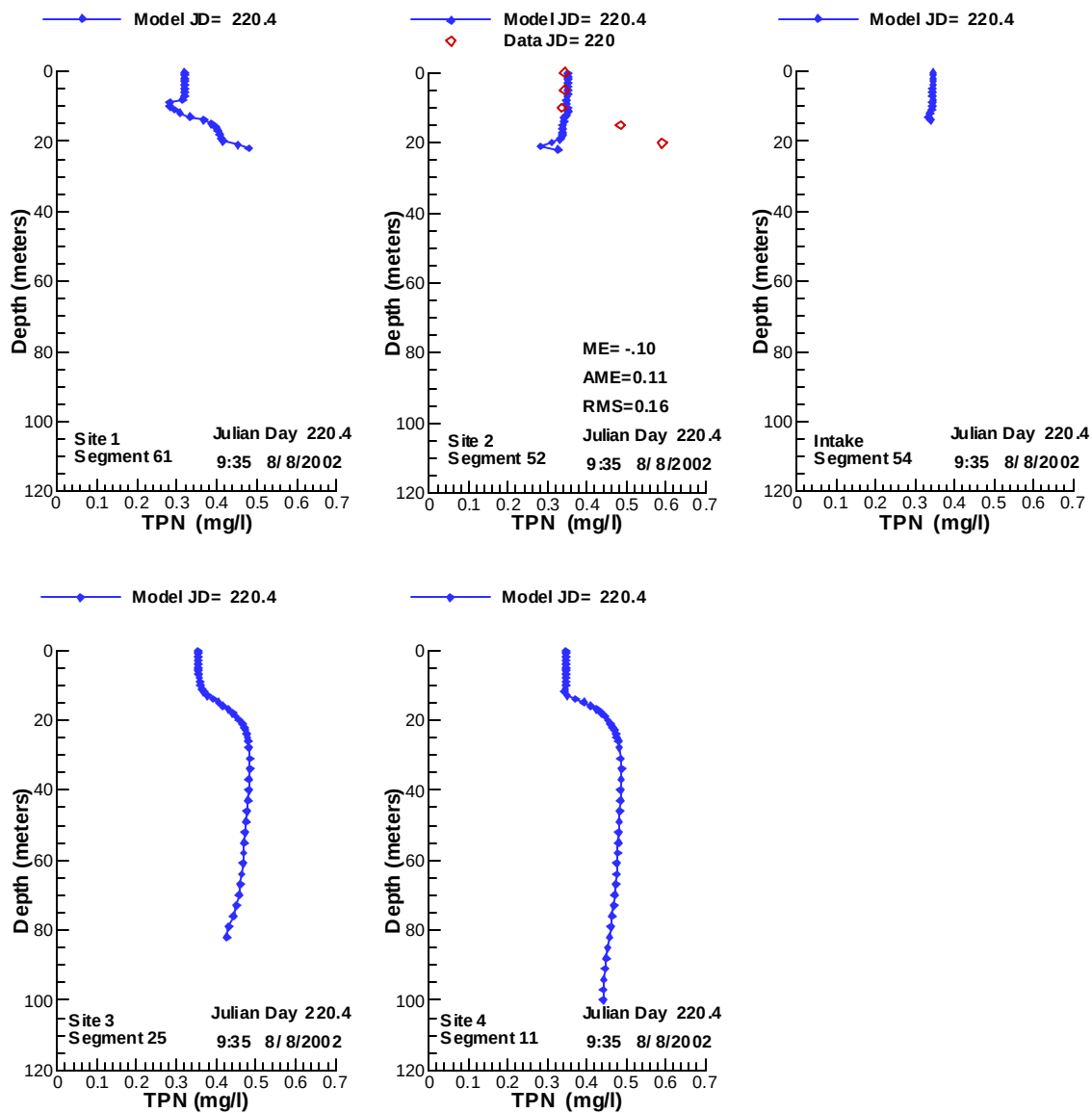


Figure 416. Vertical profiles of TOTAL NITROGEN compared with data for 8/ 8/2002.

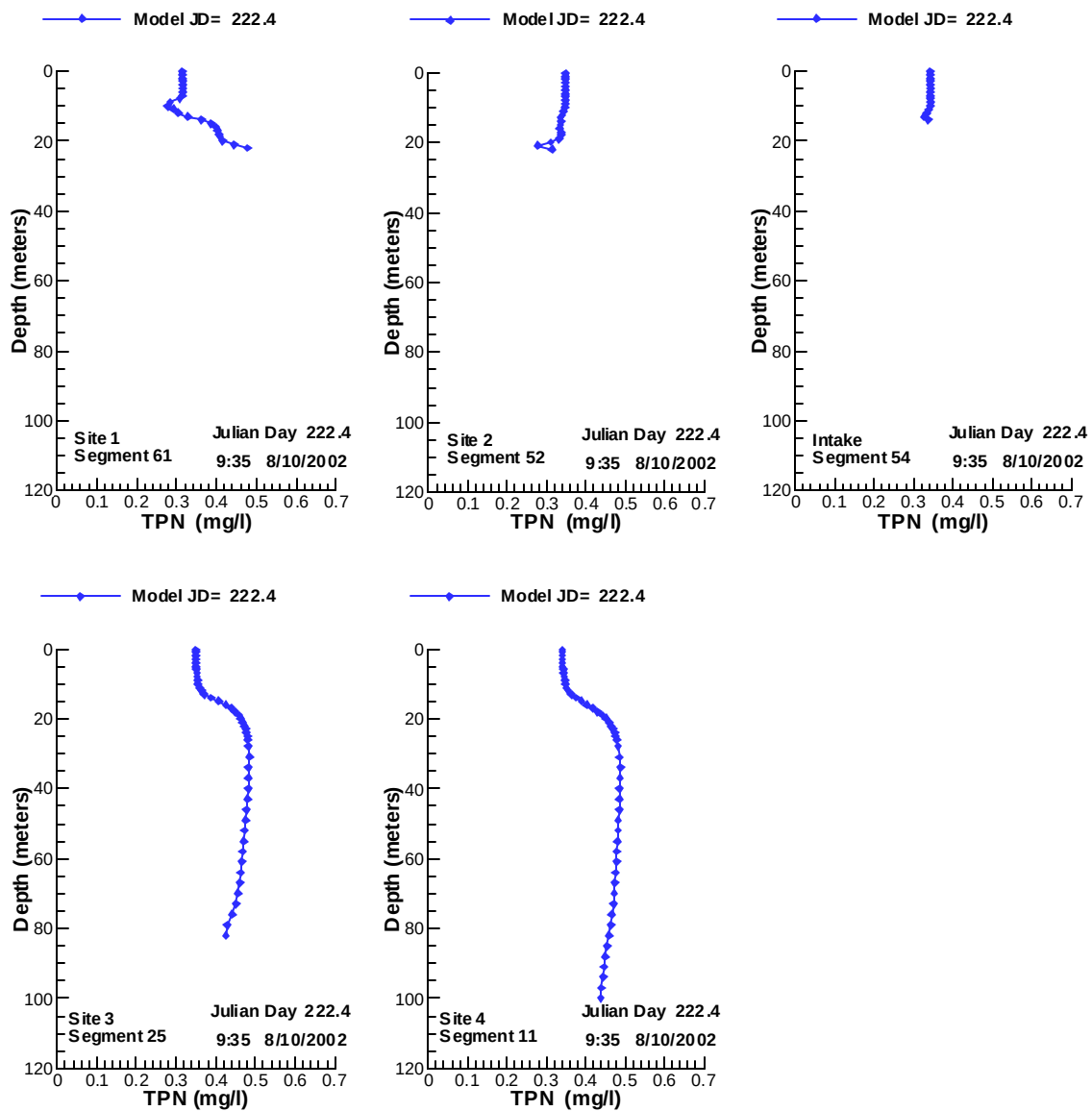


Figure 417. Vertical profiles of TOTAL NITROGEN compared with data for 8/10/2002.

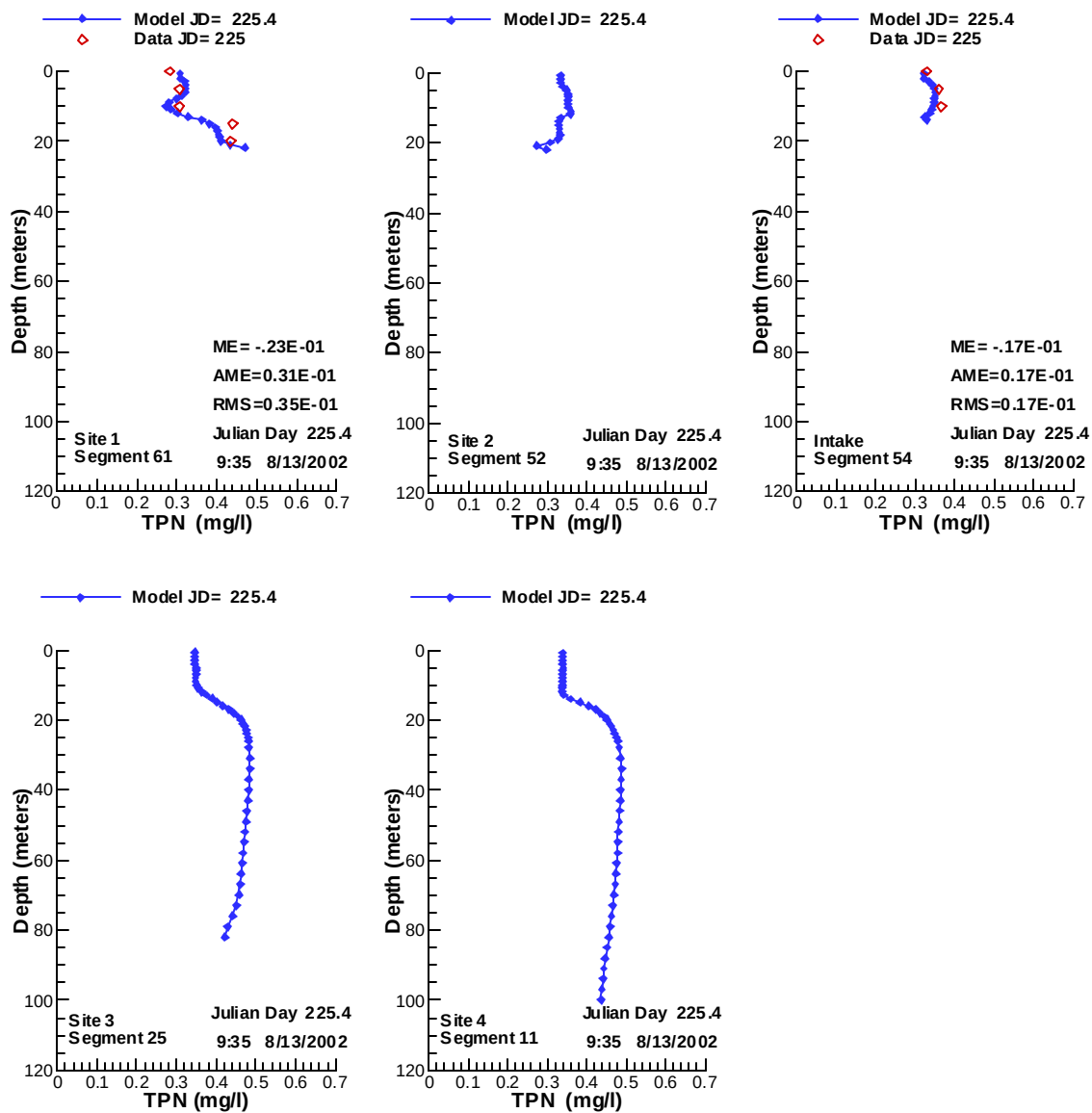


Figure 418. Vertical profiles of TOTAL NITROGEN compared with data for 8/13/2002.

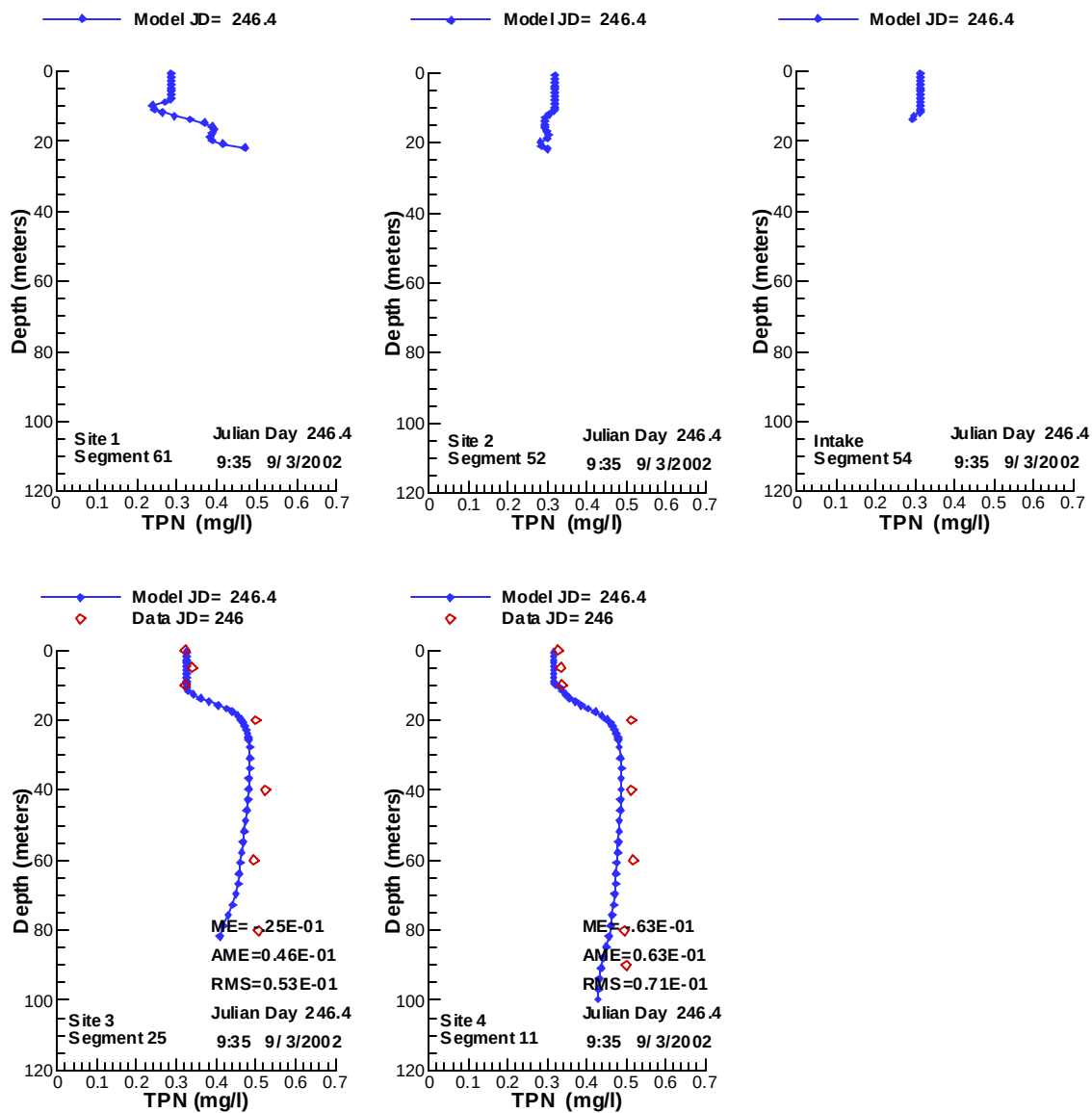


Figure 419. Vertical profiles of TOTAL NITROGEN compared with data for 9/ 3/2002.

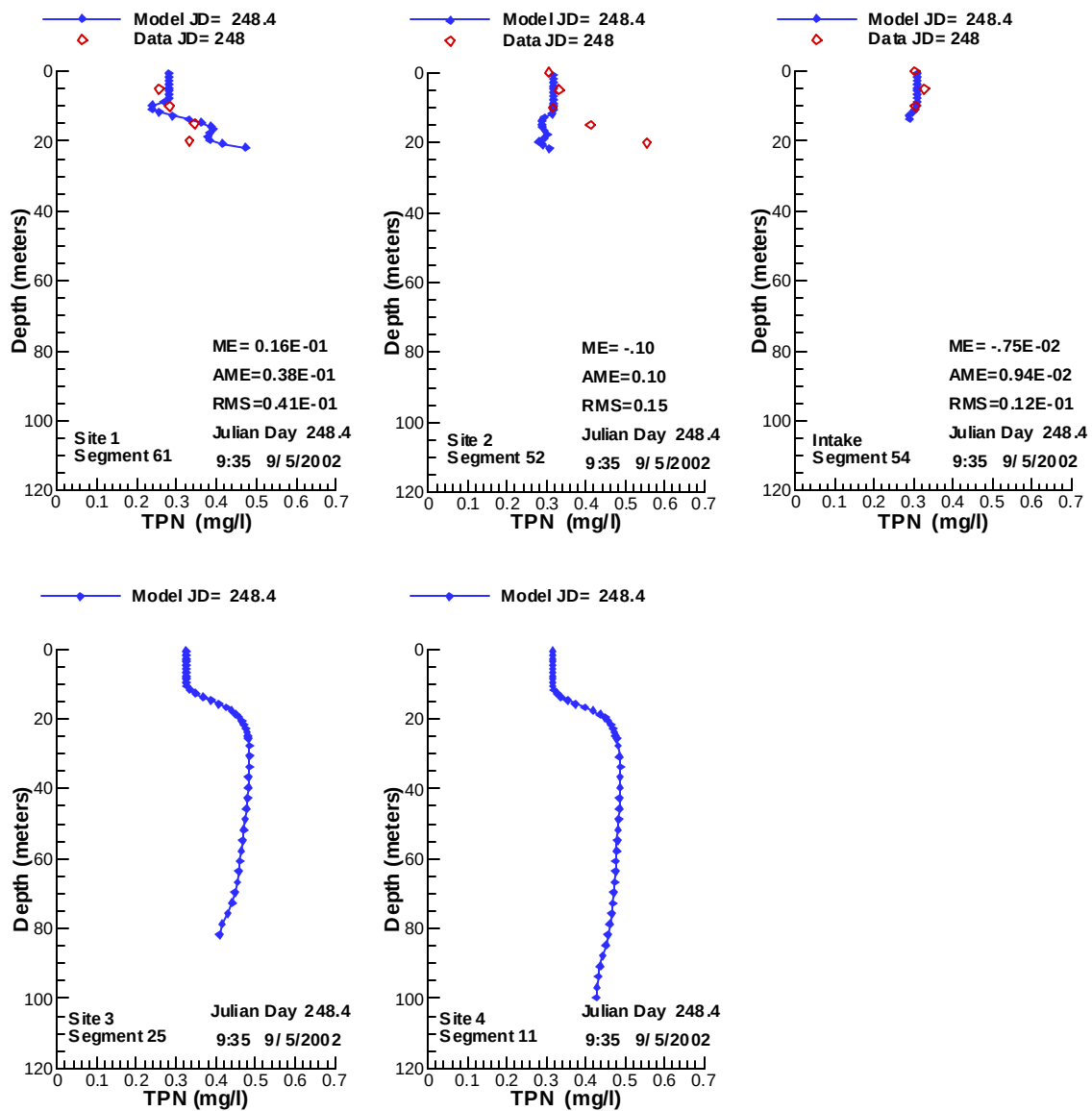


Figure 420. Vertical profiles of TOTAL NITROGEN compared with data for 9/ 5/2002.

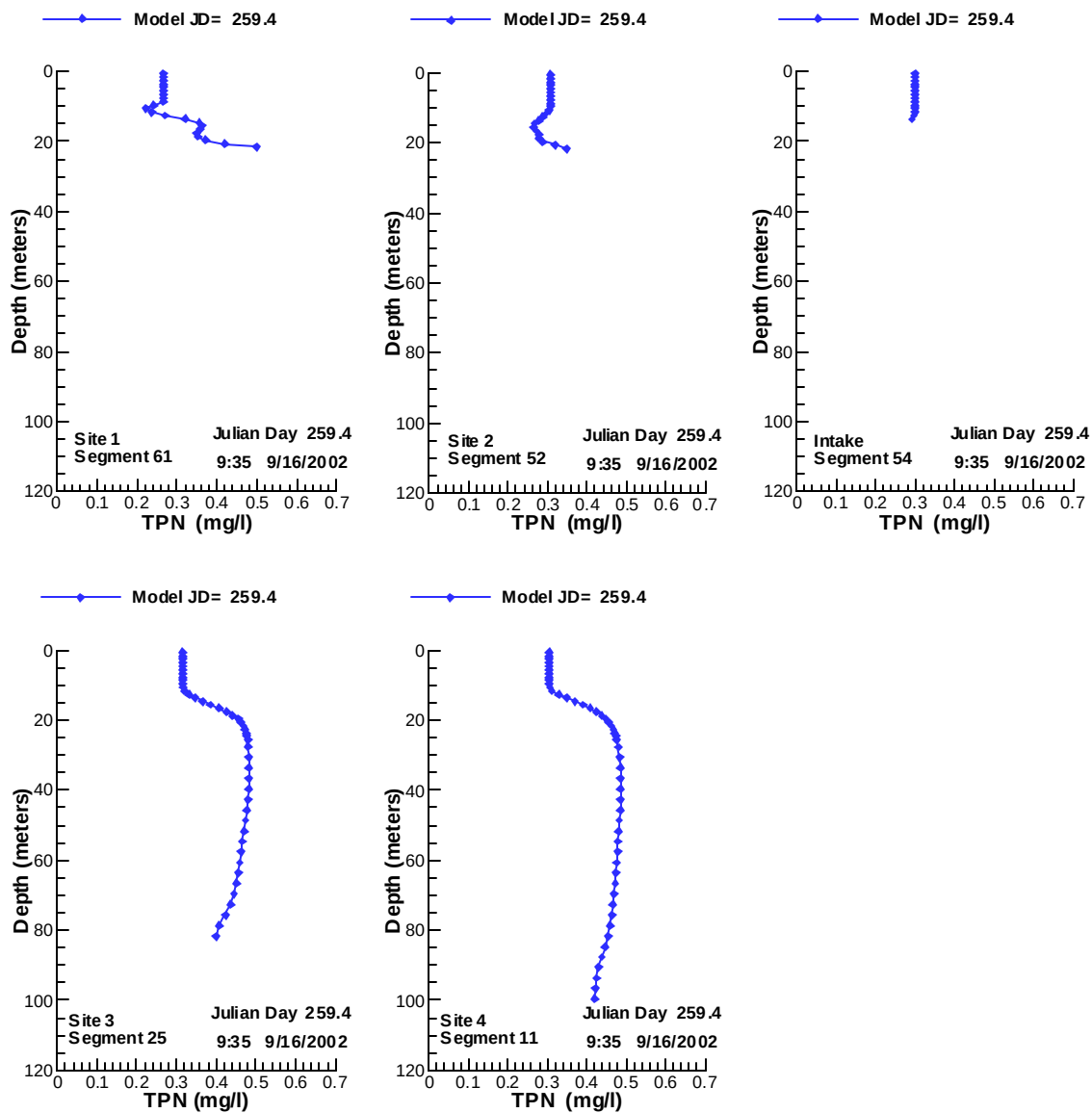


Figure 421. Vertical profiles of TOTAL NITROGEN compared with data for 9/16/2002.

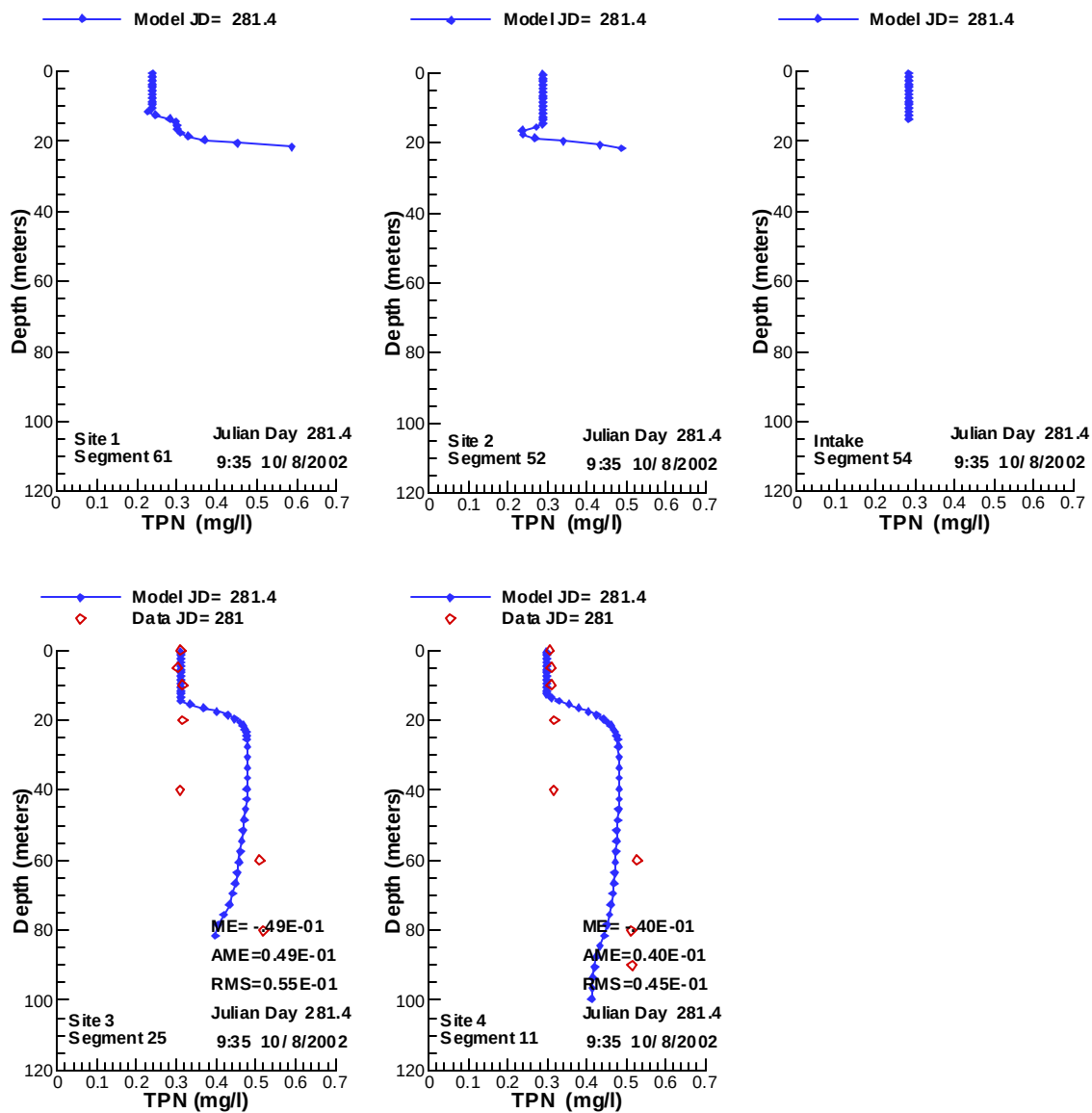


Figure 422. Vertical profiles of TOTAL NITROGEN compared with data for 10/ 8/2002.

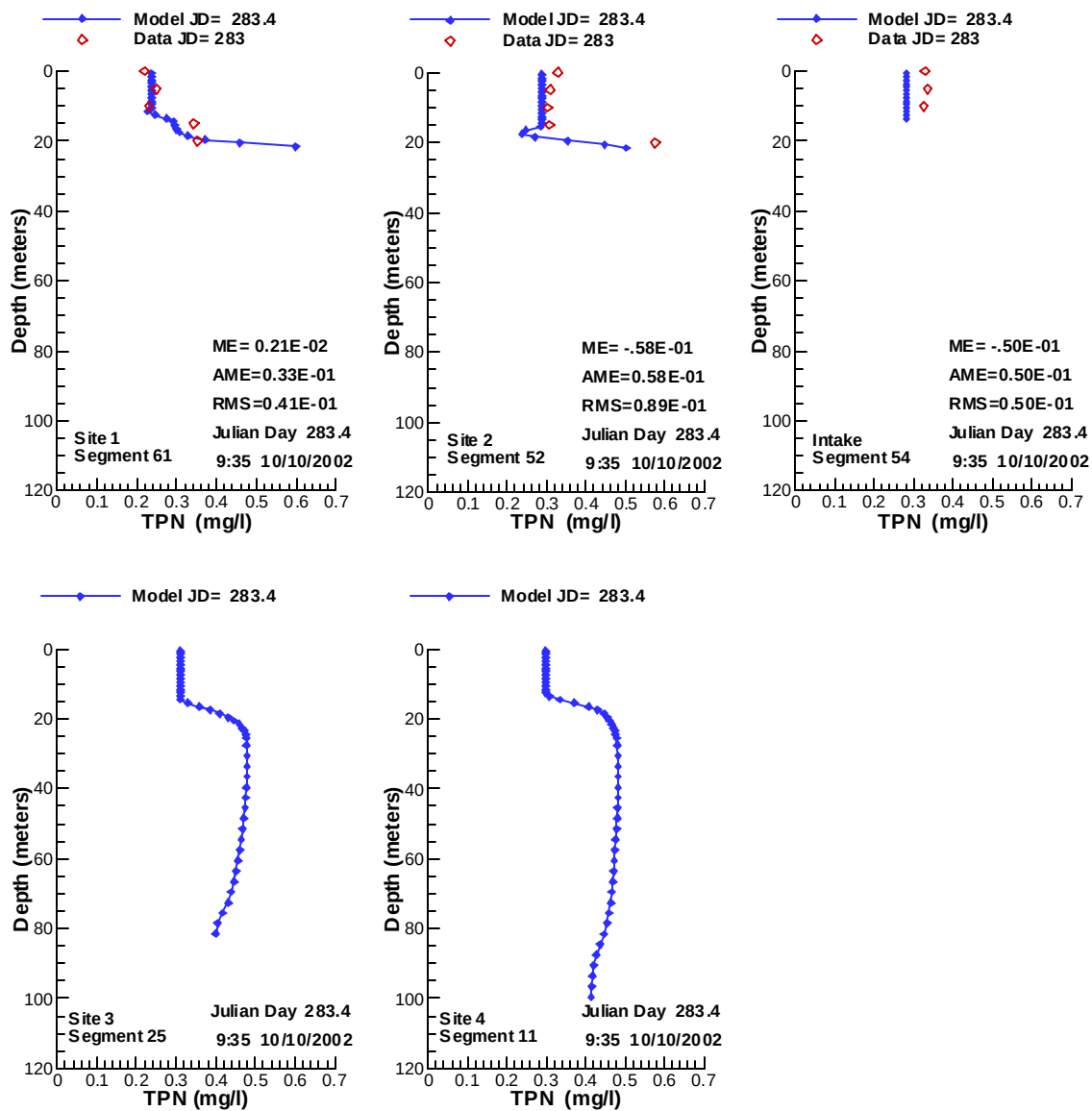


Figure 423. Vertical profiles of TOTAL NITROGEN compared with data for 10/10/2002.

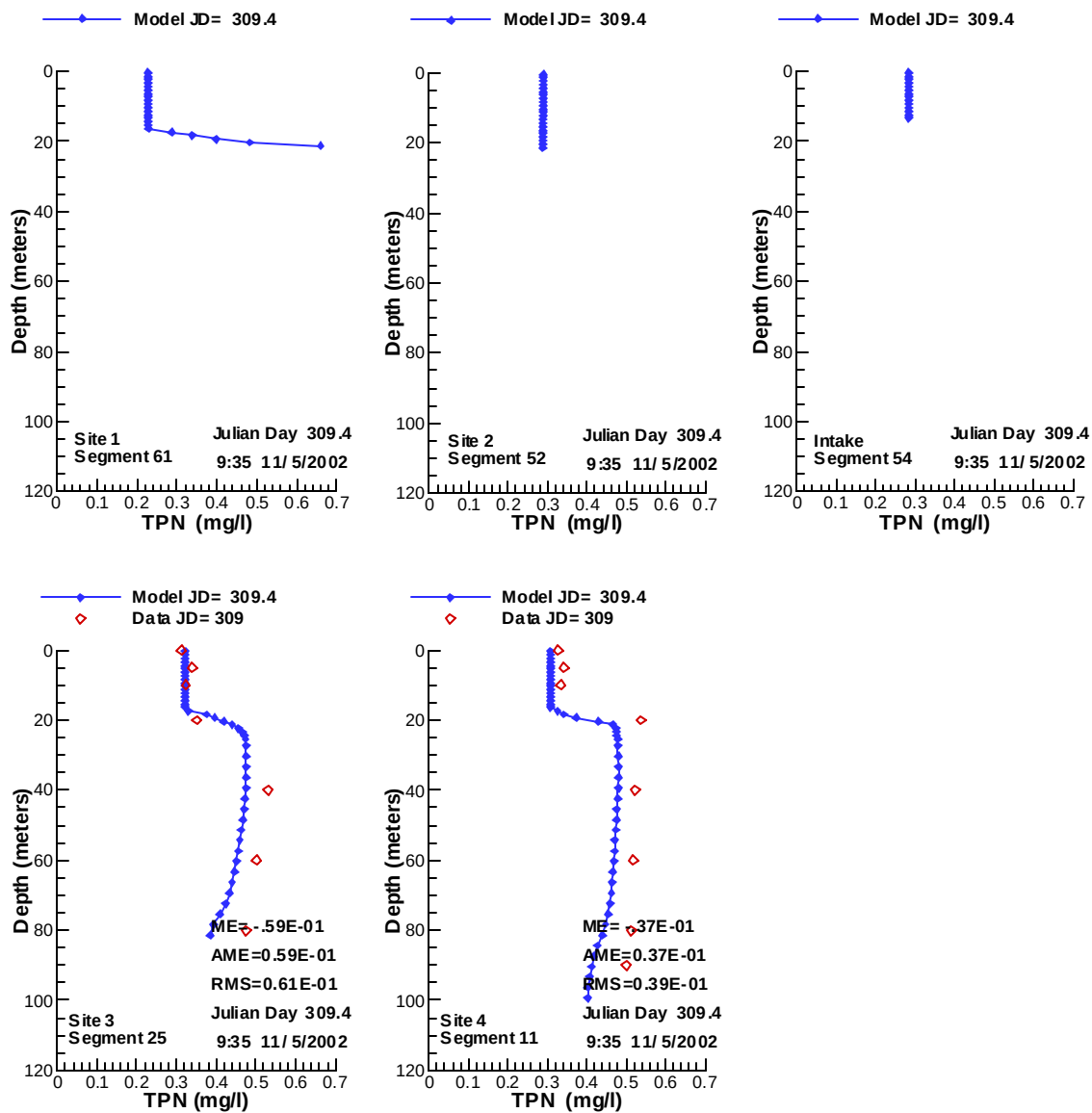


Figure 424. Vertical profiles of TOTAL NITROGEN compared with data for 11/ 5/2002.

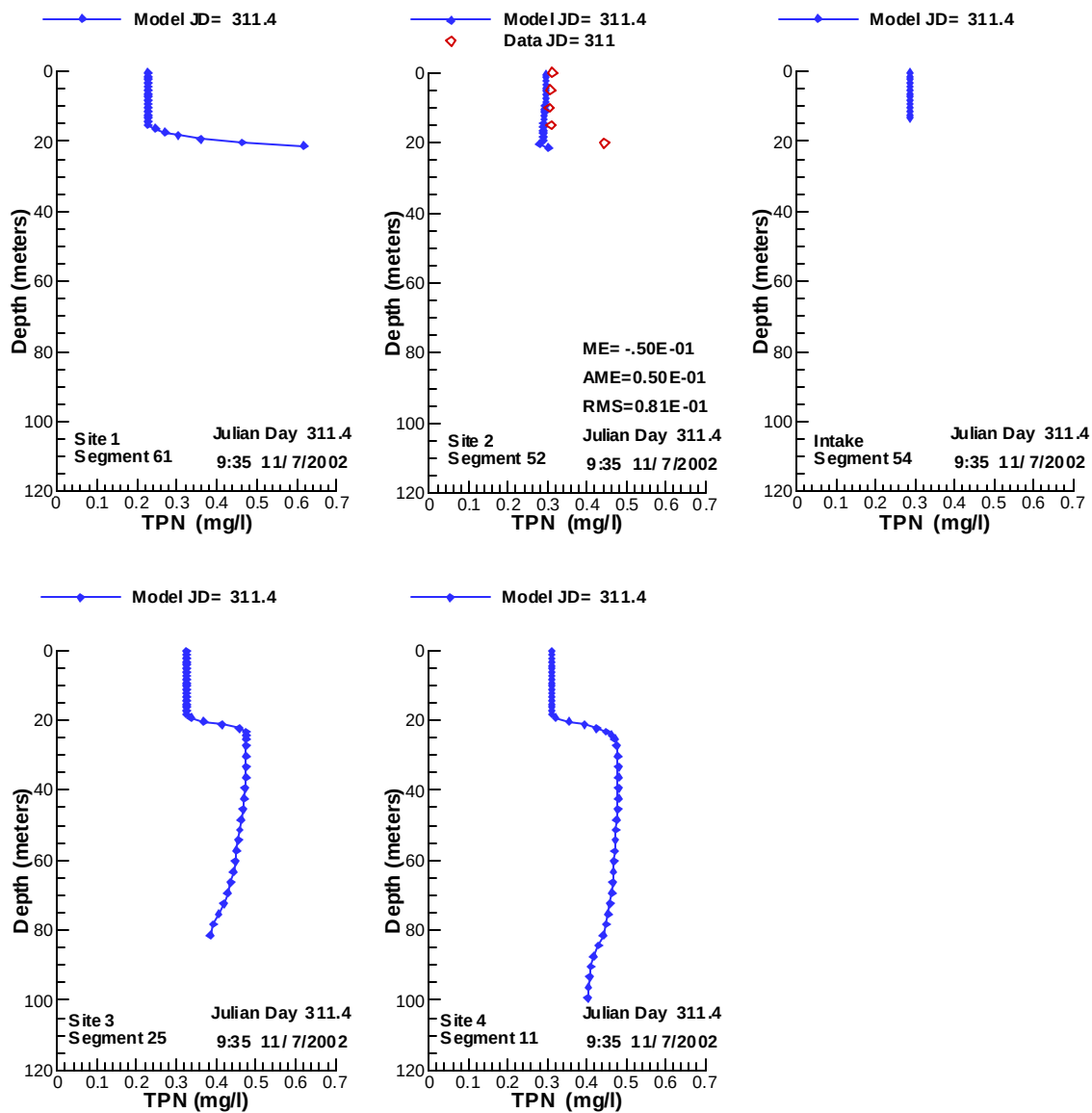


Figure 425. Vertical profiles of TOTAL NITROGEN compared with data for 11/ 7/2002.

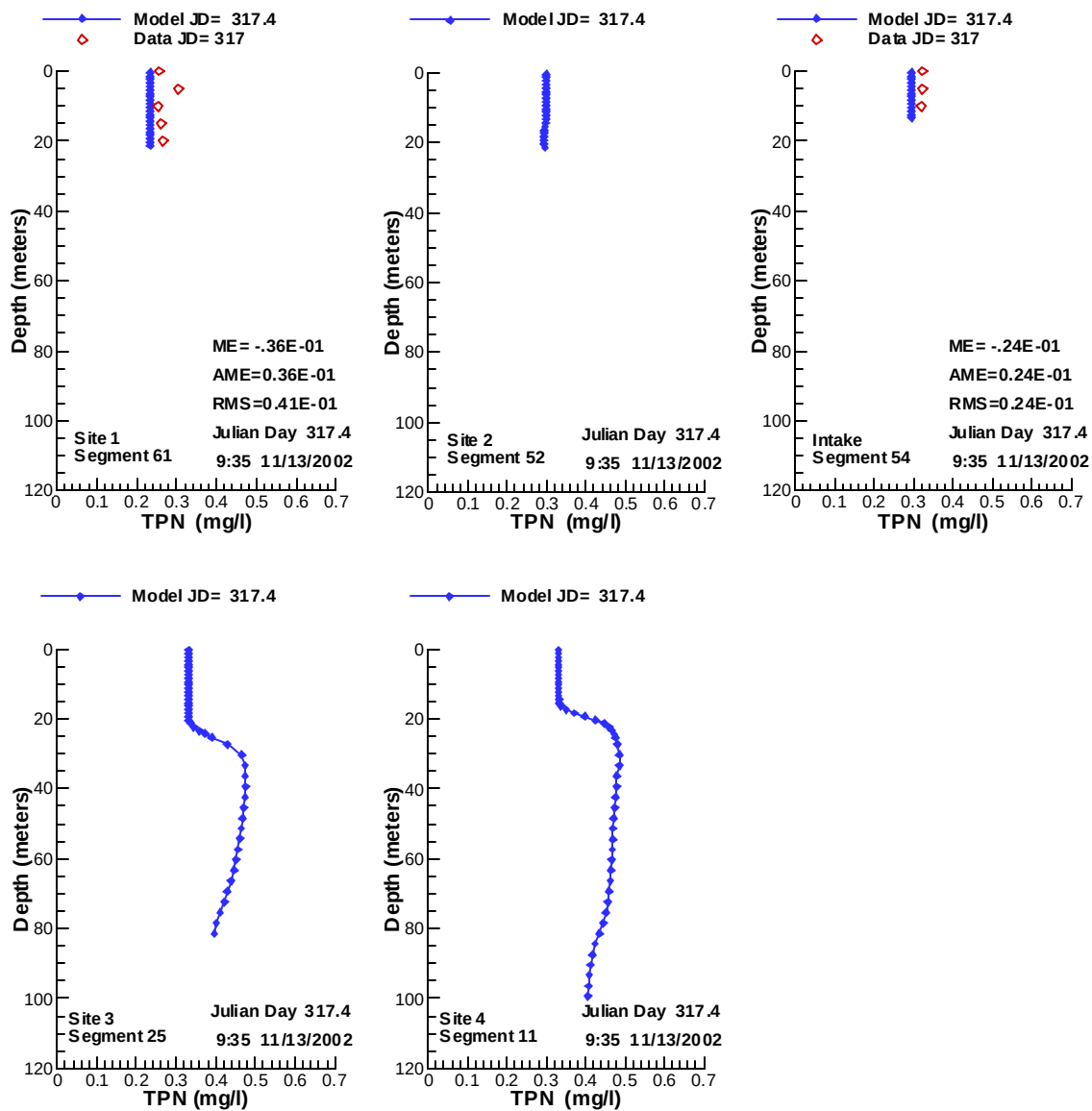


Figure 426. Vertical profiles of TOTAL NITROGEN compared with data for 11/13/2002.

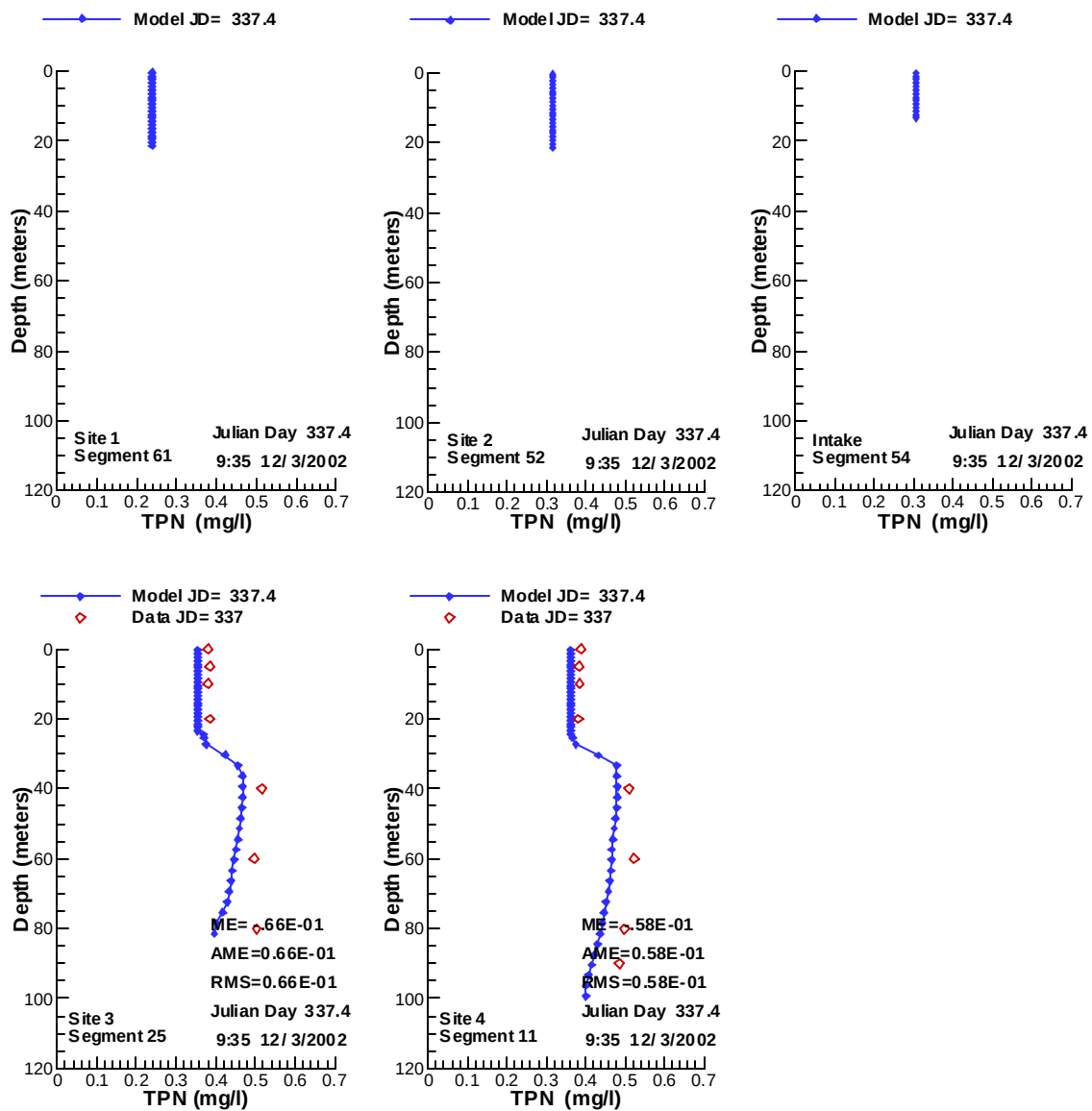


Figure 427. Vertical profiles of TOTAL NITROGEN compared with data for 12/ 3/2002.

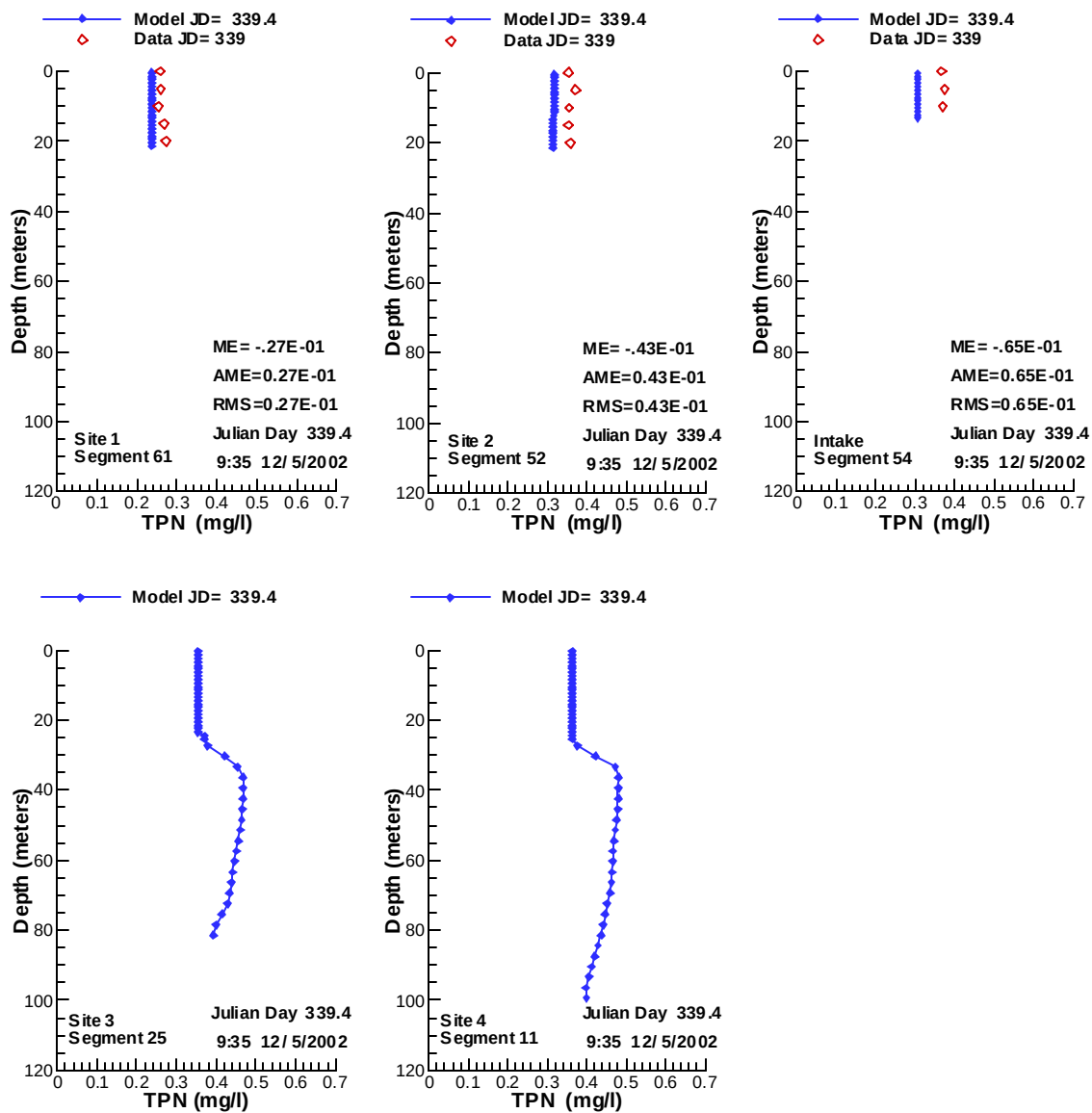


Figure 428. Vertical profiles of TOTAL NITROGEN compared with data for 12/ 5/2002.

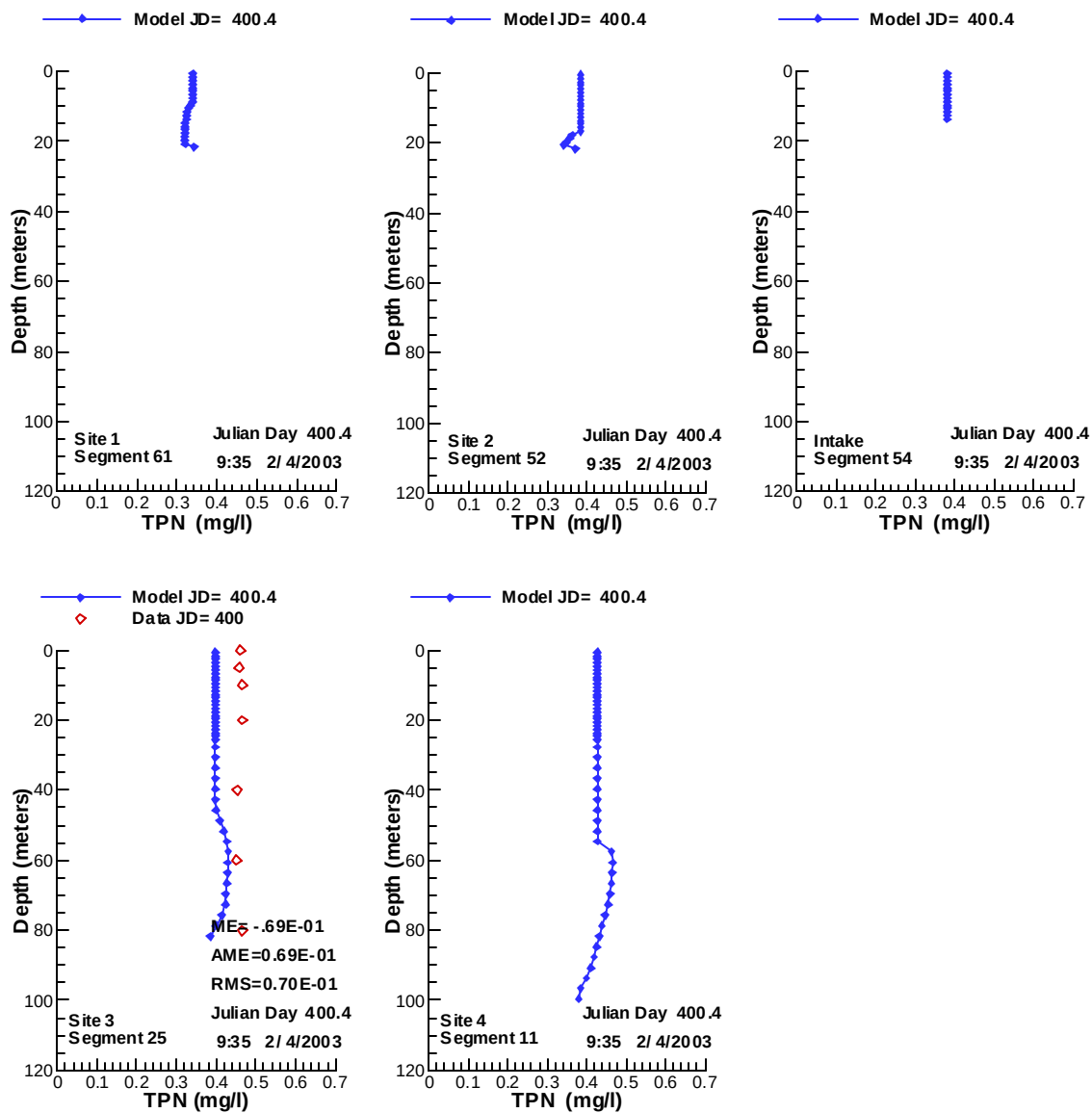


Figure 429. Vertical profiles of TOTAL NITROGEN compared with data for 2/ 4/2003.

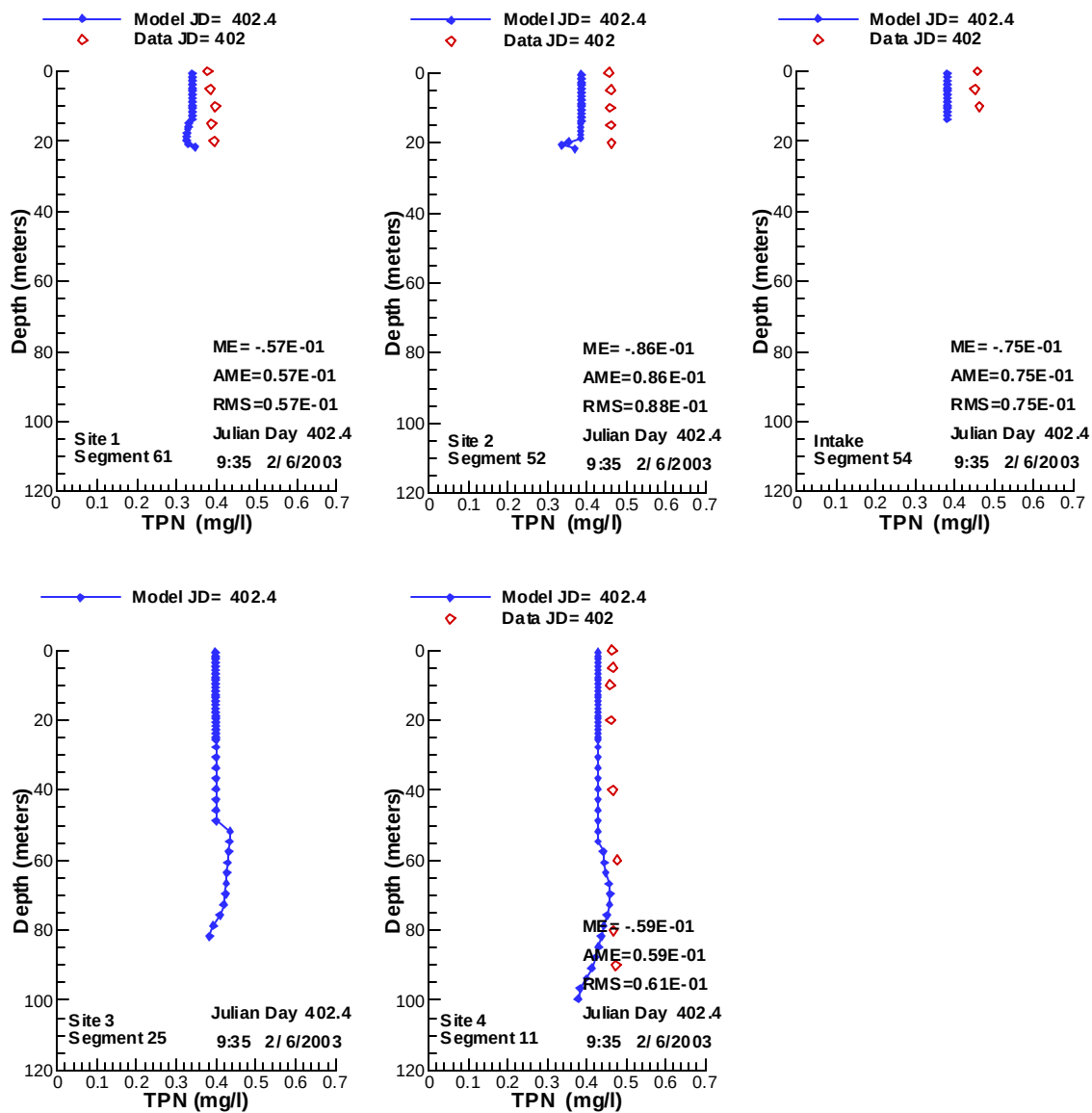


Figure 430. Vertical profiles of TOTAL NITROGEN compared with data for 2/ 6/2003.

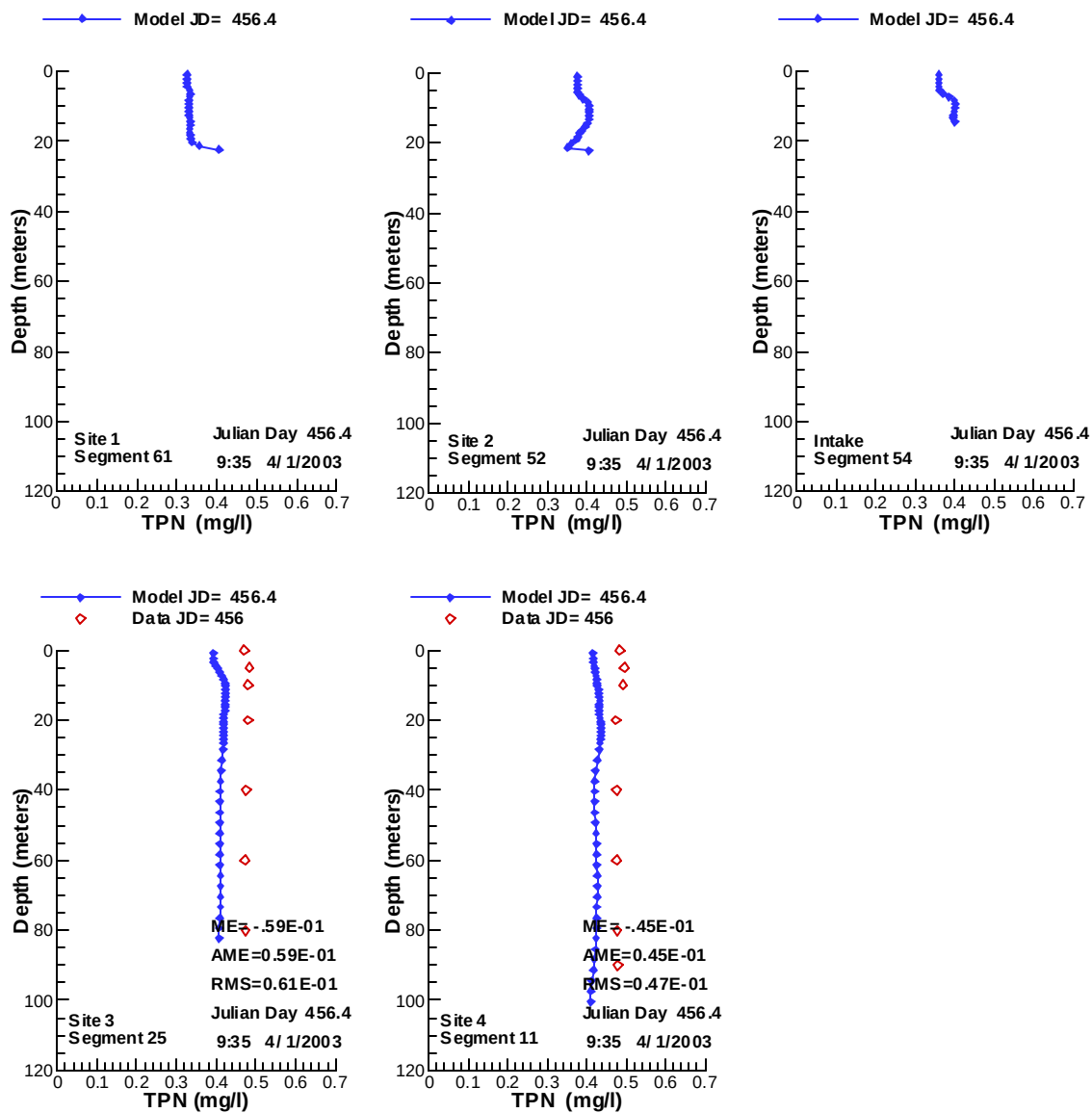


Figure 431. Vertical profiles of TOTAL NITROGEN compared with data for 4/ 1/2003.

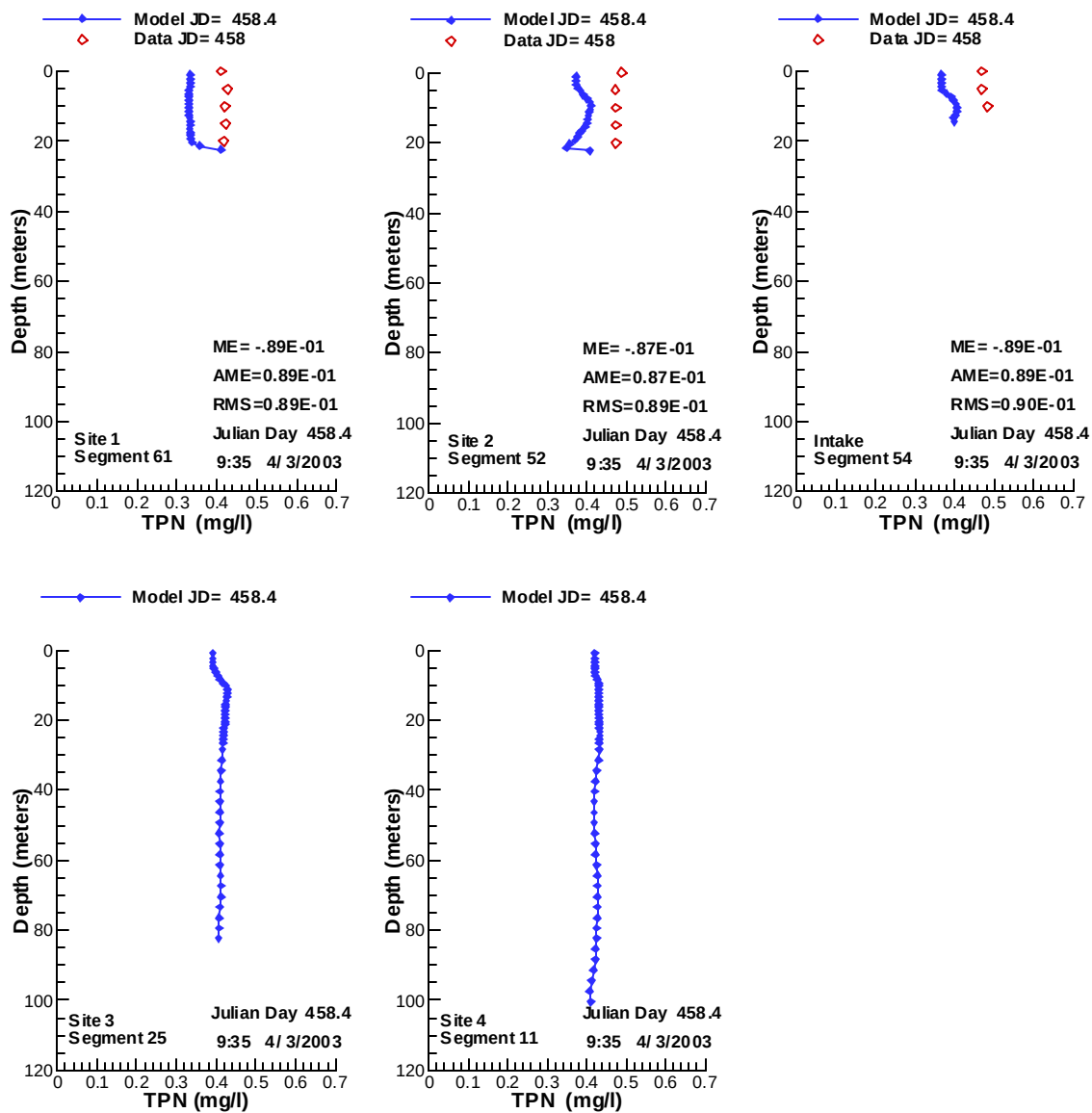


Figure 432. Vertical profiles of TOTAL NITROGEN compared with data for 4/ 3/2003.

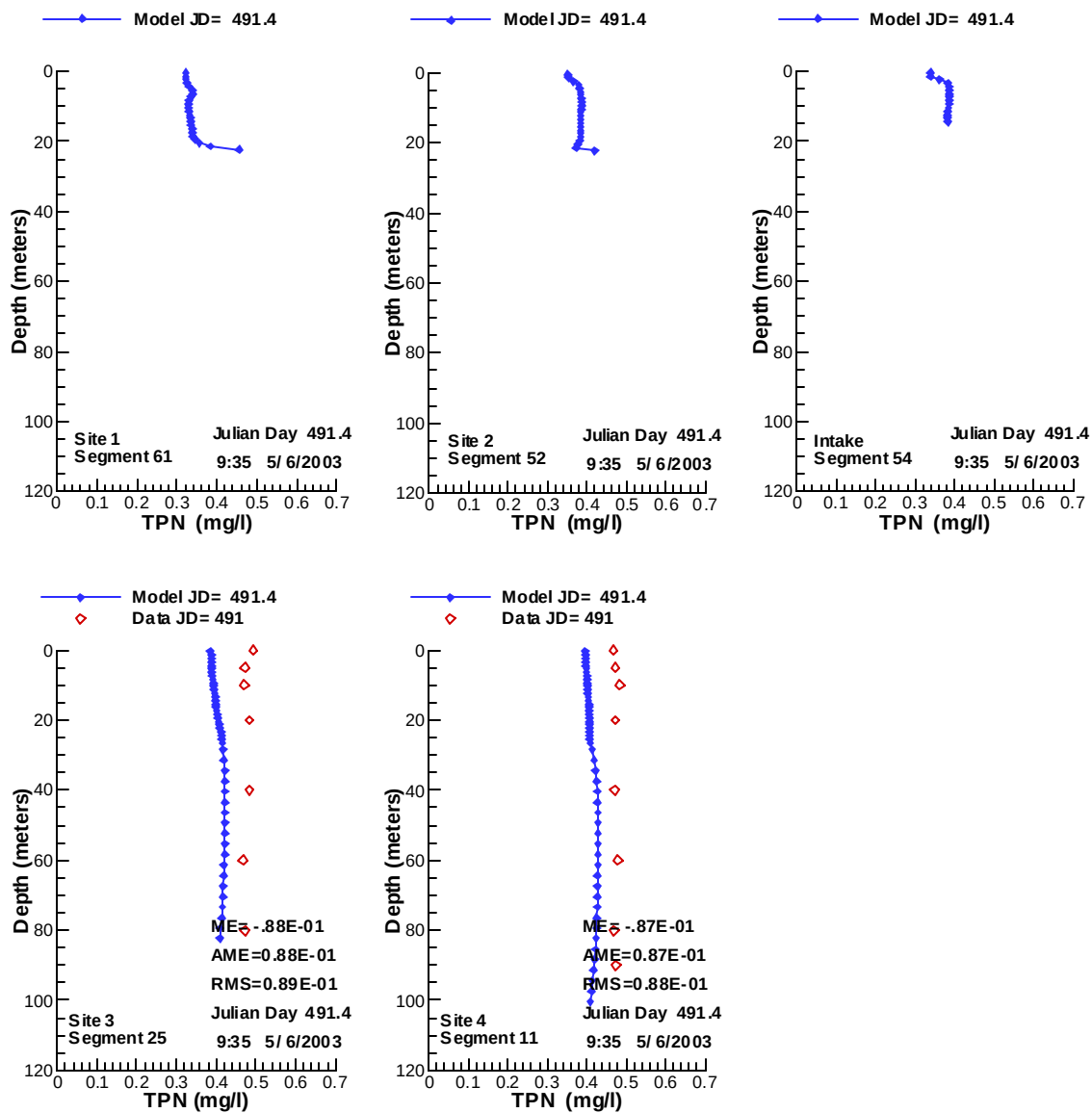


Figure 433. Vertical profiles of TOTAL NITROGEN compared with data for 5/ 6/2003.

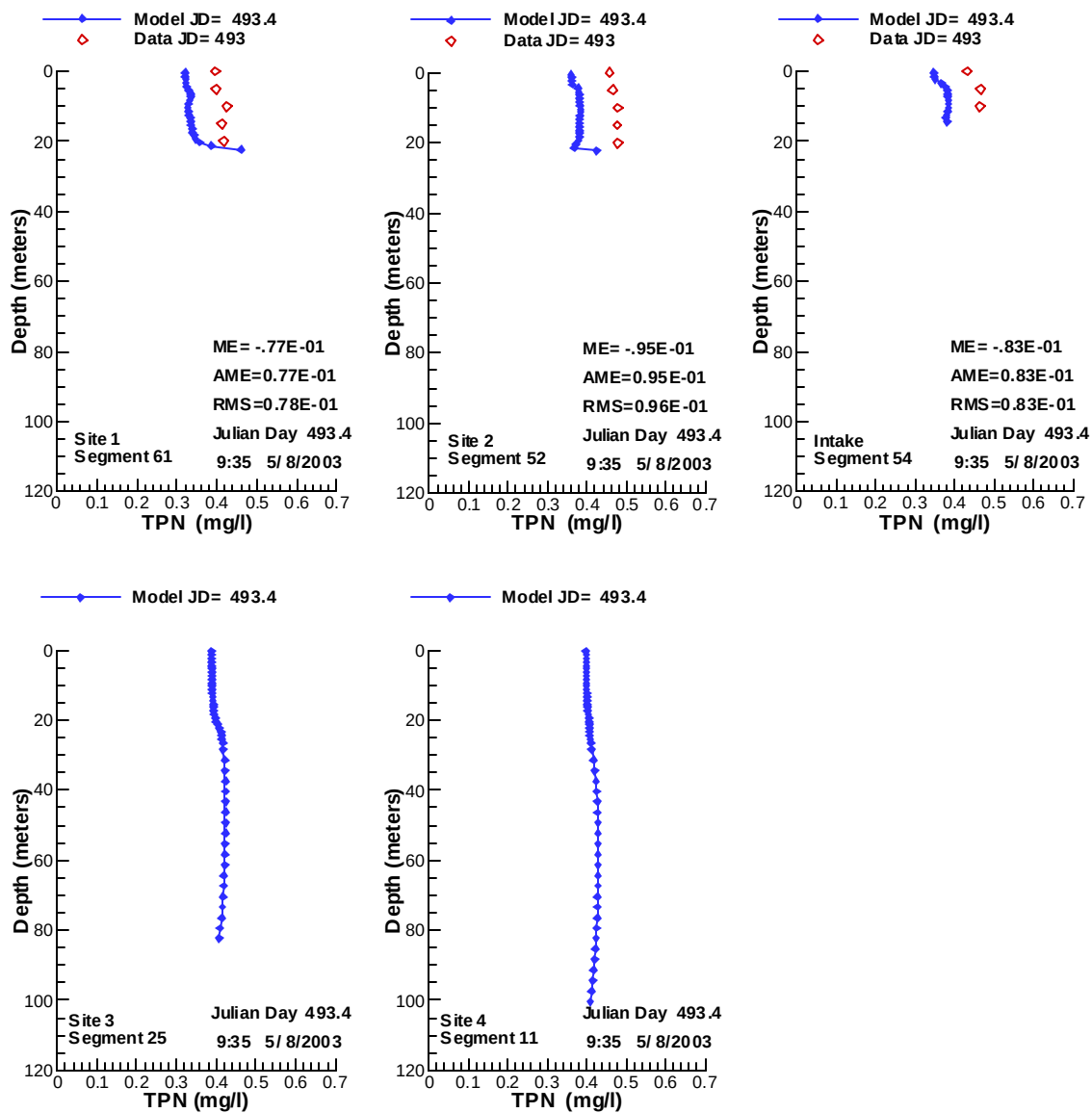


Figure 434. Vertical profiles of TOTAL NITROGEN compared with data for 5/ 8/2003.

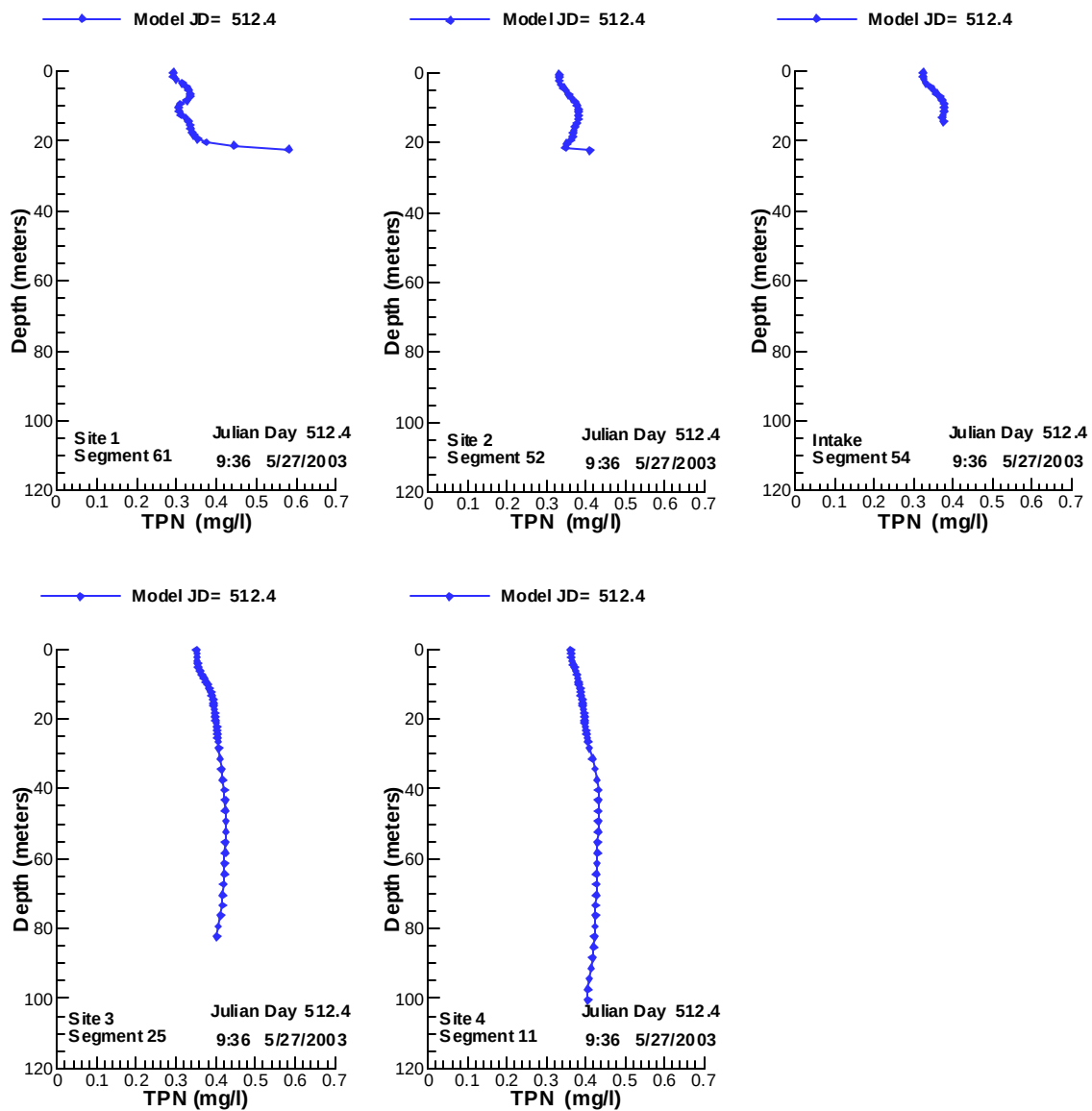


Figure 435. Vertical profiles of TOTAL NITROGEN compared with data for 5/27/2003.

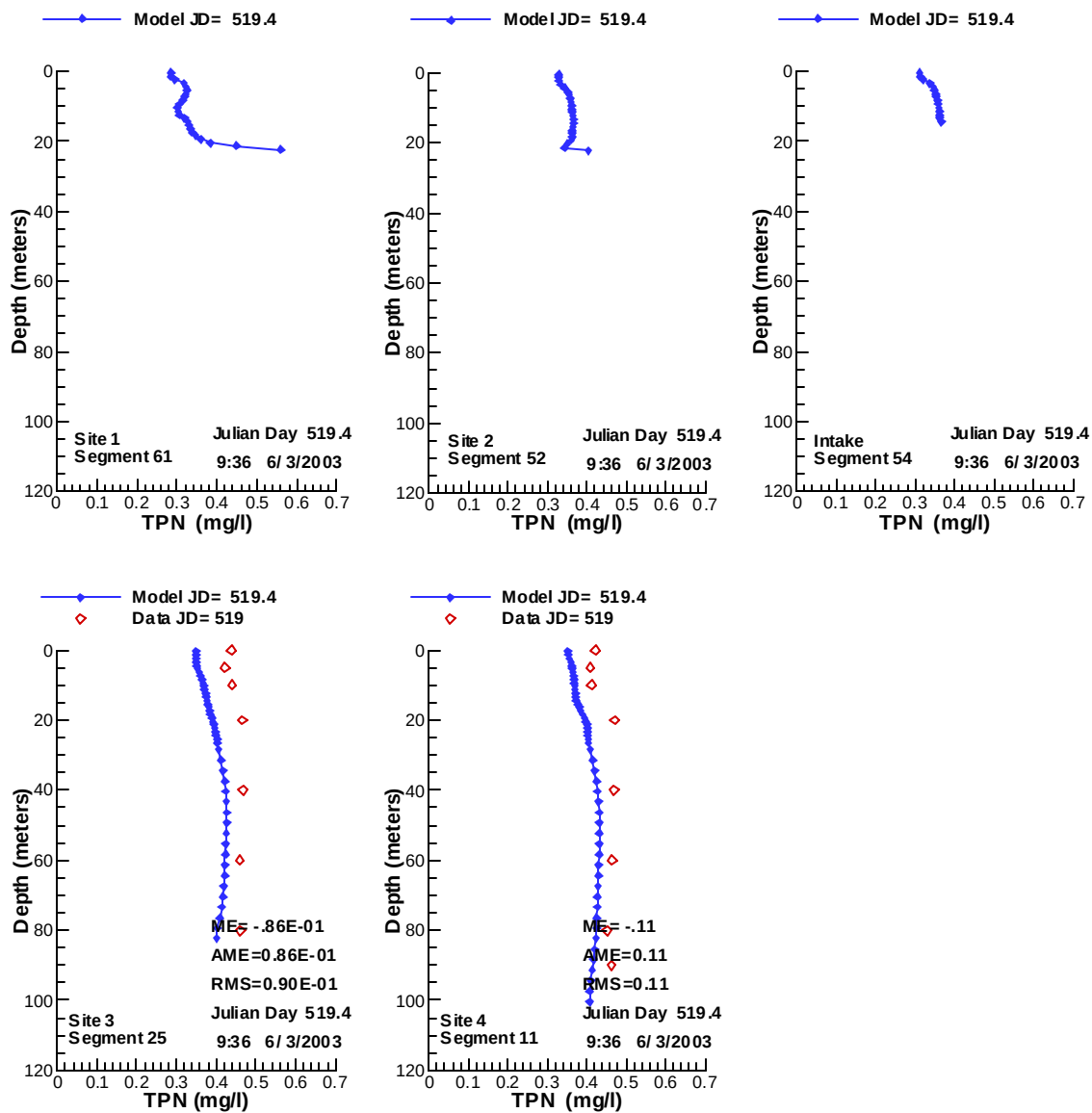


Figure 436. Vertical profiles of TOTAL NITROGEN compared with data for 6/ 3/2003.

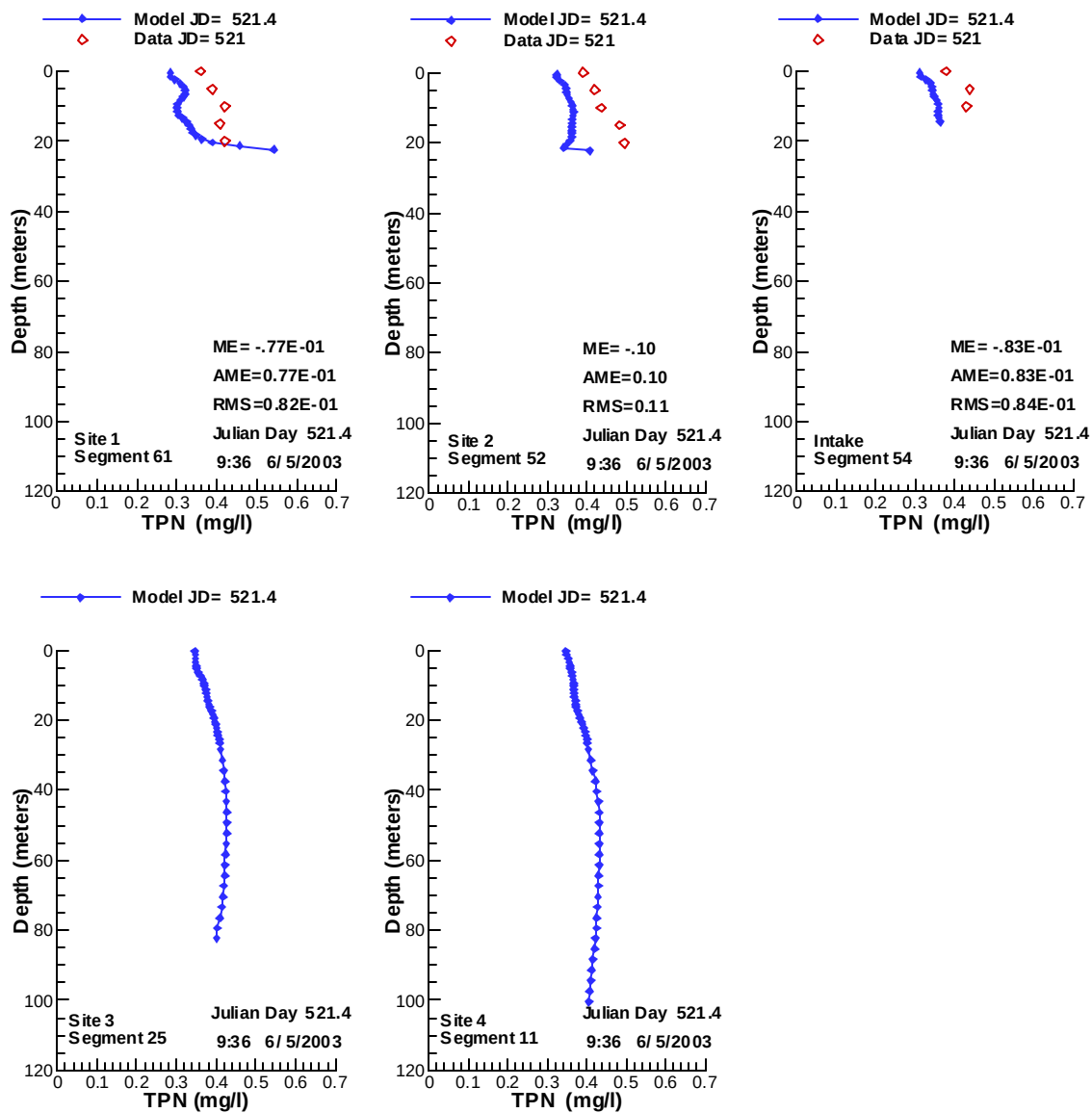


Figure 437. Vertical profiles of TOTAL NITROGEN compared with data for 6/ 5/2003.

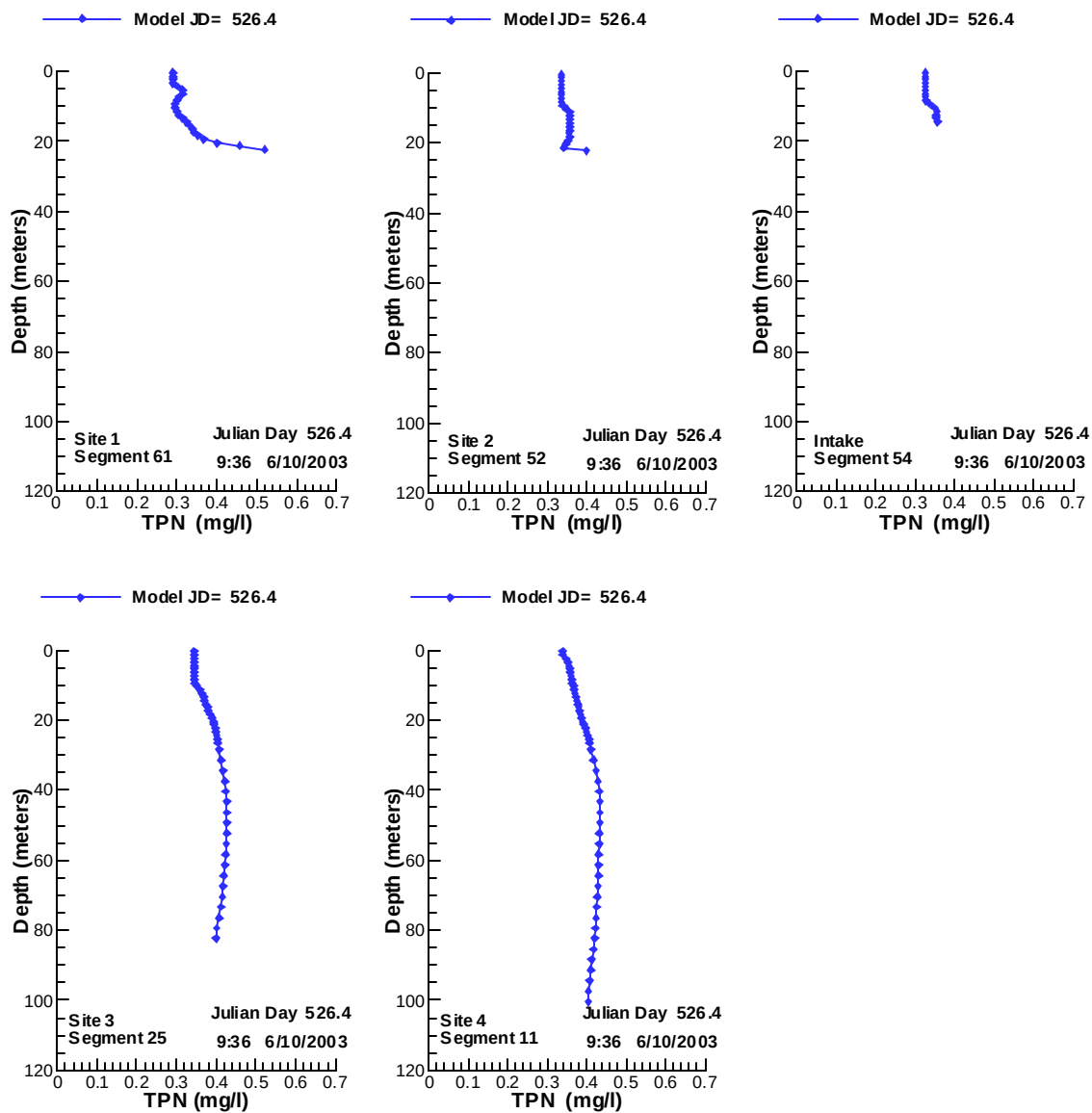


Figure 438. Vertical profiles of TOTAL NITROGEN compared with data for 6/10/2003.

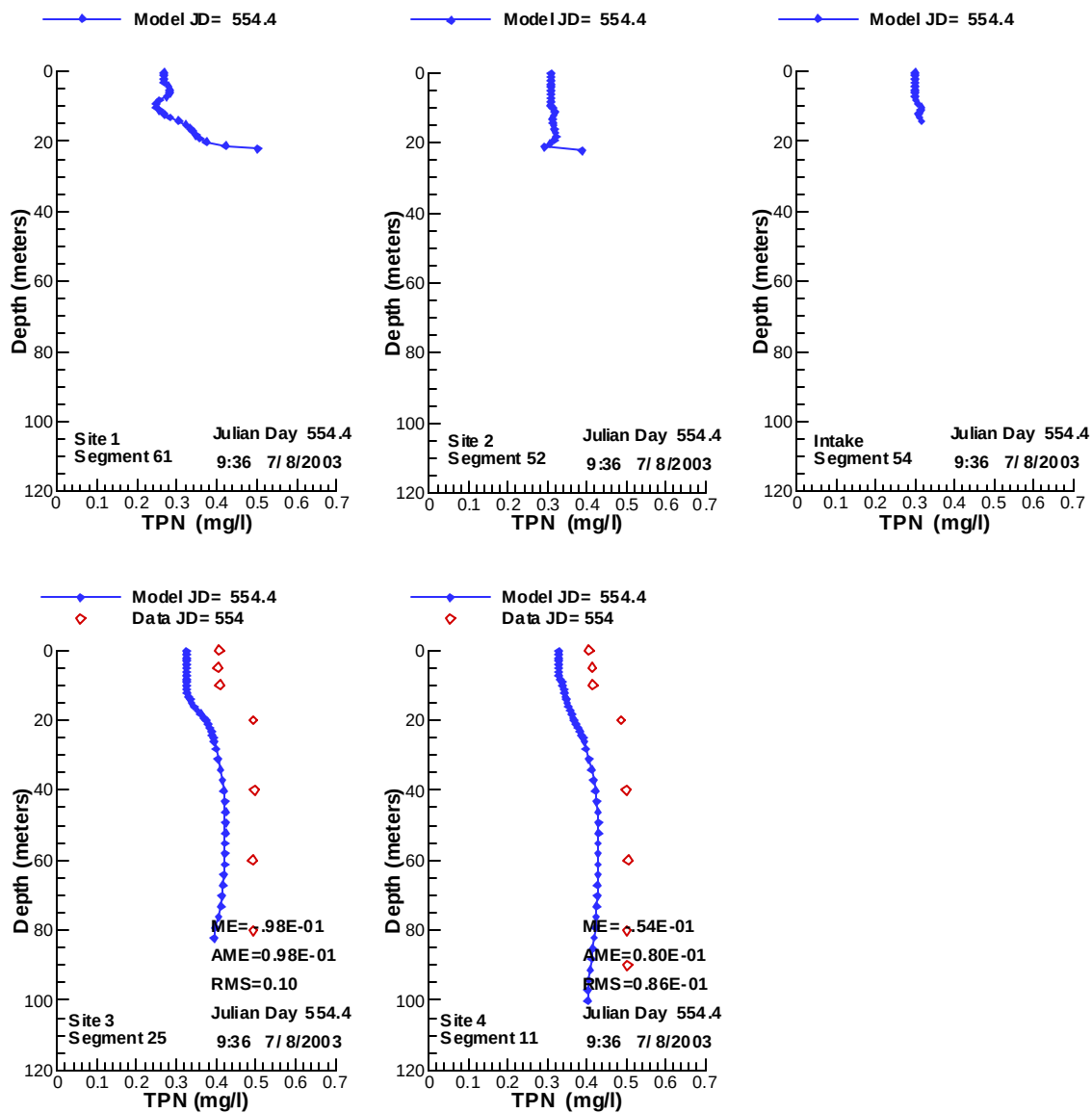


Figure 439. Vertical profiles of TOTAL NITROGEN compared with data for 7/ 8/2003.

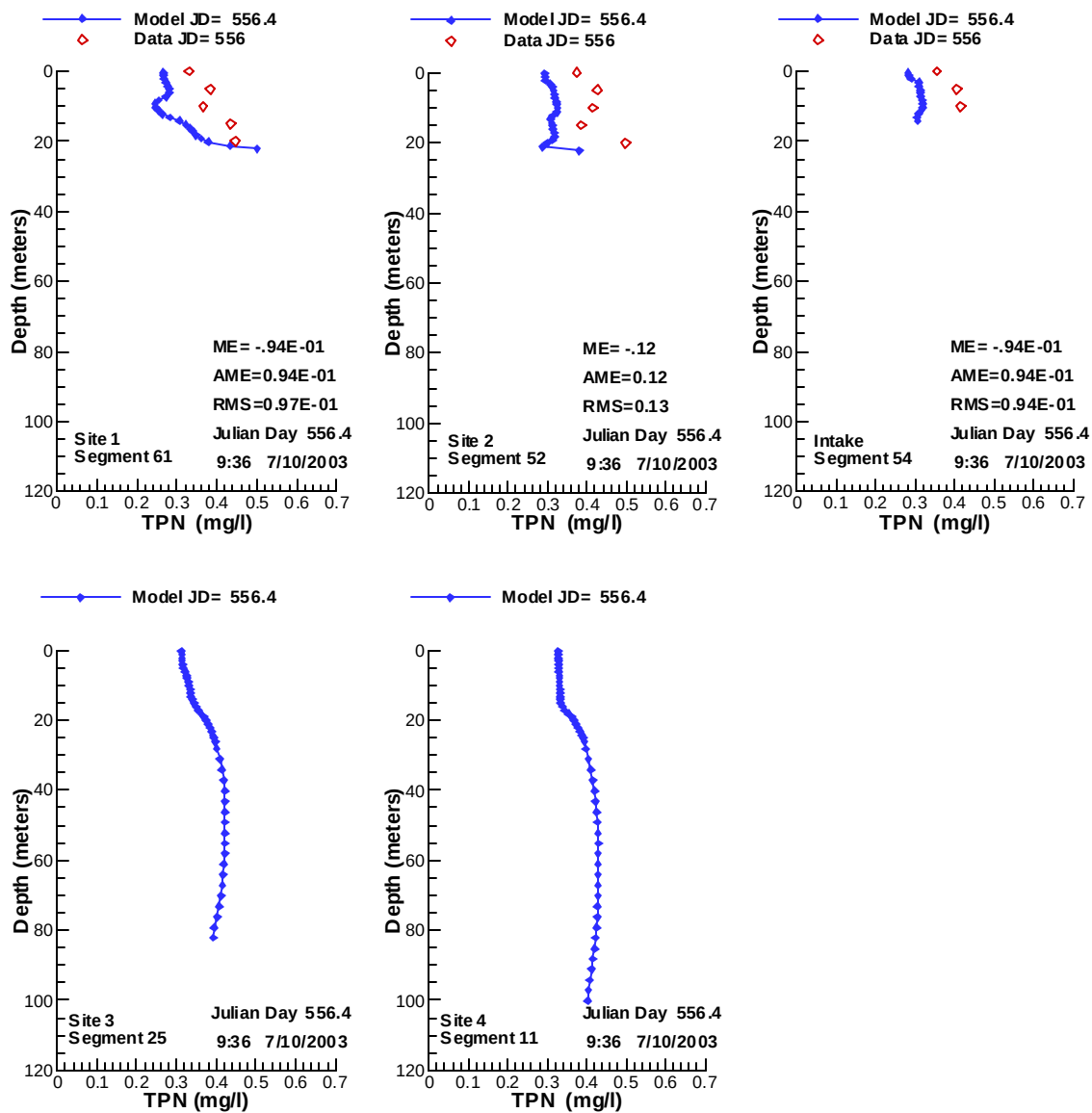


Figure 440. Vertical profiles of TOTAL NITROGEN compared with data for 7/10/2003.

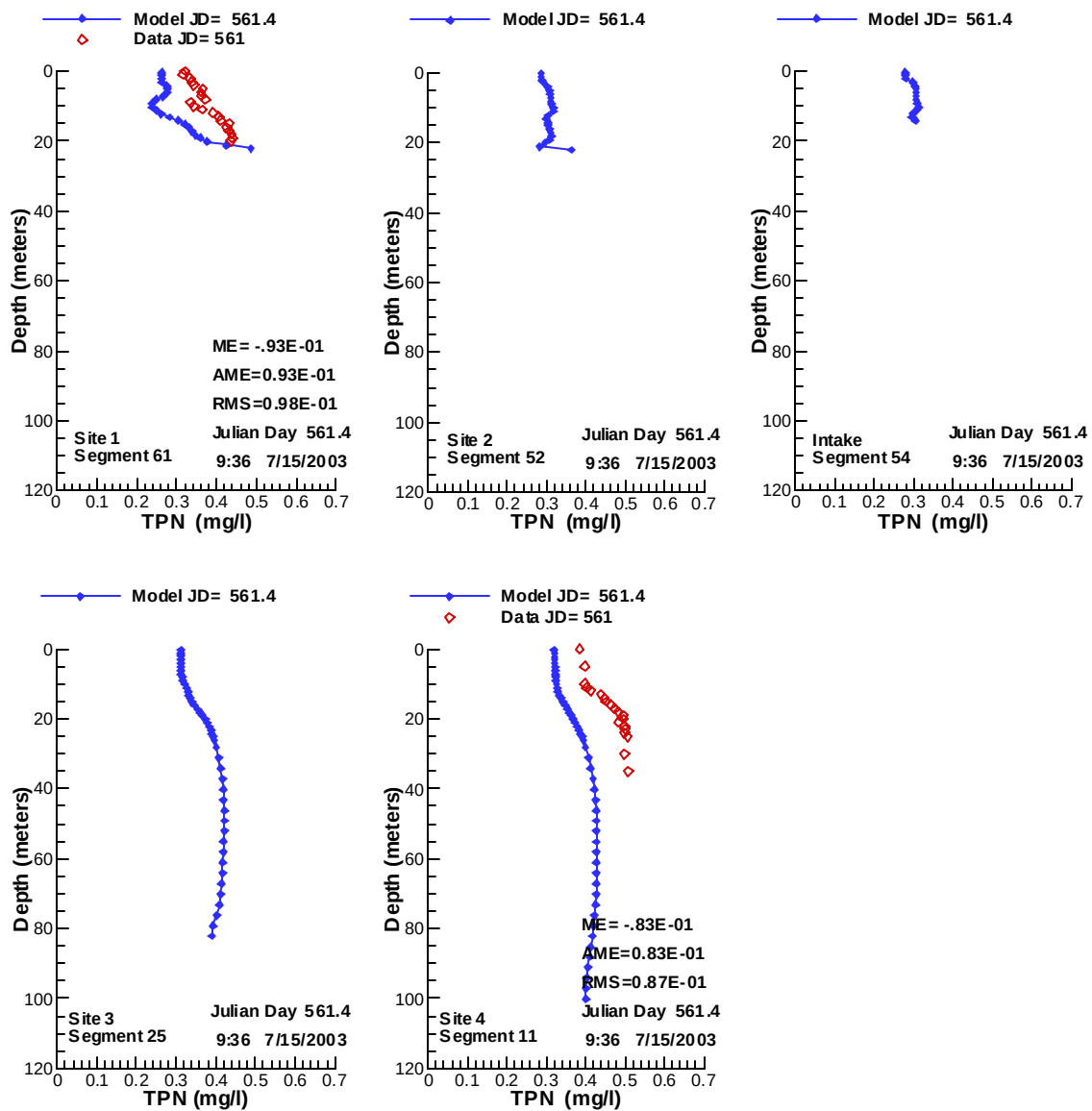


Figure 441. Vertical profiles of TOTAL NITROGEN compared with data for 7/15/2003.

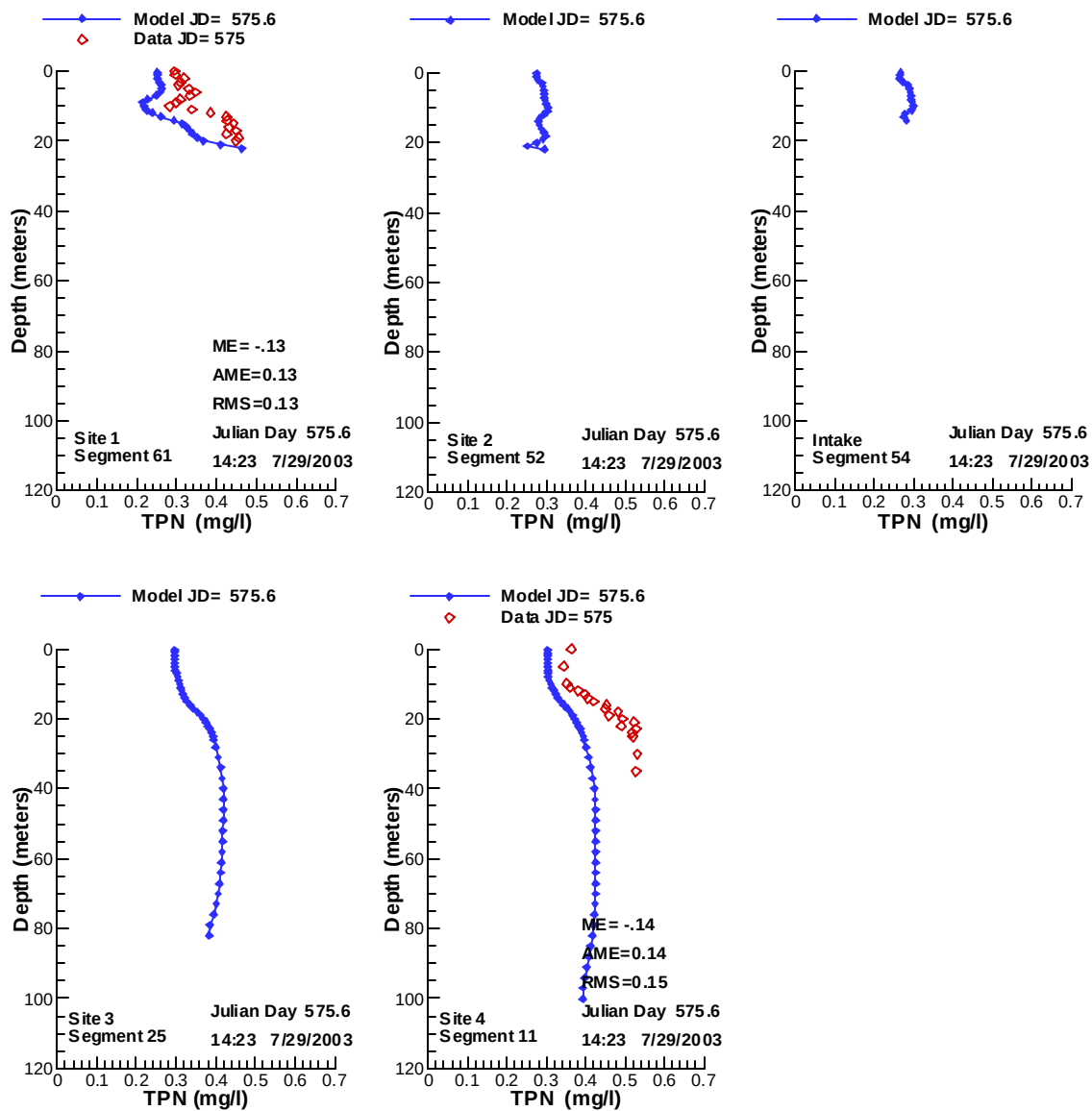


Figure 442. Vertical profiles of TOTAL NITROGEN compared with data for 7/29/2003.

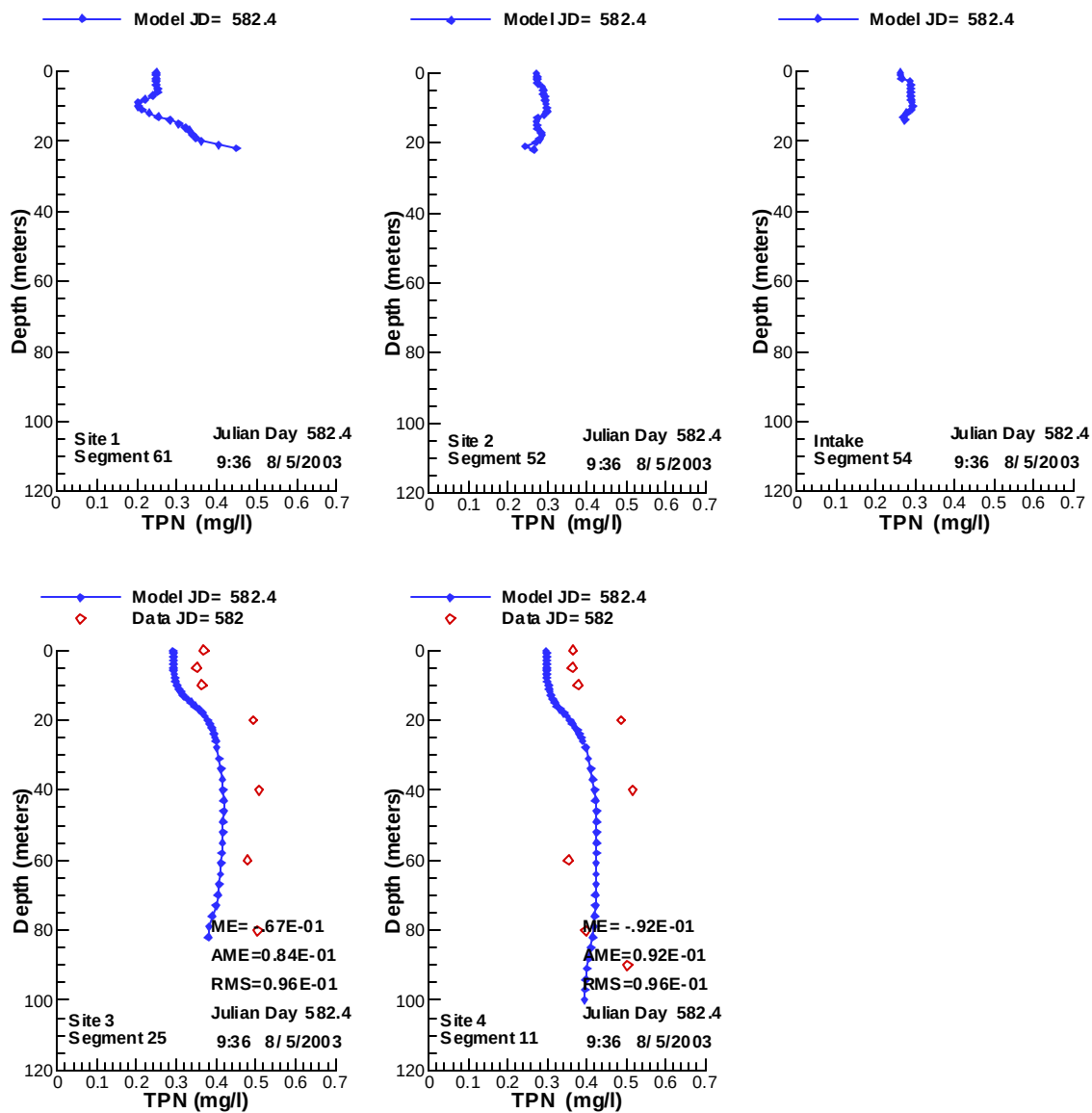


Figure 443. Vertical profiles of TOTAL NITROGEN compared with data for 8/ 5/2003.

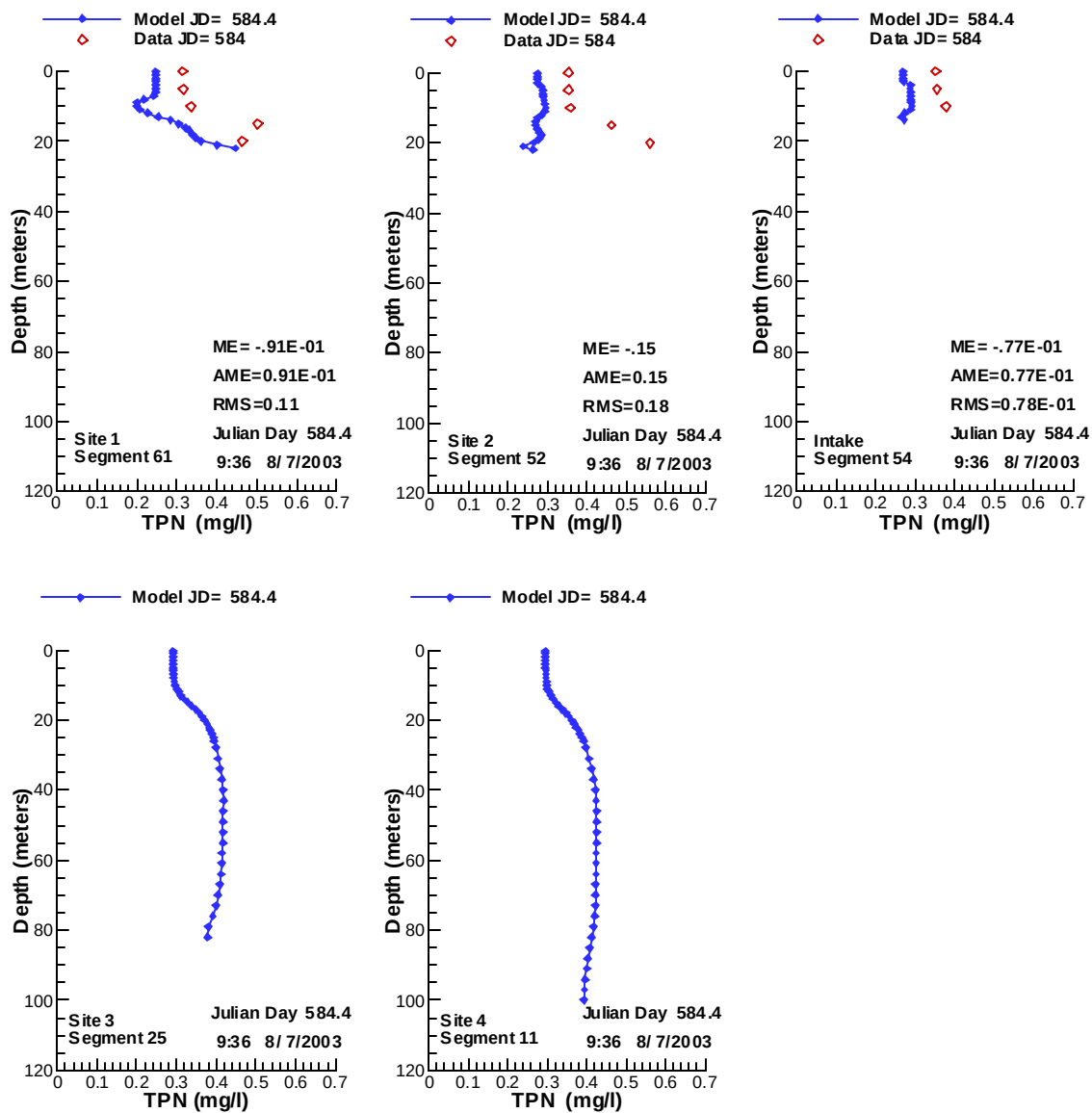


Figure 444. Vertical profiles of TOTAL NITROGEN compared with data for 8/ 7/2003.

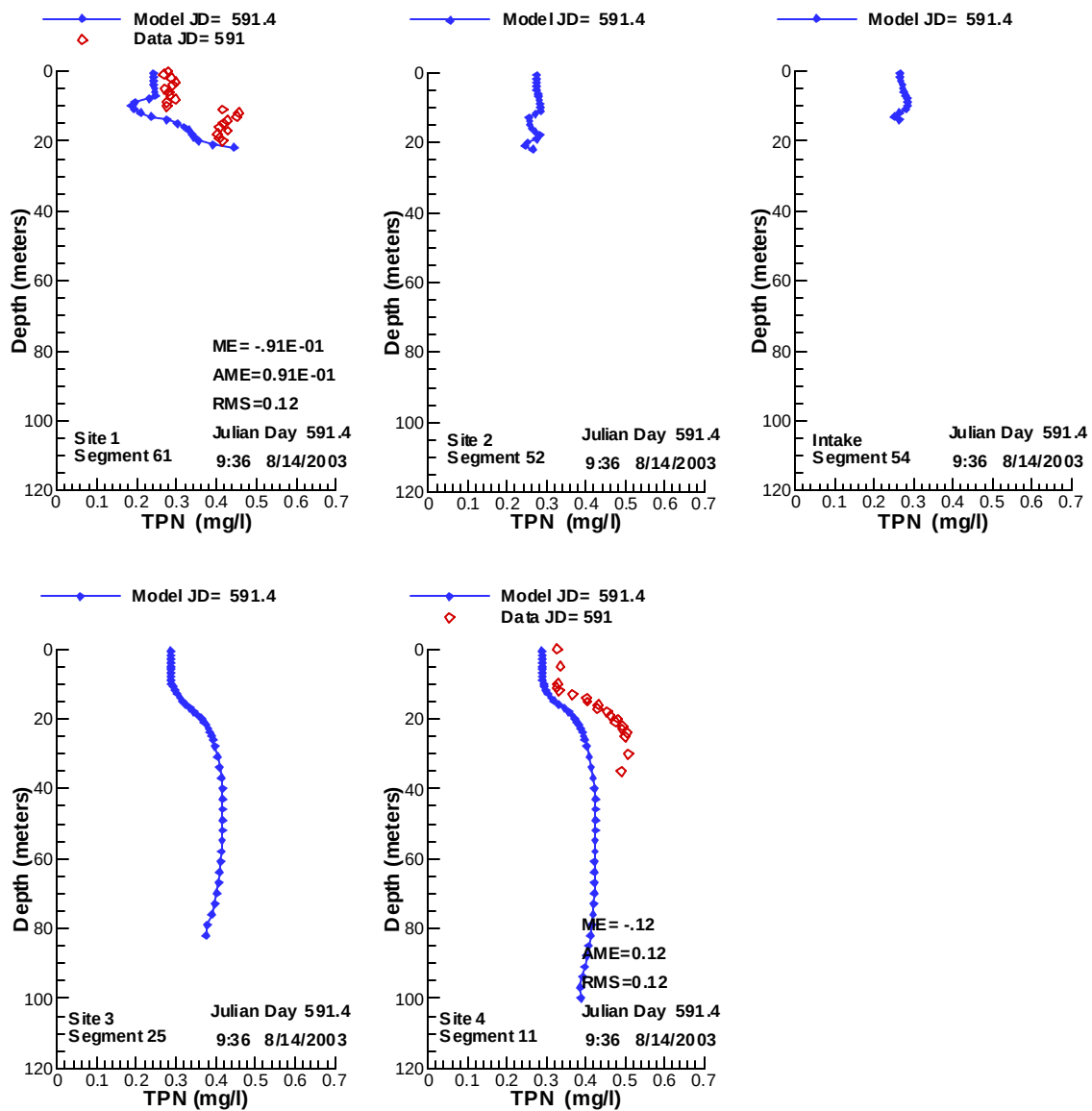


Figure 445. Vertical profiles of TOTAL NITROGEN compared with data for 8/14/2003.

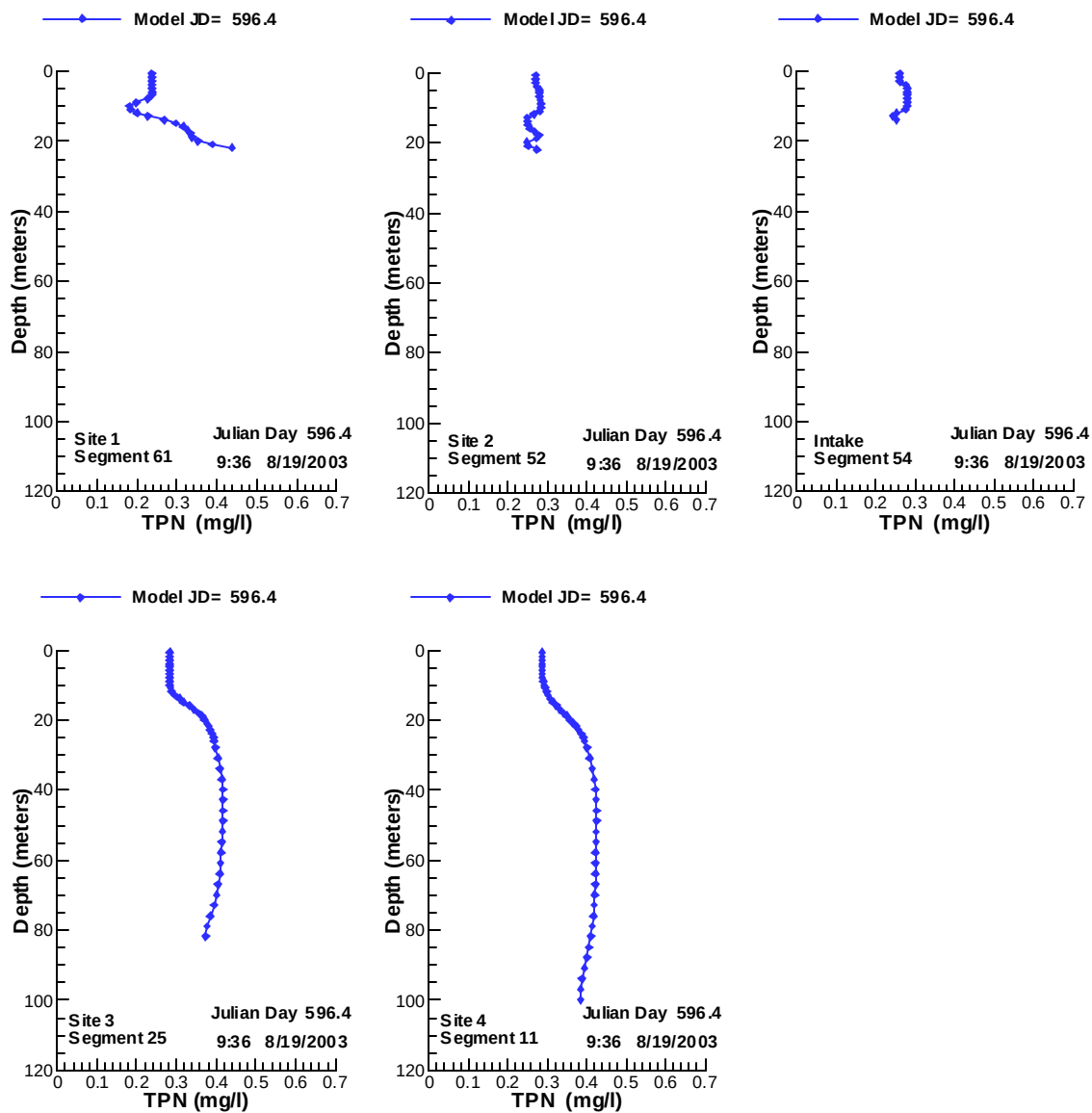


Figure 446. Vertical profiles of TOTAL NITROGEN compared with data for 8/19/2003.

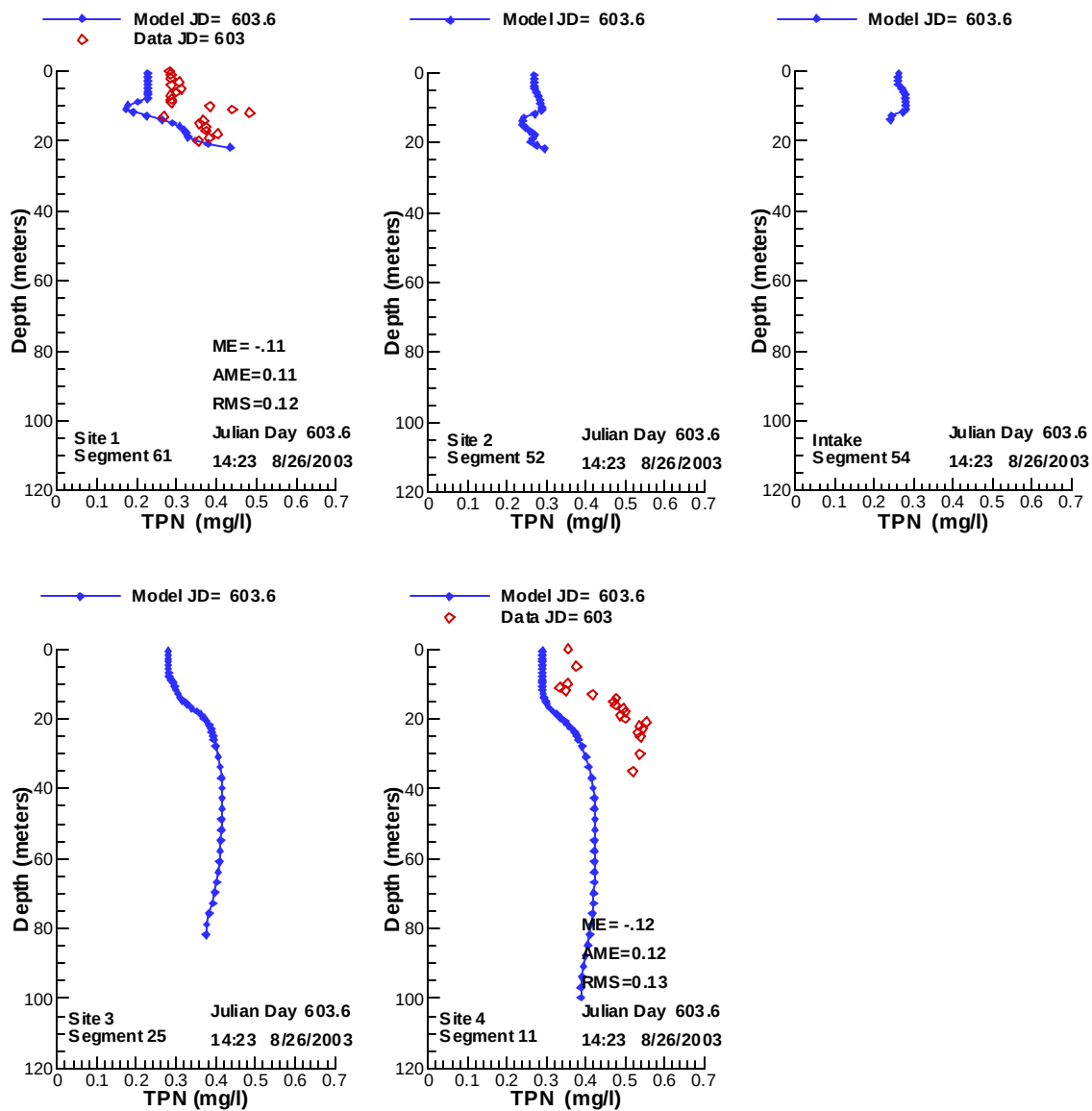


Figure 447. Vertical profiles of TOTAL NITROGEN compared with data for 8/26/2003.

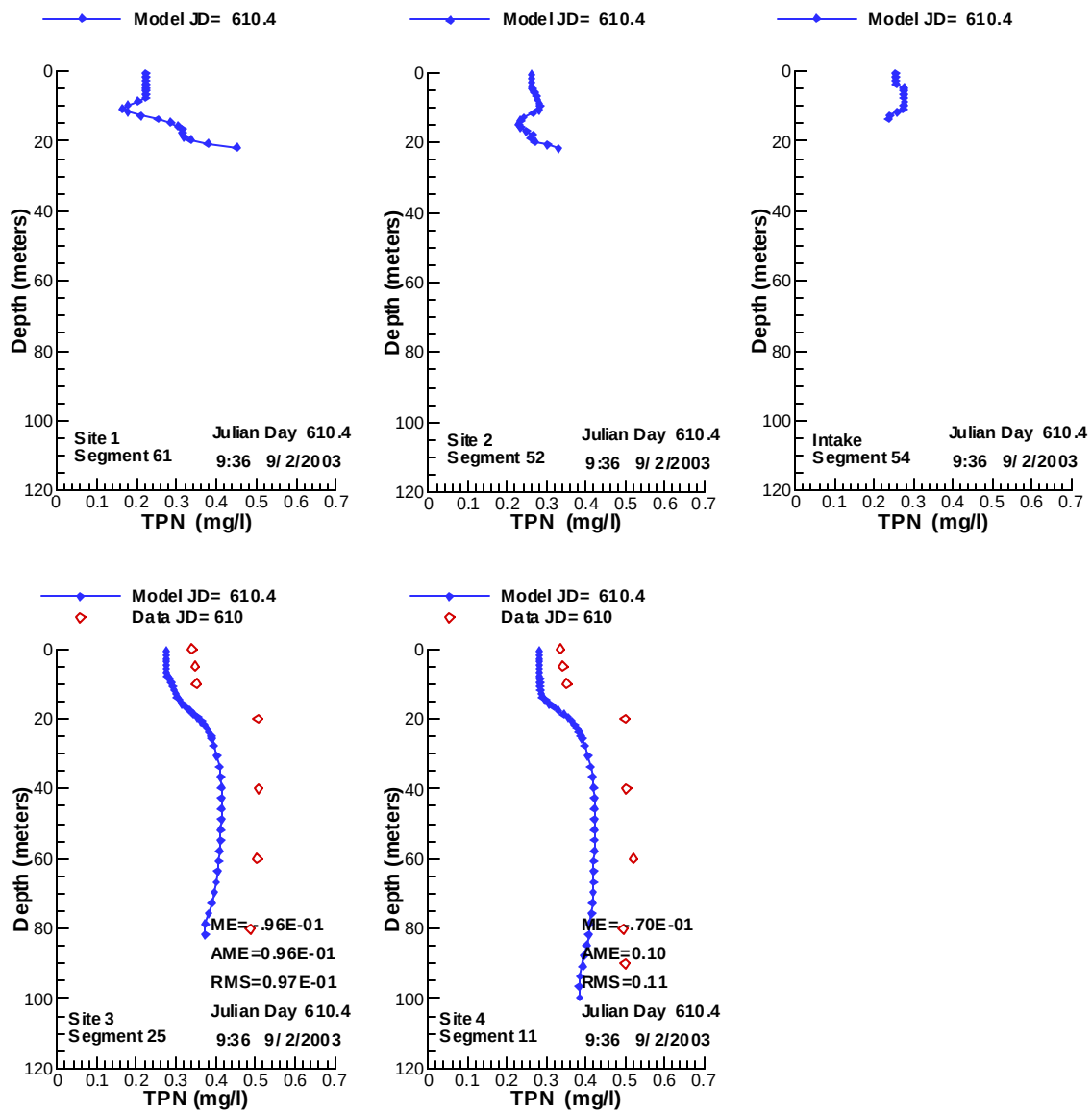


Figure 448. Vertical profiles of TOTAL NITROGEN compared with data for 9/ 2/2003.

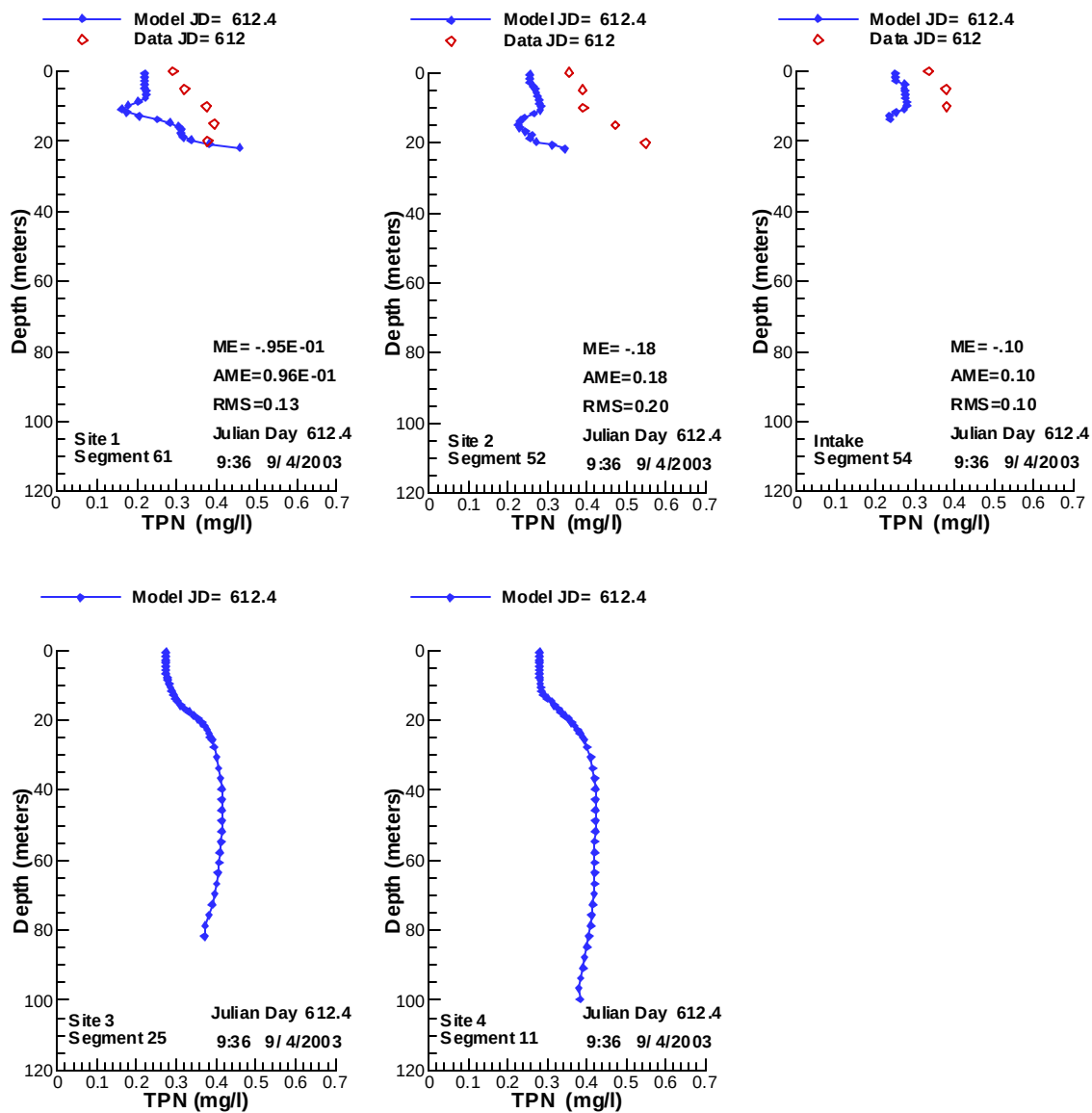


Figure 449. Vertical profiles of TOTAL NITROGEN compared with data for 9/ 4/2003.

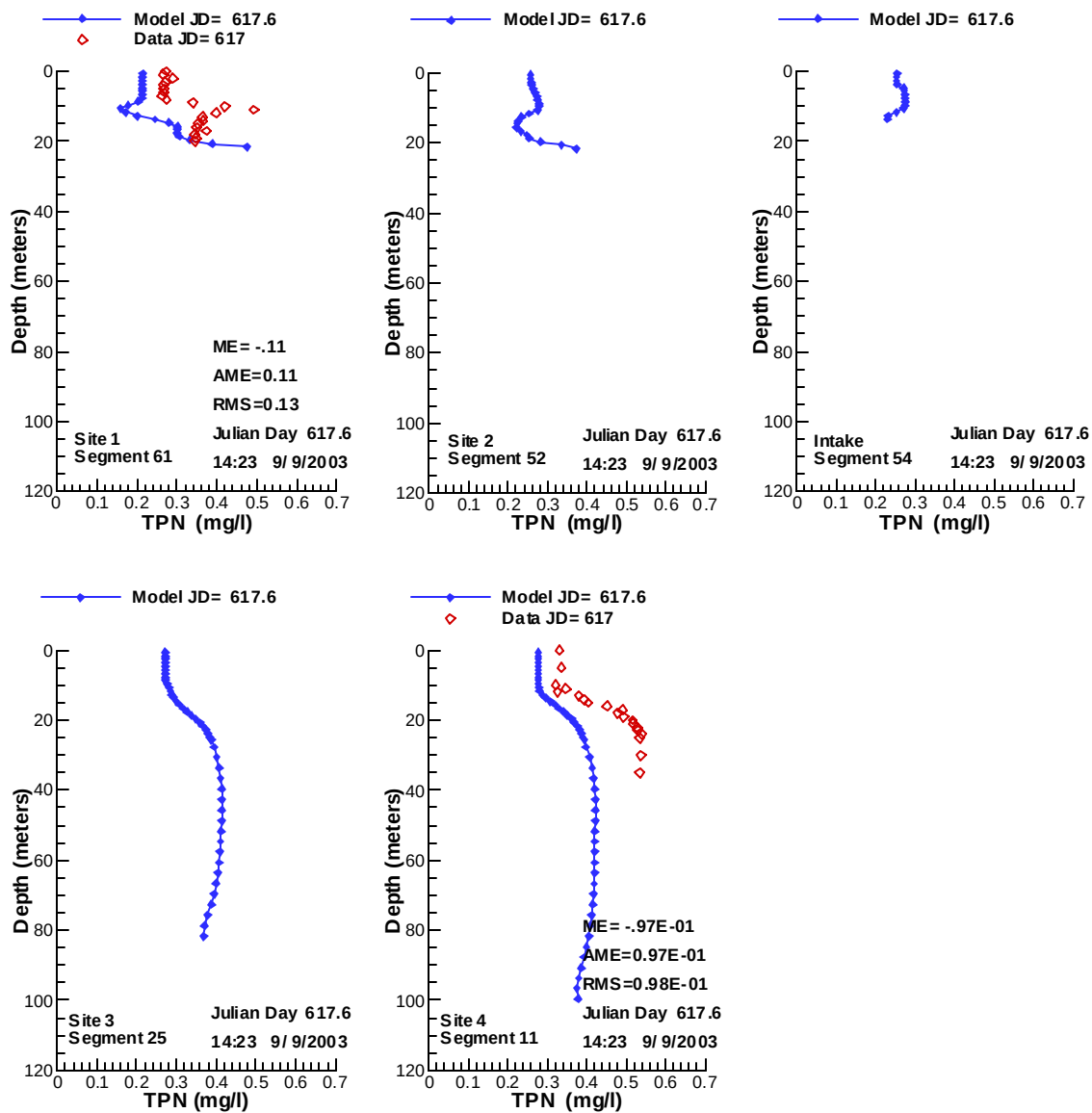


Figure 450. Vertical profiles of TOTAL NITROGEN compared with data for 9/ 9/2003.

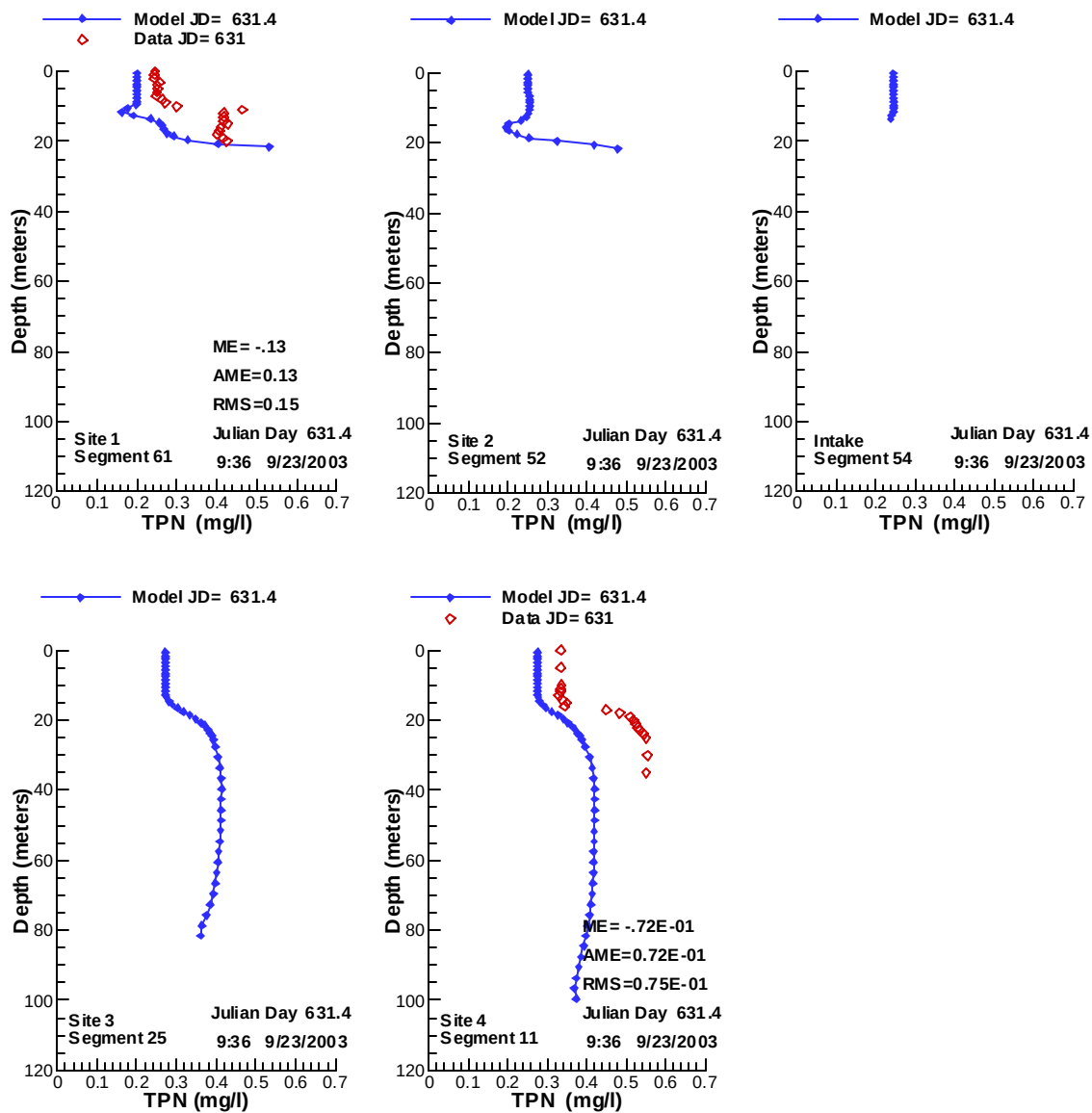


Figure 451. Vertical profiles of TOTAL NITROGEN compared with data for 9/23/2003.

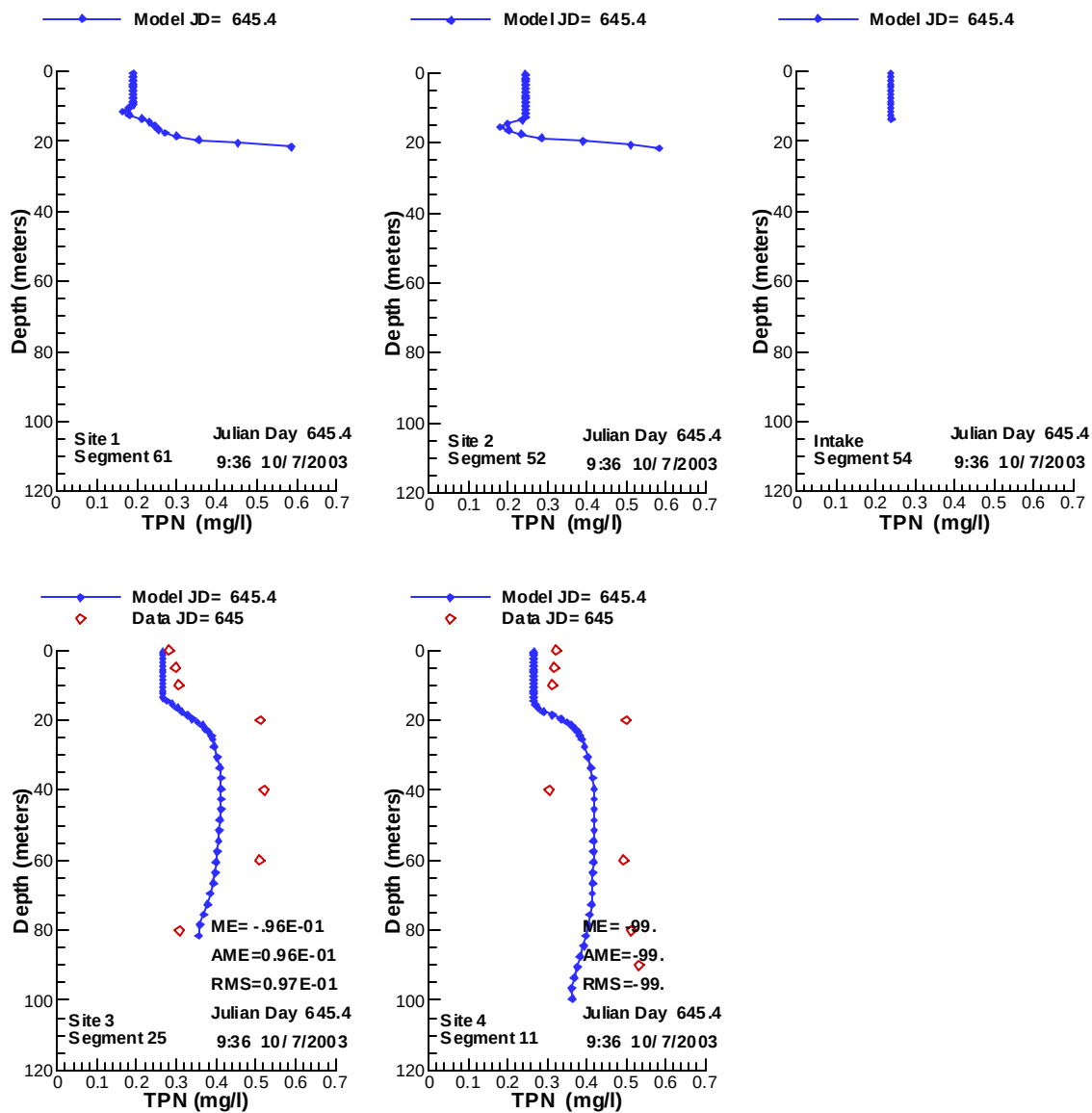


Figure 452. Vertical profiles of TOTAL NITROGEN compared with data for 10/ 7/2003.

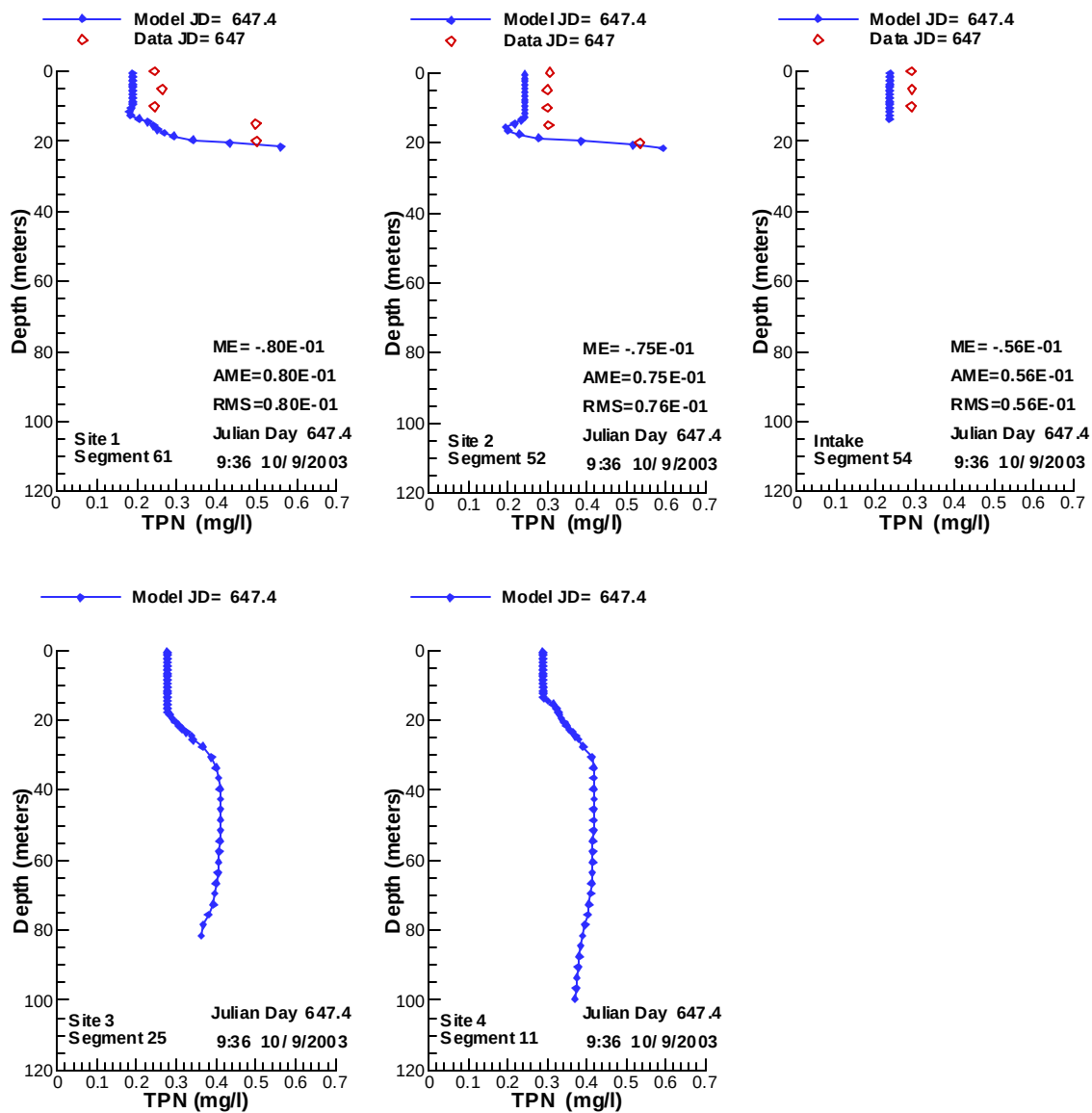


Figure 453. Vertical profiles of TOTAL NITROGEN compared with data for 10/ 9/2003.

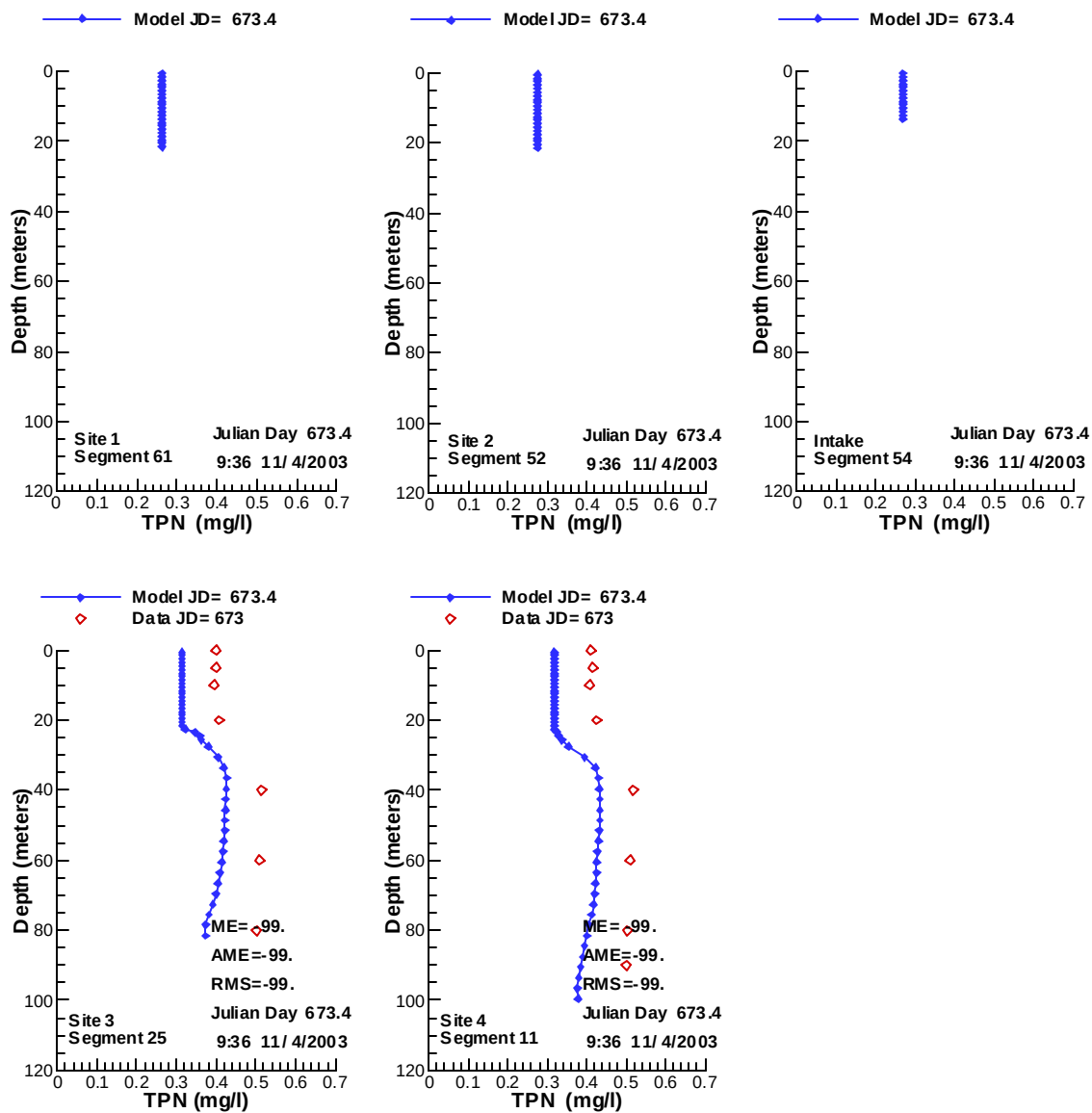


Figure 454. Vertical profiles of TOTAL NITROGEN compared with data for 11/ 4/2003.

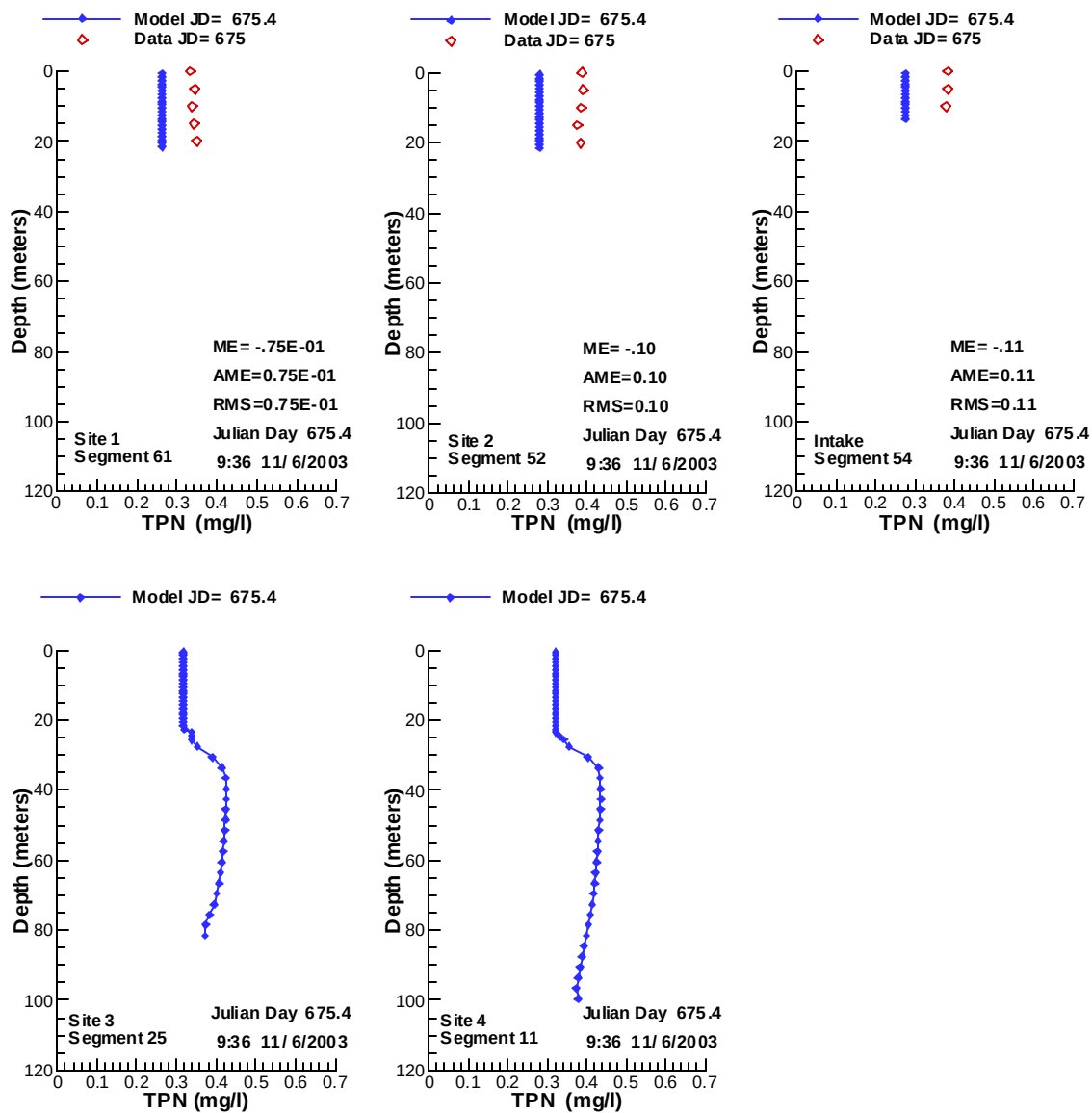


Figure 455. Vertical profiles of TOTAL NITROGEN compared with data for 11/ 6/2003.

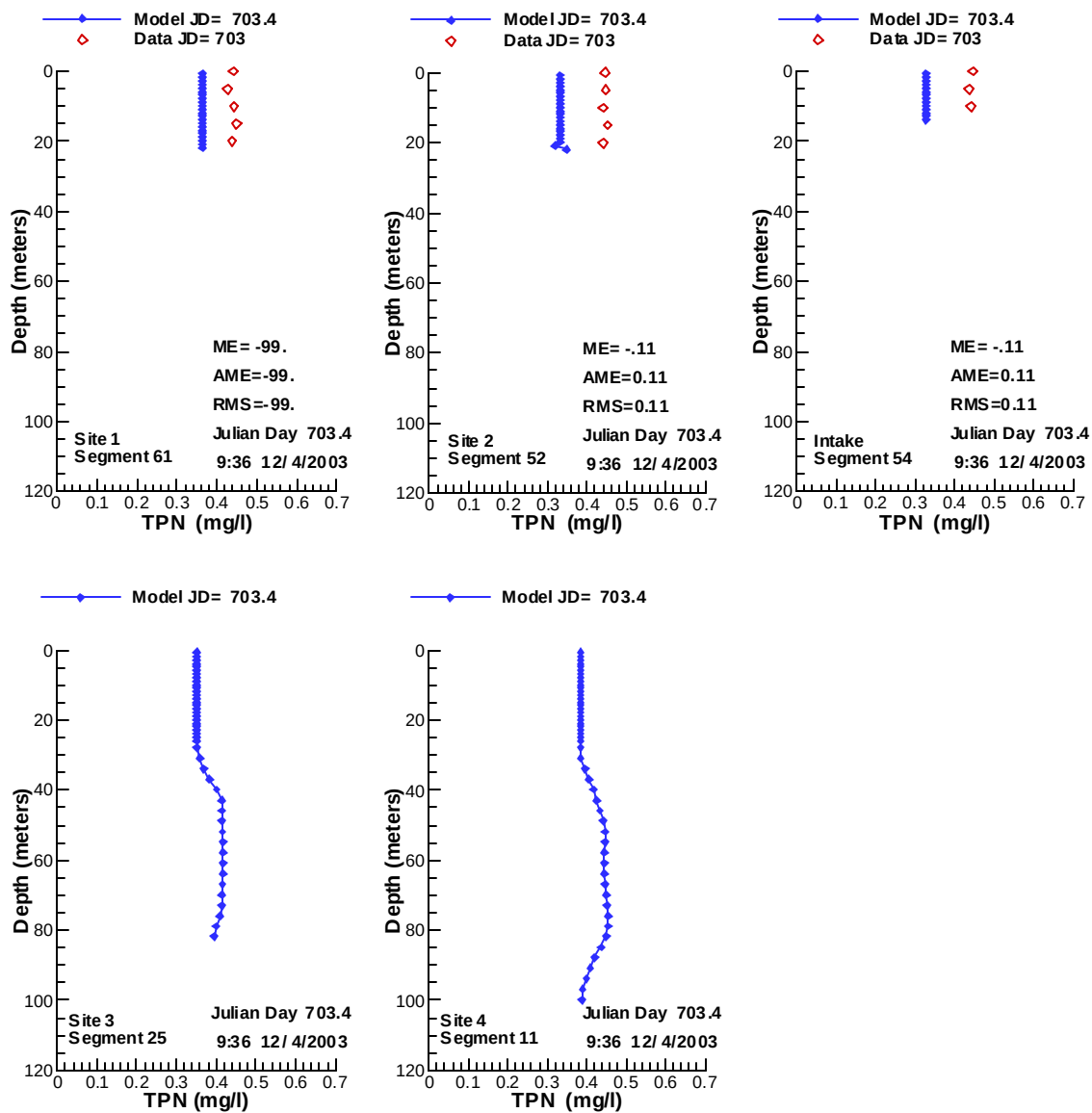


Figure 456. Vertical profiles of TOTAL NITROGEN compared with data for 12/ 4/2003.

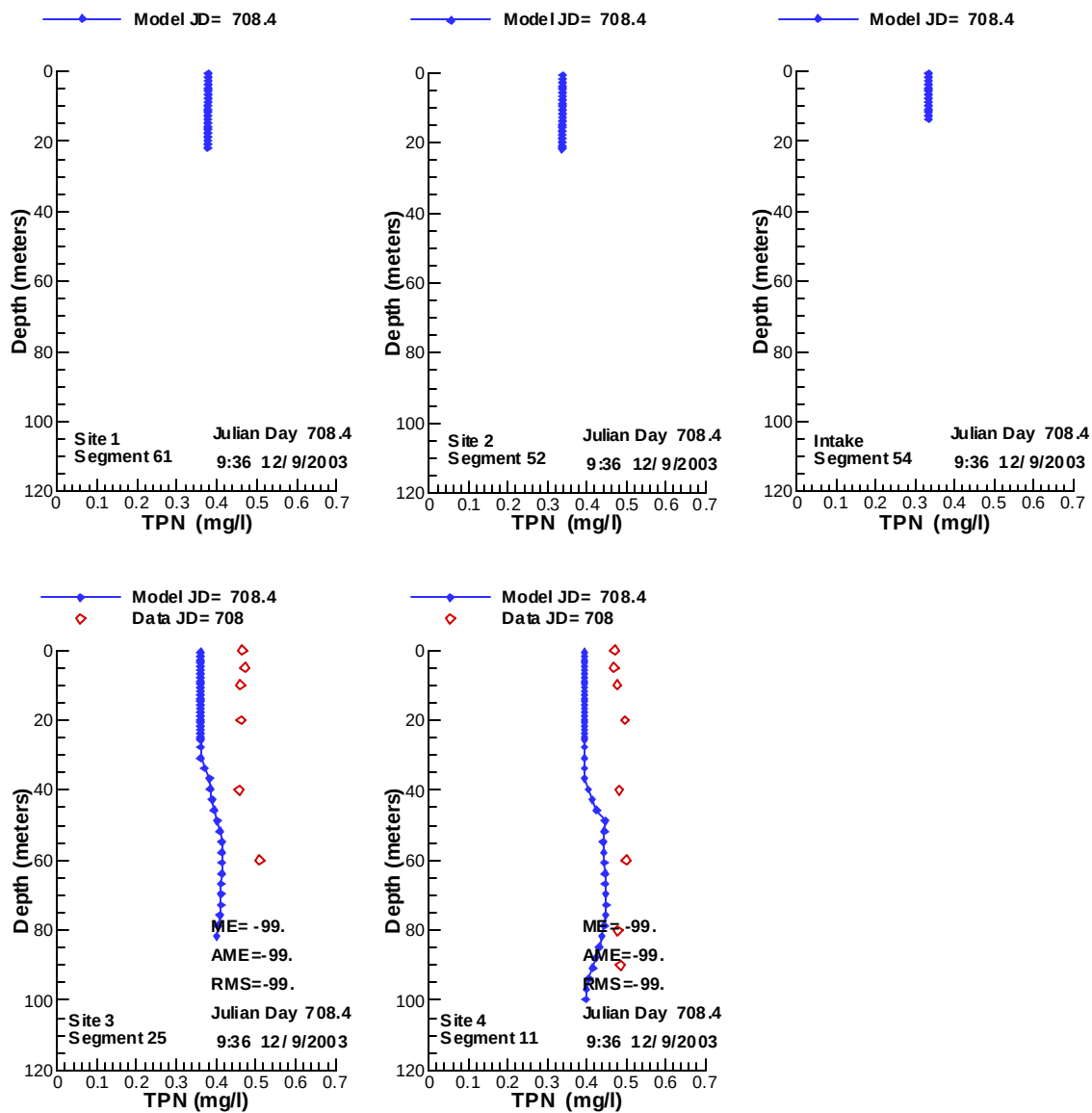


Figure 457. Vertical profiles of TOTAL NITROGEN compared with data for 12/ 9/2003.

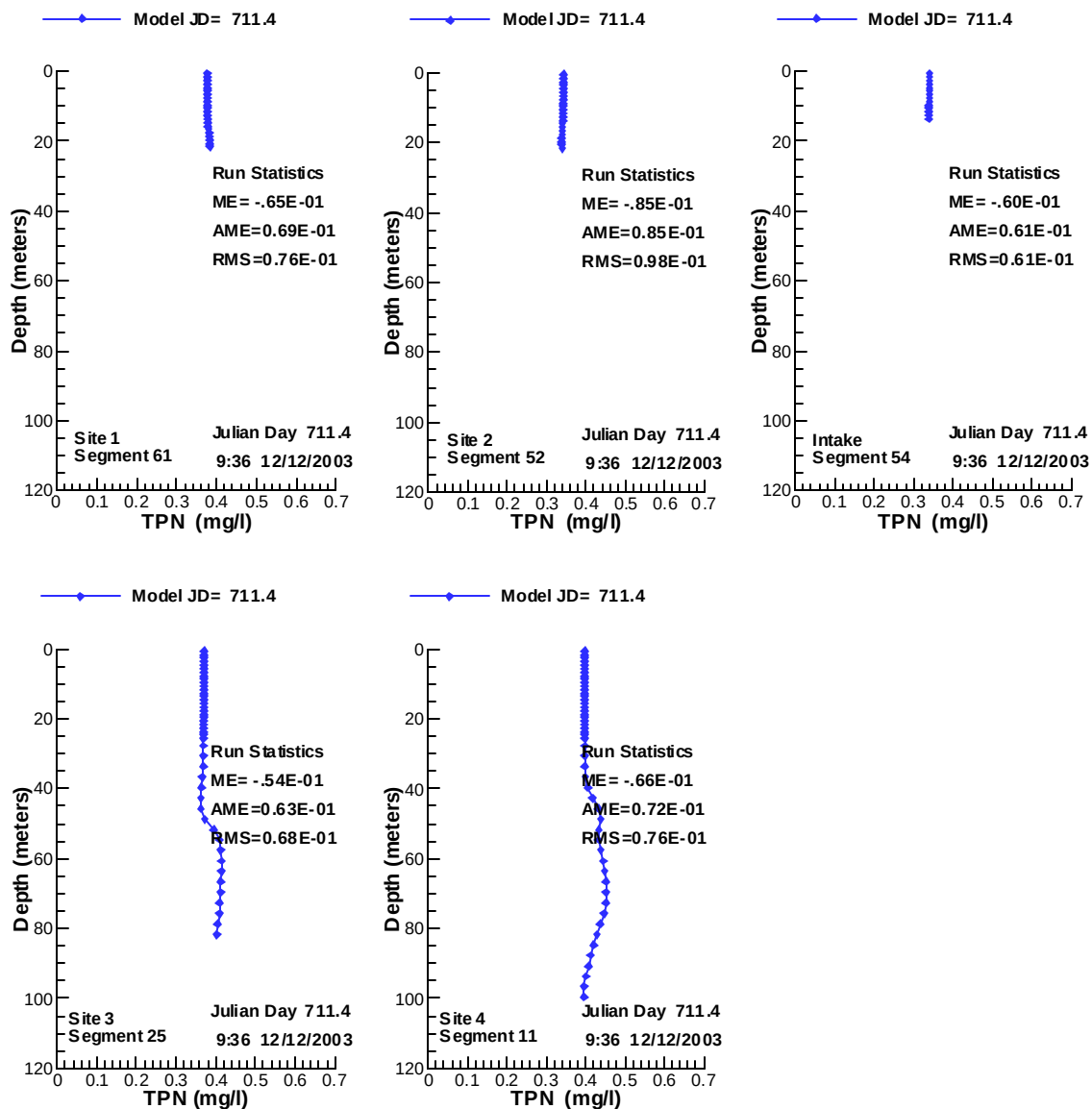


Figure 458. Vertical profiles of TOTAL NITROGEN compared with data for 12/12/2003.

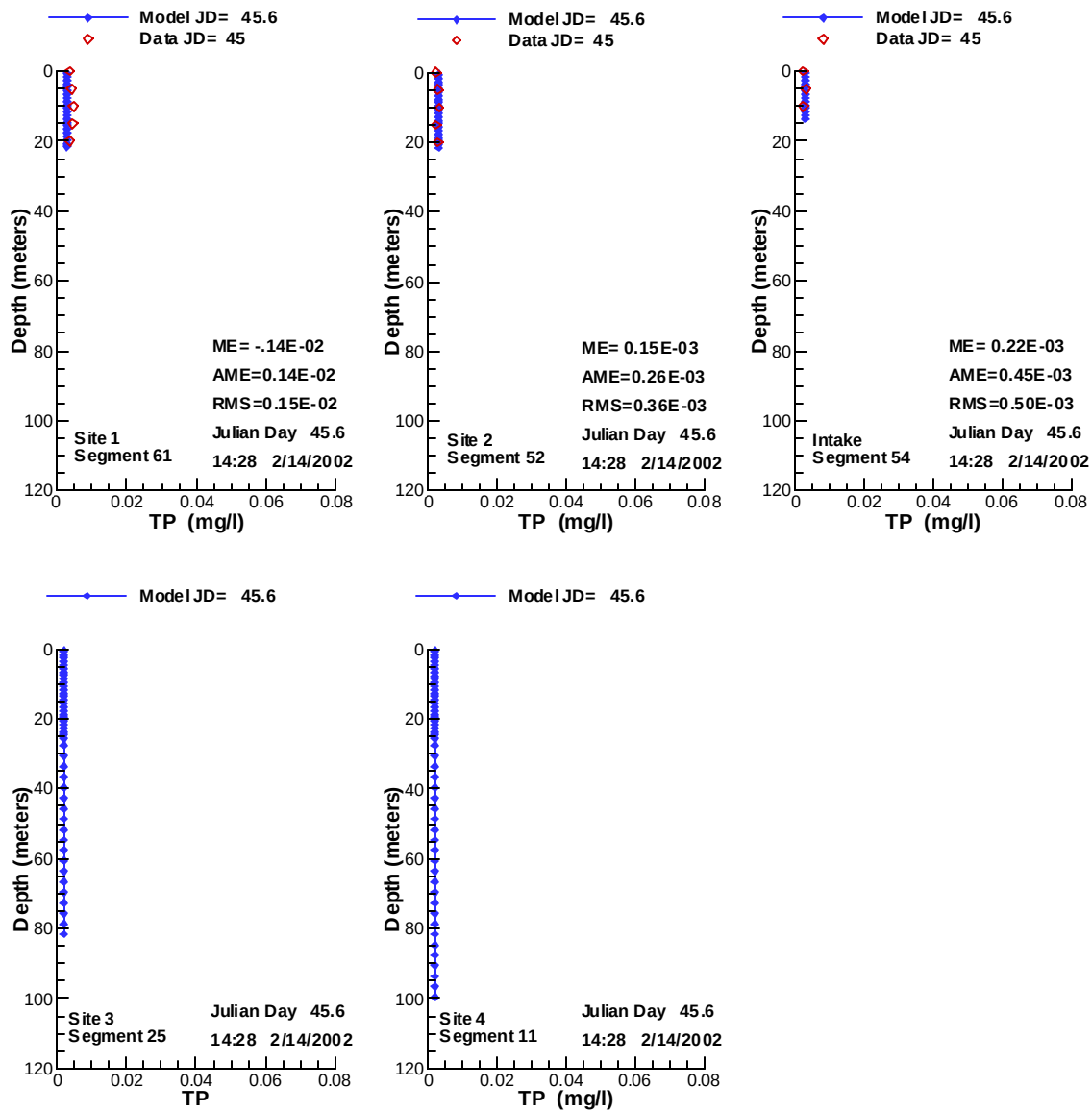


Figure 459. Vertical profiles of TOTAL PHOSPHORUS compared with data for 2/14/2002.

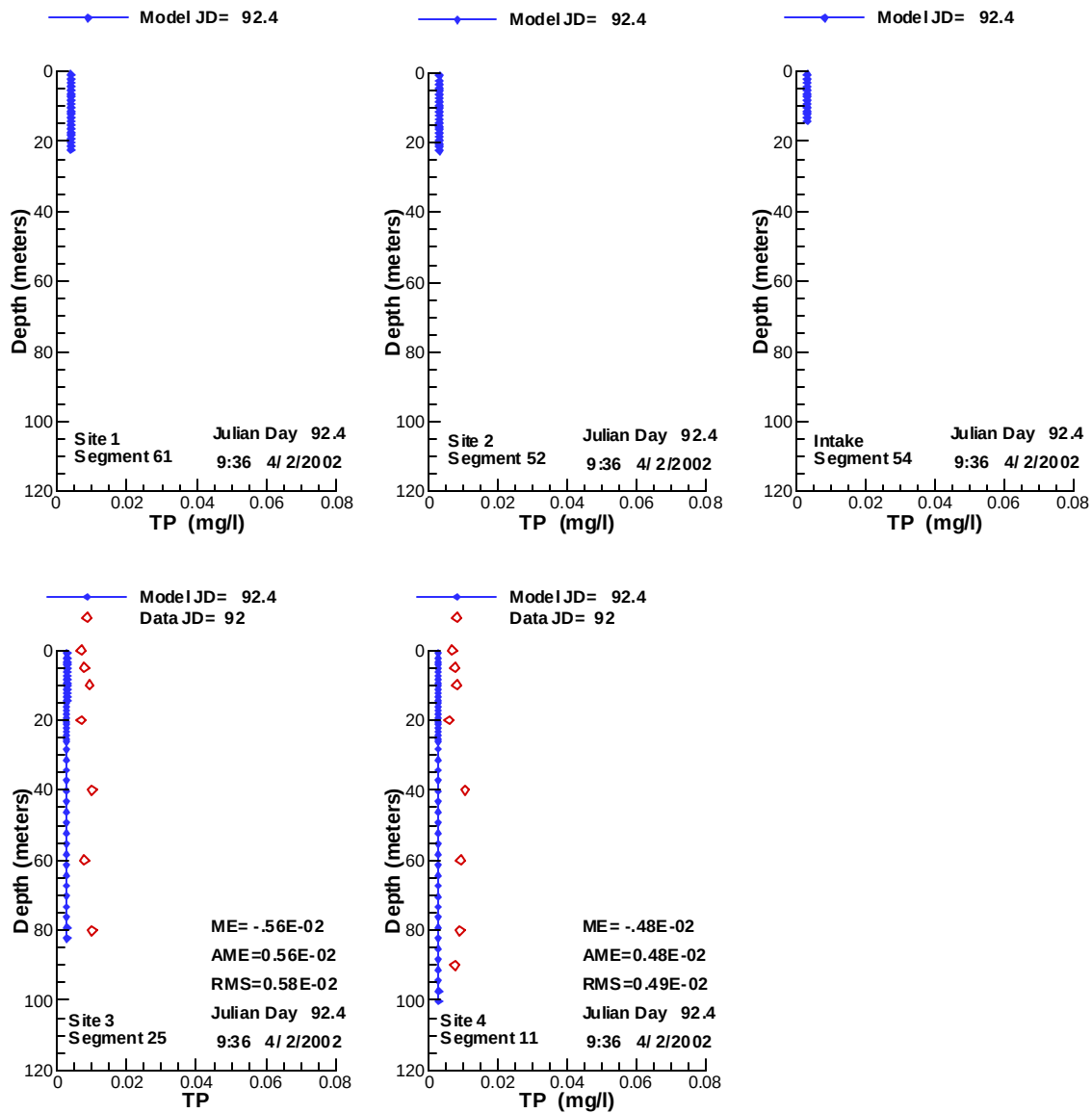


Figure 460. Vertical profiles of TOTAL PHOSPHORUS compared with data for 4/ 2/2002.

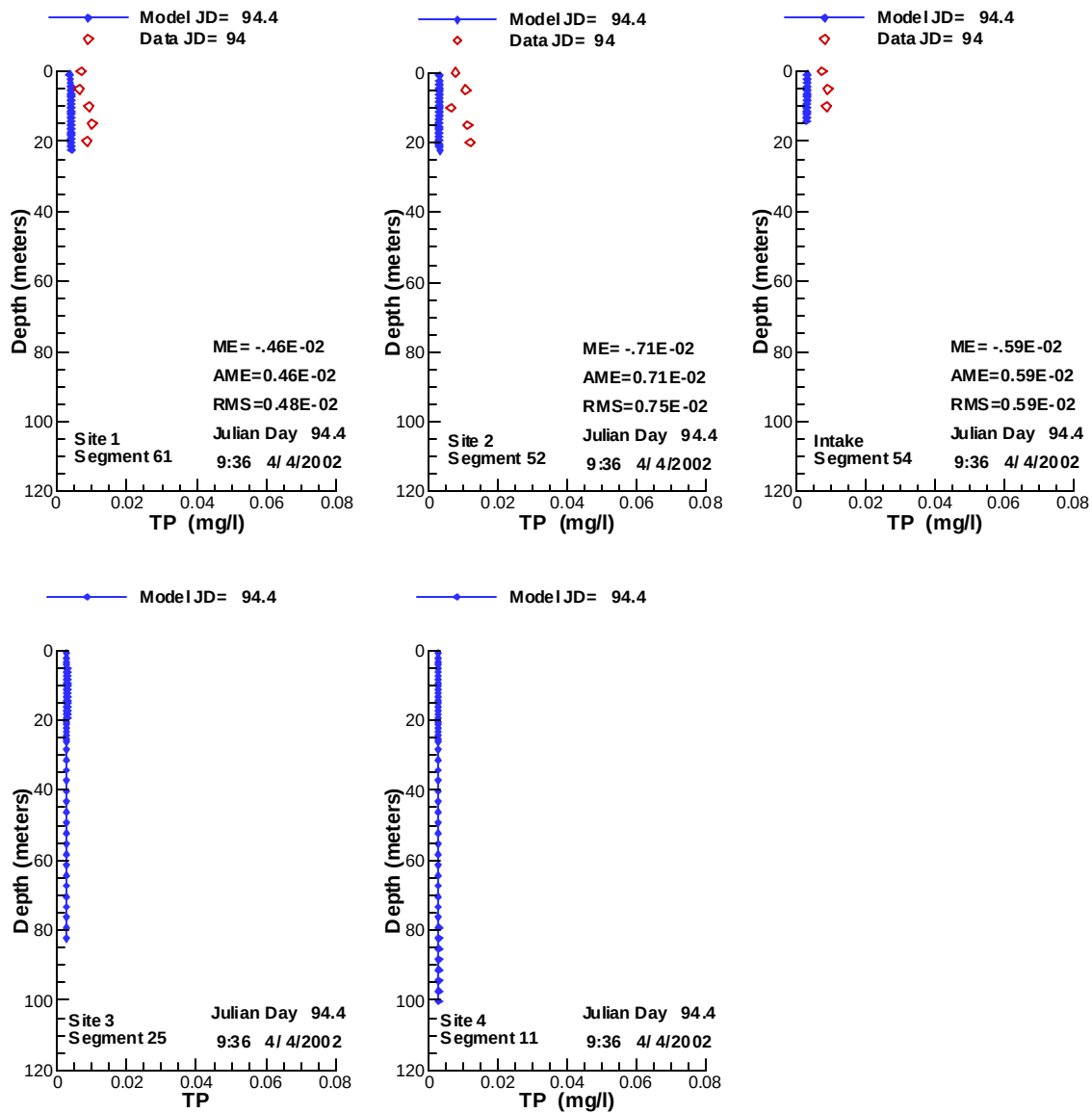


Figure 461. Vertical profiles of TOTAL PHOSPHORUS compared with data for 4/ 4/2002.

