

Long-Term Marine Sediment Monitoring



Physical Sediment Characteristics Data Summary

Table of Contents

Total Organic Carbon (TOC)	3
Sampling schedule	3
Analytical laboratories	3
Analytical laboratories and methods for TOC measurements.....	3
Graphical data summaries.....	4
Percent total organic carbon (TOC) by station.....	4
Grain Size	5
Sampling schedule	5
Analytical laboratories, methods, and grain size classes.....	5
Data analyses.....	5
Results summary.....	5
Mean sediment grain size (gravel, sand, silt, clay), by station and year.....	6
Graphical data summaries.....	9
Percent fines (silt + clay), by station	9
.....	9
TOC-grain size relationships	10
Mean TOC and grain sizes by year, by station.....	10
Correlation between TOC and percent fines, overall and by station.....	13
Marginal plots of TOC and percent fines, with regression of TOC on percent fines, overall and by station.....	13
Sulfides and Ammonia	19
Sediment total sulfides by station and year	19
Total sulfides in sediment and porewater, 2015, by station.....	20
Ammonia as Nitrogen in sediment and porewater, 2015, by station.....	21
Case Narratives	22
Case narratives for all laboratory analyses are available from the report authors upon request.....	22
References	22

Total Organic Carbon (TOC)

Sampling schedule

TOC was measured for all samples except in 1997-1999.

Analytical laboratories

Analytical laboratories and methods for TOC measurements for the Puget Sound Long-Term Sediment Monitoring Program, 1989-2015.

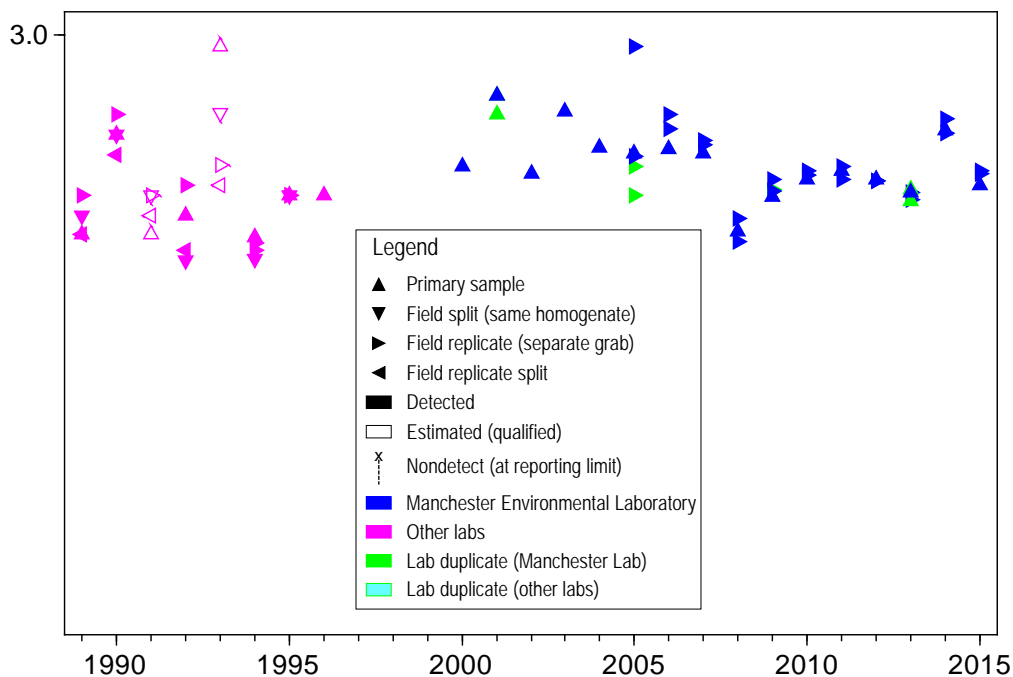
Years	Laboratory	Method
1989-1996	Analytical Resources, Inc.	PSEP, 1986 (70°C)
2000-2016	Manchester Environmental Laboratory	Both PSEP, 1986 (70°C) and Modified PSEP, 1986 (104°C)*

* Only results for PSEP, 1986 (70°C) are used.

Graphical data summaries

Percent total organic carbon (TOC) by station, for the Long-Term Sediment Monitoring Program, 1989-2016. All field replicates and lab duplicates are shown, along with result qualifiers, by analytical laboratory.

Example and legend for total organic carbon content:



Graphical depictions for TOC data are linked below:

[Station 3, Strait of Georgia](#)

[Station 4, Bellingham Bay](#)

[Station 13, North Hood Canal](#)

[Station 21, Port Gardner](#)

[Station 29, Shilshole](#)

[Station 34, Sinclair Inlet](#)

[Station 38, Point Pully](#)

[Station 40, Thea Foss Waterway](#)

[Station 44, East Anderson Island](#)

[Station 49, Inner Budd Inlet](#)

Grain Size

Sampling schedule

Grain size was measured for all samples; however, the results for 1995 were deemed by Ecology to be unusable.

Analytical laboratories, methods, and grain size classes

Analytical laboratories, methods, and grain size classes for the Puget Sound Long-Term Sediment Monitoring Program, 1989-2016. Except in 1995, analyses followed the PSEP protocol (wet-sieving plus pipetting of fines) with salt correction (PSEP, 1986). In 1995, ASTM D-422 (dry sieving plus hydrometer for fines) was used; however, the results for the coarse and fine fractions were not reconciled by the lab and therefore were deemed by Ecology to be unusable.

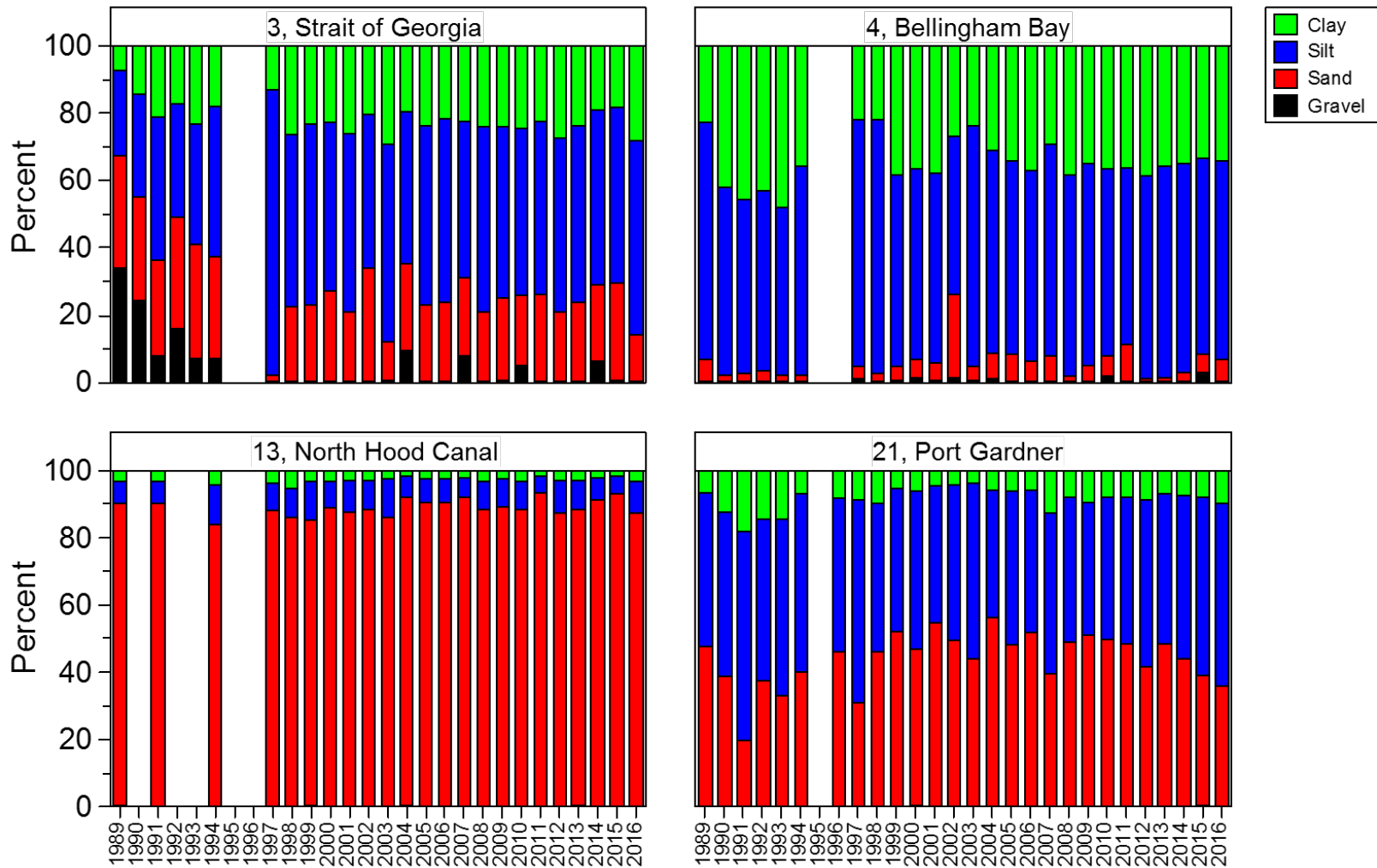
Years	Laboratory	Method	Size Classes
1989	Columbia Analytical Services, Inc.	PSEP, 1986	Gravel/sand/silt/clay
1990	Hart Crowser	PSEP, 1986	Gravel/sand/silt/clay
1991-1994	Soil Technology, Inc.	PSEP, 1986	Gravel/sand/silt/clay
1995	Columbia Analytical Services, Inc.	ASTM D-422	Gravel/sand/silt/clay
1996	Soil Technology, Inc.	PSEP, 1986	Gravel/sand/silt/clay
1997	Columbia Analytical Services, Inc.	PSEP, 1986	Modified Wentworth (gravel/5 sand classes/silt/clay)
1998	Hart Crowser	PSEP, 1986	Modified Wentworth
1999-2004	Rosa Environmental and Geotechnical Laboratory	PSEP, 1986	Modified Wentworth
2005-2014	Analytical Resources, Inc. (formerly Rosa)	PSEP, 1986	Modified Wentworth
2015-2016	Materials Testing & Consulting, Inc. (ARI spin-off; formerly Rosa)	PSEP, 1986	Modified Wentworth

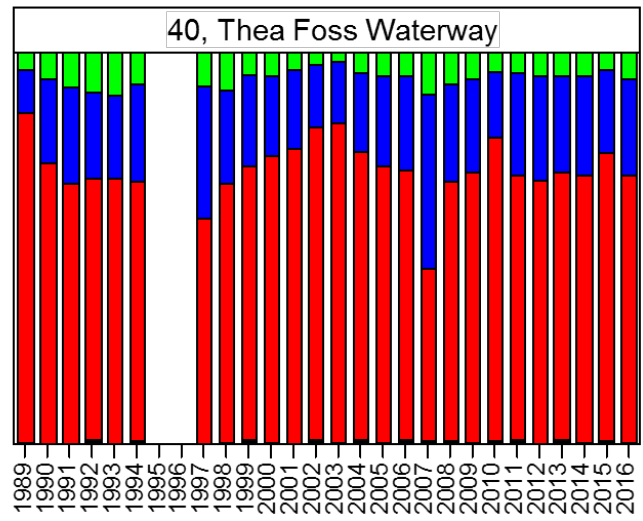
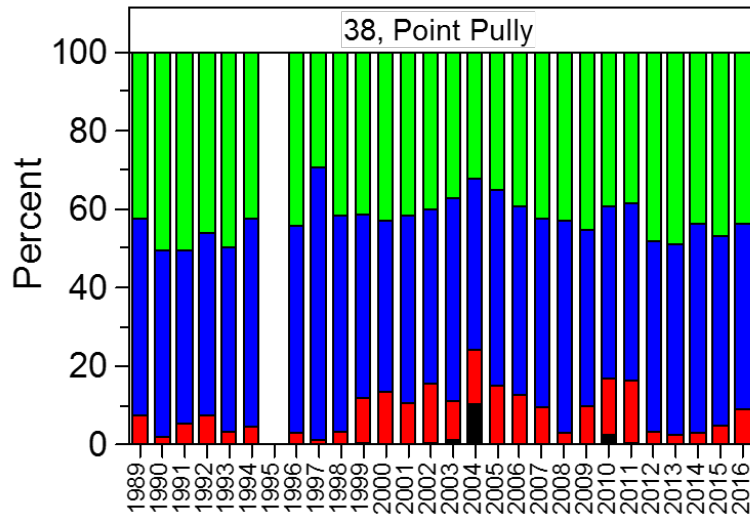
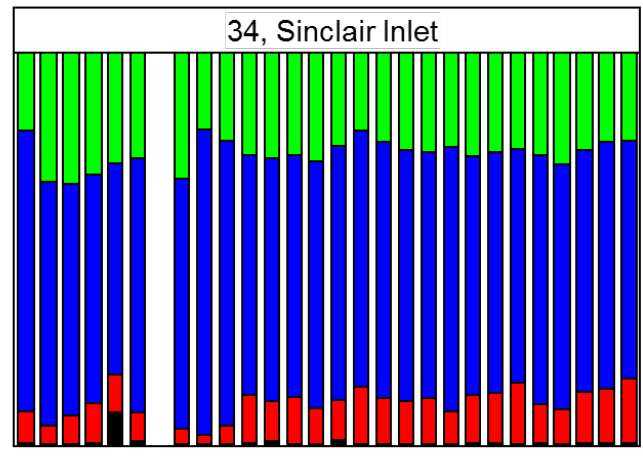
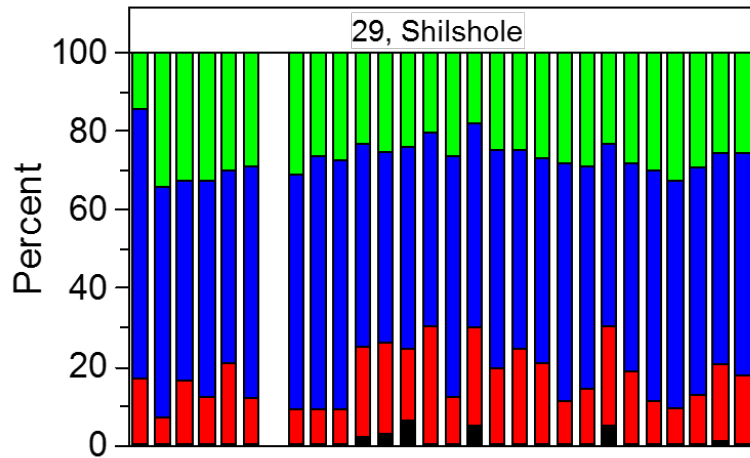
Data analyses

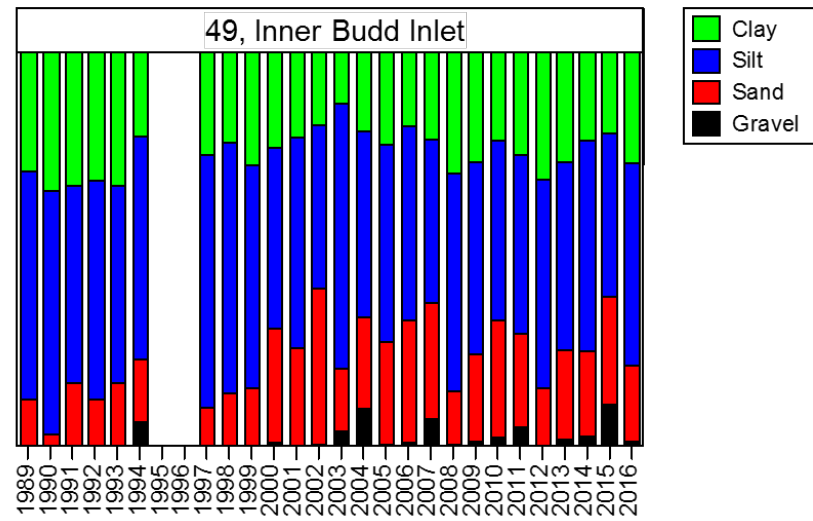
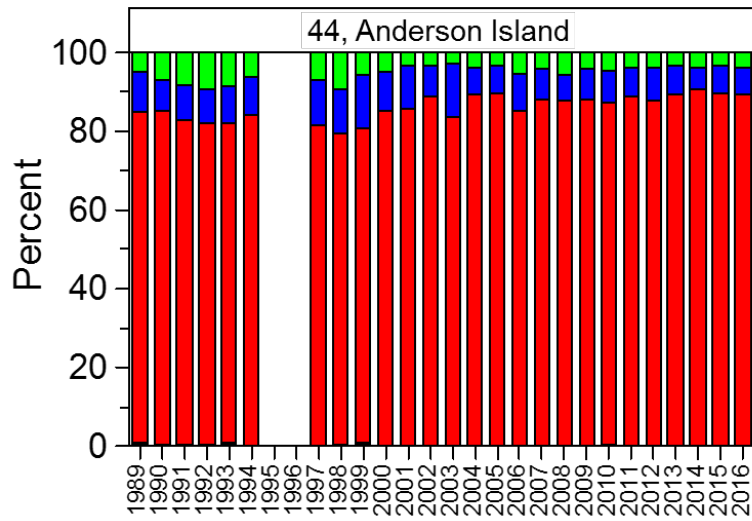
Prior to data analysis, all grain size data were standardized to 100%.

Results summary

Mean sediment grain size (gravel, sand, silt, clay), by station and year, for the Long-Term Sediment Monitoring Program, 1989-2016.



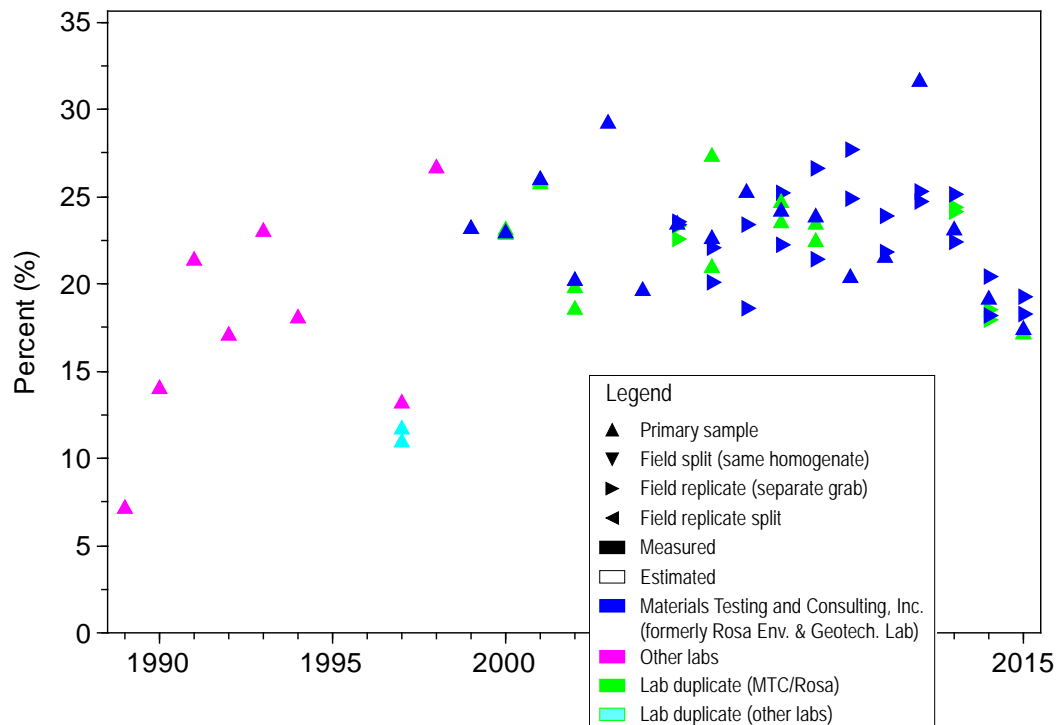




Graphical data summaries

Percent fines (silt + clay), by station, for the Long-Term Sediment Monitoring Program, 1989-2016. All field replicates and lab duplicates are shown, by analytical laboratory.

Example and legend for grain size proportions:



Graphical depictions for grain size data are linked below:

[Station 3, Strait of Georgia](#)

[Station 4, Bellingham Bay](#)

[Station 13, North Hood Canal](#)

[Station 21, Port Gardner](#)

[Station 29, Shilshole](#)

[Station 34, Sinclair Inlet](#)

[Station 38, Point Pully](#)

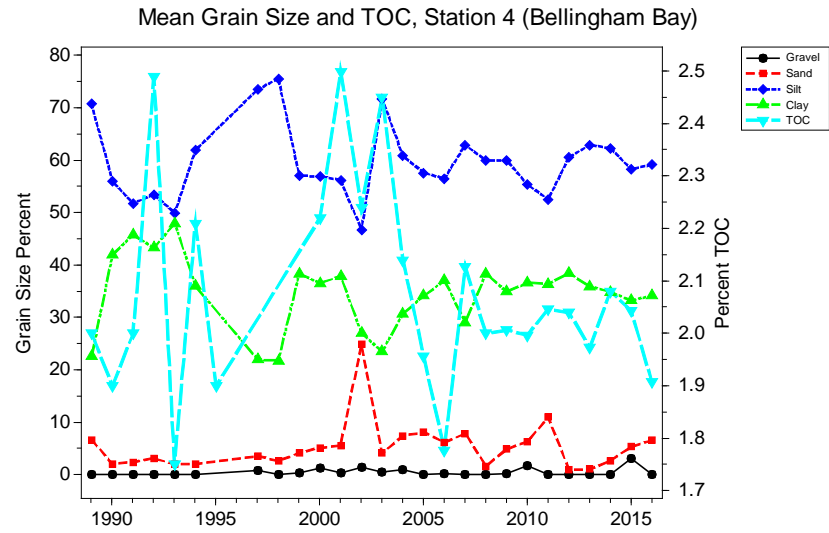
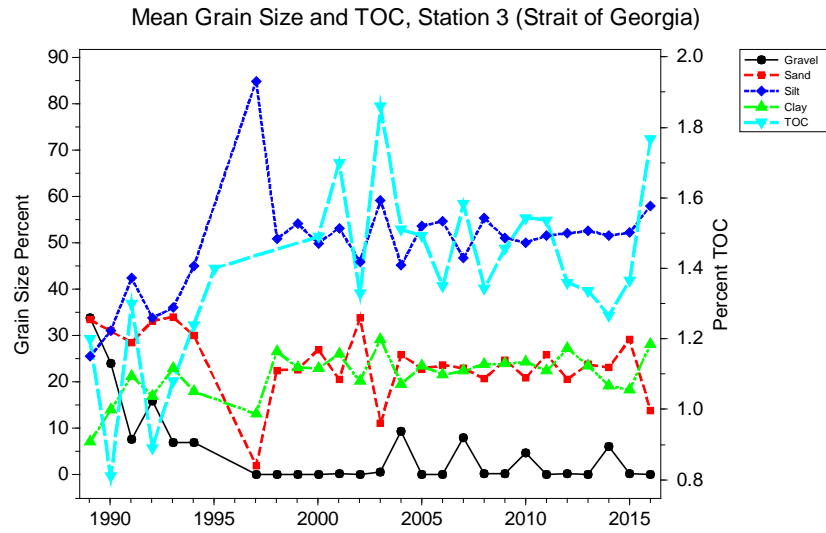
[Station 40, Thea Foss Waterway](#)

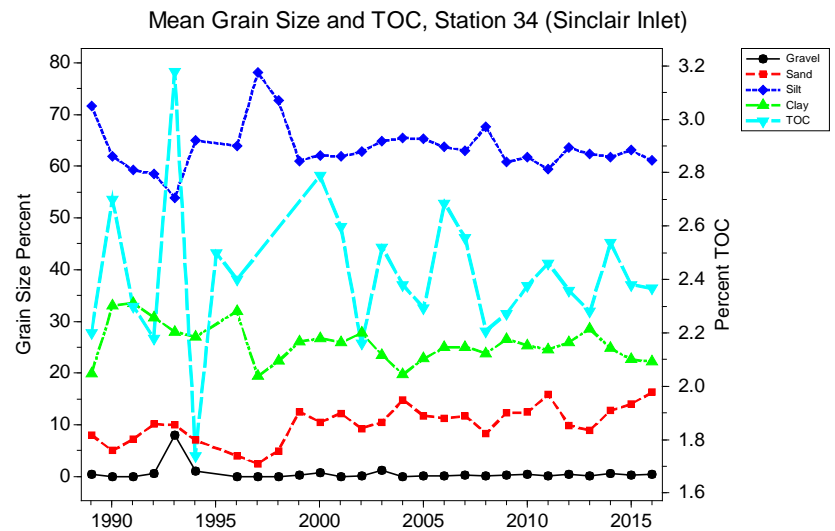
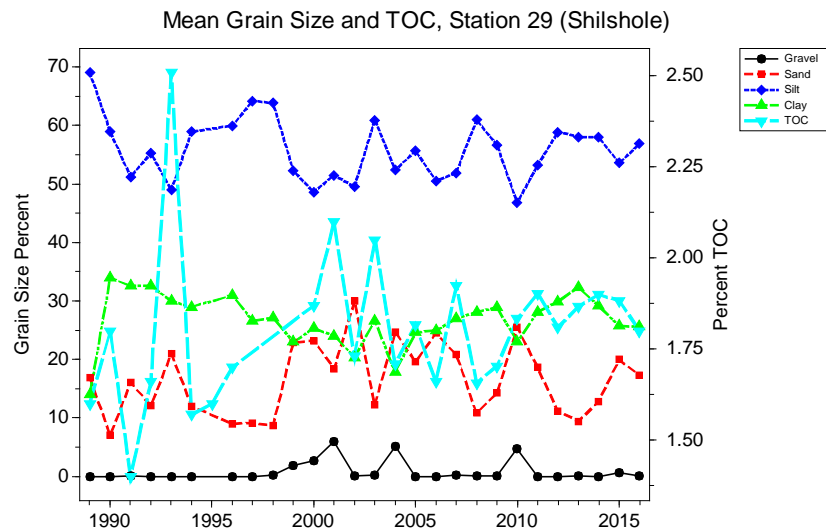
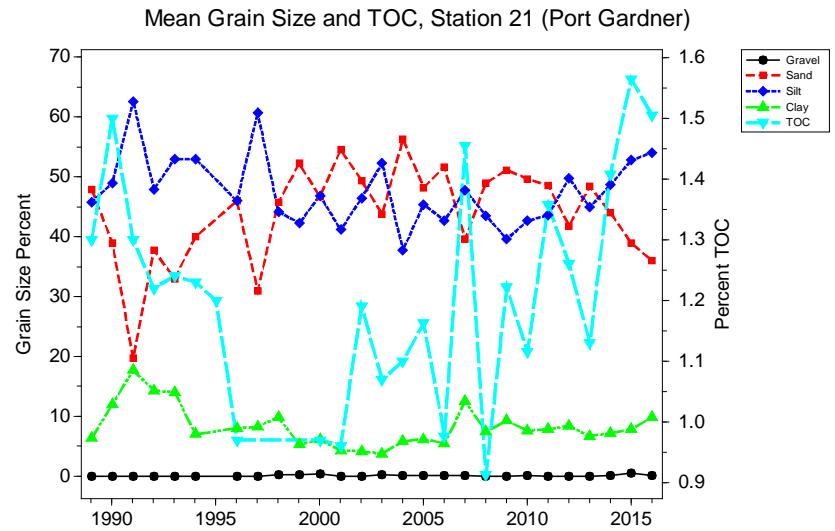
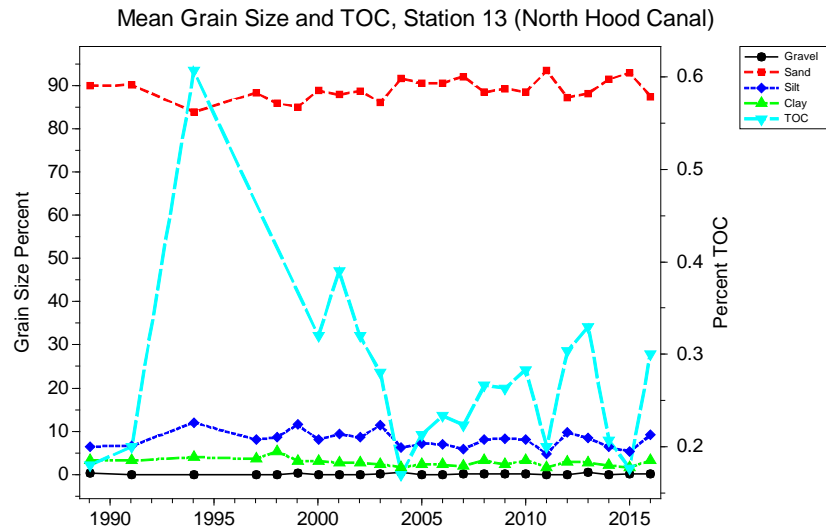
[Station 44, East Anderson Island](#)

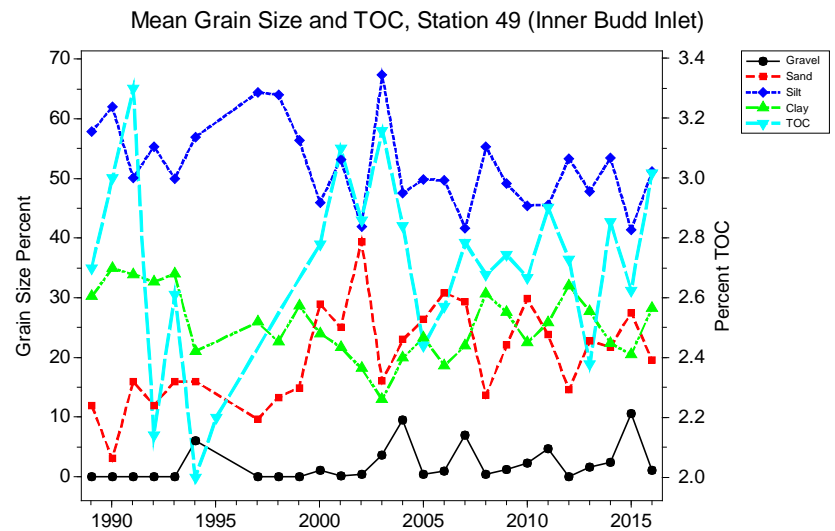
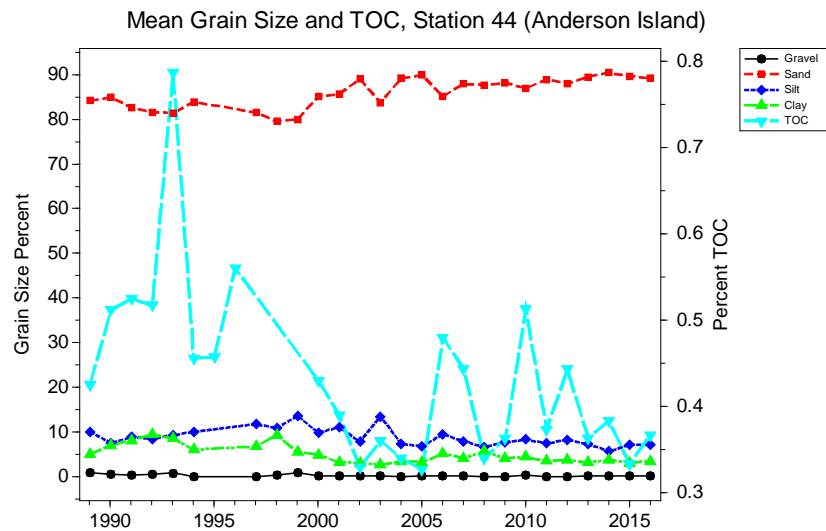
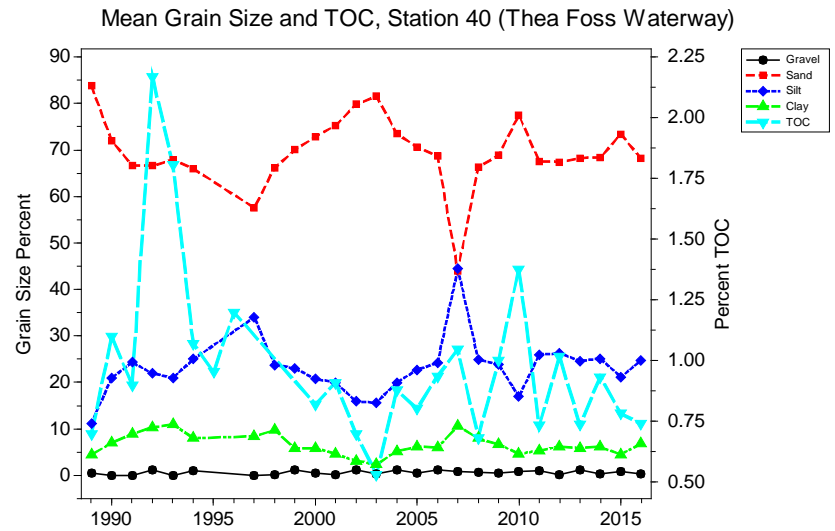
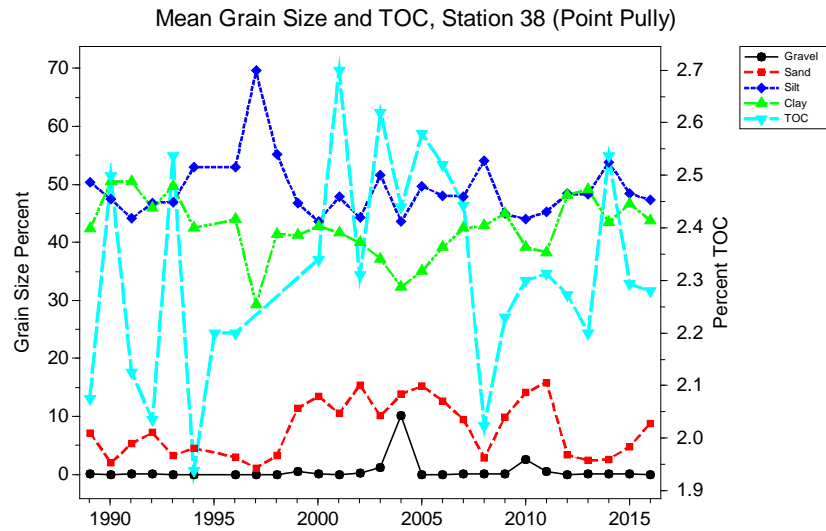
[Station 49, Inner Budd Inlet](#)

TOC-grain size relationships

Mean TOC and grain sizes by year, by station.



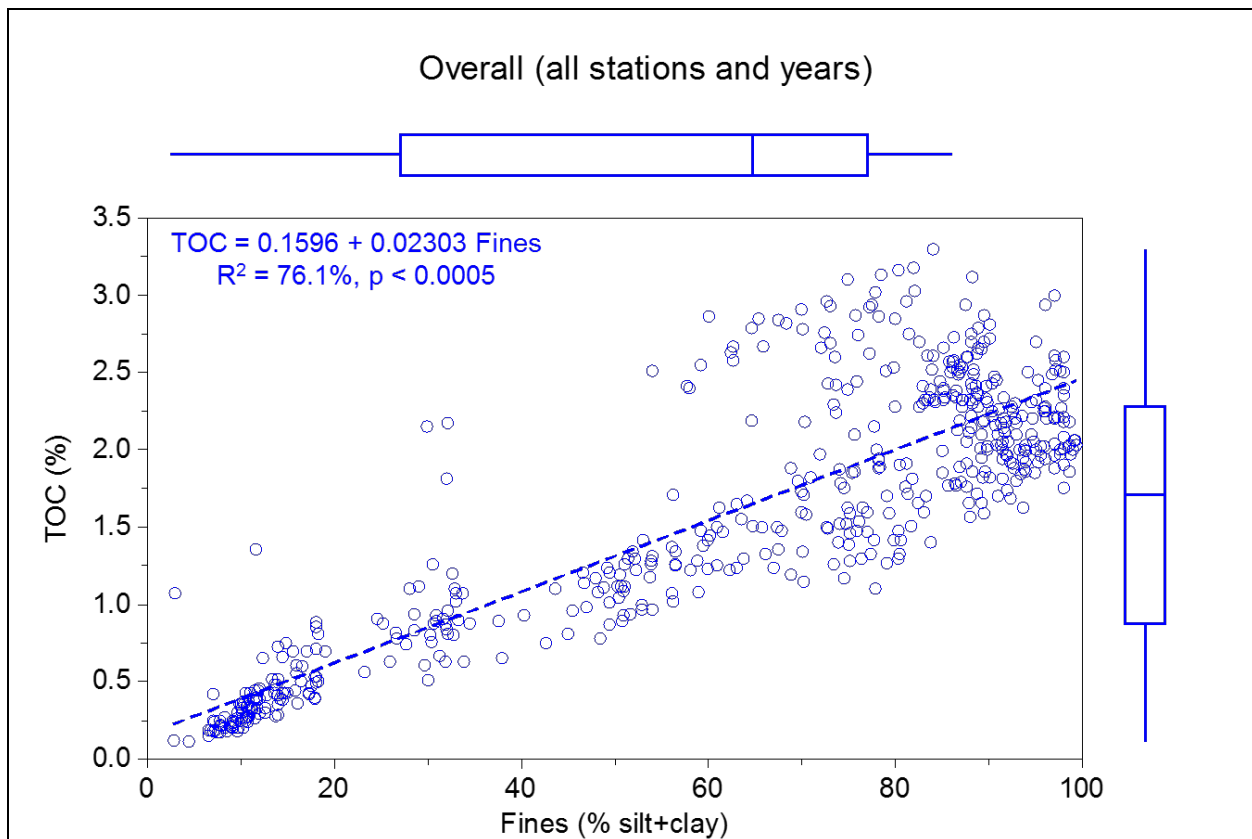


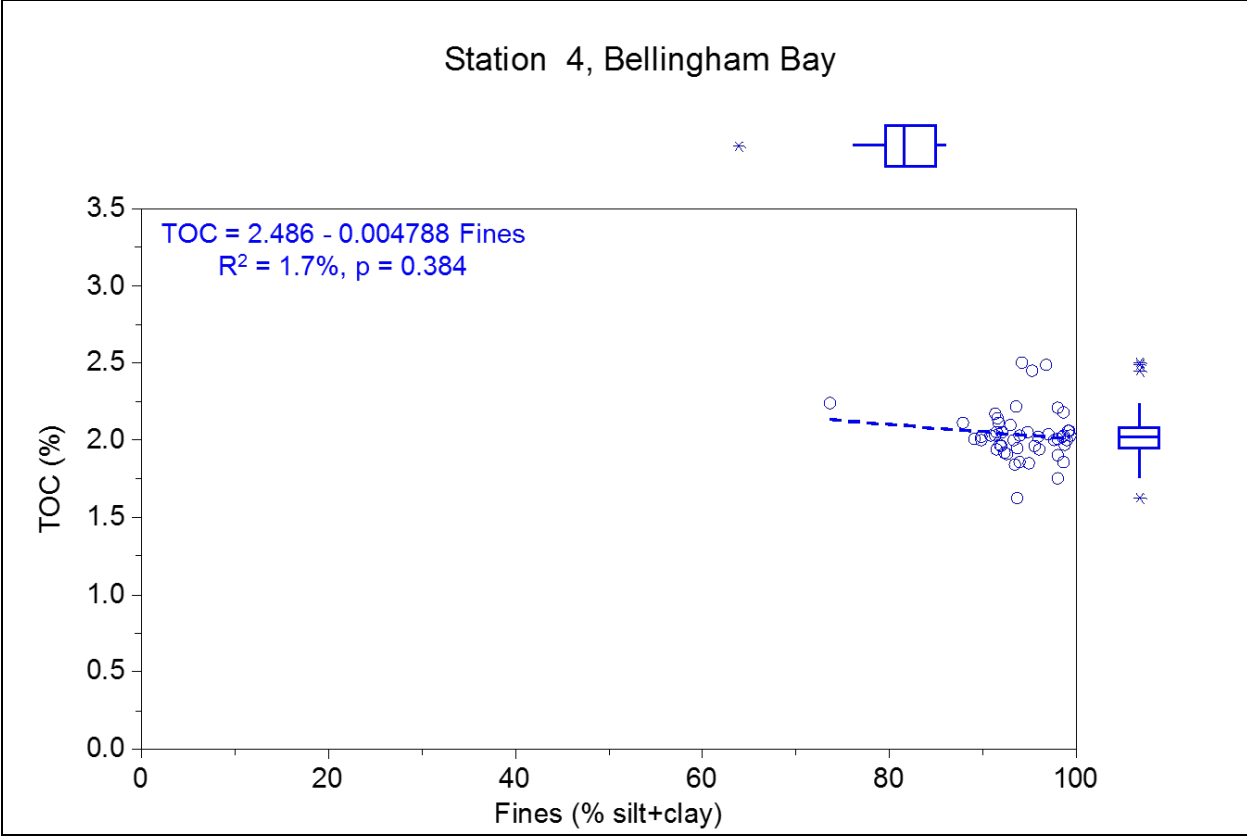
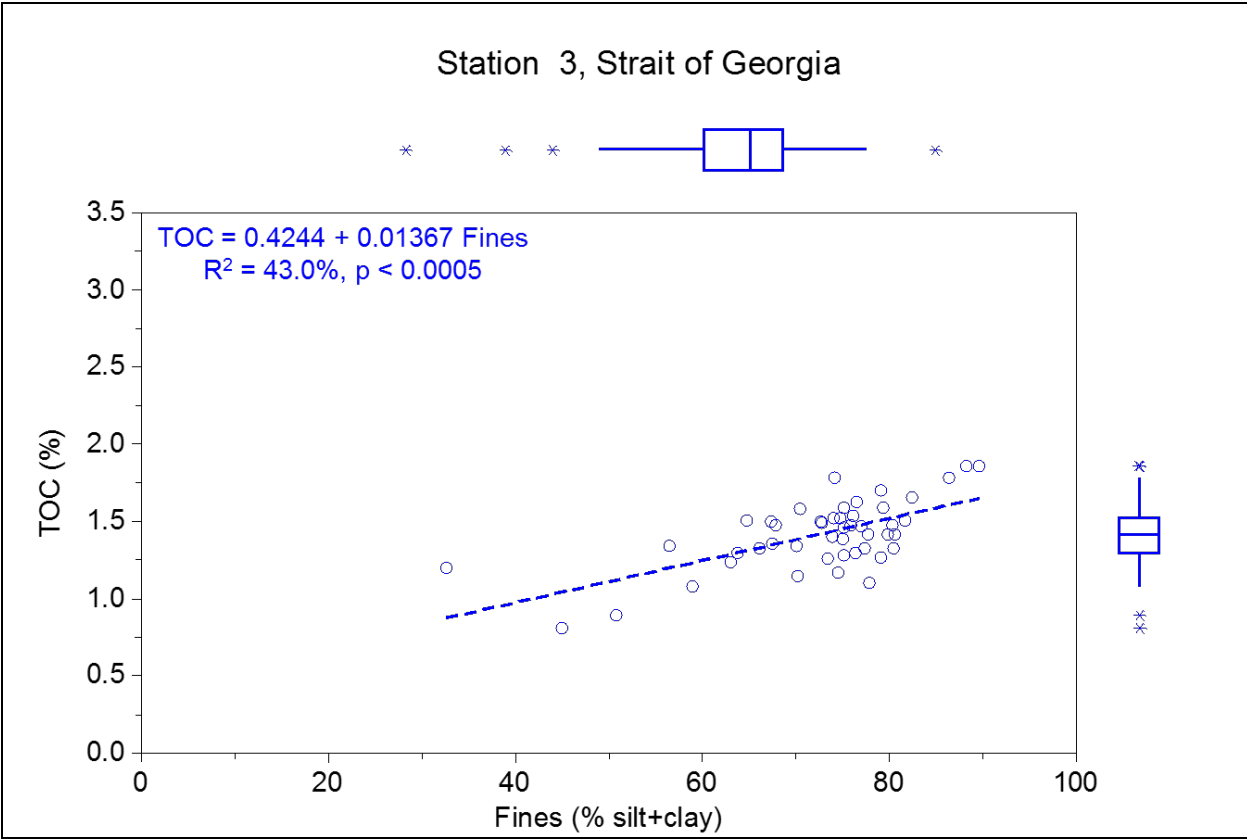


Correlation between TOC and percent fines, overall and by station.

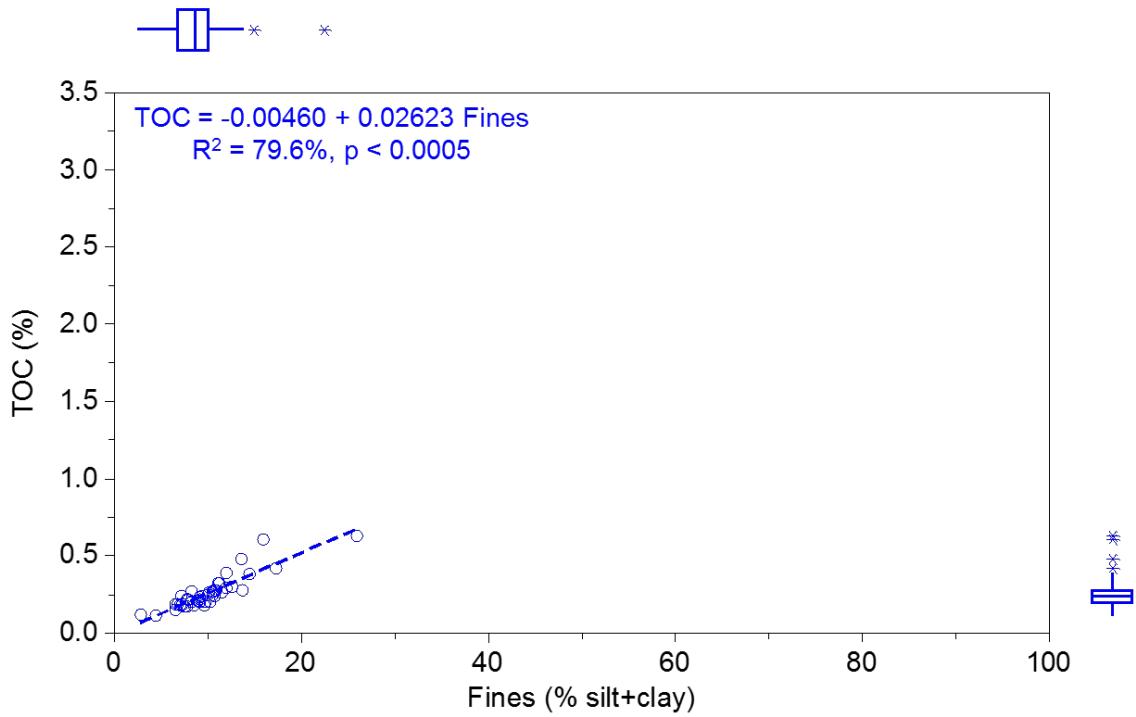
Station	Pearson correlation, r	p -value
Overall	0.872	<0.0005
3	0.656	<0.0005
4	-0.129	0.384
13	0.892	<0.0005
21	0.658	<0.0005
29	-0.169	0.240
34	-0.218	0.097
38	-0.196	0.115
40	0.160	0.272
44	0.663	<0.0005
49	0.258	0.051

Marginal plots of TOC and percent fines, with regression of TOC on percent fines, overall and by station.