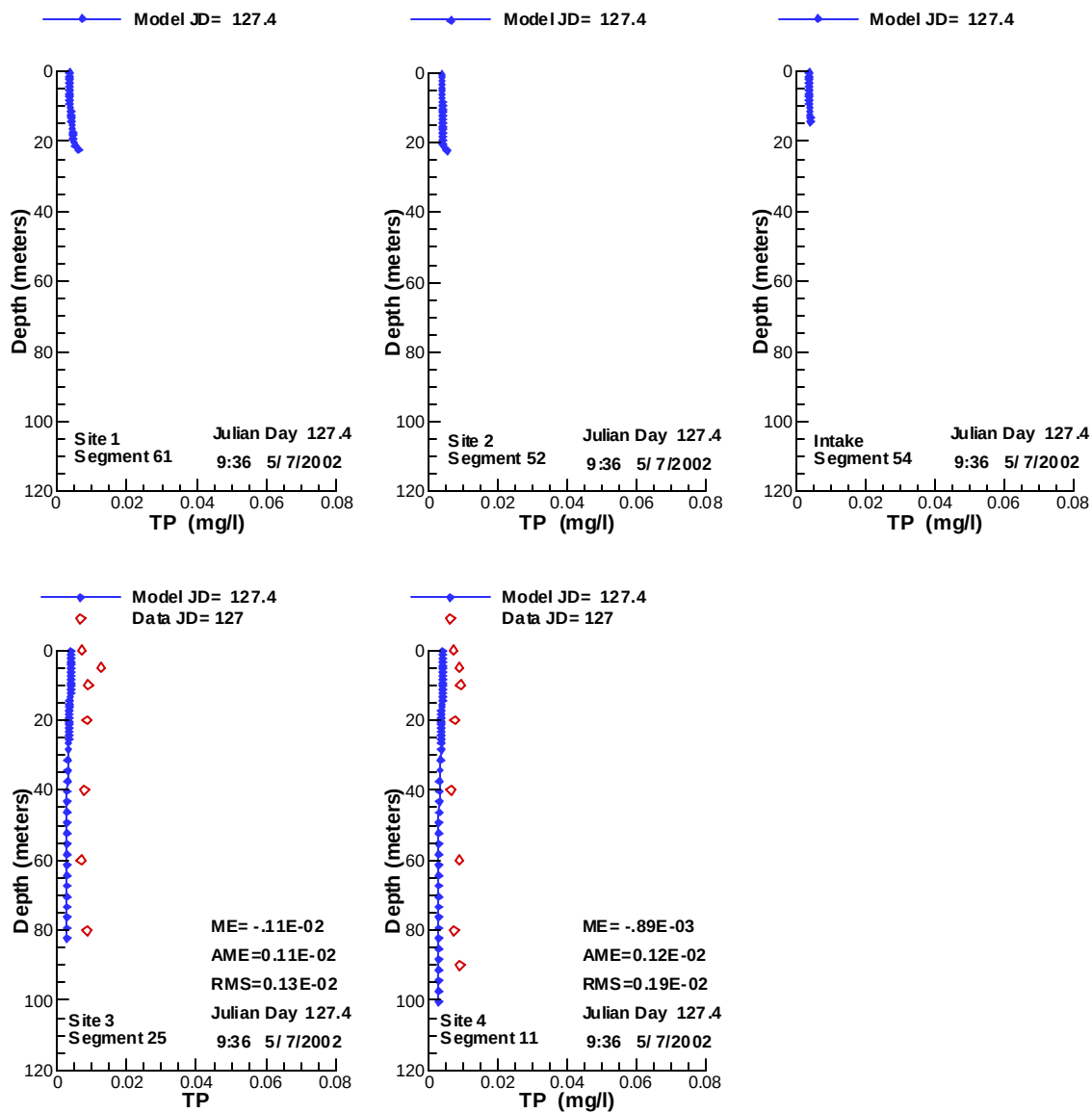


Figure 462. Vertical profiles of TOTAL PHOSPHORUS compared with data for 5/ 7/2002.

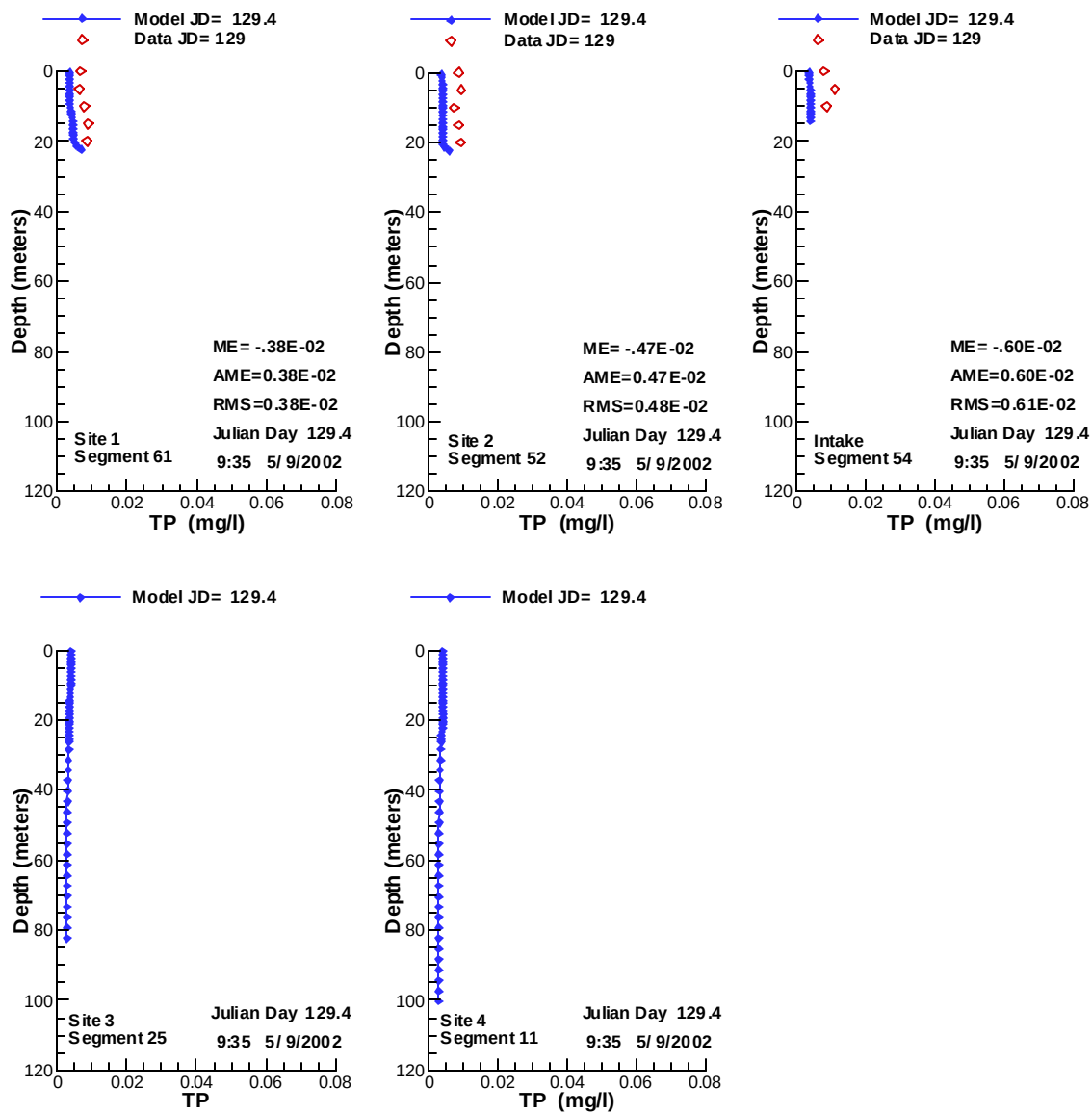


Figure 463. Vertical profiles of TOTAL PHOSPHORUS compared with data for 5/ 9/2002.

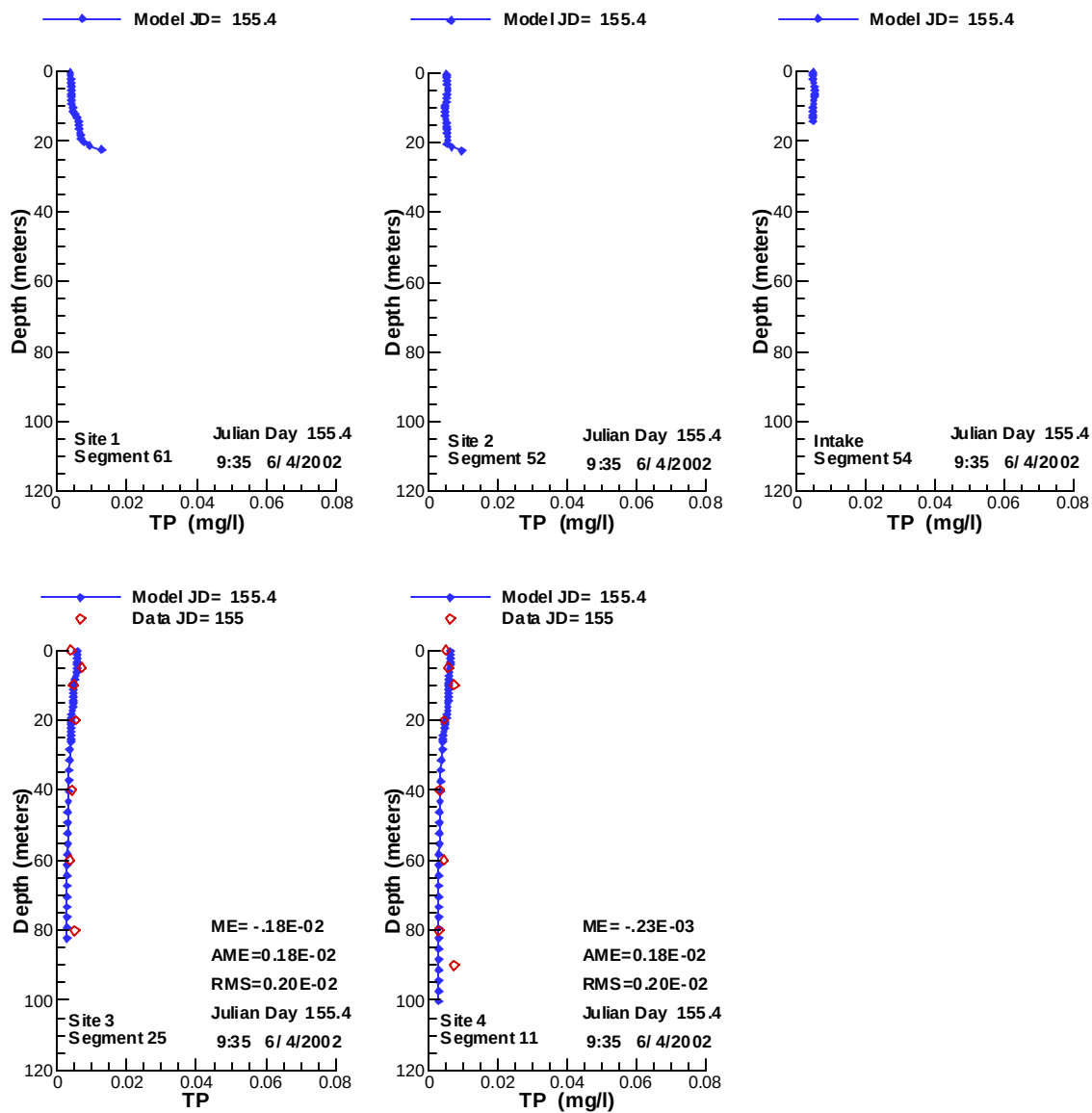


Figure 464. Vertical profiles of TOTAL PHOSPHORUS compared with data for 6/ 4/2002.

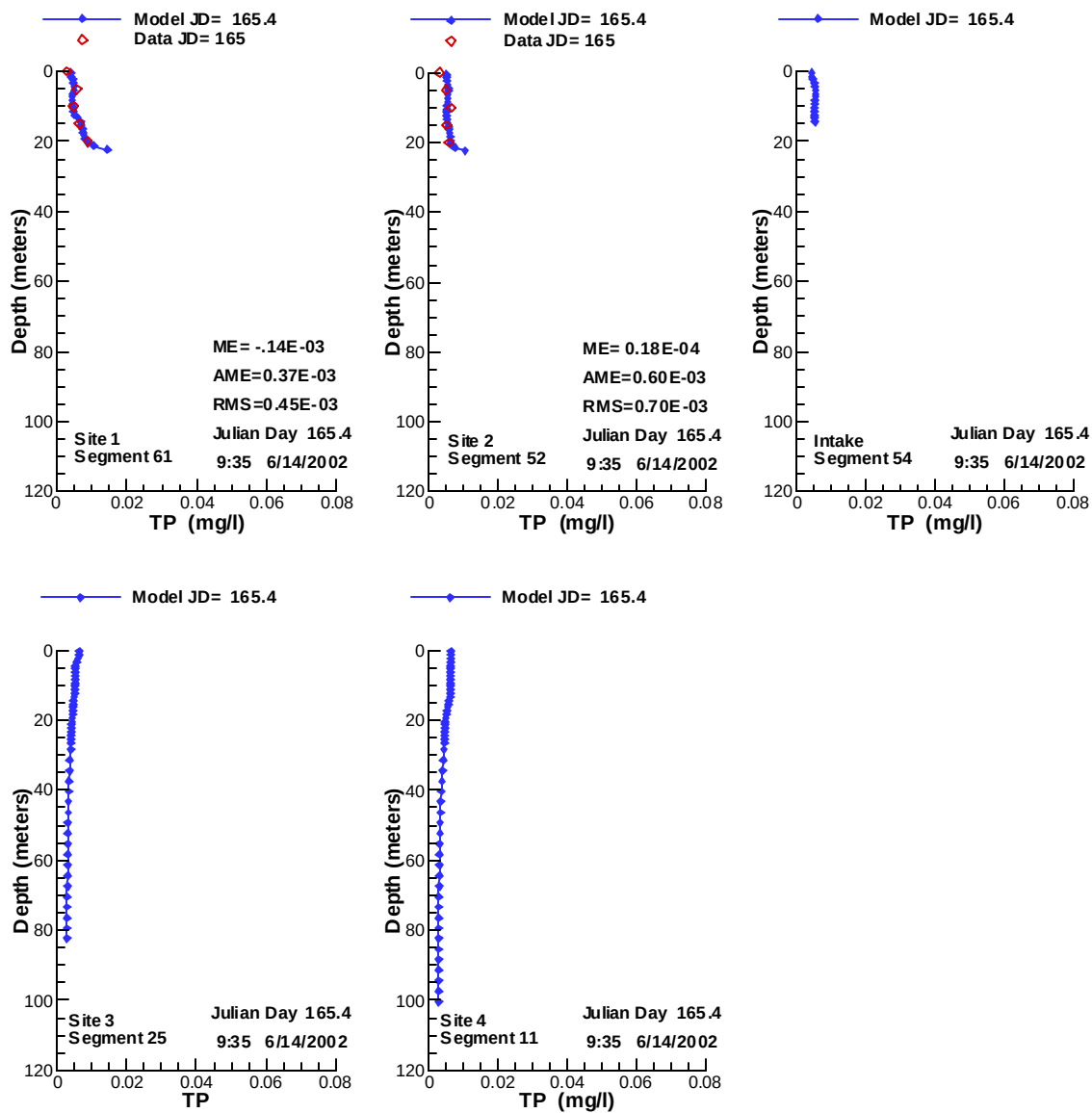


Figure 465. Vertical profiles of TOTAL PHOSPHORUS compared with data for 6/14/2002.

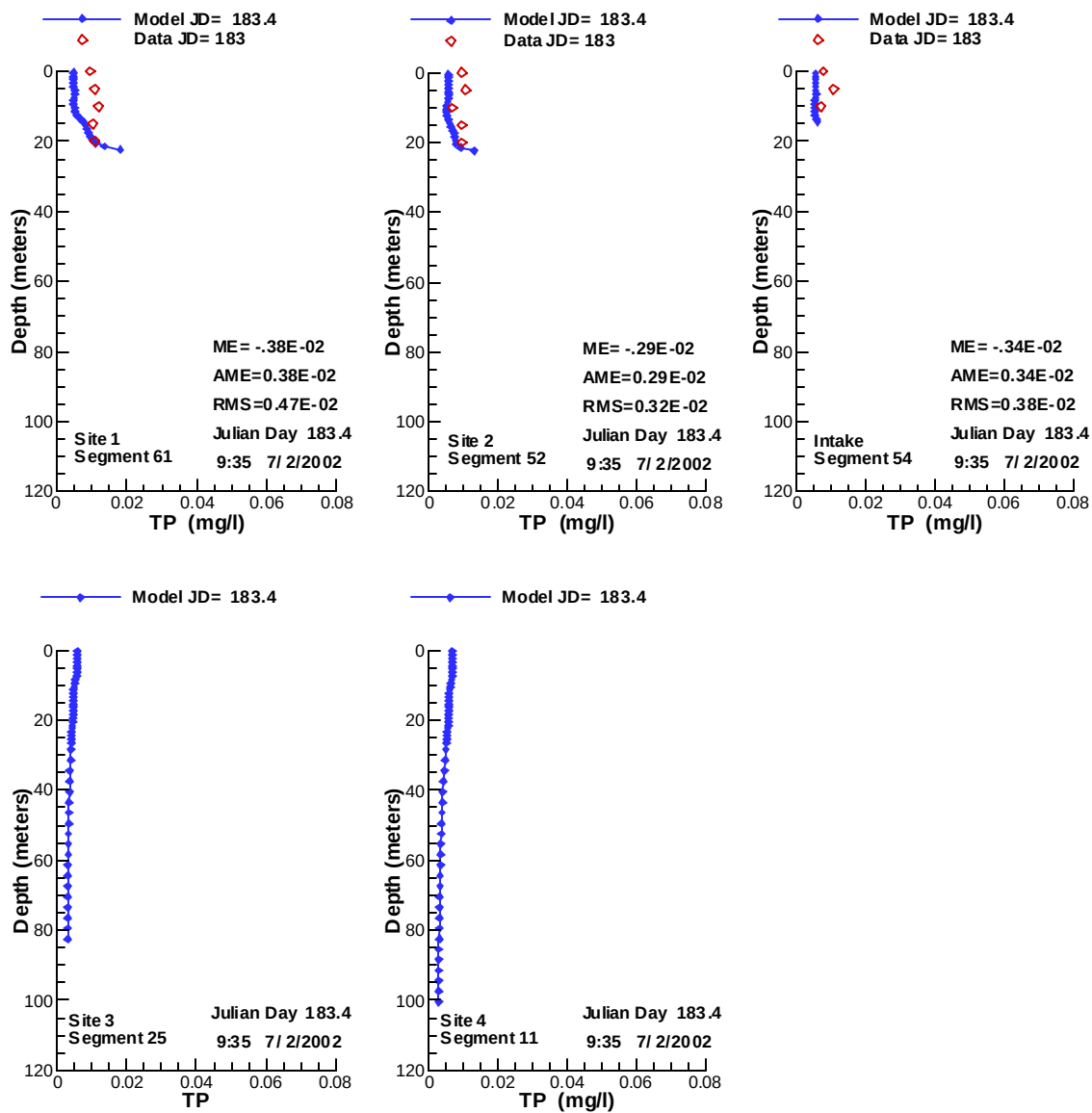


Figure 466. Vertical profiles of TOTAL PHOSPHORUS compared with data for 7/ 2/2002.

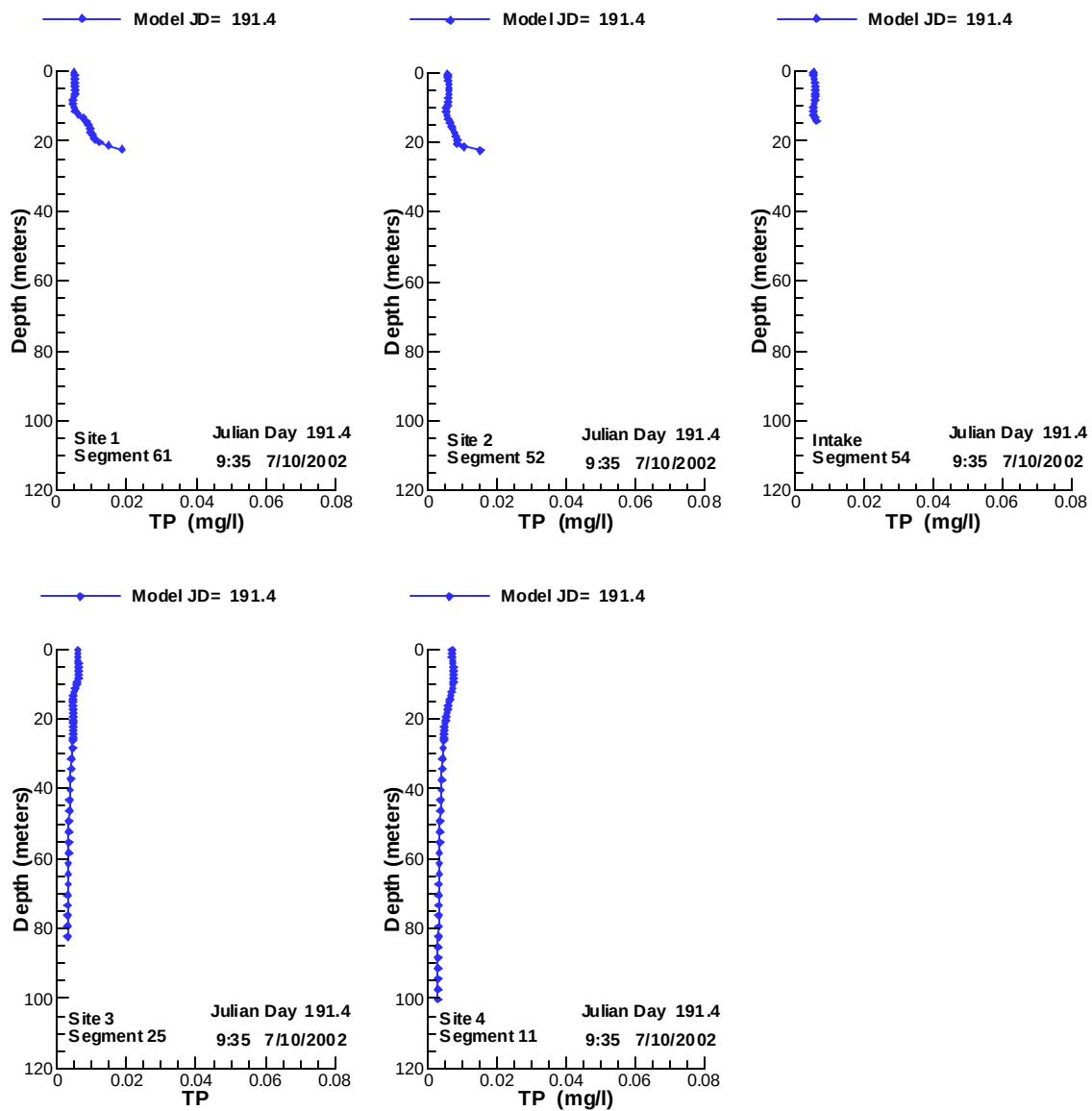


Figure 467. Vertical profiles of TOTAL PHOSPHORUS compared with data for 7/10/2002.

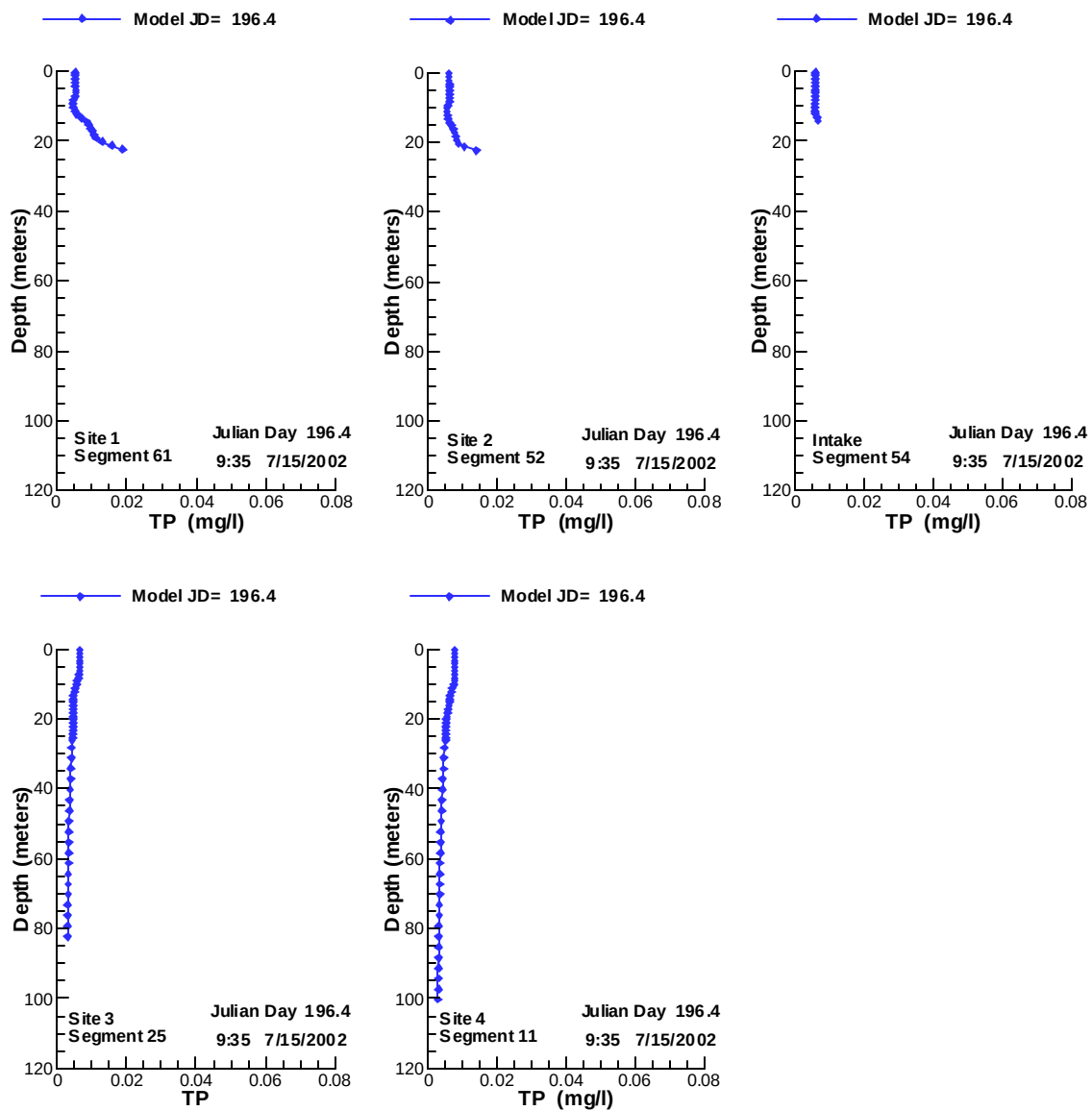


Figure 468. Vertical profiles of TOTAL PHOSPHORUS compared with data for 7/15/2002.

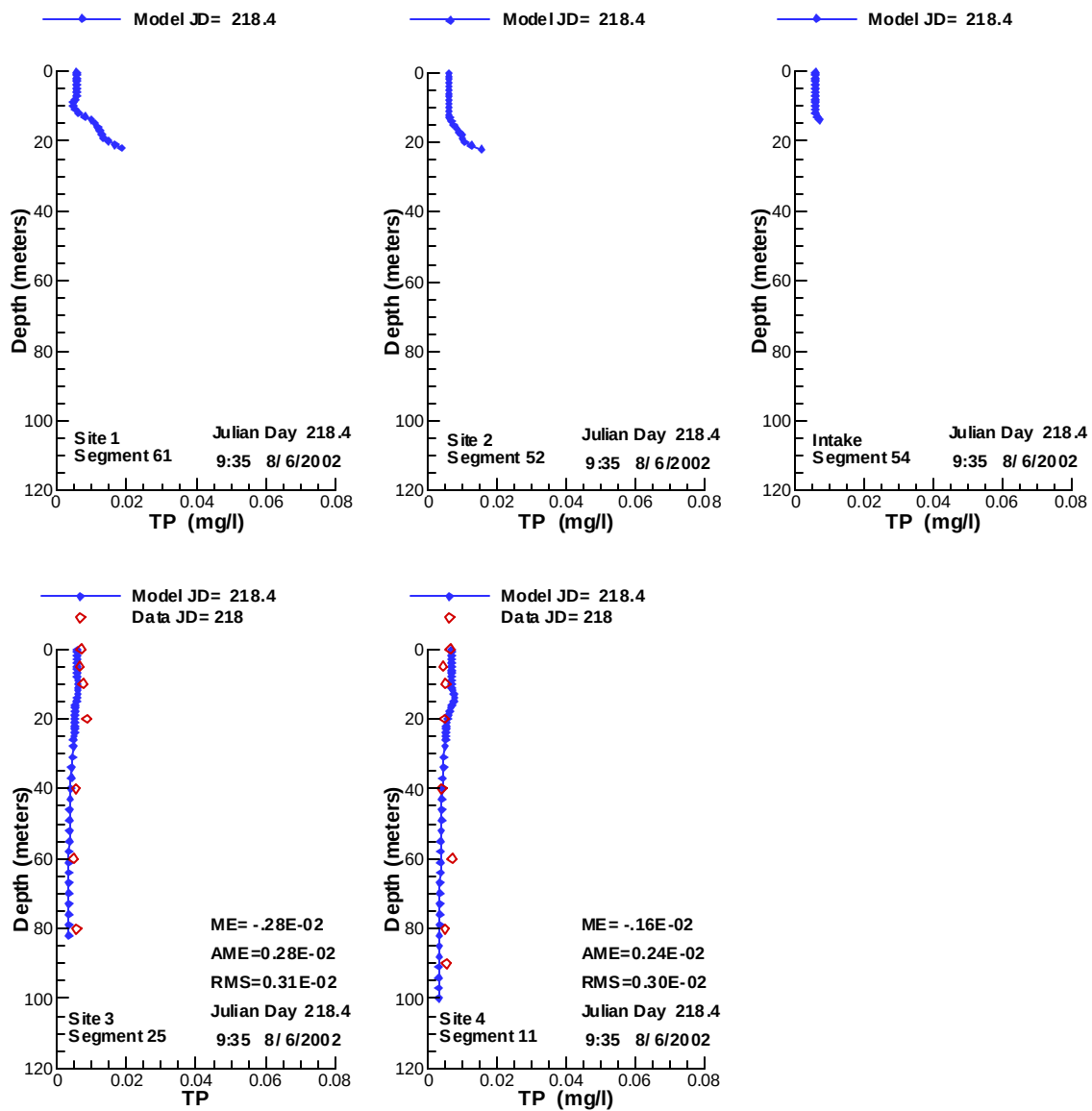


Figure 469. Vertical profiles of TOTAL PHOSPHORUS compared with data for 8/ 6/2002.

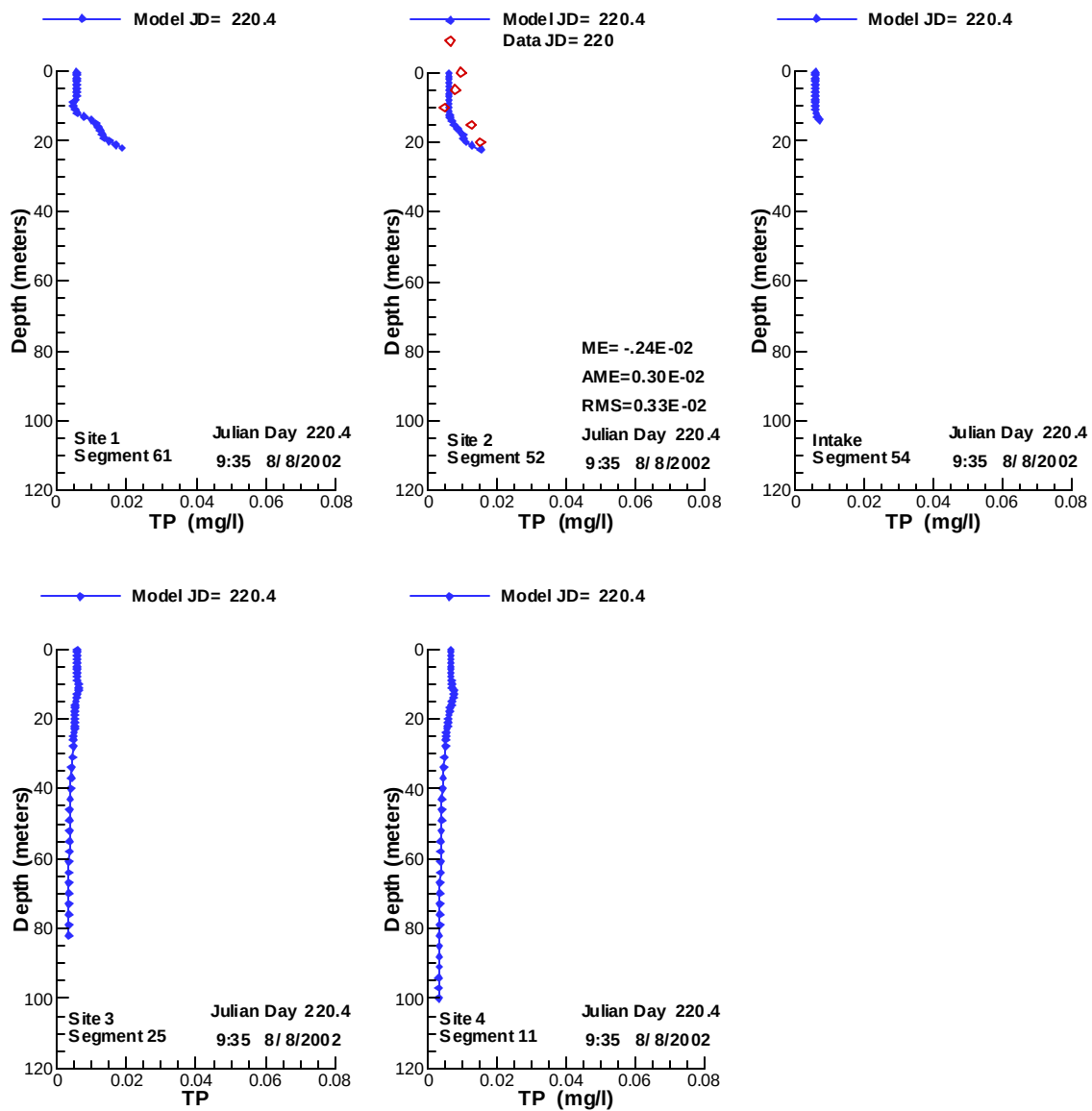


Figure 470. Vertical profiles of TOTAL PHOSPHORUS compared with data for 8/ 8/2002.

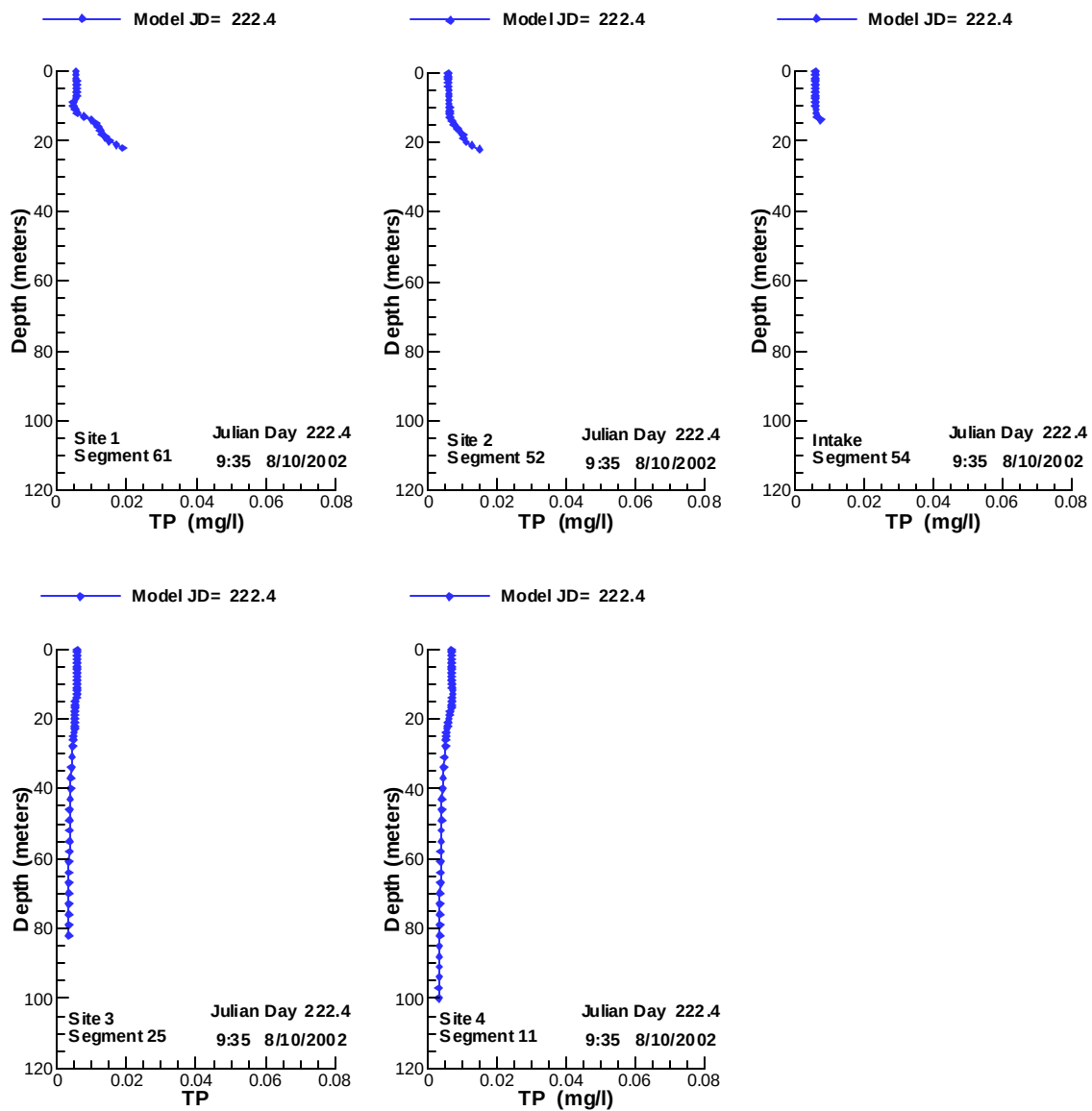


Figure 471. Vertical profiles of TOTAL PHOSPHORUS compared with data for 8/10/2002.

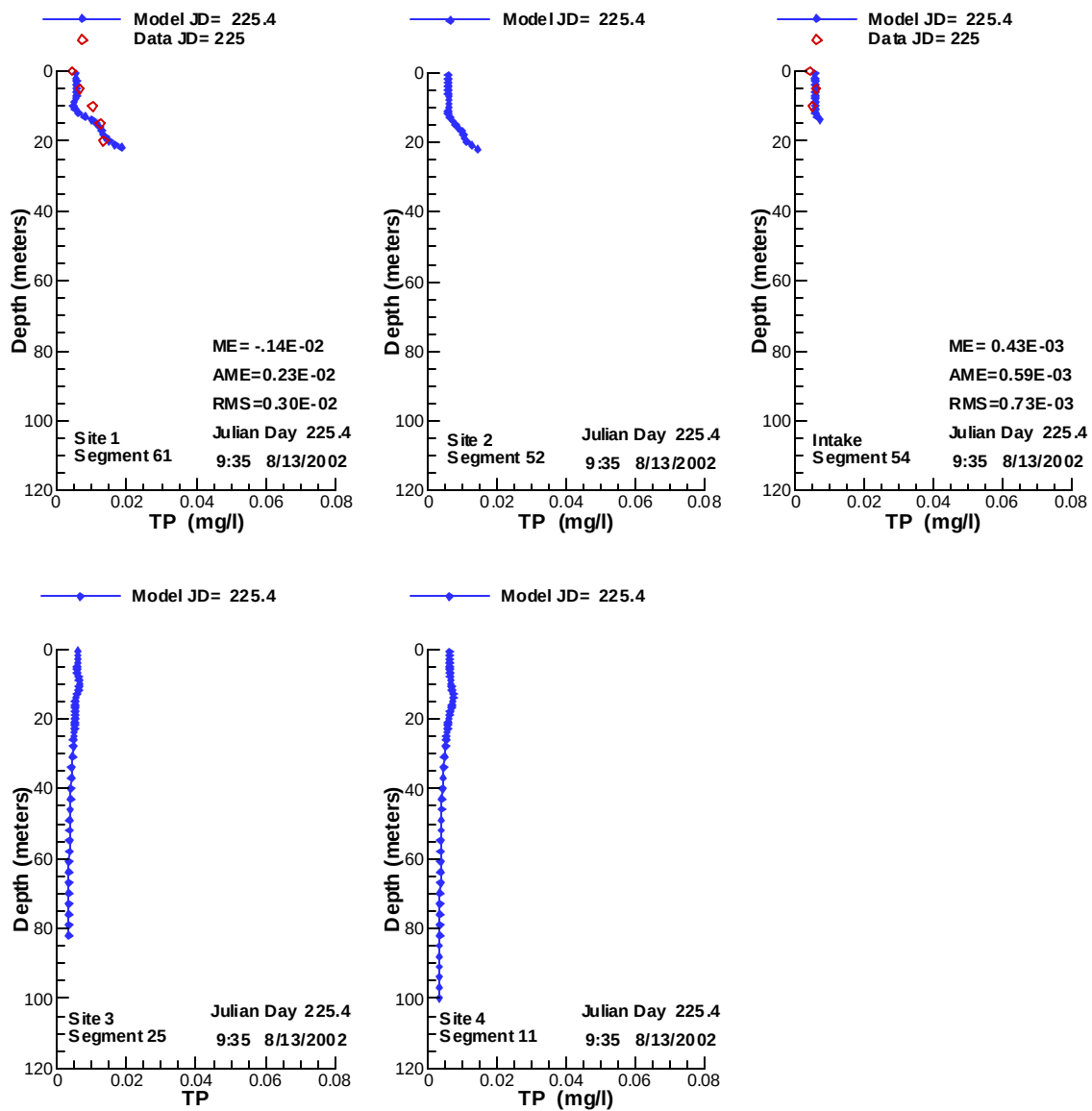


Figure 472. Vertical profiles of TOTAL PHOSPHORUS compared with data for 8/13/2002.

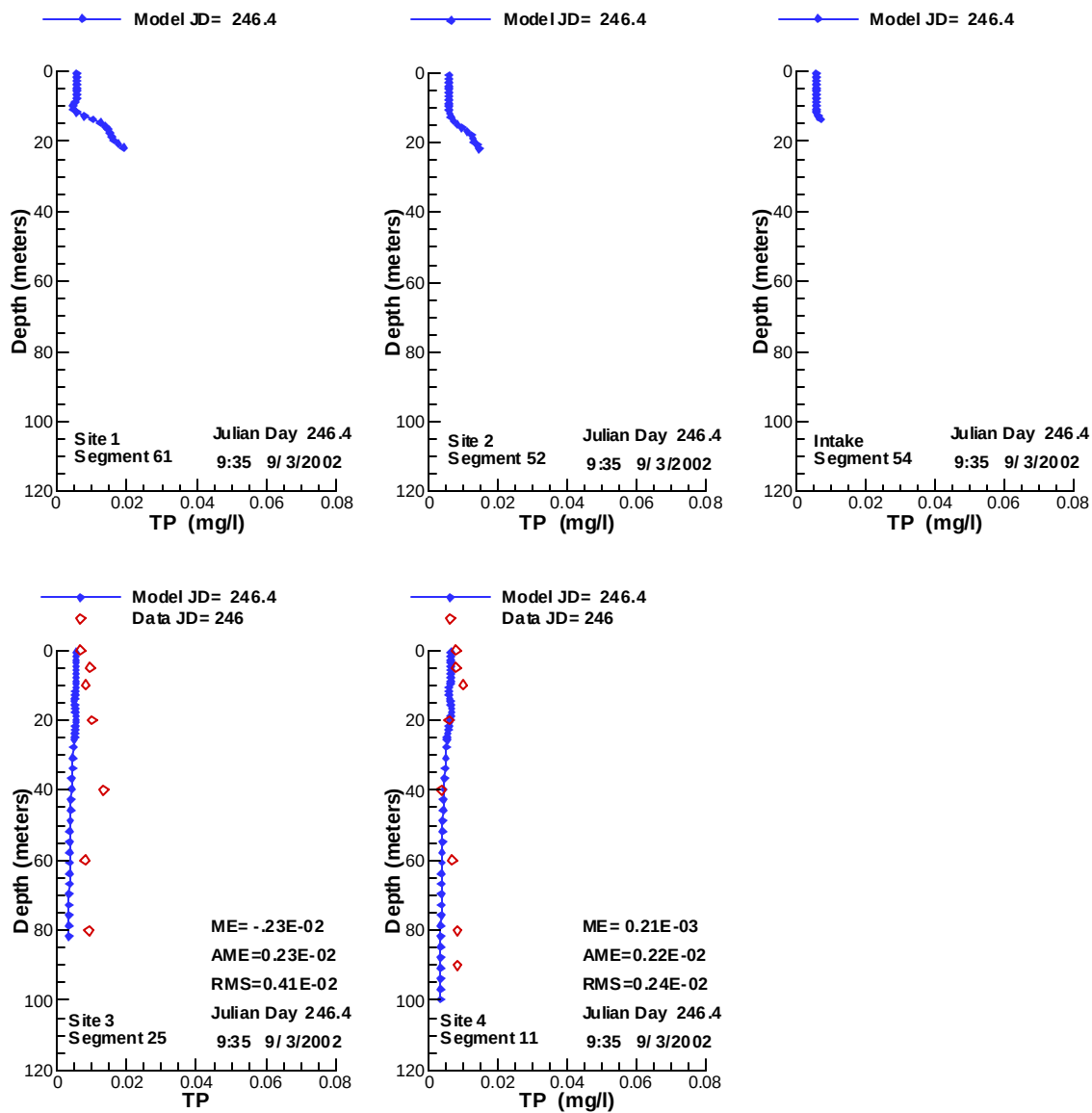


Figure 473. Vertical profiles of TOTAL PHOSPHORUS compared with data for 9/ 3/2002.

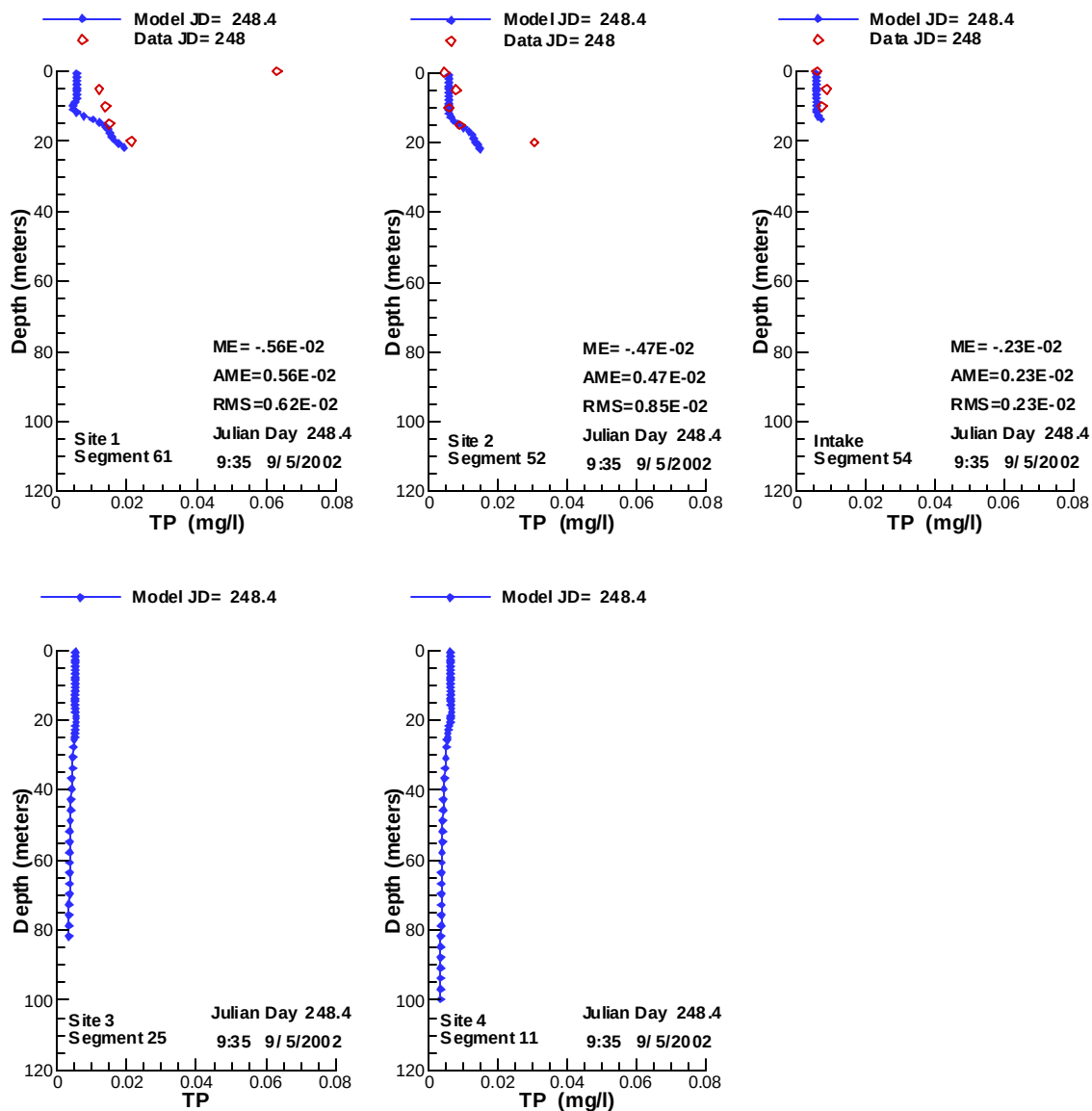


Figure 474. Vertical profiles of TOTAL PHOSPHORUS compared with data for 9/ 5/2002.

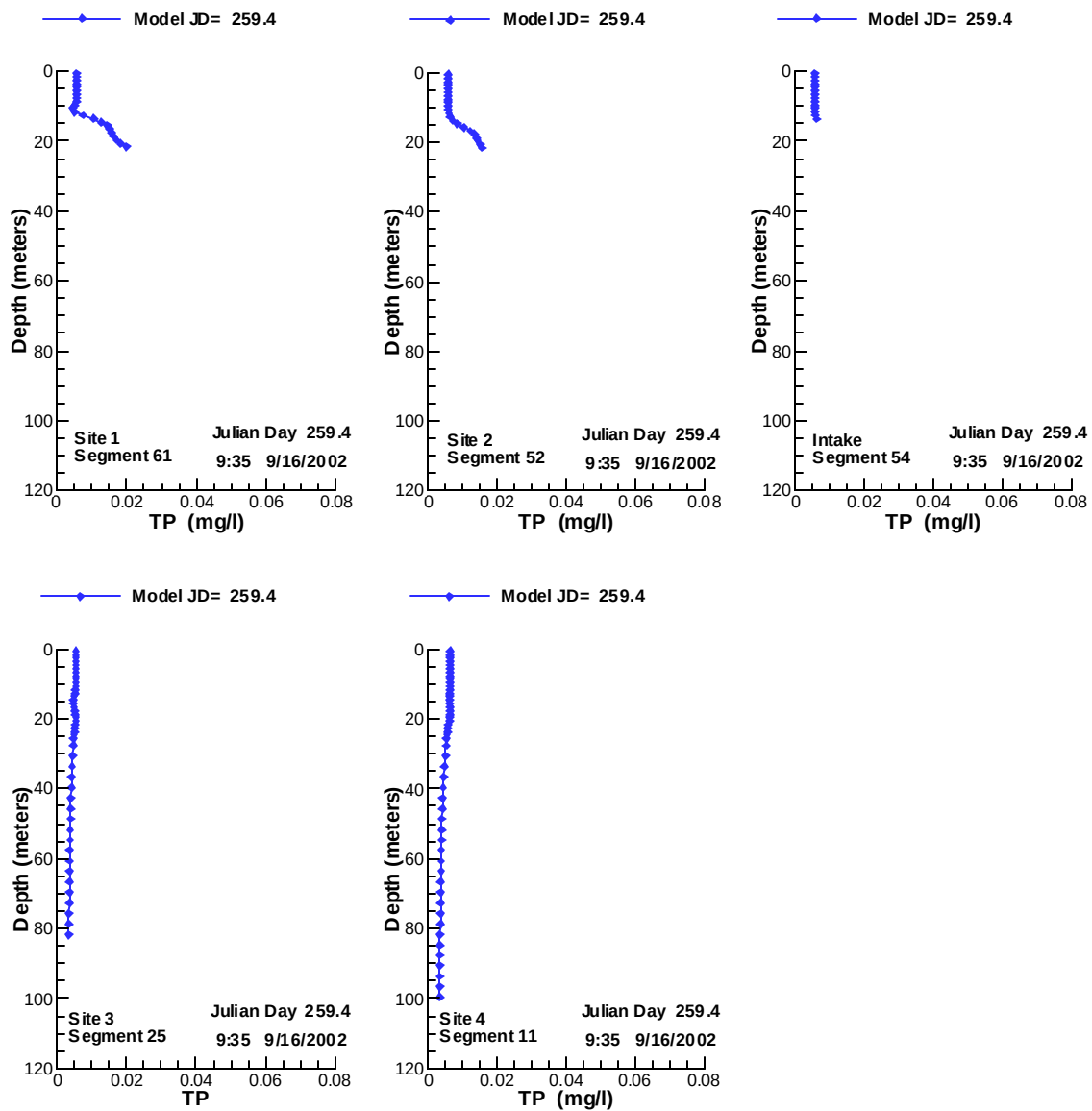


Figure 475. Vertical profiles of TOTAL PHOSPHORUS compared with data for 9/16/2002.

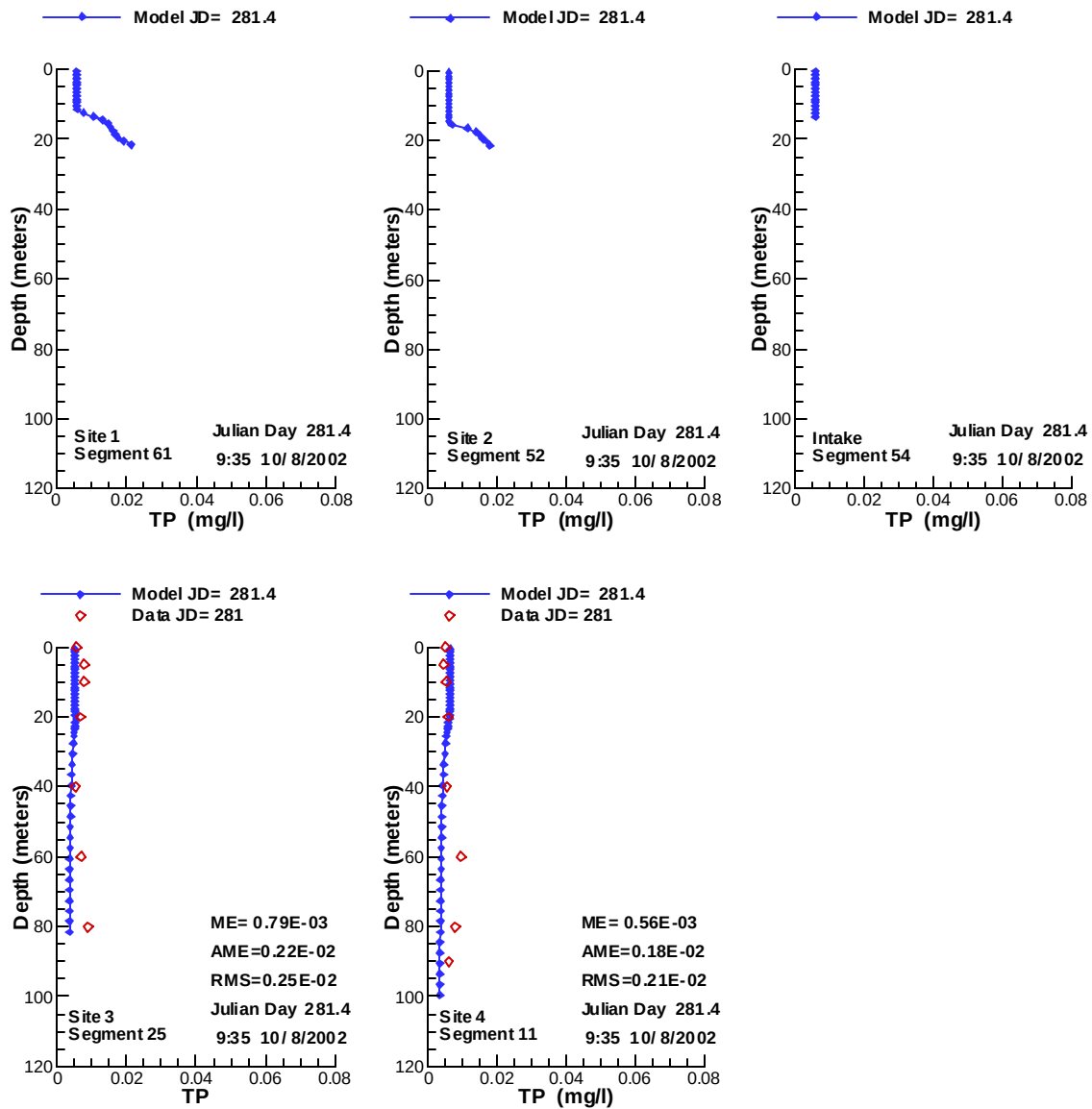


Figure 476. Vertical profiles of TOTAL PHOSPHORUS compared with data for 10/ 8/2002.

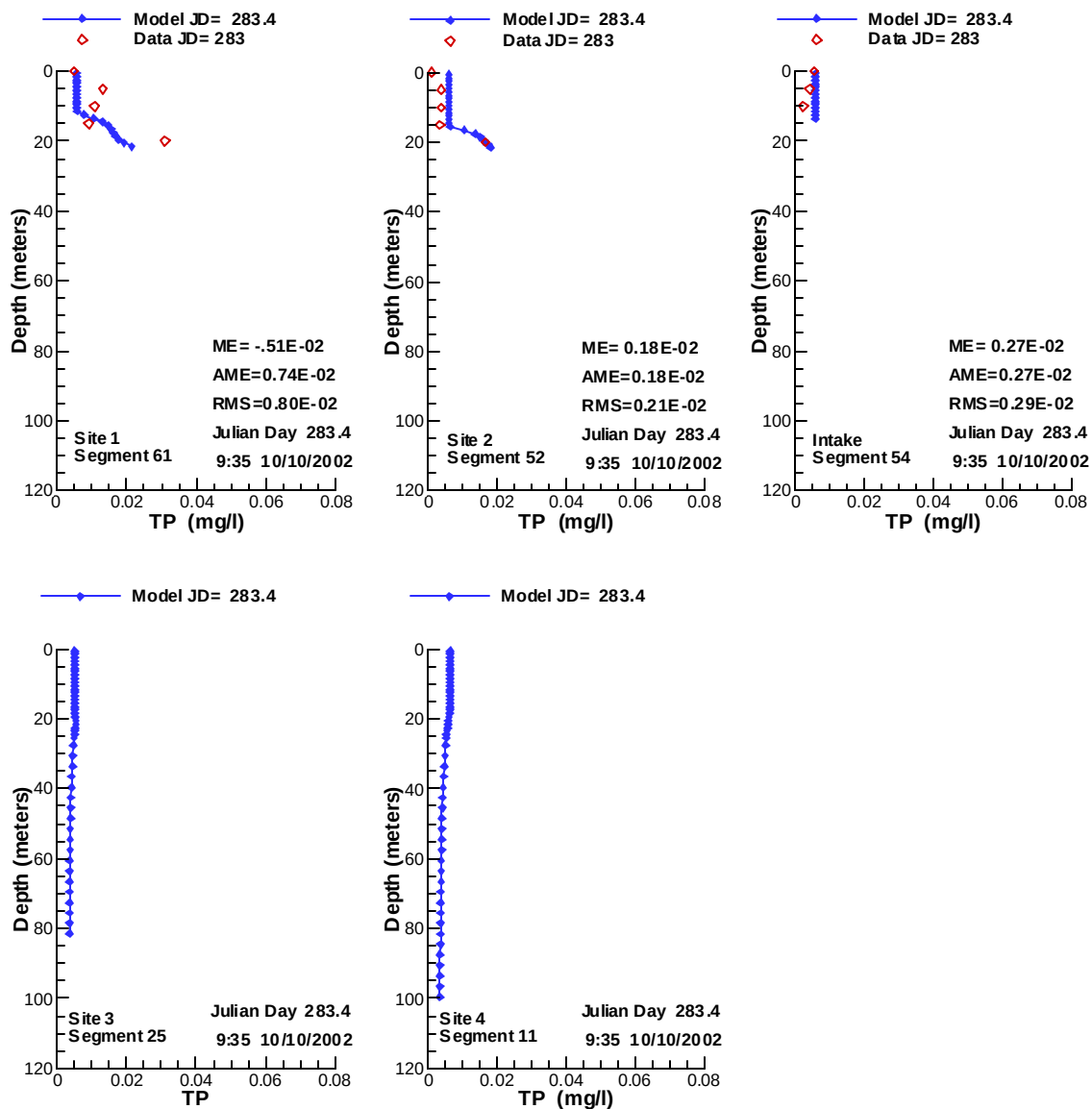


Figure 477. Vertical profiles of TOTAL PHOSPHORUS compared with data for 10/10/2002.

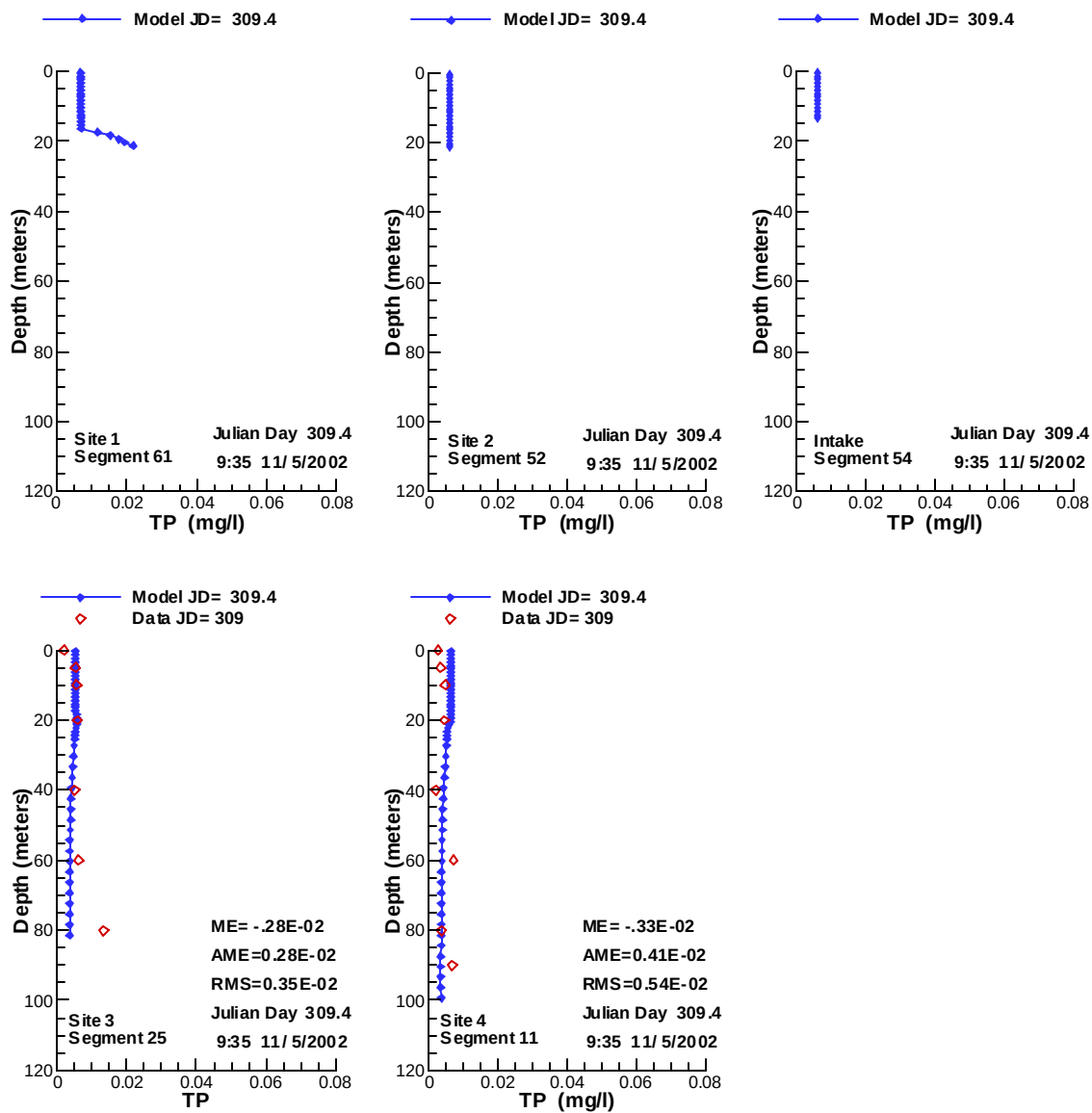


Figure 478. Vertical profiles of TOTAL PHOSPHORUS compared with data for 11/ 5/2002.

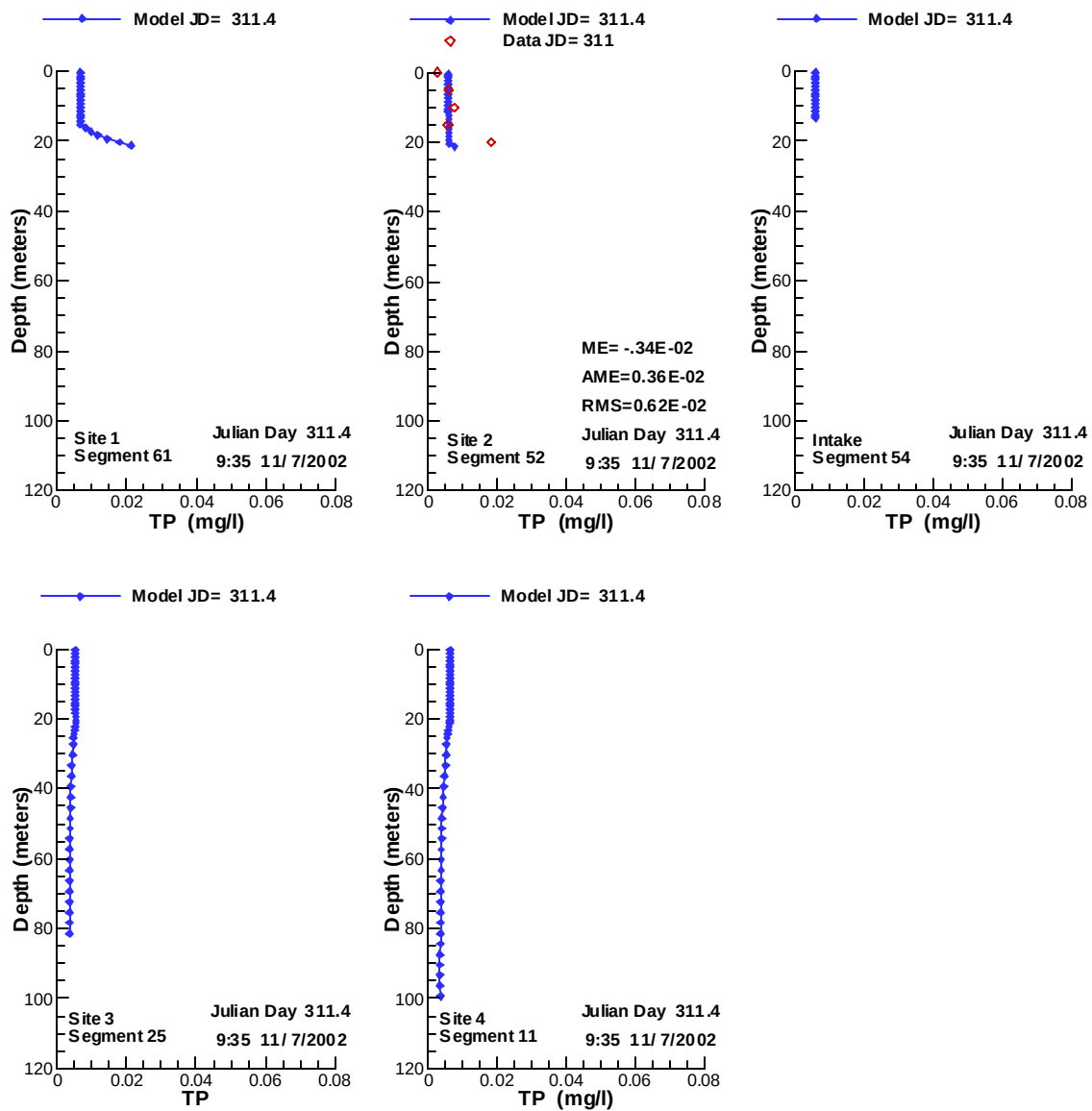


Figure 479. Vertical profiles of TOTAL PHOSPHORUS compared with data for 11/ 7/2002.

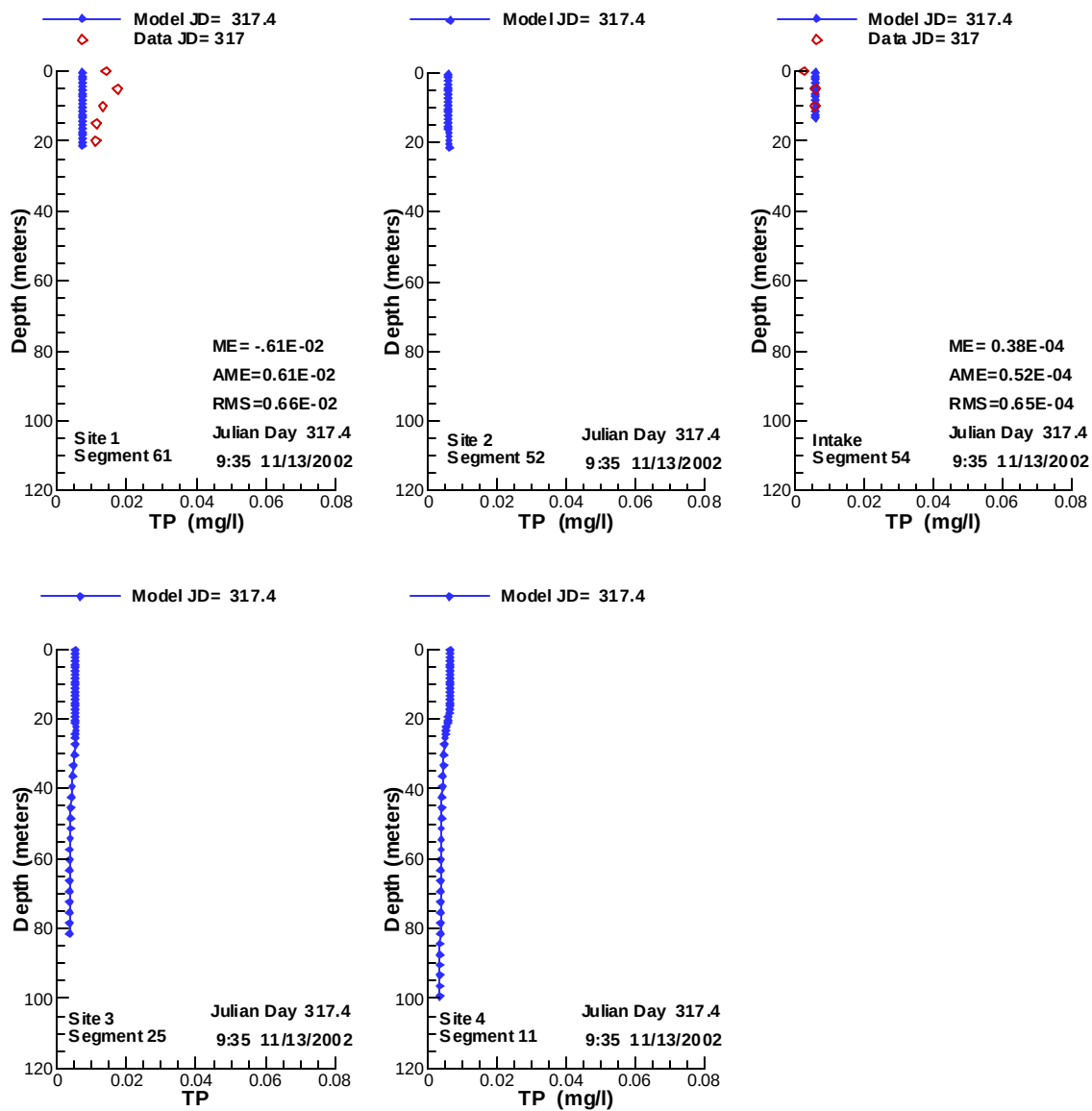


Figure 480. Vertical profiles of TOTAL PHOSPHORUS compared with data for 11/13/2002.

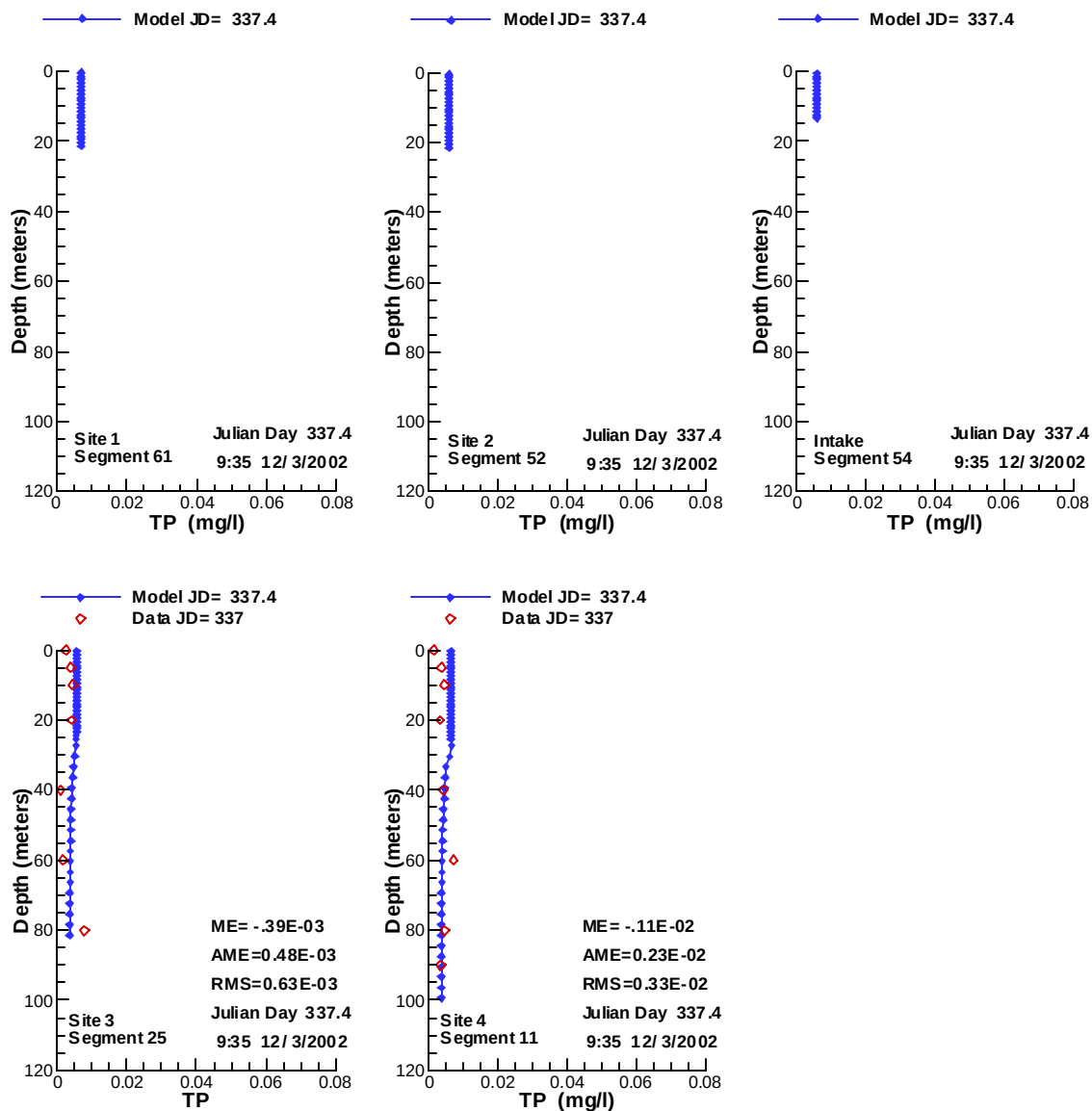


Figure 481. Vertical profiles of TOTAL PHOSPHORUS compared with data for 12/ 3/2002.

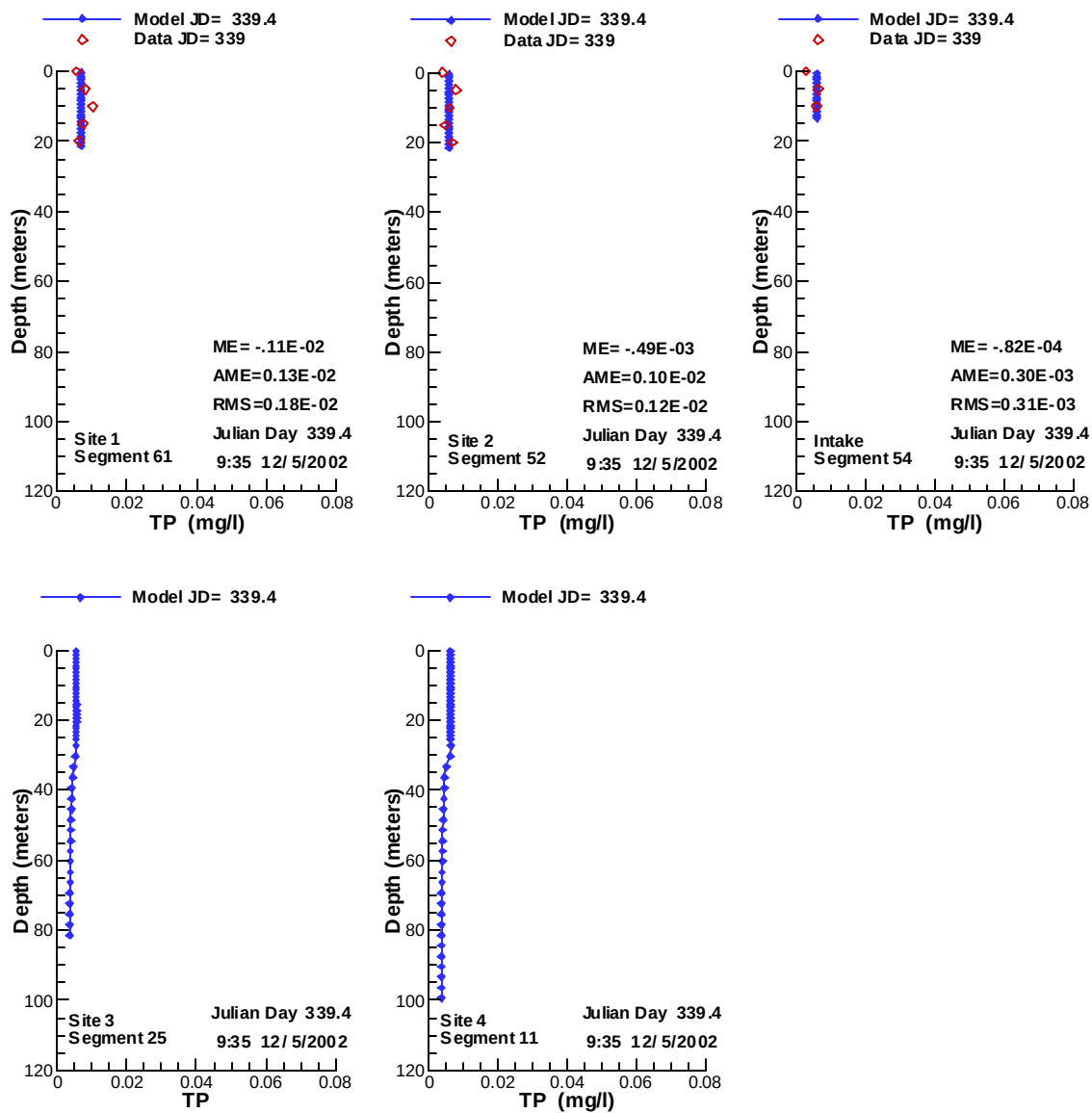


Figure 482. Vertical profiles of TOTAL PHOSPHORUS compared with data for 12/ 5/2002.

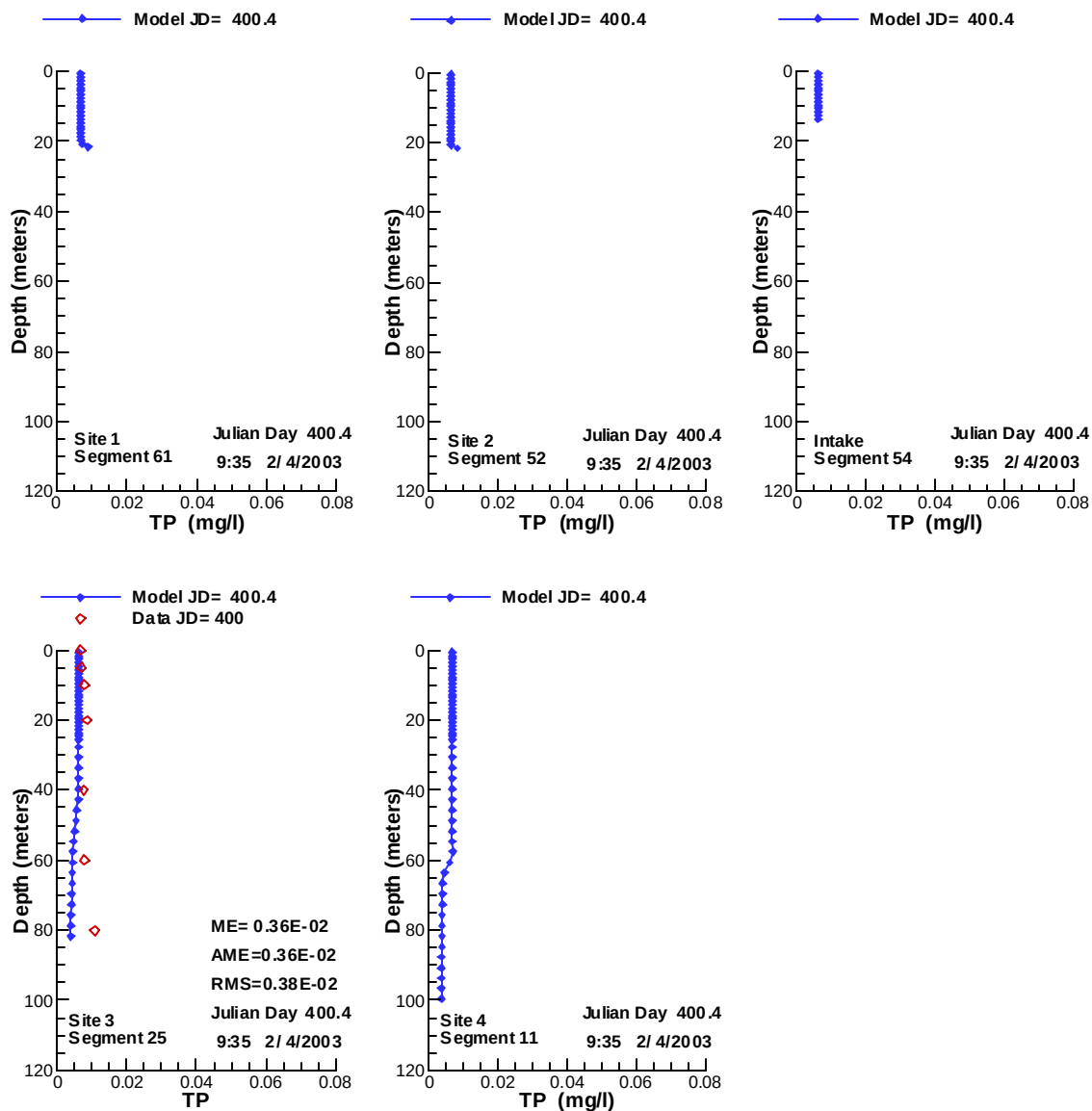


Figure 483. Vertical profiles of TOTAL PHOSPHORUS compared with data for 2/ 4/2003.

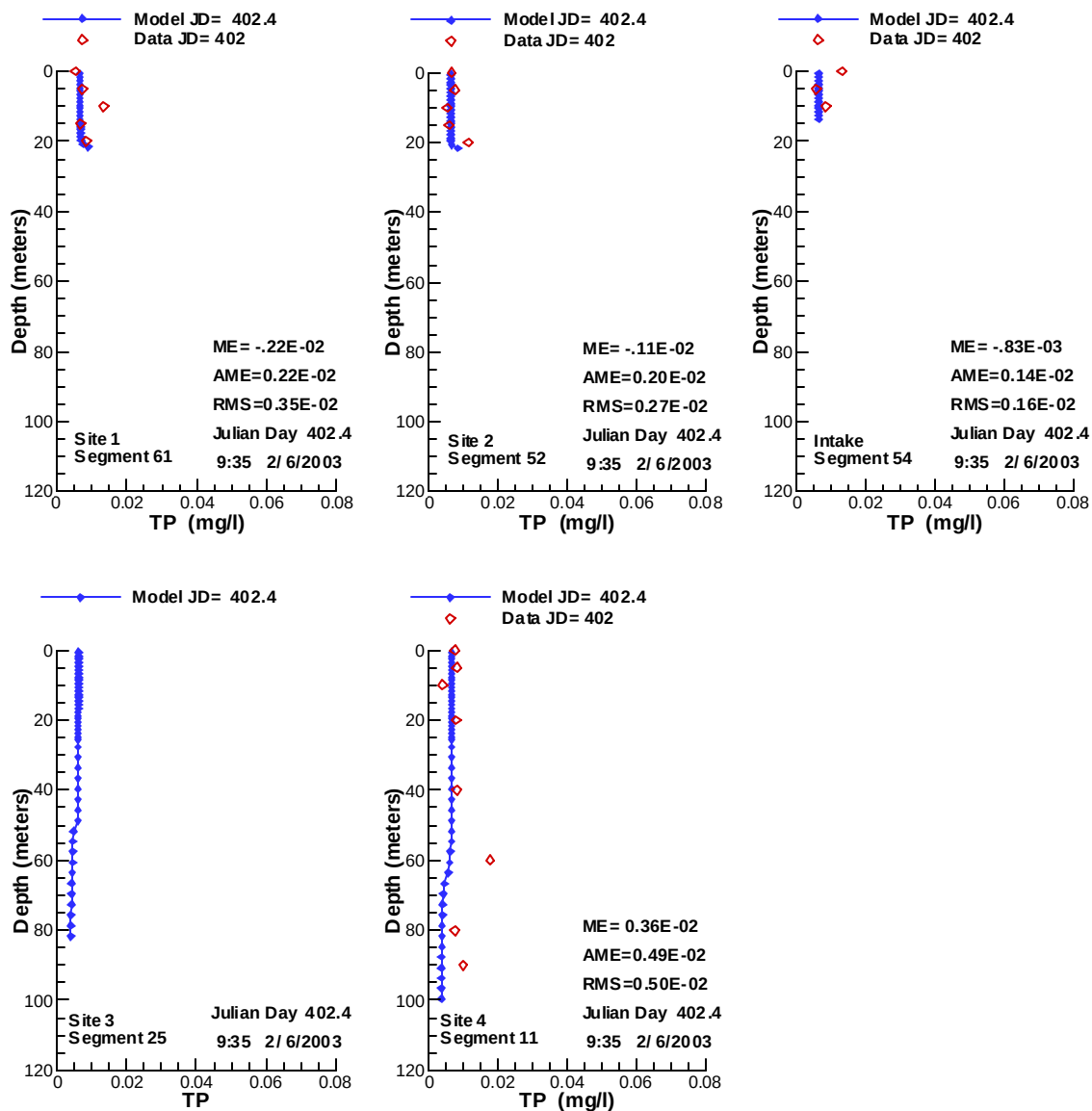


Figure 484. Vertical profiles of TOTAL PHOSPHORUS compared with data for 2/ 6/2003.

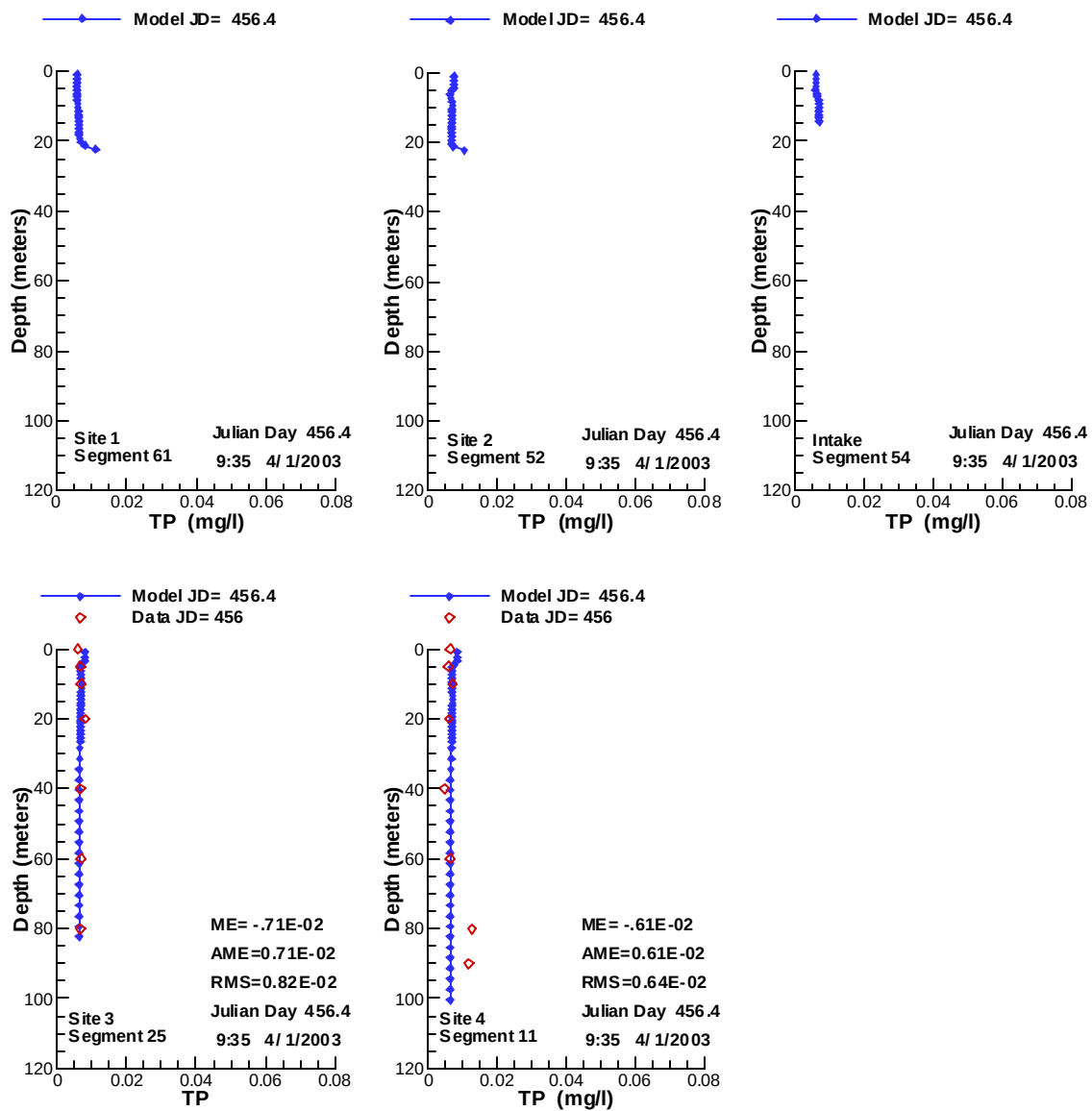


Figure 485. Vertical profiles of TOTAL PHOSPHORUS compared with data for 4/ 1/2003.

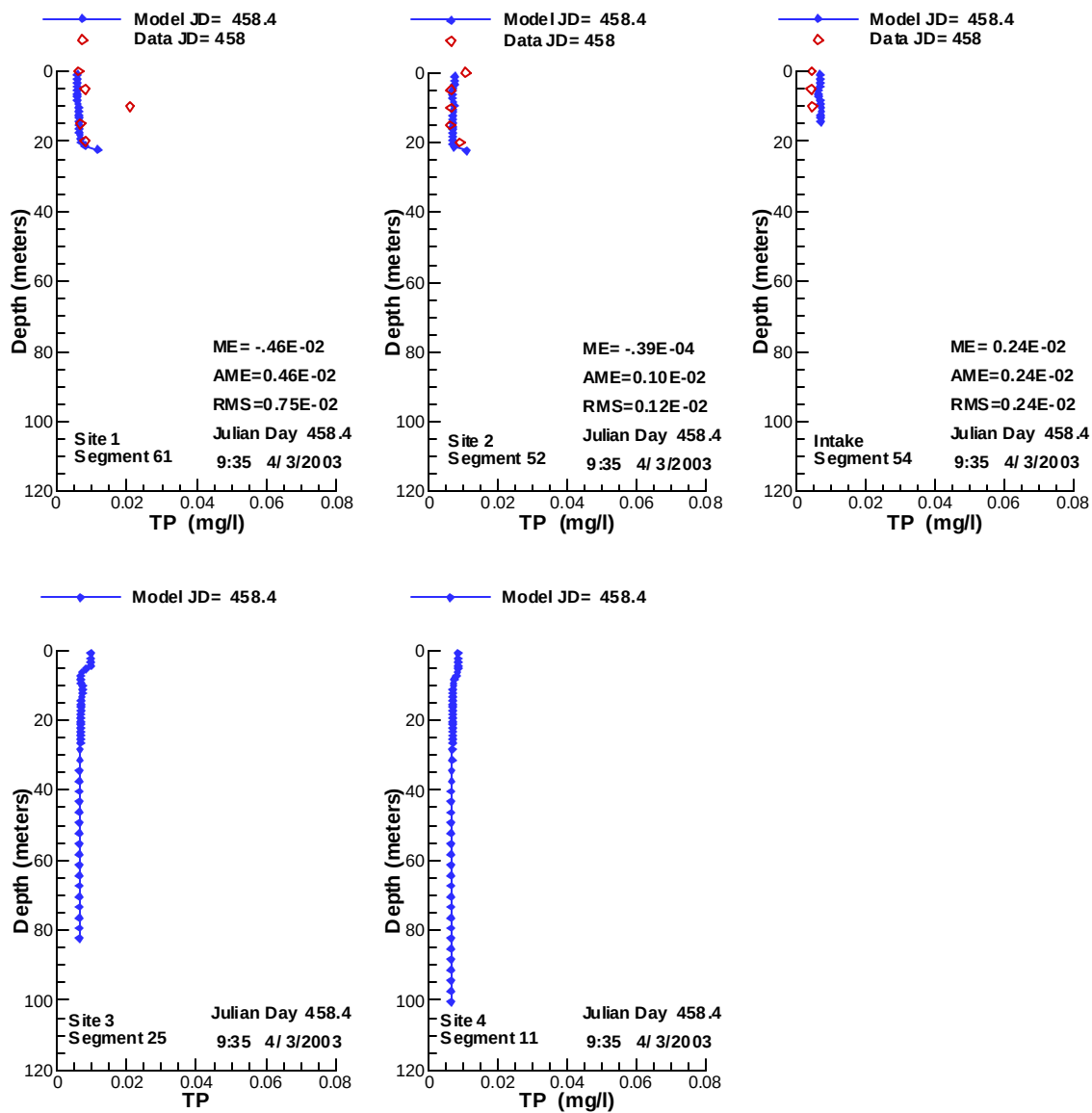


Figure 486. Vertical profiles of TOTAL PHOSPHORUS compared with data for 4/ 3/2003.

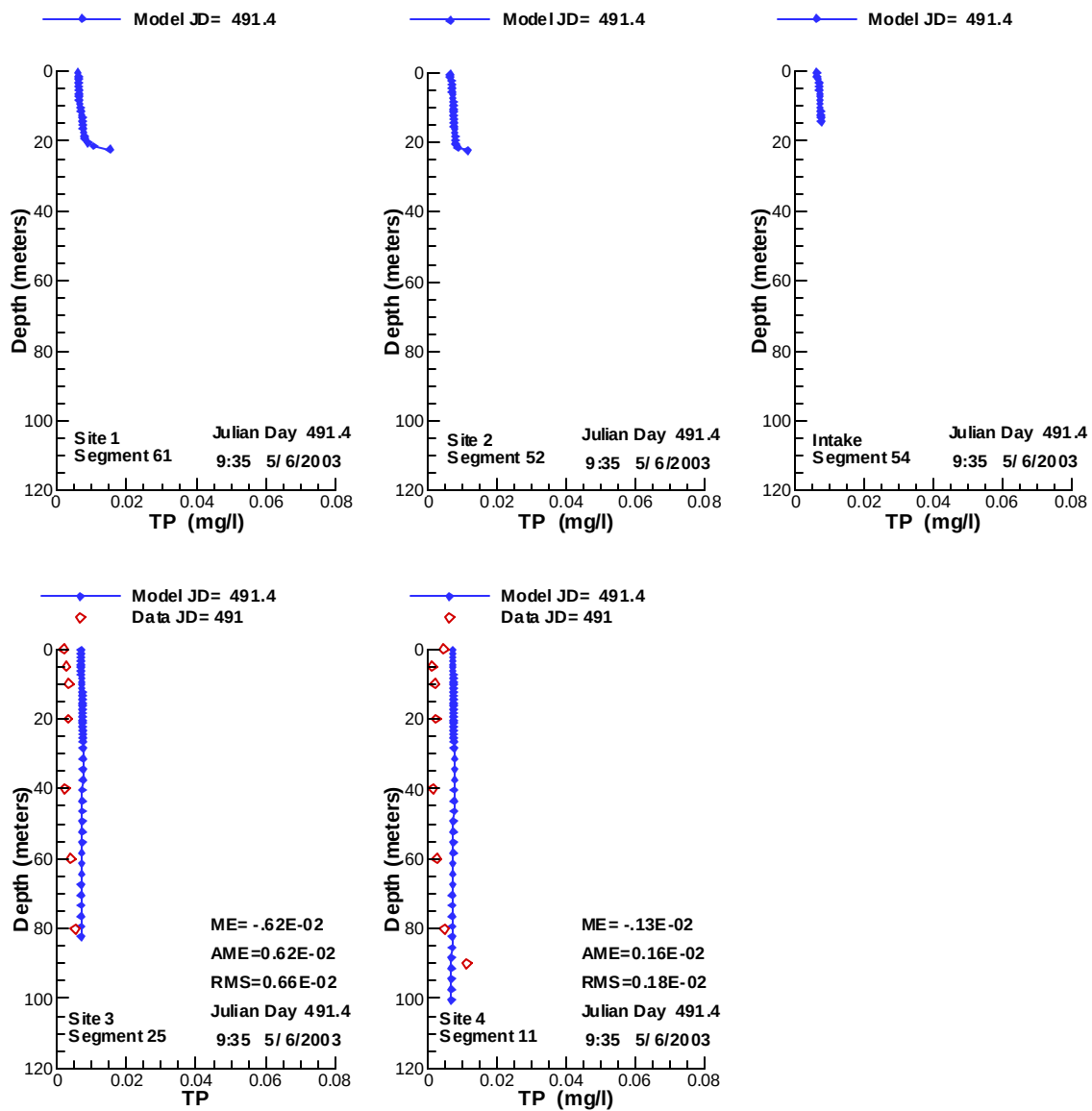


Figure 487. Vertical profiles of TOTAL PHOSPHORUS compared with data for 5/ 6/2003.

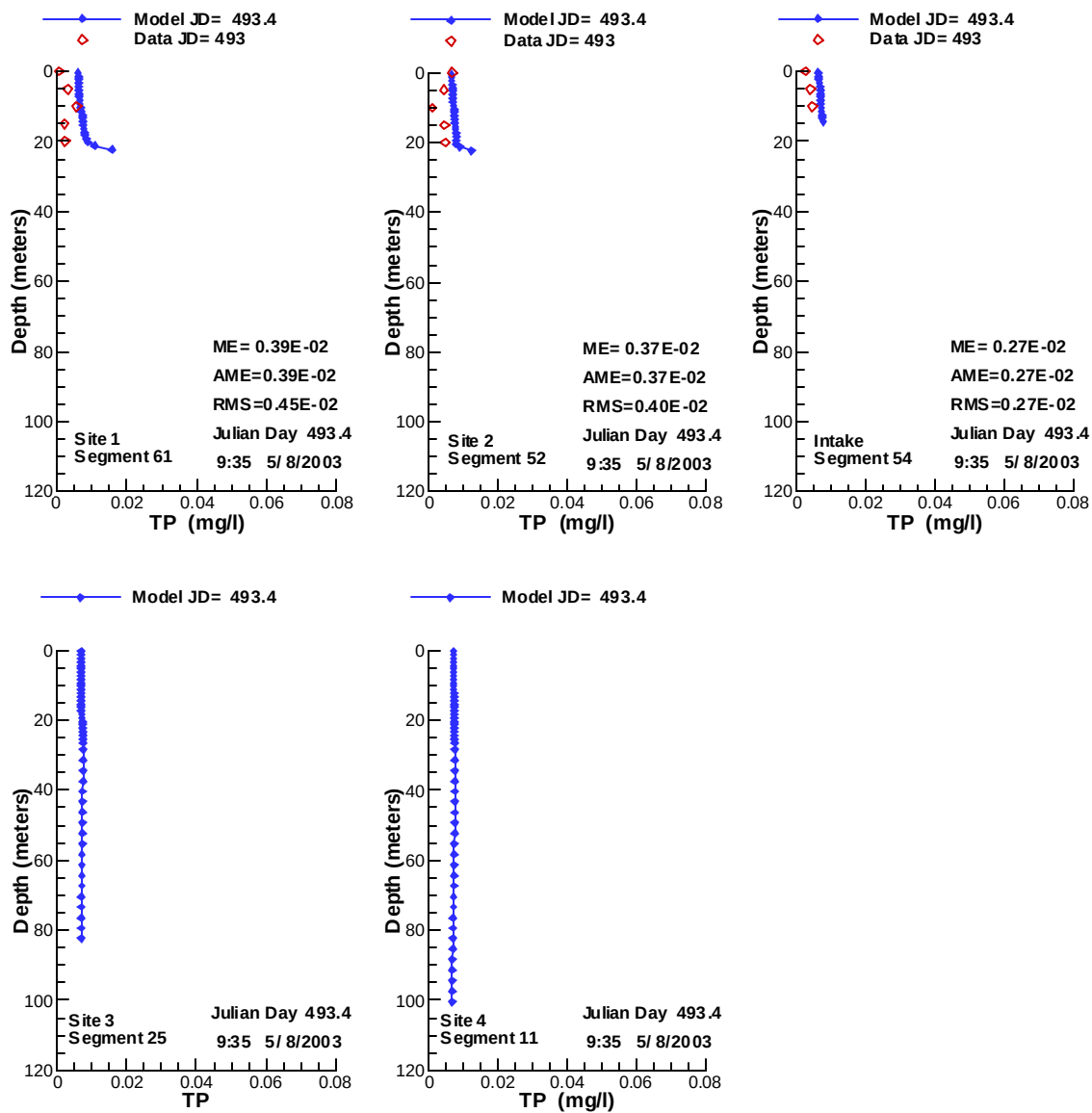


Figure 488. Vertical profiles of TOTAL PHOSPHORUS compared with data for 5/ 8/2003.

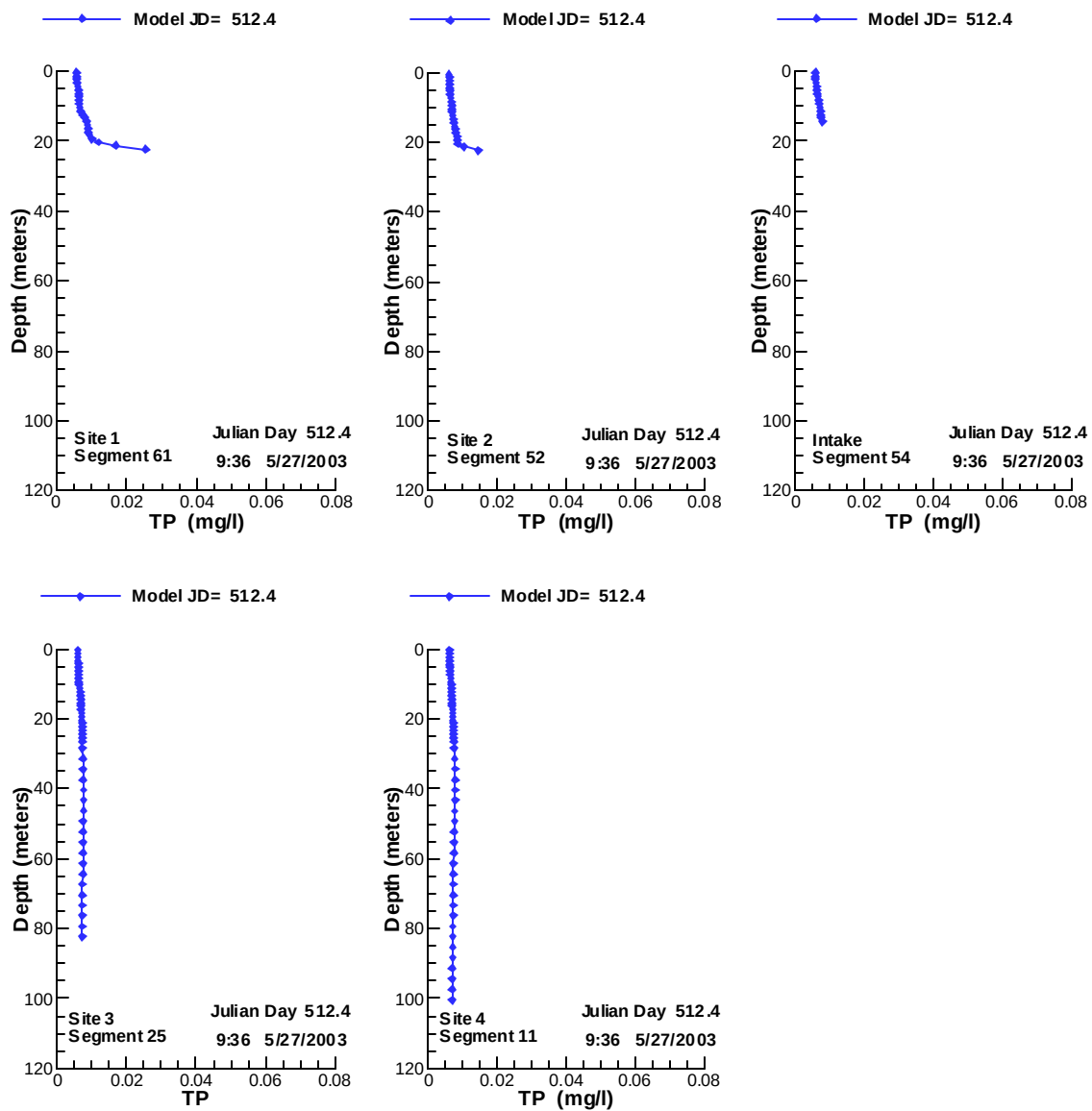


Figure 489. Vertical profiles of TOTAL PHOSPHORUS compared with data for 5/27/2003.

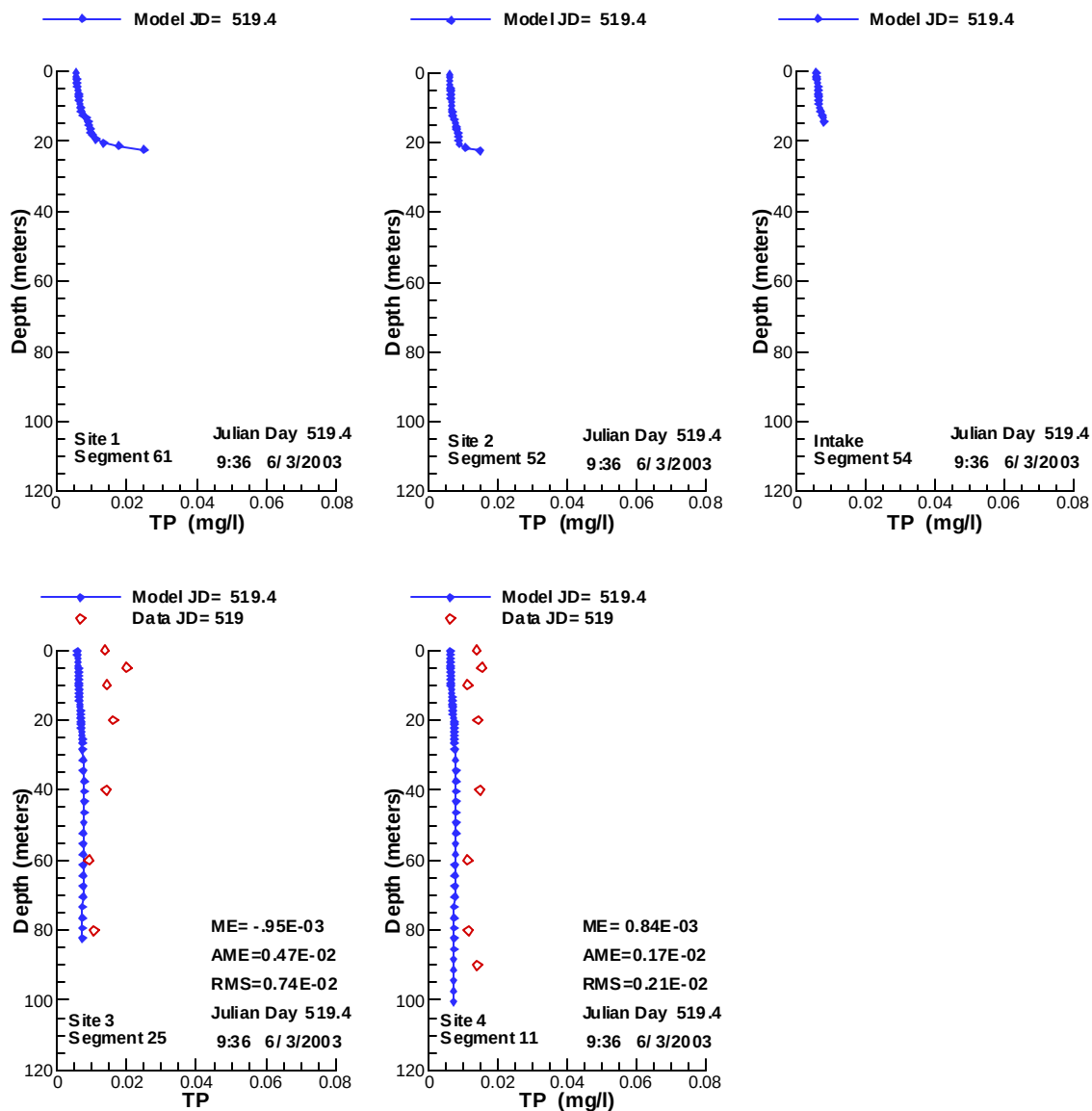


Figure 490. Vertical profiles of TOTAL PHOSPHORUS compared with data for 6/ 3/2003.

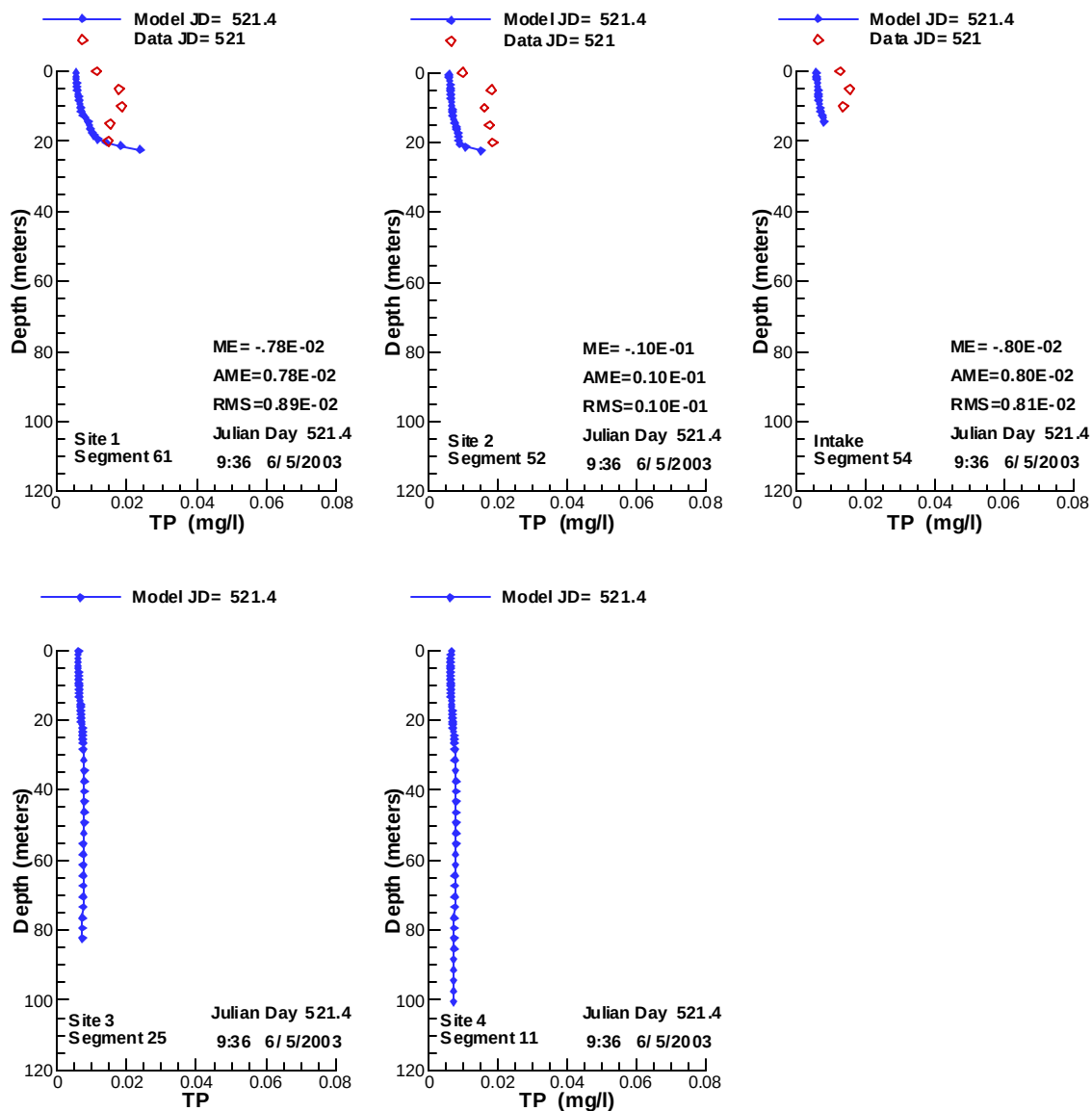


Figure 491. Vertical profiles of TOTAL PHOSPHORUS compared with data for 6/ 5/2003.

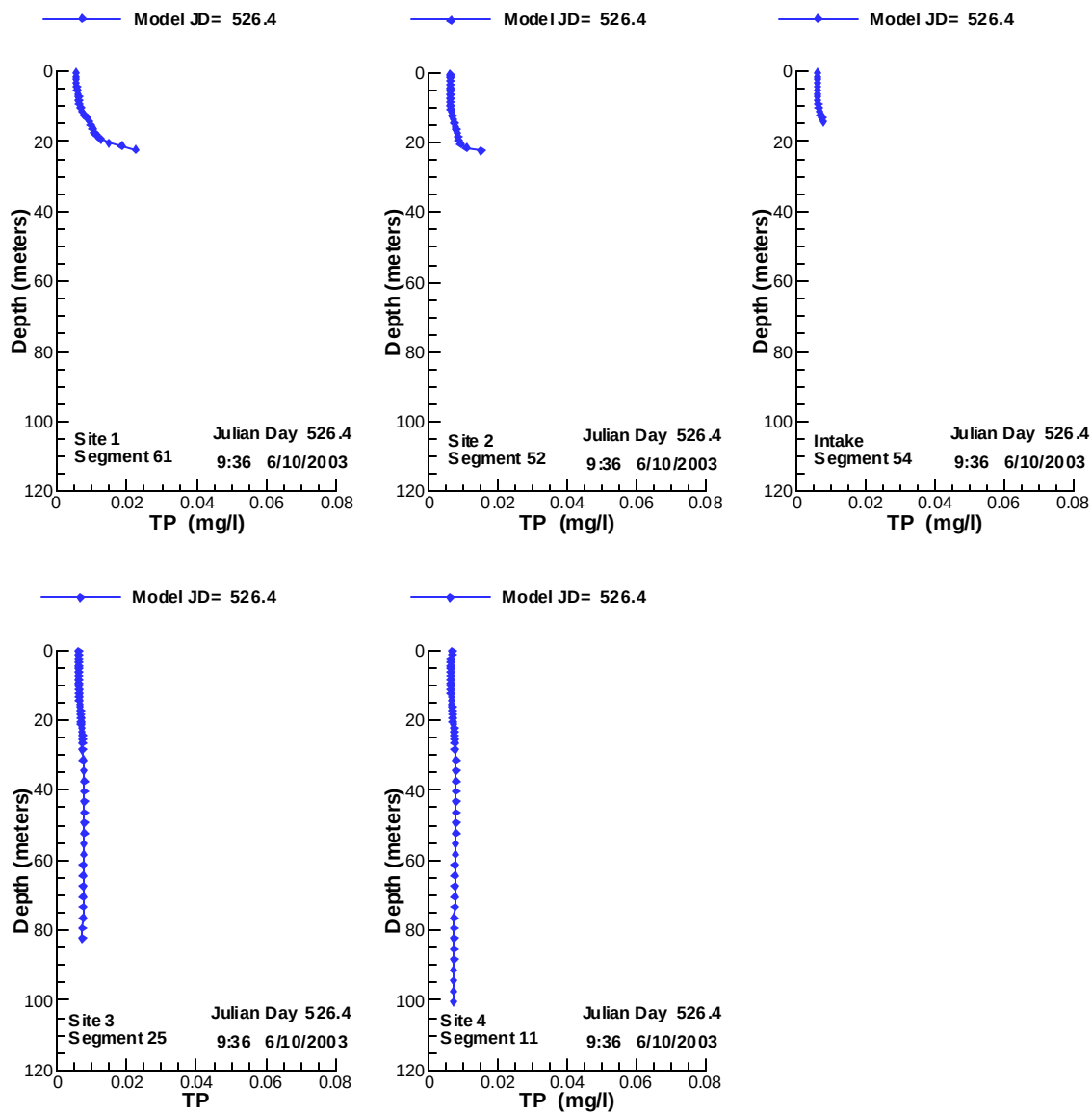


Figure 492. Vertical profiles of TOTAL PHOSPHORUS compared with data for 6/10/2003.

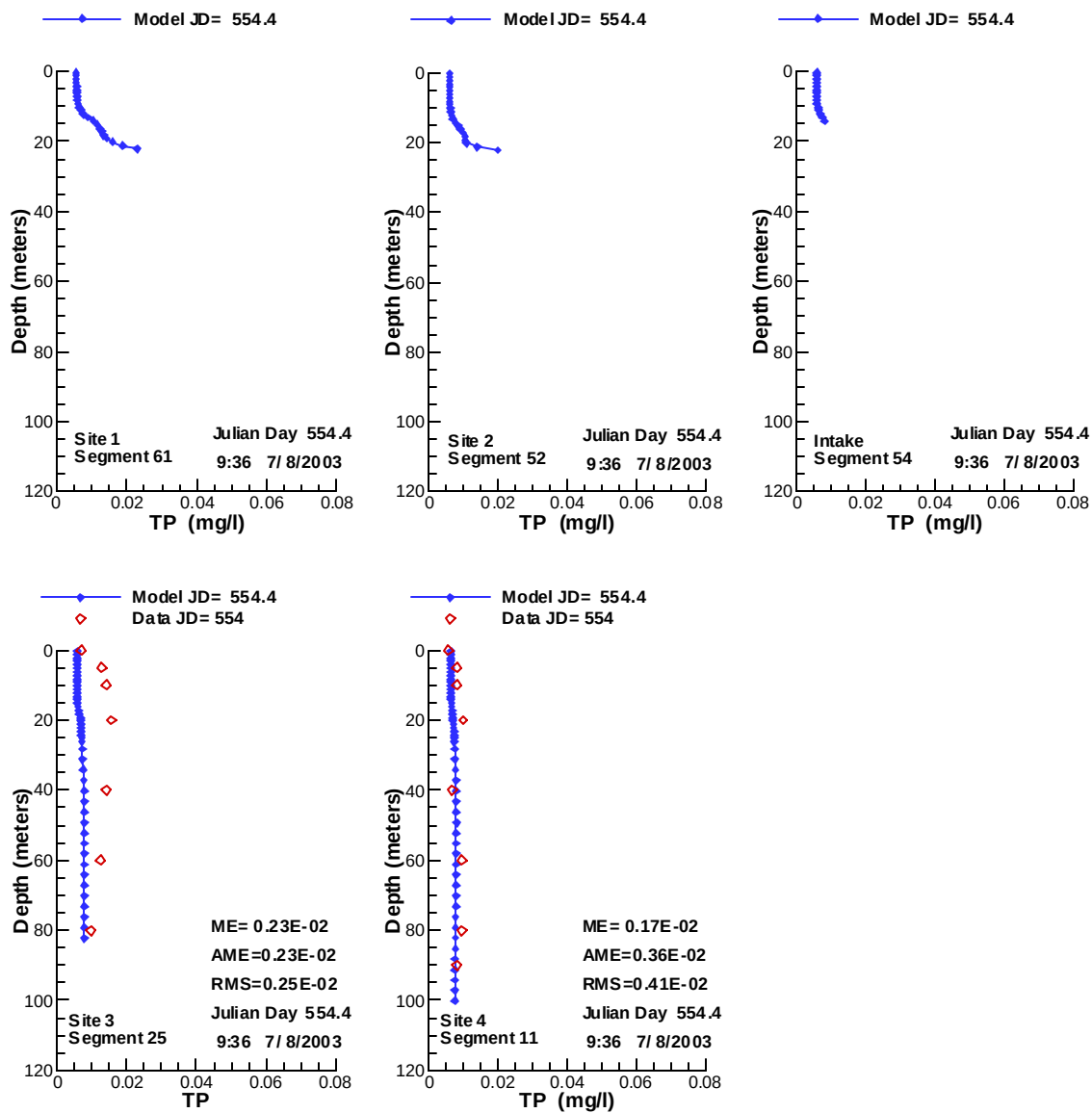


Figure 493. Vertical profiles of TOTAL PHOSPHORUS compared with data for 7/ 8/2003.

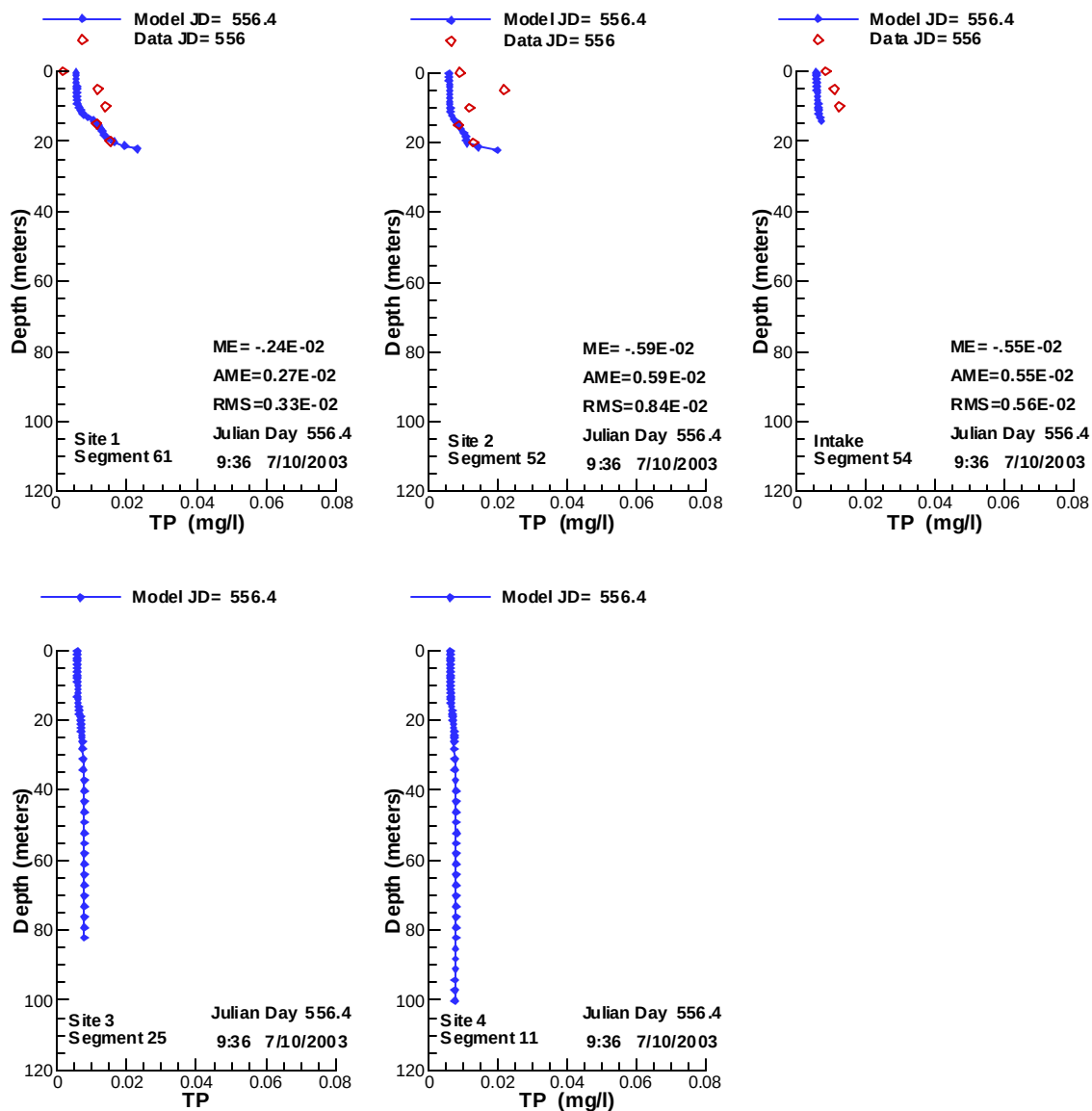


Figure 494. Vertical profiles of TOTAL PHOSPHORUS compared with data for 7/10/2003.

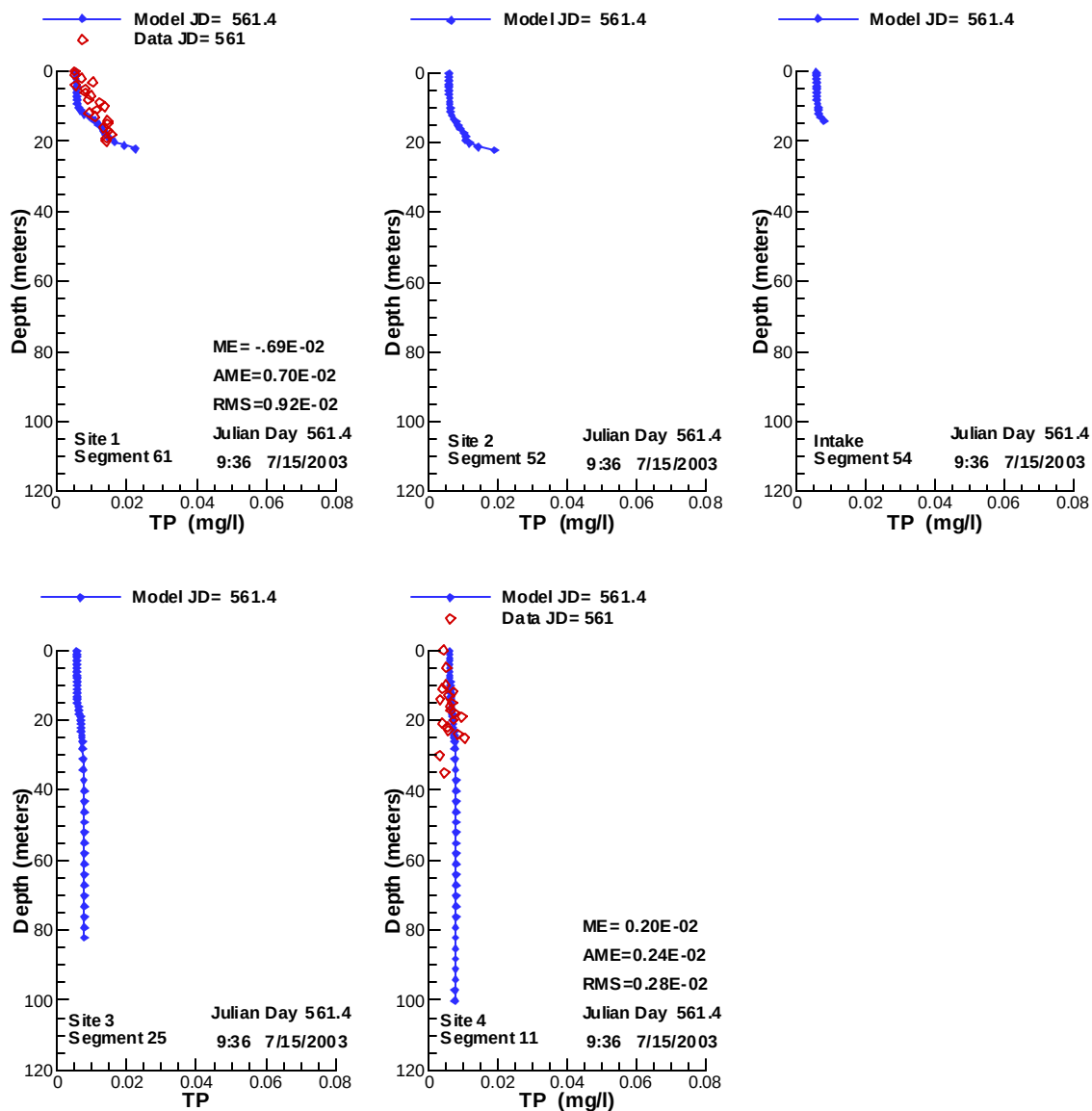


Figure 495. Vertical profiles of TOTAL PHOSPHORUS compared with data for 7/15/2003.

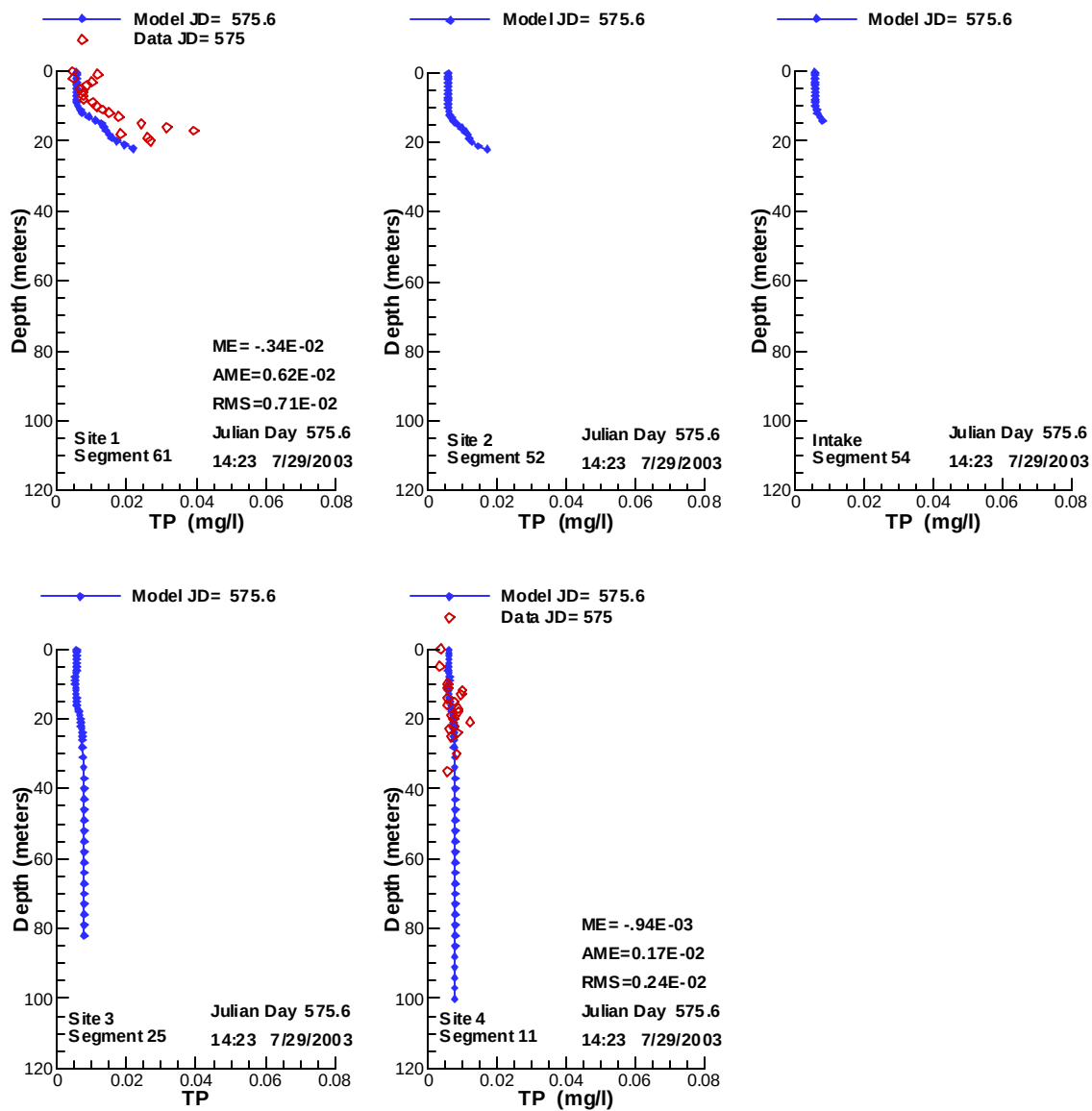


Figure 496. Vertical profiles of TOTAL PHOSPHORUS compared with data for 7/29/2003.

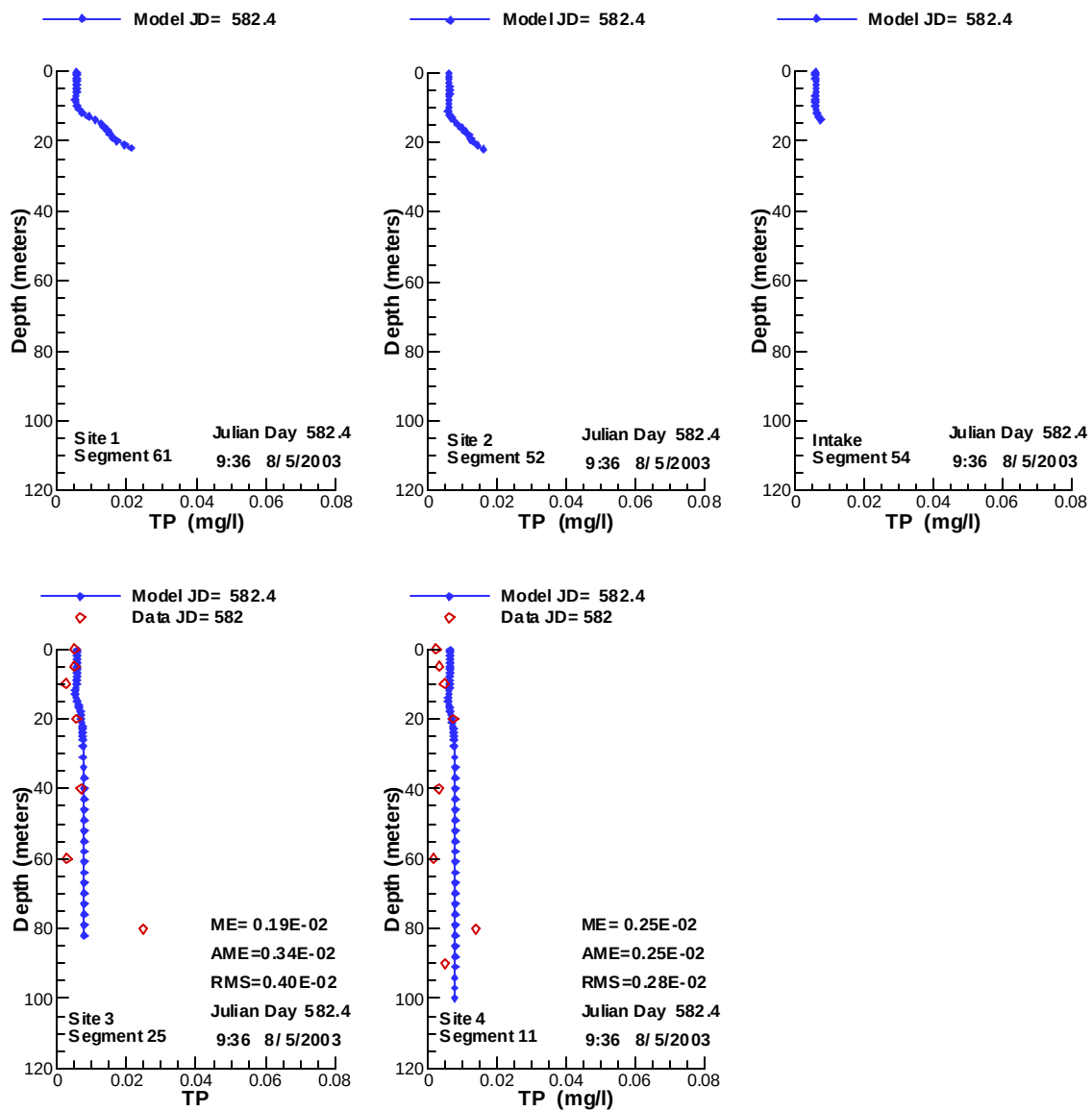


Figure 497. Vertical profiles of TOTAL PHOSPHORUS compared with data for 8/ 5/2003.

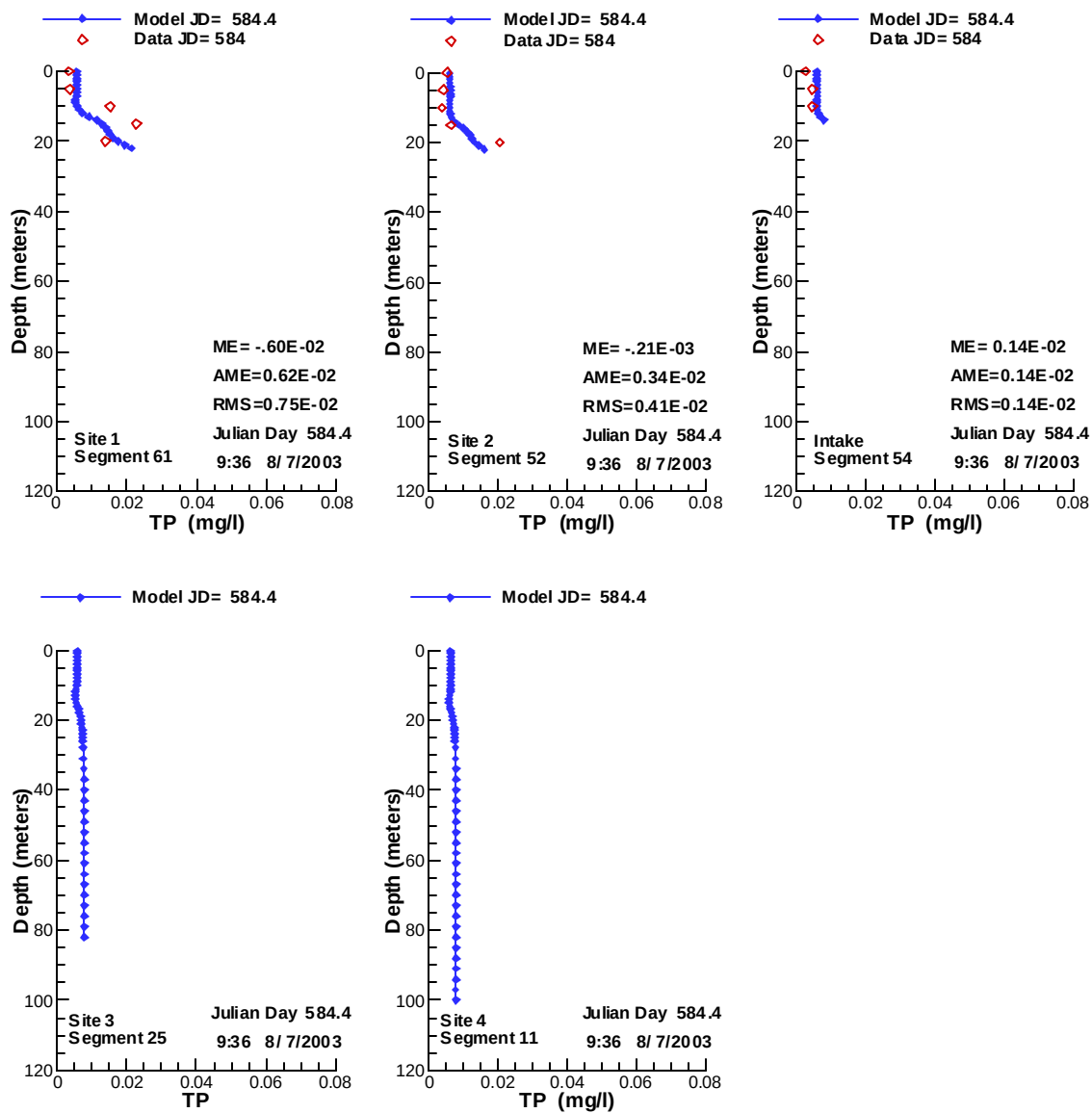


Figure 498. Vertical profiles of TOTAL PHOSPHORUS compared with data for 8/ 7/2003.

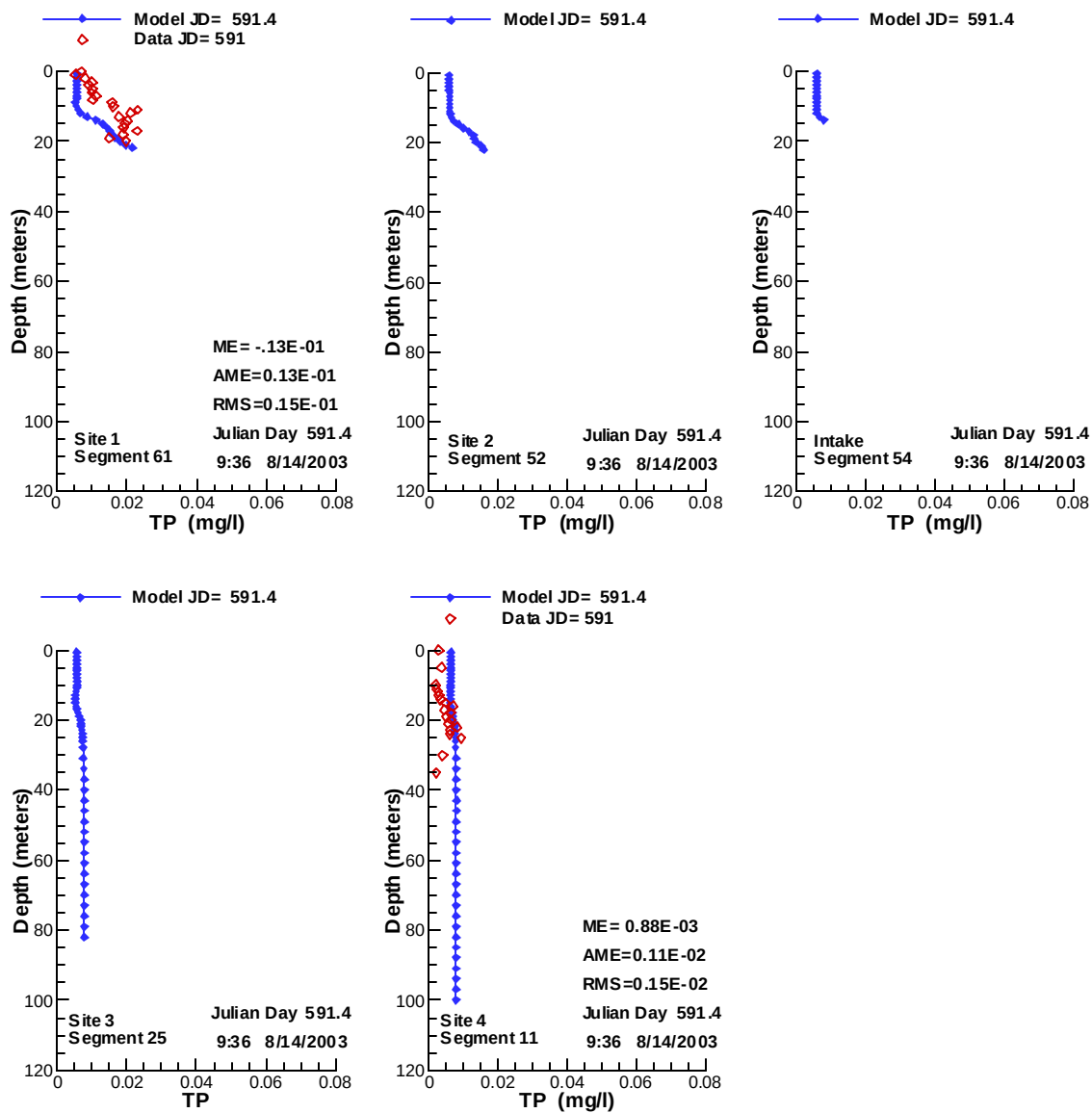


Figure 499. Vertical profiles of TOTAL PHOSPHORUS compared with data for 8/14/2003.

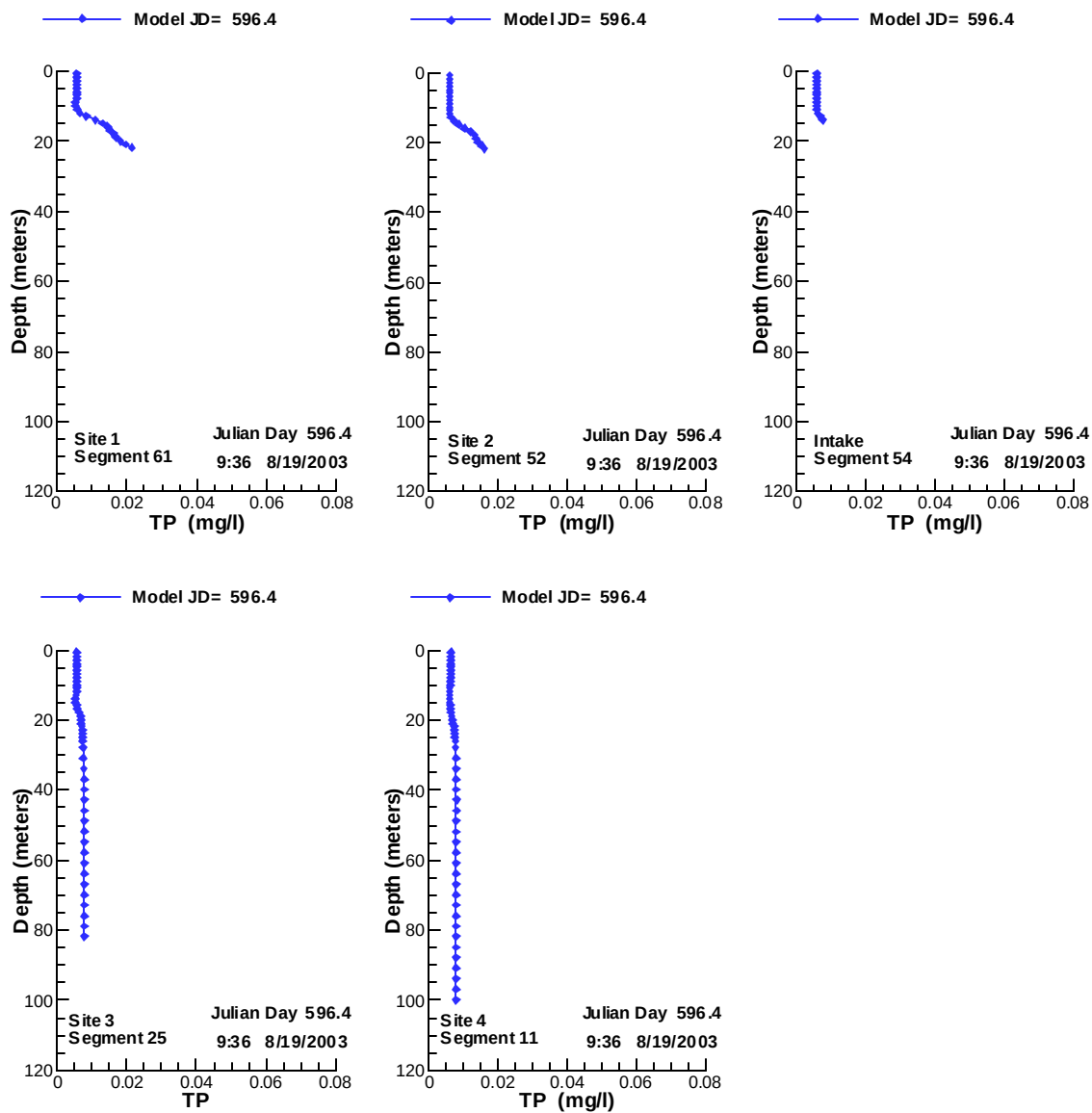


Figure 500. Vertical profiles of TOTAL PHOSPHORUS compared with data for 8/19/2003.

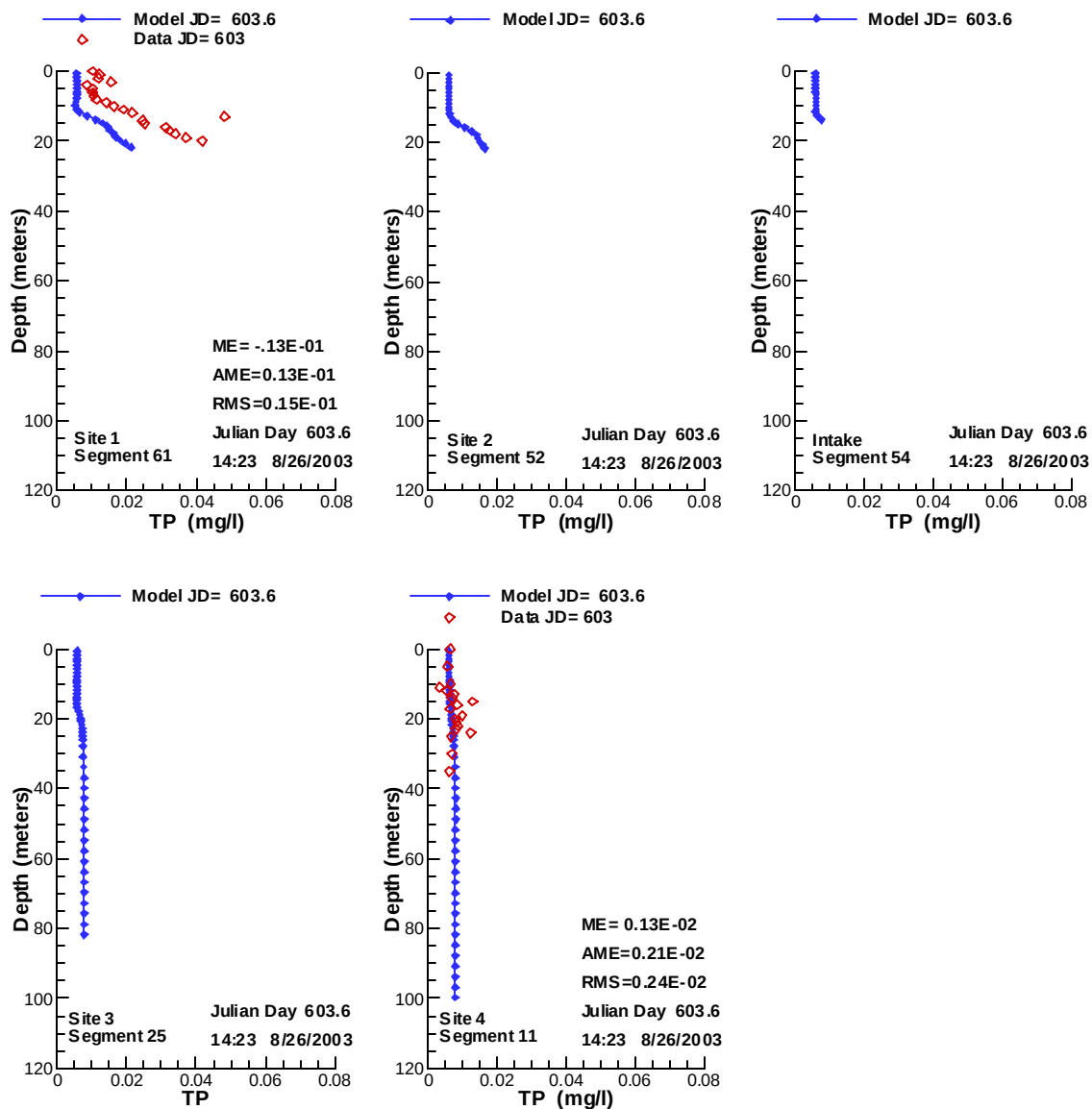


Figure 501. Vertical profiles of TOTAL PHOSPHORUS compared with data for 8/26/2003.

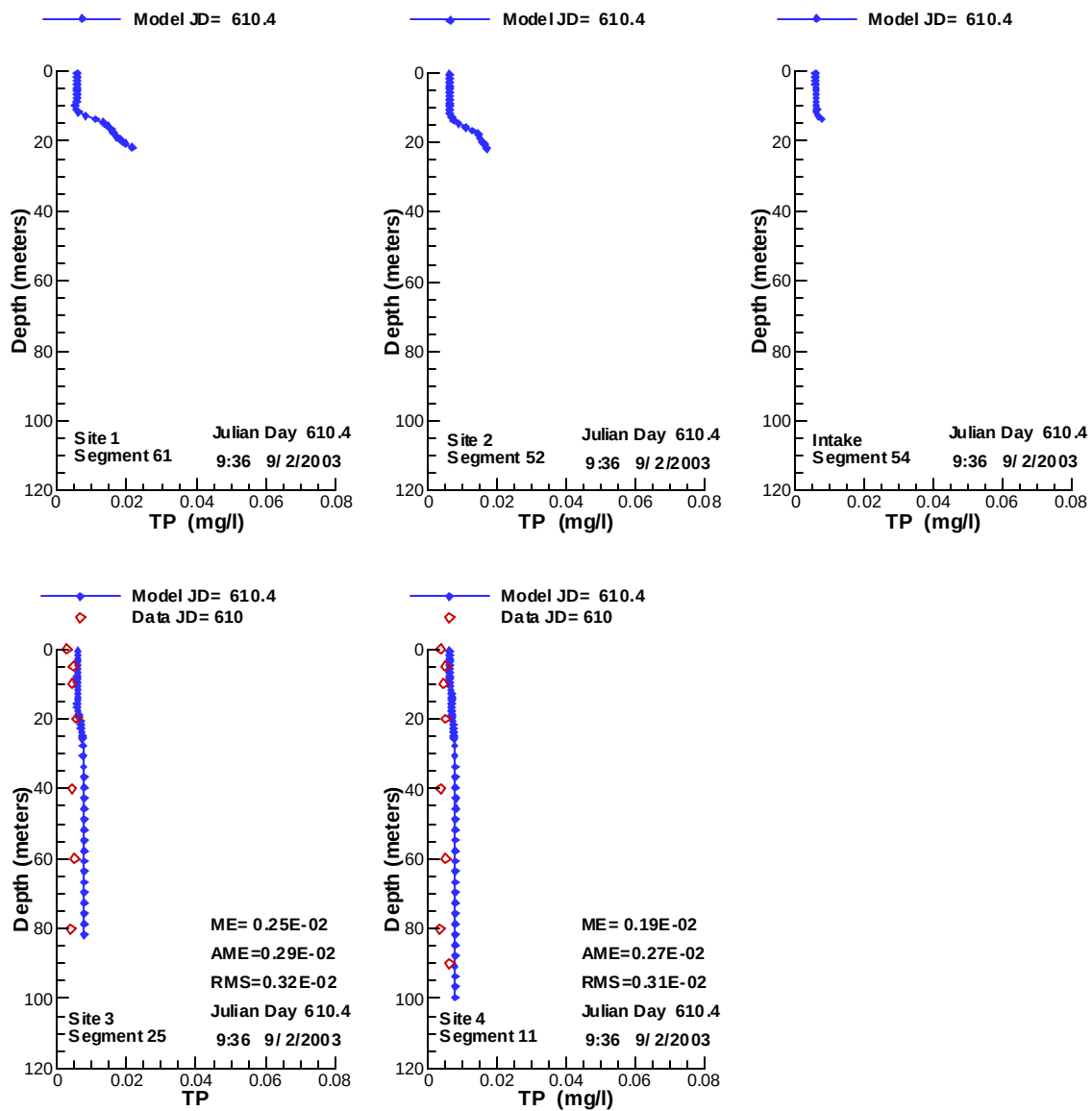


Figure 502. Vertical profiles of TOTAL PHOSPHORUS compared with data for 9/ 2/2003.

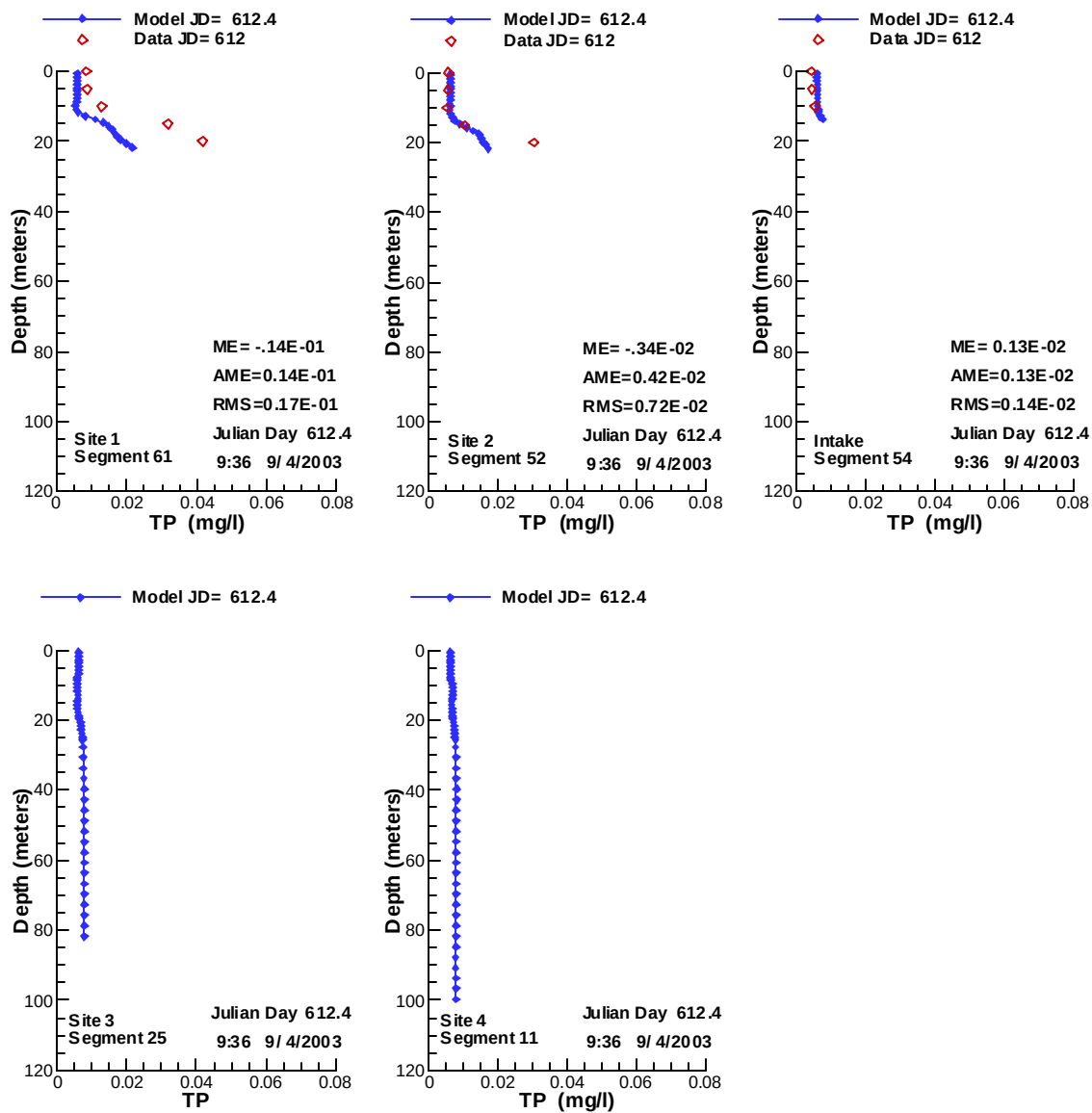


Figure 503. Vertical profiles of TOTAL PHOSPHORUS compared with data for 9/ 4/2003.

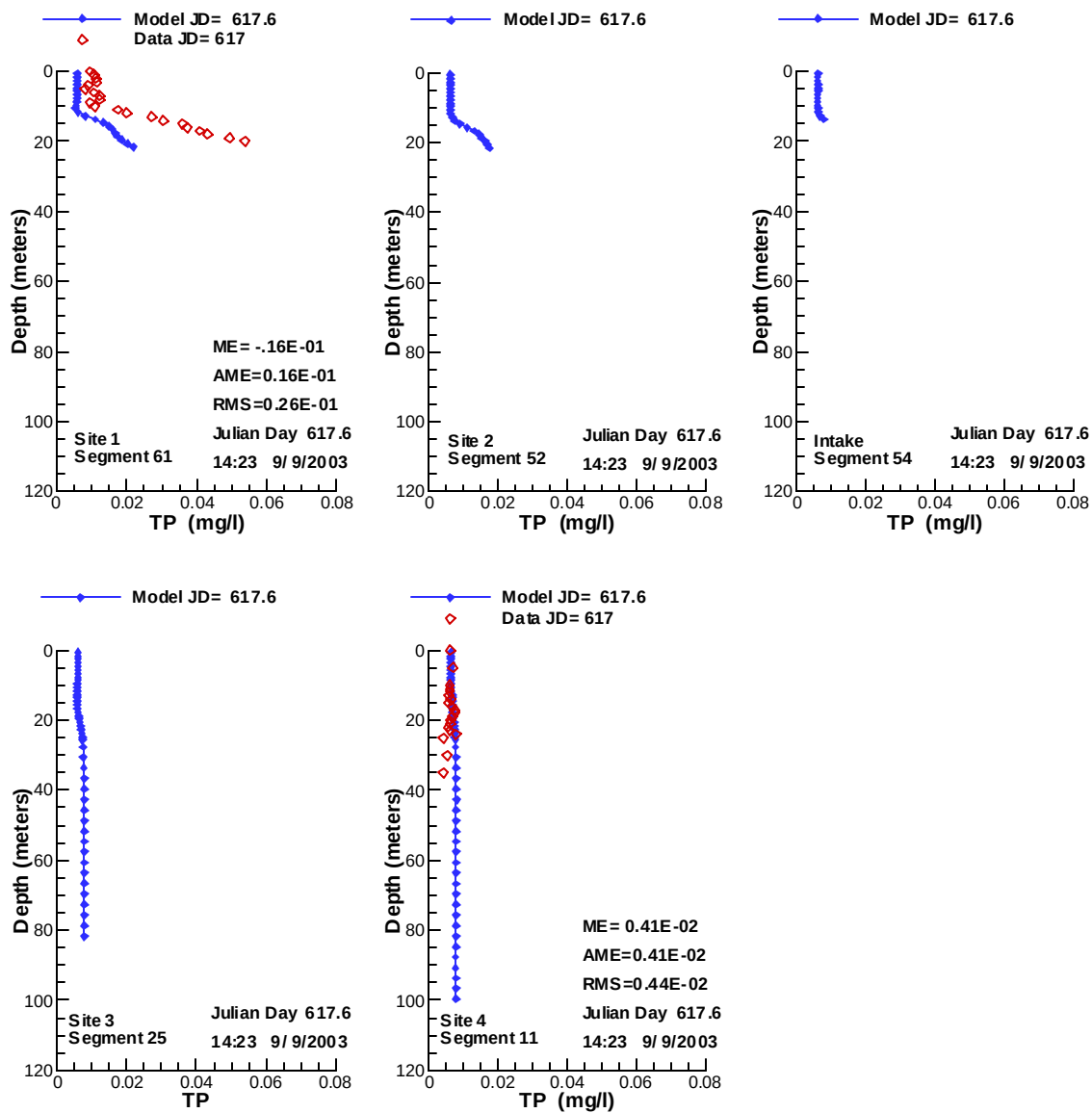


Figure 504. Vertical profiles of TOTAL PHOSPHORUS compared with data for 9/ 9/2003.

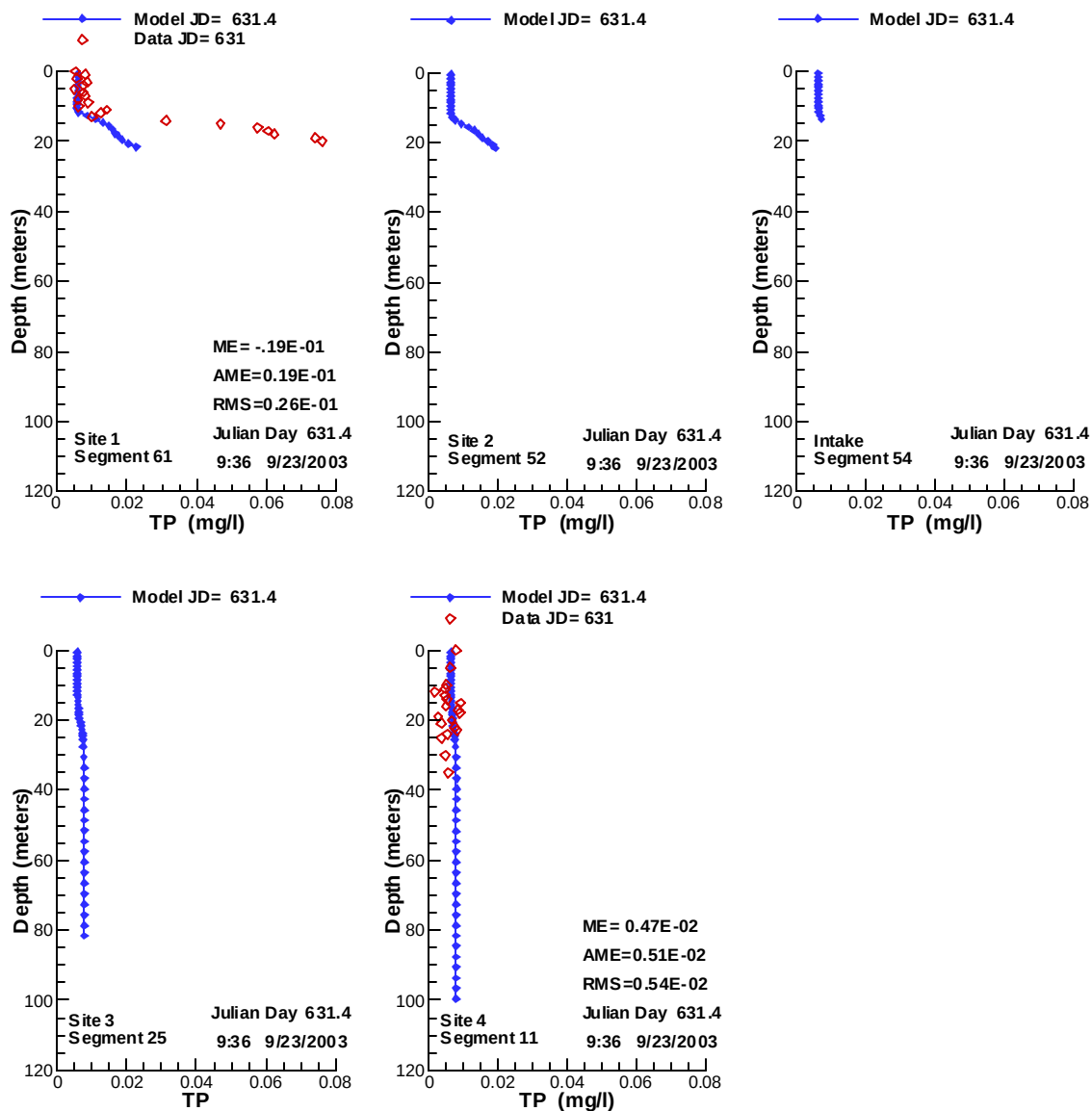


Figure 505. Vertical profiles of TOTAL PHOSPHORUS compared with data for 9/23/2003.

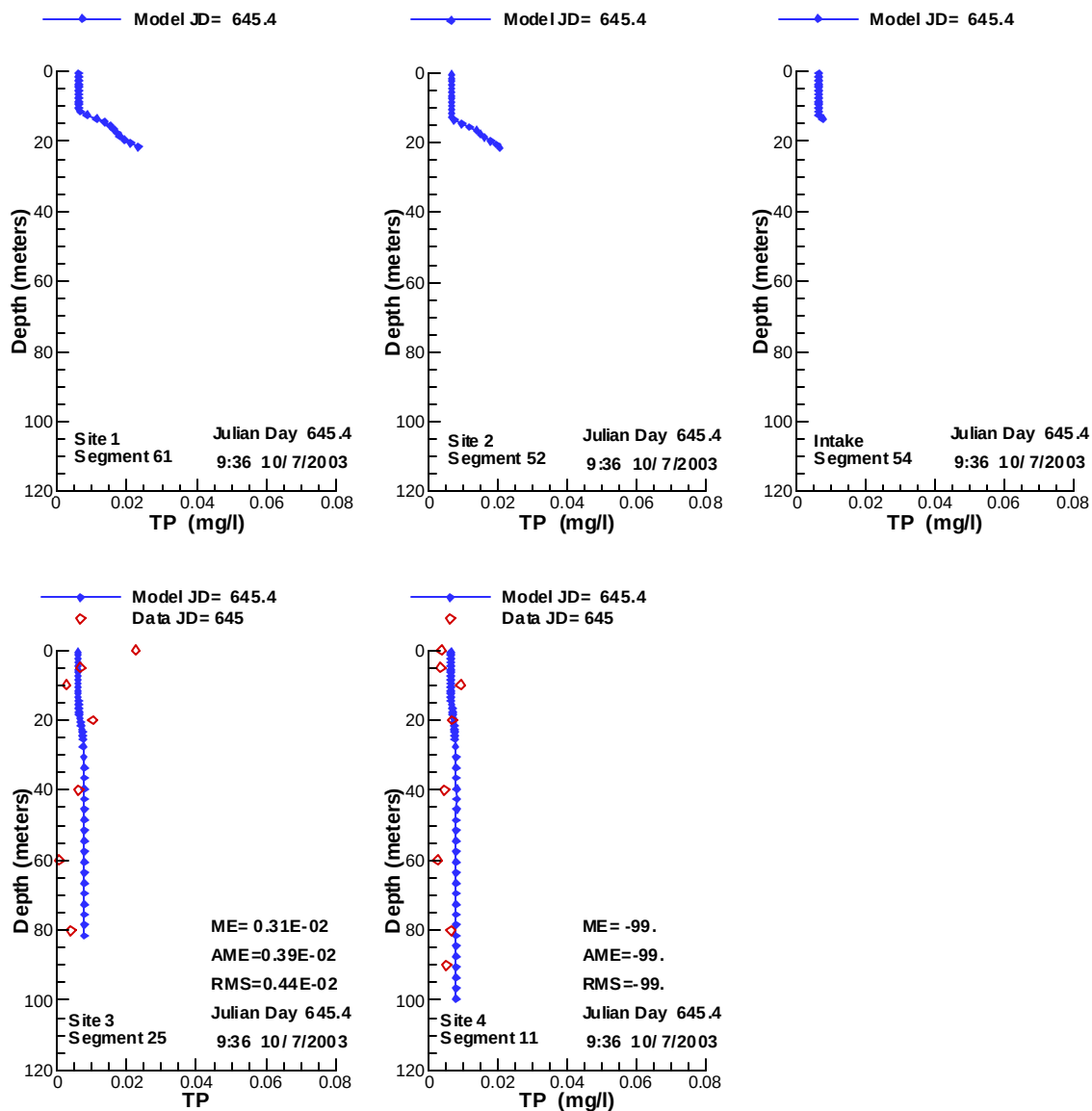


Figure 506. Vertical profiles of TOTAL PHOSPHORUS compared with data for 10/ 7/2003.