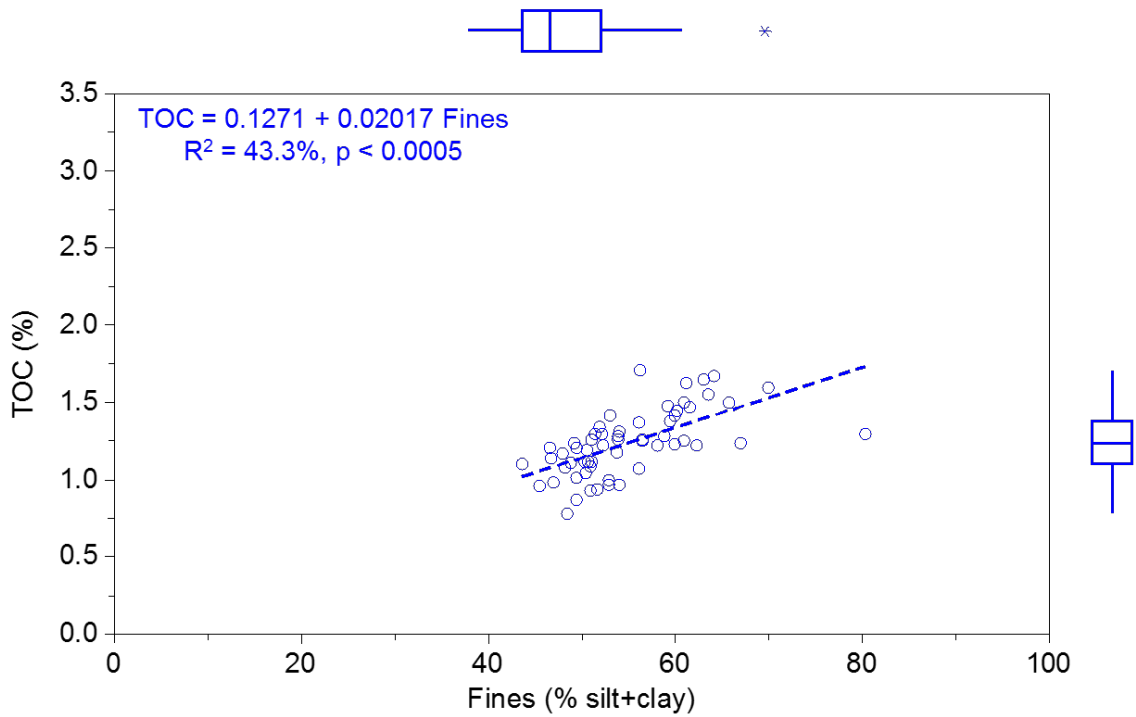


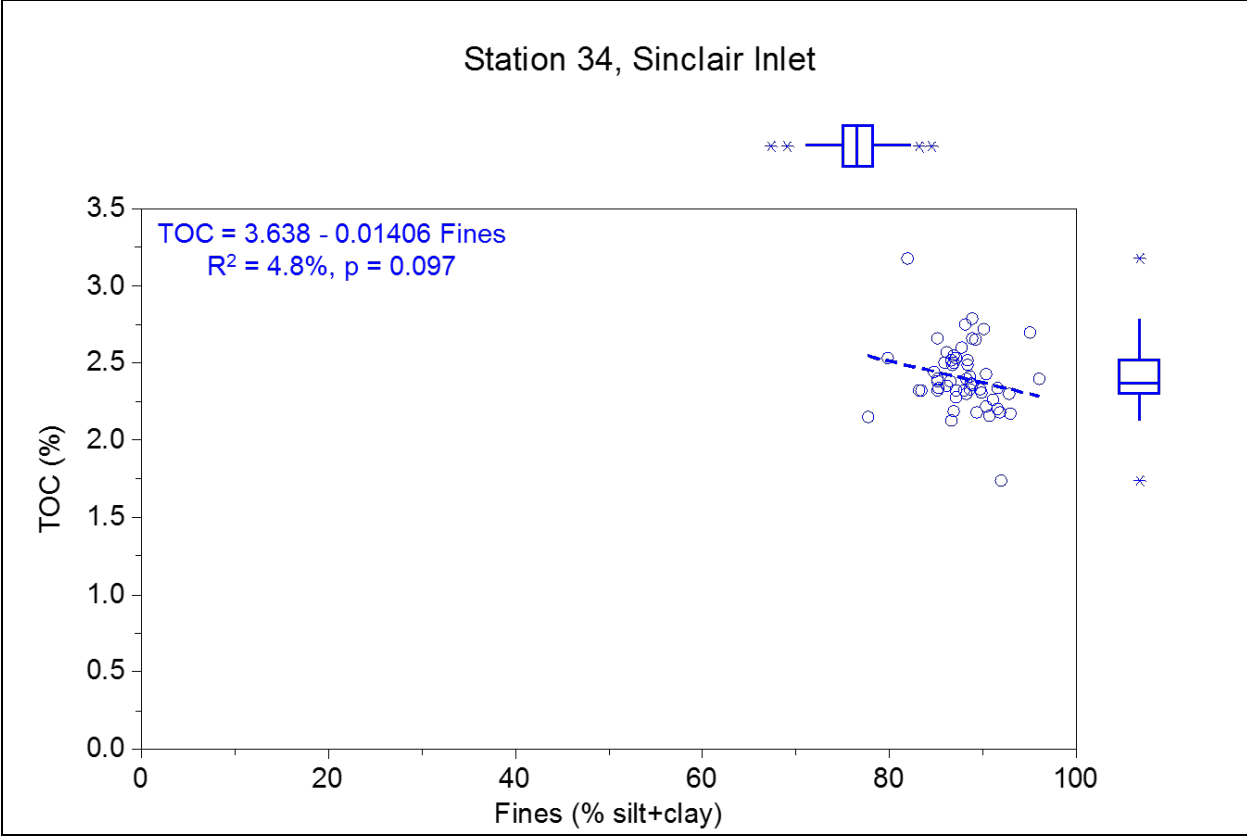
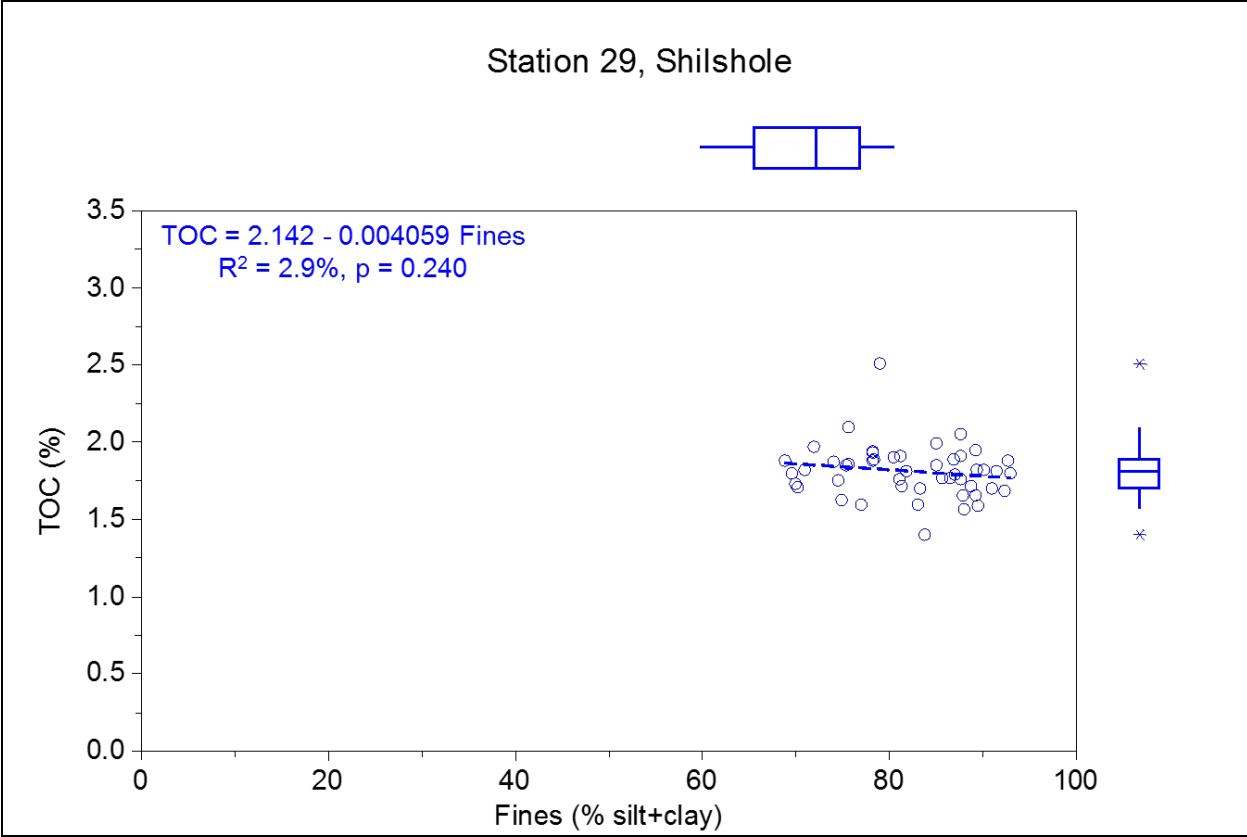


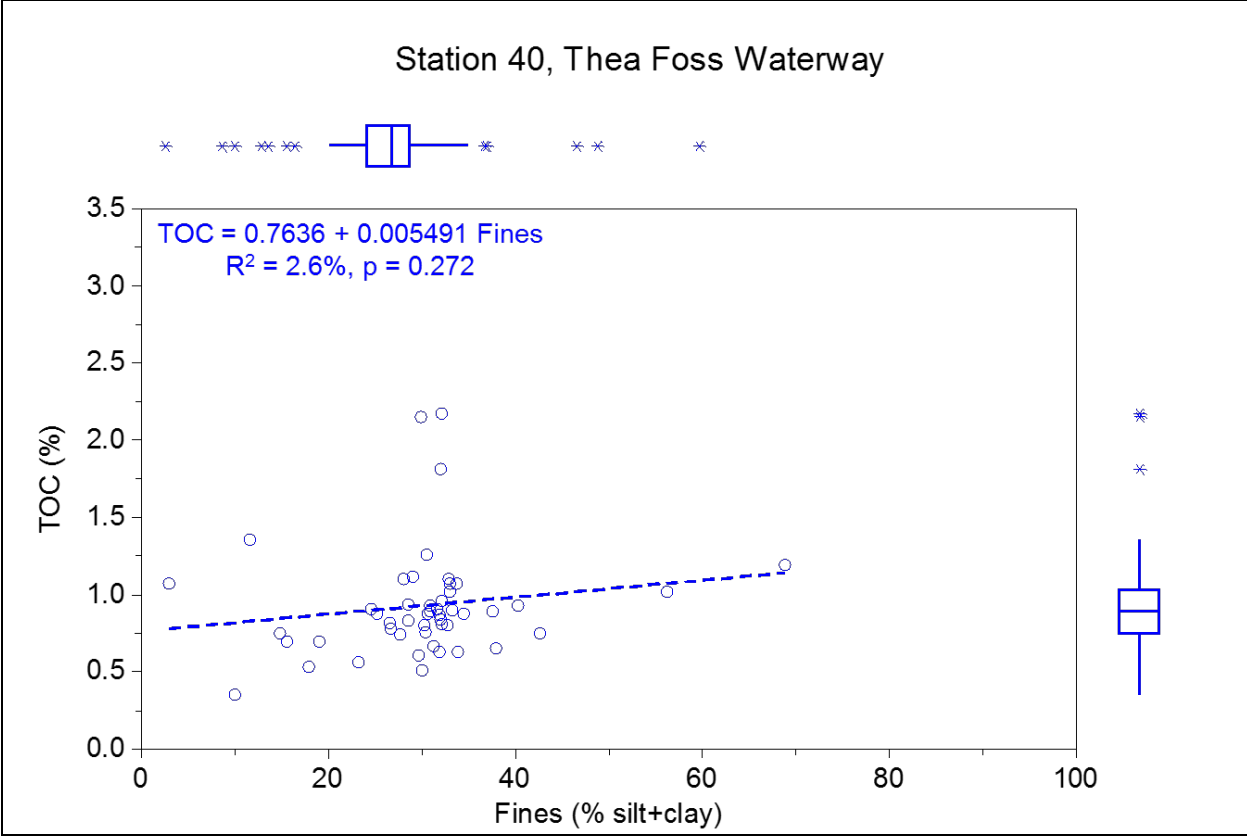
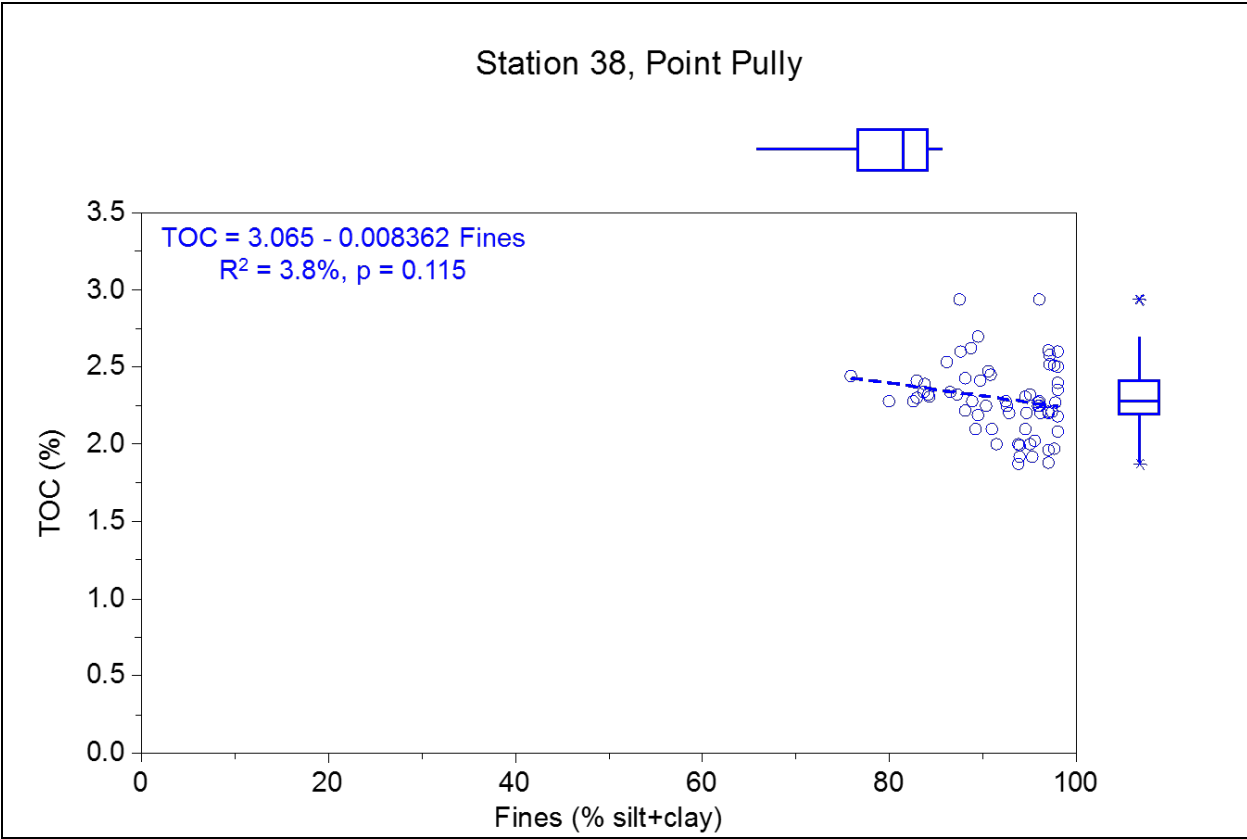
Station 13, North Hood Canal

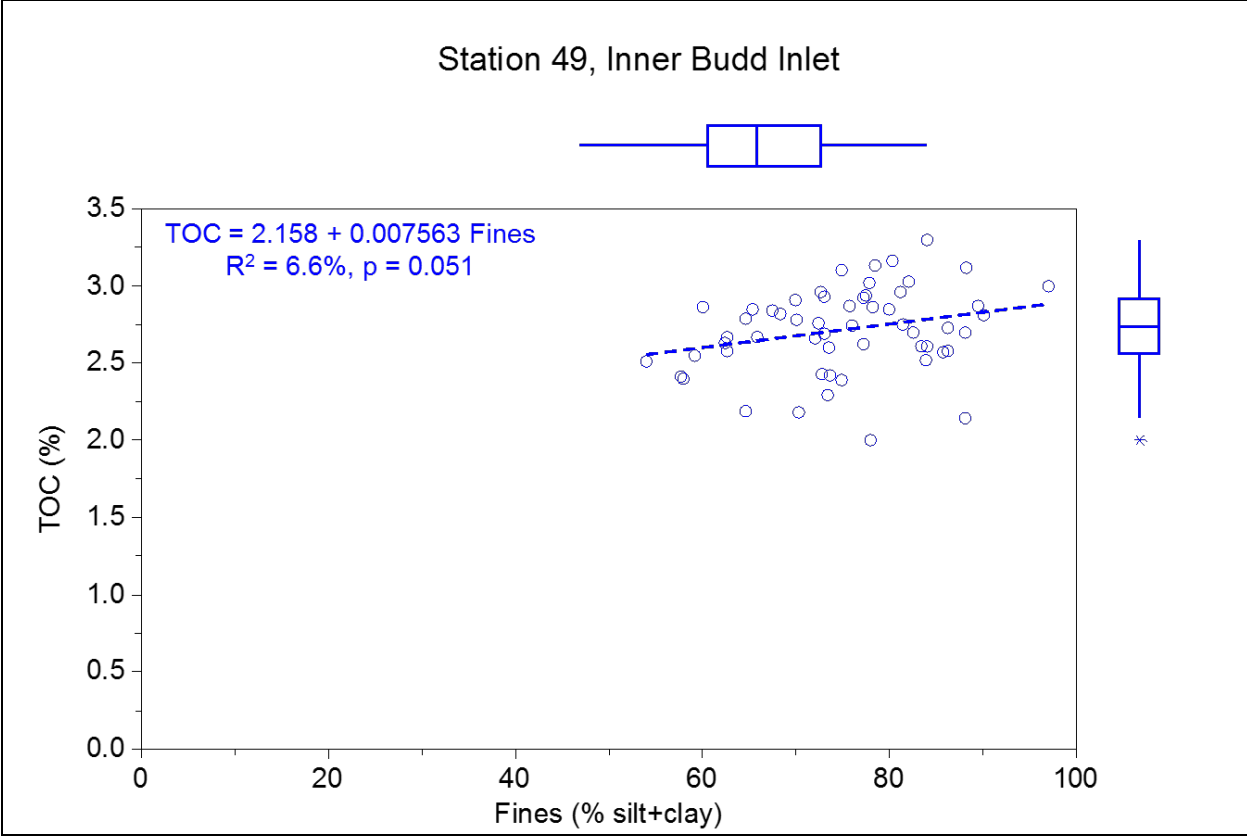
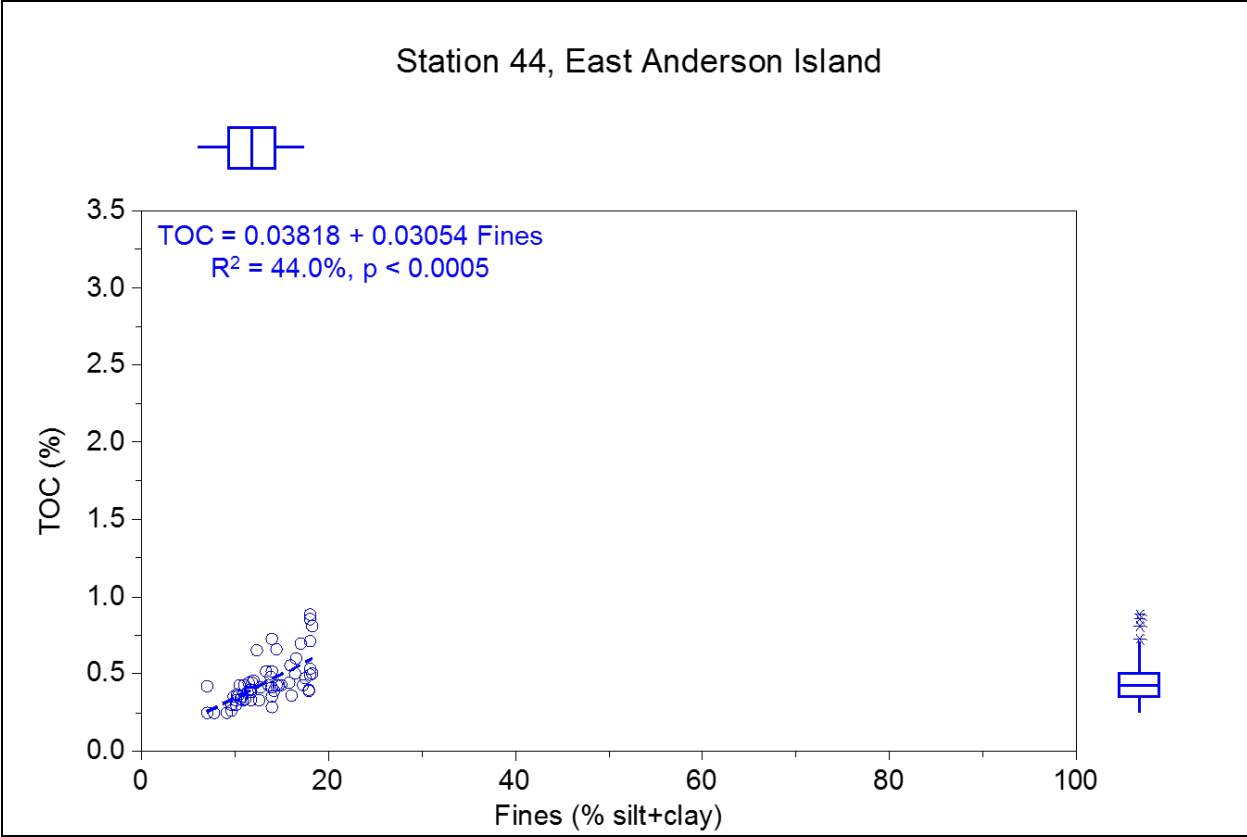


Station 21, Port Gardner



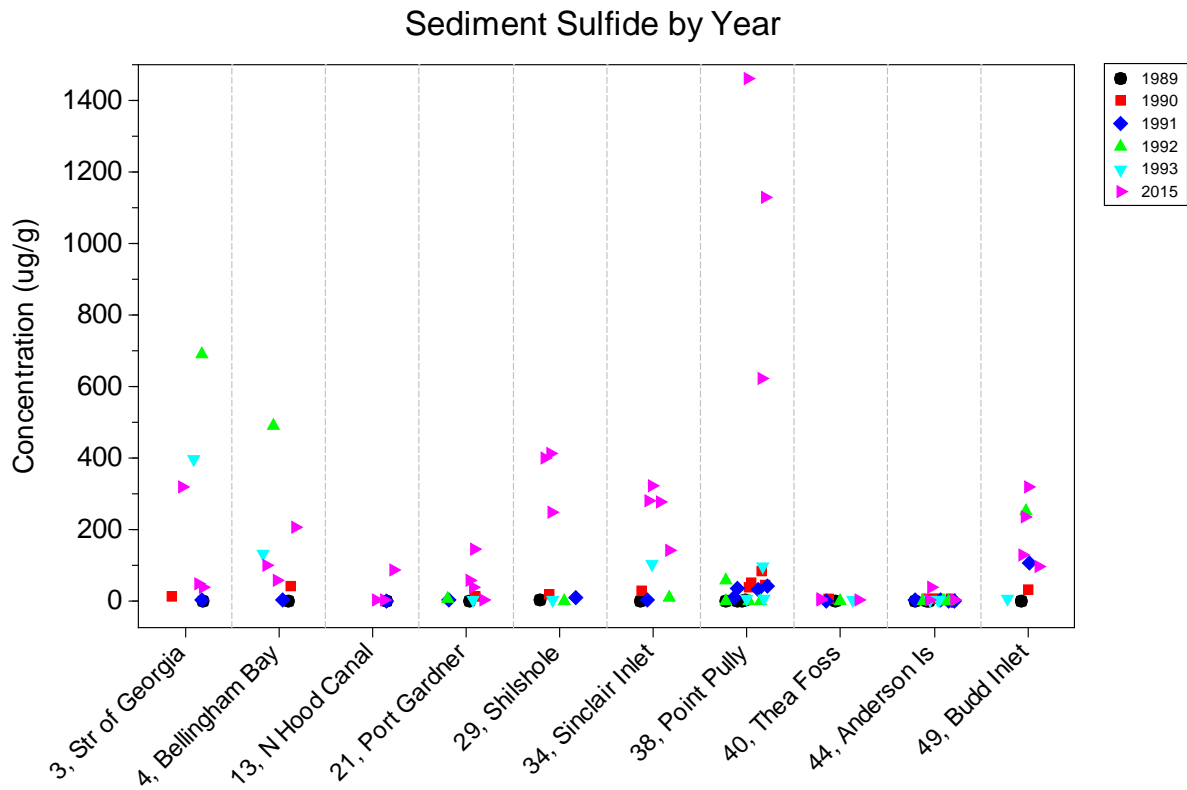




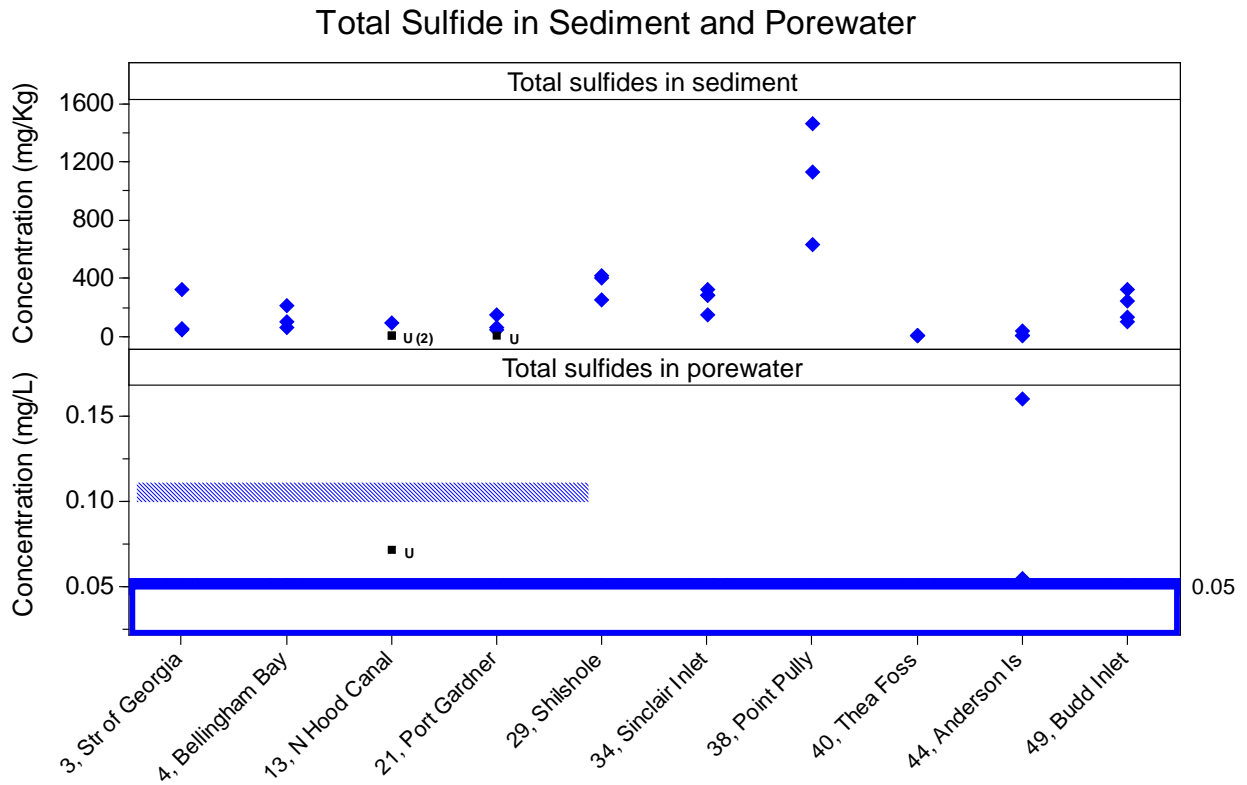


Sulfides and Ammonia

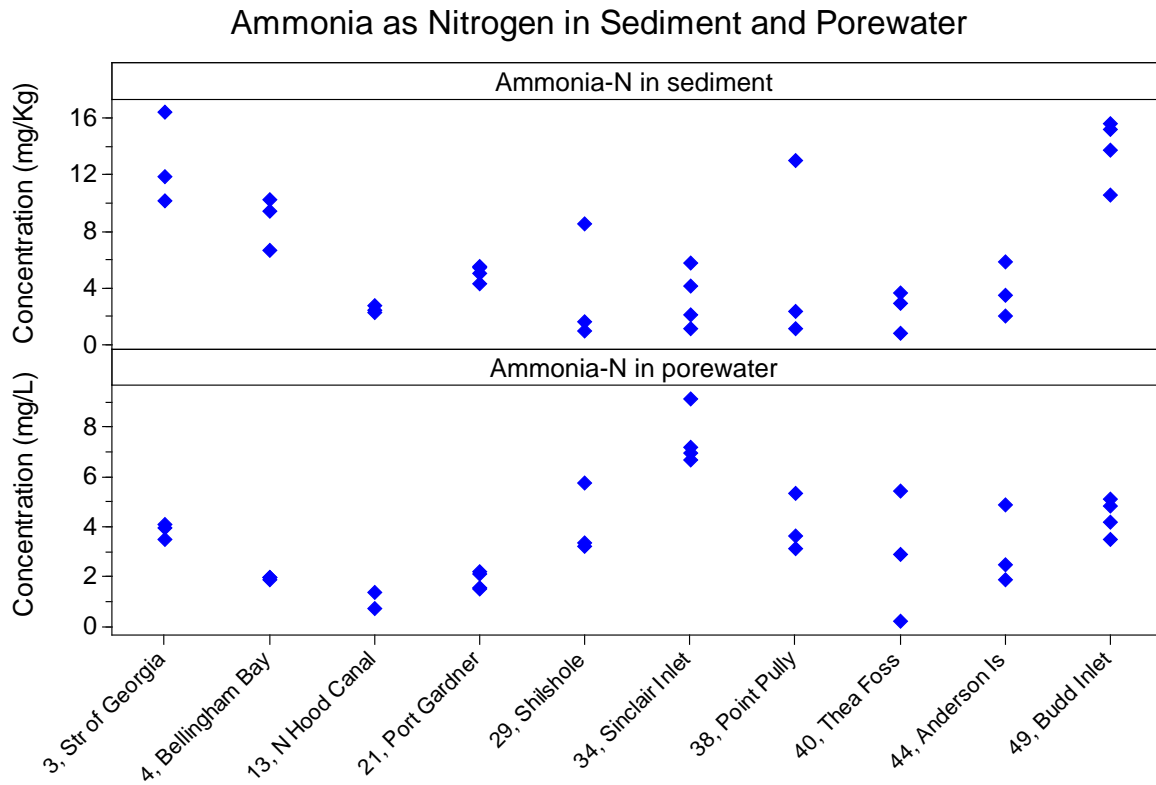
Sediment total sulfides by station and year



Total sulfides in sediment and porewater, 2015, by station.



Ammonia as Nitrogen in sediment and porewater, 2015, by station.



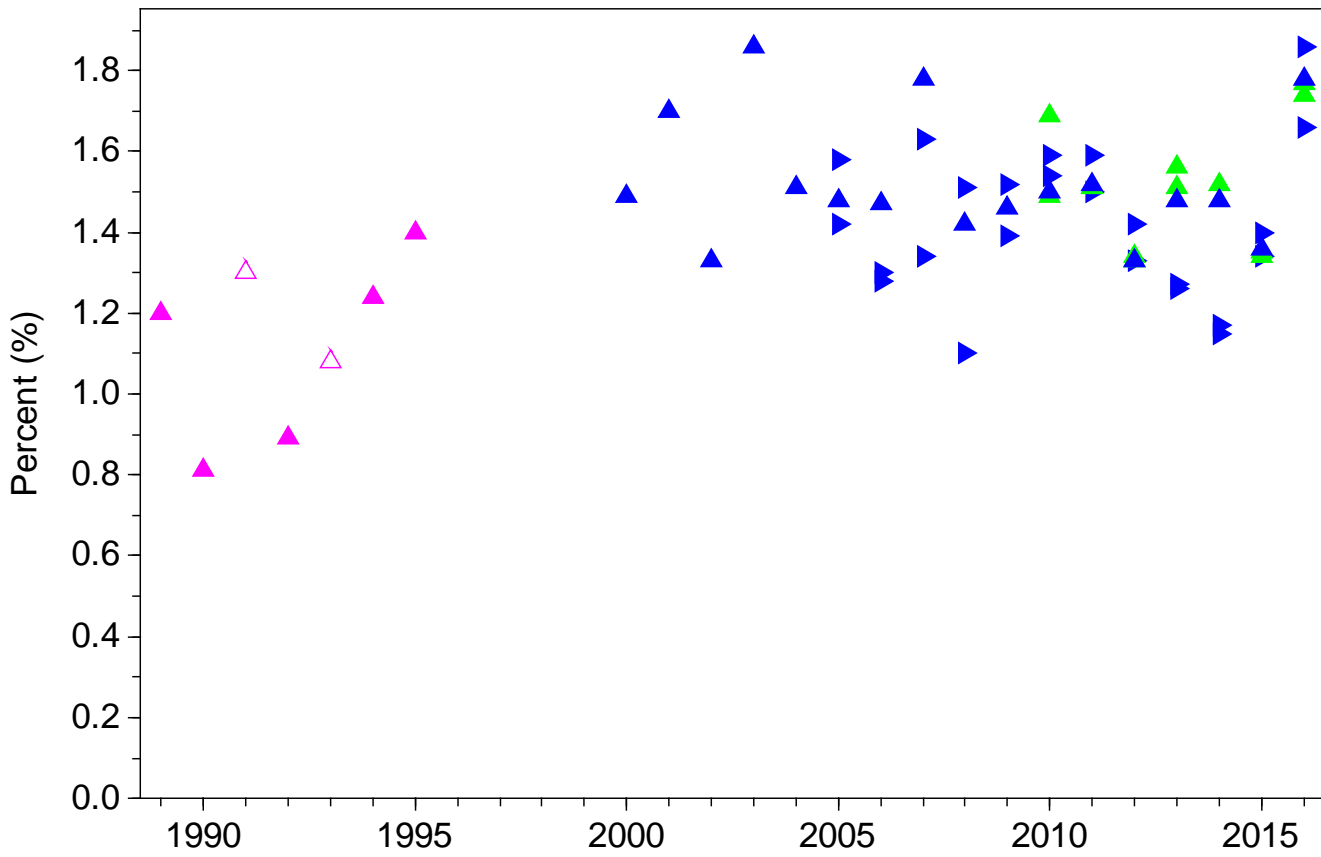
Case Narratives

Case narratives for all laboratory analyses are available from the report authors upon request.

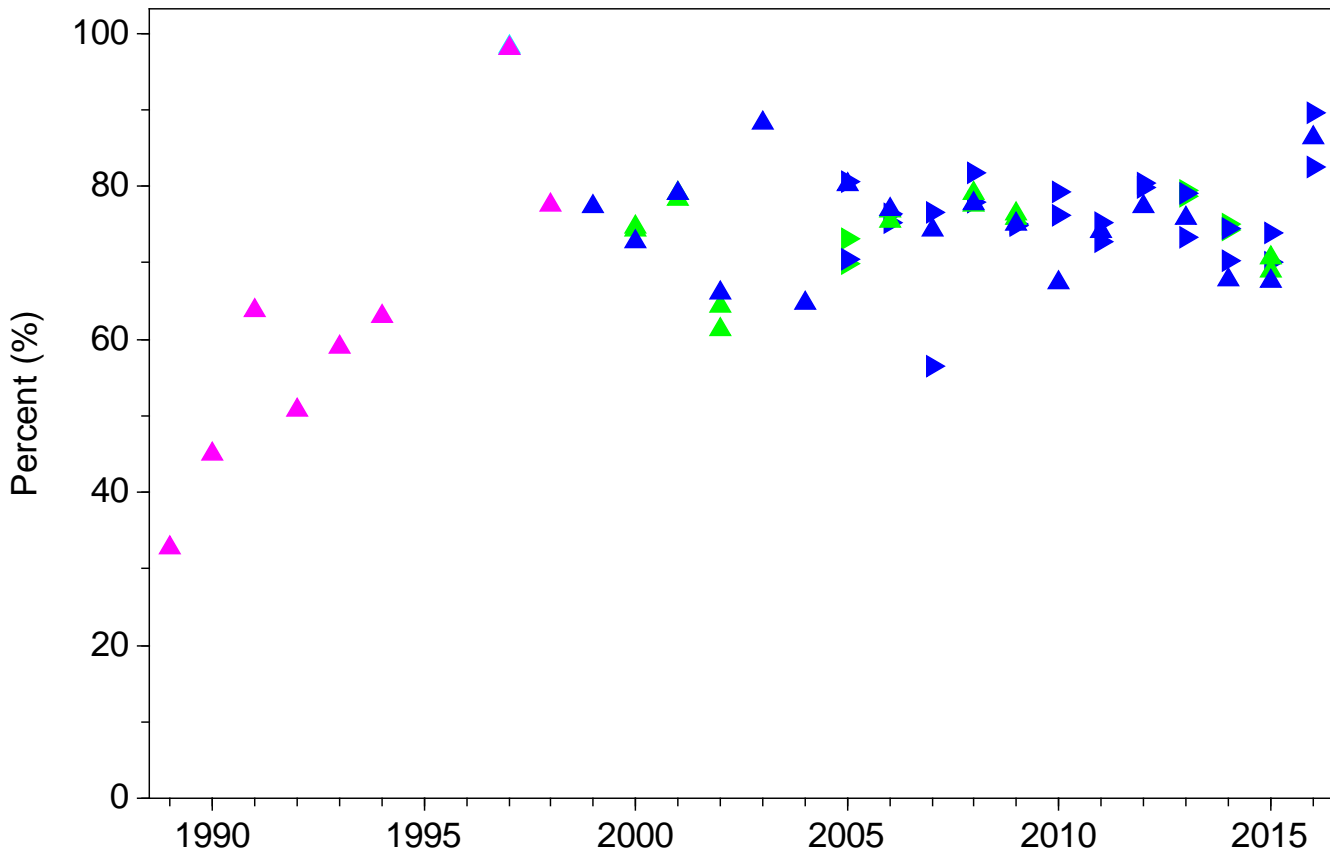
References

Partridge, V., K. Welch, S. Aasen, and M. Dutch. 2005. Temporal Monitoring of Puget Sound Sediments: Results of the Puget Sound Ambient Monitoring Program, 1989-2000 Washington State Department of Ecology, Olympia, WA. Publication 05-03-016. <https://fortress.wa.gov/ecy/publications/SummaryPages/0503016.html>.