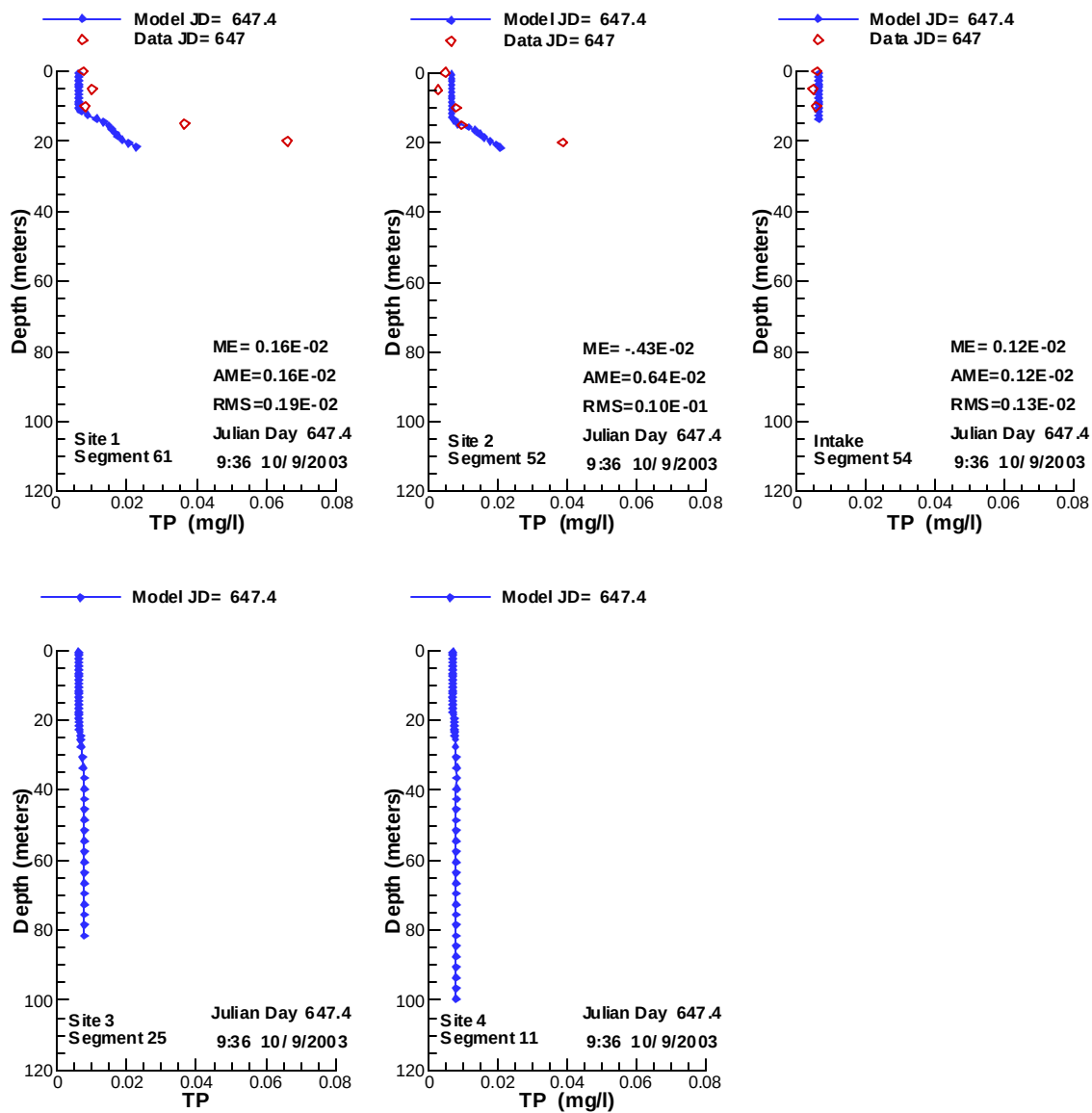


Figure 507. Vertical profiles of TOTAL PHOSPHORUS compared with data for 10/ 9/2003.

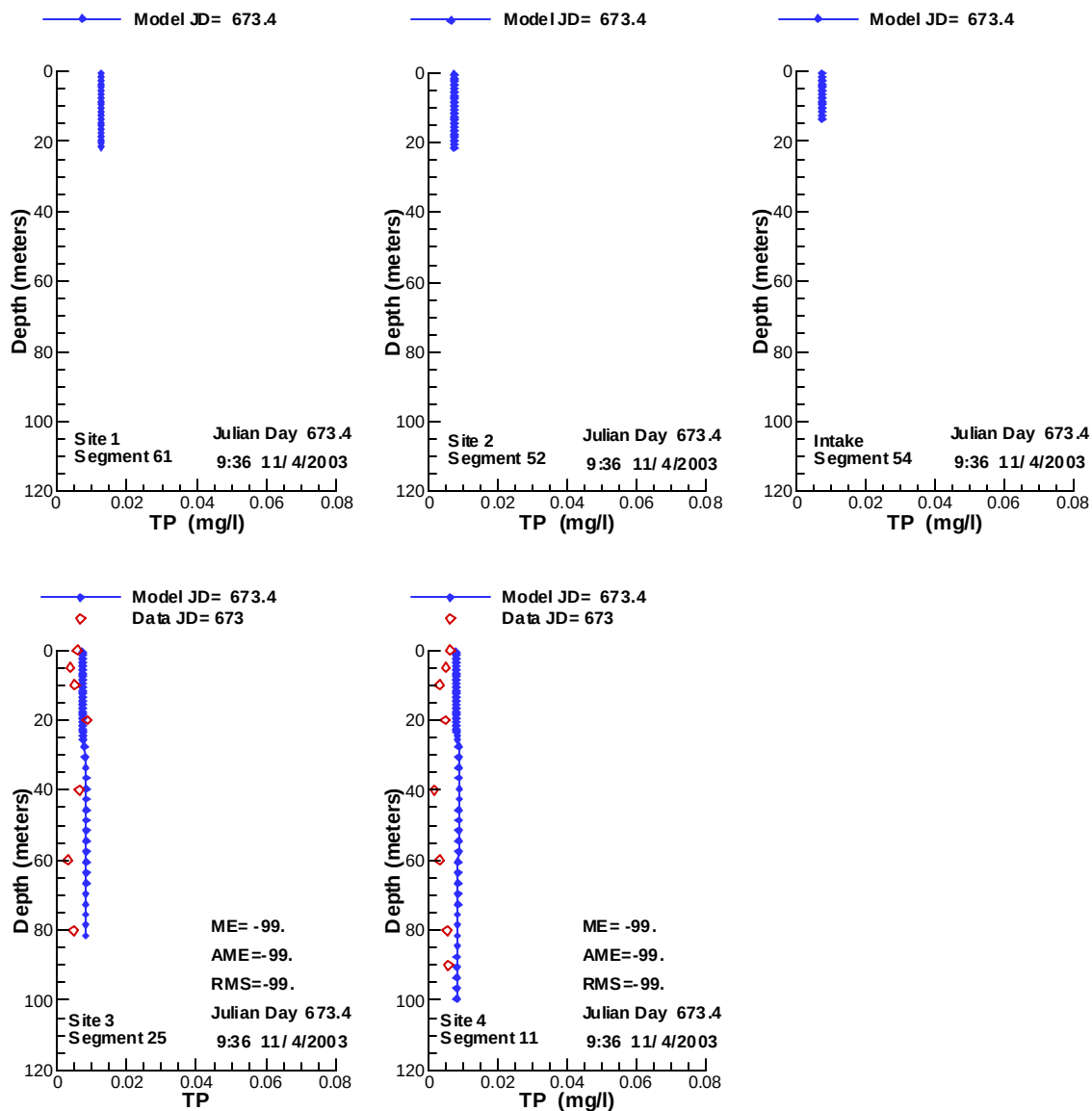


Figure 508. Vertical profiles of TOTAL PHOSPHORUS compared with data for 11/ 4/2003.

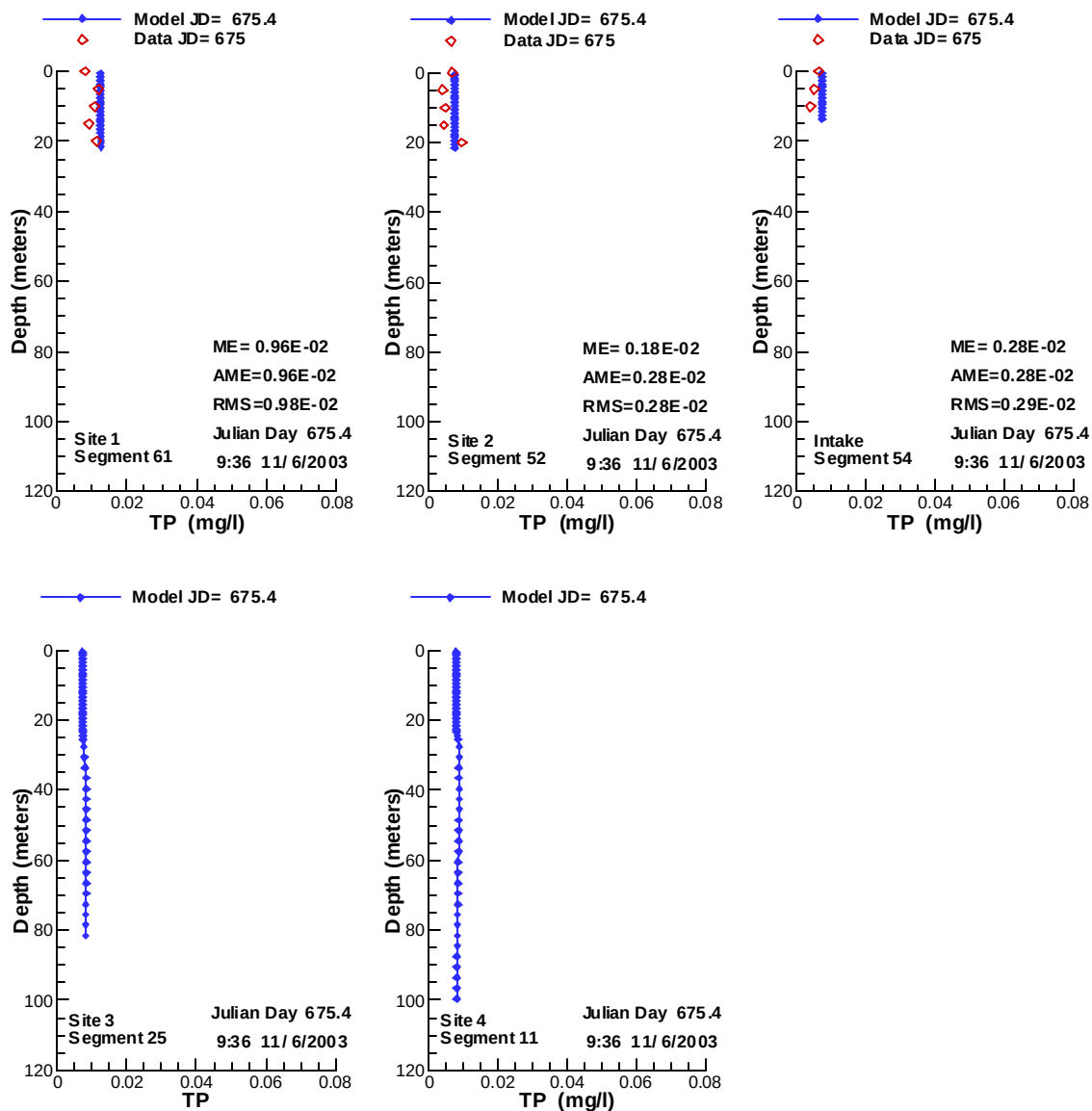


Figure 509. Vertical profiles of TOTAL PHOSPHORUS compared with data for 11/ 6/2003.

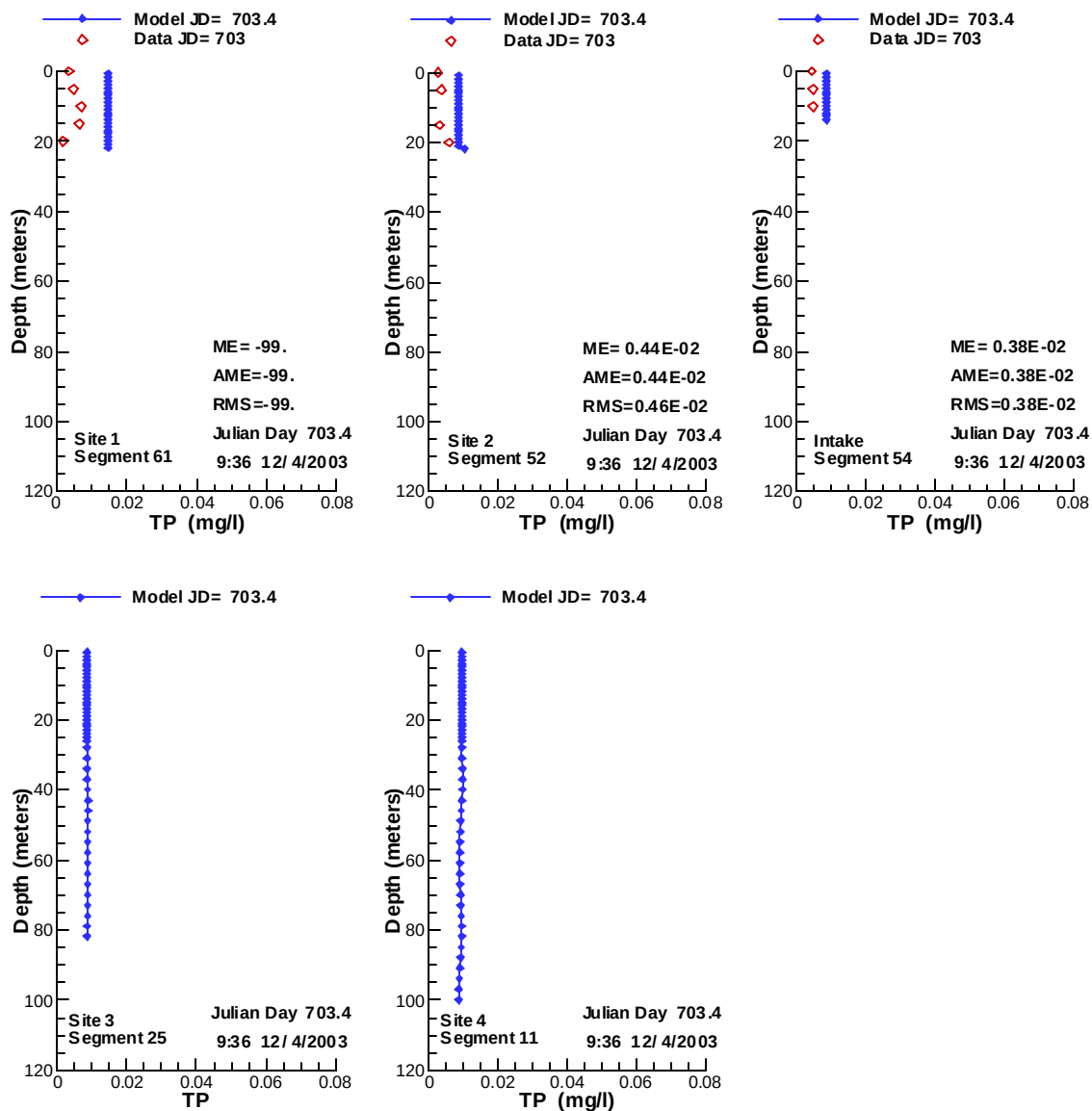


Figure 510. Vertical profiles of TOTAL PHOSPHORUS compared with data for 12/ 4/2003.

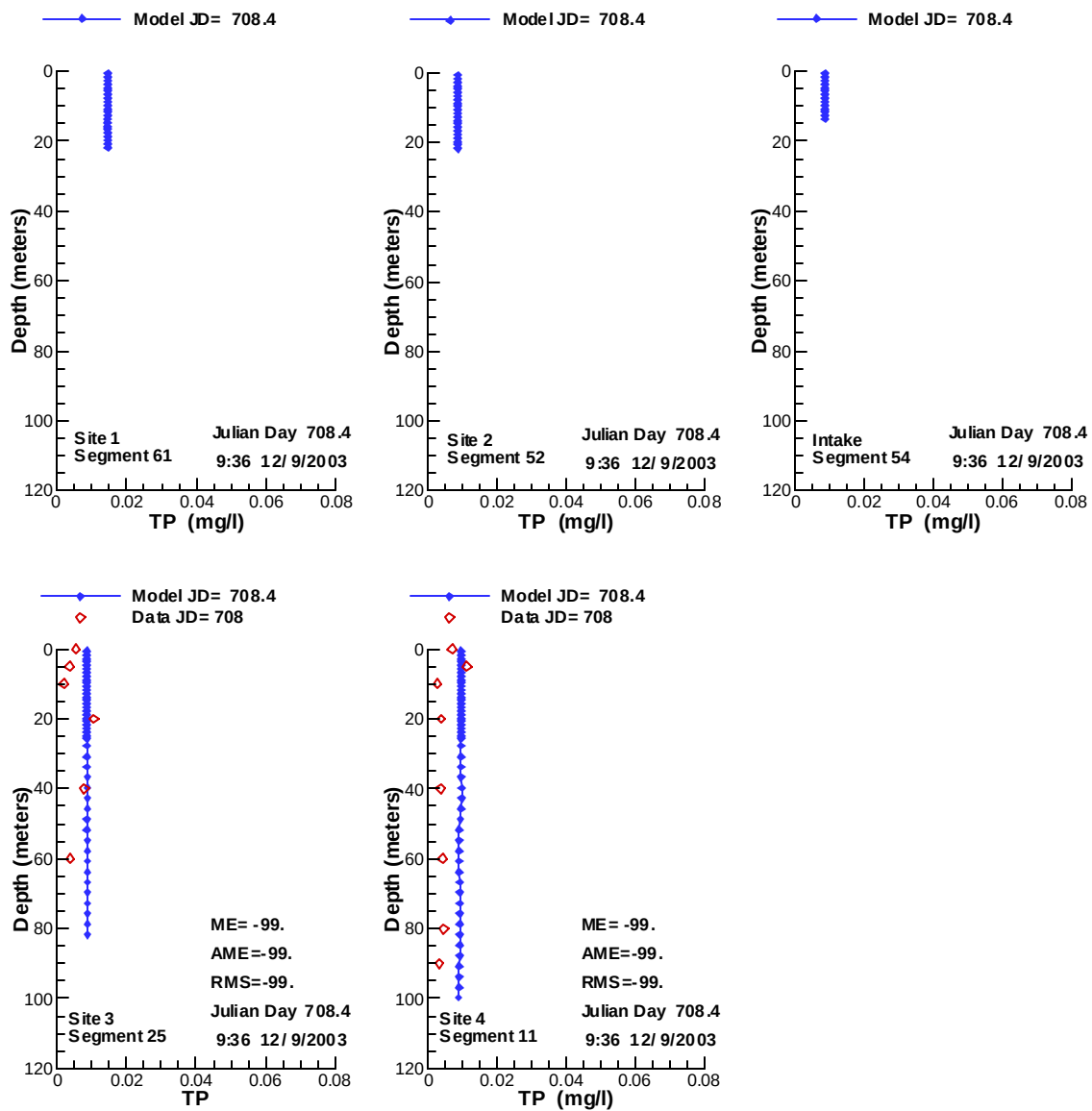


Figure 511. Vertical profiles of TOTAL PHOSPHORUS compared with data for 12/ 9/2003.

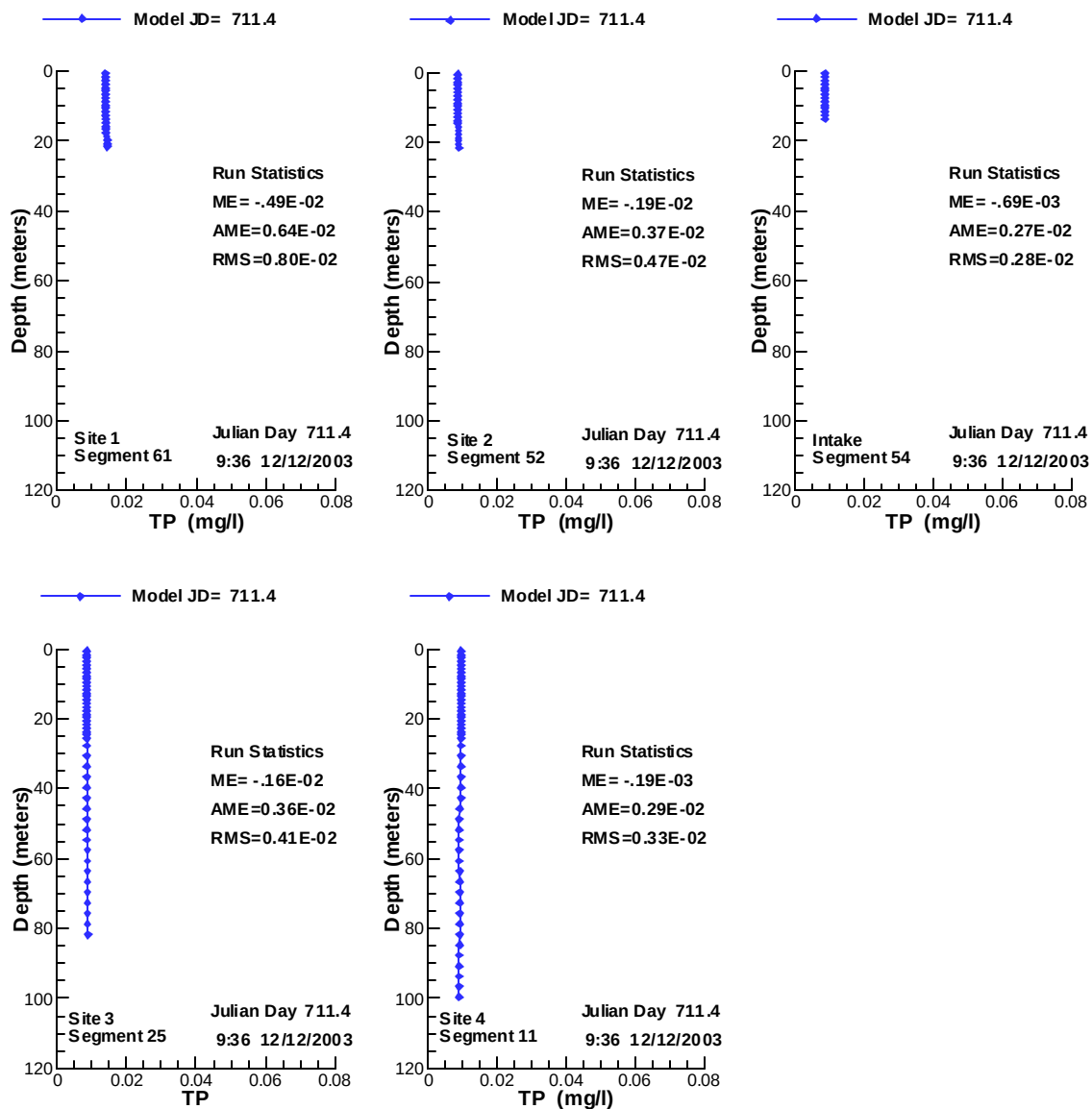


Figure 512. Vertical profiles of TOTAL PHOSPHORUS compared with data for 12/12/2003.

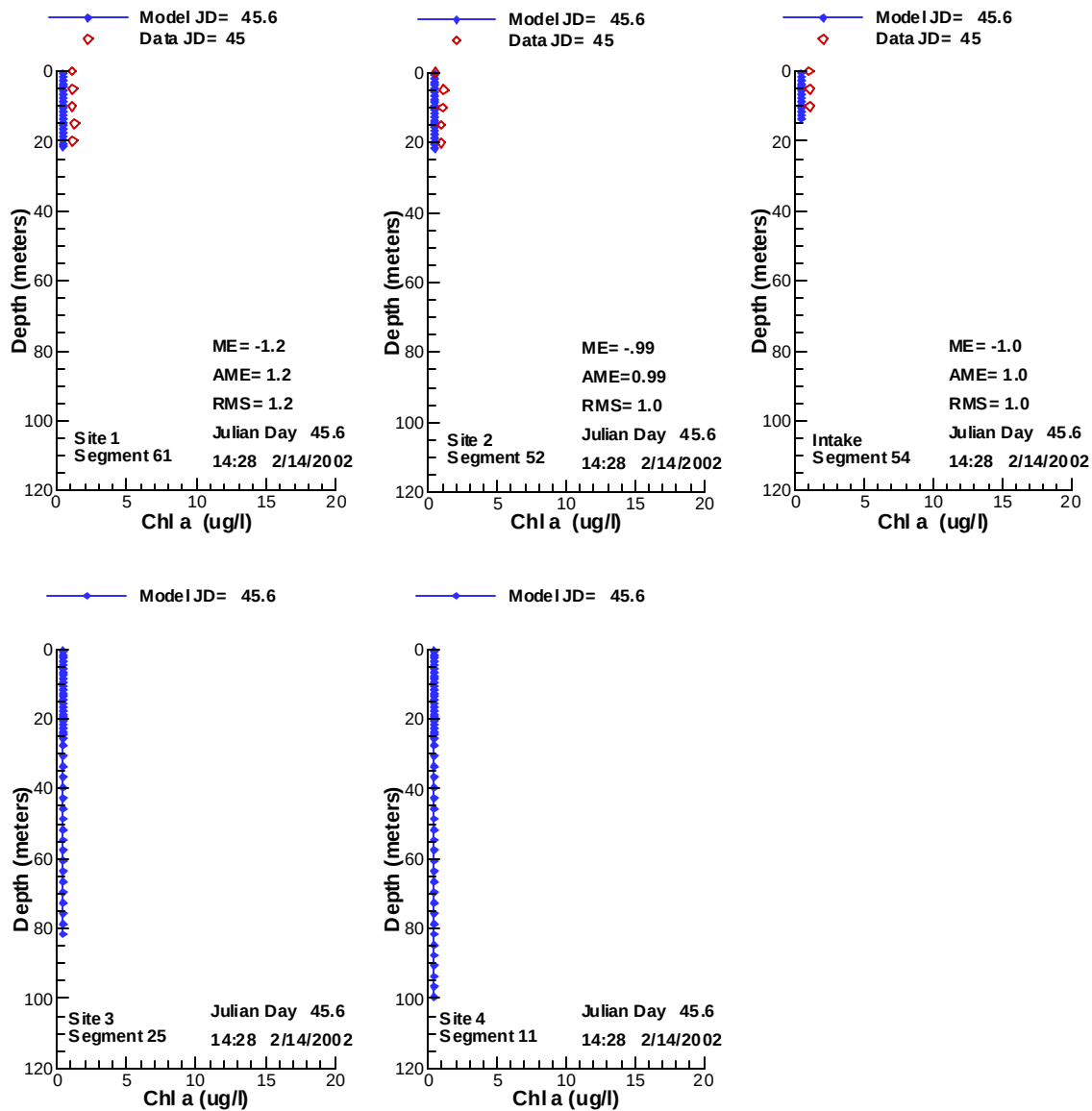


Figure 513. Vertical profiles of Chlorophyll compared with data for 2/14/2002.

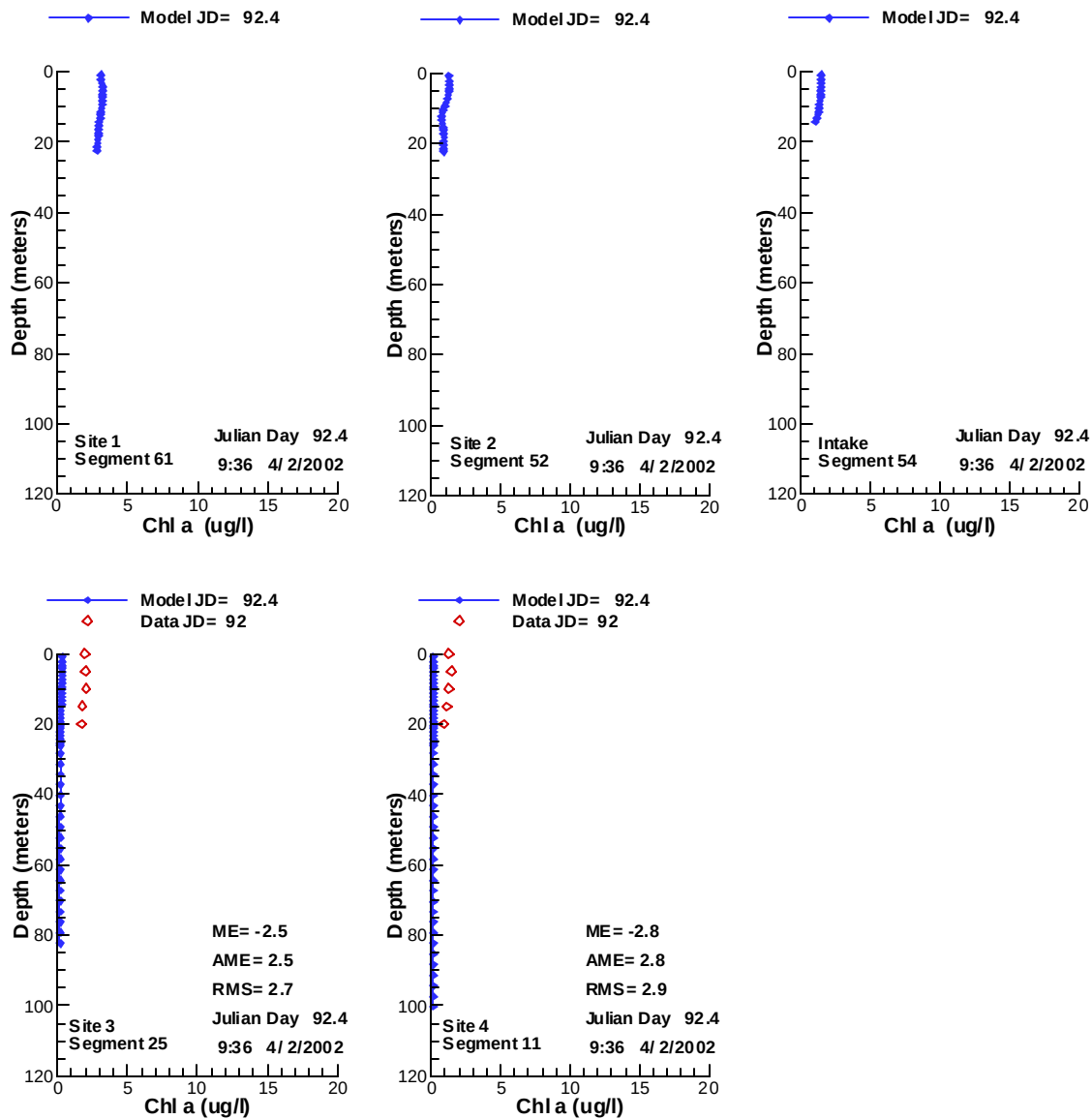


Figure 514. Vertical profiles of Chlorophyll compared with data for 4/ 2/2002.

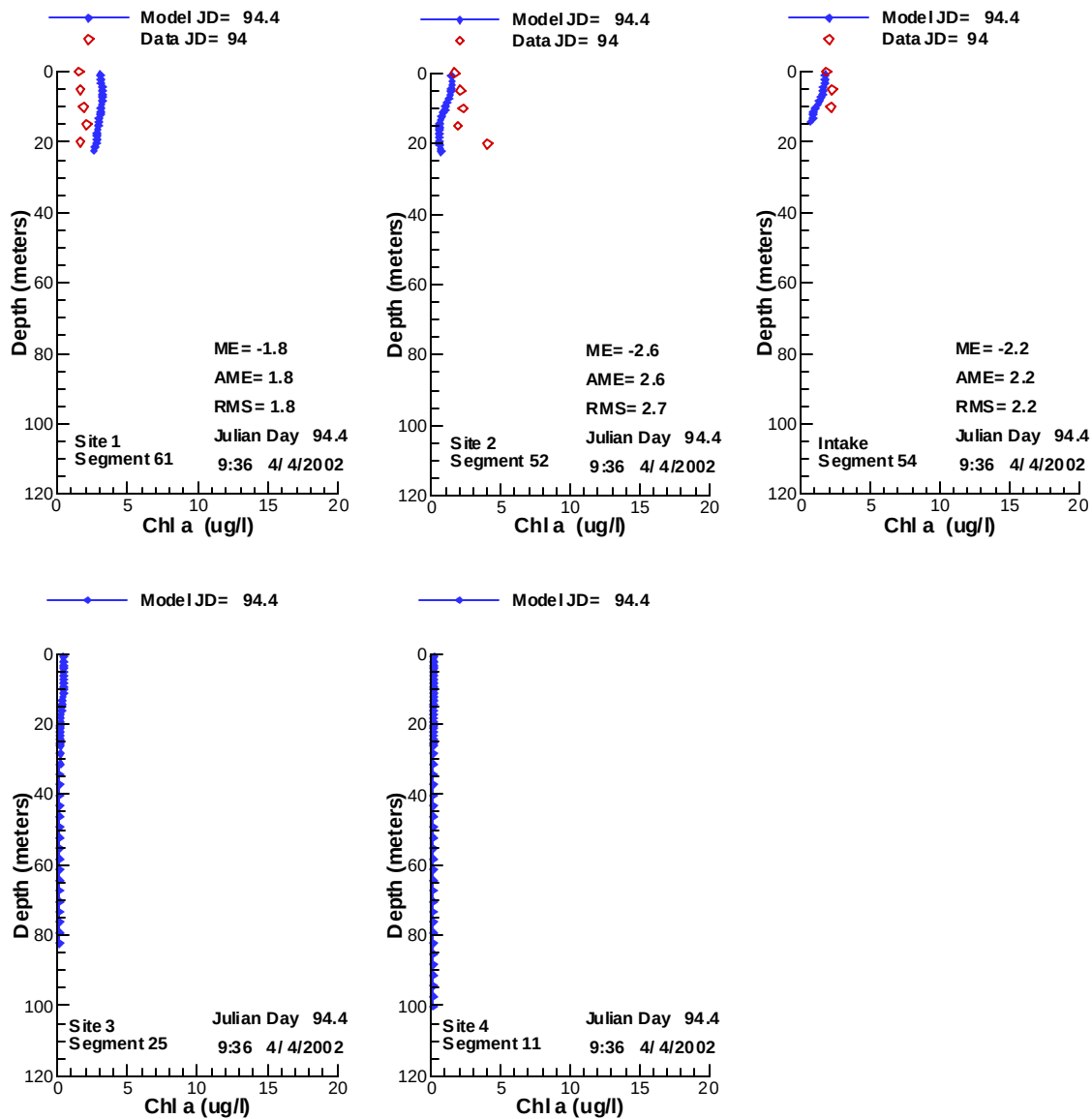


Figure 515. Vertical profiles of Chlorophyll compared with data for 4/ 4/2002.

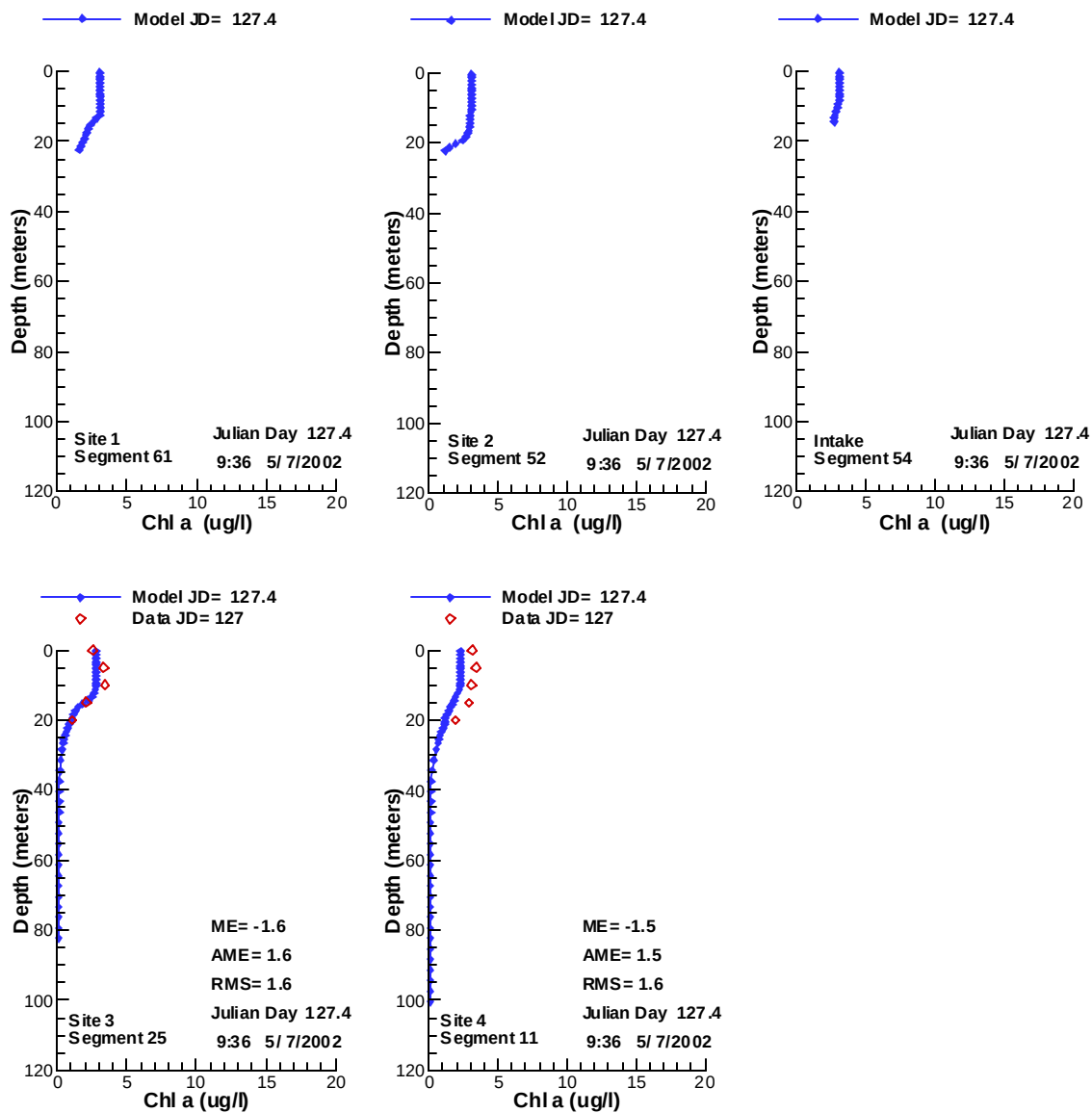


Figure 516. Vertical profiles of Chlorophyll compared with data for 5/ 7/2002.

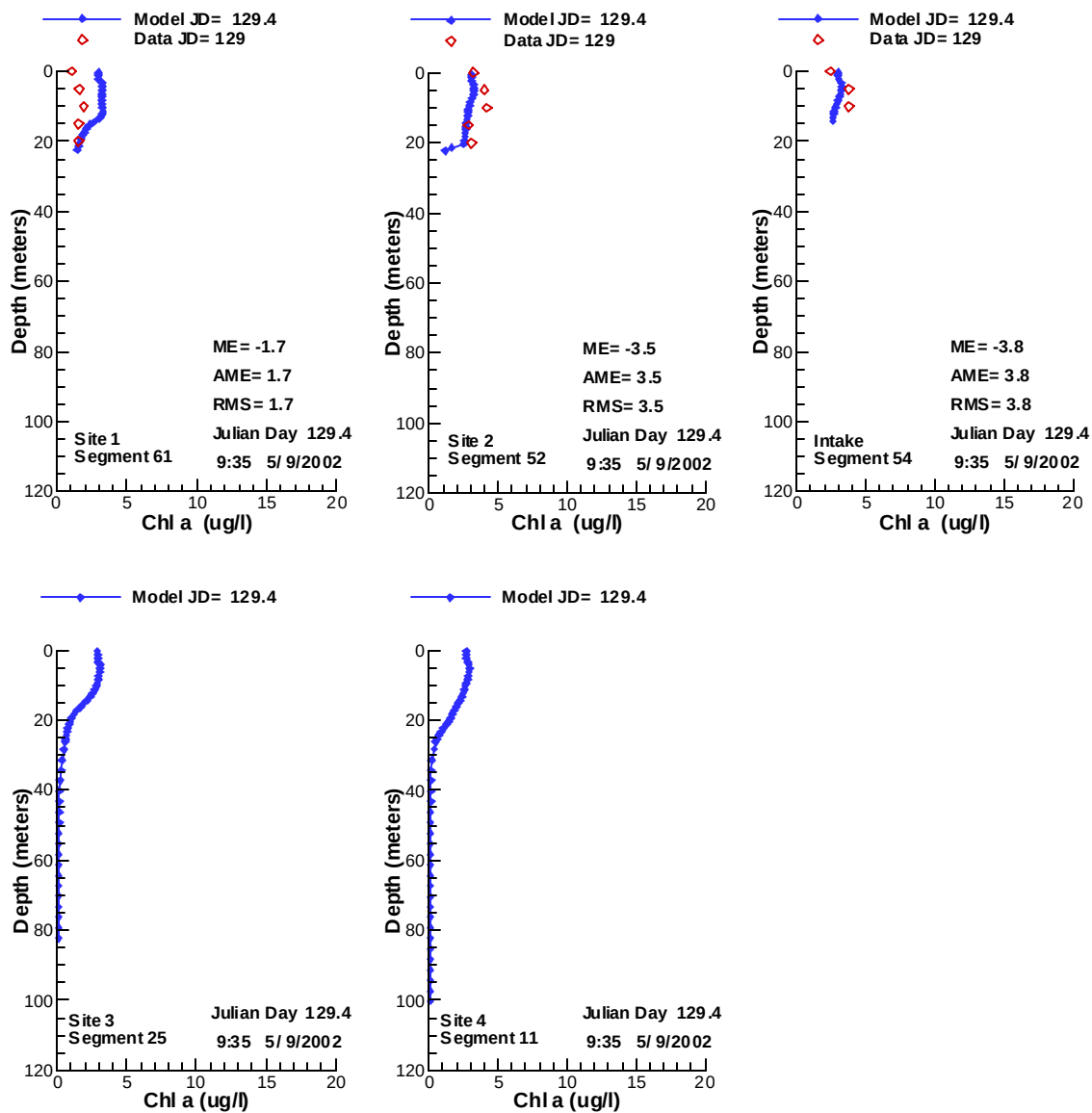


Figure 517. Vertical profiles of Chlorophyll compared with data for 5/ 9/2002.

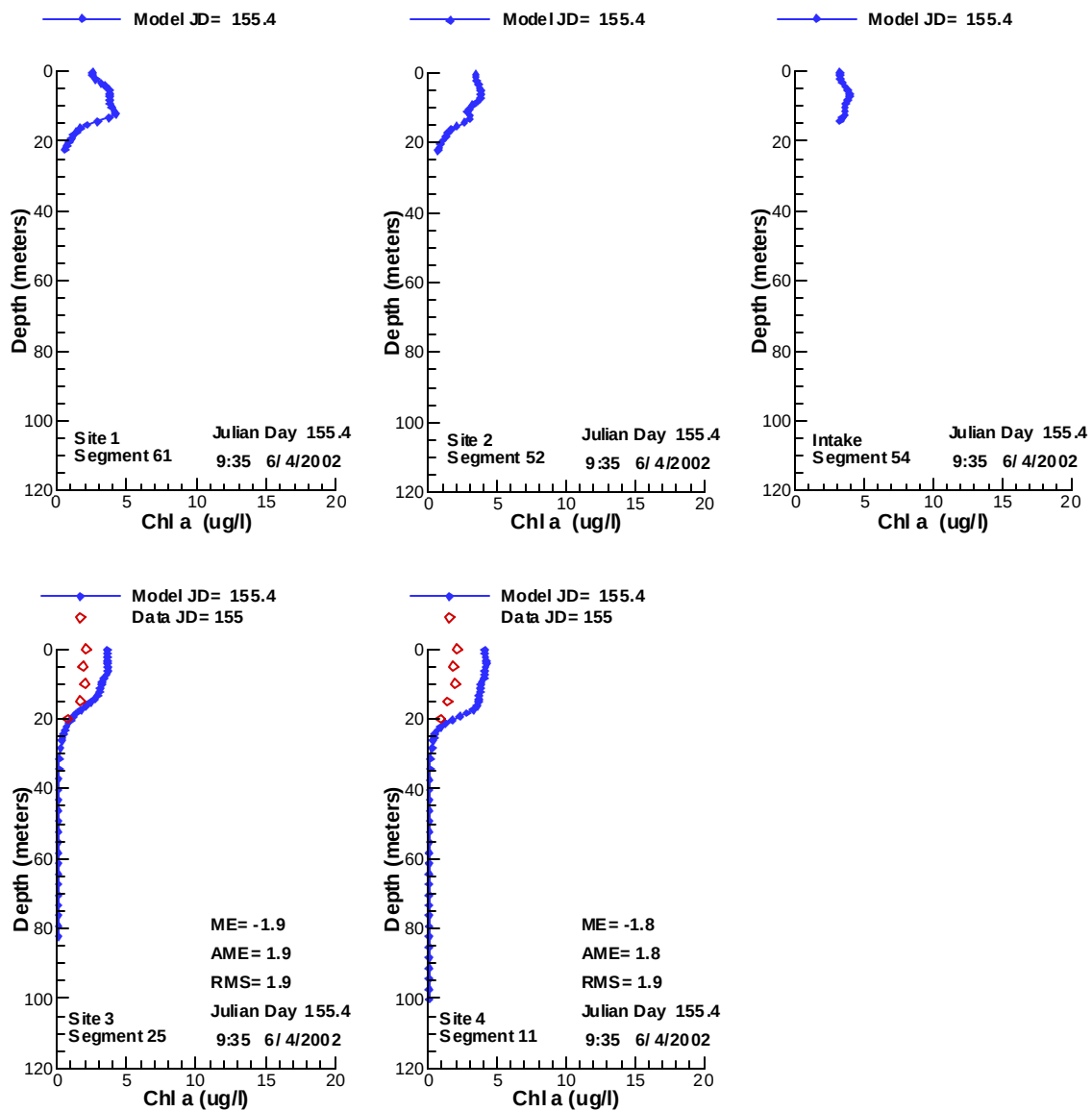


Figure 518. Vertical profiles of Chlorophyll compared with data for 6/ 4/2002.

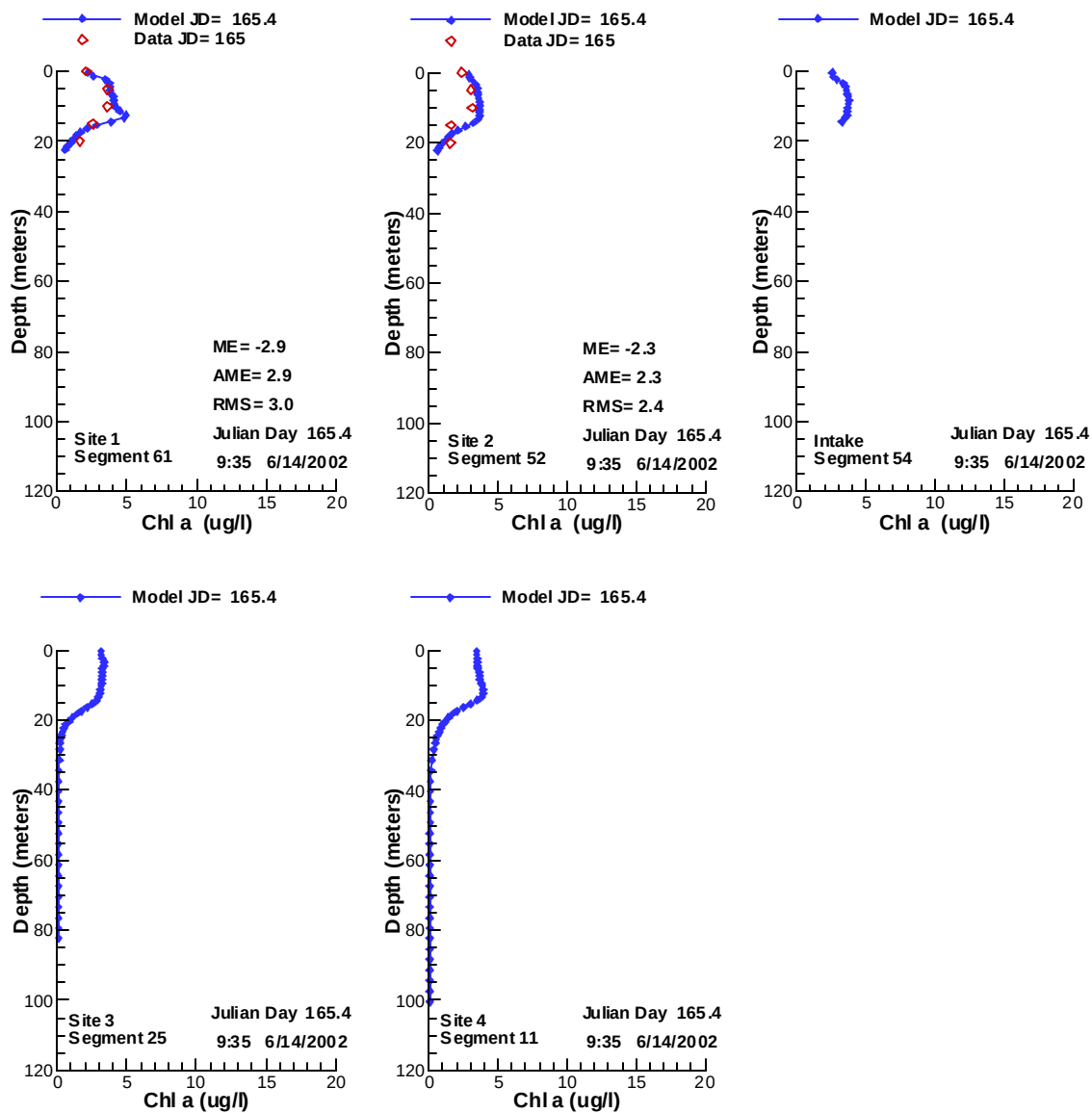


Figure 519. Vertical profiles of Chlorophyll compared with data for 6/14/2002.

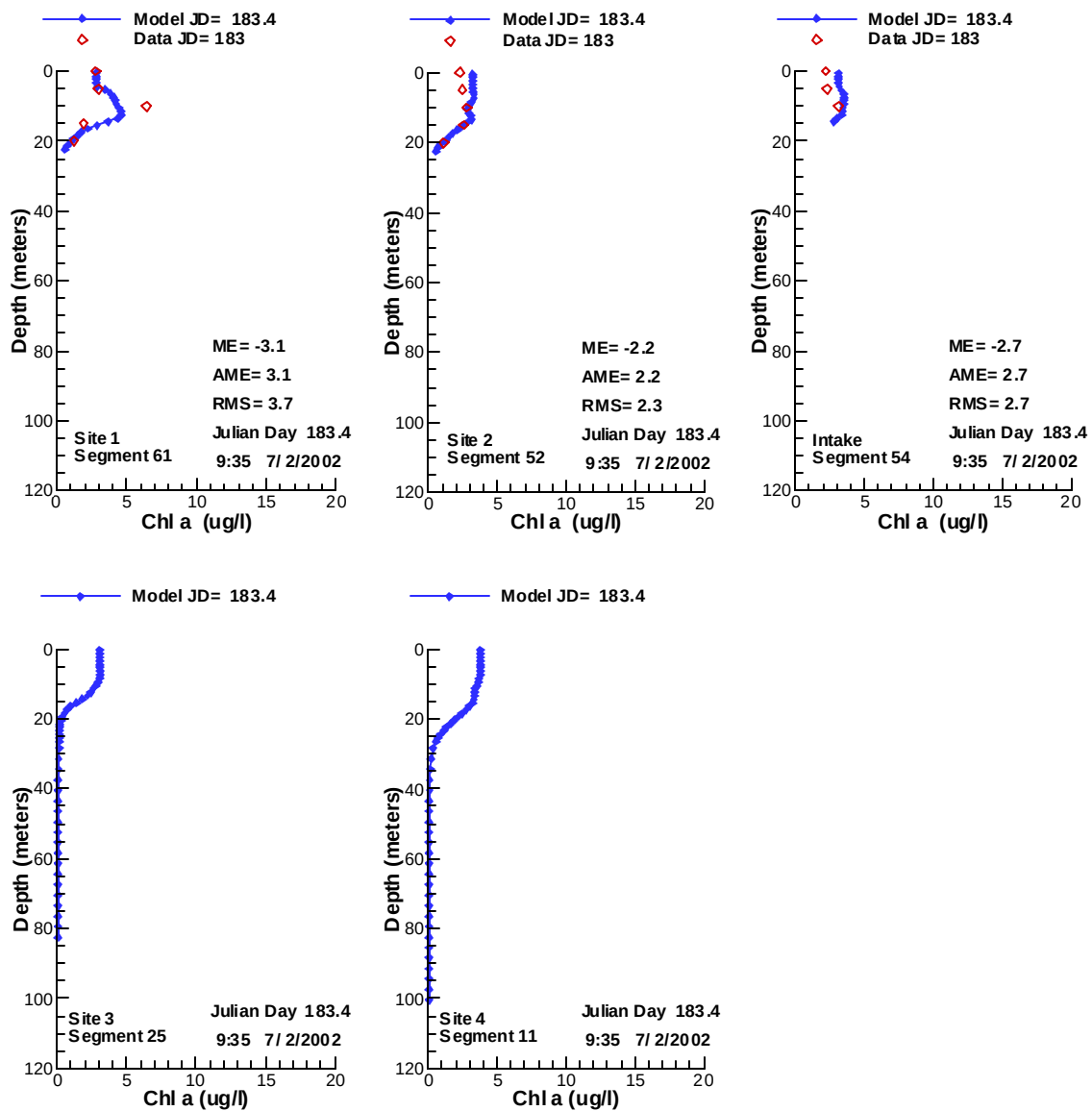


Figure 520. Vertical profiles of Chlorophyll compared with data for 7/ 2/2002.

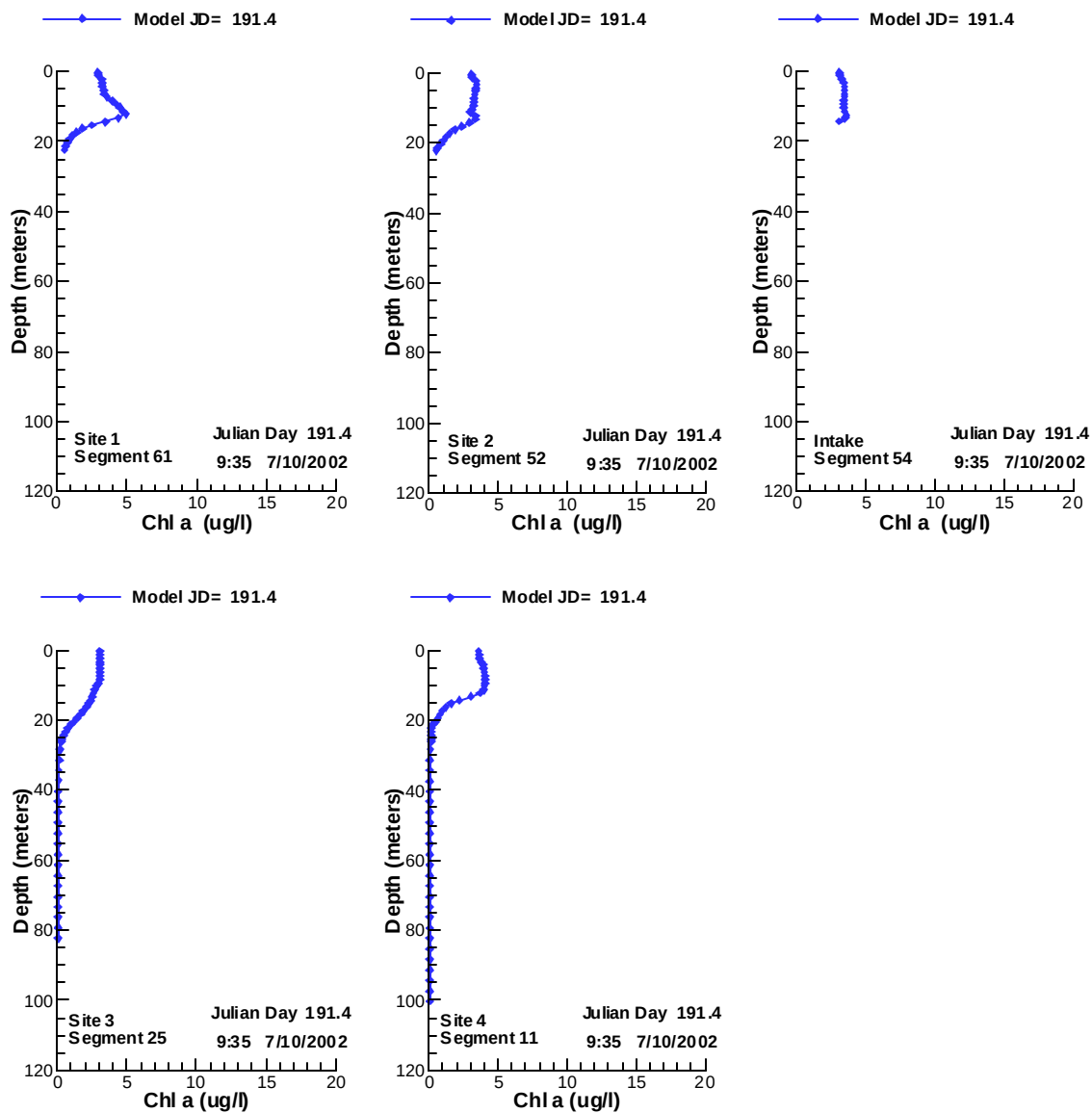


Figure 521. Vertical profiles of Chlorophyll compared with data for 7/10/2002.

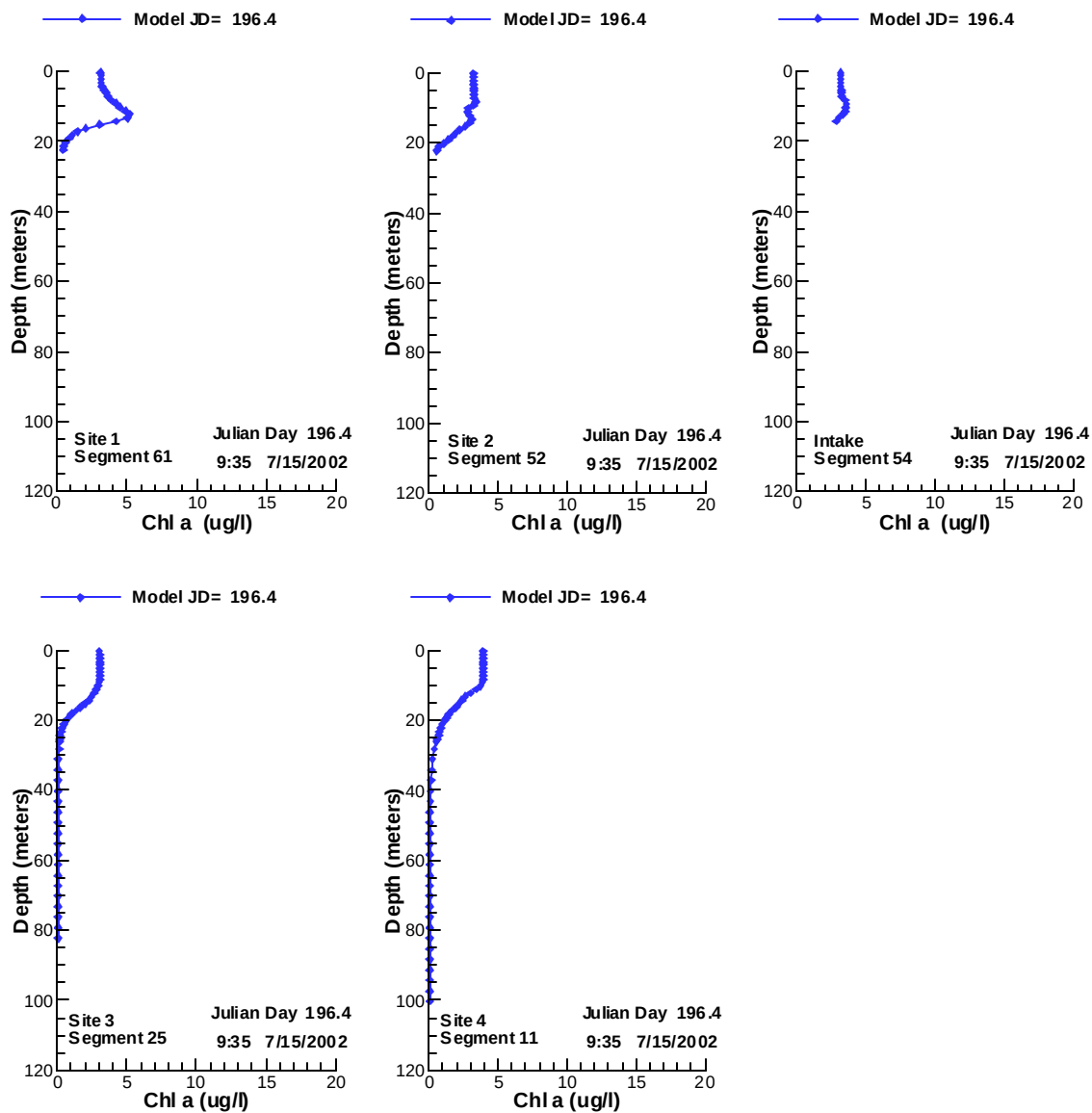


Figure 522. Vertical profiles of Chlorophyll compared with data for 7/15/2002.

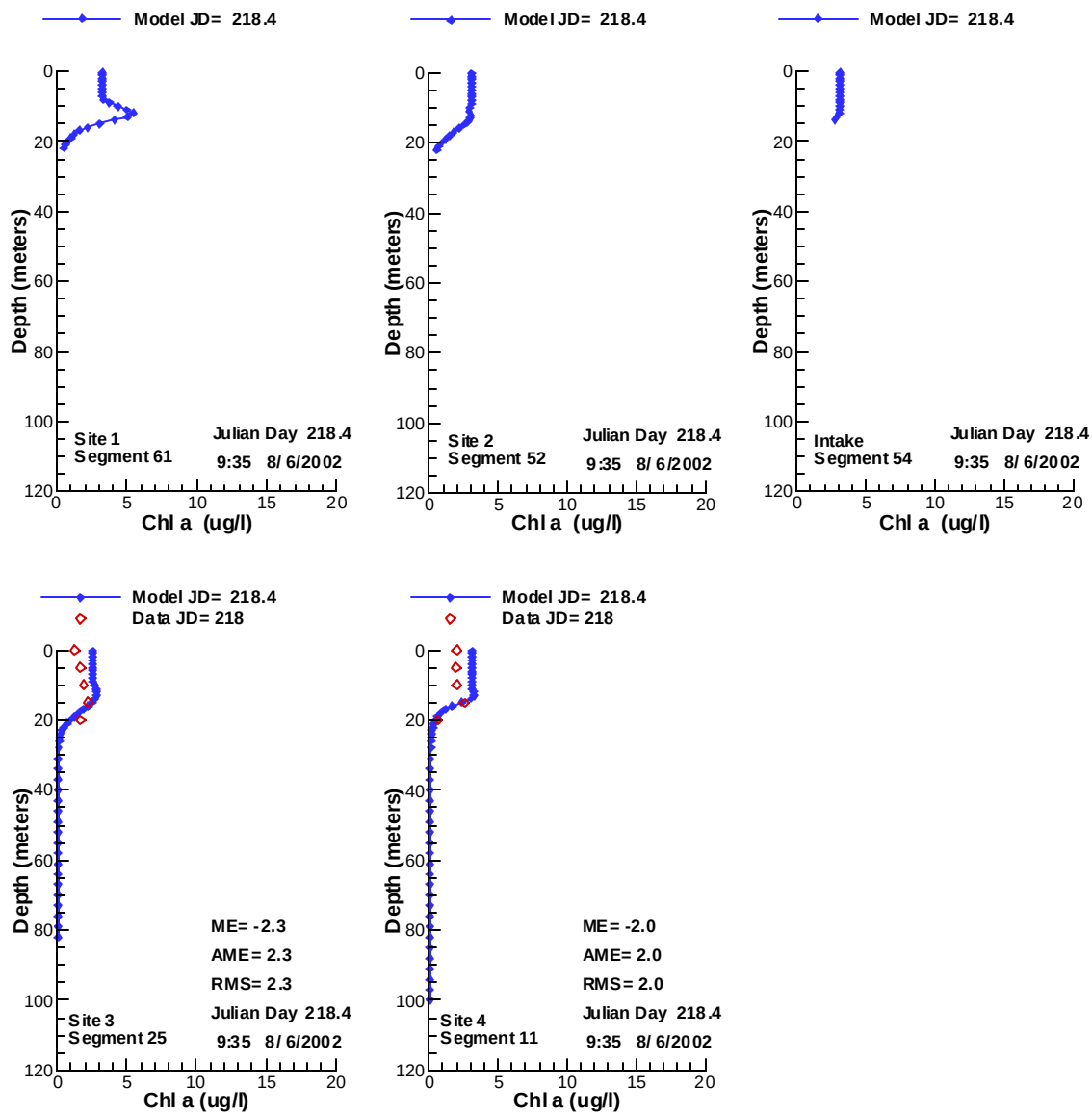


Figure 523. Vertical profiles of Chlorophyll compared with data for 8/ 6/2002.

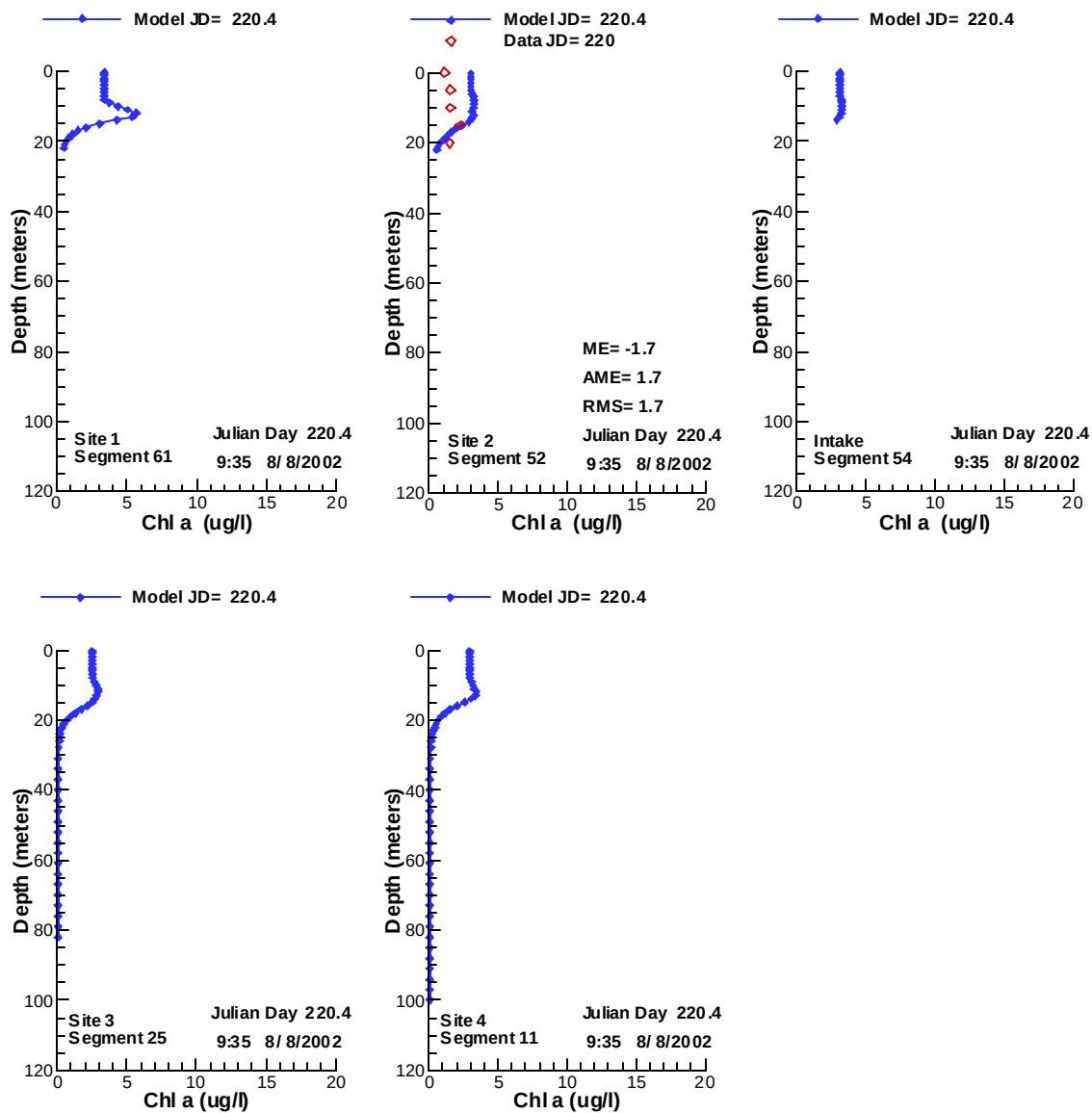


Figure 524. Vertical profiles of Chlorophyll compared with data for 8/ 8/2002.

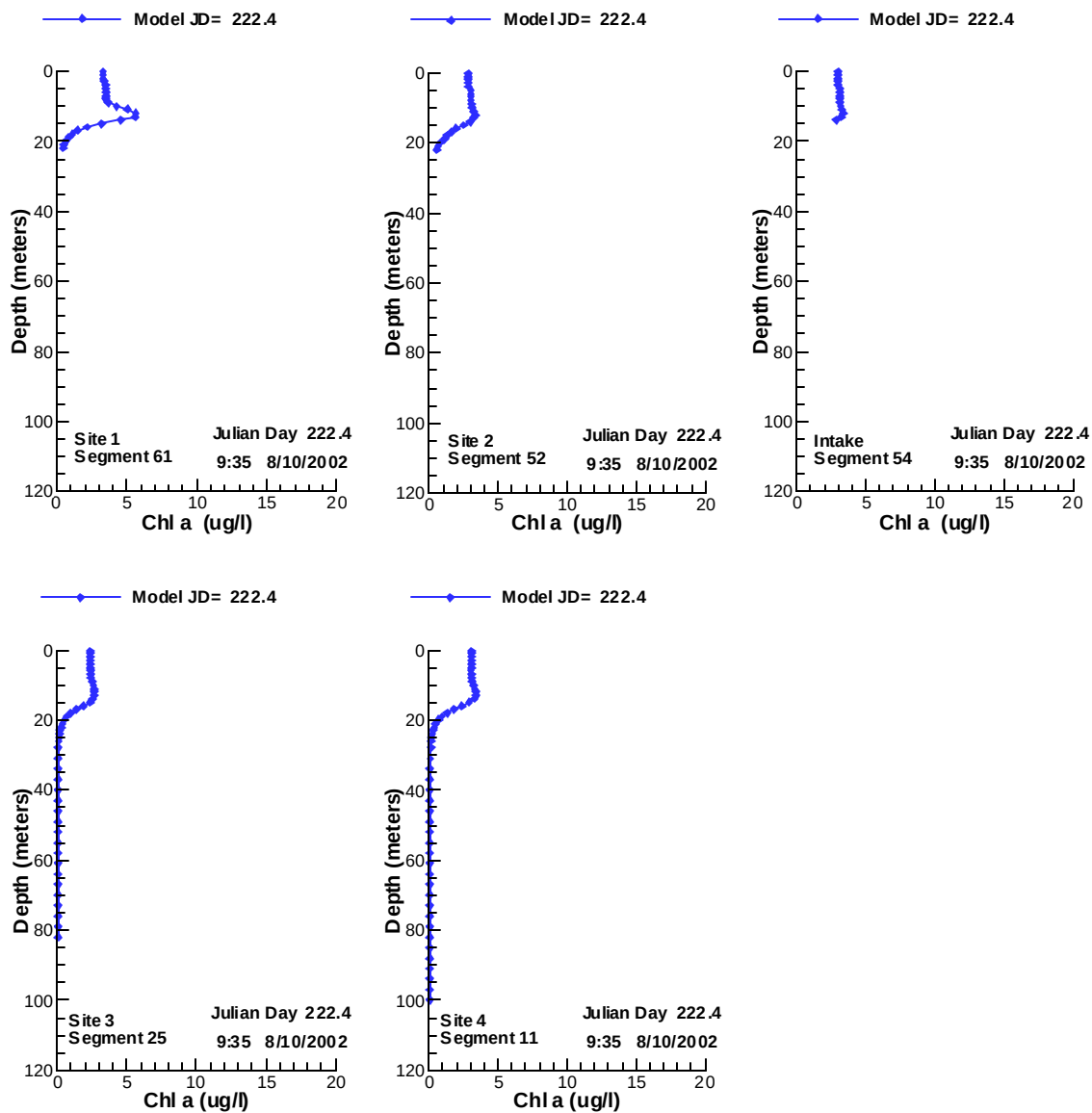


Figure 525. Vertical profiles of Chlorophyll compared with data for 8/10/2002.

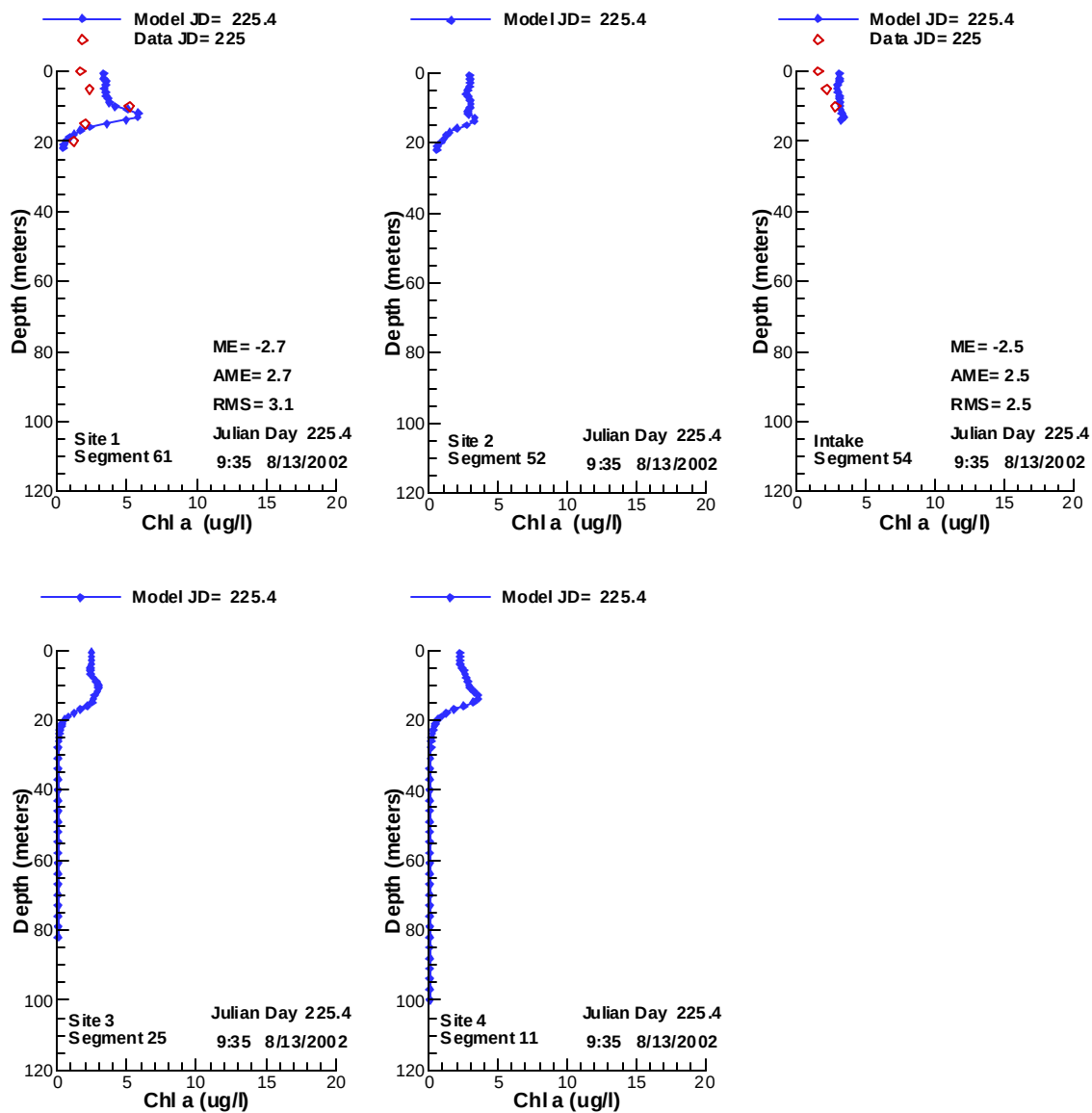


Figure 526. Vertical profiles of Chlorophyll compared with data for 8/13/2002.

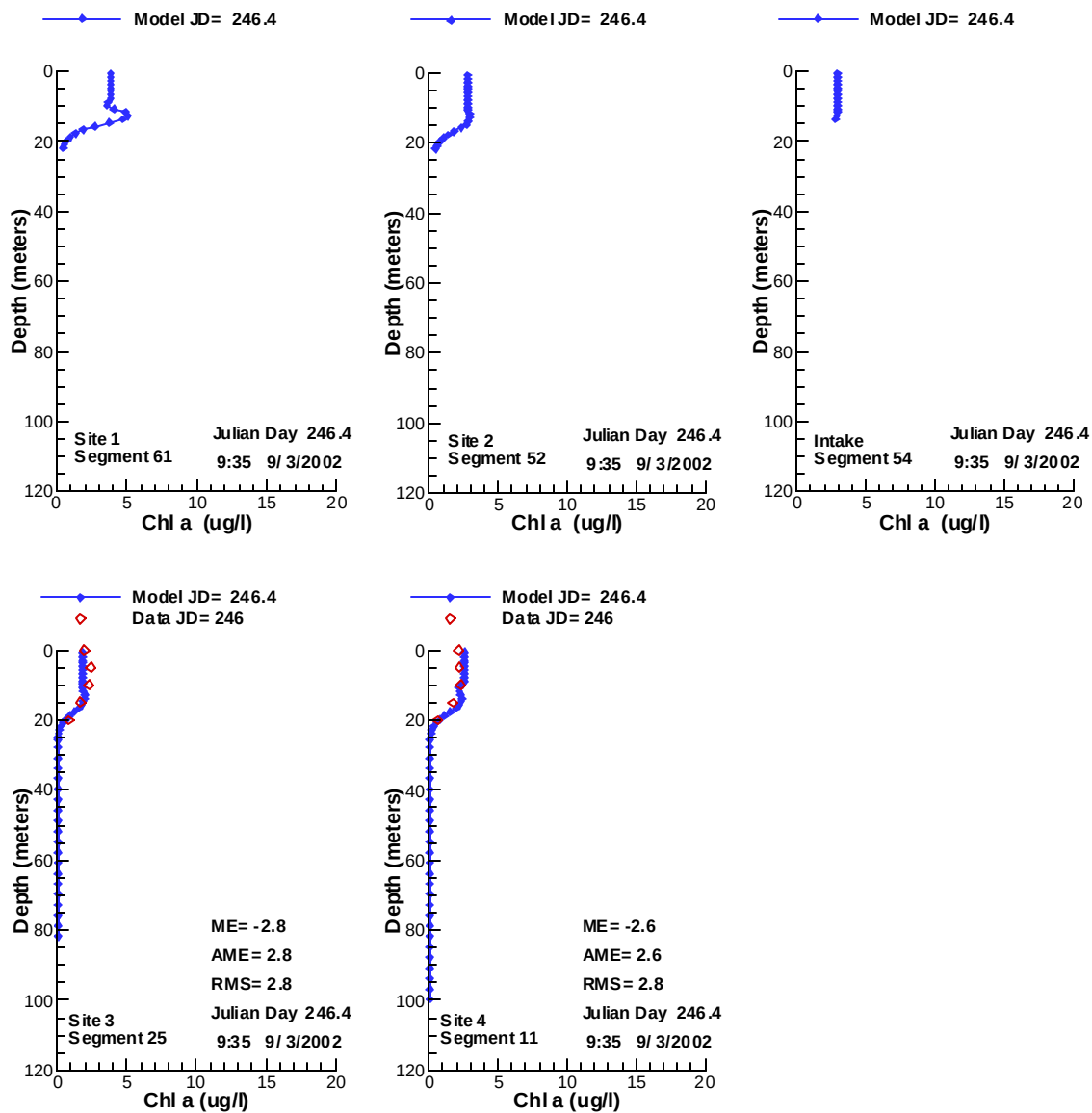


Figure 527. Vertical profiles of Chlorophyll compared with data for 9/ 3/2002.

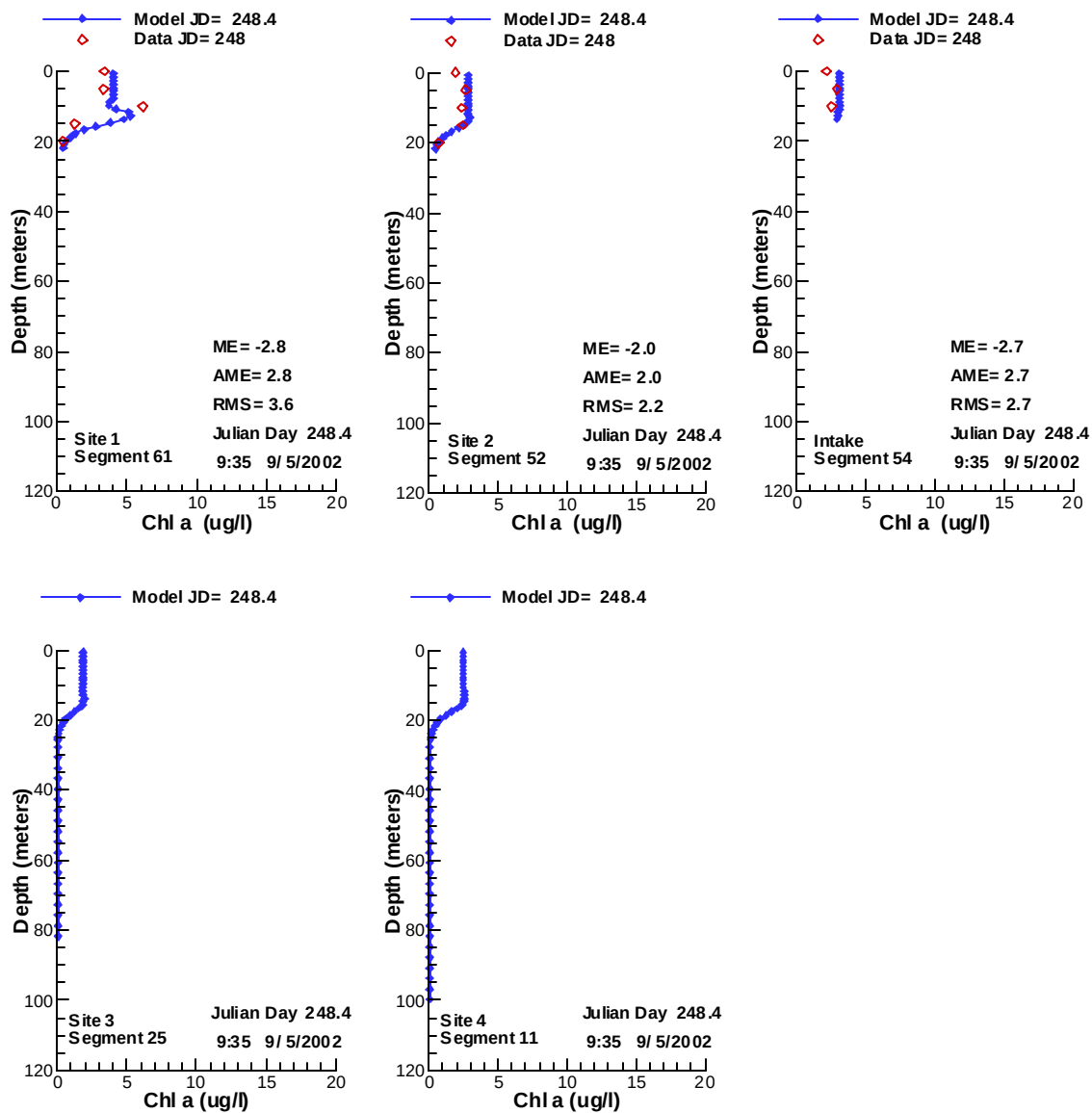


Figure 528. Vertical profiles of Chlorophyll compared with data for 9/ 5/2002.

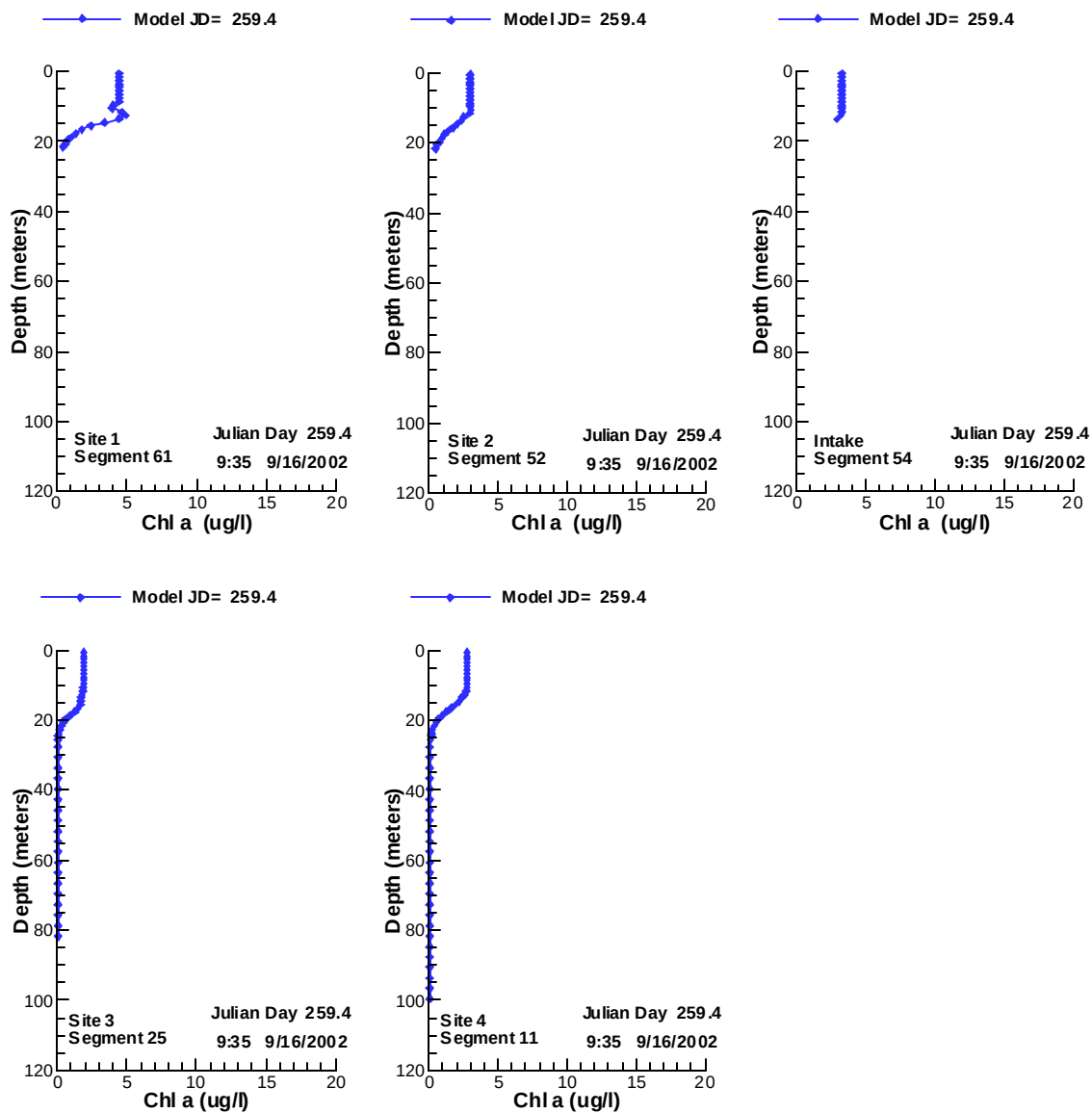


Figure 529. Vertical profiles of Chlorophyll compared with data for 9/16/2002.

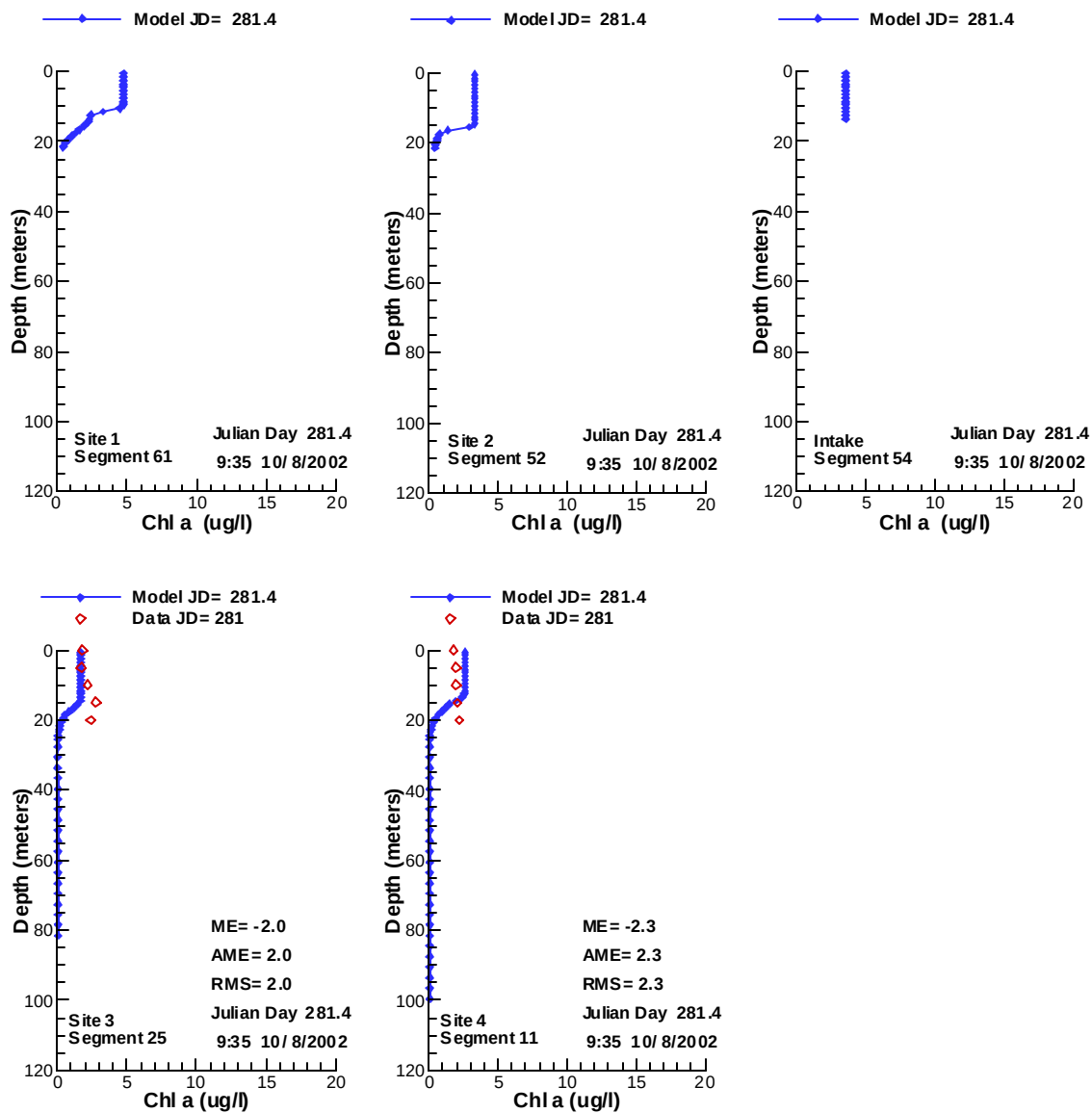


Figure 530. Vertical profiles of Chlorophyll compared with data for 10/ 8/2002.

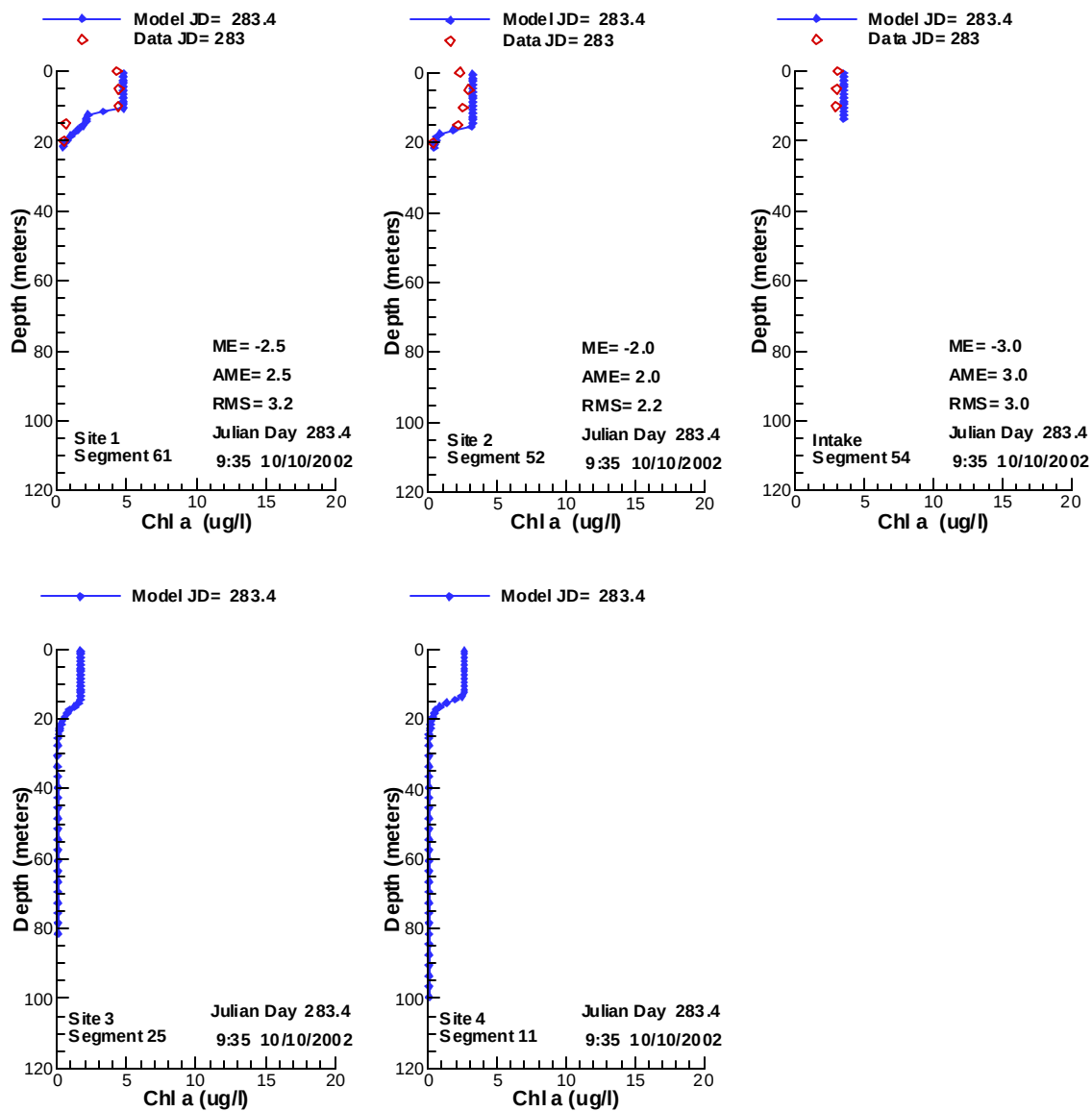


Figure 531. Vertical profiles of Chlorophyll compared with data for 10/10/2002.

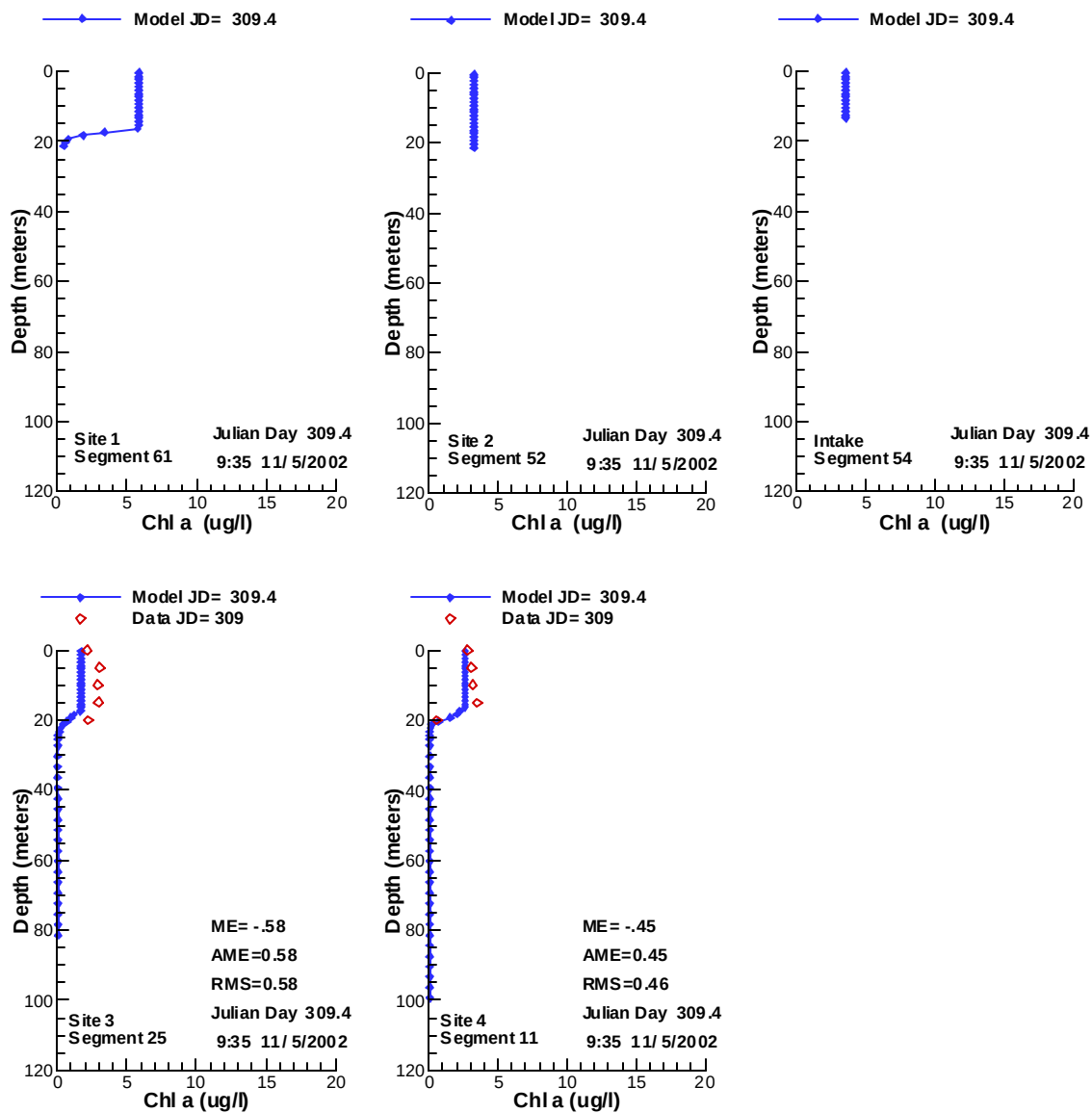


Figure 532. Vertical profiles of Chlorophyll compared with data for 11/ 5/2002.

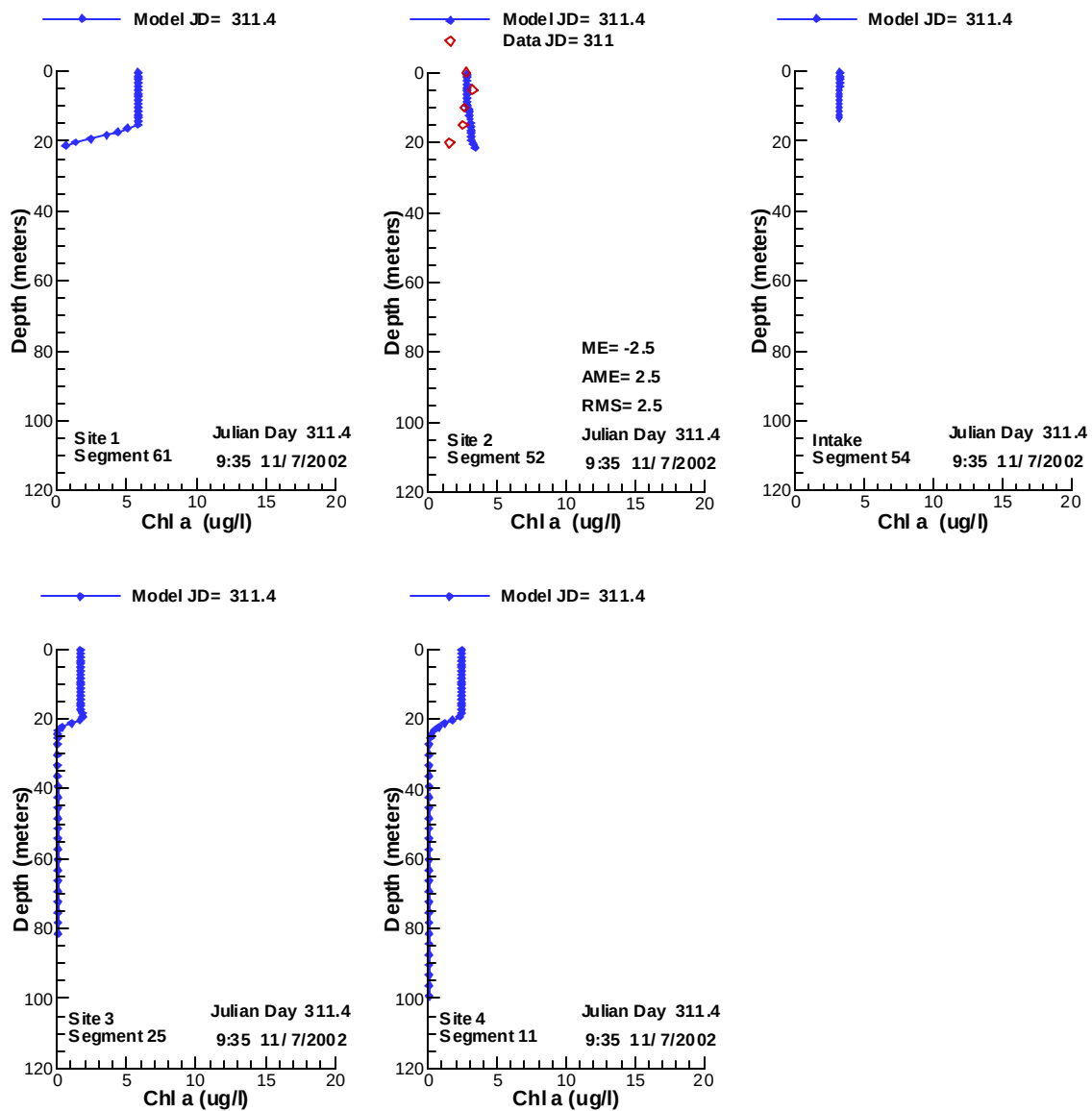


Figure 533. Vertical profiles of Chlorophyll compared with data for 11/ 7/2002.

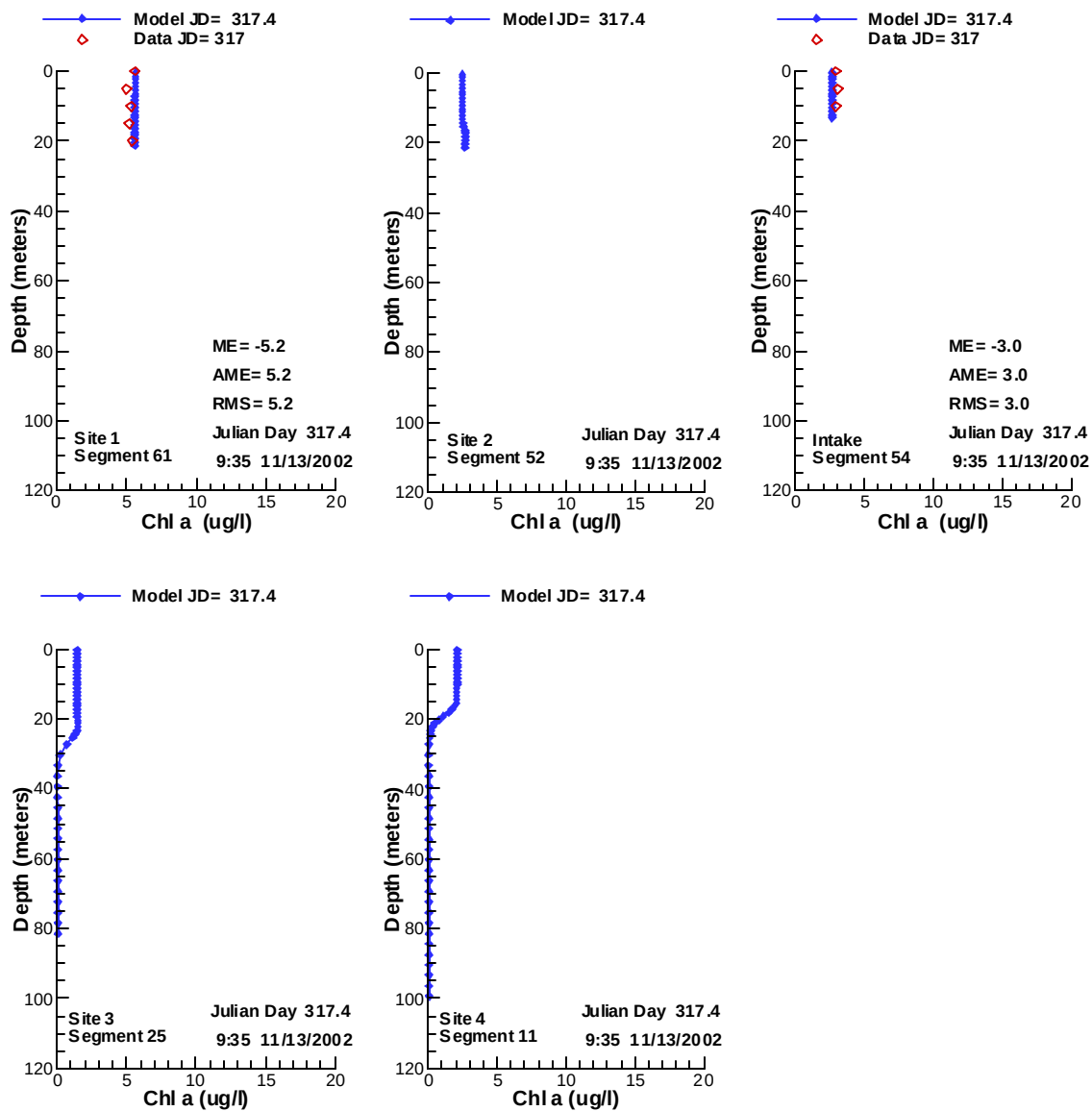


Figure 534. Vertical profiles of Chlorophyll compared with data for 11/13/2002.

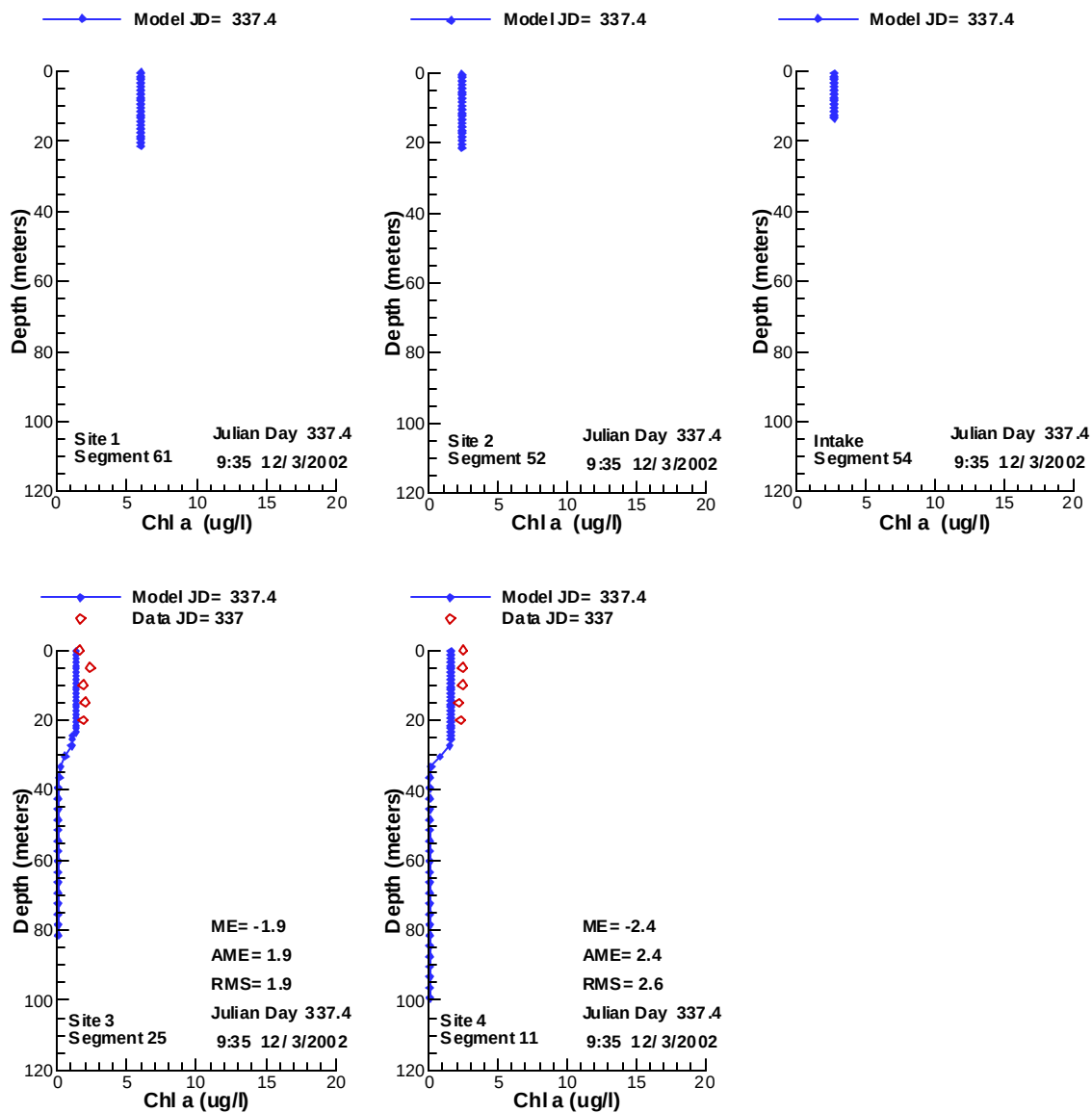


Figure 535. Vertical profiles of Chlorophyll compared with data for 12/ 3/2002.

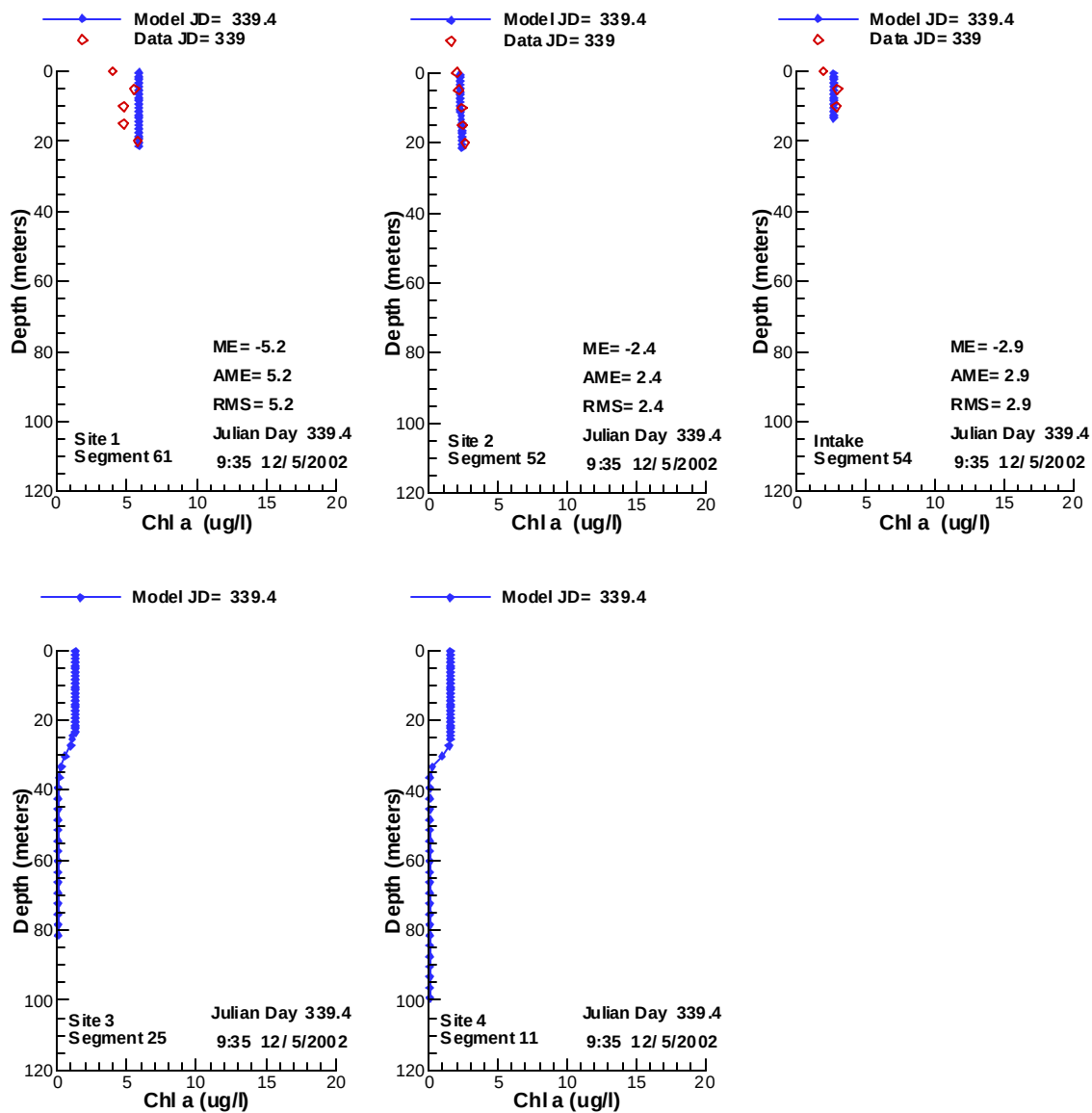


Figure 536. Vertical profiles of Chlorophyll compared with data for 12/ 5/2002.

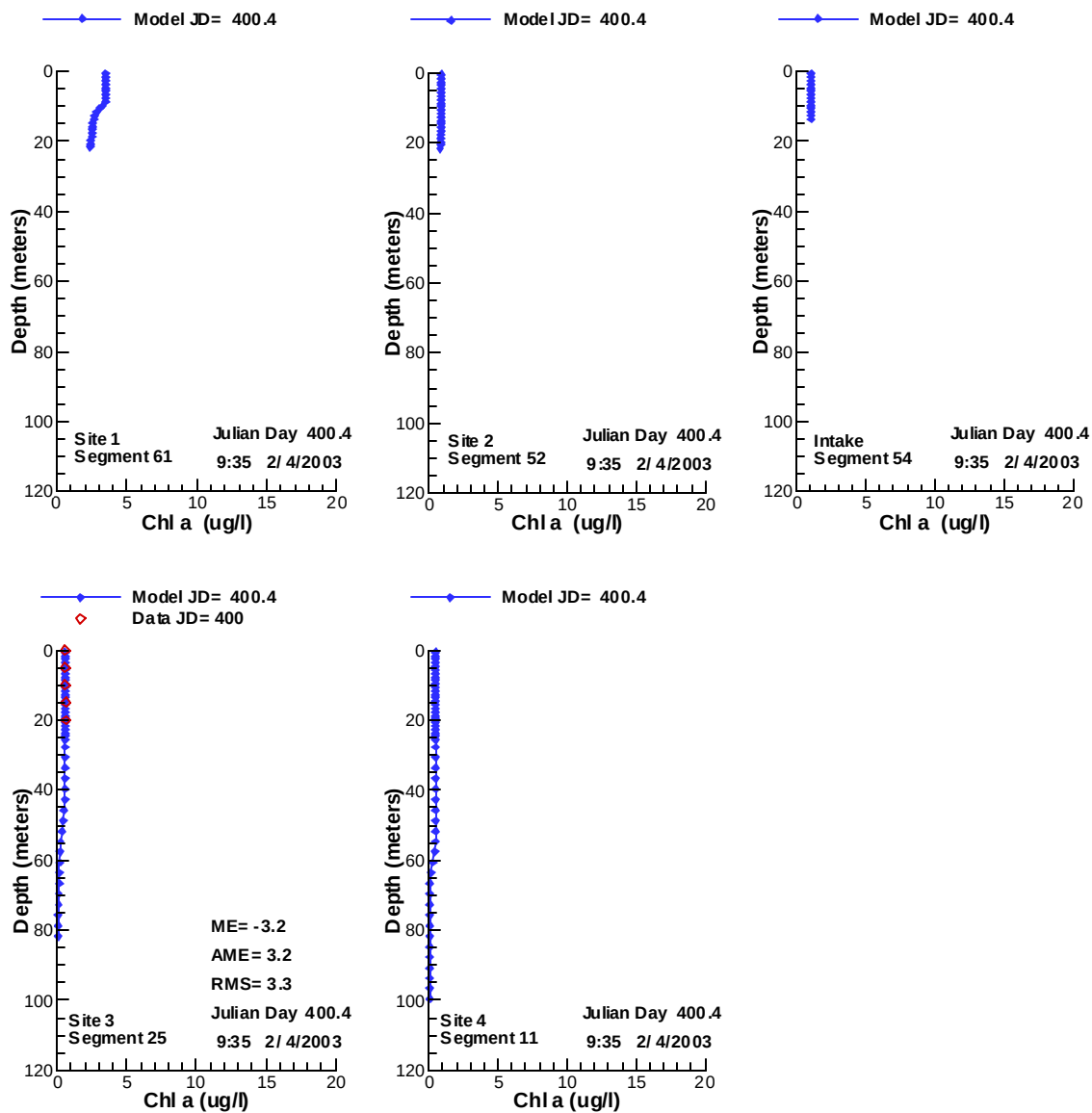


Figure 537. Vertical profiles of Chlorophyll compared with data for 2/ 4/2003.

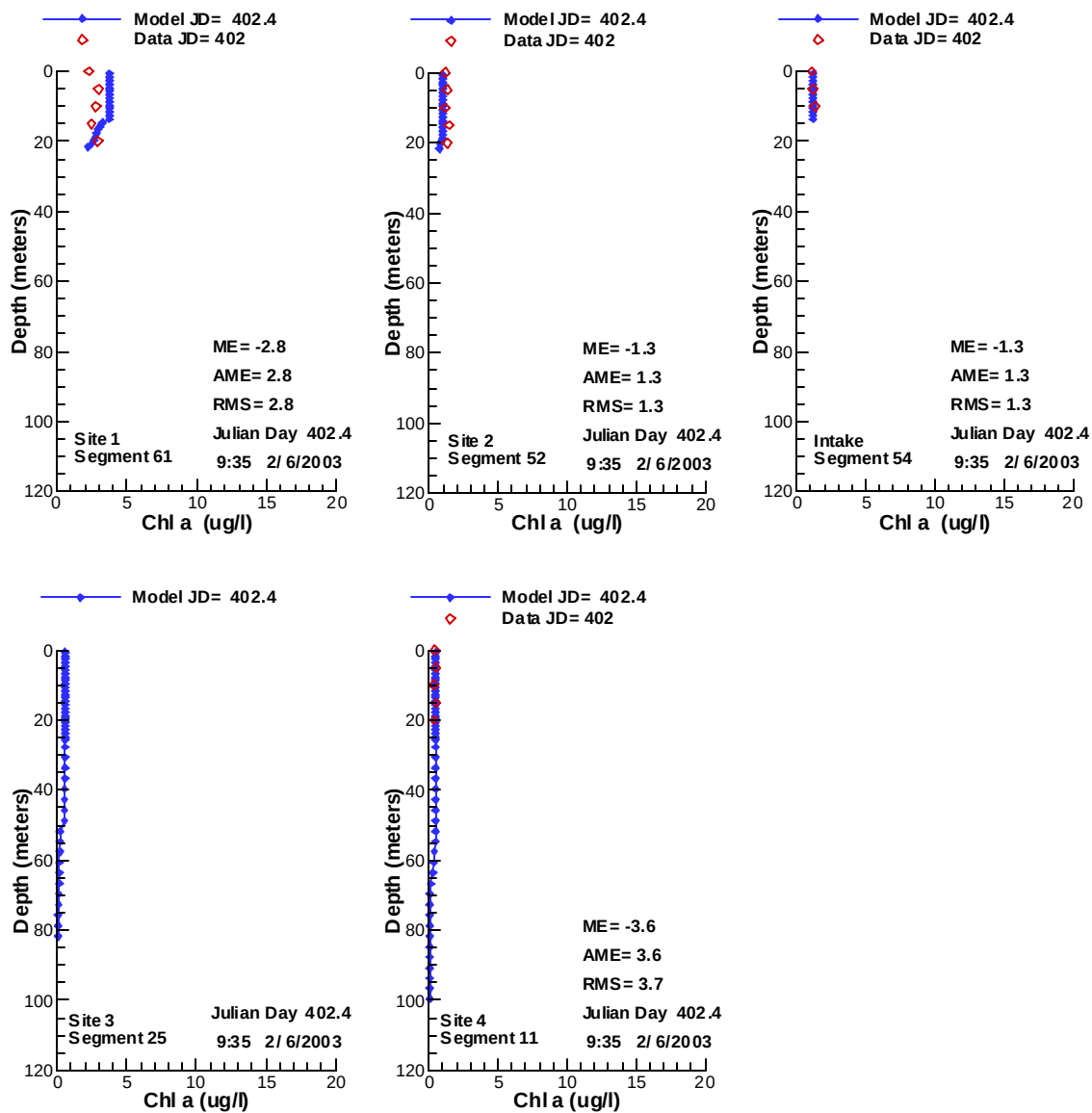


Figure 538. Vertical profiles of Chlorophyll compared with data for 2/ 6/2003.

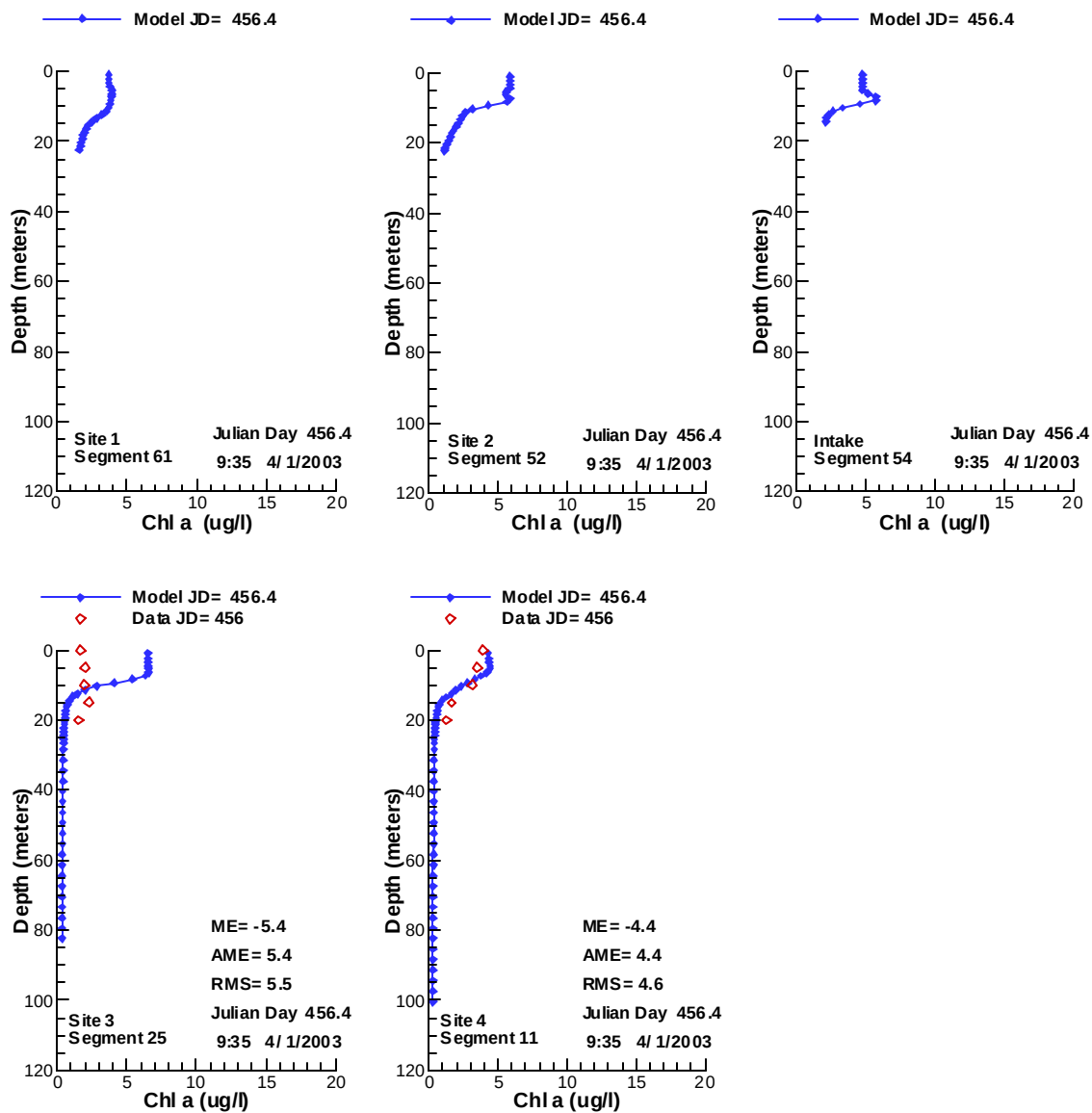


Figure 539. Vertical profiles of Chlorophyll compared with data for 4/ 1/2003.

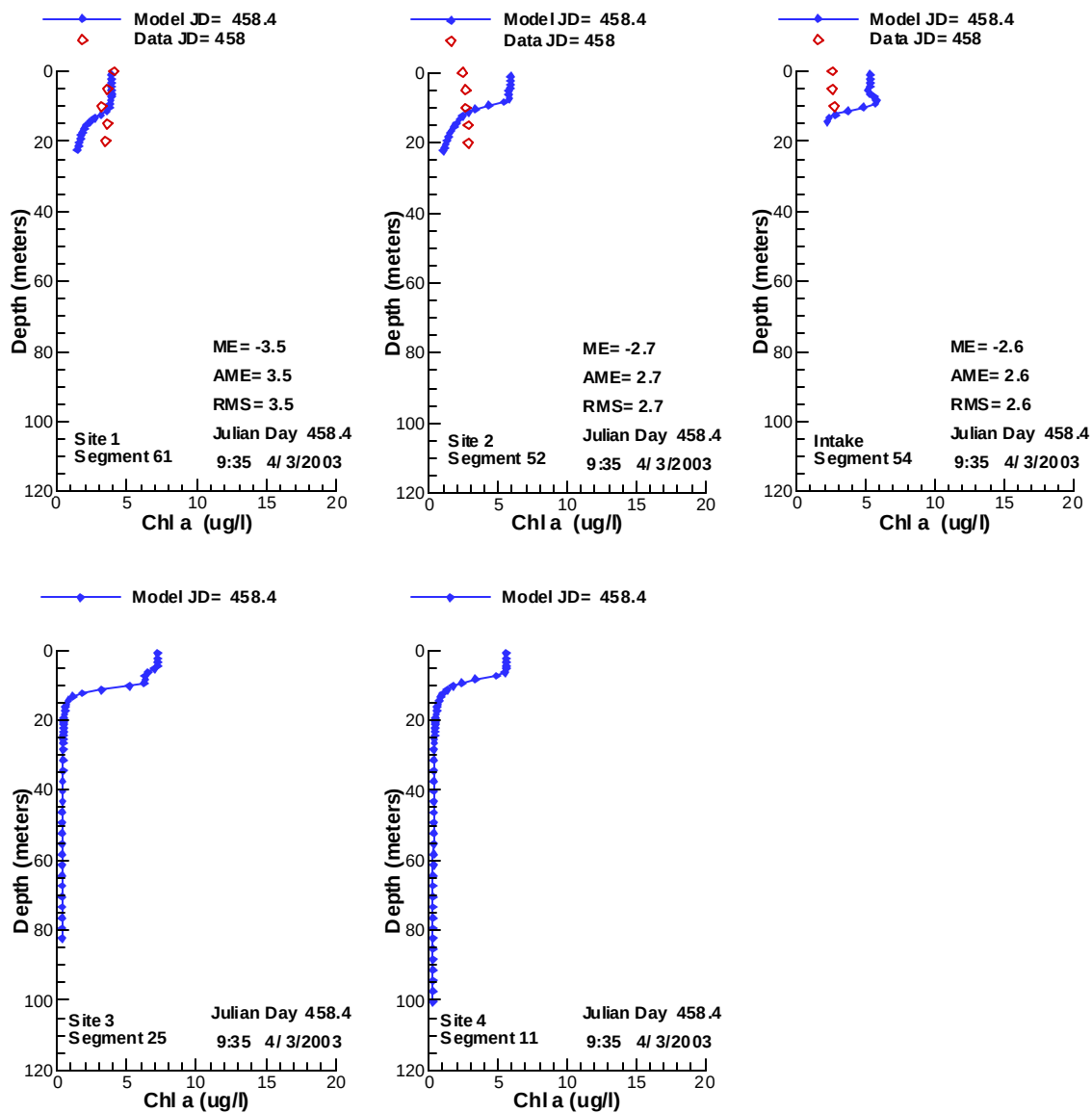


Figure 540. Vertical profiles of Chlorophyll compared with data for 4/ 3/2003.

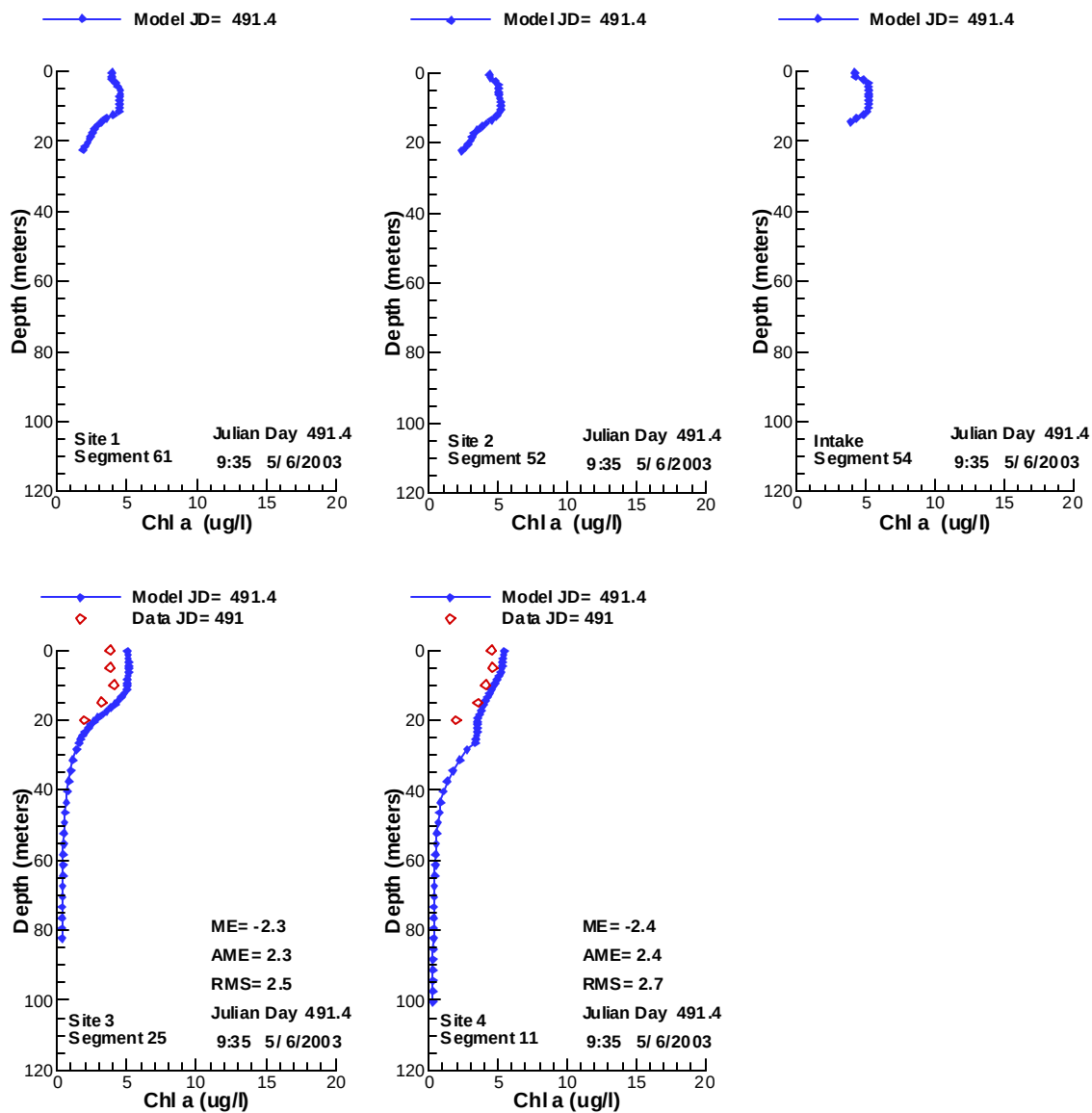


Figure 541. Vertical profiles of Chlorophyll compared with data for 5/ 6/2003.

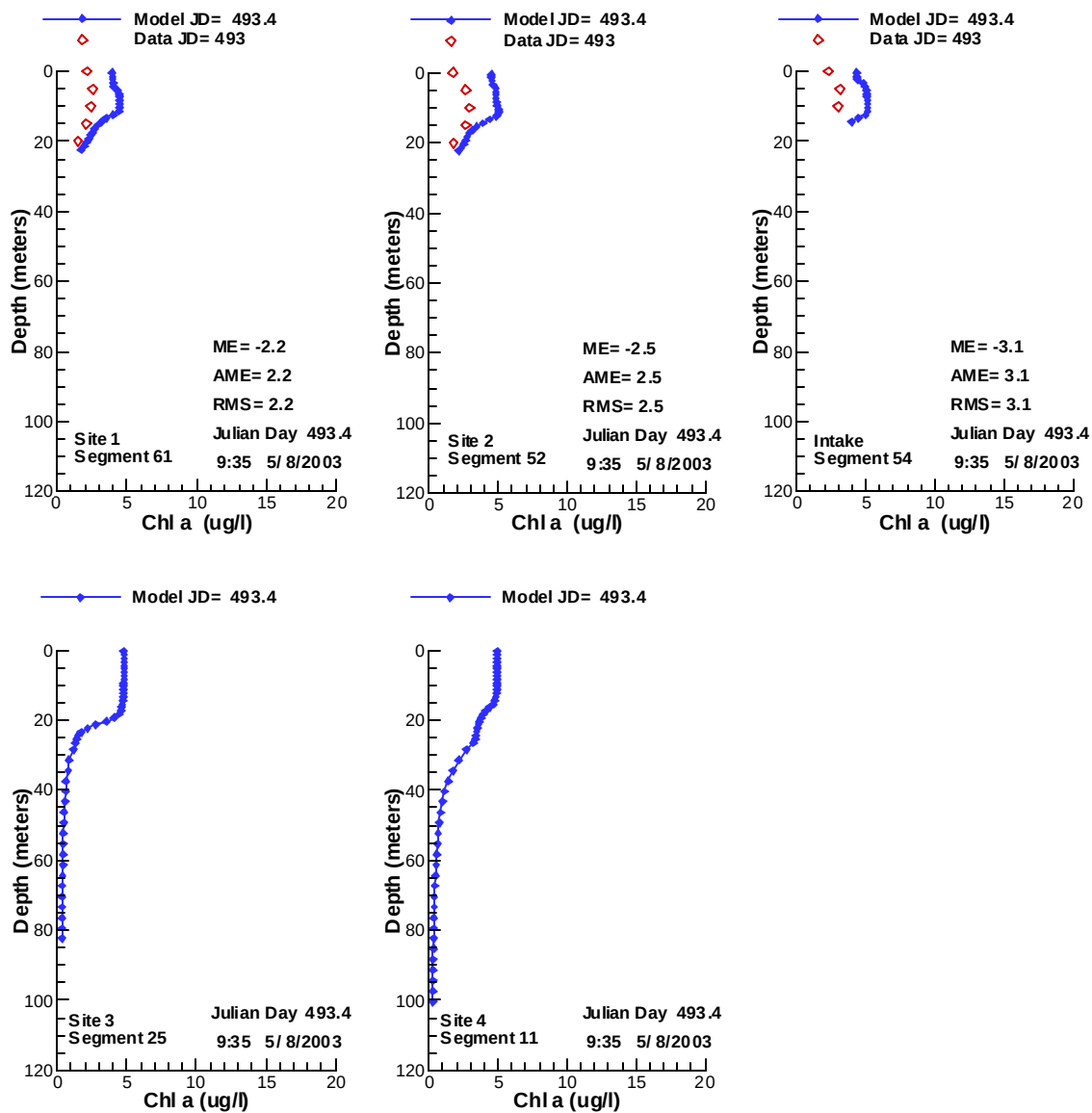


Figure 542. Vertical profiles of Chlorophyll compared with data for 5/ 8/2003.

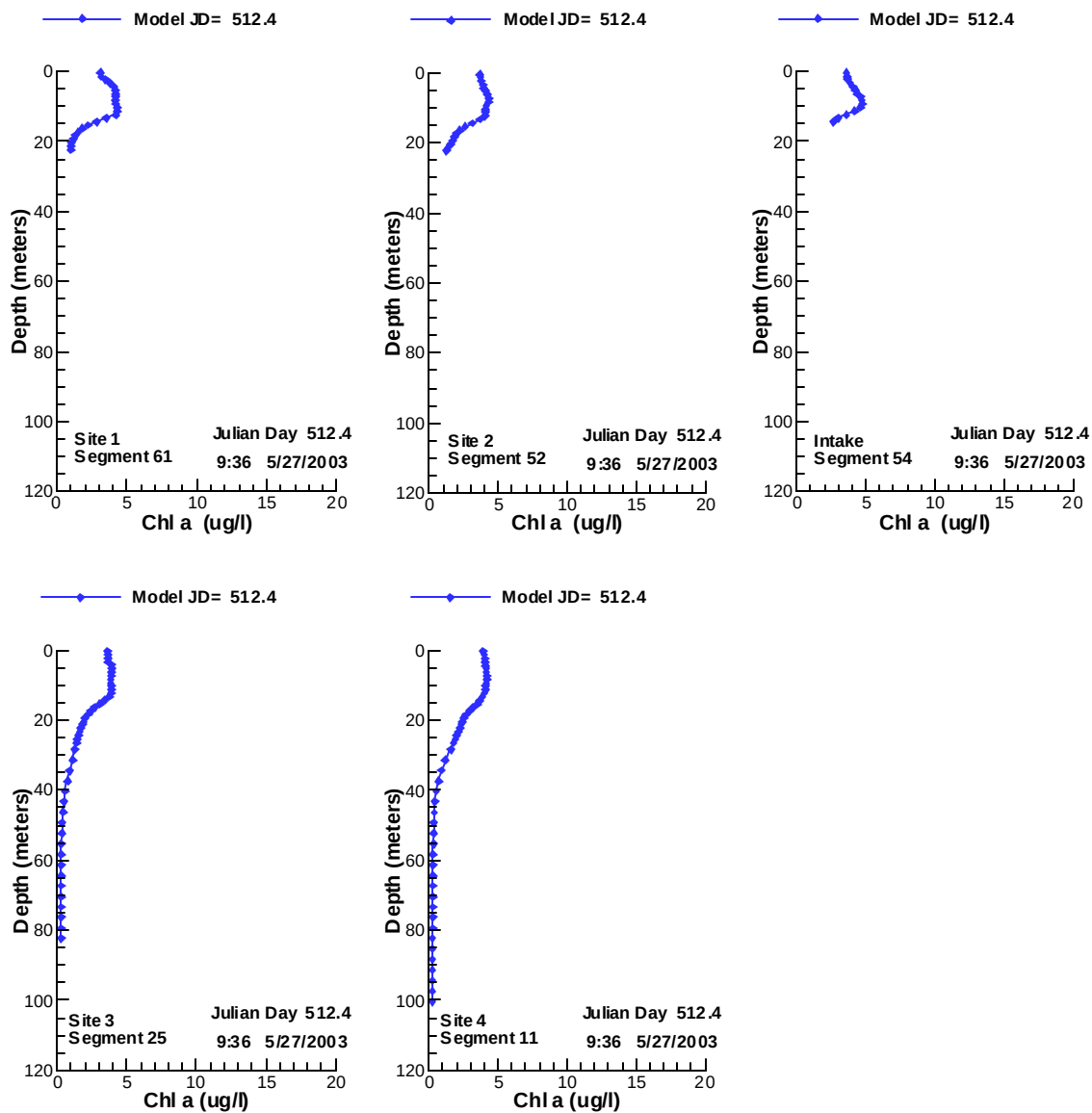


Figure 543. Vertical profiles of Chlorophyll compared with data for 5/27/2003.

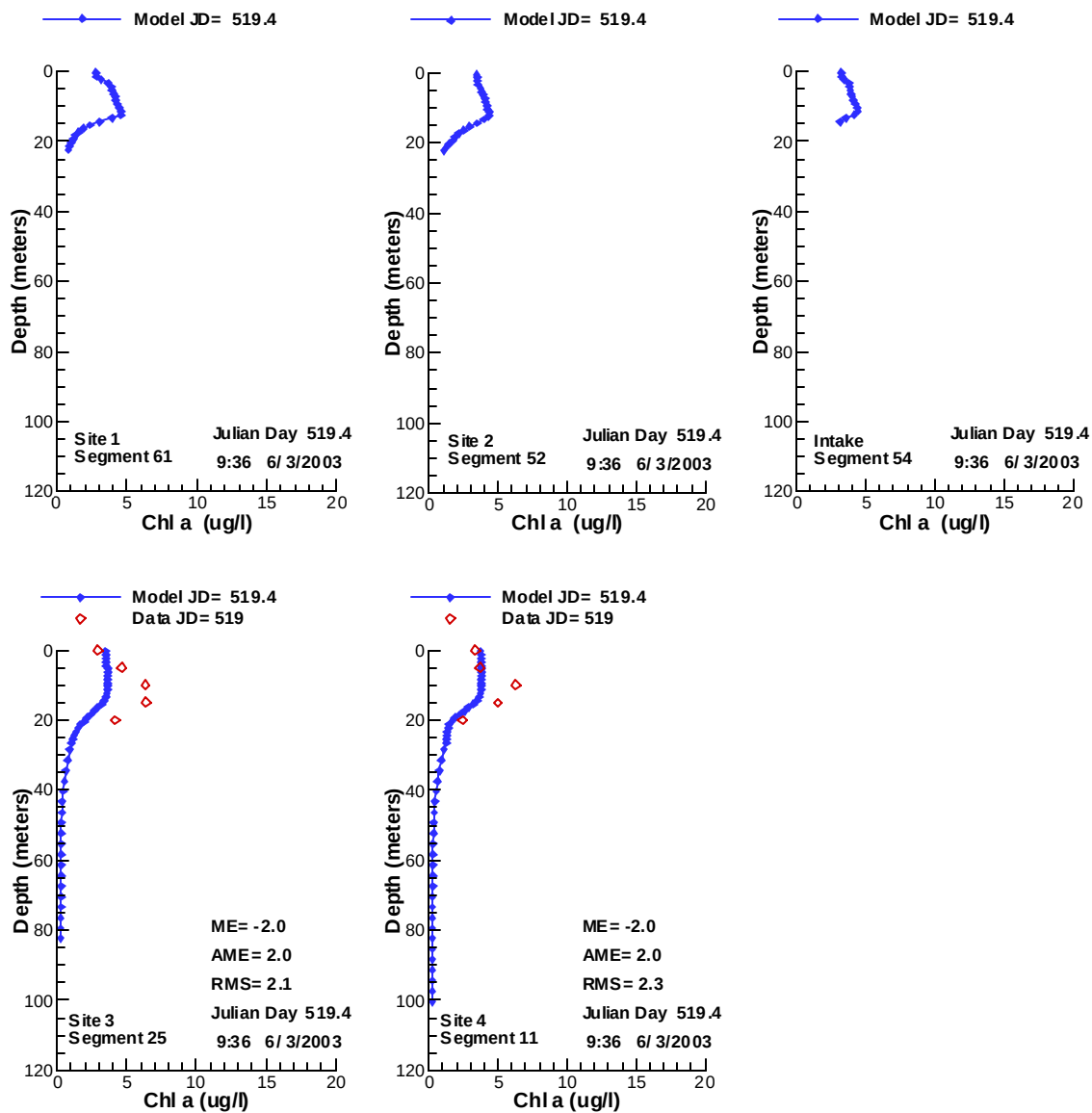


Figure 544. Vertical profiles of Chlorophyll compared with data for 6/ 3/2003.

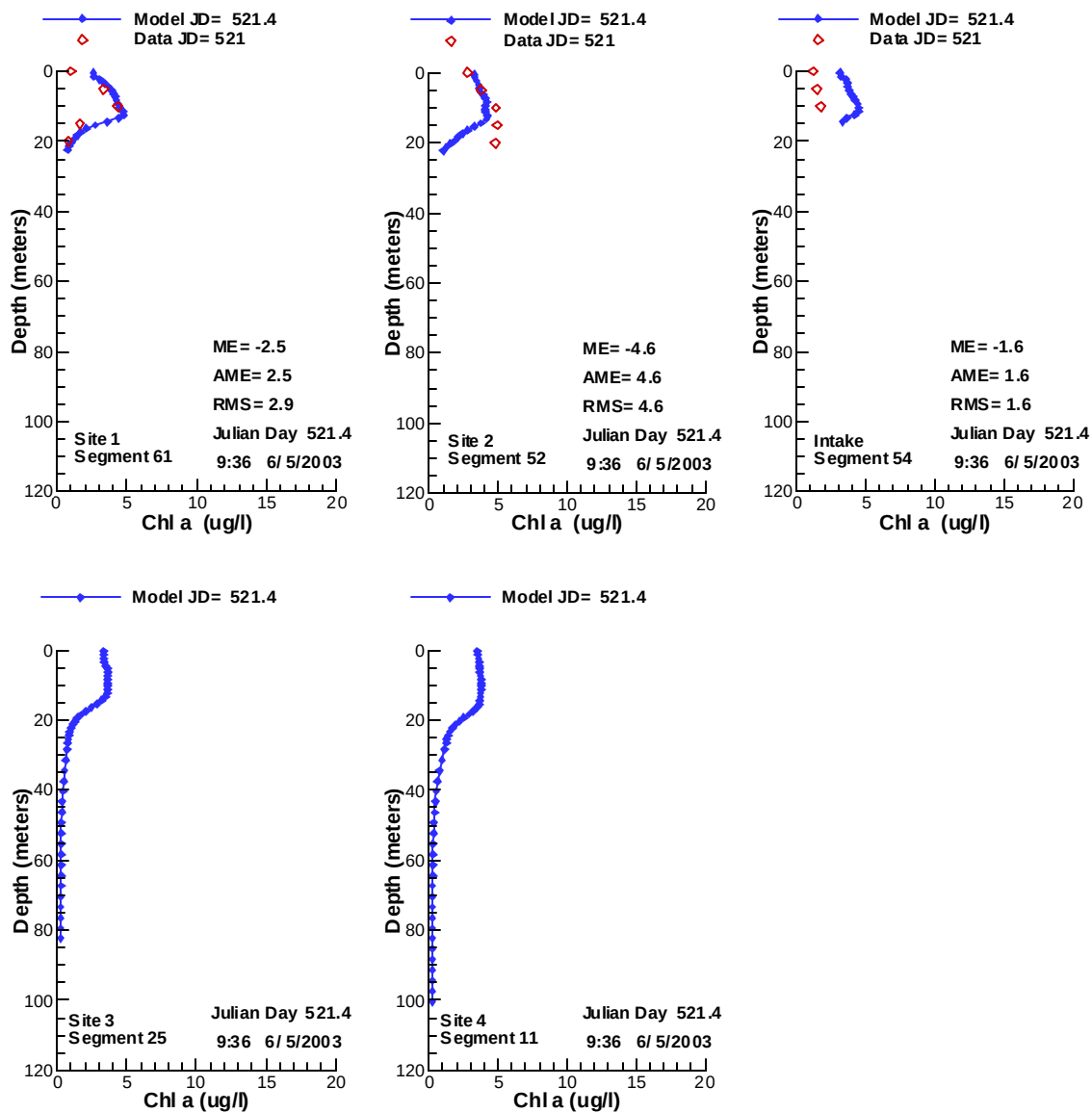


Figure 545. Vertical profiles of Chlorophyll compared with data for 6/ 5/2003.

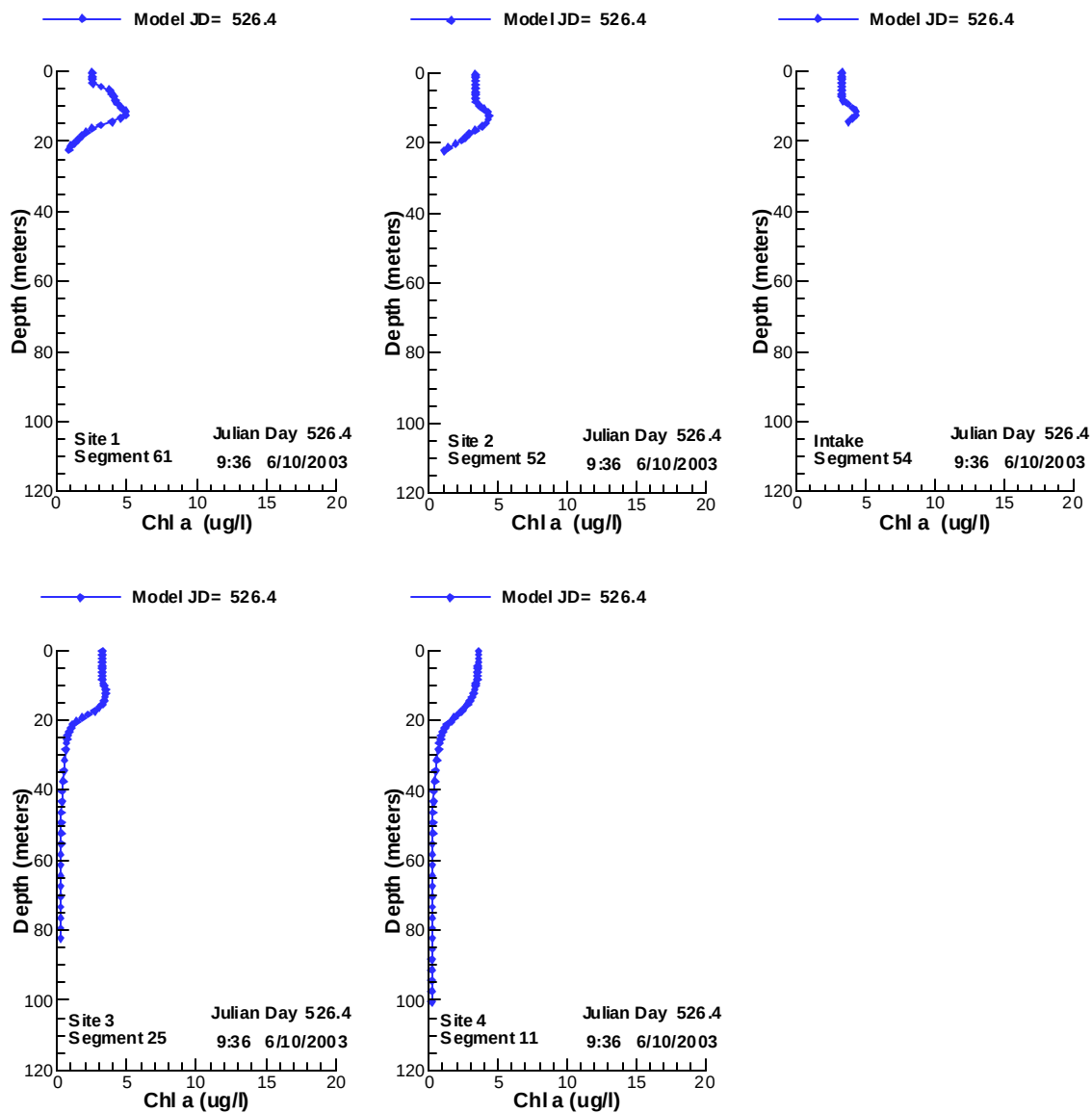


Figure 546. Vertical profiles of Chlorophyll compared with data for 6/10/2003.

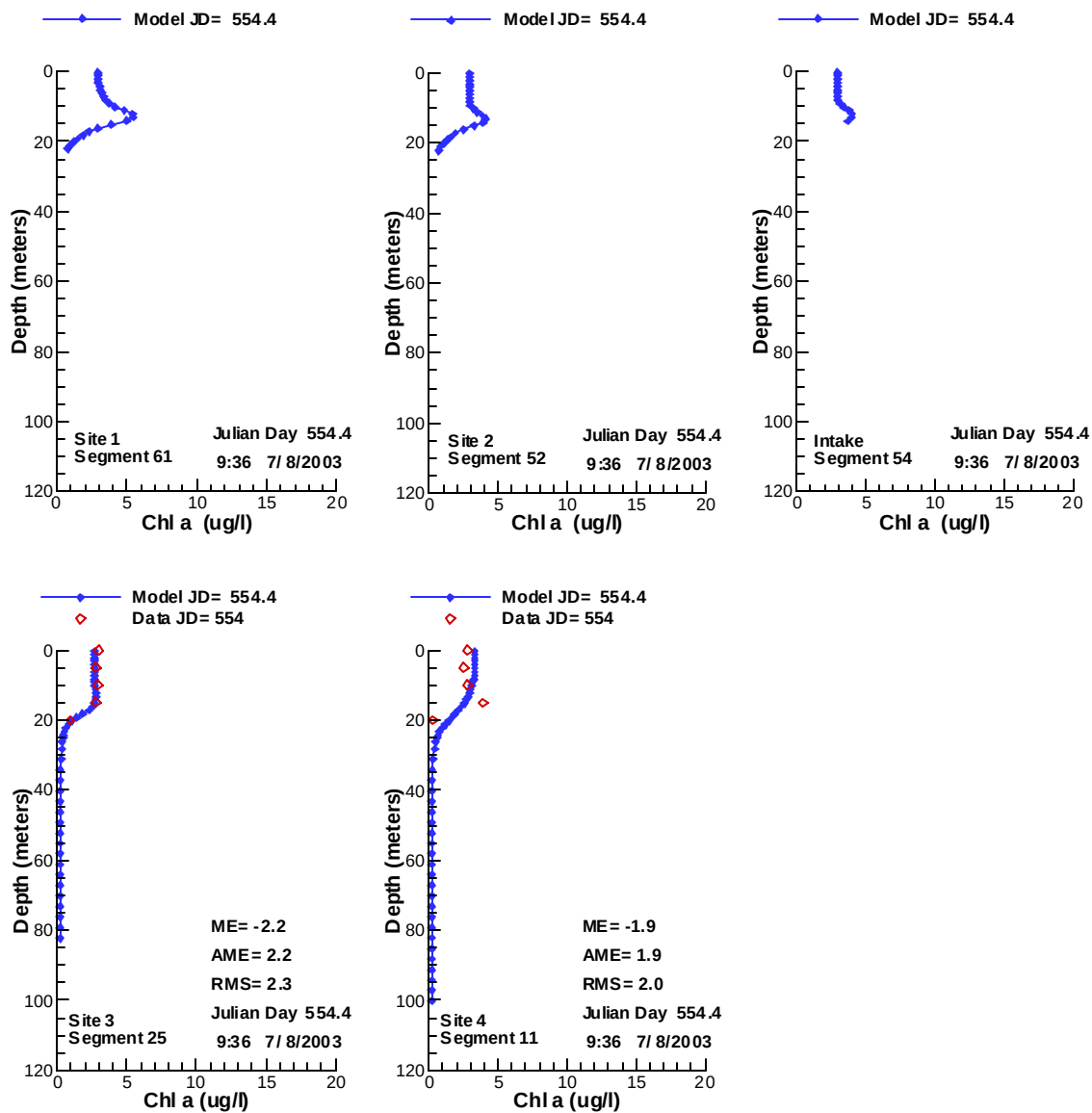


Figure 547. Vertical profiles of Chlorophyll compared with data for 7/ 8/2003.

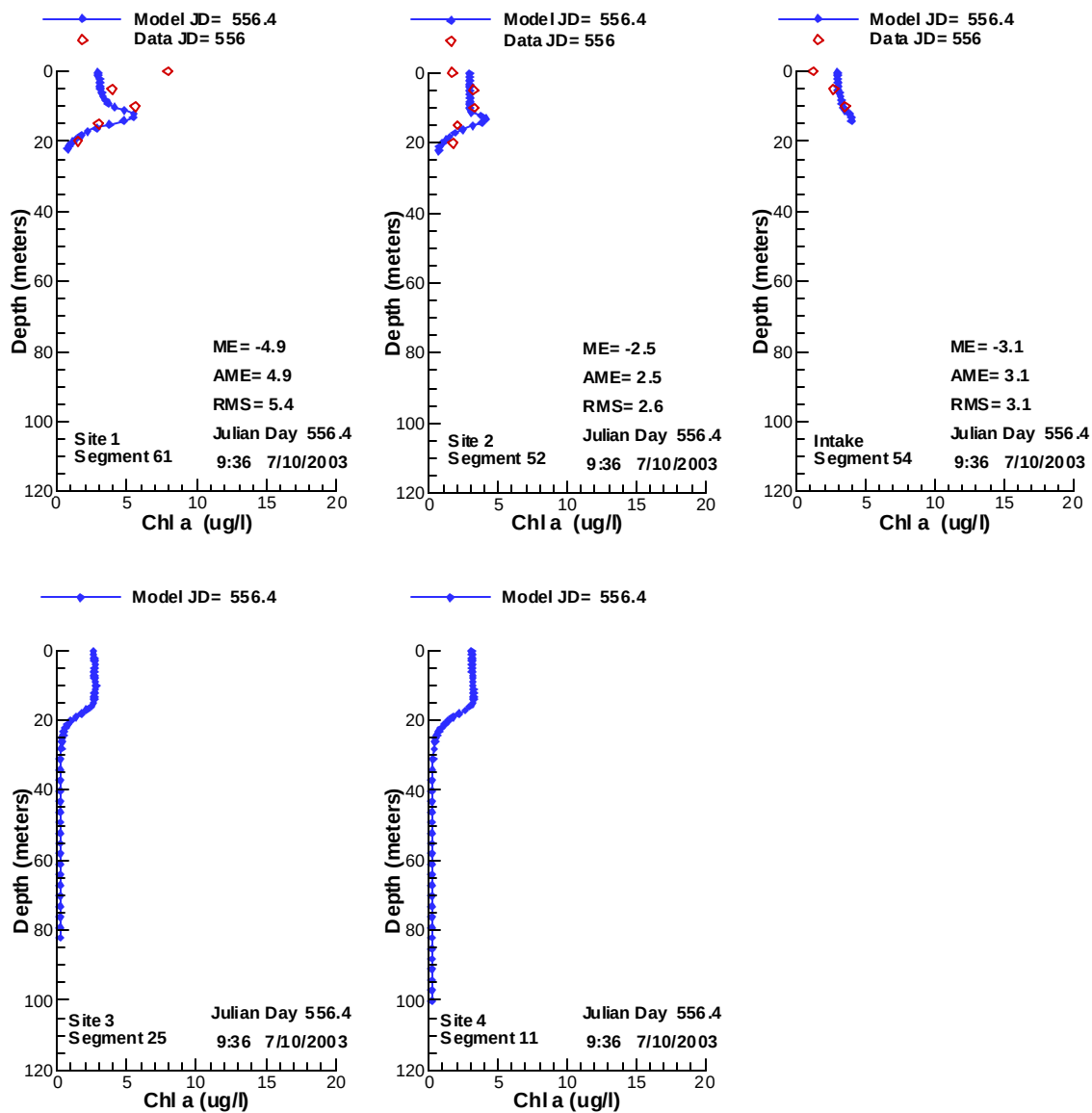


Figure 548. Vertical profiles of Chlorophyll compared with data for 7/10/2003.

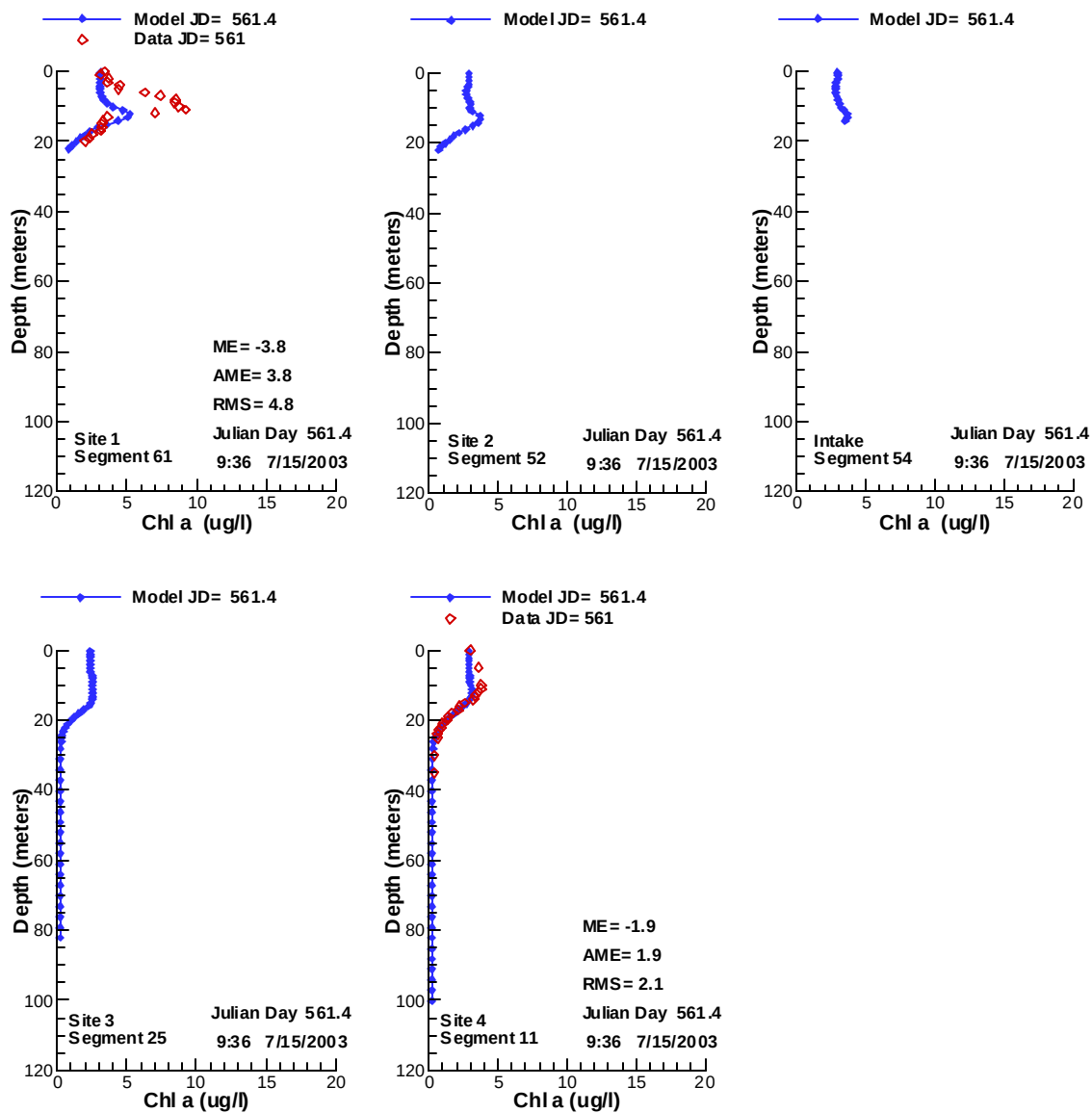


Figure 549. Vertical profiles of Chlorophyll compared with data for 7/15/2003.

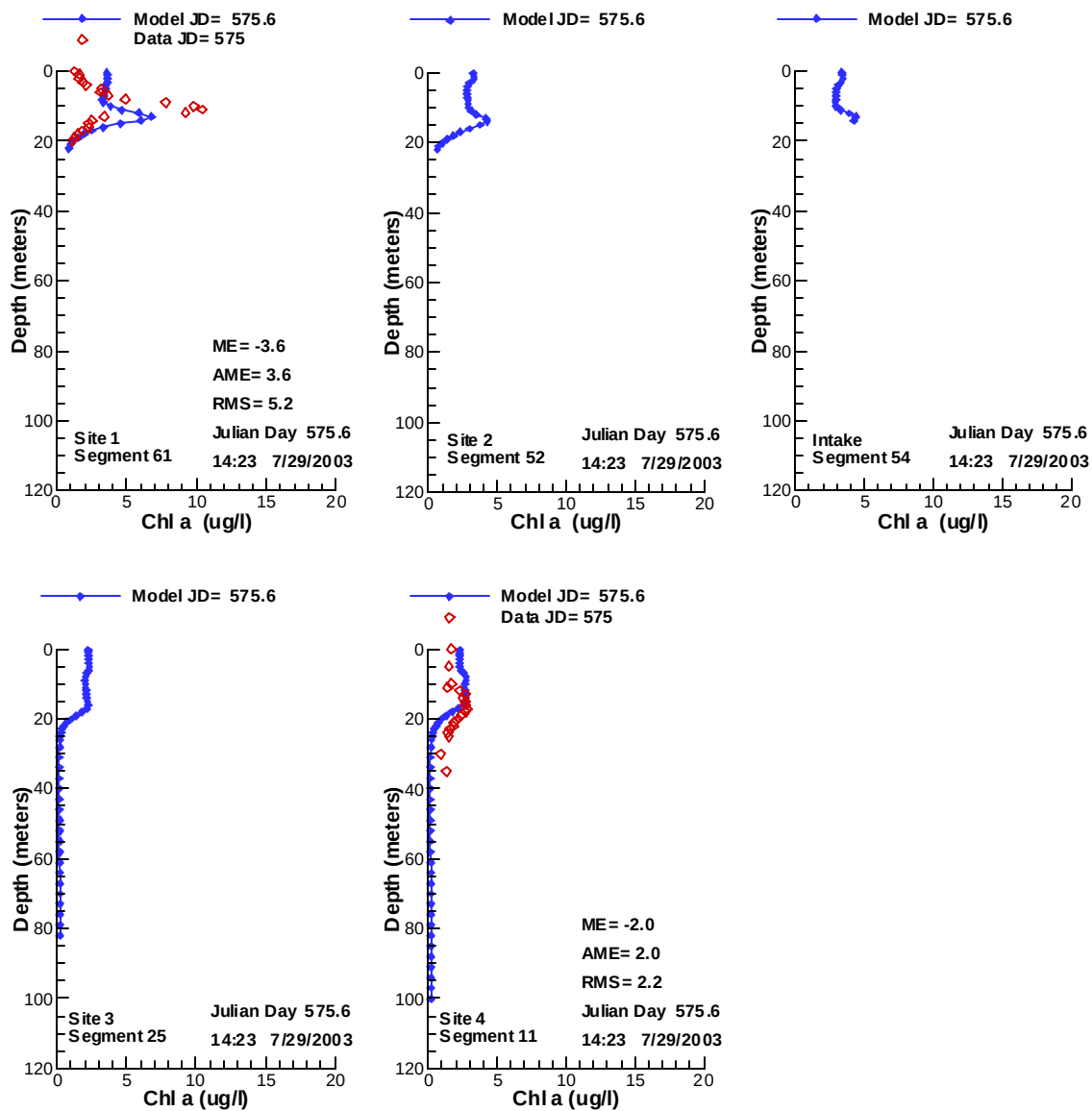


Figure 550. Vertical profiles of Chlorophyll compared with data for 7/29/2003.

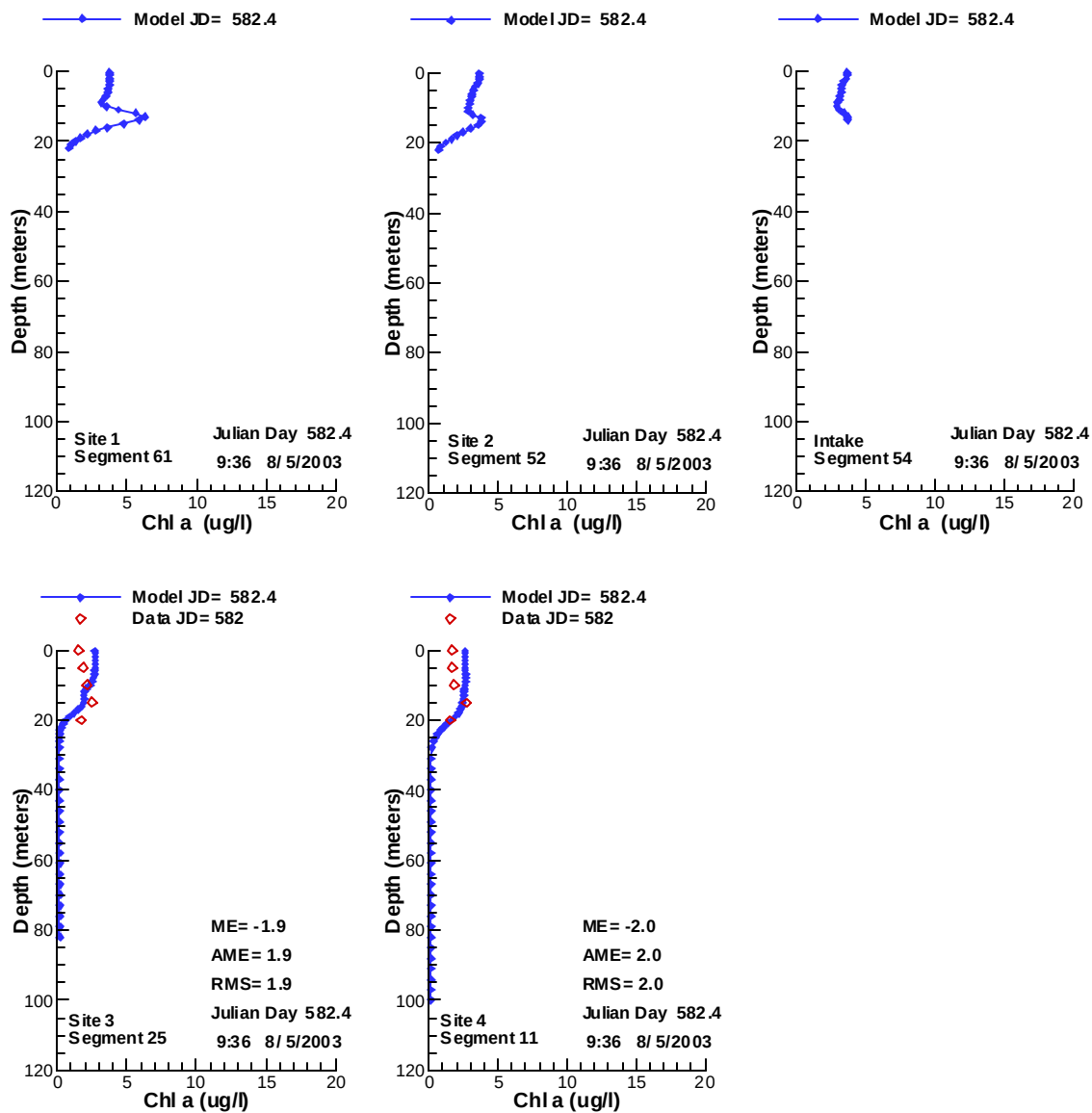


Figure 551. Vertical profiles of Chlorophyll compared with data for 8/ 5/2003.

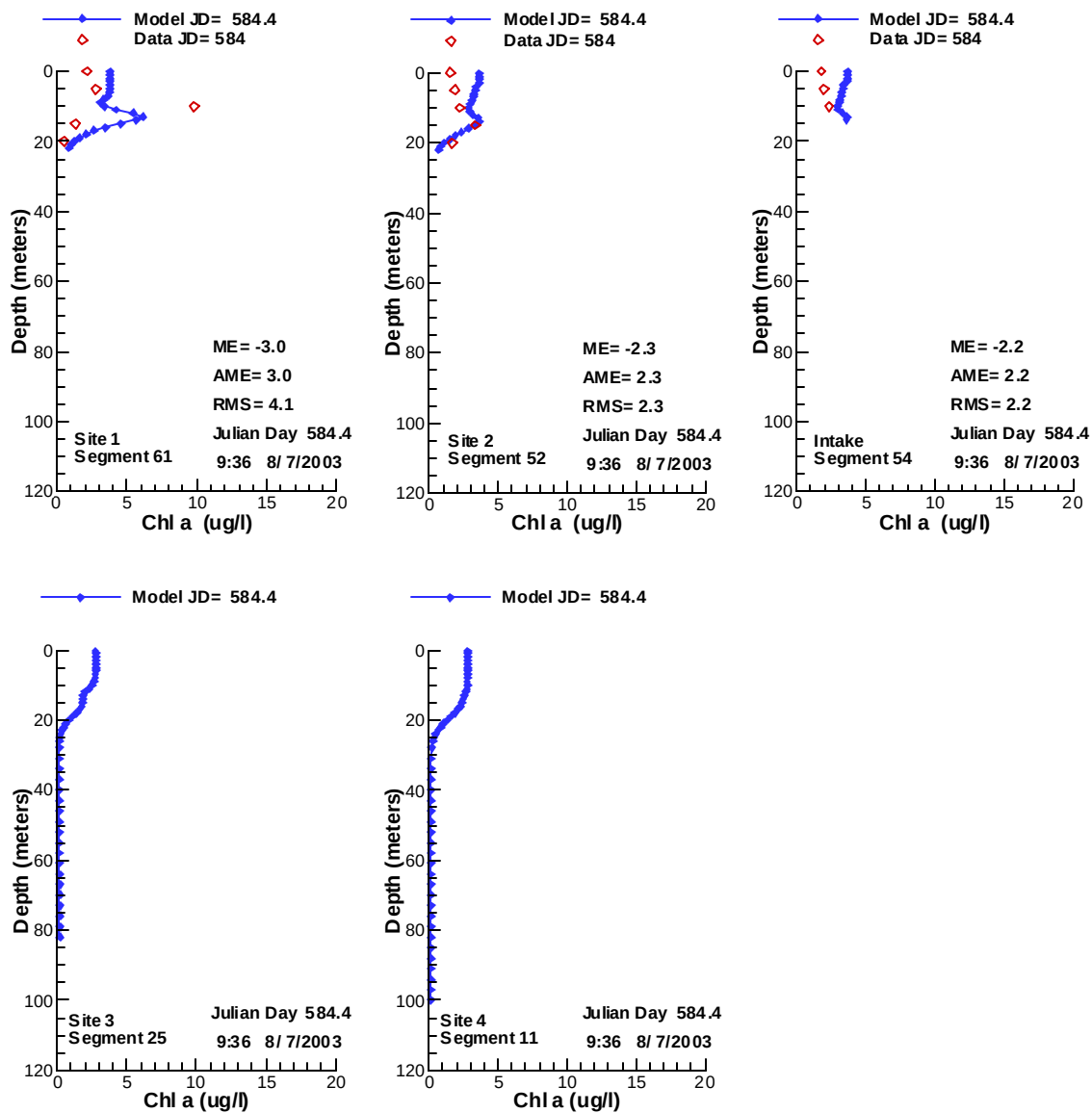


Figure 552. Vertical profiles of Chlorophyll compared with data for 8/ 7/2003.

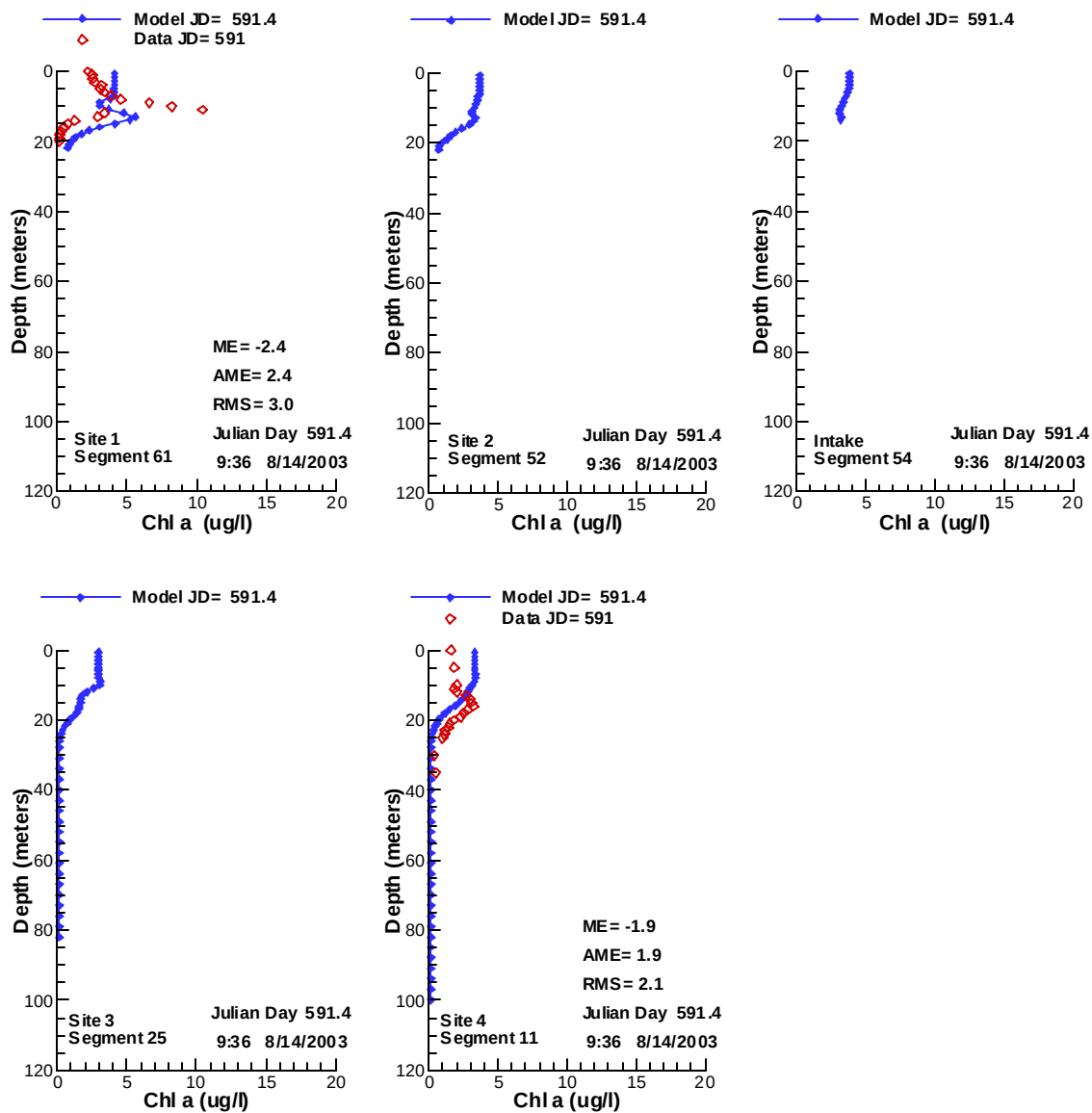


Figure 553. Vertical profiles of Chlorophyll compared with data for 8/14/2003.

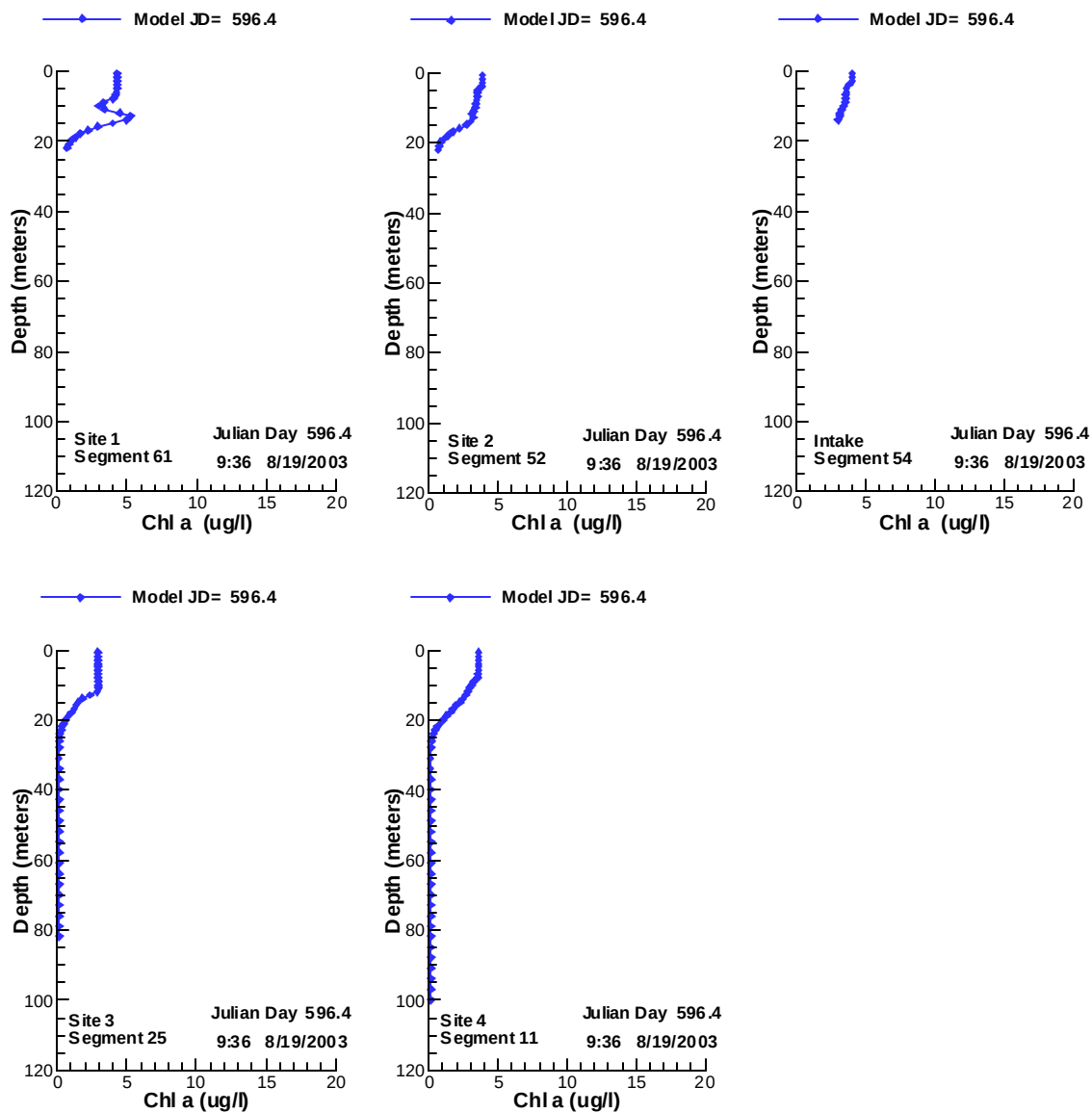


Figure 554. Vertical profiles of Chlorophyll compared with data for 8/19/2003.

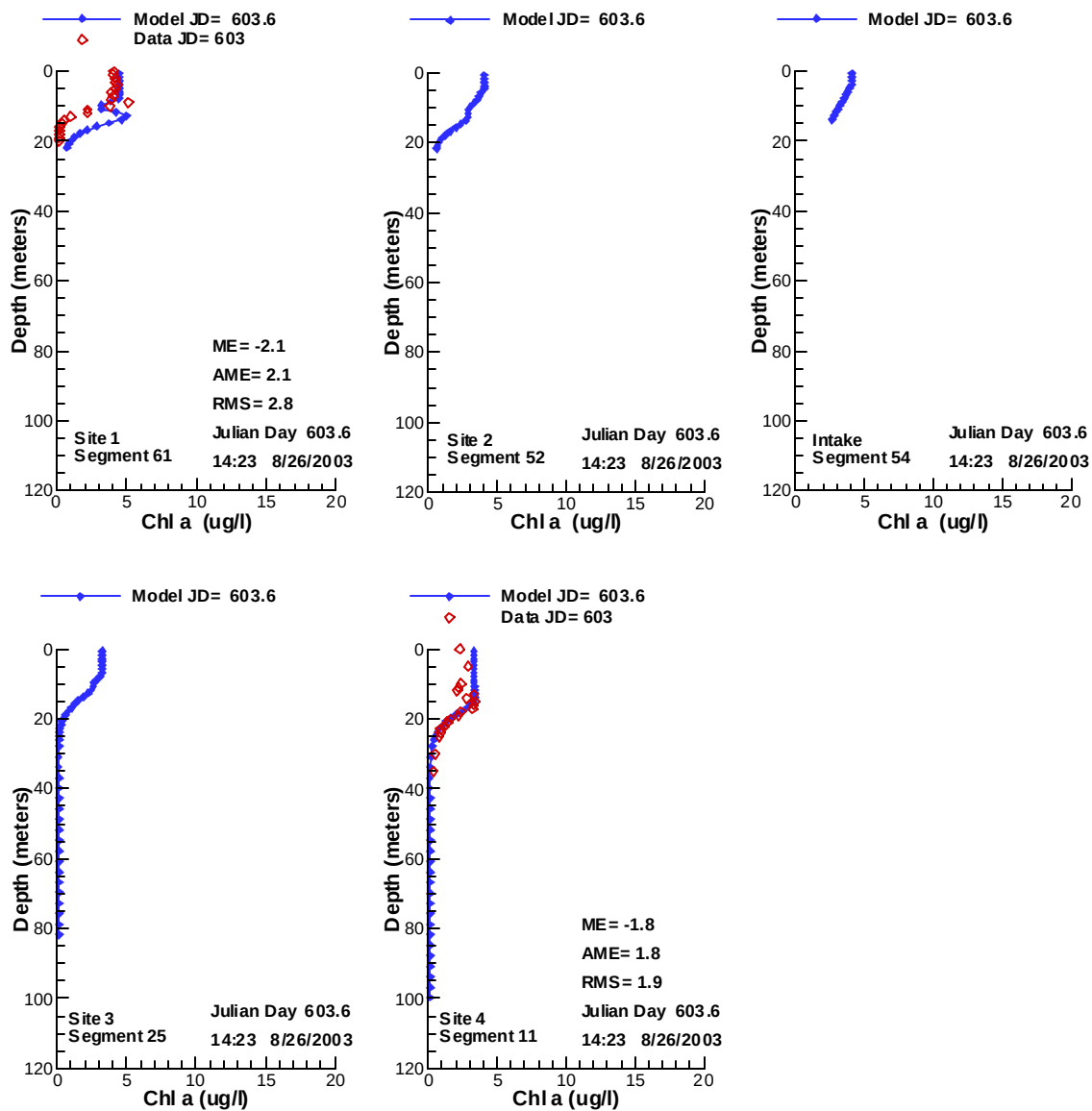


Figure 555. Vertical profiles of Chlorophyll compared with data for 8/26/2003.

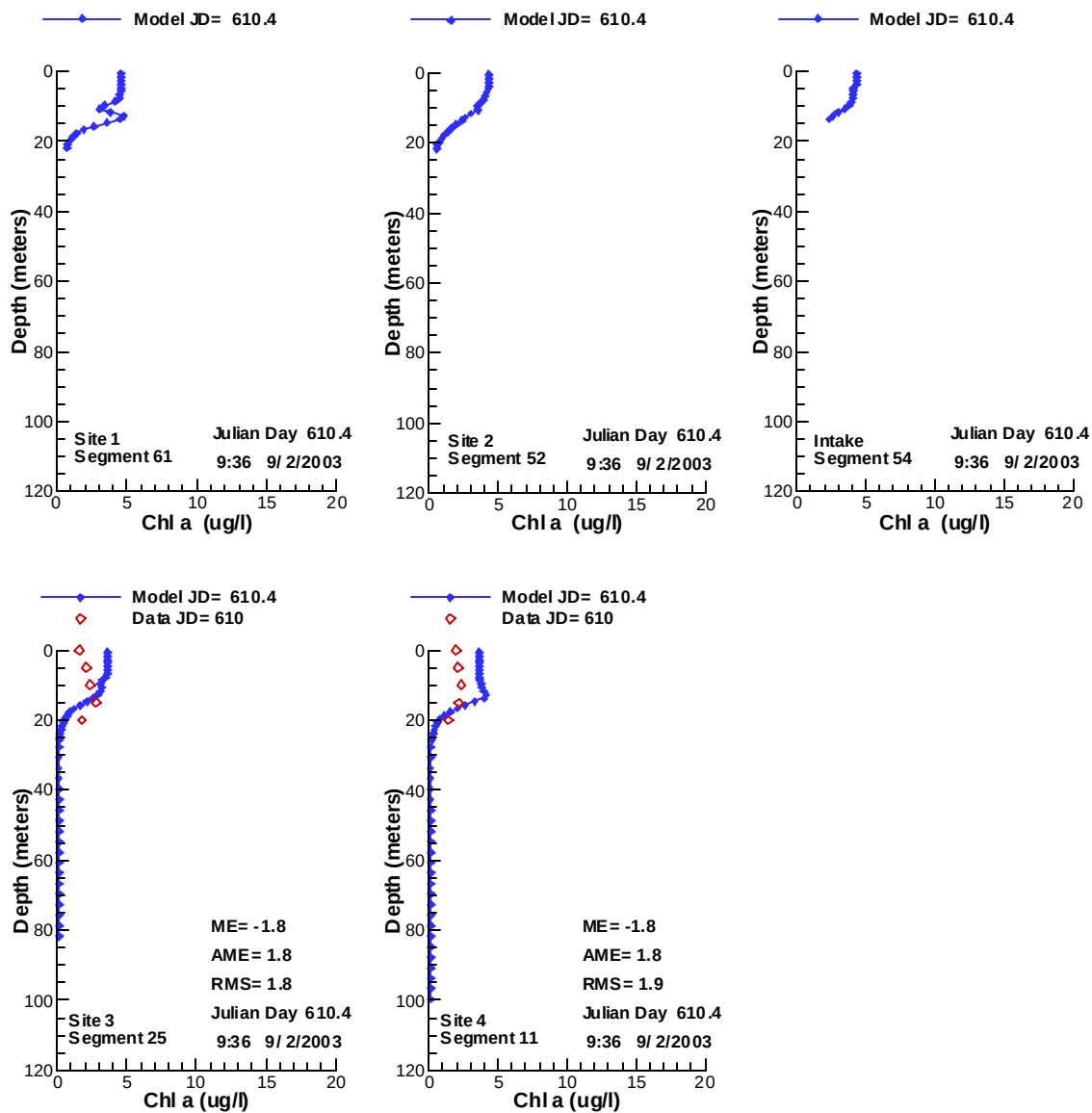


Figure 556. Vertical profiles of Chlorophyll compared with data for 9/ 2/2003.

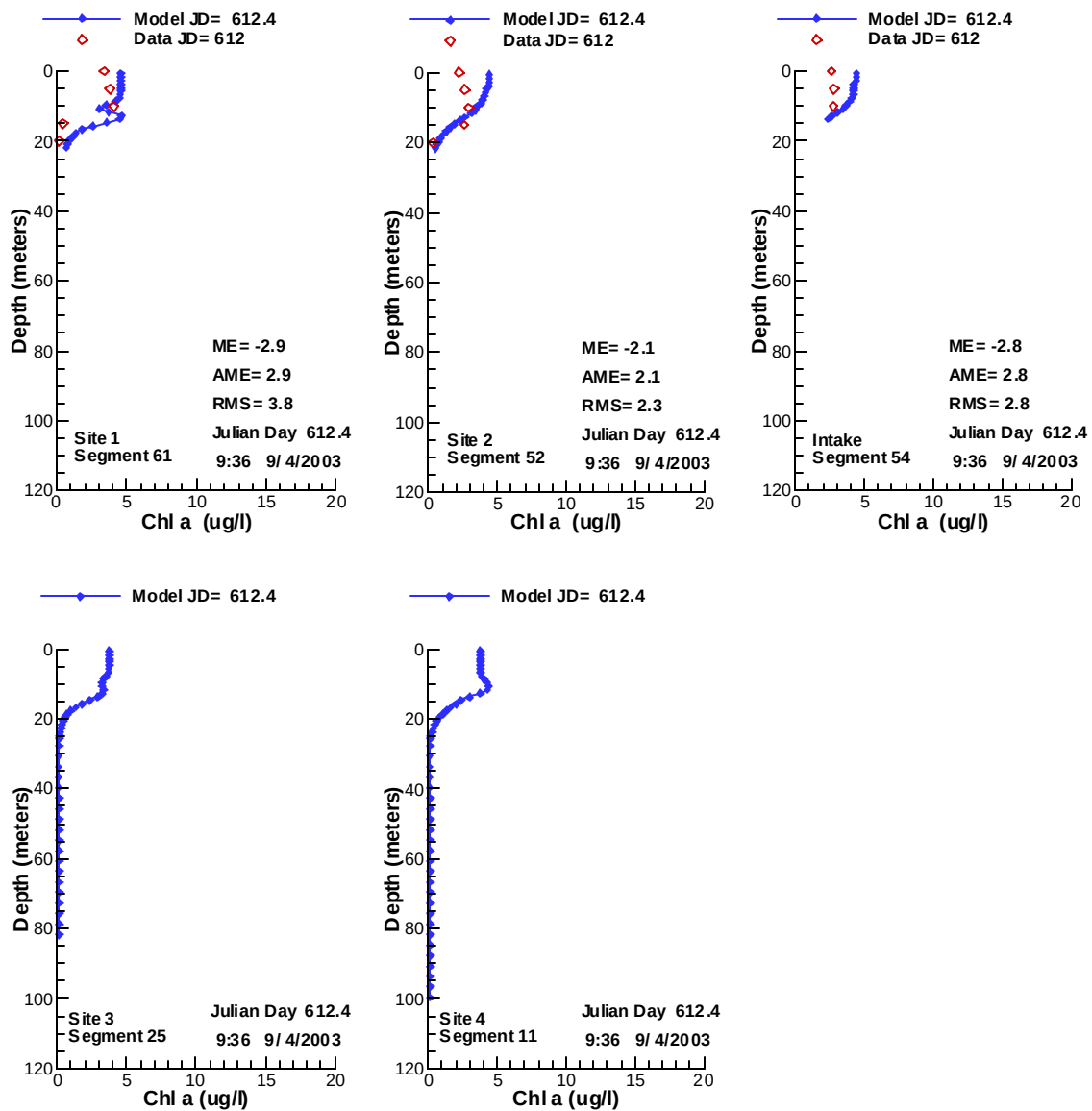


Figure 557. Vertical profiles of Chlorophyll compared with data for 9/ 4/2003.

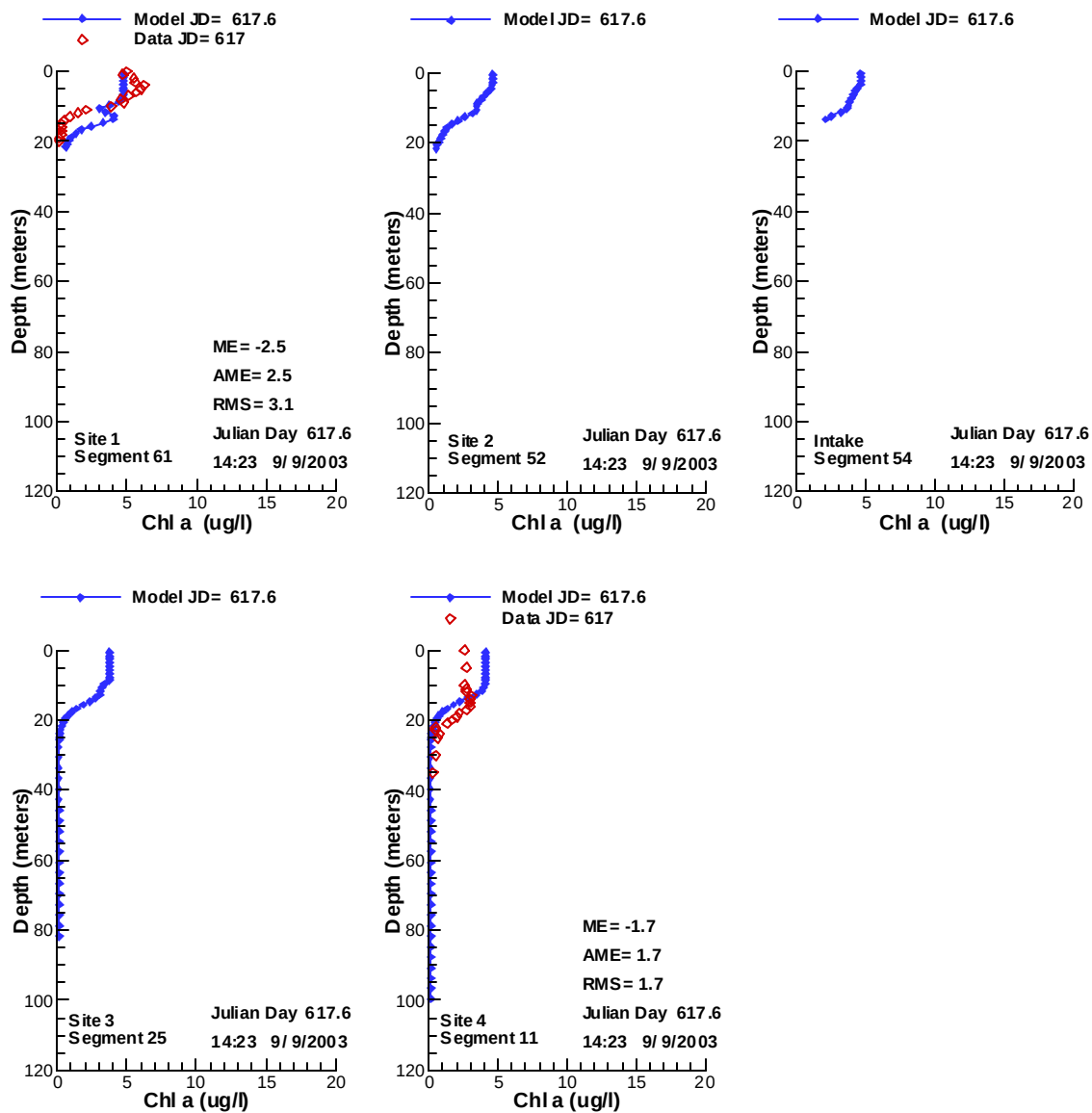


Figure 558. Vertical profiles of Chlorophyll compared with data for 9/ 9/2003.

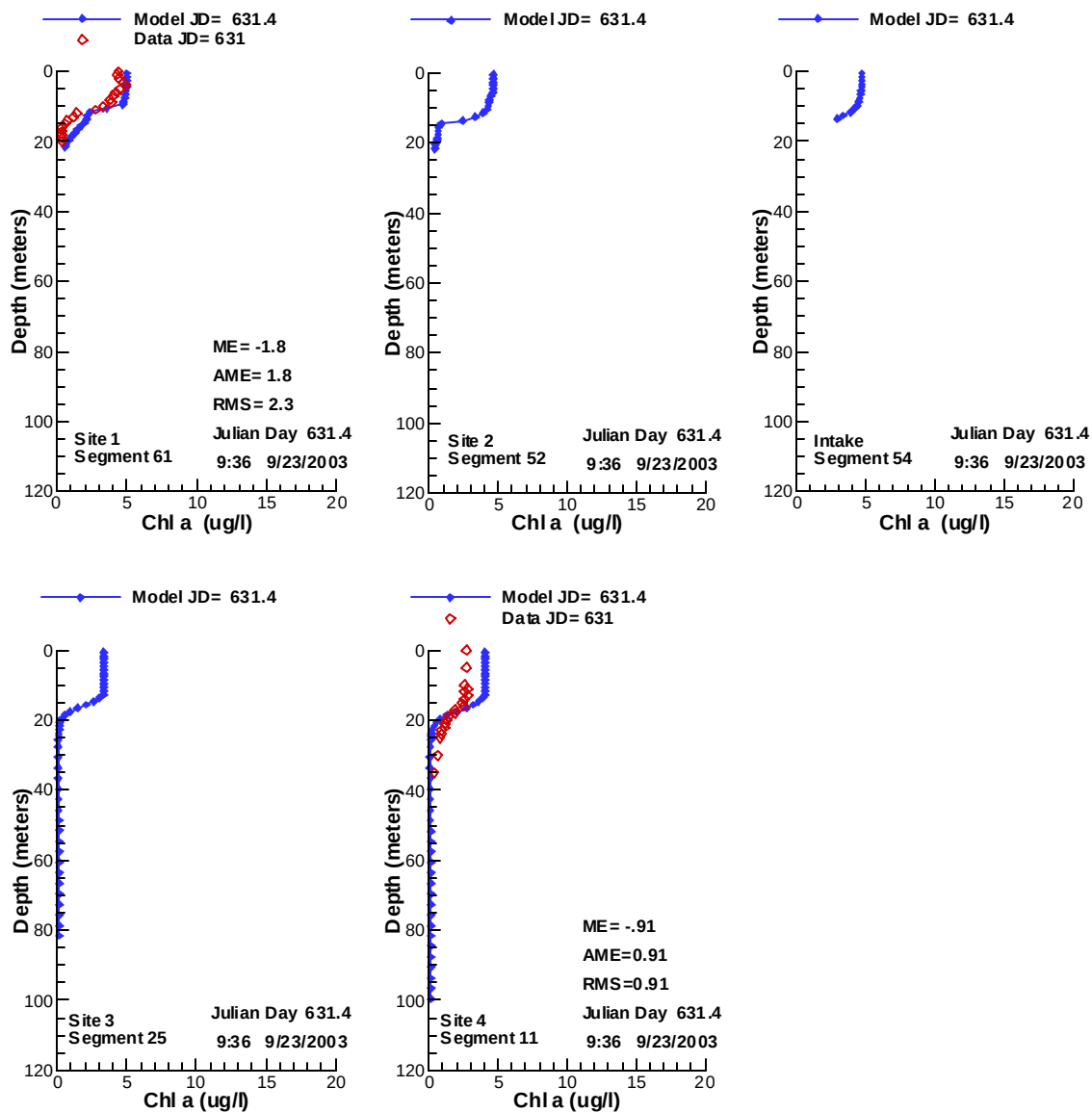


Figure 559. Vertical profiles of Chlorophyll compared with data for 9/23/2003.

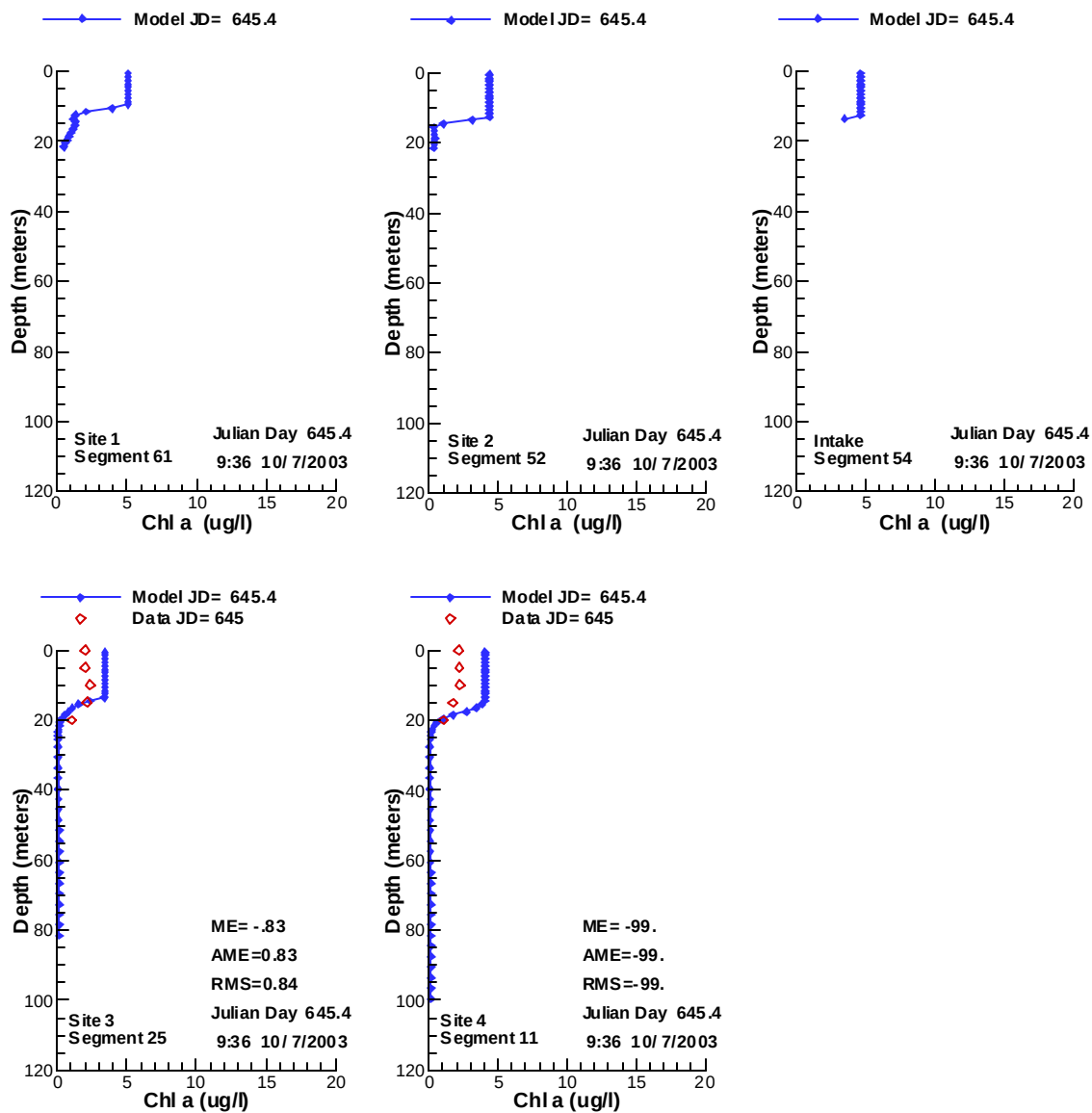


Figure 560. Vertical profiles of Chlorophyll compared with data for 10/ 7/2003.

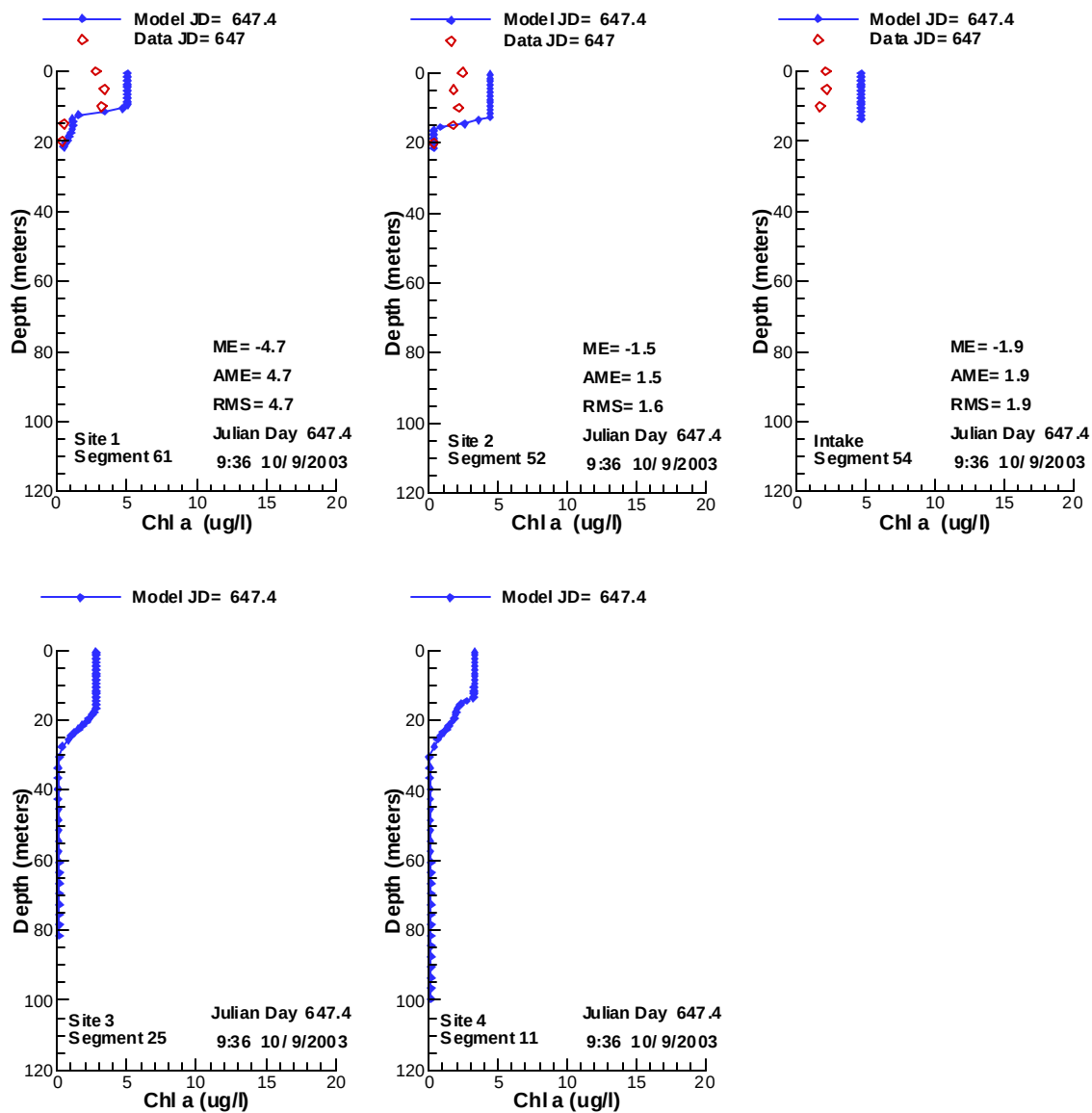


Figure 561. Vertical profiles of Chlorophyll compared with data for 10/ 9/2003.

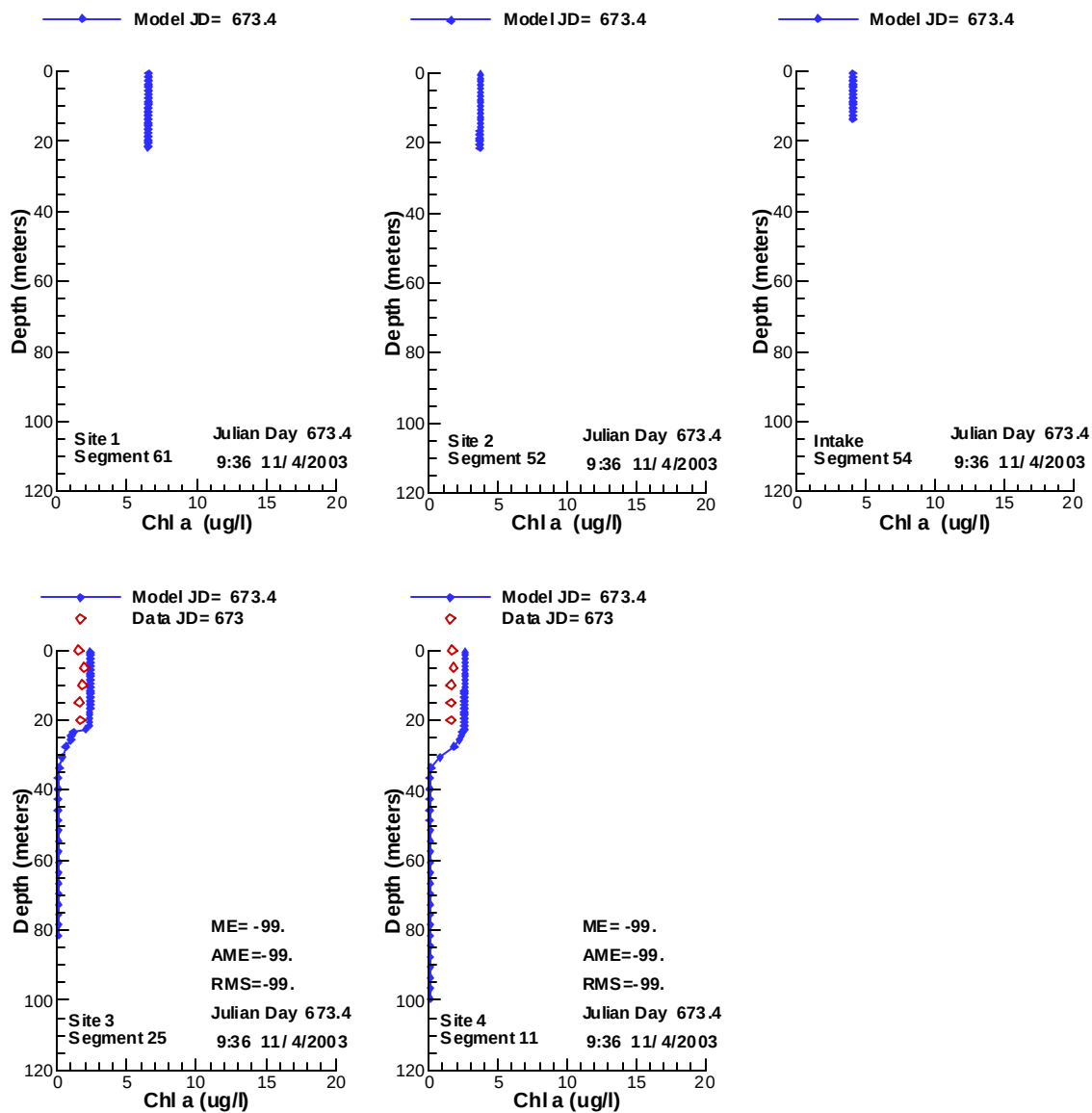


Figure 562. Vertical profiles of Chlorophyll compared with data for 11/ 4/2003.

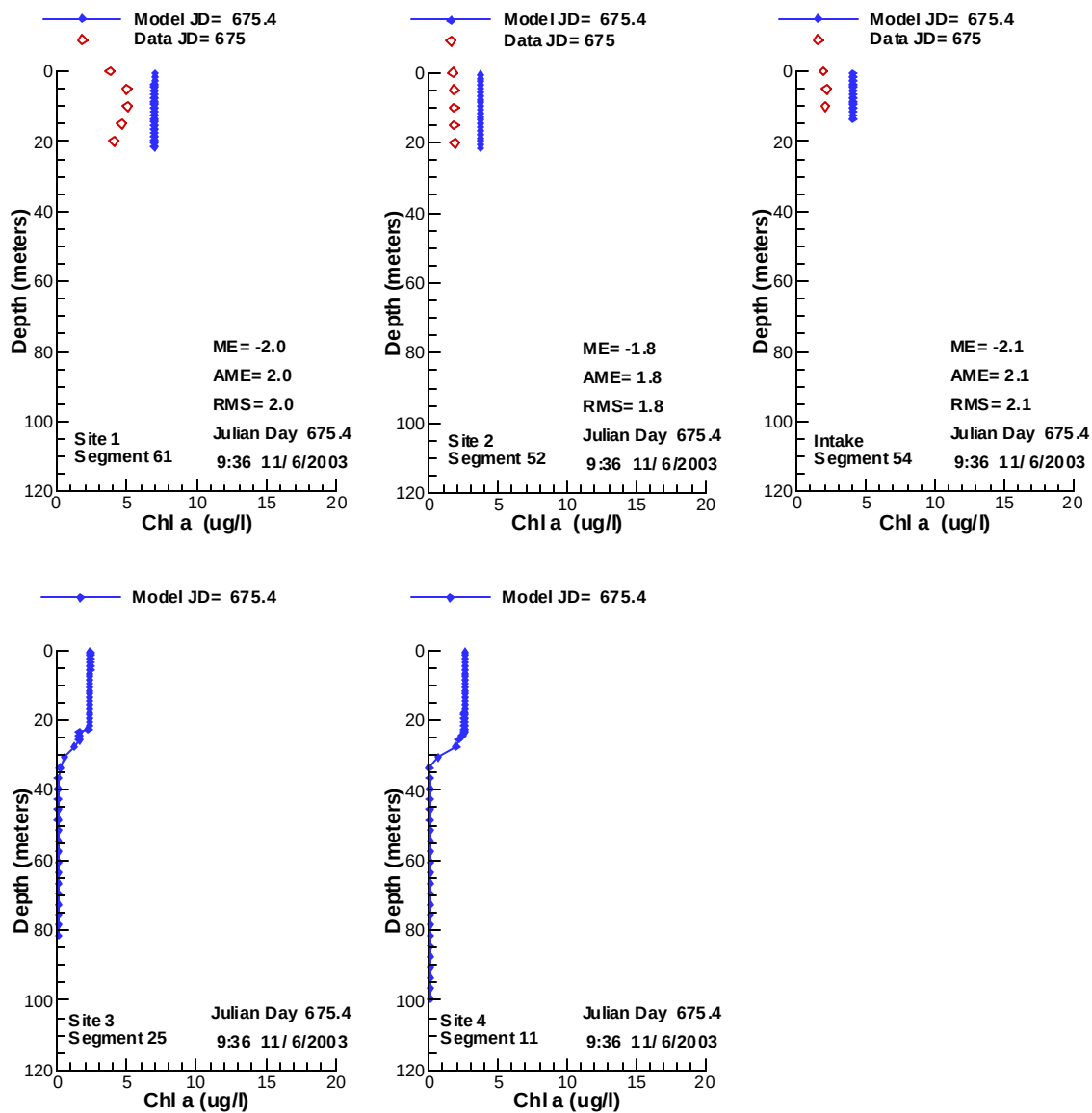


Figure 563. Vertical profiles of Chlorophyll compared with data for 11/ 6/2003.

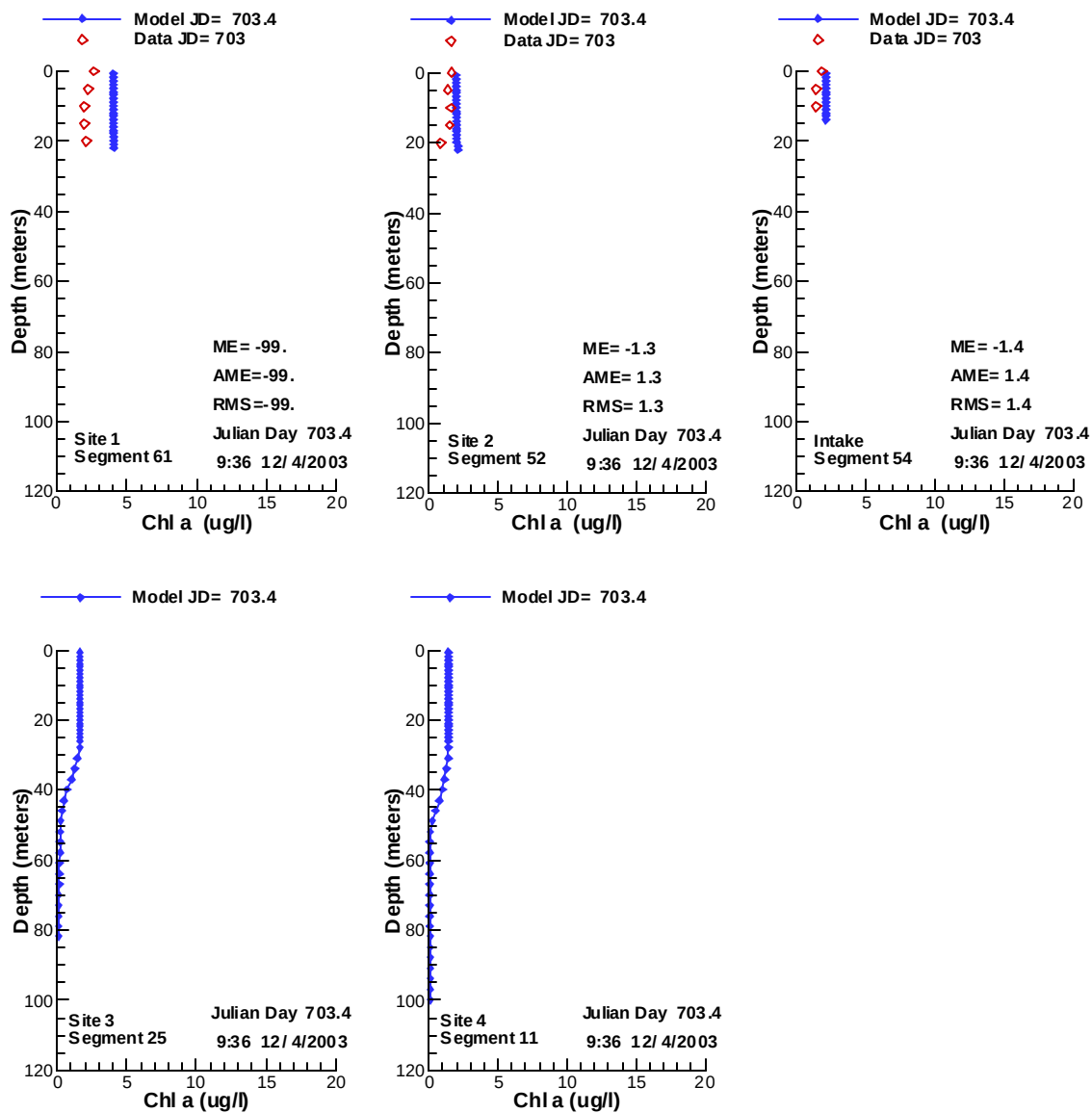


Figure 564. Vertical profiles of Chlorophyll compared with data for 12/ 4/2003.

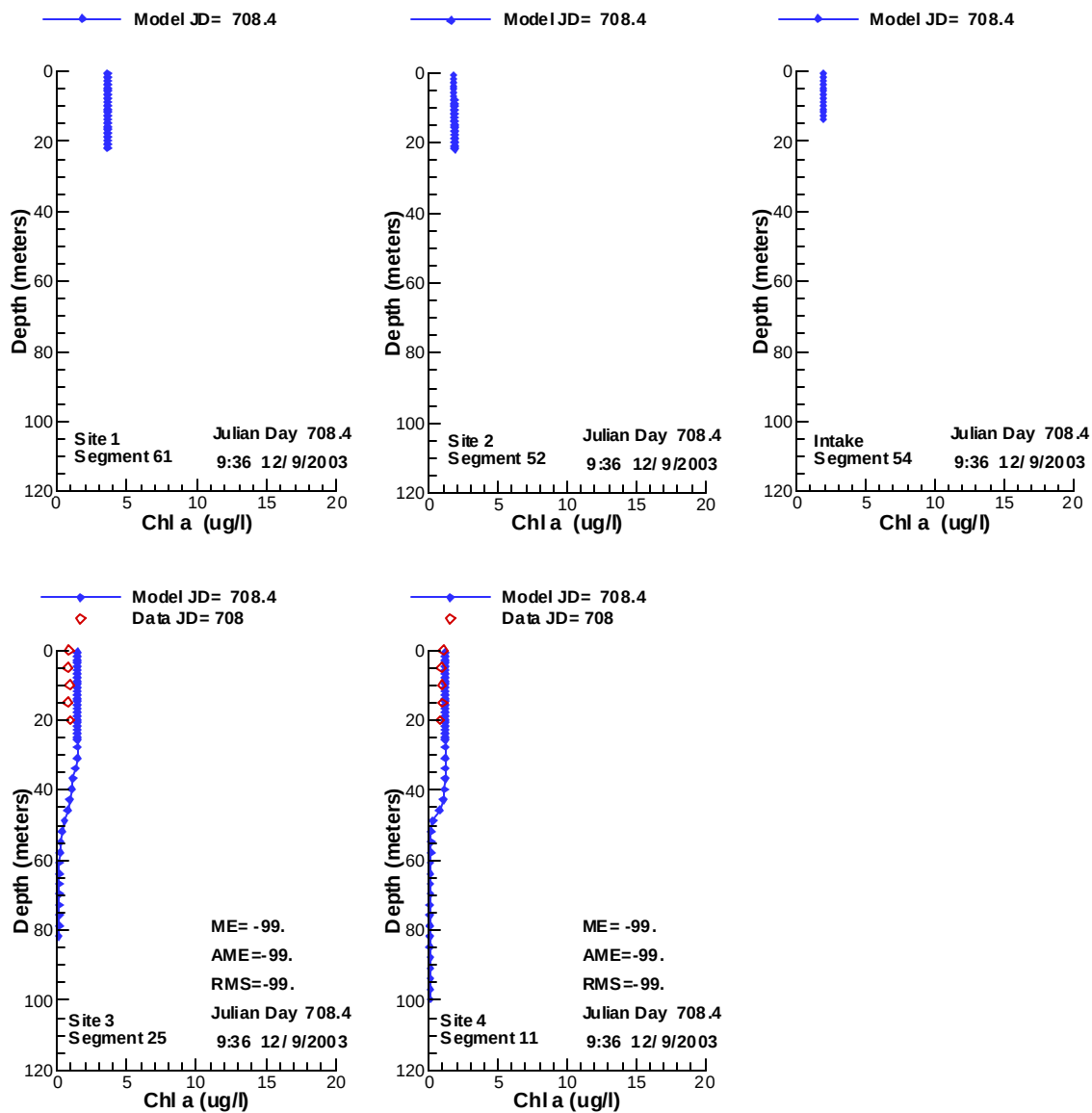


Figure 565. Vertical profiles of Chlorophyll compared with data for 12/ 9/2003.

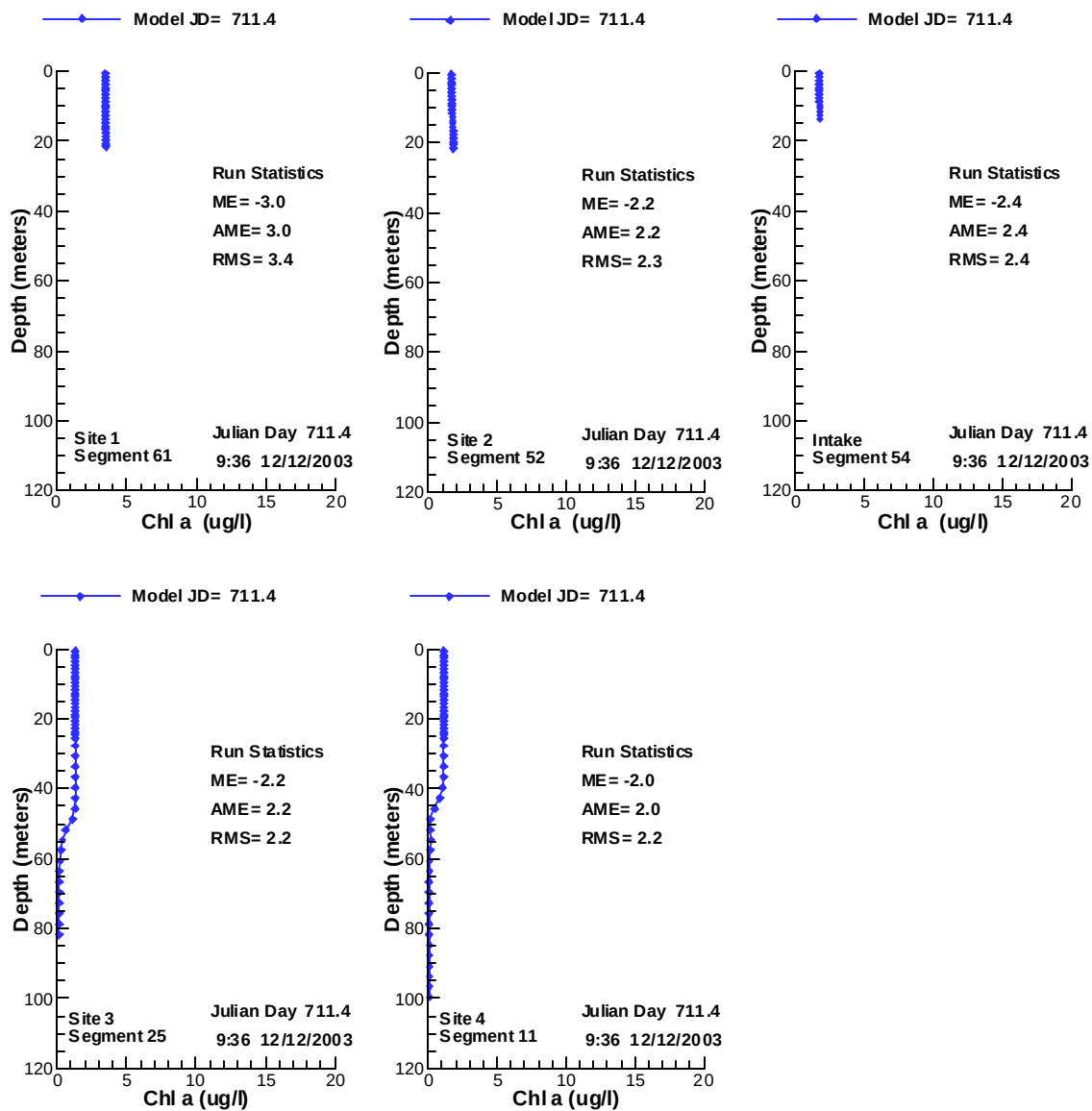


Figure 566. Vertical profiles of Chlorophyll compared with data for 12/12/2003.

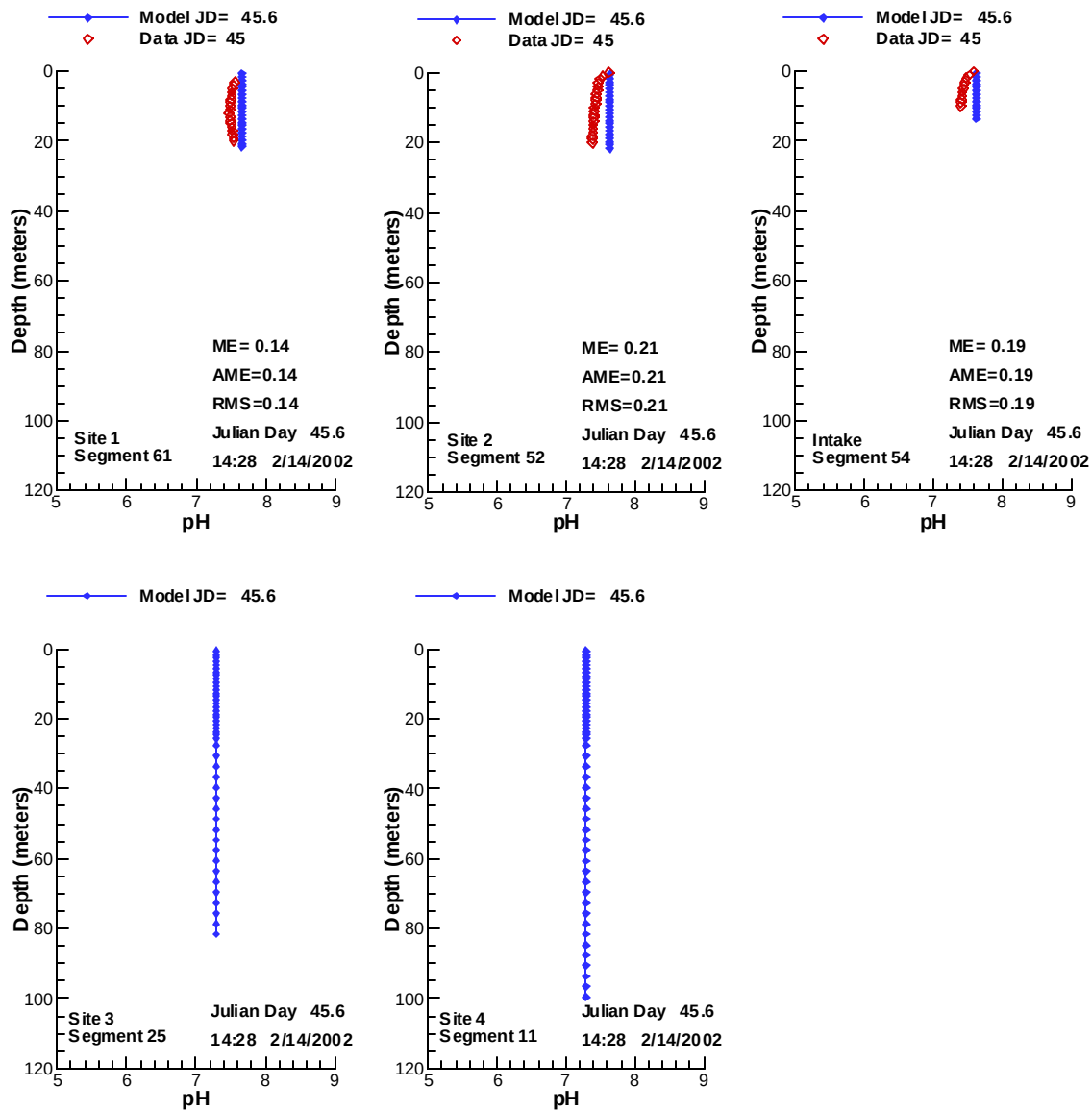


Figure 567. Vertical profiles of pH compared with data for 2/14/2002.

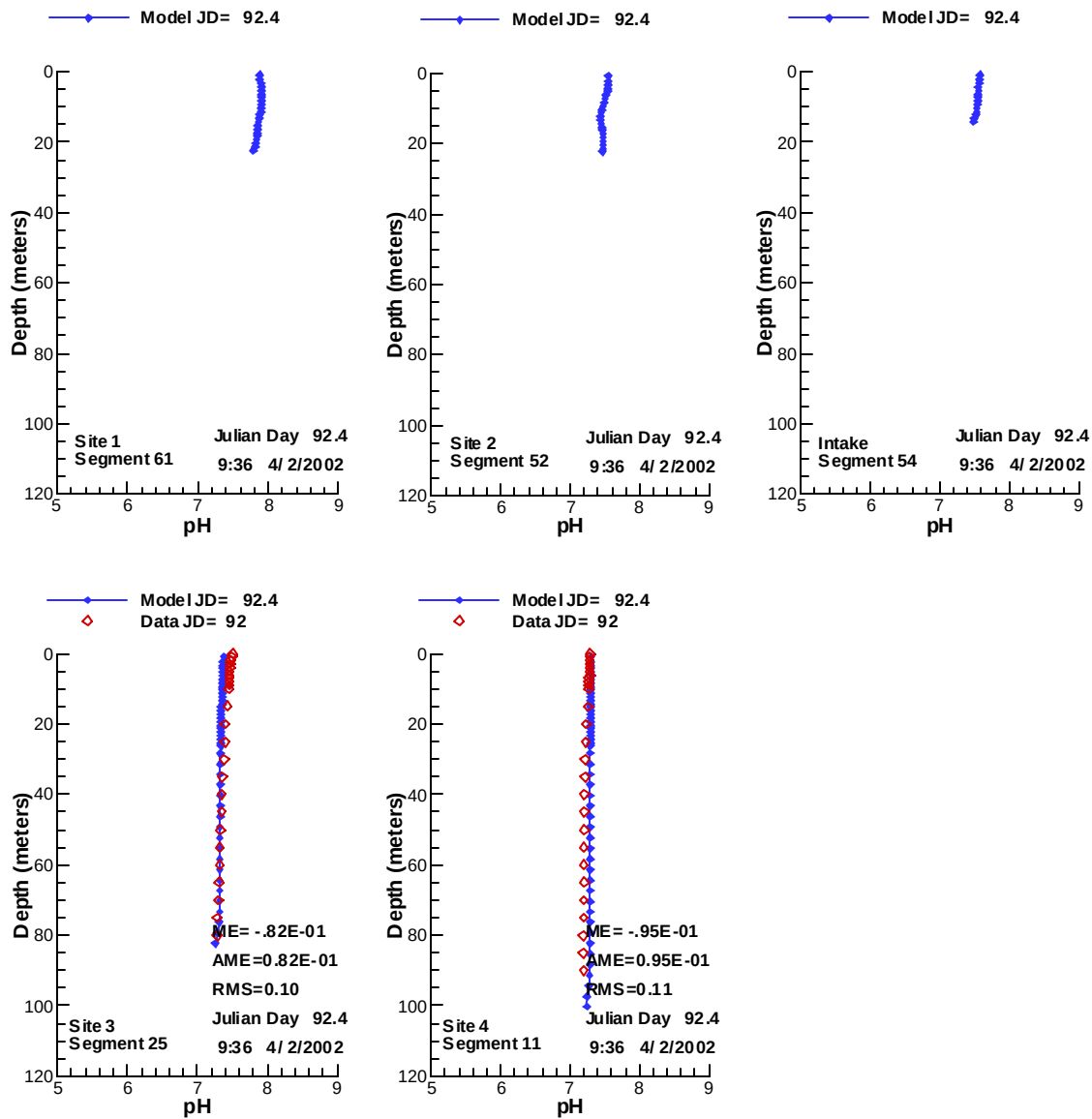


Figure 568. Vertical profiles of pH compared with data for 4/ 2/2002.

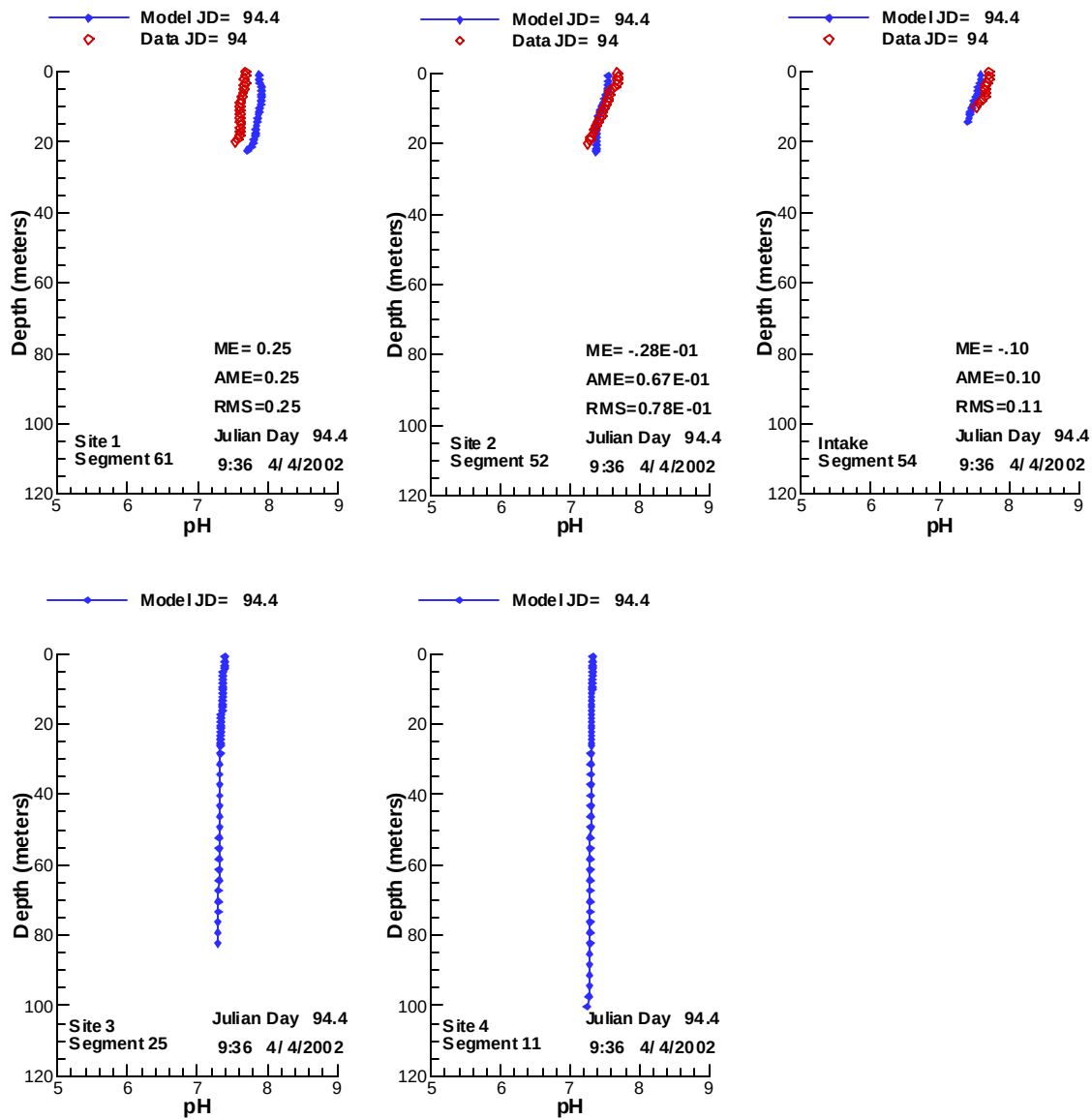


Figure 569. Vertical profiles of pH compared with data for 4/ 4/2002.

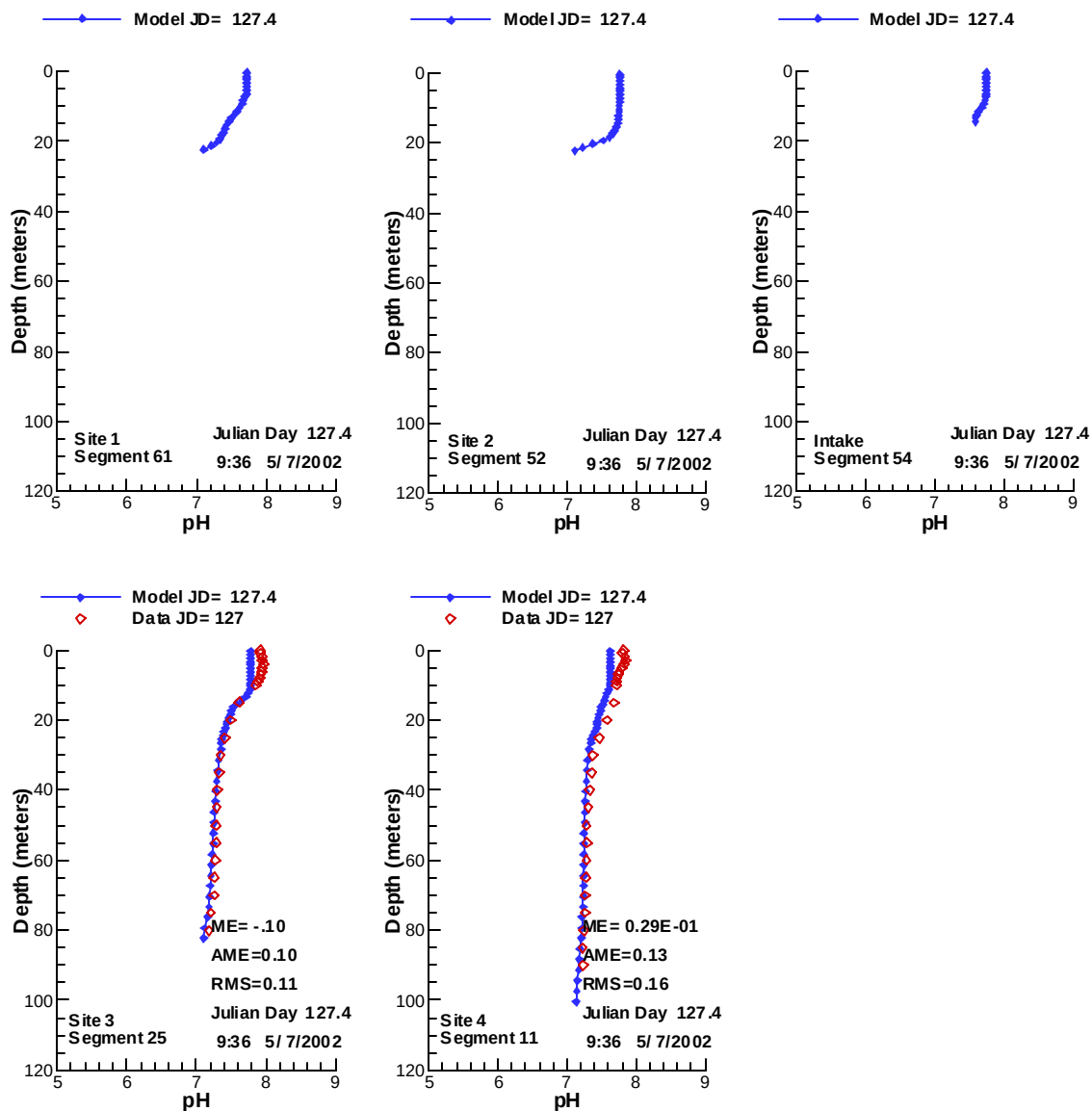


Figure 570. Vertical profiles of pH compared with data for 5/ 7/2002.

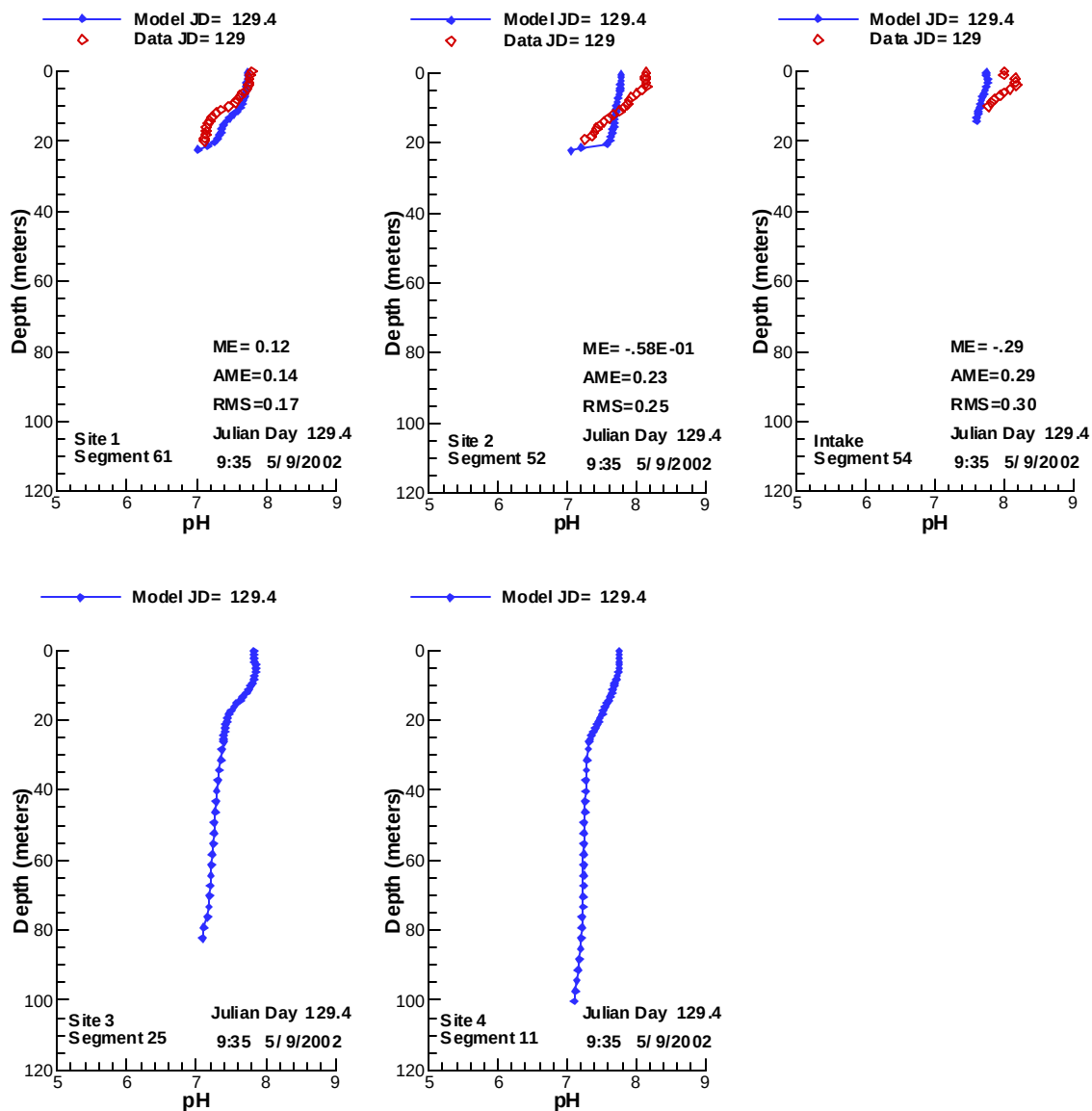


Figure 571. Vertical profiles of pH compared with data for 5/ 9/2002.

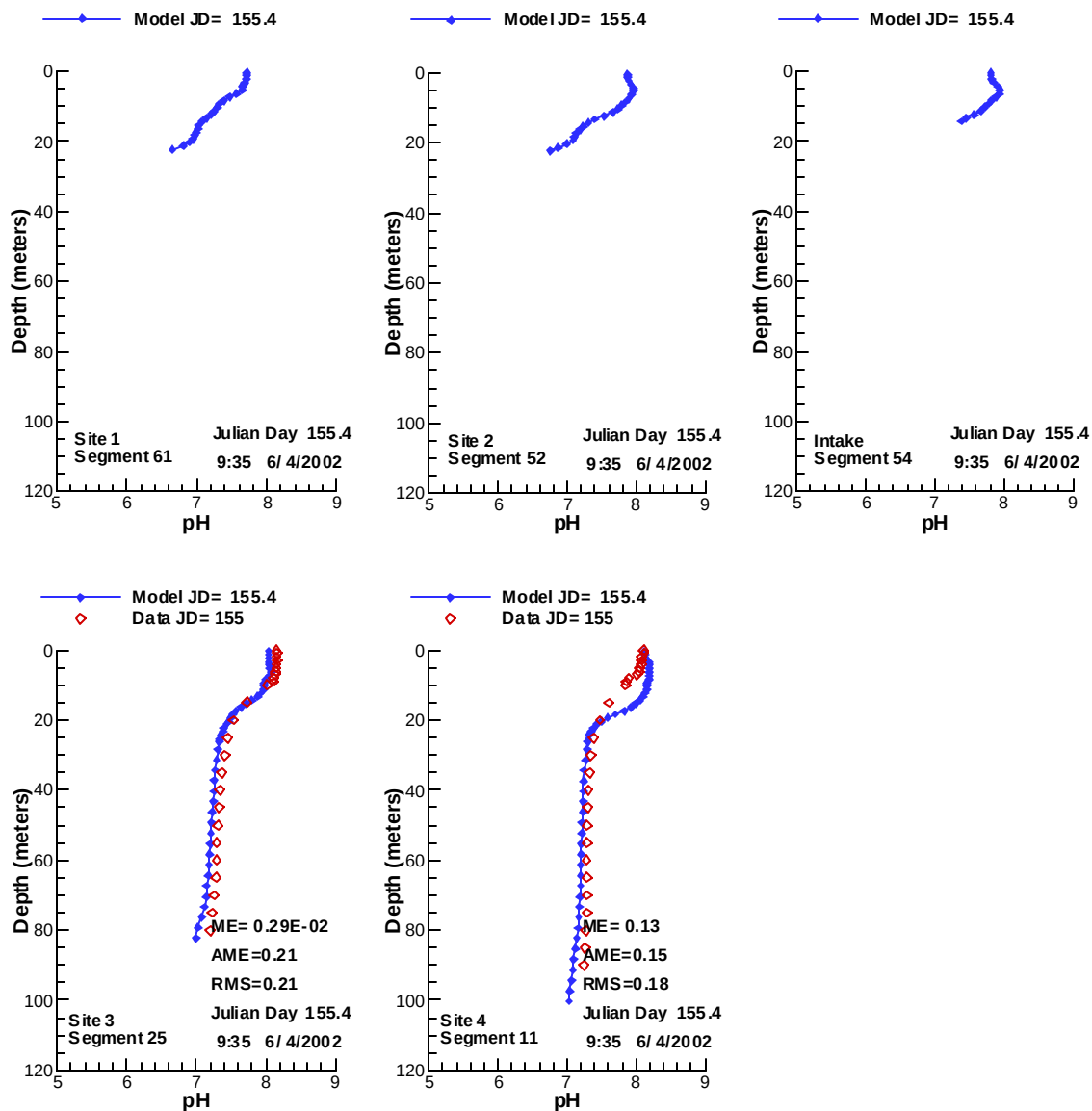


Figure 572. Vertical profiles of pH compared with data for 6/ 4/2002.

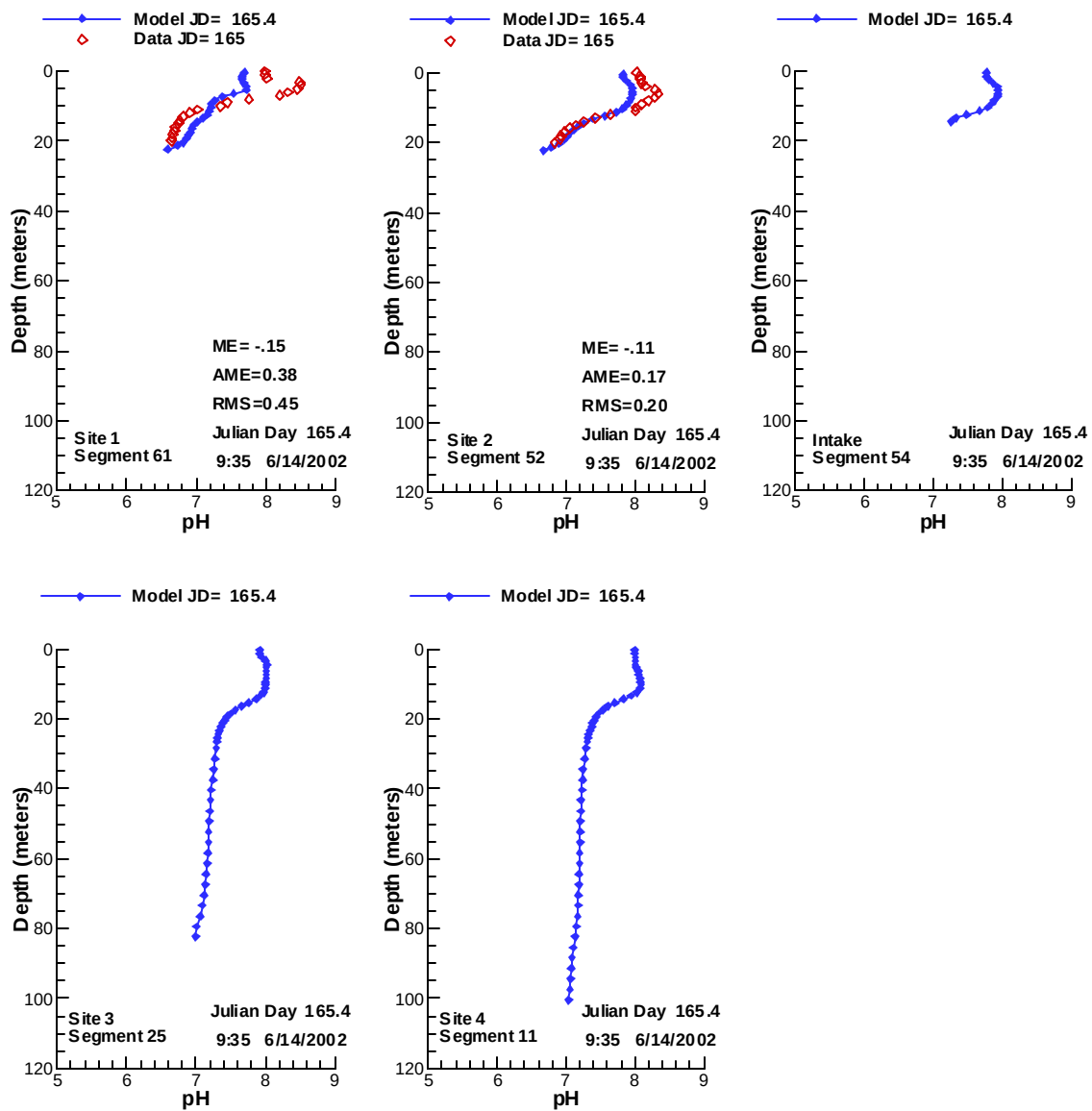


Figure 573. Vertical profiles of pH compared with data for 6/14/2002.

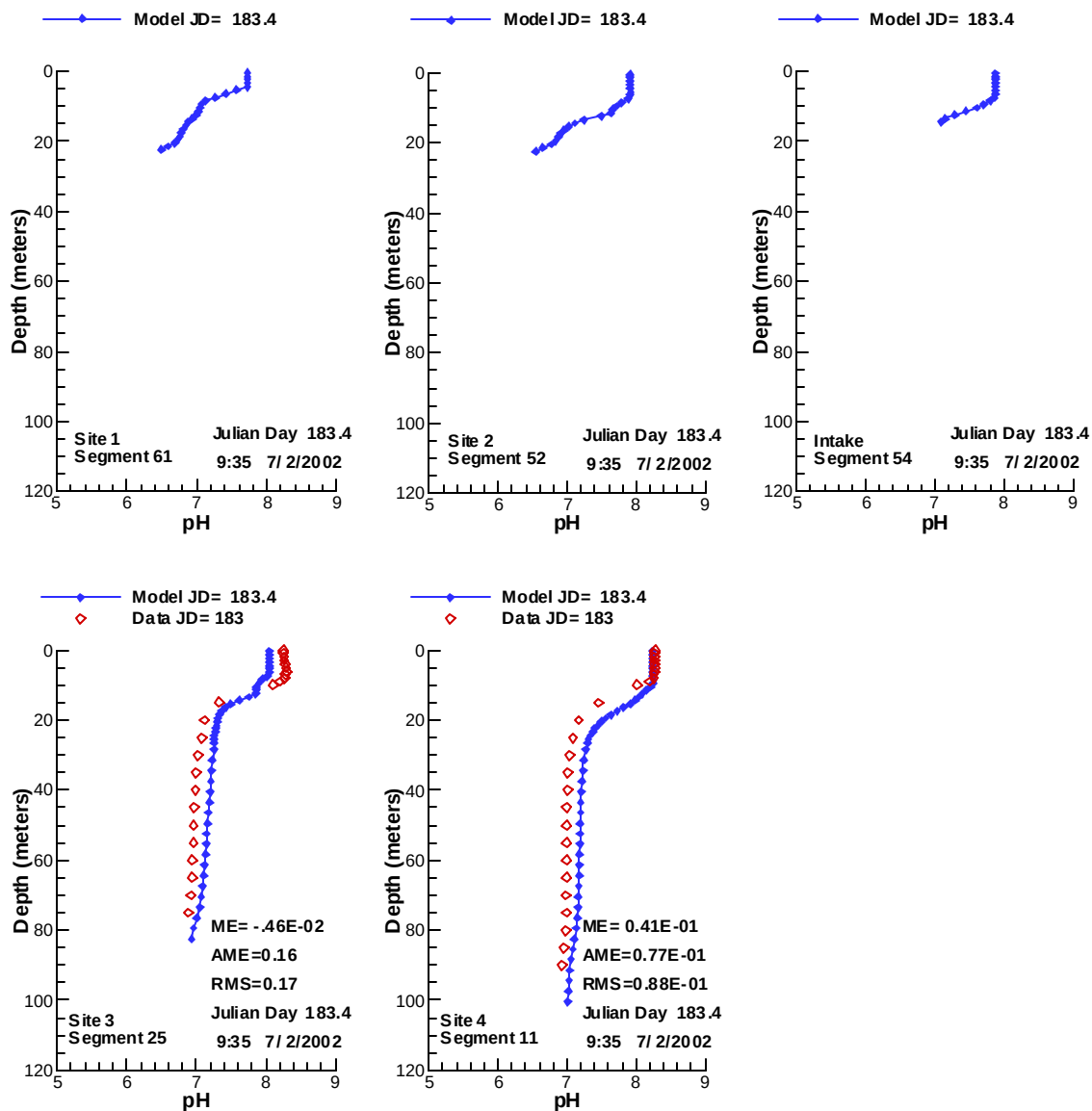


Figure 574. Vertical profiles of pH compared with data for 7/ 2/2002.

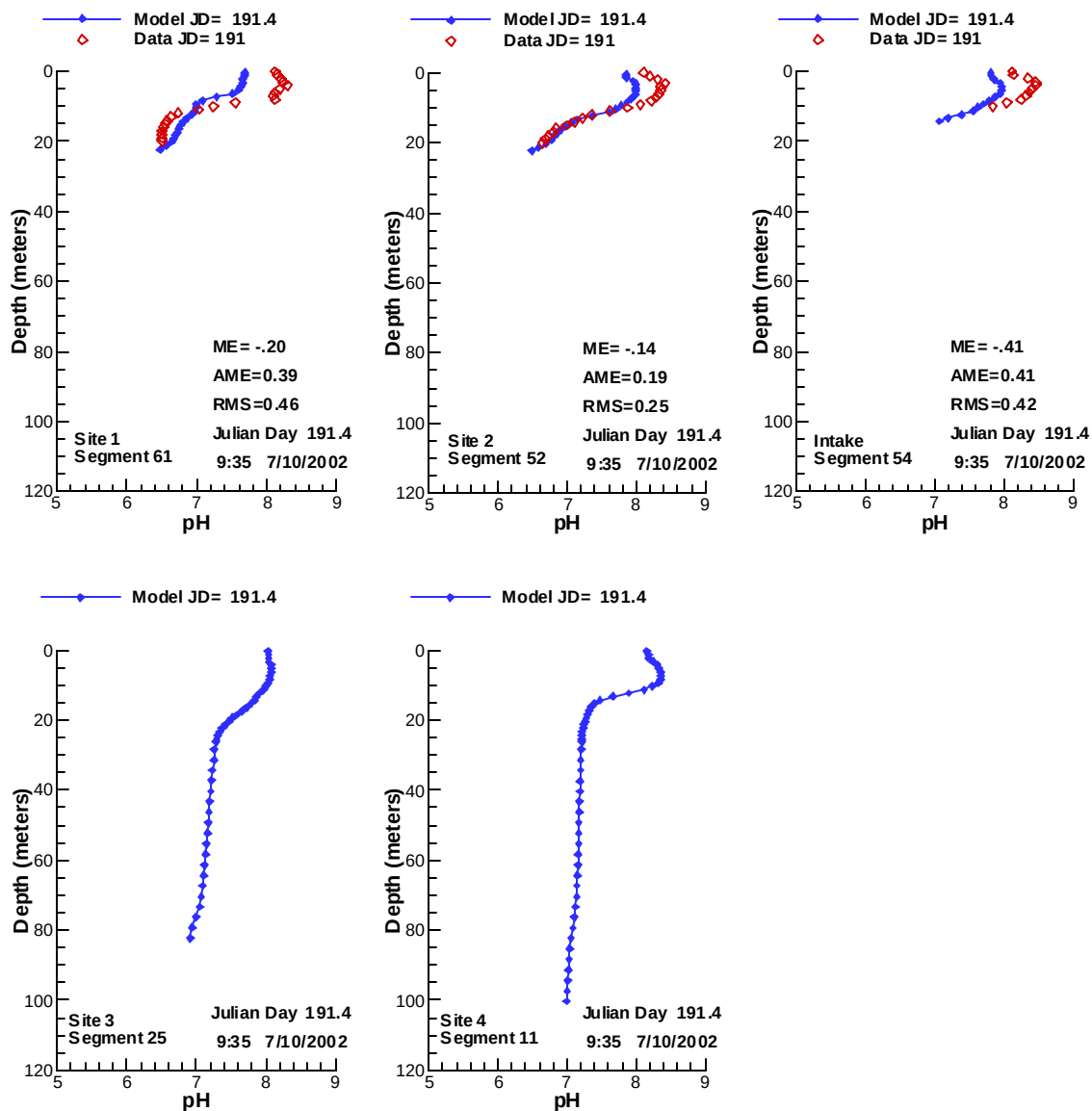


Figure 575. Vertical profiles of pH compared with data for 7/10/2002.

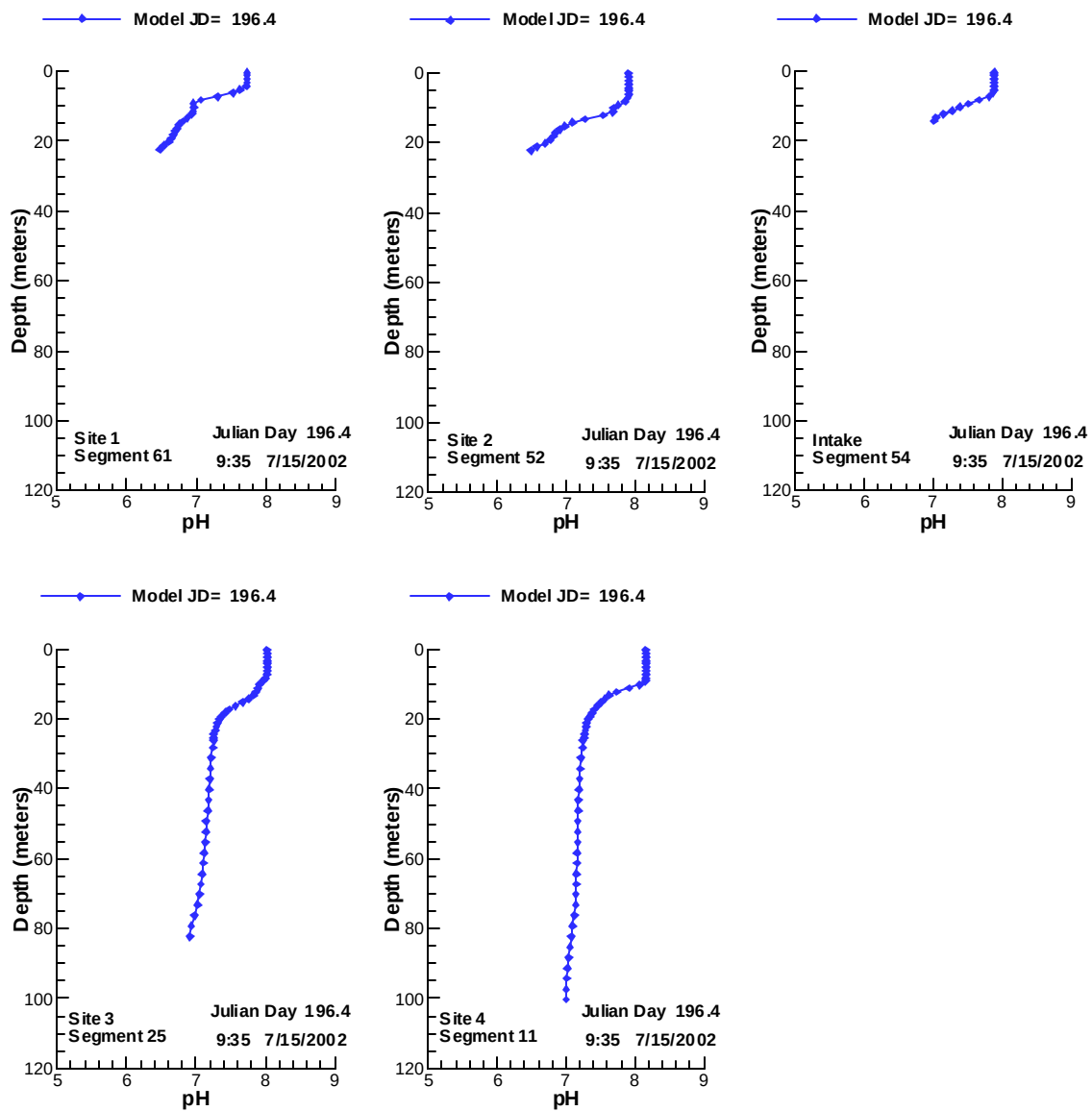


Figure 576. Vertical profiles of pH compared with data for 7/15/2002.

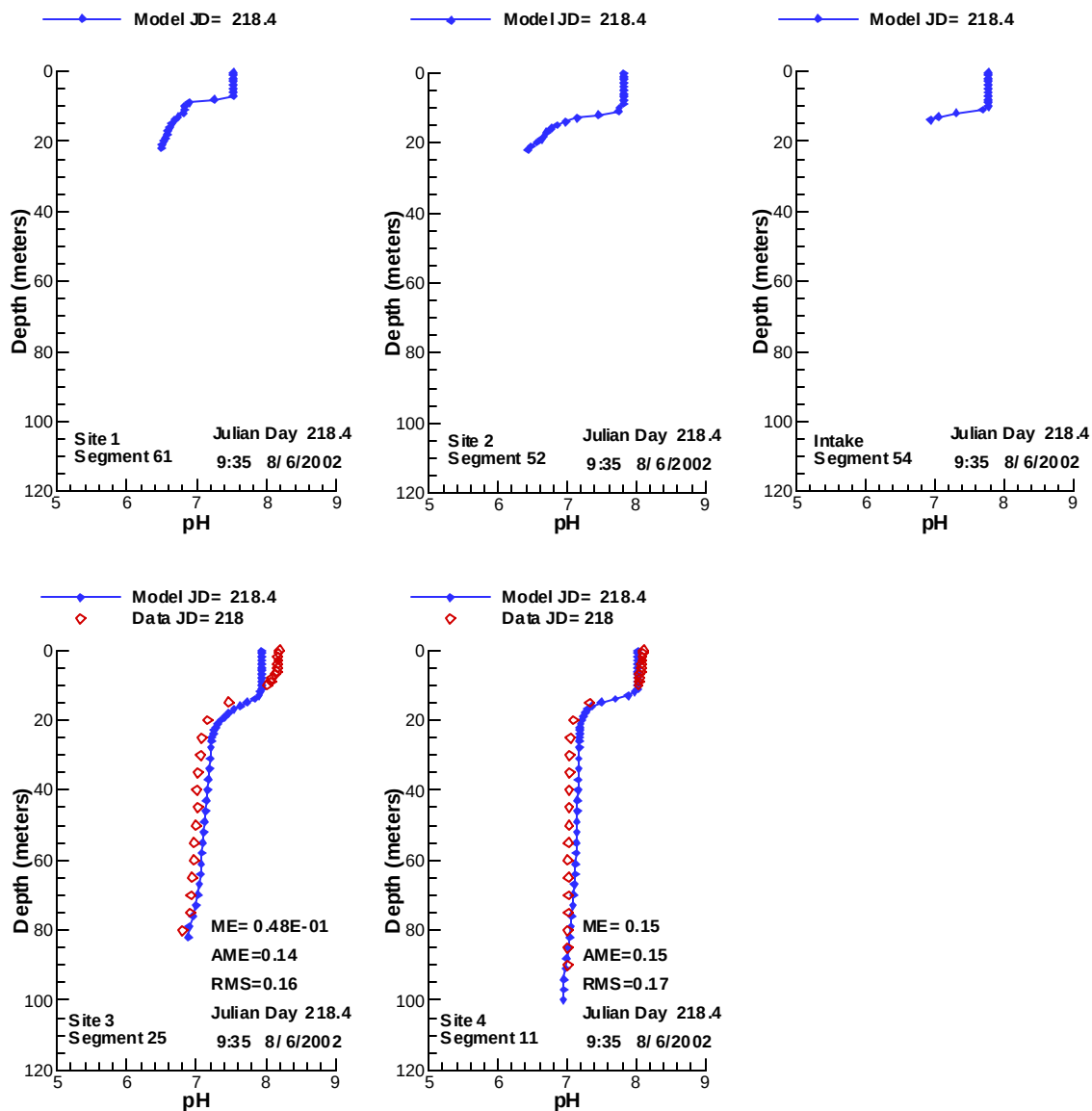


Figure 577. Vertical profiles of pH compared with data for 8/ 6/2002.

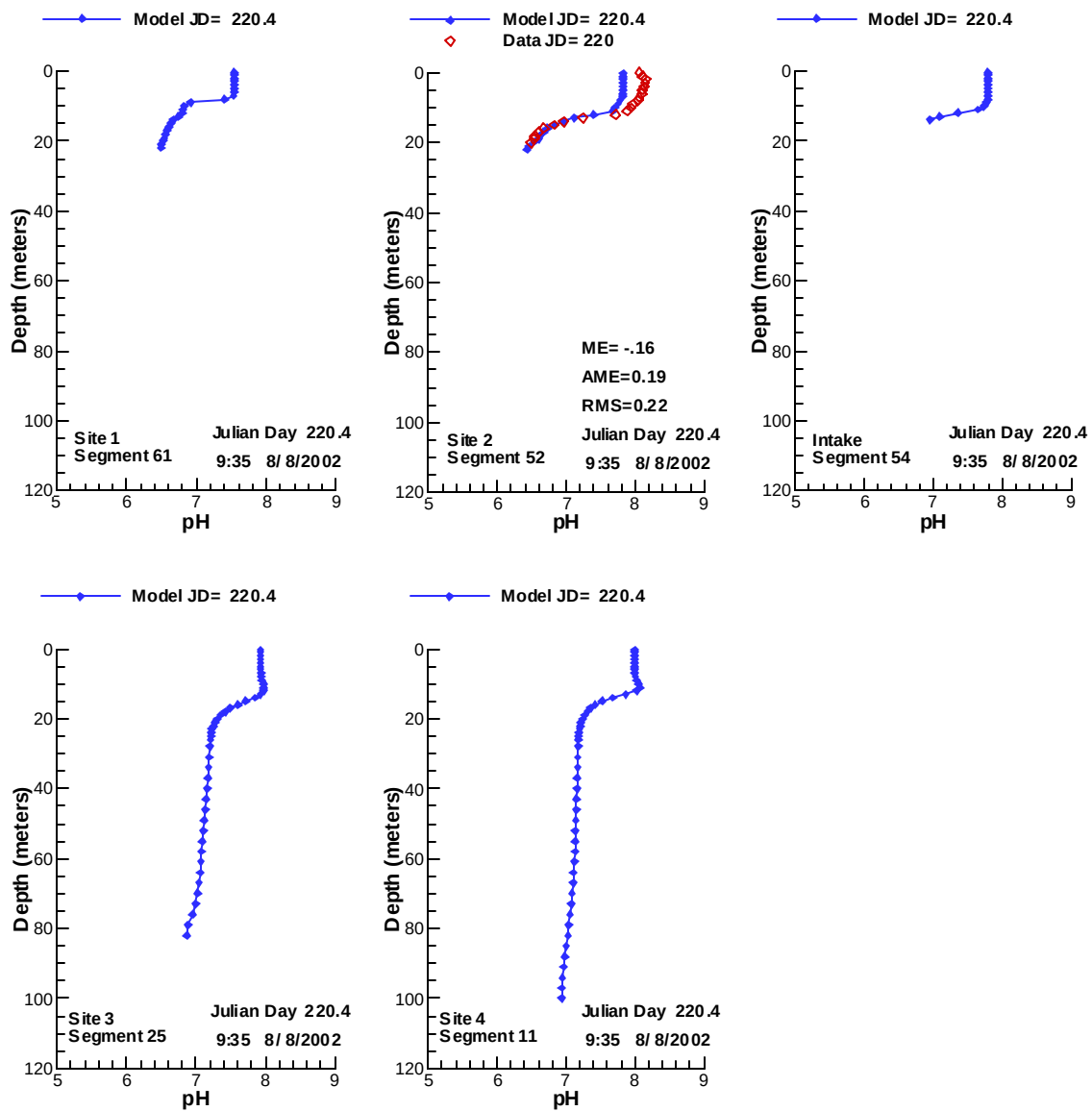


Figure 578. Vertical profiles of pH compared with data for 8/ 8/2002.

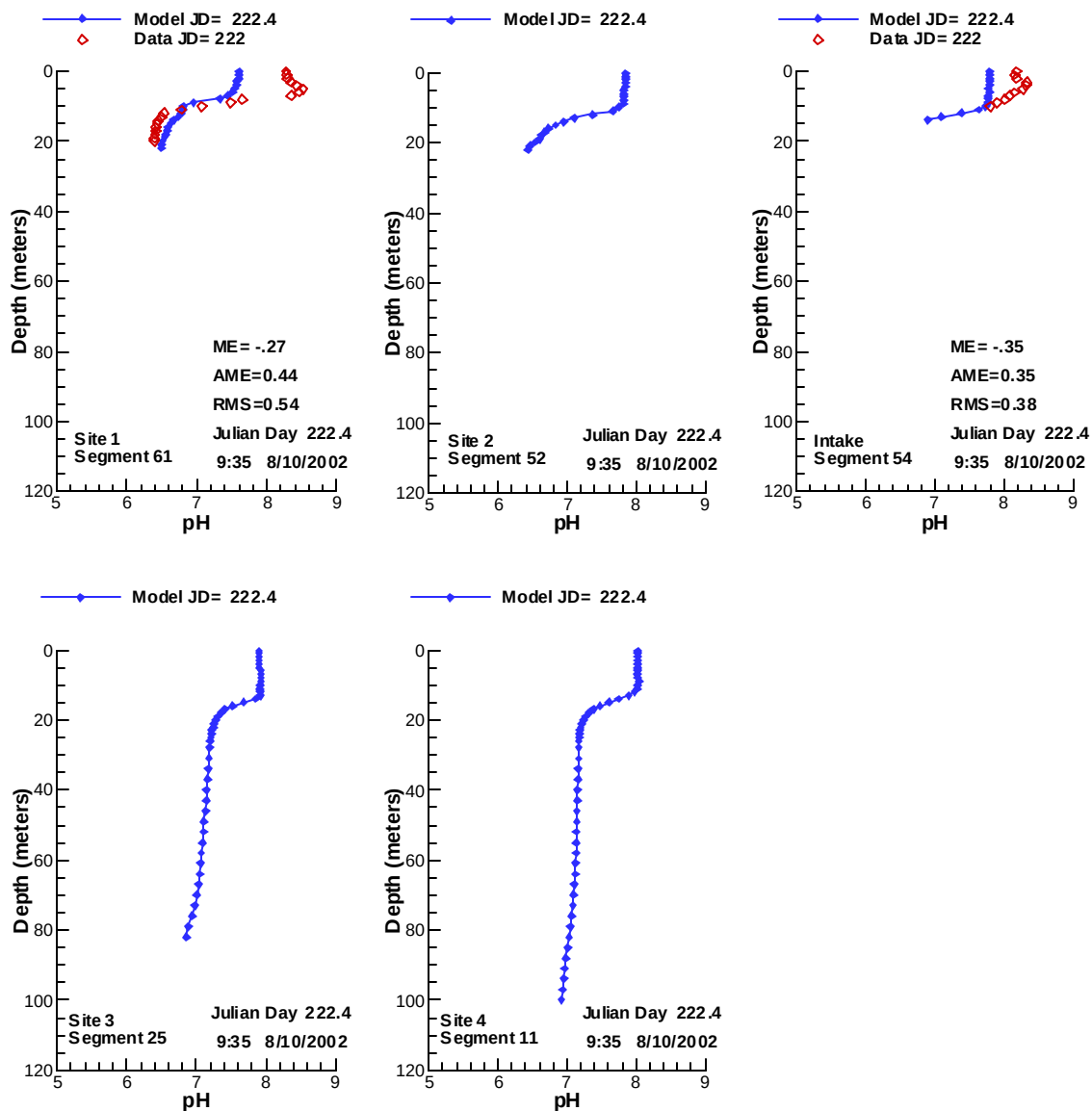


Figure 579. Vertical profiles of pH compared with data for 8/10/2002.

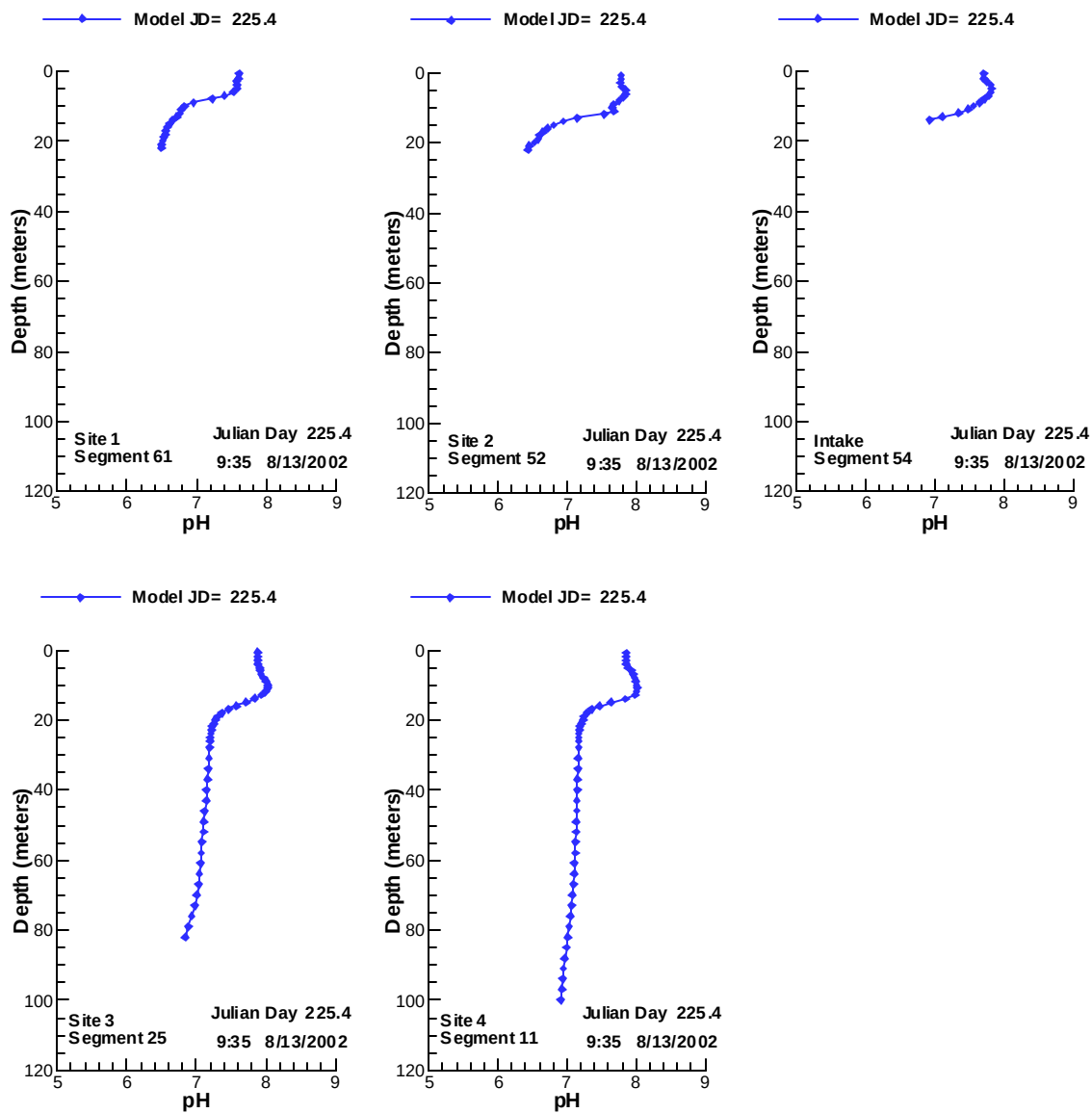


Figure 580. Vertical profiles of pH compared with data for 8/13/2002.

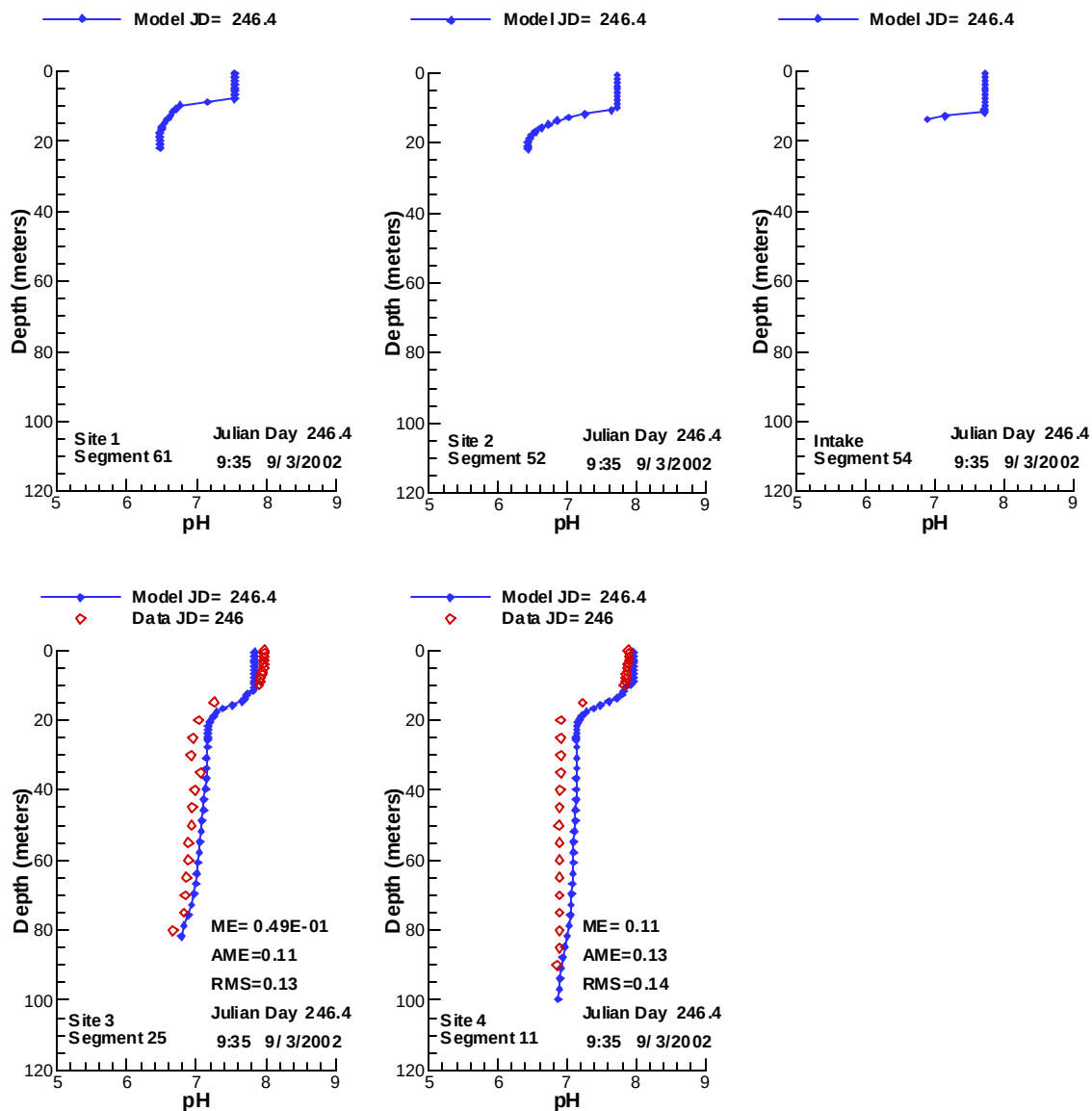


Figure 581. Vertical profiles of pH compared with data for 9/ 3/2002.

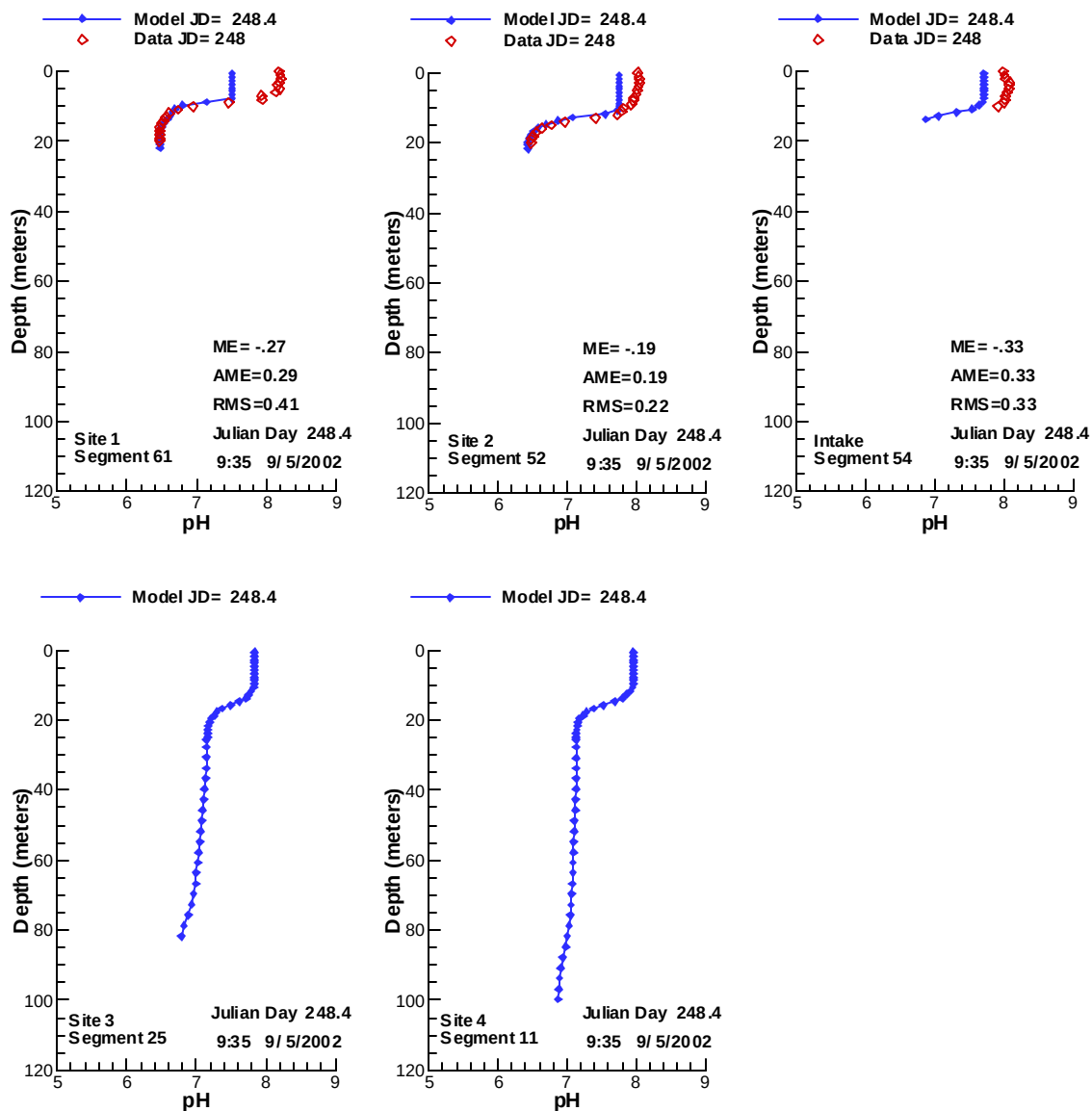


Figure 582. Vertical profiles of pH compared with data for 9/ 5/2002.

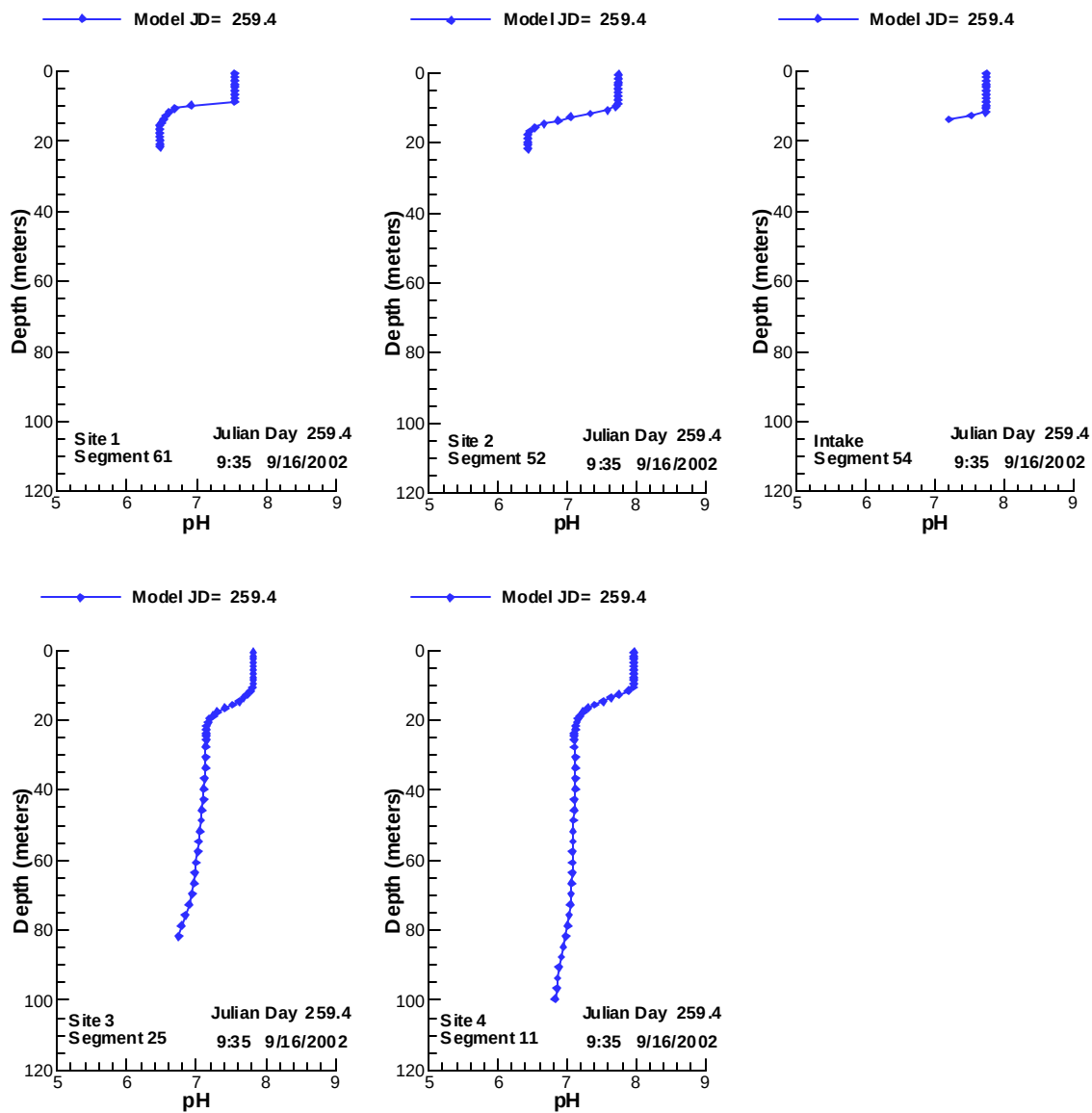


Figure 583. Vertical profiles of pH compared with data for 9/16/2002.

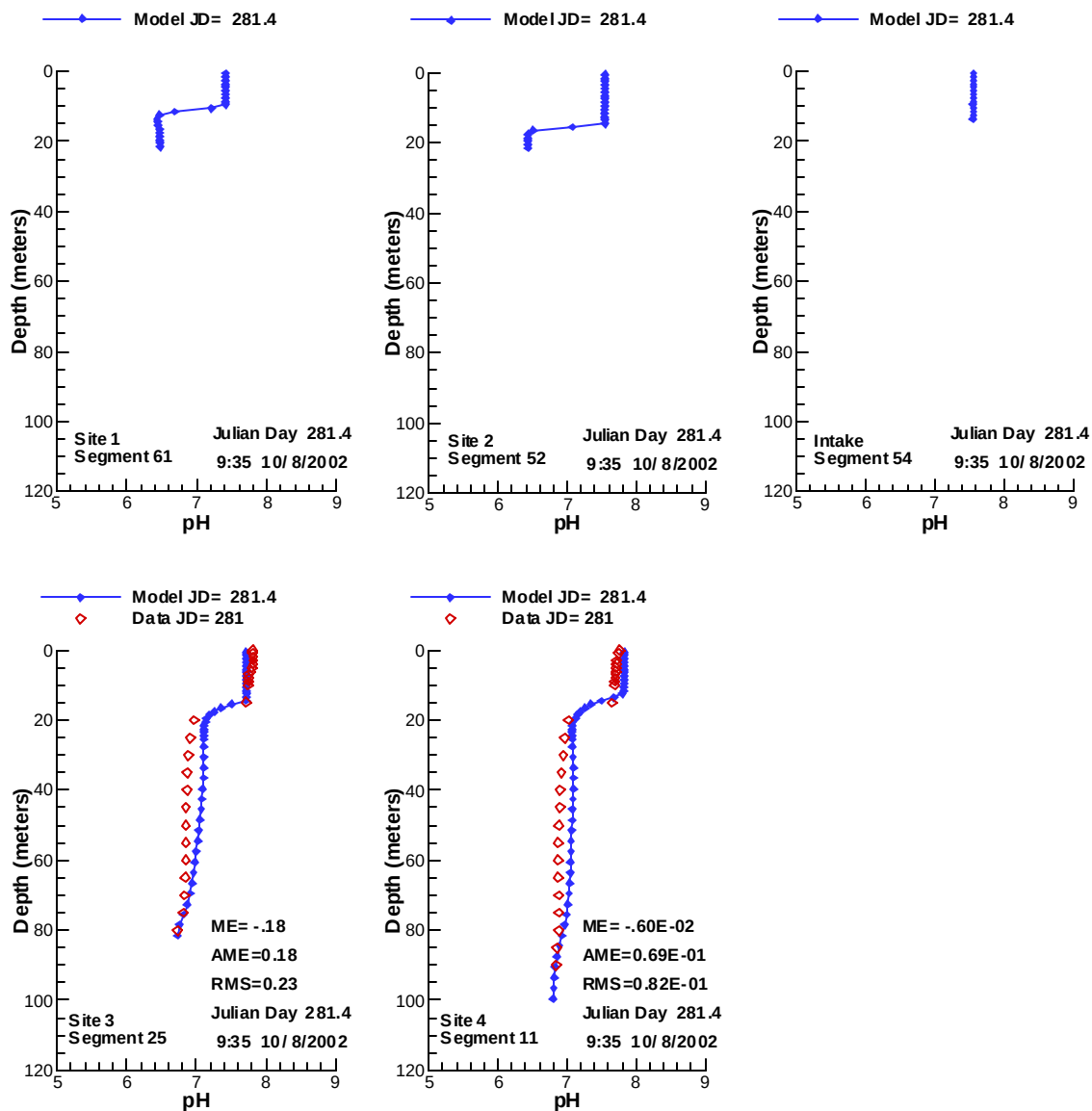


Figure 584. Vertical profiles of pH compared with data for 10/ 8/2002.

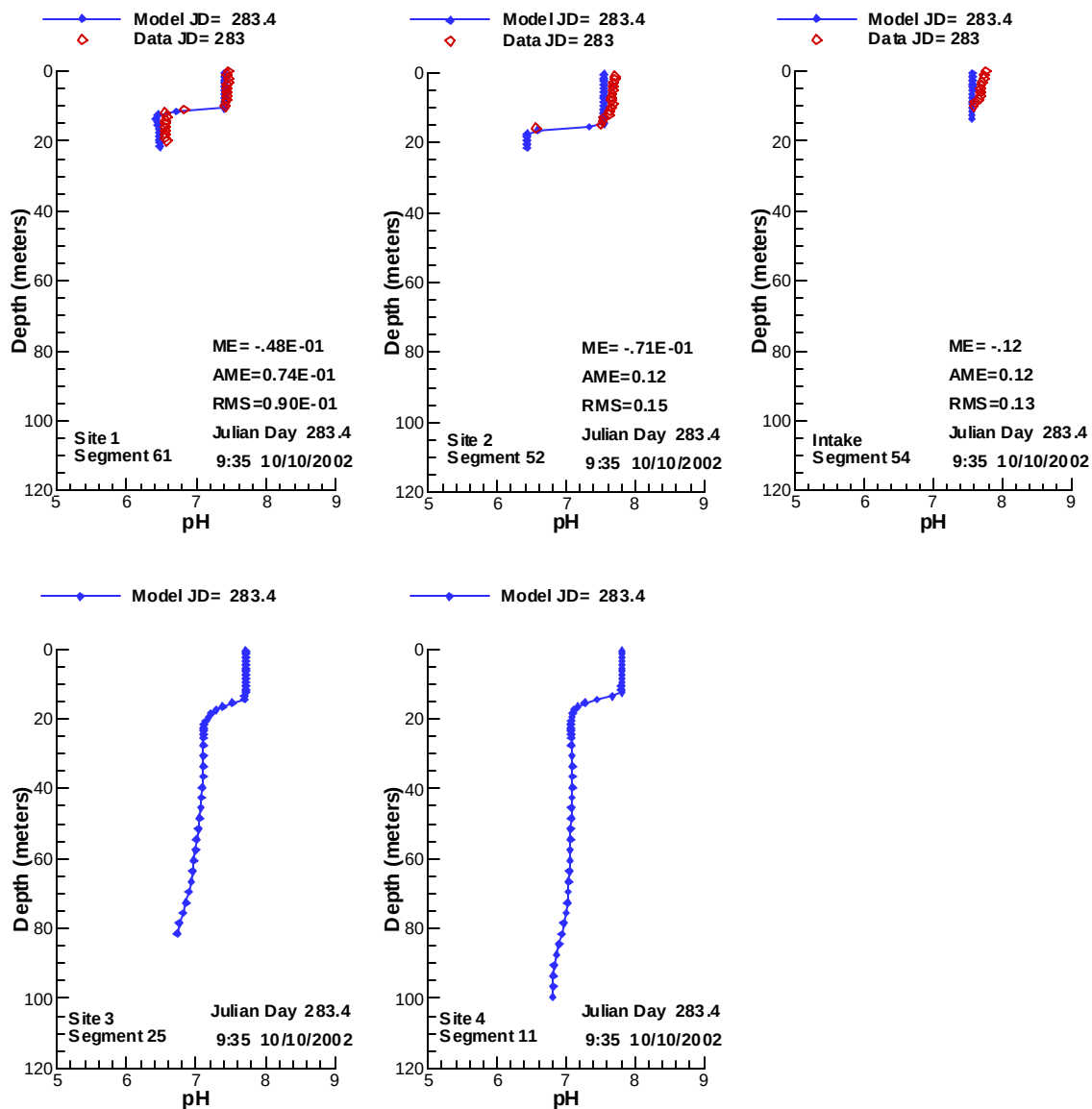


Figure 585. Vertical profiles of pH compared with data for 10/10/2002.

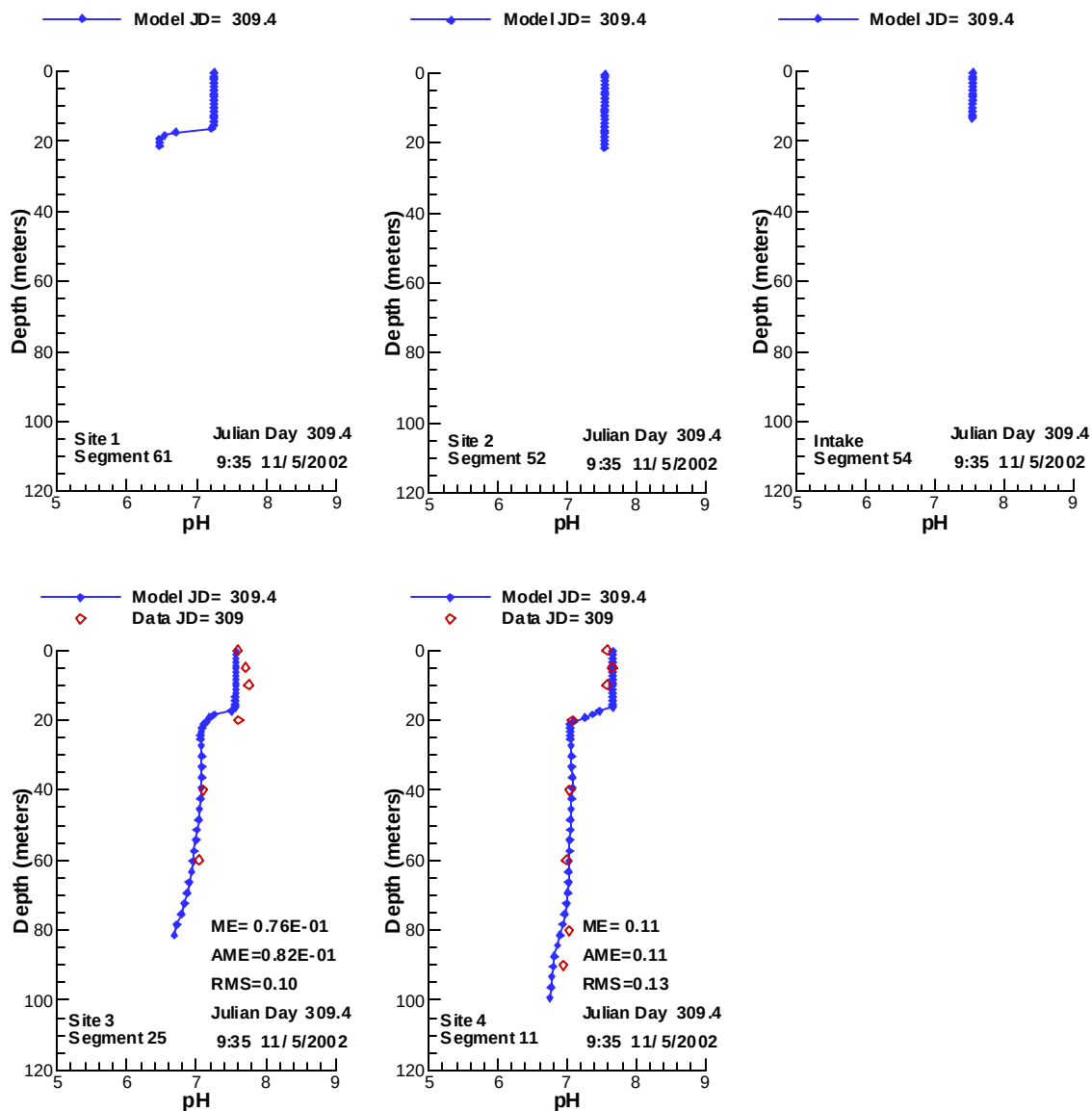


Figure 586. Vertical profiles of pH compared with data for 11/ 5/2002.

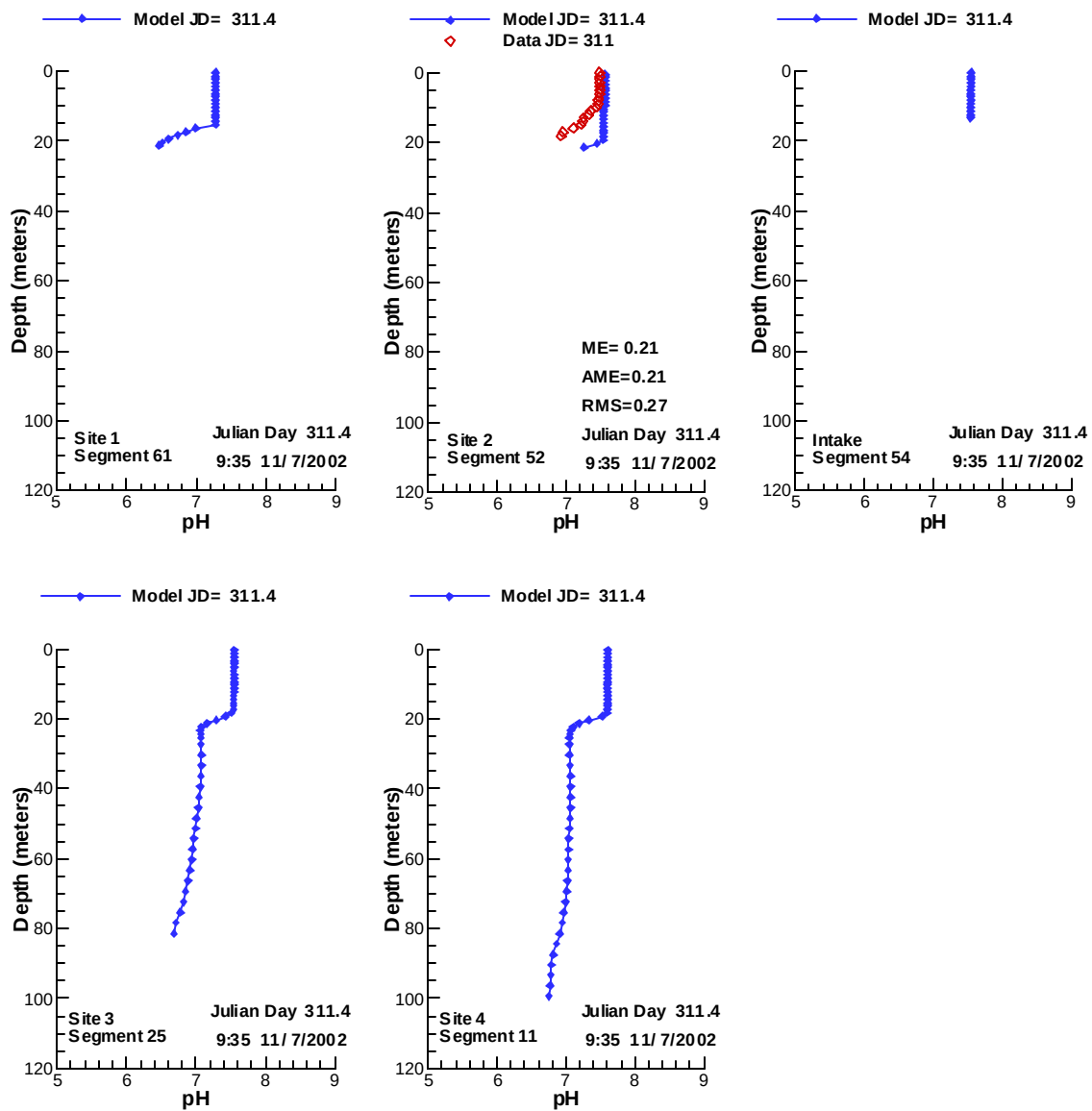


Figure 587. Vertical profiles of pH compared with data for 11/ 7/2002.

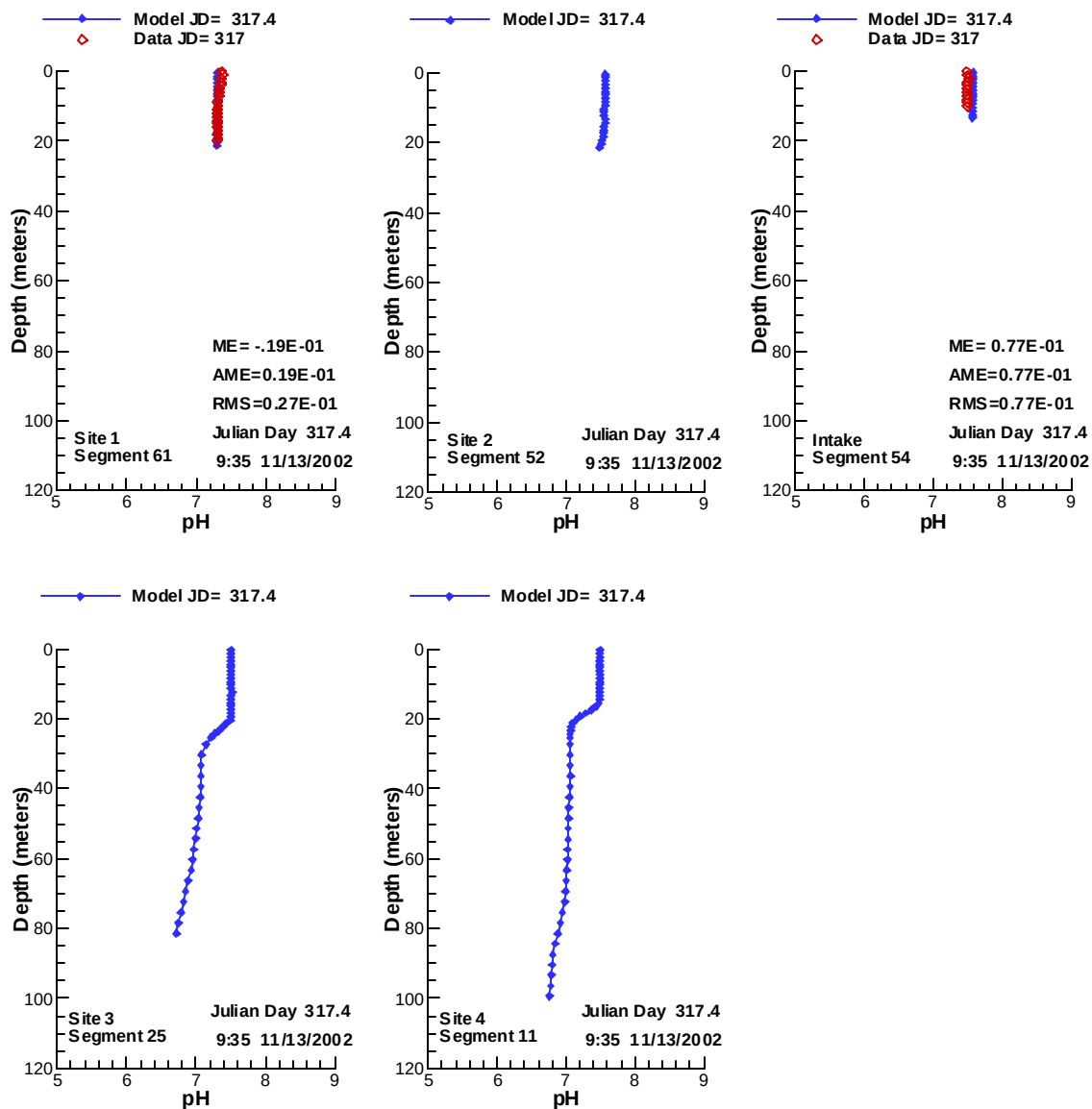


Figure 588. Vertical profiles of pH compared with data for 11/13/2002.

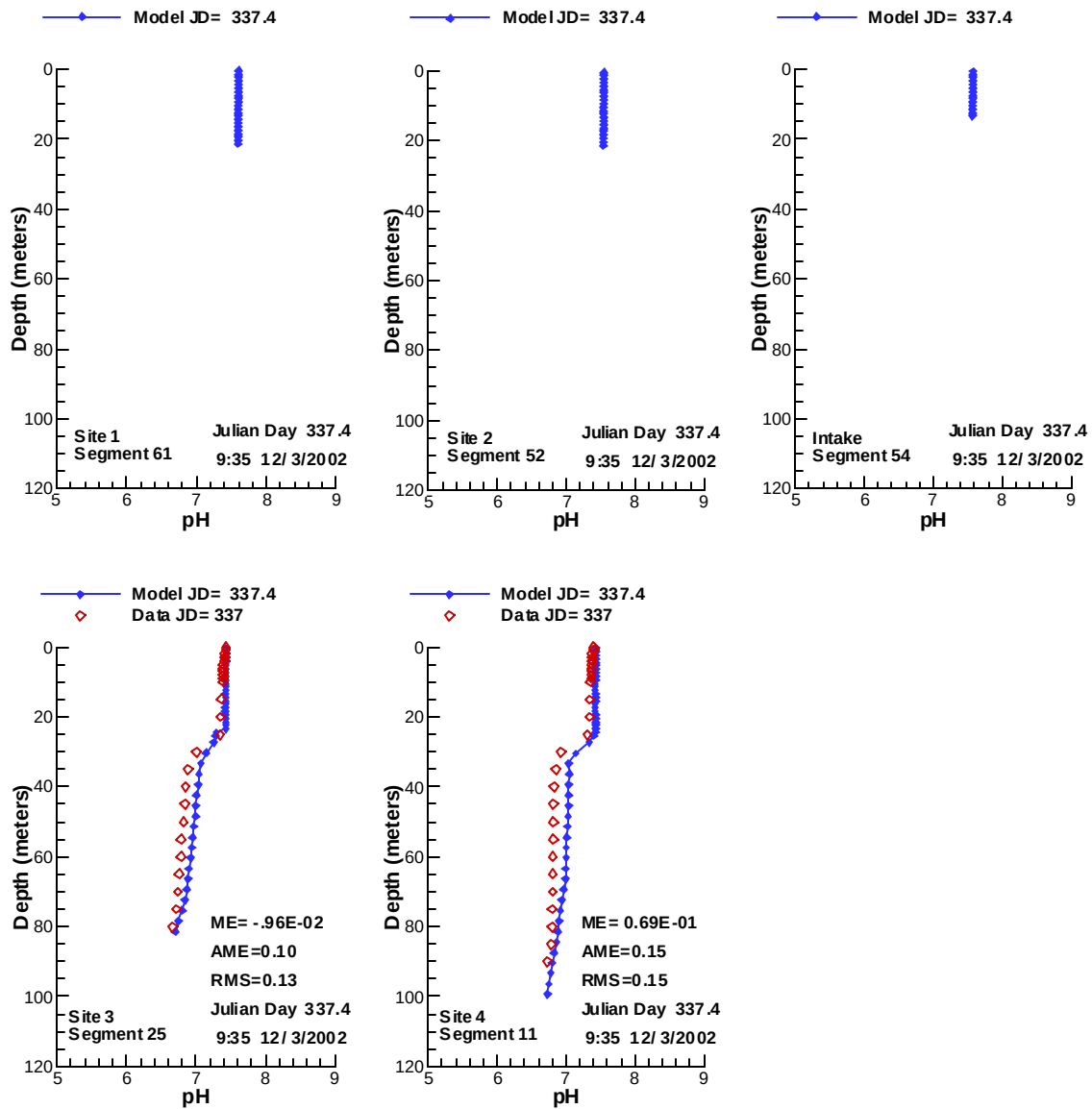


Figure 589. Vertical profiles of pH compared with data for 12/ 3/2002.

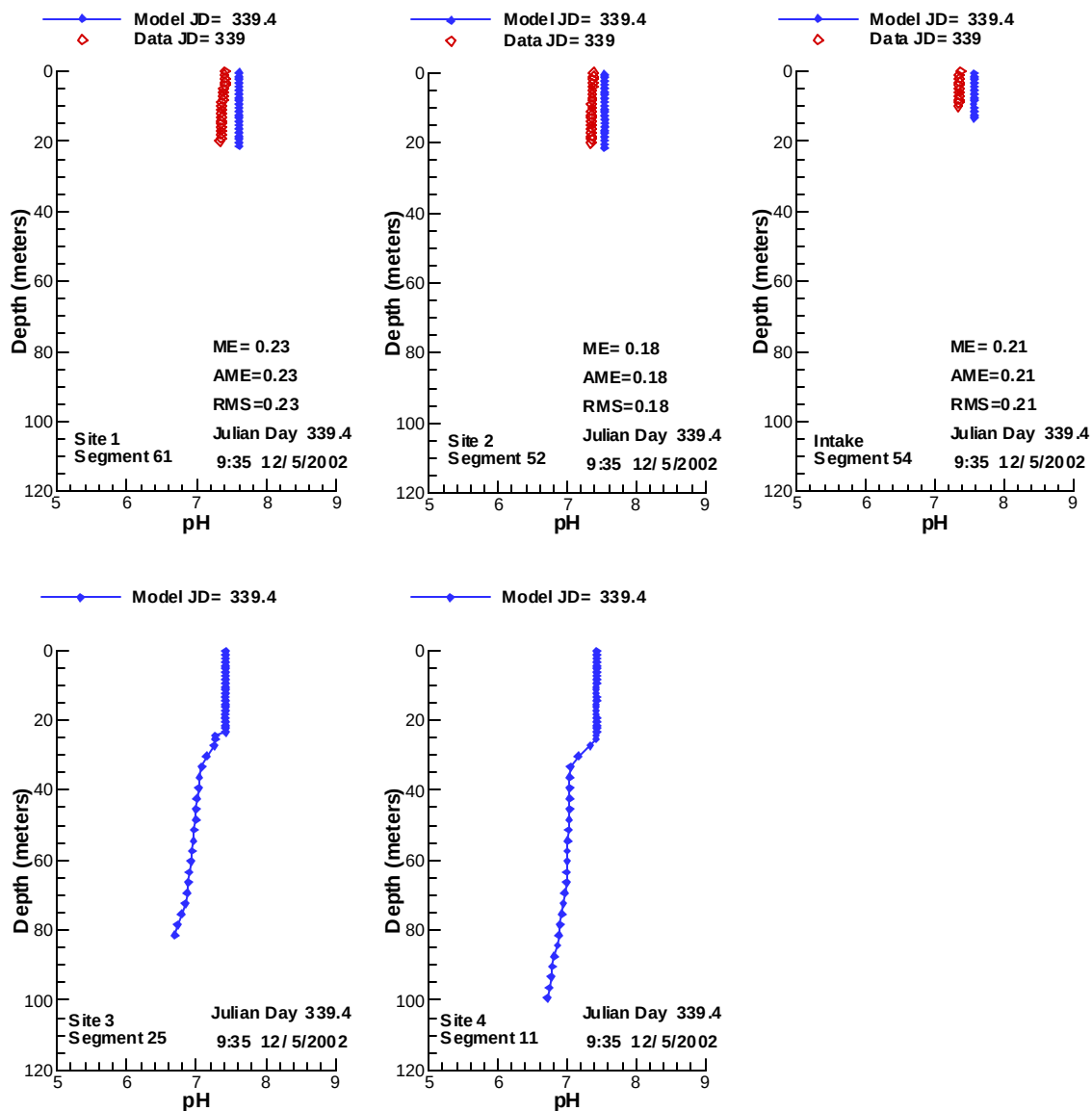


Figure 590. Vertical profiles of pH compared with data for 12/ 5/2002.

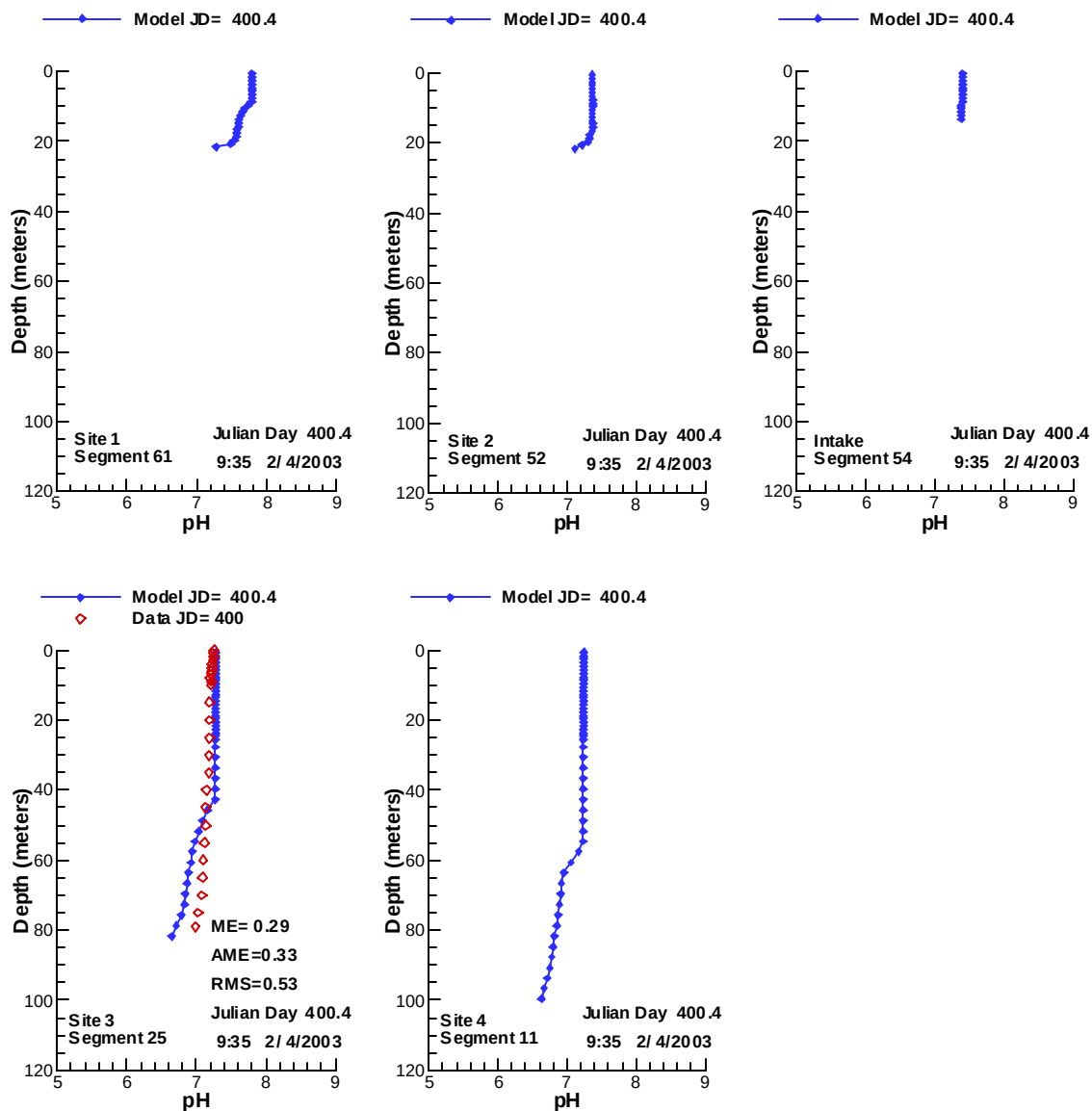


Figure 591. Vertical profiles of pH compared with data for 2/ 4/2003.

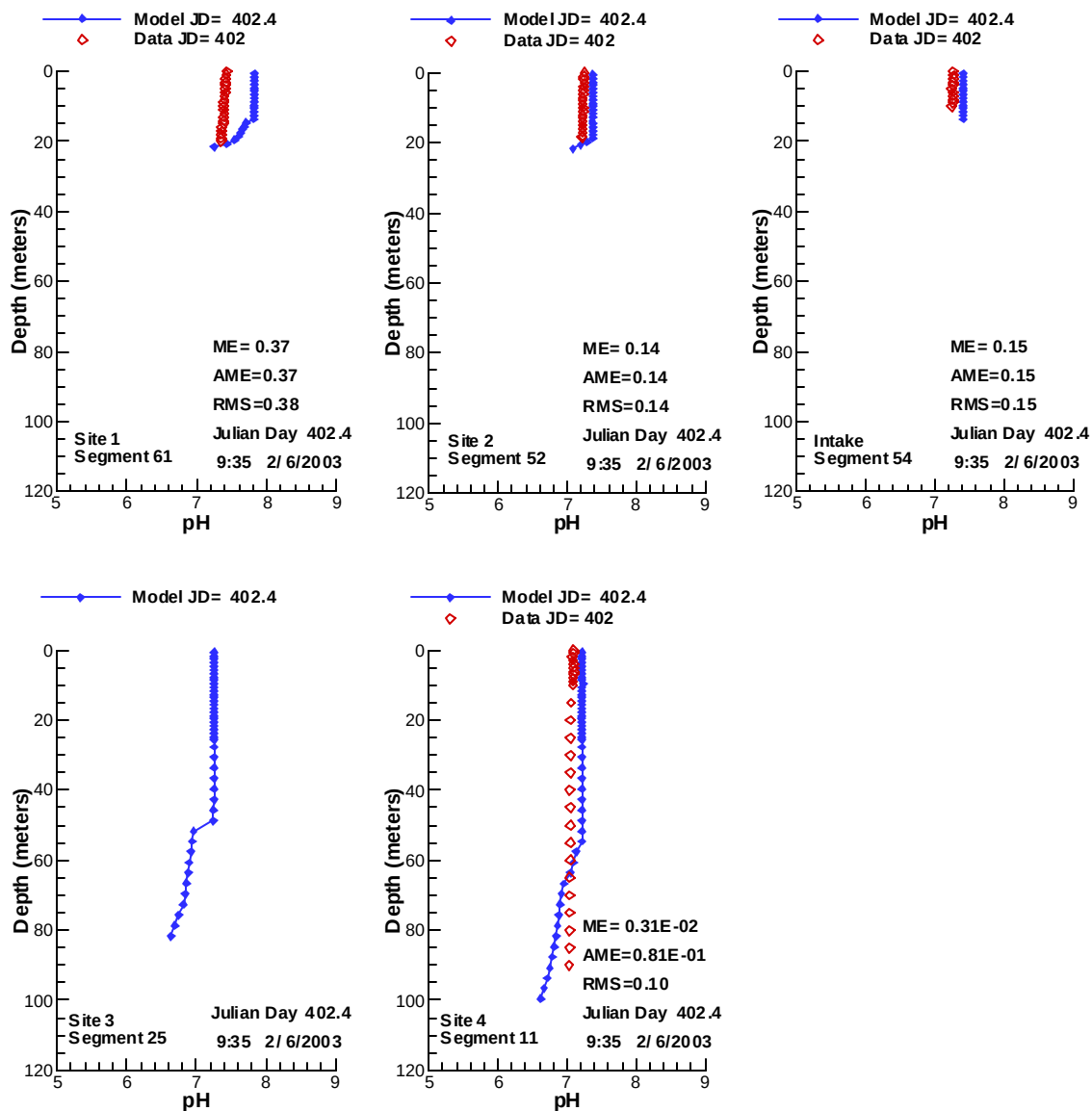


Figure 592. Vertical profiles of pH compared with data for 2/ 6/2003.

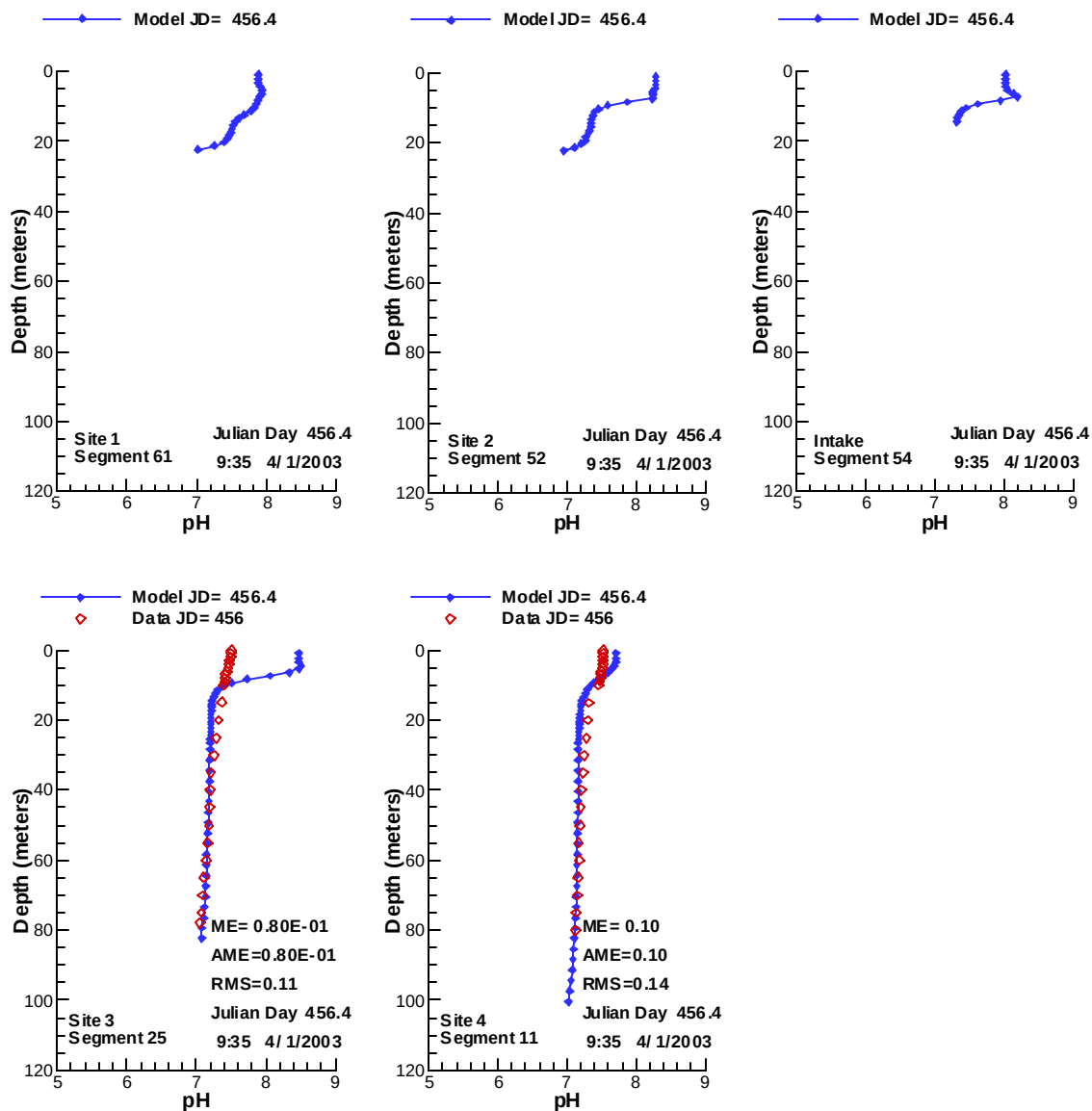


Figure 593. Vertical profiles of pH compared with data for 4/ 1/2003.

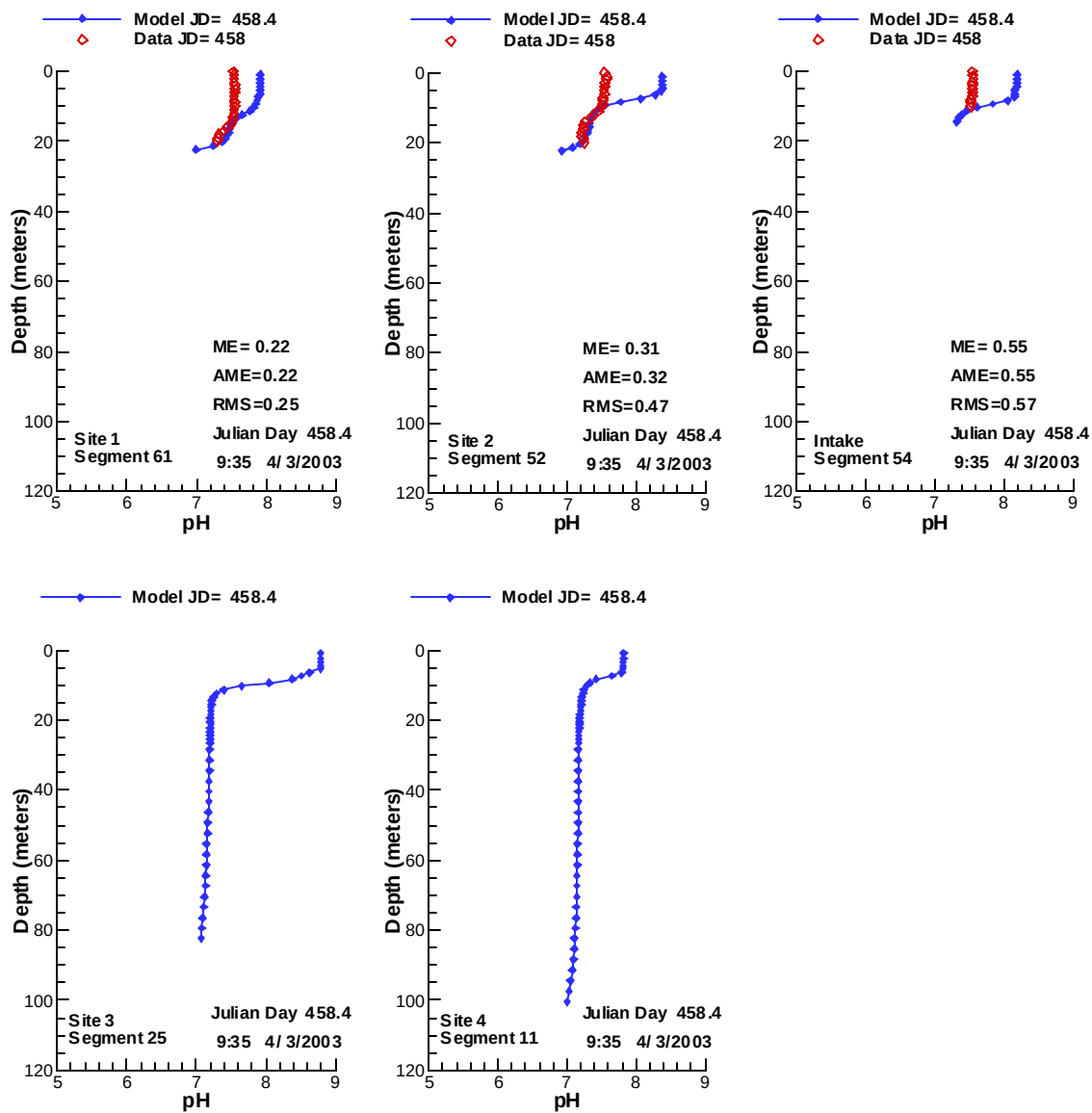


Figure 594. Vertical profiles of pH compared with data for 4/ 3/2003.

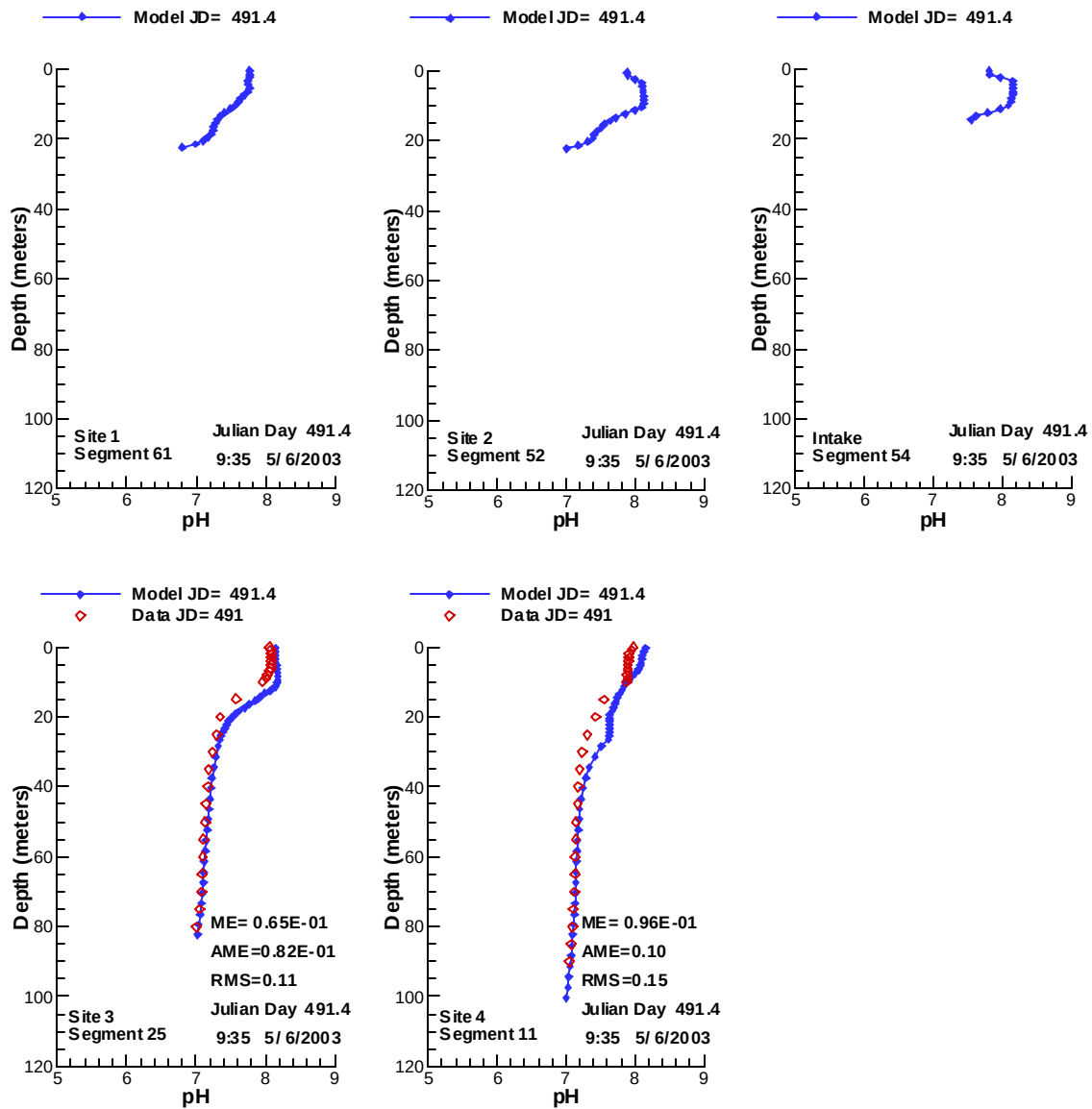


Figure 595. Vertical profiles of pH compared with data for 5/ 6/2003.

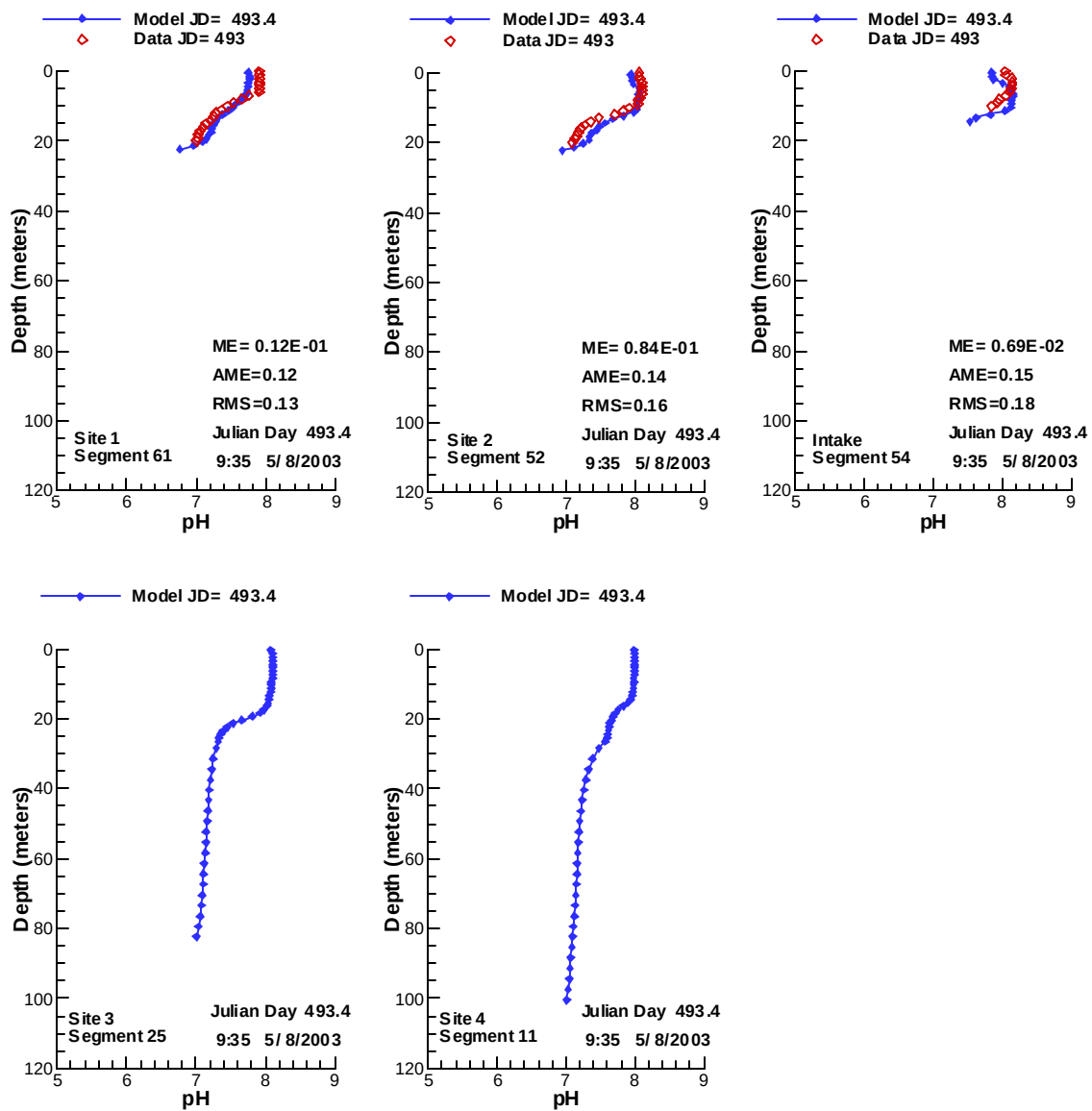


Figure 596. Vertical profiles of pH compared with data for 5/ 8/2003.

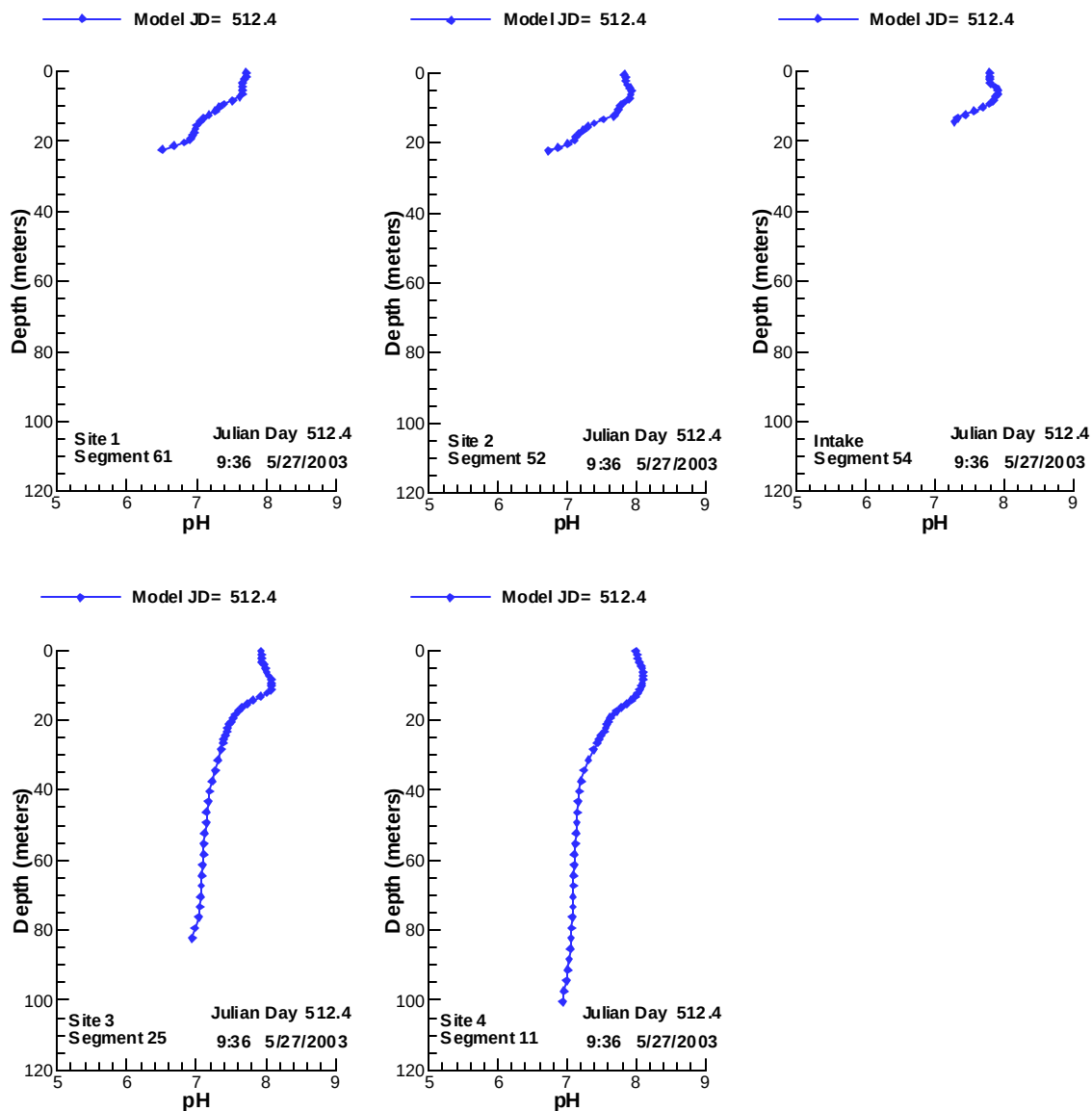


Figure 597. Vertical profiles of pH compared with data for 5/27/2003.

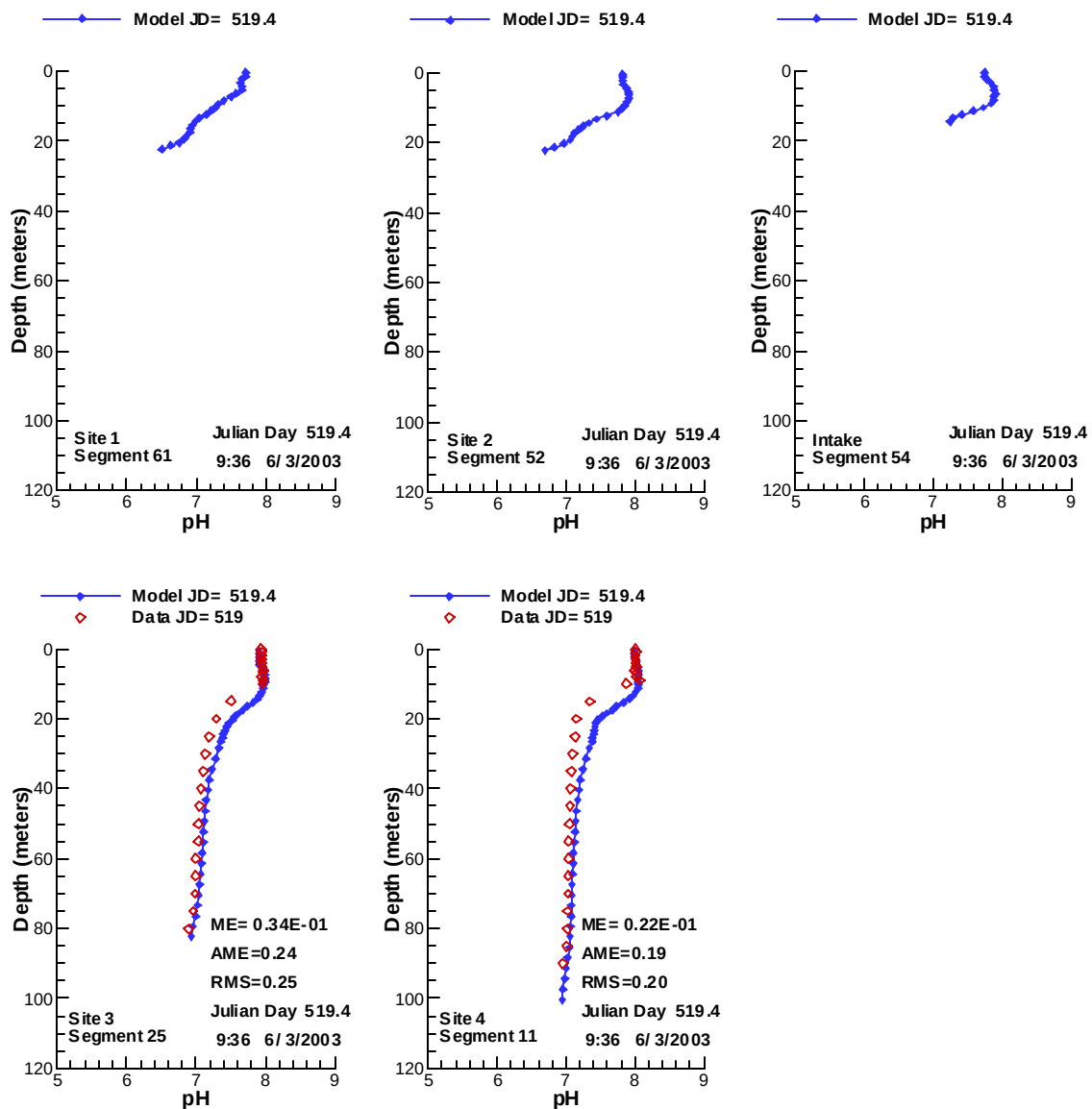


Figure 598. Vertical profiles of pH compared with data for 6/ 3/2003.