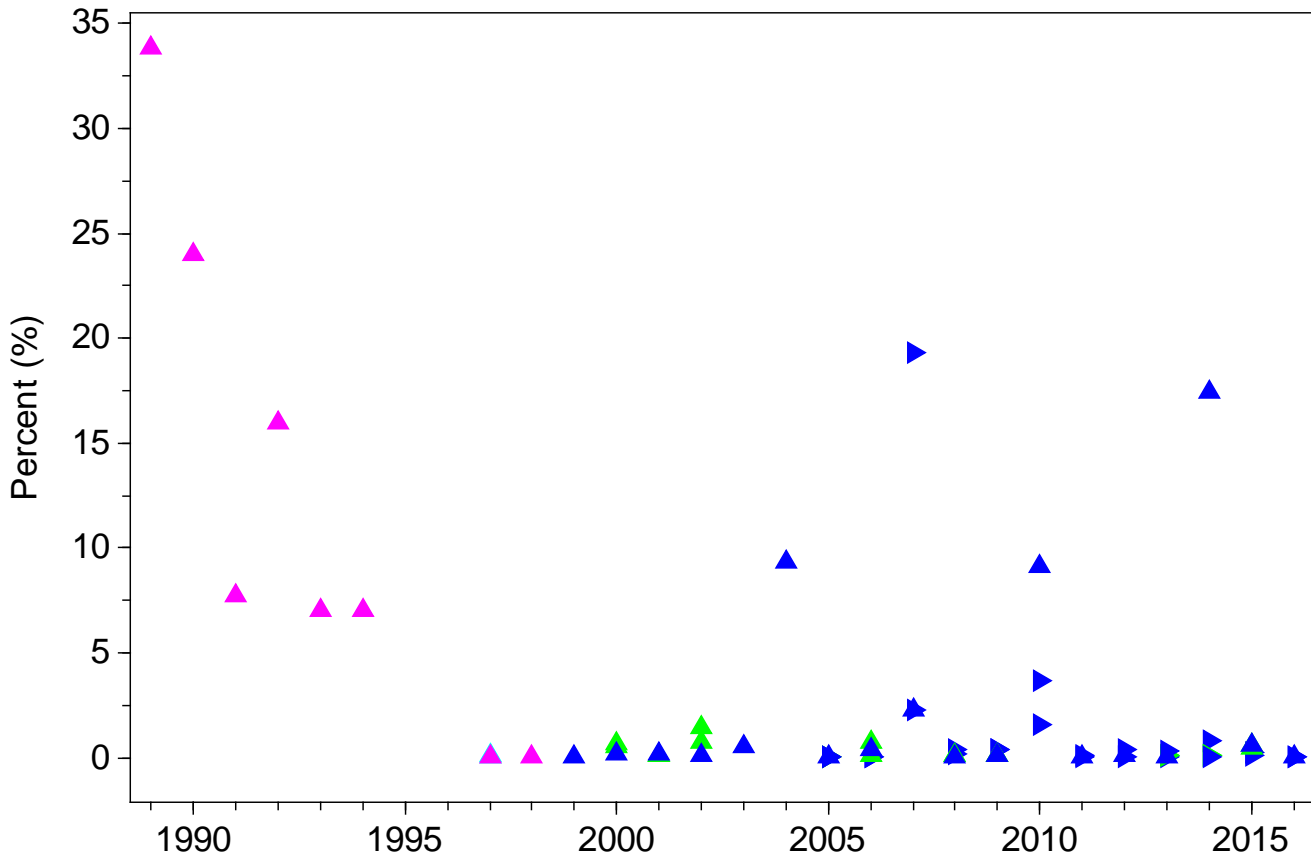
Total Organic Carbon, Station 3



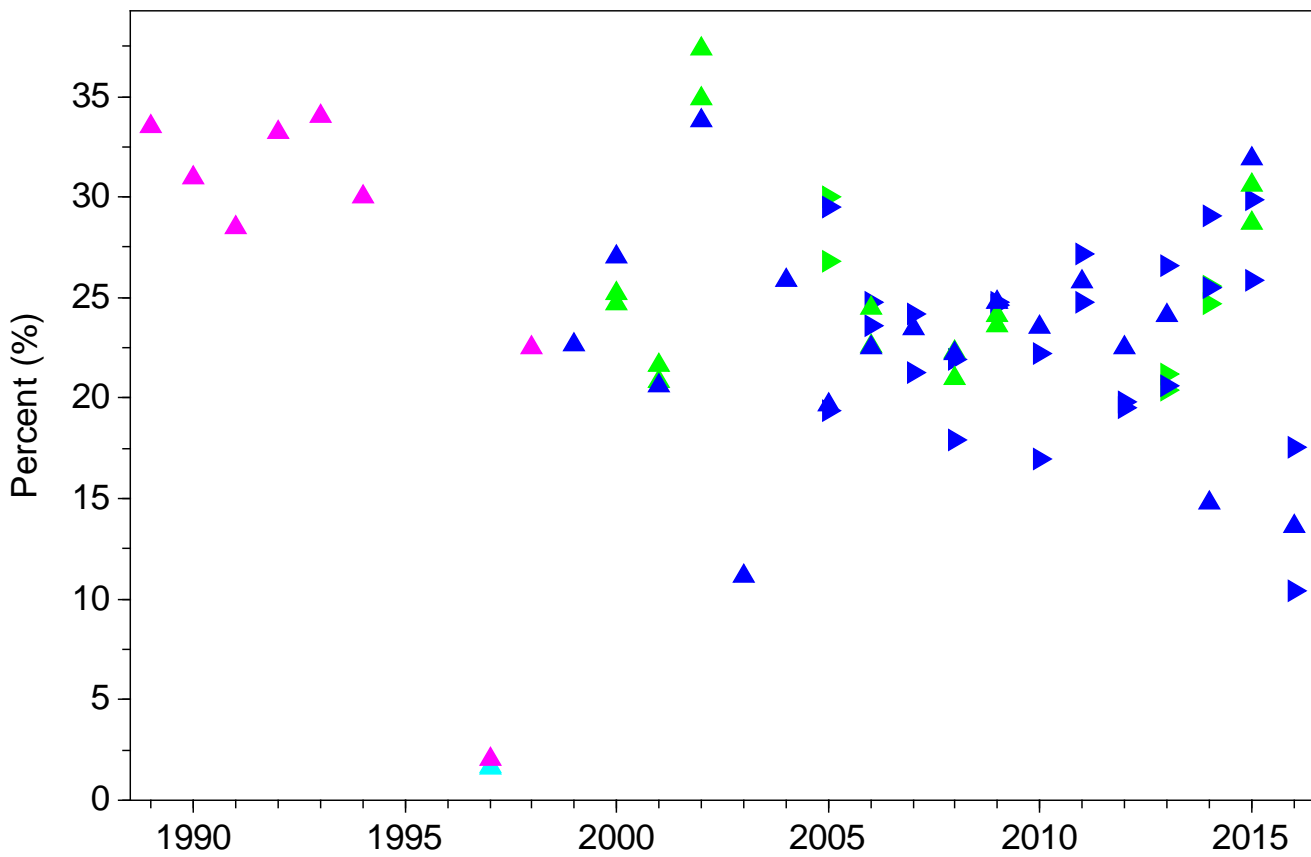
Percent Fines, Station 3



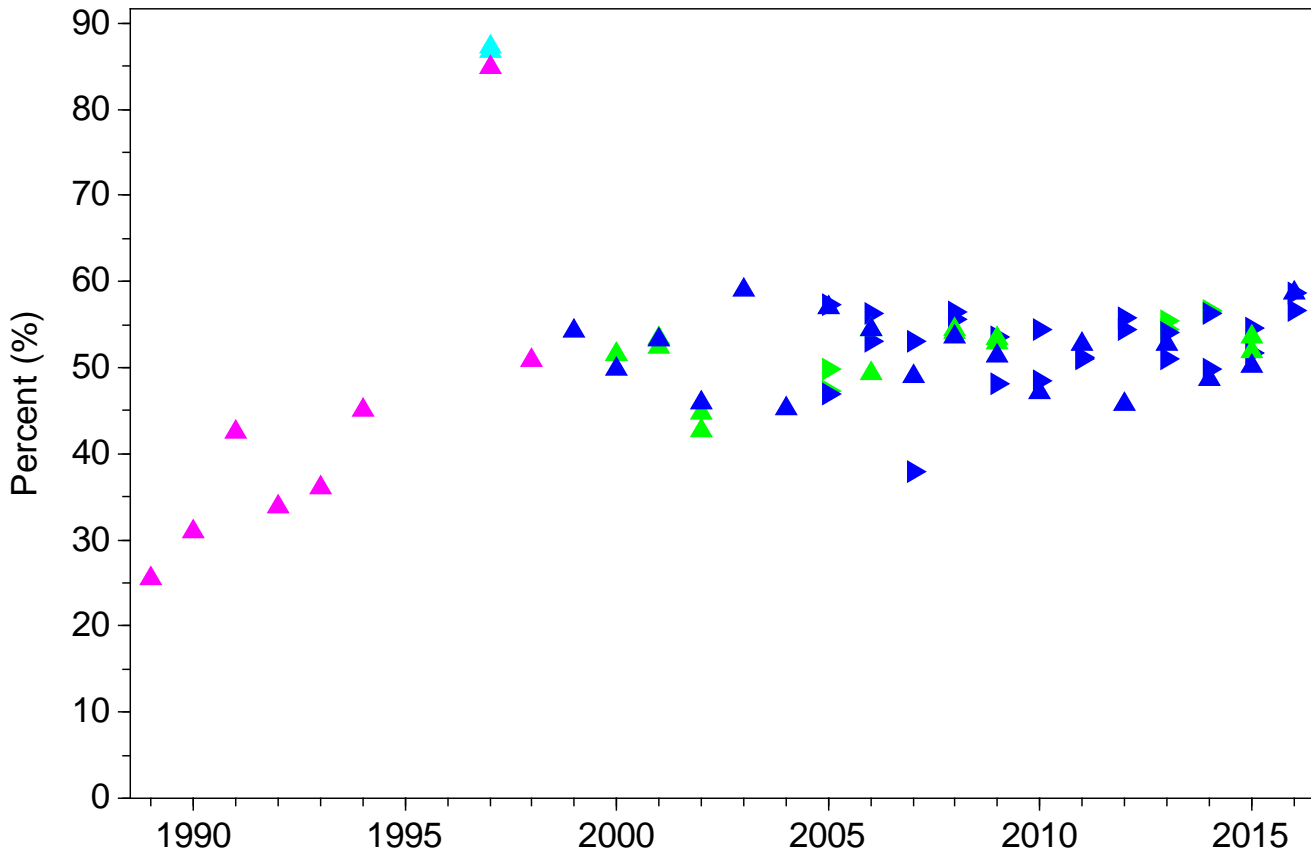
Gravel, Station 3



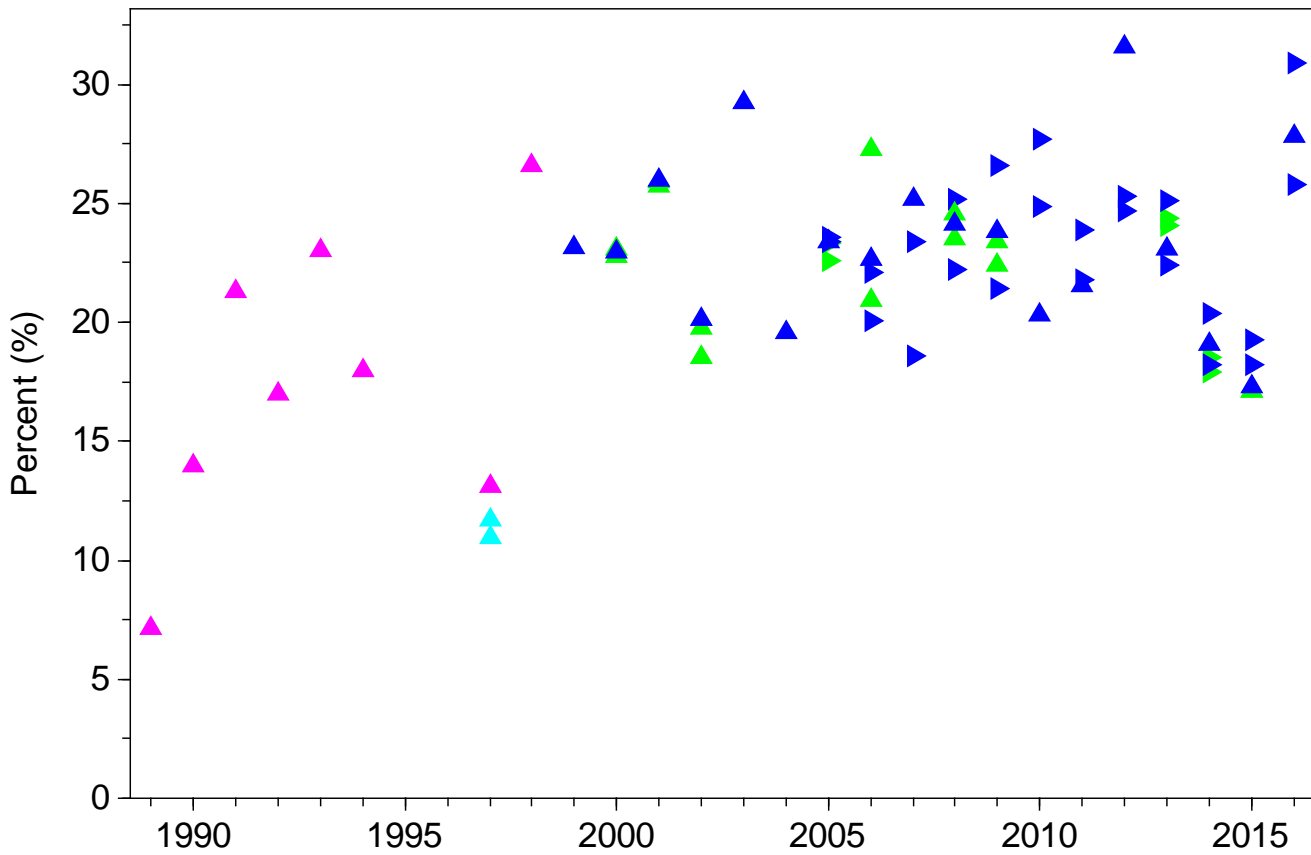
Total Sand, Station 3



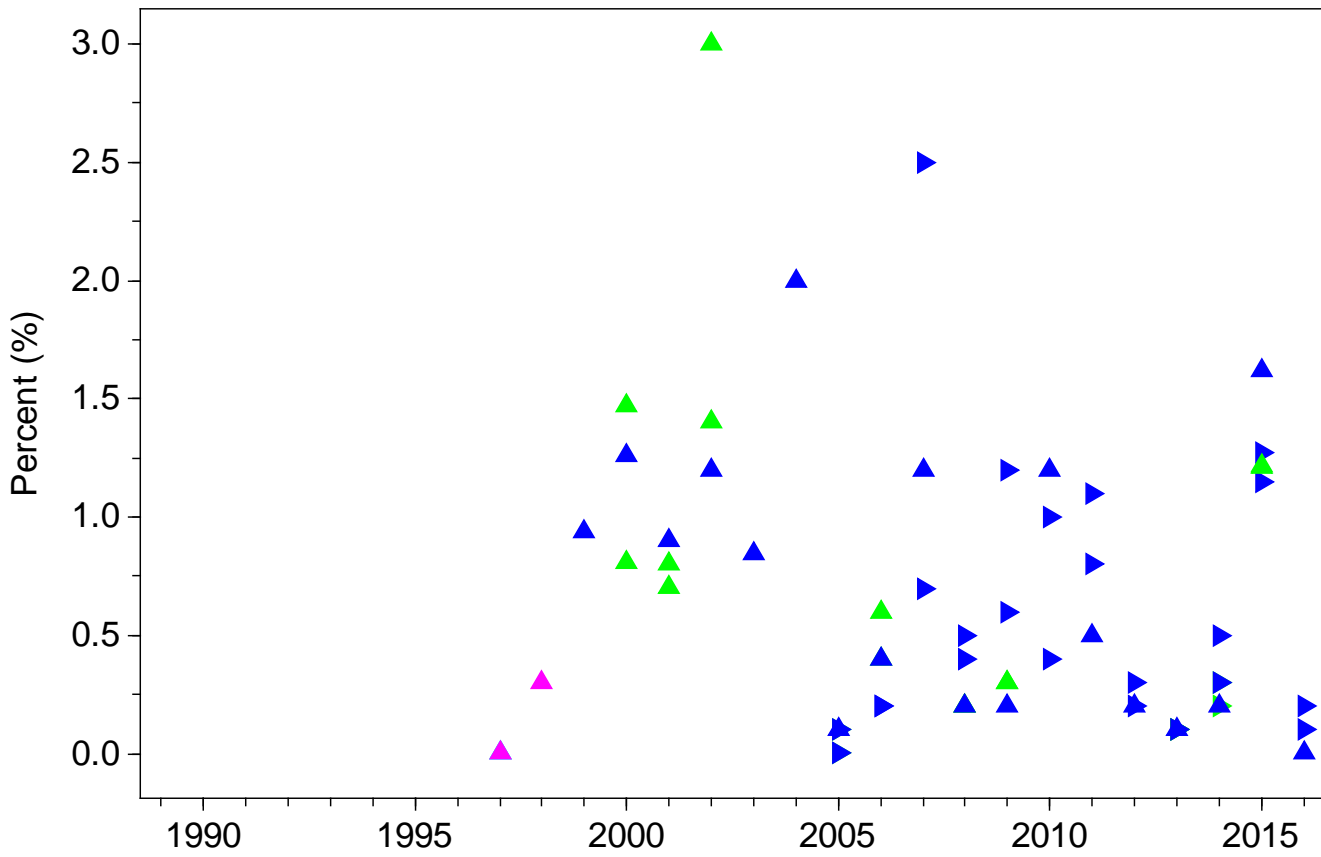
Total Silt, Station 3



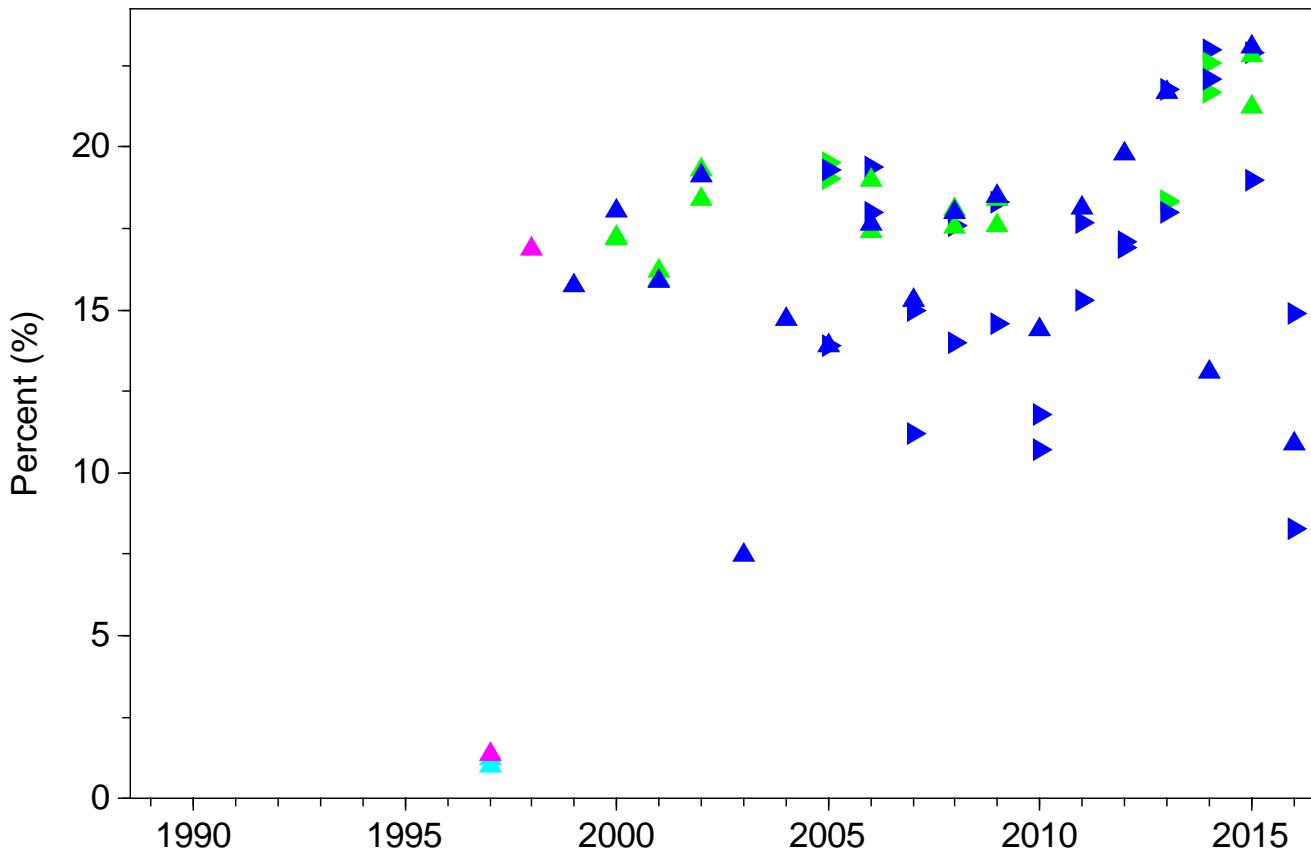
Total Clay, Station 3



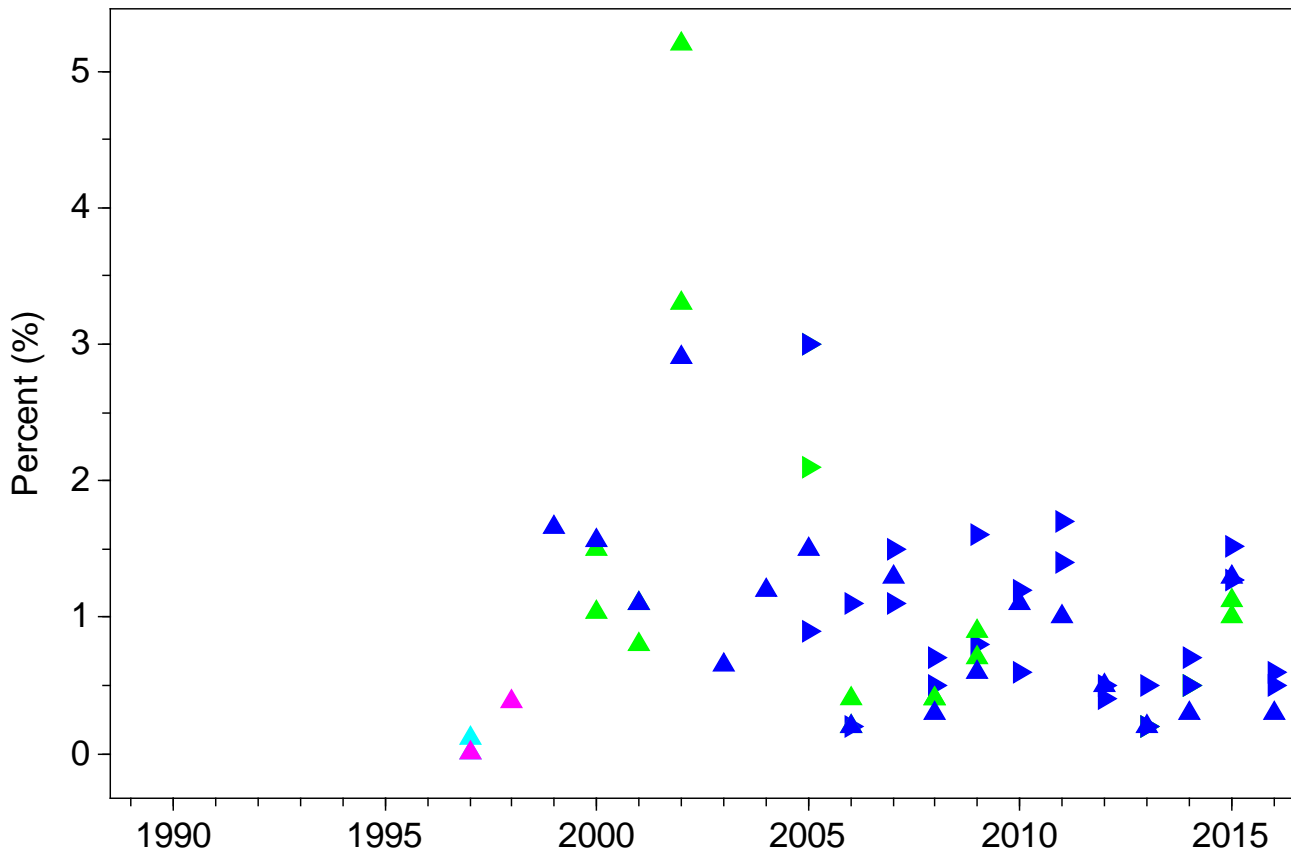
Very Coarse Sand, Station 3



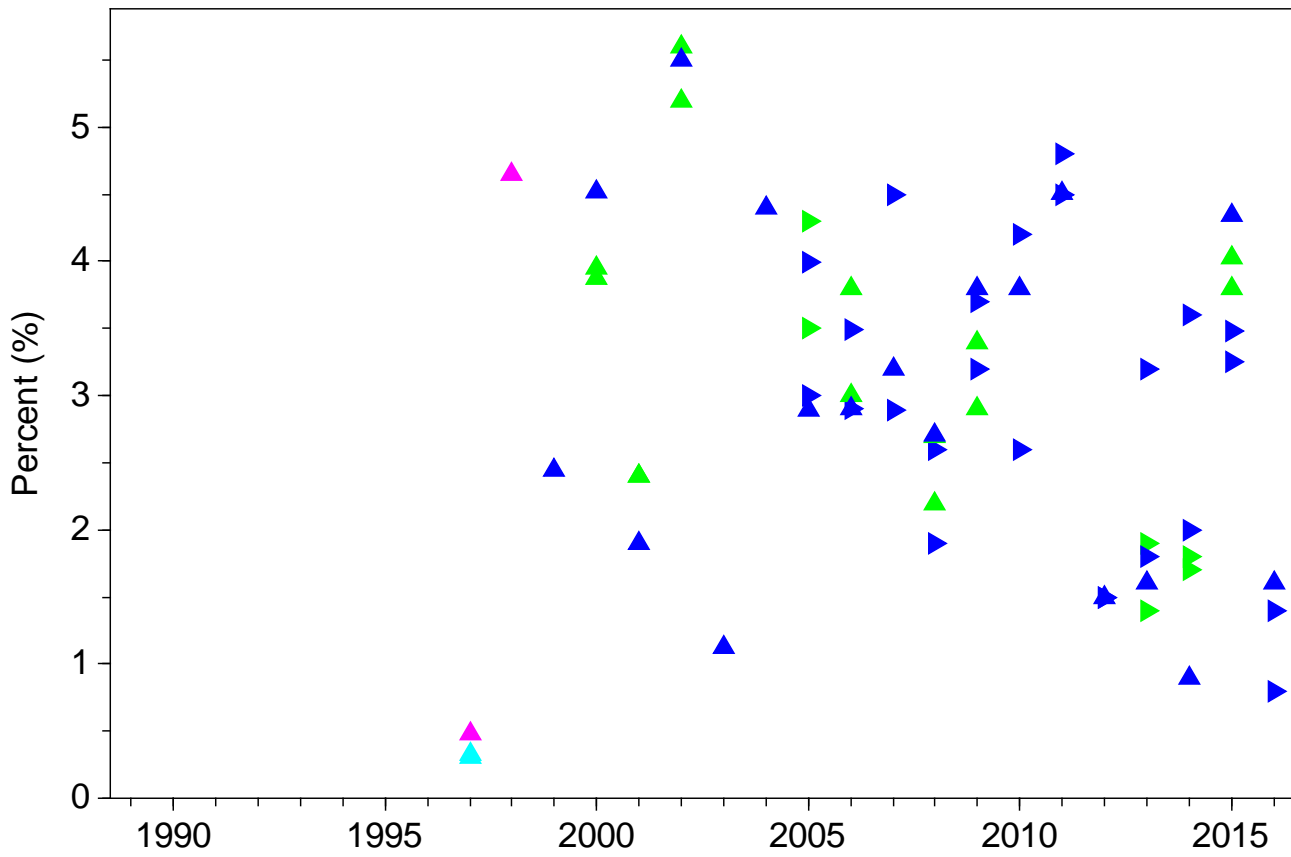
Very Fine Sand, Station 3



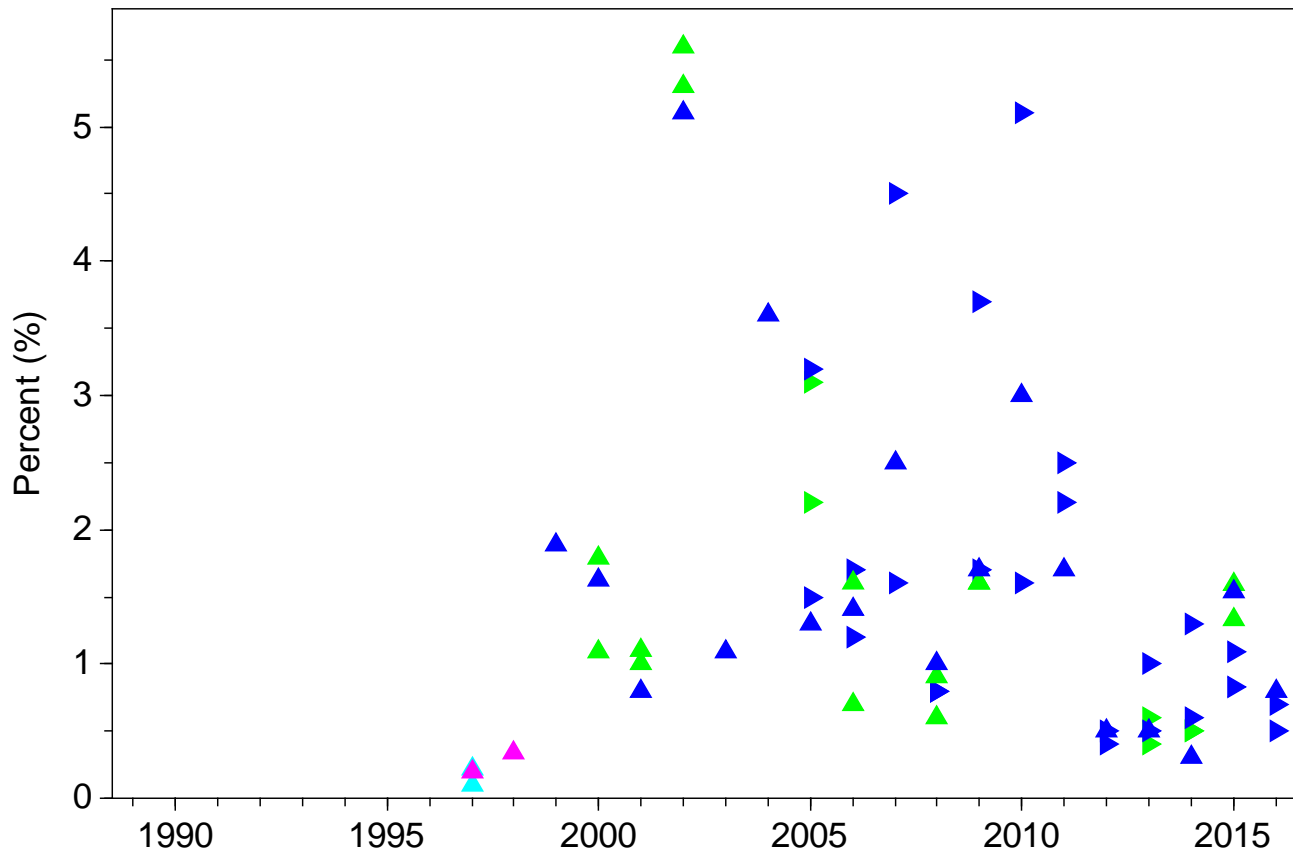
Coarse Sand, Station 3



Fine Sand, Station 3

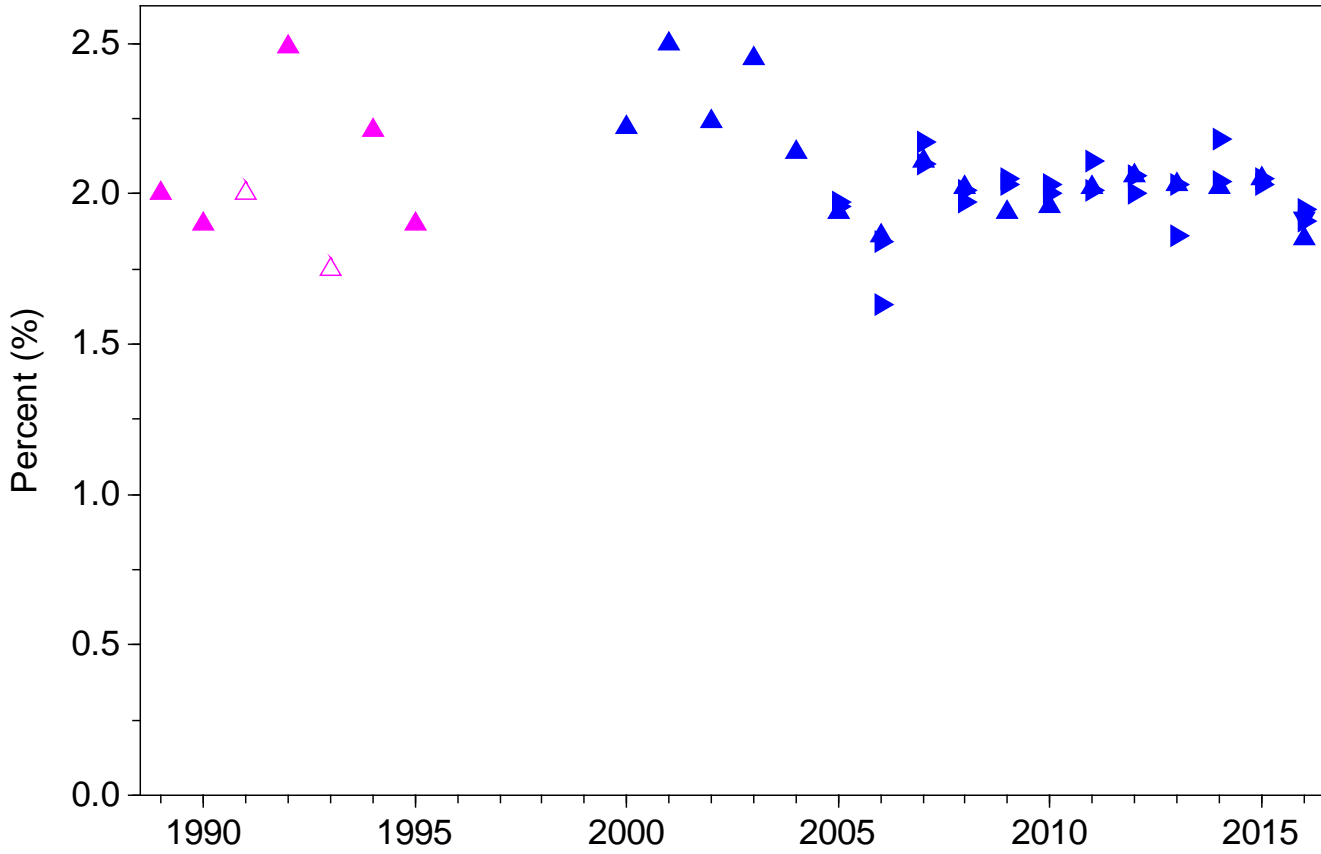


Medium Sand, Station 3

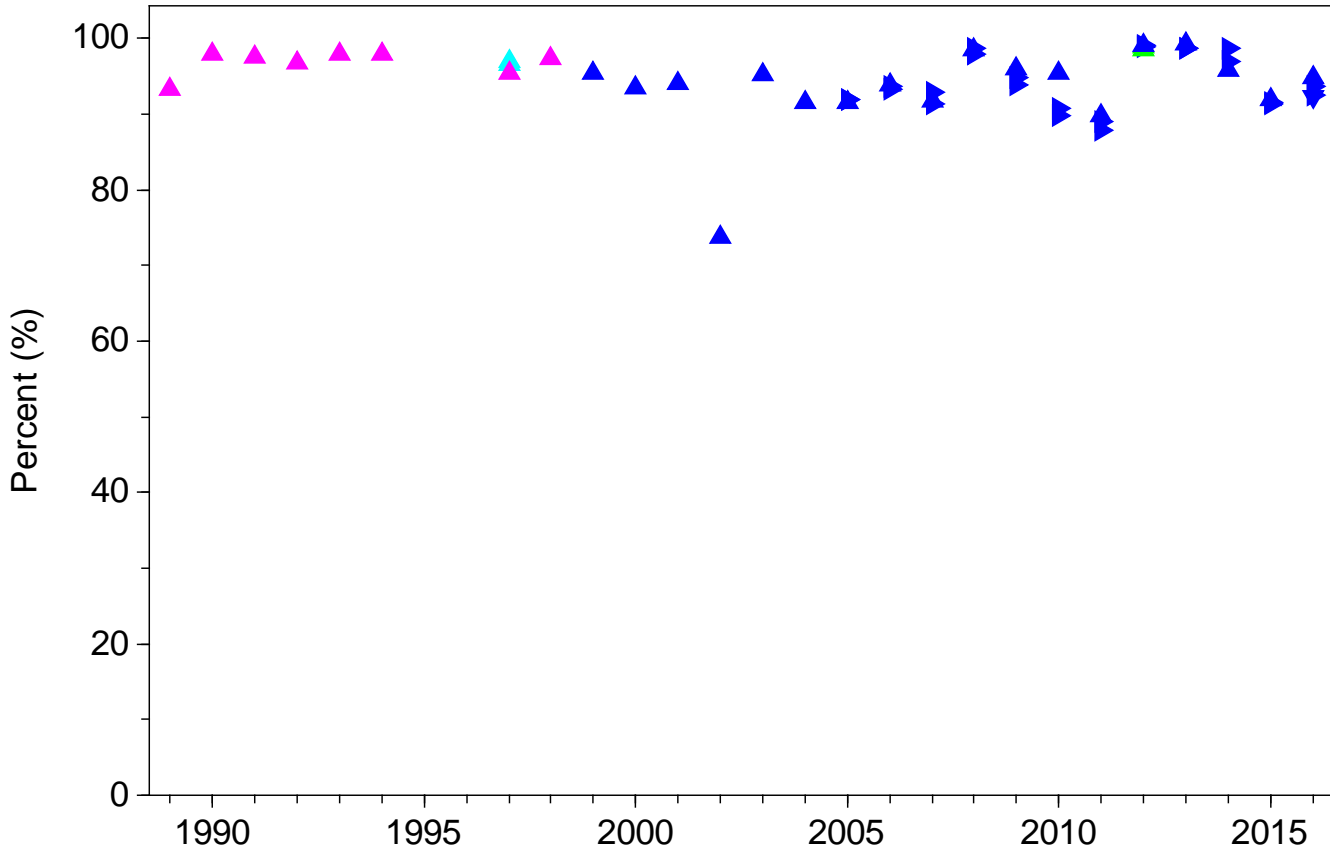


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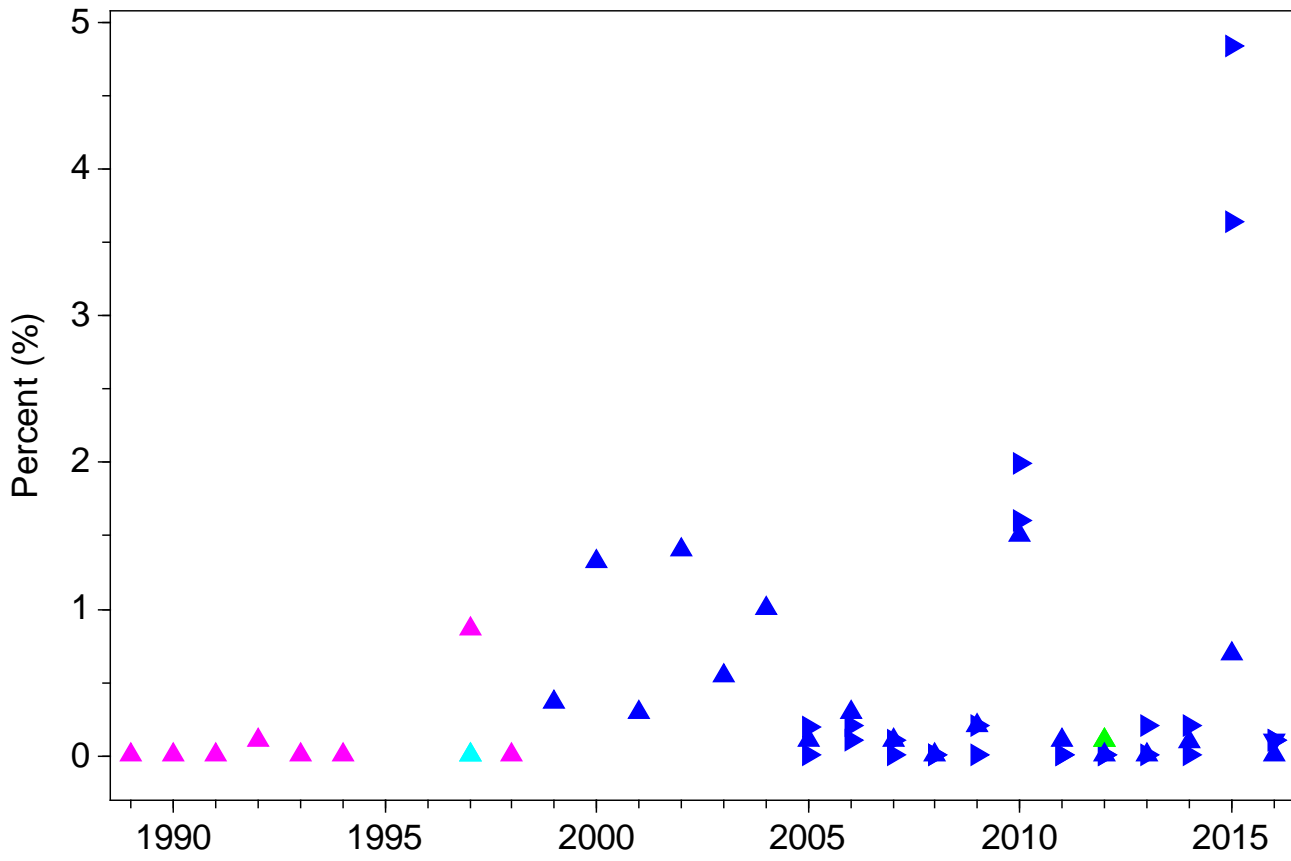
Total Organic Carbon, Station 4