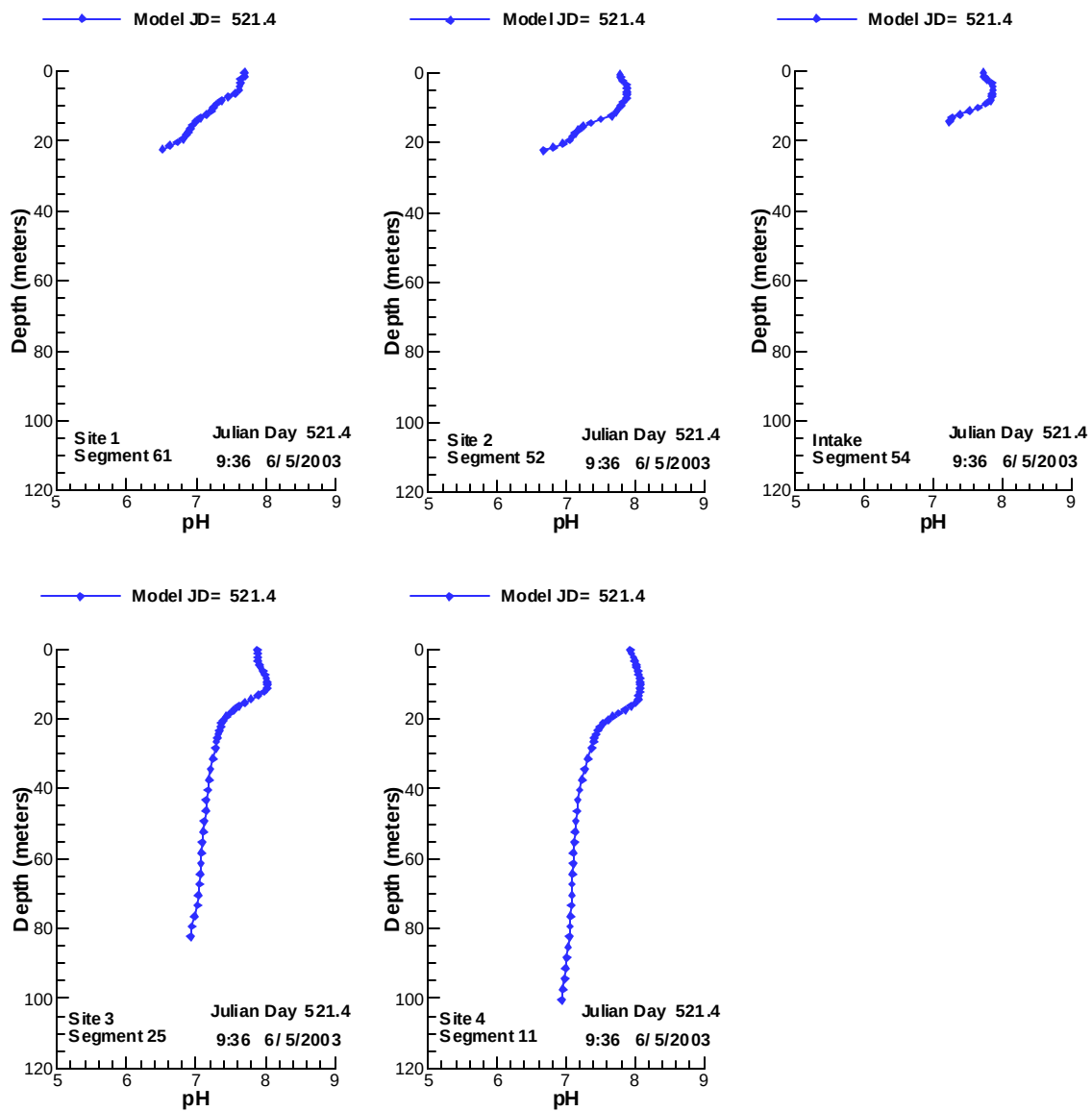


Figure 599. Vertical profiles of pH compared with data for 6/ 5/2003.

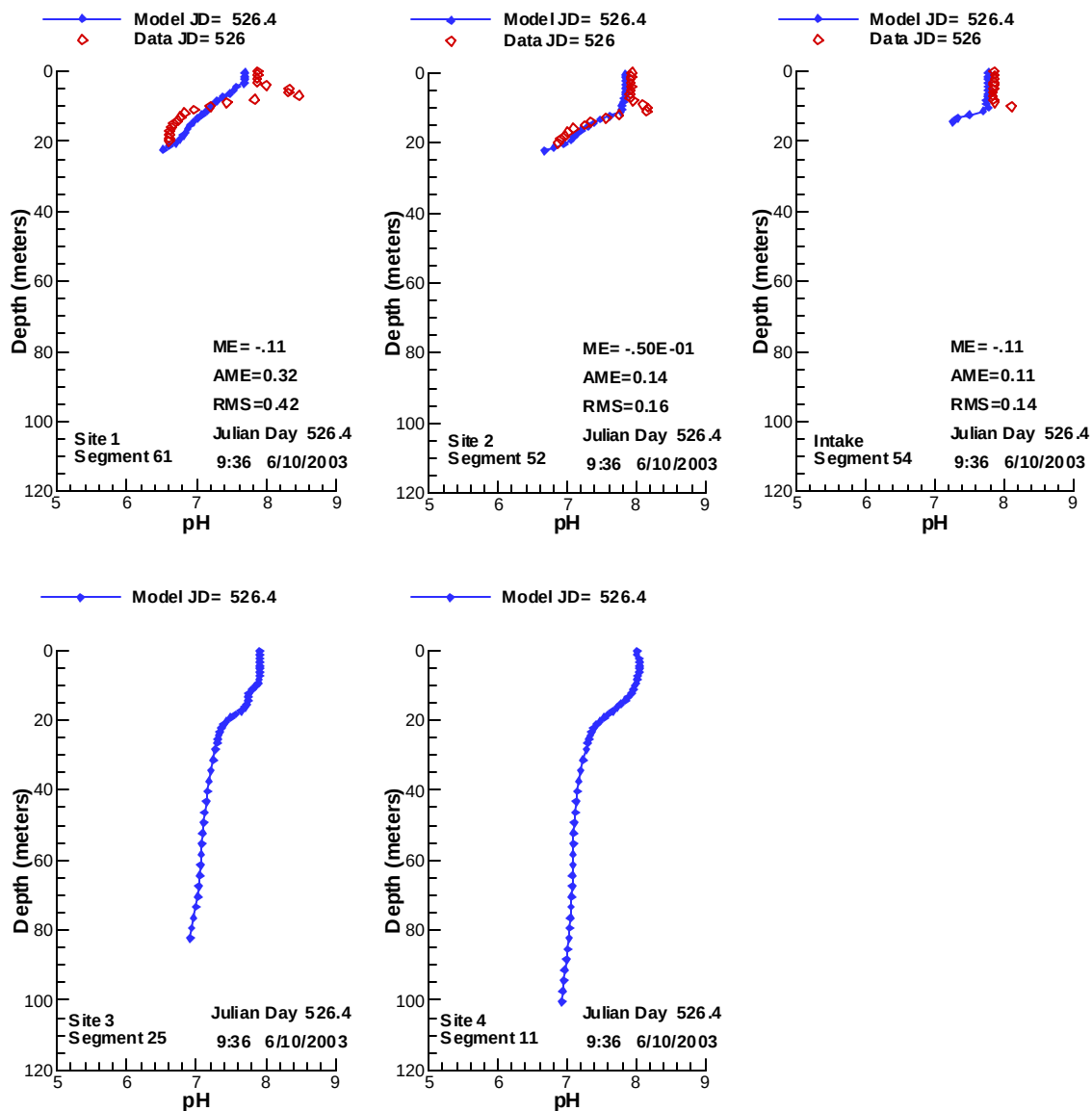


Figure 600. Vertical profiles of pH compared with data for 6/10/2003.

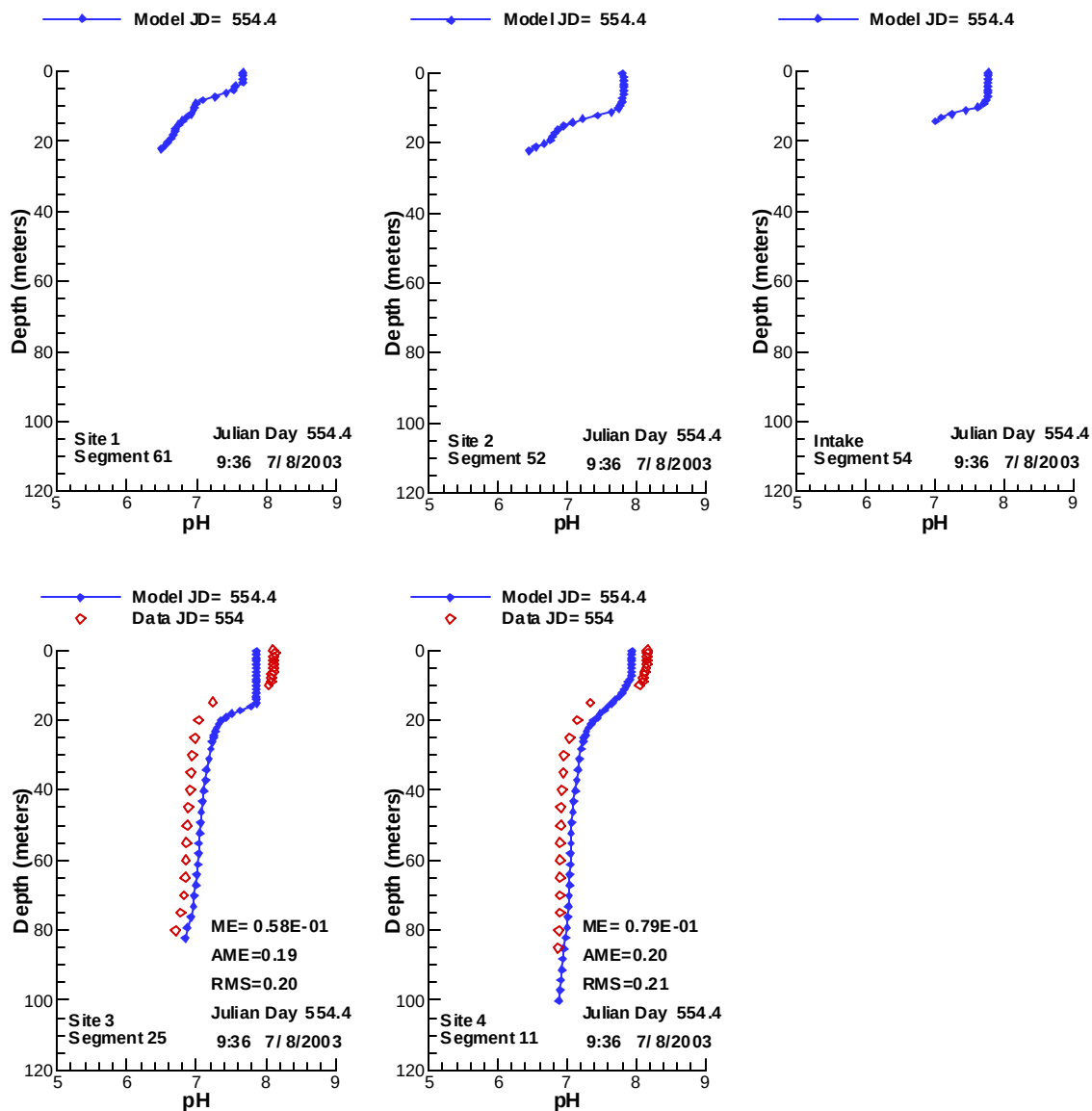


Figure 601. Vertical profiles of pH compared with data for 7/ 8/2003.

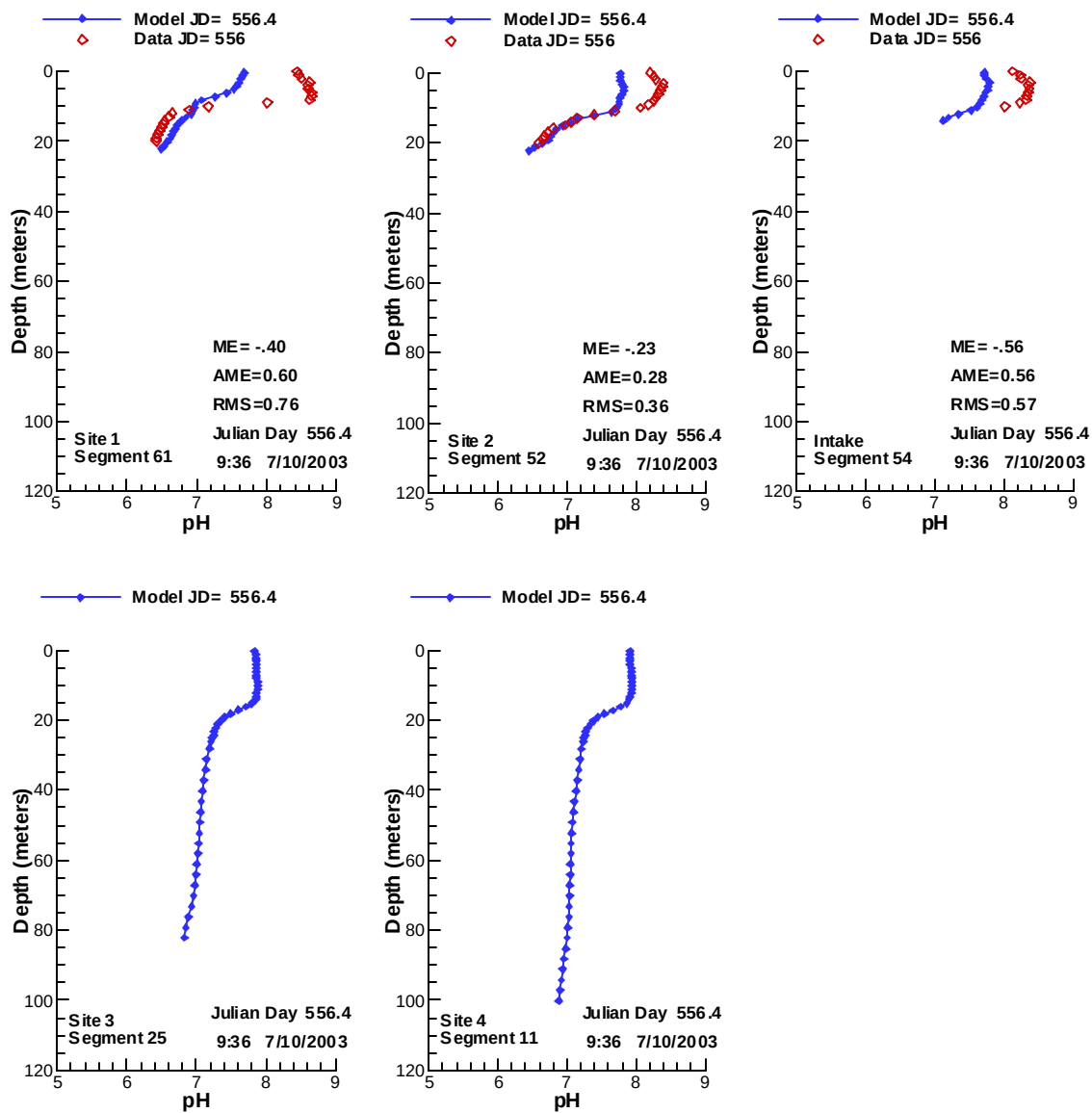


Figure 602. Vertical profiles of pH compared with data for 7/10/2003.

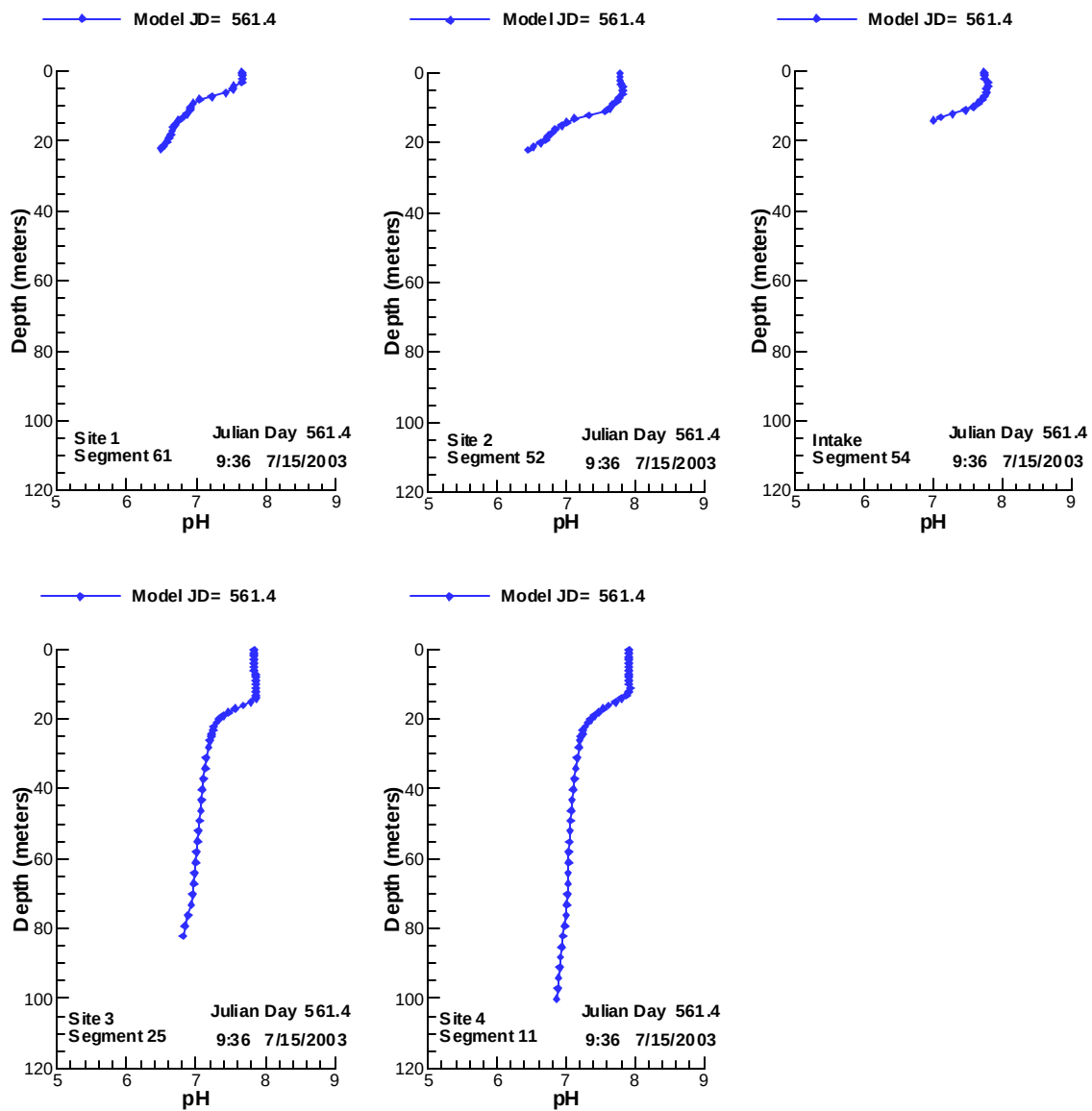


Figure 603. Vertical profiles of pH compared with data for 7/15/2003.

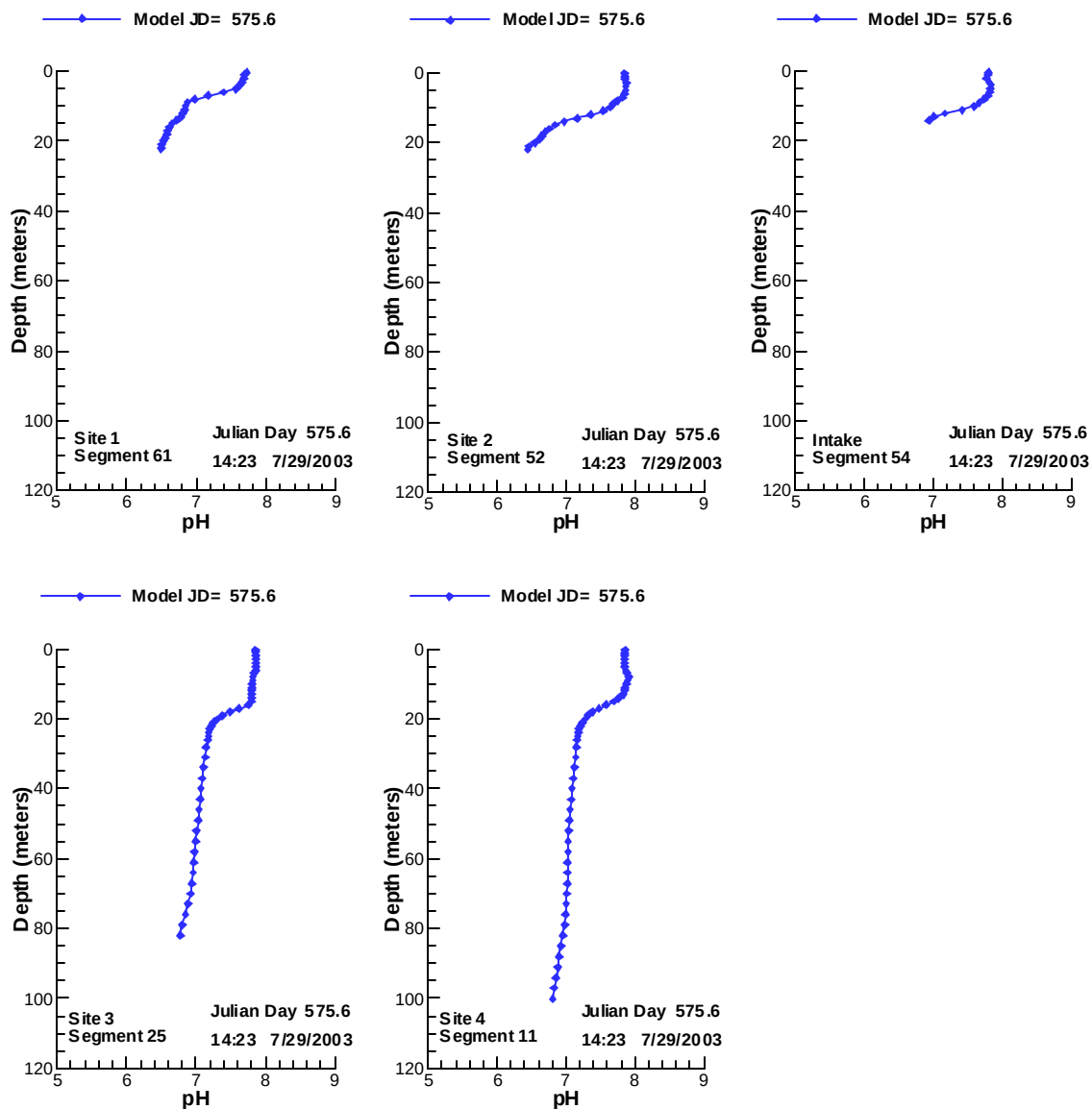


Figure 604. Vertical profiles of pH compared with data for 7/29/2003.

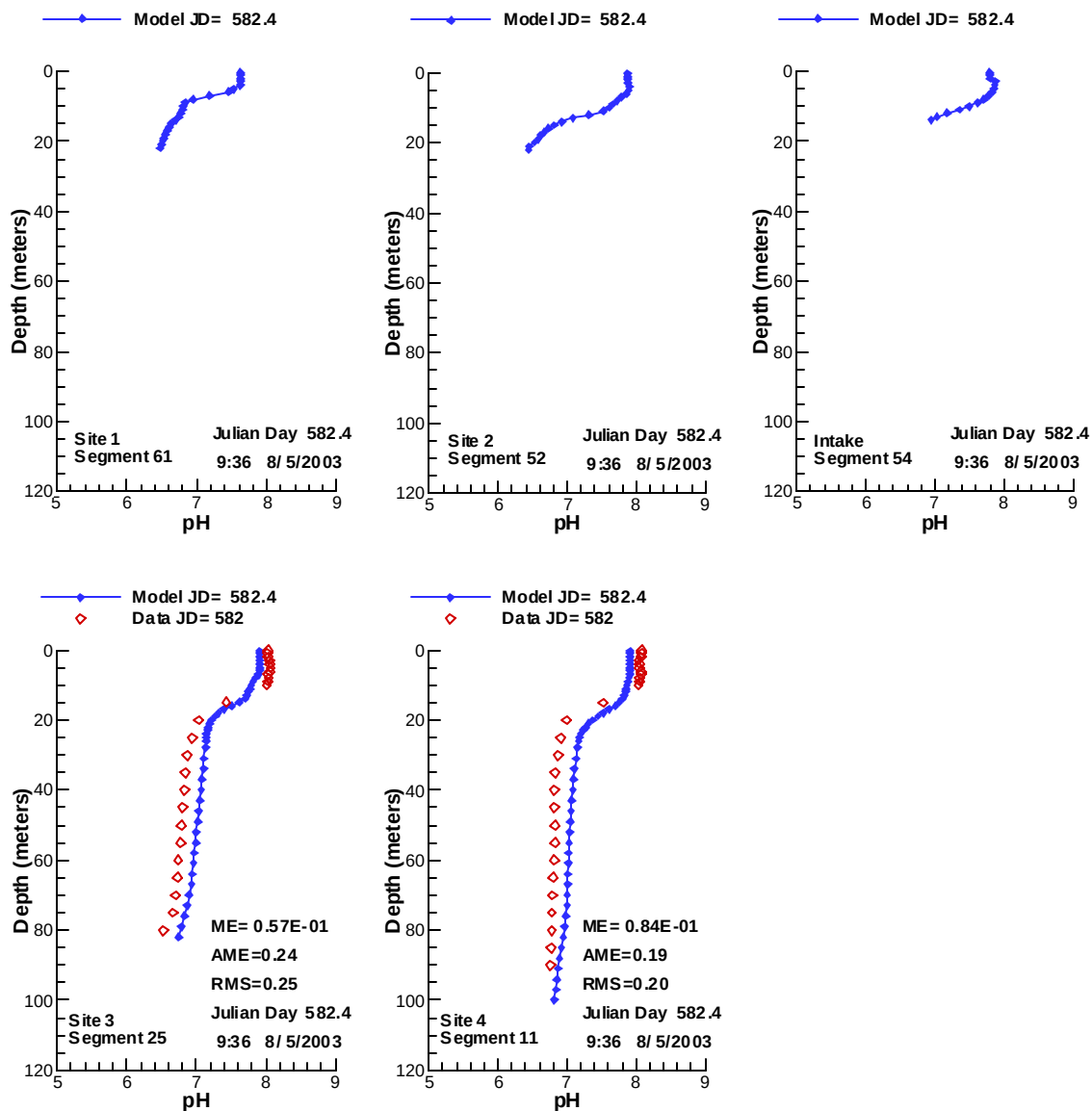


Figure 605. Vertical profiles of pH compared with data for 8/ 5/2003.

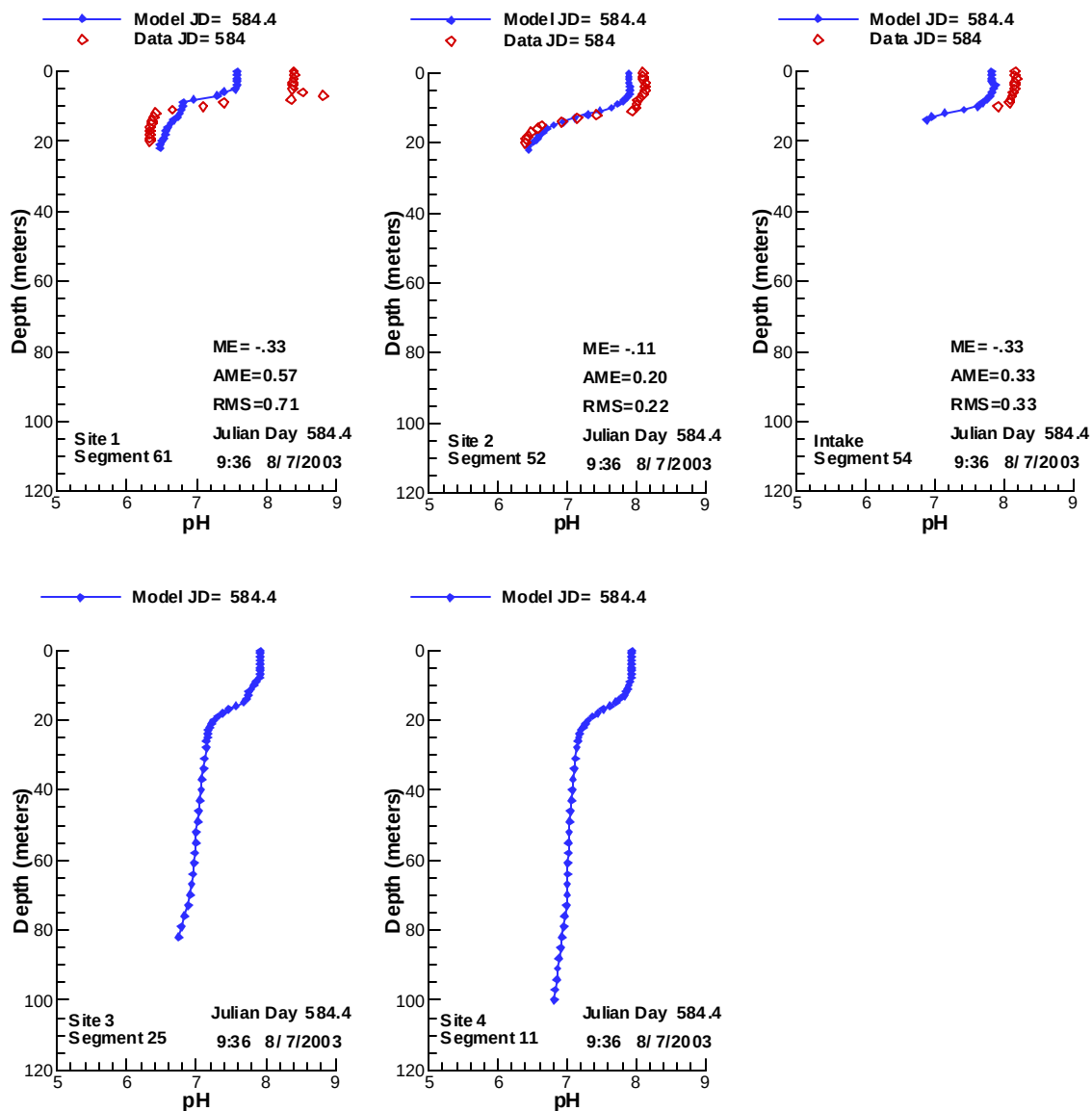


Figure 606. Vertical profiles of pH compared with data for 8/ 7/2003.

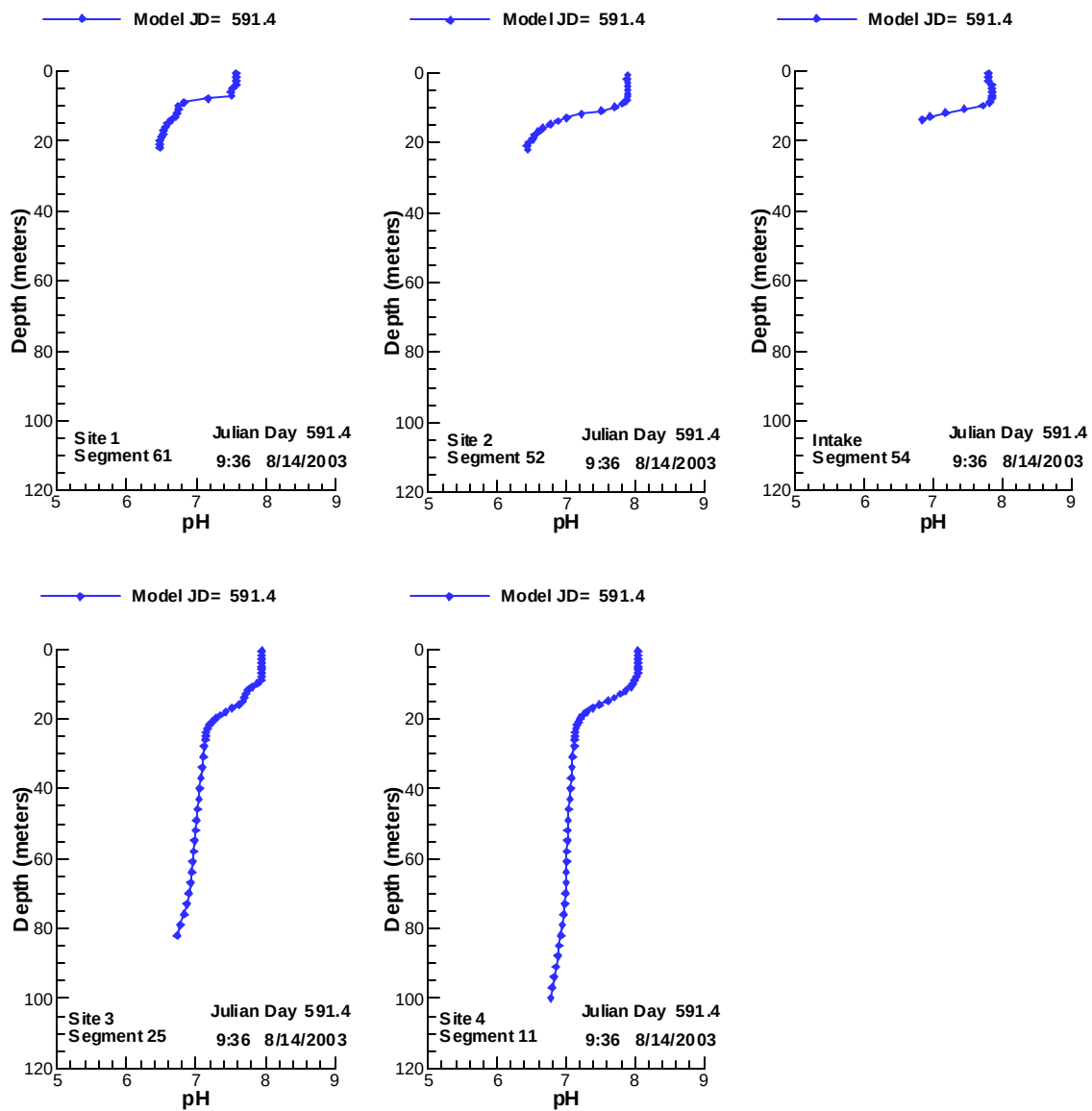


Figure 607. Vertical profiles of pH compared with data for 8/14/2003.

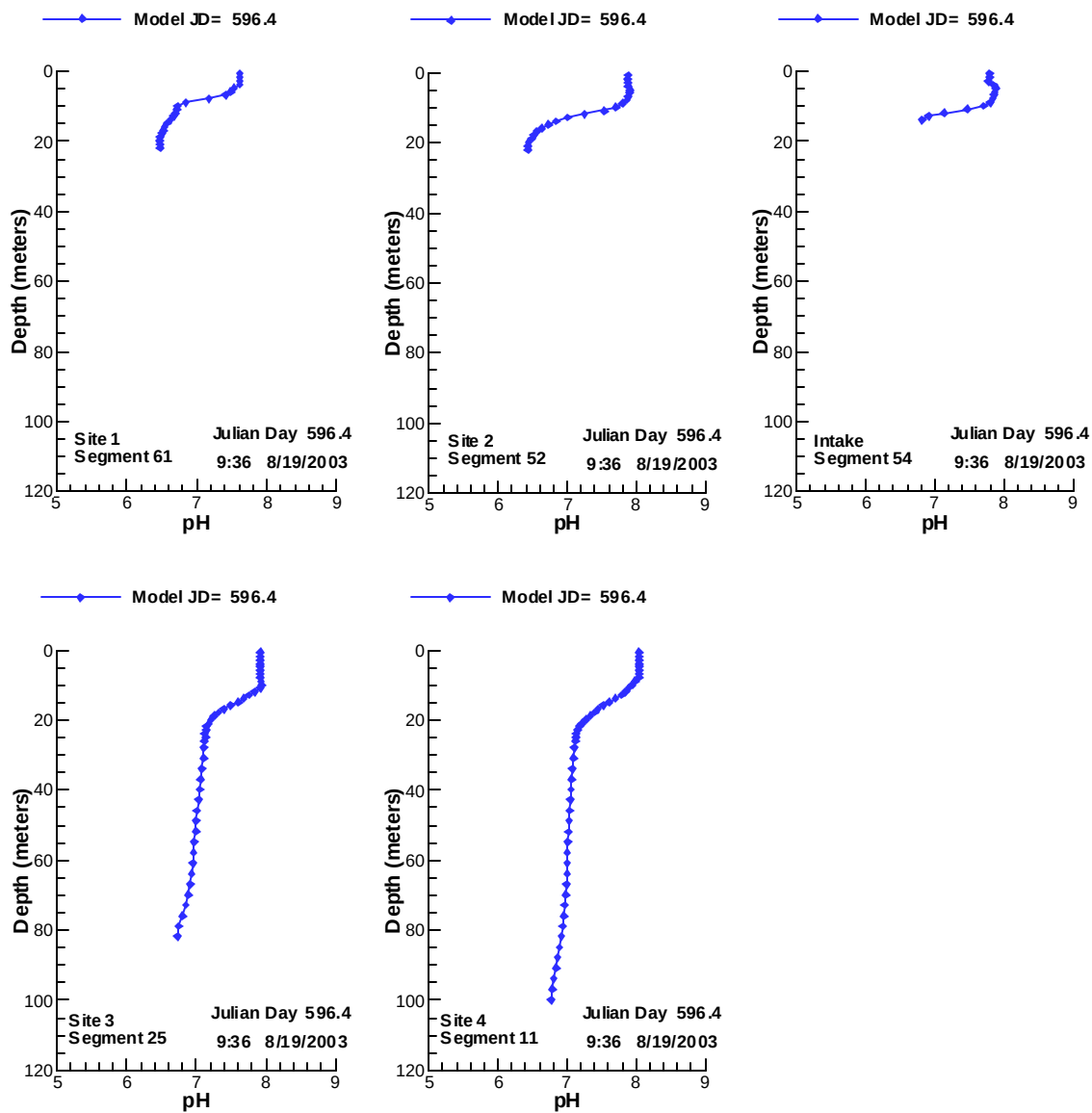


Figure 608. Vertical profiles of pH compared with data for 8/19/2003.

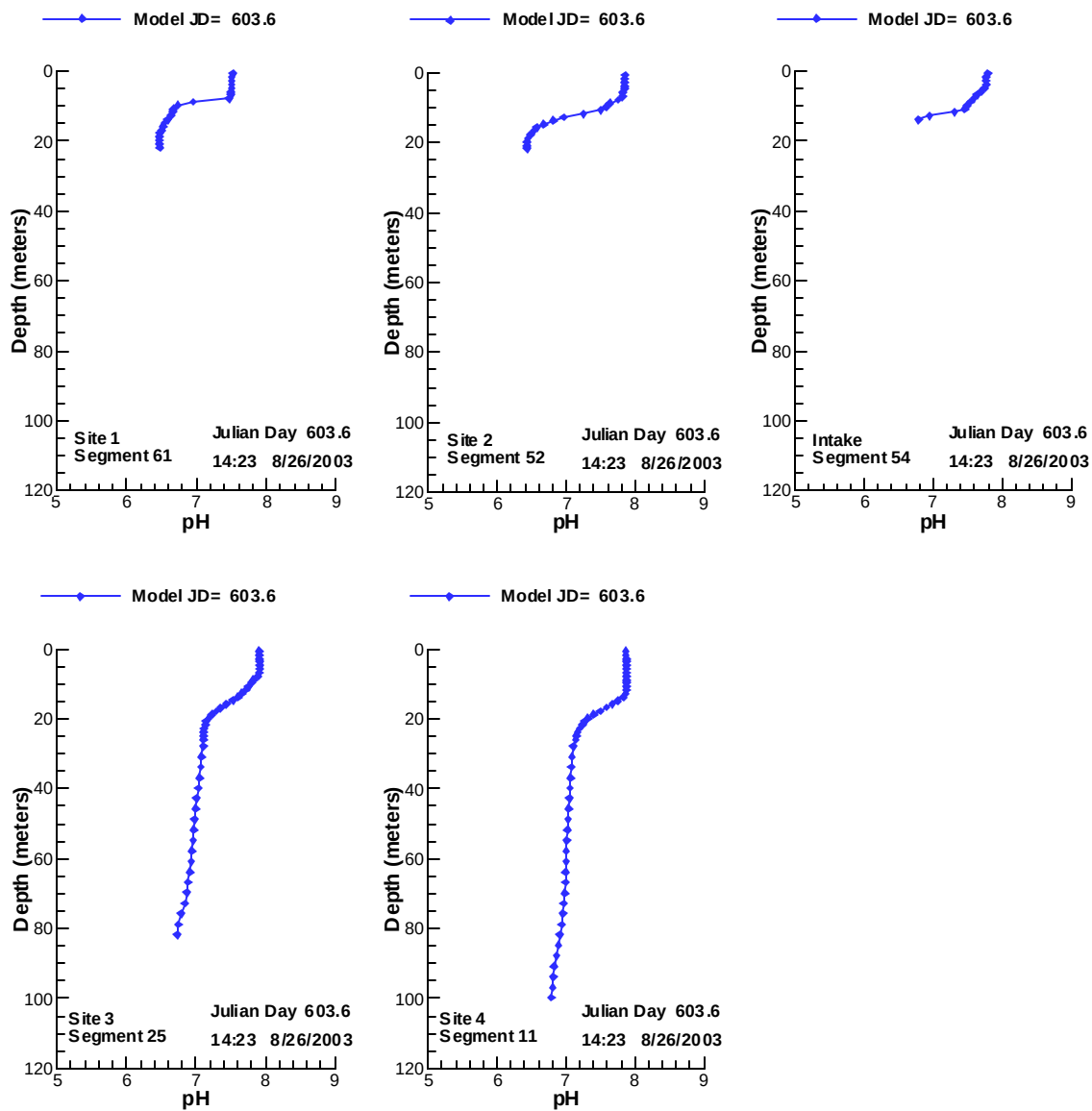


Figure 609. Vertical profiles of pH compared with data for 8/26/2003.

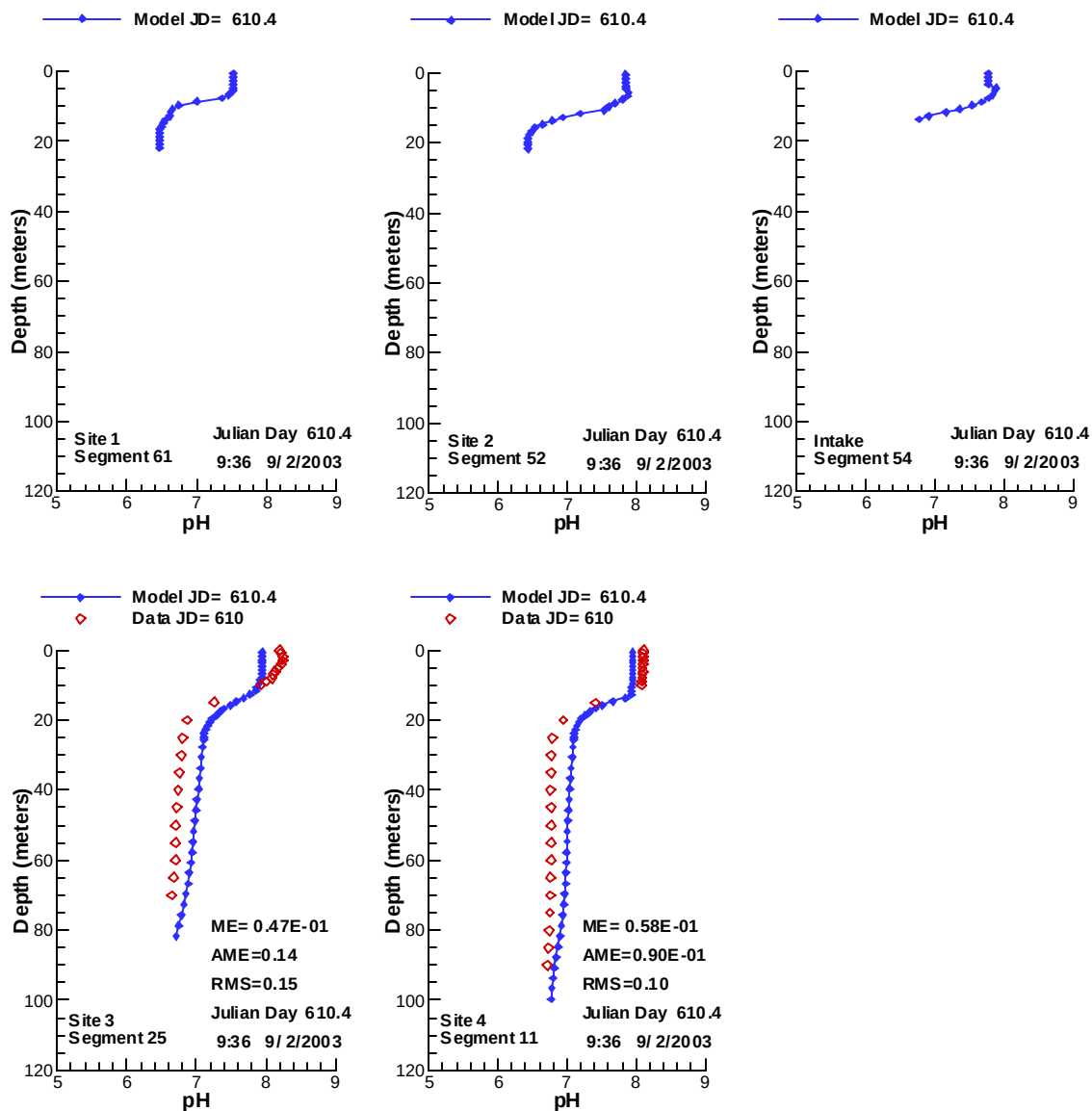


Figure 610. Vertical profiles of pH compared with data for 9/ 2/2003.

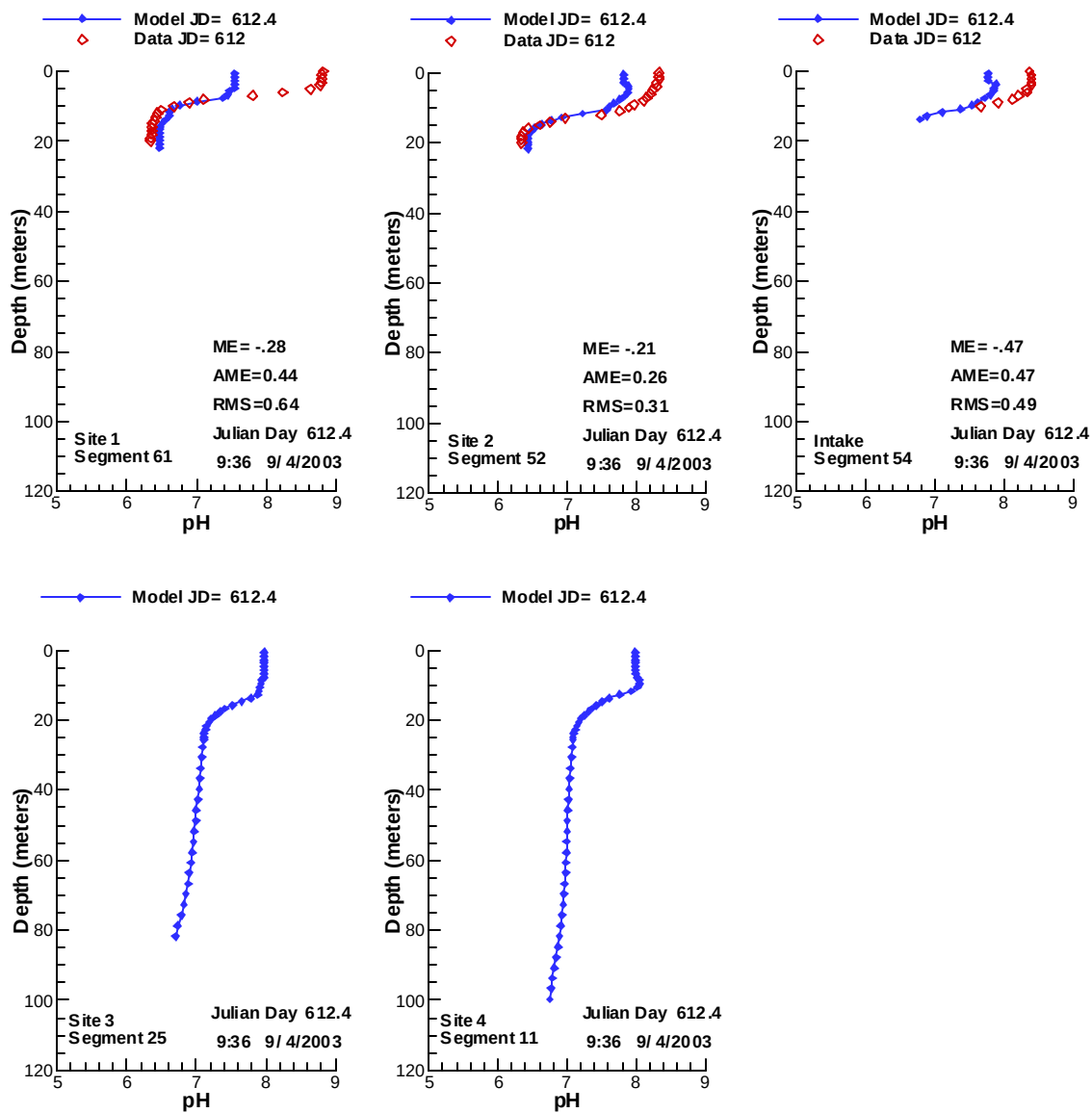


Figure 611. Vertical profiles of pH compared with data for 9/ 4/2003.

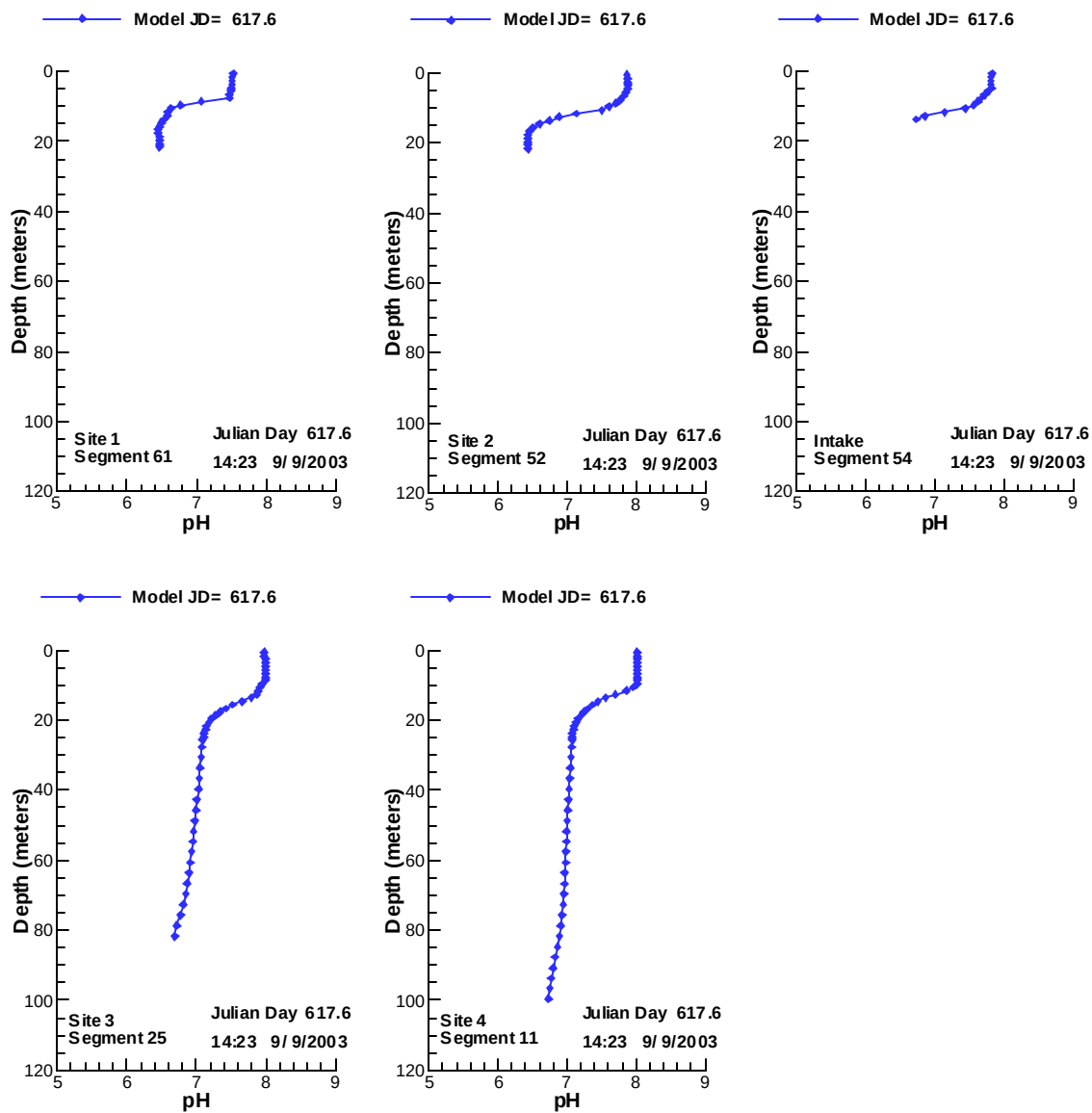


Figure 612. Vertical profiles of pH compared with data for 9/ 9/2003.

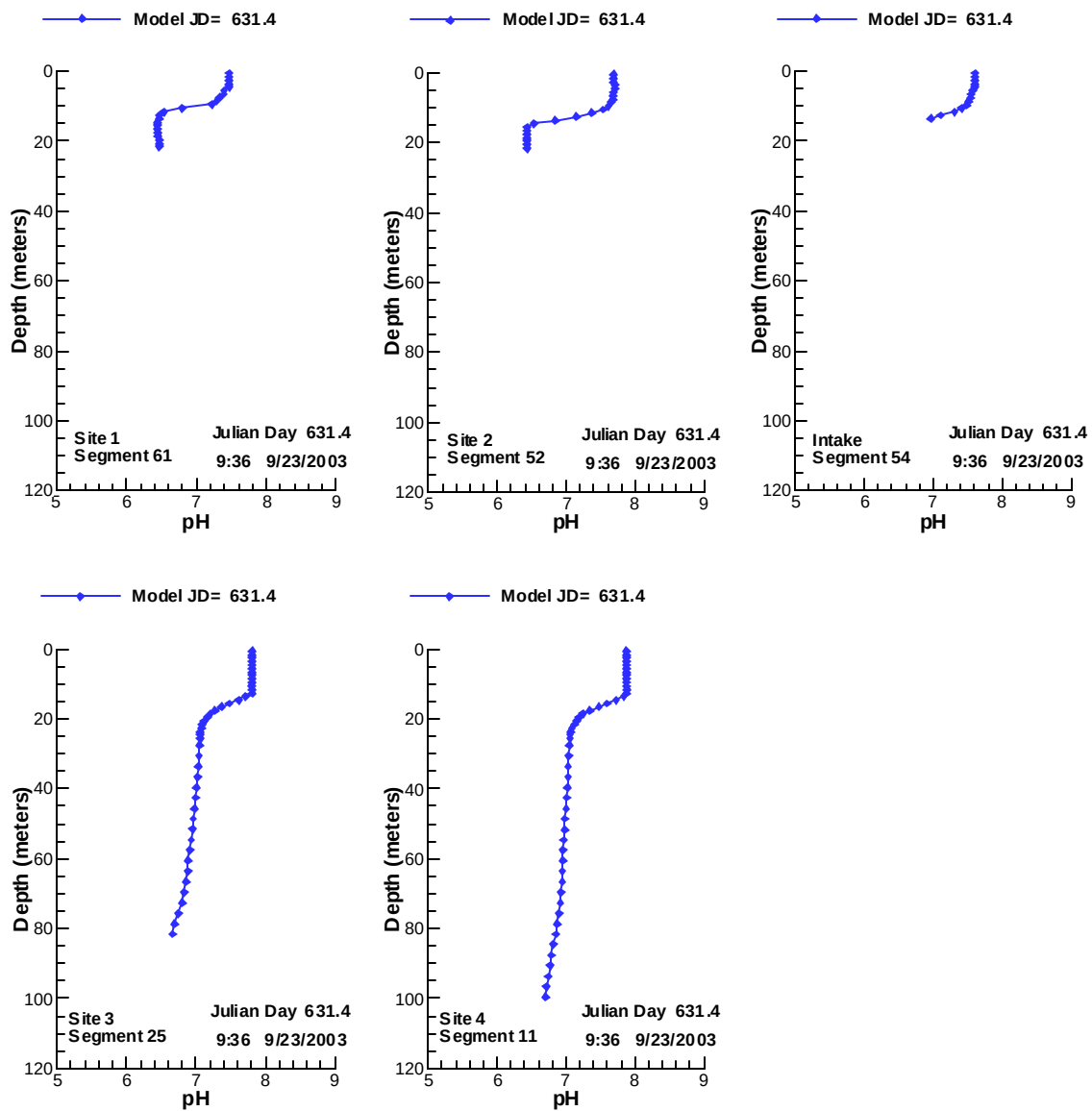


Figure 613. Vertical profiles of pH compared with data for 9/23/2003.

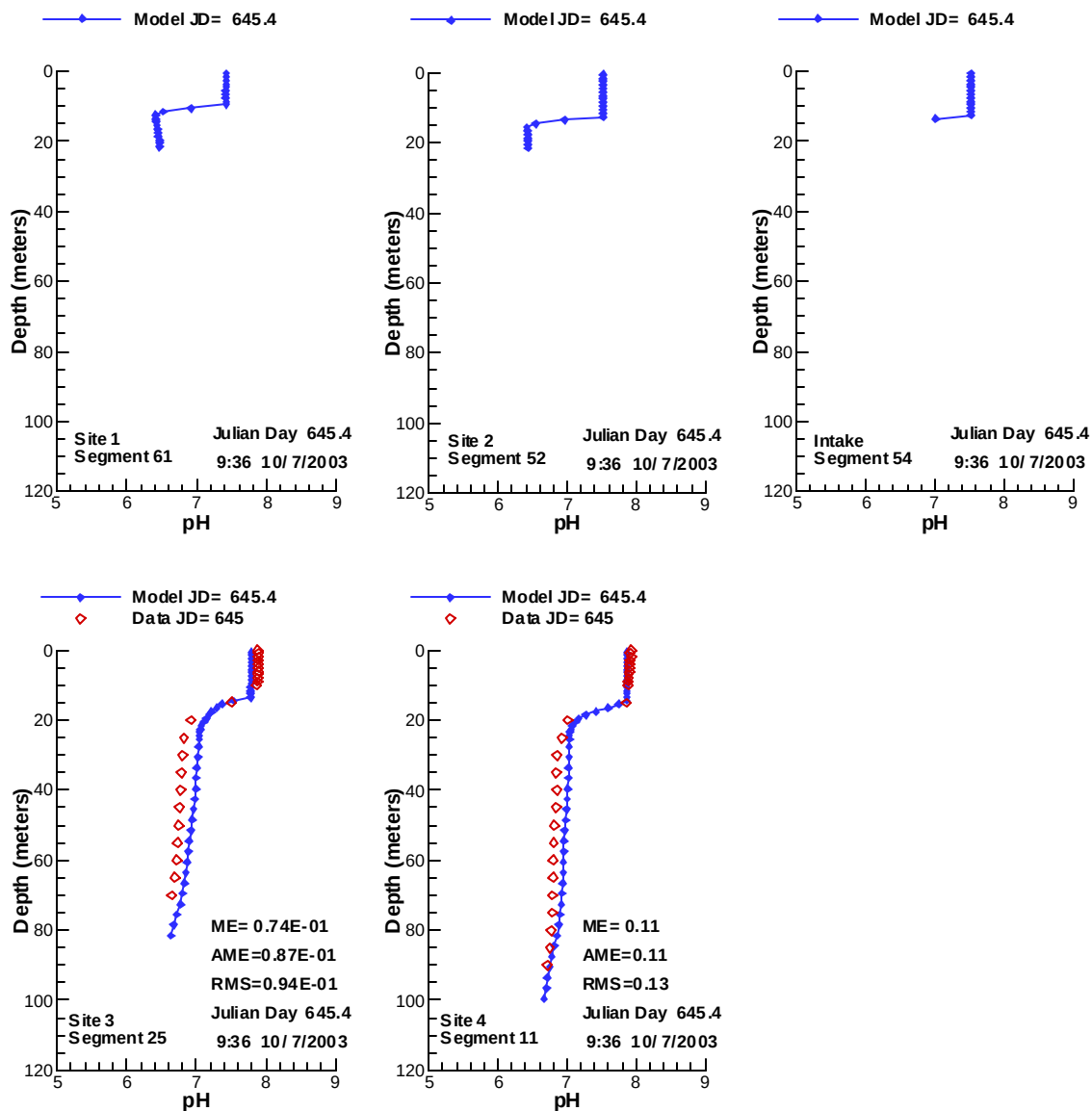


Figure 614. Vertical profiles of pH compared with data for 10/ 7/2003.

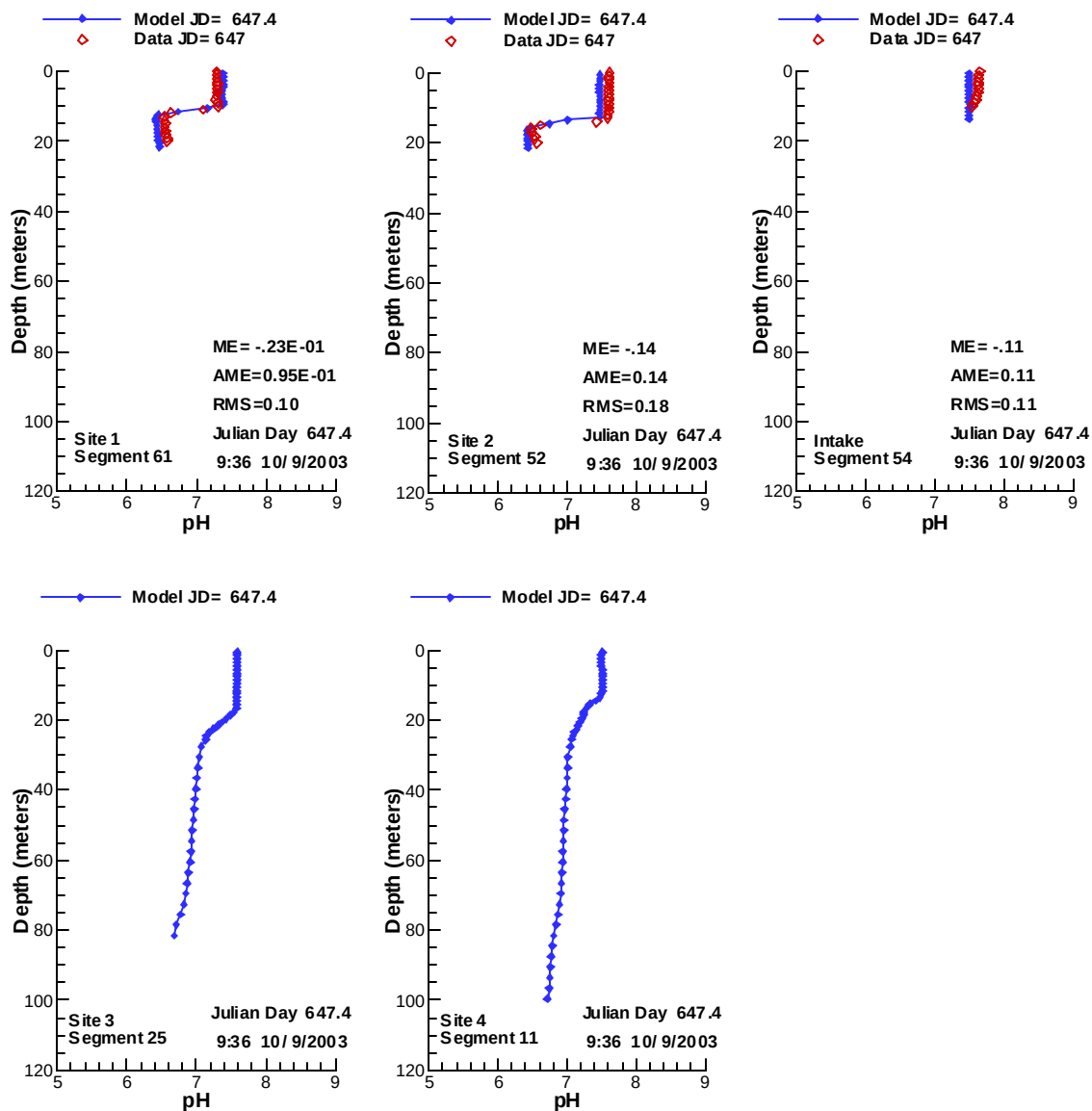


Figure 615. Vertical profiles of pH compared with data for 10/ 9/2003.

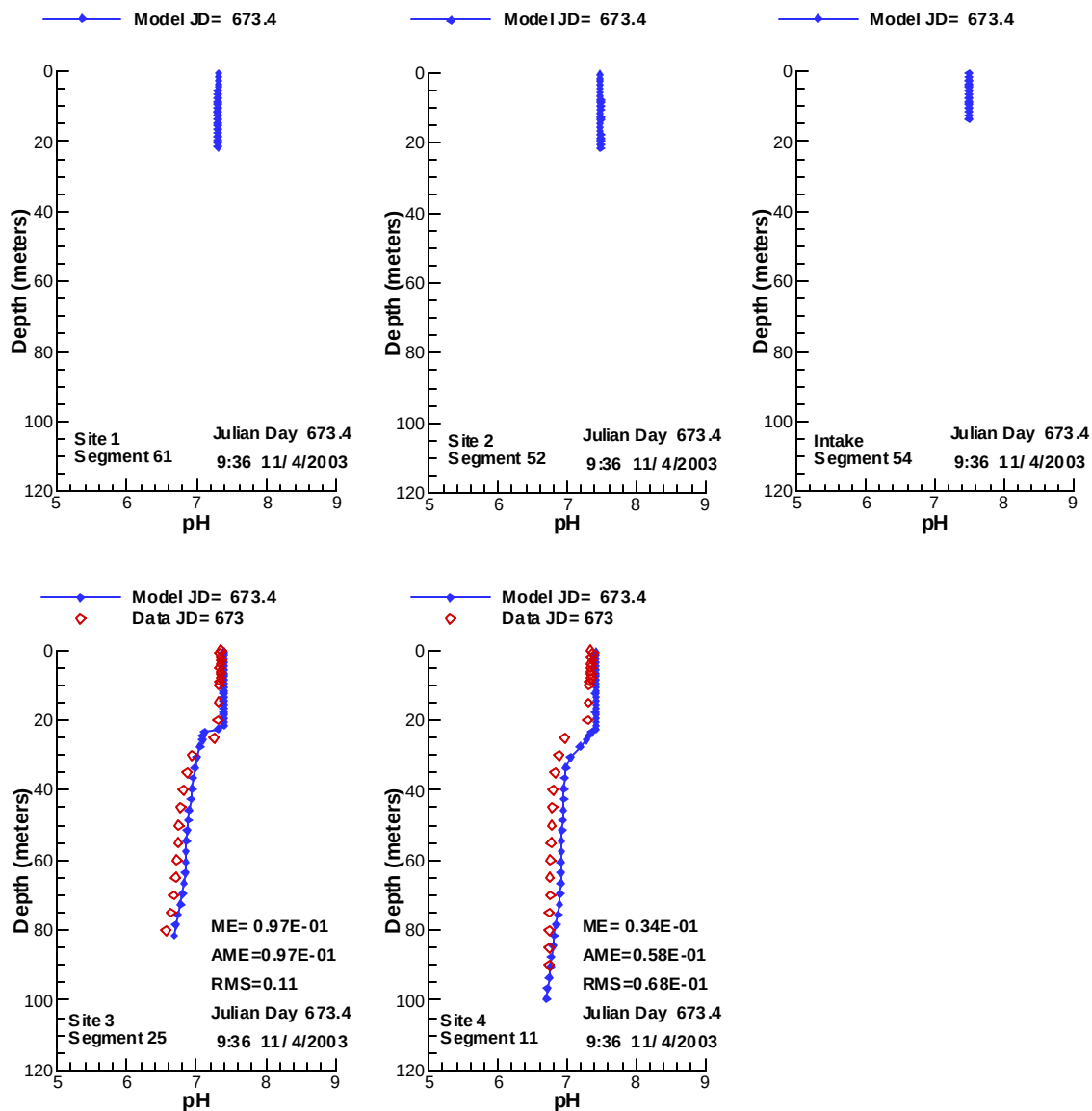


Figure 616. Vertical profiles of pH compared with data for 11/ 4/2003.

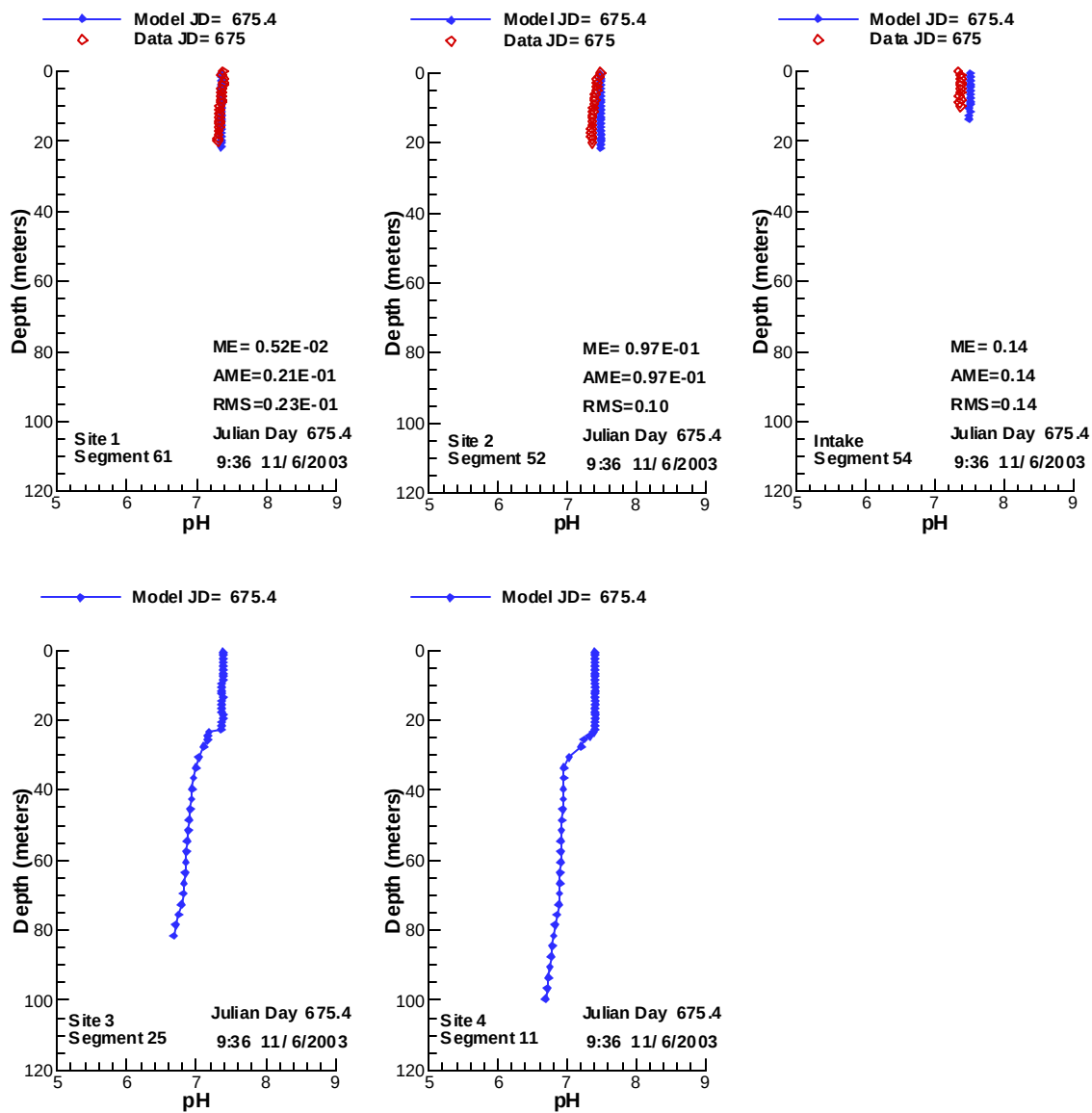


Figure 617. Vertical profiles of pH compared with data for 11/ 6/2003.

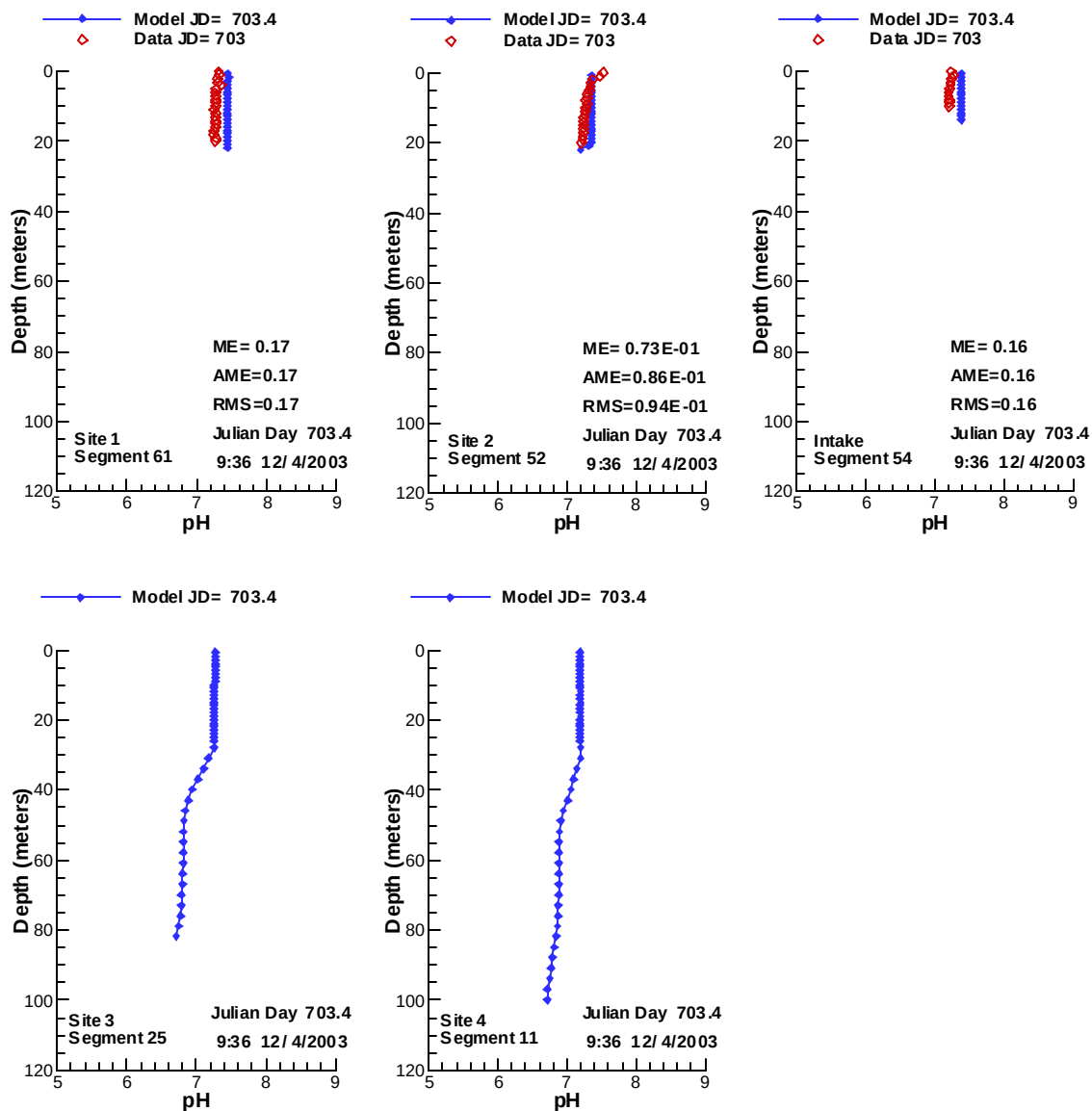


Figure 618. Vertical profiles of pH compared with data for 12/ 4/2003.

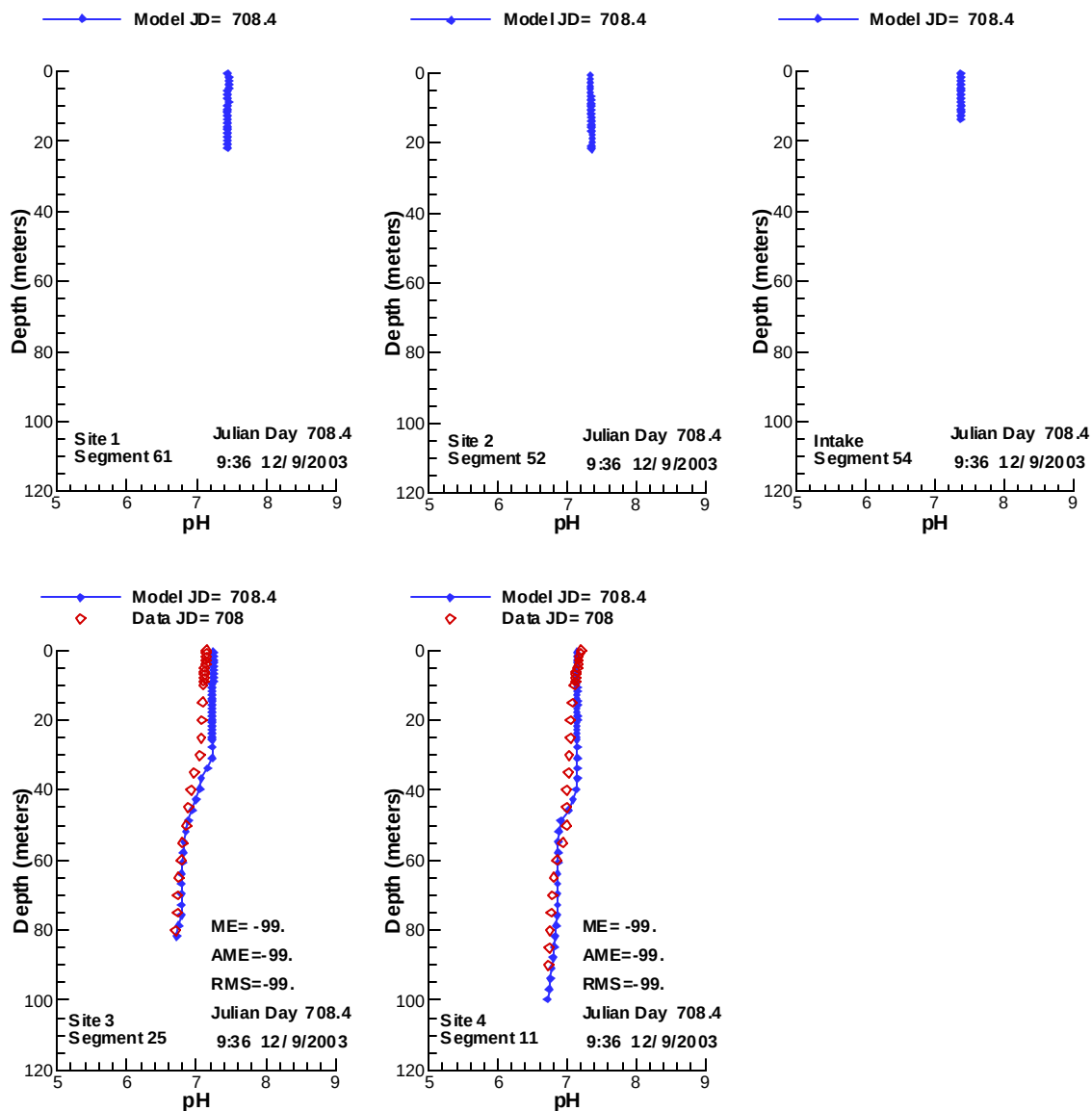


Figure 619. Vertical profiles of pH compared with data for 12/ 9/2003.

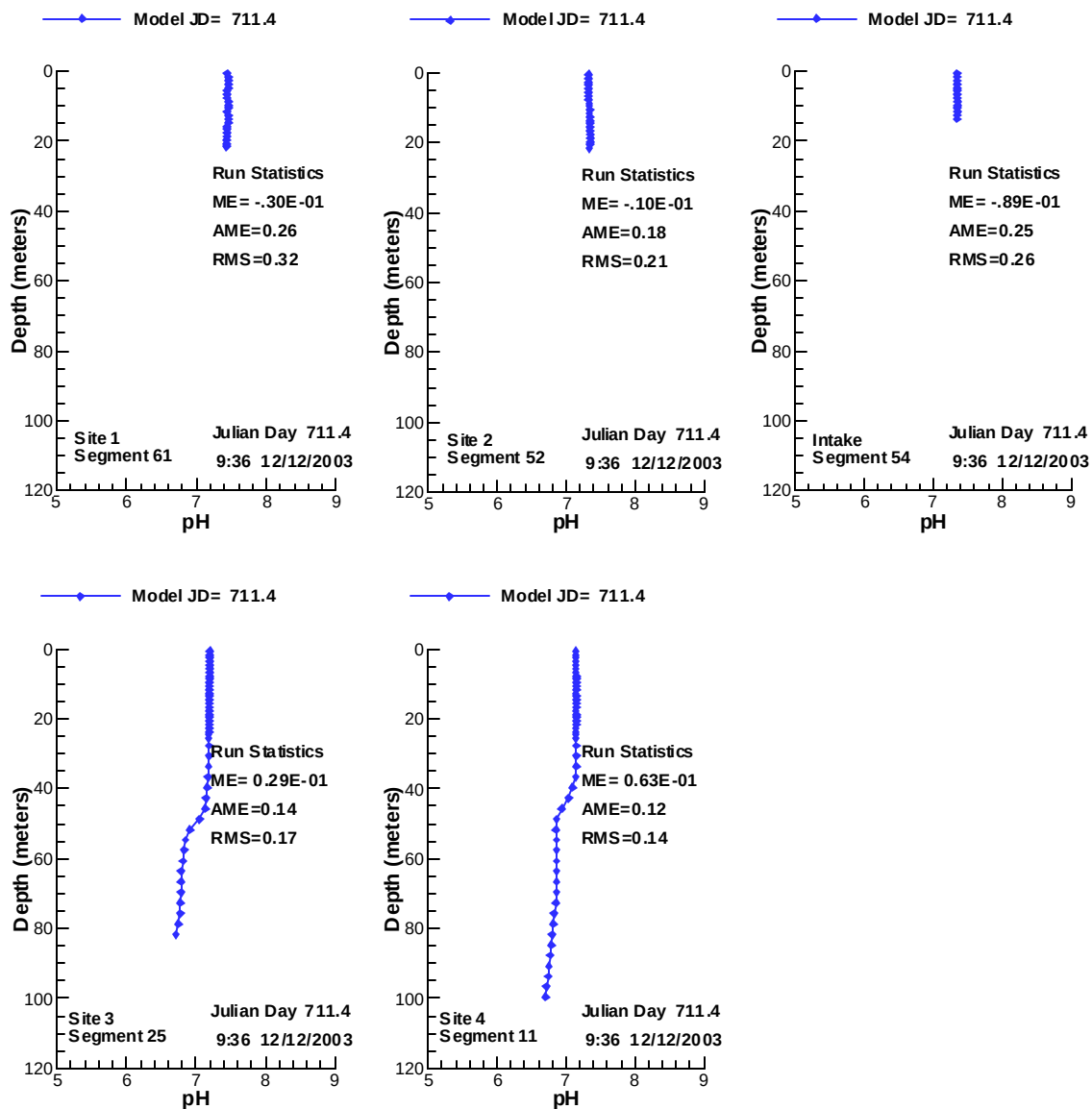


Figure 620. Vertical profiles of pH compared with data for 12/12/2003.

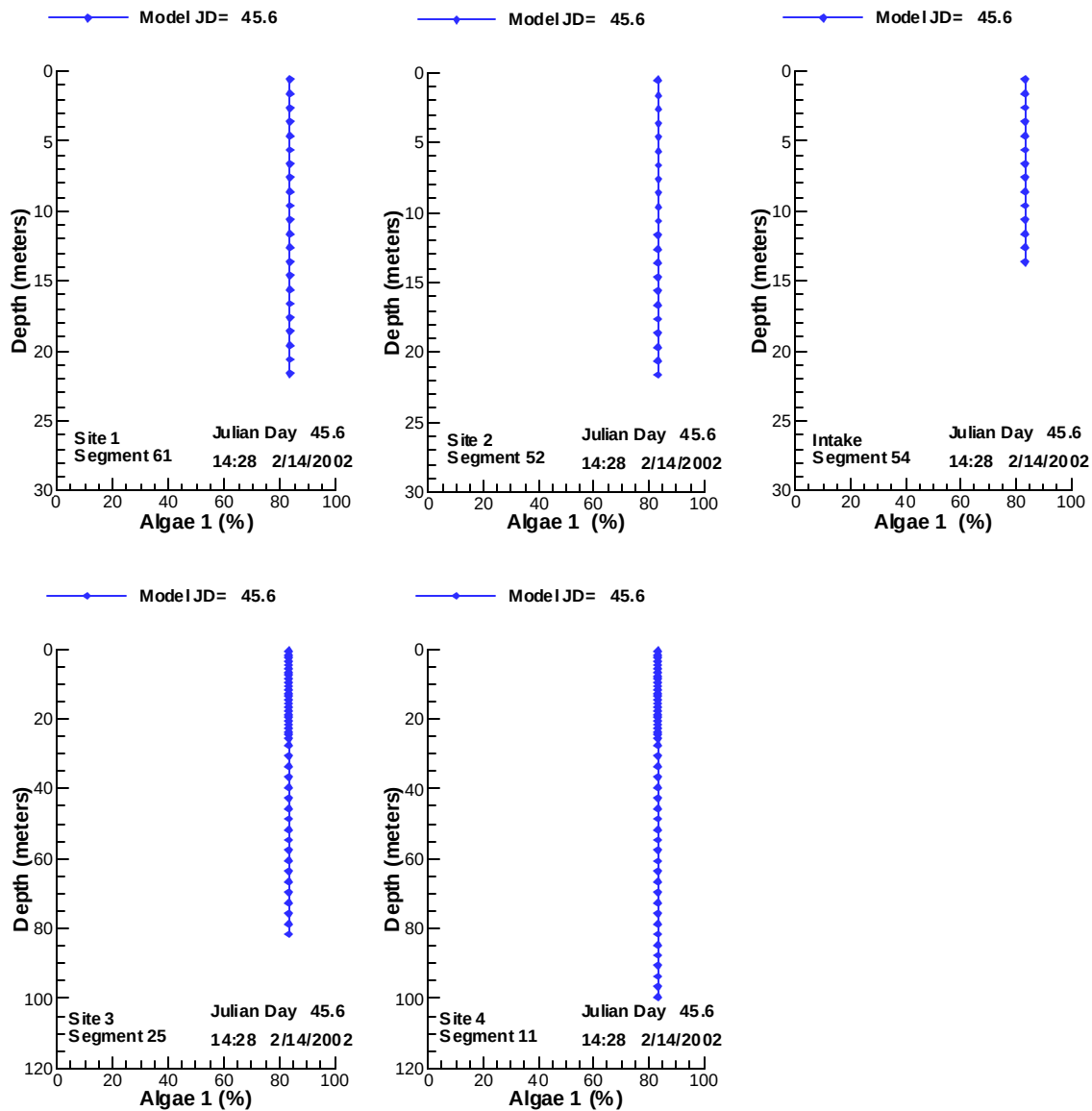


Figure 621. Vertical profiles of ALGAE 1 compared with data for 2/14/2002.

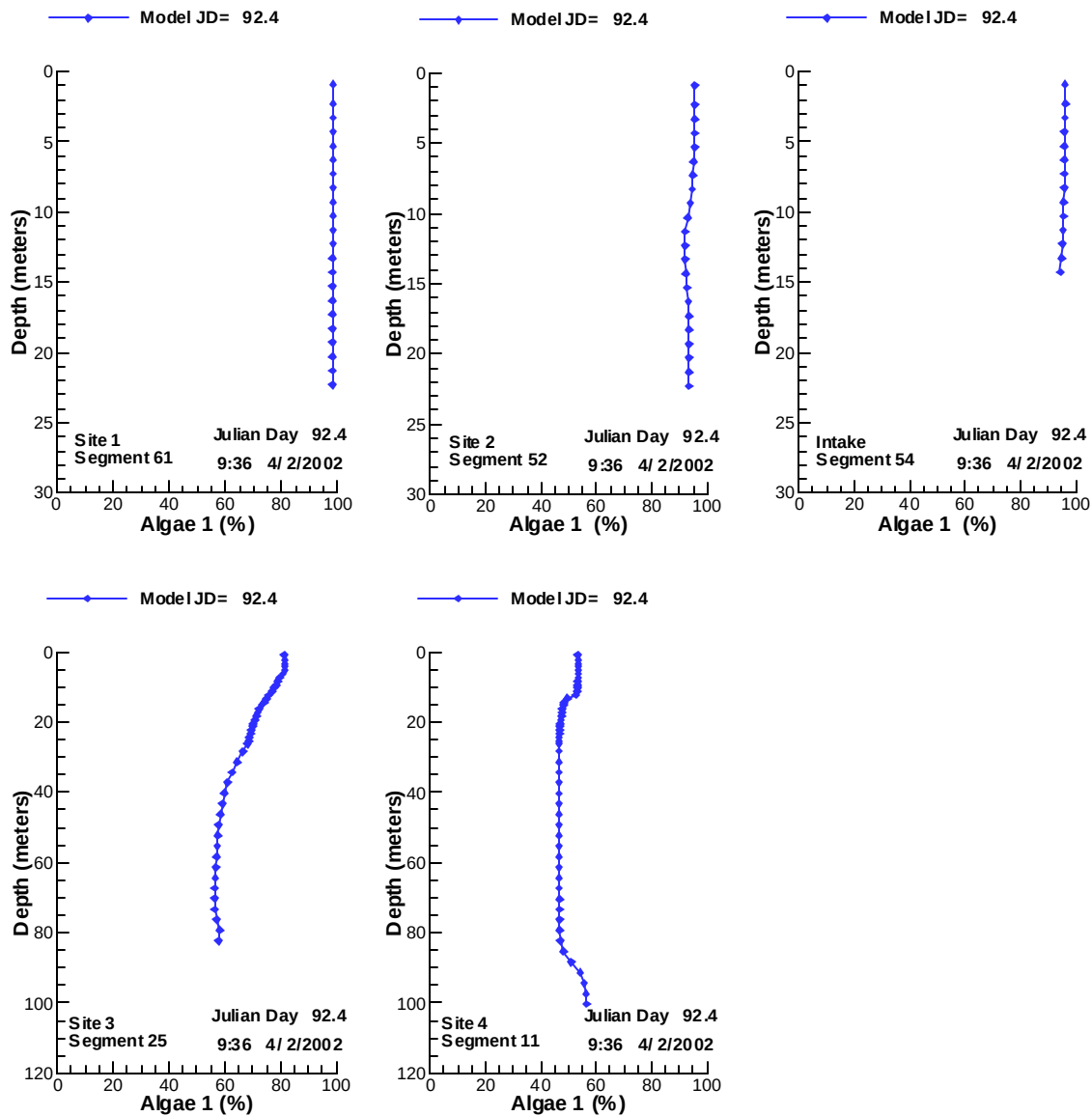


Figure 622. Vertical profiles of ALGAE 1 compared with data for 4/ 2/2002.

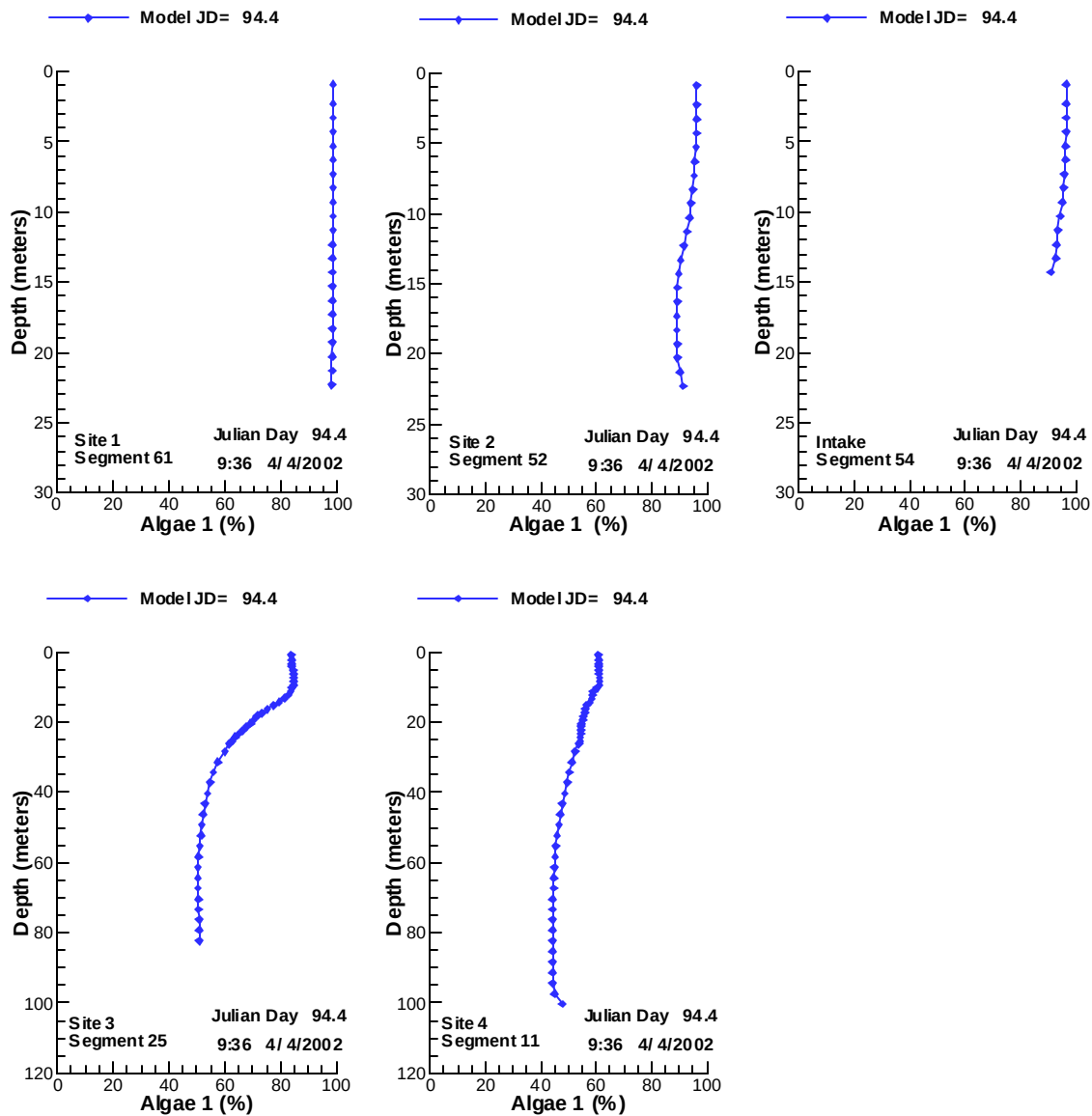


Figure 623. Vertical profiles of ALGAE 1 compared with data for 4/ 4/2002.

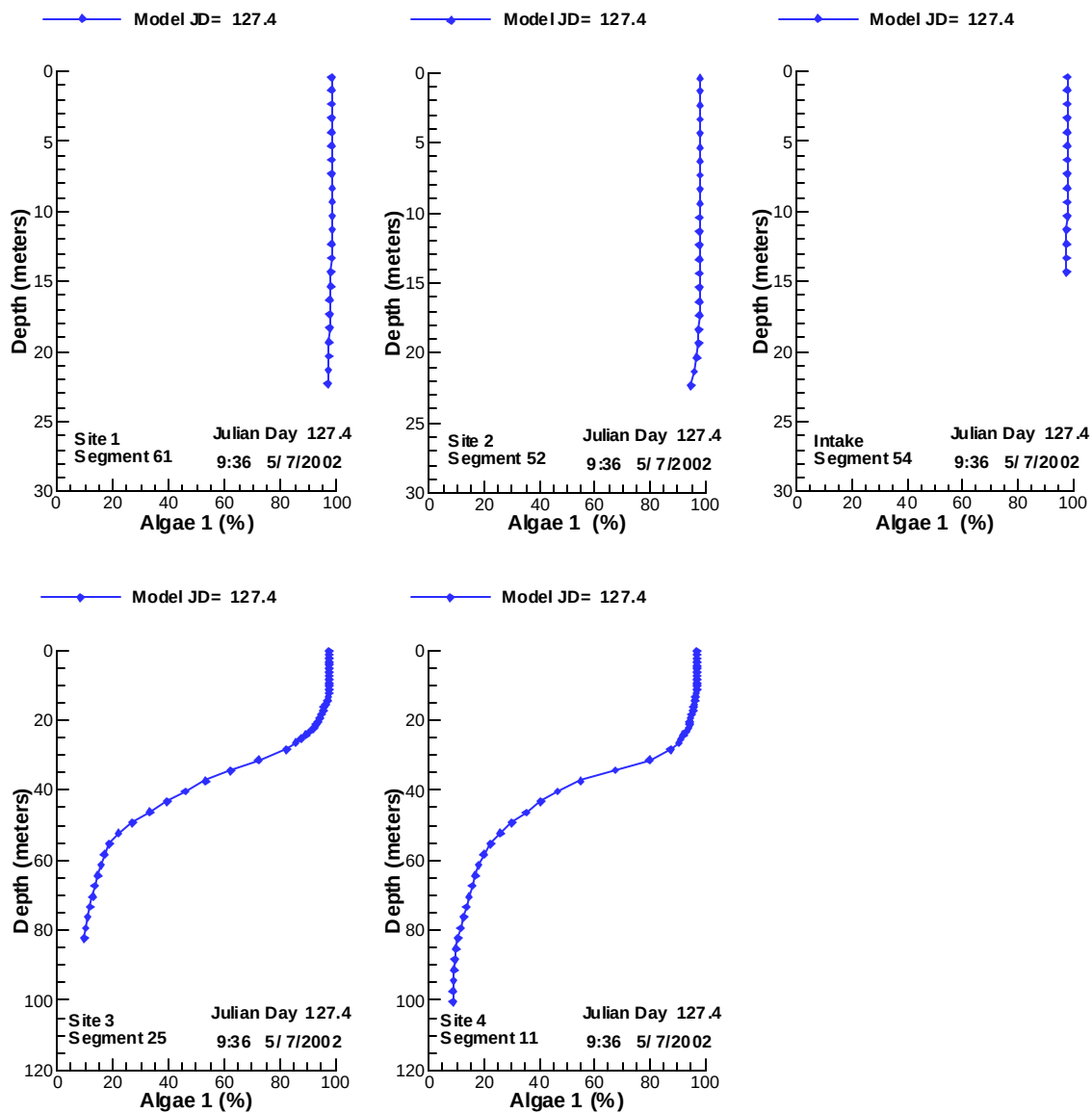


Figure 624. Vertical profiles of ALGAE 1 compared with data for 5/ 7/2002.

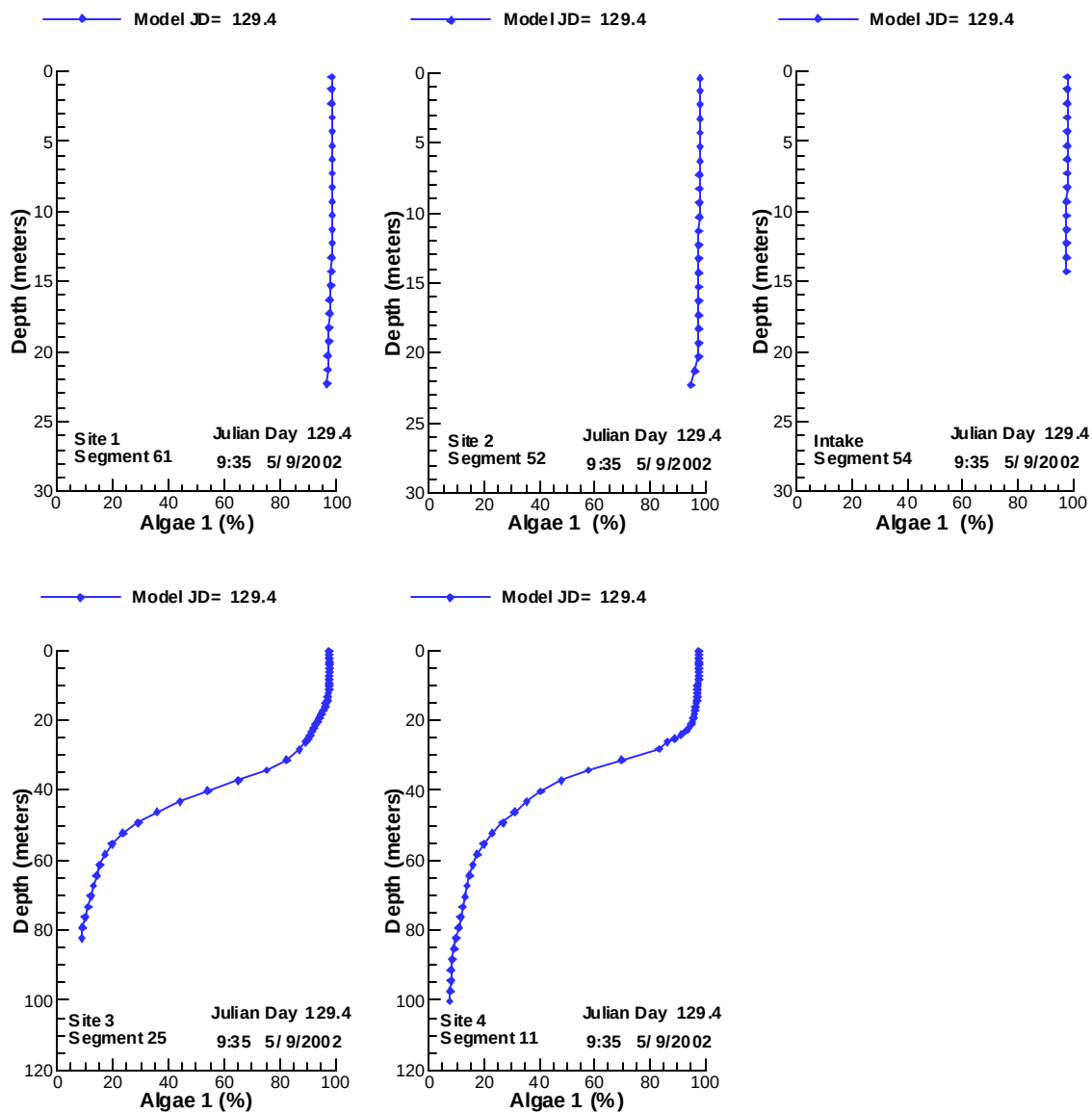


Figure 625. Vertical profiles of ALGAE 1 compared with data for 5/ 9/2002.

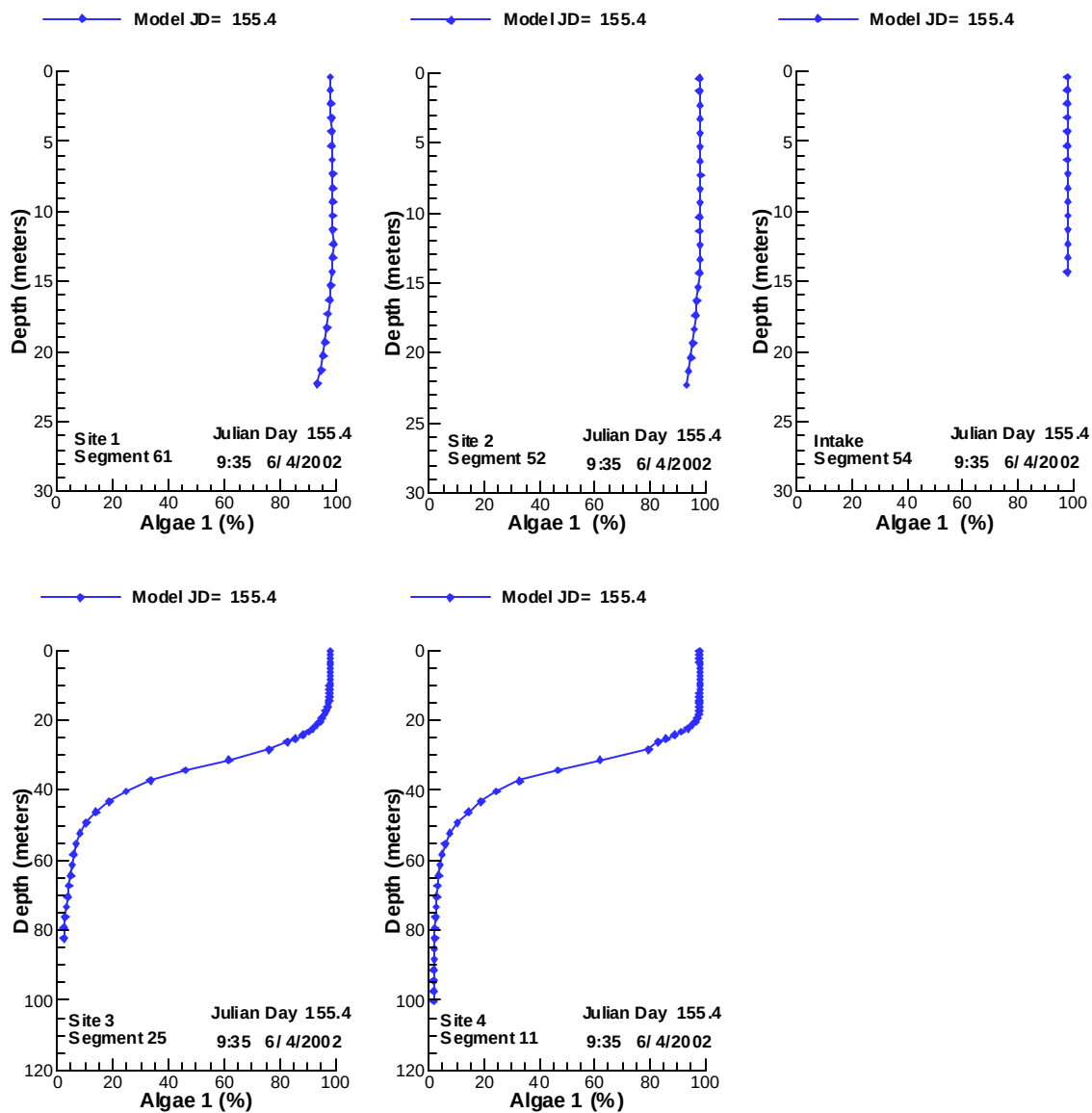


Figure 626. Vertical profiles of ALGAE 1 compared with data for 6/ 4/2002.

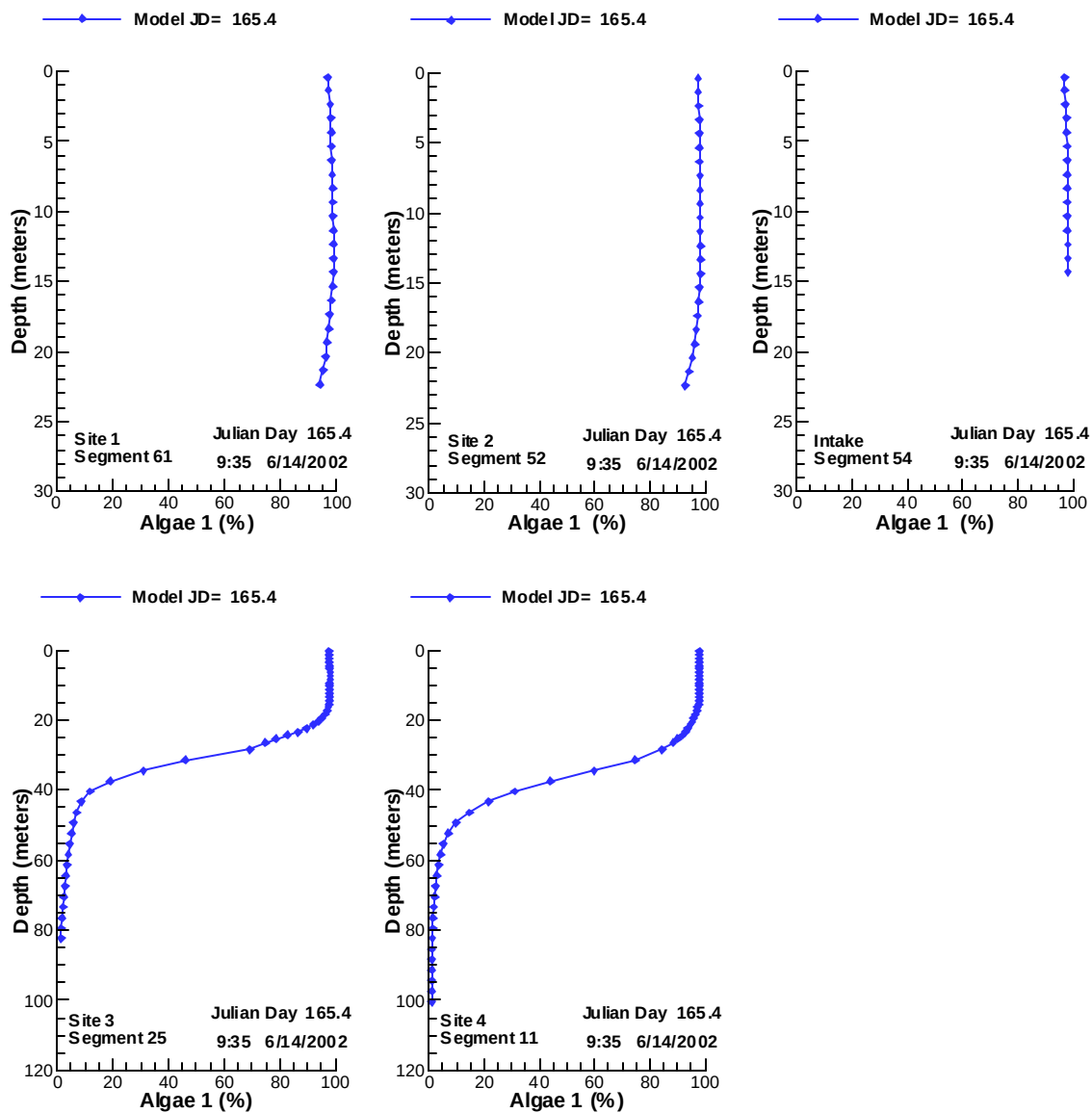


Figure 627. Vertical profiles of ALGAE 1 compared with data for 6/14/2002.

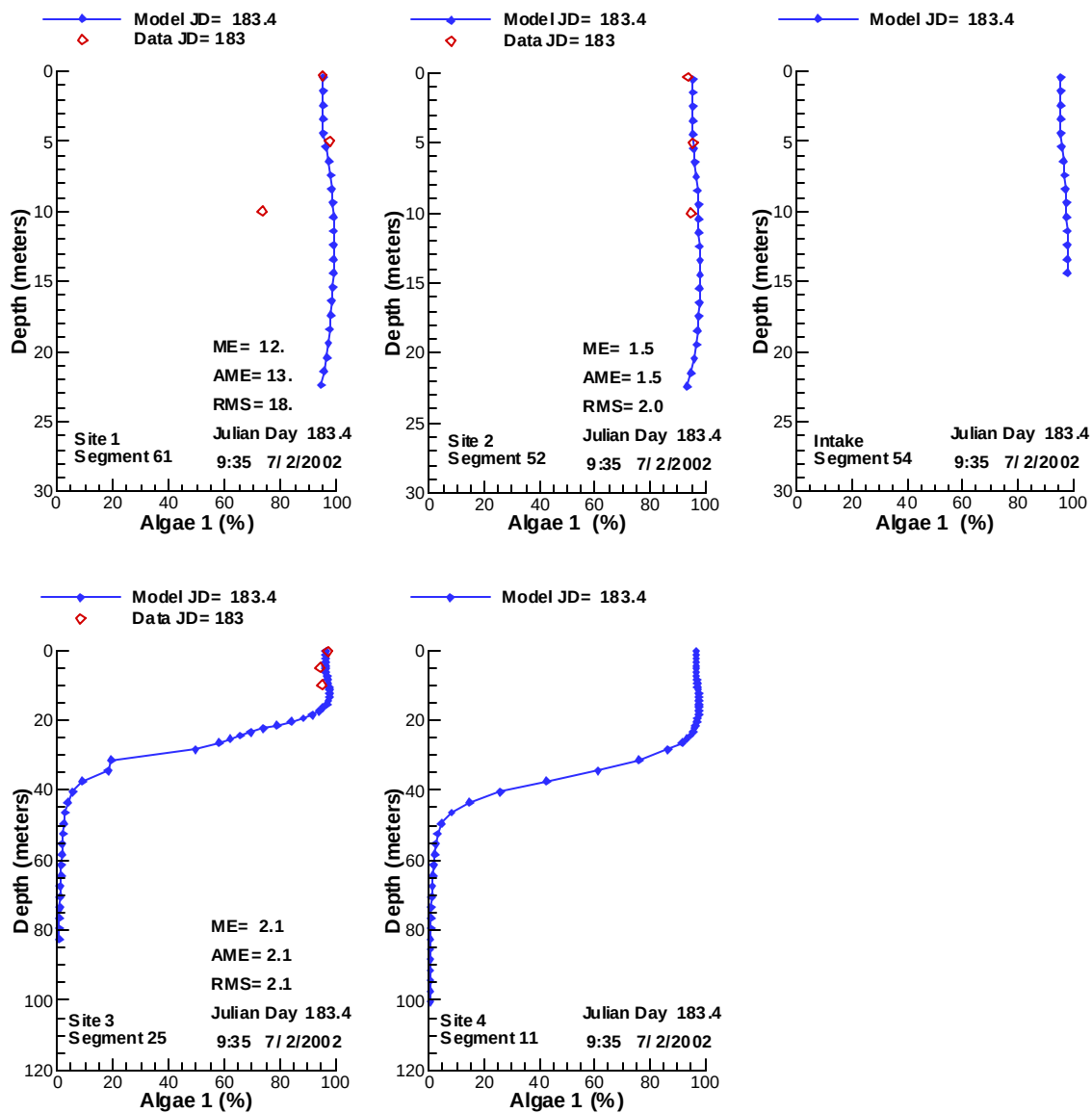


Figure 628. Vertical profiles of ALGAE 1 compared with data for 7/ 2/2002.

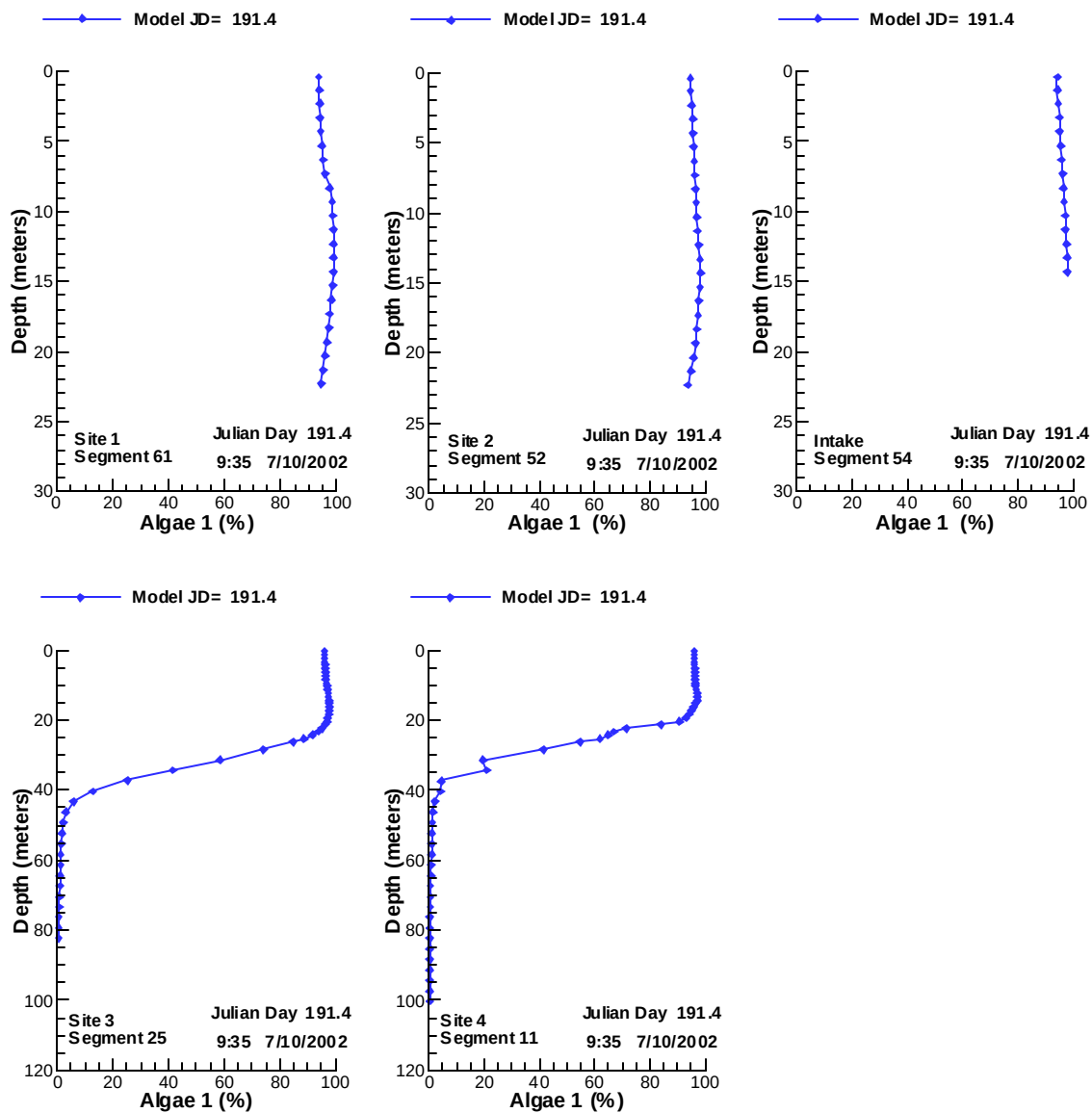


Figure 629. Vertical profiles of ALGAE 1 compared with data for 7/10/2002.

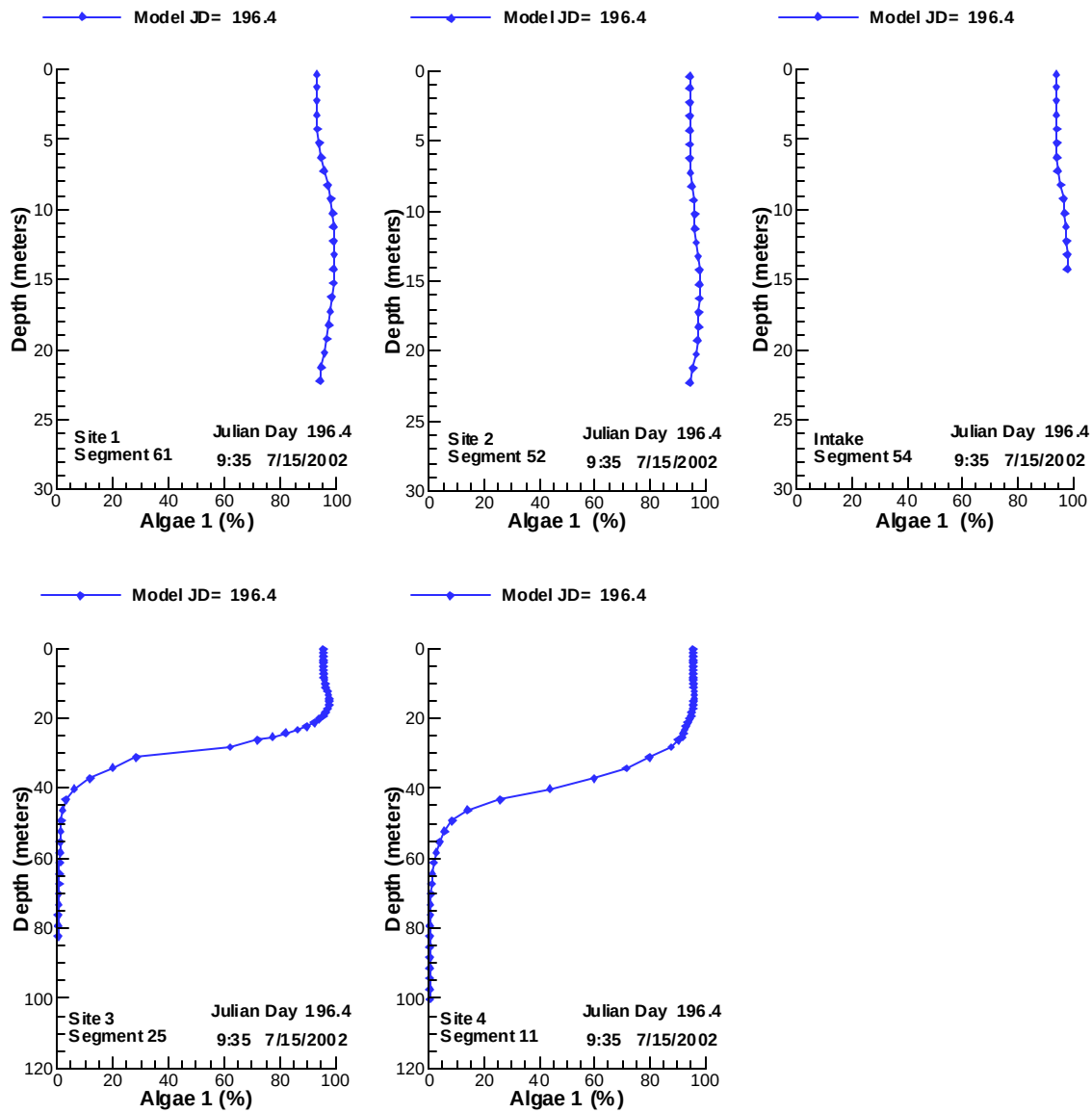


Figure 630. Vertical profiles of ALGAE 1 compared with data for 7/15/2002.

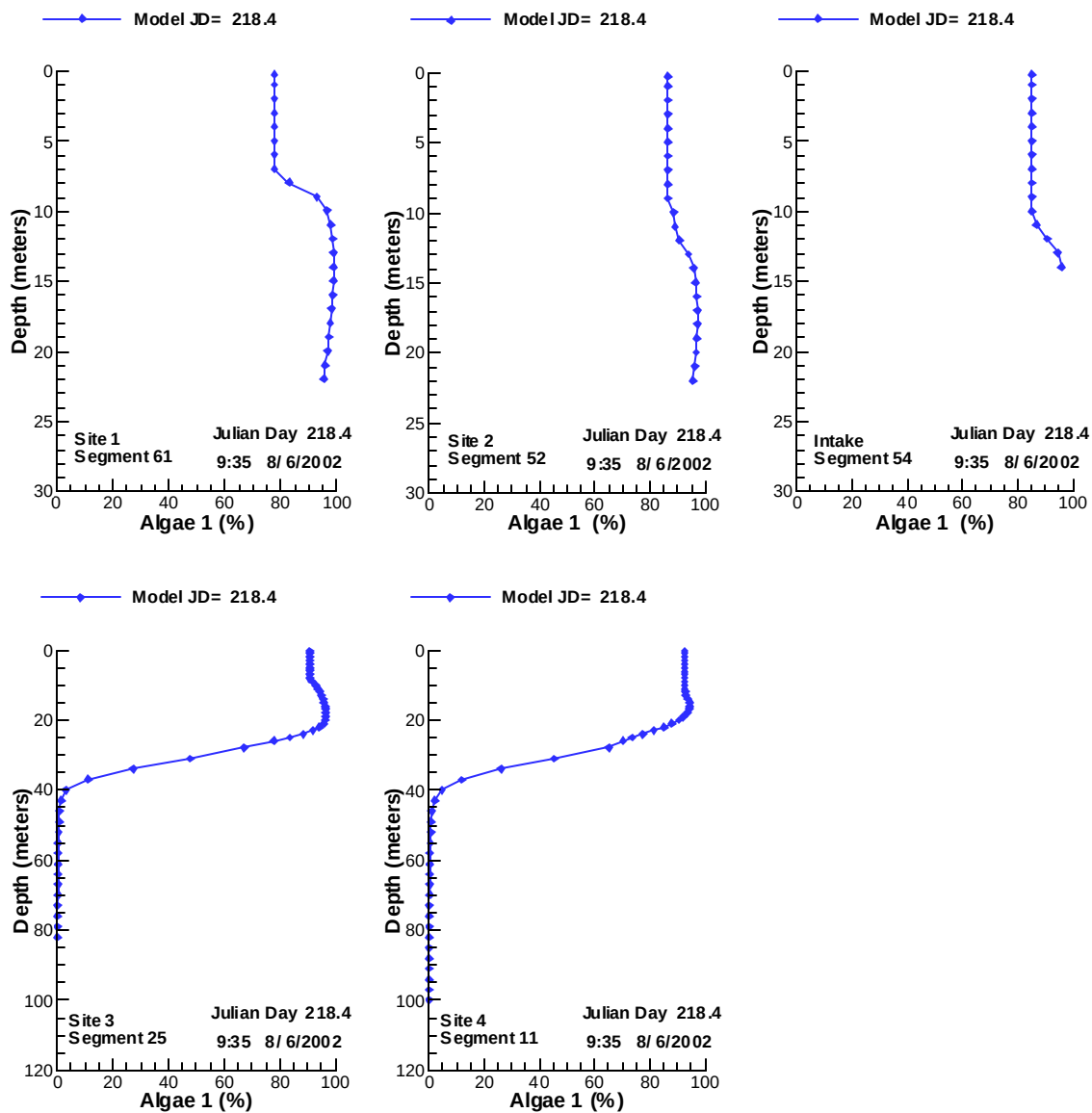


Figure 631. Vertical profiles of ALGAE 1 compared with data for 8/ 6/2002.

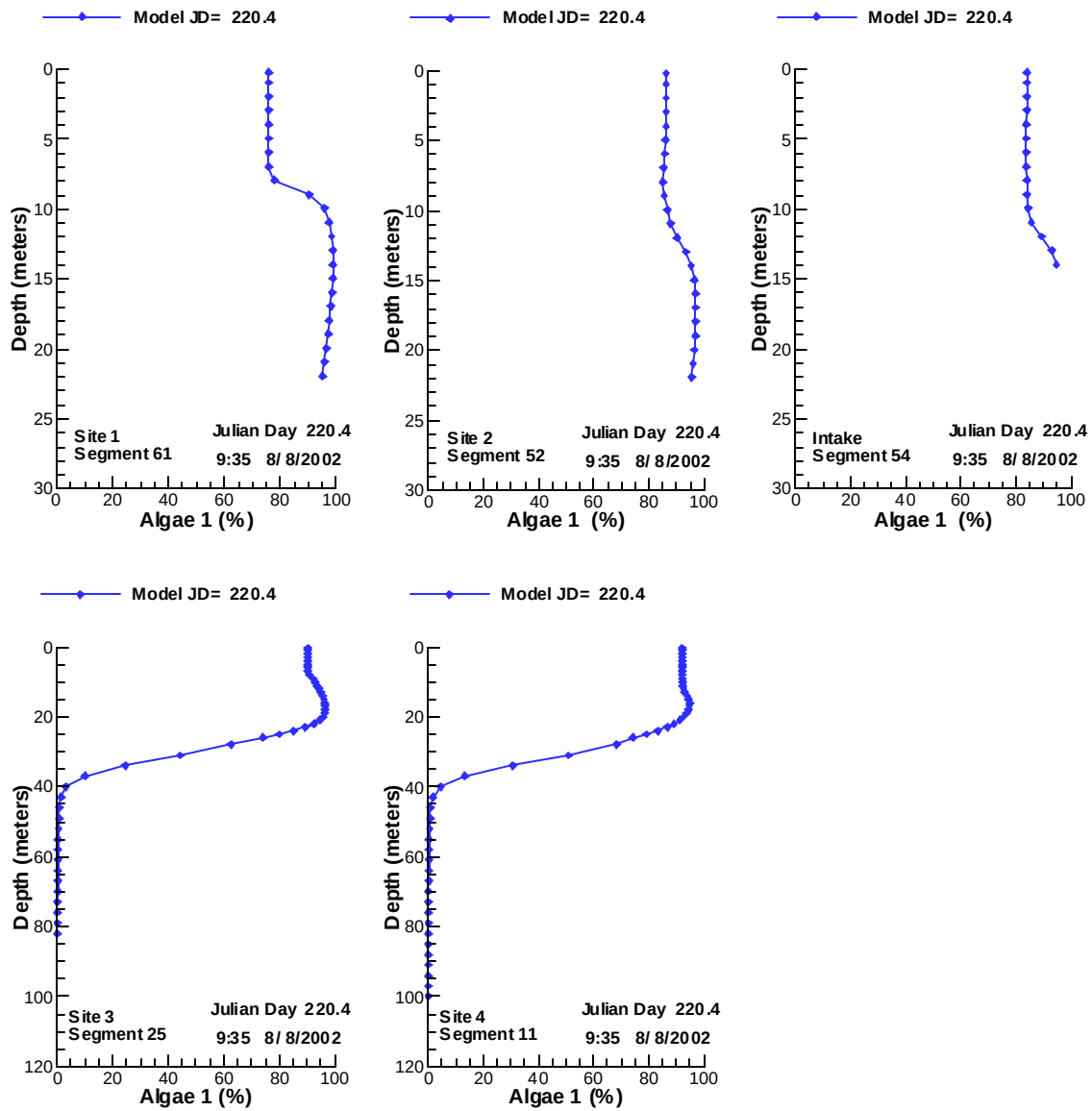


Figure 632. Vertical profiles of ALGAE 1 compared with data for 8/ 8/2002.

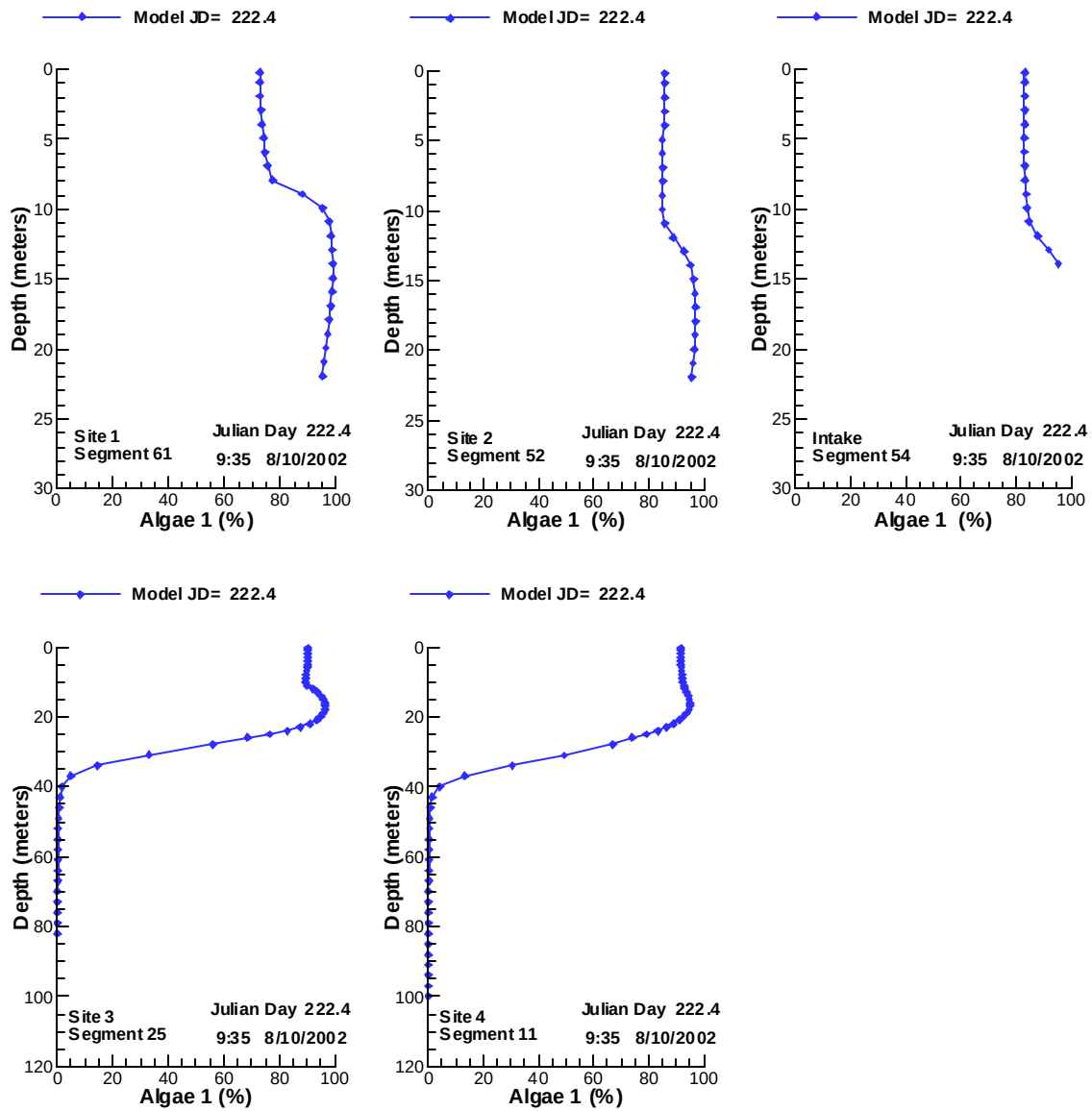


Figure 633. Vertical profiles of ALGAE 1 compared with data for 8/10/2002.

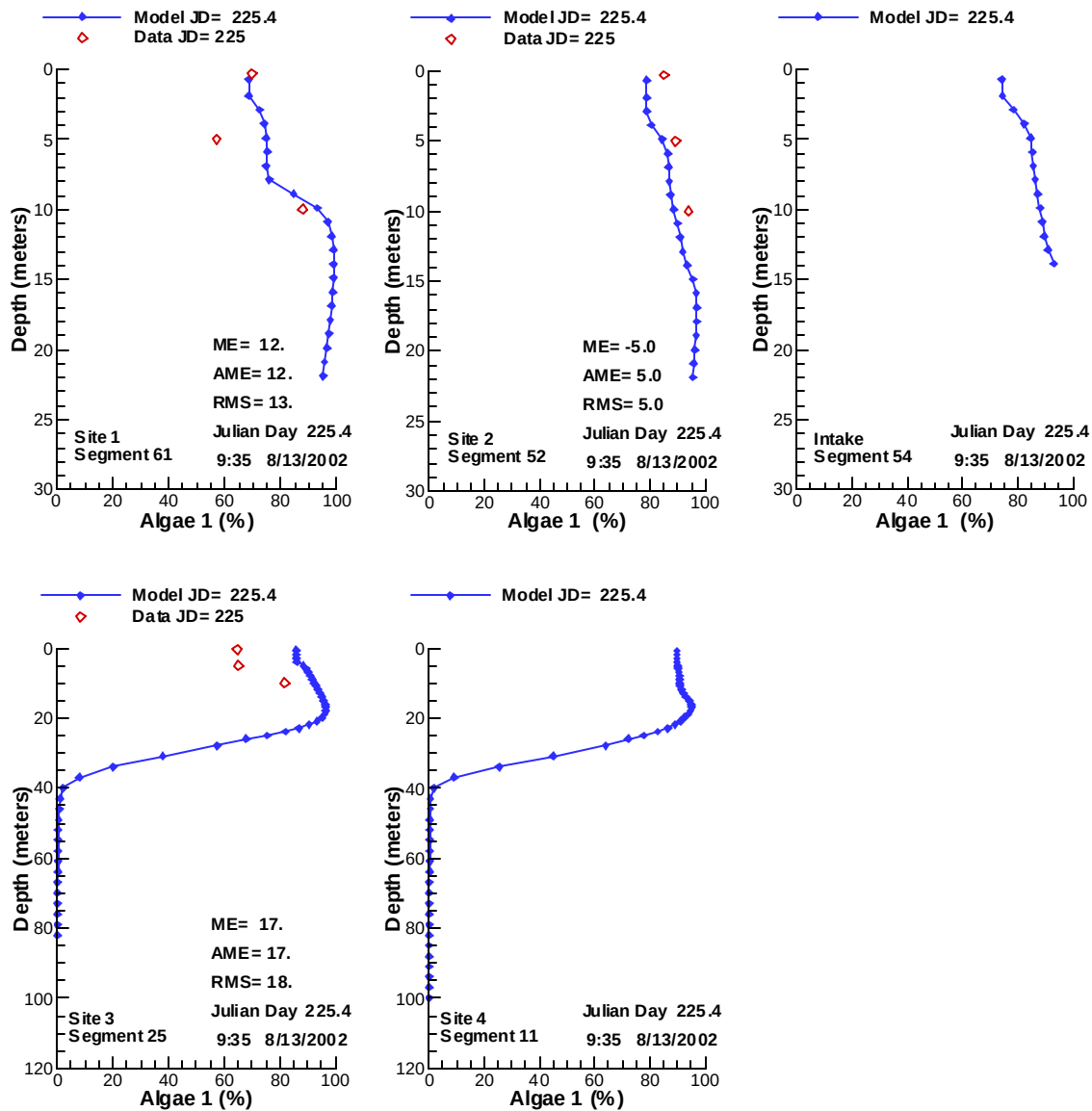


Figure 634. Vertical profiles of ALGAE 1 compared with data for 8/13/2002.

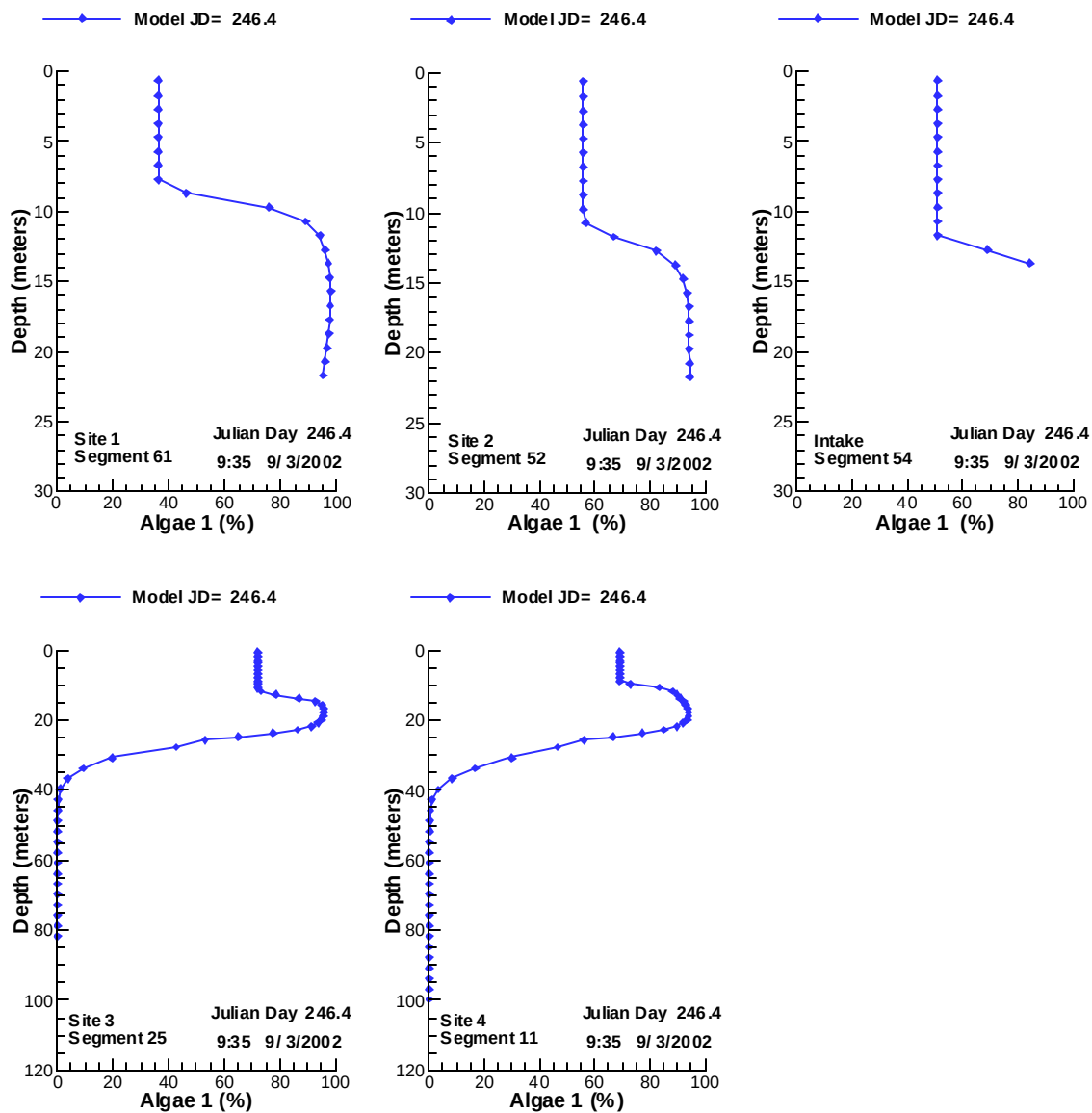


Figure 635. Vertical profiles of ALGAE 1 compared with data for 9/ 3/2002.

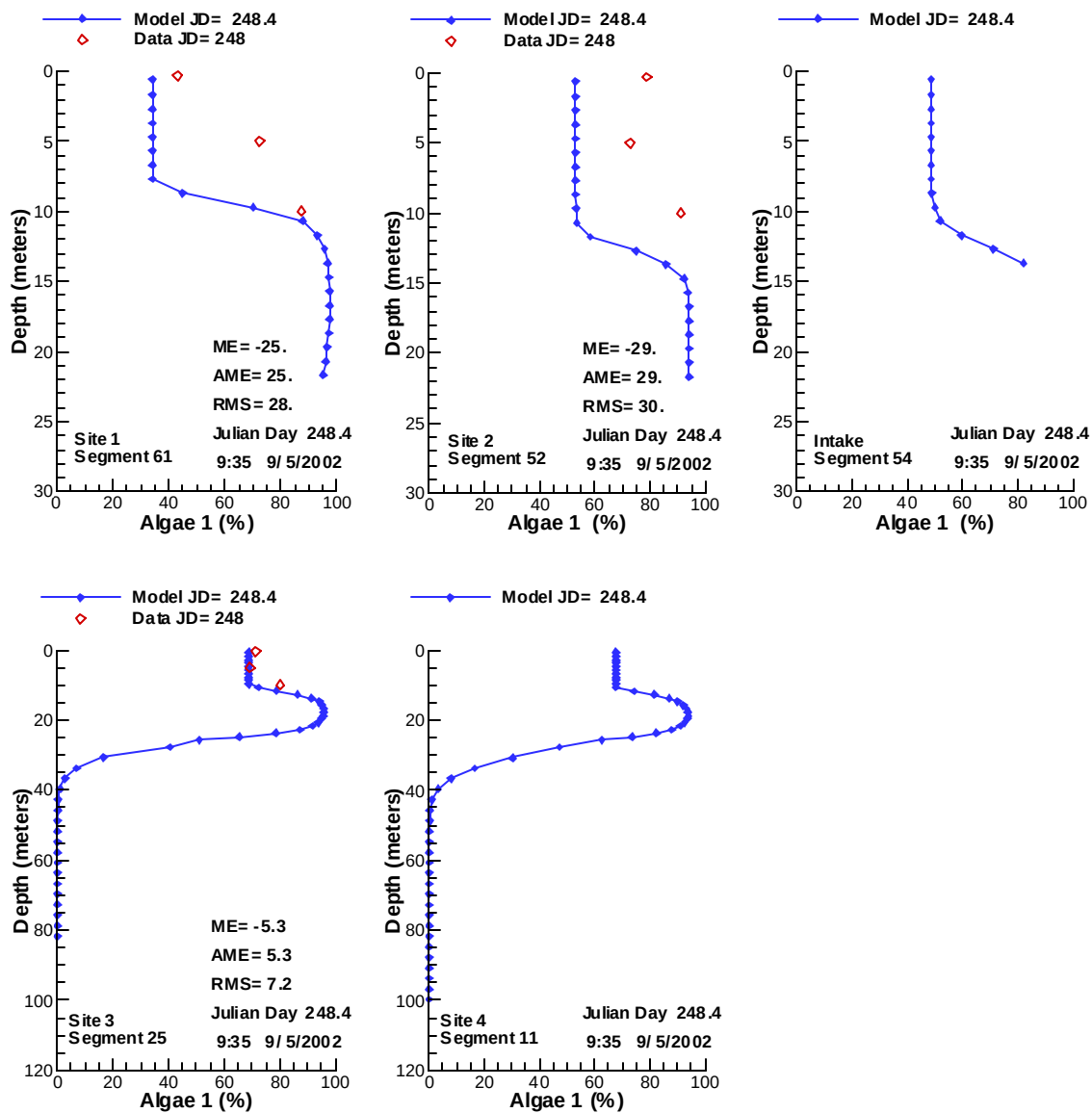


Figure 636. Vertical profiles of ALGAE 1 compared with data for 9/ 5/2002.

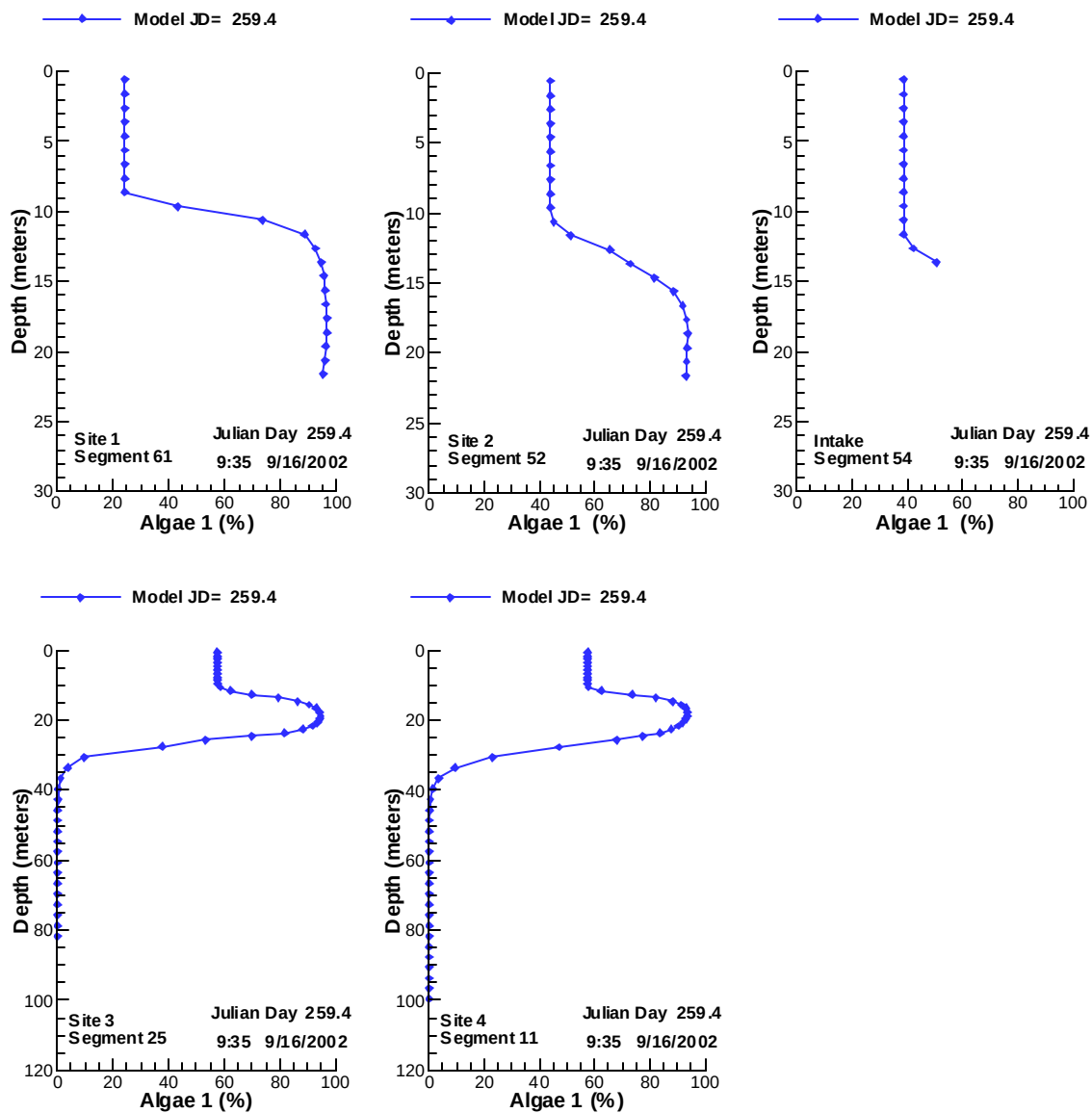


Figure 637. Vertical profiles of ALGAE 1 compared with data for 9/16/2002.

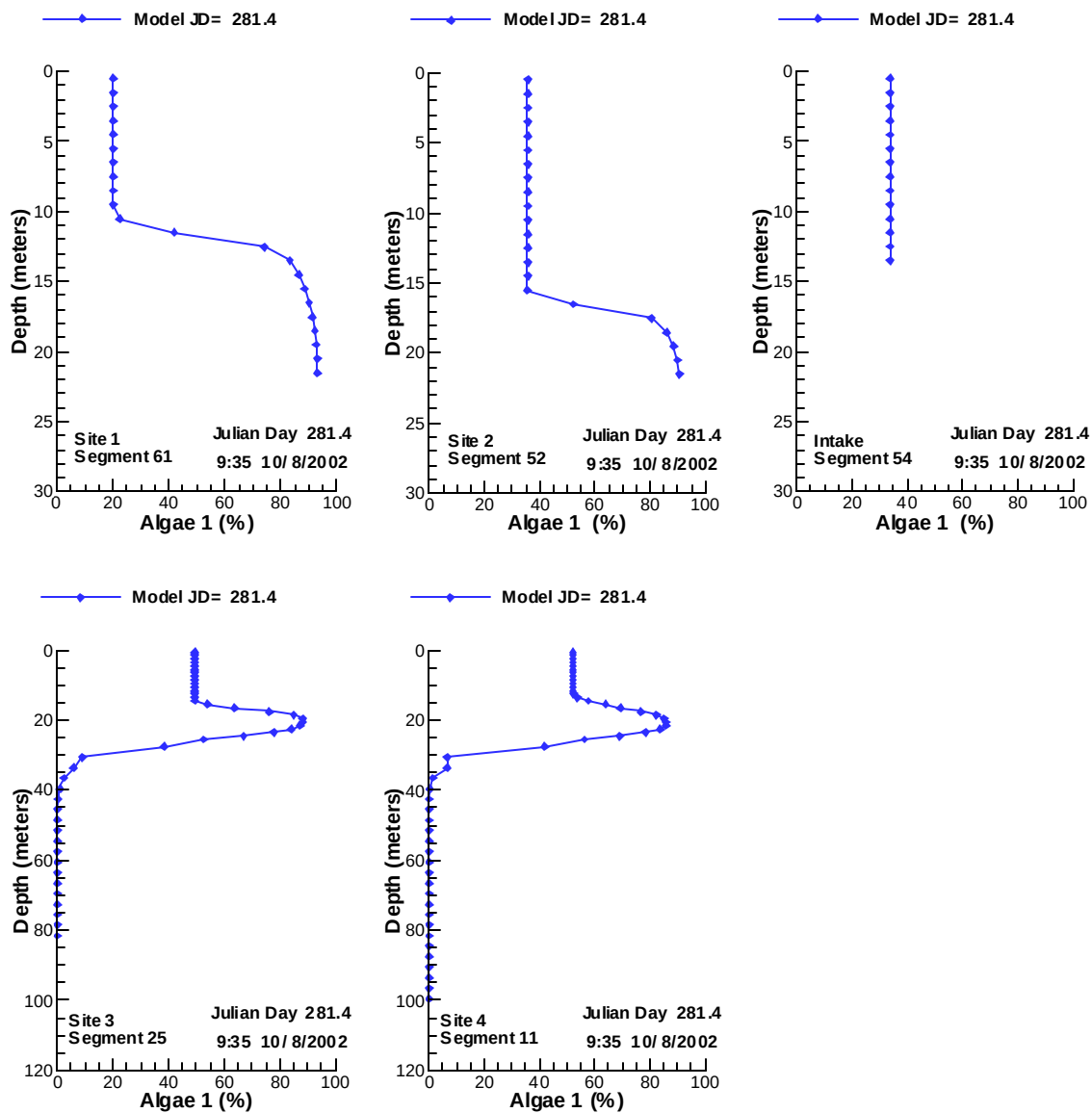


Figure 638. Vertical profiles of ALGAE 1 compared with data for 10/ 8/2002.

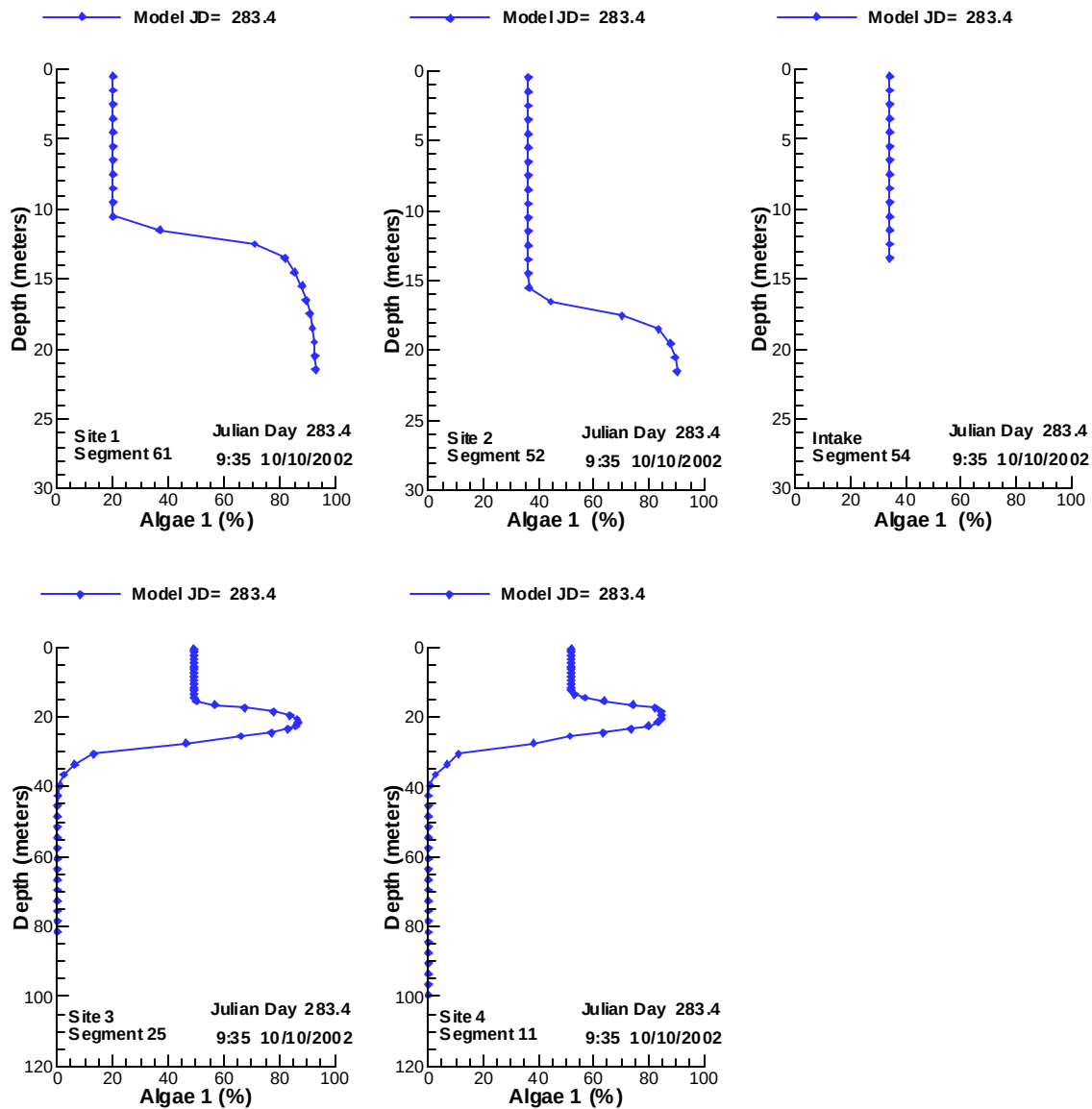


Figure 639. Vertical profiles of ALGAE 1 compared with data for 10/10/2002.

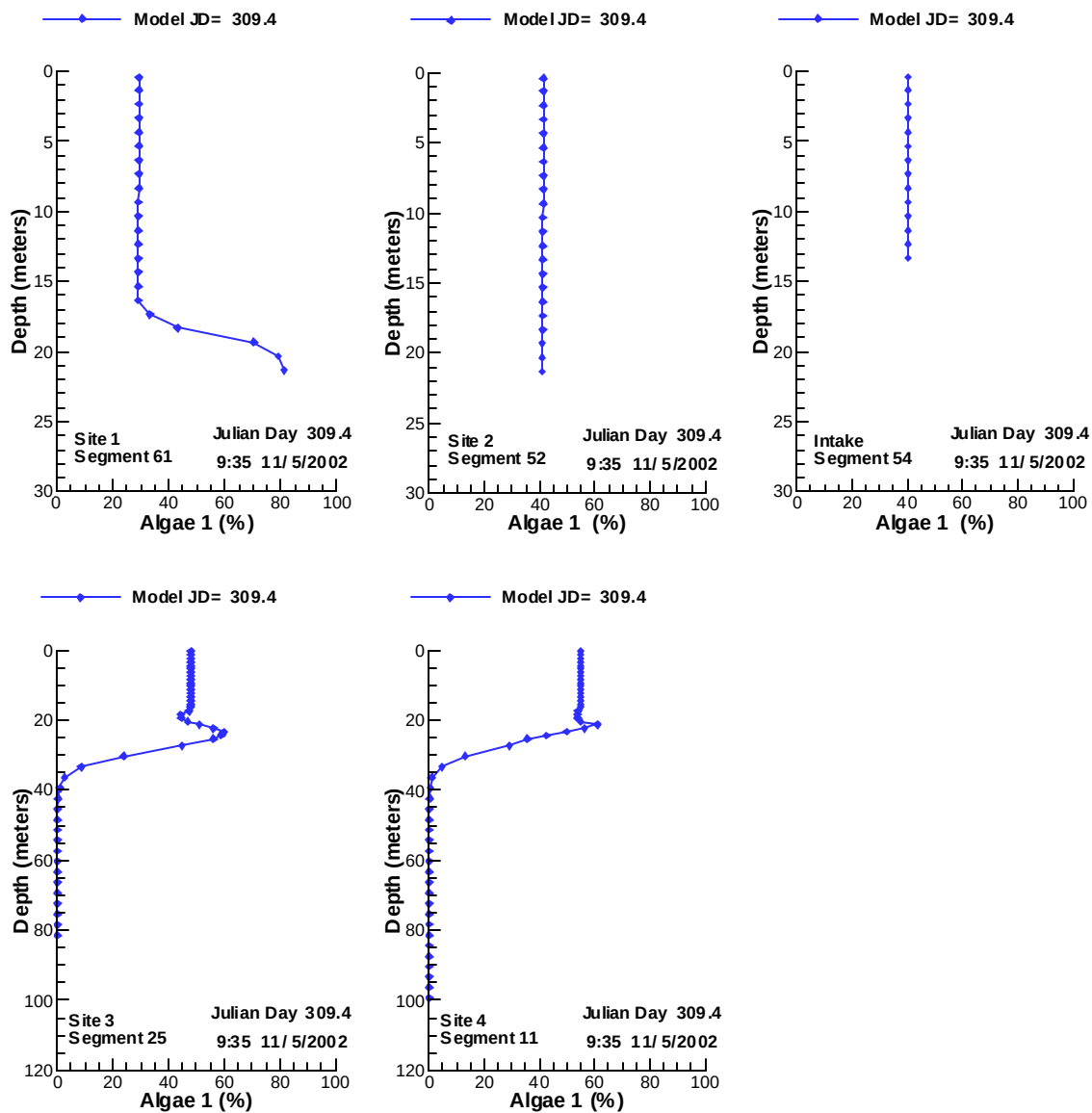


Figure 640. Vertical profiles of ALGAE 1 compared with data for 11/ 5/2002.

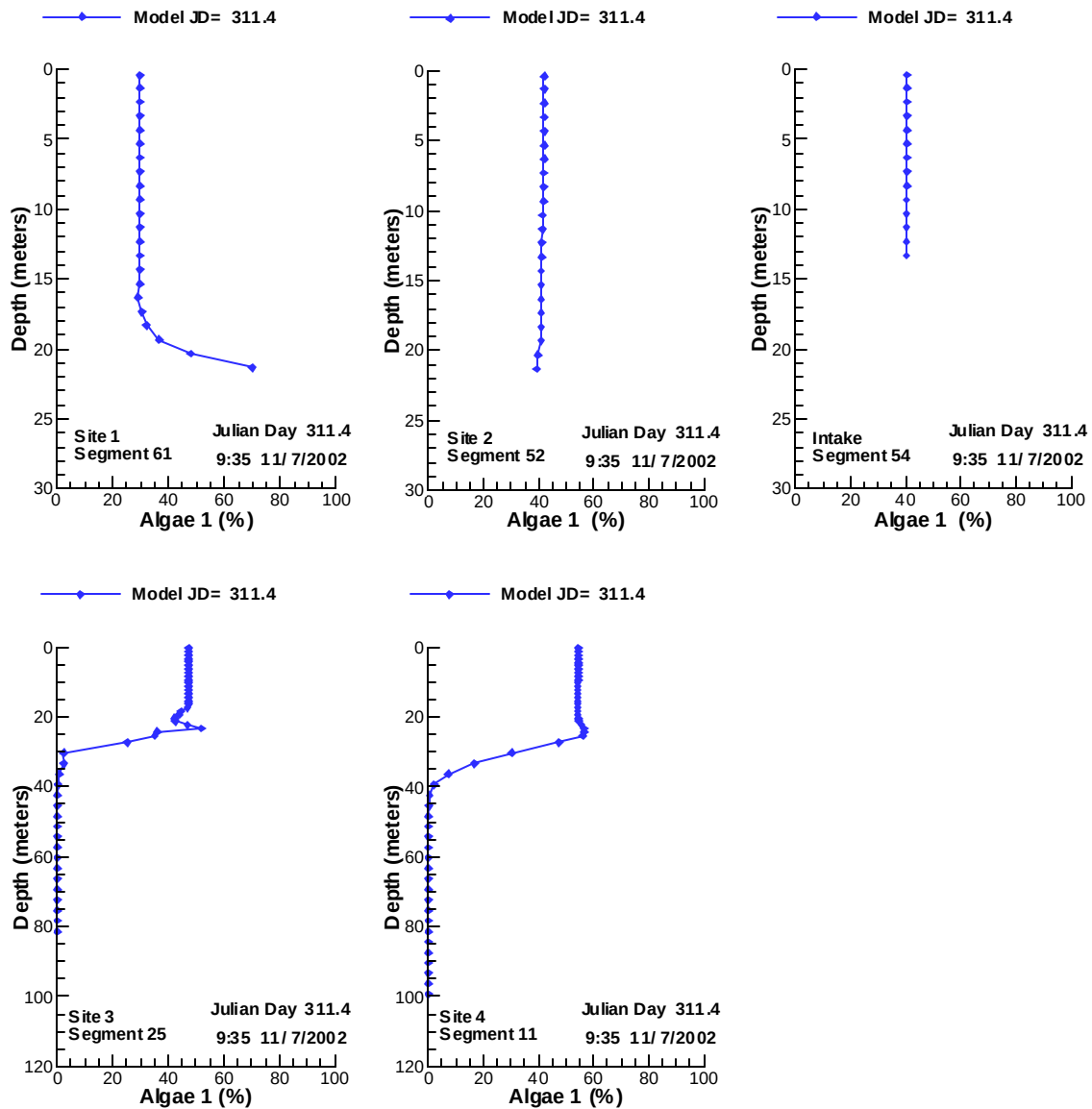


Figure 641. Vertical profiles of ALGAE 1 compared with data for 11/ 7/2002.

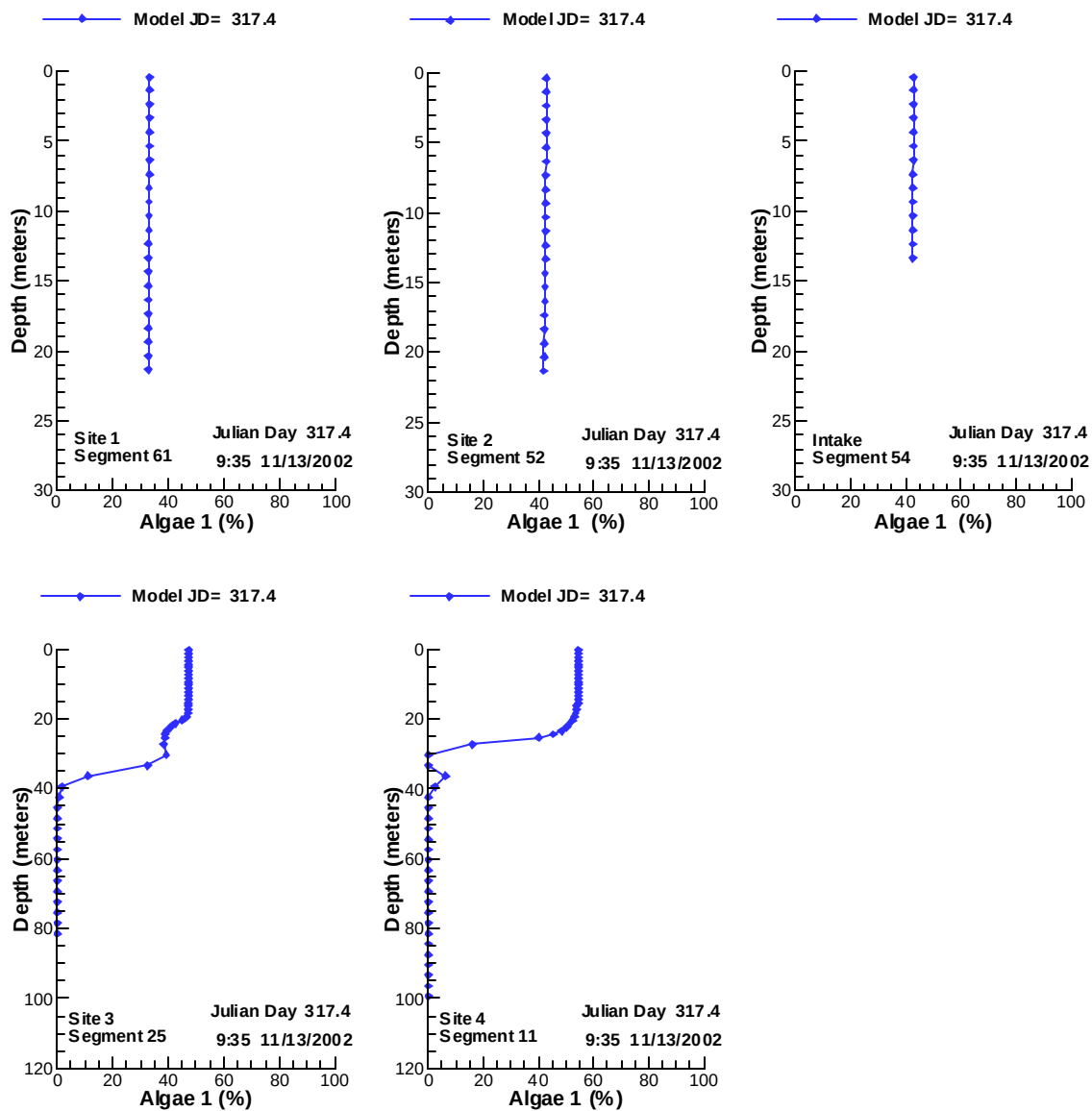


Figure 642. Vertical profiles of ALGAE 1 compared with data for 11/13/2002.

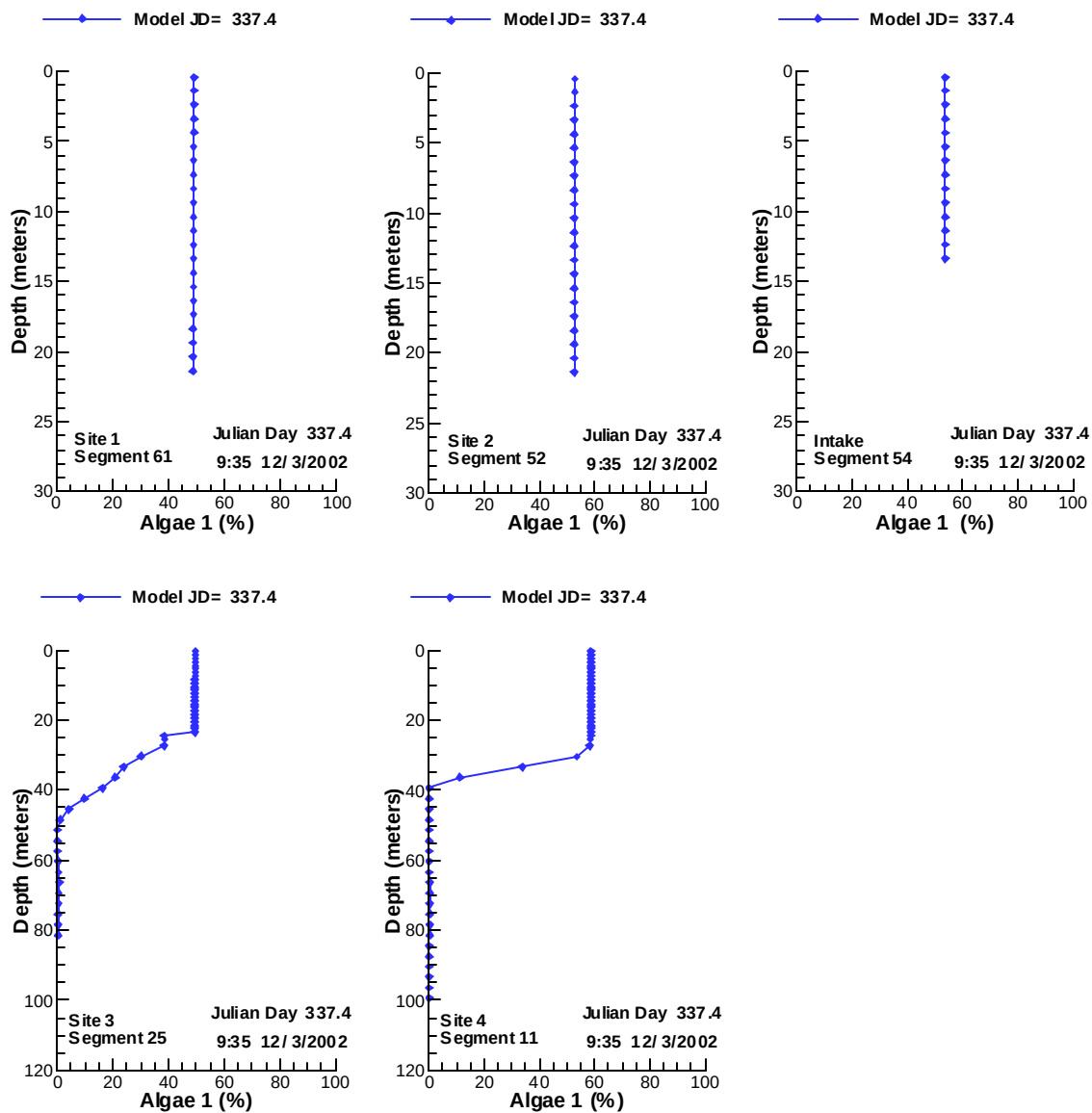


Figure 643. Vertical profiles of ALGAE 1 compared with data for 12/ 3/2002.

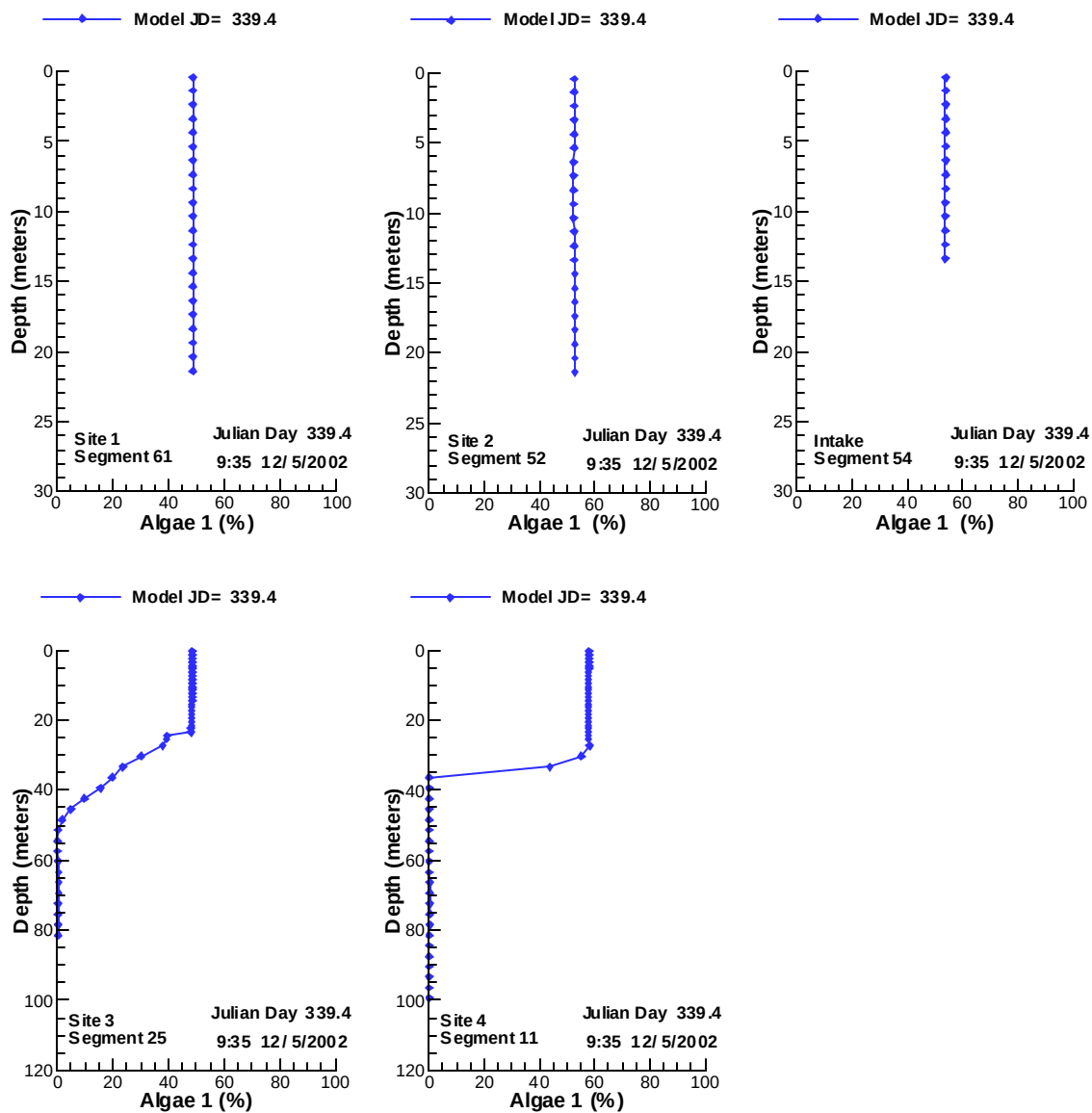


Figure 644. Vertical profiles of ALGAE 1 compared with data for 12/ 5/2002.

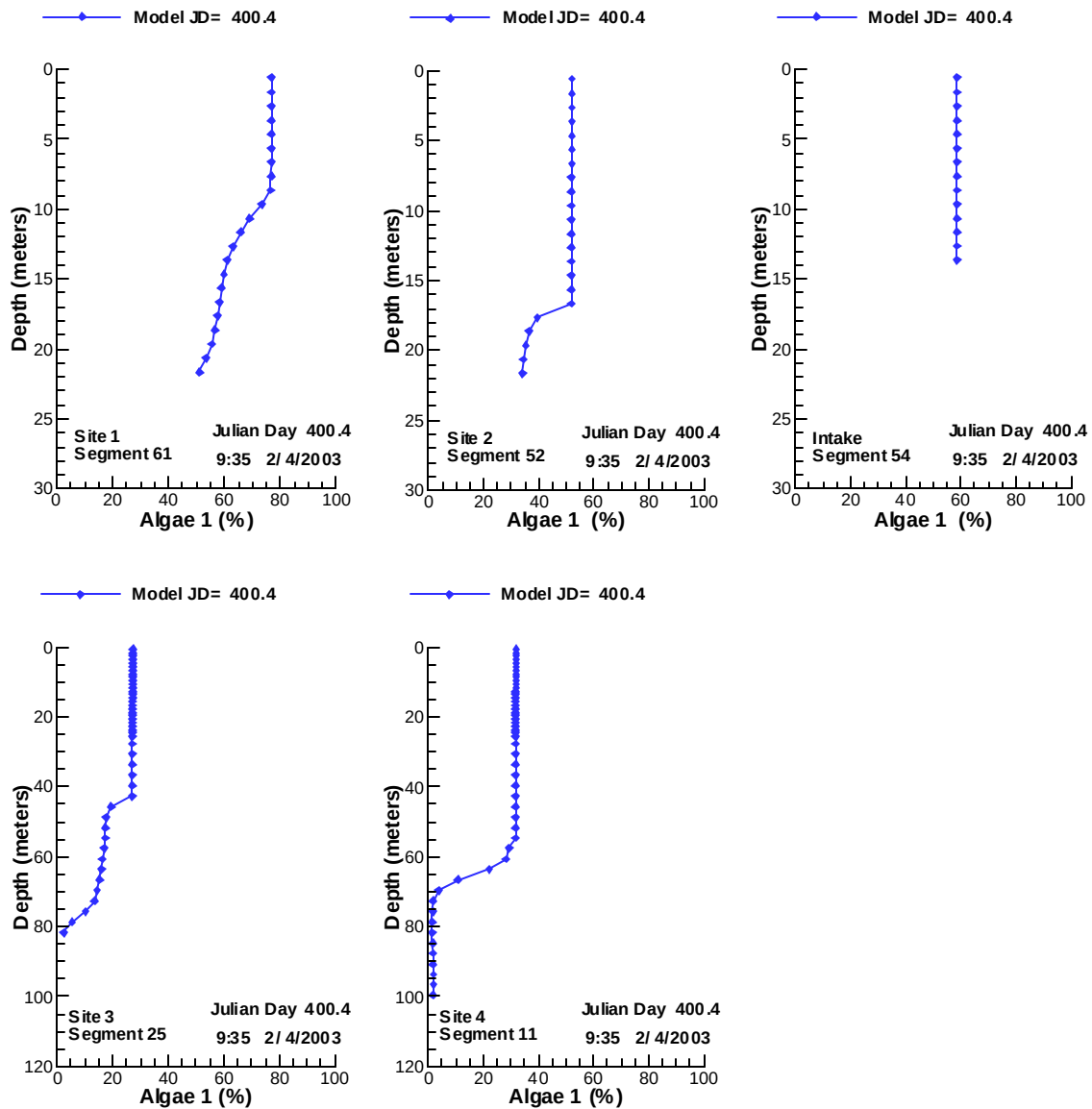


Figure 645. Vertical profiles of ALGAE 1 compared with data for 2/ 4/2003.

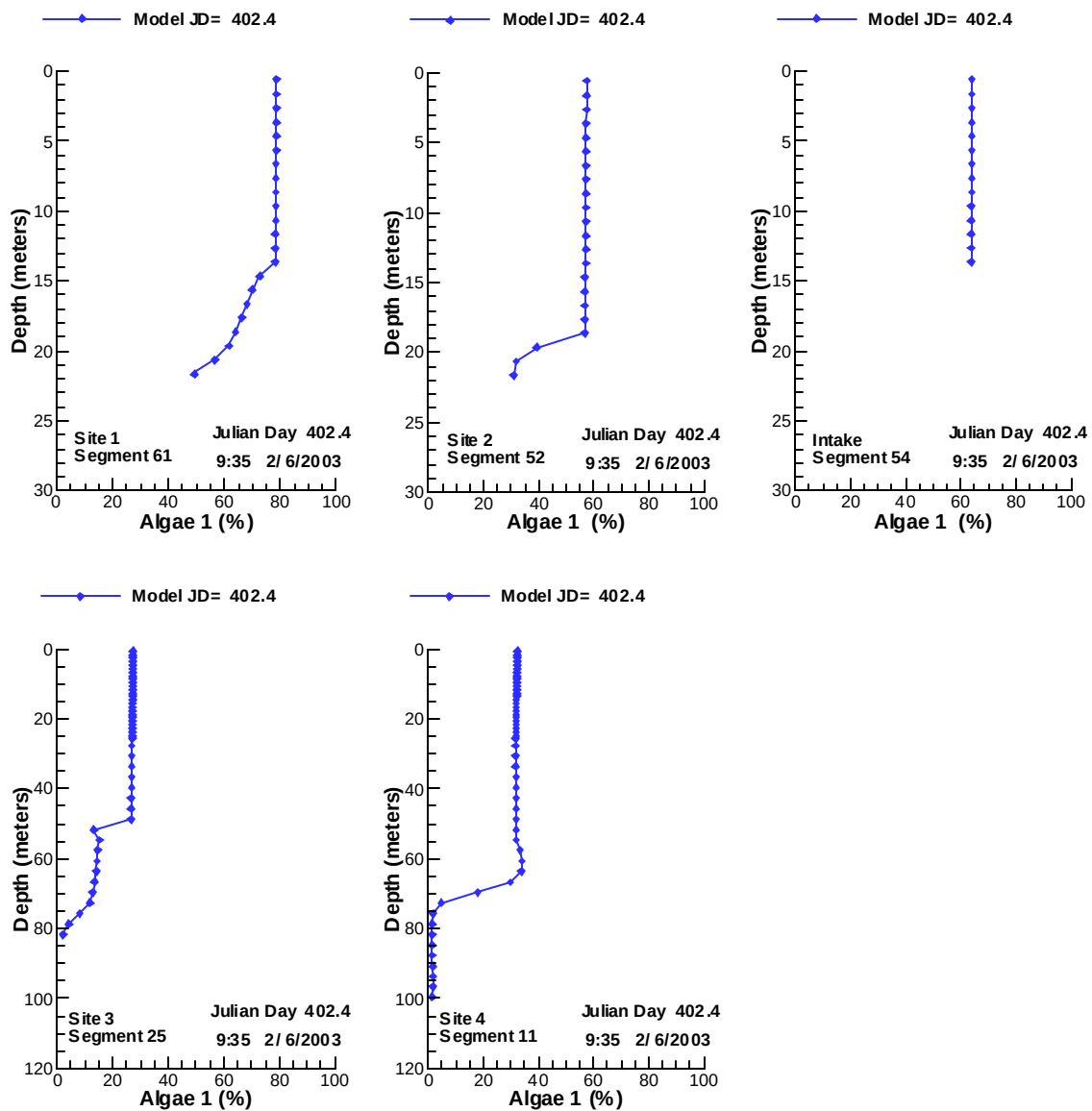


Figure 646. Vertical profiles of ALGAE 1 compared with data for 2/ 6/2003.

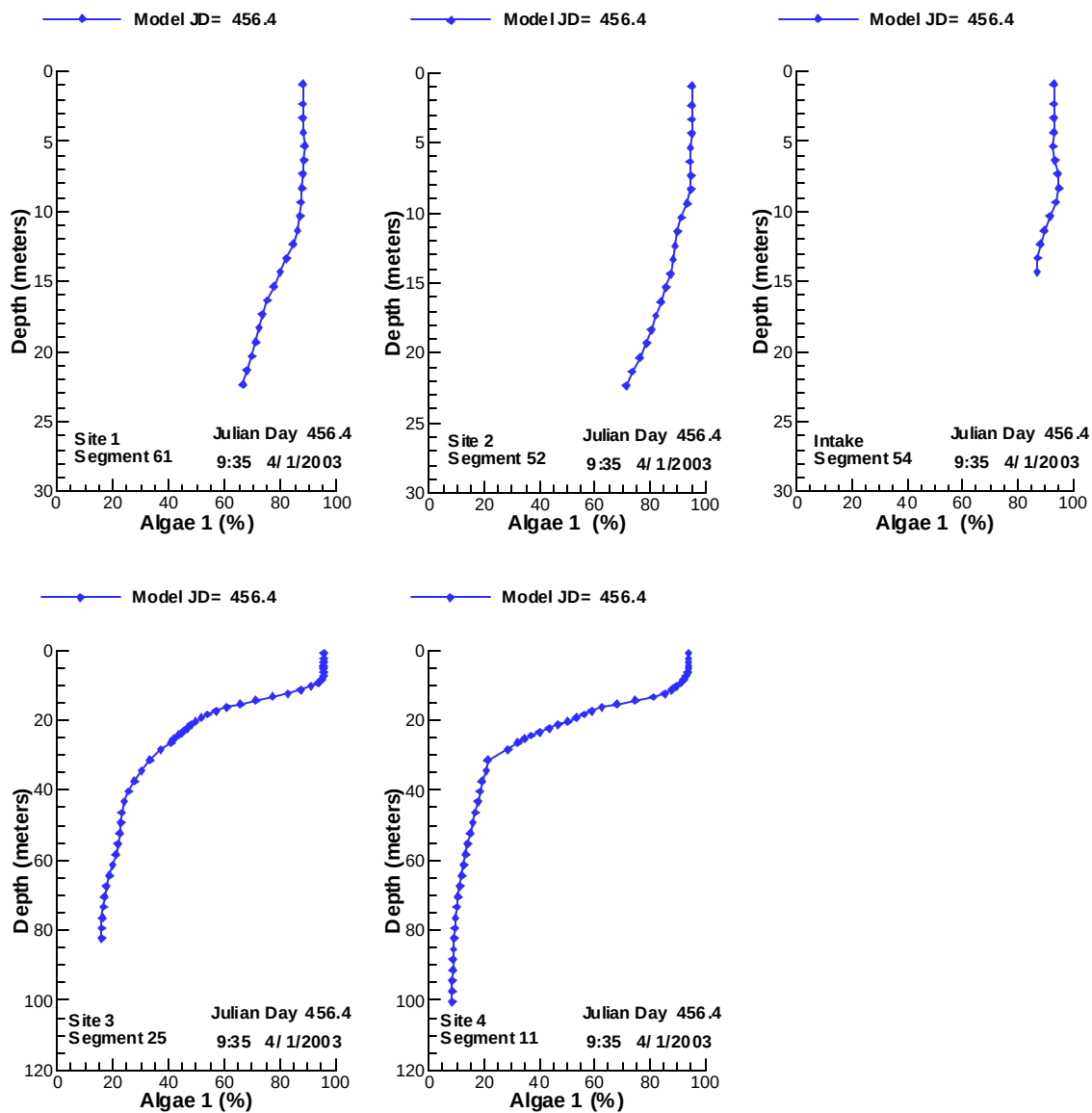


Figure 647. Vertical profiles of ALGAE 1 compared with data for 4/ 1/2003.

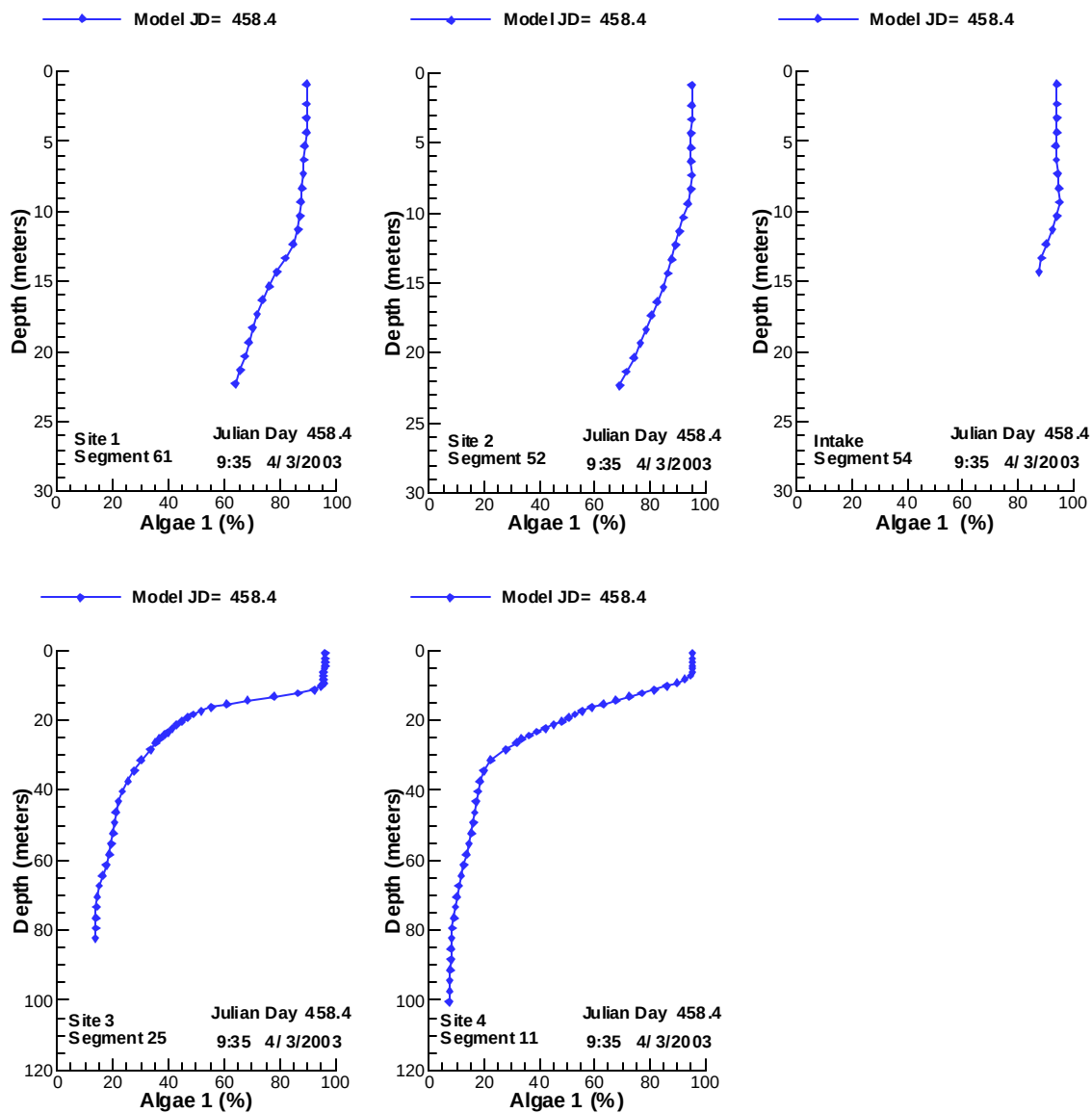


Figure 648. Vertical profiles of ALGAE 1 compared with data for 4/ 3/2003.

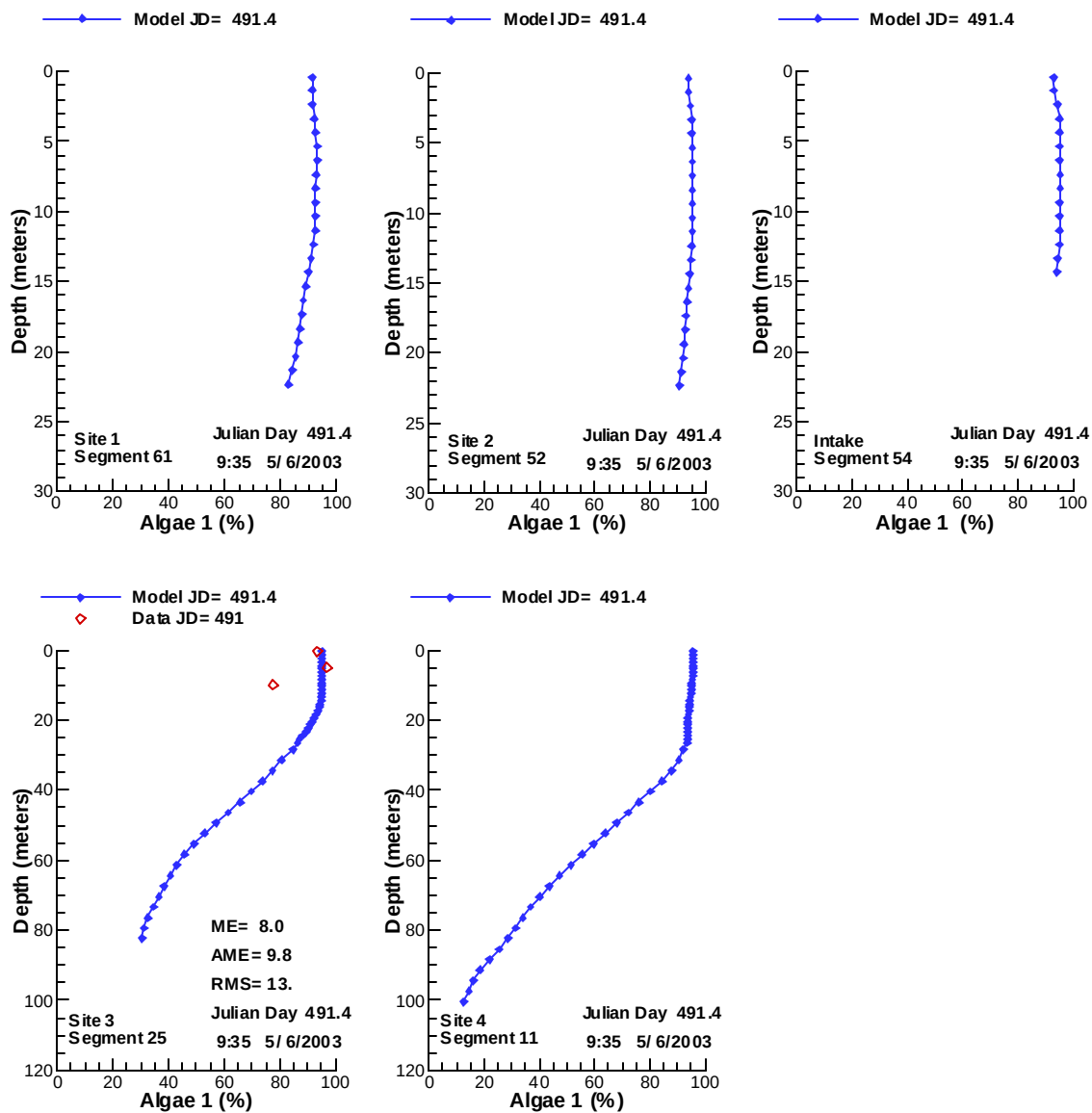


Figure 649. Vertical profiles of ALGAE 1 compared with data for 5/ 6/2003.

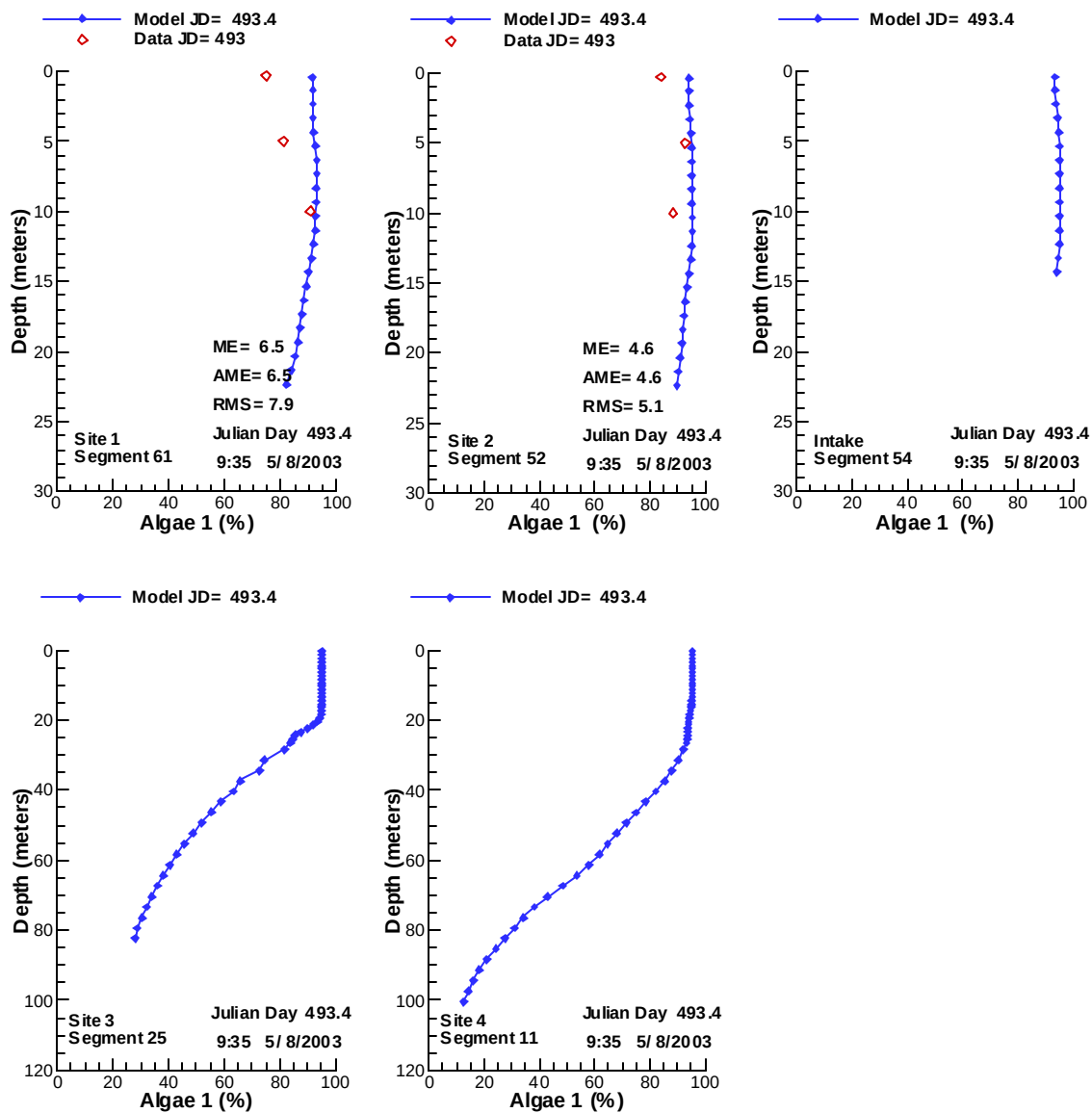


Figure 650. Vertical profiles of ALGAE 1 compared with data for 5/ 8/2003.

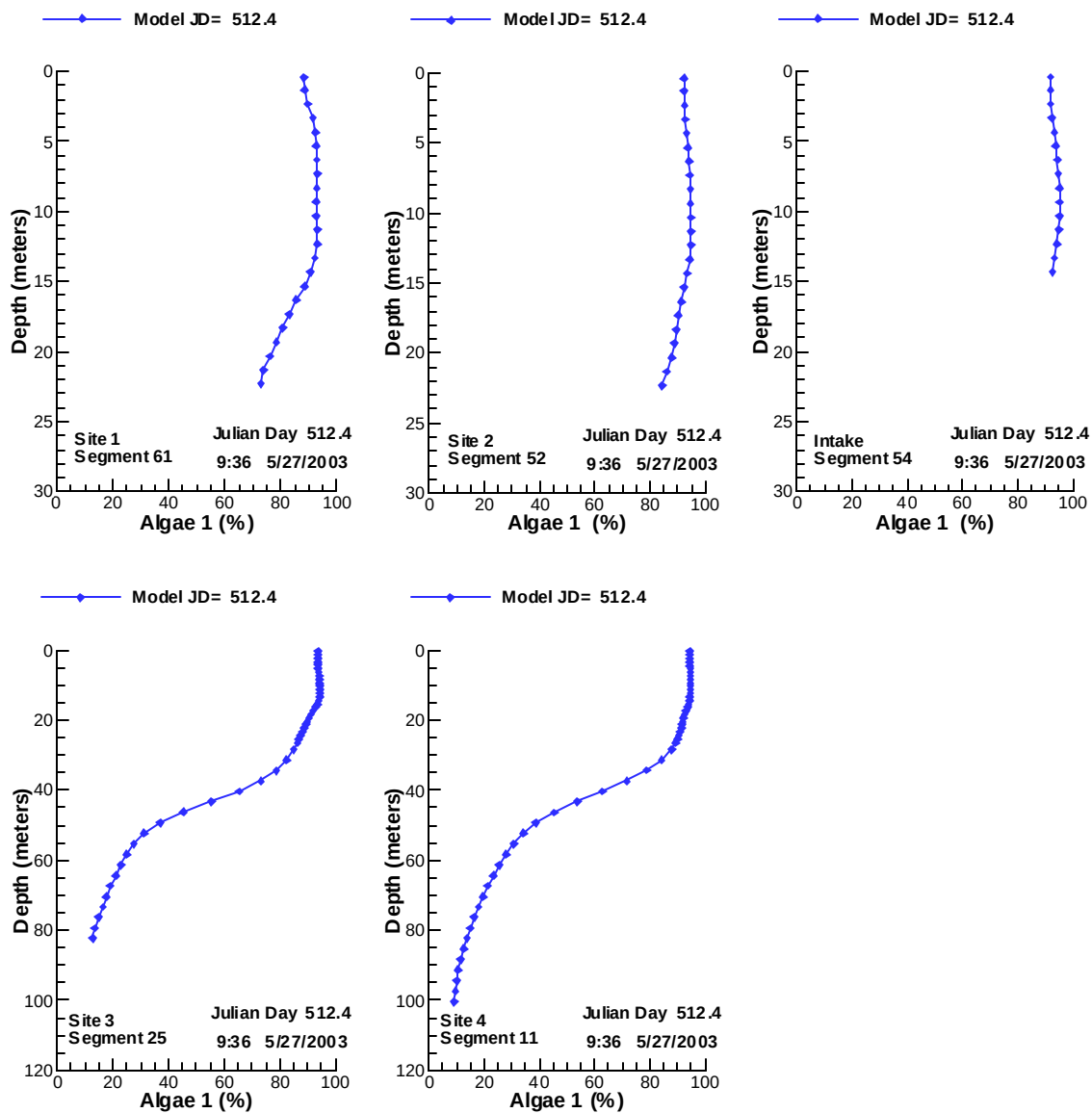


Figure 651. Vertical profiles of ALGAE 1 compared with data for 5/27/2003.

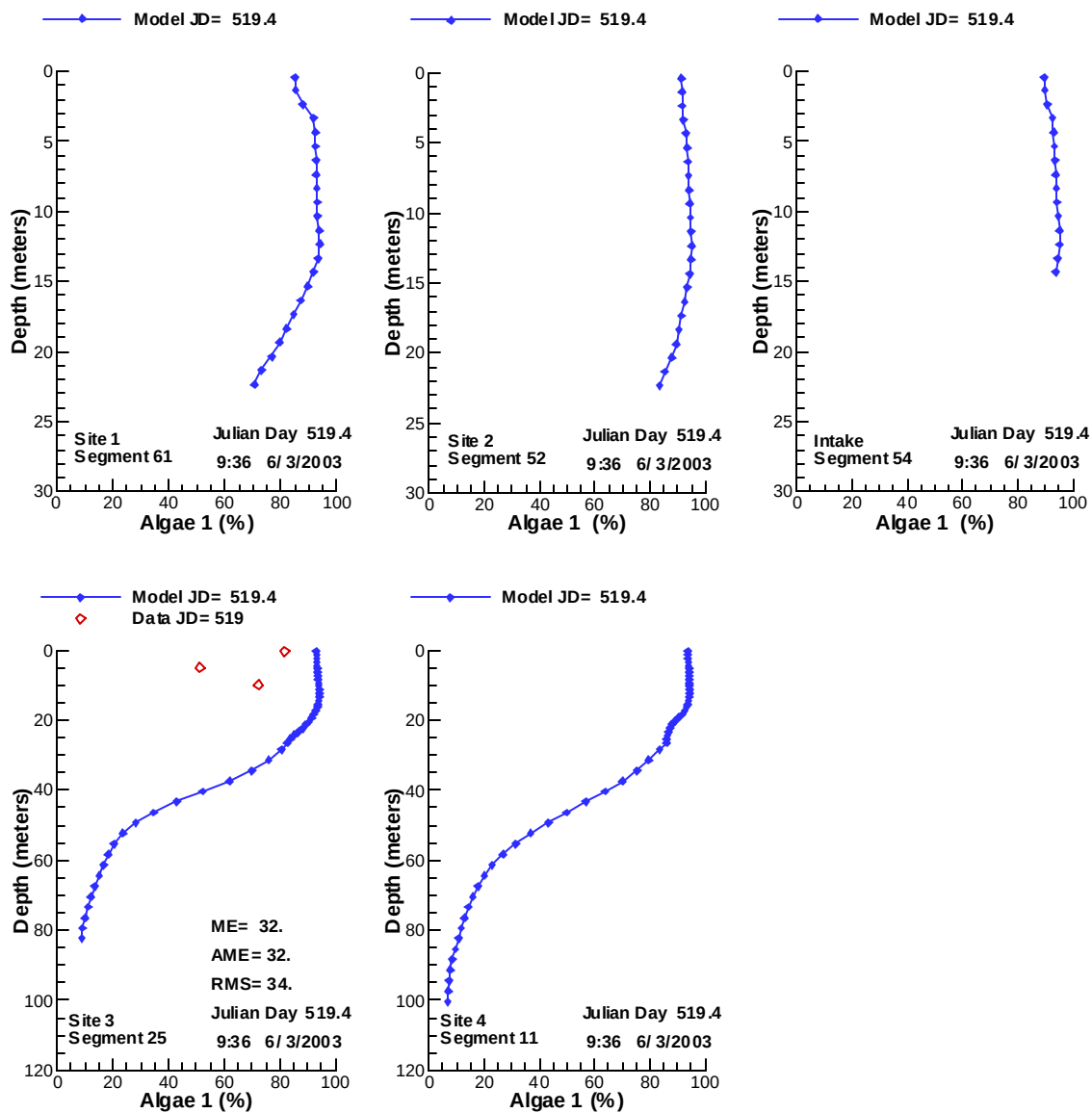


Figure 652. Vertical profiles of ALGAE 1 compared with data for 6/ 3/2003.

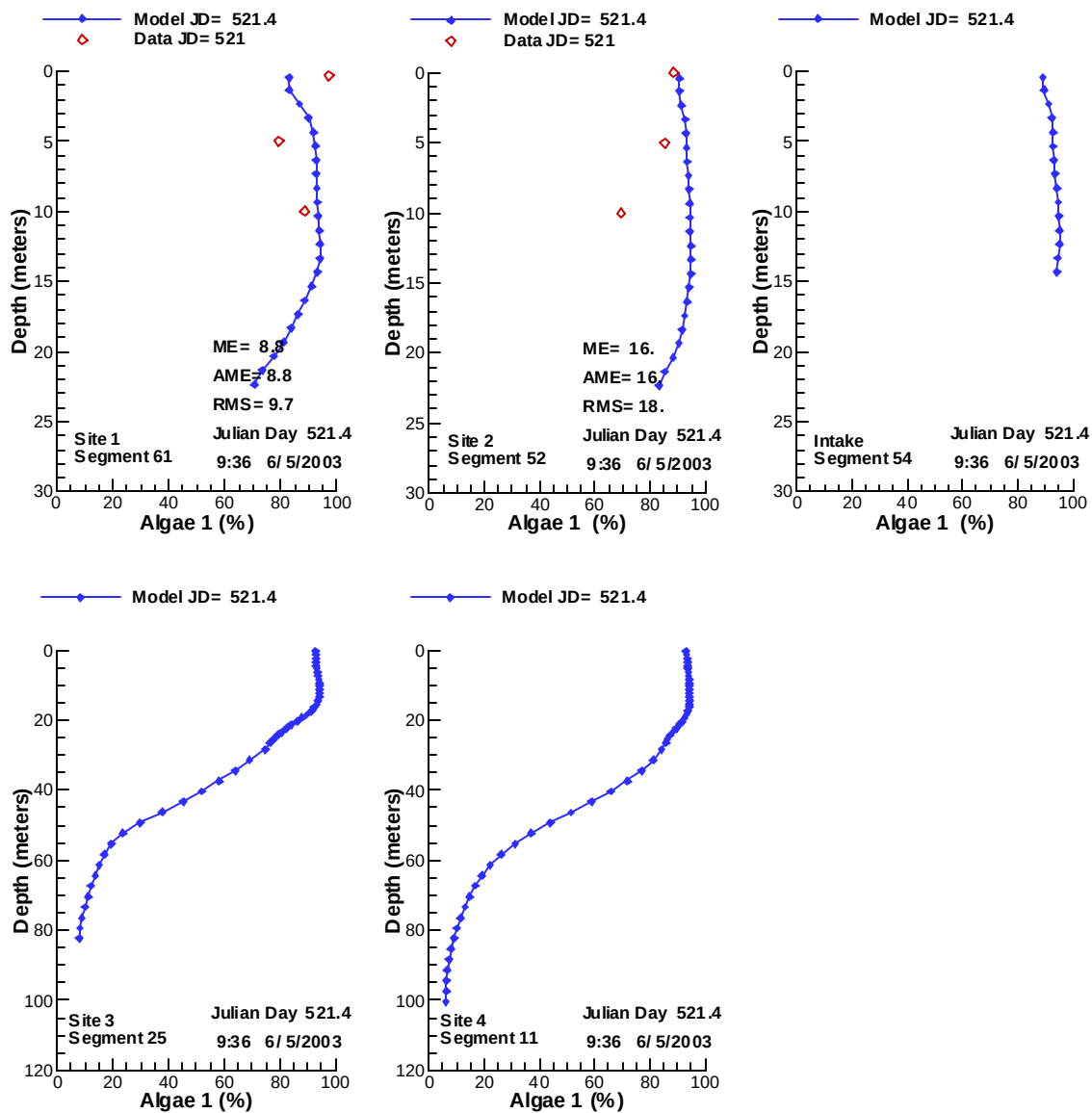


Figure 653. Vertical profiles of ALGAE 1 compared with data for 6/ 5/2003.

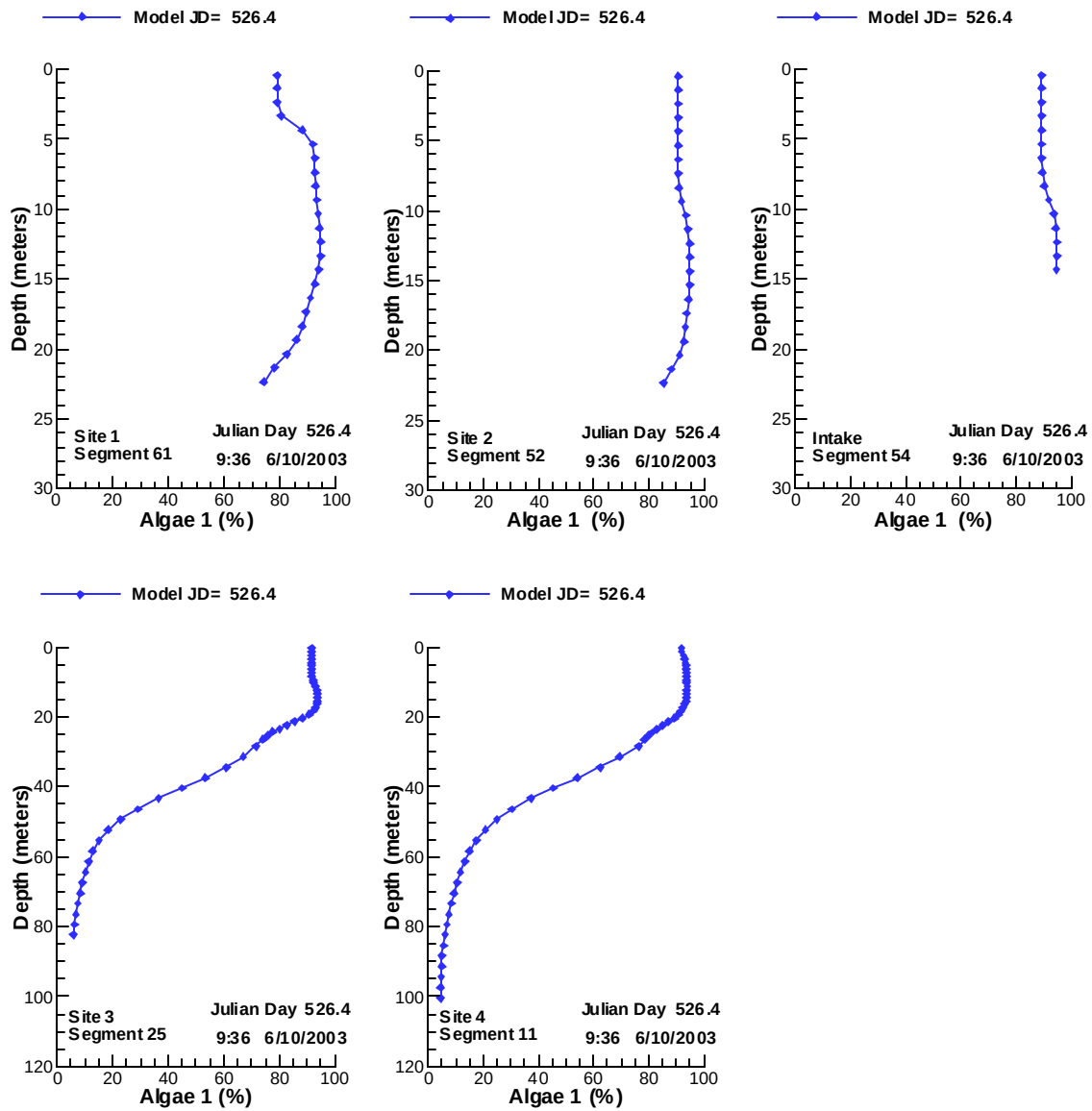


Figure 654. Vertical profiles of ALGAE 1 compared with data for 6/10/2003.

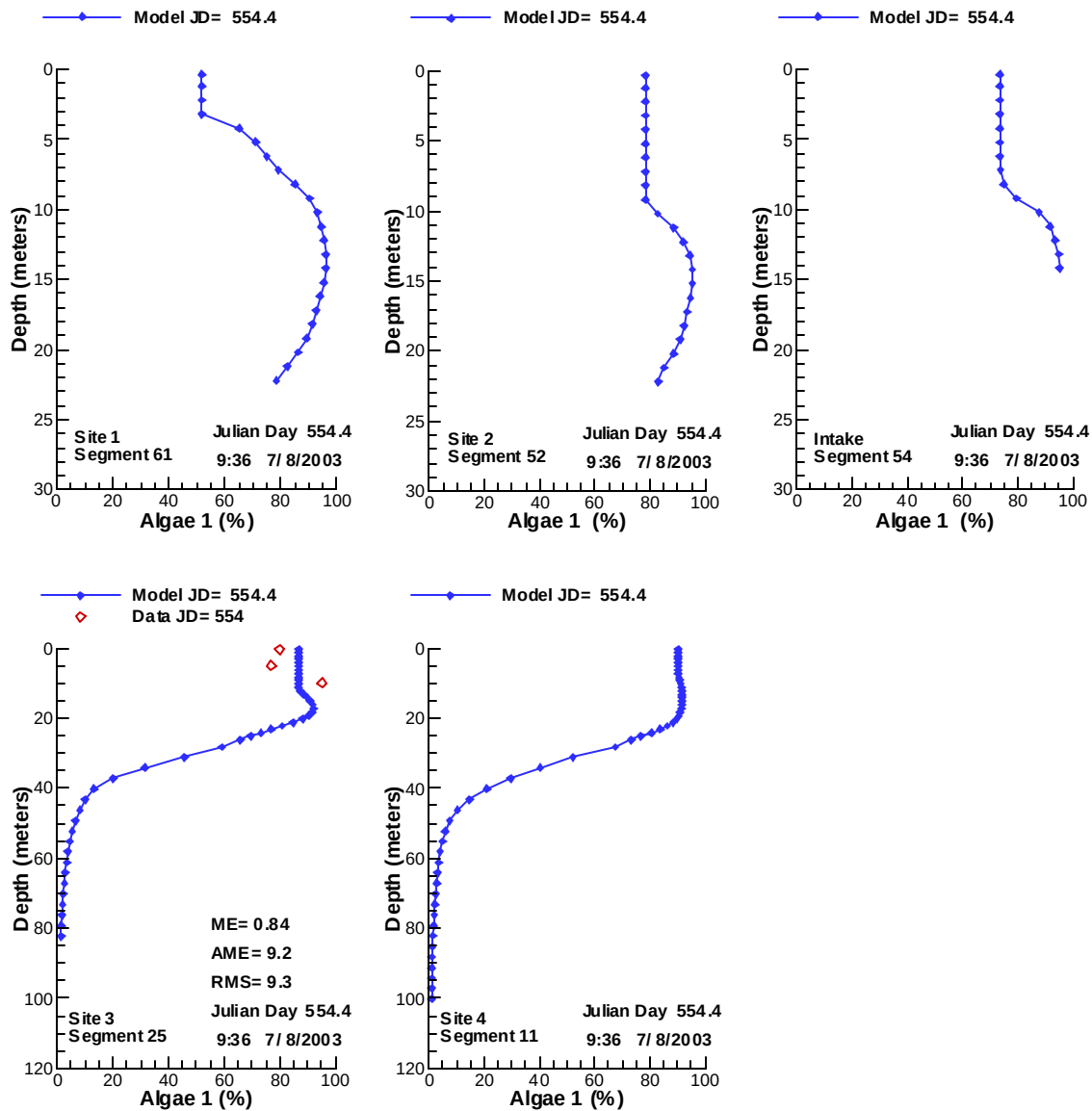


Figure 655. Vertical profiles of ALGAE 1 compared with data for 7/ 8/2003.

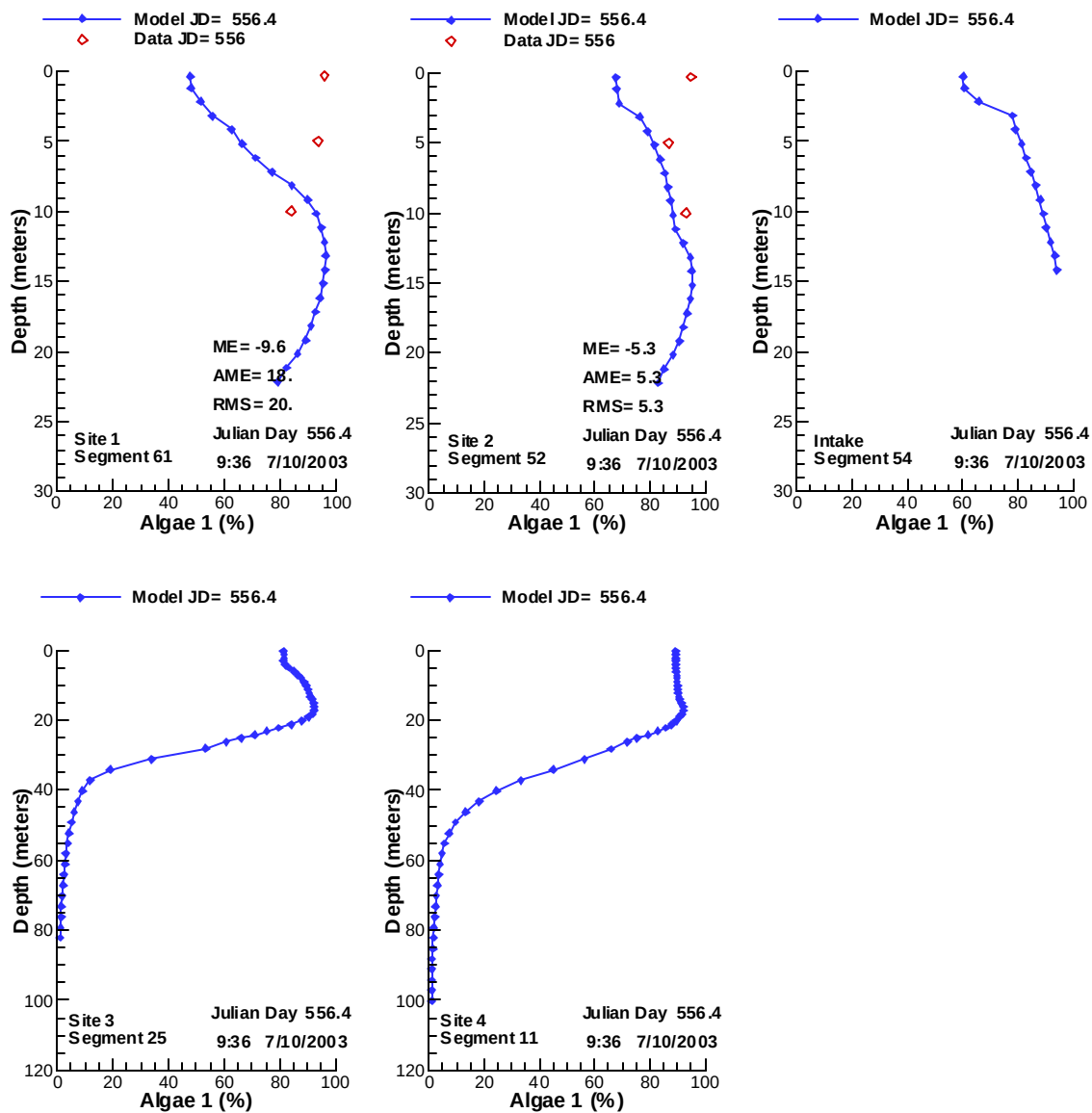


Figure 656. Vertical profiles of ALGAE 1 compared with data for 7/10/2003.

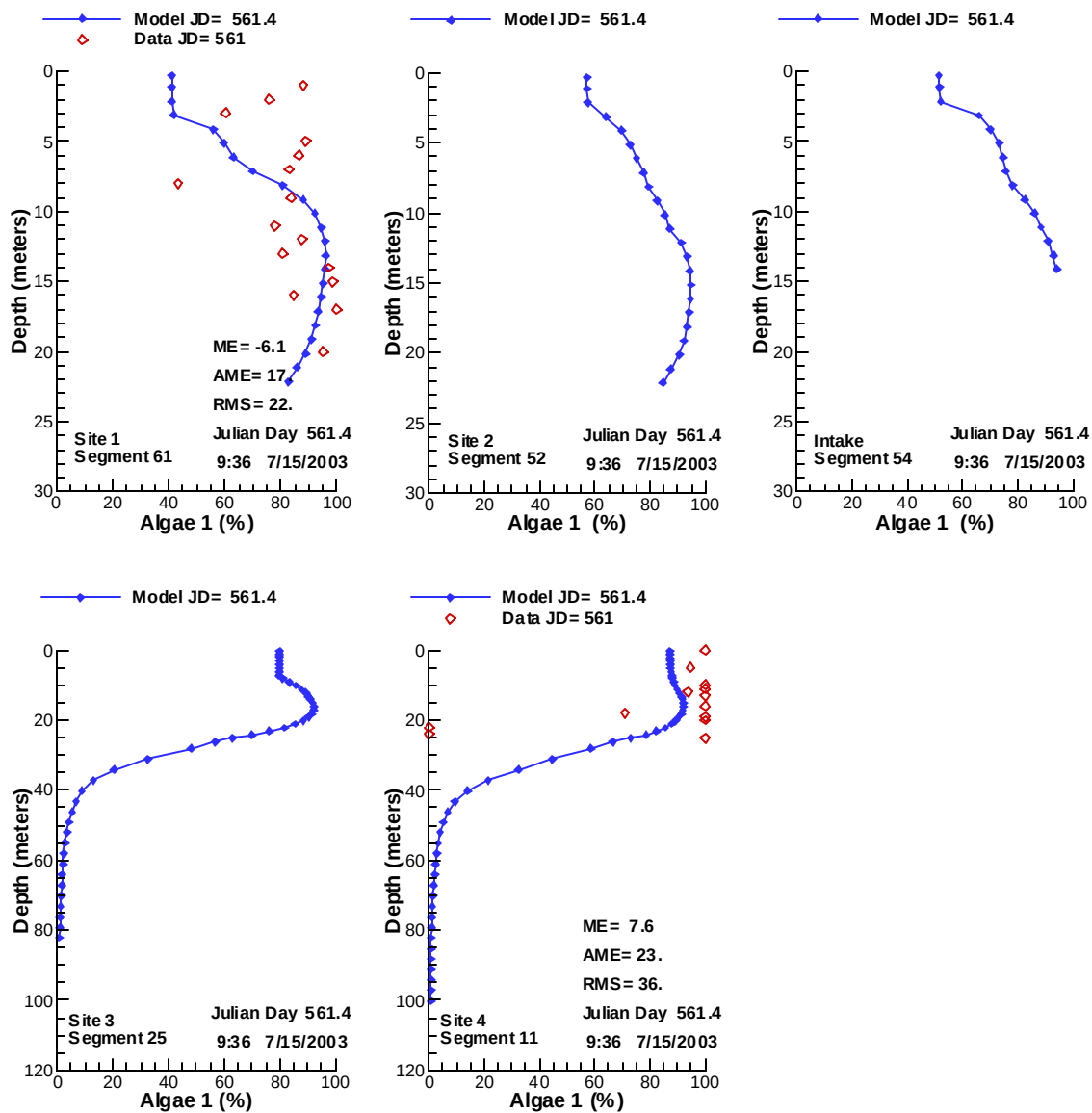


Figure 657. Vertical profiles of ALGAE 1 compared with data for 7/15/2003.

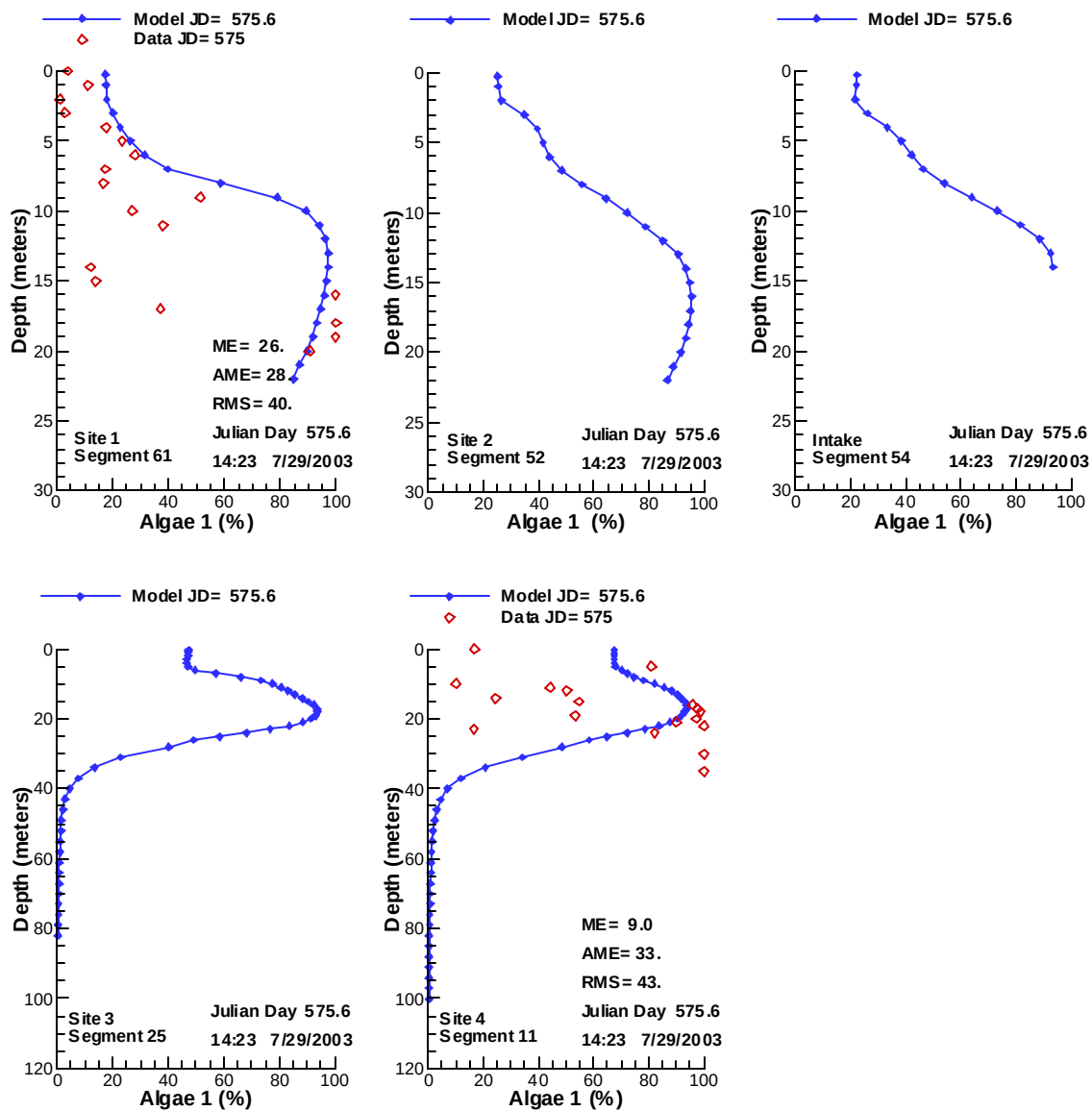


Figure 658. Vertical profiles of ALGAE 1 compared with data for 7/29/2003.

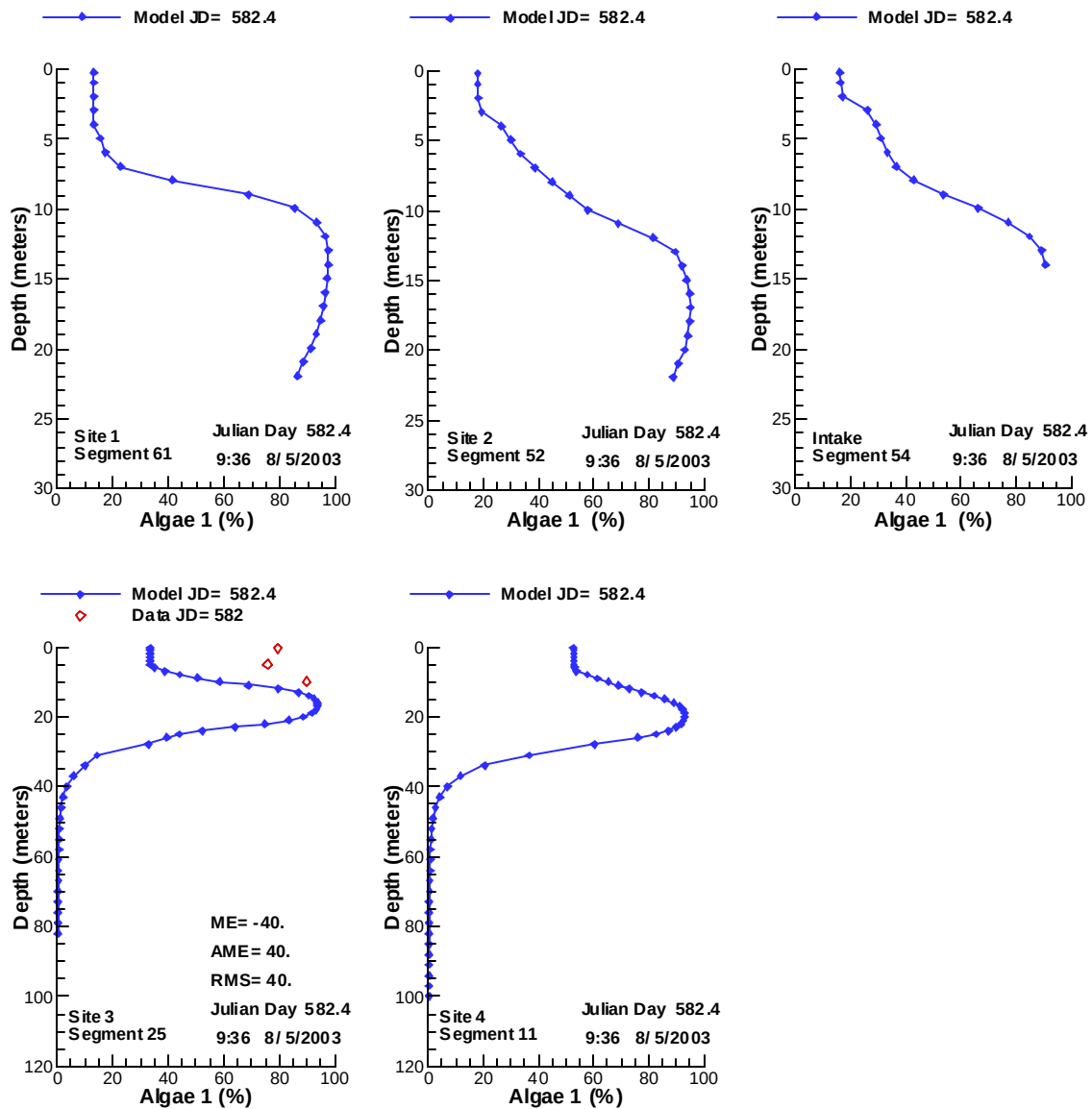


Figure 659. Vertical profiles of ALGAE 1 compared with data for 8/ 5/2003.

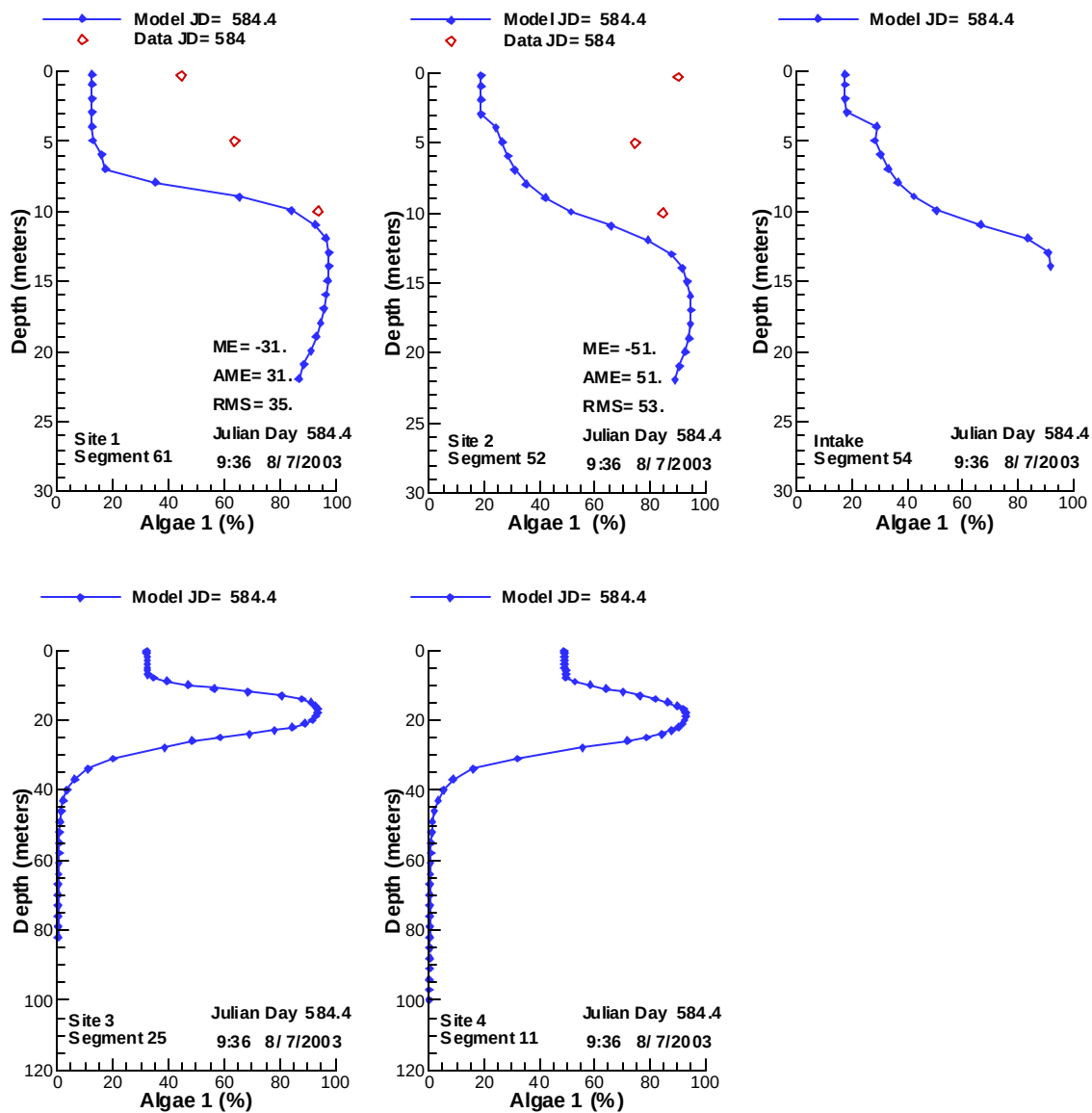


Figure 660. Vertical profiles of ALGAE 1 compared with data for 8/ 7/2003.

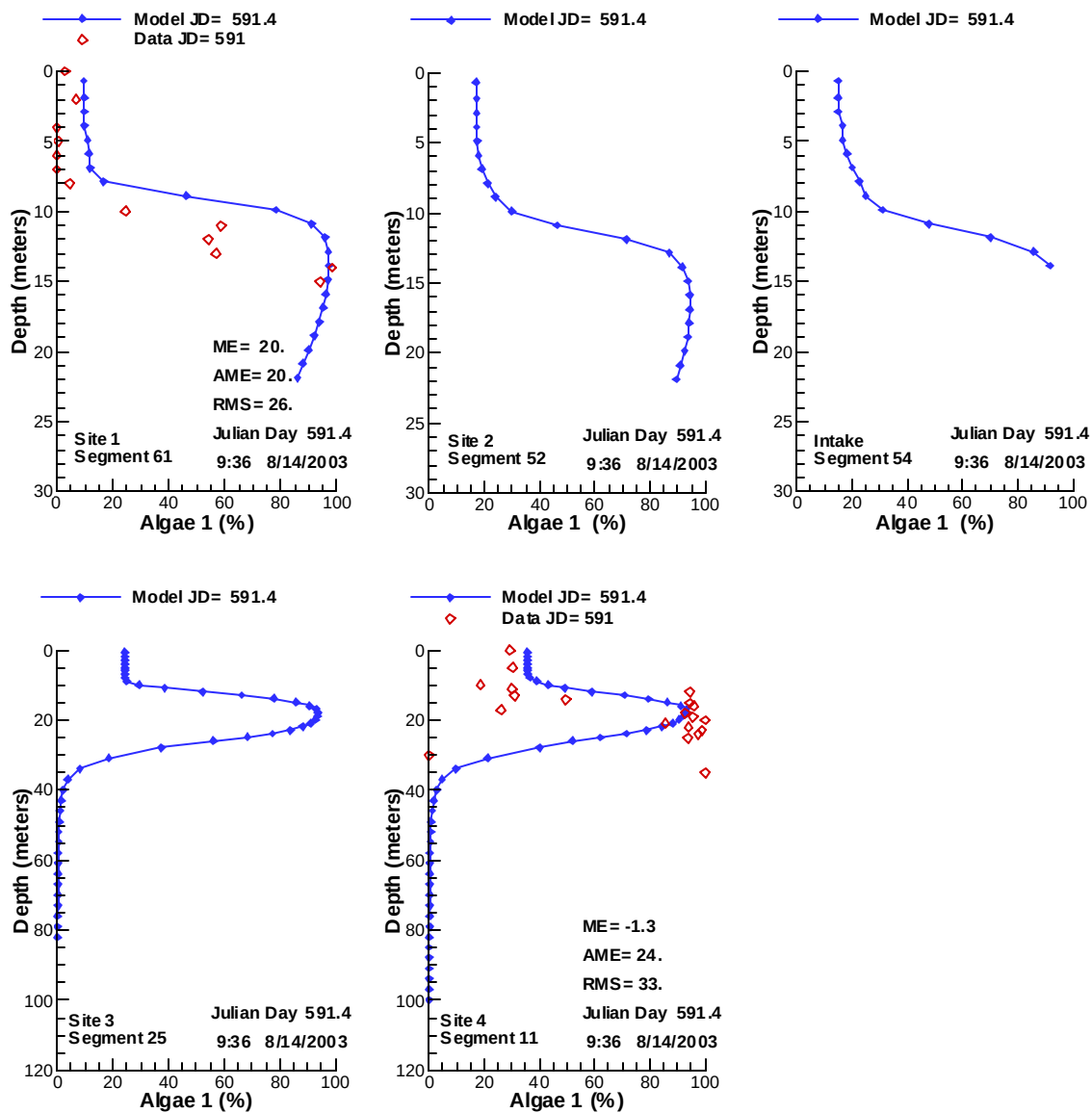


Figure 661. Vertical profiles of ALGAE 1 compared with data for 8/14/2003.

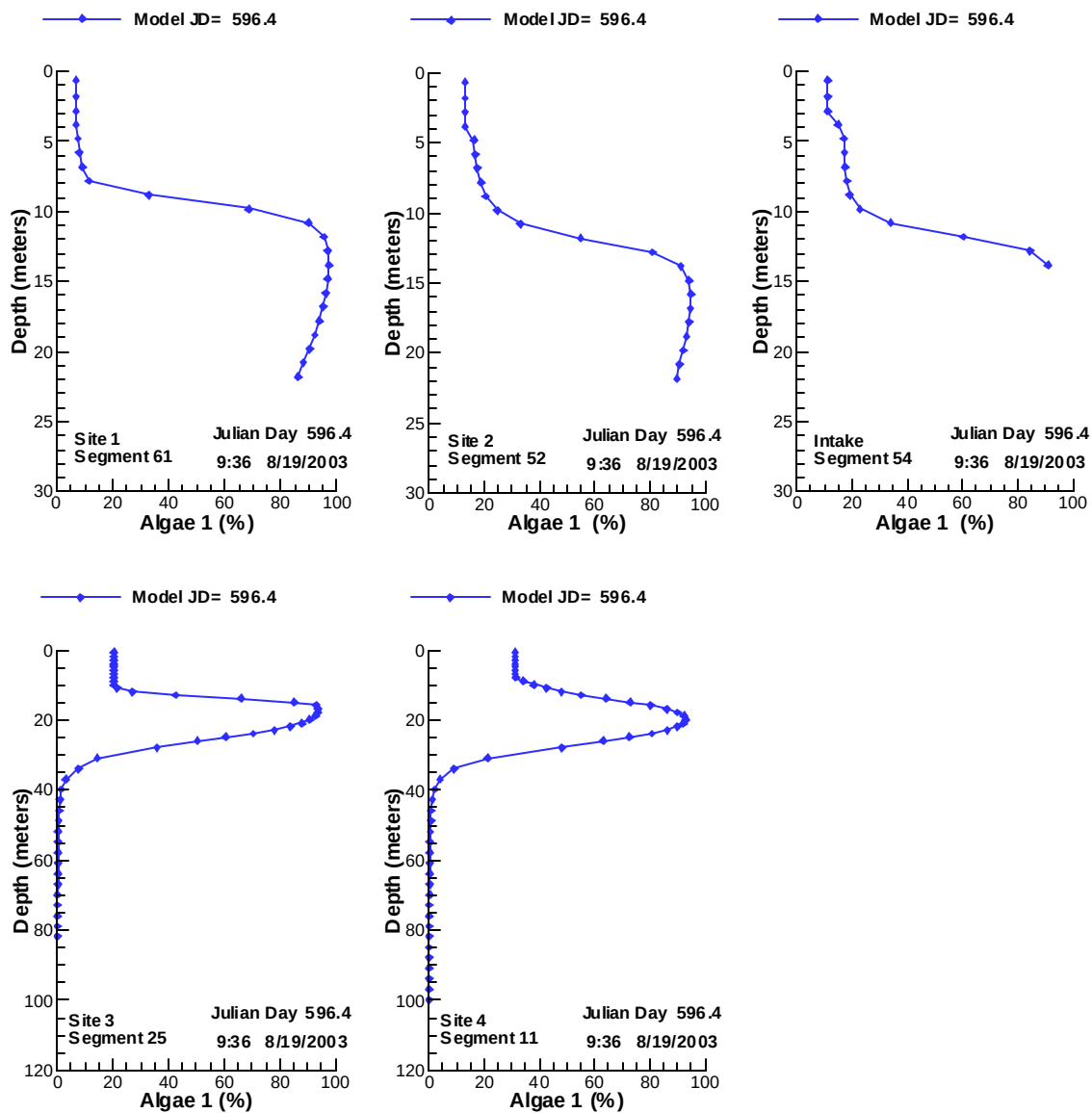


Figure 662. Vertical profiles of ALGAE 1 compared with data for 8/19/2003.

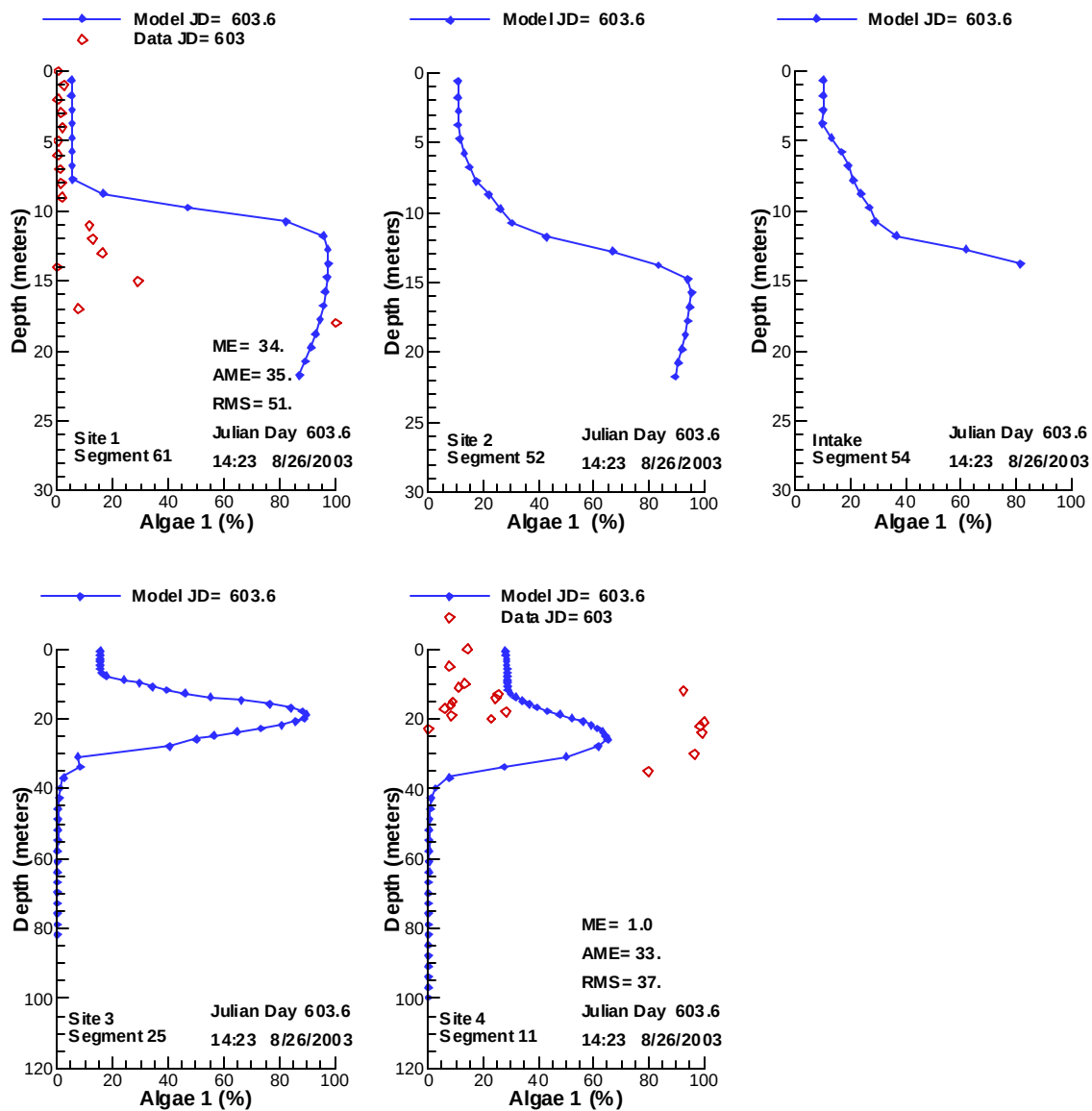


Figure 663. Vertical profiles of ALGAE 1 compared with data for 8/26/2003.

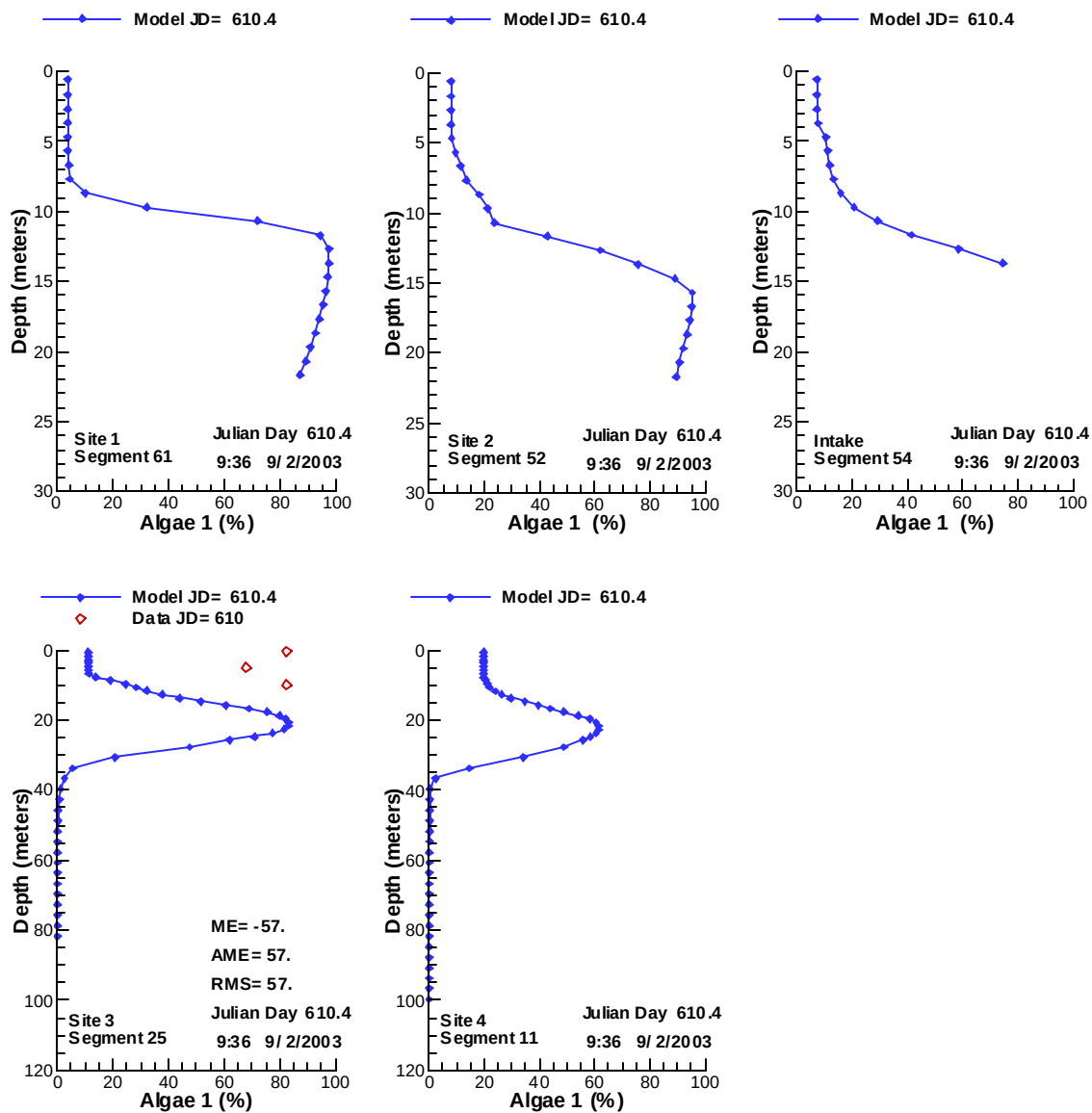


Figure 664. Vertical profiles of ALGAE 1 compared with data for 9/ 2/2003.

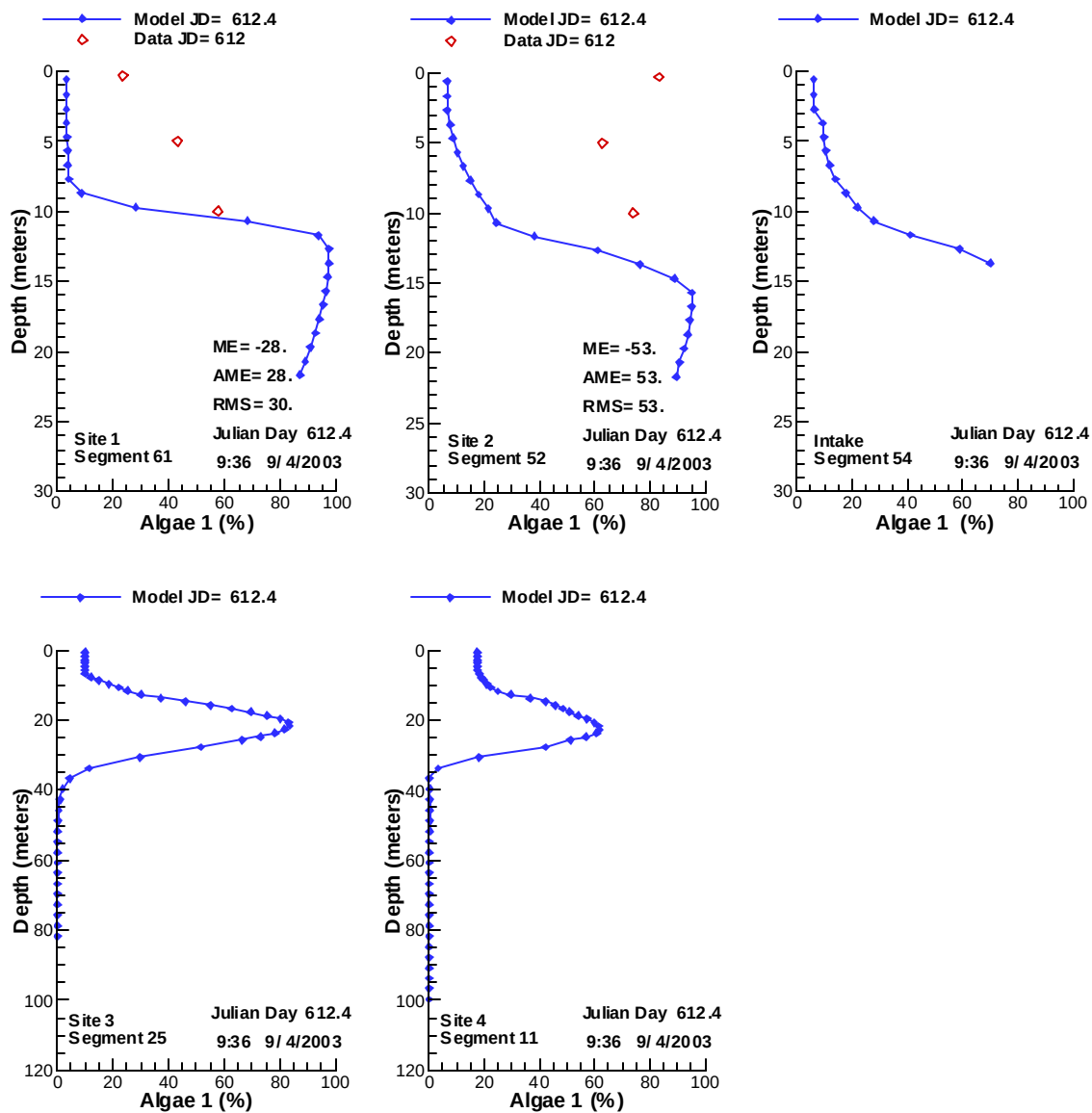


Figure 665. Vertical profiles of ALGAE 1 compared with data for 9/ 4/2003.

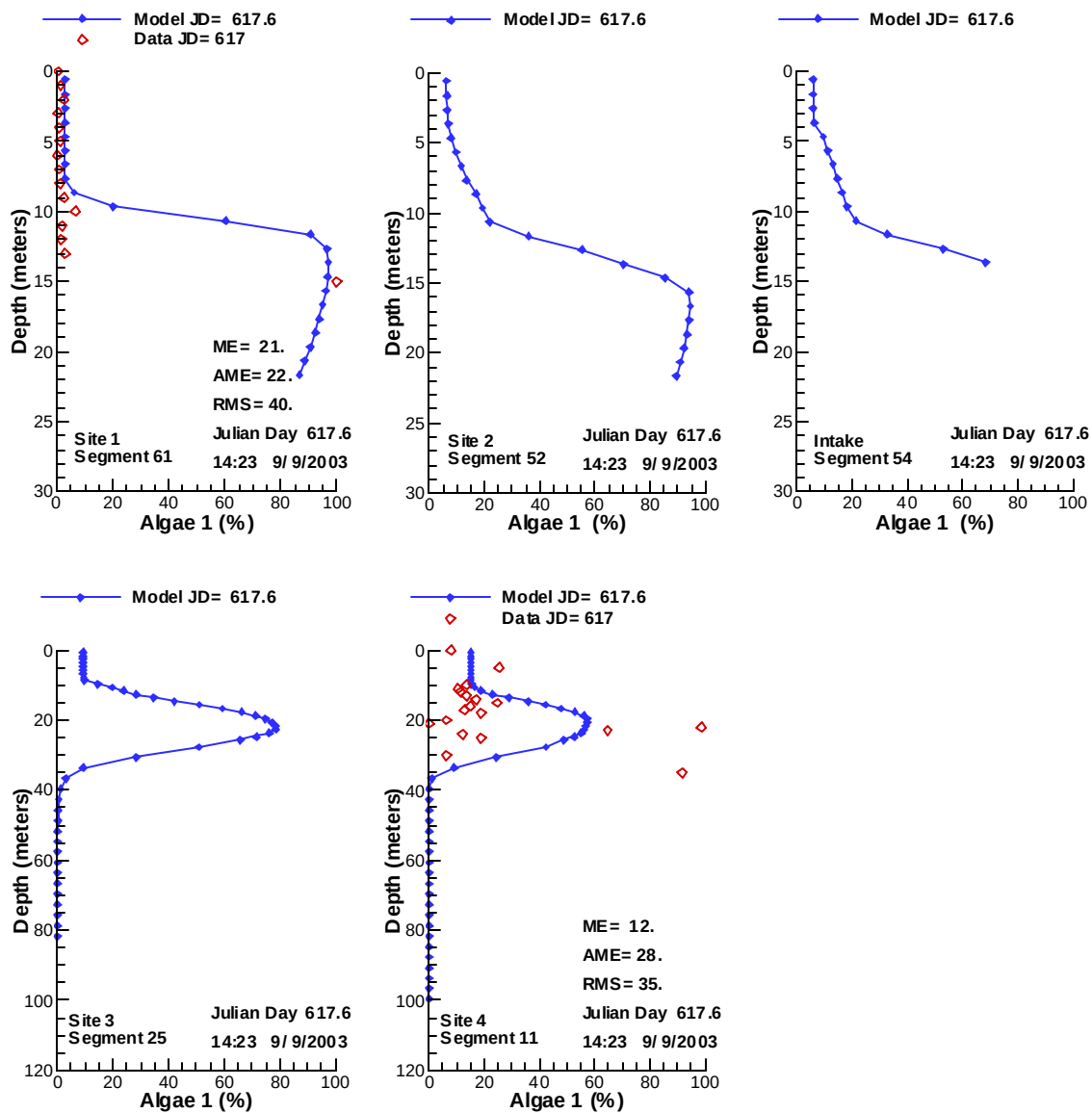


Figure 666. Vertical profiles of ALGAE 1 compared with data for 9/ 9/2003.

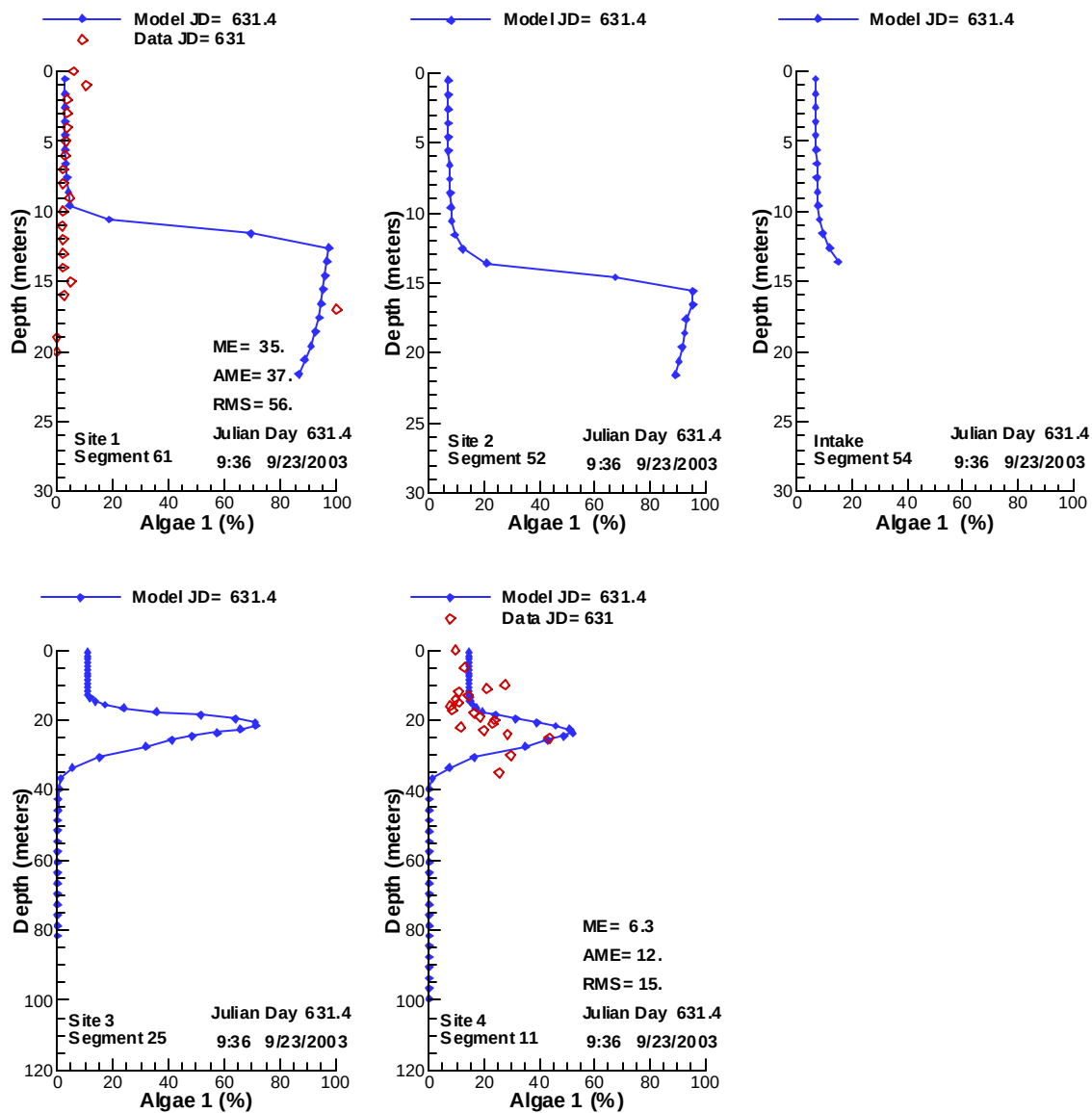


Figure 667. Vertical profiles of ALGAE 1 compared with data for 9/23/2003.

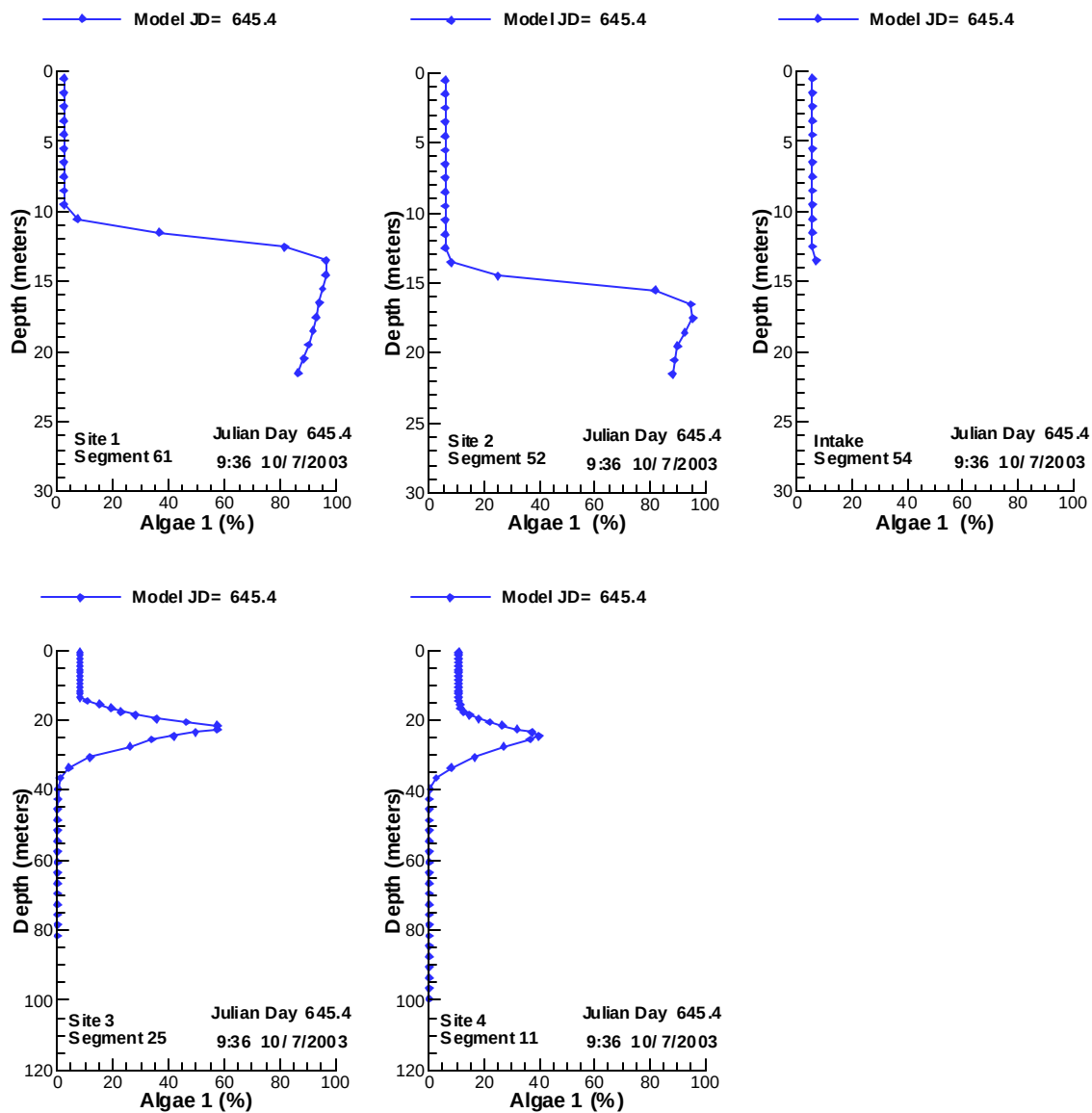


Figure 668. Vertical profiles of ALGAE 1 compared with data for 10/ 7/2003.

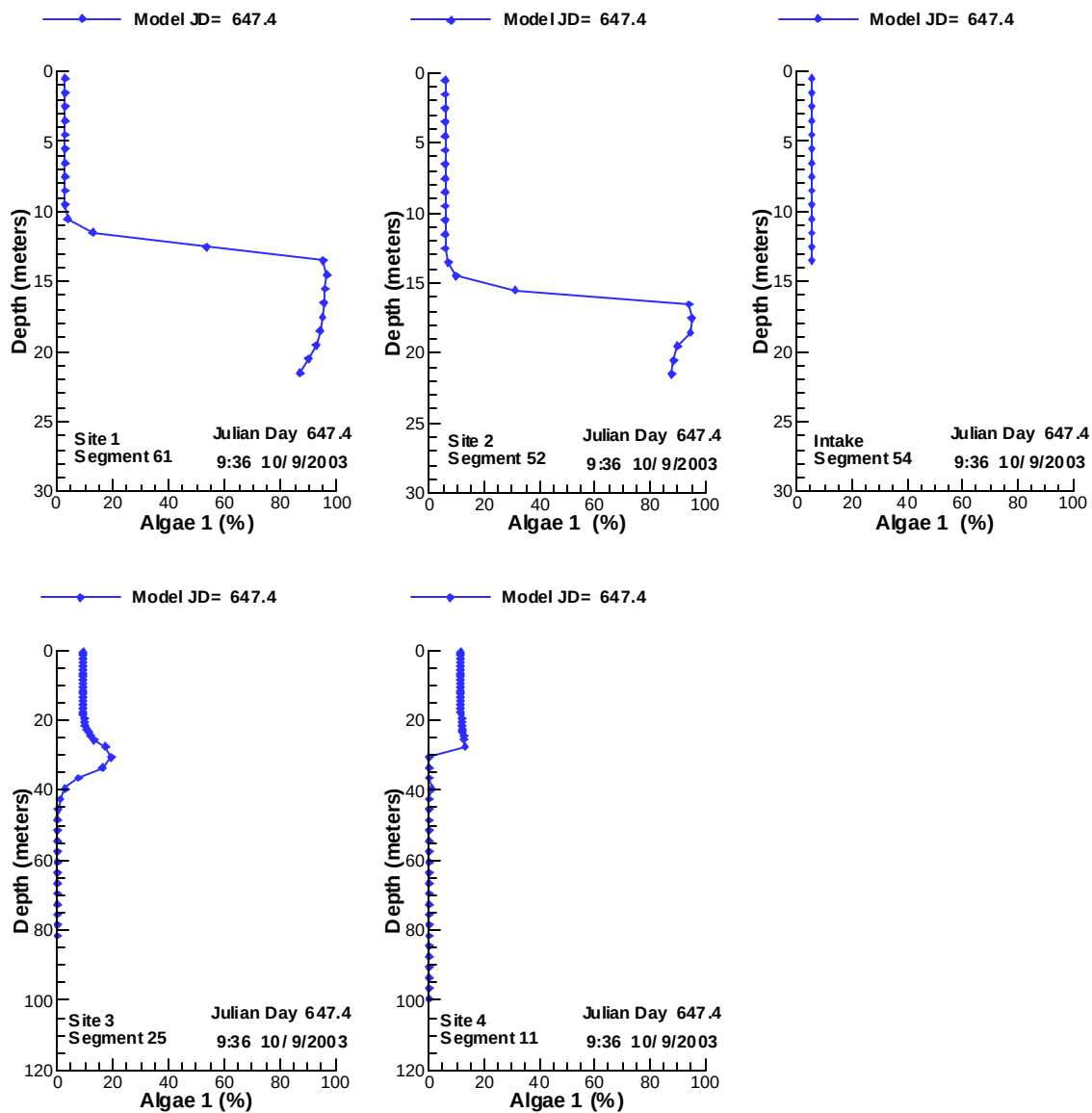


Figure 669. Vertical profiles of ALGAE 1 compared with data for 10/ 9/2003.

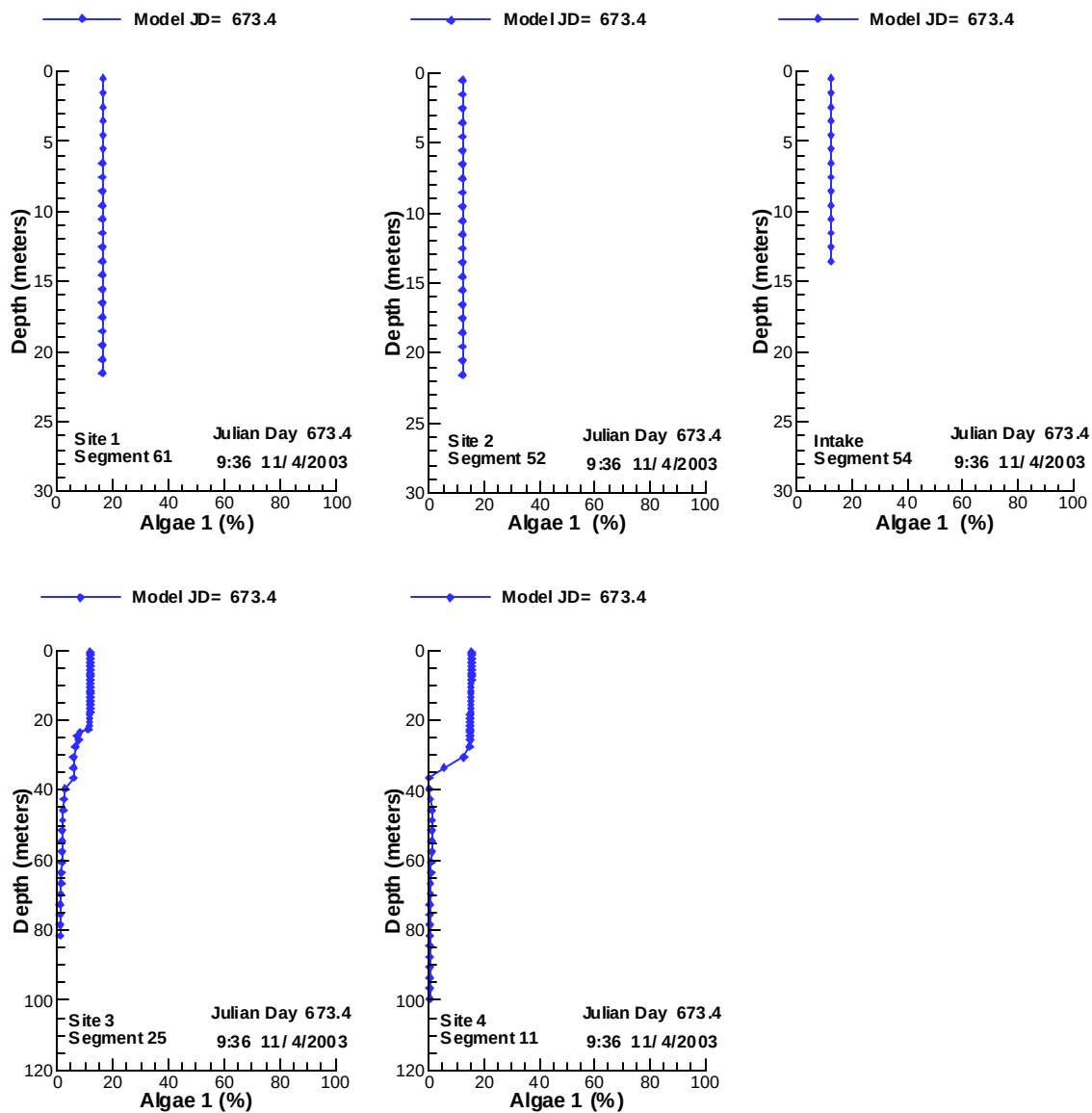


Figure 670. Vertical profiles of ALGAE 1 compared with data for 11/ 4/2003.

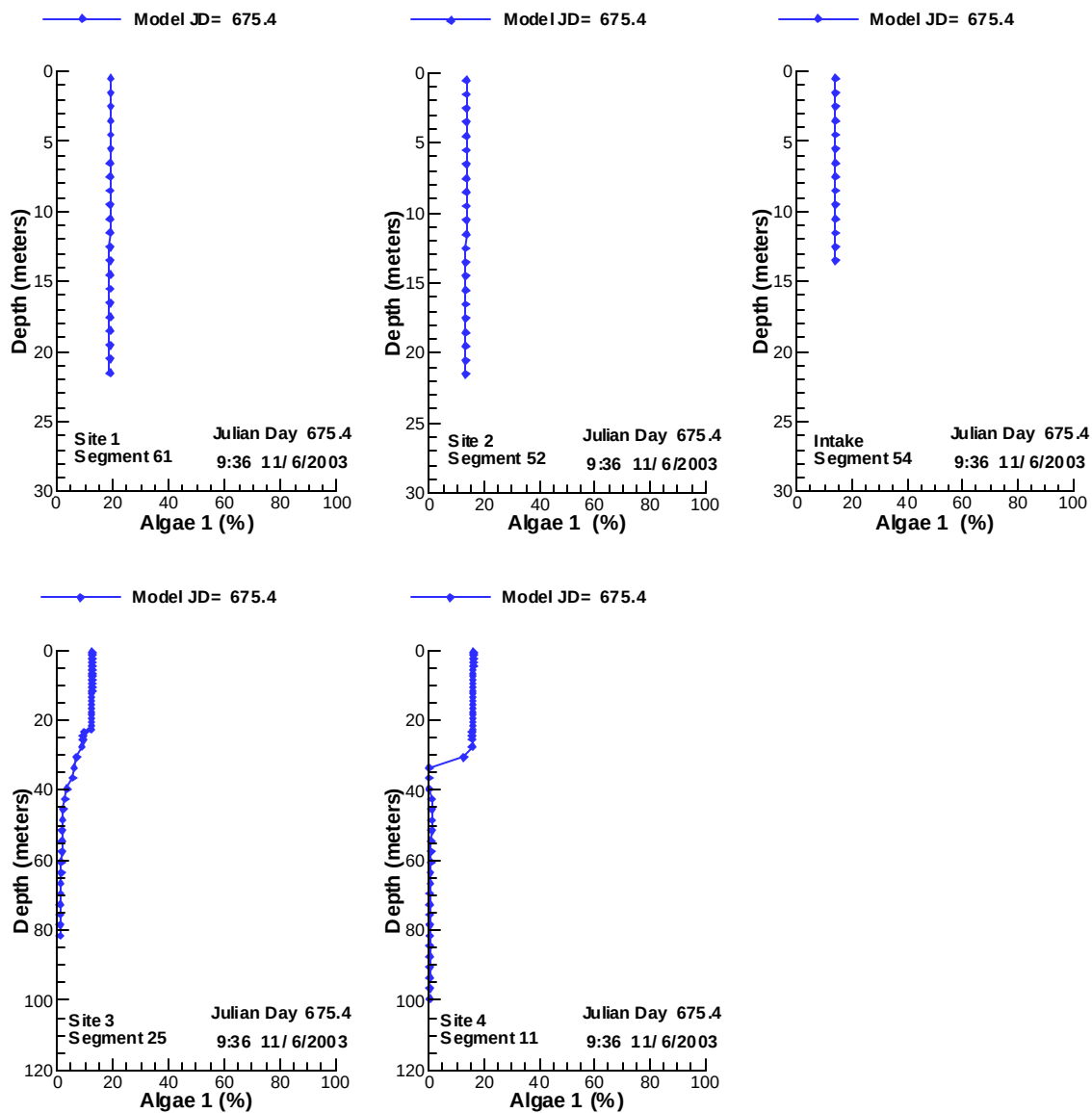


Figure 671. Vertical profiles of ALGAE 1 compared with data for 11/ 6/2003.

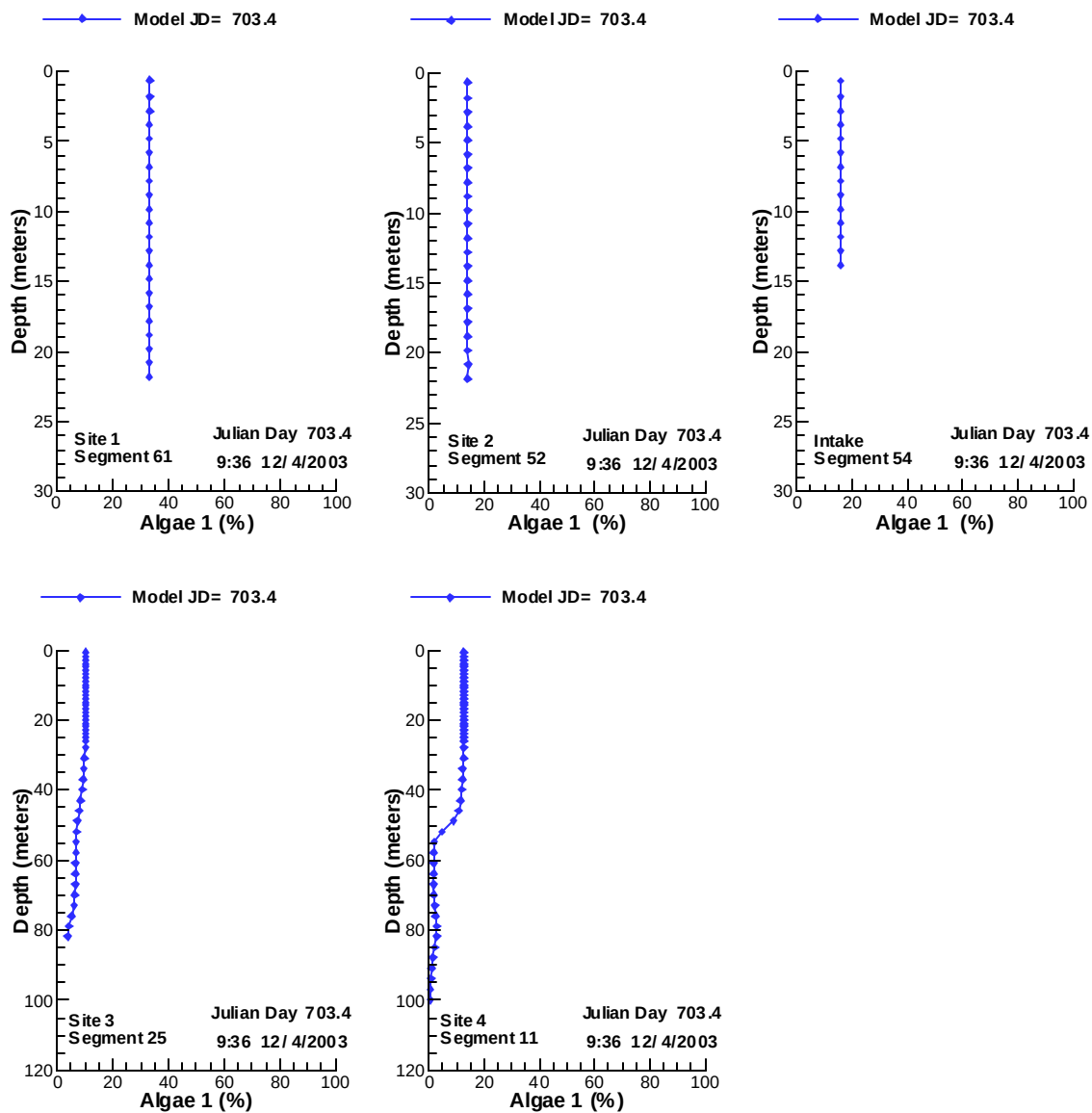


Figure 672. Vertical profiles of ALGAE 1 compared with data for 12/ 4/2003.

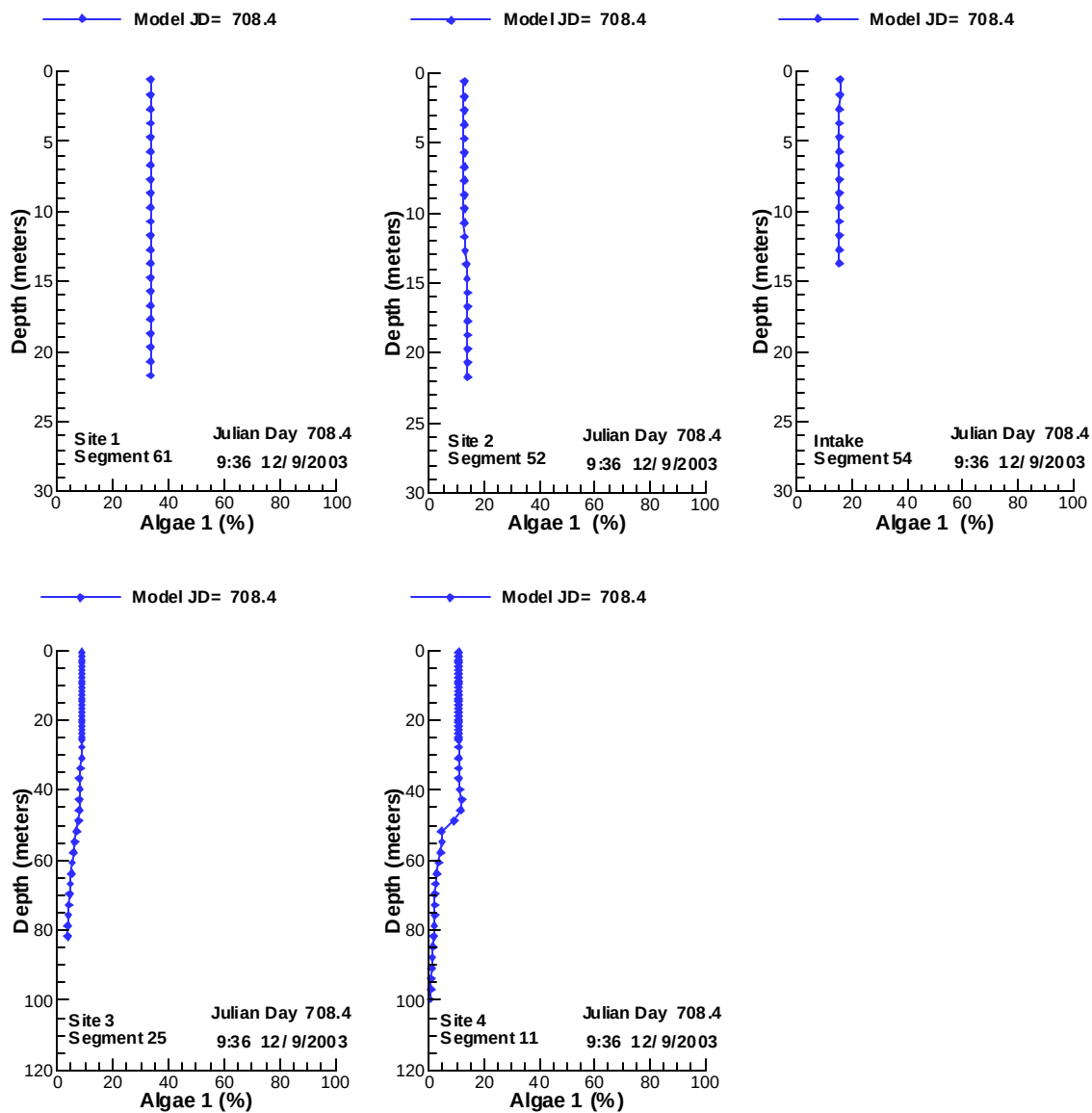


Figure 673. Vertical profiles of ALGAE 1 compared with data for 12/ 9/2003.

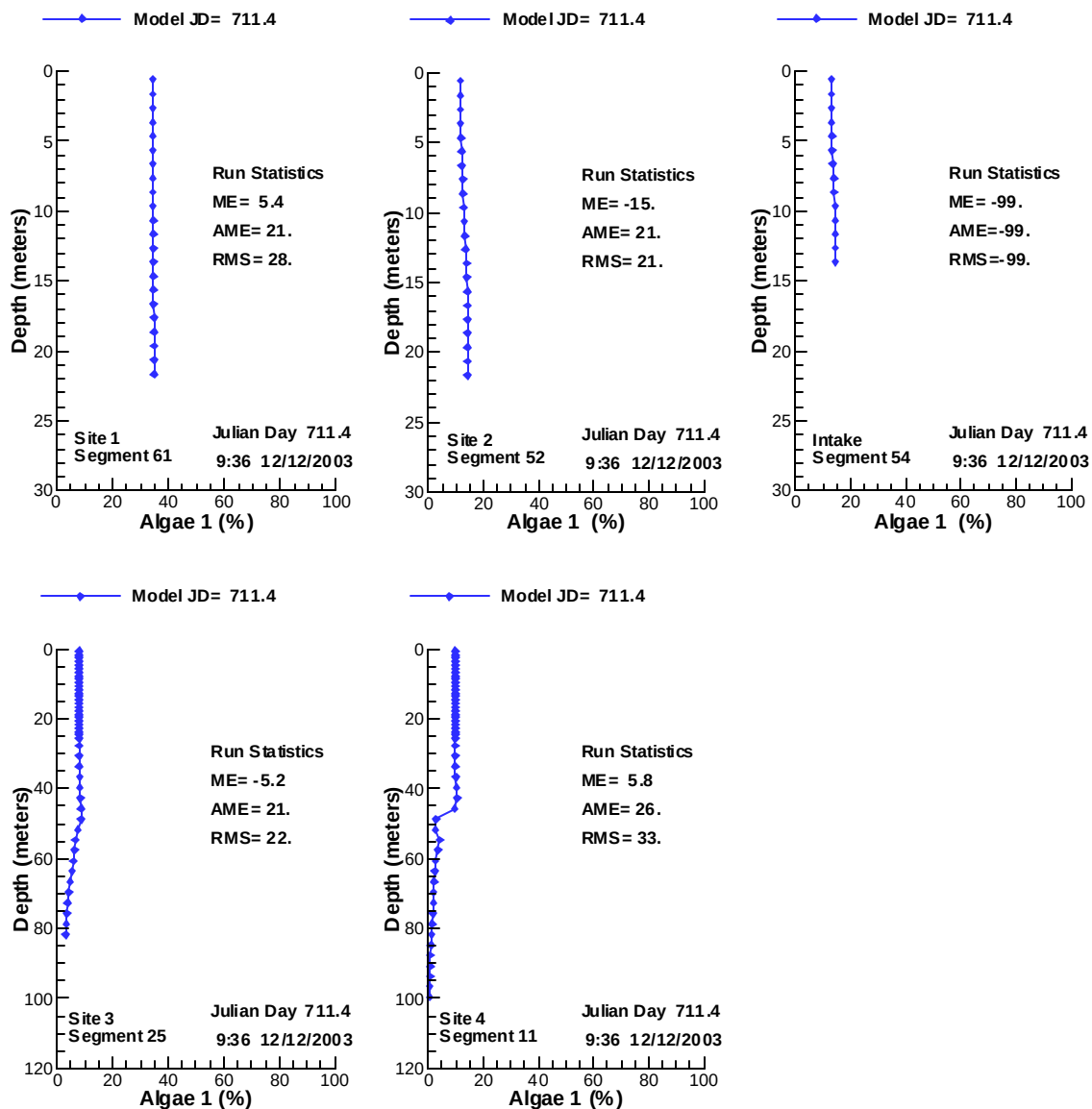


Figure 674. Vertical profiles of ALGAE 1 compared with data for 12/12/2003.

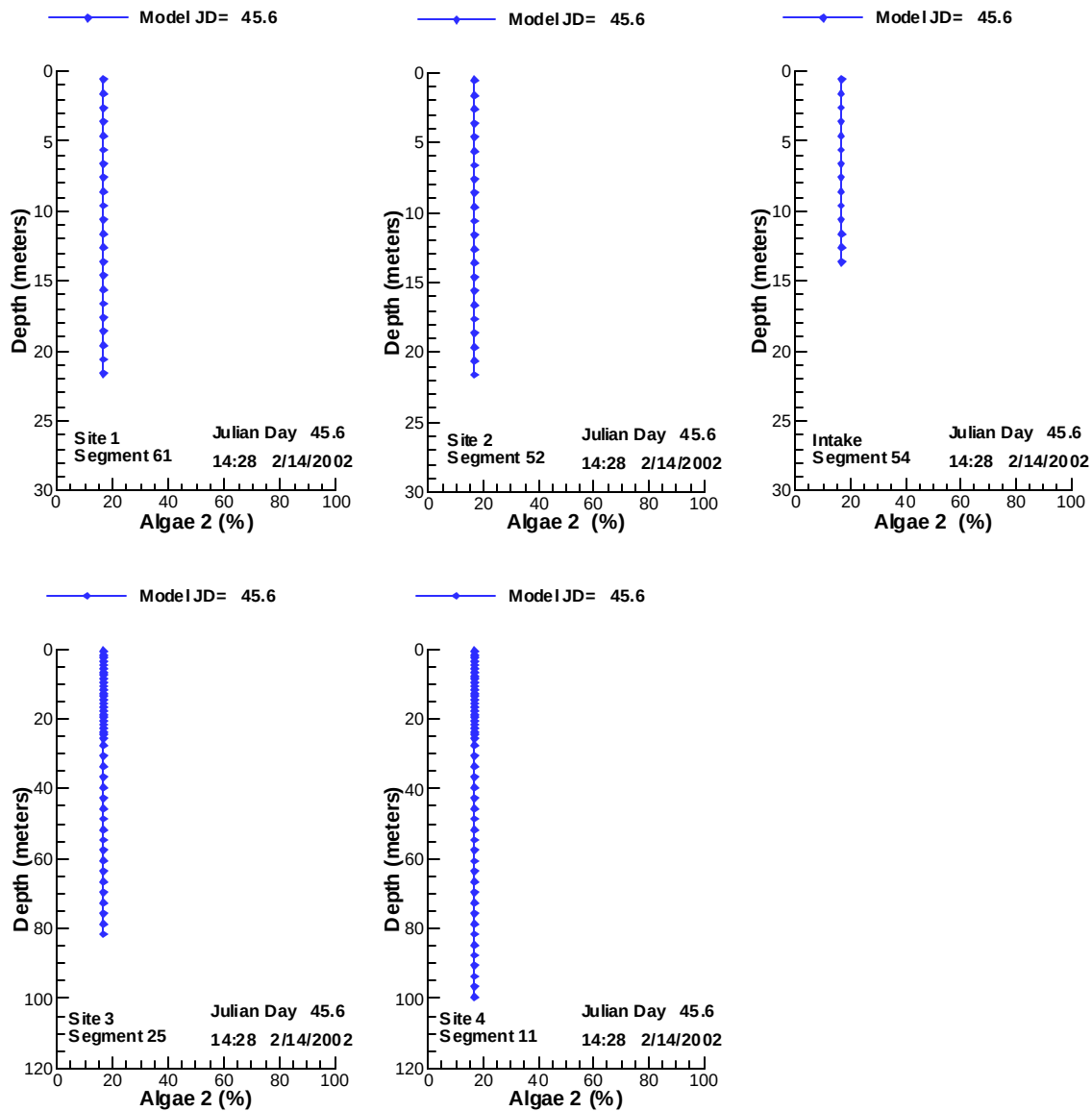


Figure 675. Vertical profiles of ALGAE 2 compared with data for 2/14/2002.

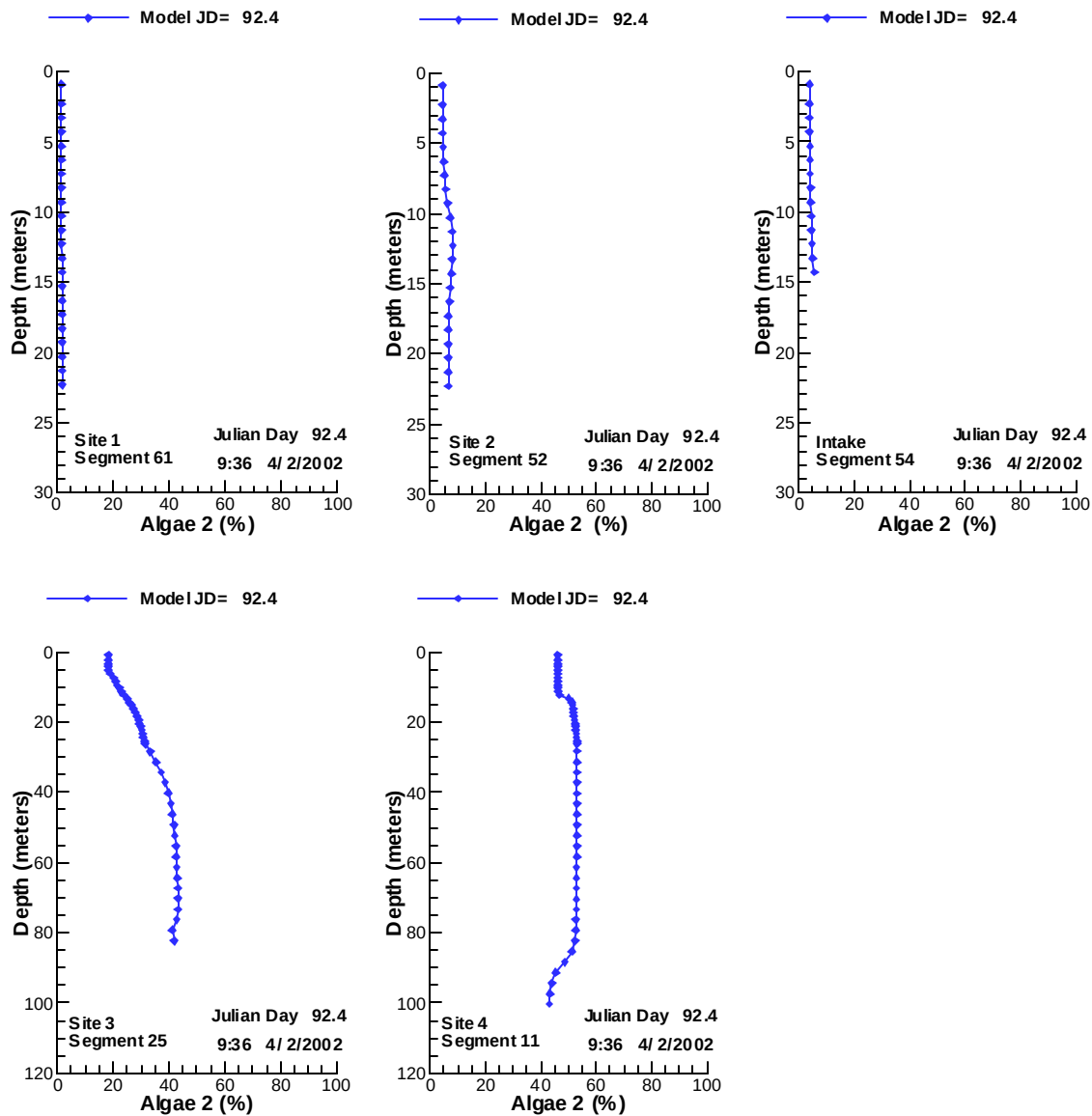


Figure 676. Vertical profiles of ALGAE 2 compared with data for 4/ 2/2002.

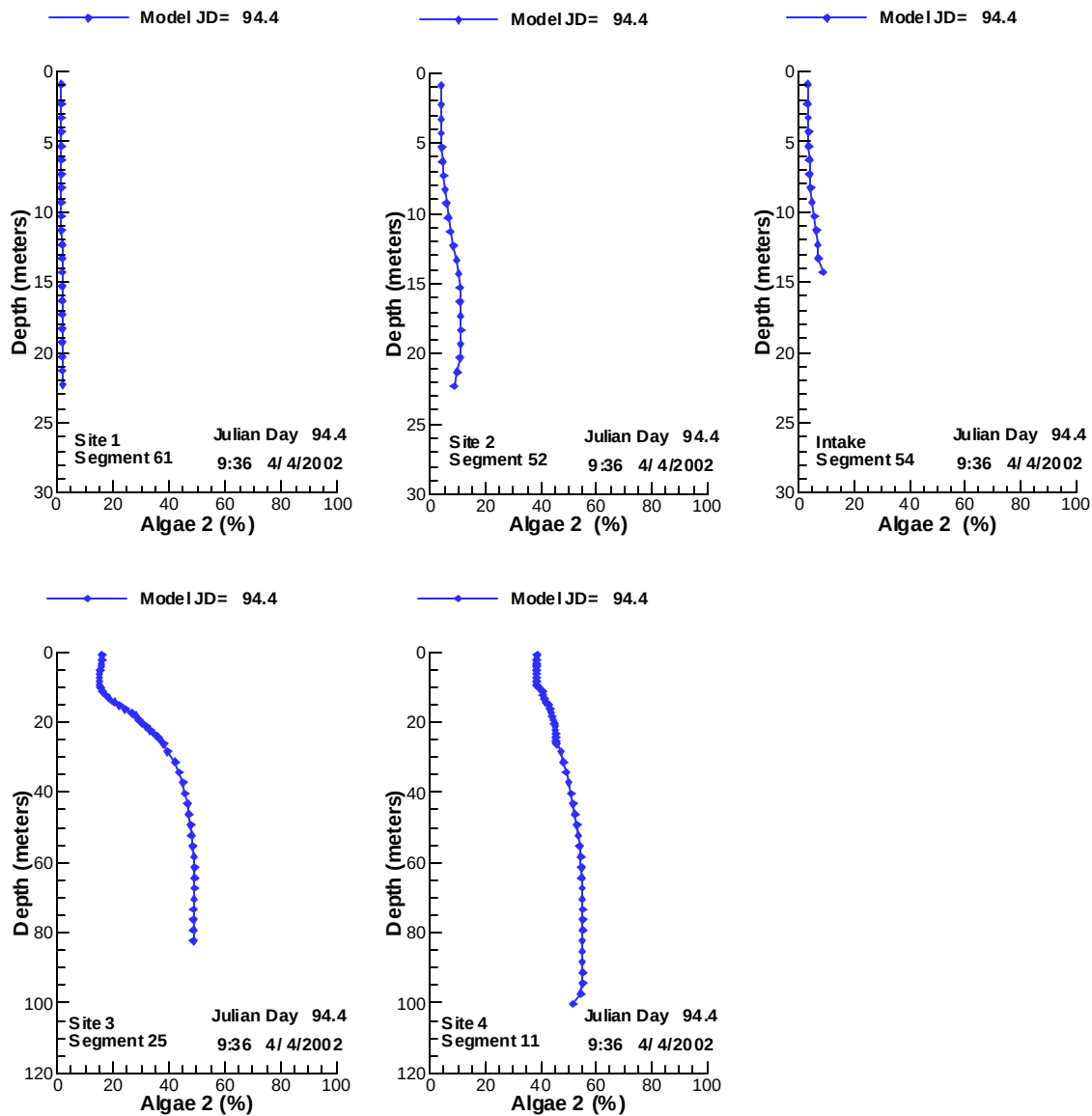


Figure 677. Vertical profiles of ALGAE 2 compared with data for 4/ 4/2002.

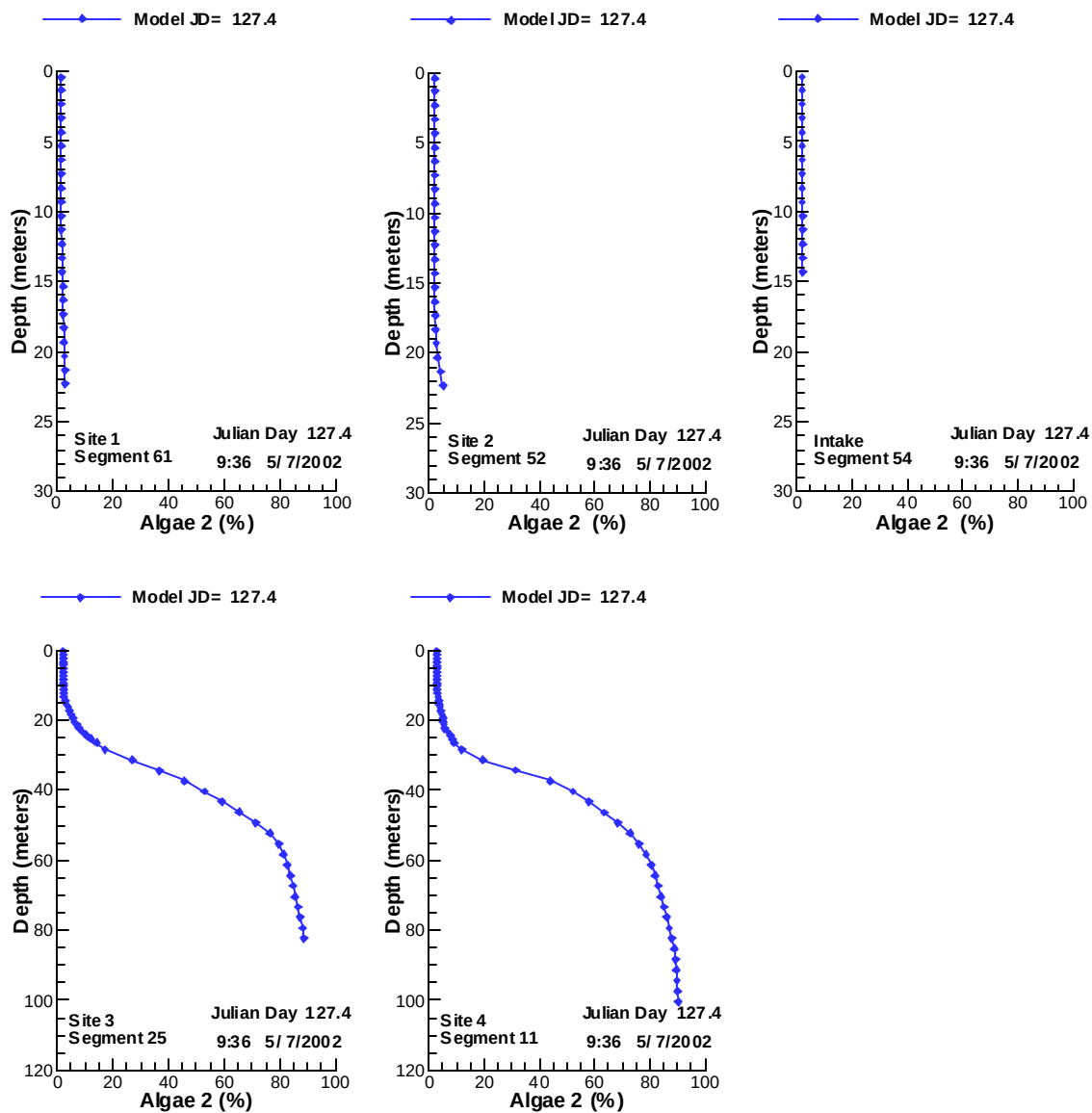


Figure 678. Vertical profiles of ALGAE 2 compared with data for 5/ 7/2002.

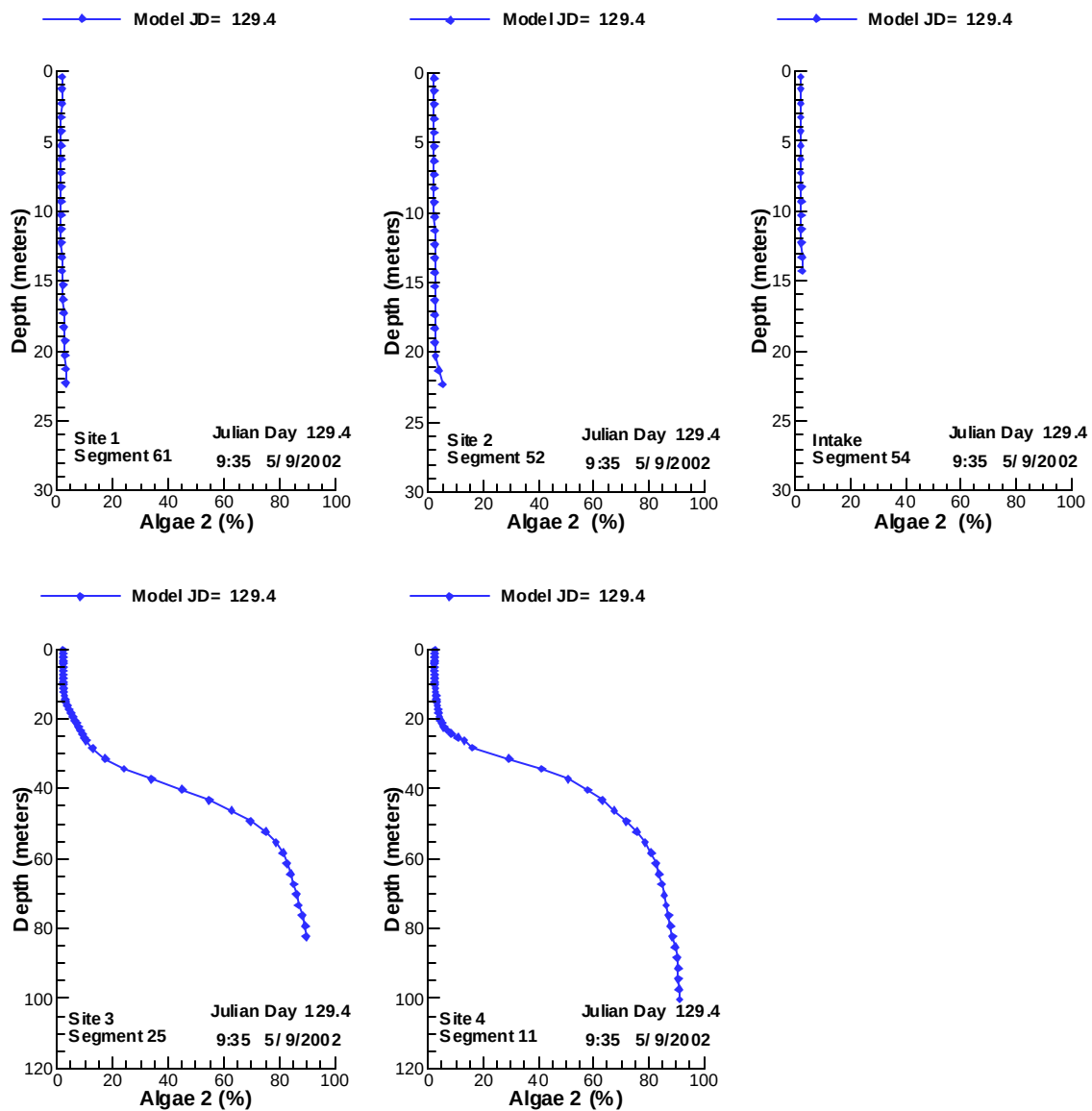


Figure 679. Vertical profiles of ALGAE 2 compared with data for 5/ 9/2002.

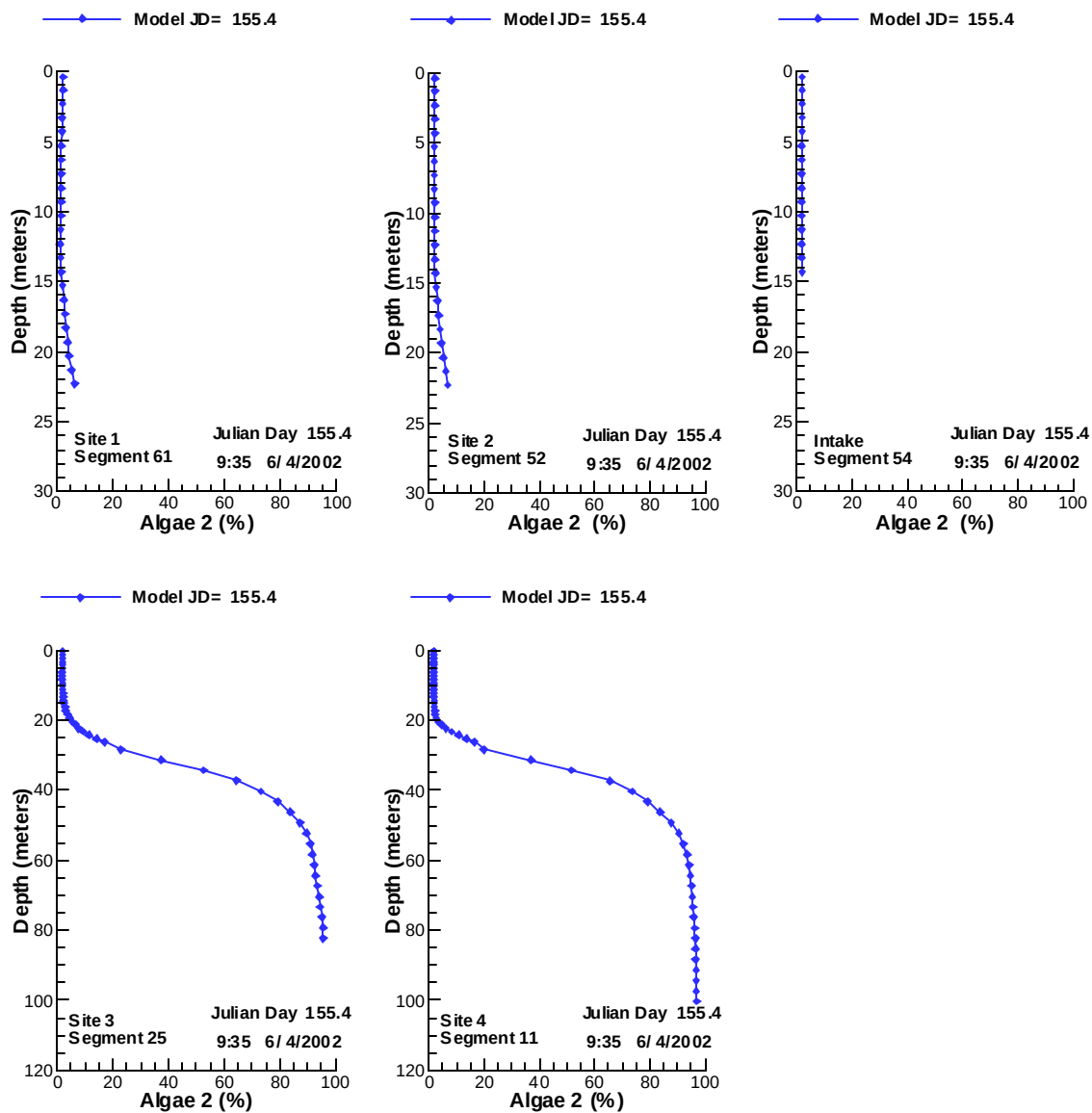


Figure 680. Vertical profiles of ALGAE 2 compared with data for 6/ 4/2002.

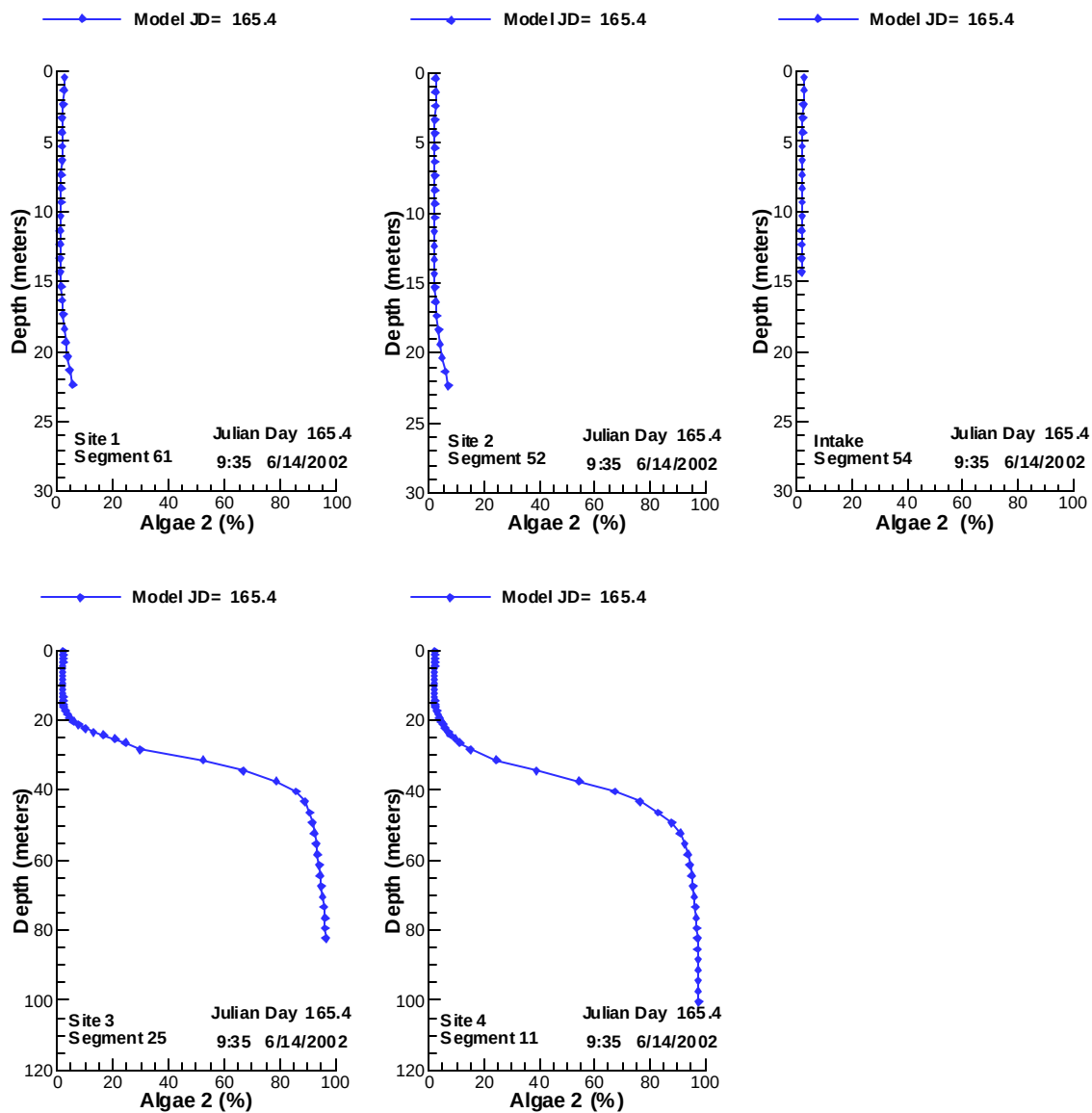


Figure 681. Vertical profiles of ALGAE 2 compared with data for 6/14/2002.

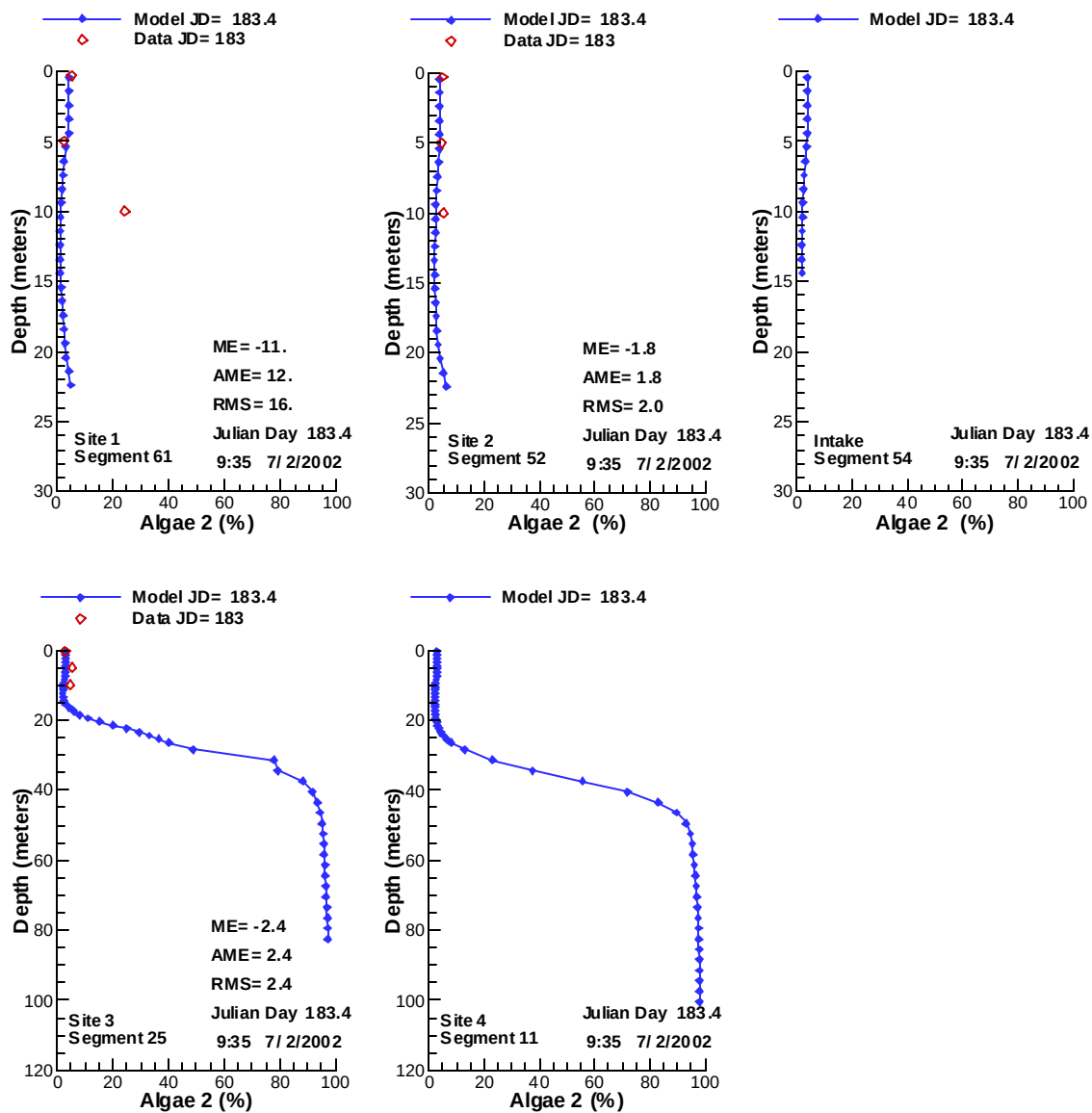


Figure 682. Vertical profiles of ALGAE 2 compared with data for 7/ 2/2002.

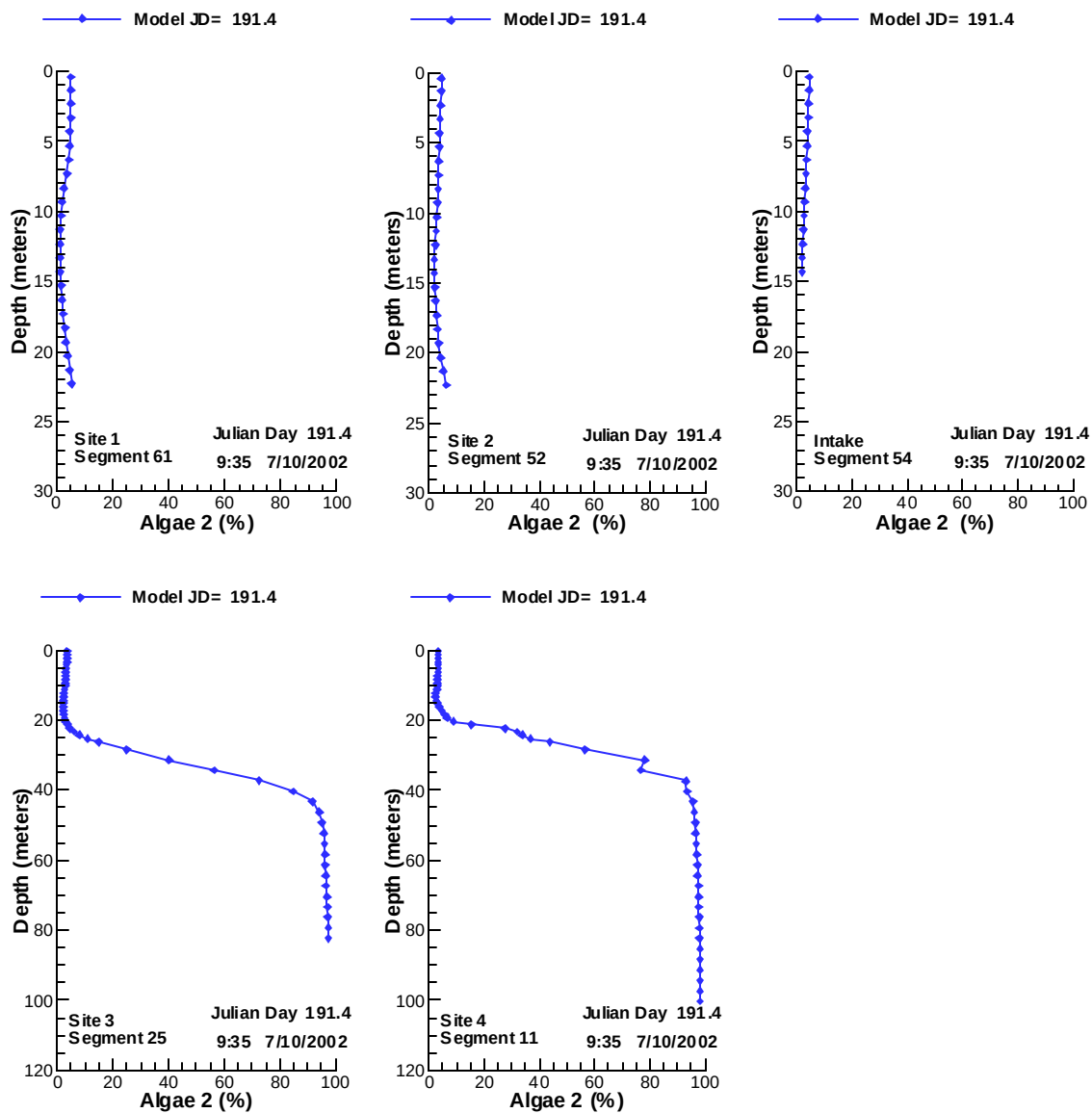


Figure 683. Vertical profiles of ALGAE 2 compared with data for 7/10/2002.

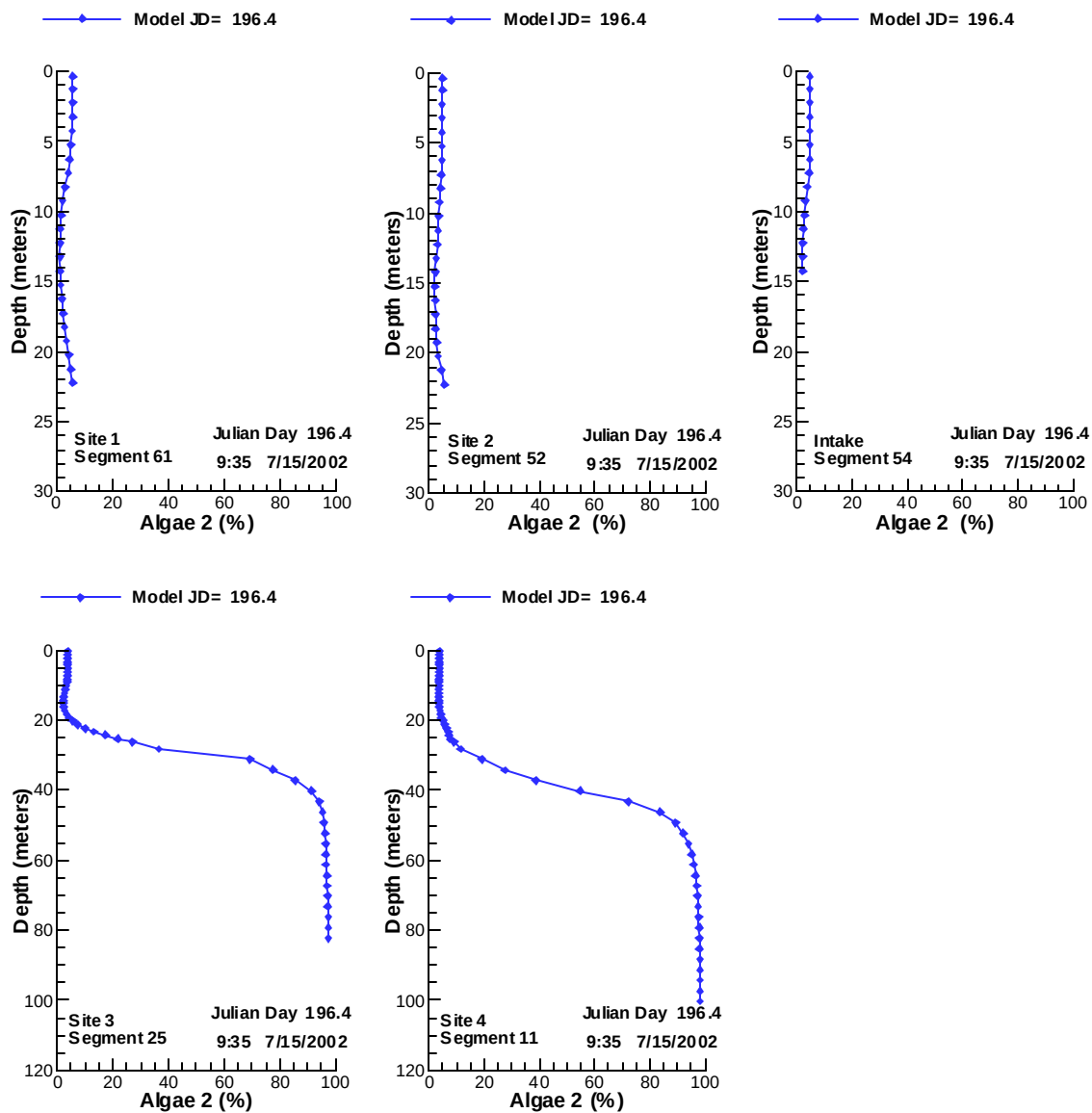


Figure 684. Vertical profiles of ALGAE 2 compared with data for 7/15/2002.

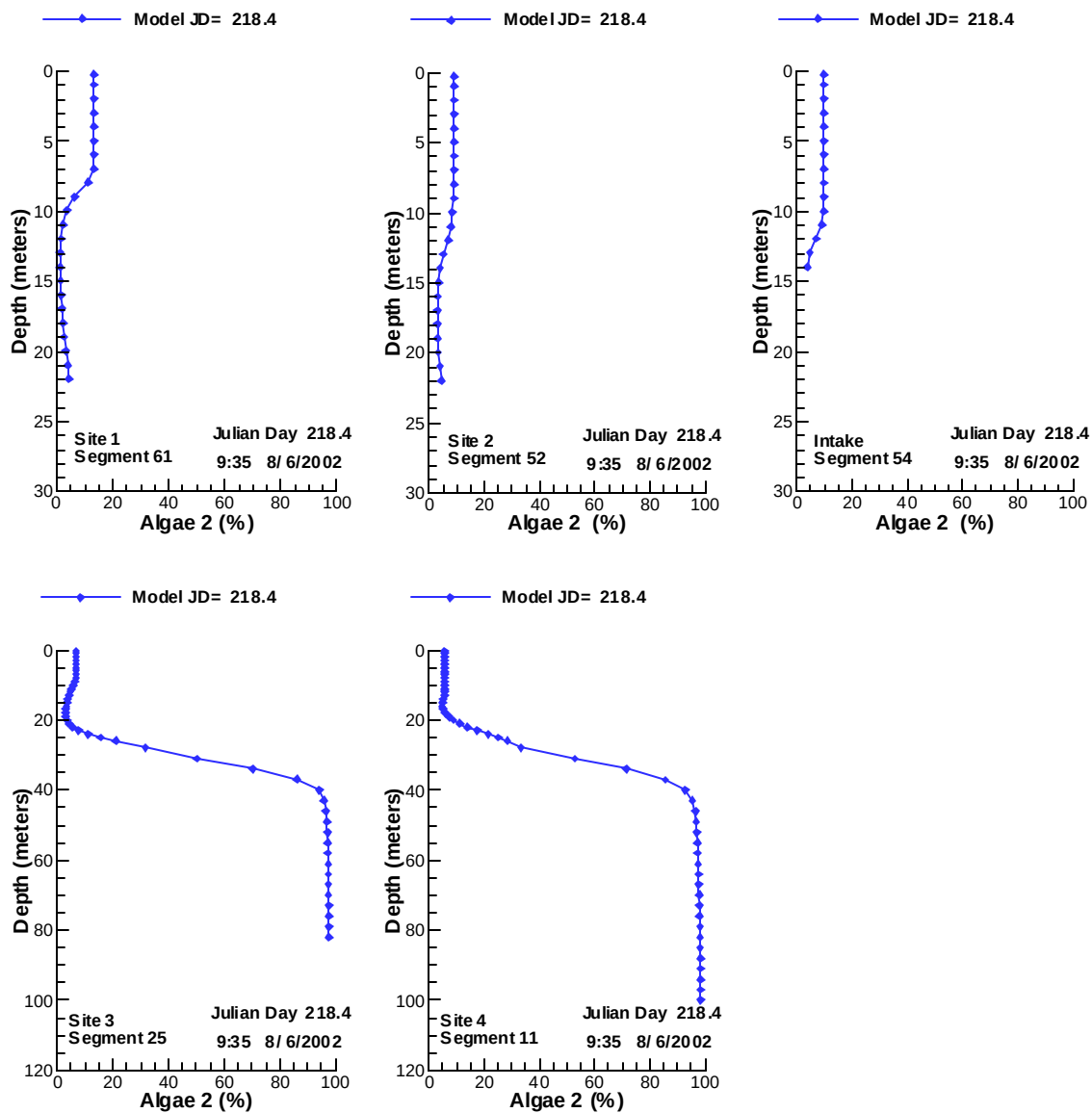


Figure 685. Vertical profiles of ALGAE 2 compared with data for 8/ 6/2002.

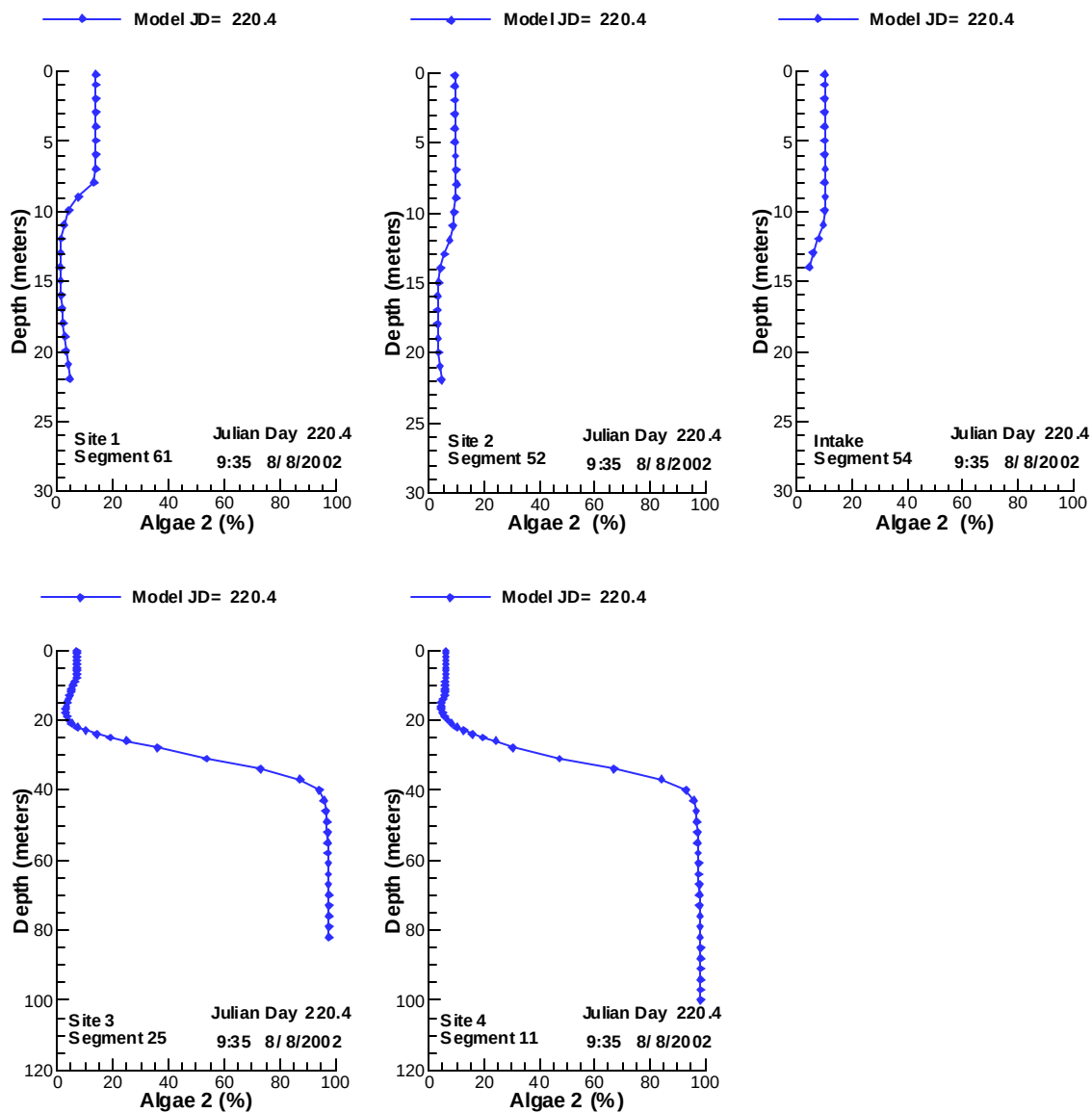


Figure 686. Vertical profiles of ALGAE 2 compared with data for 8/ 8/2002.

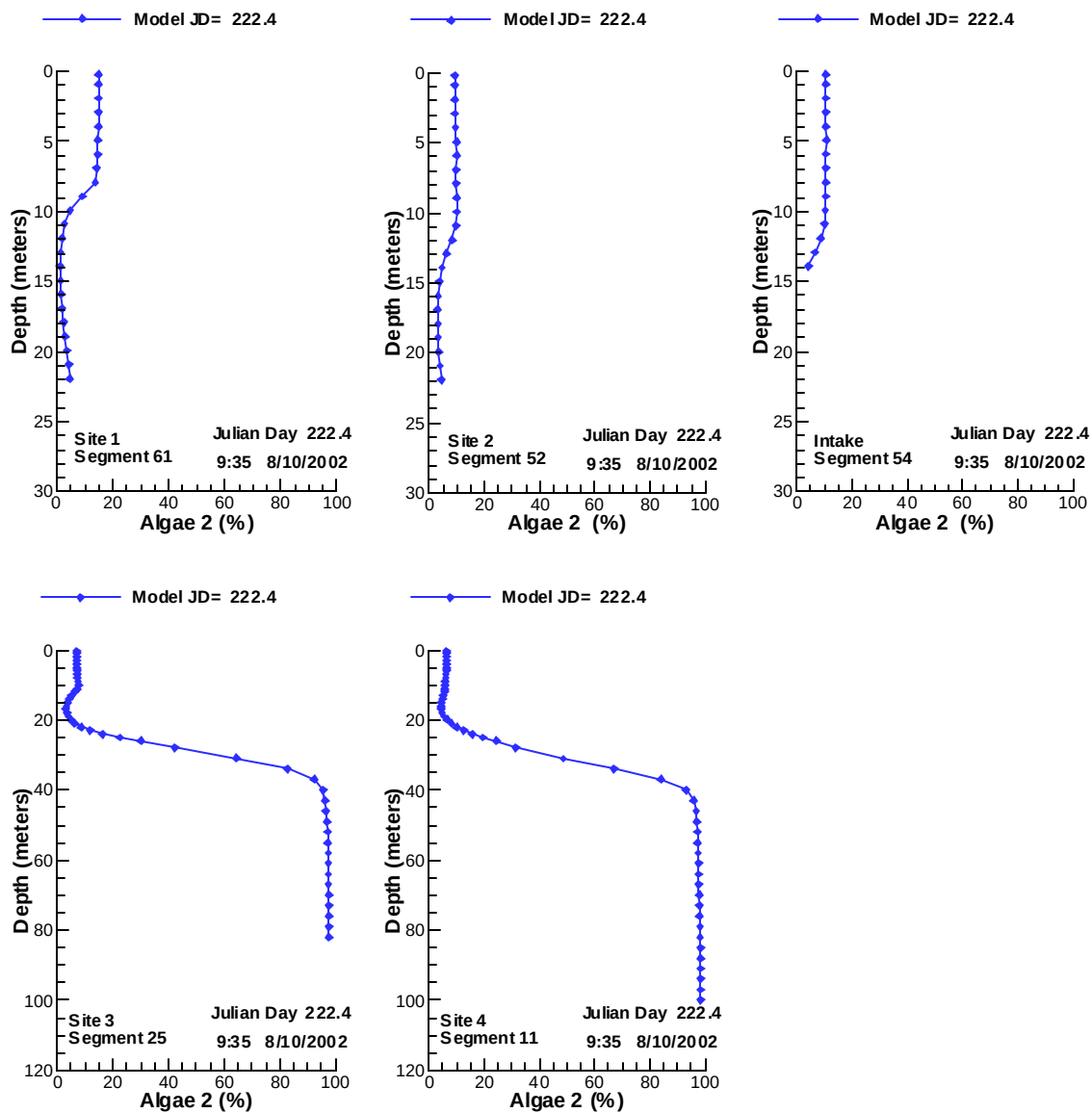


Figure 687. Vertical profiles of ALGAE 2 compared with data for 8/10/2002.

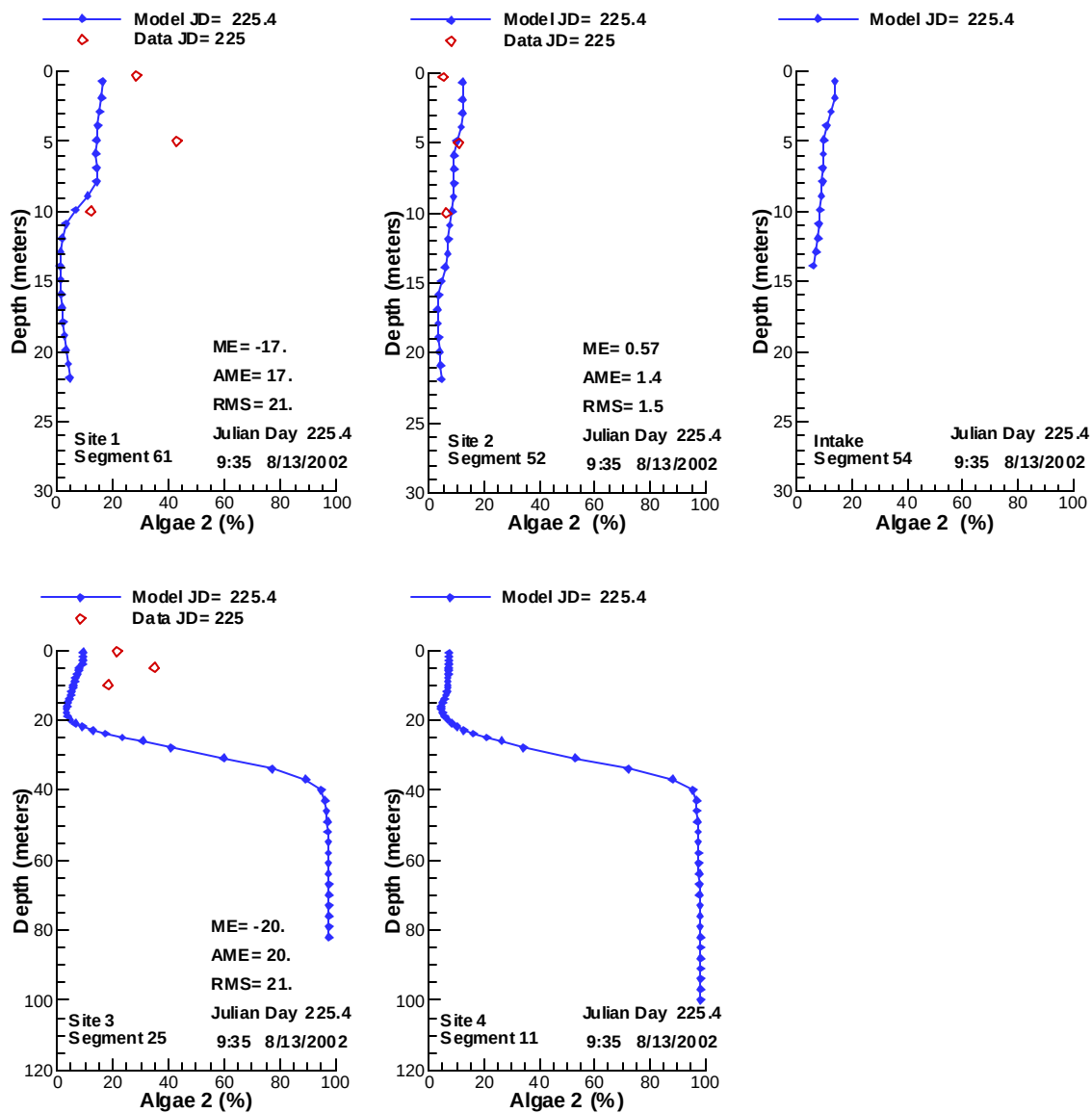


Figure 688. Vertical profiles of ALGAE 2 compared with data for 8/13/2002.

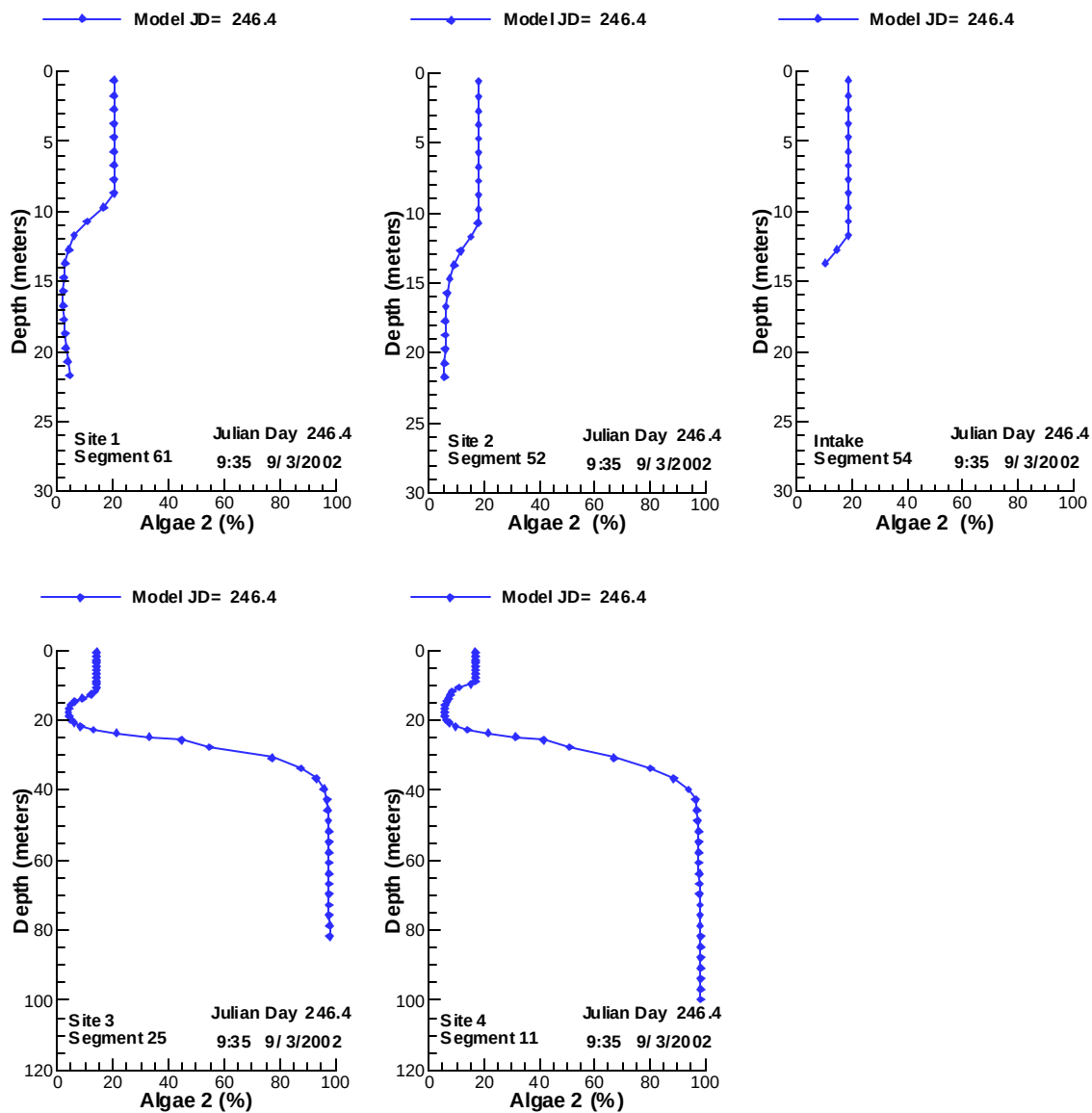


Figure 689. Vertical profiles of ALGAE 2 compared with data for 9/ 3/2002.

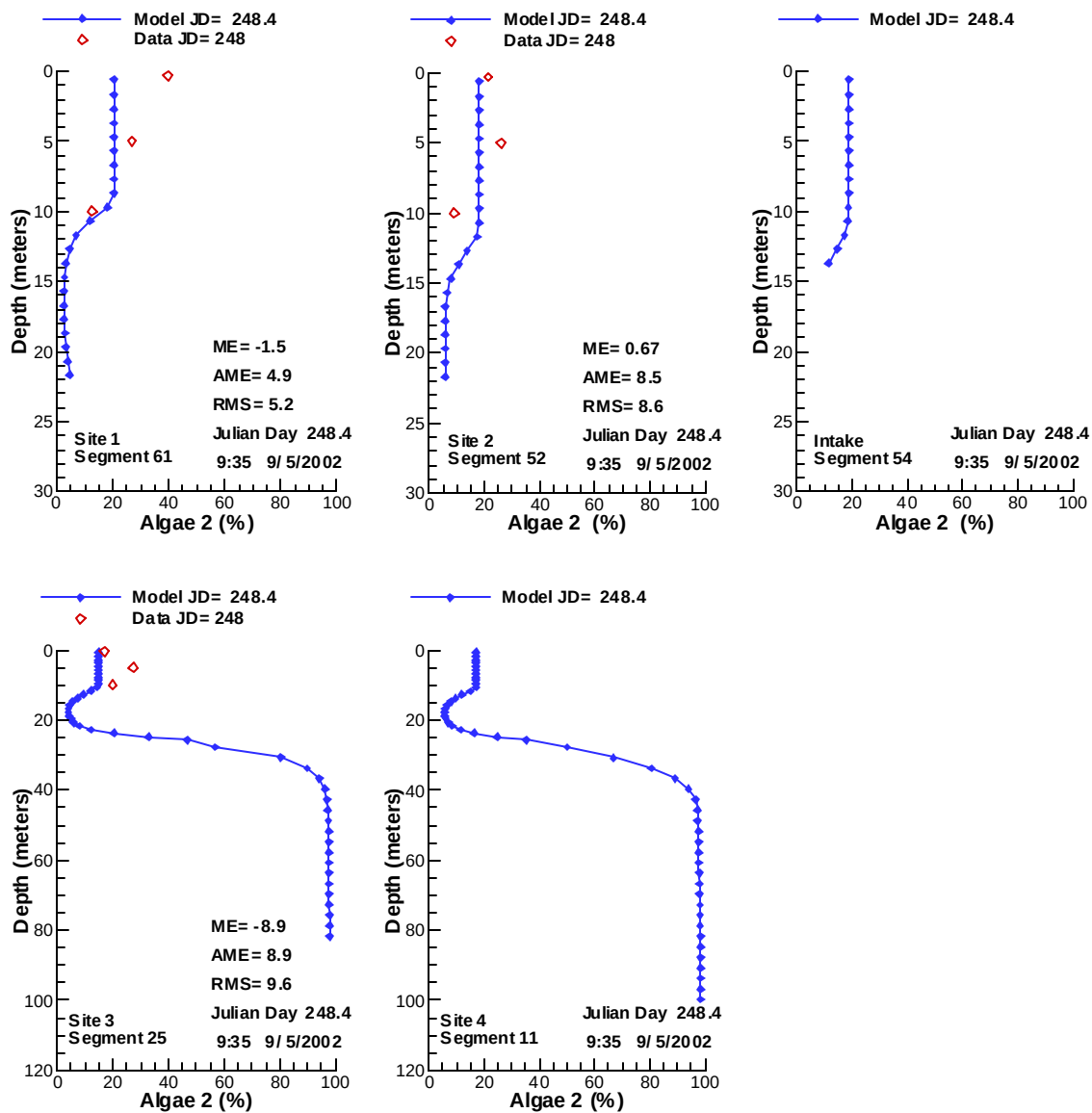


Figure 690. Vertical profiles of ALGAE 2 compared with data for 9/ 5/2002.