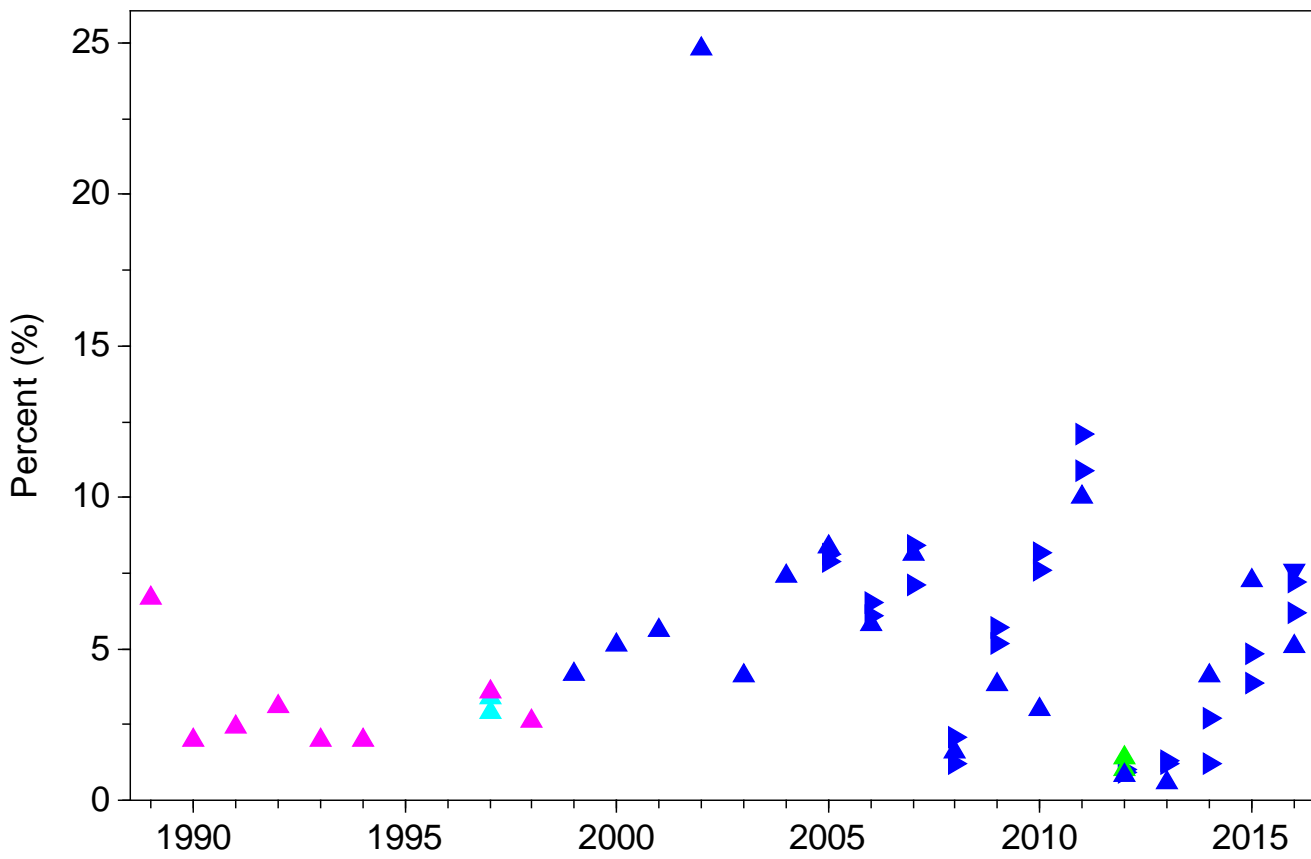
Percent Fines, Station 4



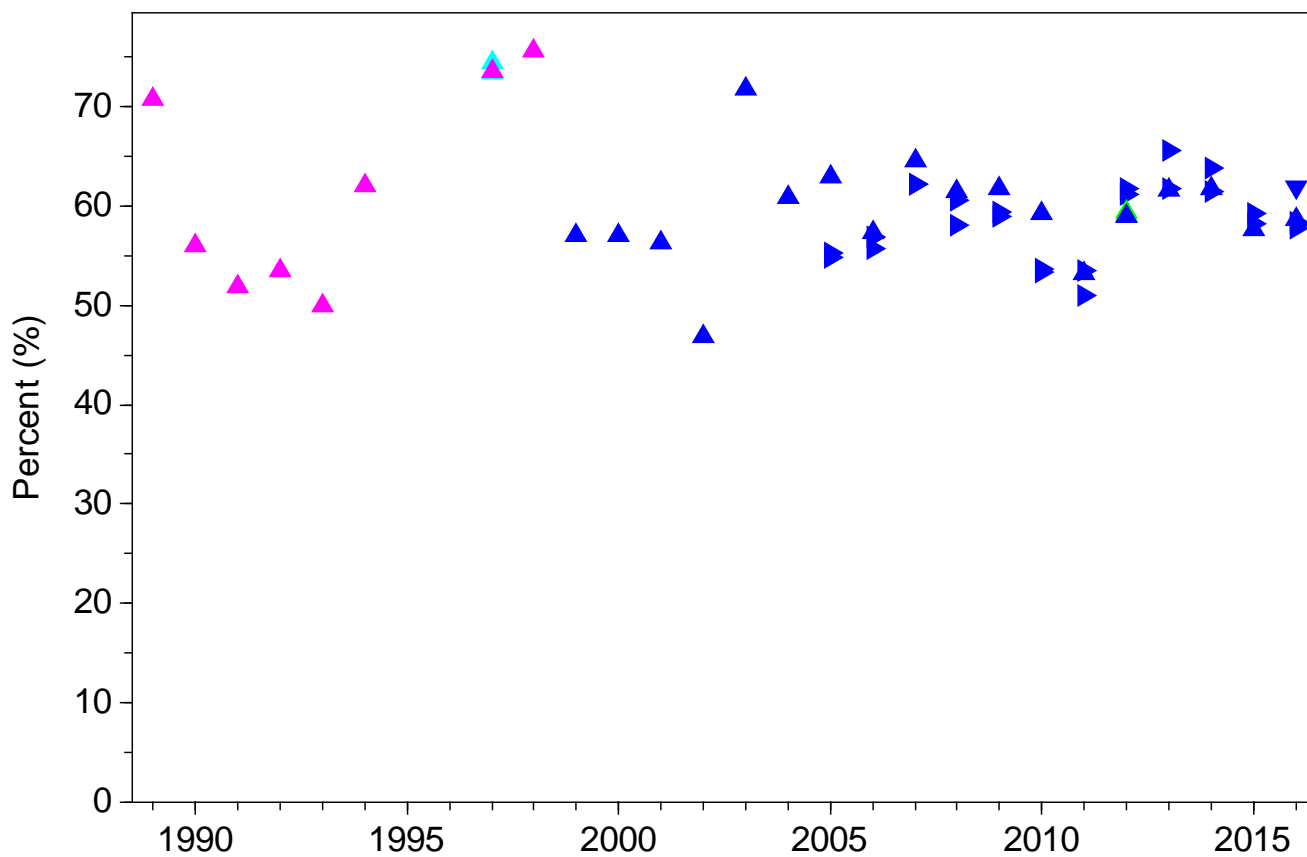
Gravel, Station 4



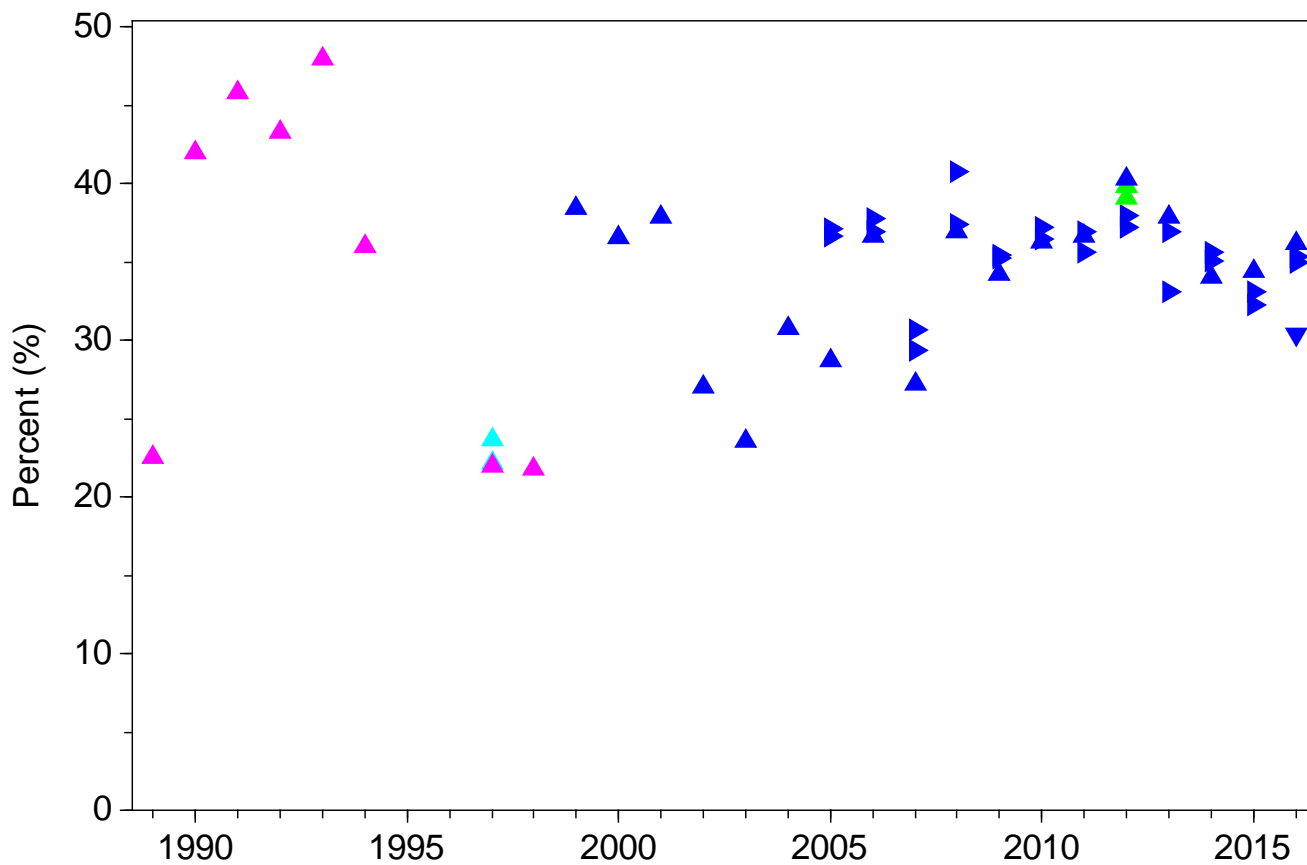
Total Sand, Station 4



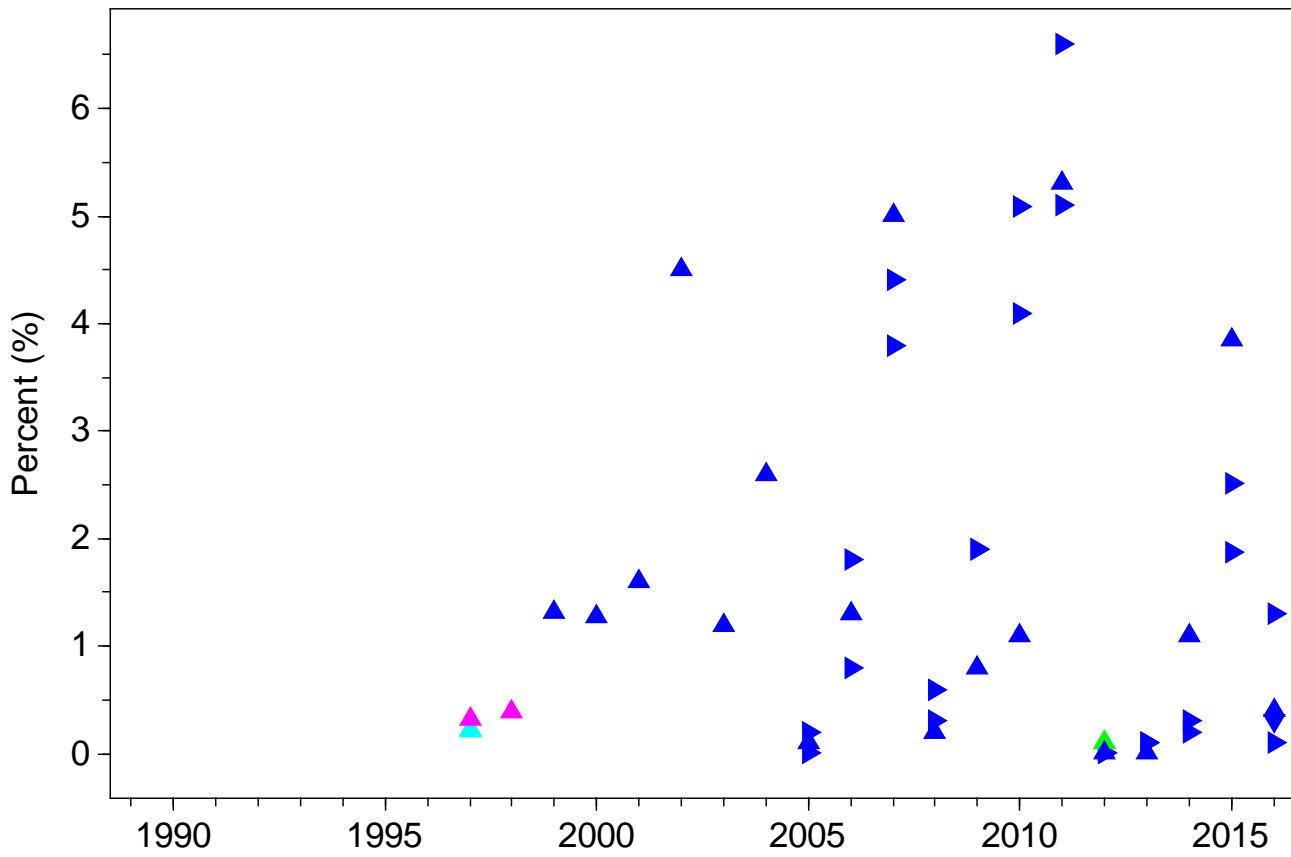
Total Silt, Station 4



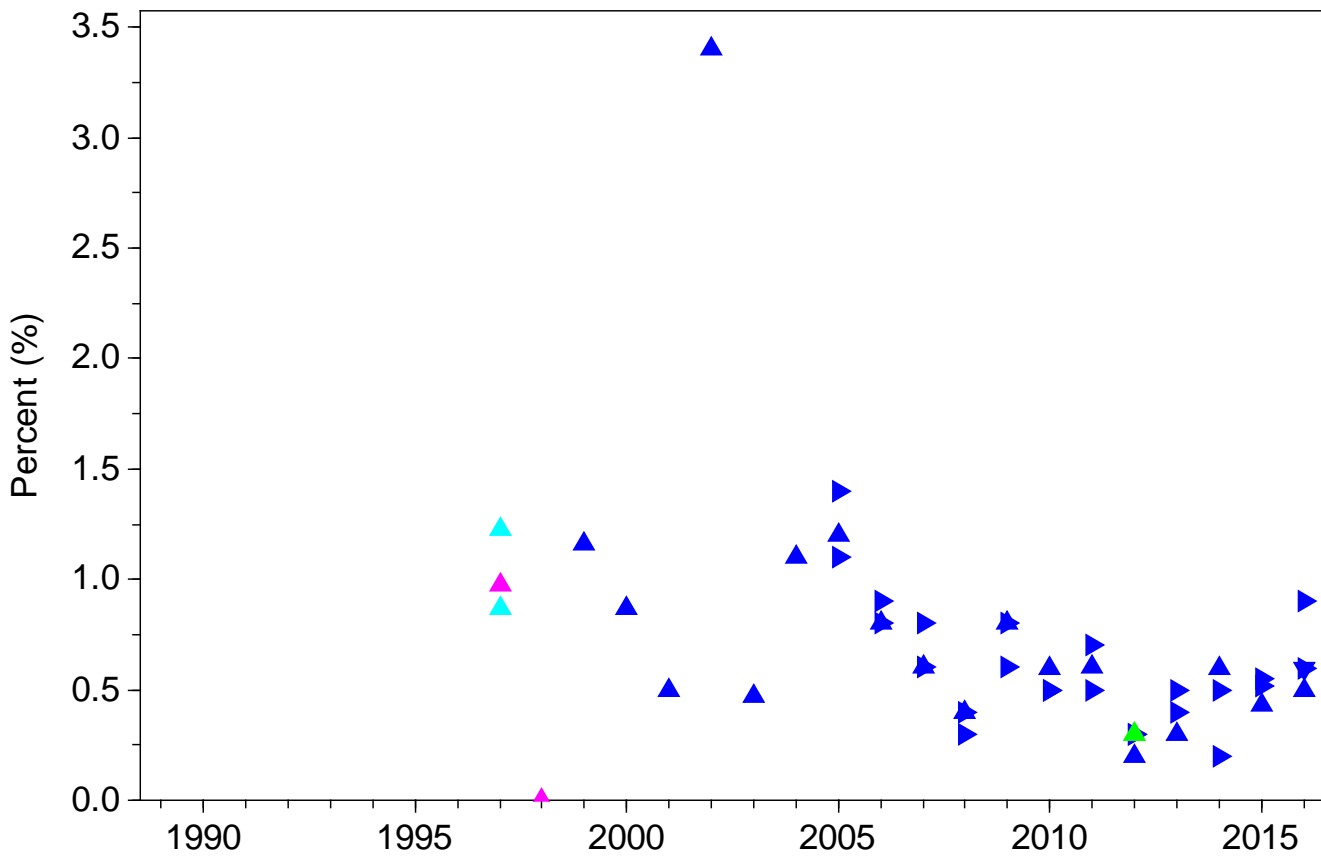
Total Clay, Station 4



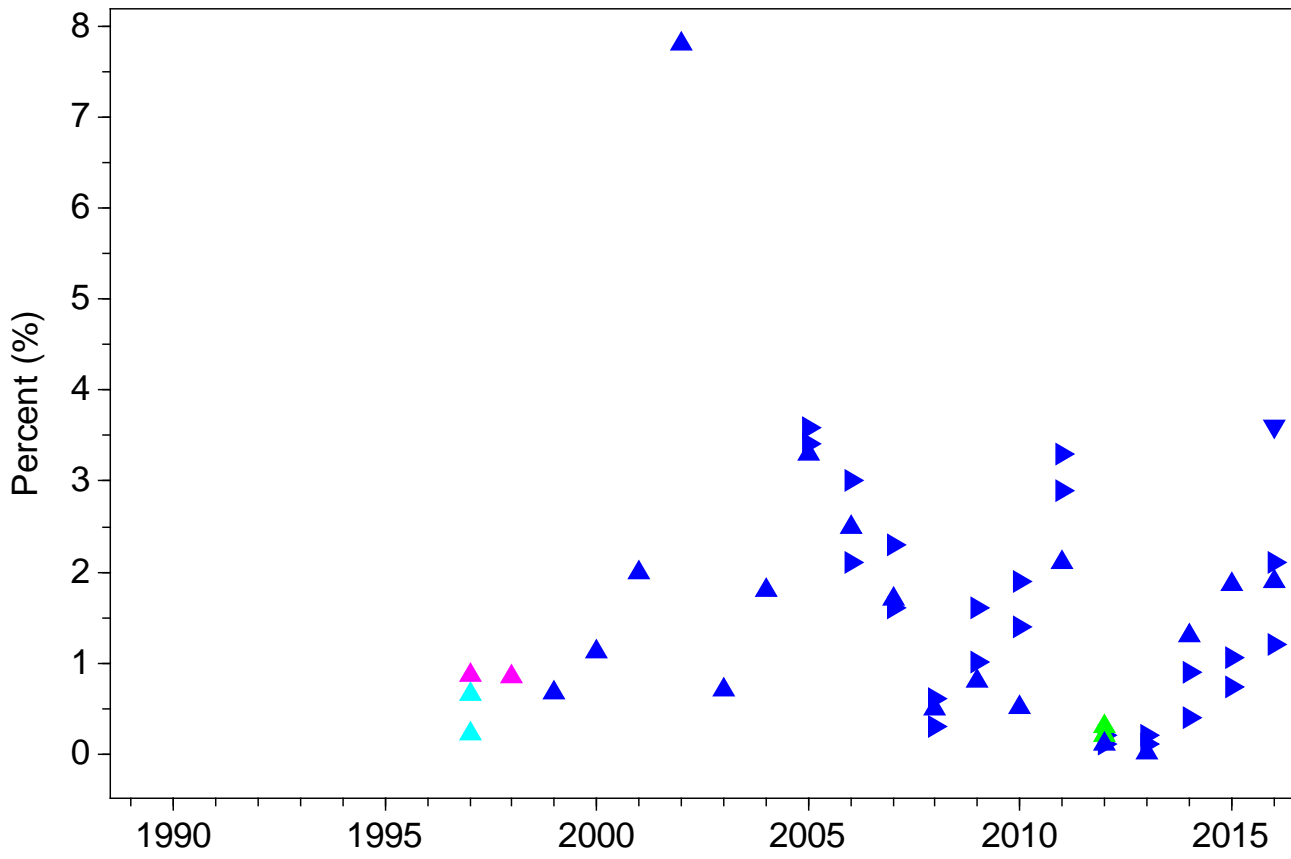
Very Coarse Sand, Station 4



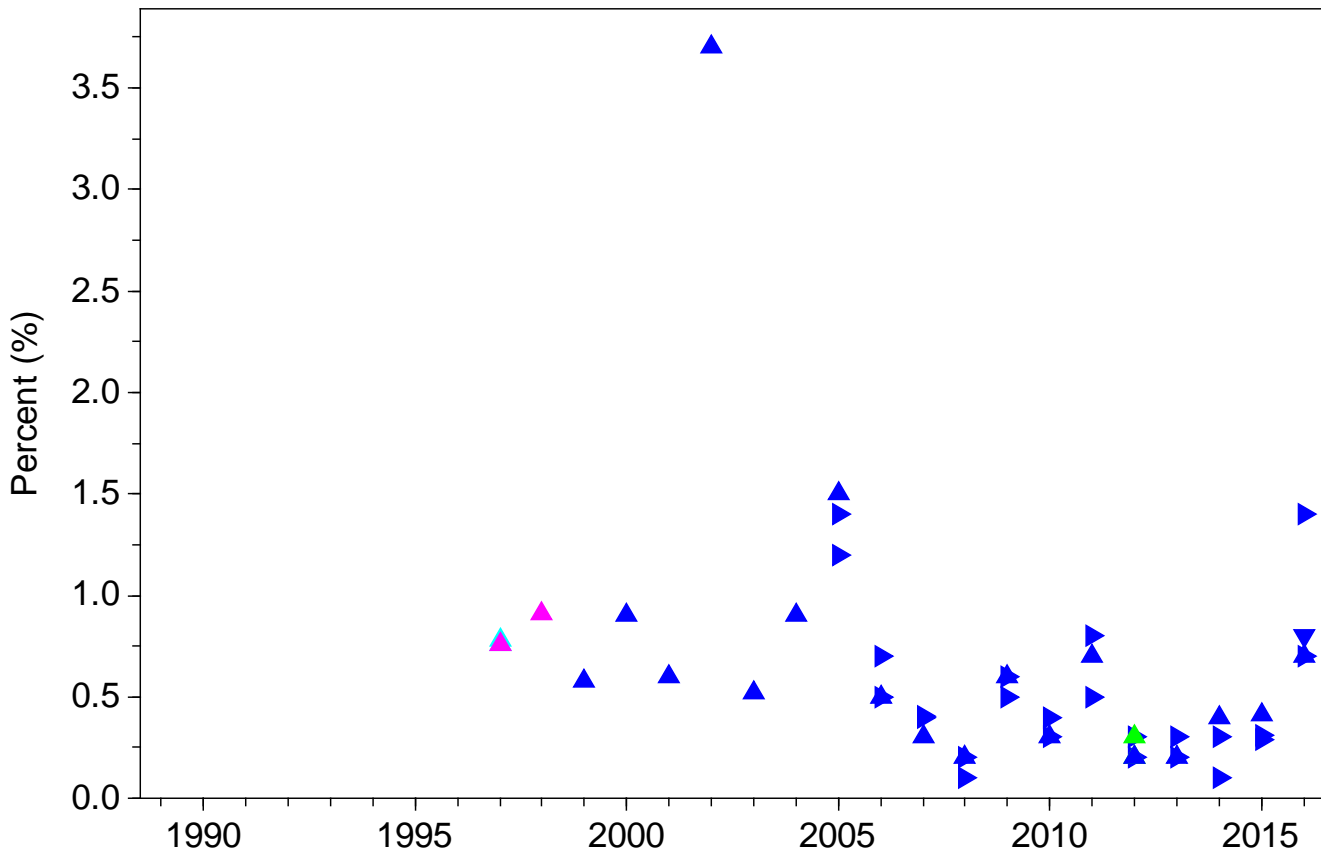
Very Fine Sand, Station 4



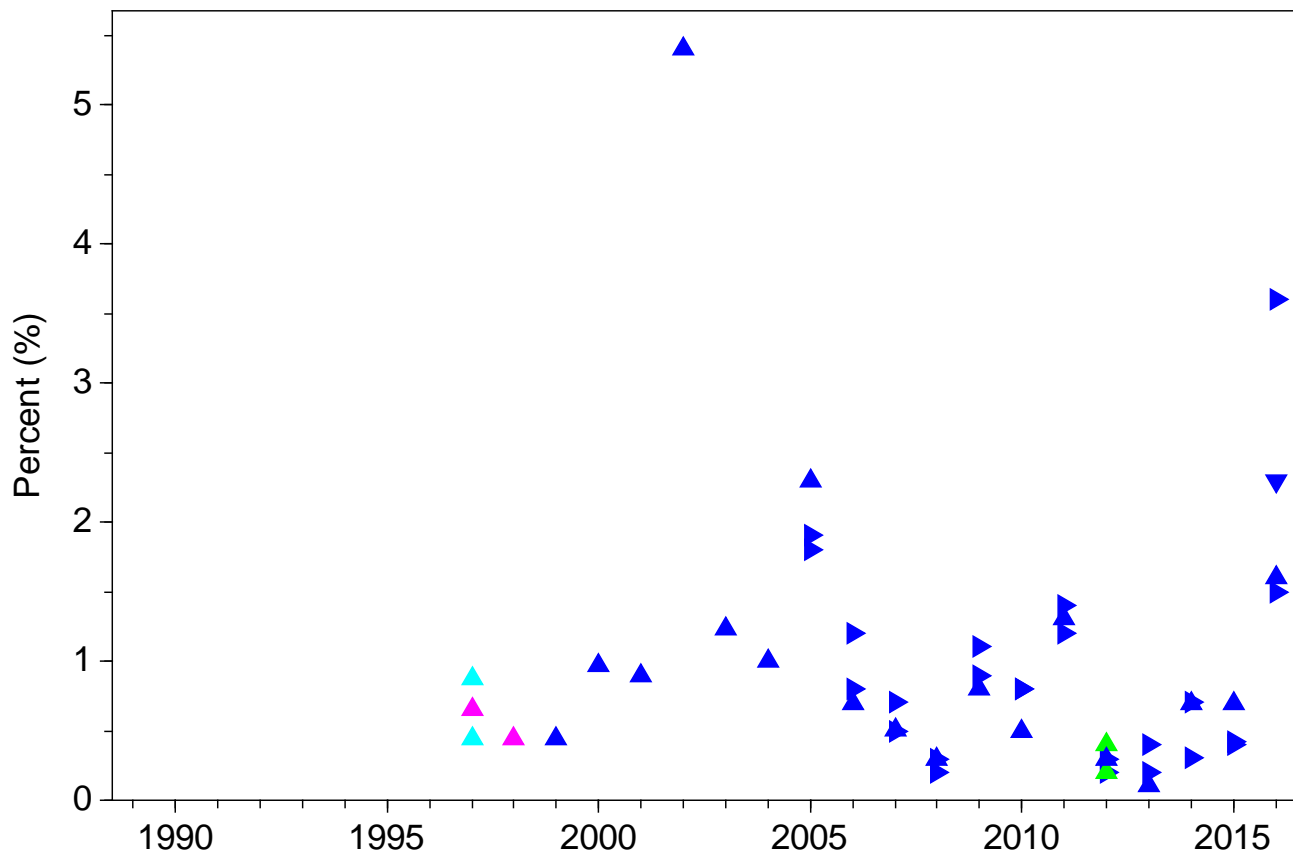
Coarse Sand, Station 4



Fine Sand, Station 4

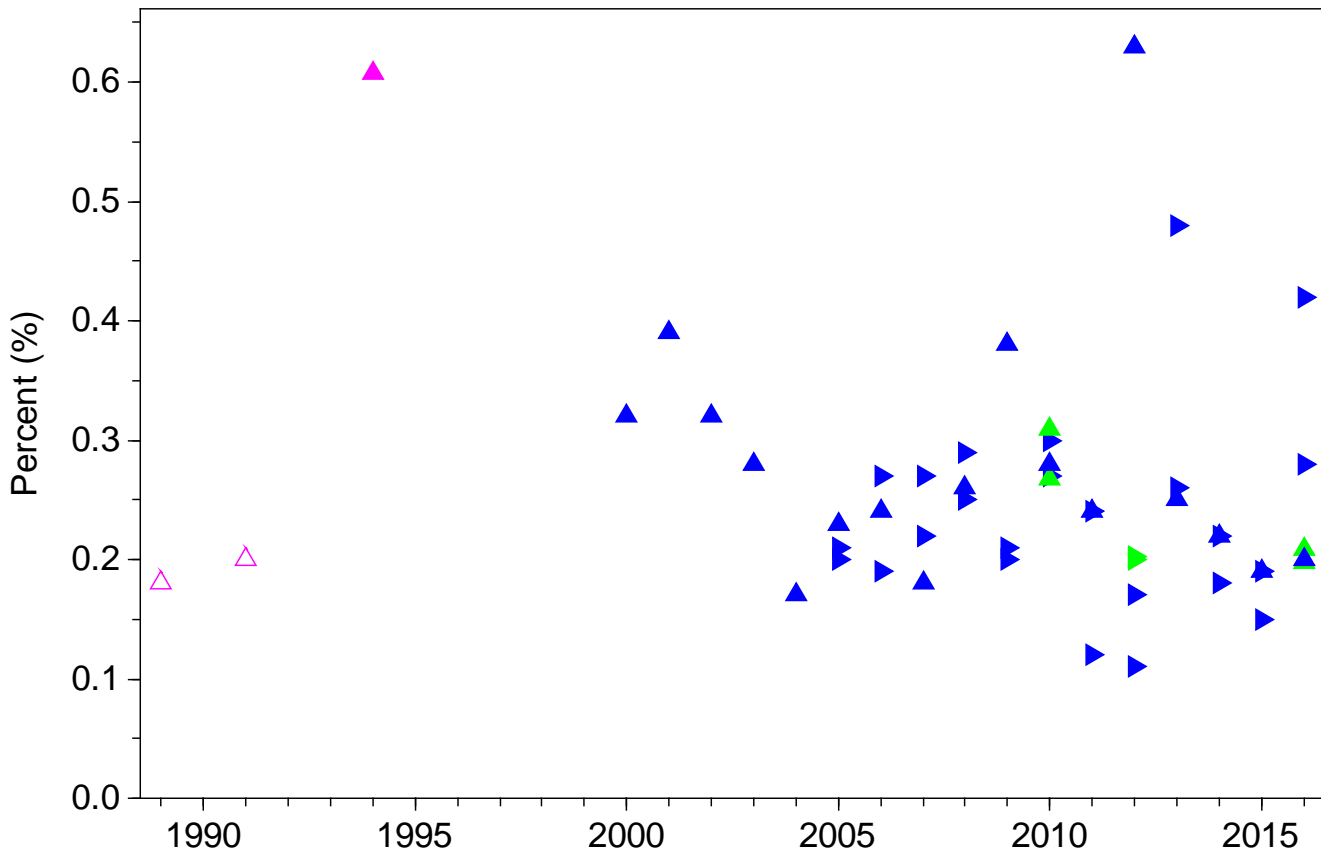


Medium Sand, Station 4

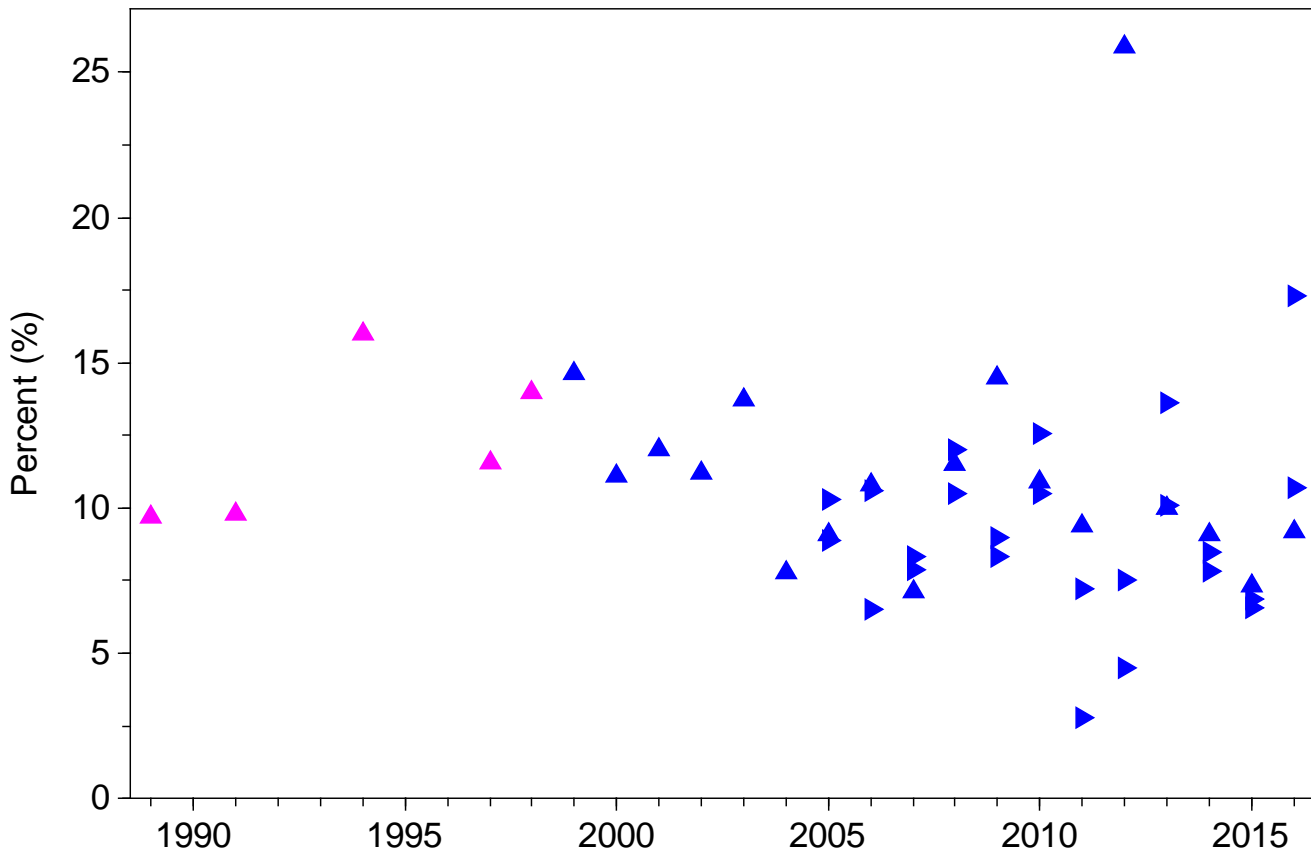


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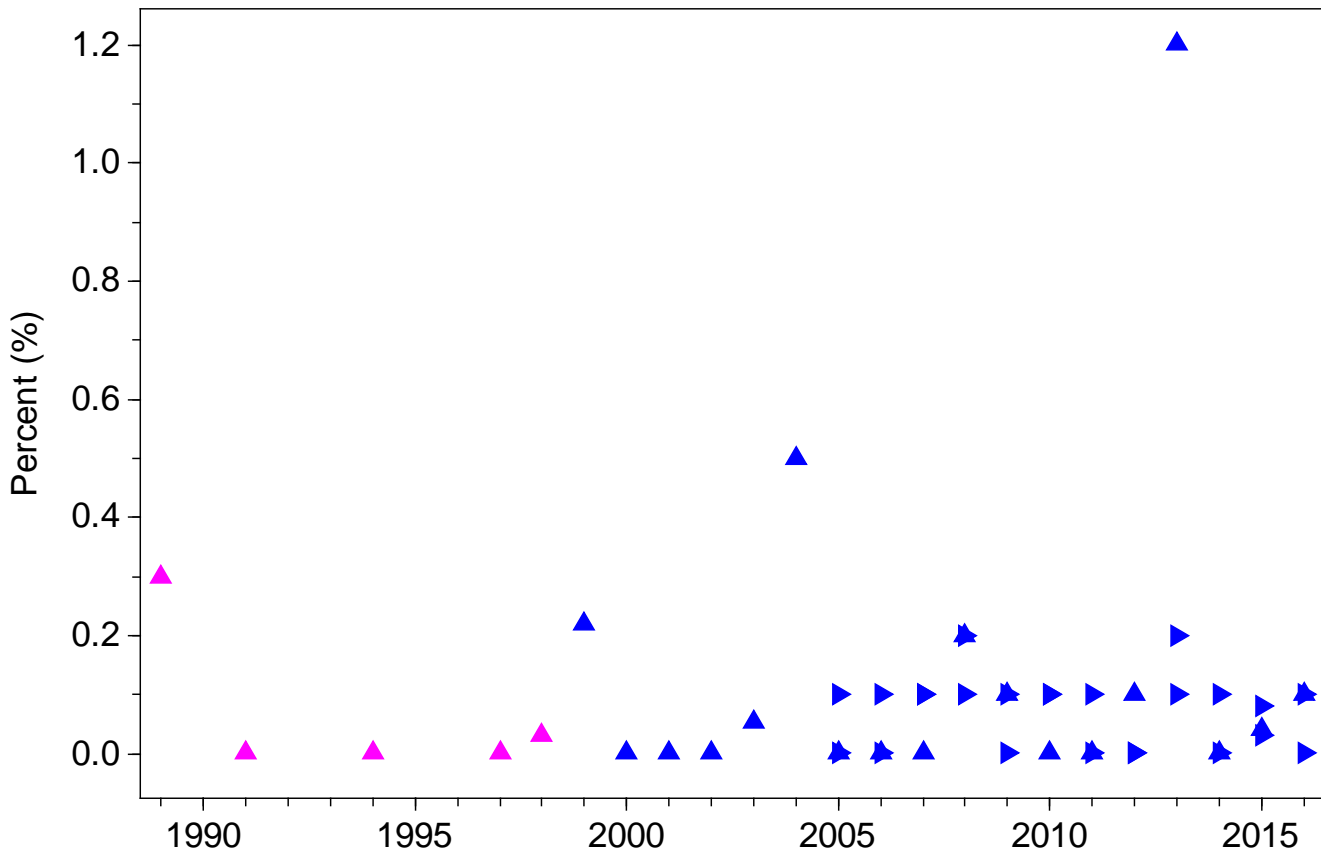
Total Organic Carbon, Station 13



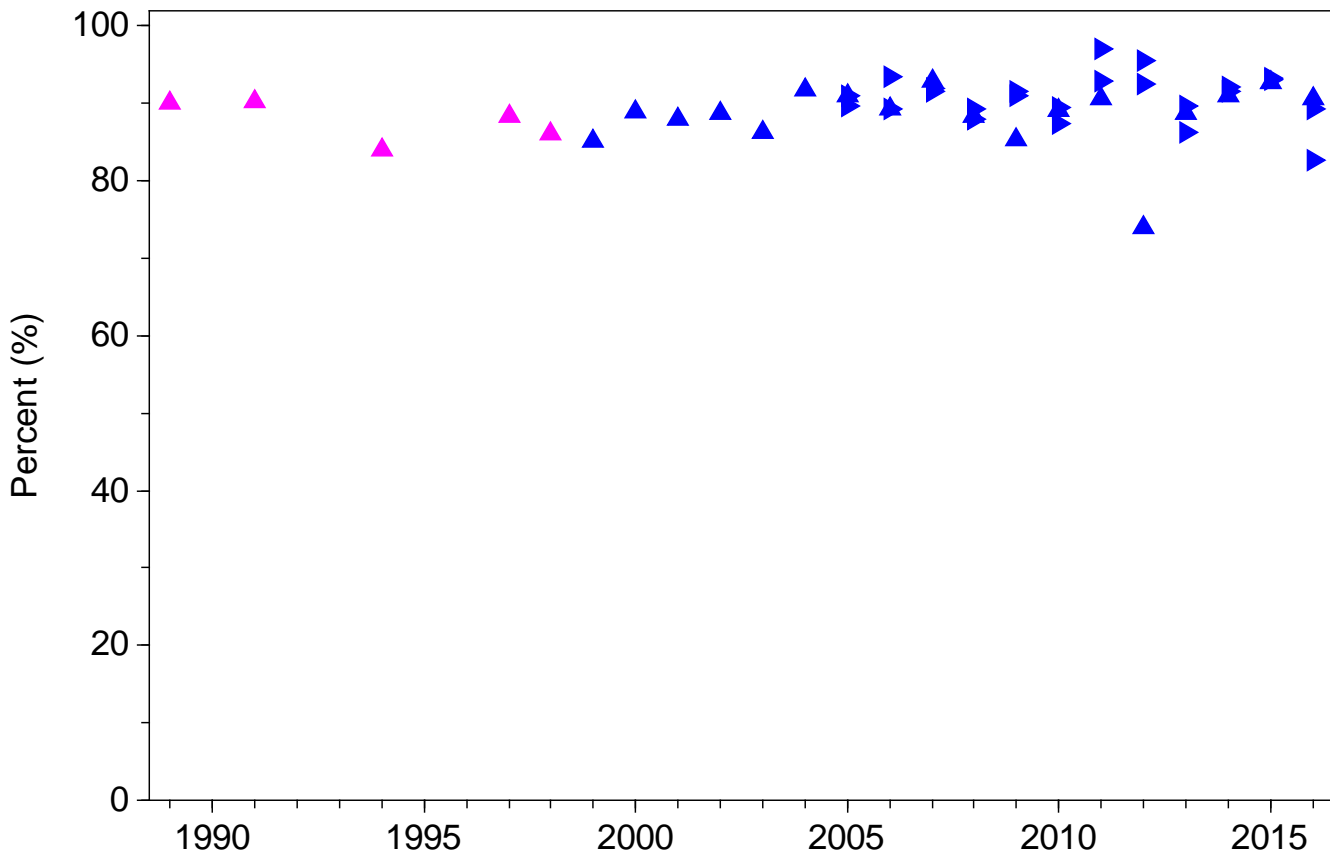
Percent Fines, Station 13



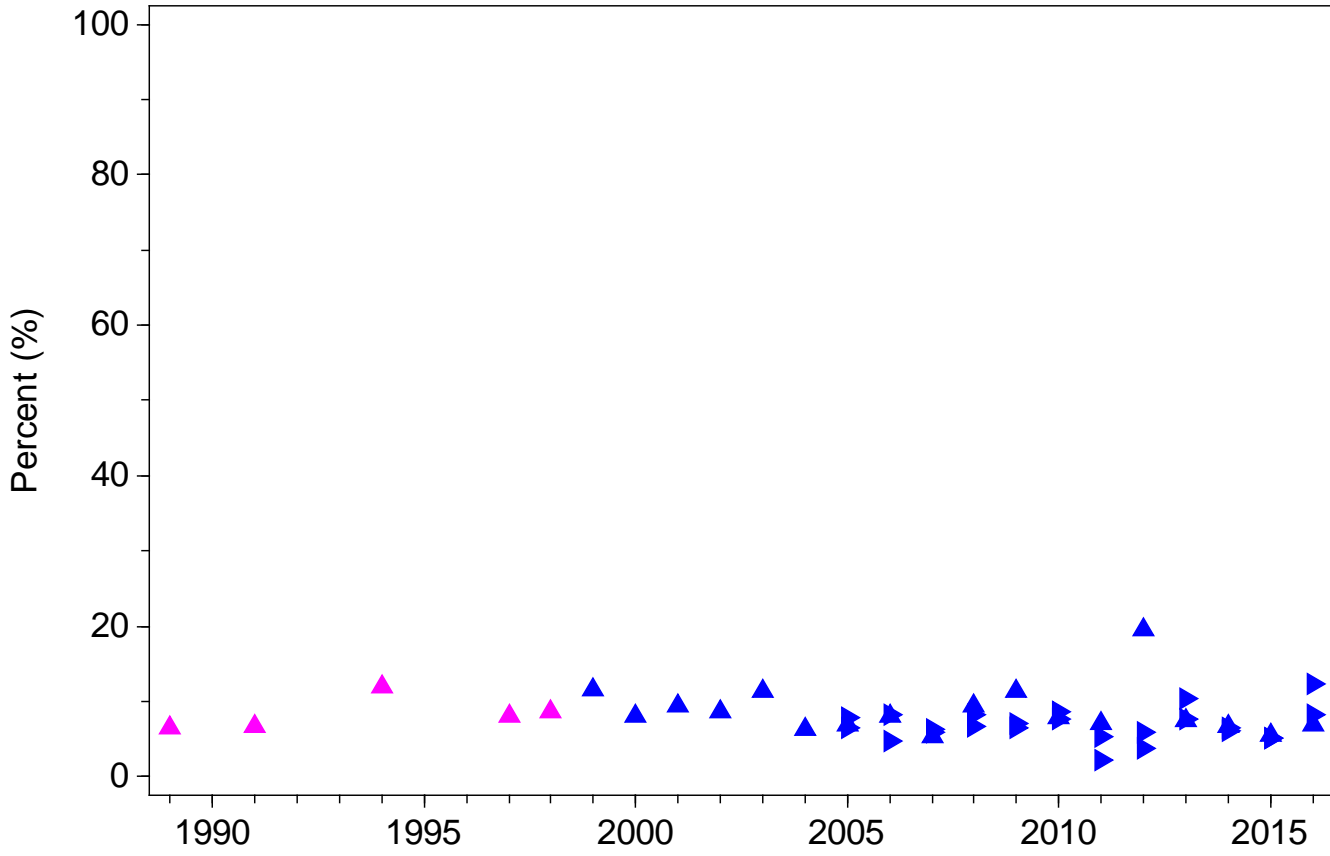
Gravel, Station 13



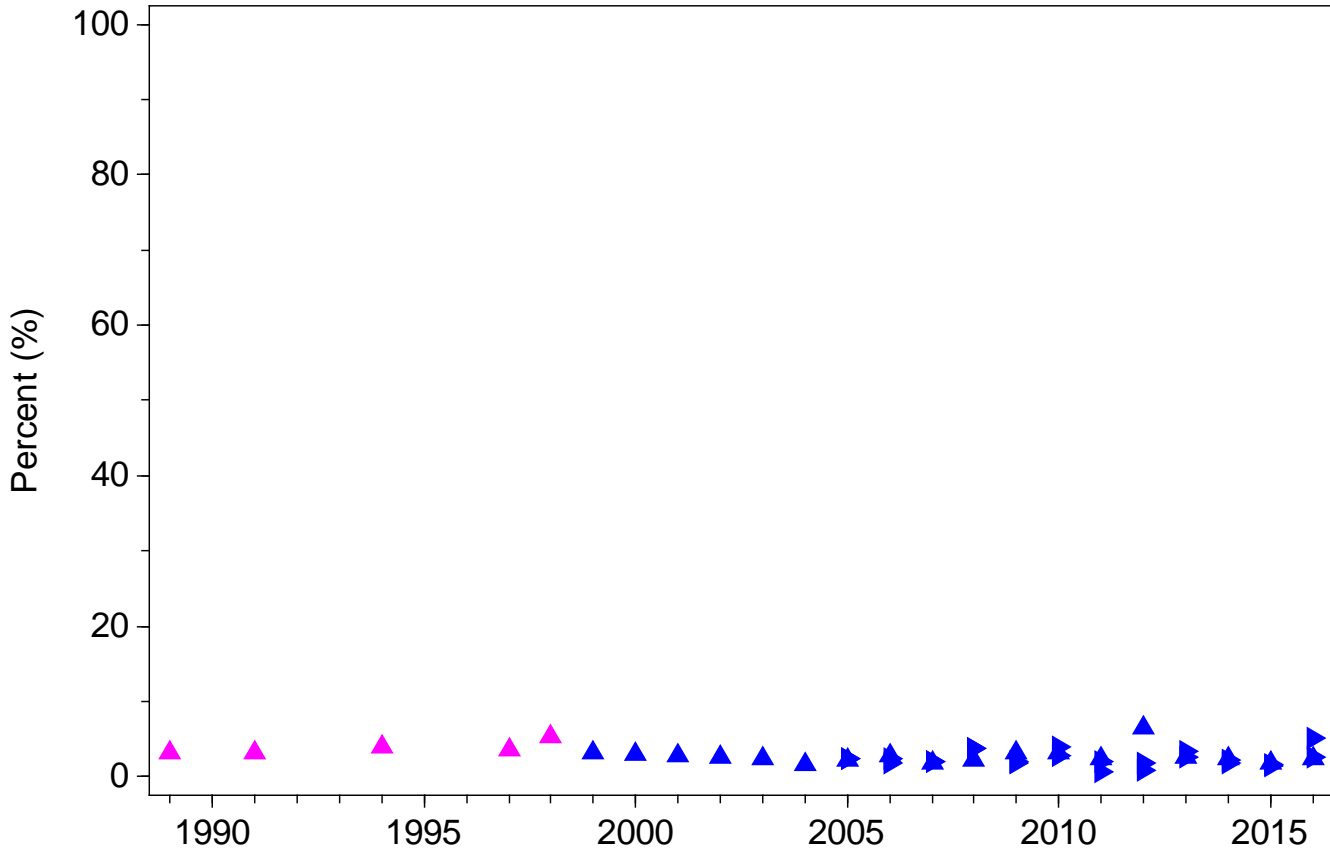
Total Sand, Station 13



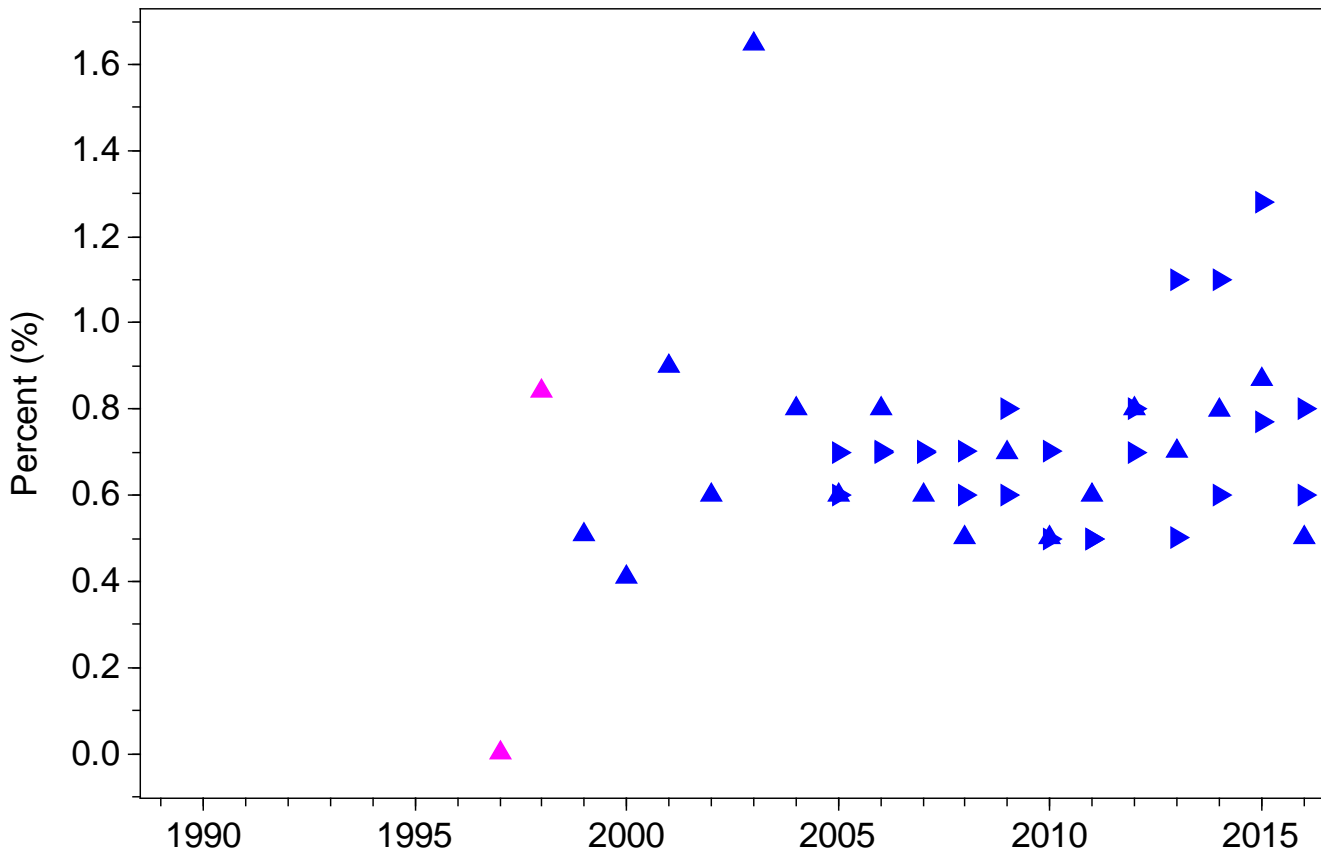
Total Silt, Station 13 (North Hood Canal)



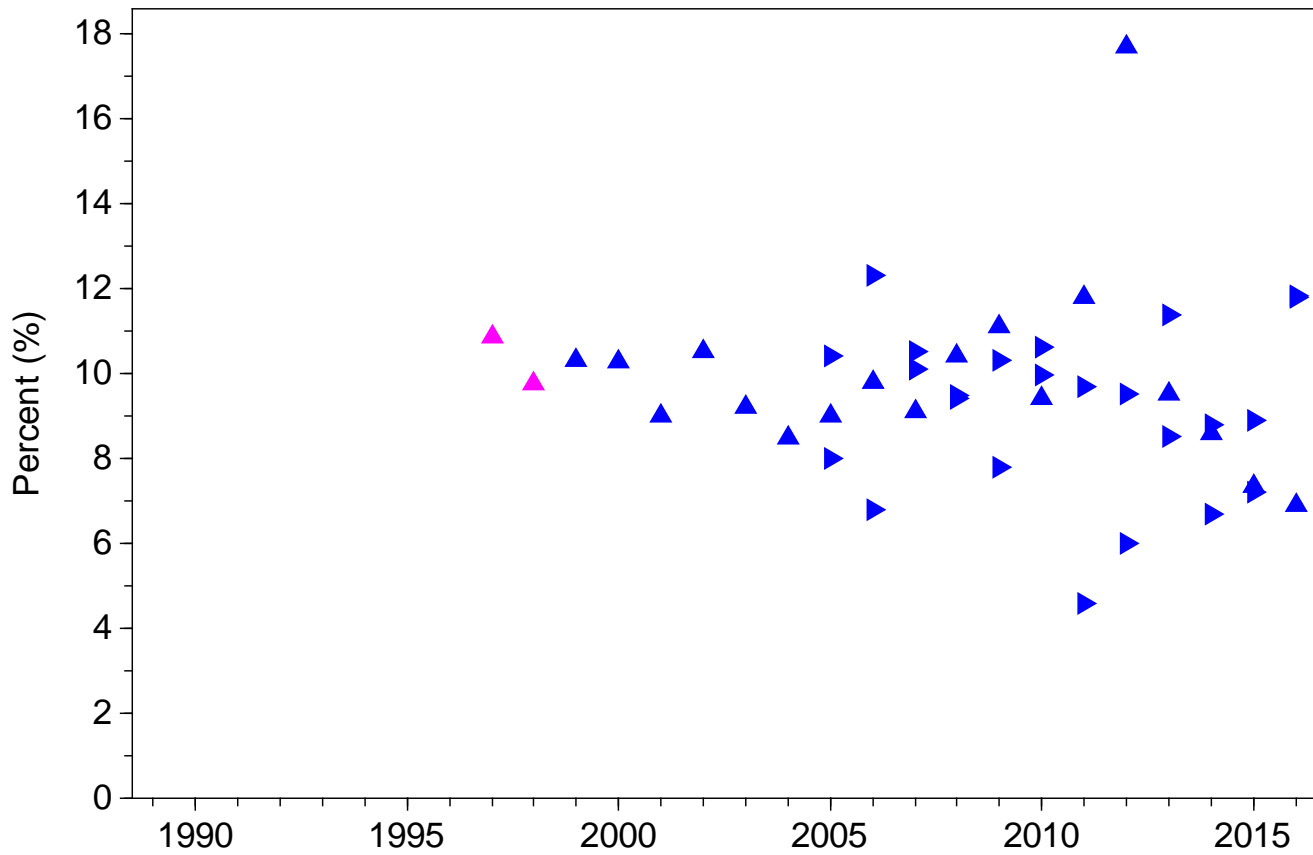
Total Clay, Station 13 (North Hood Canal)



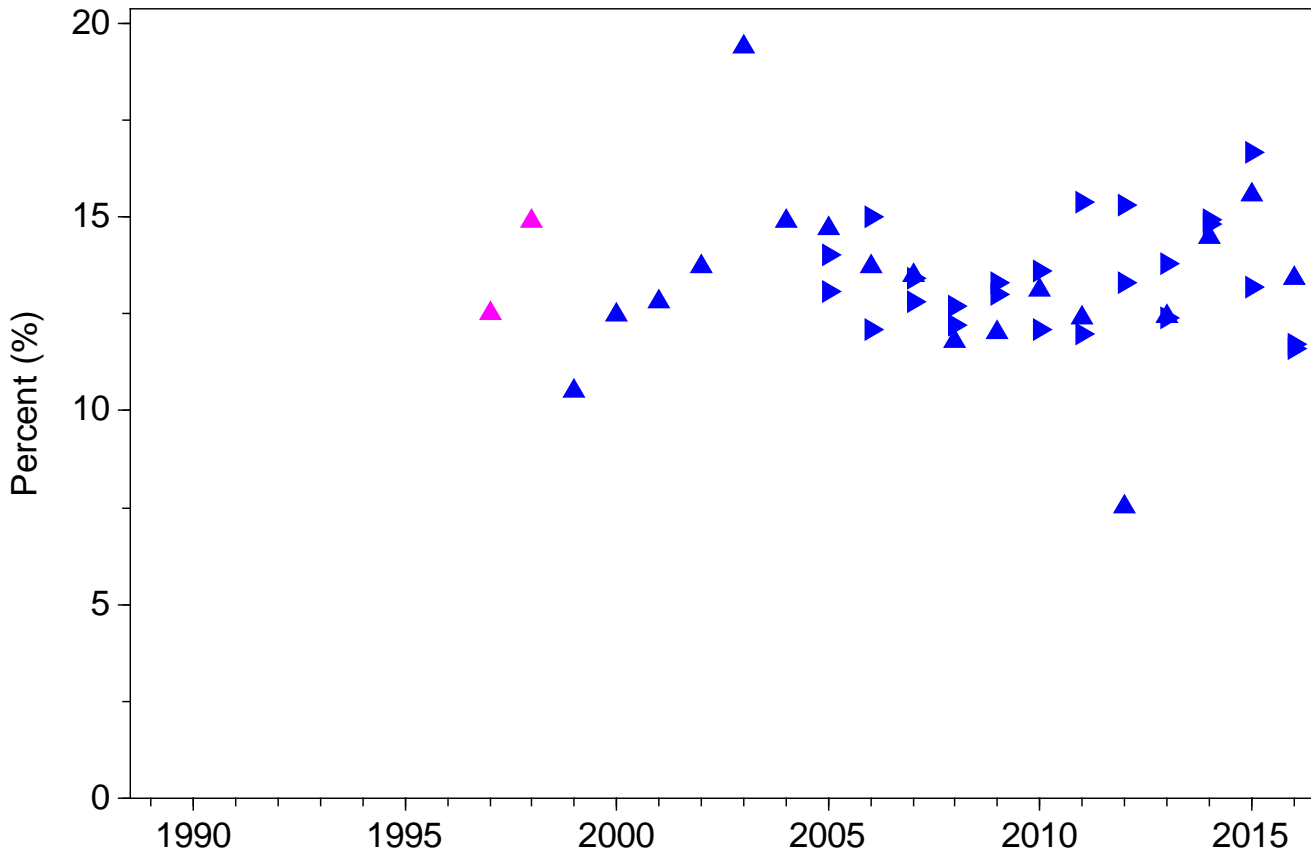
Very Coarse Sand, Station 13



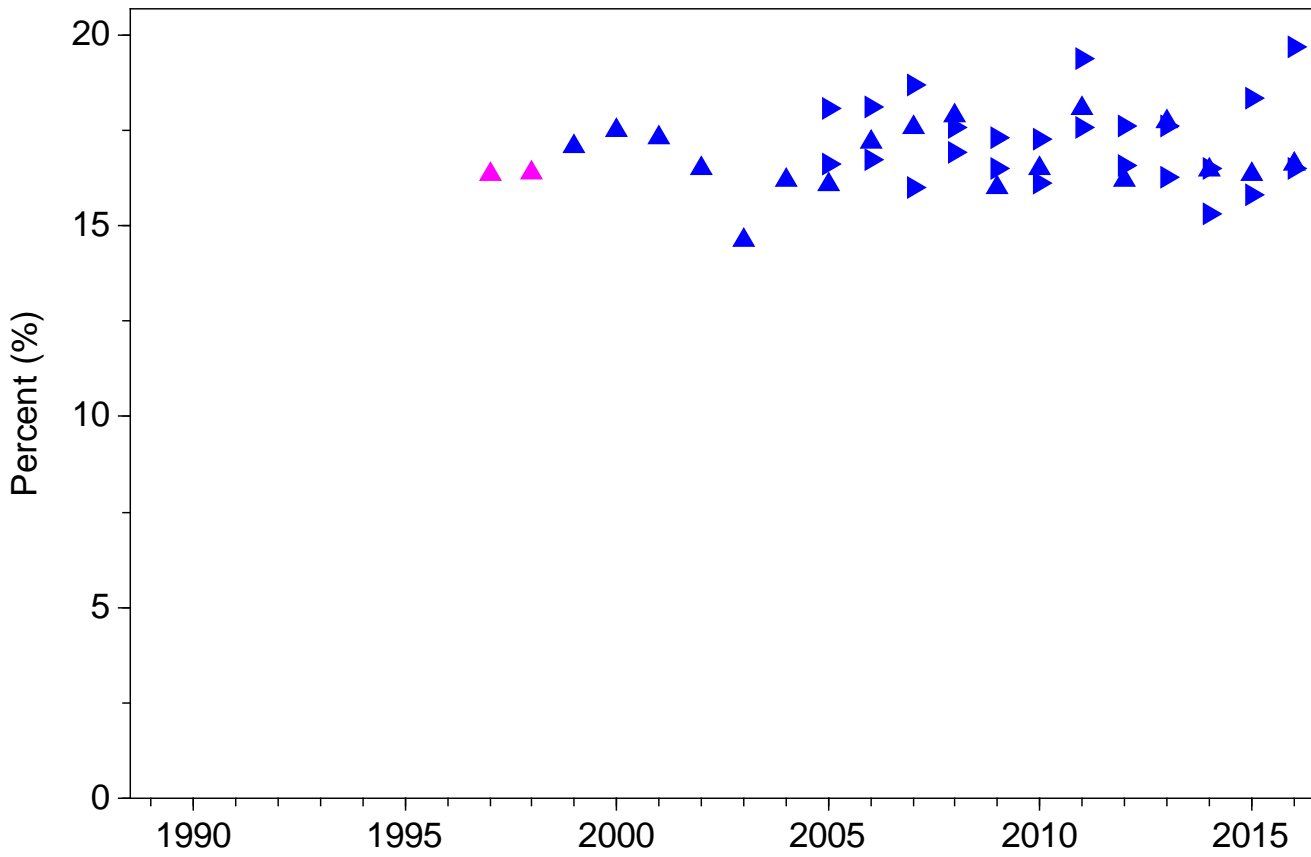
Very Fine Sand, Station 13



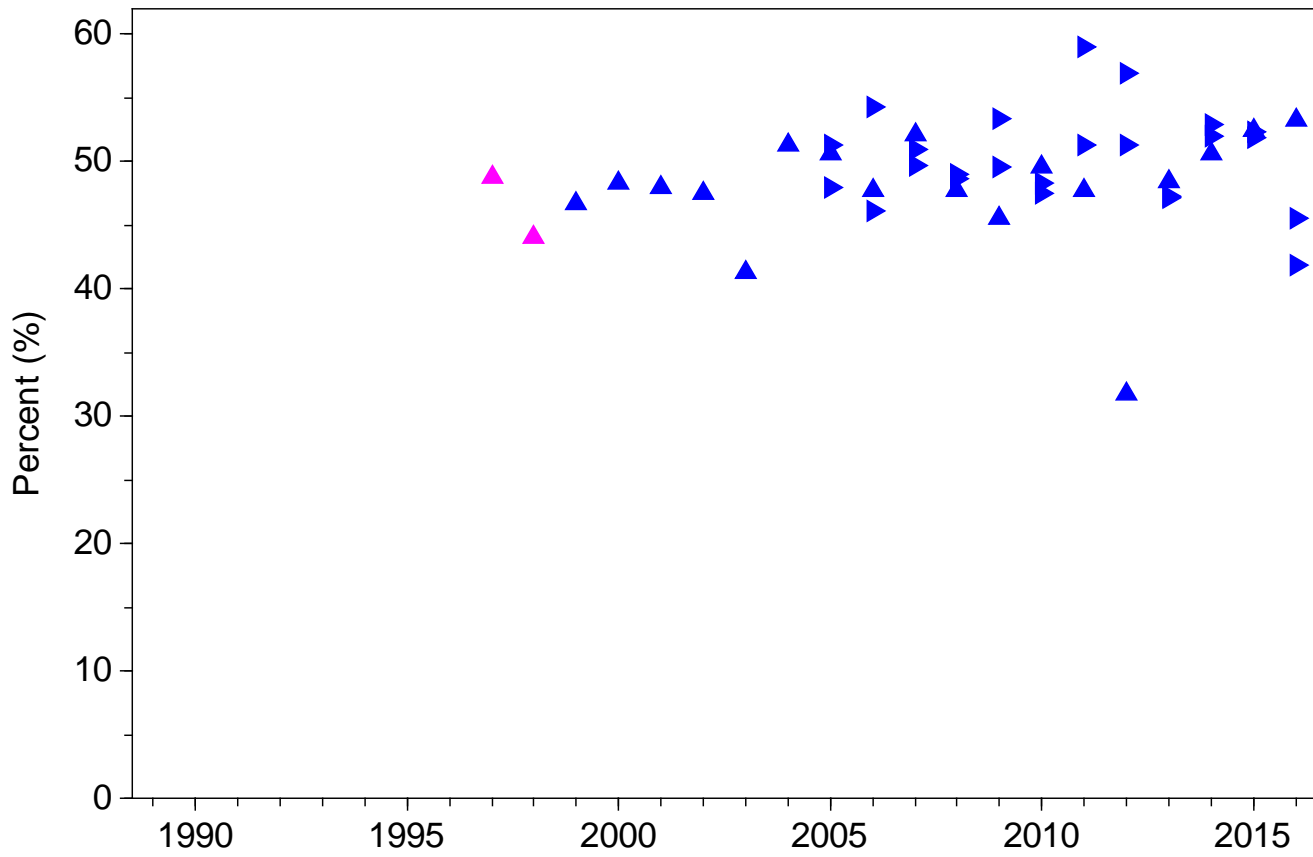
Coarse Sand, Station 13



Fine Sand, Station 13

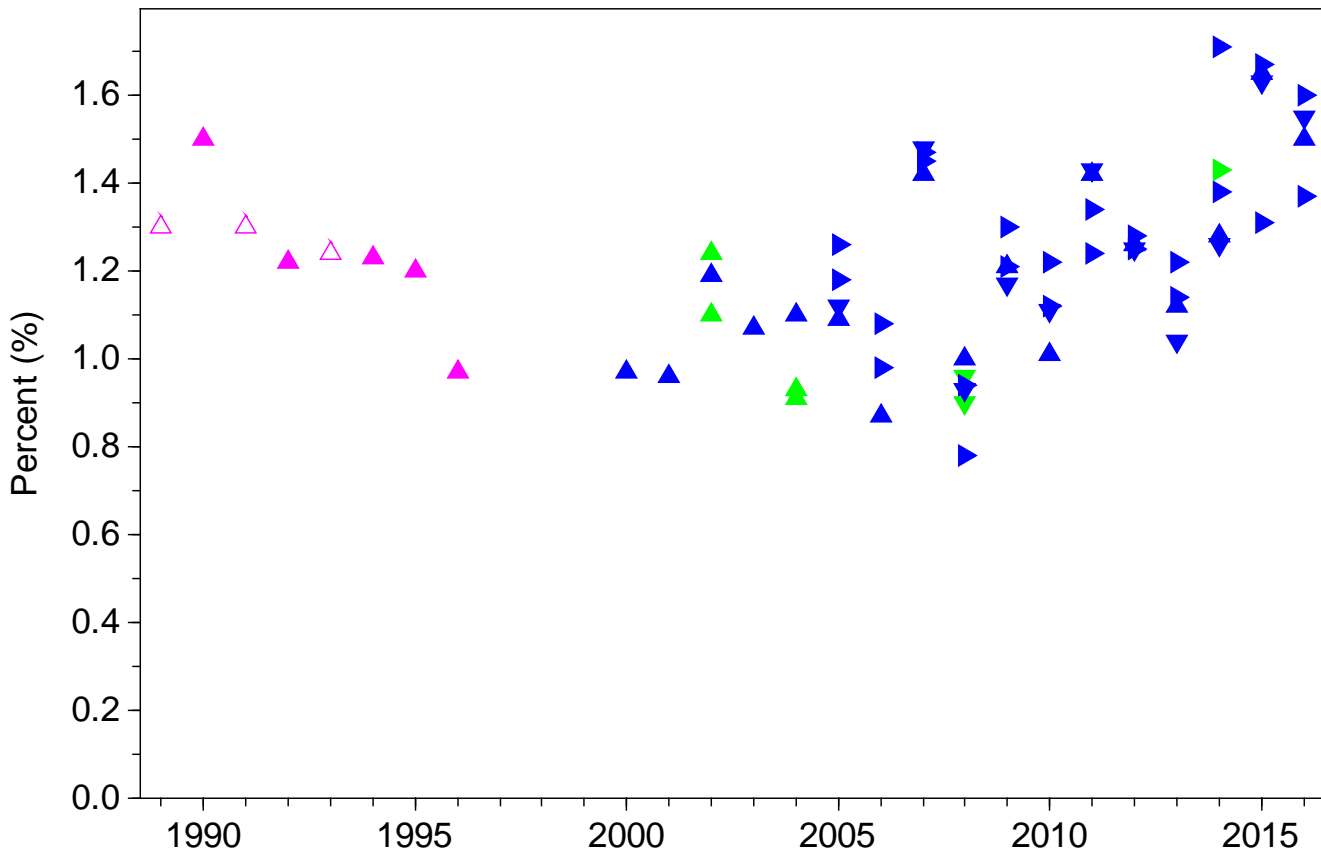


Medium Sand, Station 13

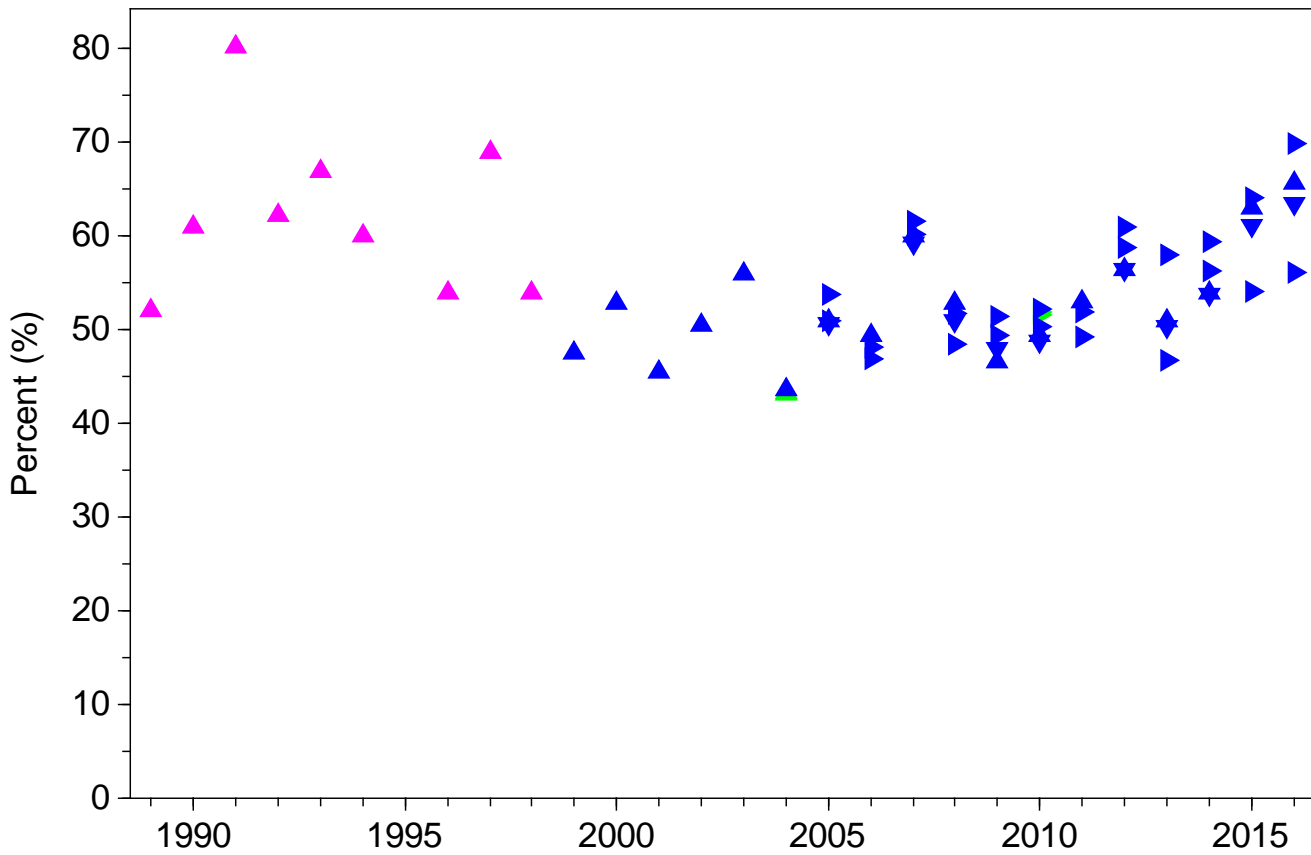


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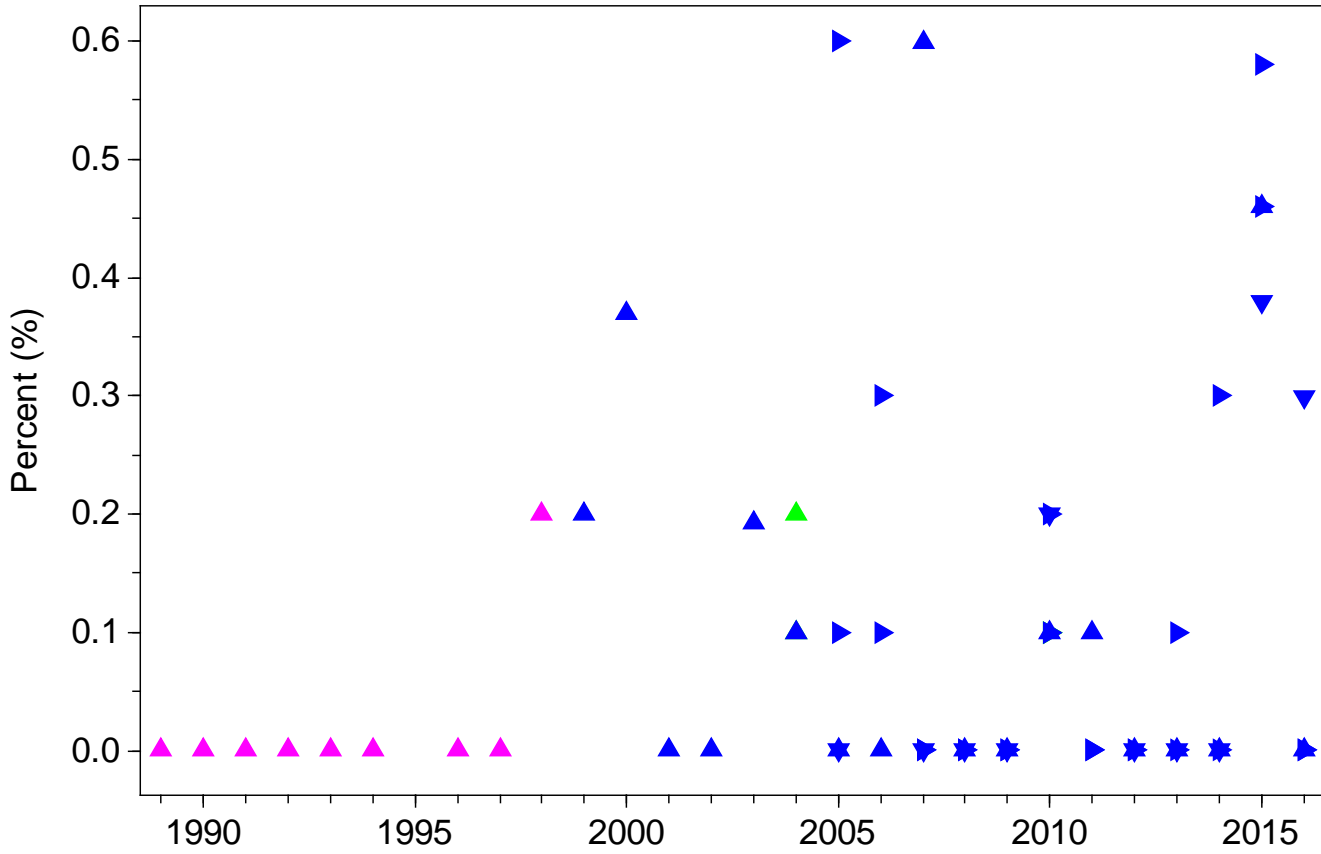
Total Organic Carbon, Station 21