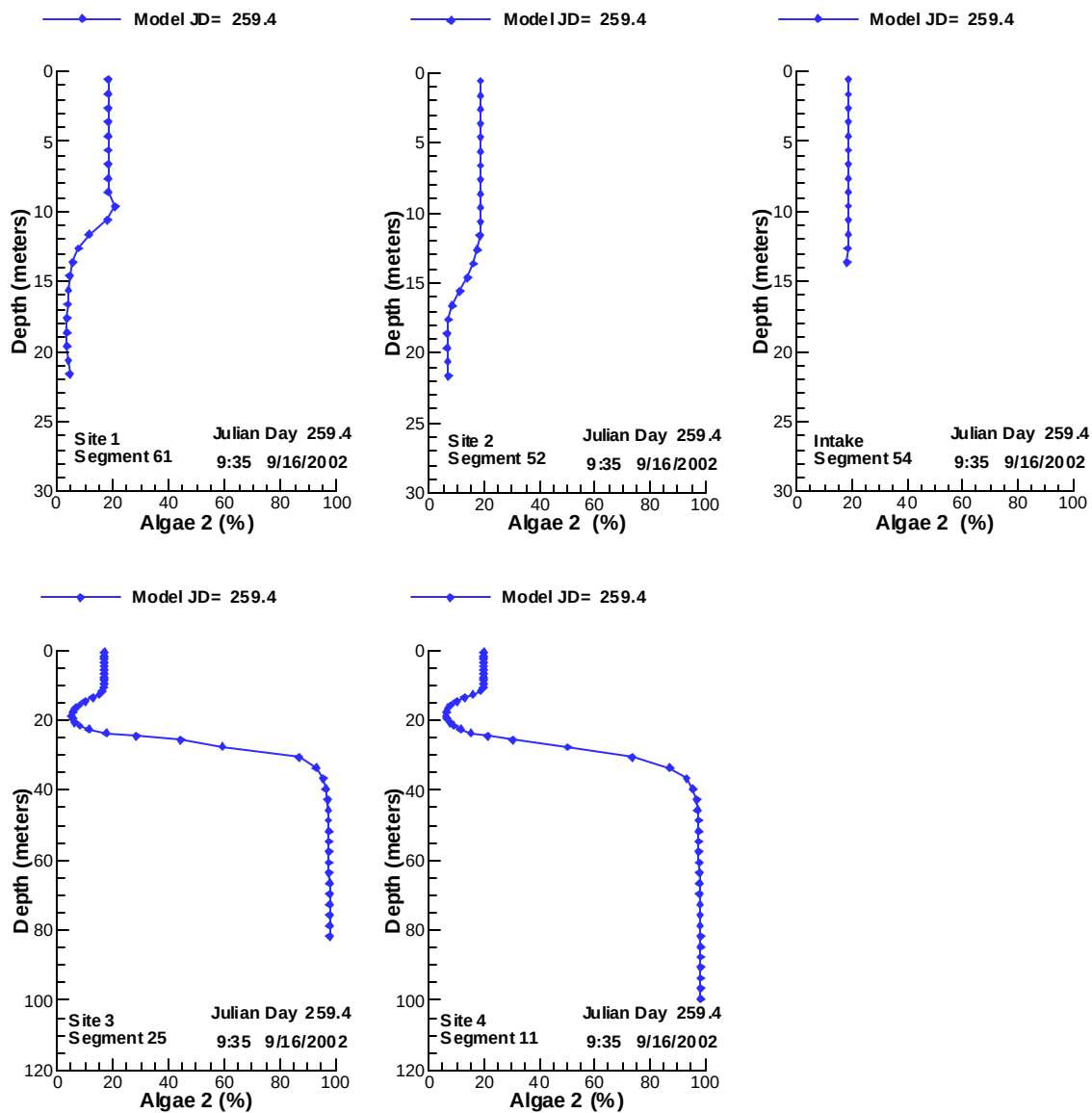


Figure 691. Vertical profiles of ALGAE 2 compared with data for 9/16/2002.

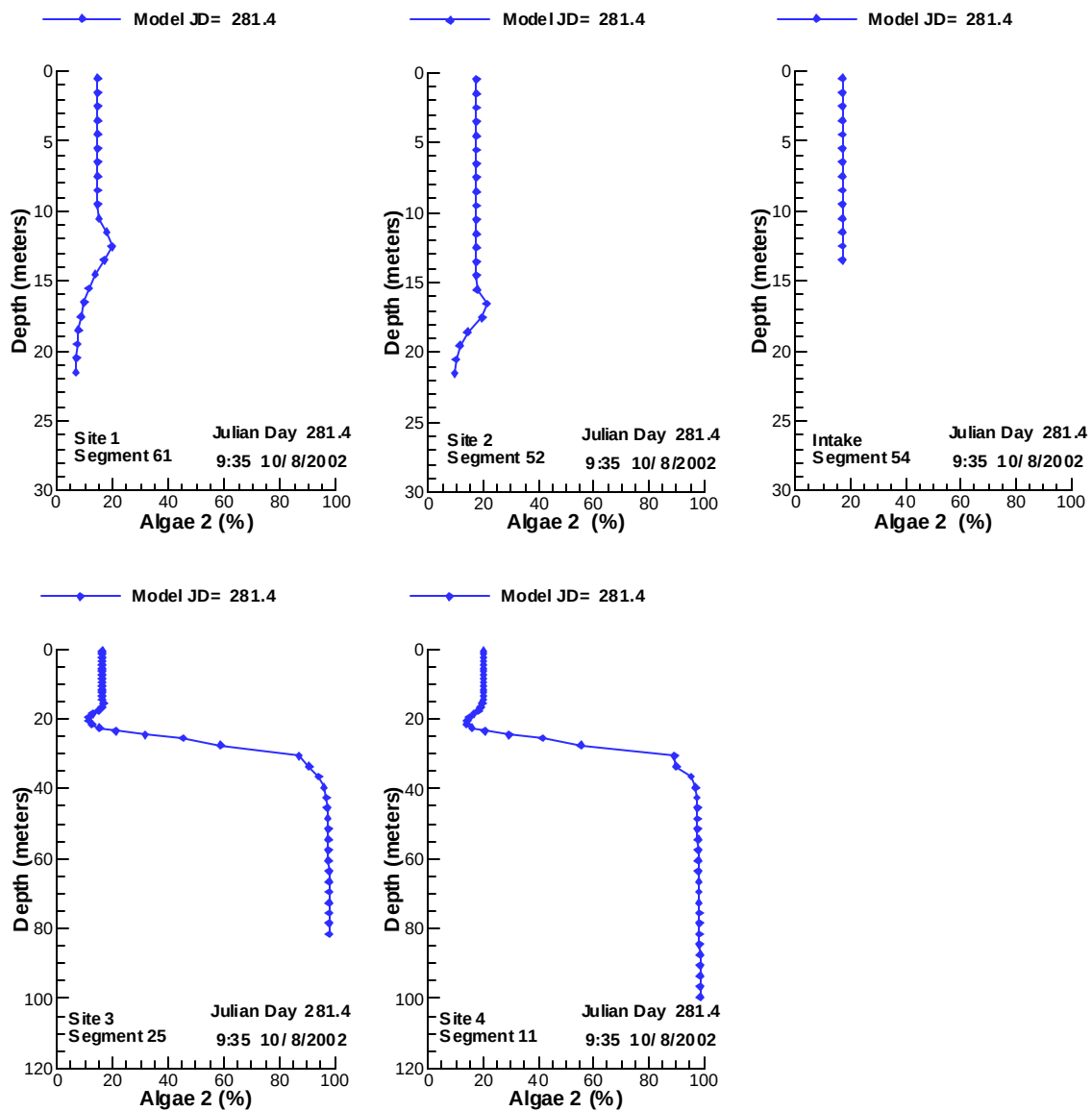


Figure 692. Vertical profiles of ALGAE 2 compared with data for 10/ 8/2002.

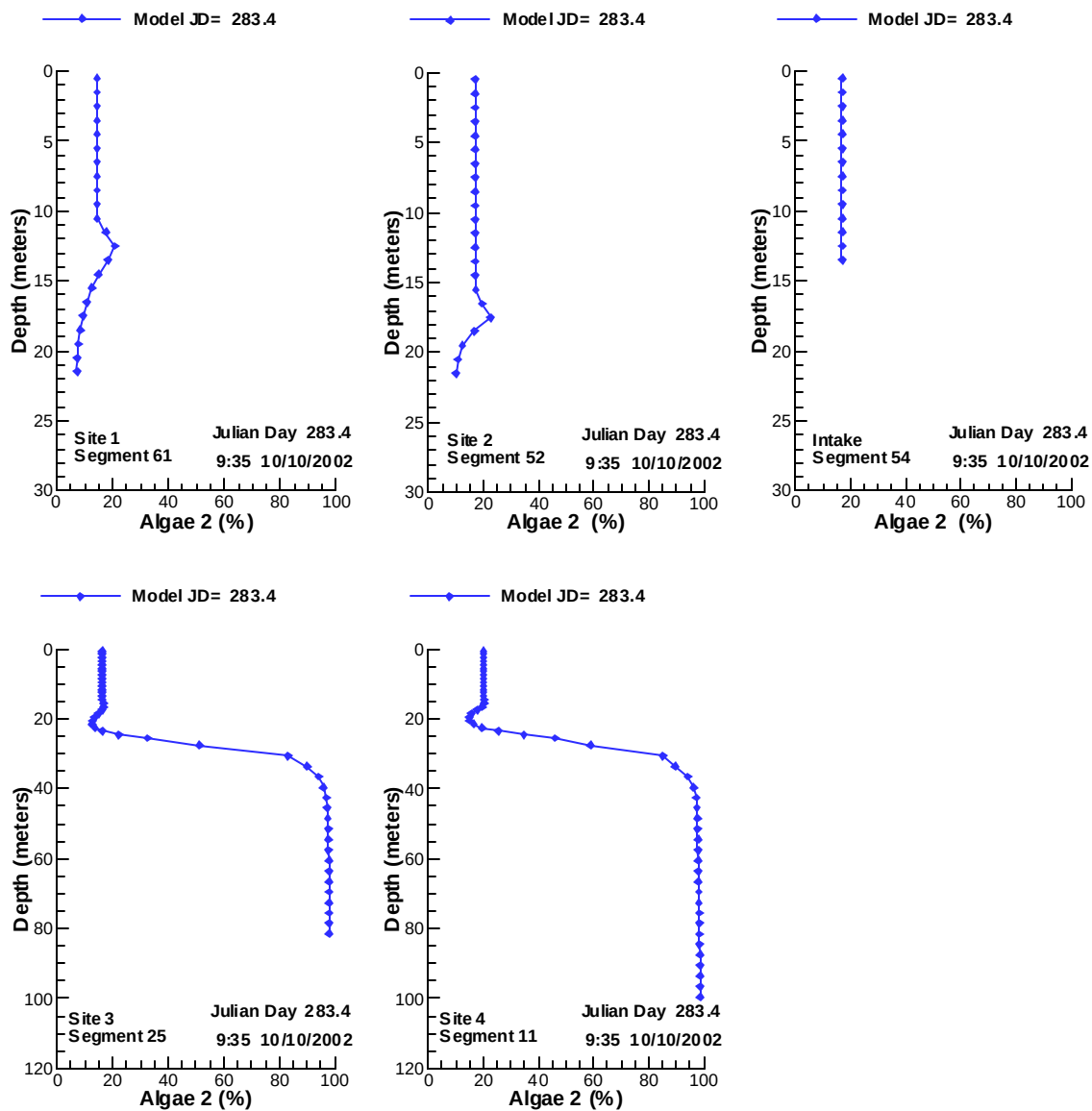


Figure 693. Vertical profiles of ALGAE 2 compared with data for 10/10/2002.

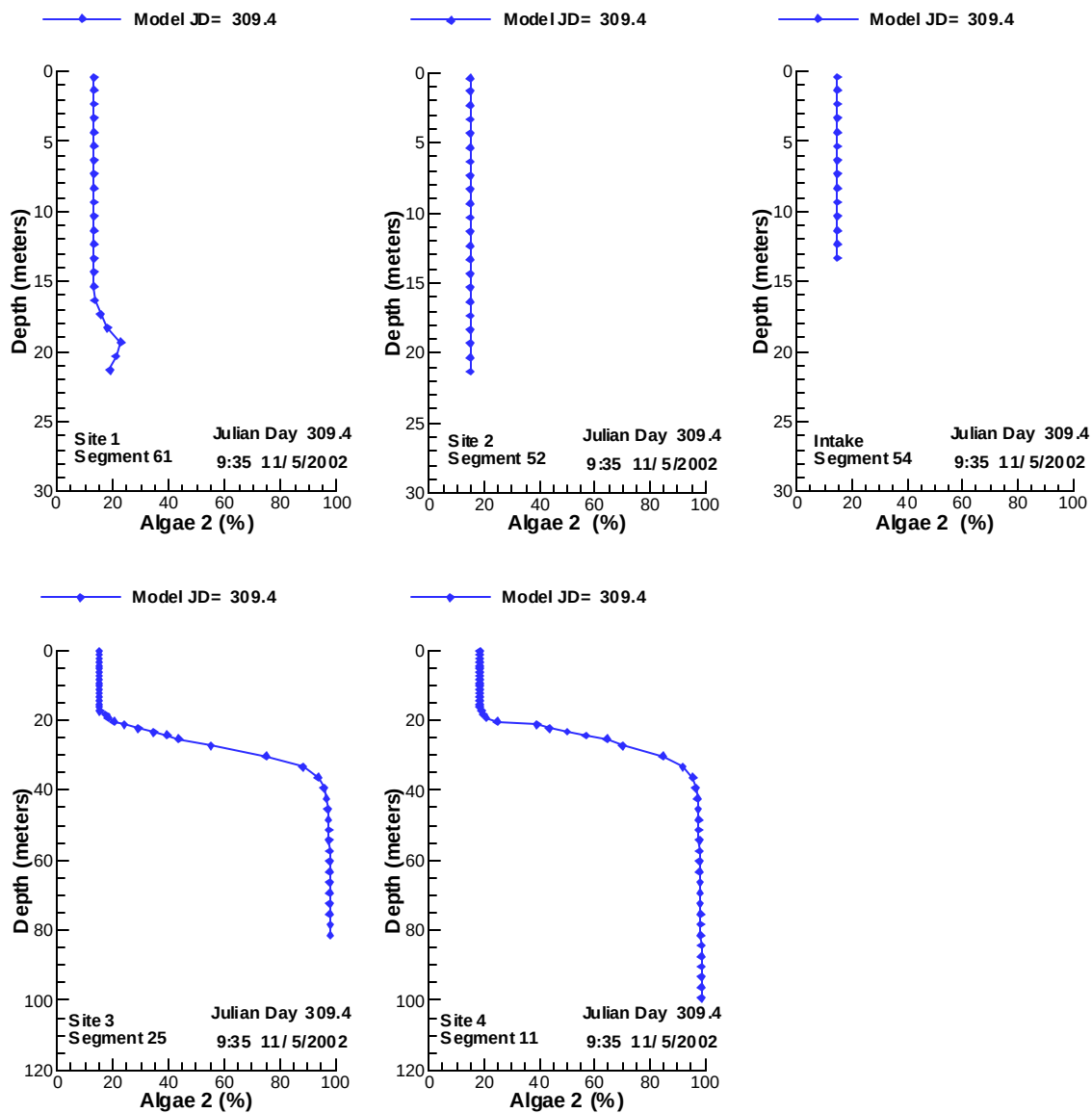


Figure 694. Vertical profiles of ALGAE 2 compared with data for 11/ 5/2002.

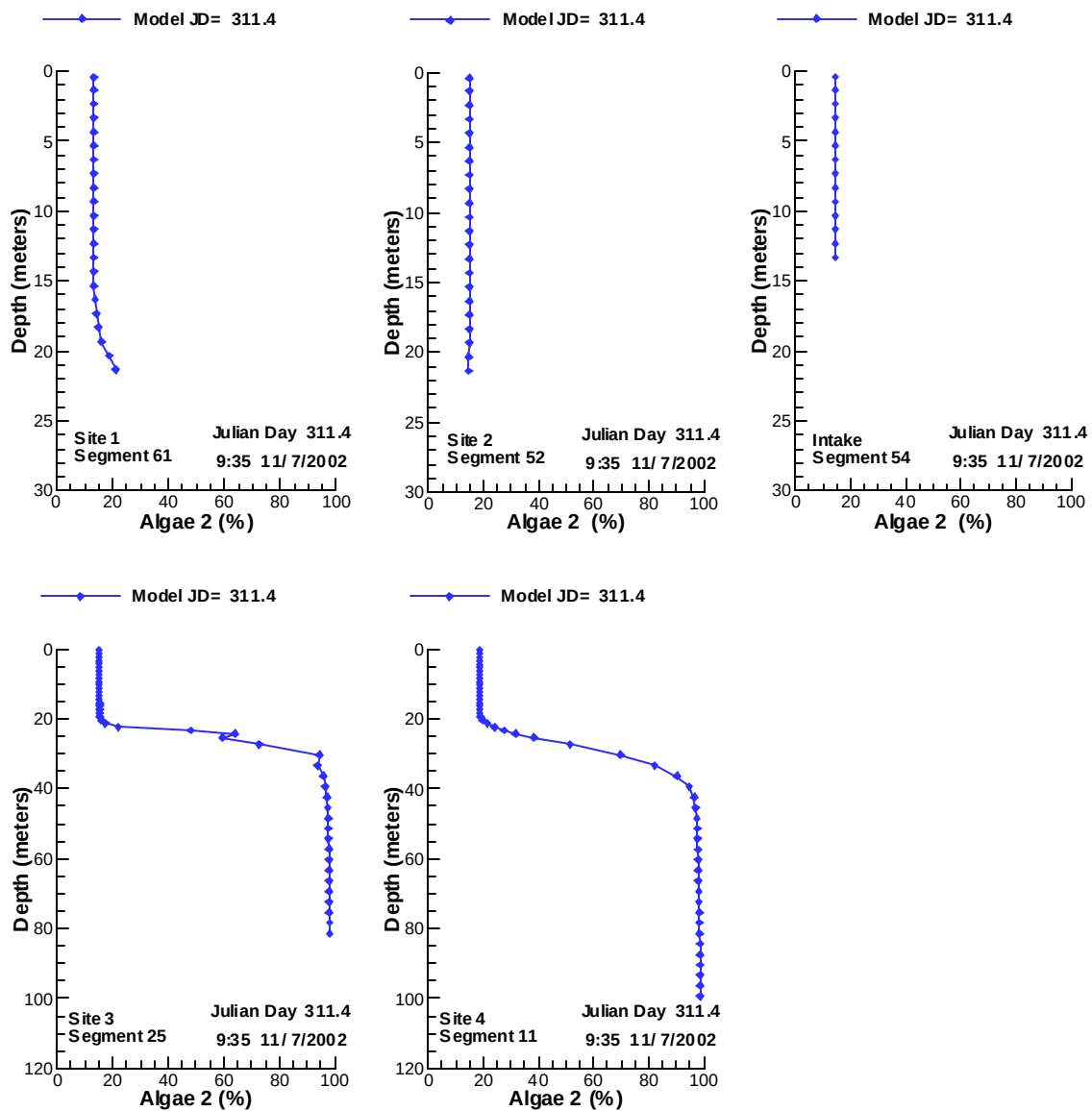


Figure 695. Vertical profiles of ALGAE 2 compared with data for 11/ 7/2002.

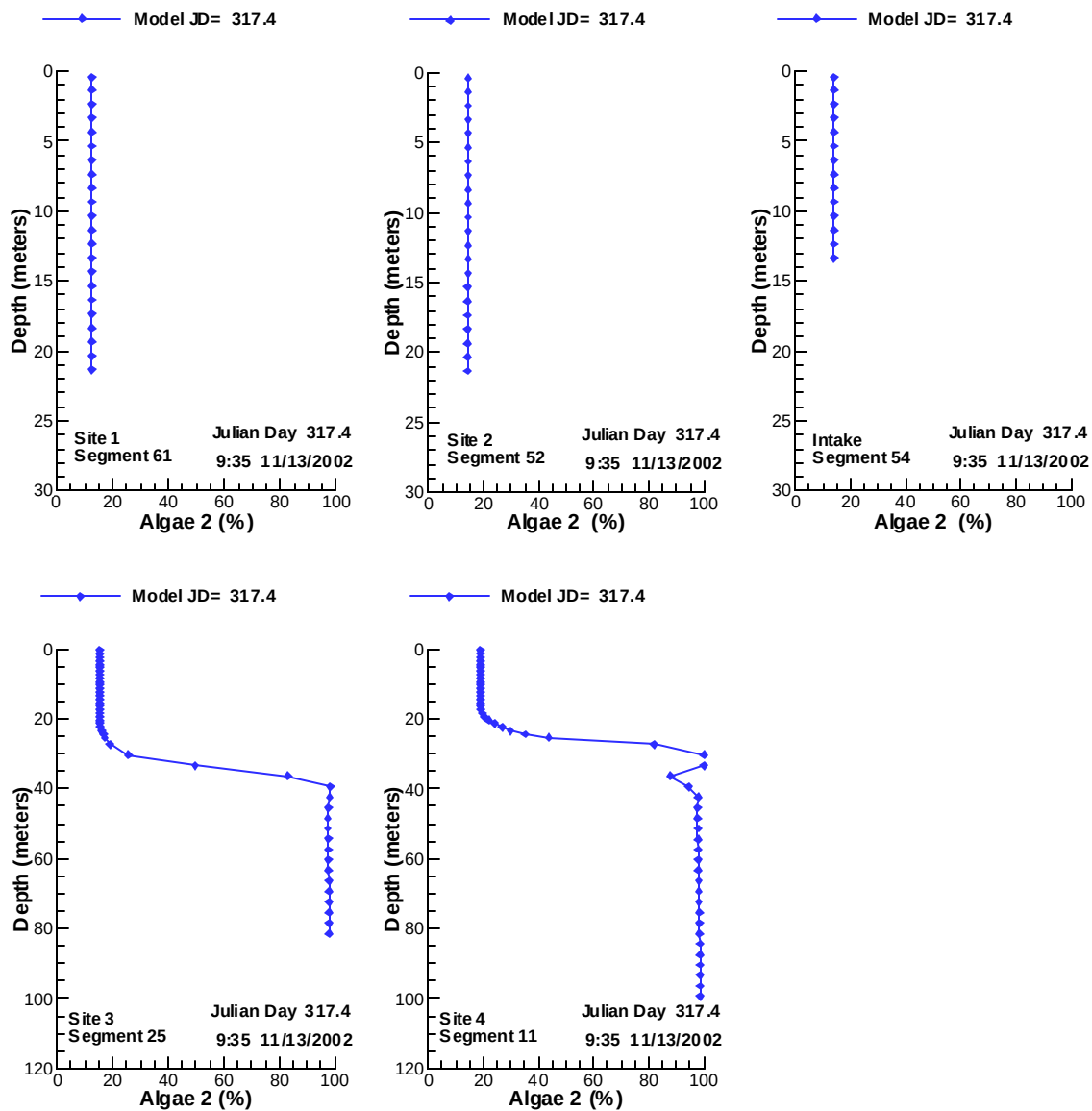


Figure 696. Vertical profiles of ALGAE 2 compared with data for 11/13/2002.

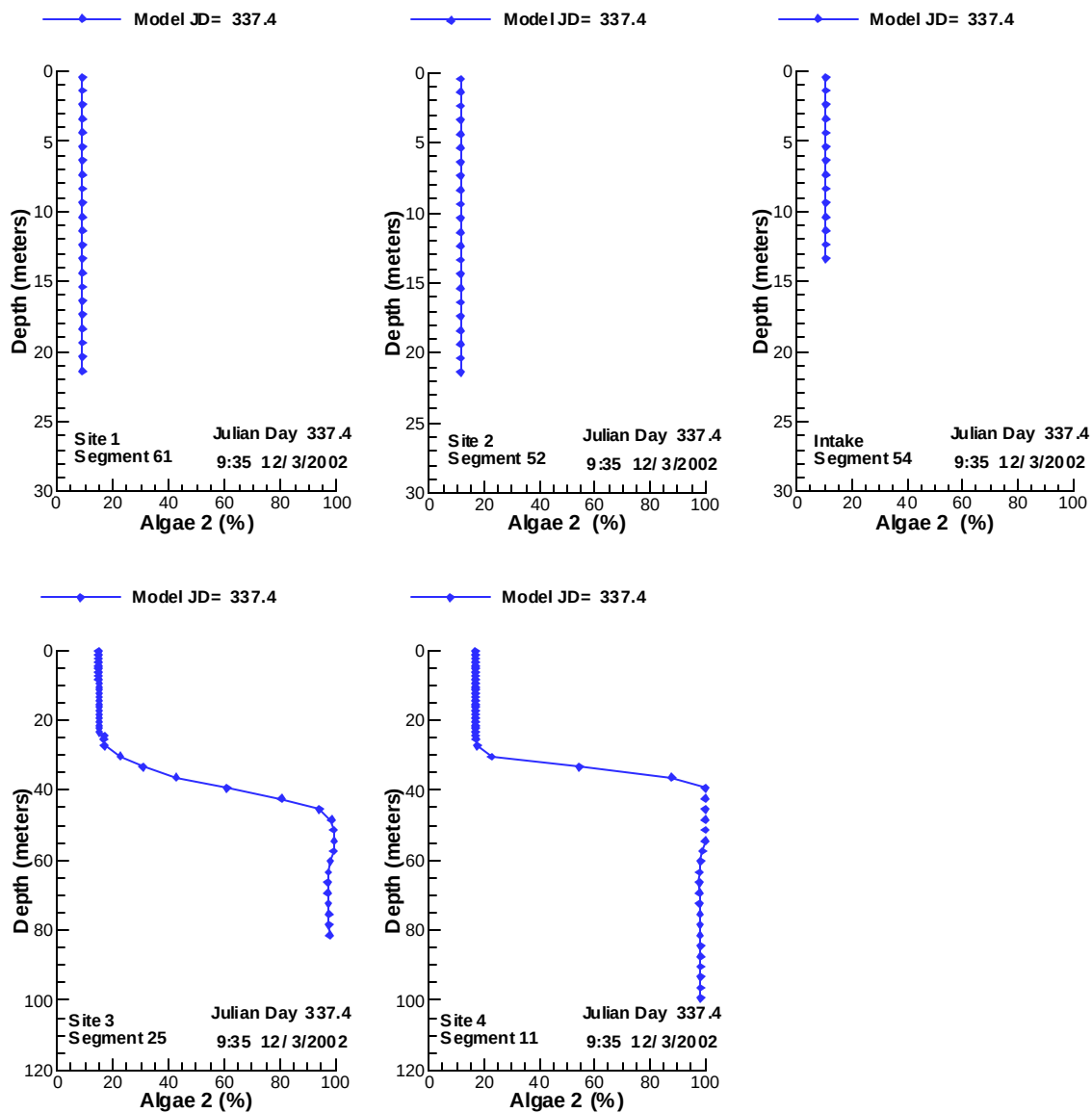


Figure 697. Vertical profiles of ALGAE 2 compared with data for 12/ 3/2002.

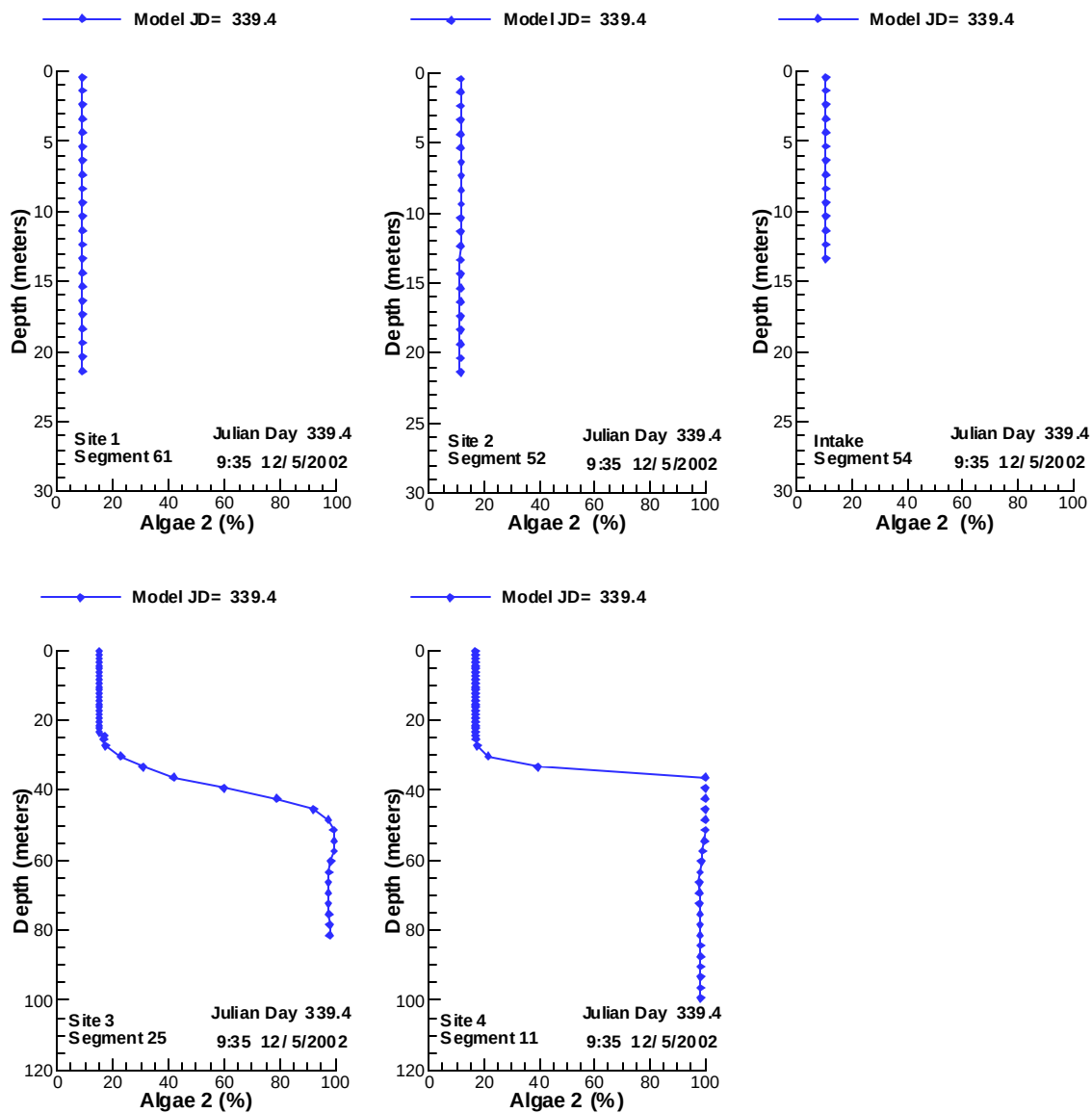


Figure 698. Vertical profiles of ALGAE 2 compared with data for 12/ 5/2002.

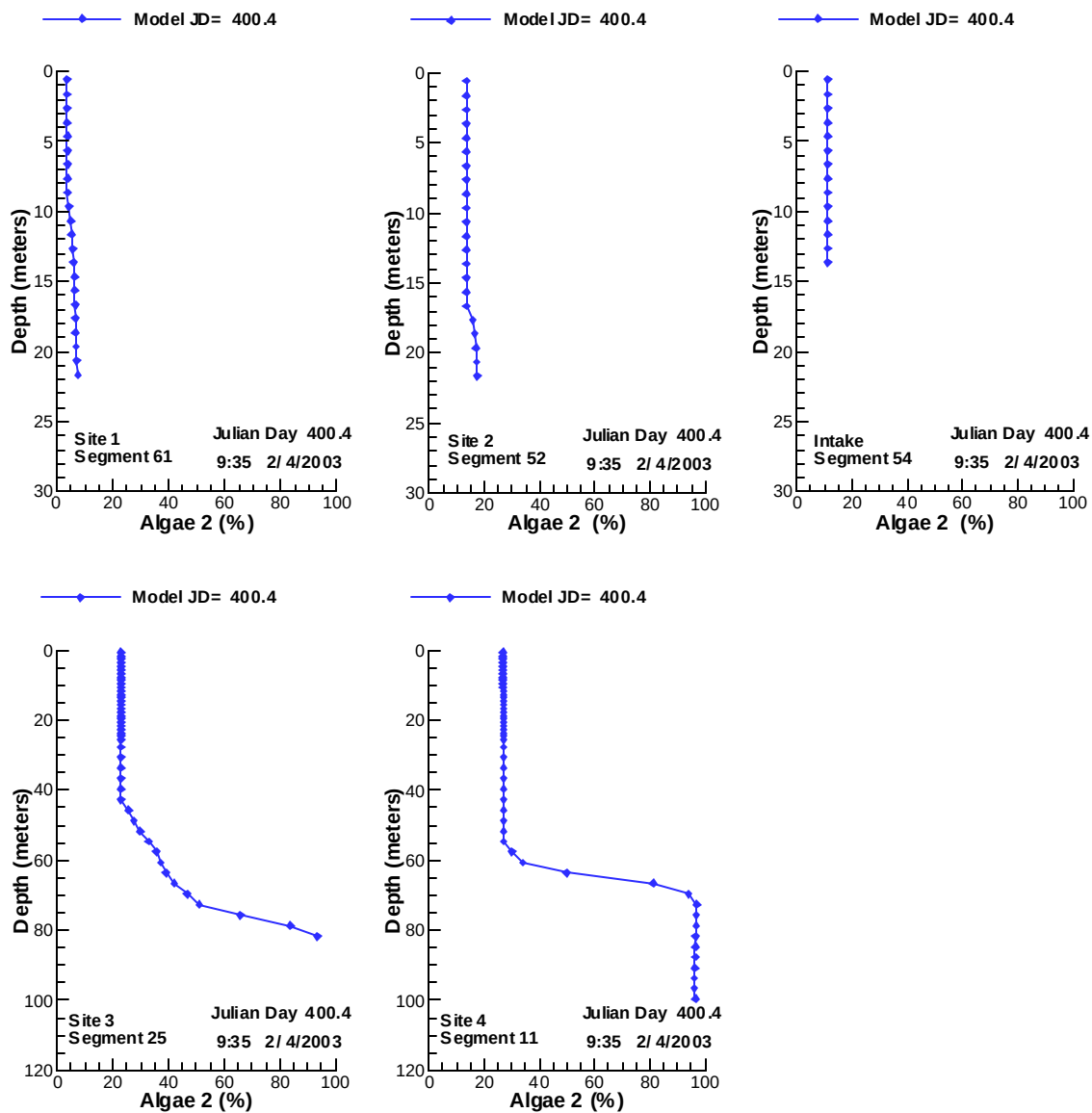


Figure 699. Vertical profiles of ALGAE 2 compared with data for 2/4/2003.

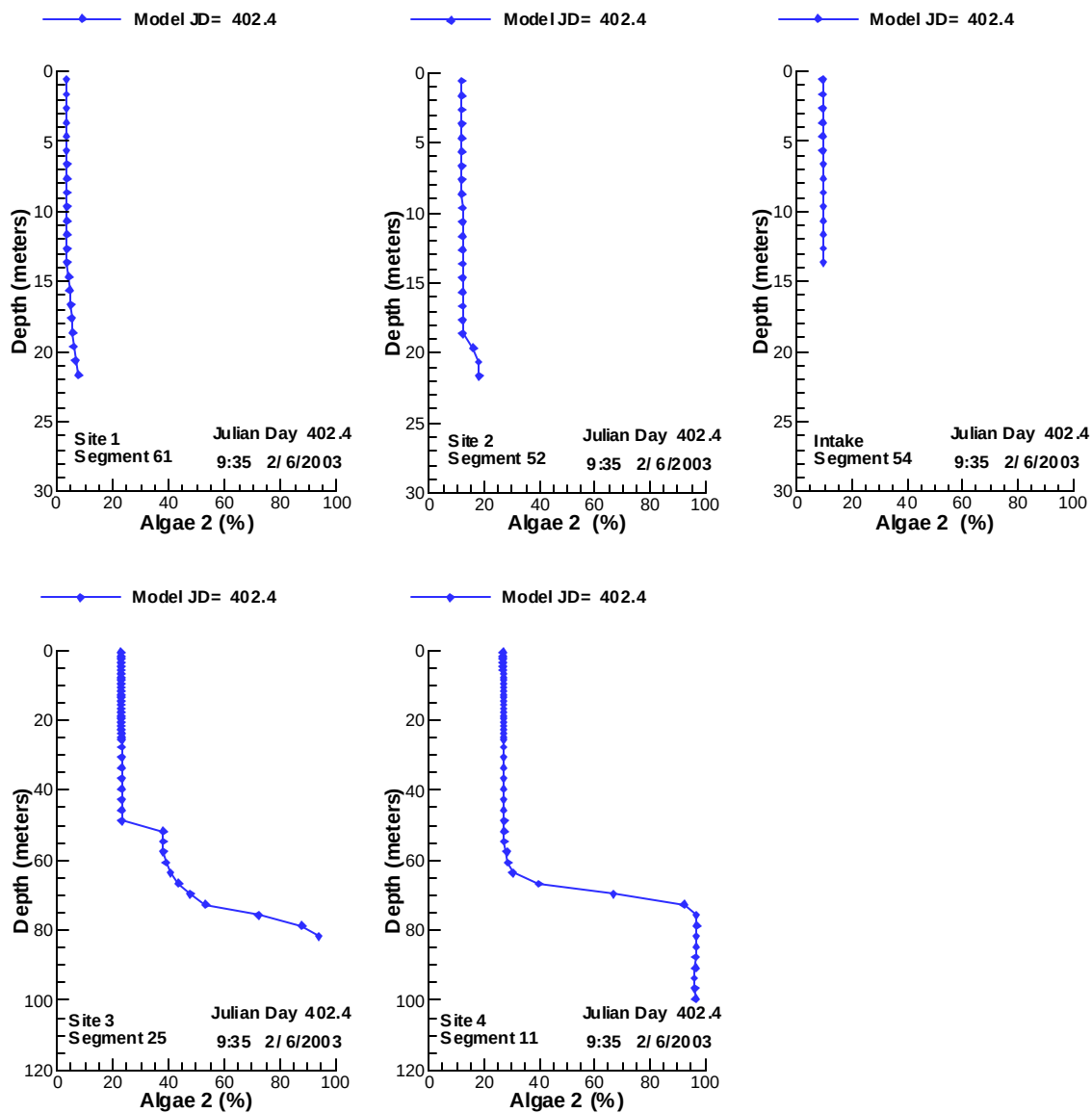


Figure 700. Vertical profiles of ALGAE 2 compared with data for 2/ 6/2003.

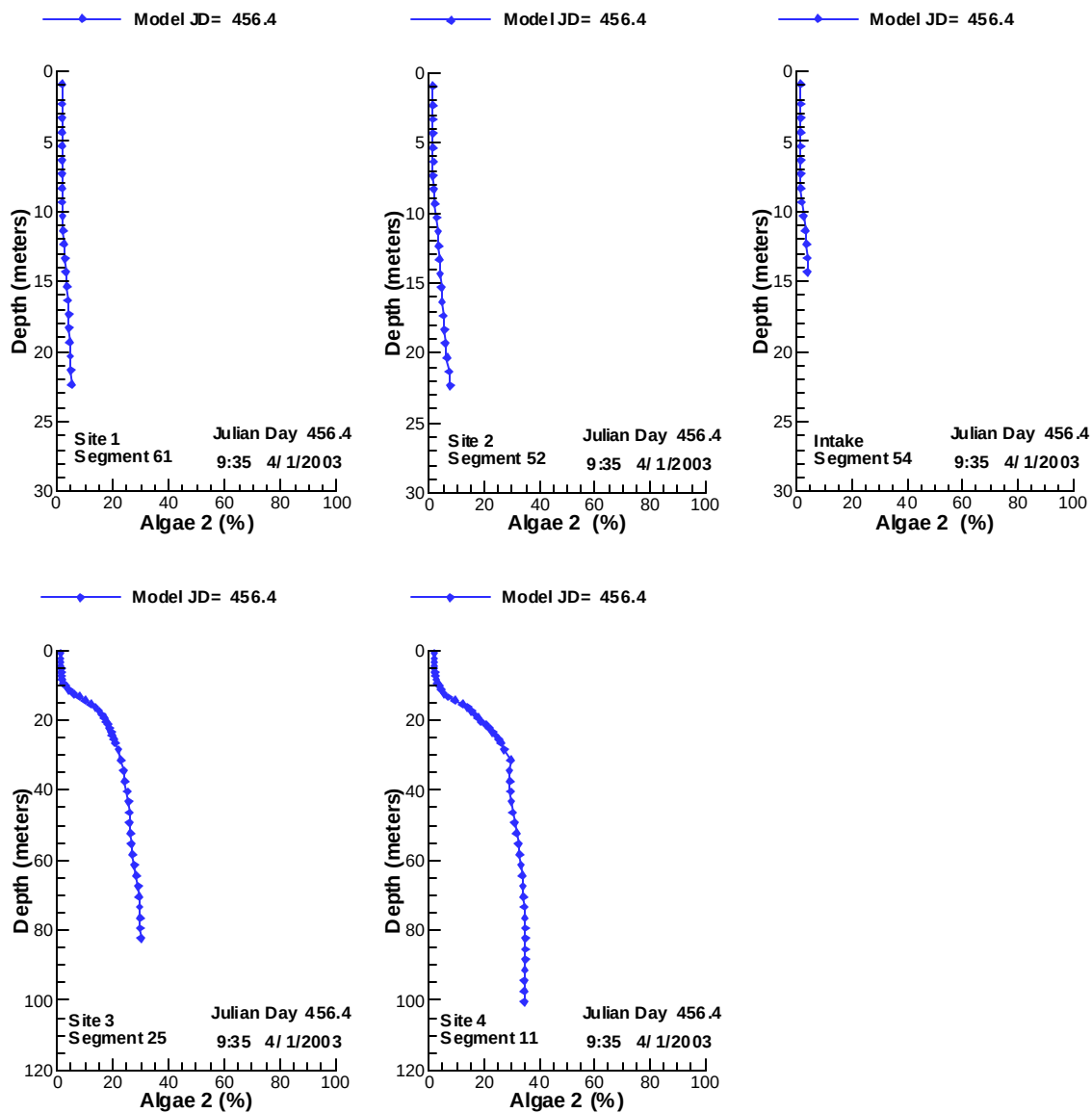


Figure 701. Vertical profiles of ALGAE 2 compared with data for 4/ 1/2003.

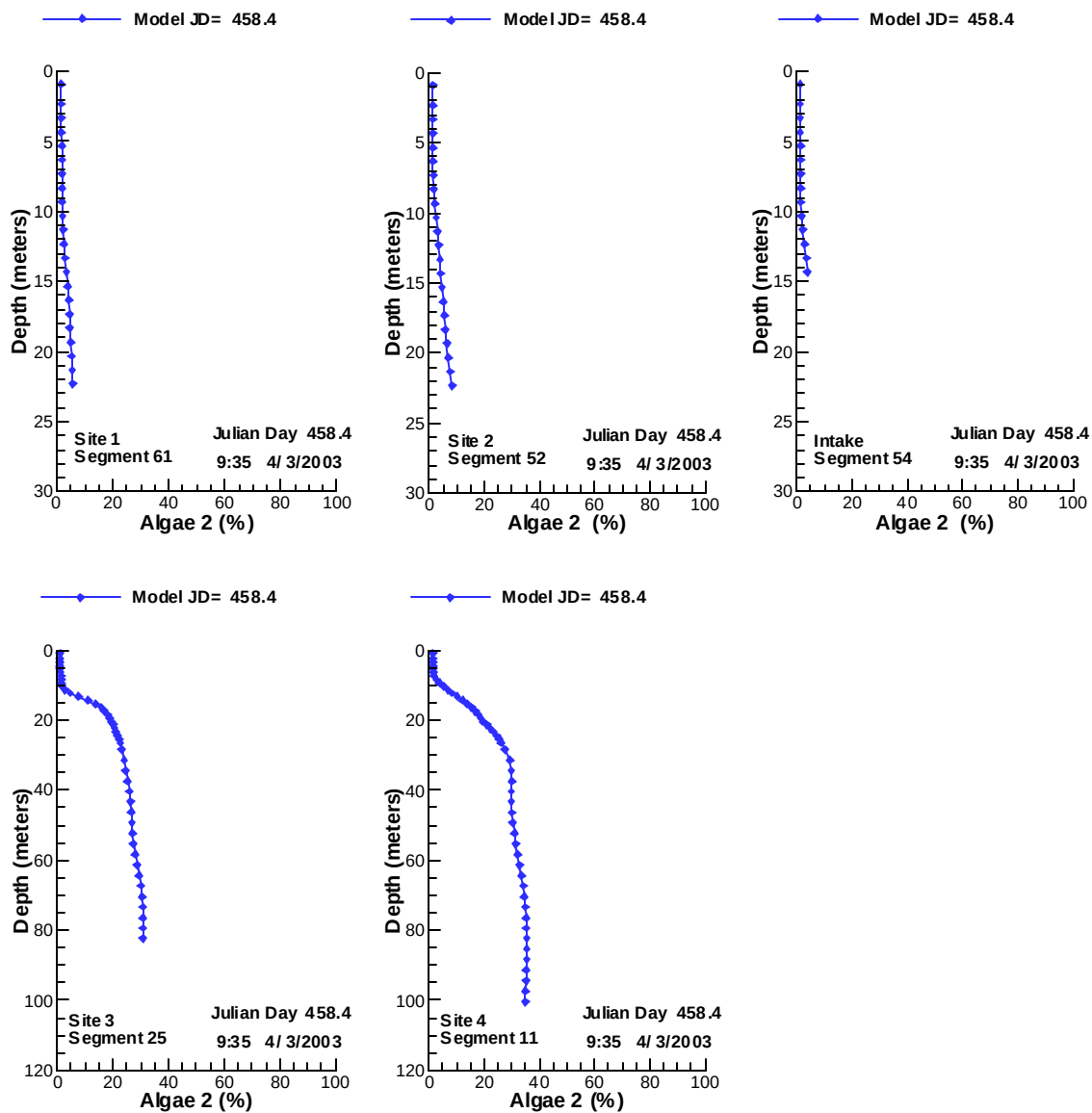


Figure 702. Vertical profiles of ALGAE 2 compared with data for 4/ 3/2003.

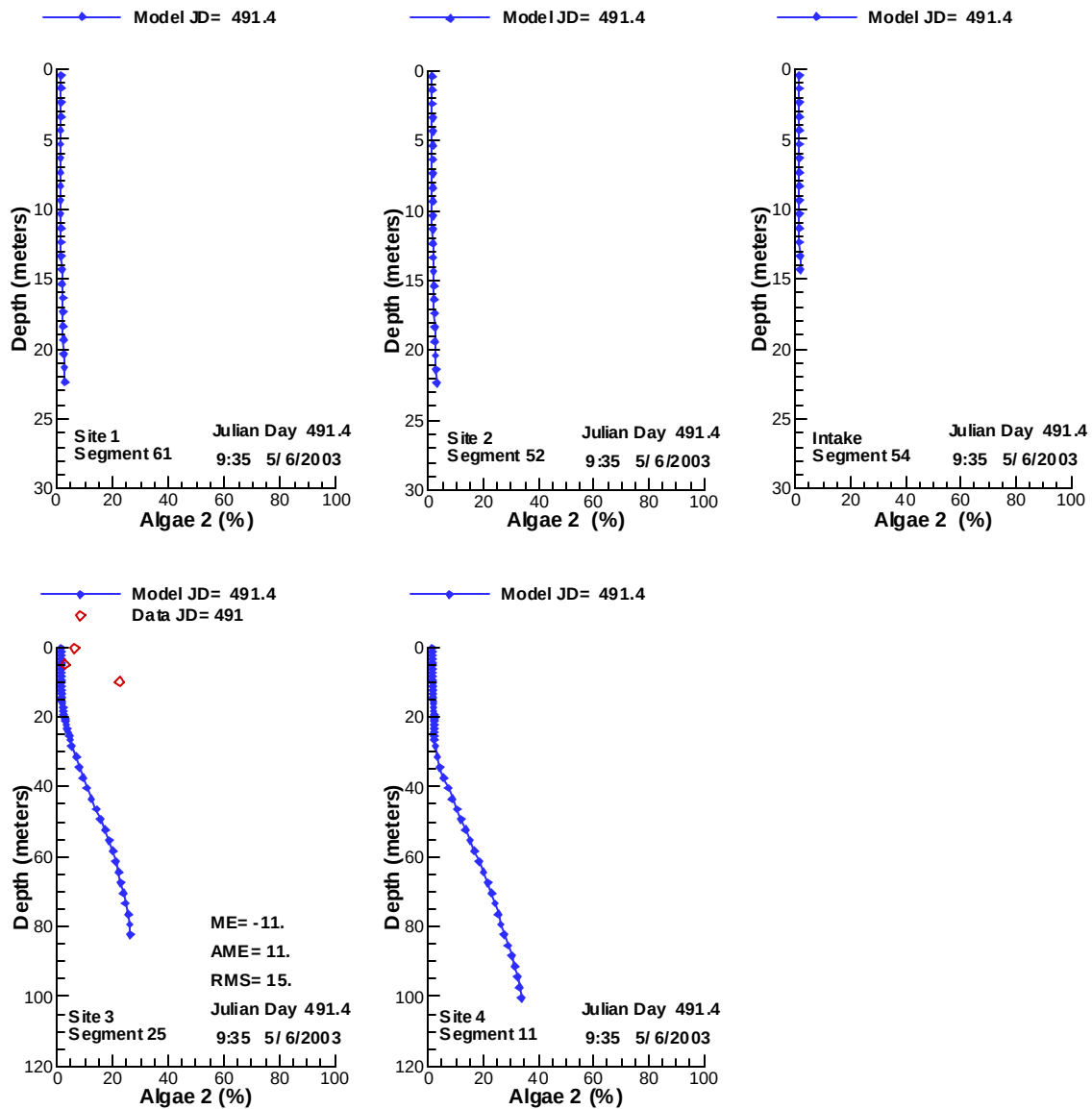


Figure 703. Vertical profiles of ALGAE 2 compared with data for 5/ 6/2003.

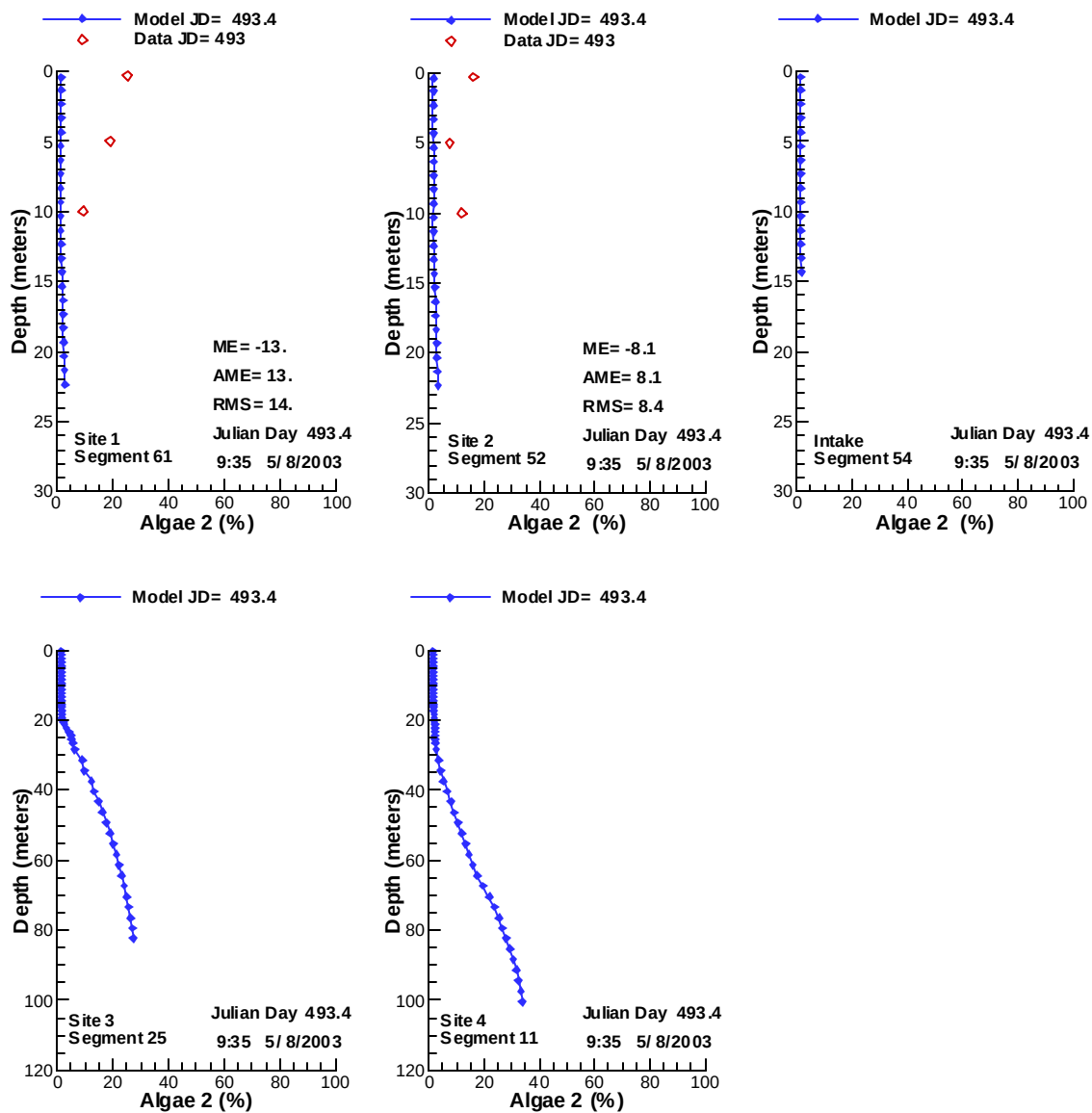


Figure 704. Vertical profiles of ALGAE 2 compared with data for 5/ 8/2003.

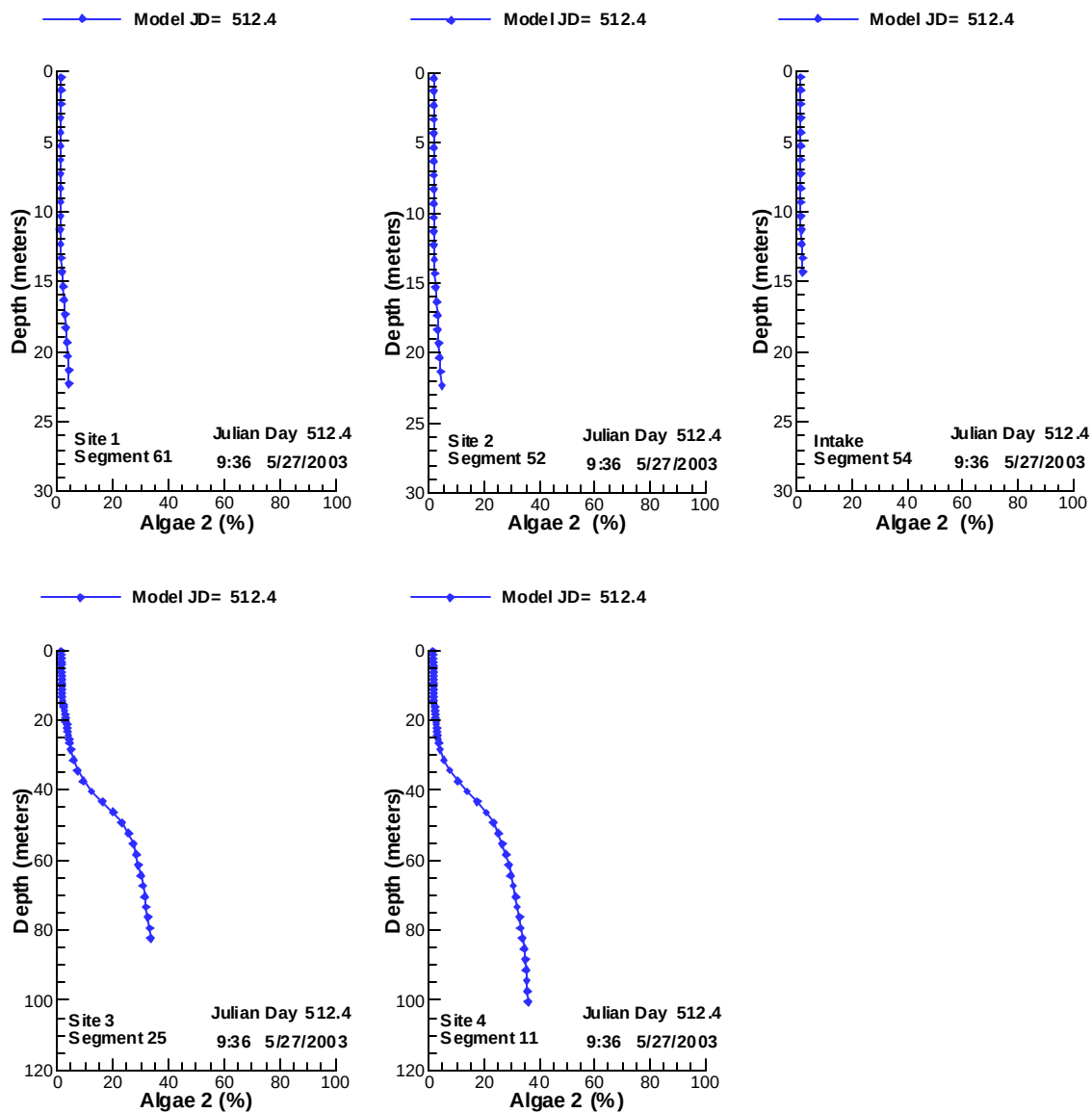


Figure 705. Vertical profiles of ALGAE 2 compared with data for 5/27/2003.

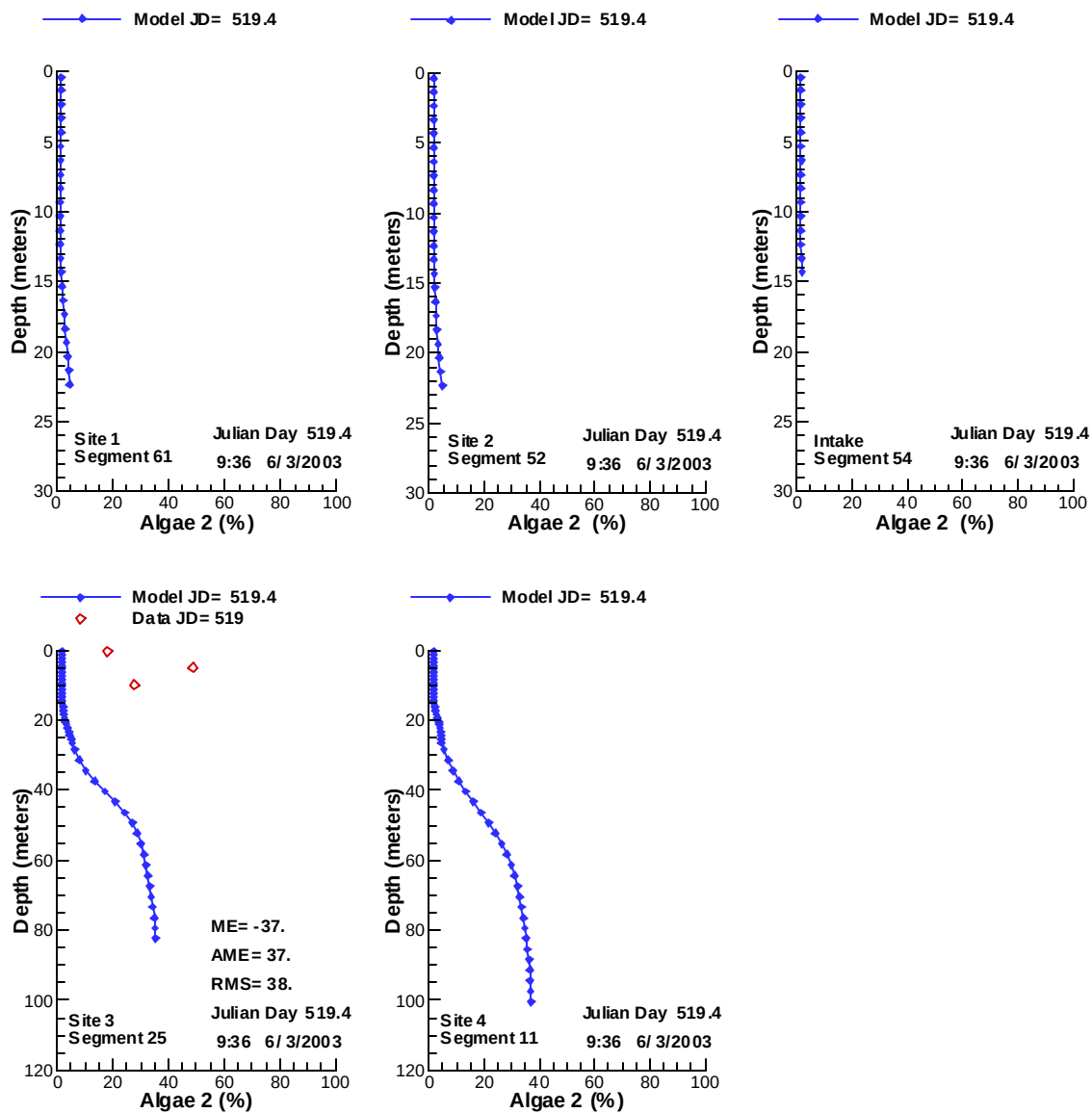


Figure 706. Vertical profiles of ALGAE 2 compared with data for 6/ 3/2003.

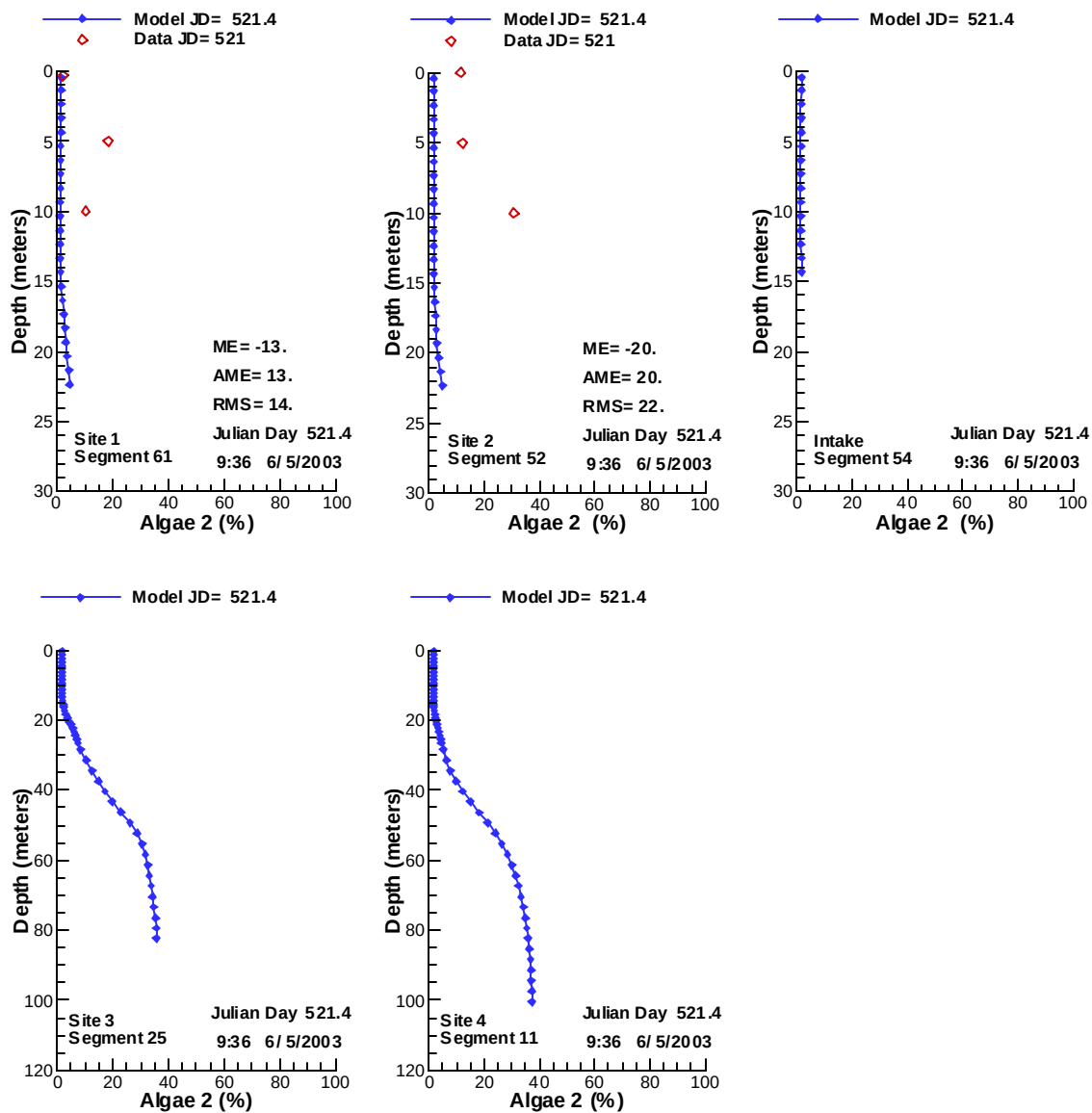


Figure 707. Vertical profiles of ALGAE 2 compared with data for 6/ 5/2003.

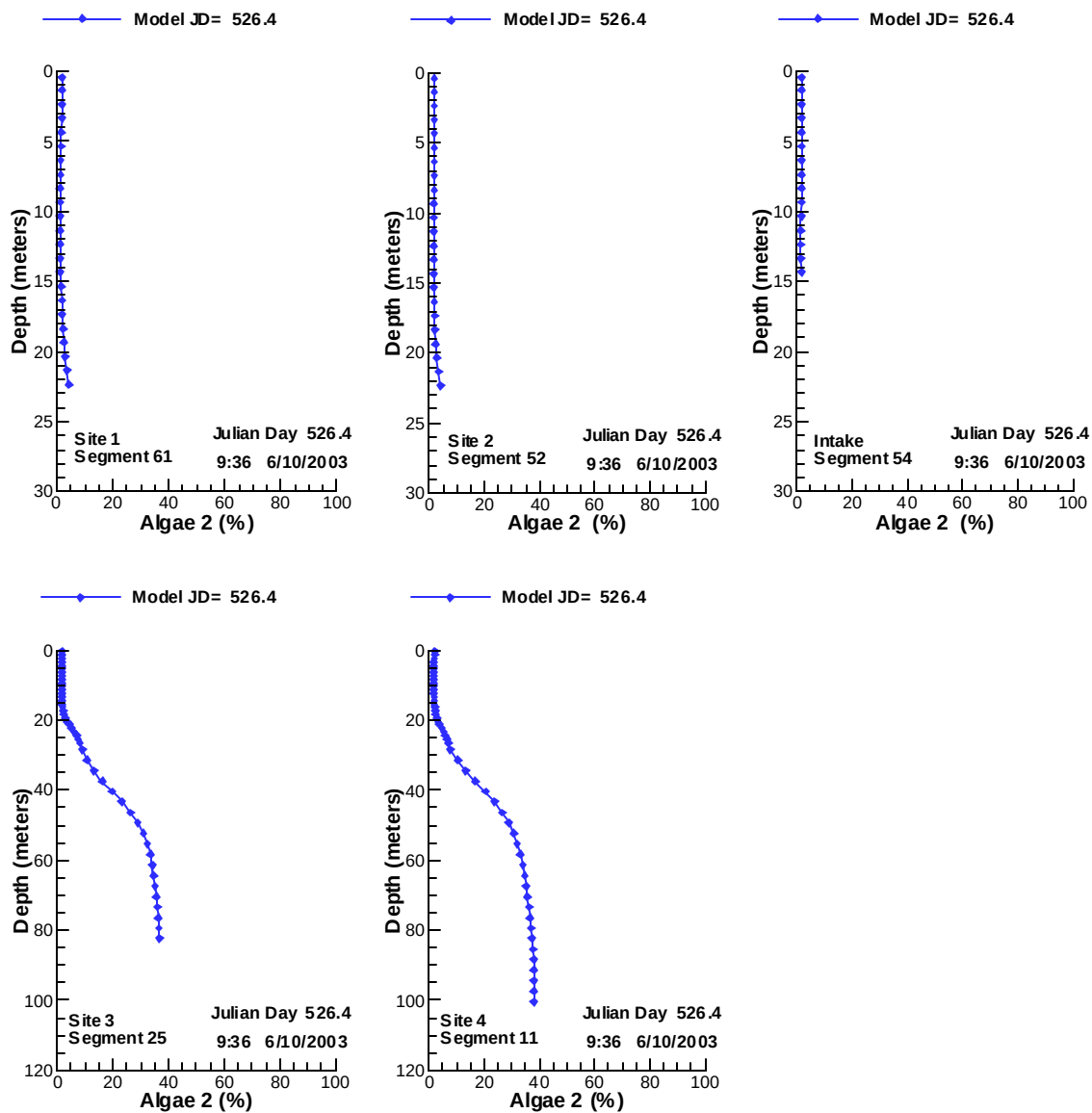


Figure 708. Vertical profiles of ALGAE 2 compared with data for 6/10/2003.

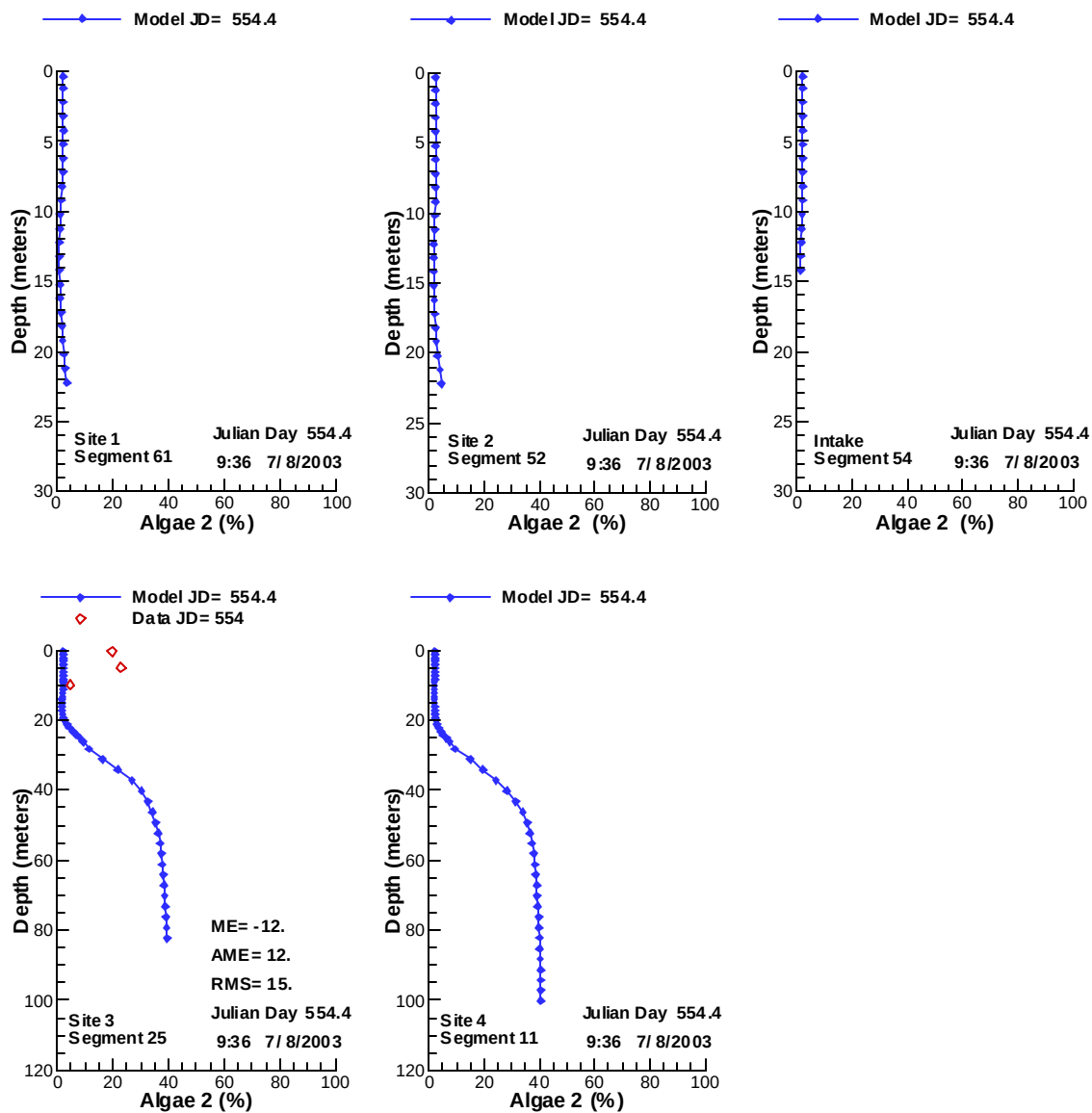


Figure 709. Vertical profiles of ALGAE 2 compared with data for 7/ 8/2003.

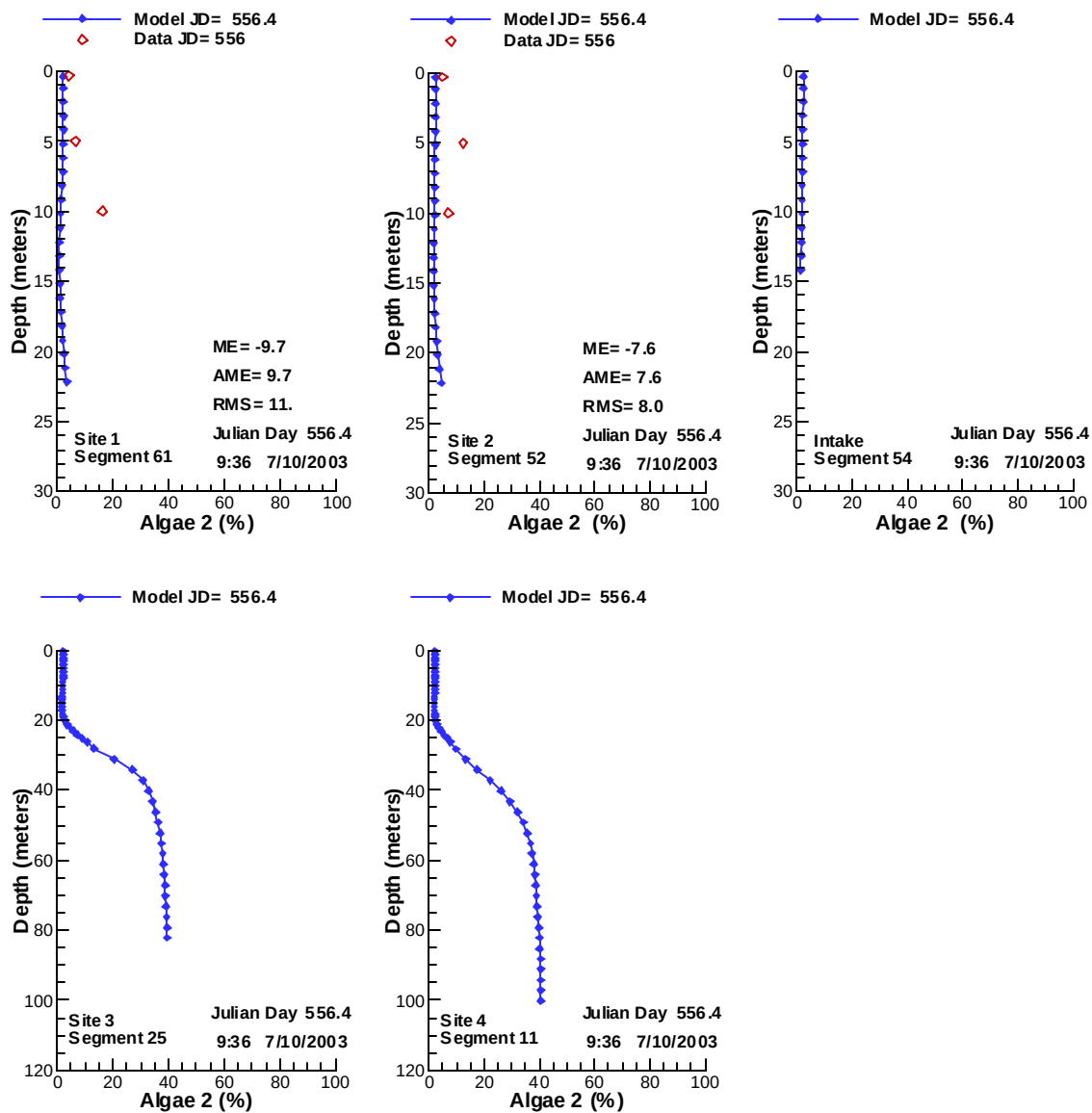


Figure 710. Vertical profiles of ALGAE 2 compared with data for 7/10/2003.

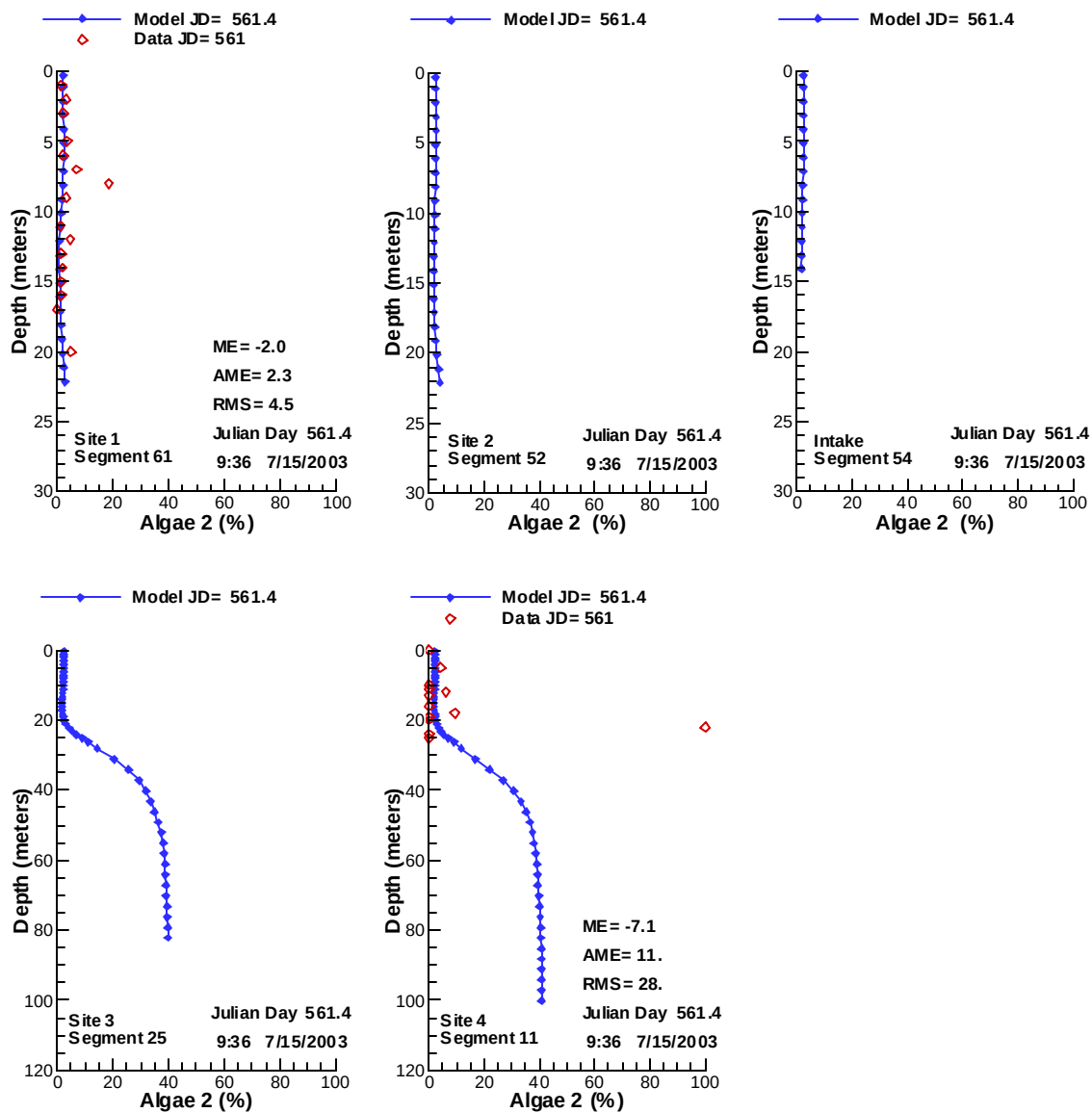


Figure 711. Vertical profiles of ALGAE 2 compared with data for 7/15/2003.

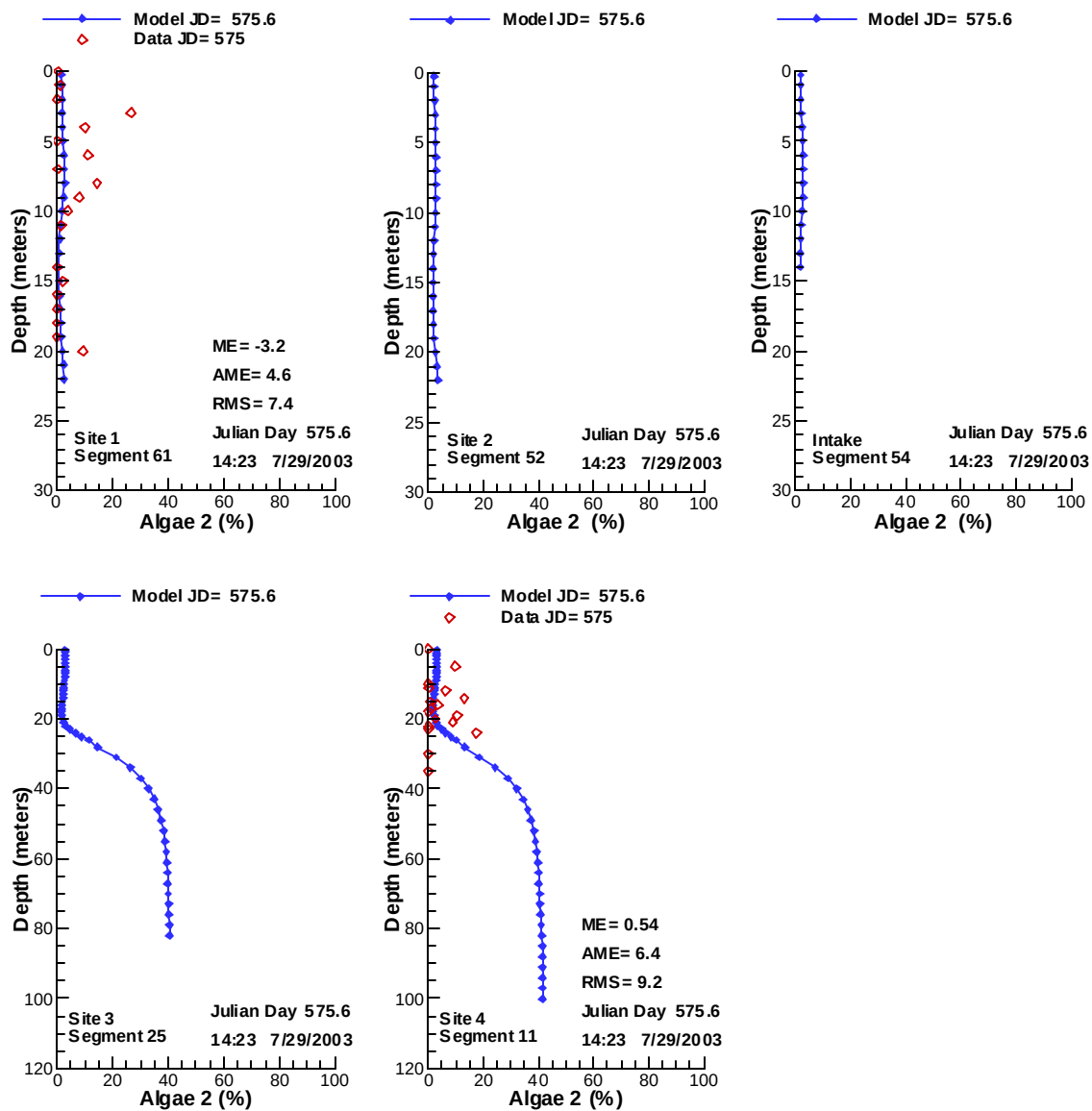


Figure 712. Vertical profiles of ALGAE 2 compared with data for 7/29/2003.

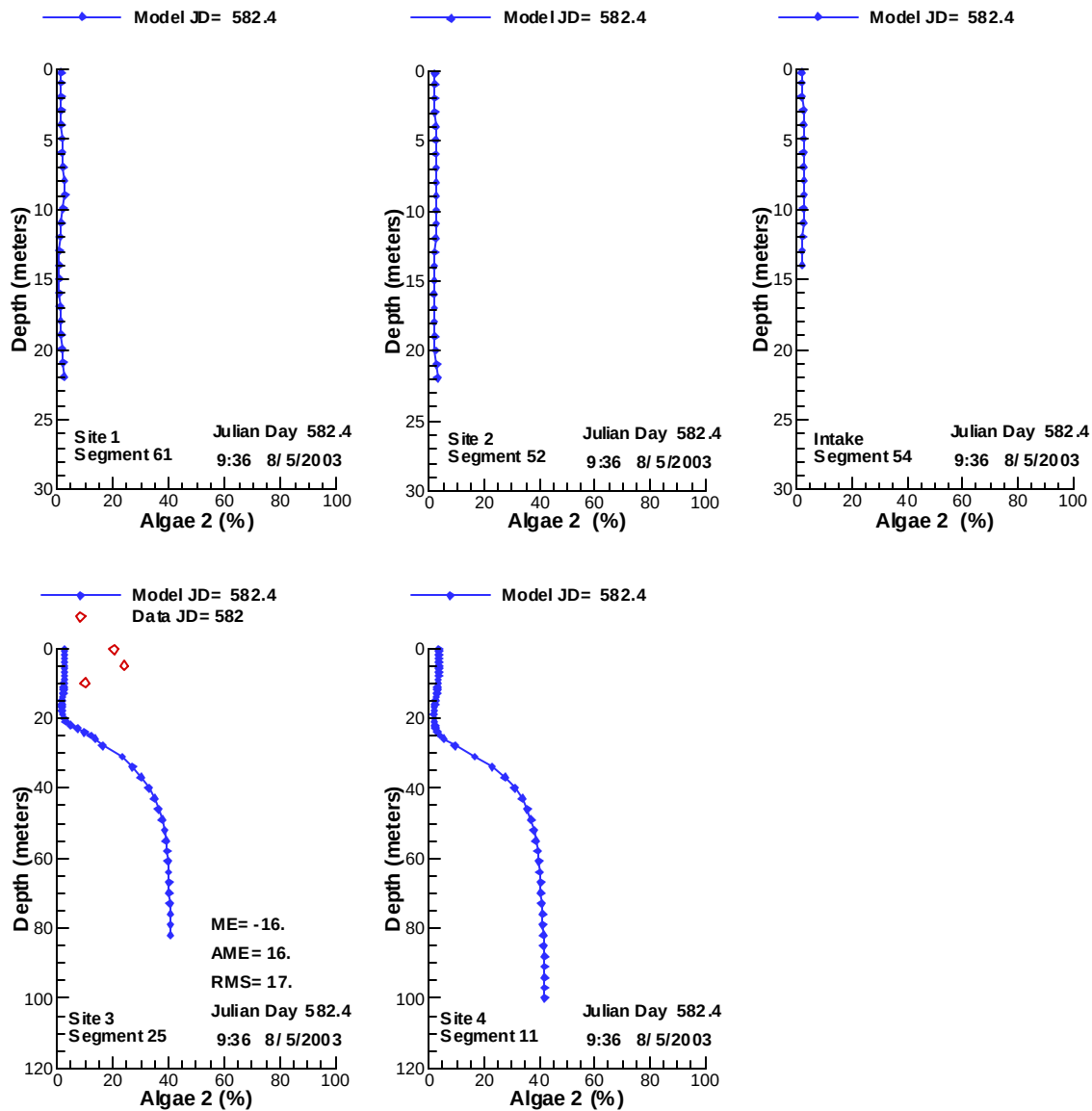


Figure 713. Vertical profiles of ALGAE 2 compared with data for 8/ 5/2003.

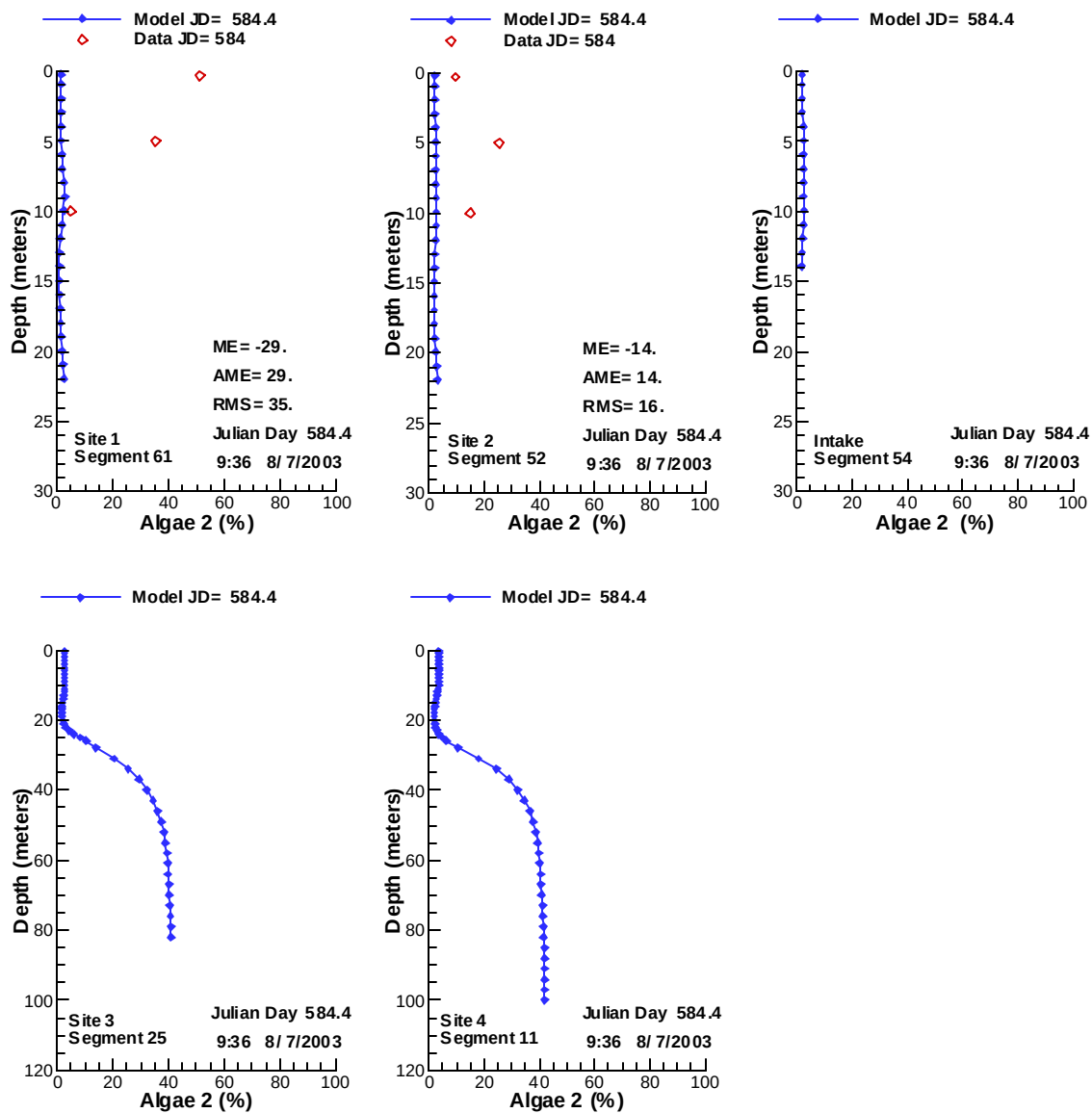


Figure 714. Vertical profiles of ALGAE 2 compared with data for 8/ 7/2003.

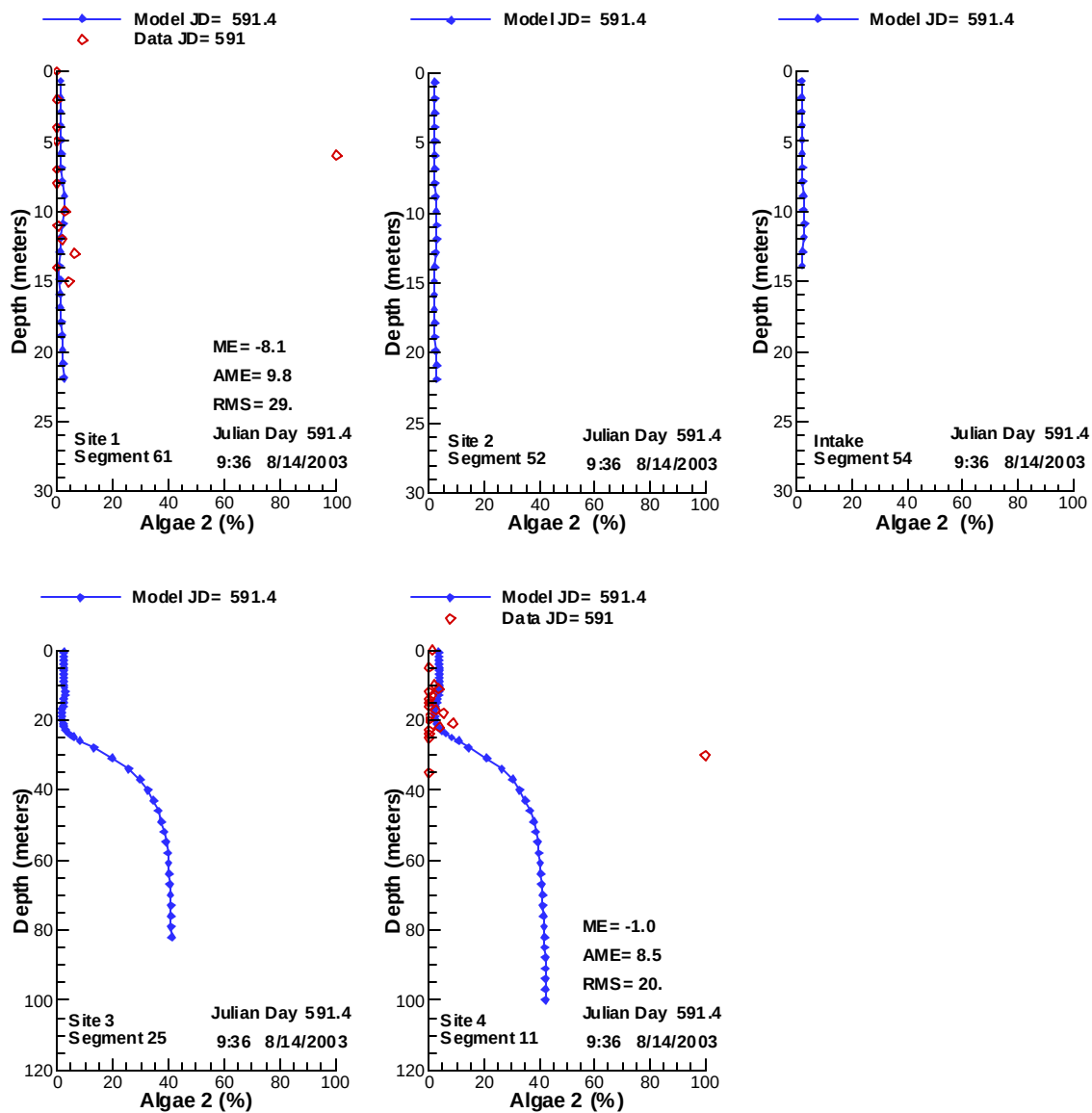


Figure 715. Vertical profiles of ALGAE 2 compared with data for 8/14/2003.

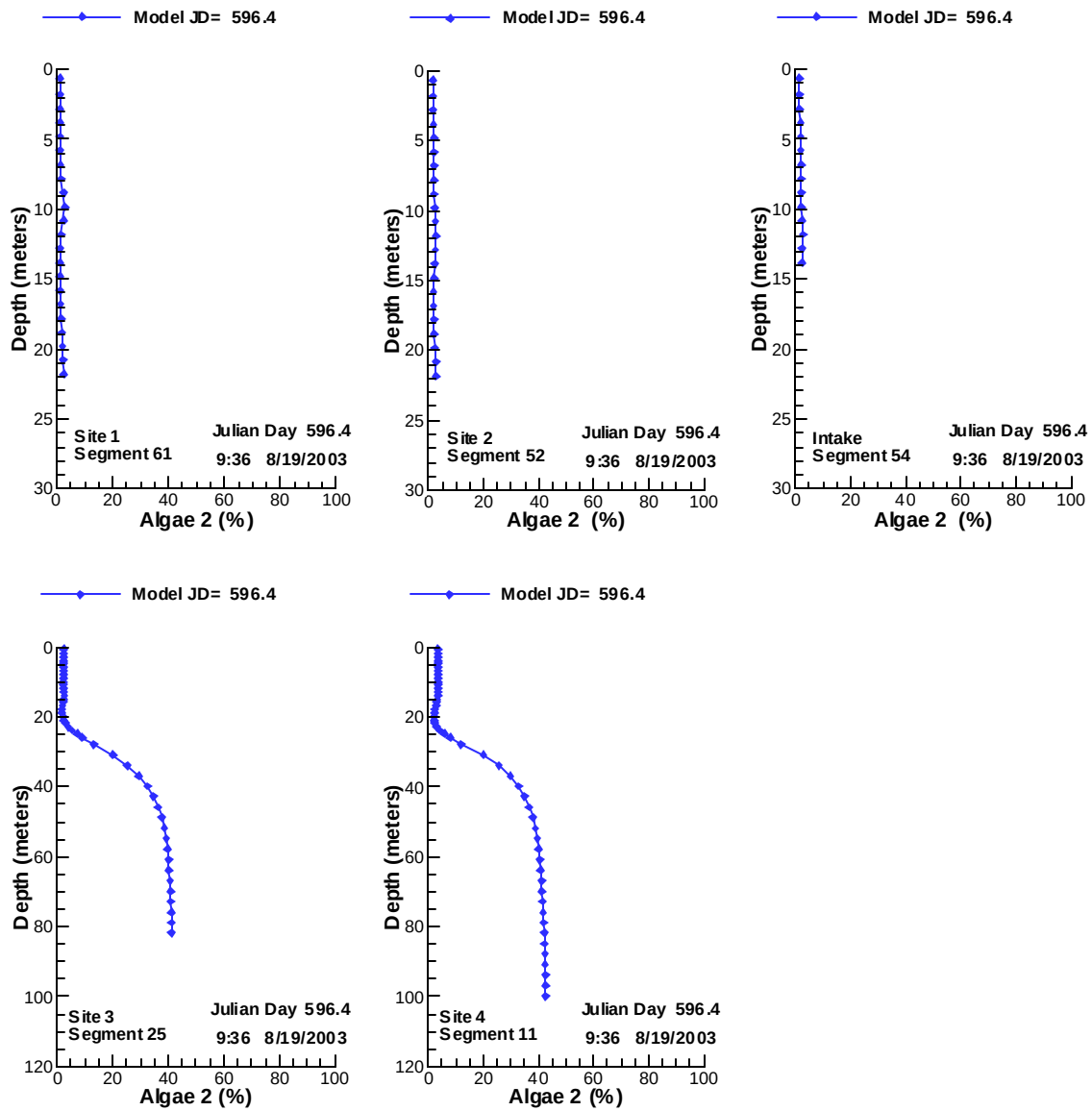


Figure 716. Vertical profiles of ALGAE 2 compared with data for 8/19/2003.

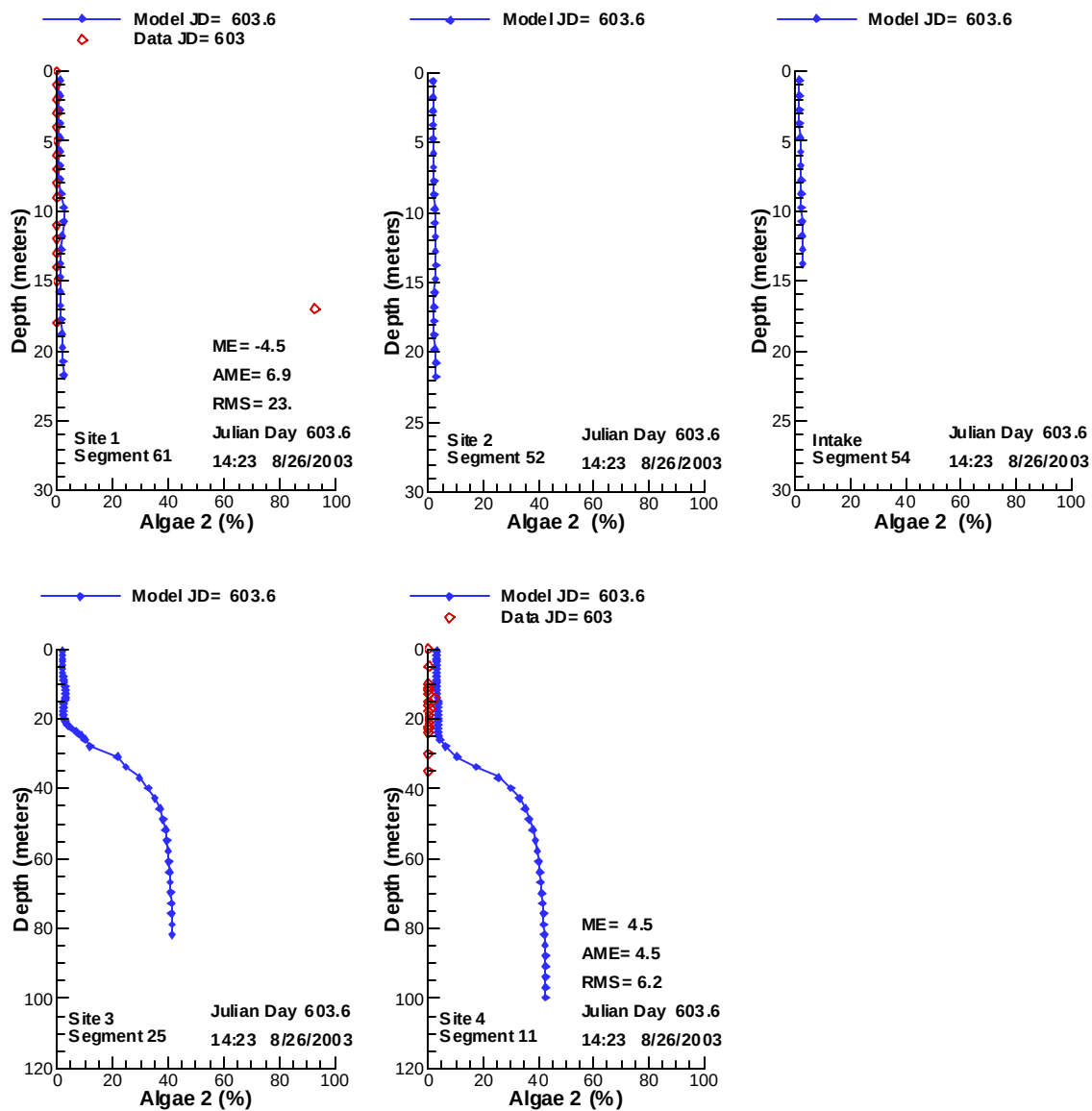


Figure 717. Vertical profiles of ALGAE 2 compared with data for 8/26/2003.

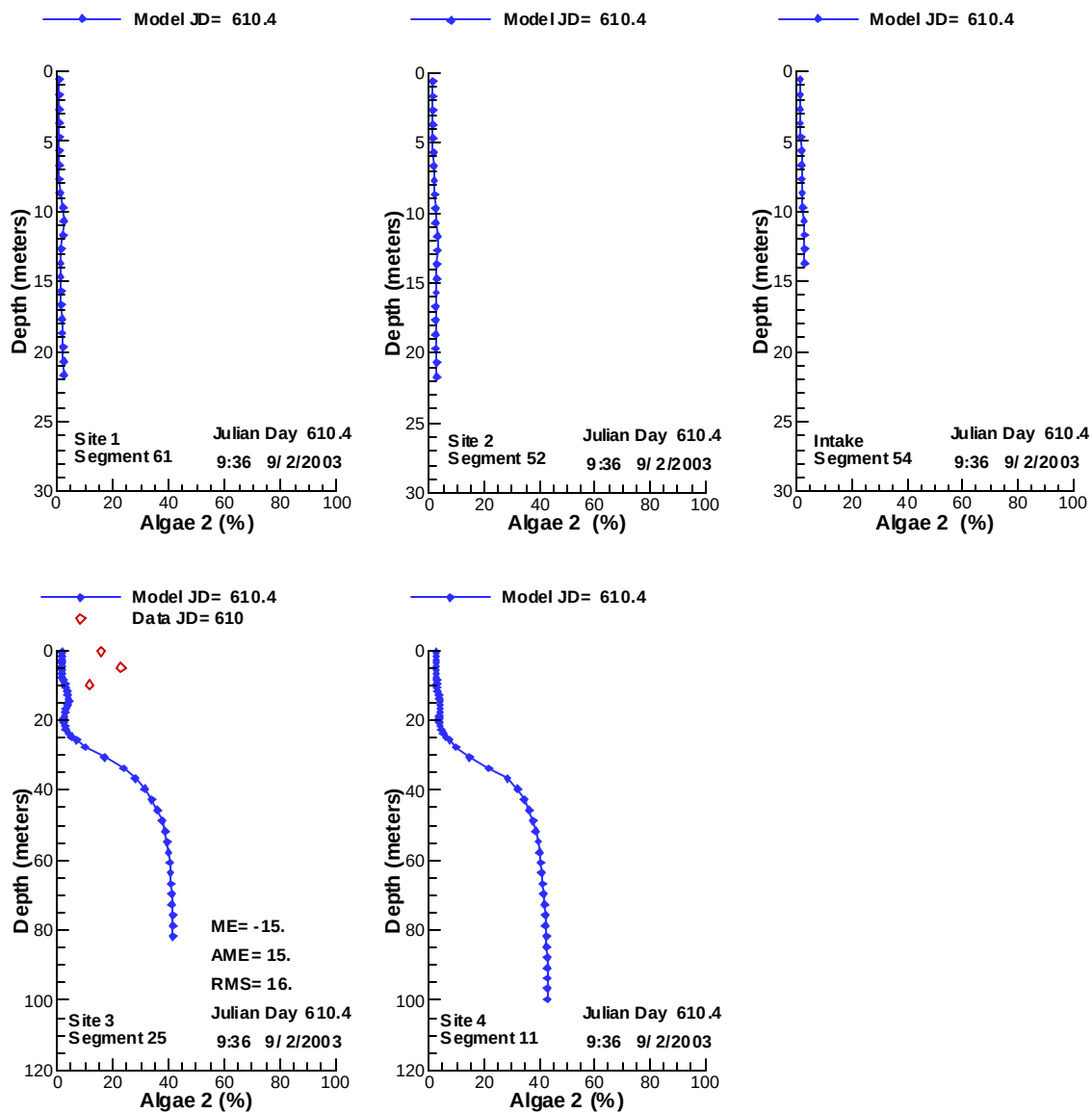


Figure 718. Vertical profiles of ALGAE 2 compared with data for 9/ 2/2003.

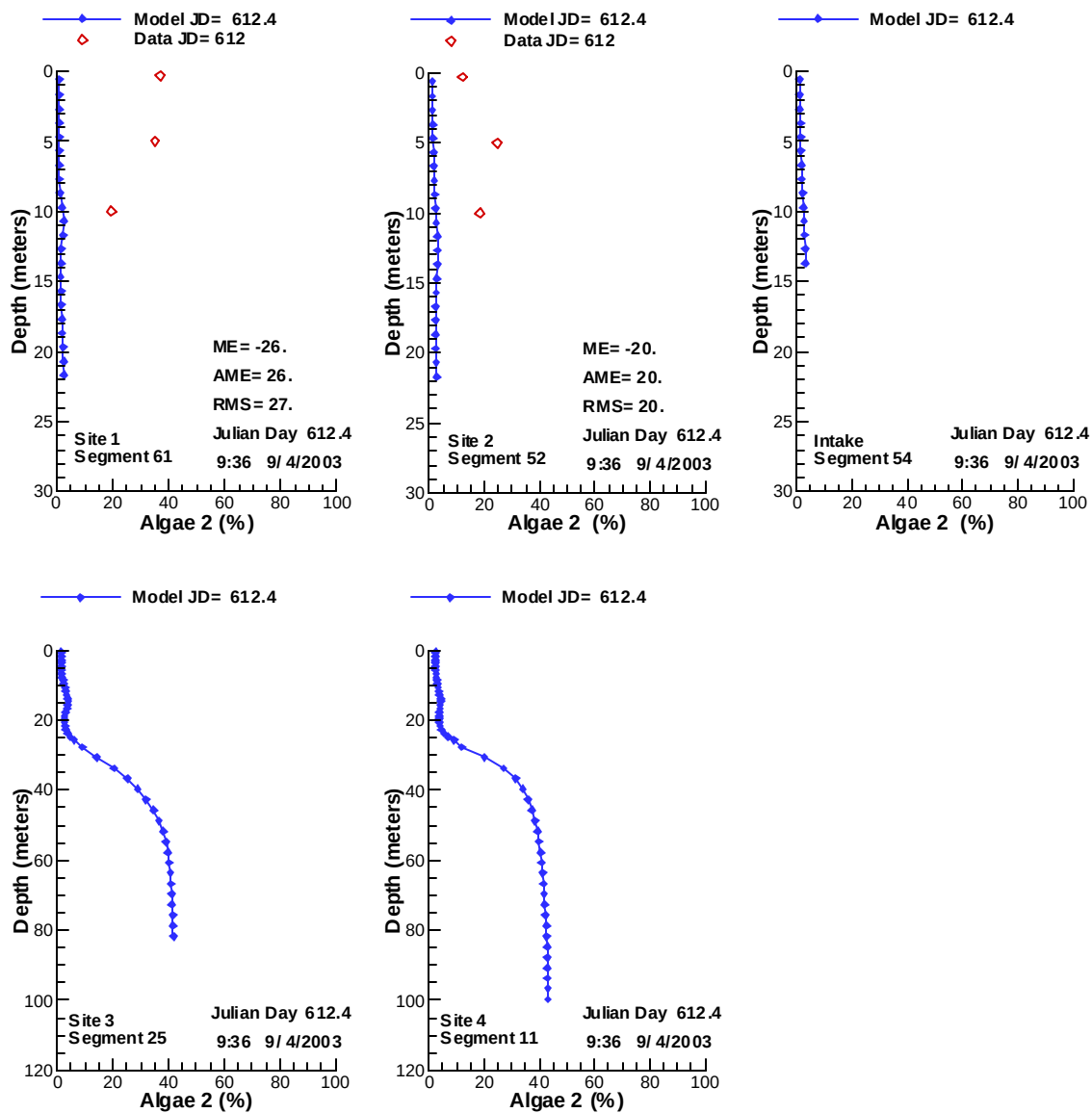


Figure 719. Vertical profiles of ALGAE 2 compared with data for 9/ 4/2003.

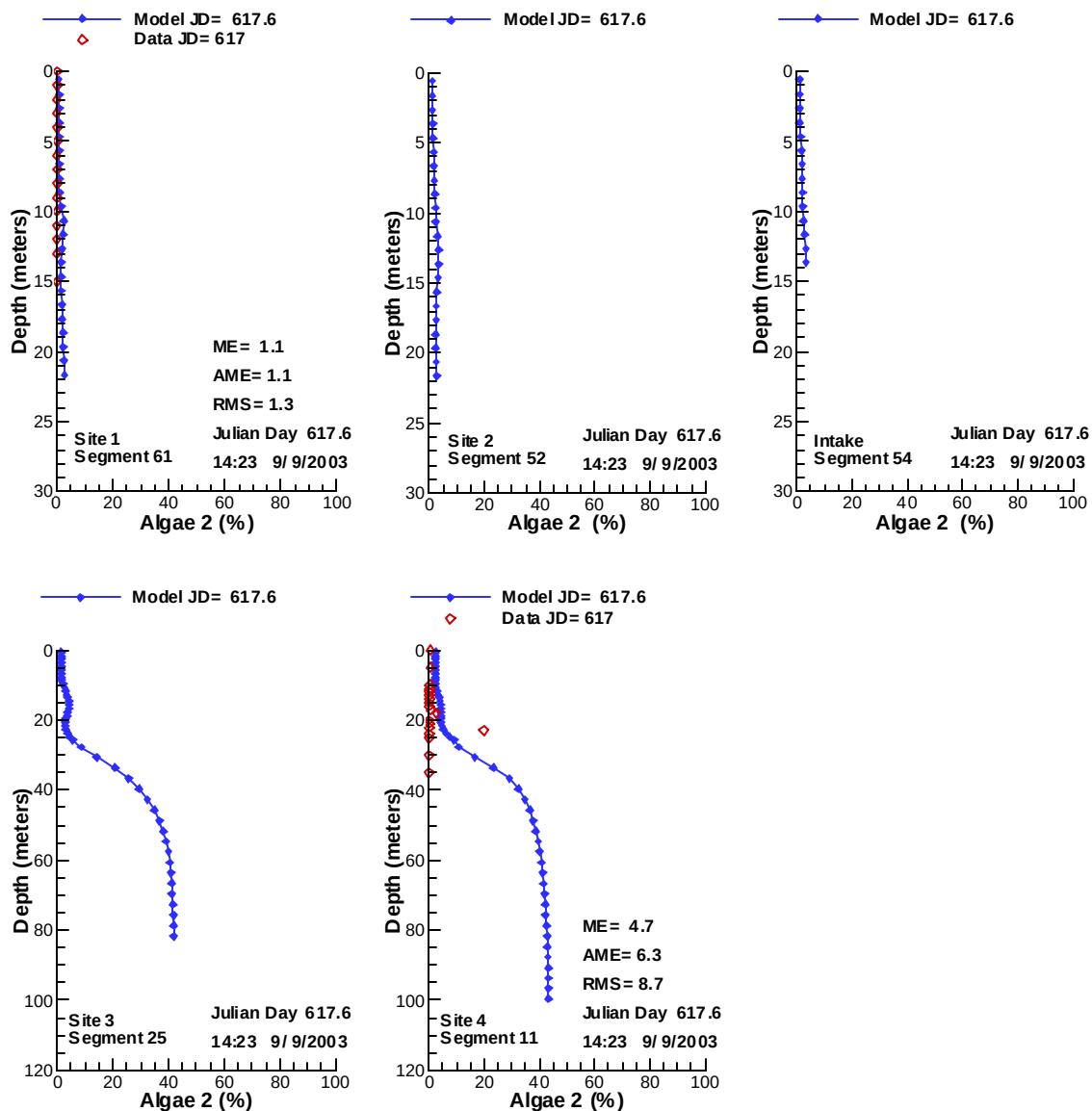


Figure 720. Vertical profiles of ALGAE 2 compared with data for 9/ 9/2003.

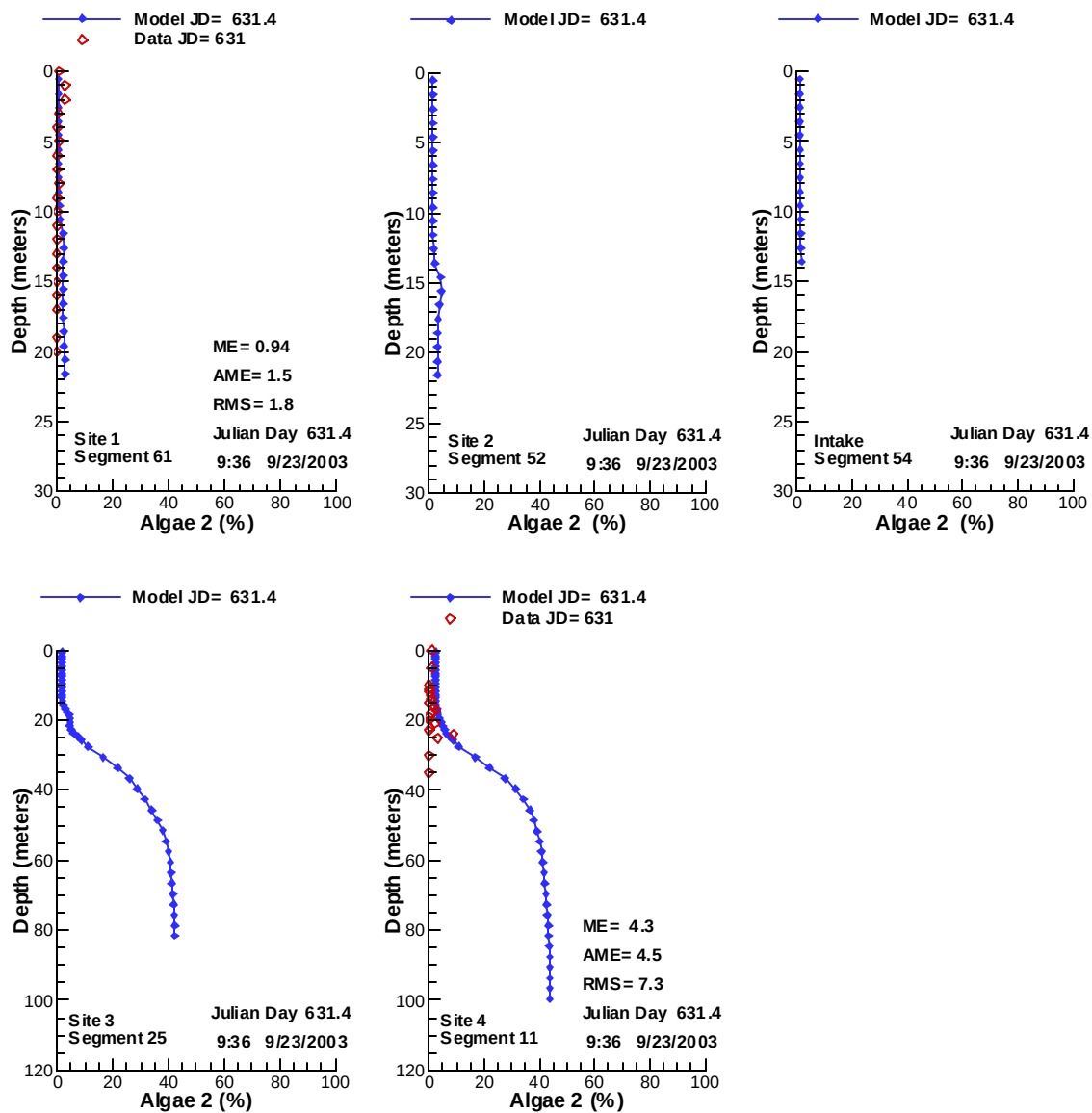


Figure 721. Vertical profiles of ALGAE 2 compared with data for 9/23/2003.

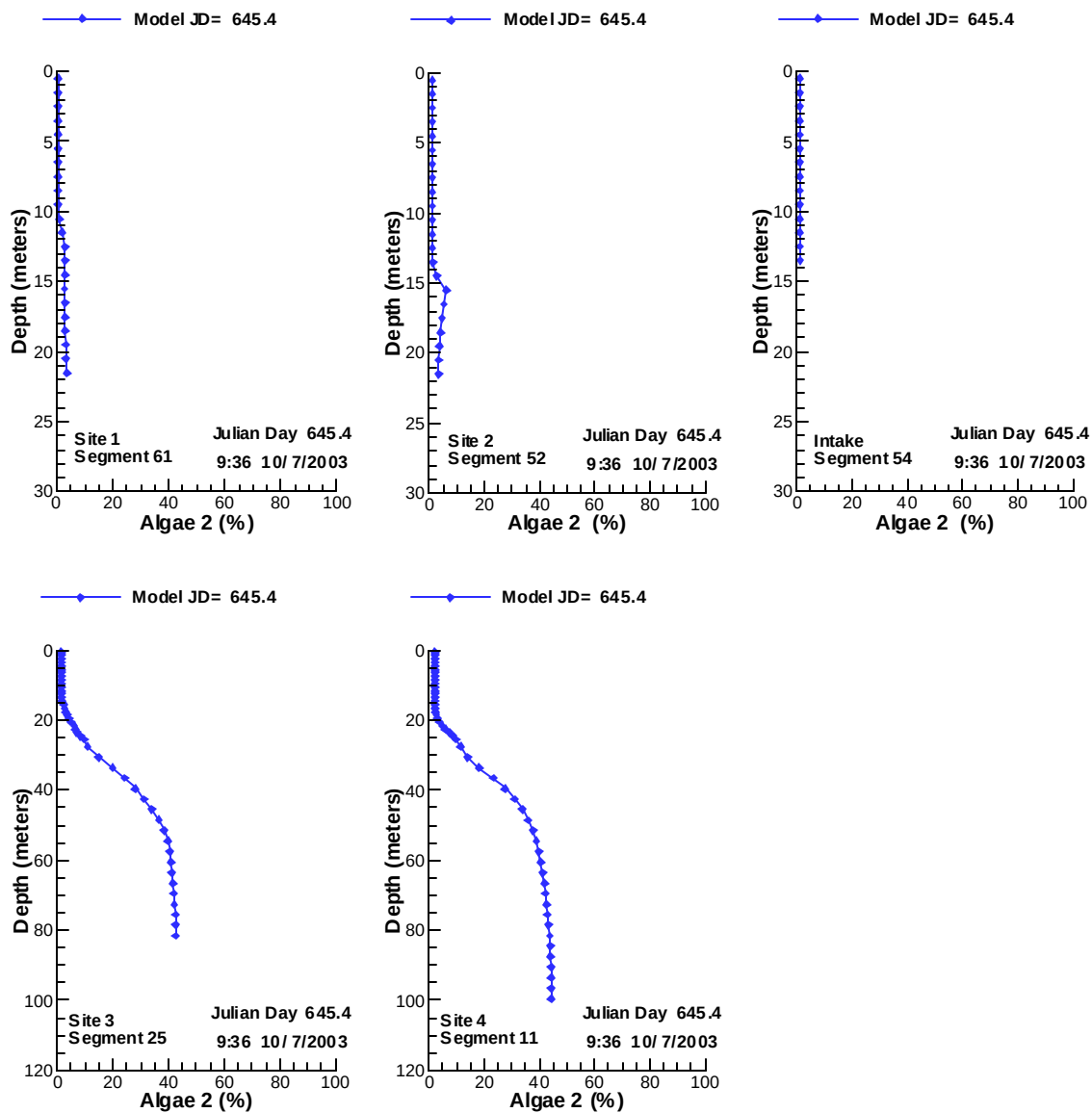


Figure 722. Vertical profiles of ALGAE 2 compared with data for 10/ 7/2003.

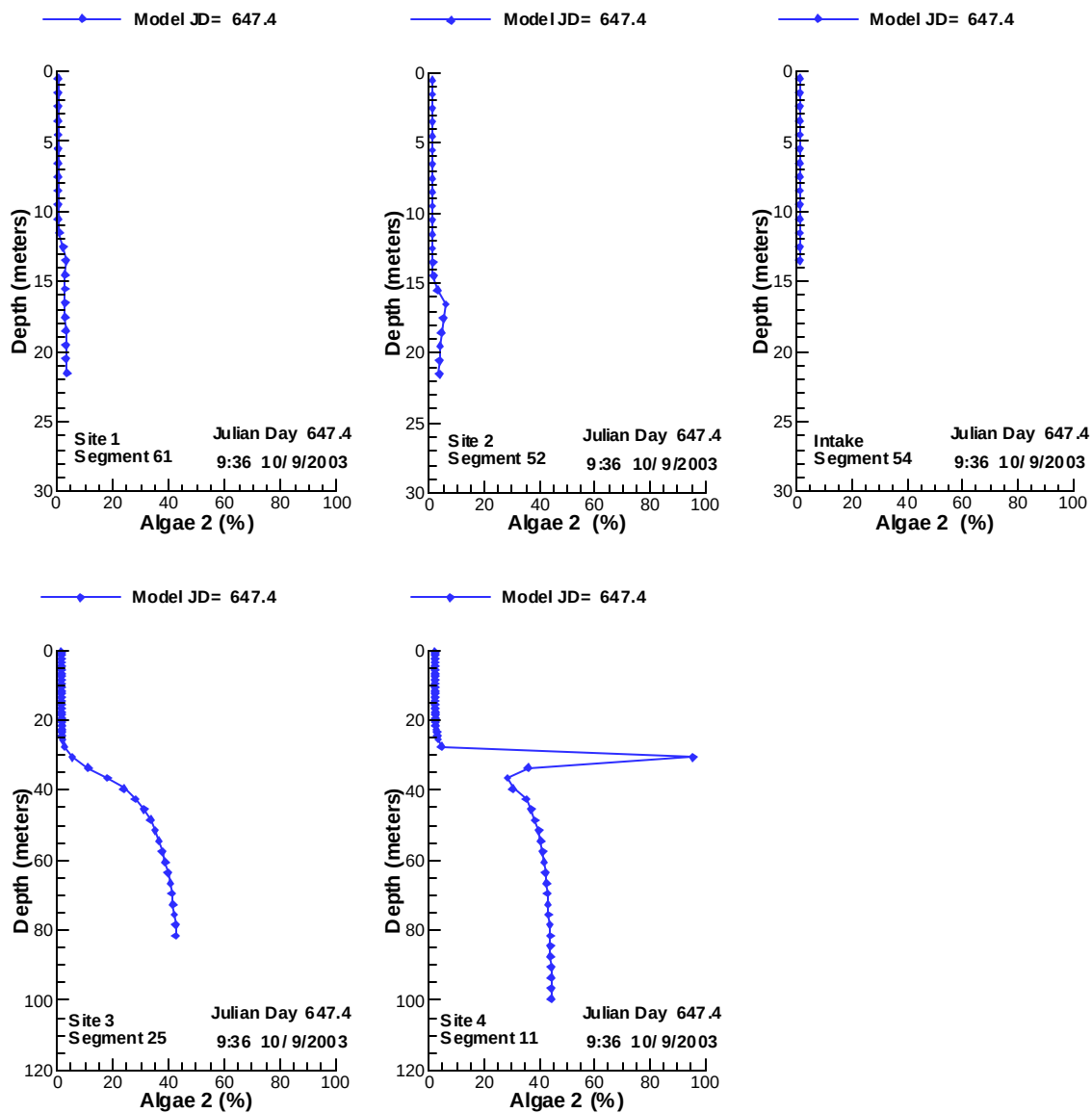


Figure 723. Vertical profiles of ALGAE 2 compared with data for 10/ 9/2003.

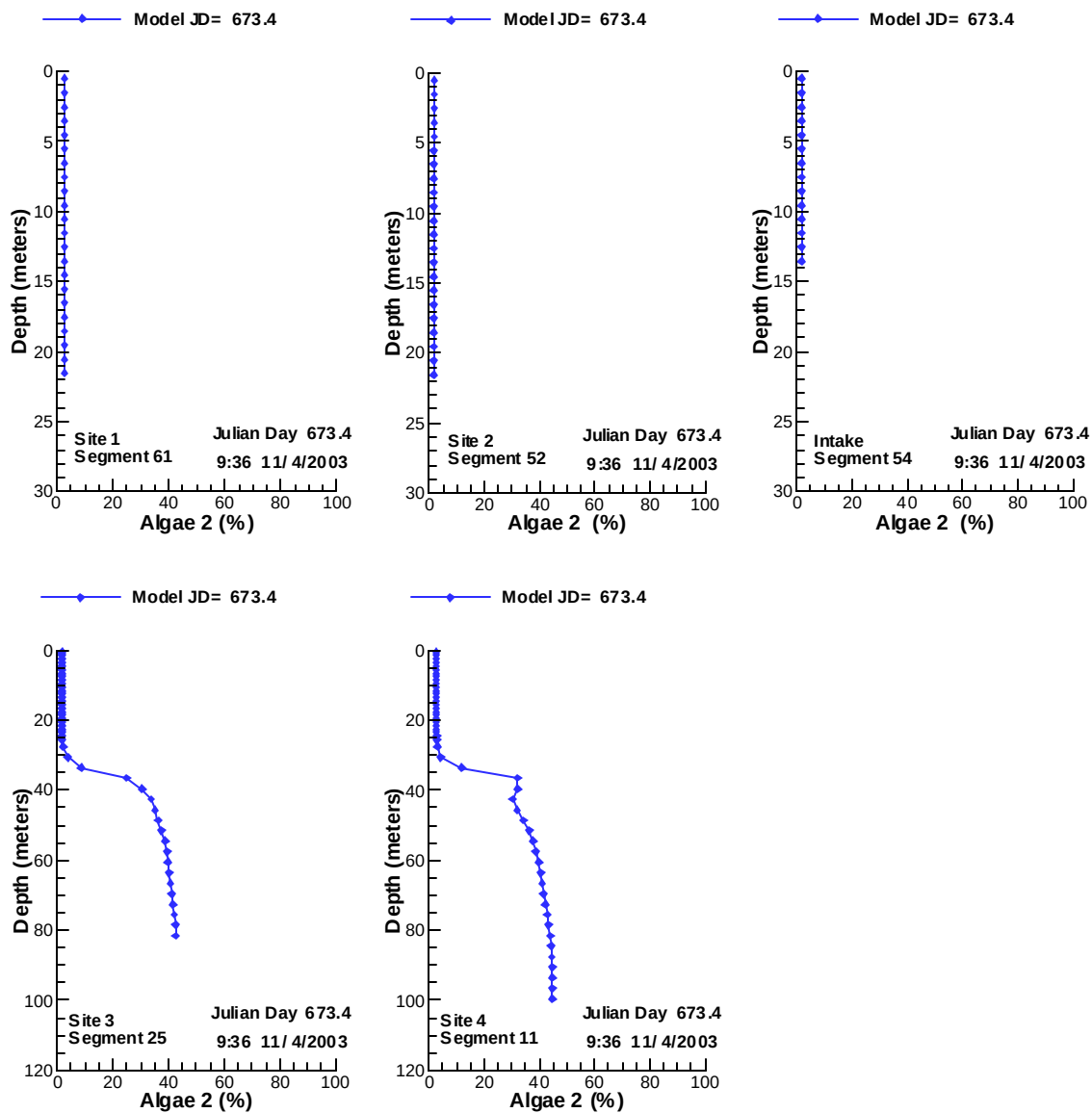


Figure 724. Vertical profiles of ALGAE 2 compared with data for 11/ 4/2003.

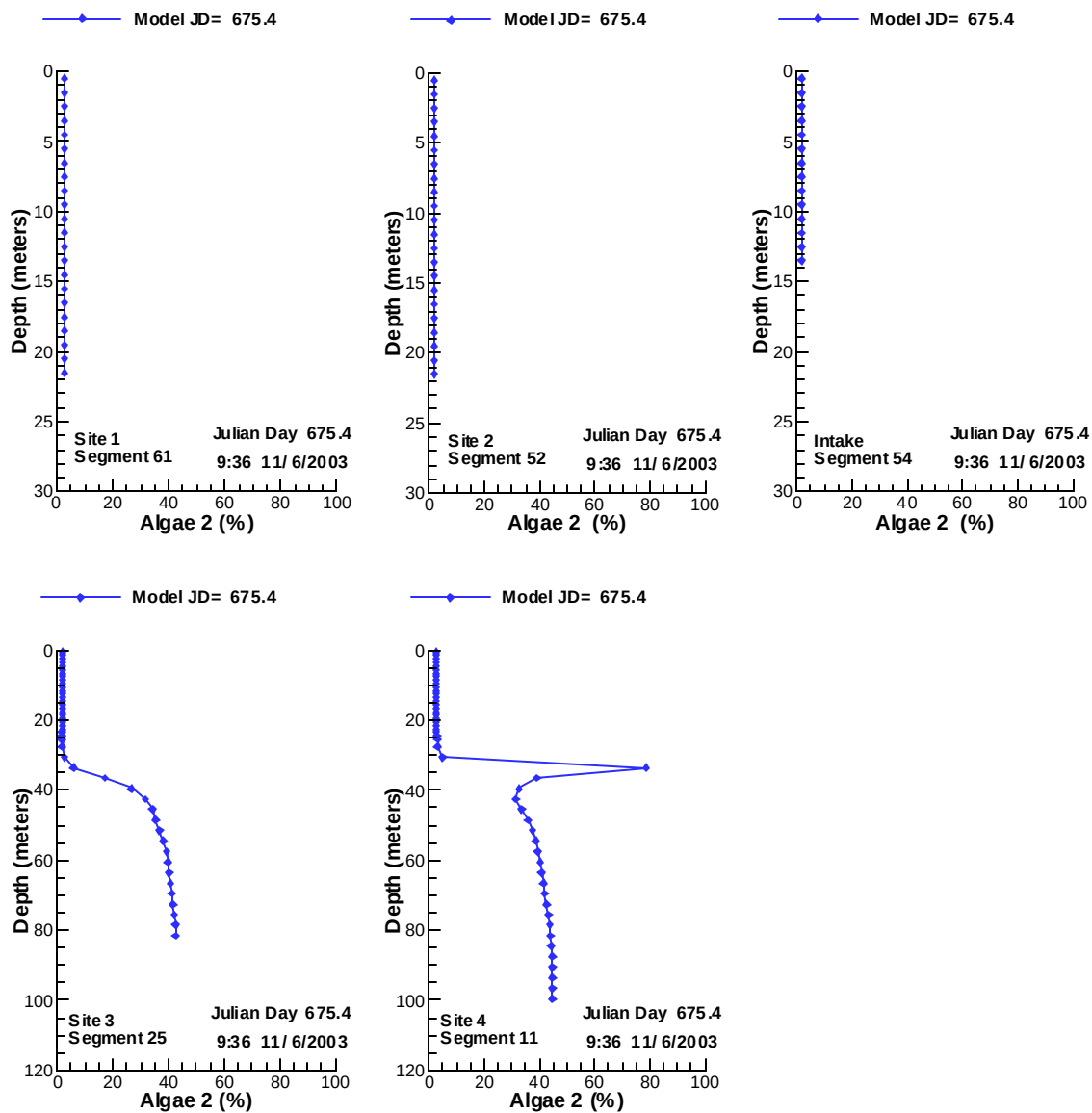


Figure 725. Vertical profiles of ALGAE 2 compared with data for 11/ 6/2003.

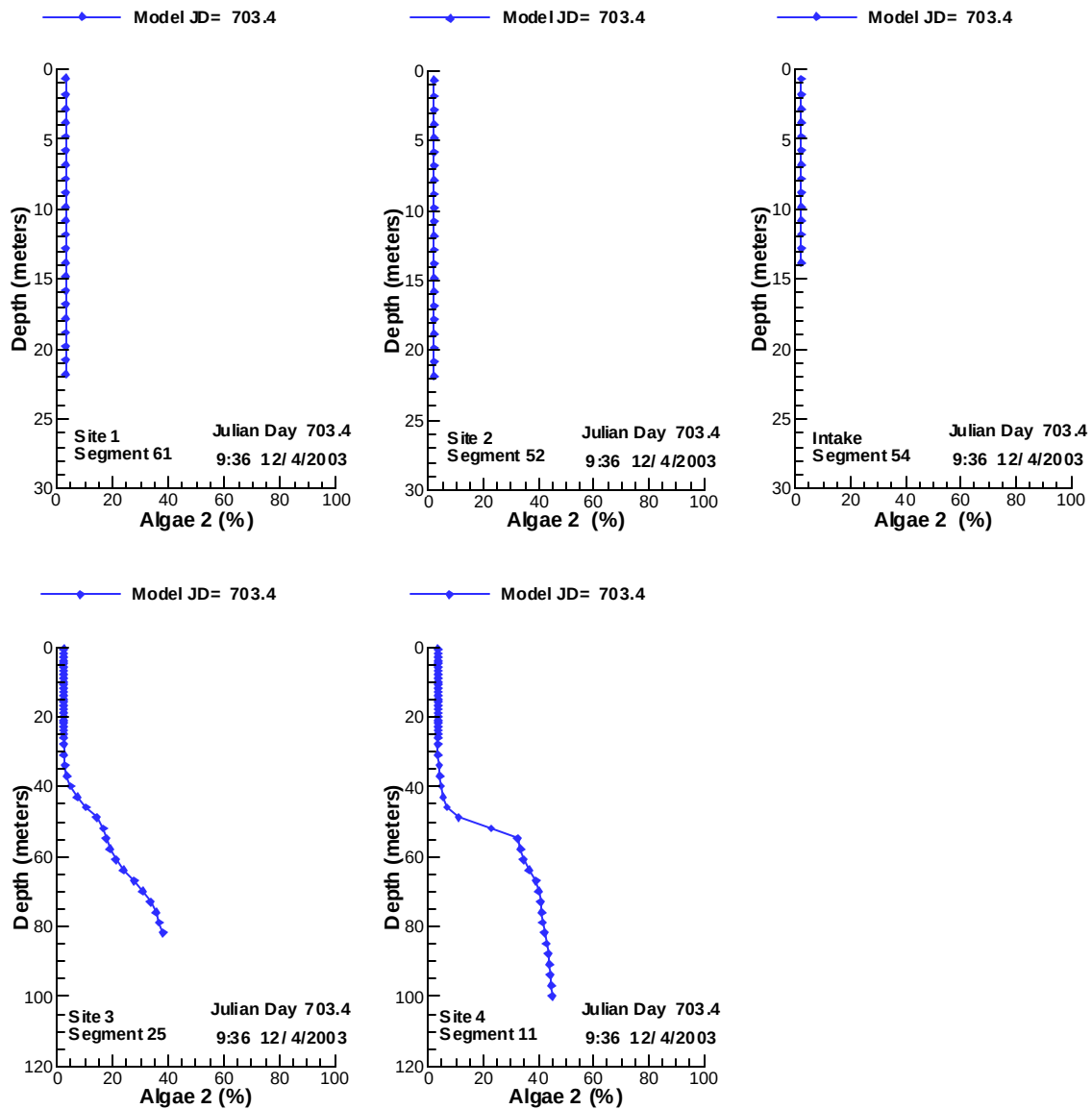


Figure 726. Vertical profiles of ALGAE 2 compared with data for 12/ 4/2003.

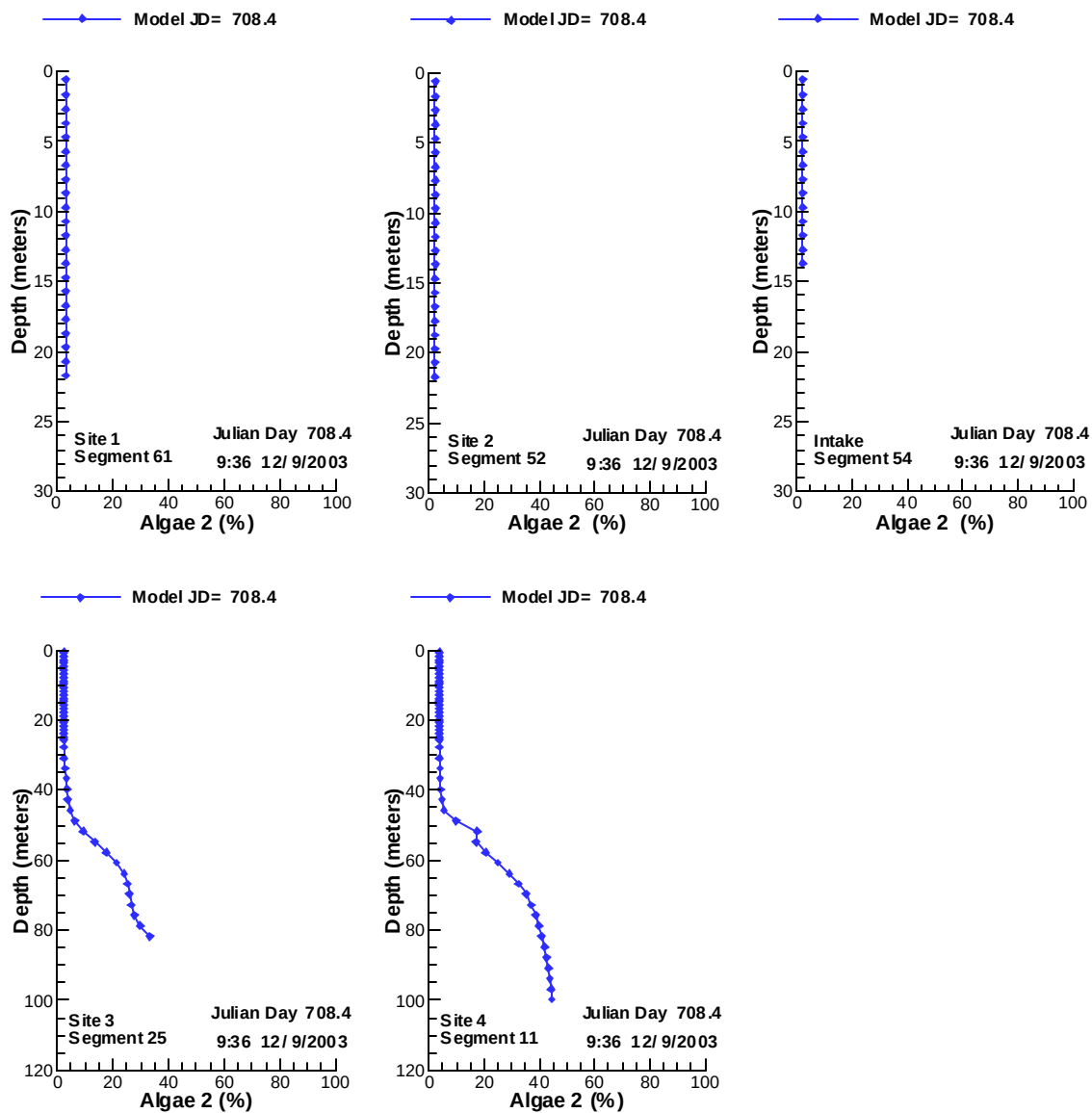


Figure 727. Vertical profiles of ALGAE 2 compared with data for 12/ 9/2003.

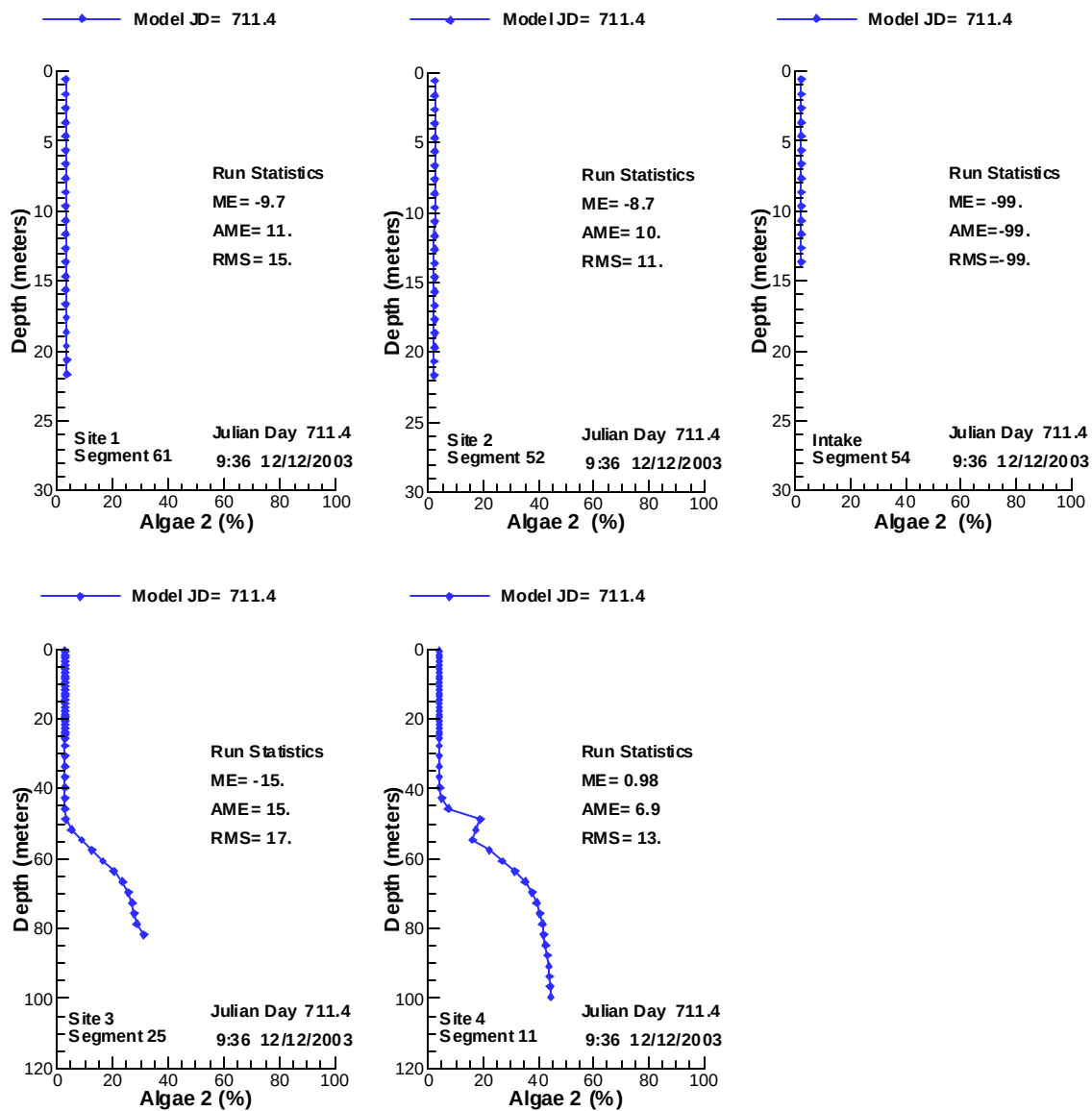


Figure 728. Vertical profiles of ALGAE 2 compared with data for 12/12/2003.

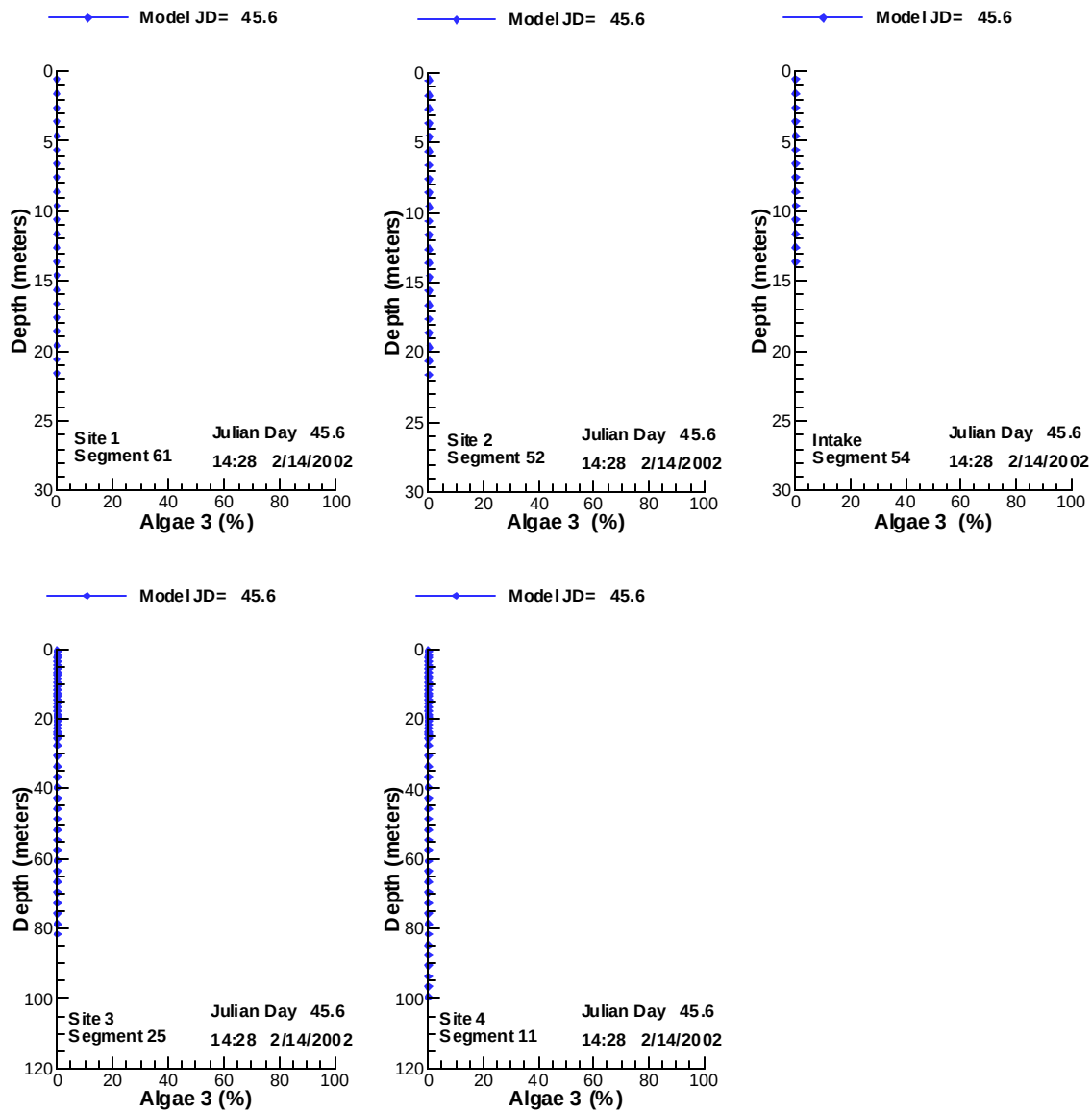


Figure 729. Vertical profiles of ALGAE 3 compared with data for 2/14/2002.

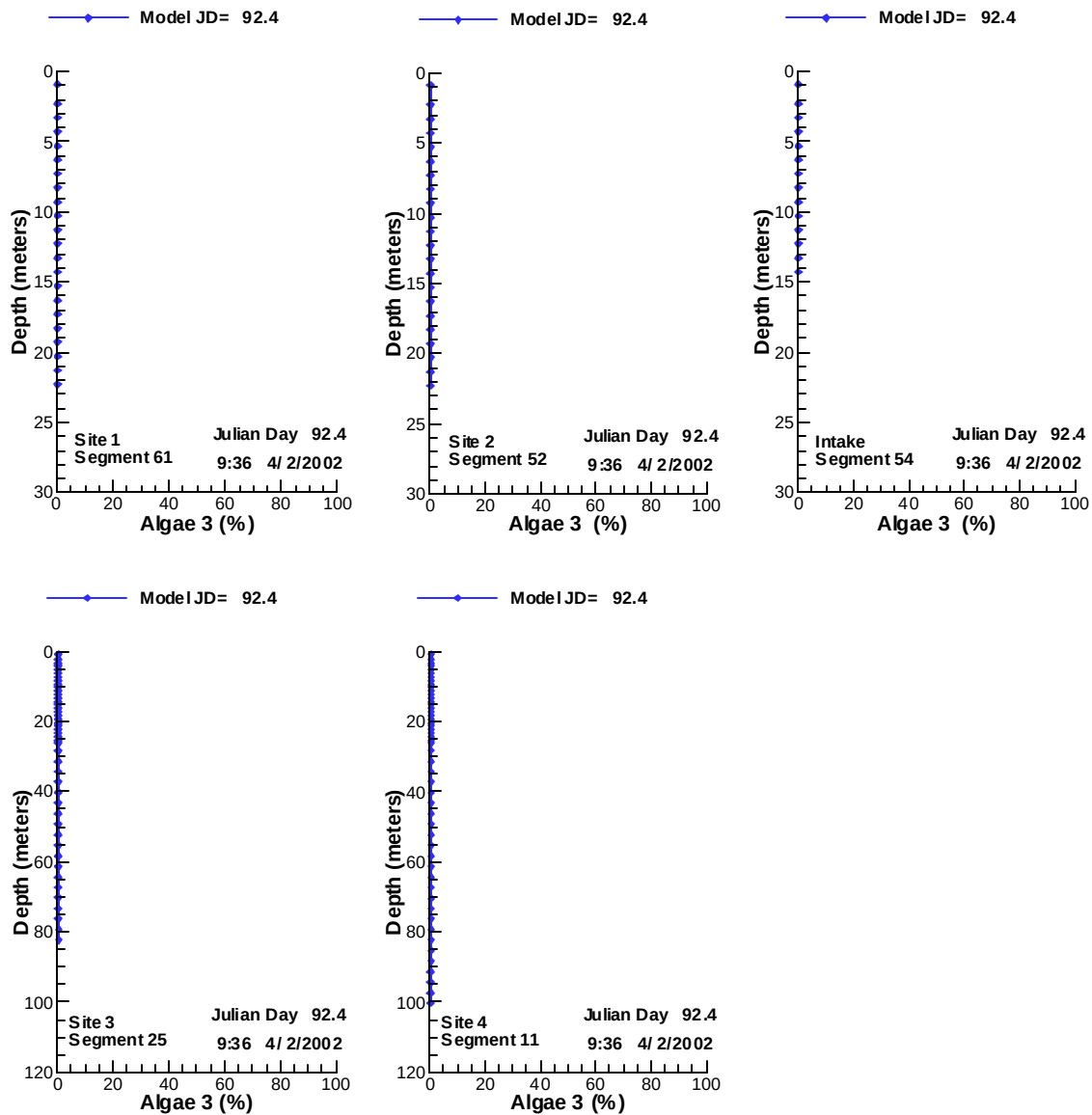


Figure 730. Vertical profiles of ALGAE 3 compared with data for 4/ 2/2002.

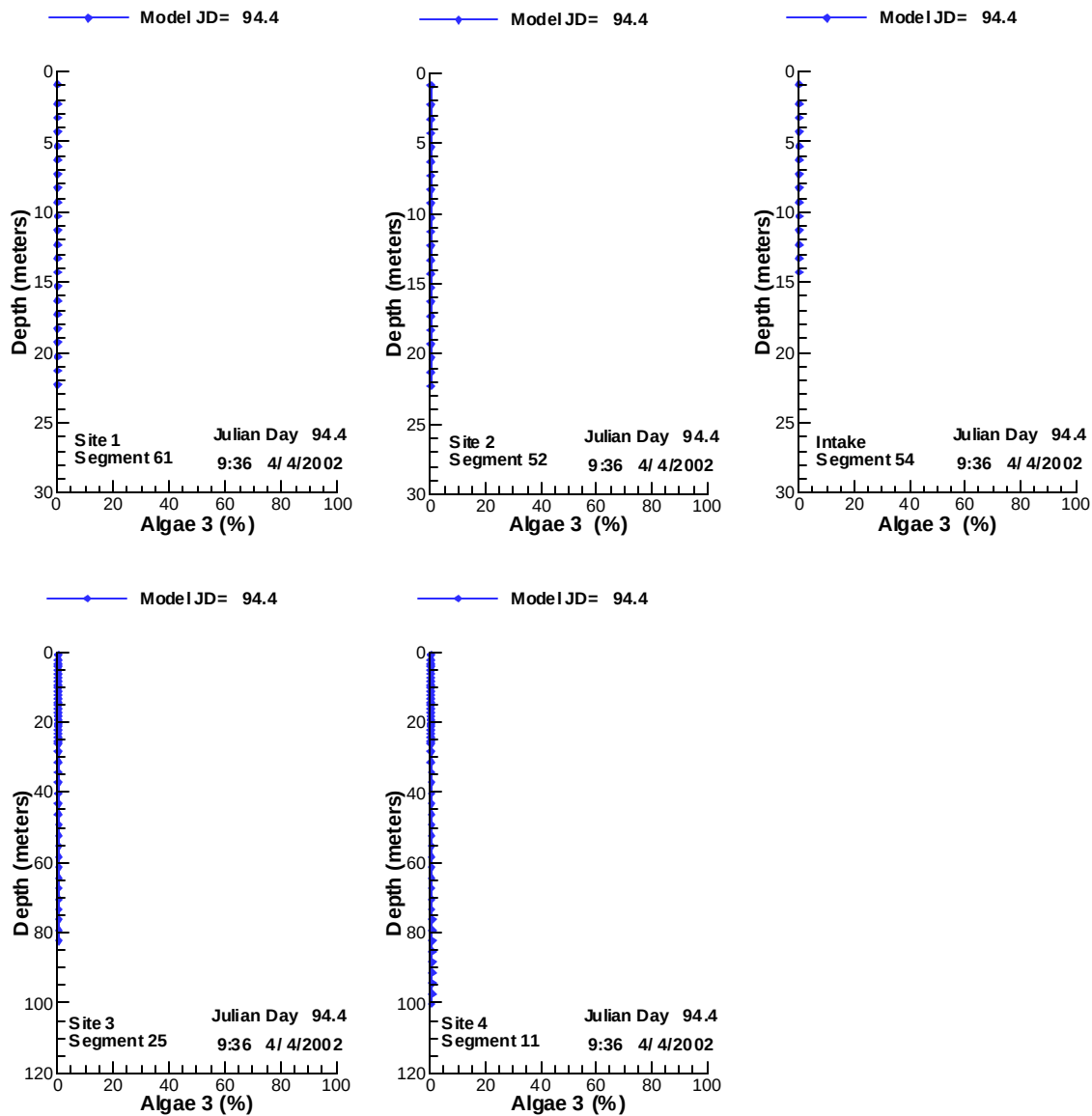


Figure 731. Vertical profiles of ALGAE 3 compared with data for 4/4/2002.

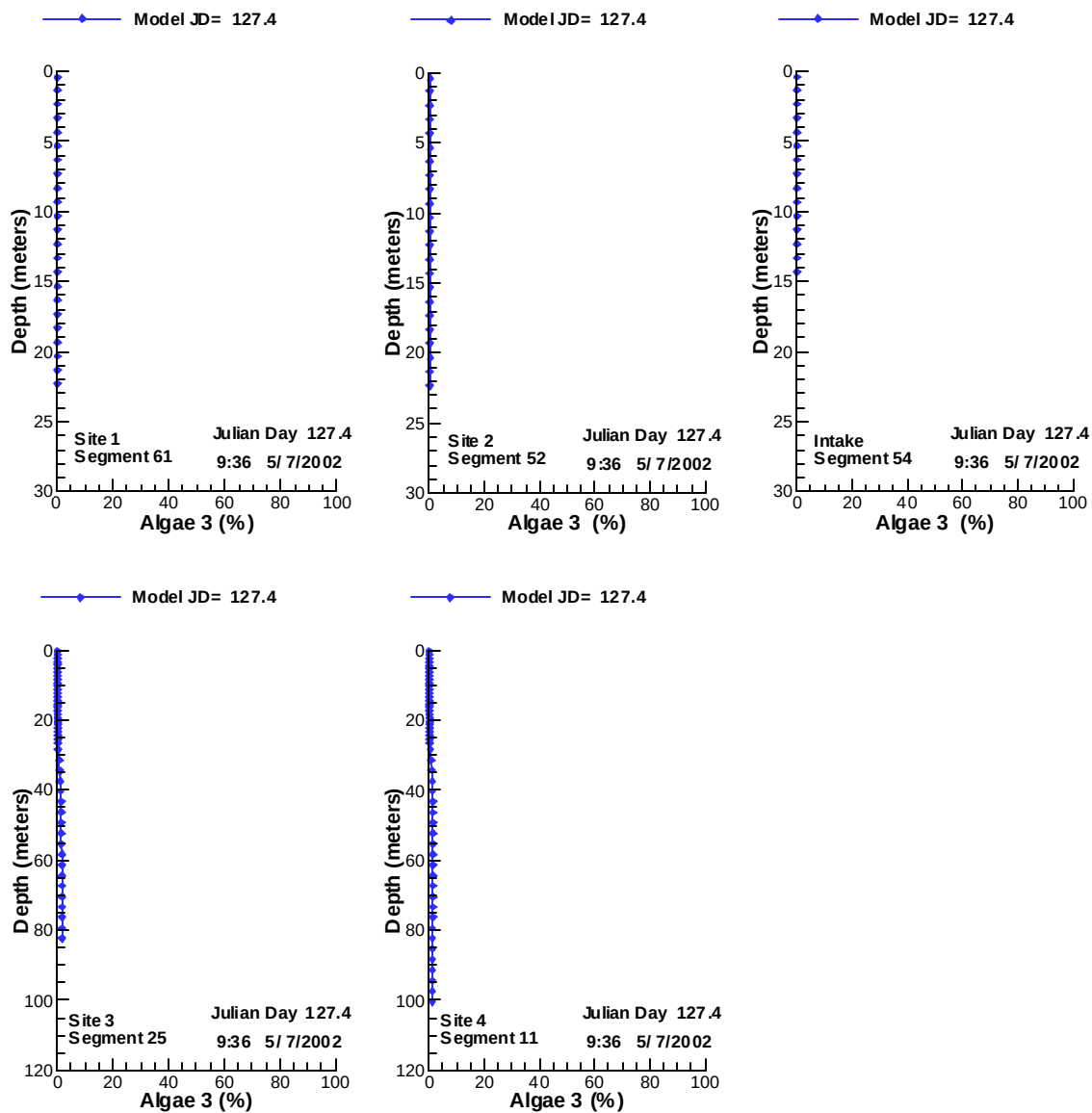


Figure 732. Vertical profiles of ALGAE 3 compared with data for 5/ 7/2002.

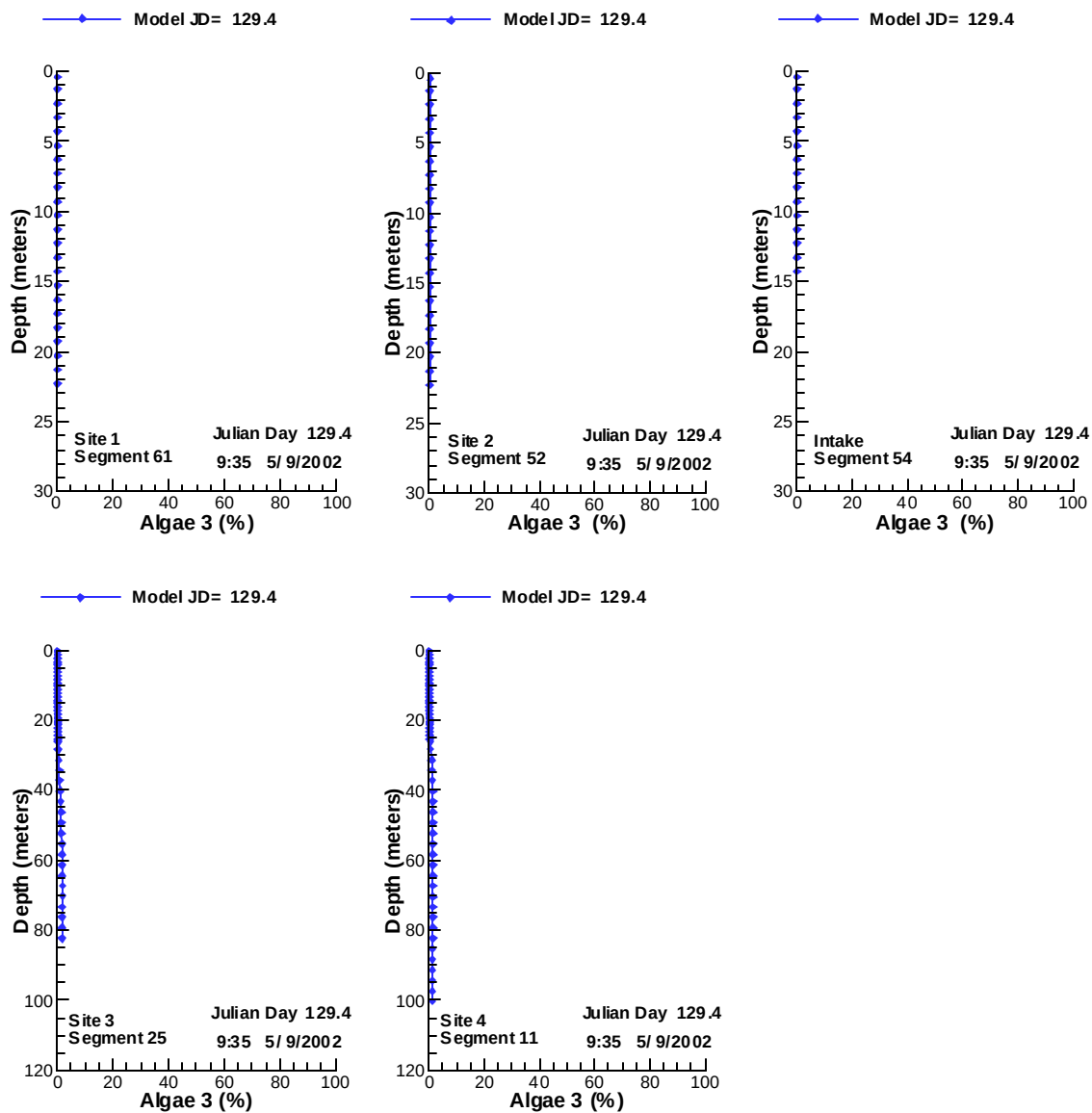


Figure 733. Vertical profiles of ALGAE 3 compared with data for 5/ 9/2002.

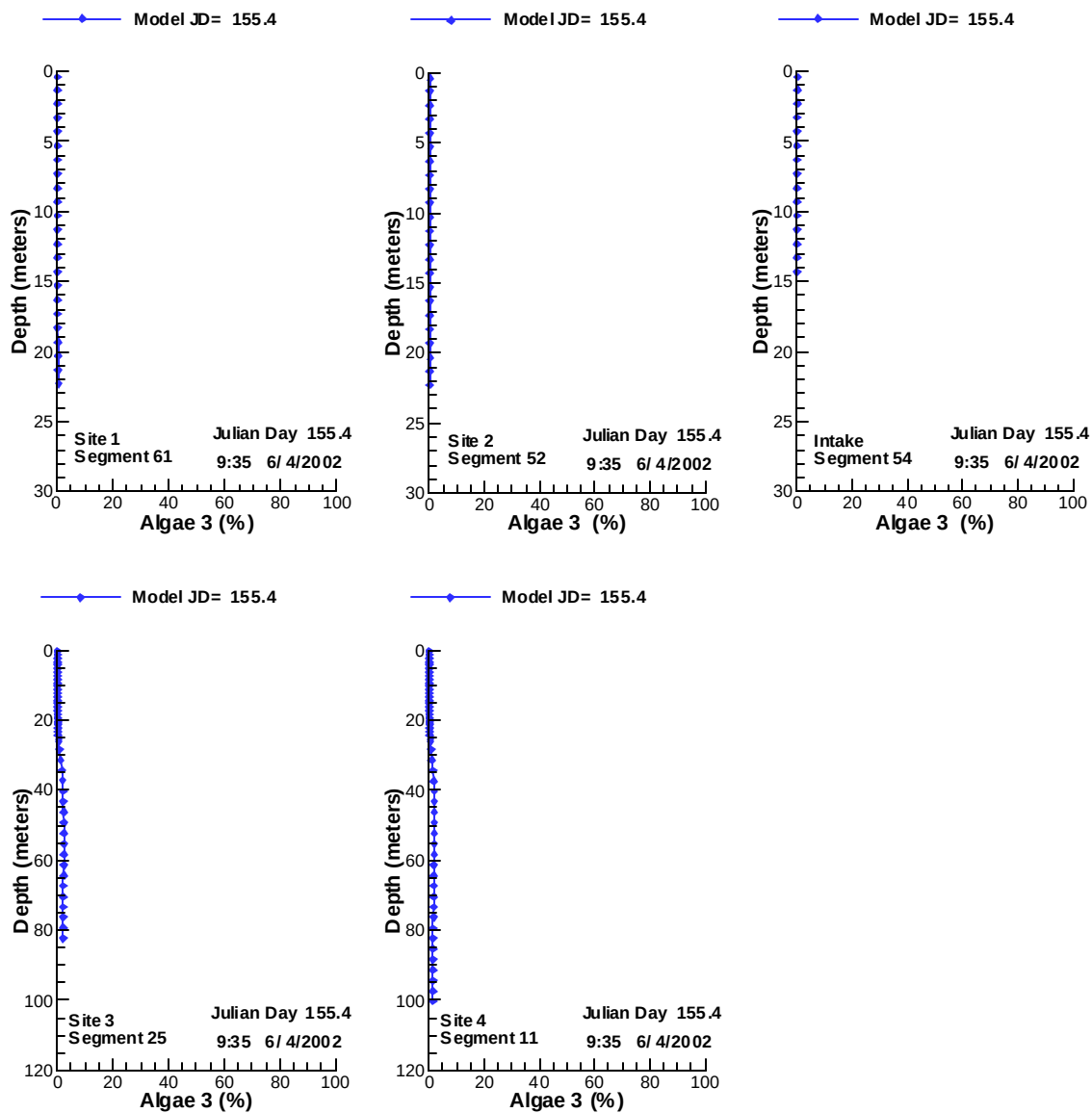


Figure 734. Vertical profiles of ALGAE 3 compared with data for 6/ 4/2002.

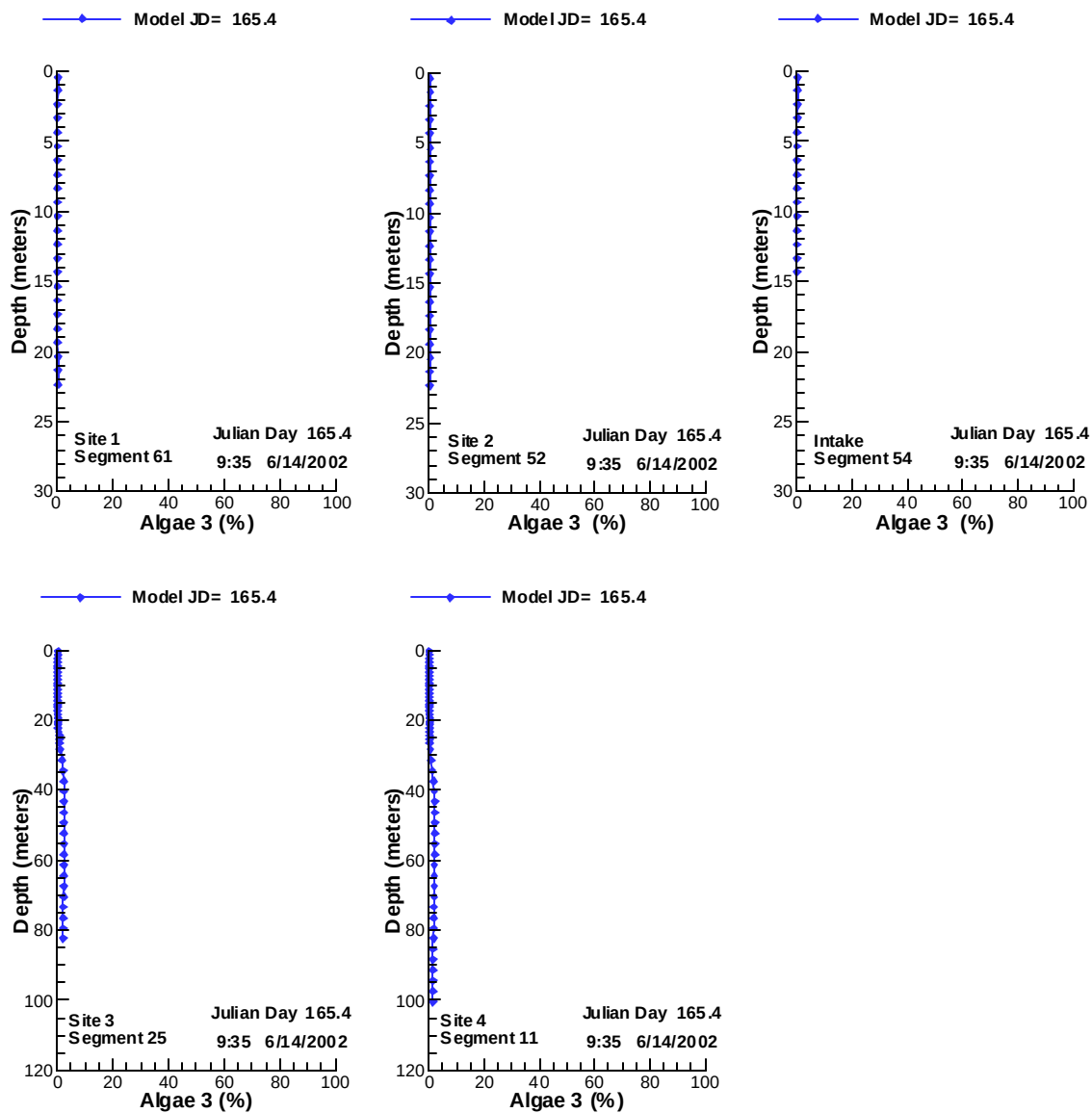


Figure 735. Vertical profiles of ALGAE 3 compared with data for 6/14/2002.

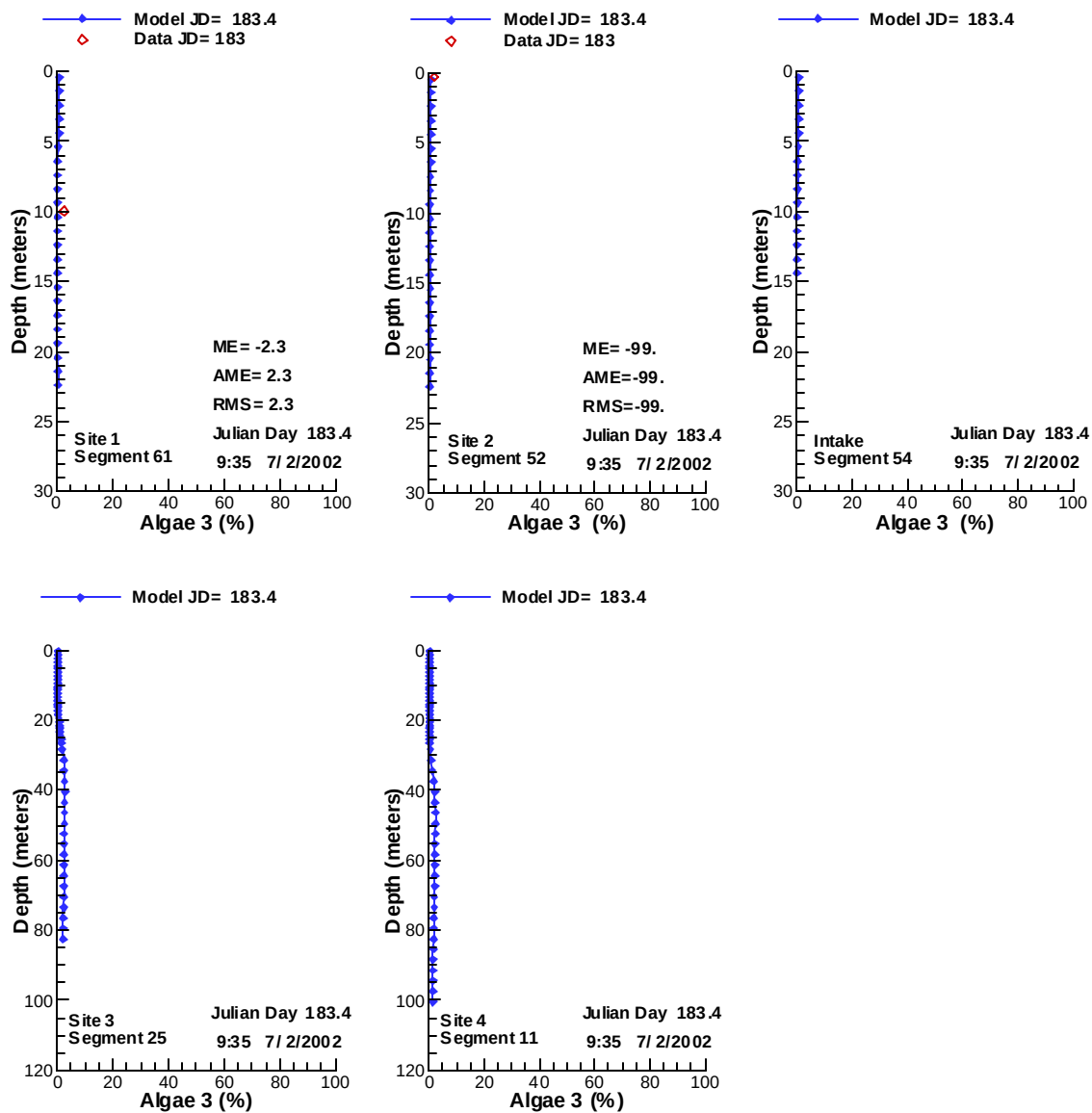


Figure 736. Vertical profiles of ALGAE 3 compared with data for 7/ 2/2002.