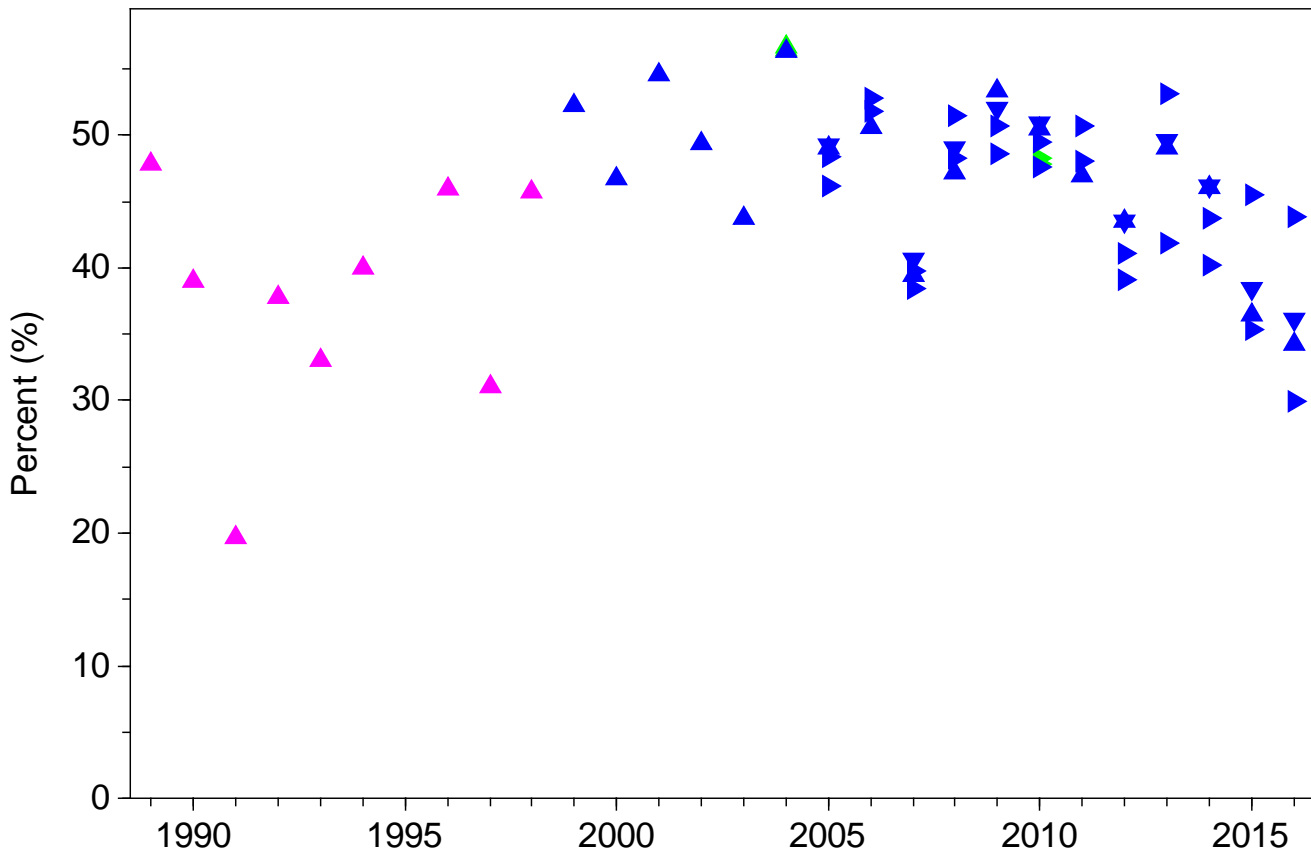
Percent Fines, Station 21



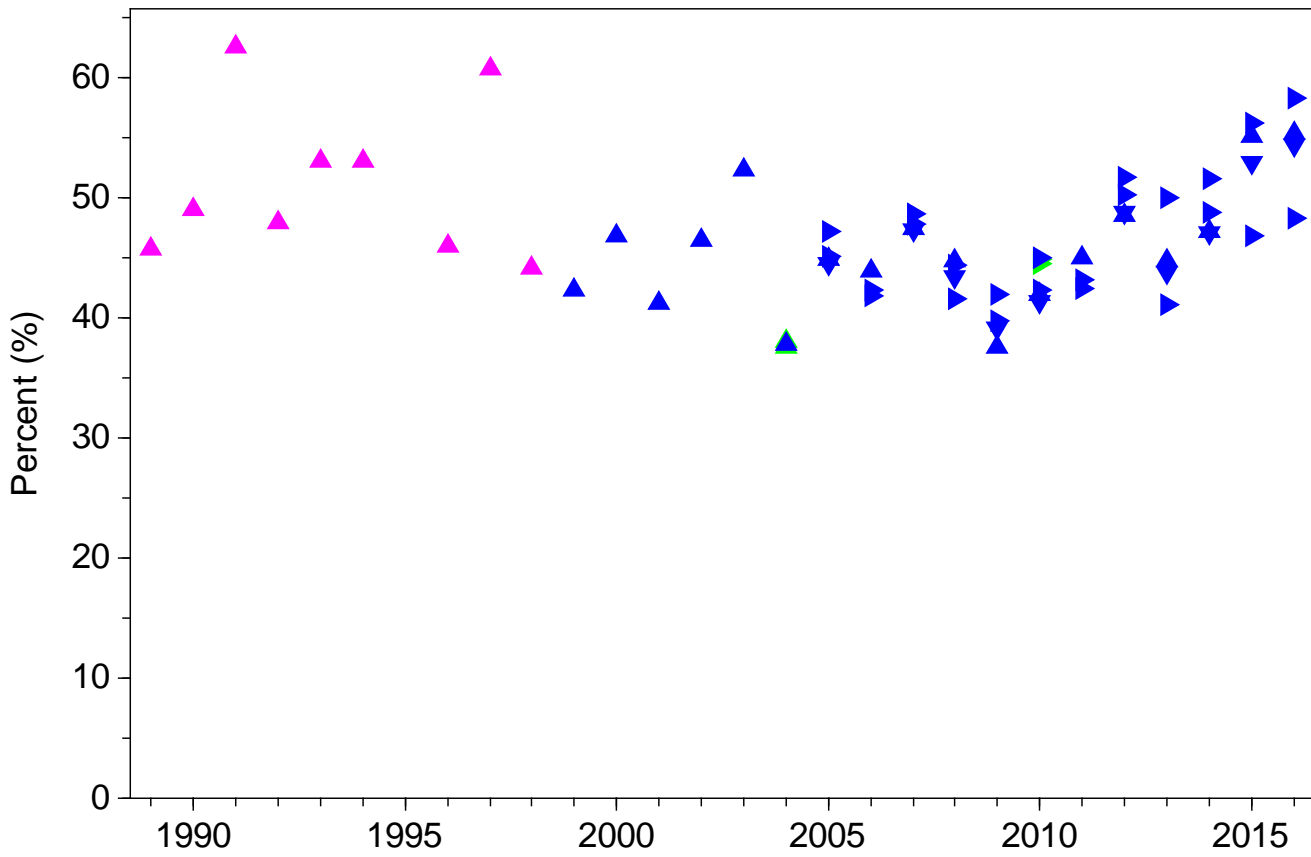
Gravel, Station 21



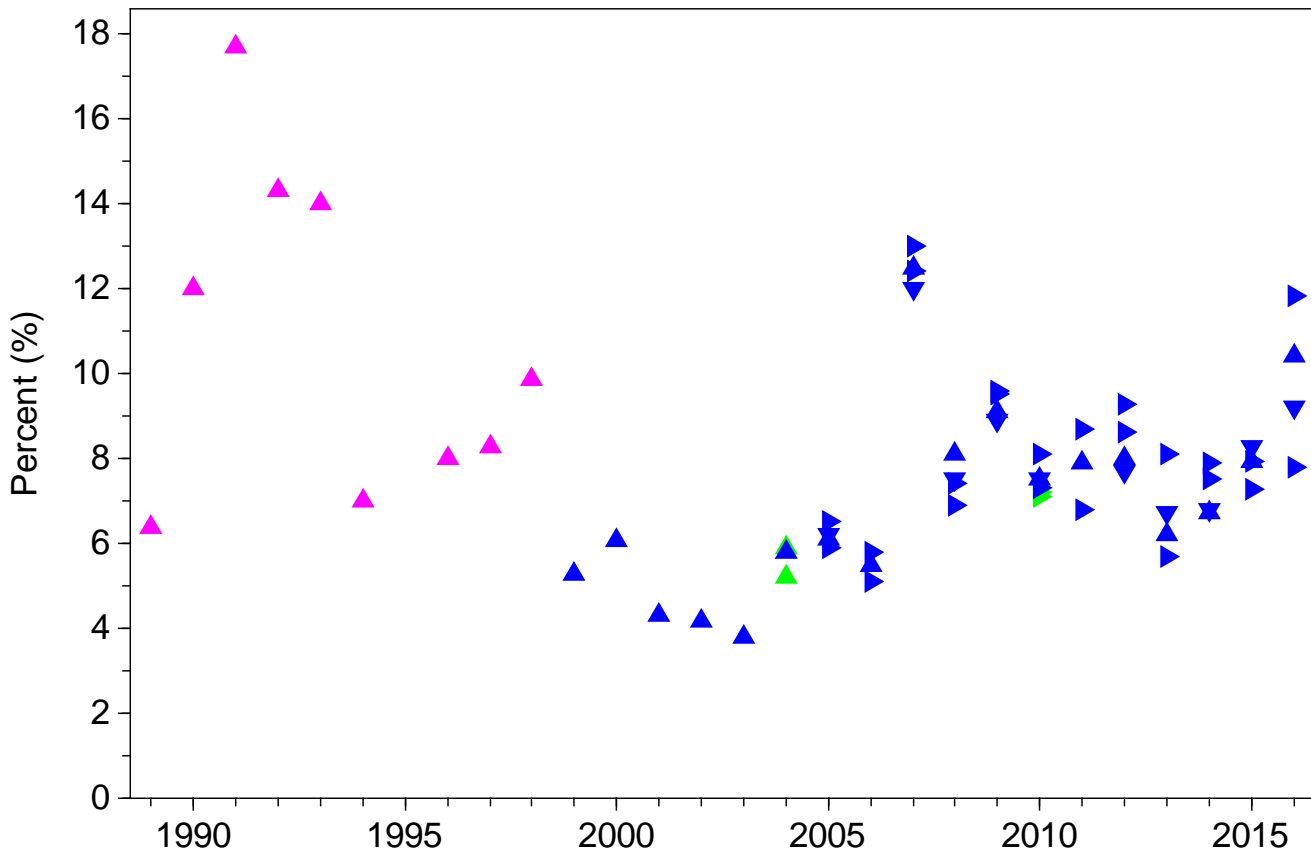
Total Sand, Station 21



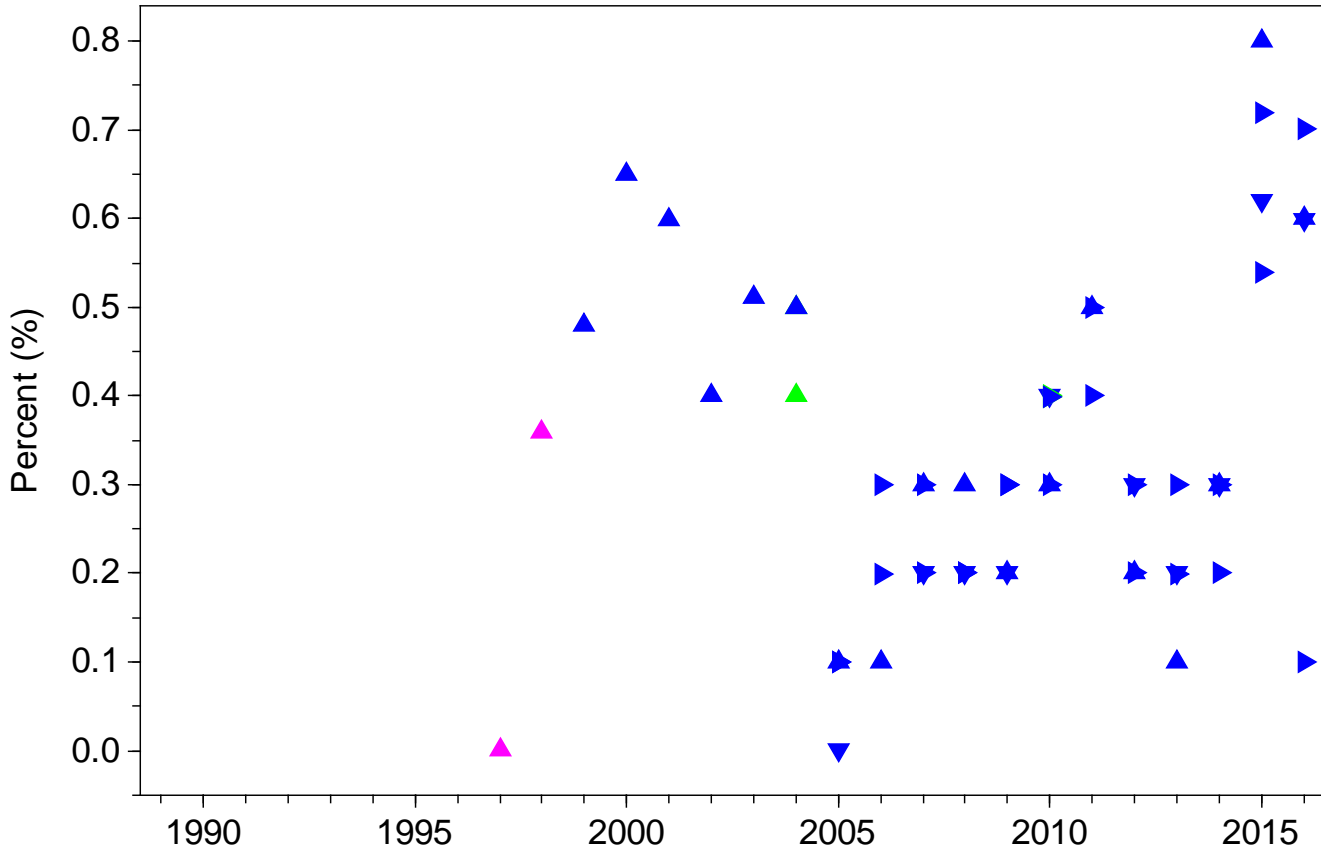
Total Silt, Station 21



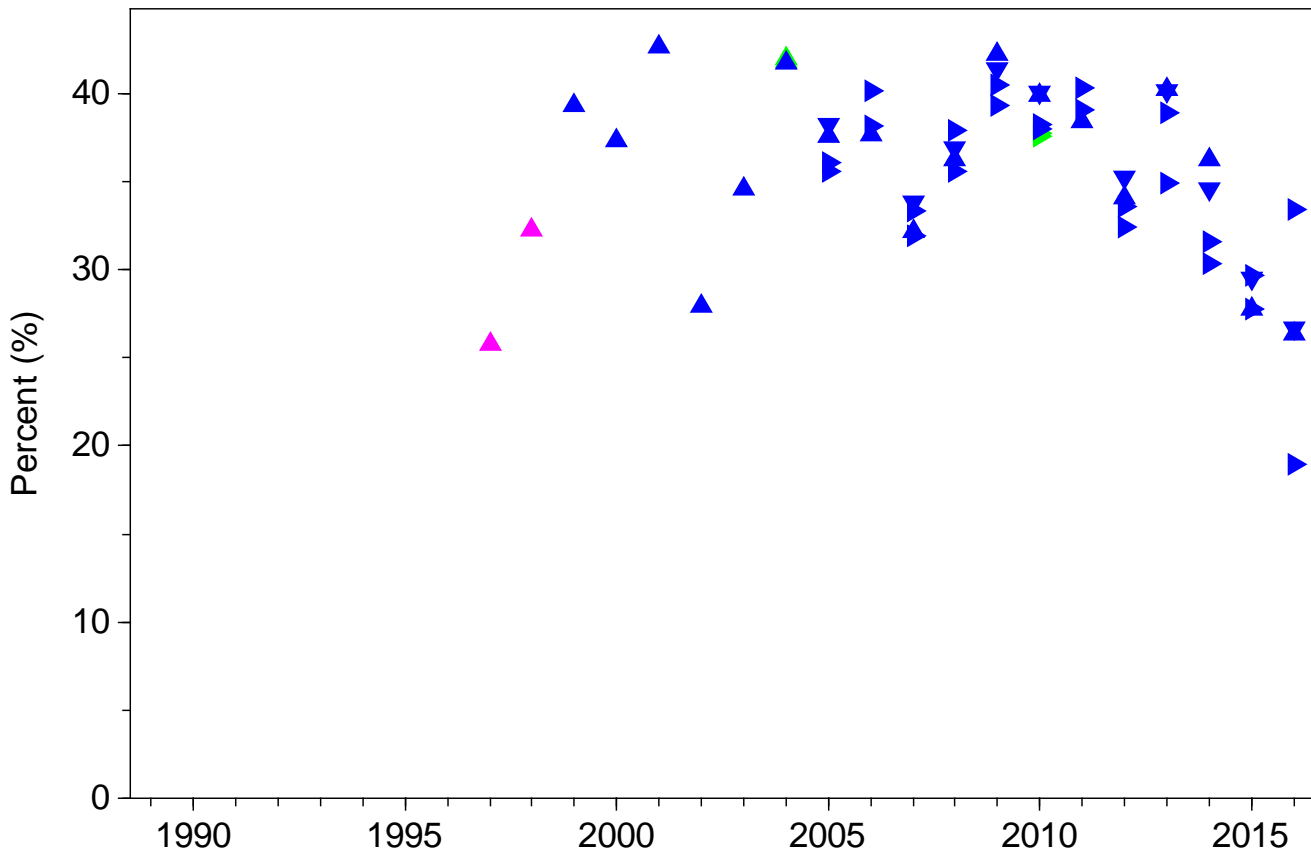
Total Clay, Station 21



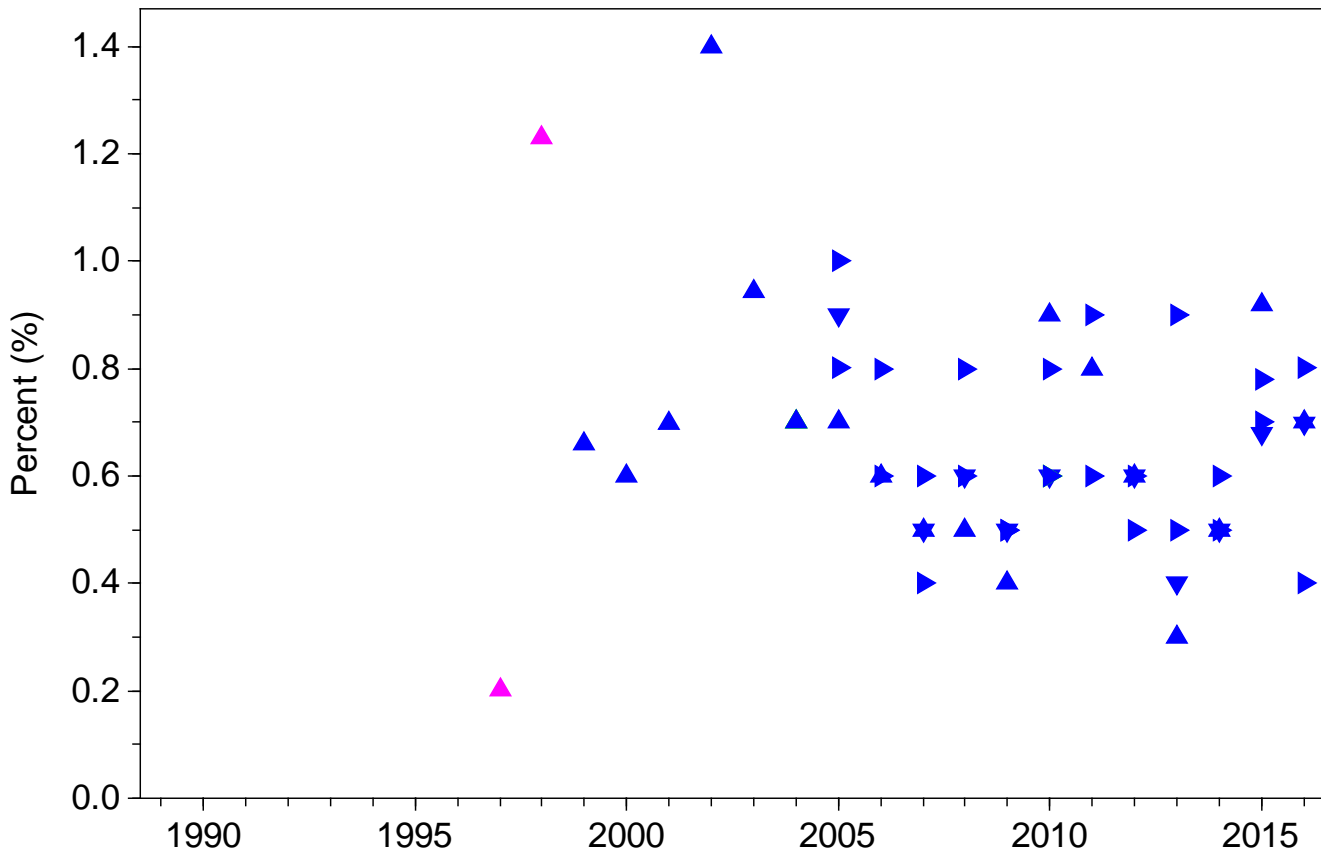
Very Coarse Sand, Station 21



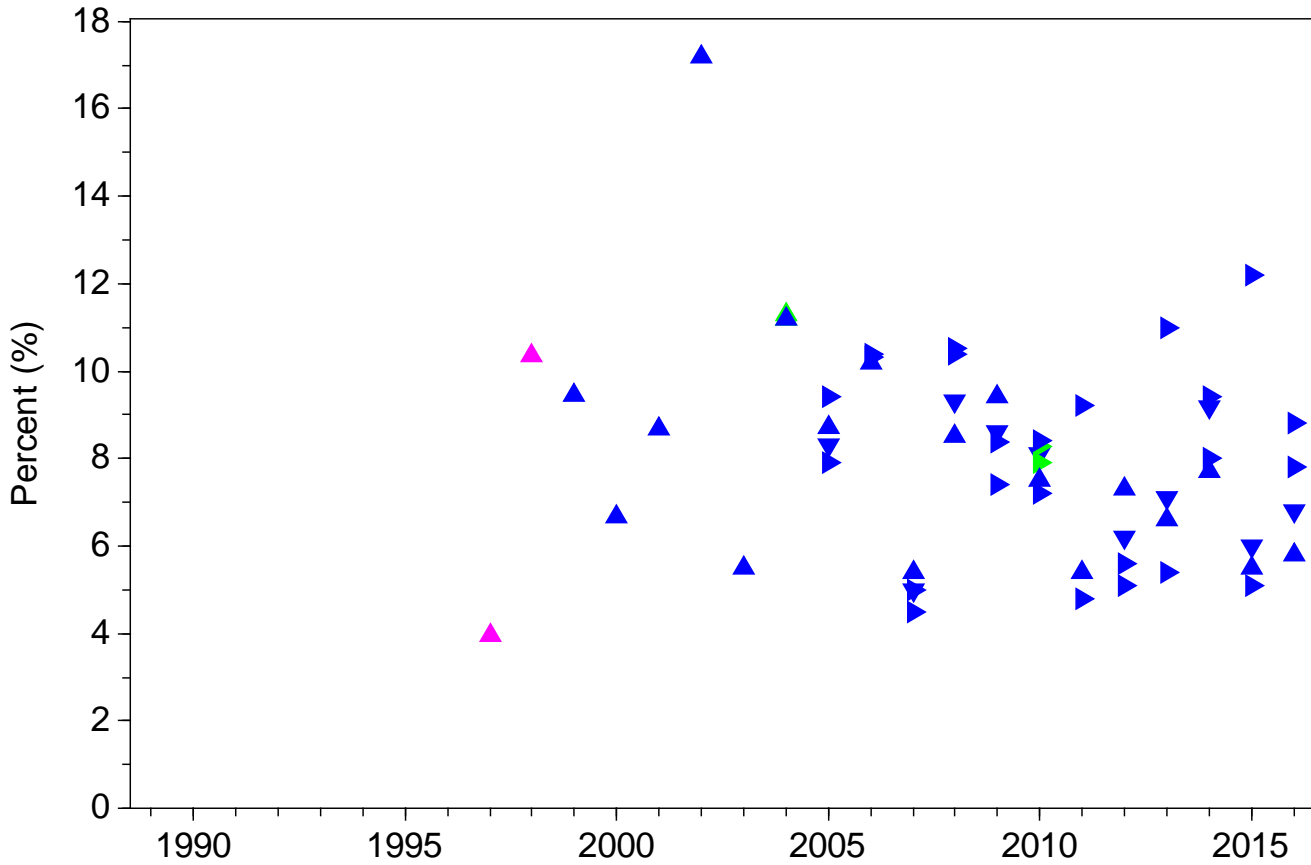
Very Fine Sand, Station 21



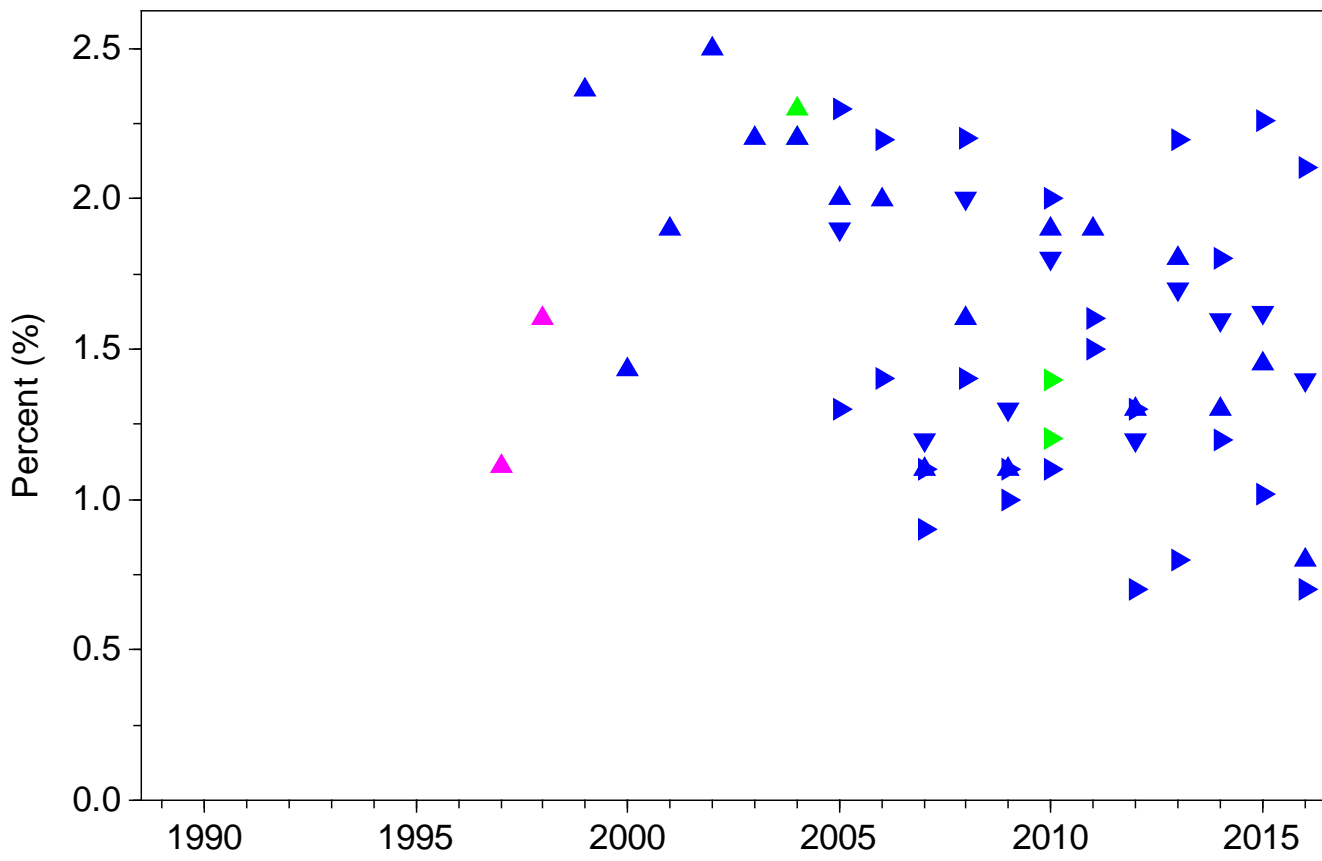
Coarse Sand, Station 21



Fine Sand, Station 21

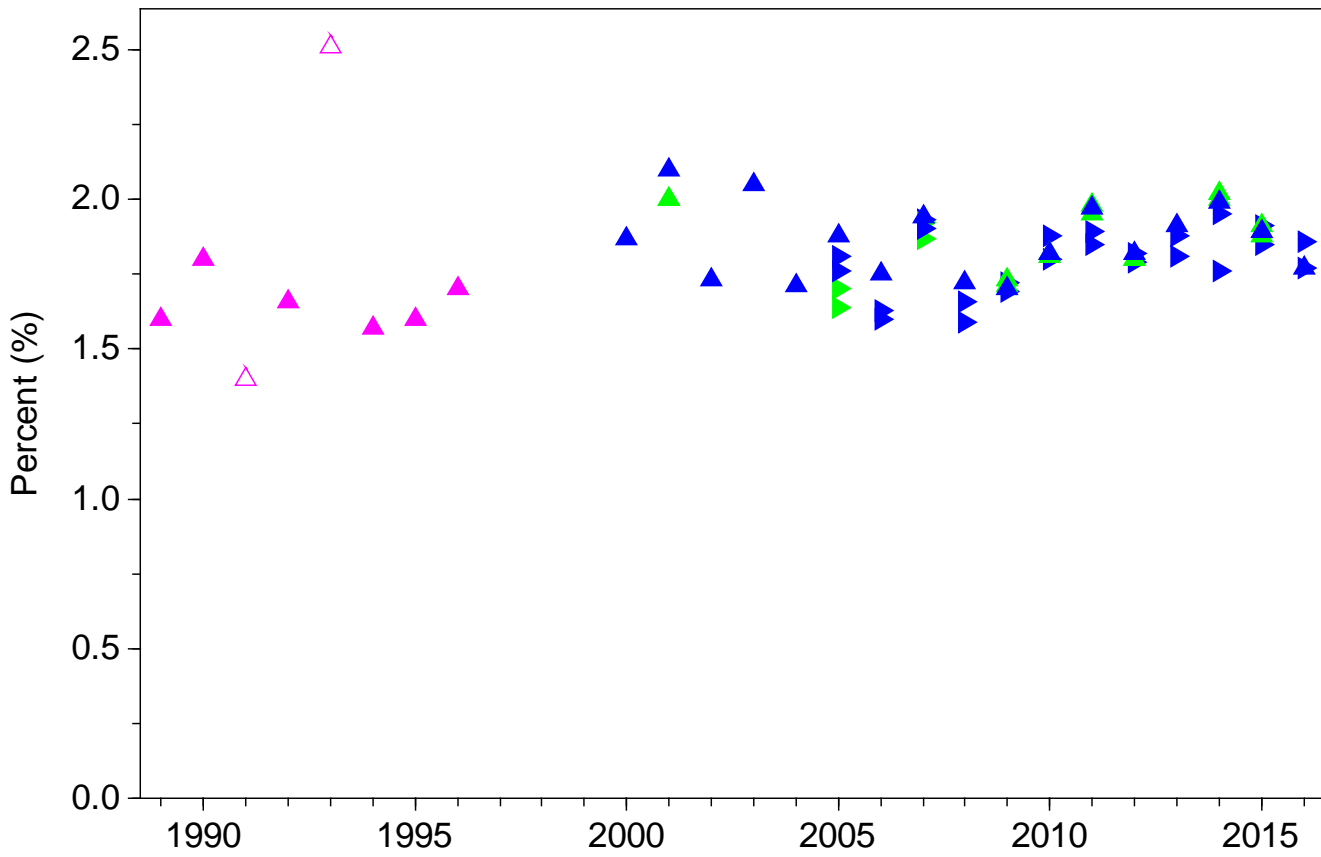


Medium Sand, Station 21

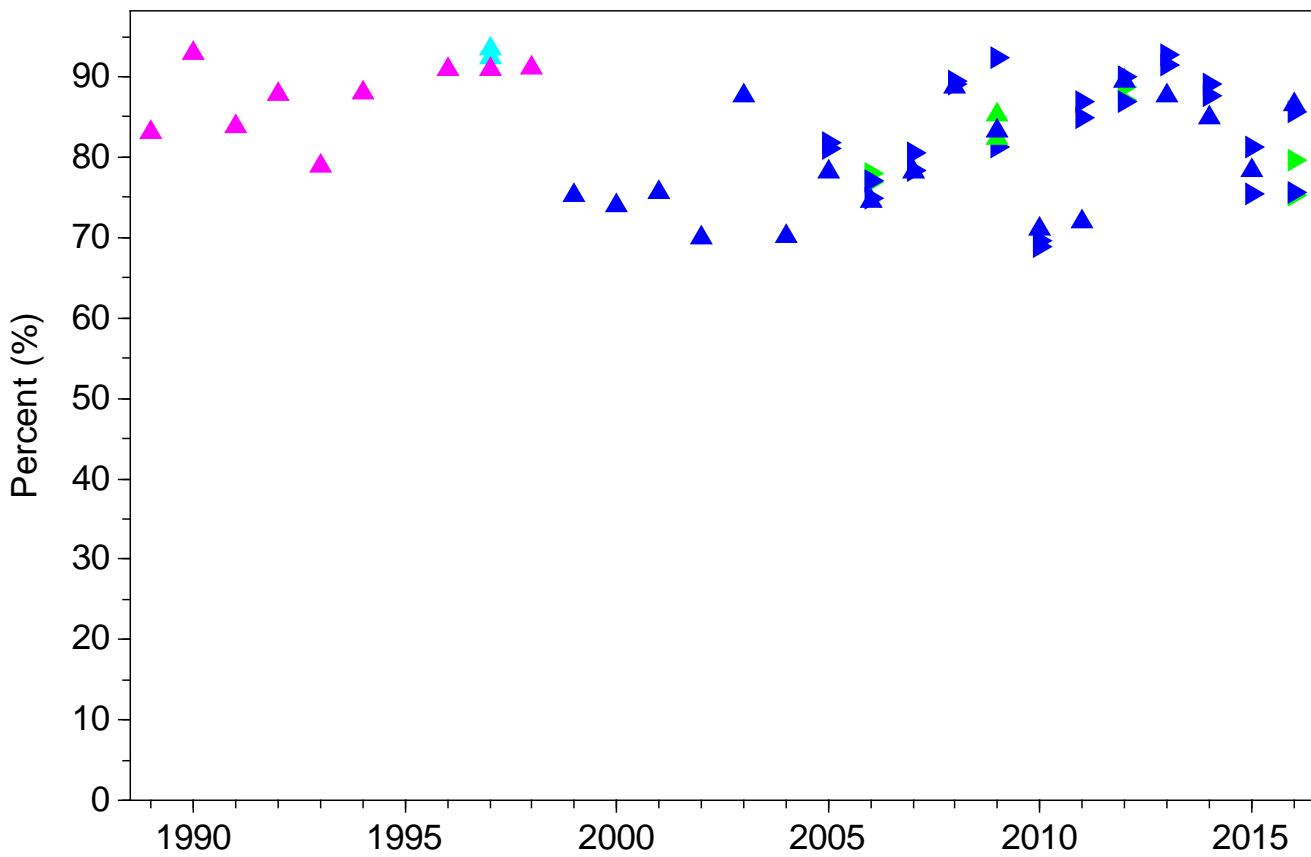


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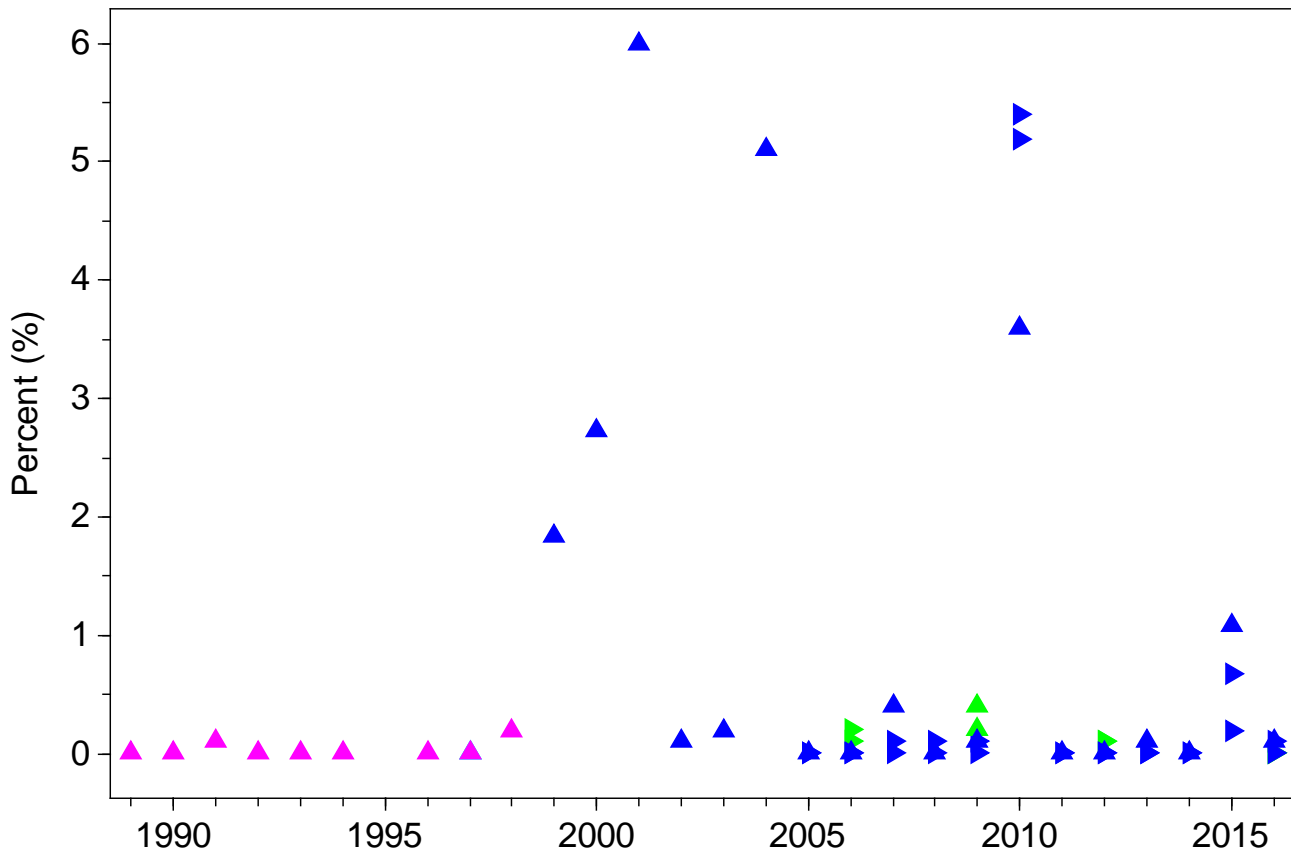
Total Organic Carbon, Station 29



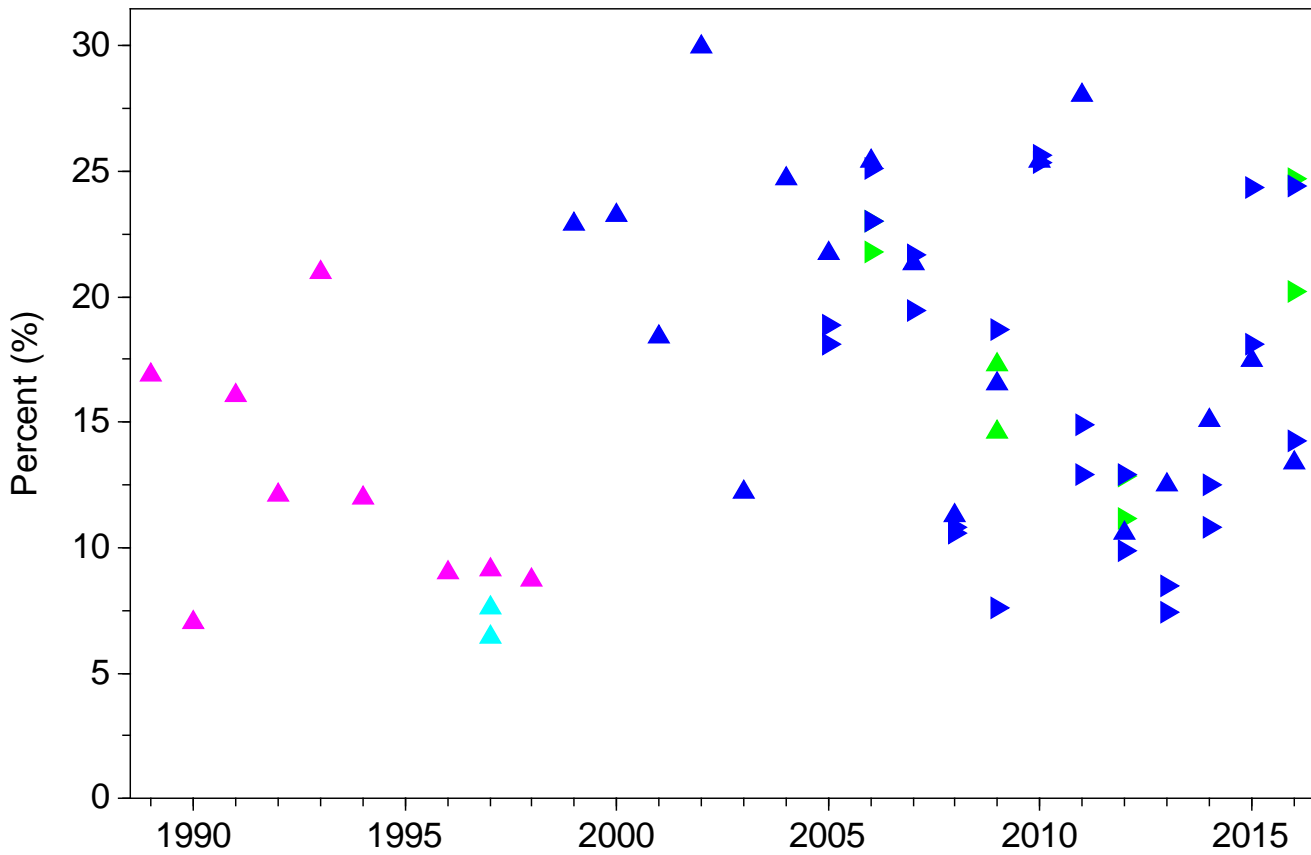
Percent Fines, Station 29



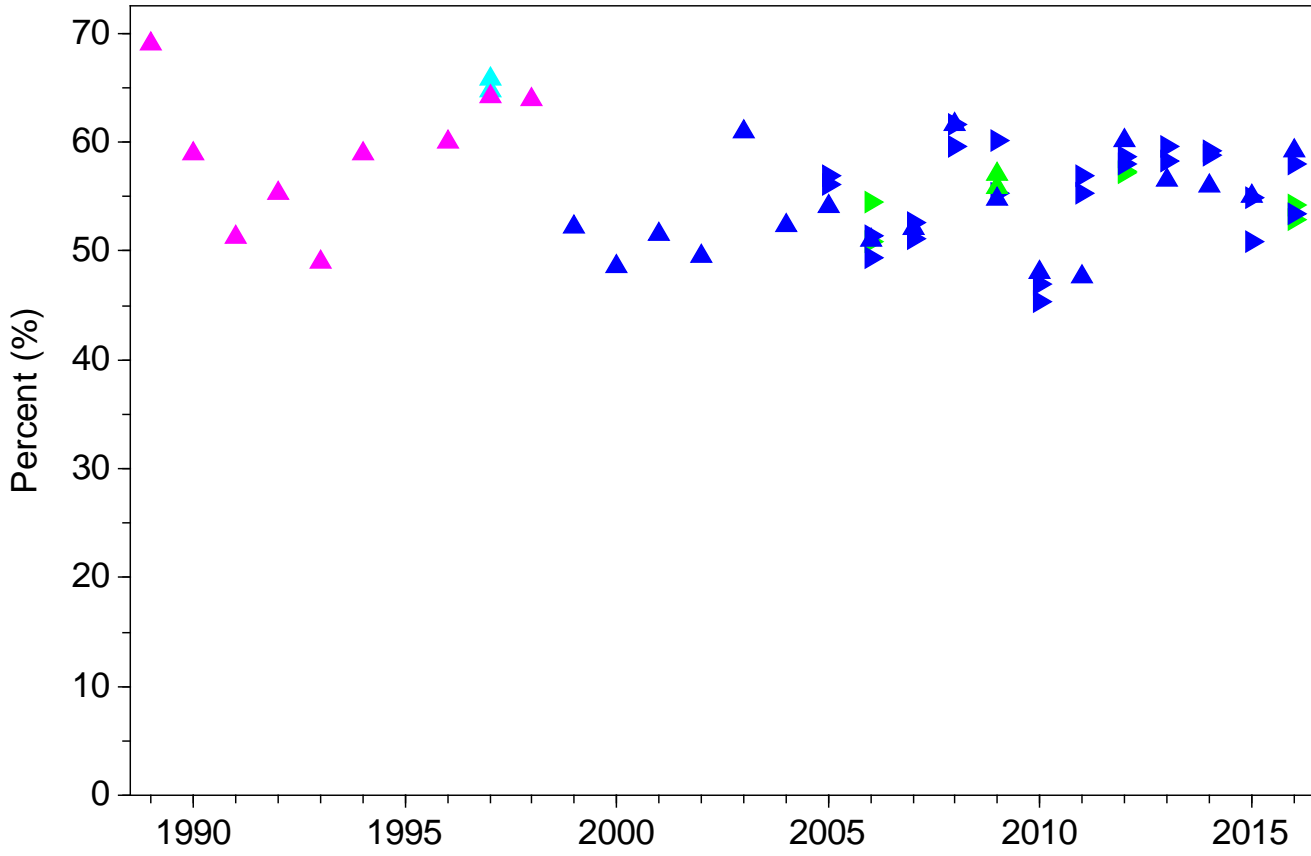
Gravel, Station 29



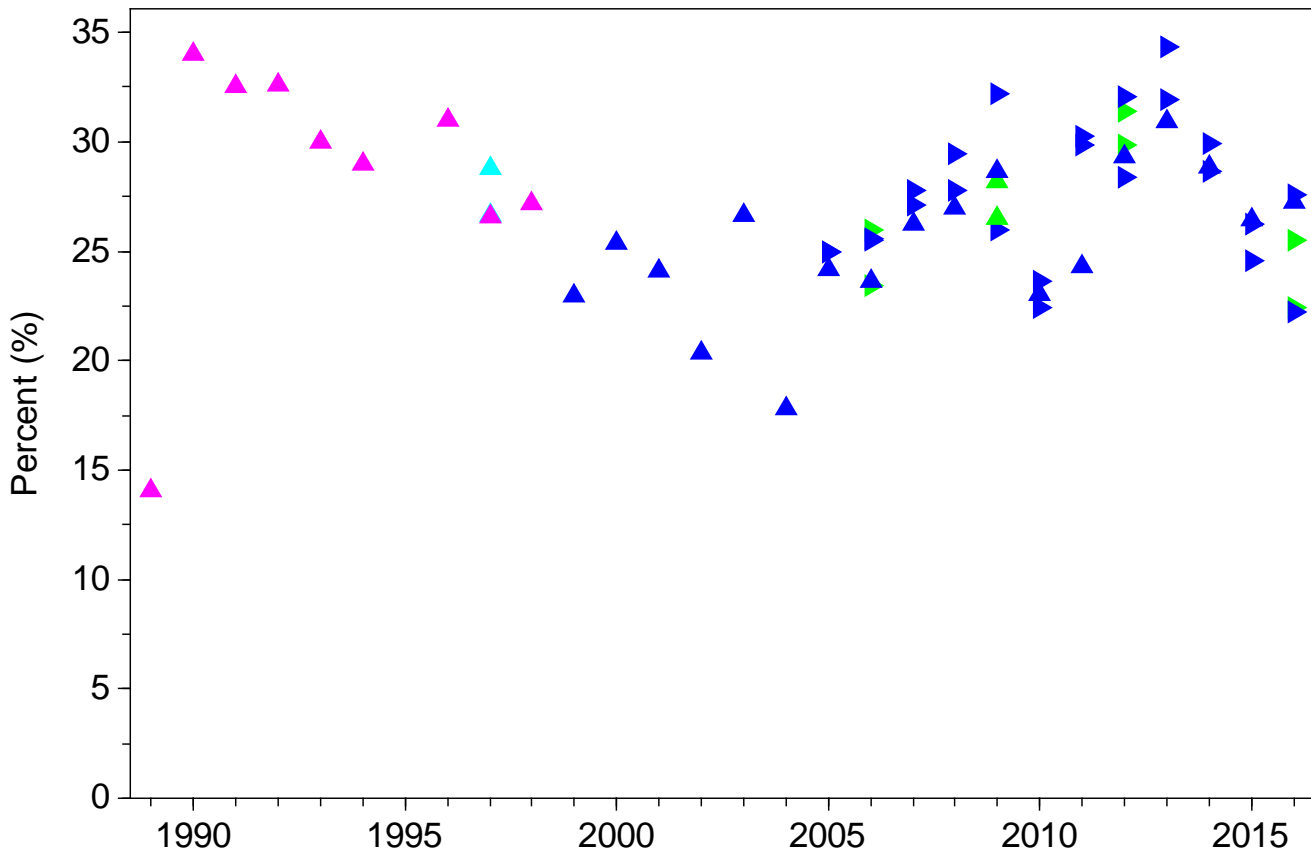
Total Sand, Station 29



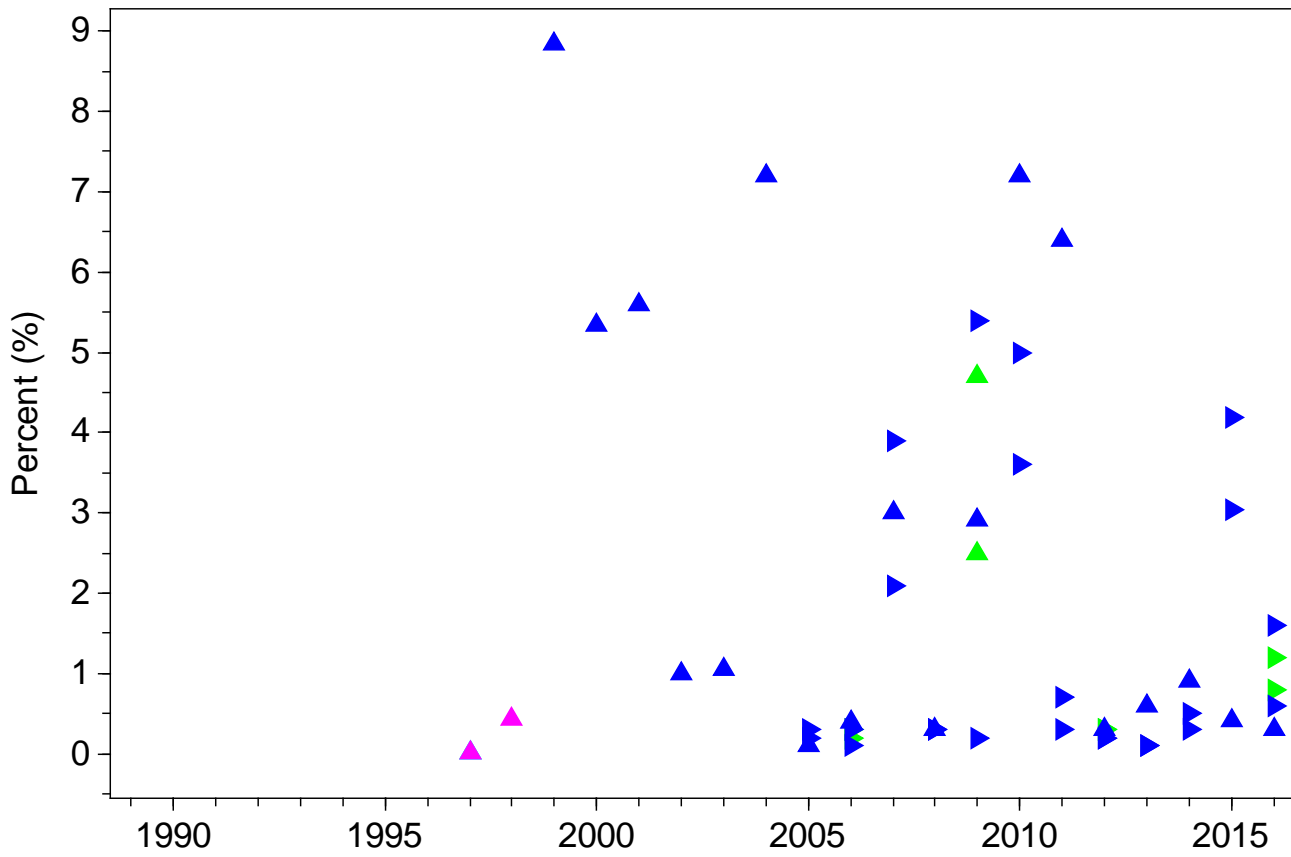
Total Silt, Station 29



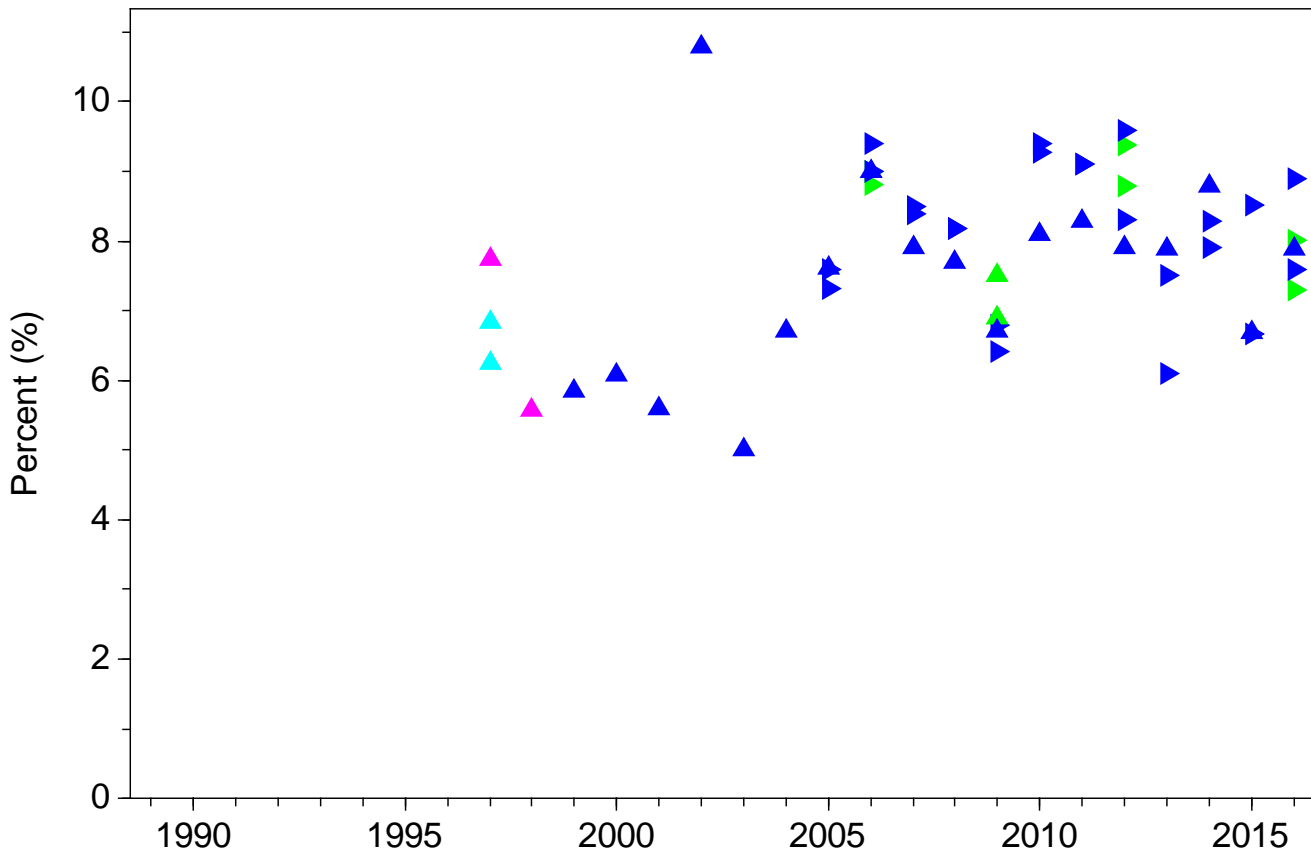
Total Clay, Station 29



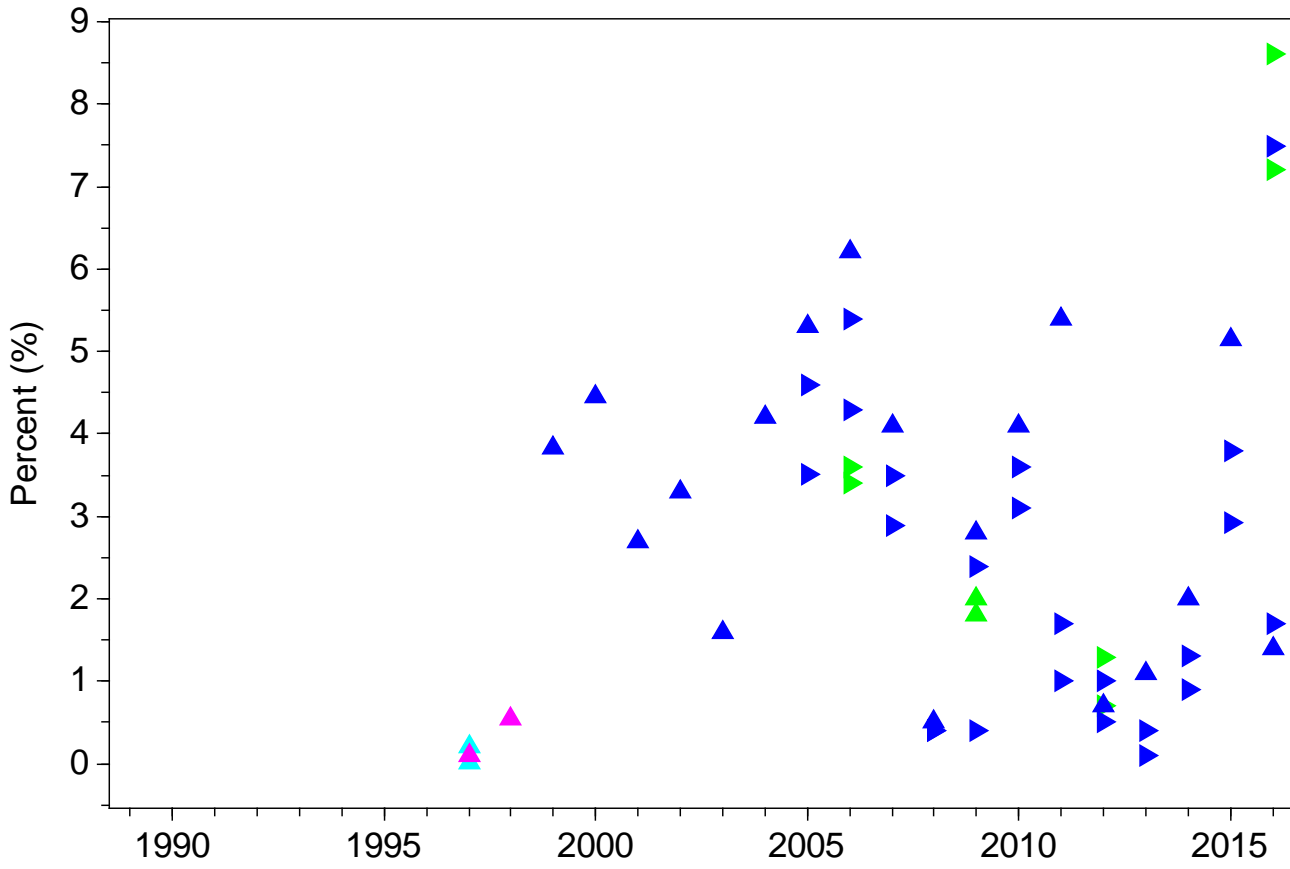
Very Coarse Sand, Station 29



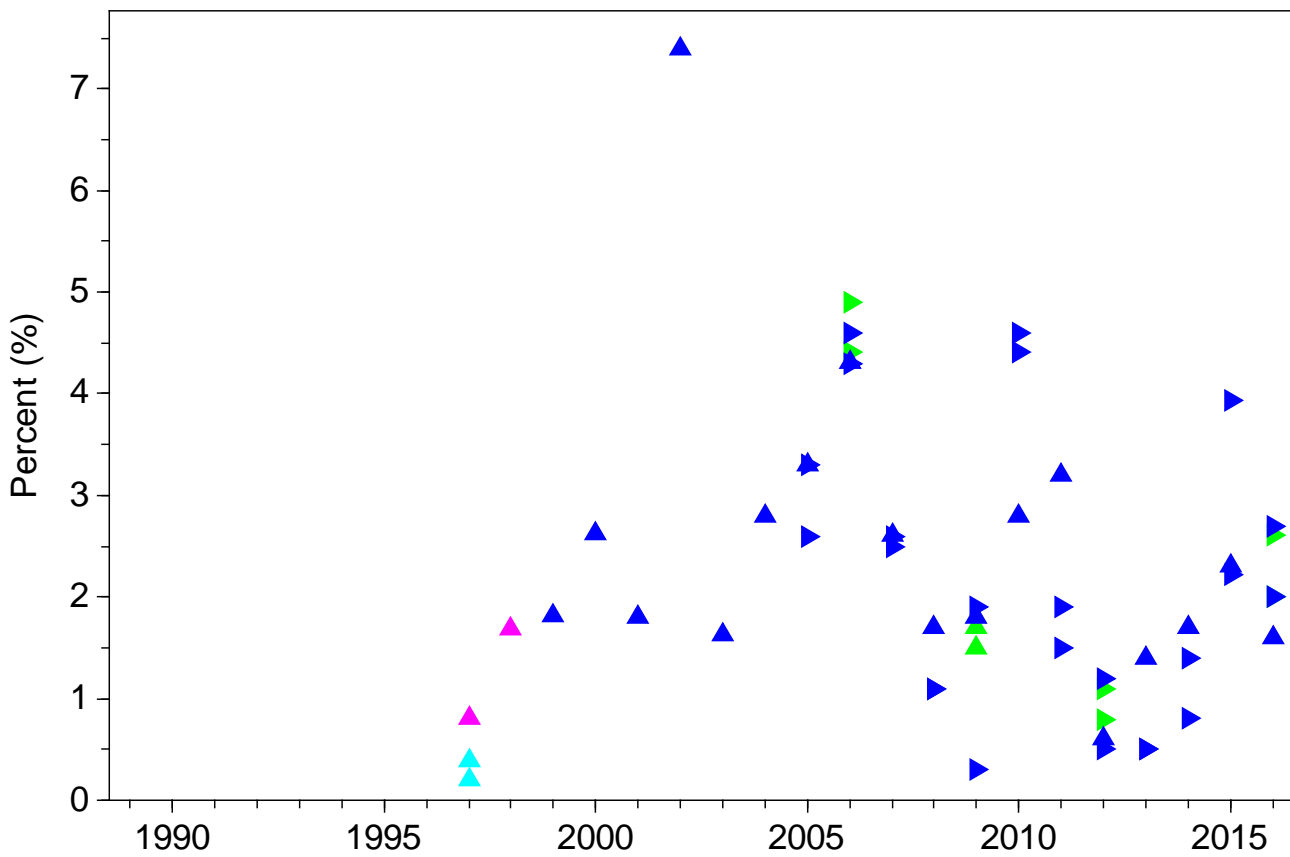
Very Fine Sand, Station 29



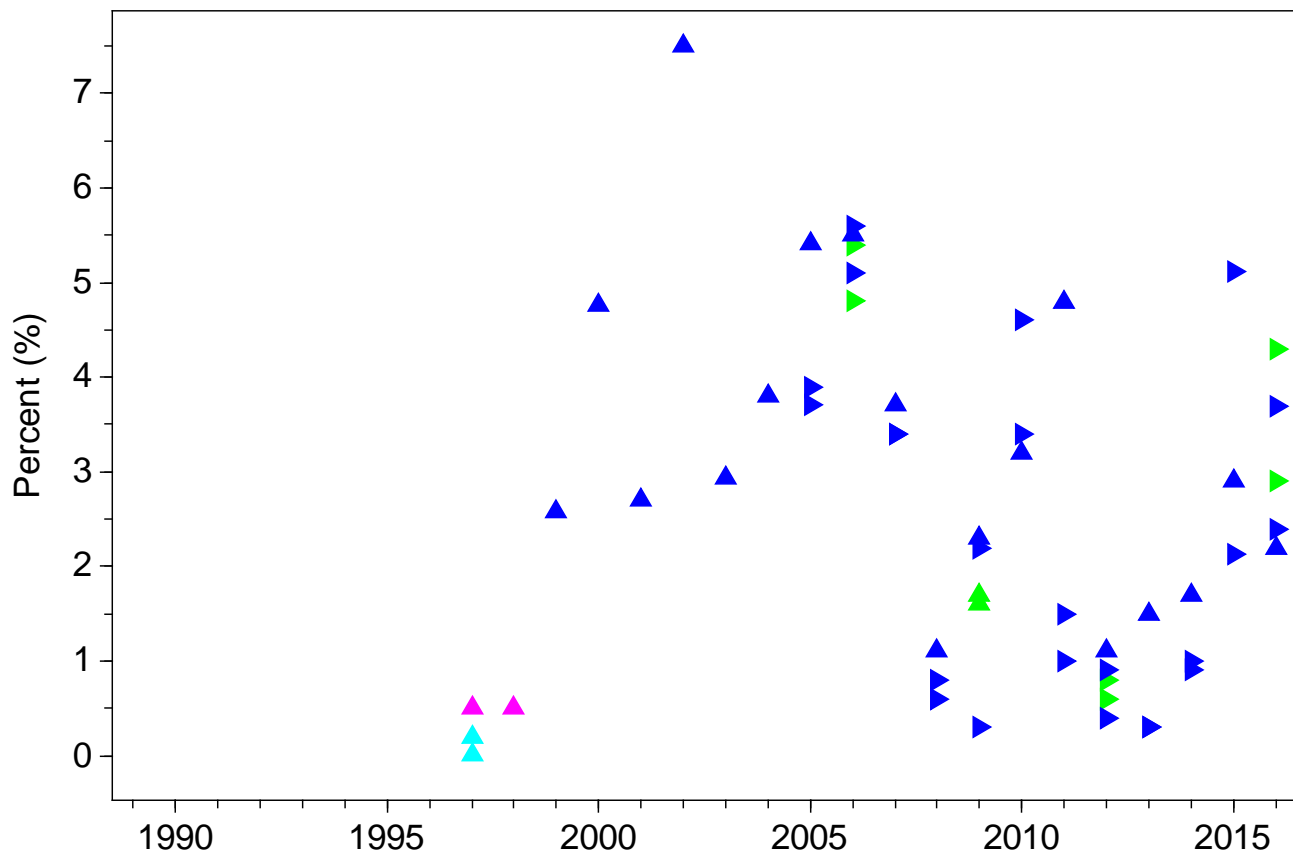
Coarse Sand, Station 29



Fine Sand, Station 29

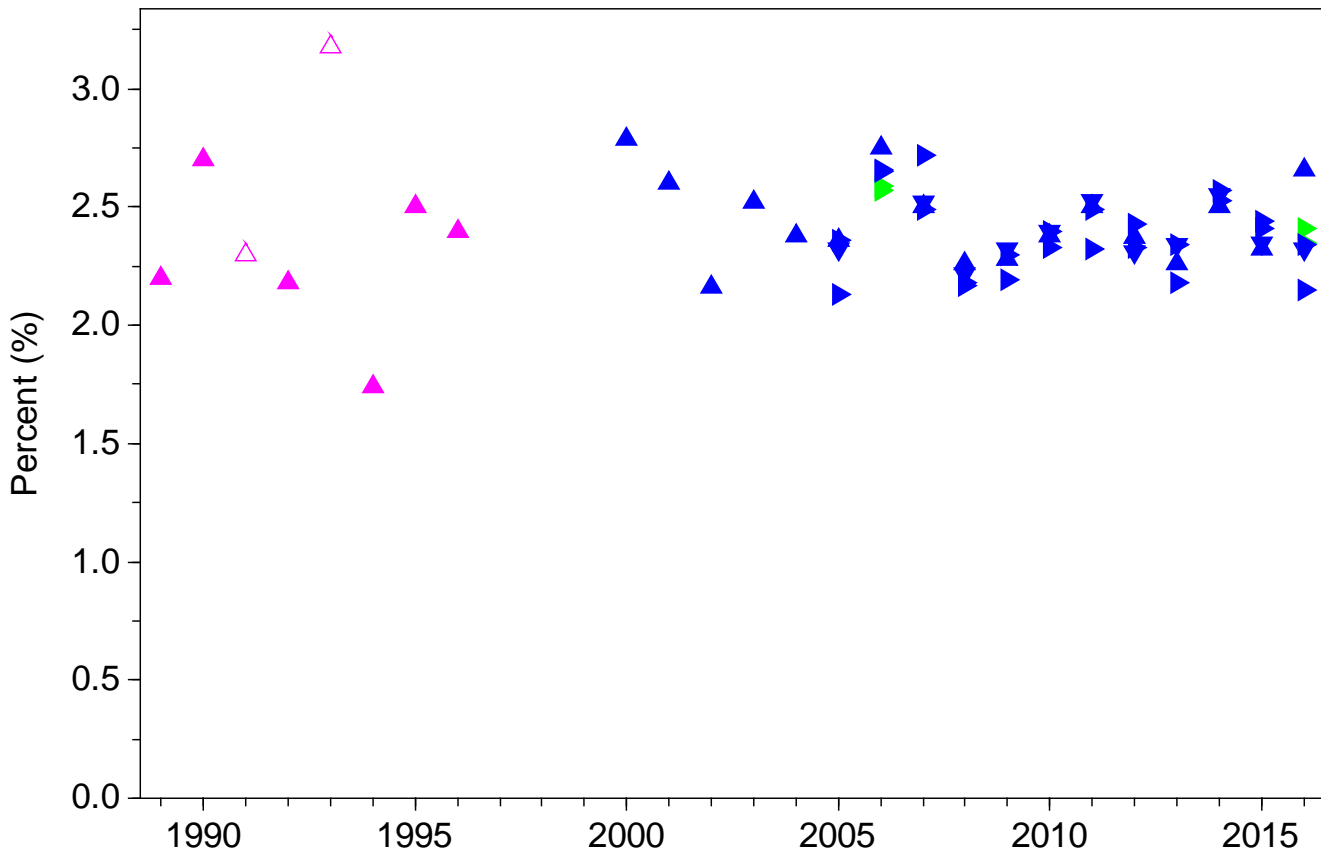


Medium Sand, Station 29

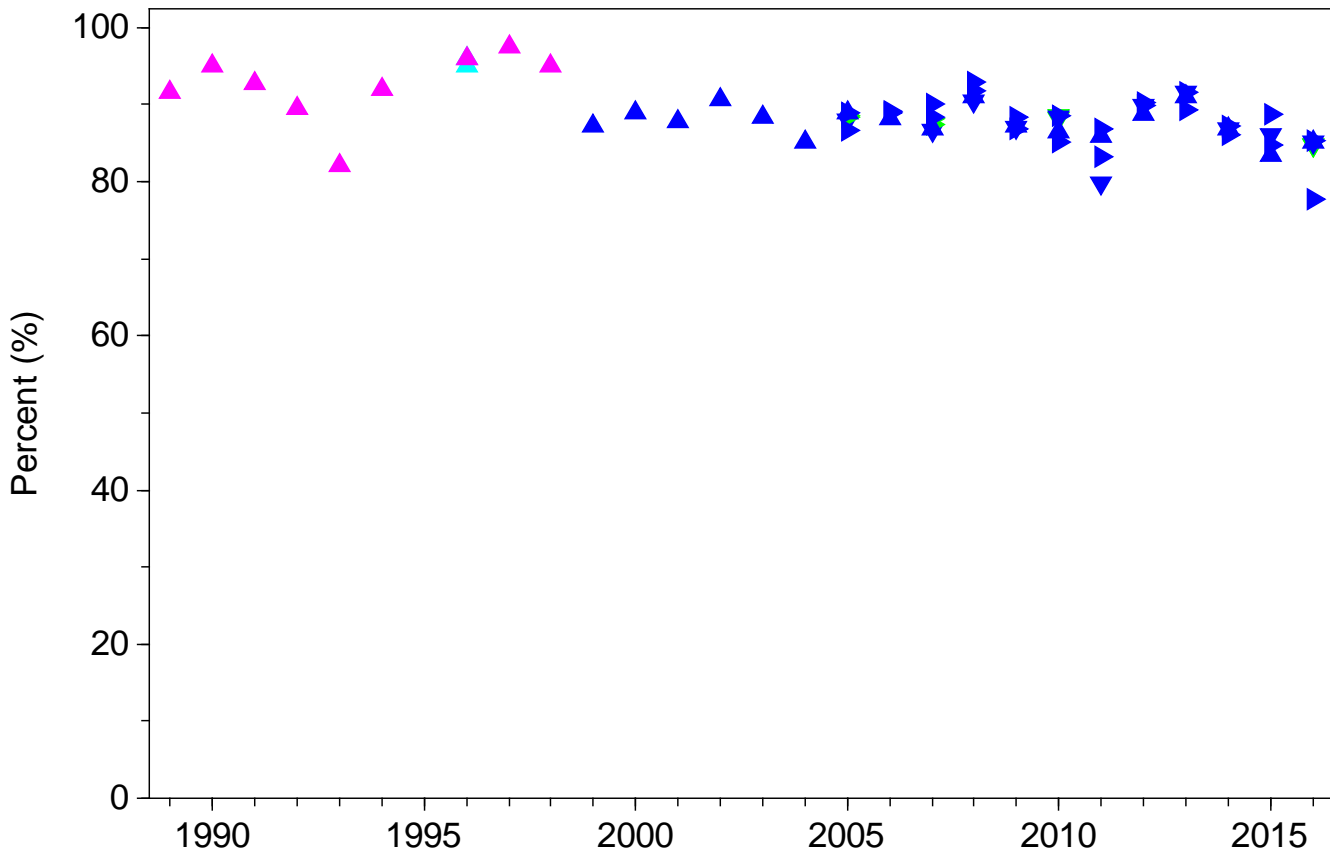


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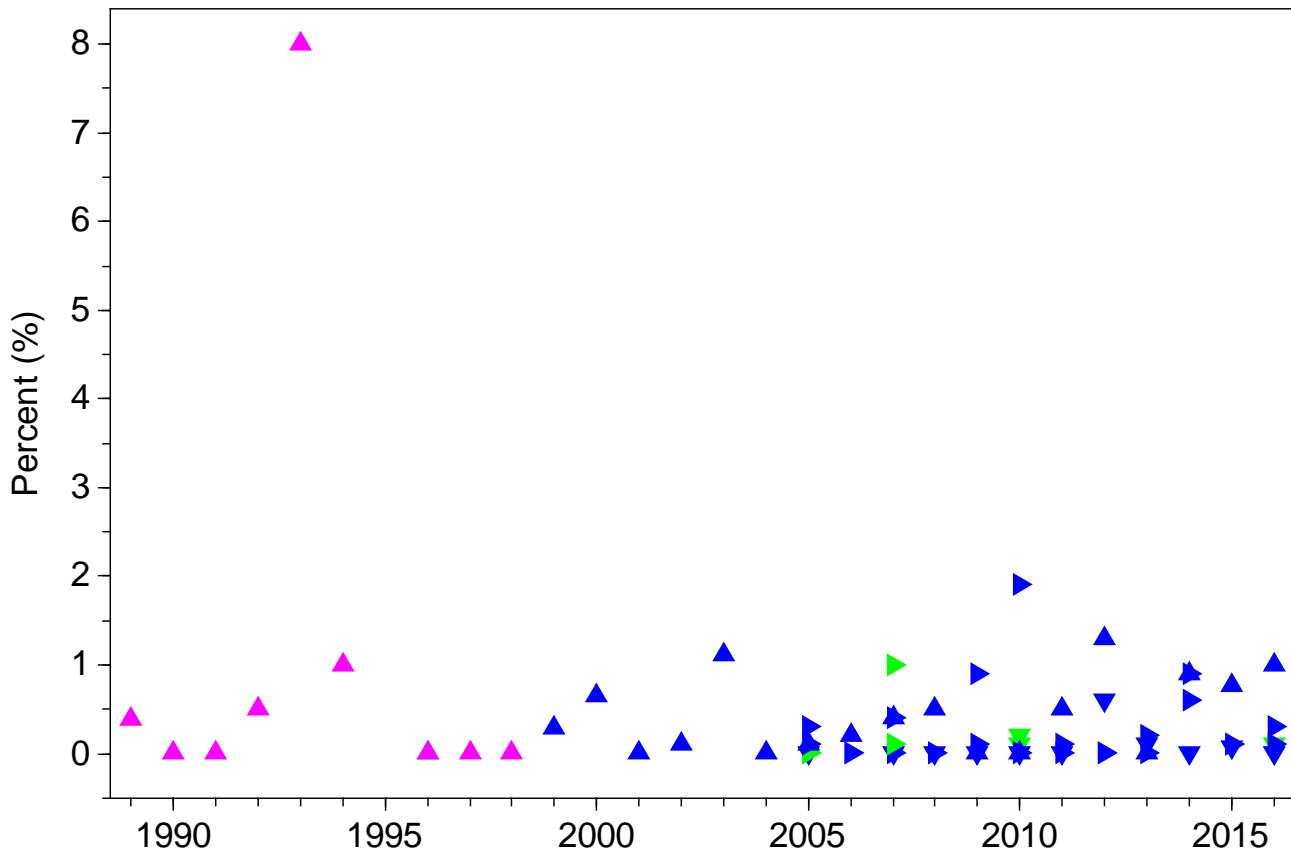
Total Organic Carbon, Station 34



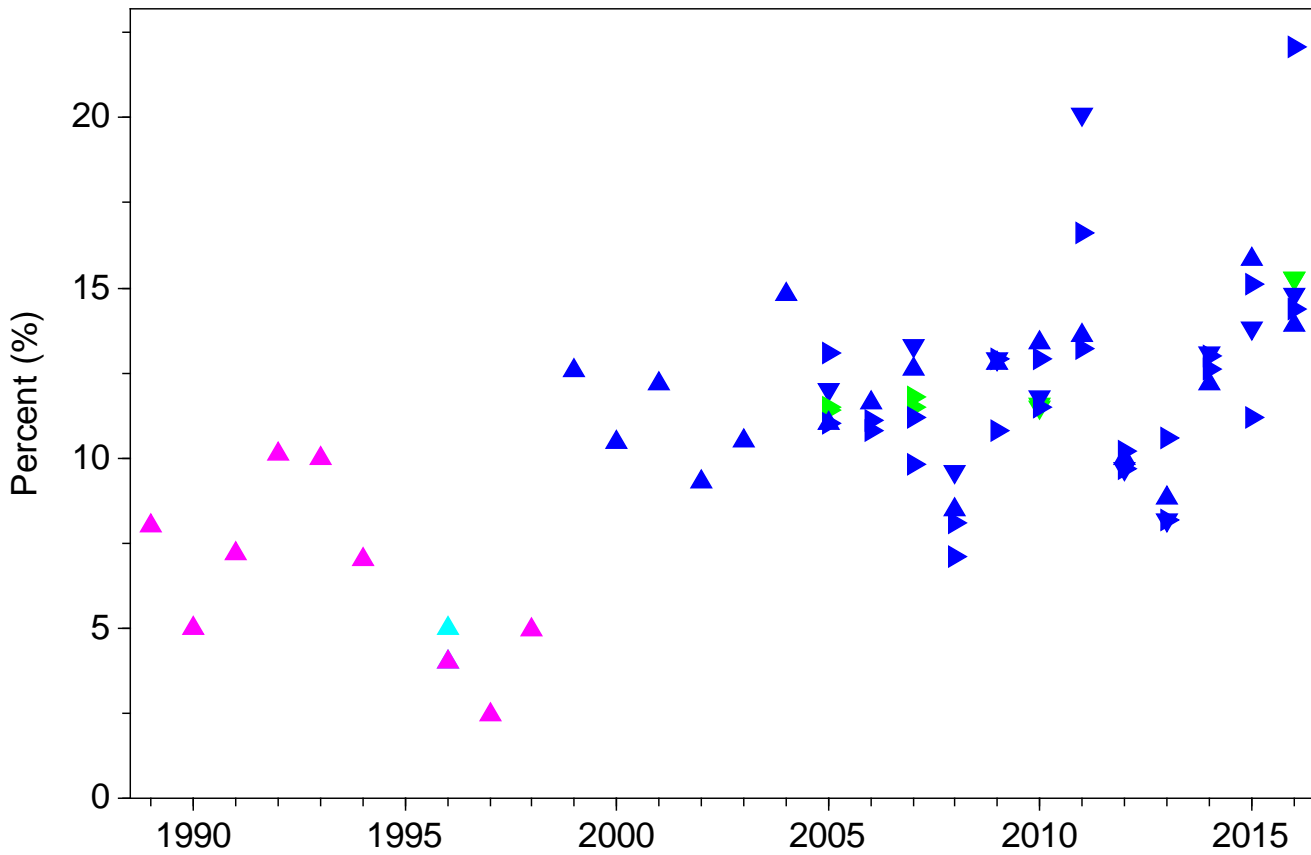
Percent Fines, Station 34



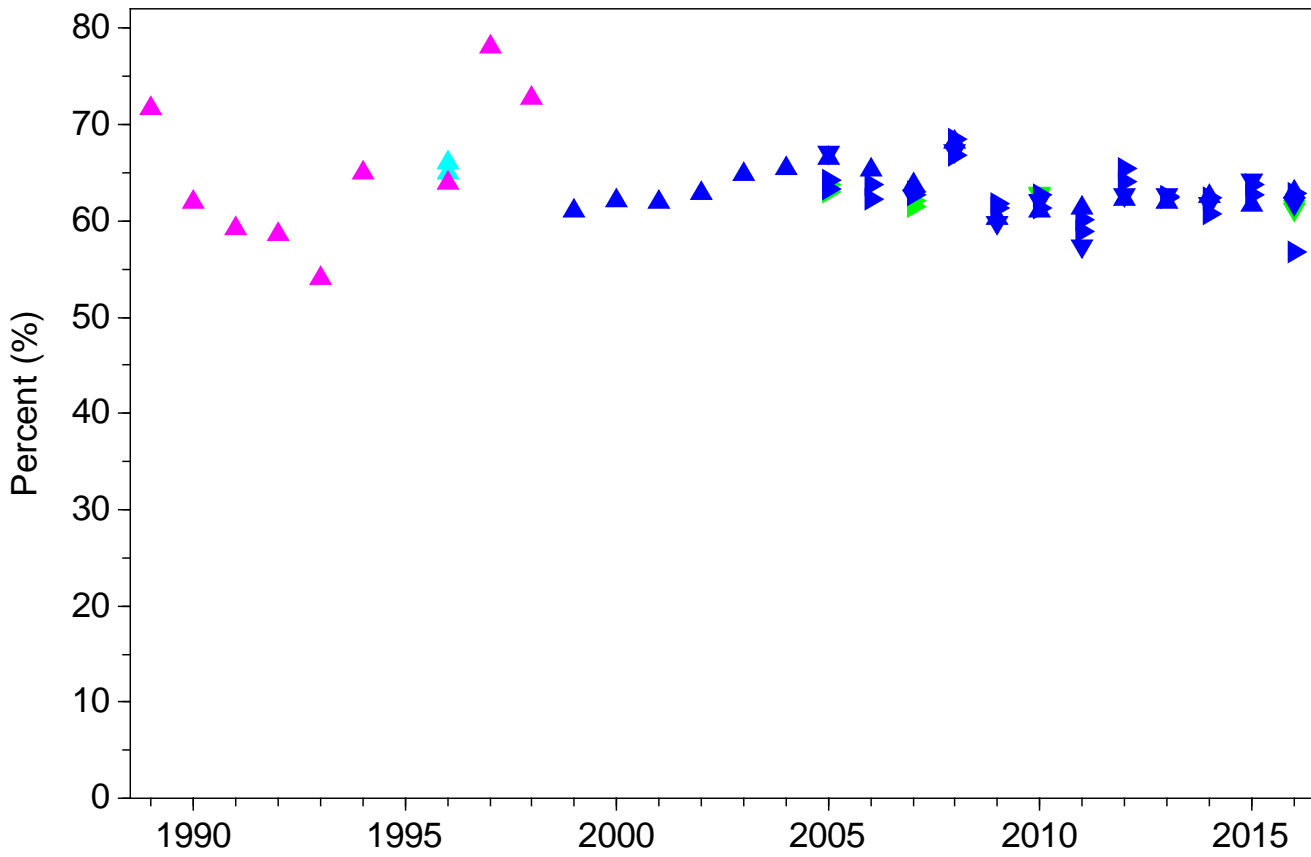
Gravel, Station 34



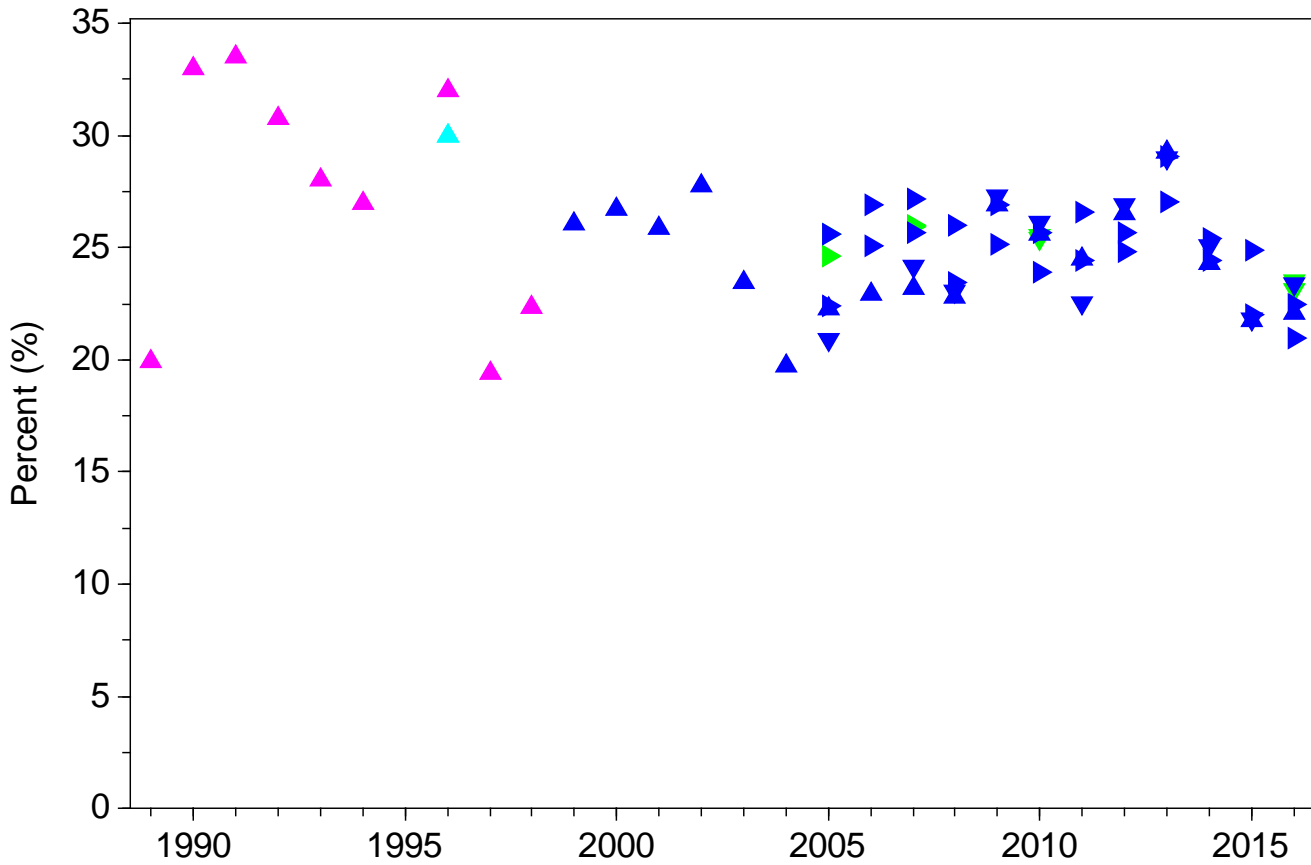
Total Sand, Station 34



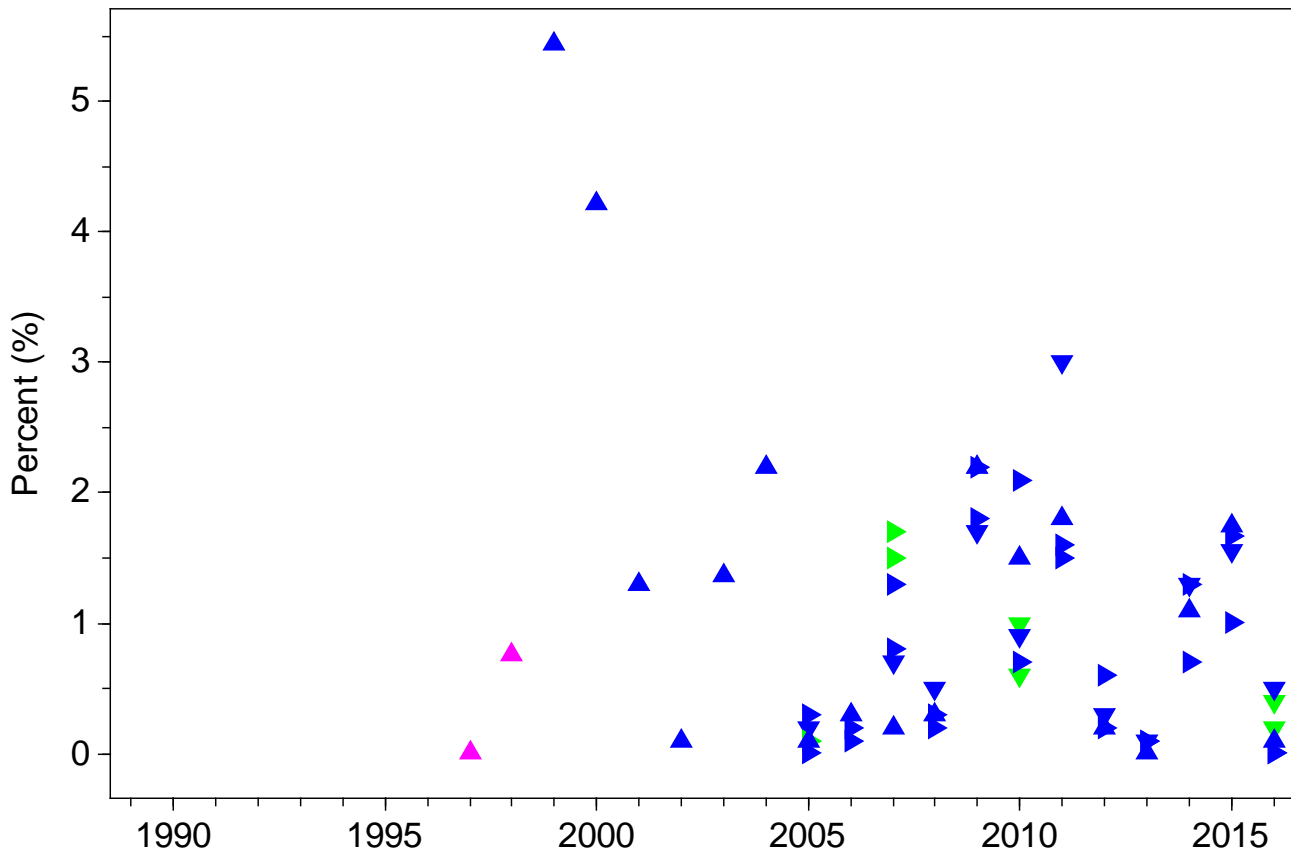
Total Silt, Station 34



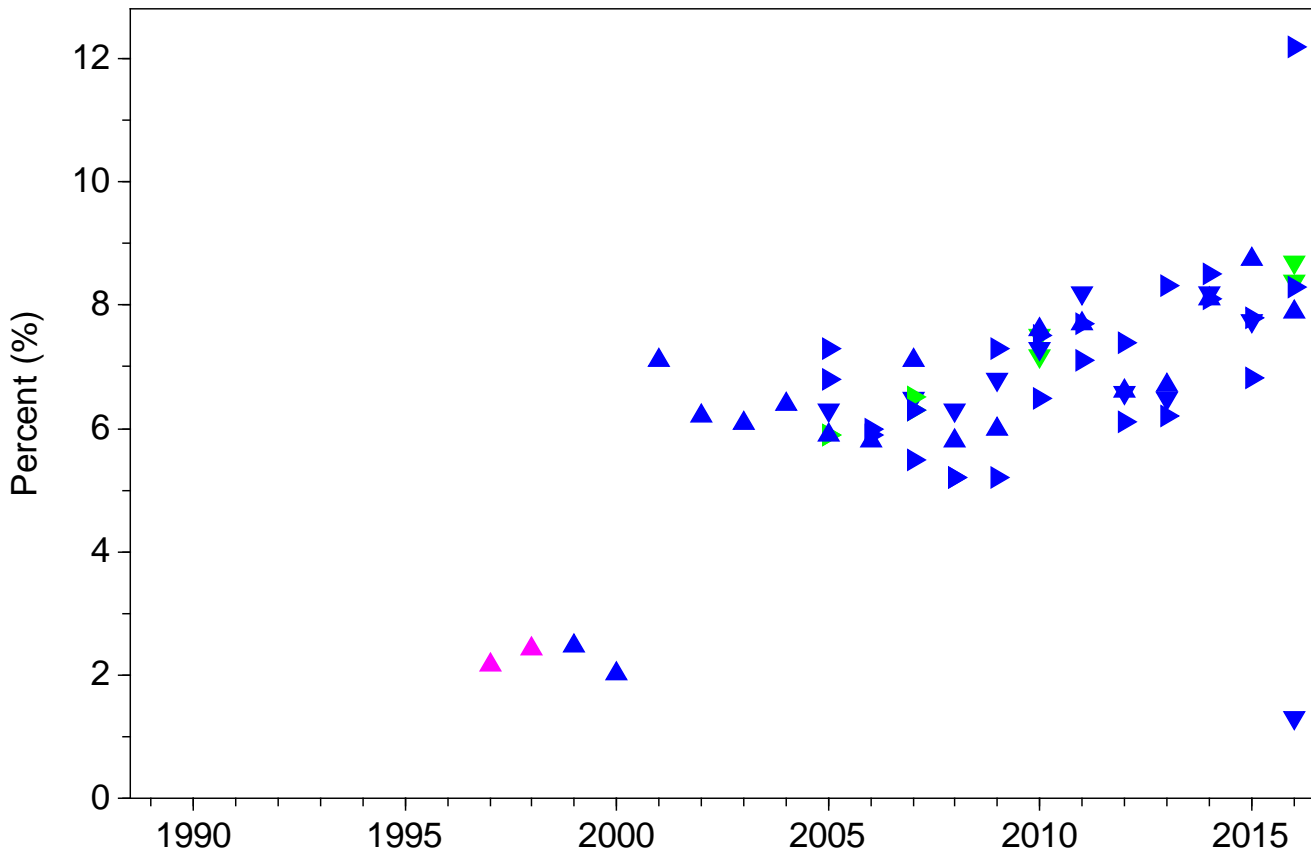
Total Clay, Station 34



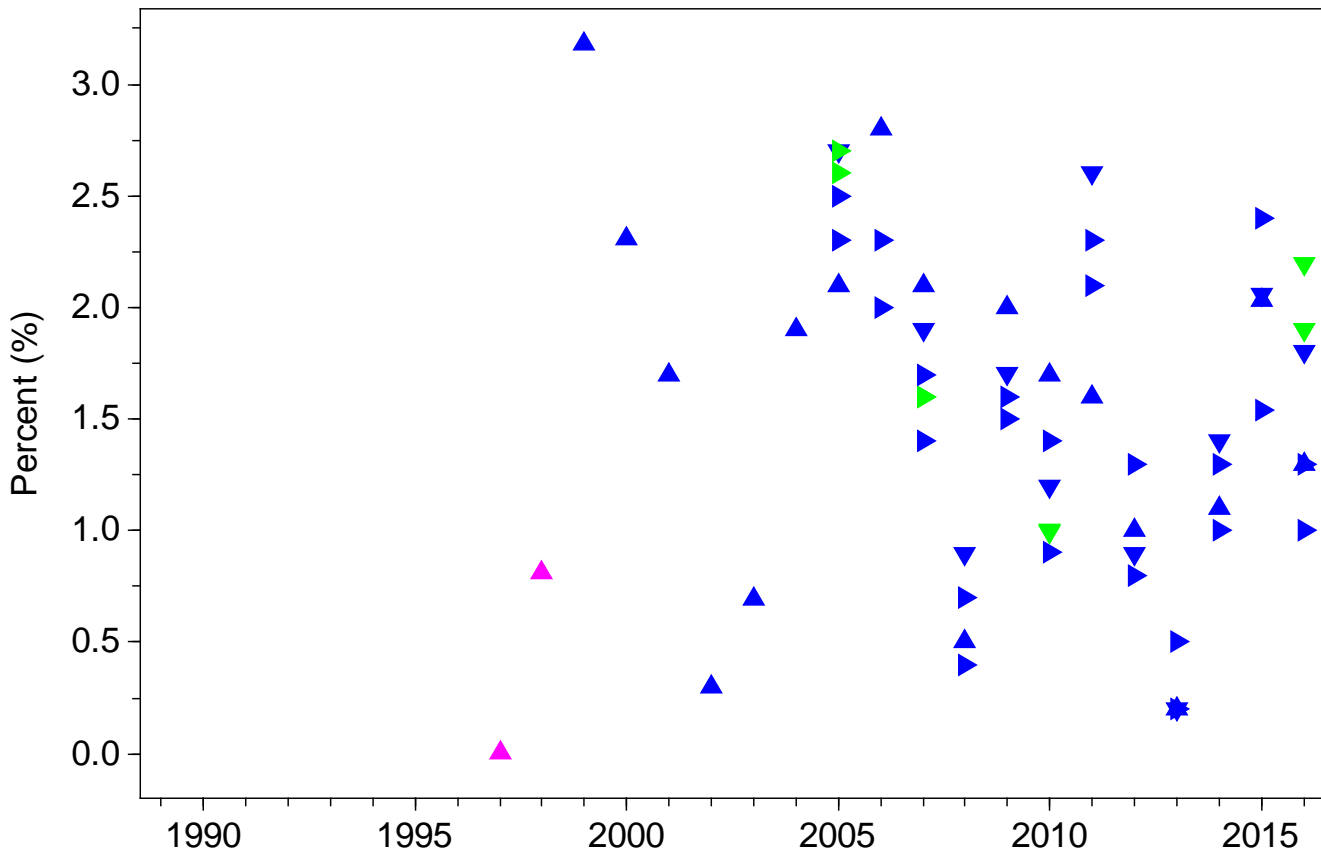
Very Coarse Sand, Station 34



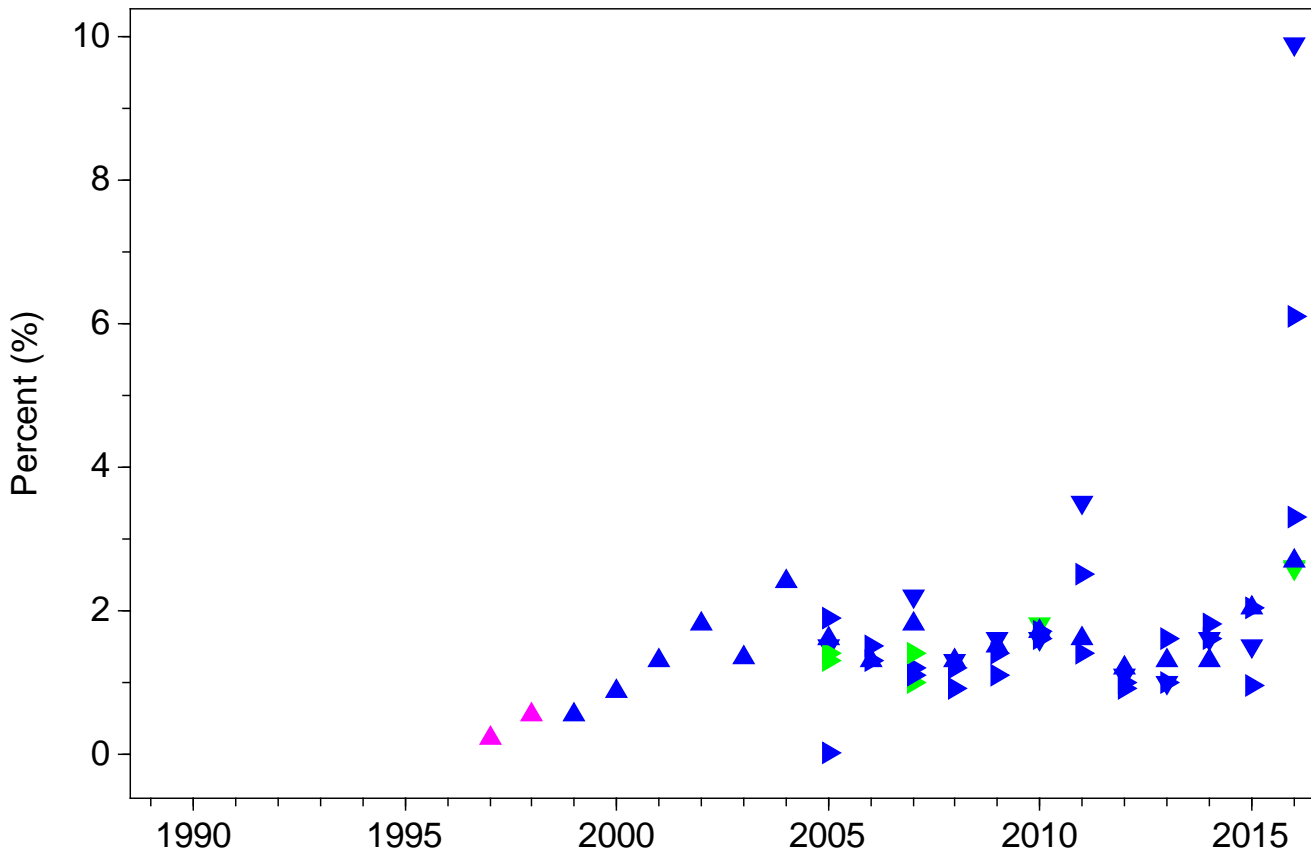
Very Fine Sand, Station 34



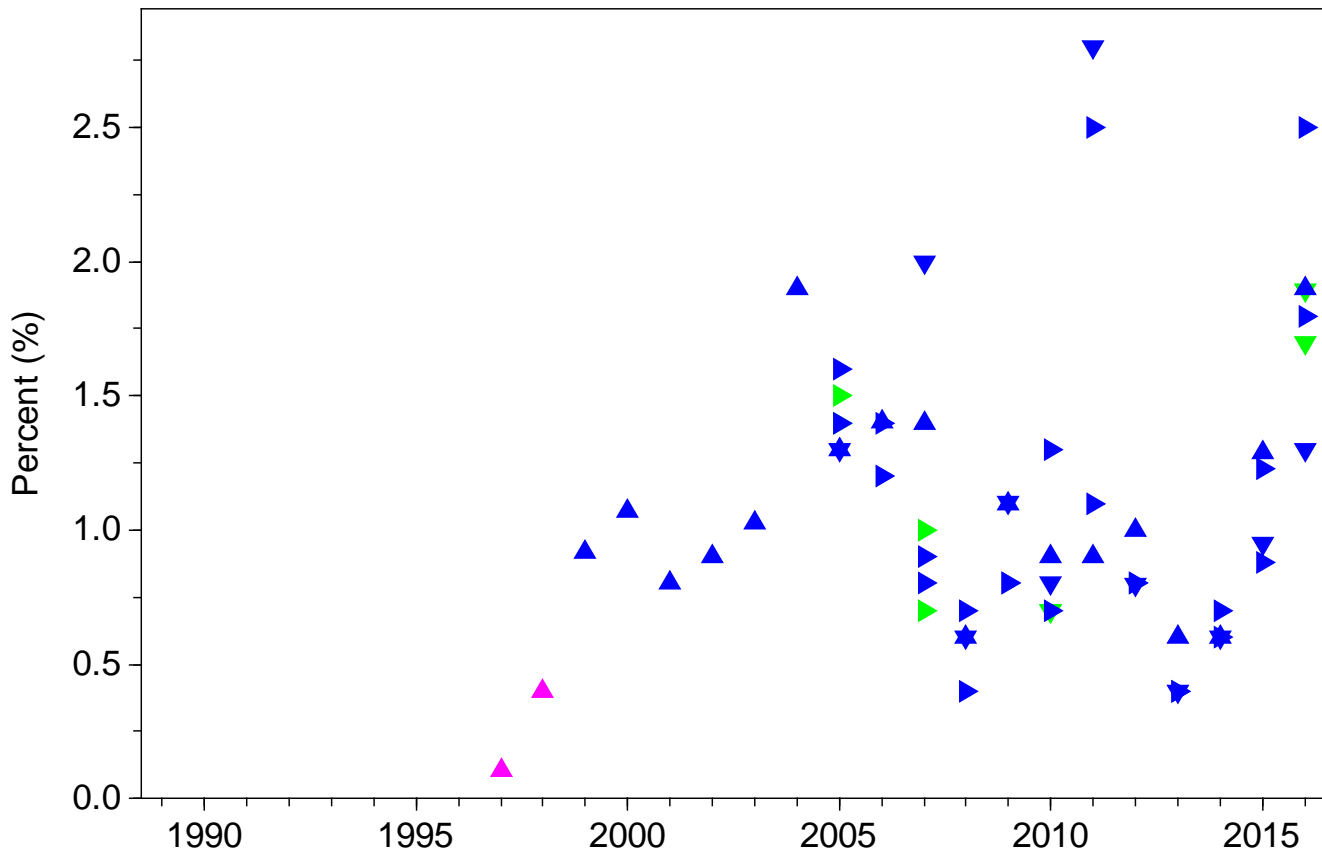
Coarse Sand, Station 34



Fine Sand, Station 34

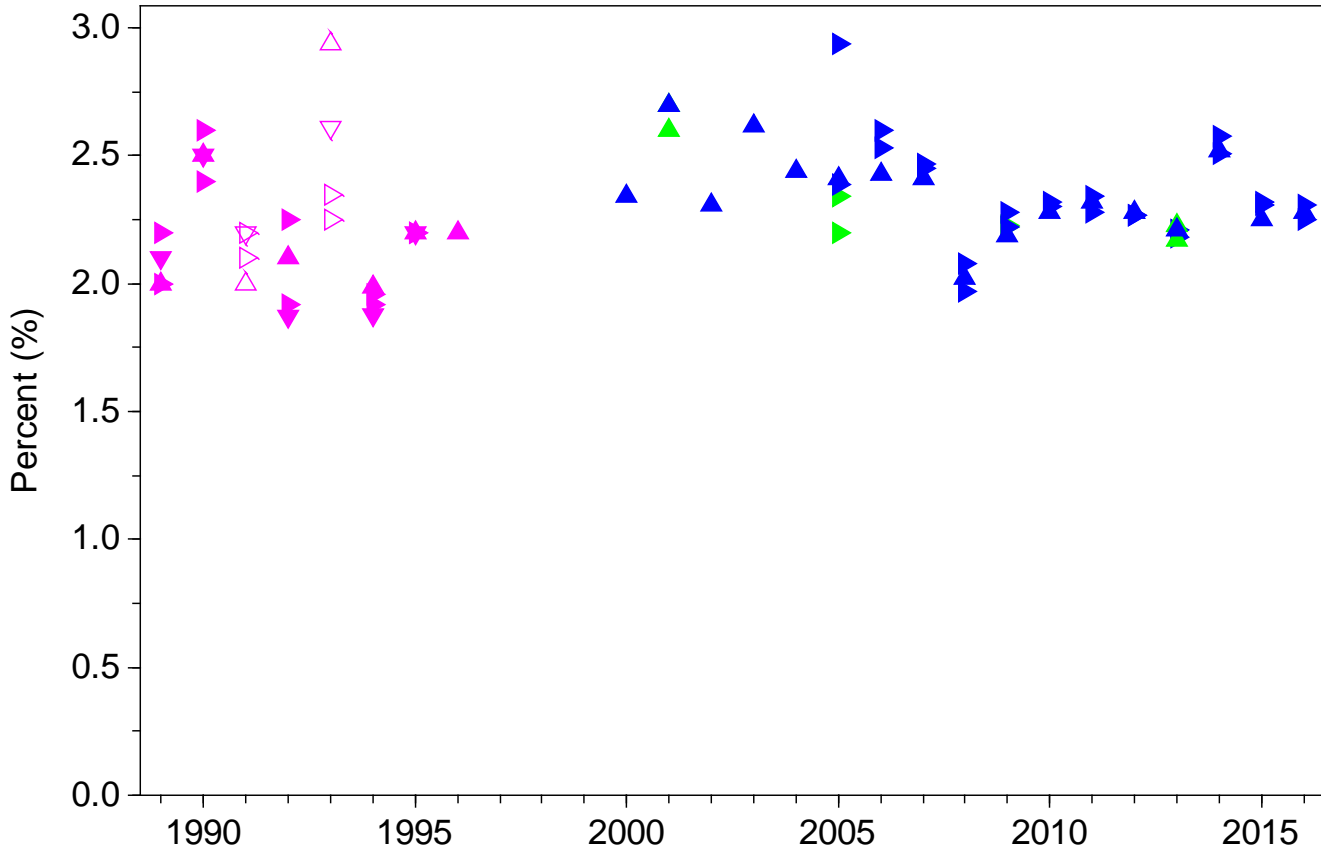


Medium Sand, Station 34

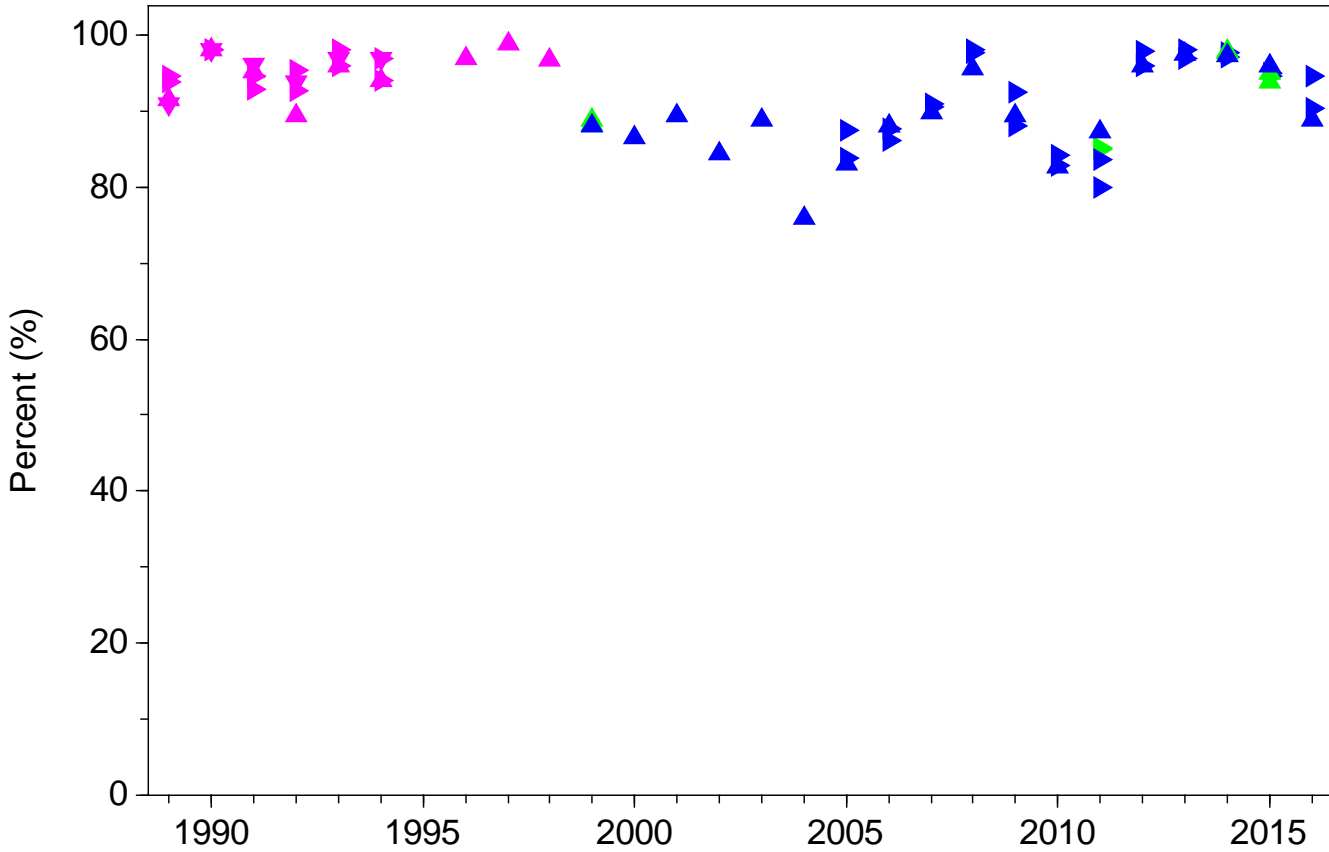


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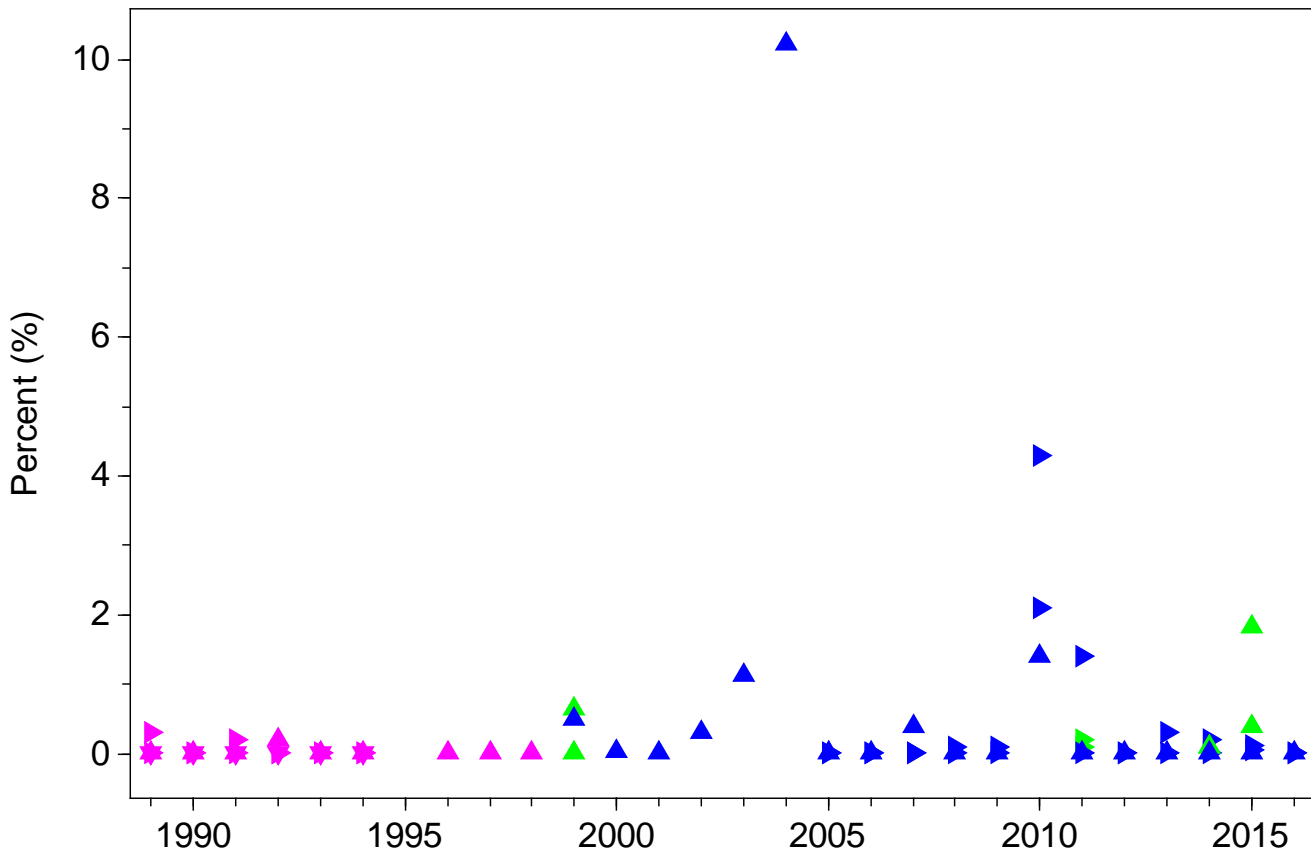
Total Organic Carbon, Station 38