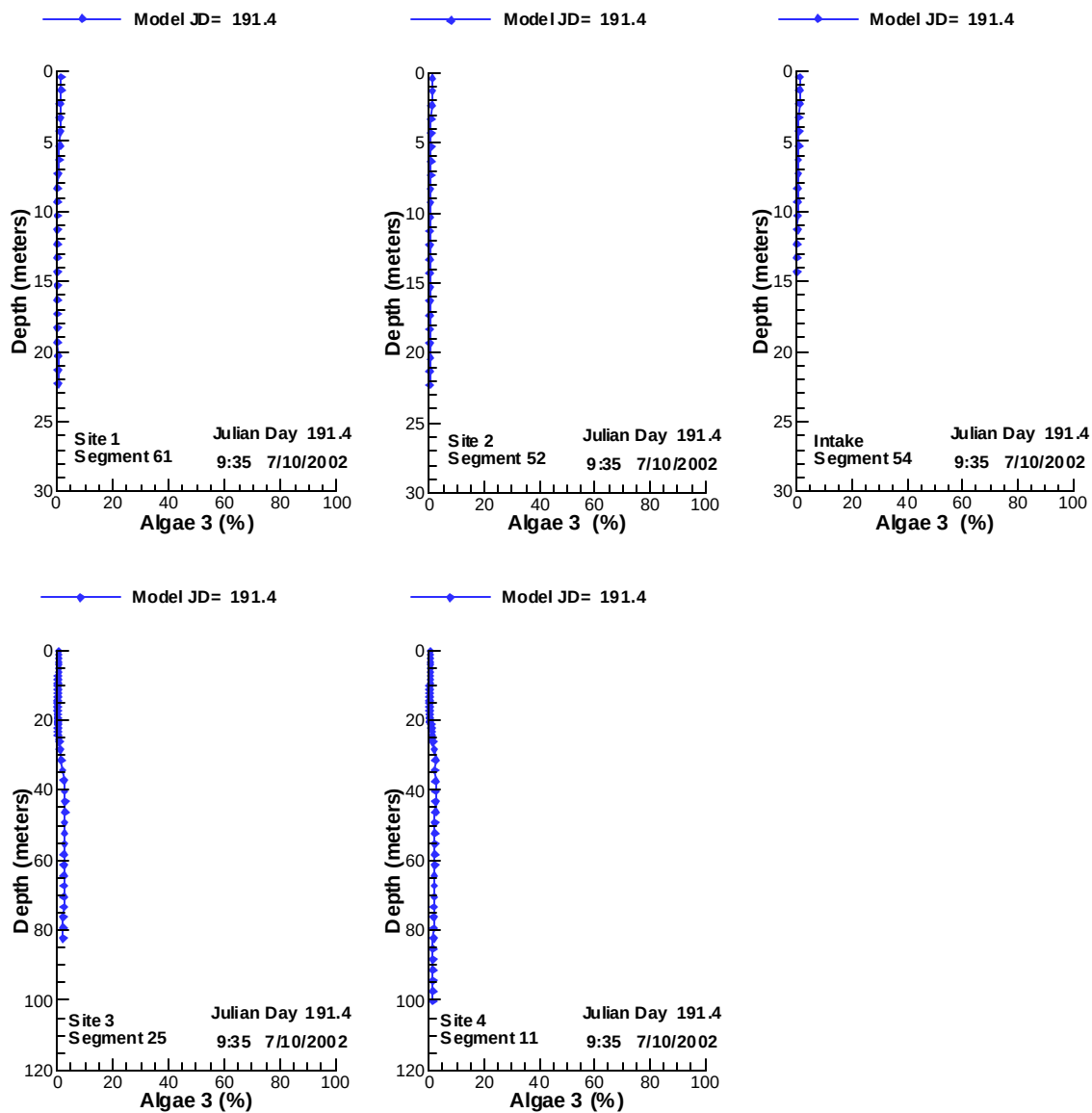


Figure 737. Vertical profiles of ALGAE 3 compared with data for 7/10/2002.

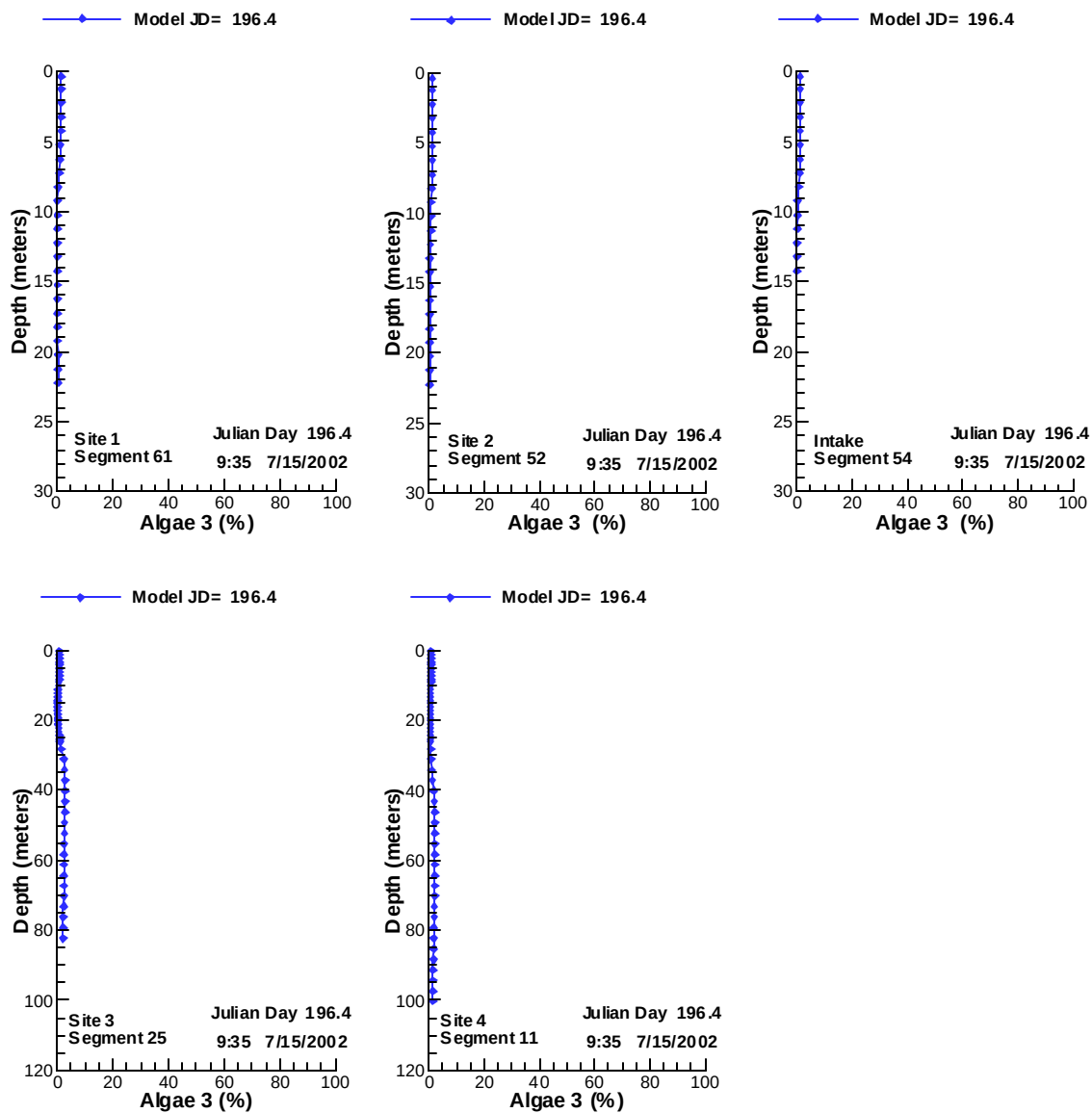


Figure 738. Vertical profiles of ALGAE 3 compared with data for 7/15/2002.

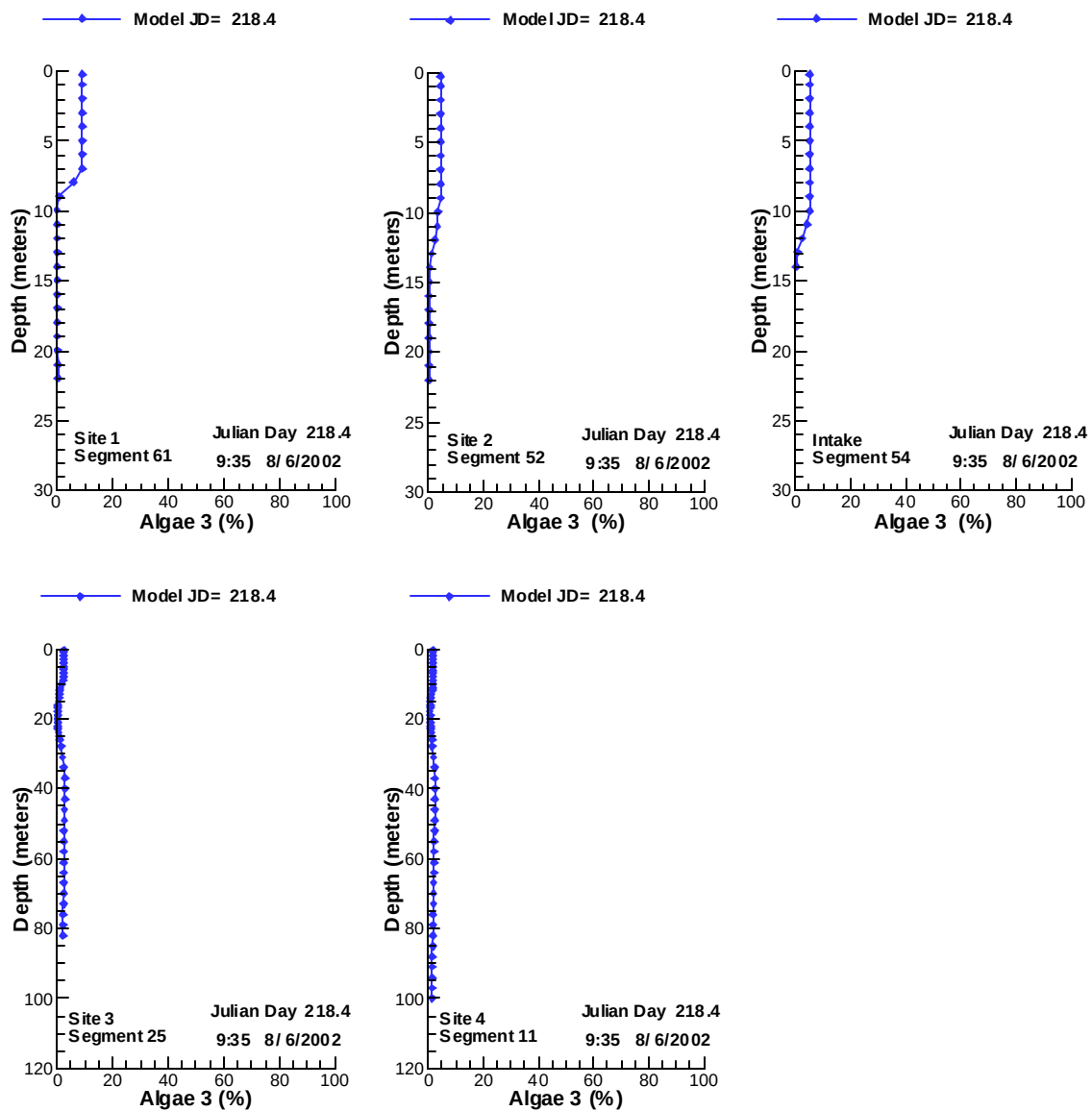


Figure 739. Vertical profiles of ALGAE 3 compared with data for 8/ 6/2002.

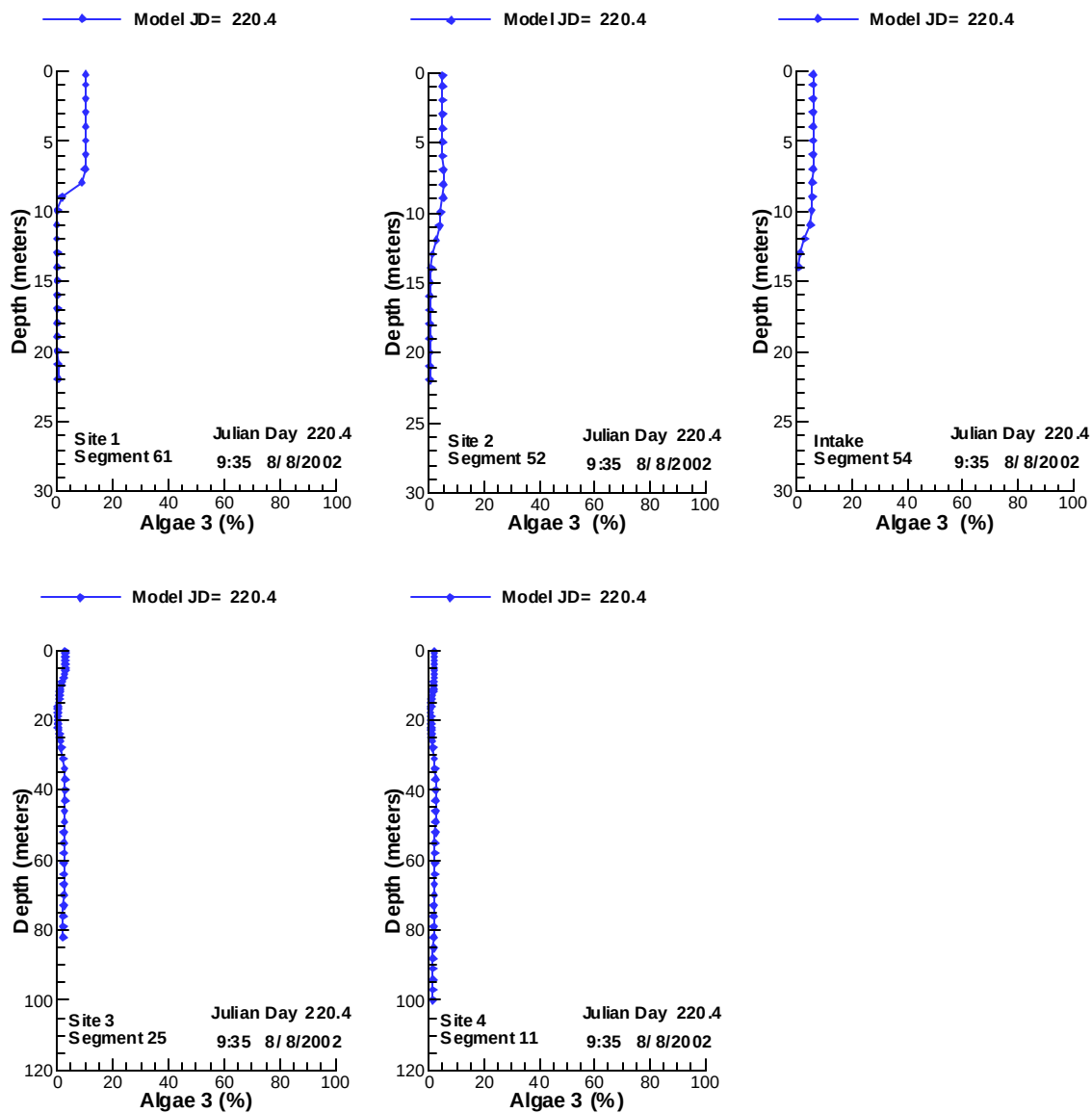


Figure 740. Vertical profiles of ALGAE 3 compared with data for 8/ 8/2002.

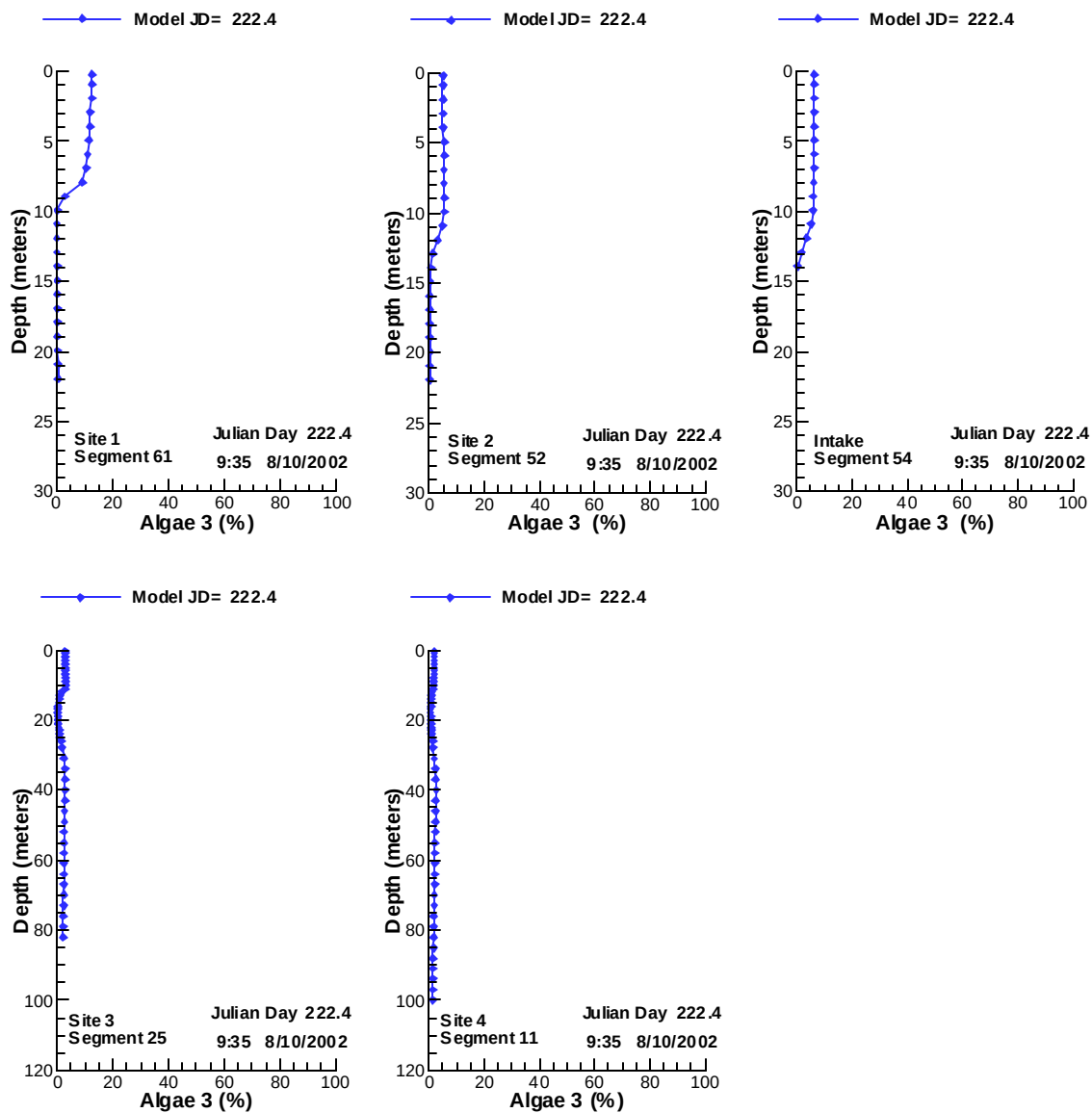


Figure 741. Vertical profiles of ALGAE 3 compared with data for 8/10/2002.

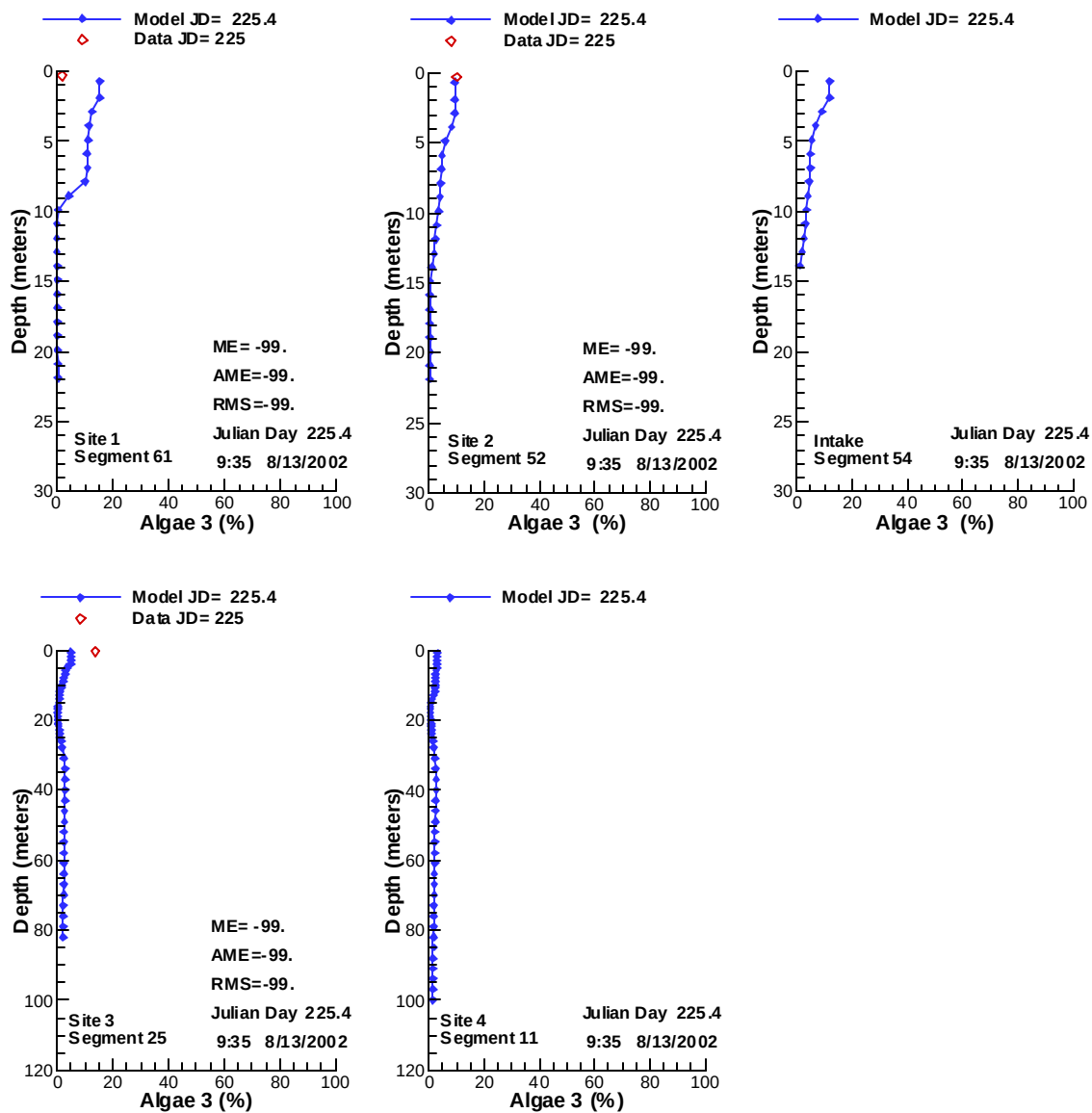


Figure 742. Vertical profiles of ALGAE 3 compared with data for 8/13/2002.

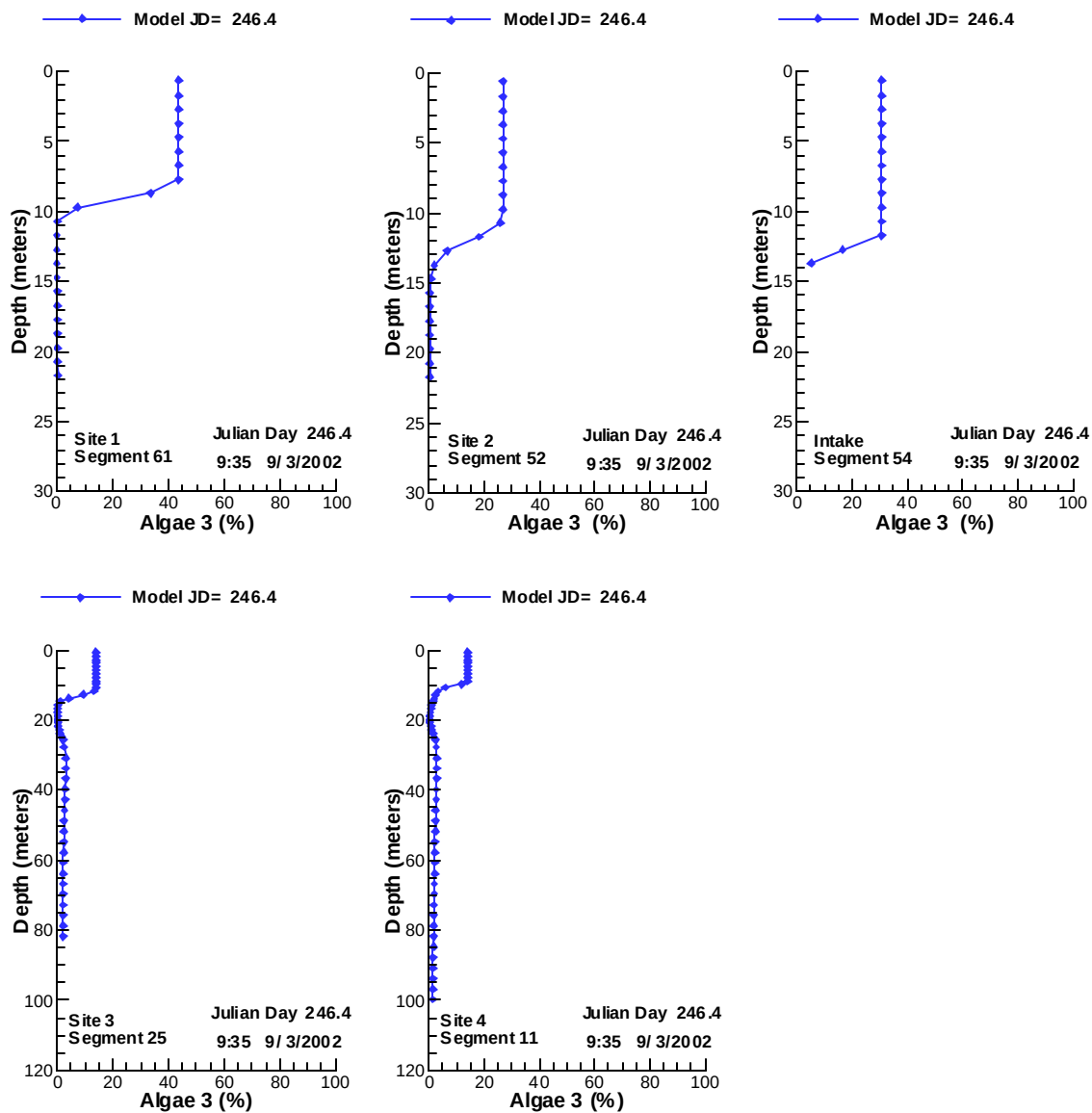


Figure 743. Vertical profiles of ALGAE 3 compared with data for 9/ 3/2002.

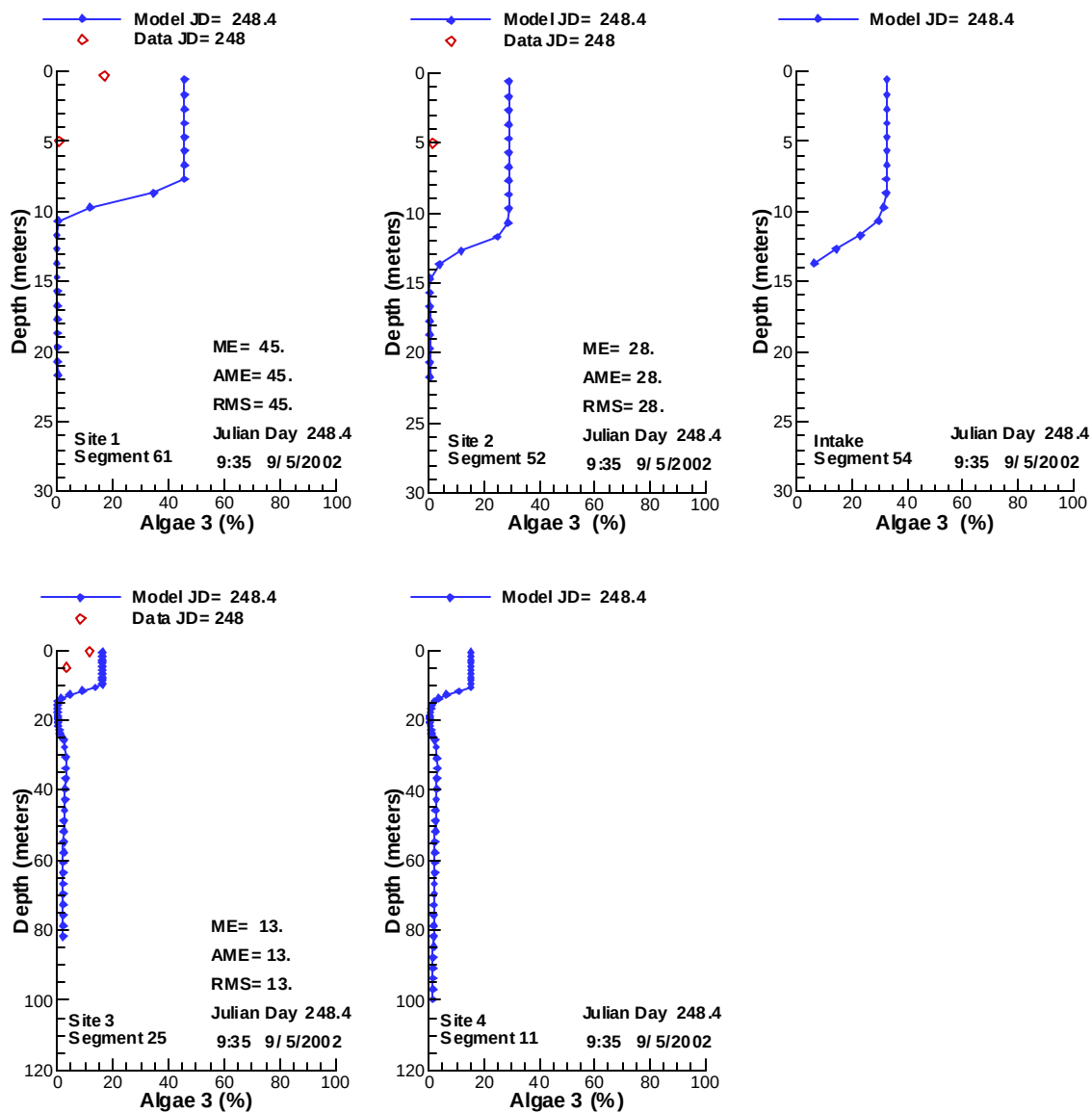


Figure 744. Vertical profiles of ALGAE 3 compared with data for 9/ 5/2002.

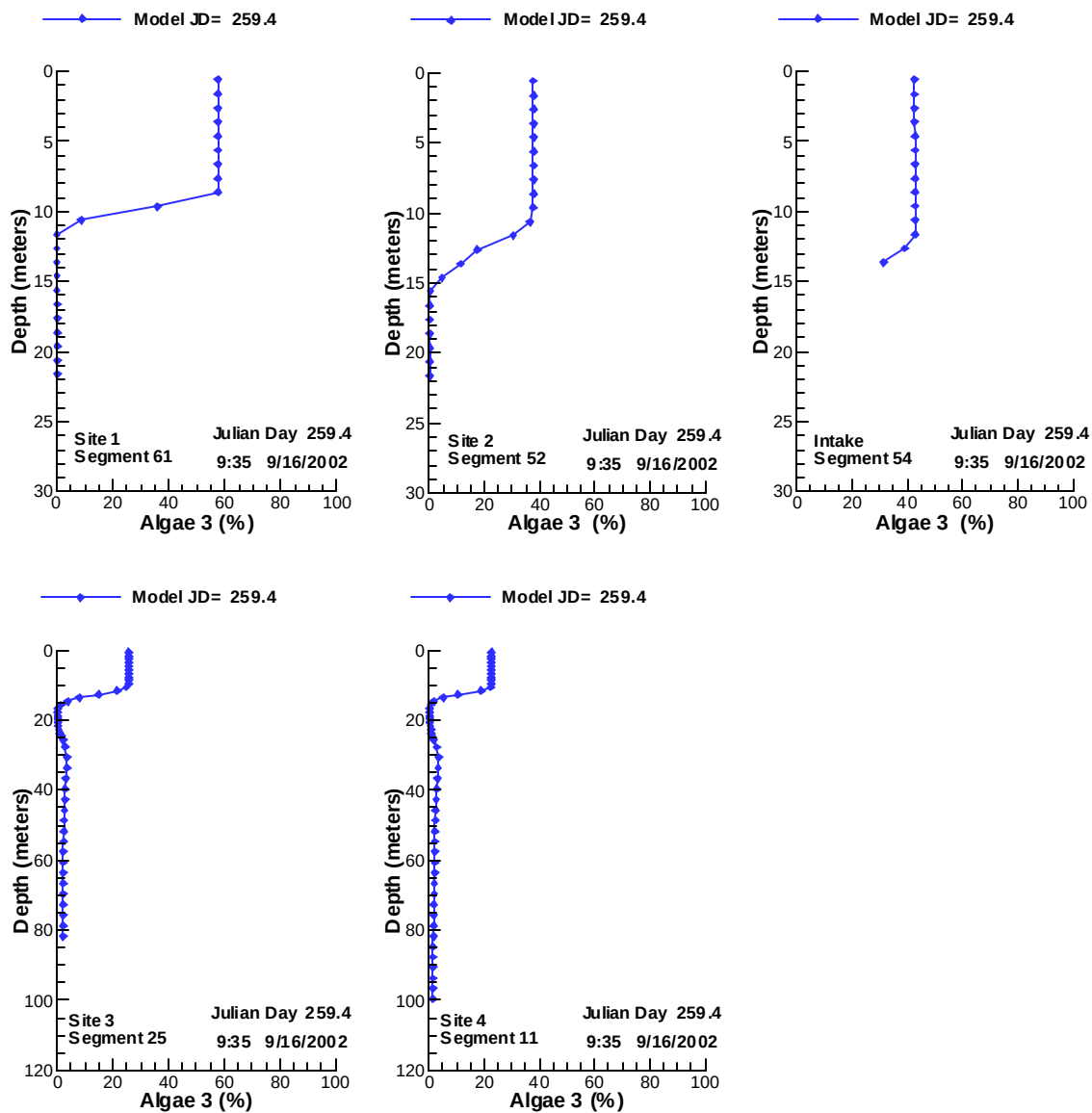


Figure 745. Vertical profiles of ALGAE 3 compared with data for 9/16/2002.

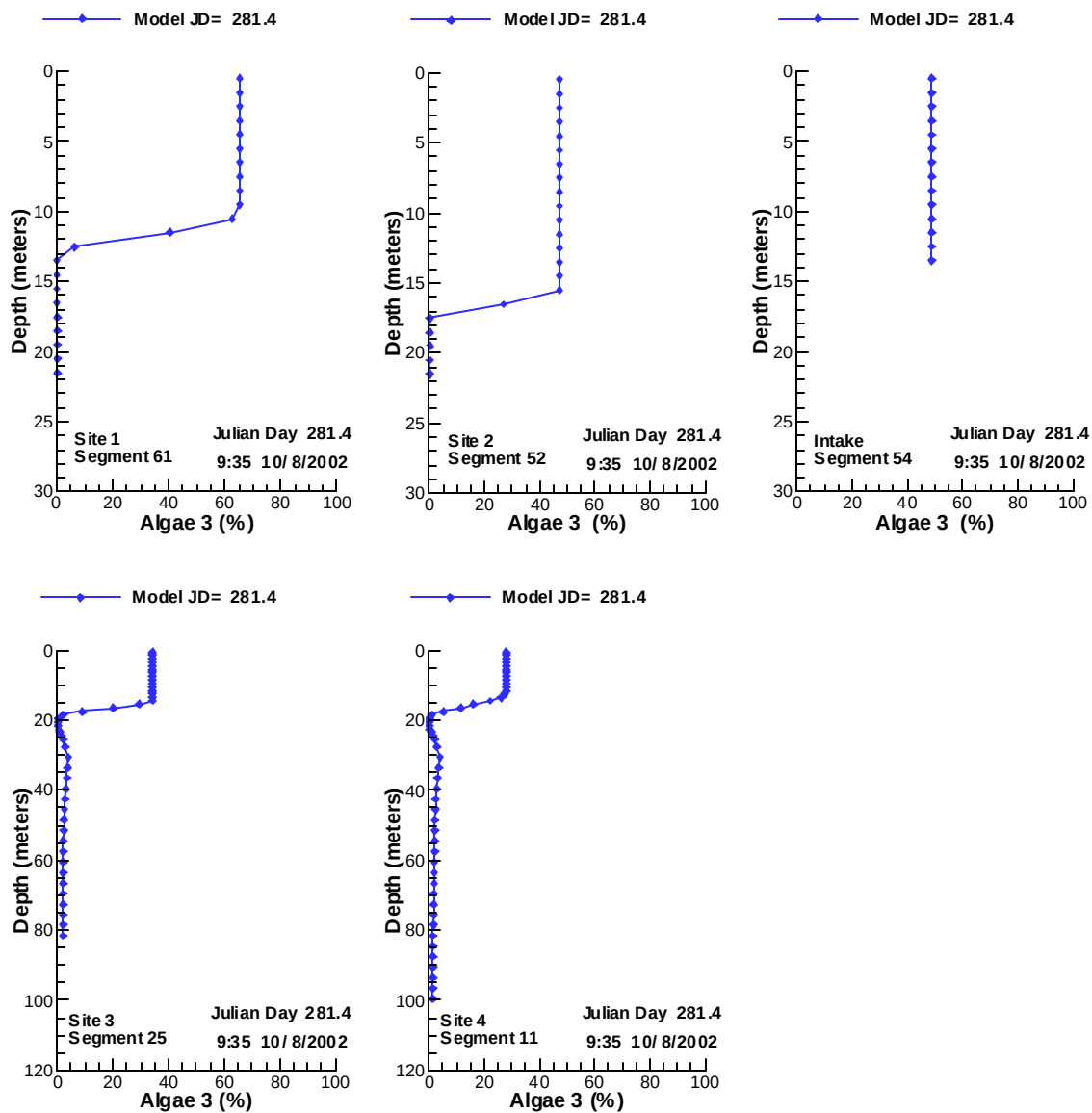


Figure 746. Vertical profiles of ALGAE 3 compared with data for 10/ 8/2002.

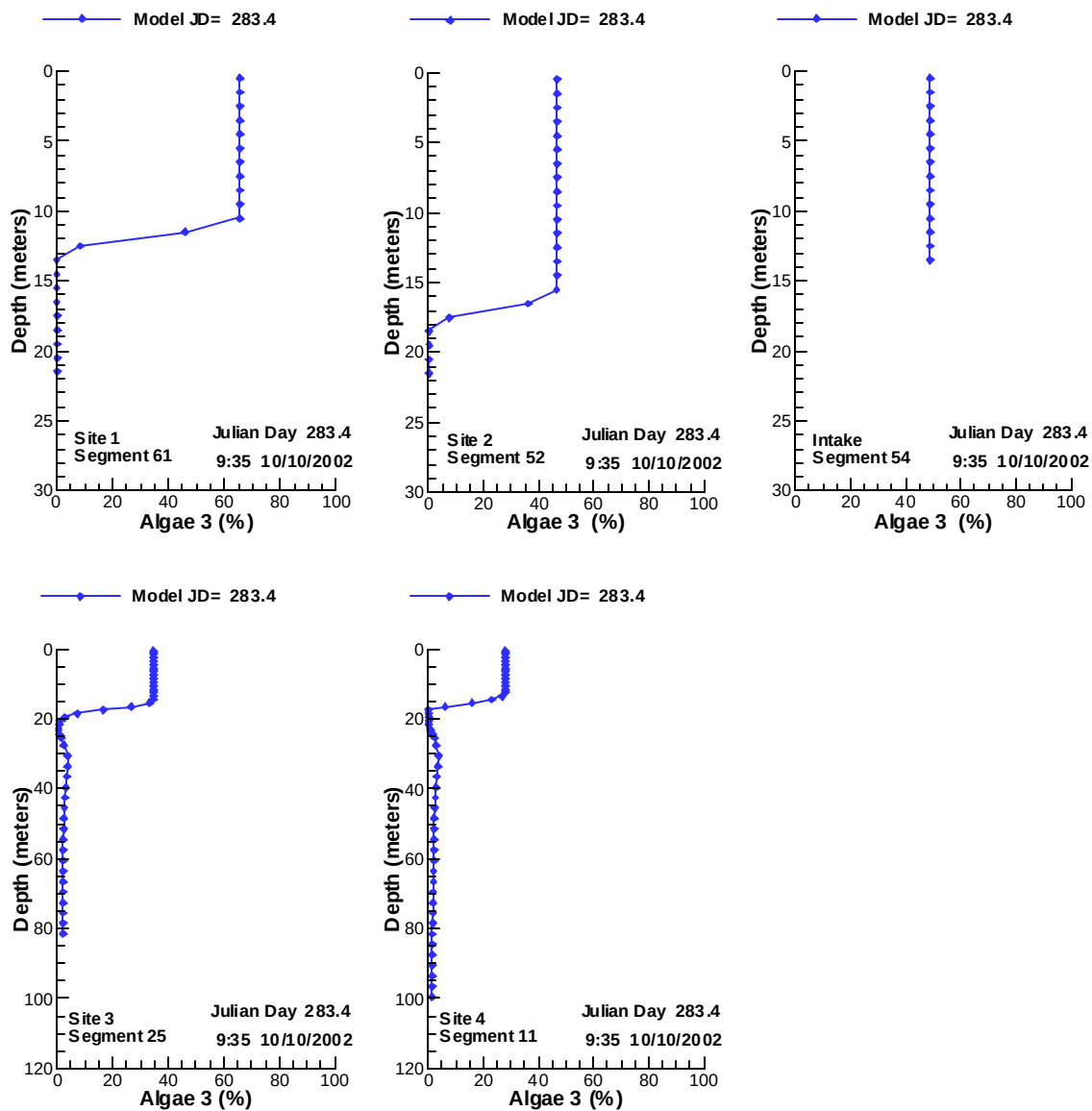


Figure 747. Vertical profiles of ALGAE 3 compared with data for 10/10/2002.

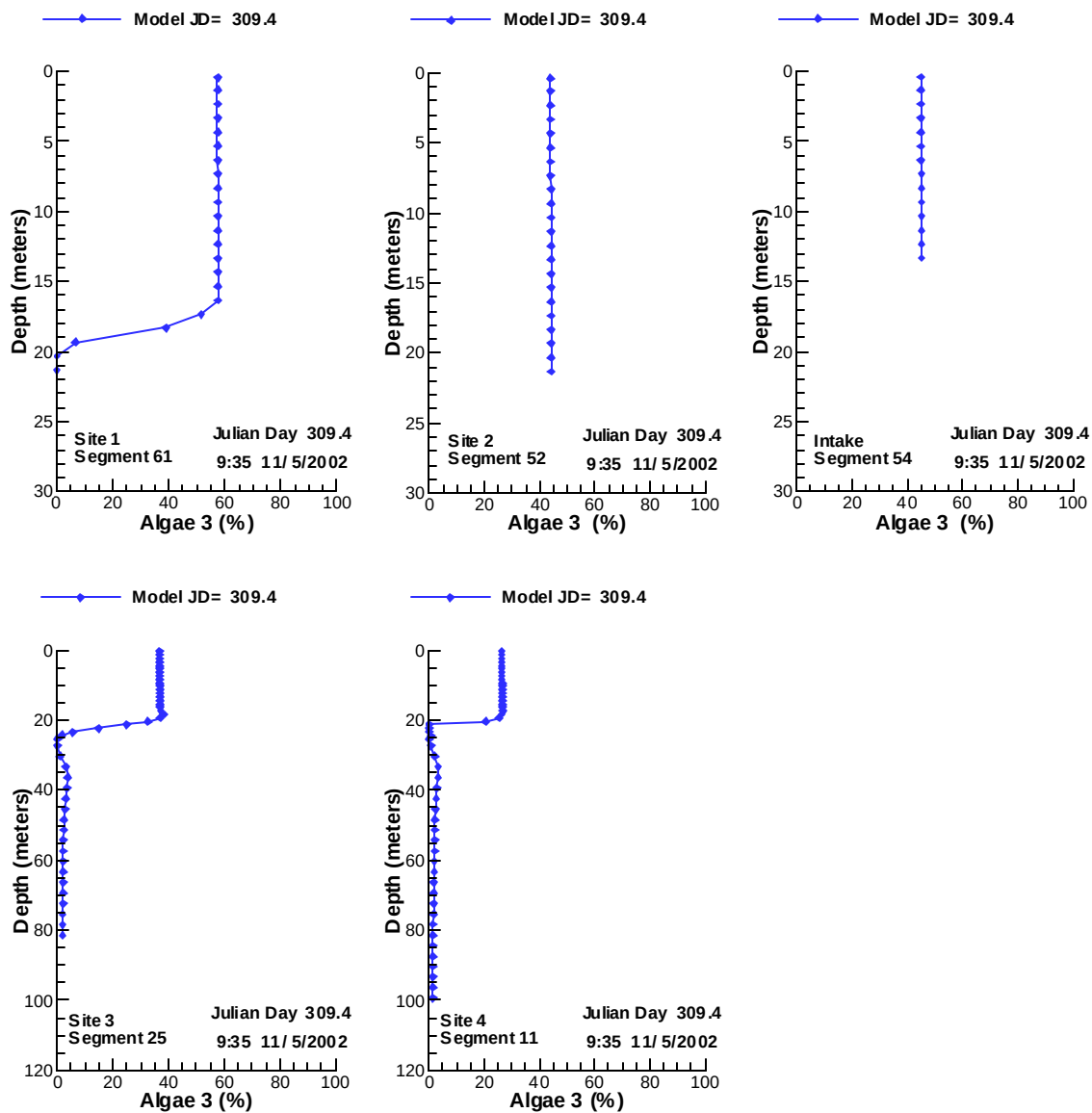


Figure 748. Vertical profiles of ALGAE 3 compared with data for 11/ 5/2002.

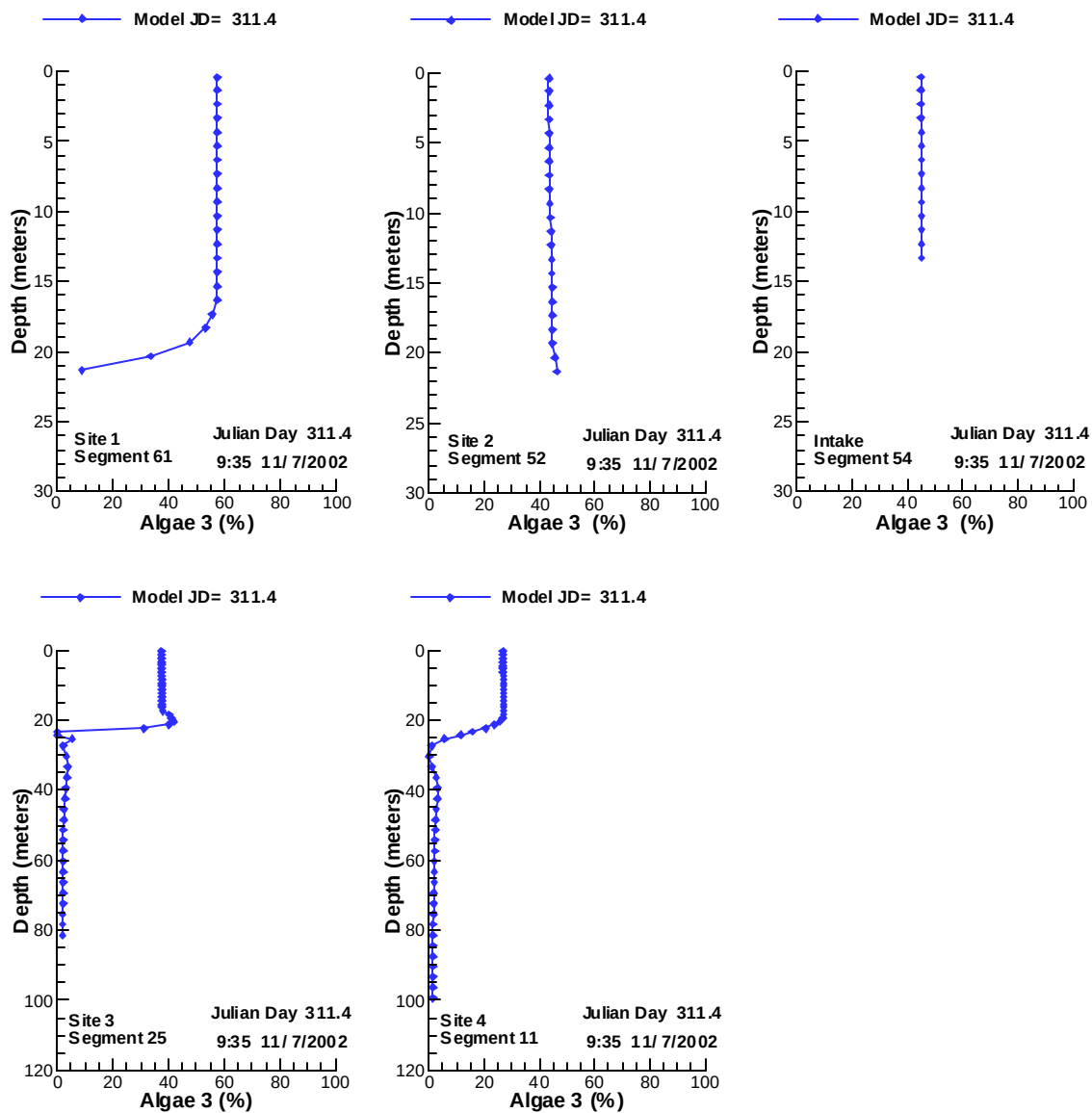


Figure 749. Vertical profiles of ALGAE 3 compared with data for 11/ 7/2002.

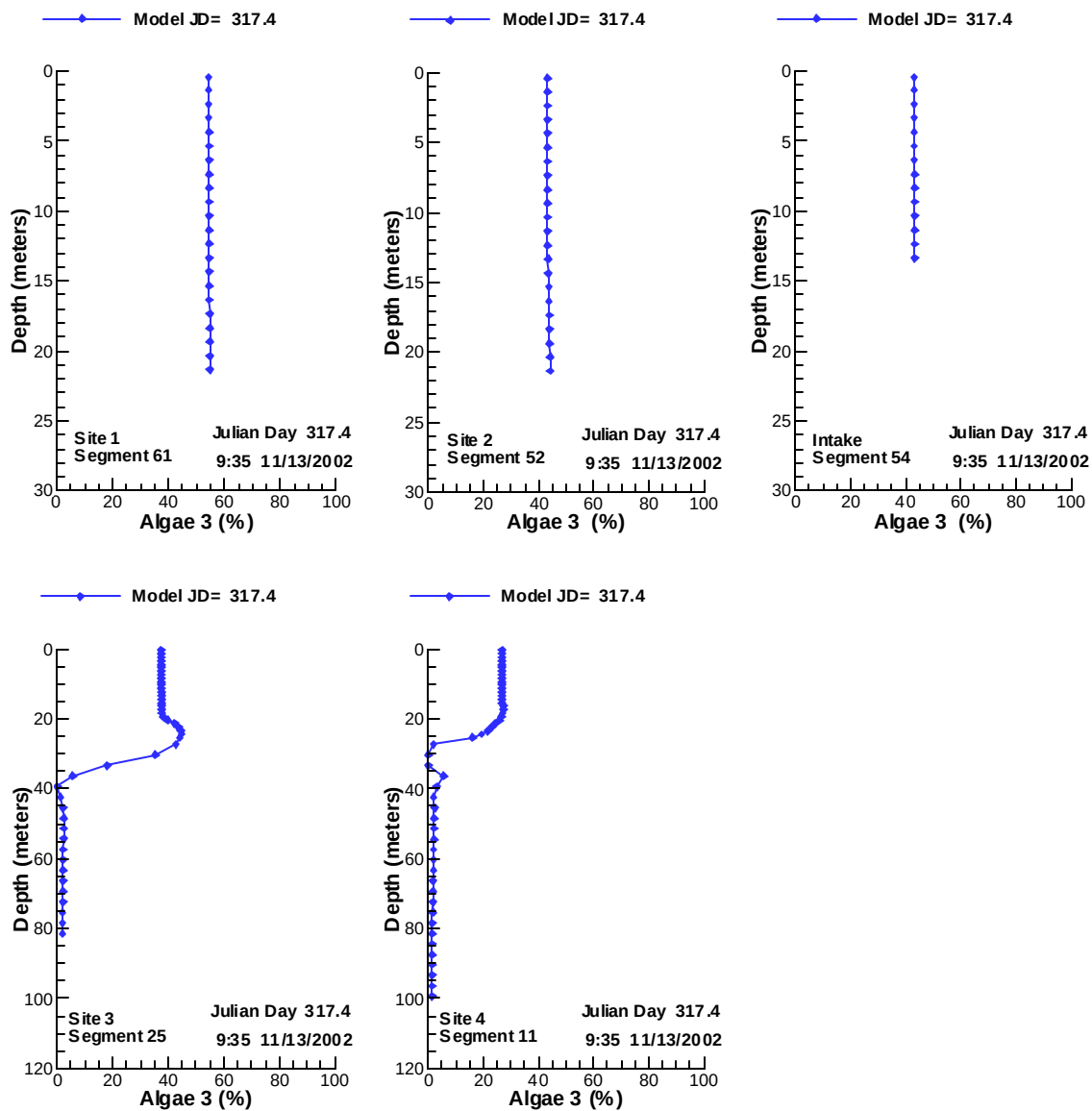


Figure 750. Vertical profiles of ALGAE 3 compared with data for 11/13/2002.

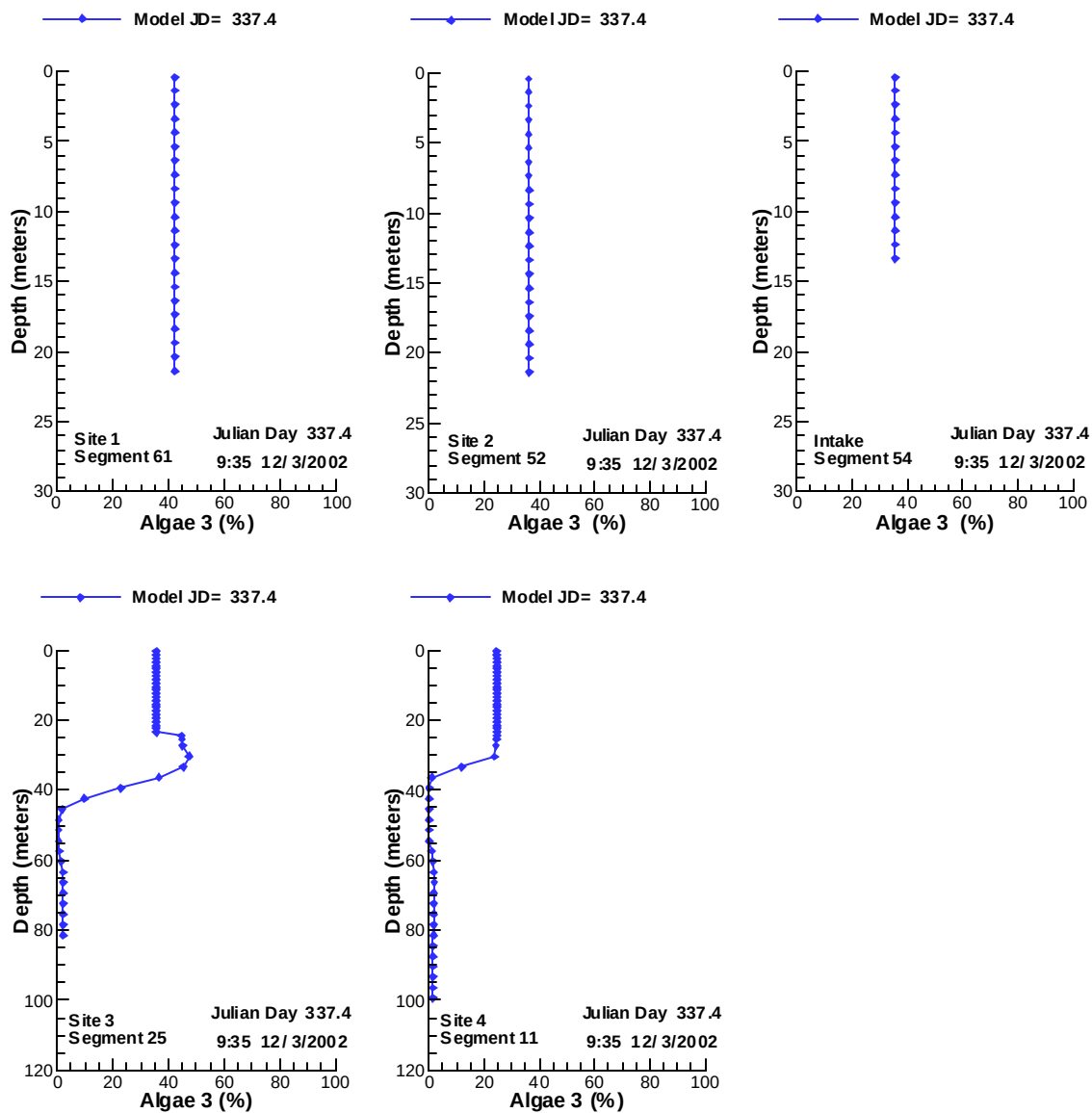


Figure 751. Vertical profiles of ALGAE 3 compared with data for 12/ 3/2002.

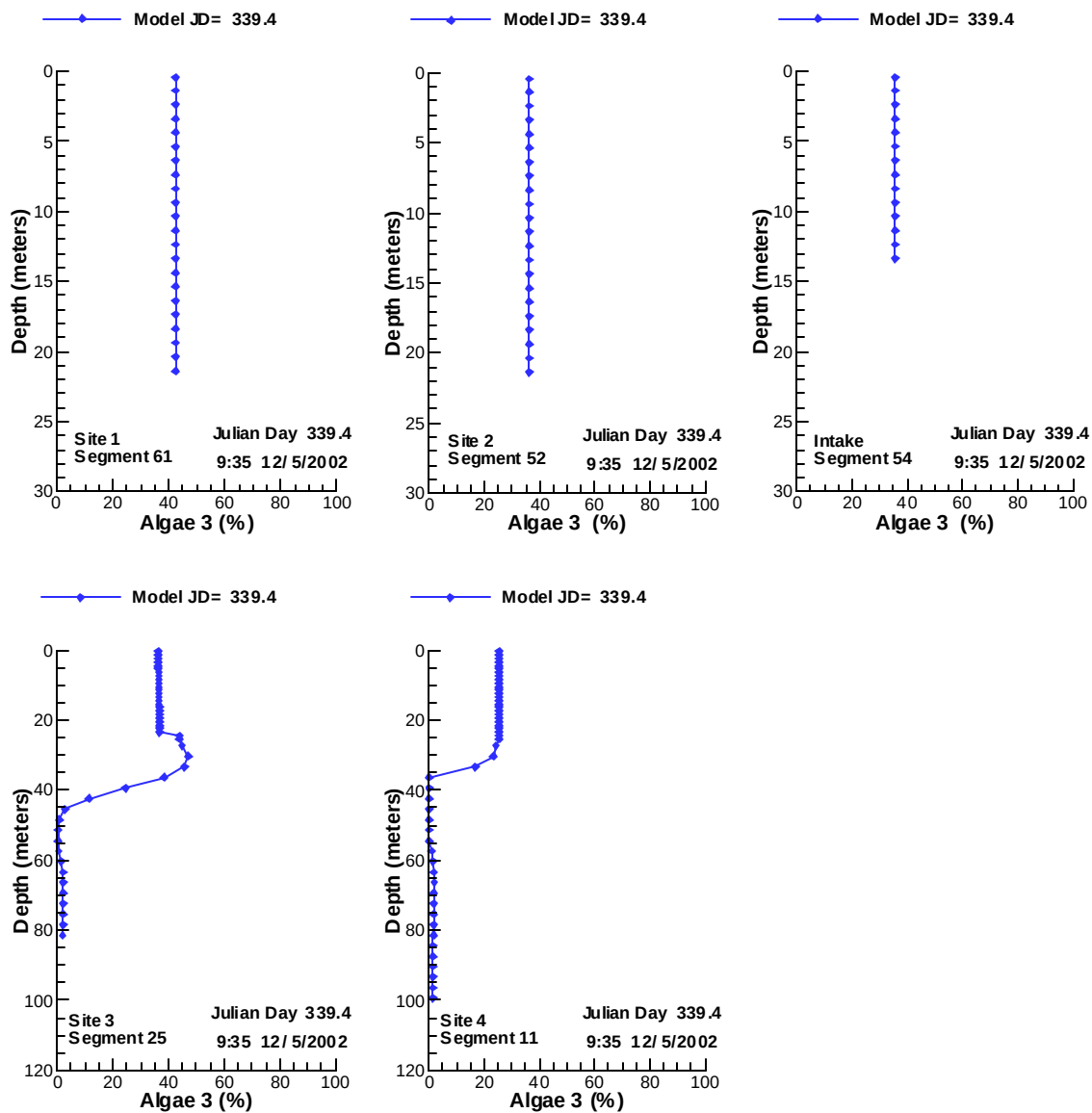


Figure 752. Vertical profiles of ALGAE 3 compared with data for 12/ 5/2002.

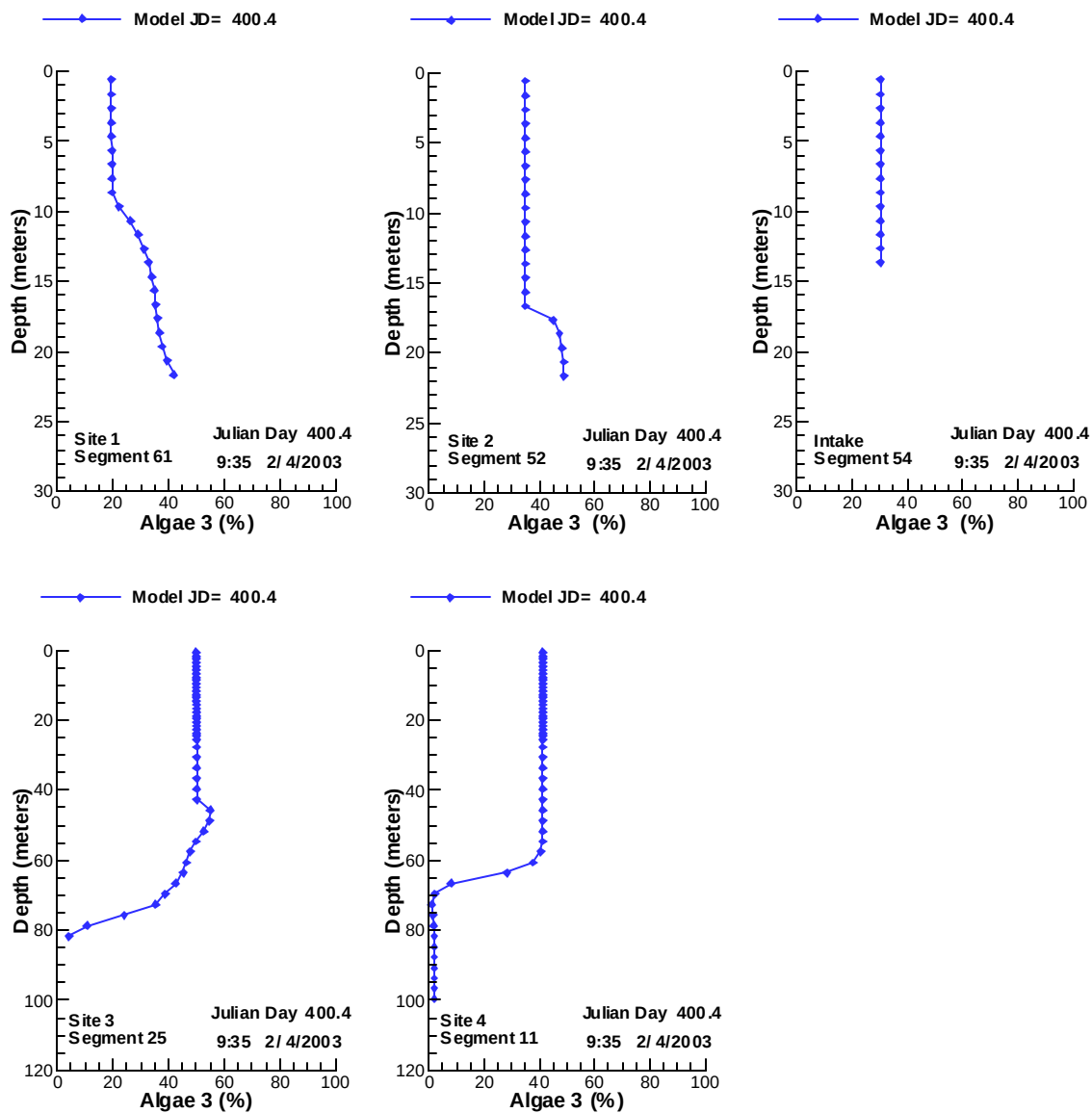


Figure 753. Vertical profiles of ALGAE 3 compared with data for 2/ 4/2003.

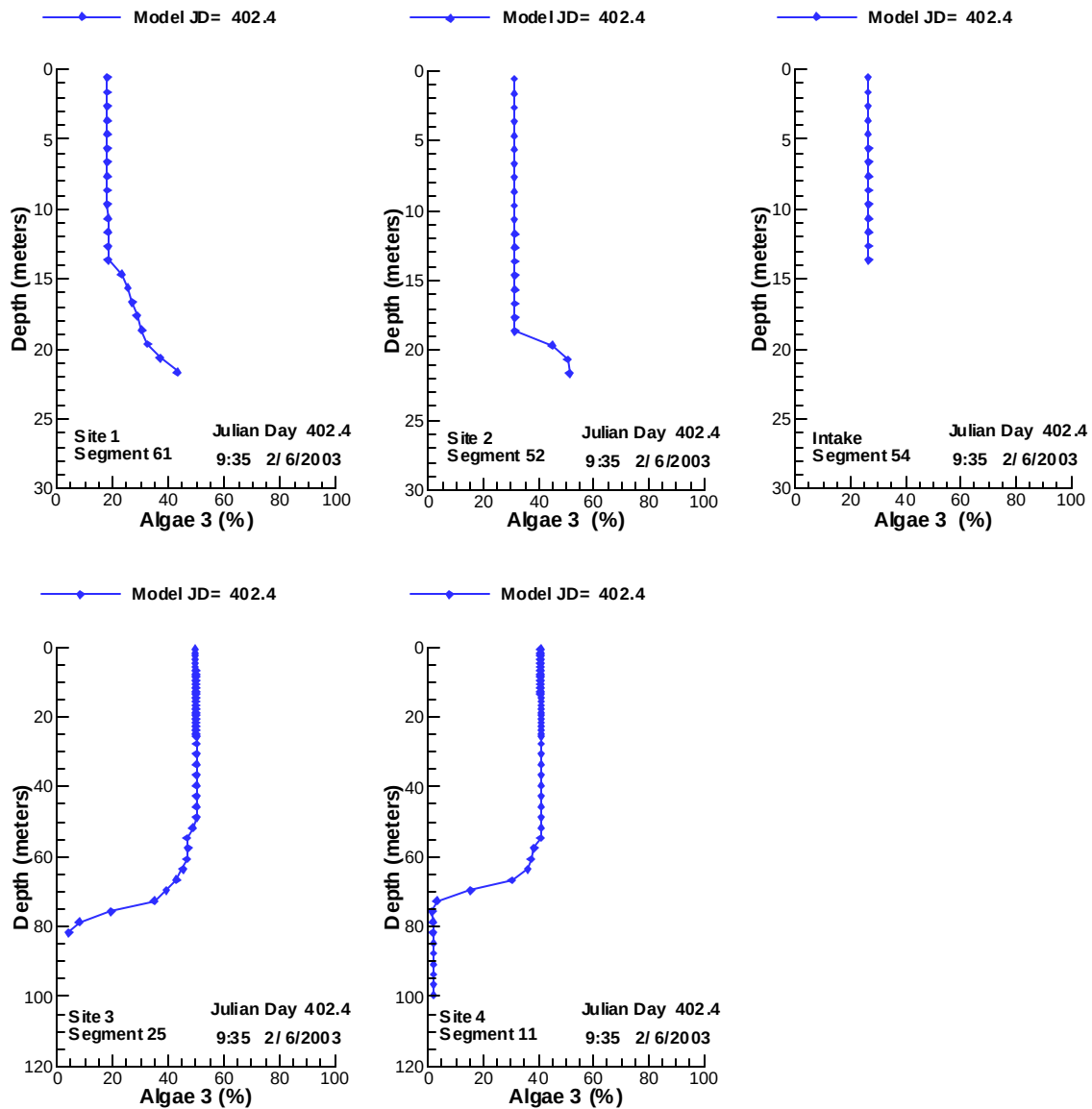


Figure 754. Vertical profiles of ALGAE 3 compared with data for 2/ 6/2003.

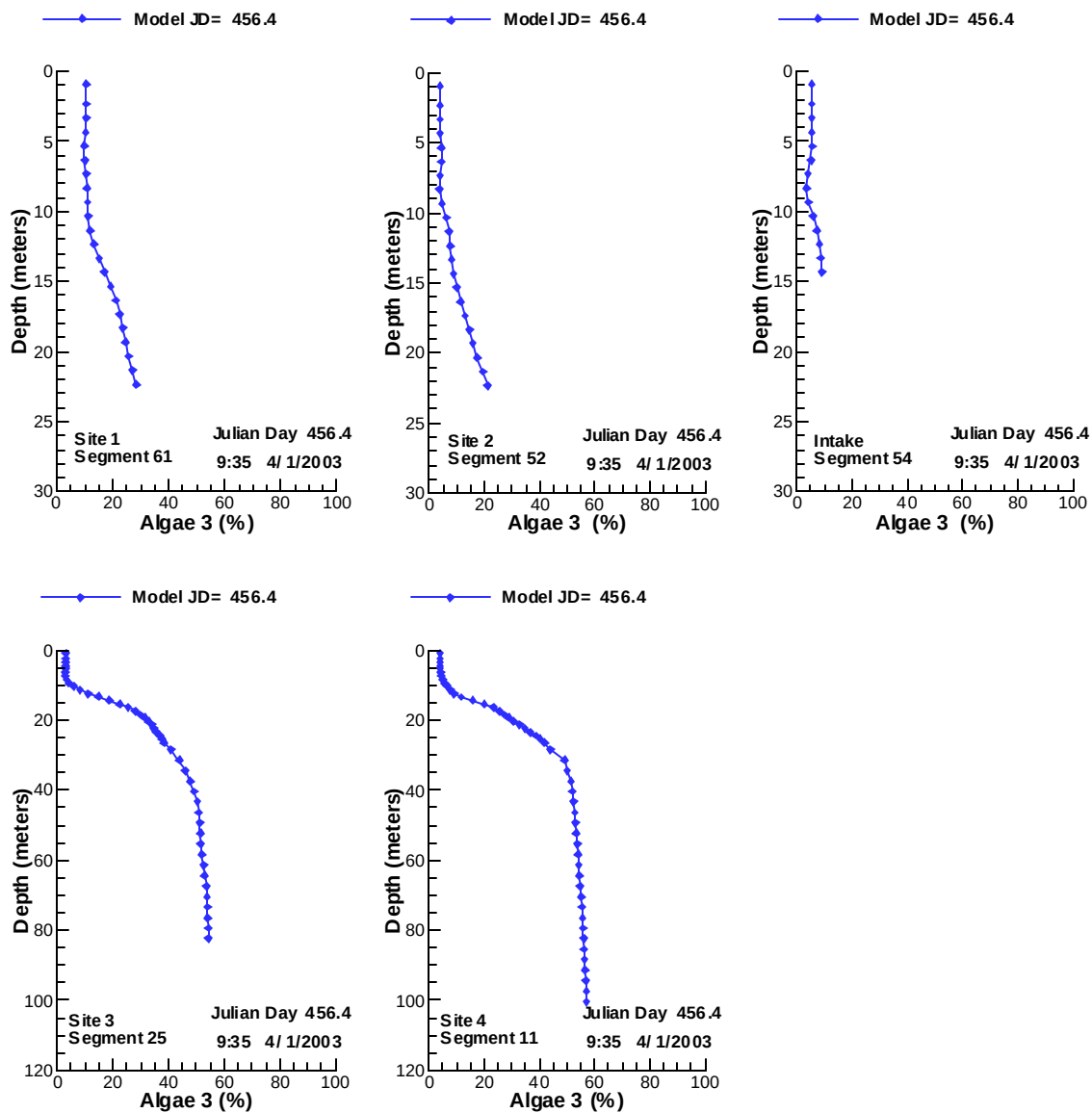


Figure 755. Vertical profiles of ALGAE 3 compared with data for 4/ 1/2003.

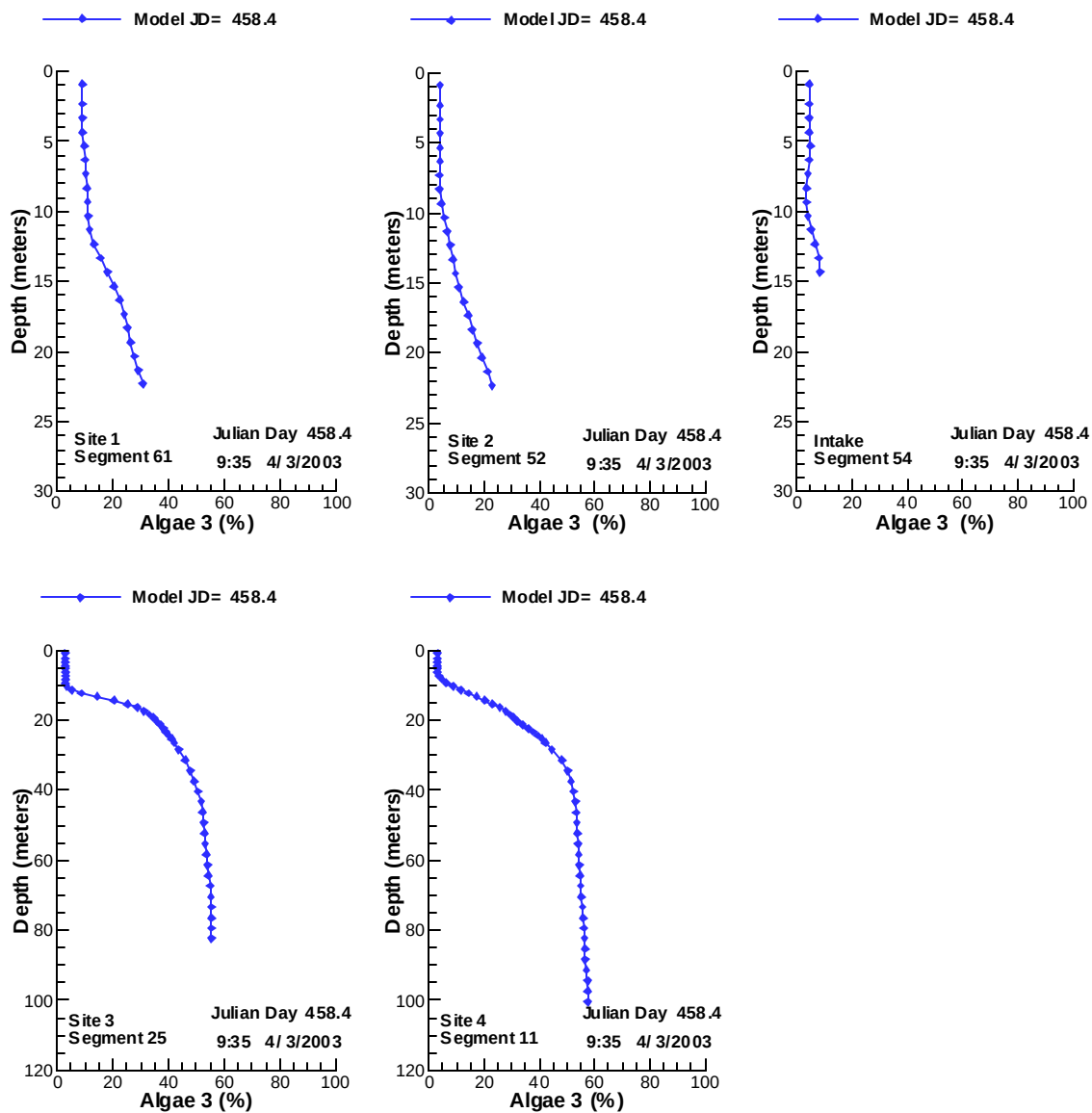


Figure 756. Vertical profiles of ALGAE 3 compared with data for 4/ 3/2003.

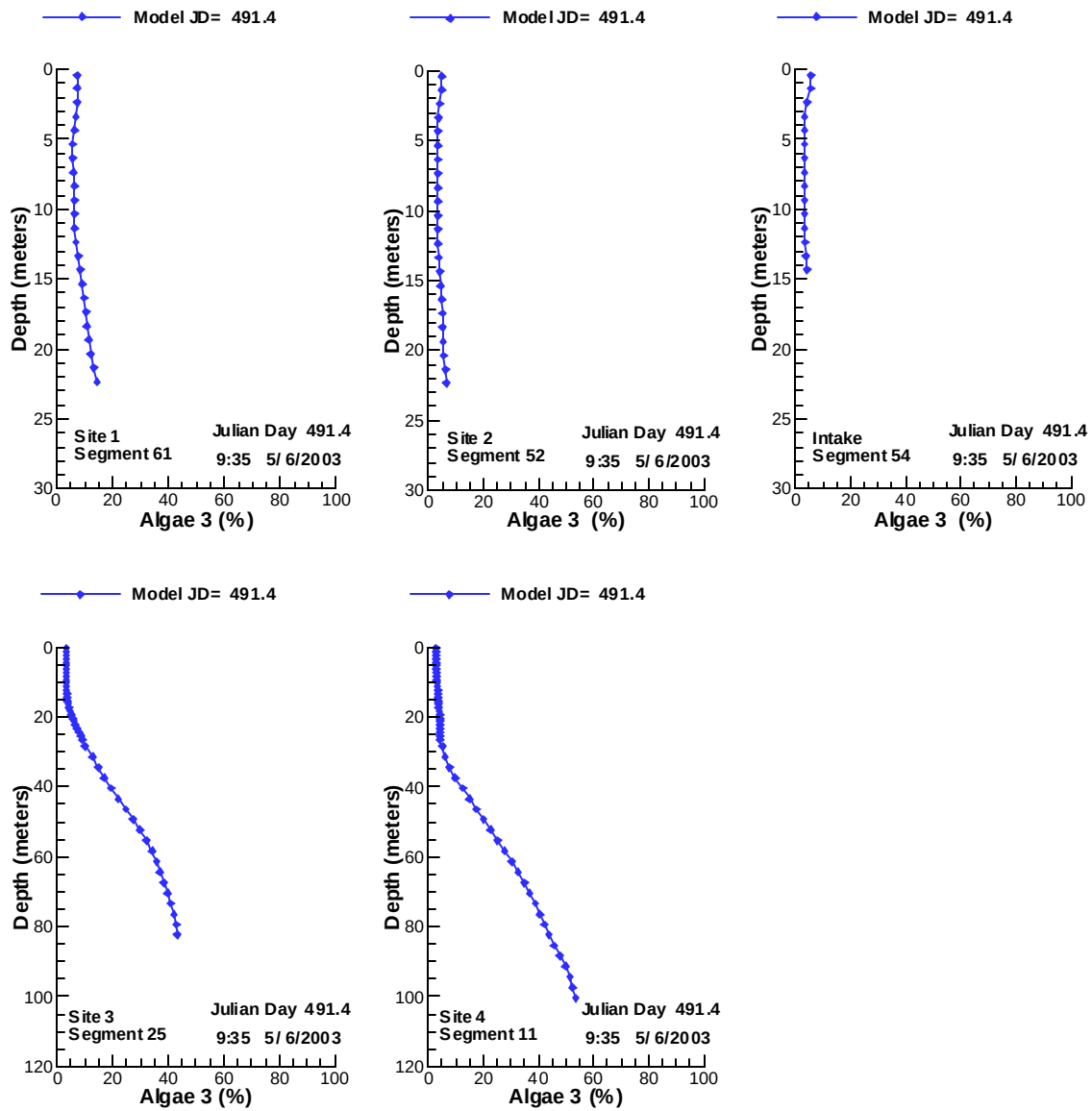


Figure 757. Vertical profiles of ALGAE 3 compared with data for 5/ 6/2003.

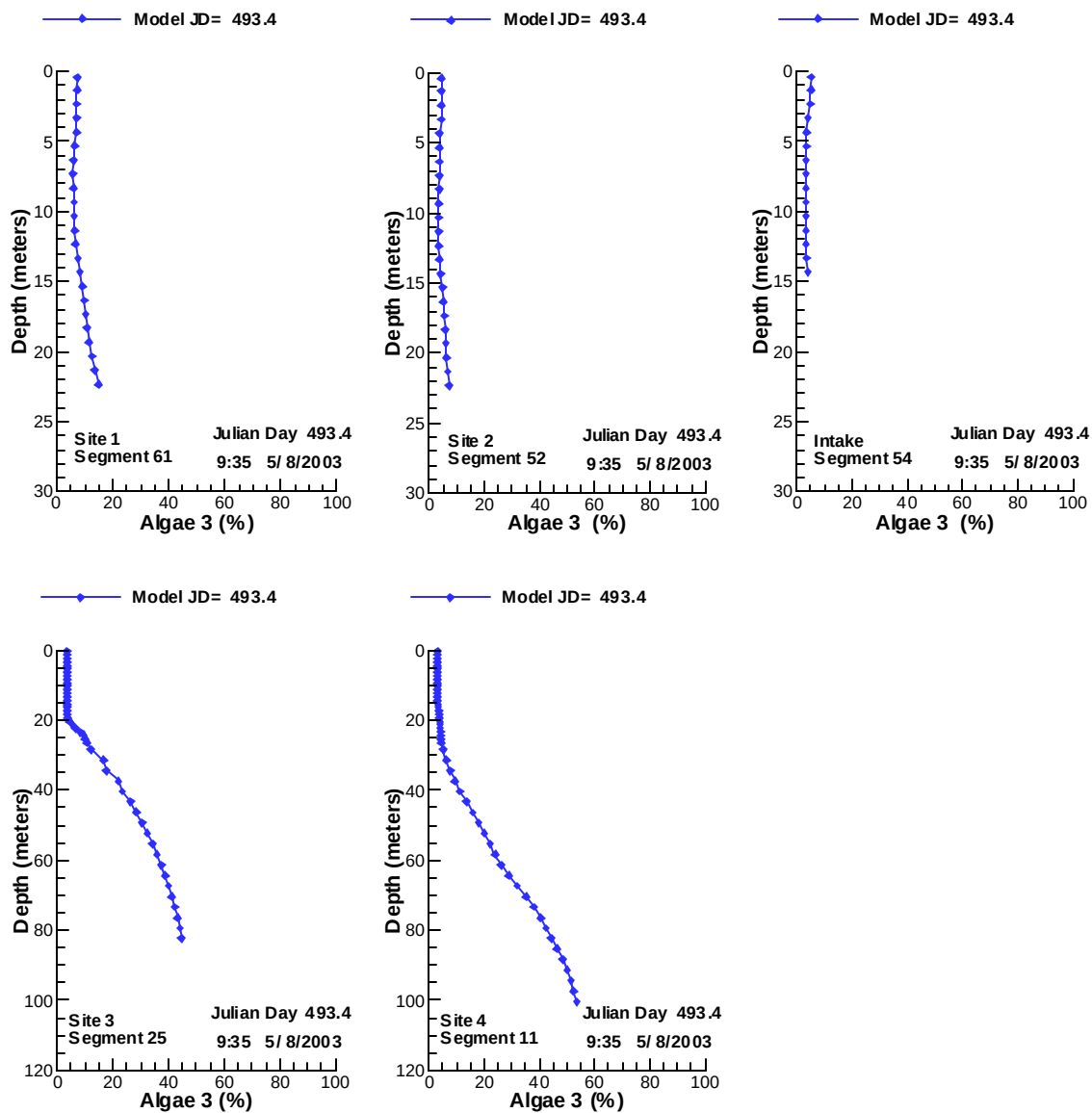


Figure 758. Vertical profiles of ALGAE 3 compared with data for 5/ 8/2003.

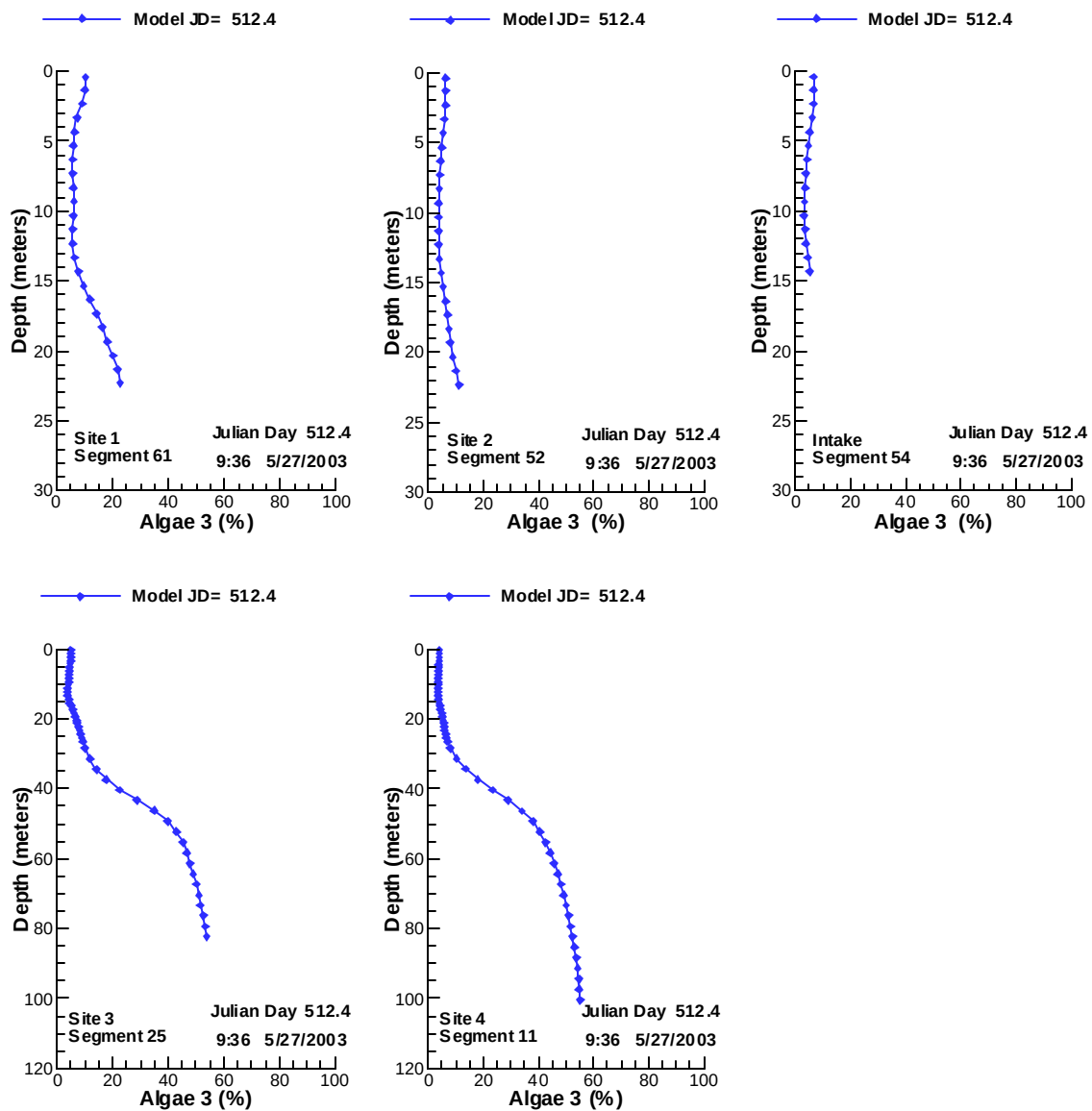


Figure 759. Vertical profiles of ALGAE 3 compared with data for 5/27/2003.

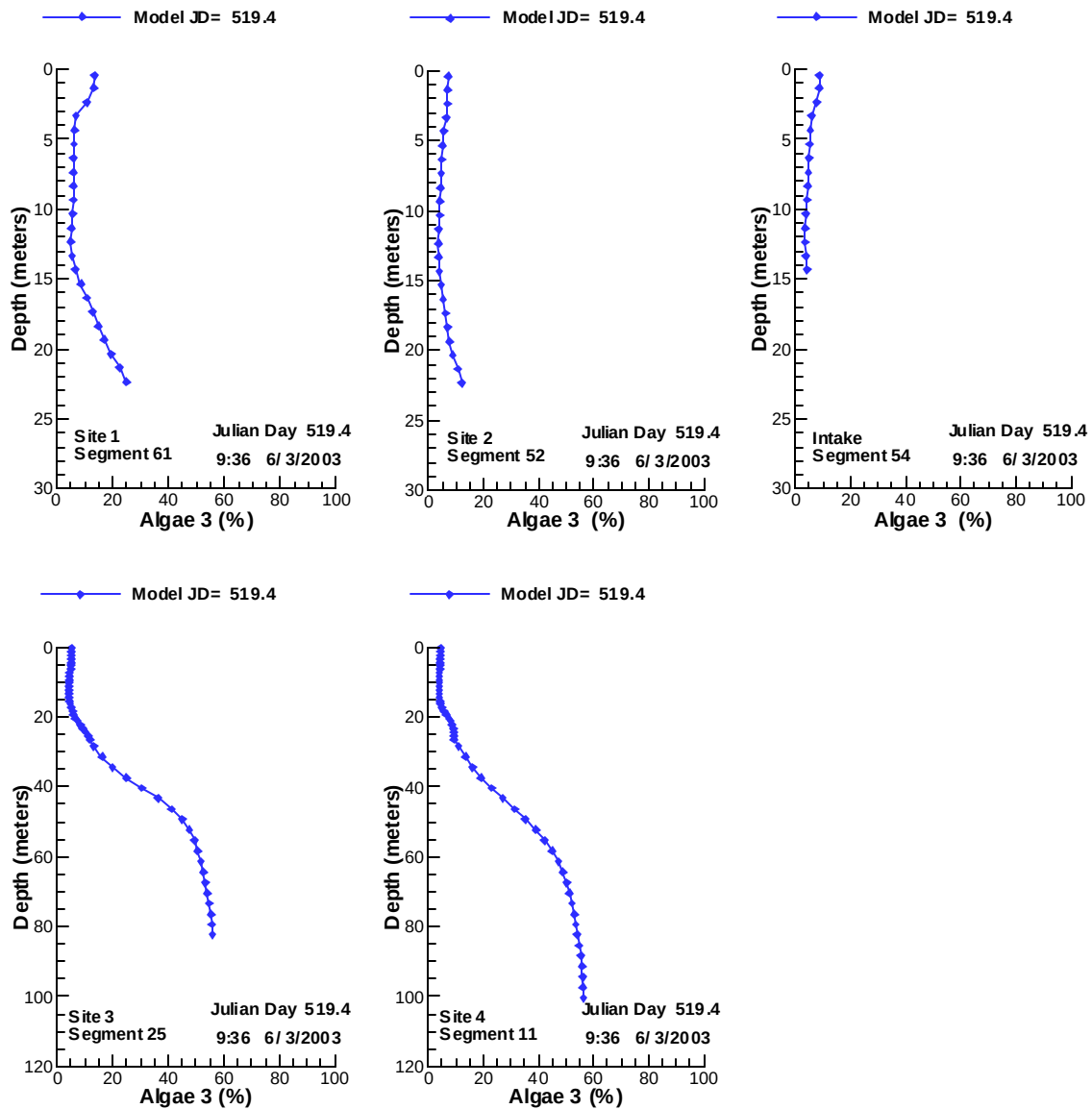


Figure 760. Vertical profiles of ALGAE 3 compared with data for 6/ 3/2003.

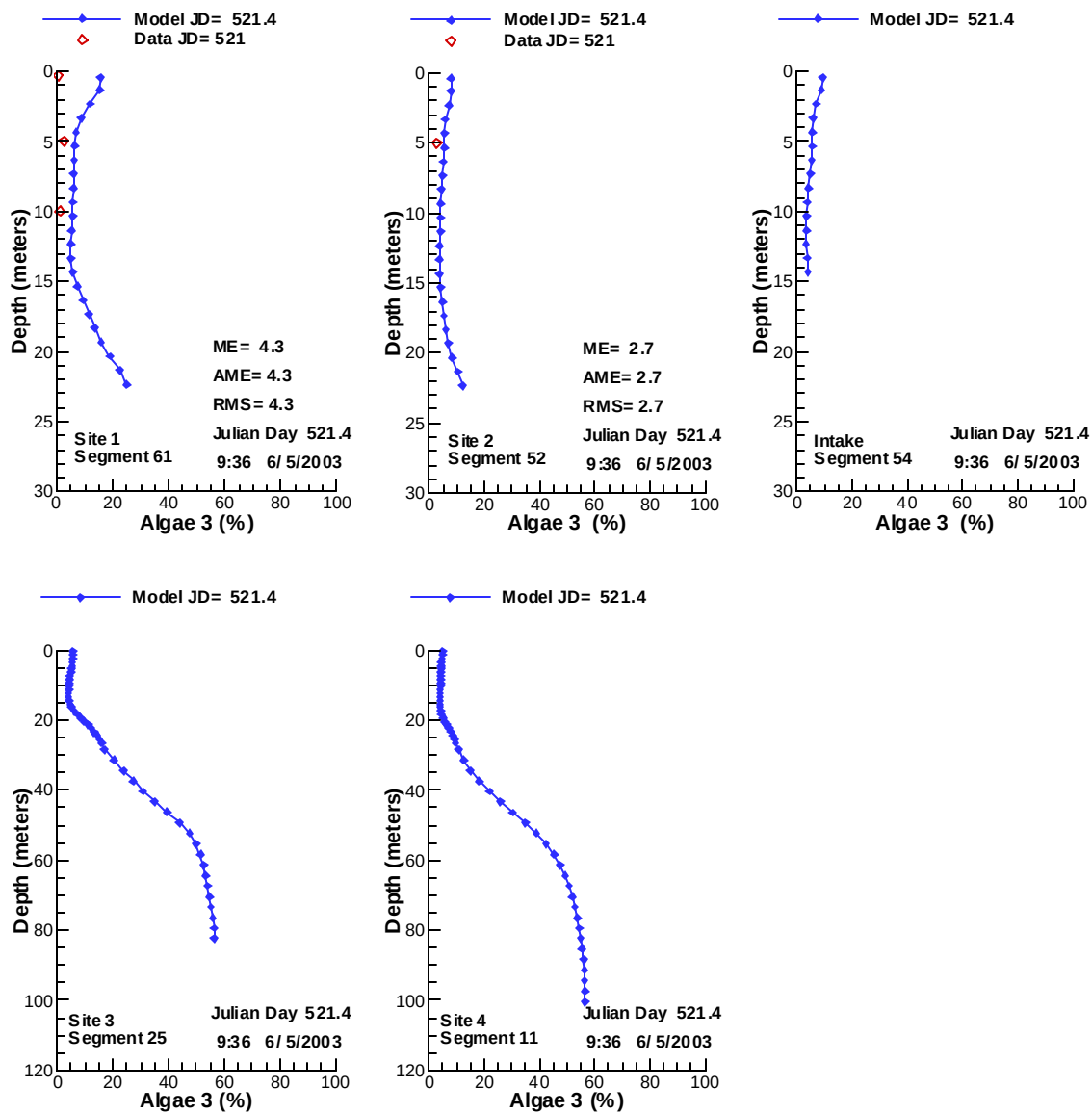


Figure 761. Vertical profiles of ALGAE 3 compared with data for 6/ 5/2003.

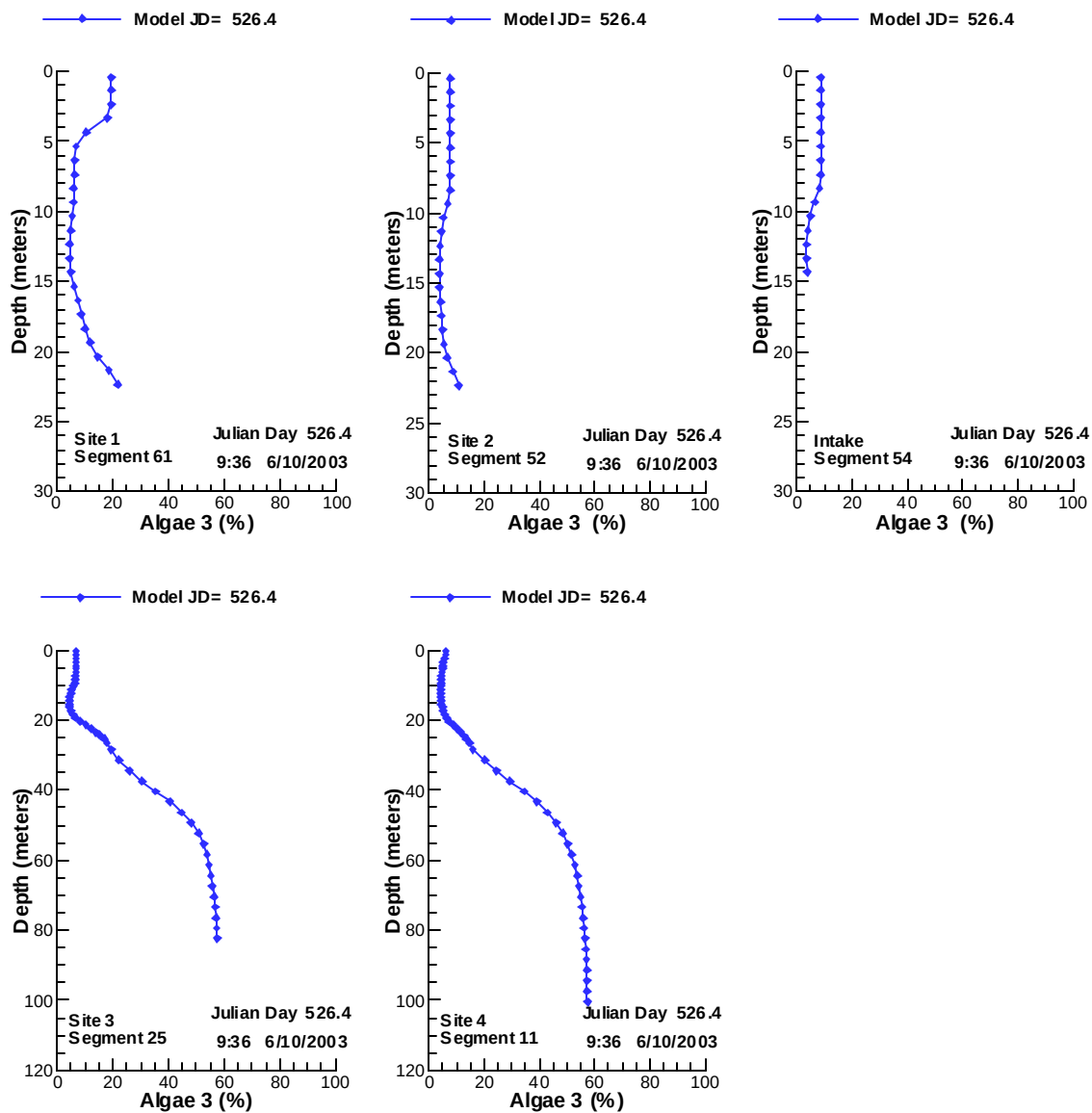


Figure 762. Vertical profiles of ALGAE 3 compared with data for 6/10/2003.

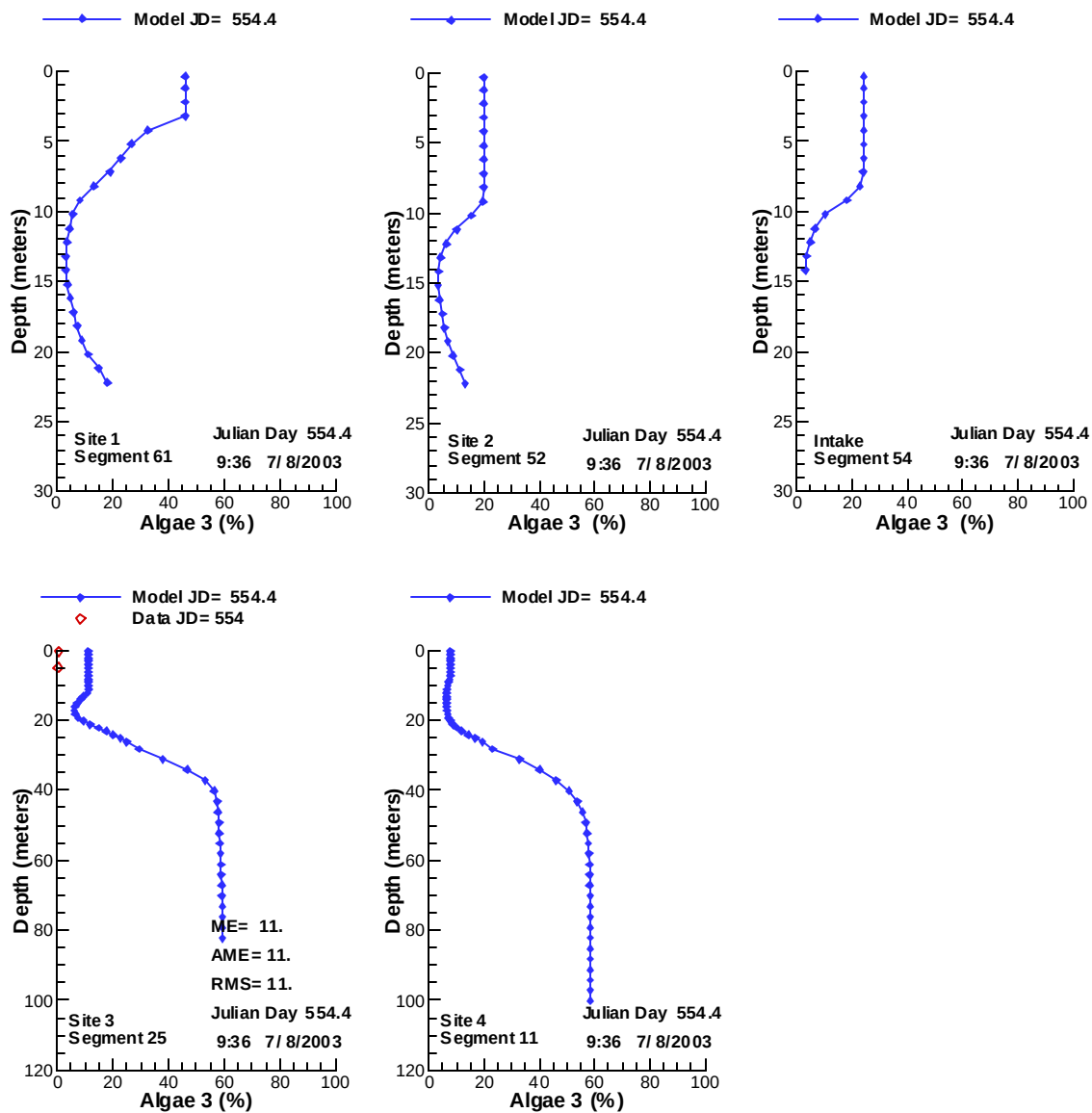


Figure 763. Vertical profiles of ALGAE 3 compared with data for 7/ 8/2003.

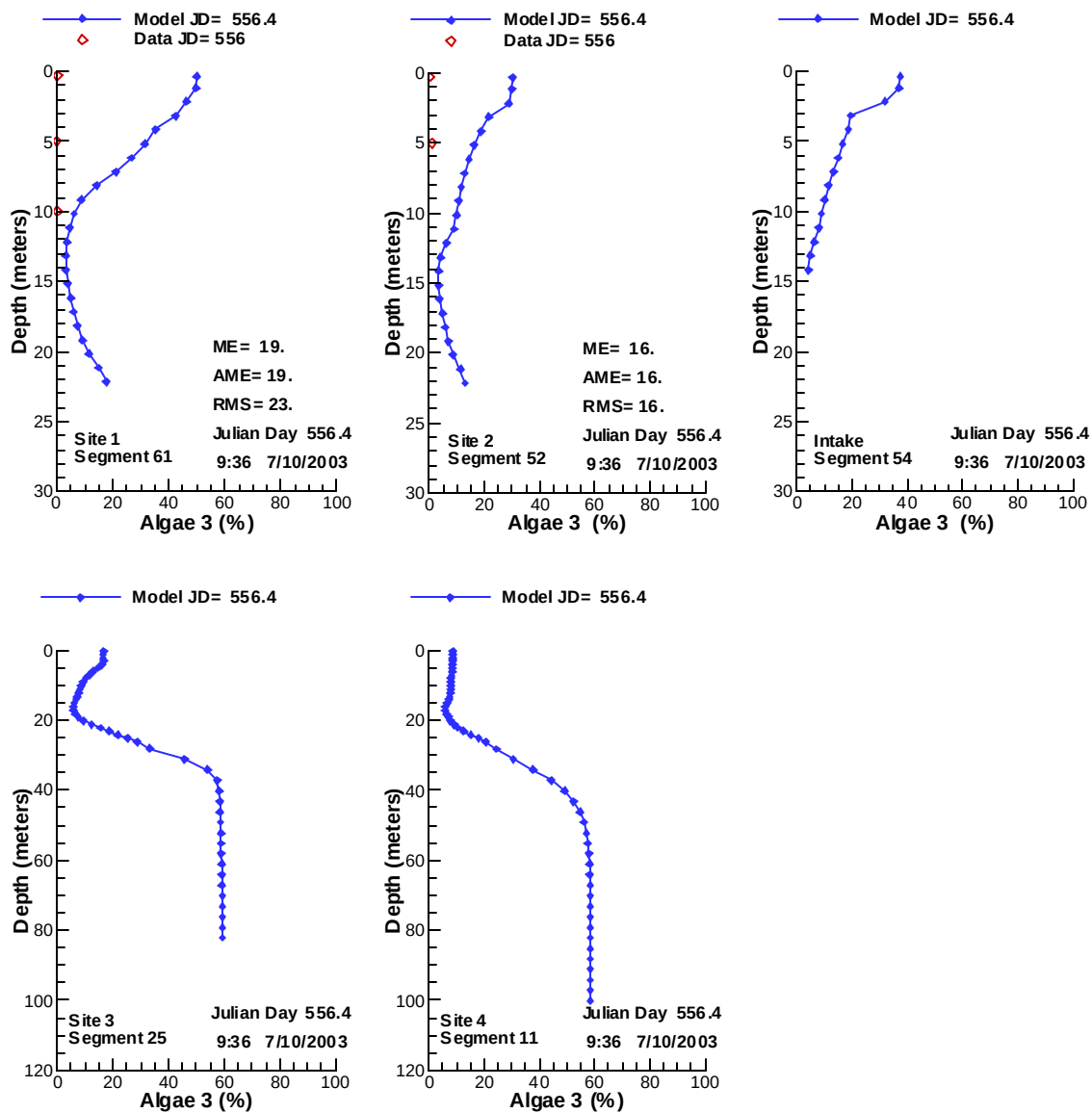


Figure 764. Vertical profiles of ALGAE 3 compared with data for 7/10/2003.

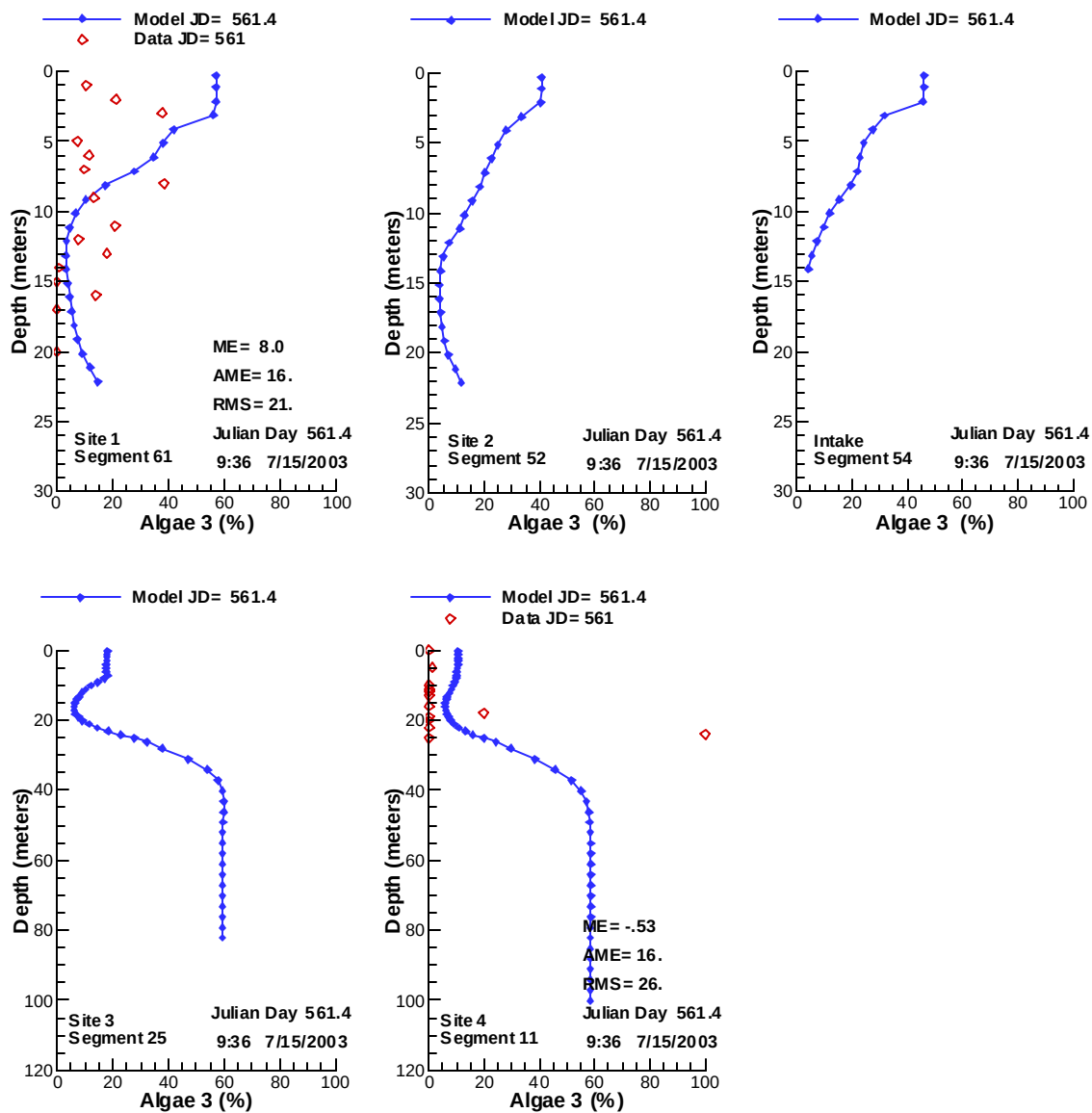


Figure 765. Vertical profiles of ALGAE 3 compared with data for 7/15/2003.

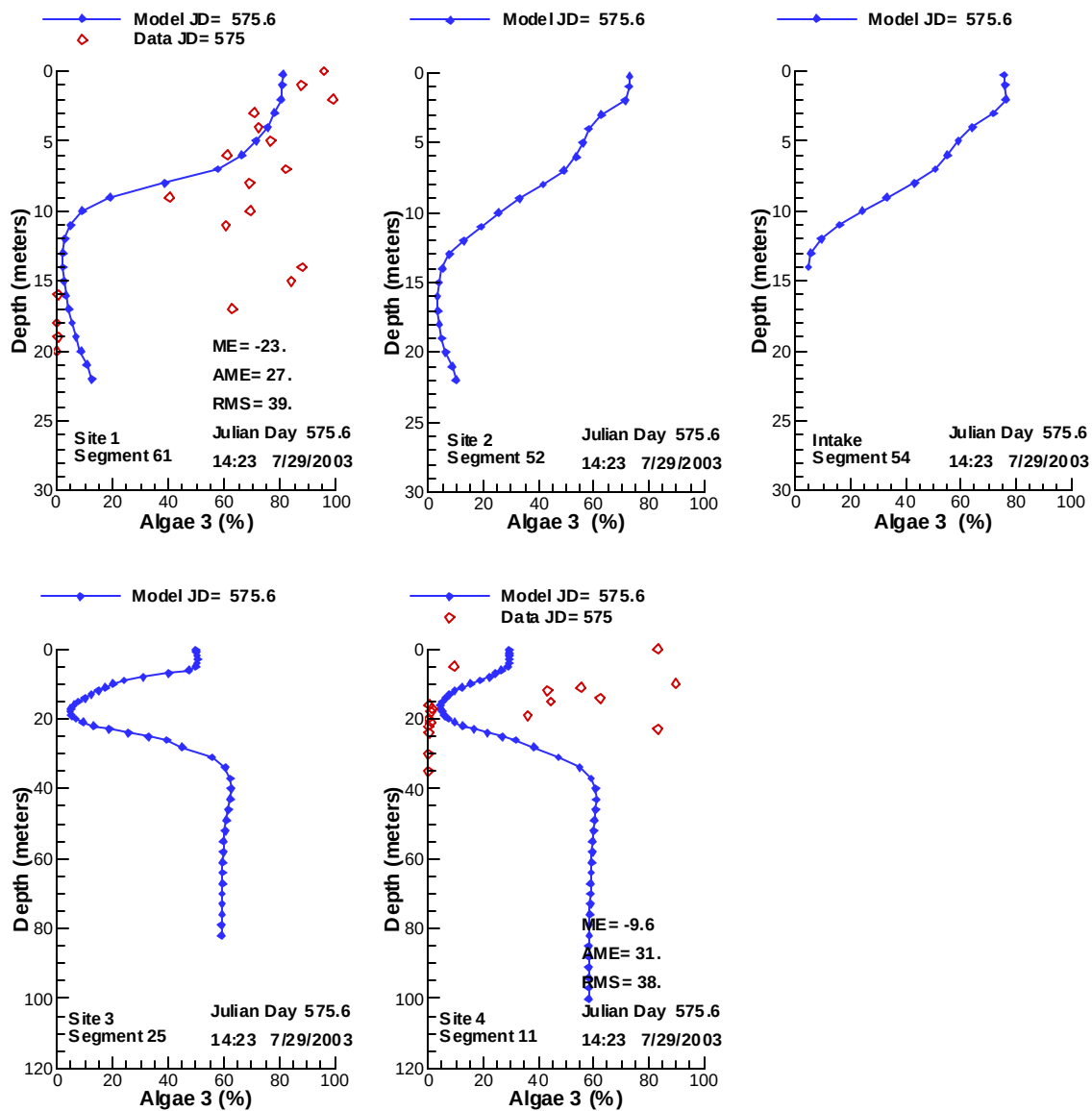


Figure 766. Vertical profiles of ALGAE 3 compared with data for 7/29/2003.

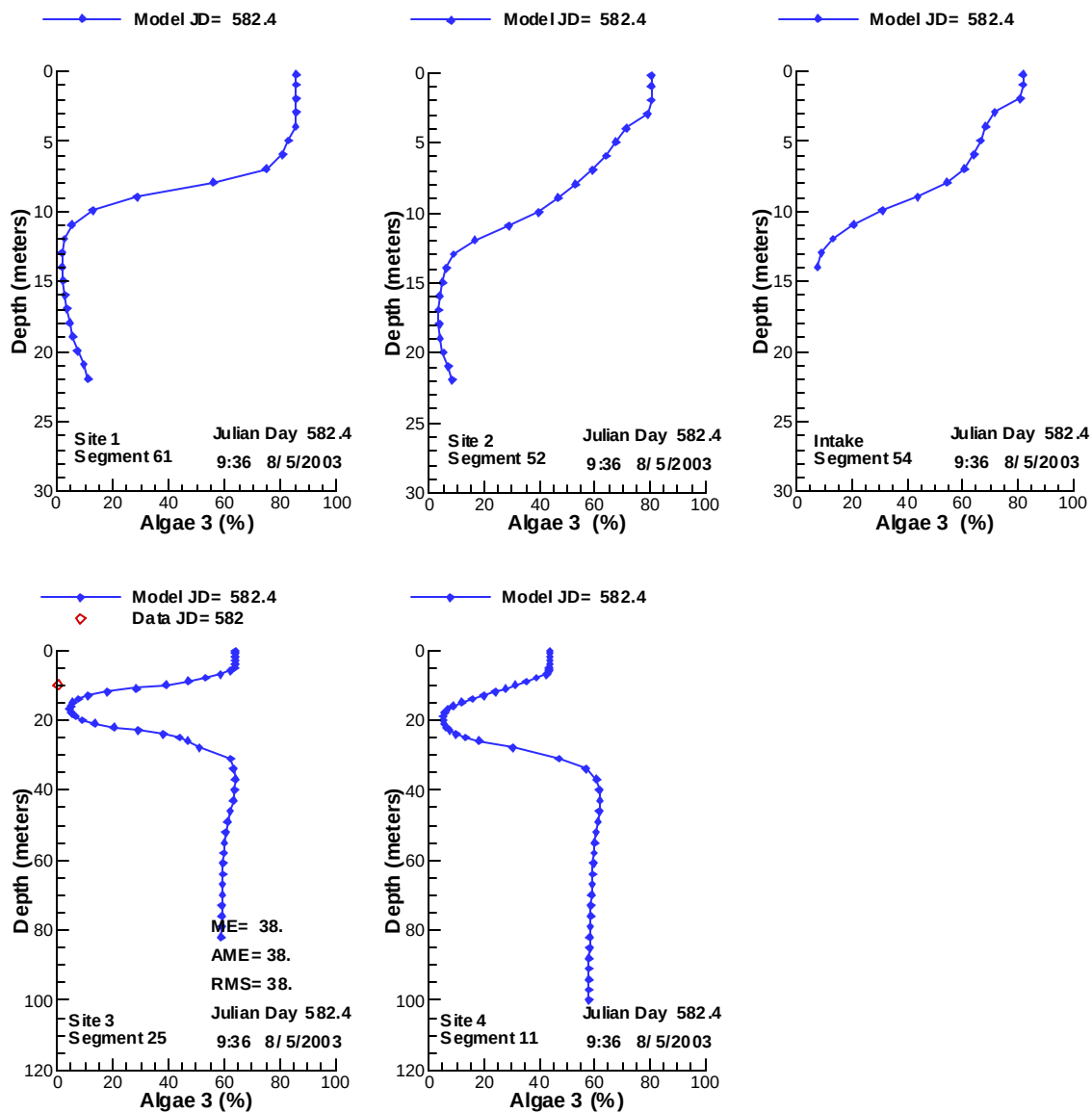


Figure 767. Vertical profiles of ALGAE 3 compared with data for 8/ 5/2003.

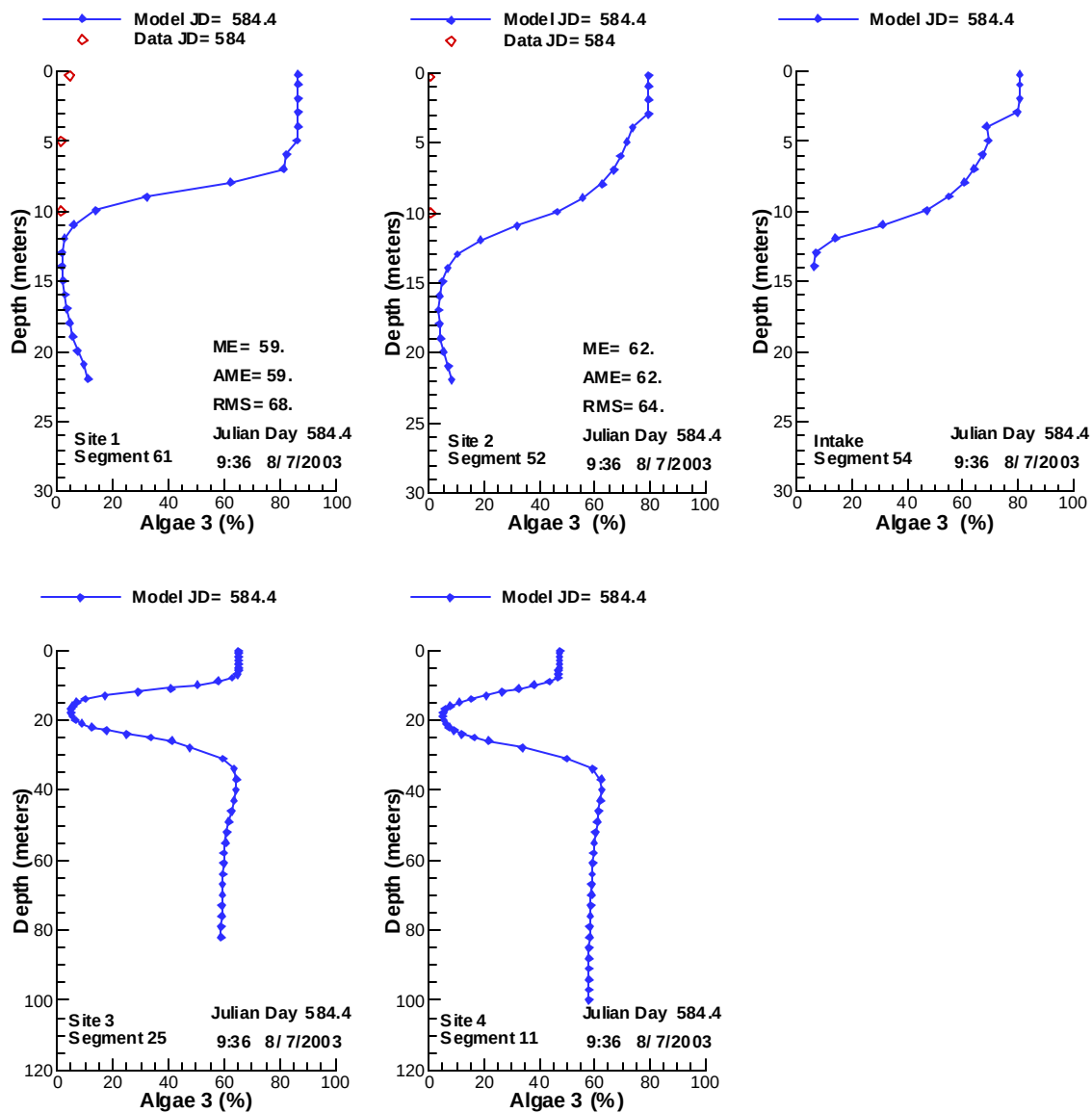


Figure 768. Vertical profiles of ALGAE 3 compared with data for 8/ 7/2003.

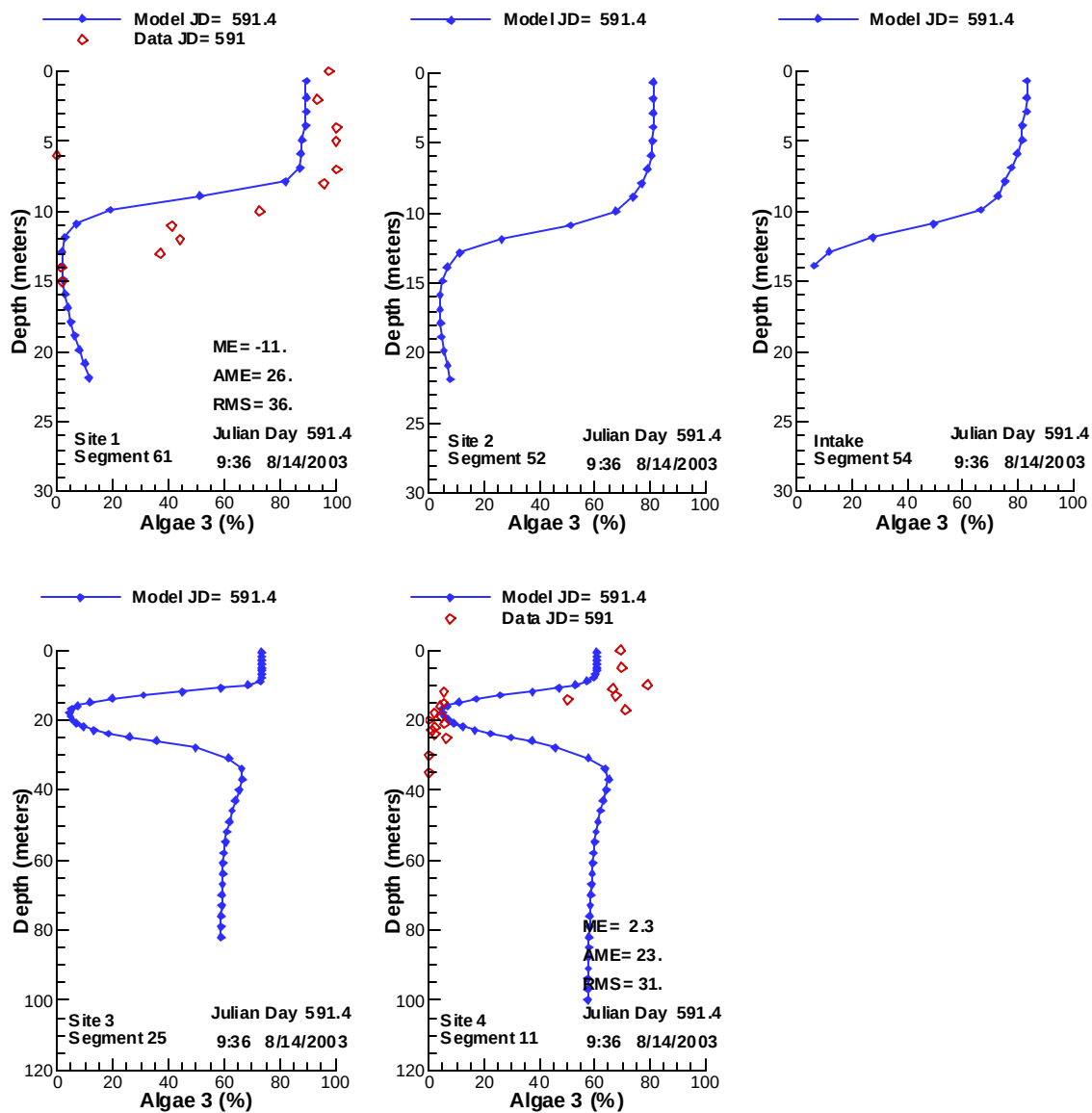


Figure 769. Vertical profiles of ALGAE 3 compared with data for 8/14/2003.

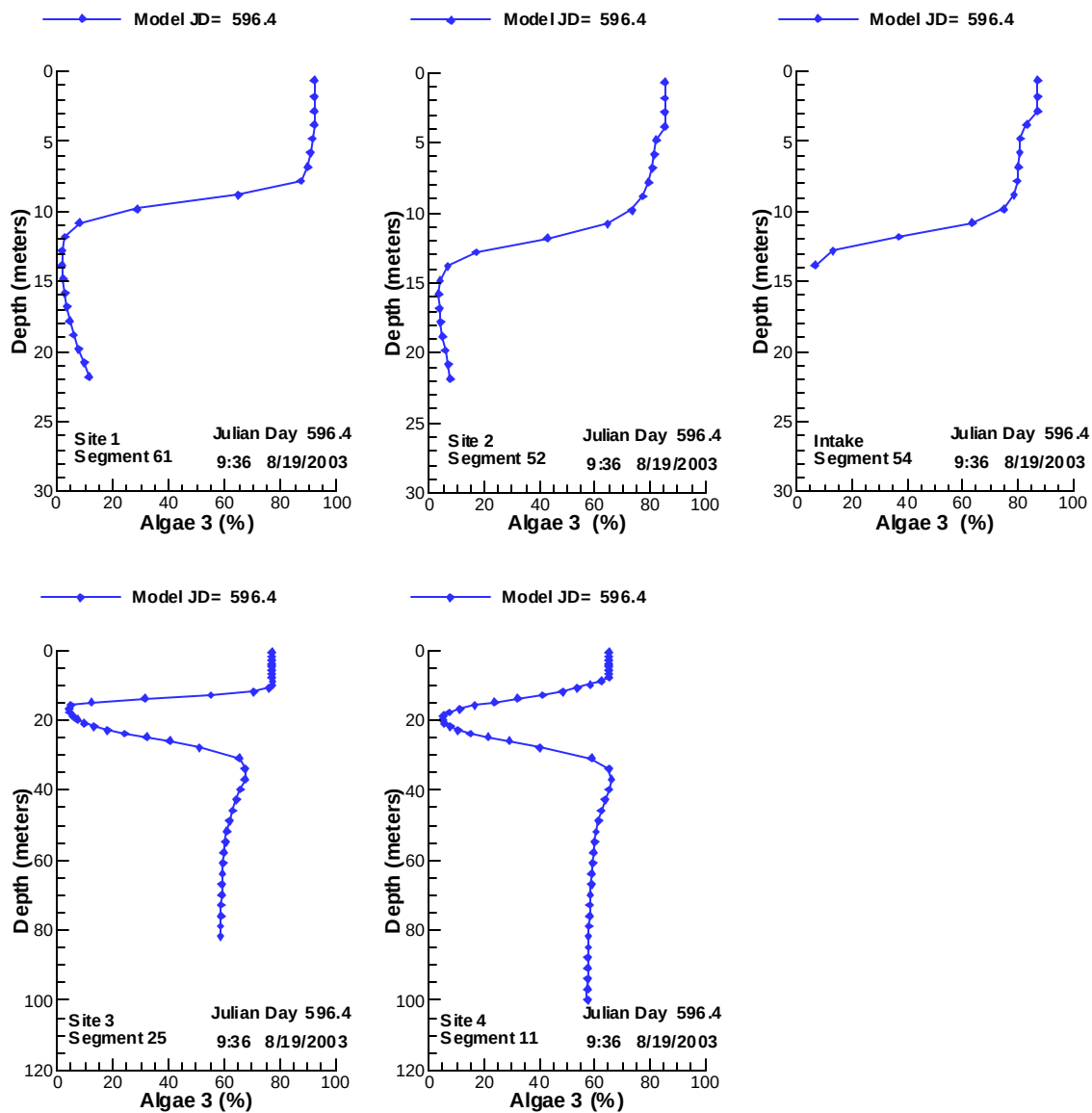


Figure 770. Vertical profiles of ALGAE 3 compared with data for 8/19/2003.

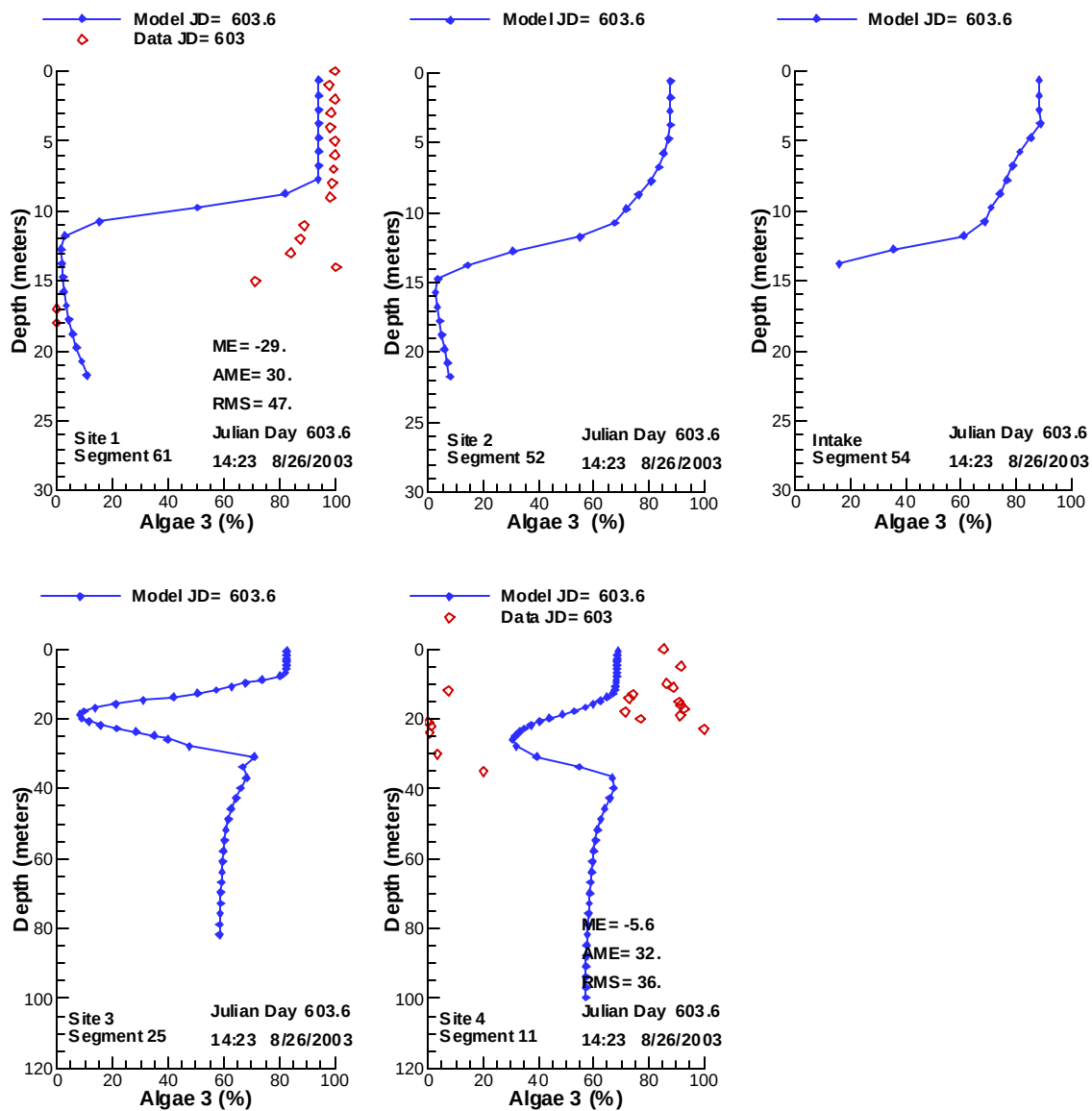


Figure 771. Vertical profiles of ALGAE 3 compared with data for 8/26/2003.

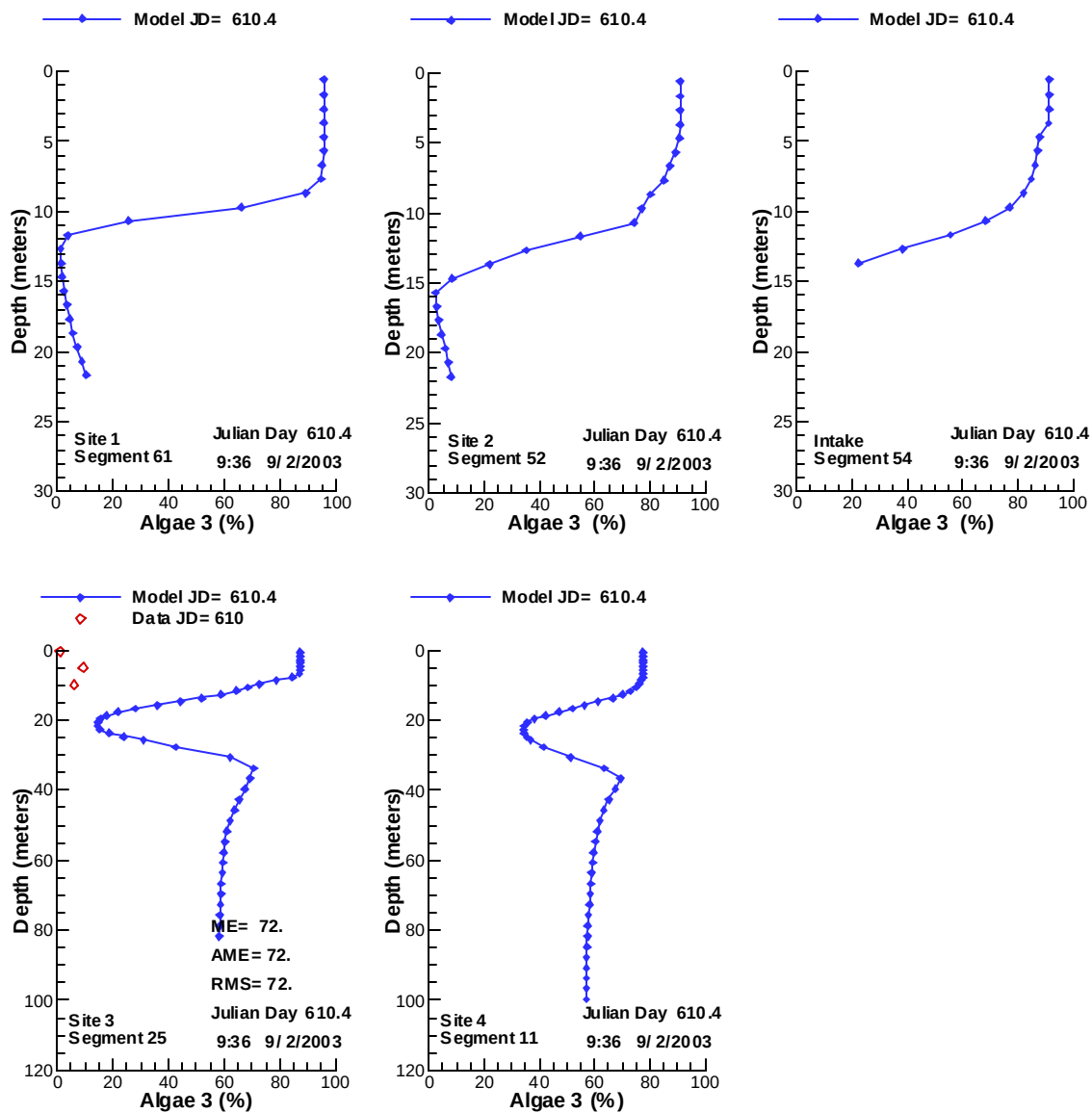


Figure 772. Vertical profiles of ALGAE 3 compared with data for 9/ 2/2003.

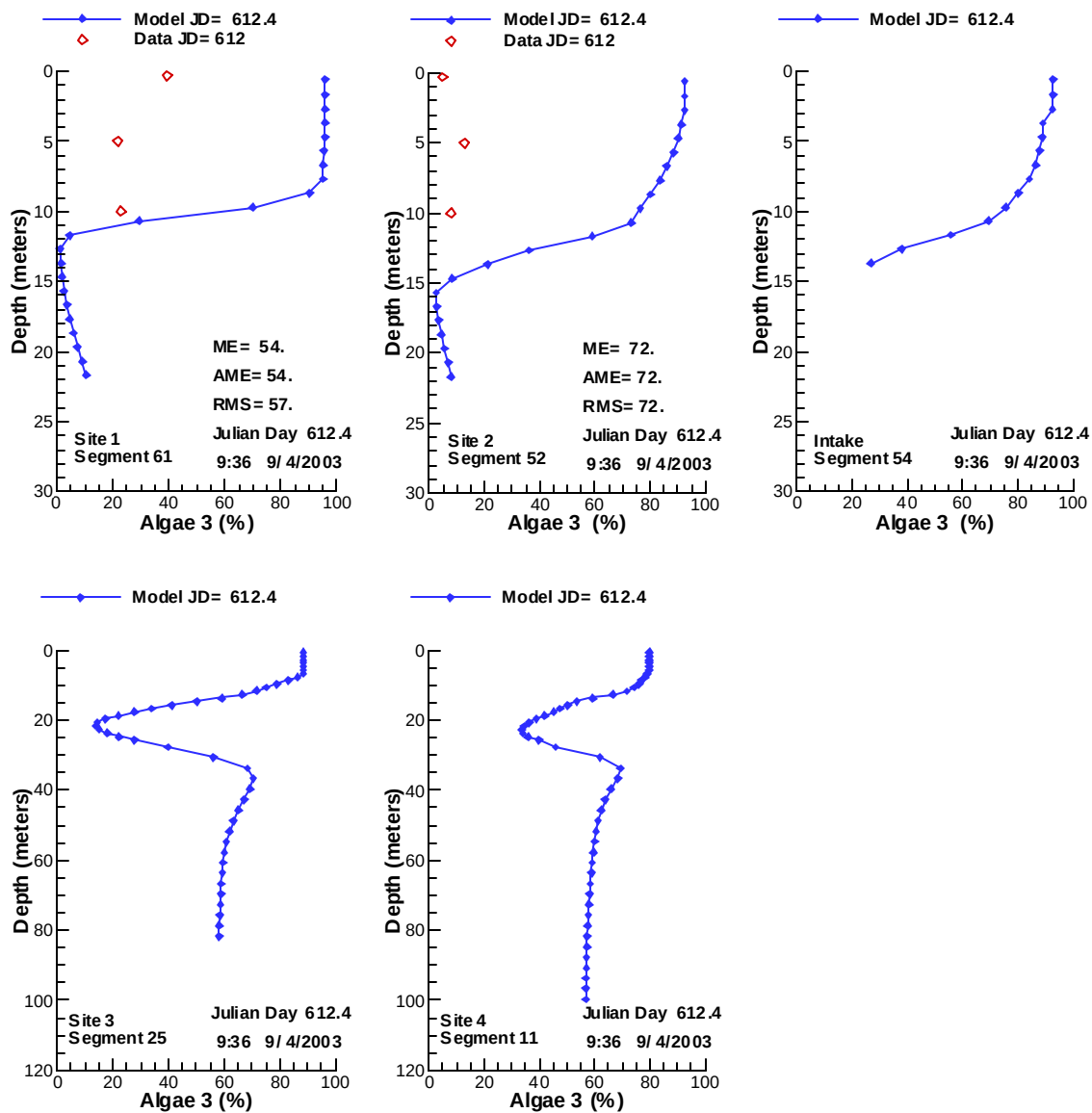


Figure 773. Vertical profiles of ALGAE 3 compared with data for 9/ 4/2003.

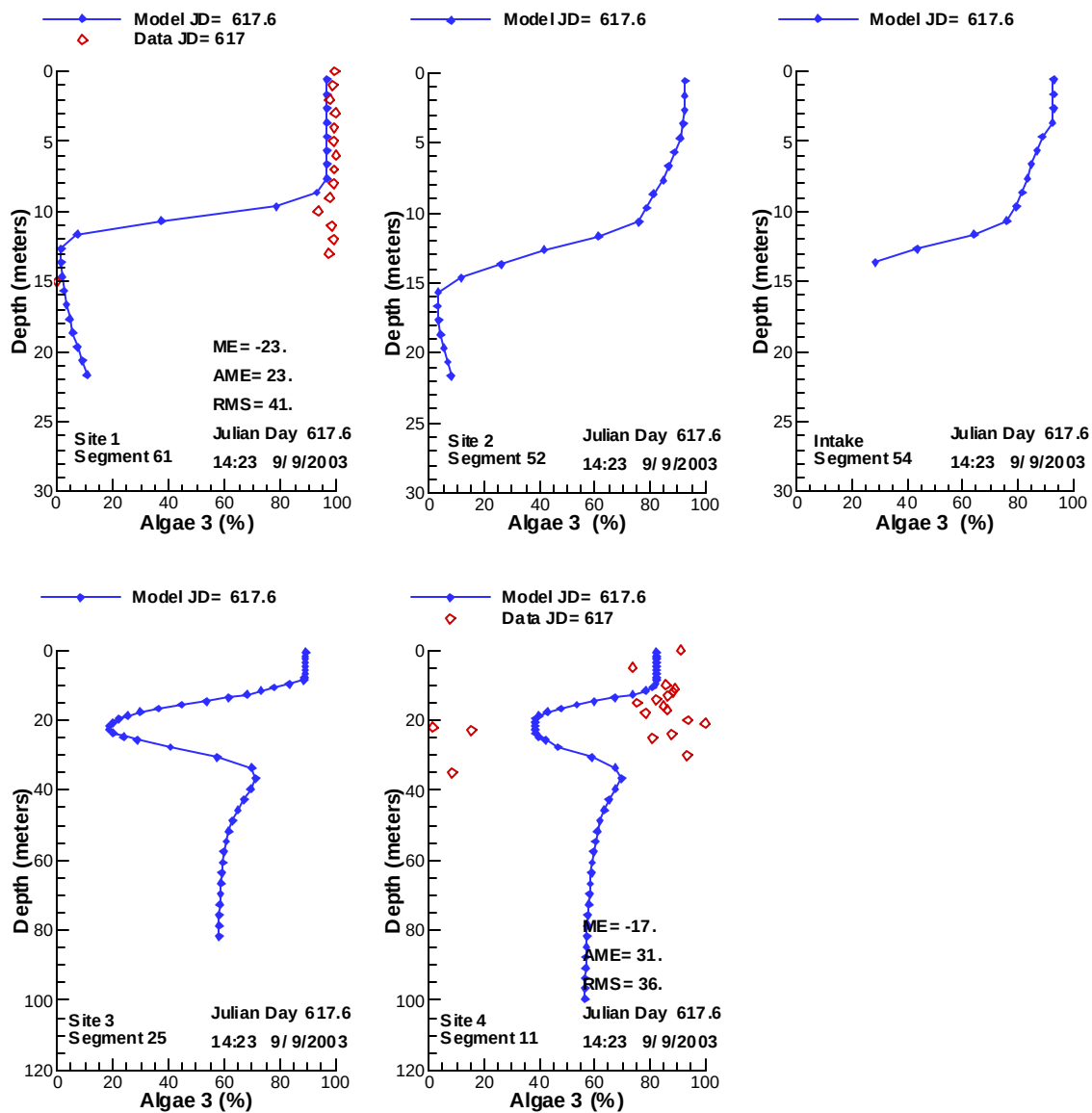


Figure 774. Vertical profiles of ALGAE 3 compared with data for 9/ 9/2003.

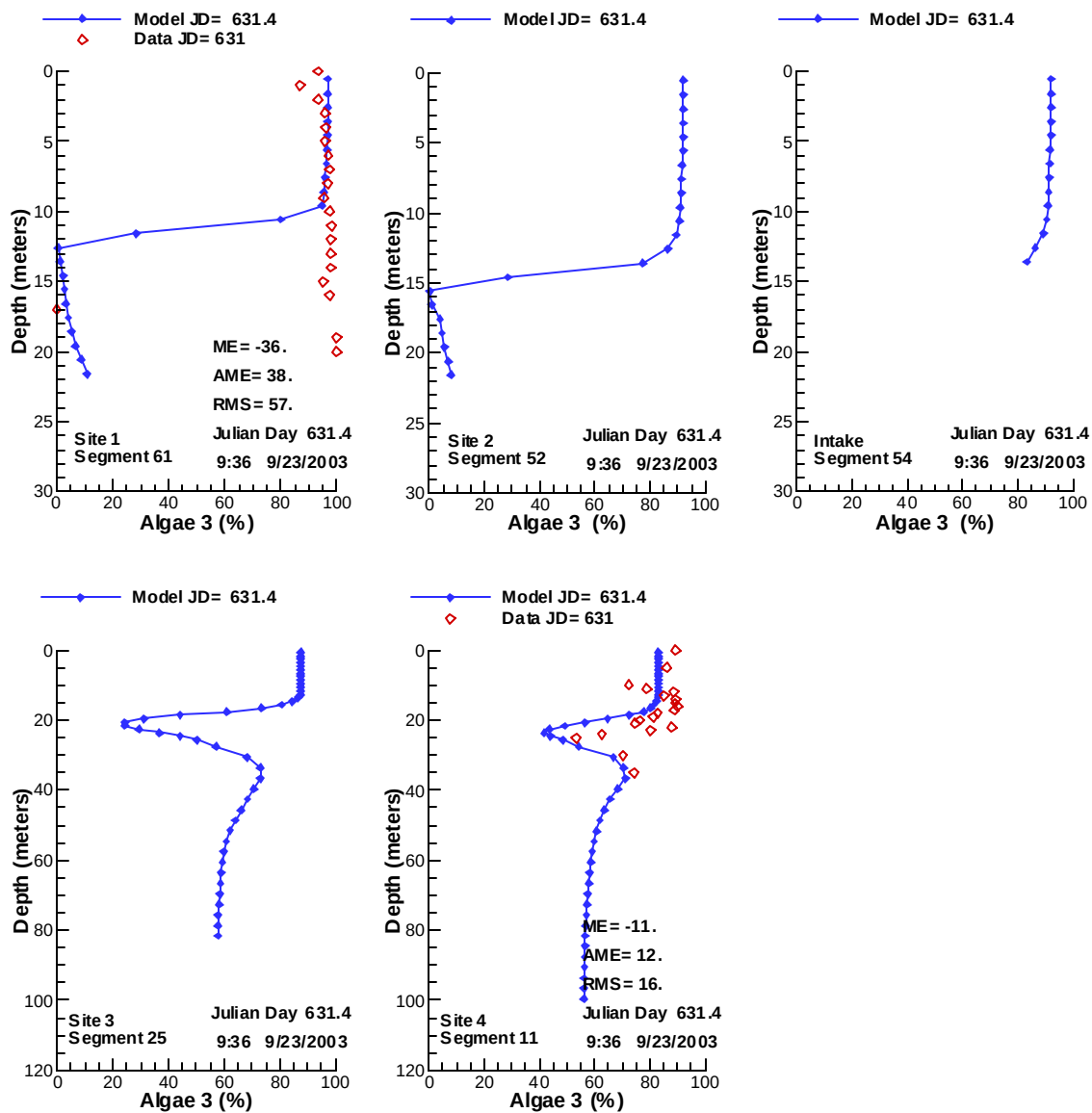


Figure 775. Vertical profiles of ALGAE 3 compared with data for 9/23/2003.

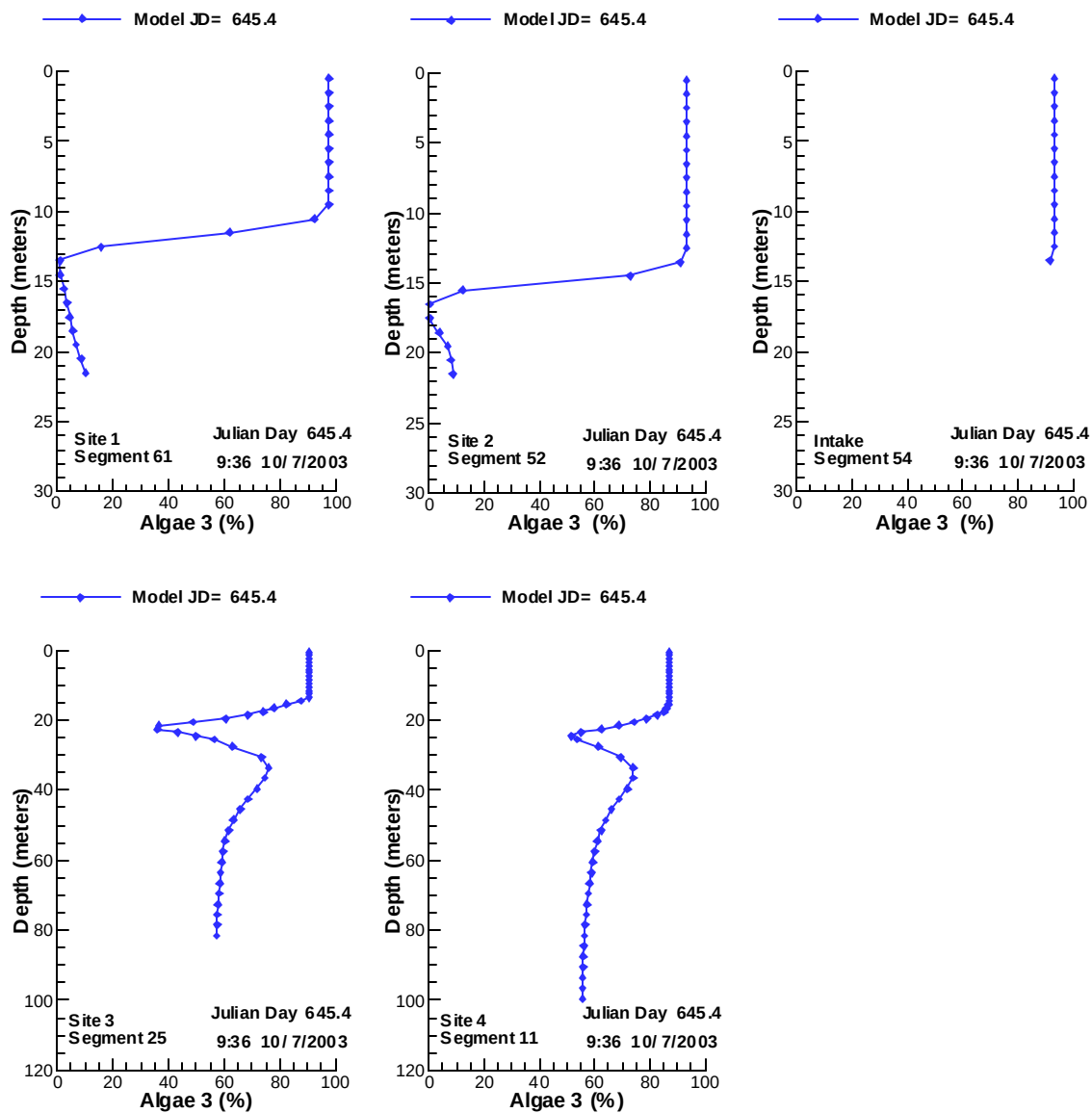


Figure 776. Vertical profiles of ALGAE 3 compared with data for 10/ 7/2003.

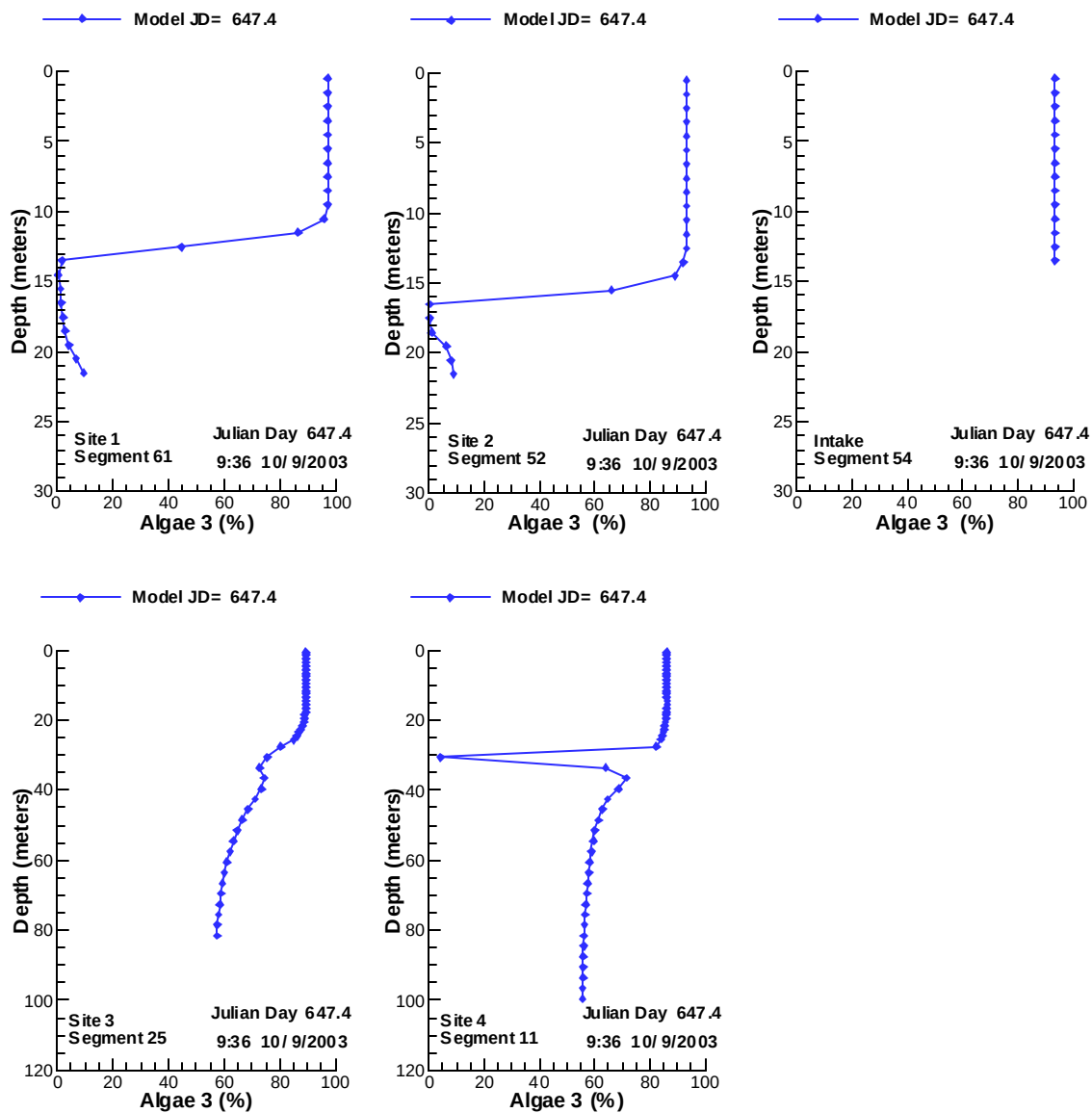


Figure 777. Vertical profiles of ALGAE 3 compared with data for 10/ 9/2003.

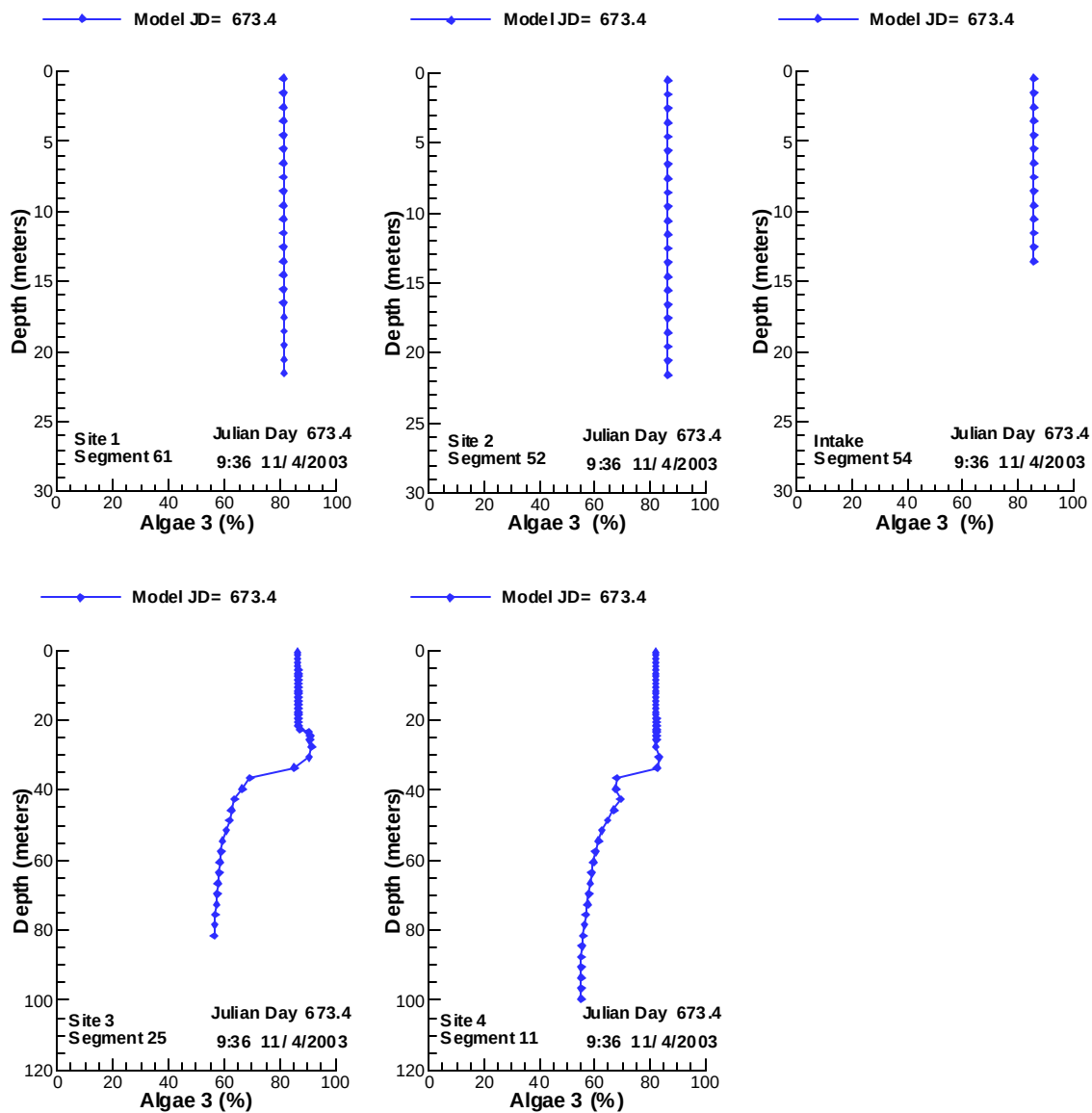


Figure 778. Vertical profiles of ALGAE 3 compared with data for 11/ 4/2003.

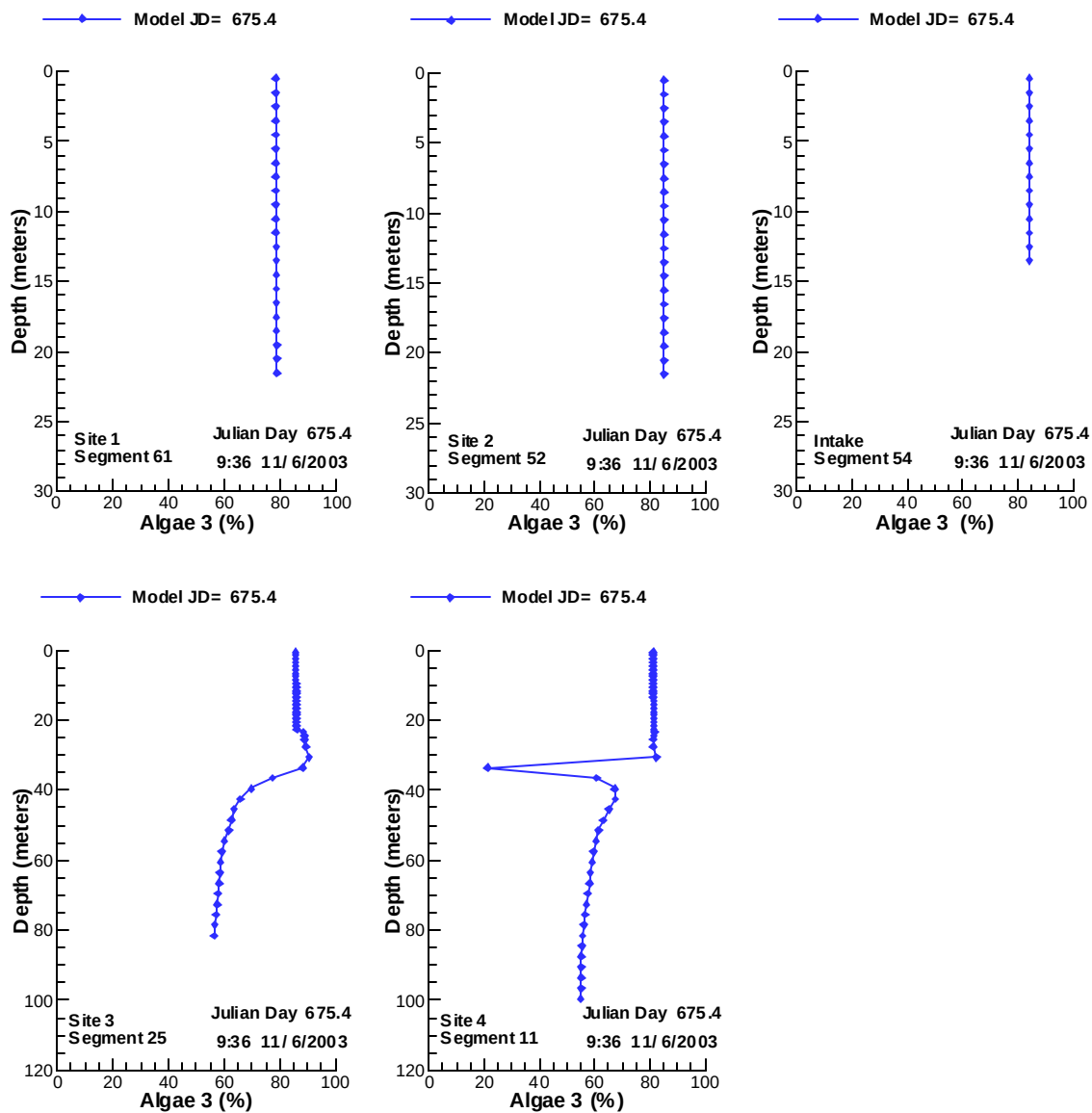


Figure 779. Vertical profiles of ALGAE 3 compared with data for 11/ 6/2003.

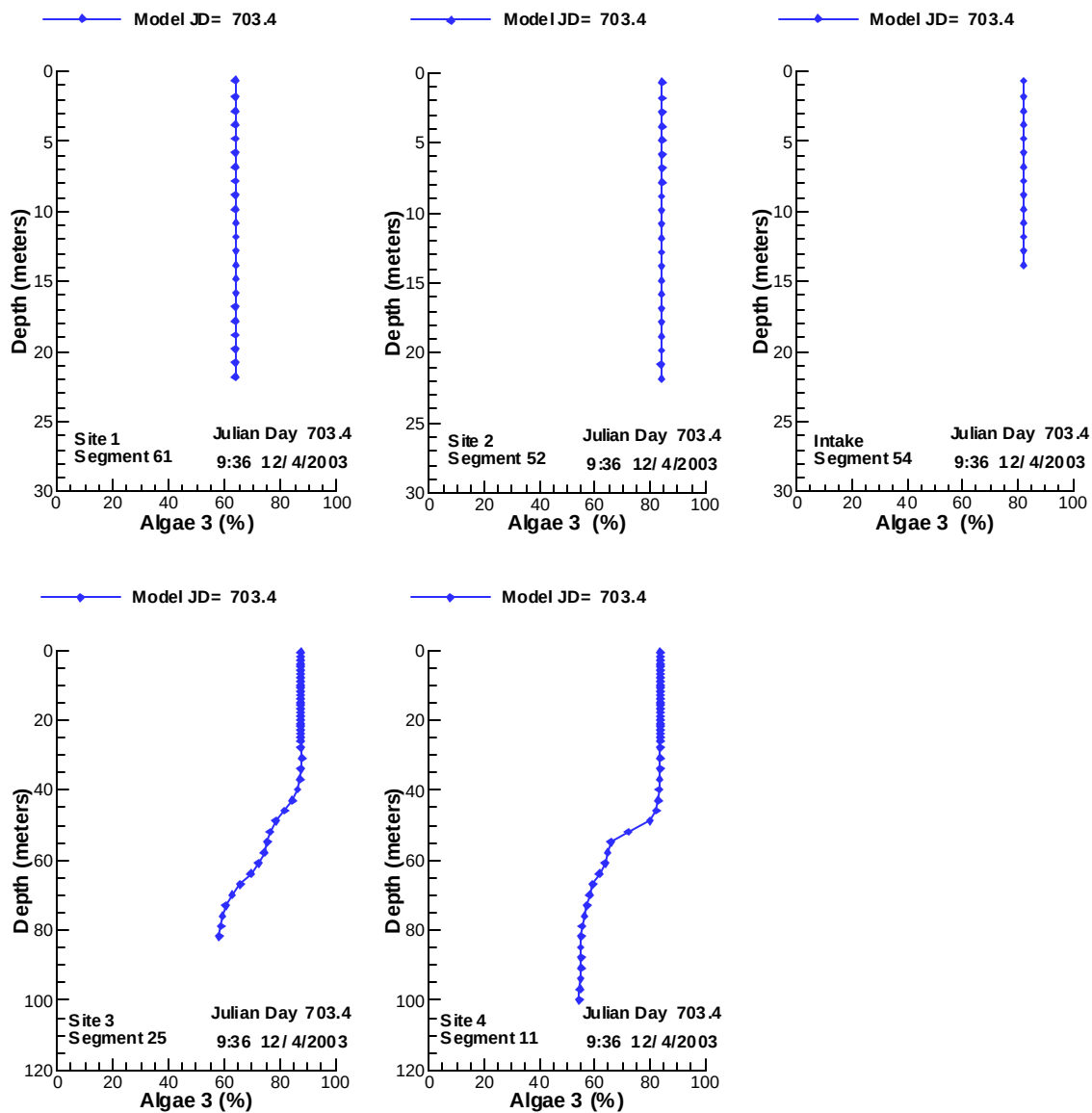


Figure 780. Vertical profiles of ALGAE 3 compared with data for 12/ 4/2003.

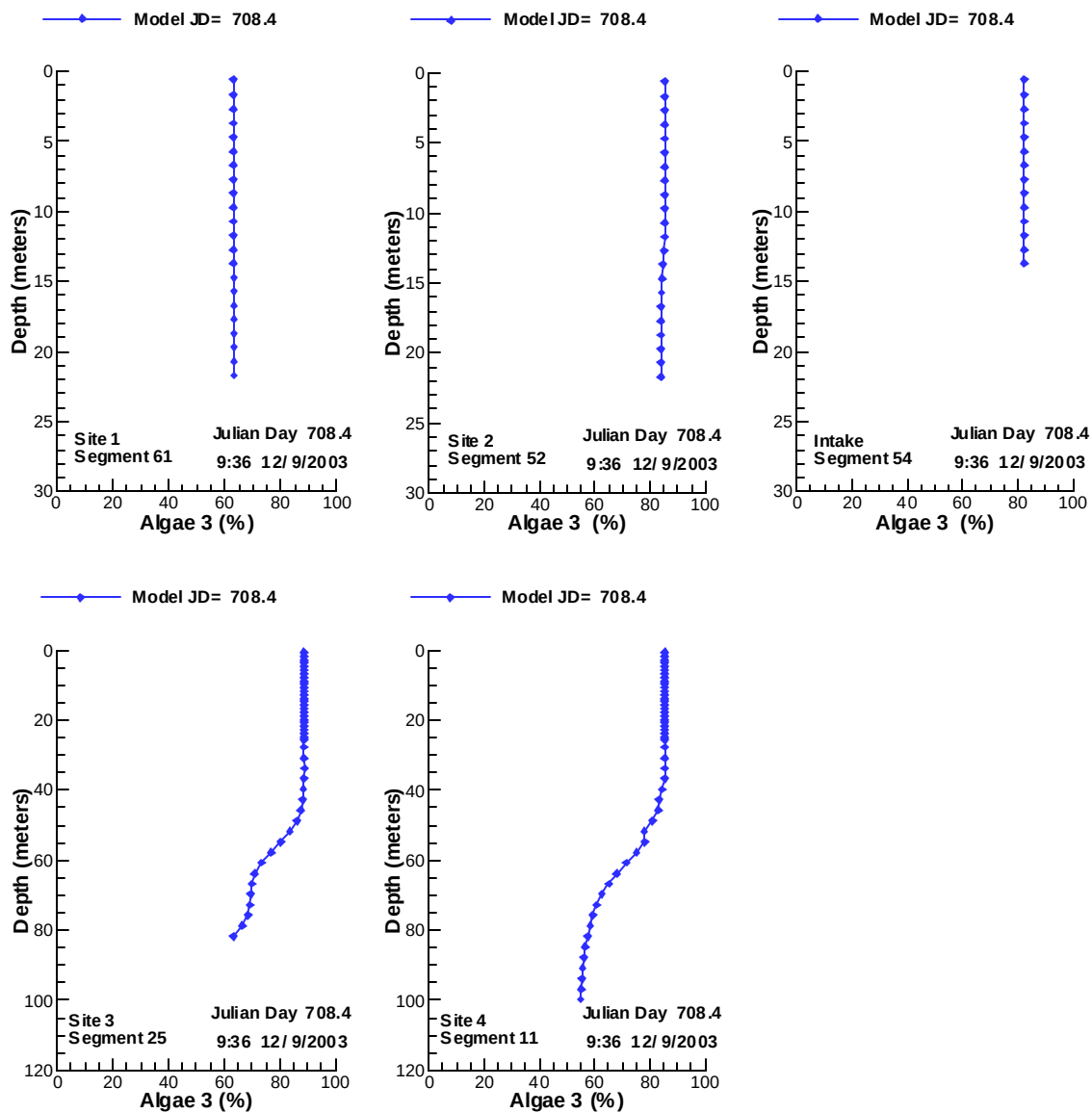


Figure 781. Vertical profiles of ALGAE 3 compared with data for 12/ 9/2003.

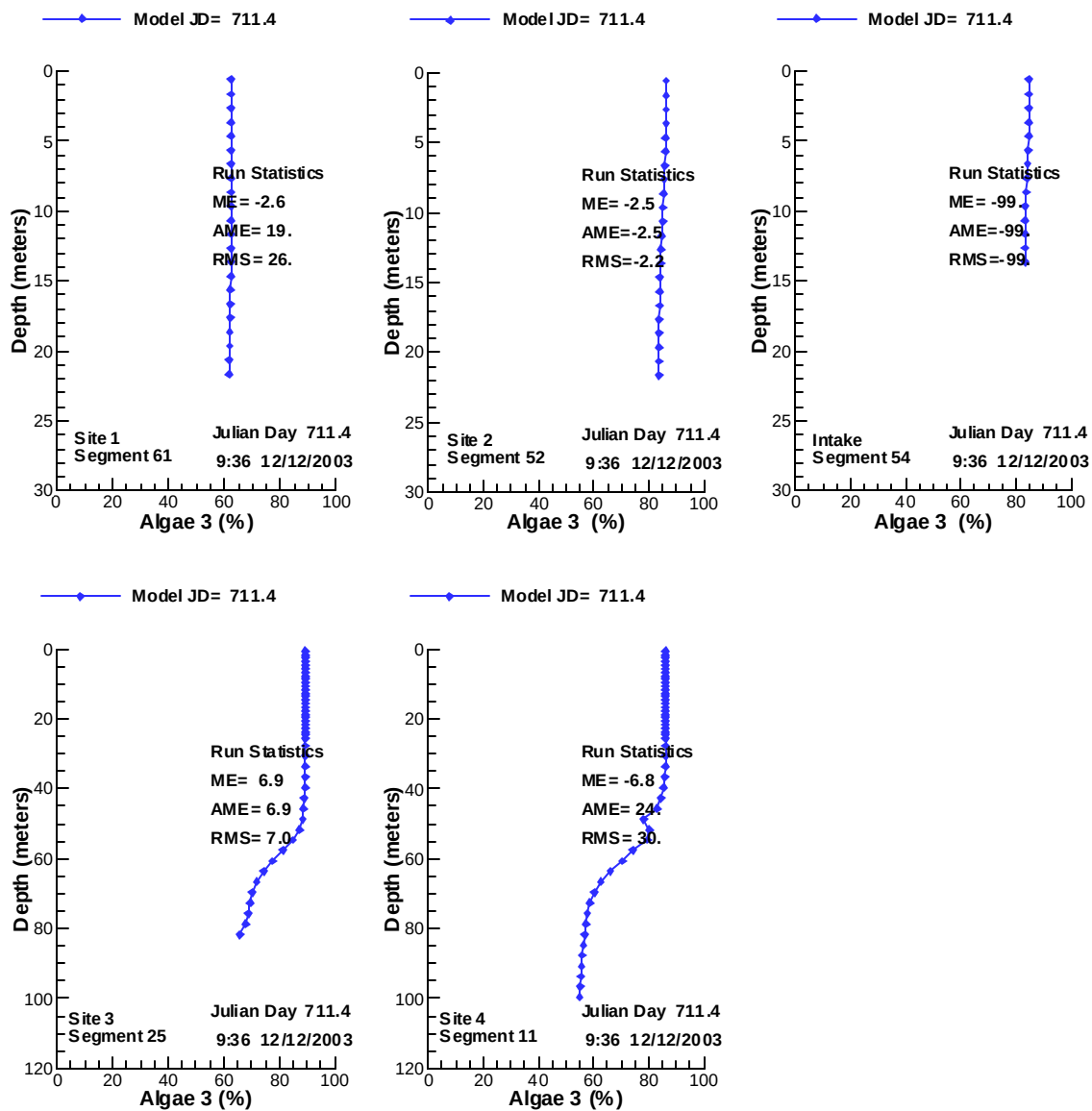


Figure 782. Vertical profiles of ALGAE 3 compared with data for 12/12/2003.