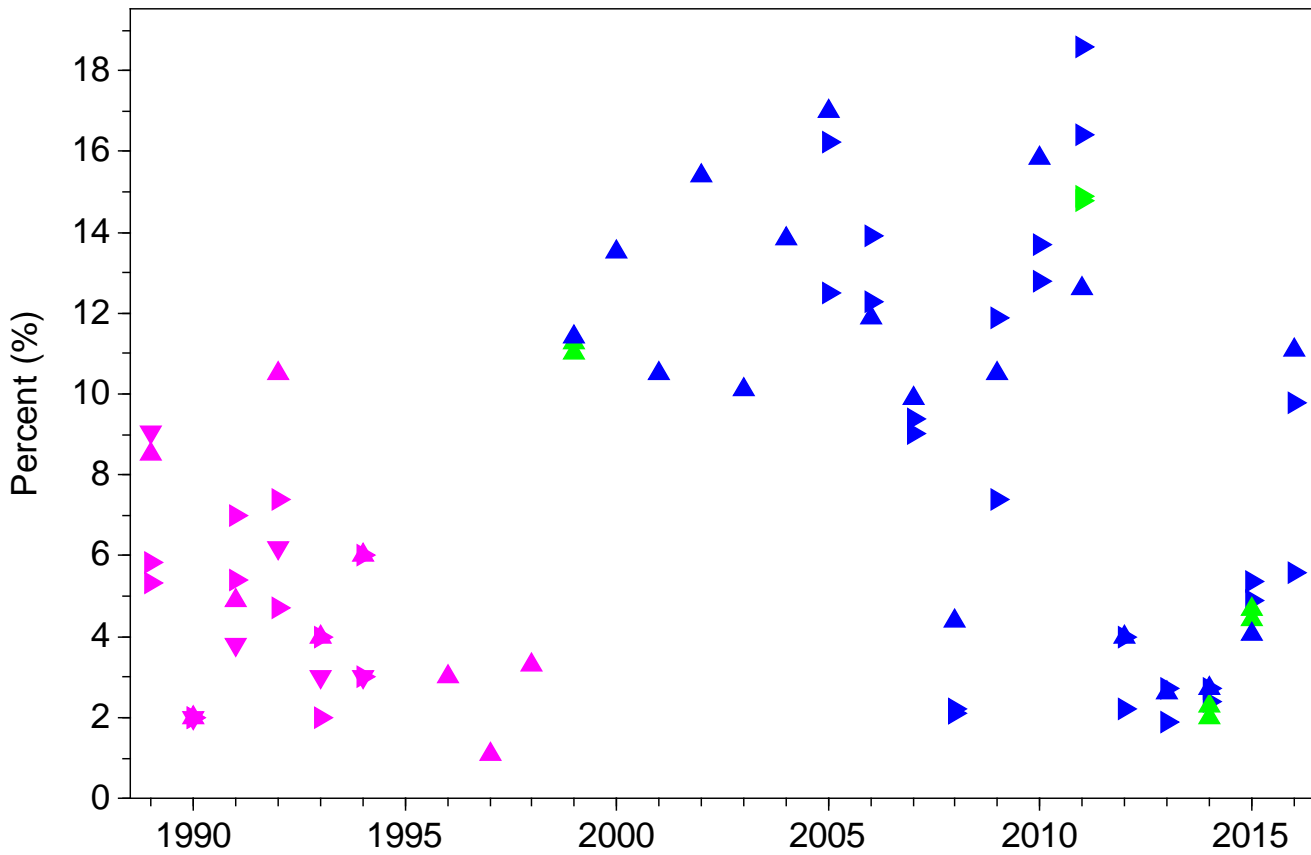
Percent Fines, Station 38



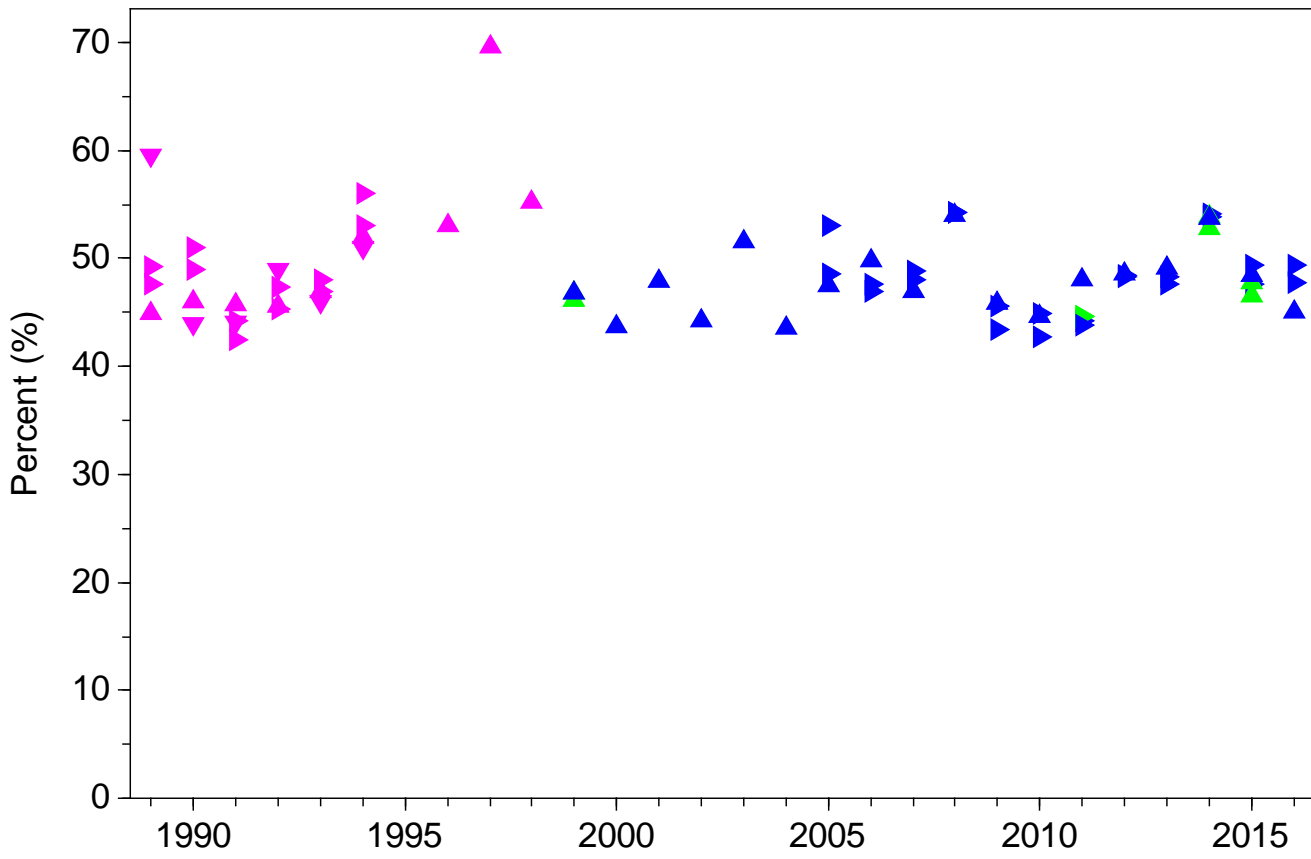
Gravel, Station 38



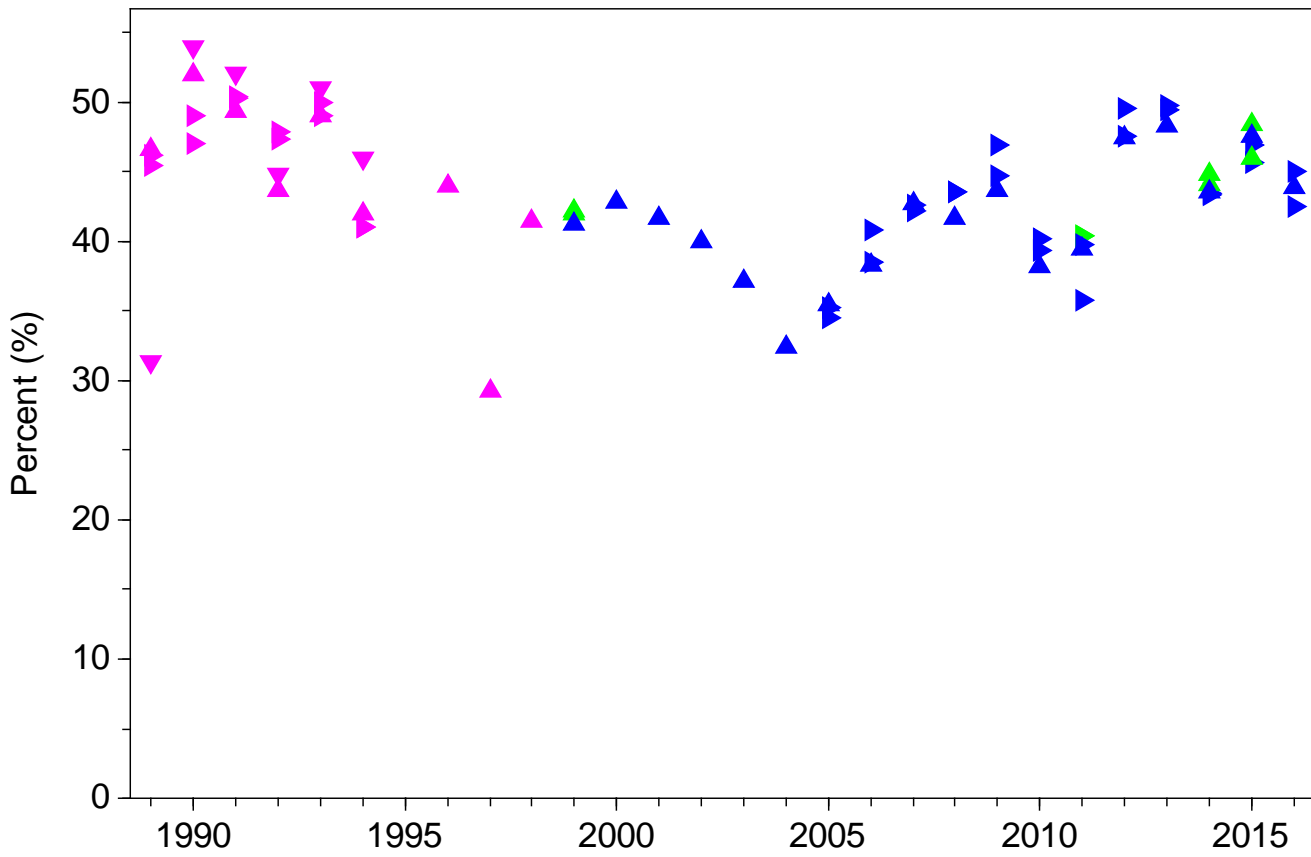
Total Sand, Station 38



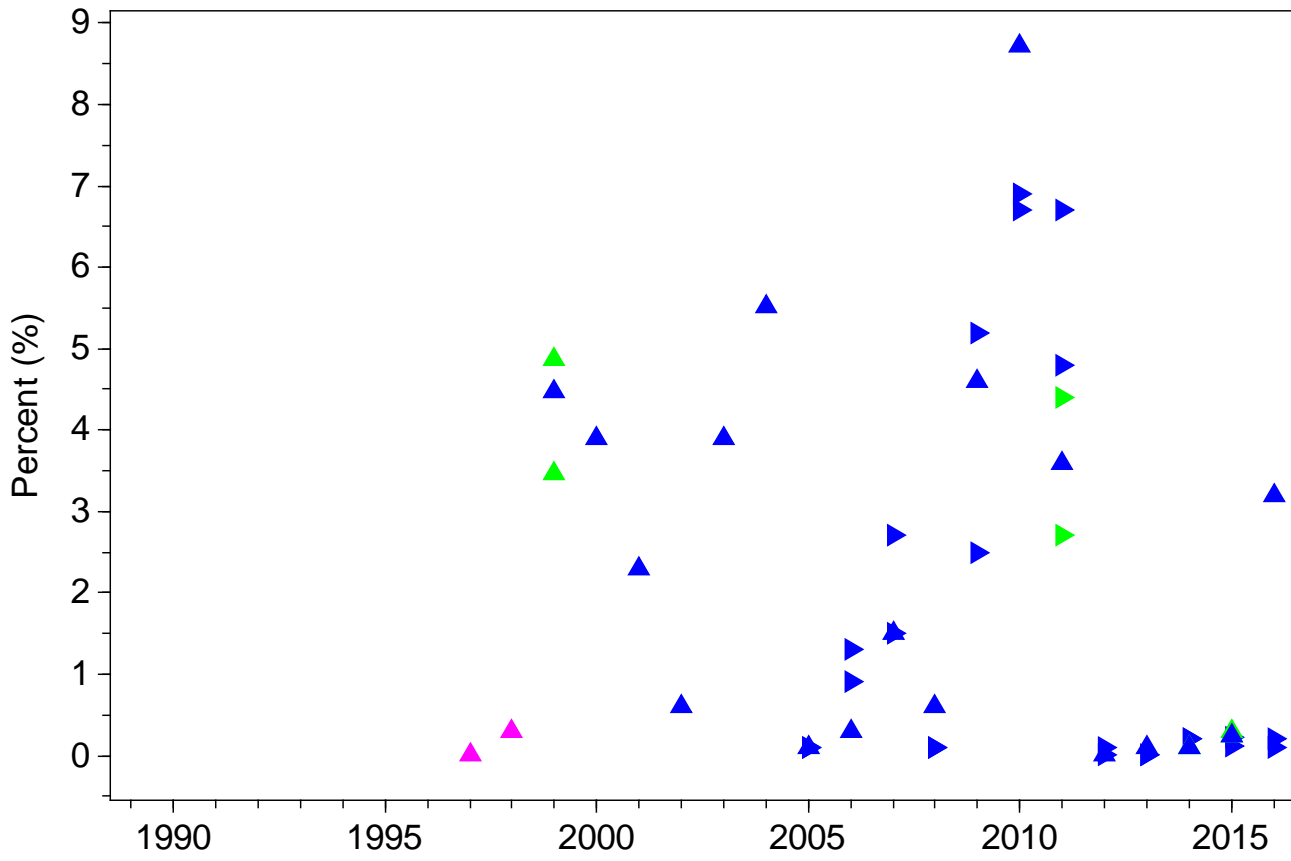
Total Silt, Station 38



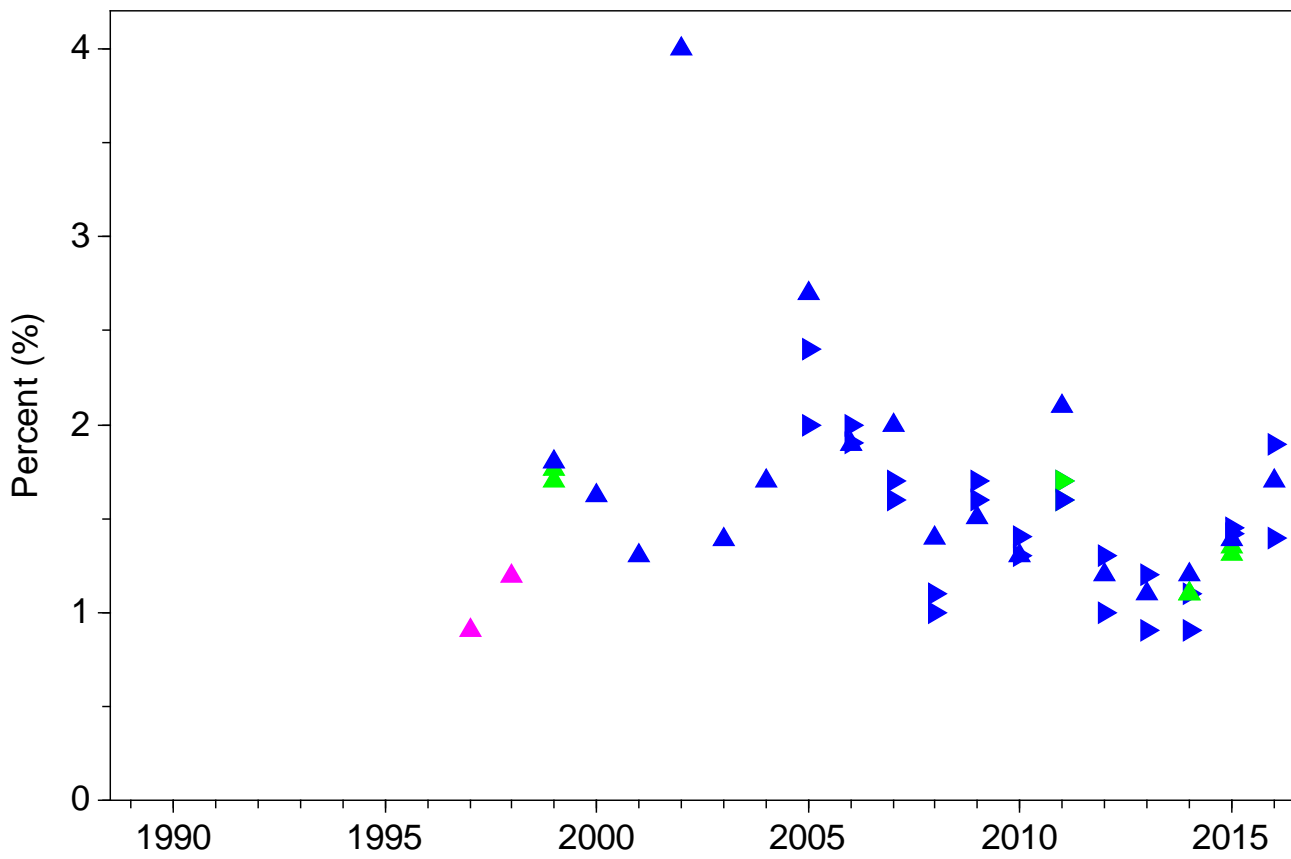
Total Clay, Station 38



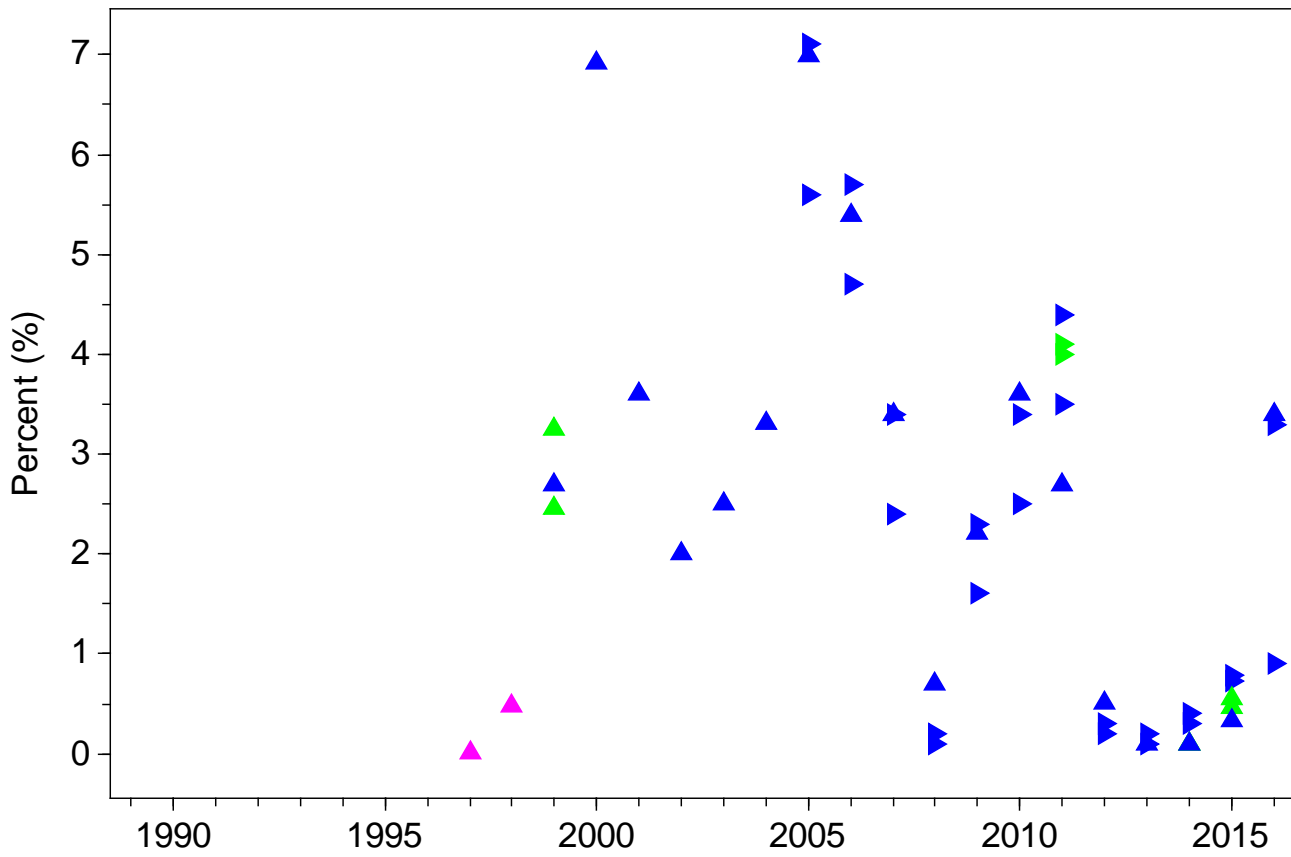
Very Coarse Sand, Station 38



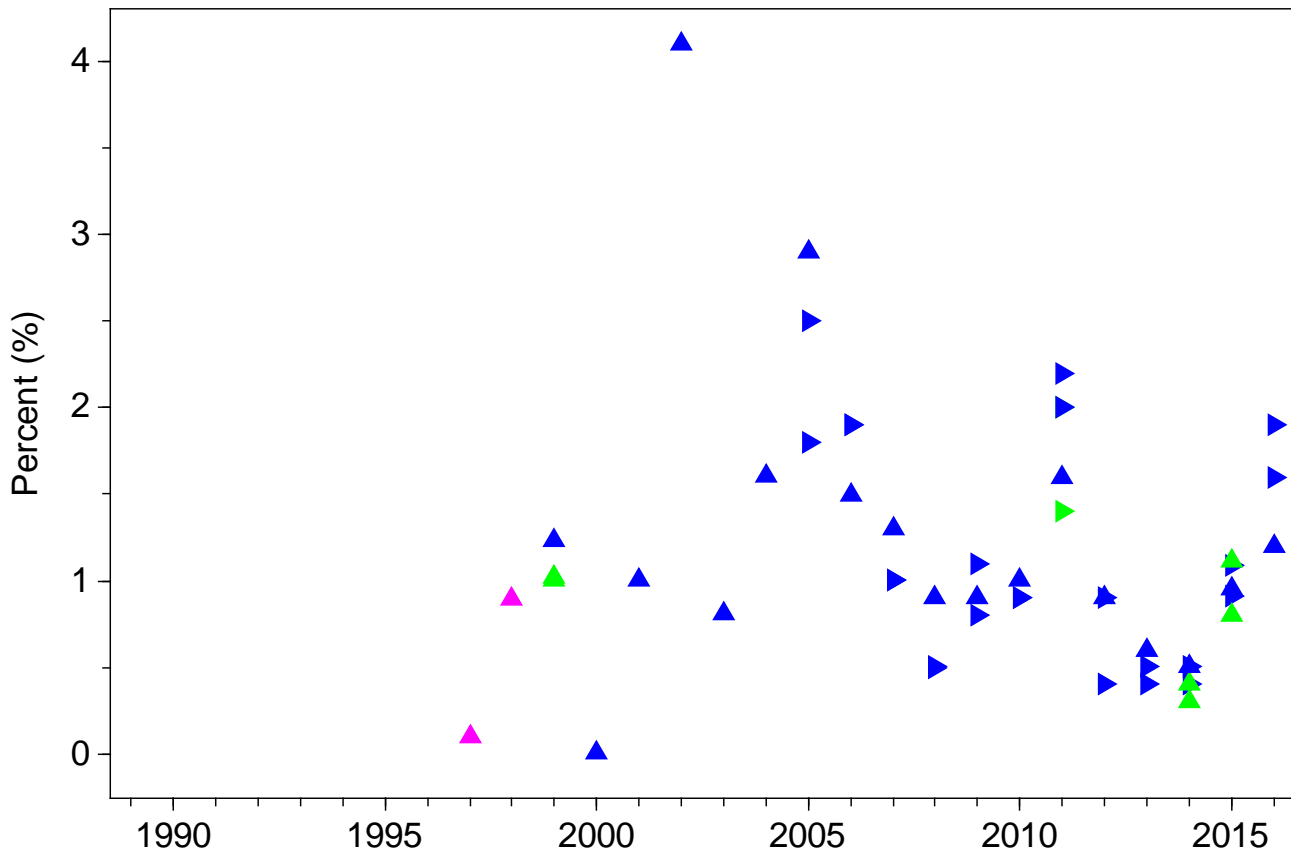
Very Fine Sand, Station 38



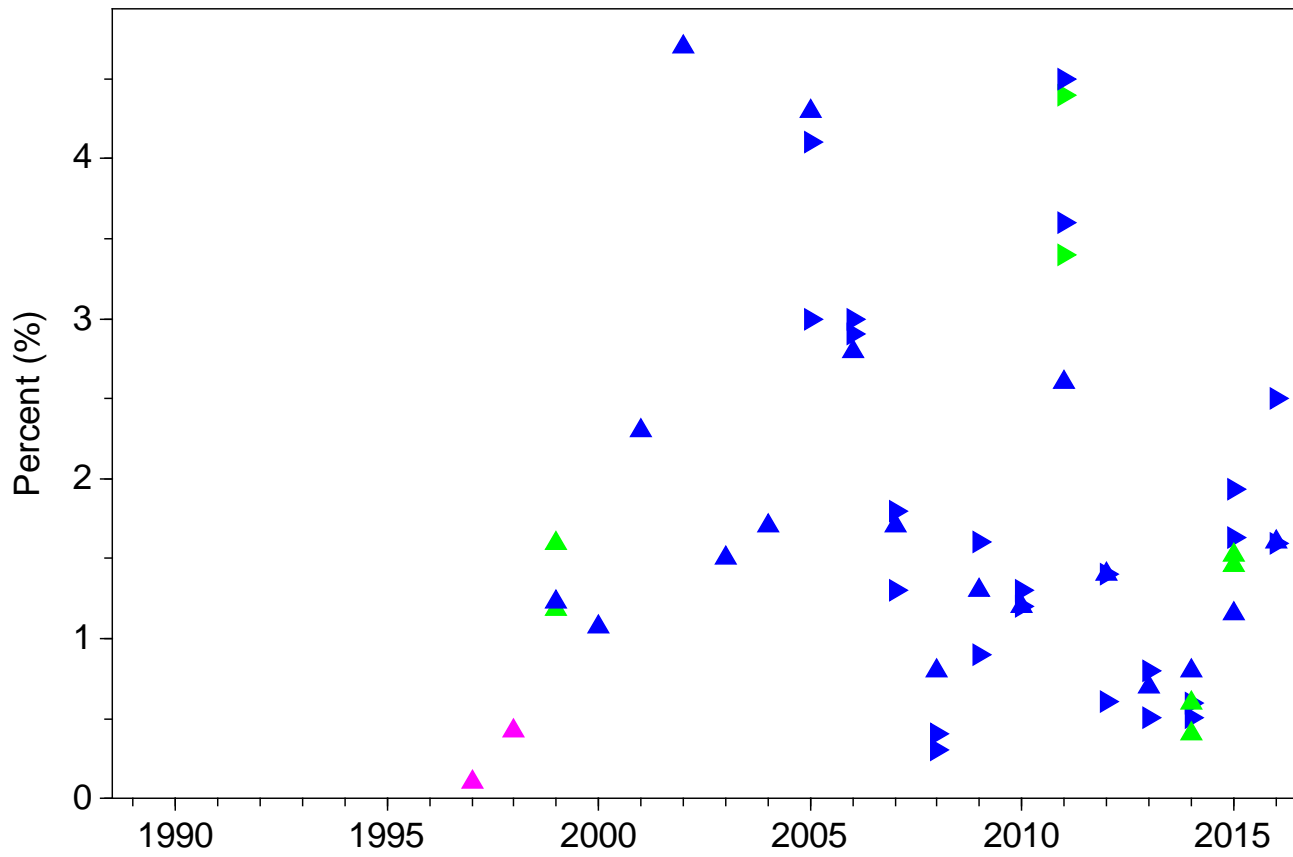
Coarse Sand, Station 38



Fine Sand, Station 38

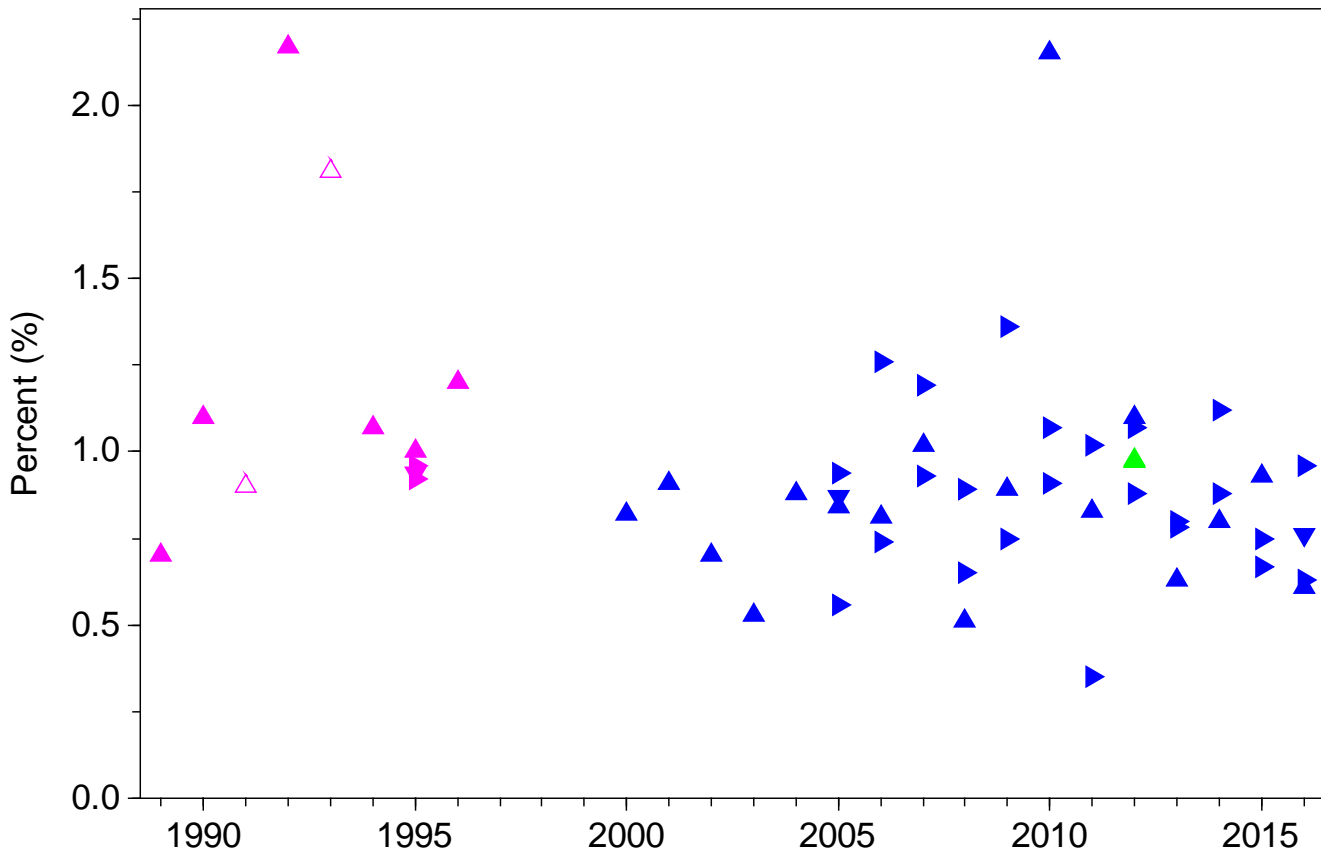


Medium Sand, Station 38

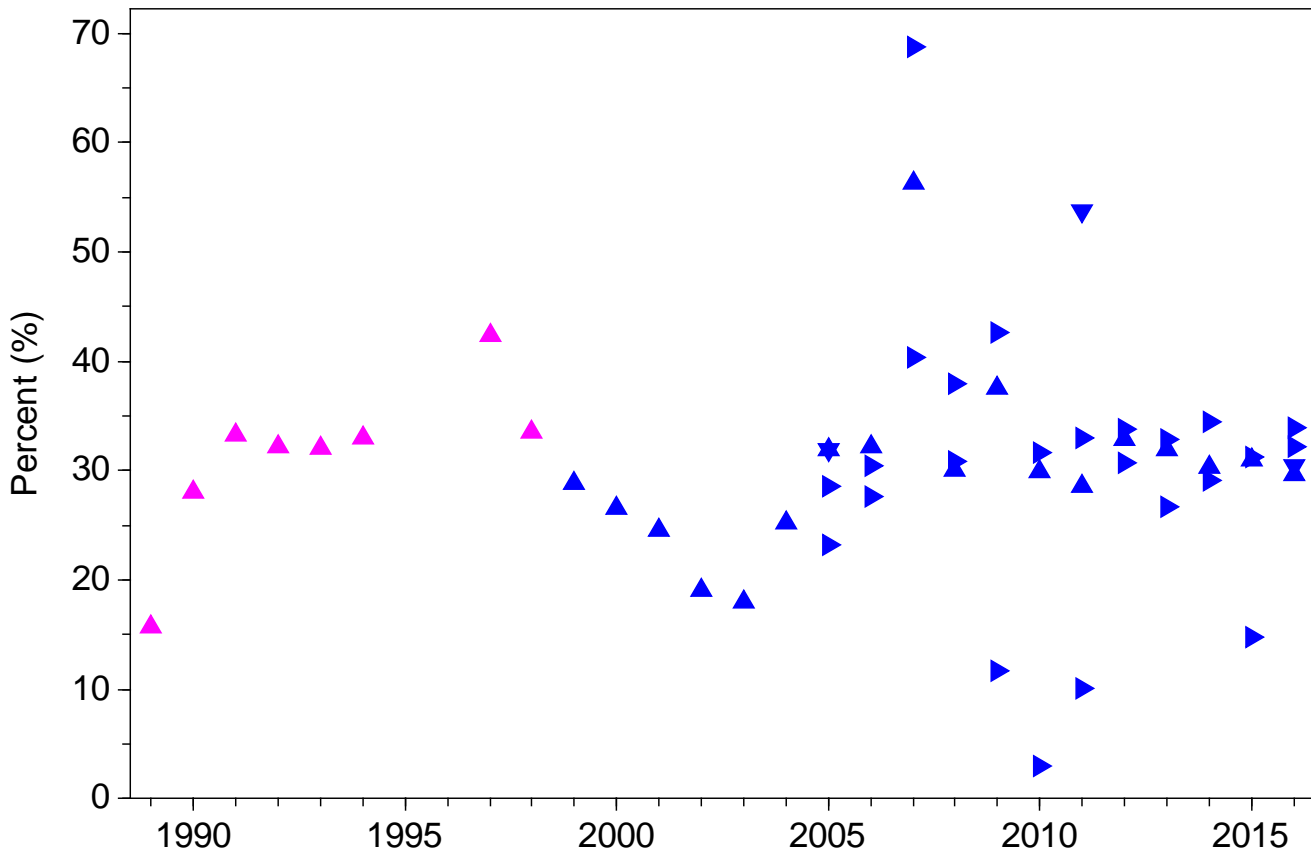


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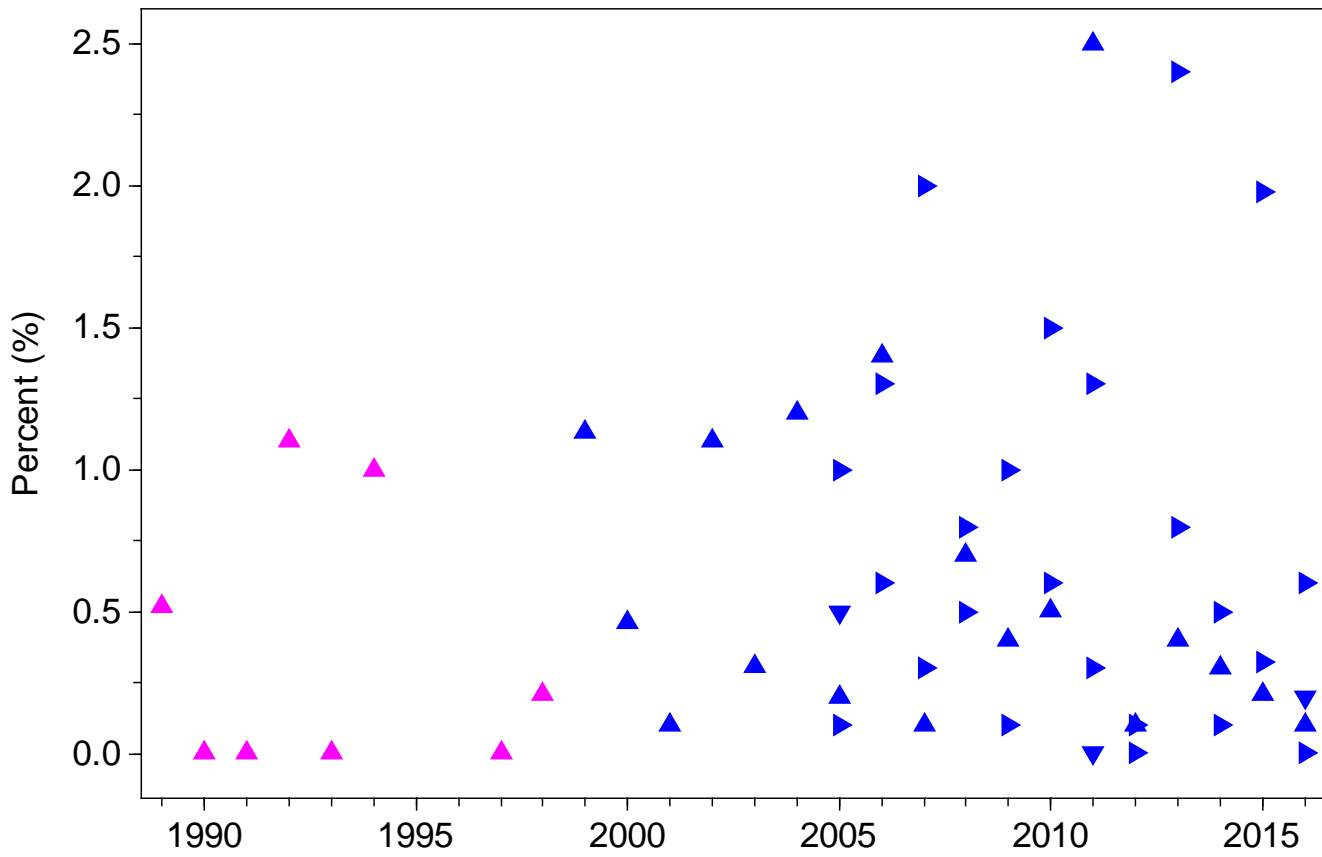
Total Organic Carbon, Station 40



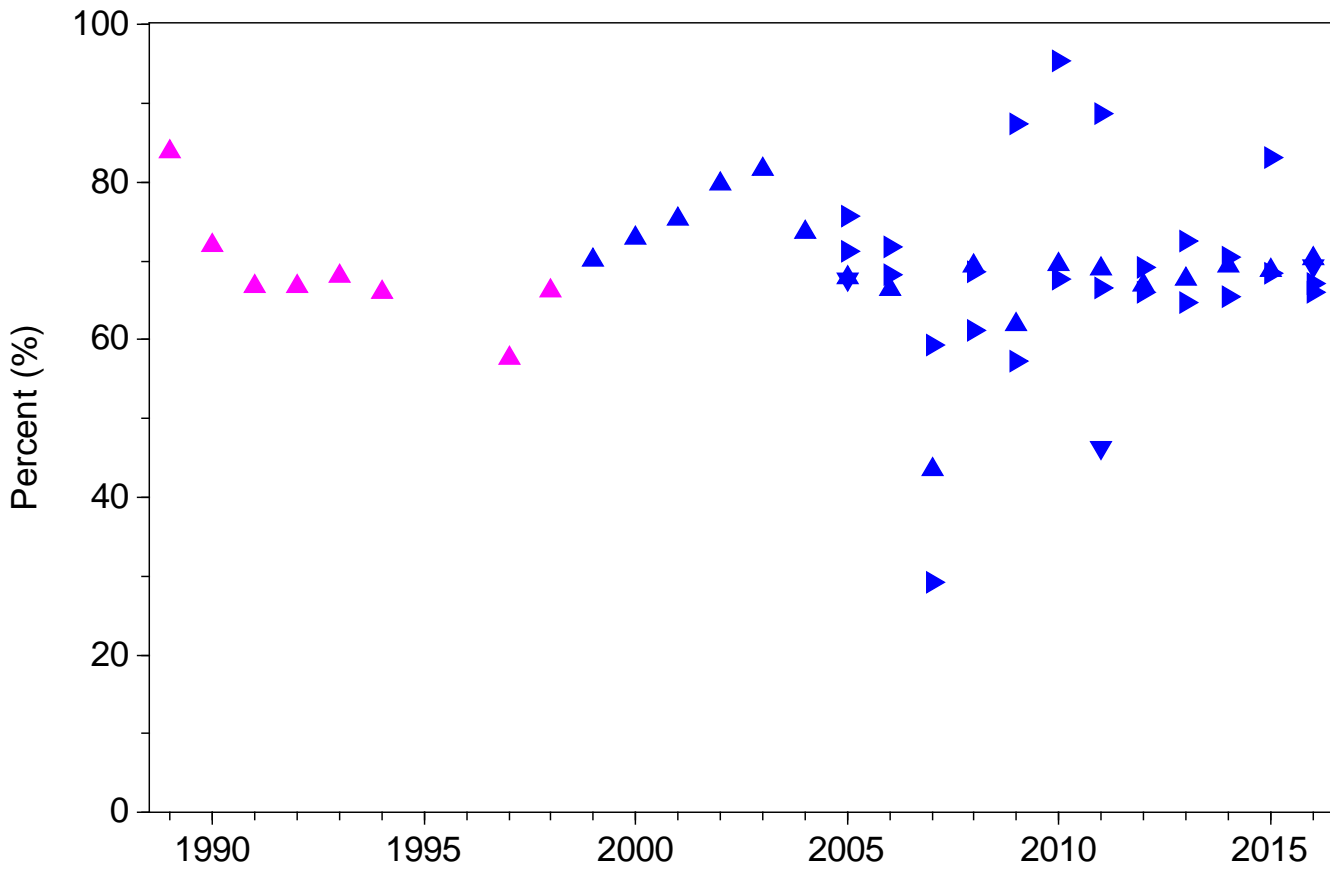
Percent Fines, Station 40



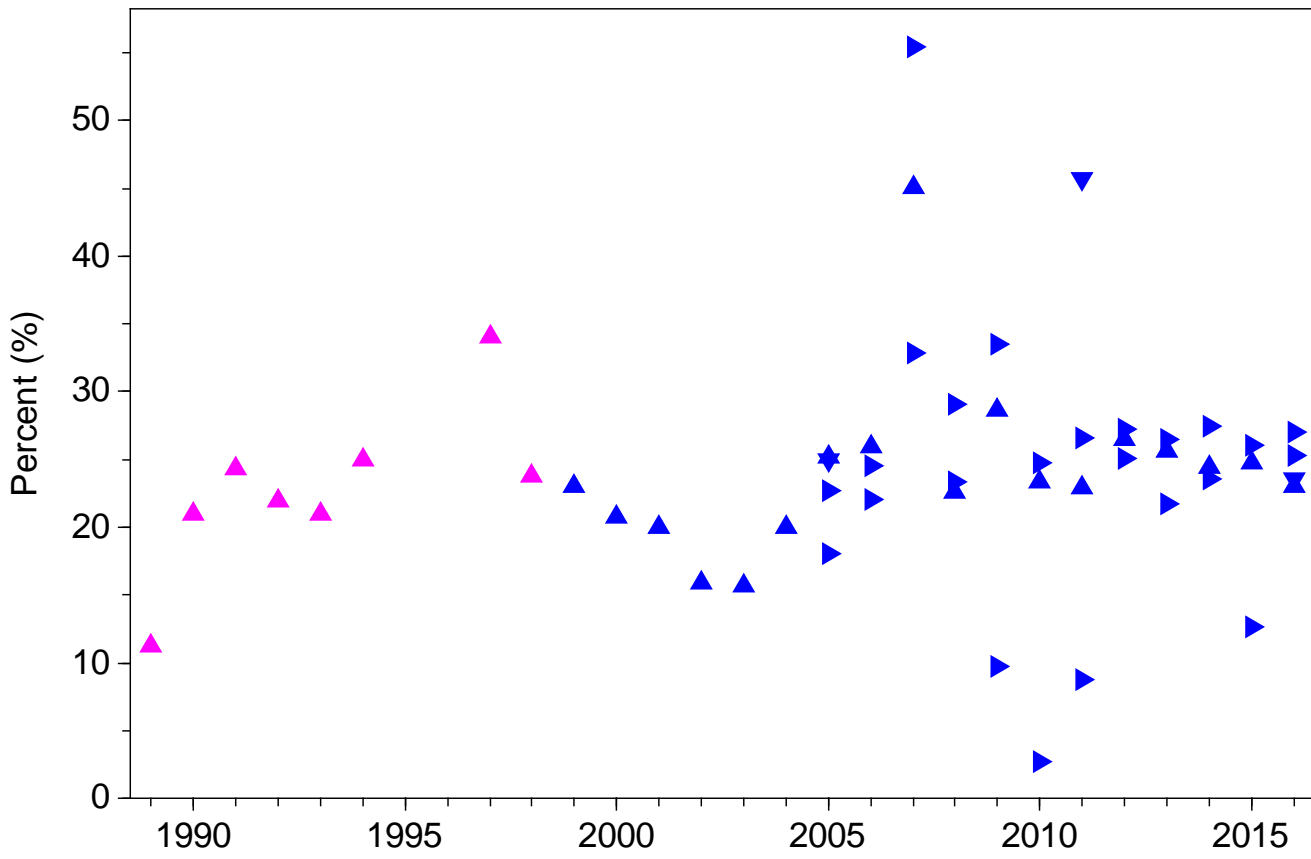
Gravel, Station 40



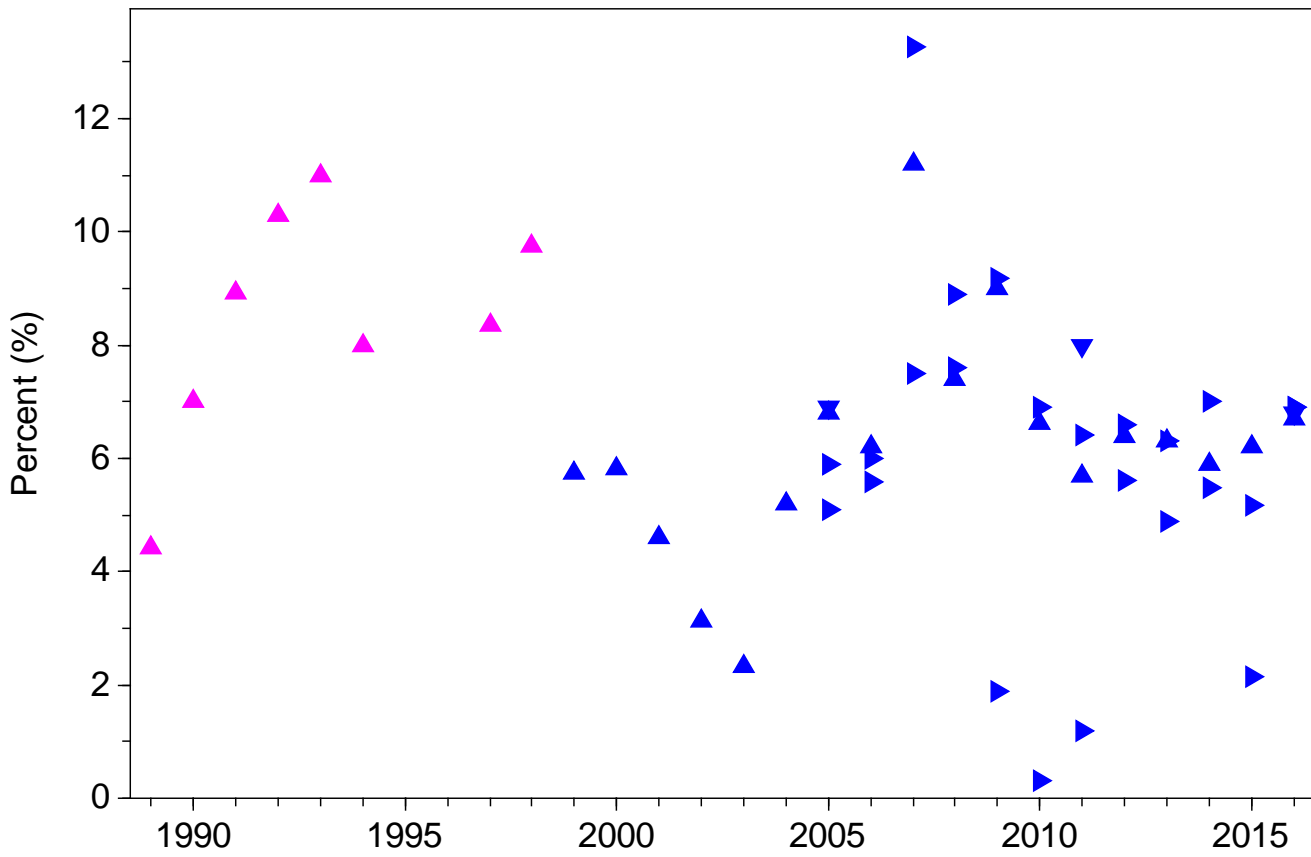
Total Sand, Station 40



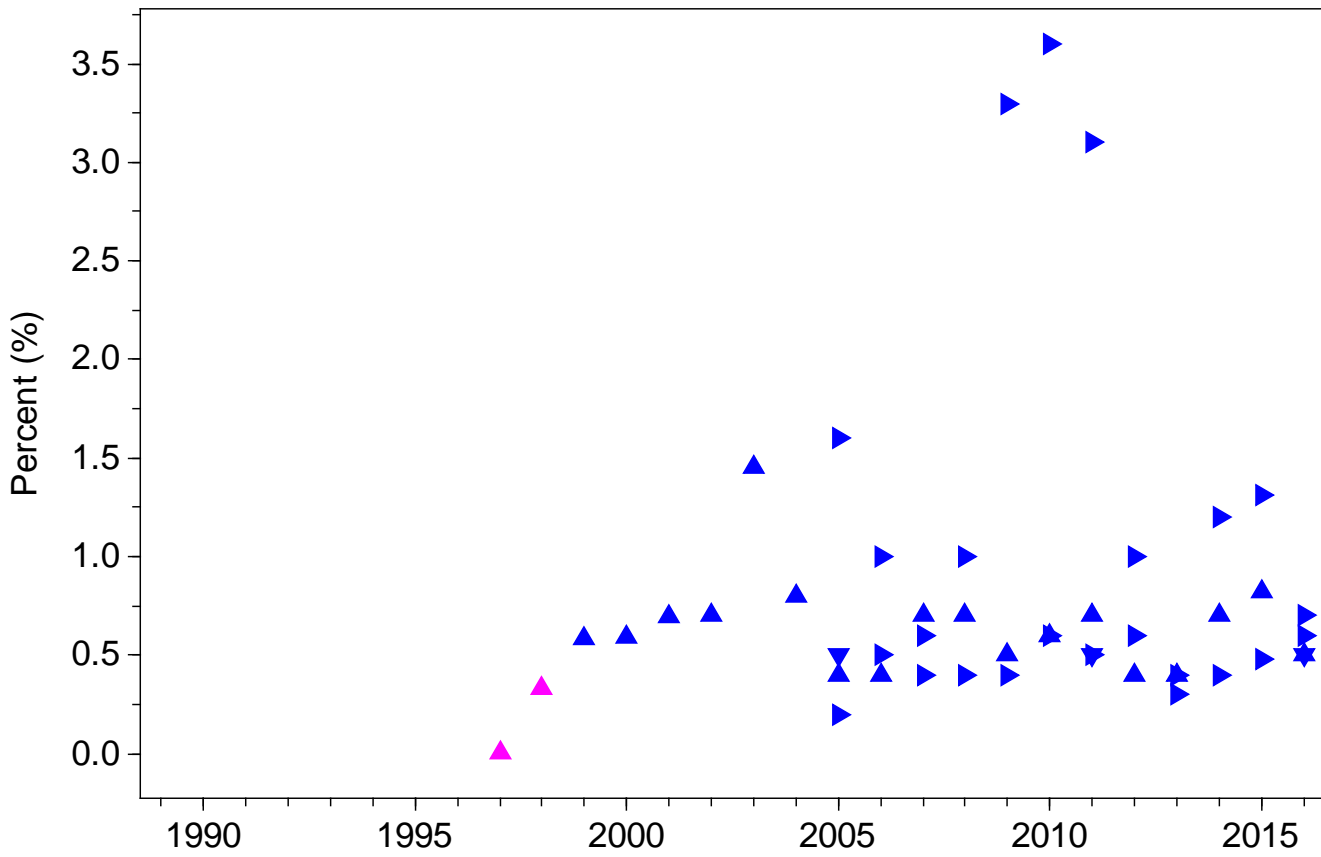
Total Silt, Station 40



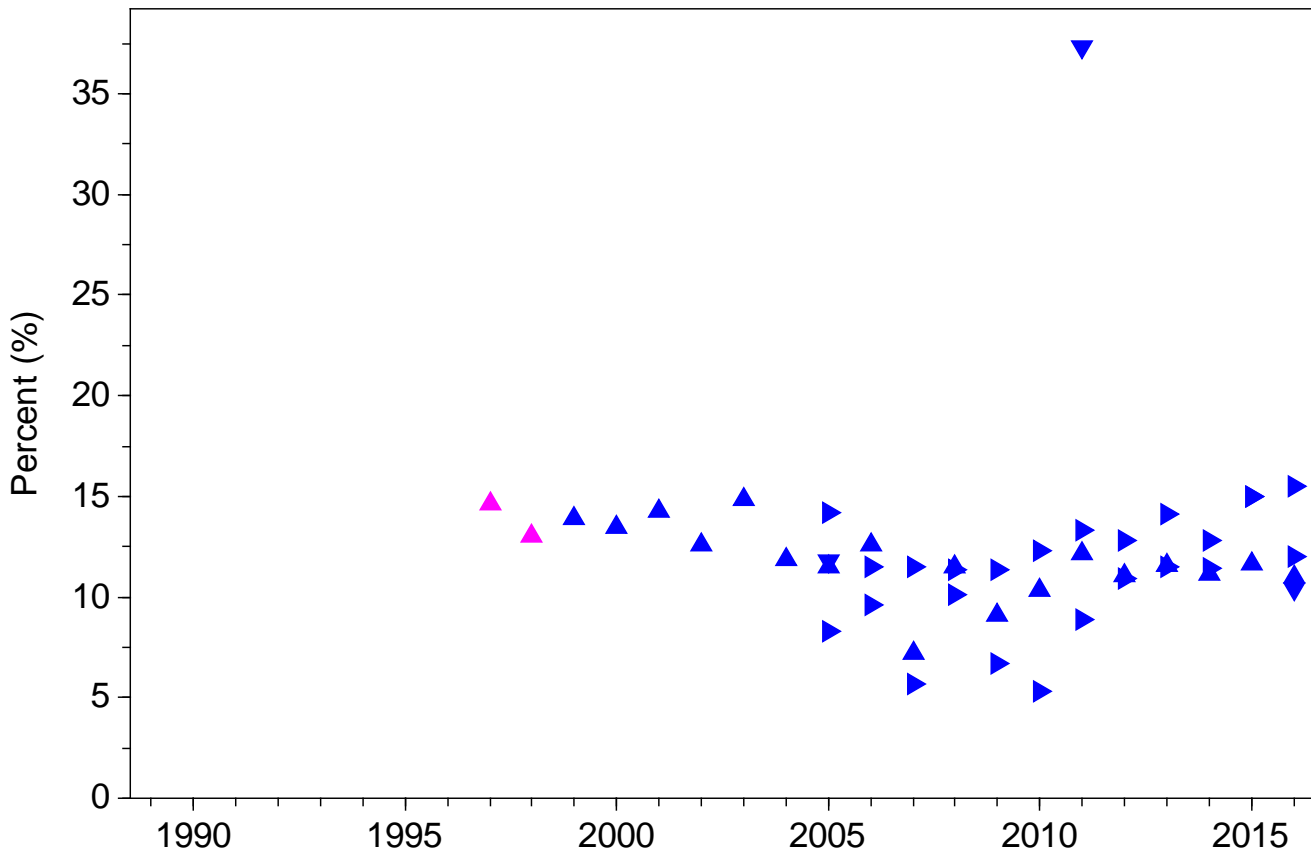
Total Clay, Station 40



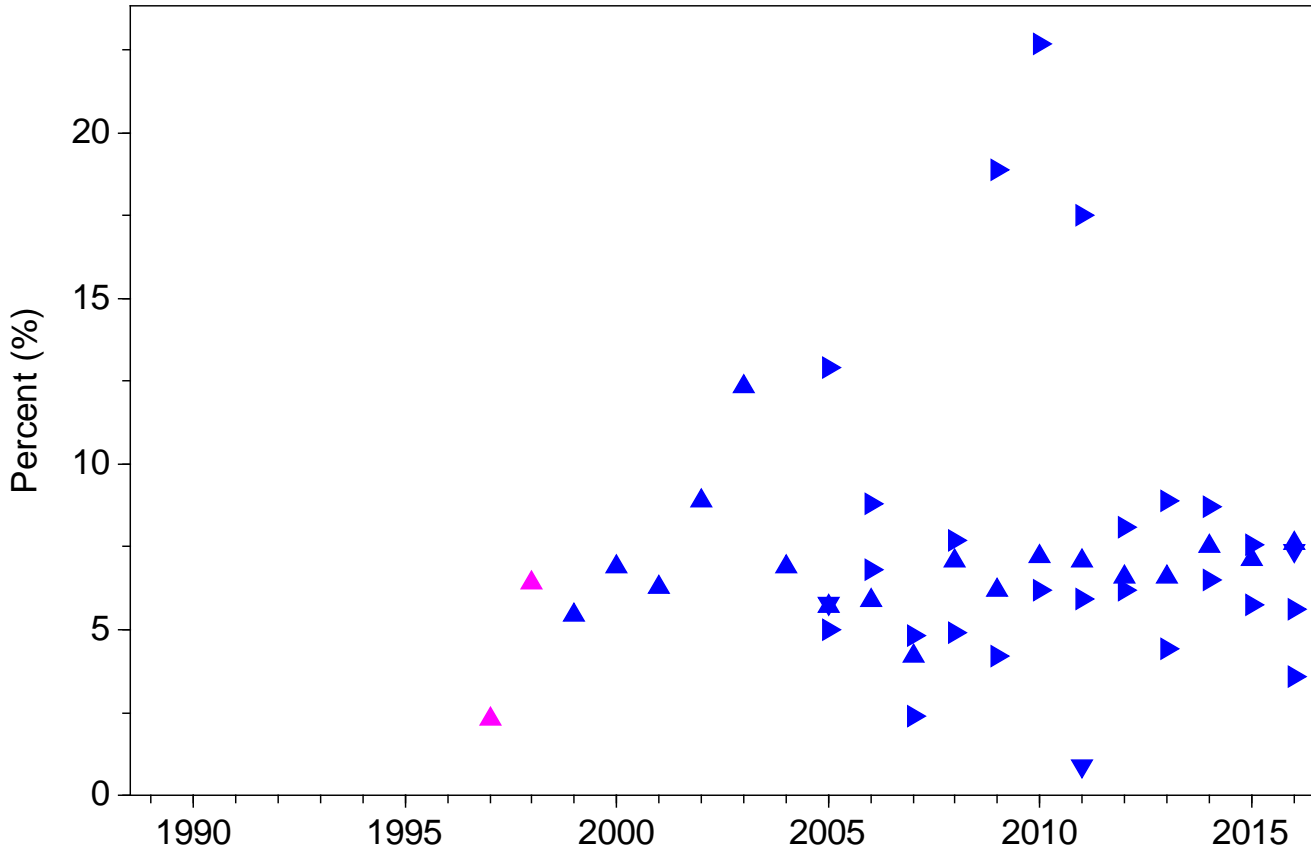
Very Coarse Sand, Station 40



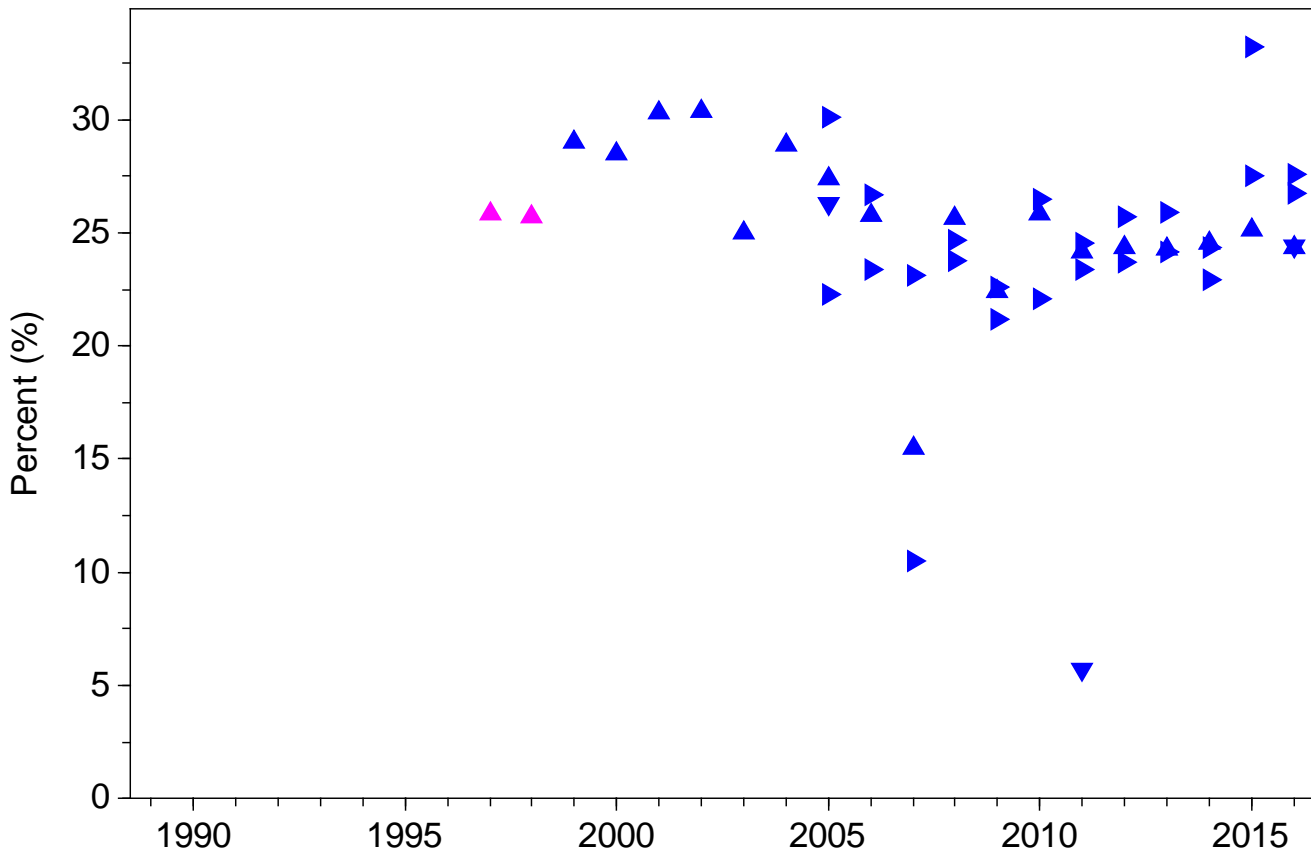
Very Fine Sand, Station 40



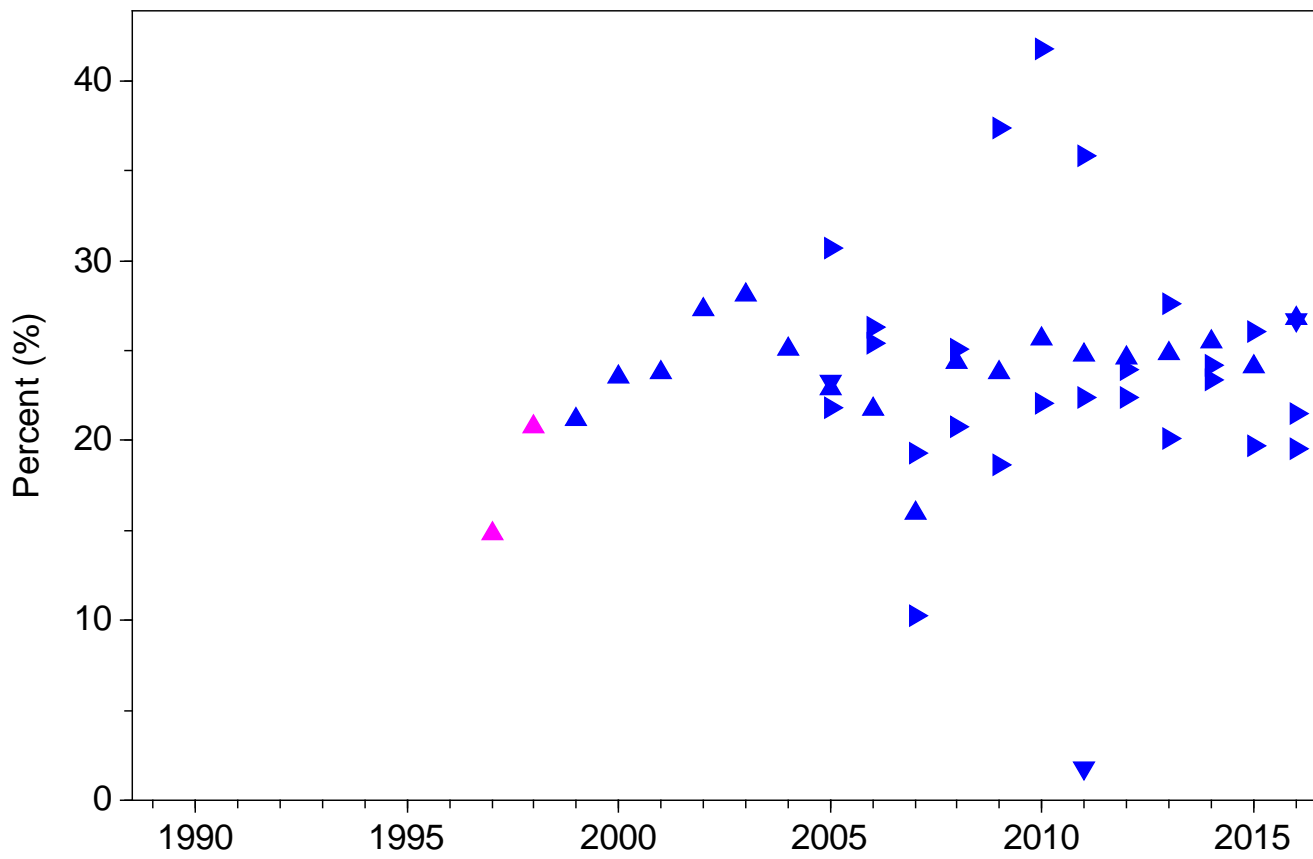
Coarse Sand, Station 40



Fine Sand, Station 40

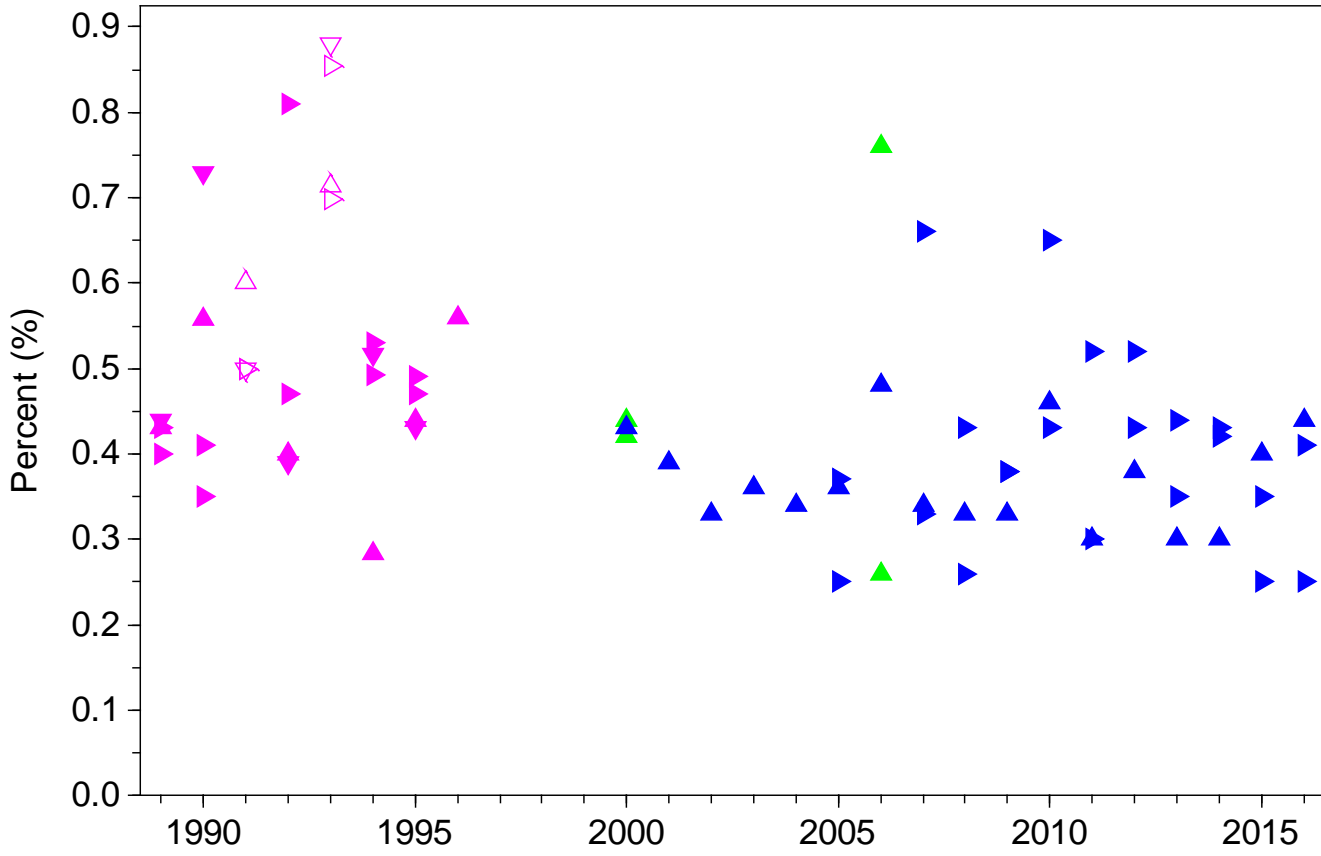


Medium Sand, Station 40

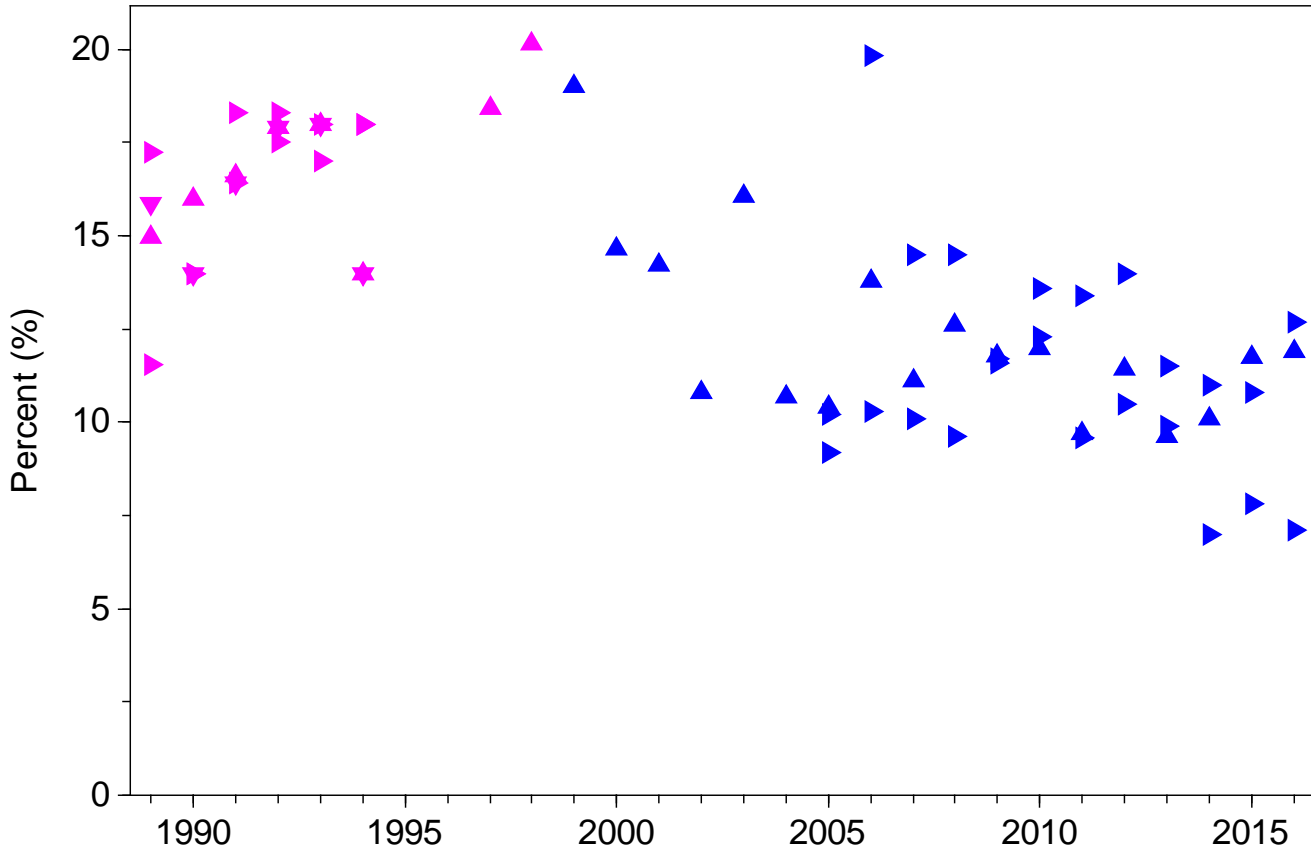


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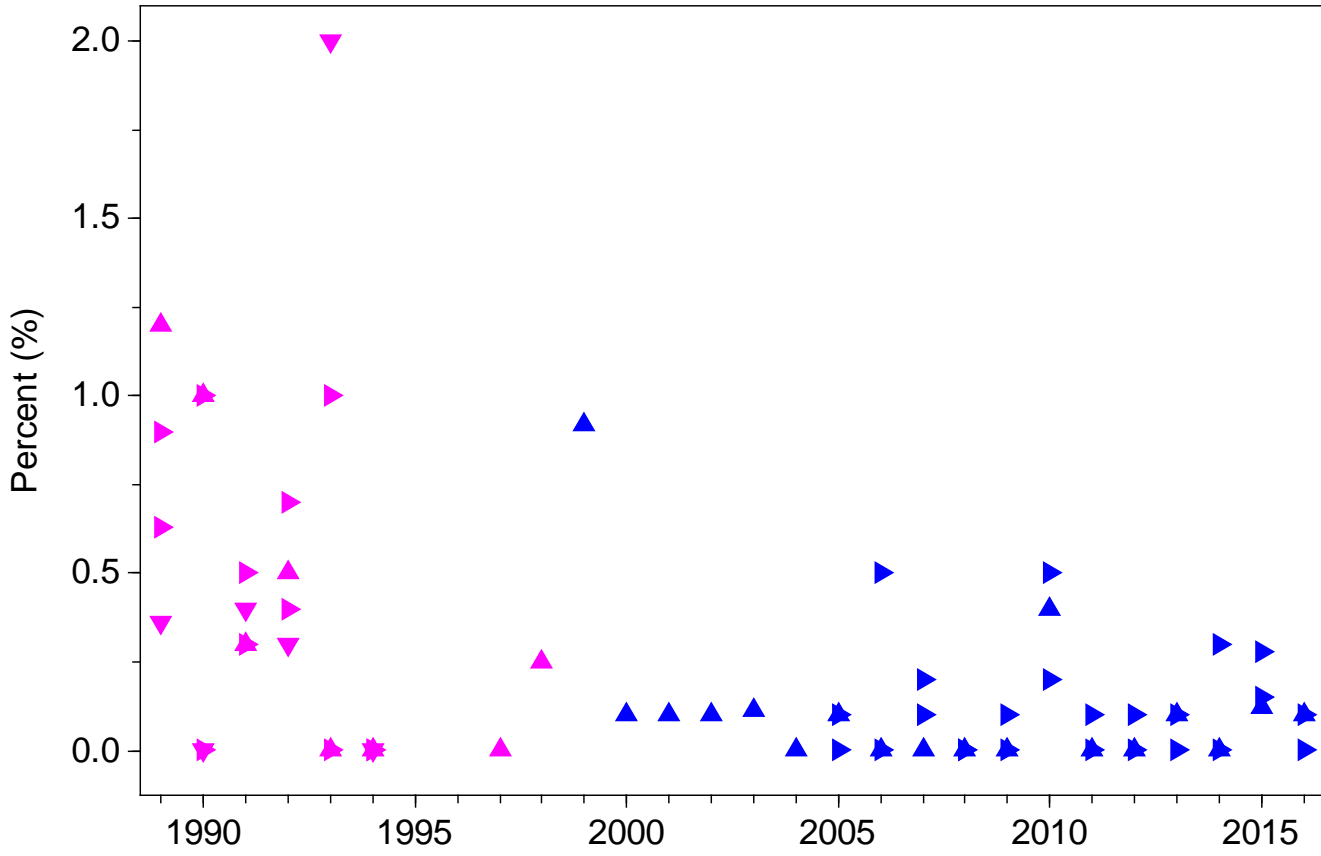
Total Organic Carbon, Station 44



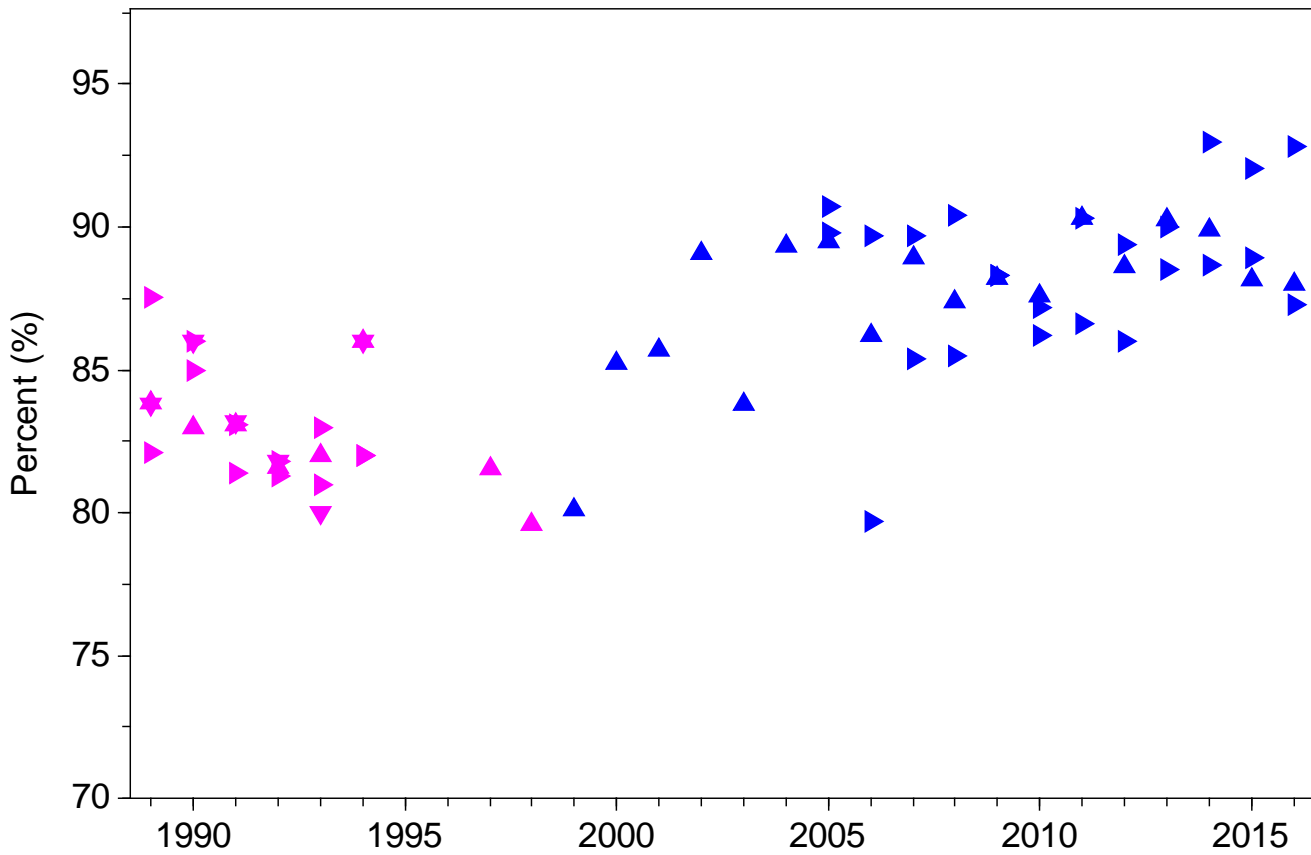
Percent Fines, Station 44



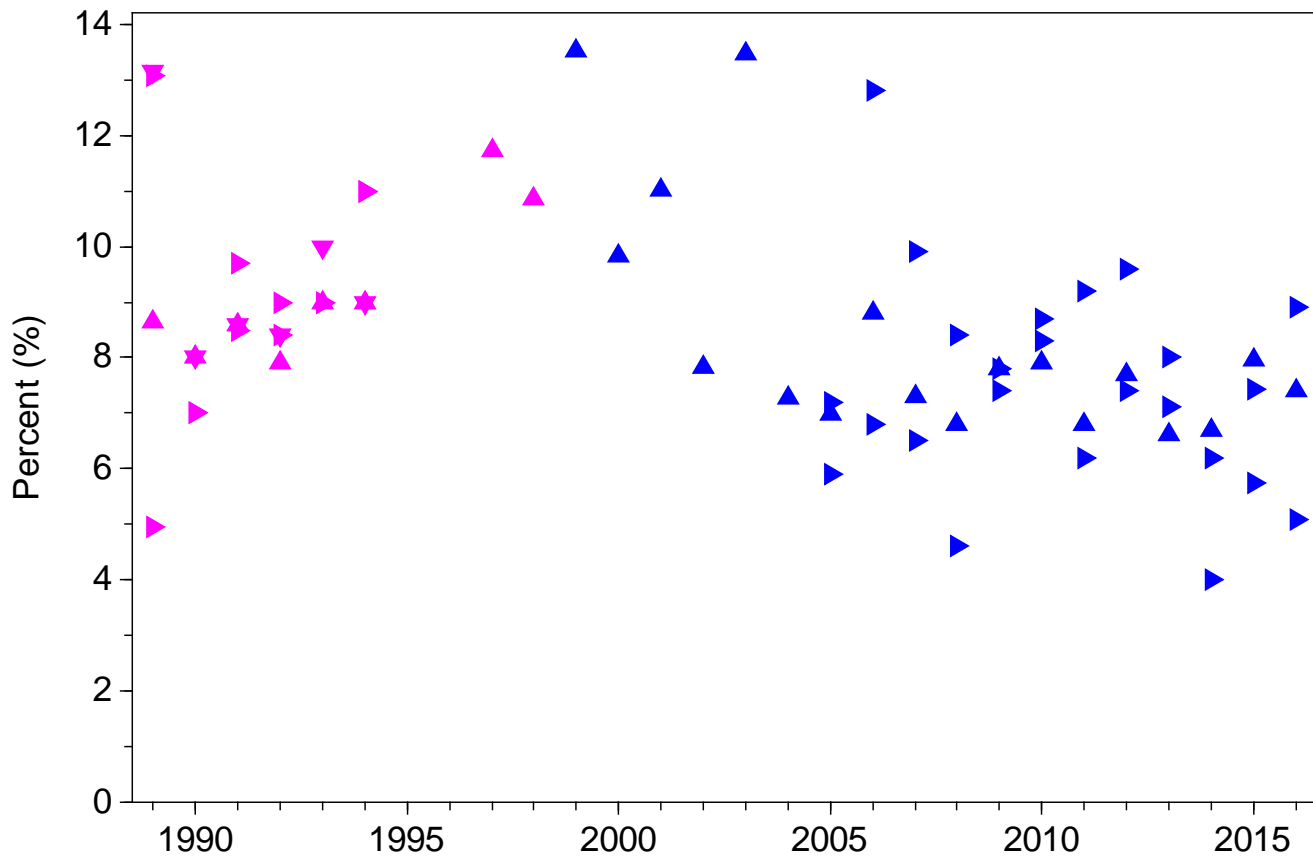
Gravel, Station 44



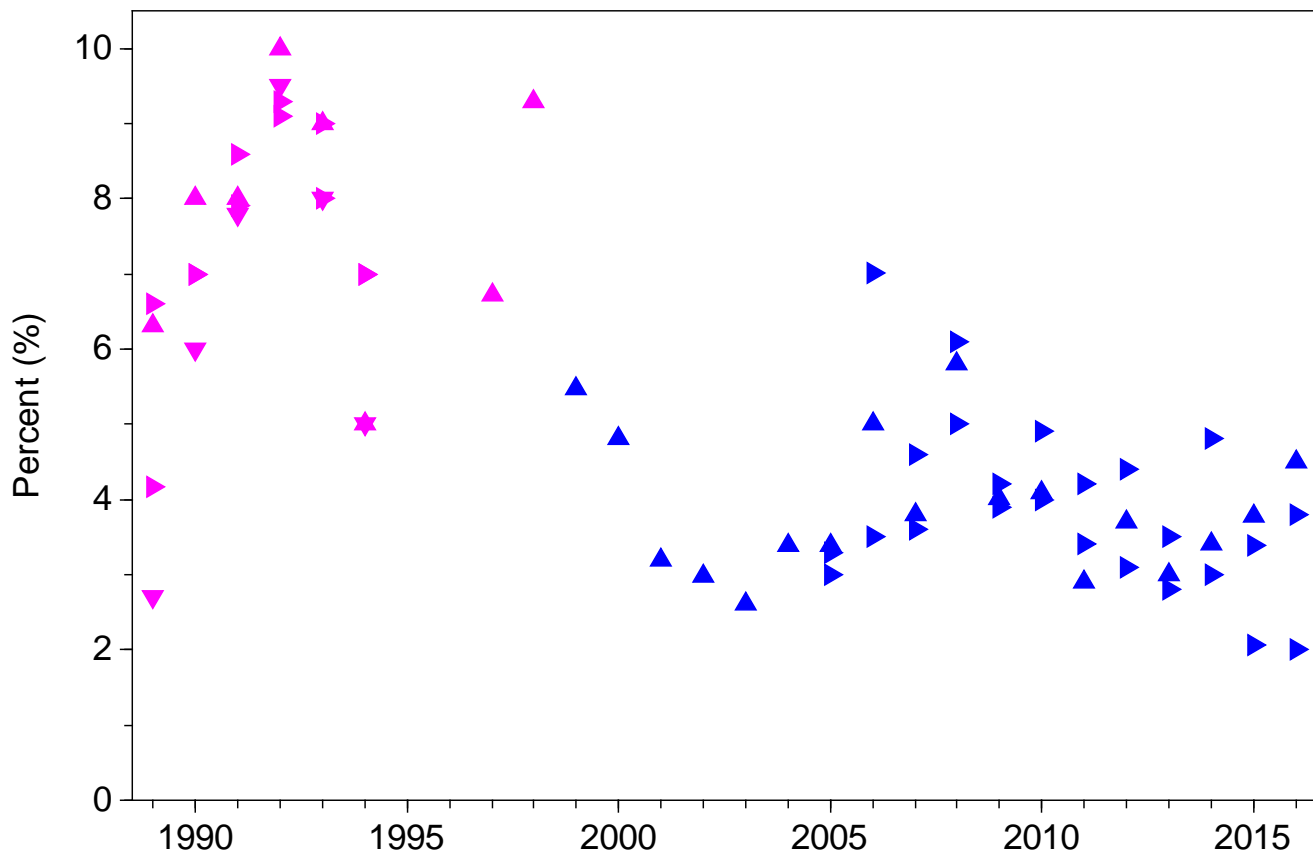
Total Sand, Station 44



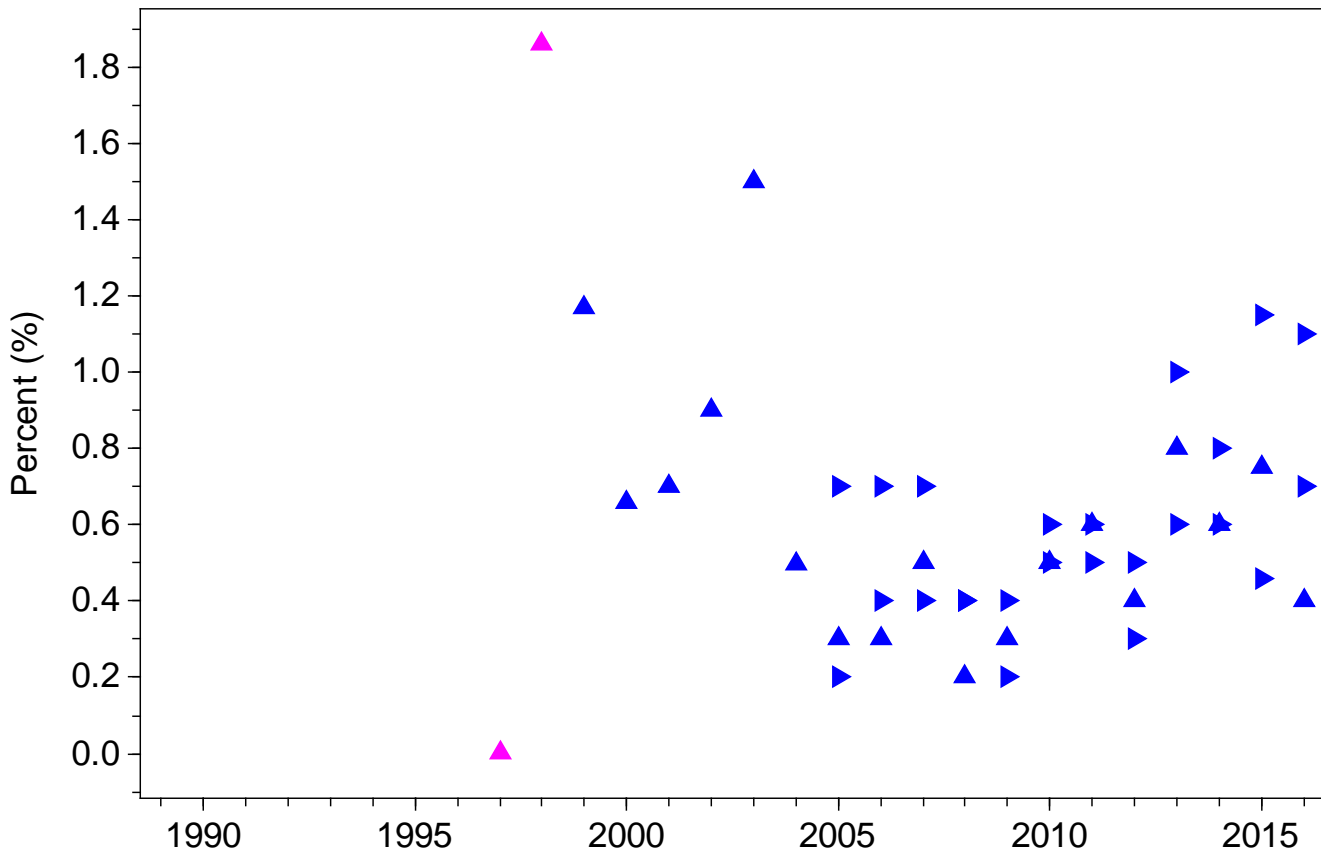
Total Silt, Station 44



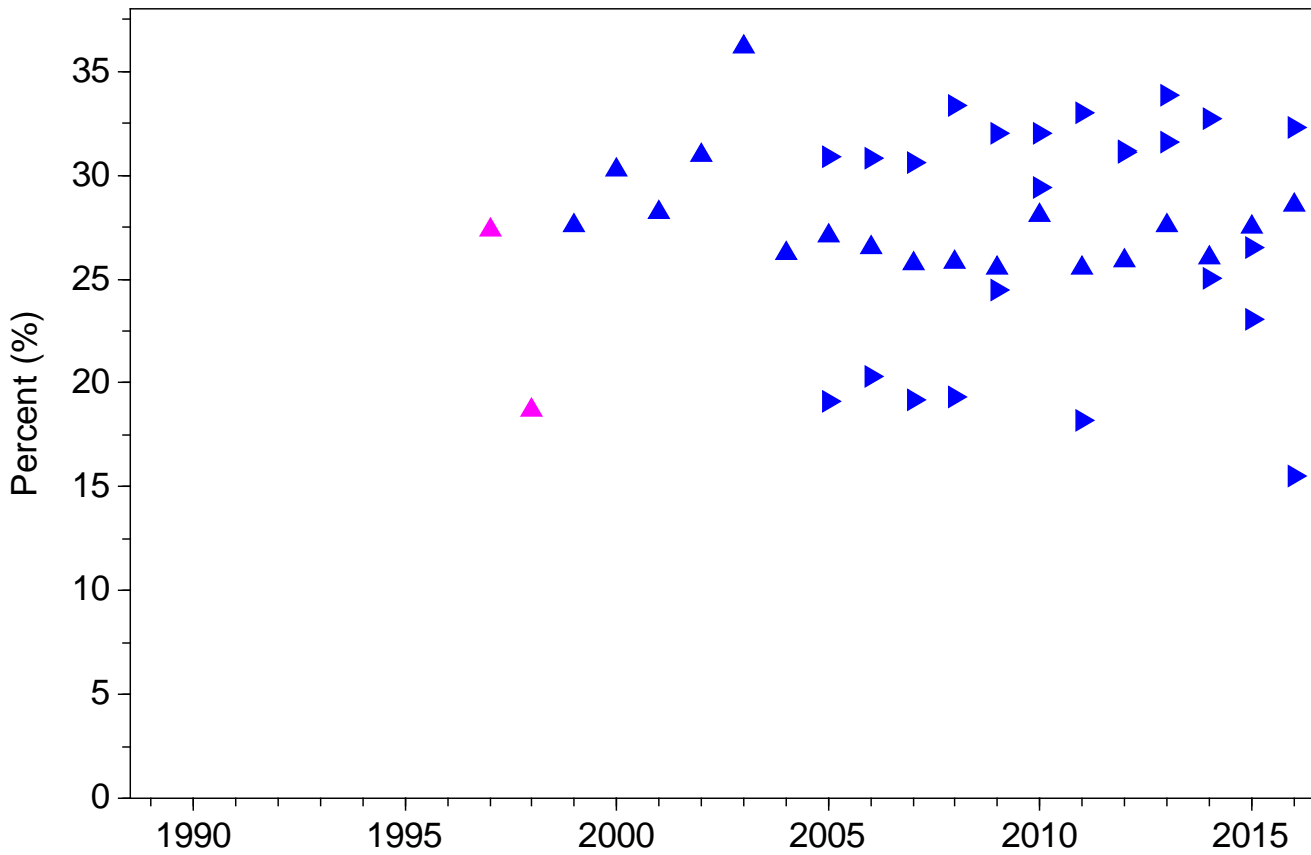
Total Clay, Station 44



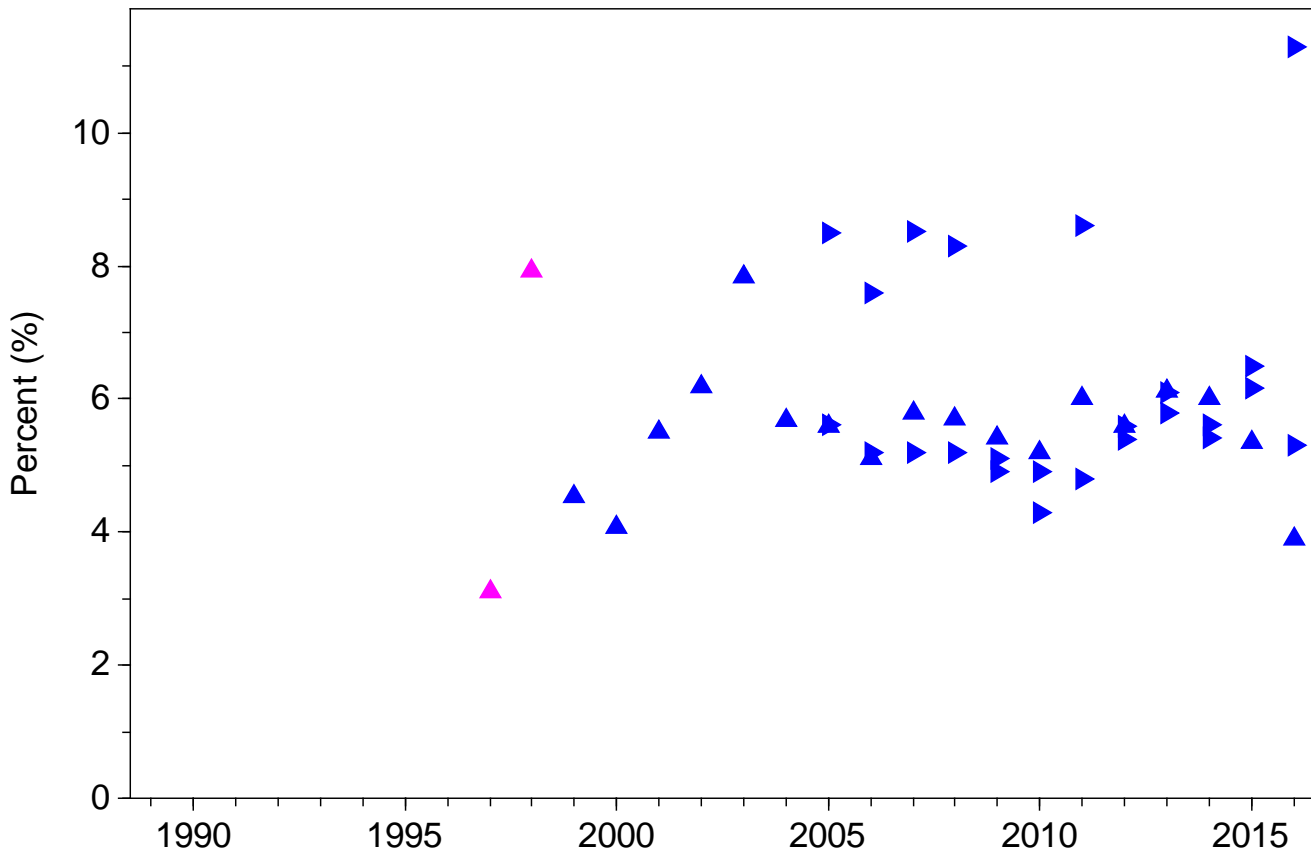
Very Coarse Sand, Station 44



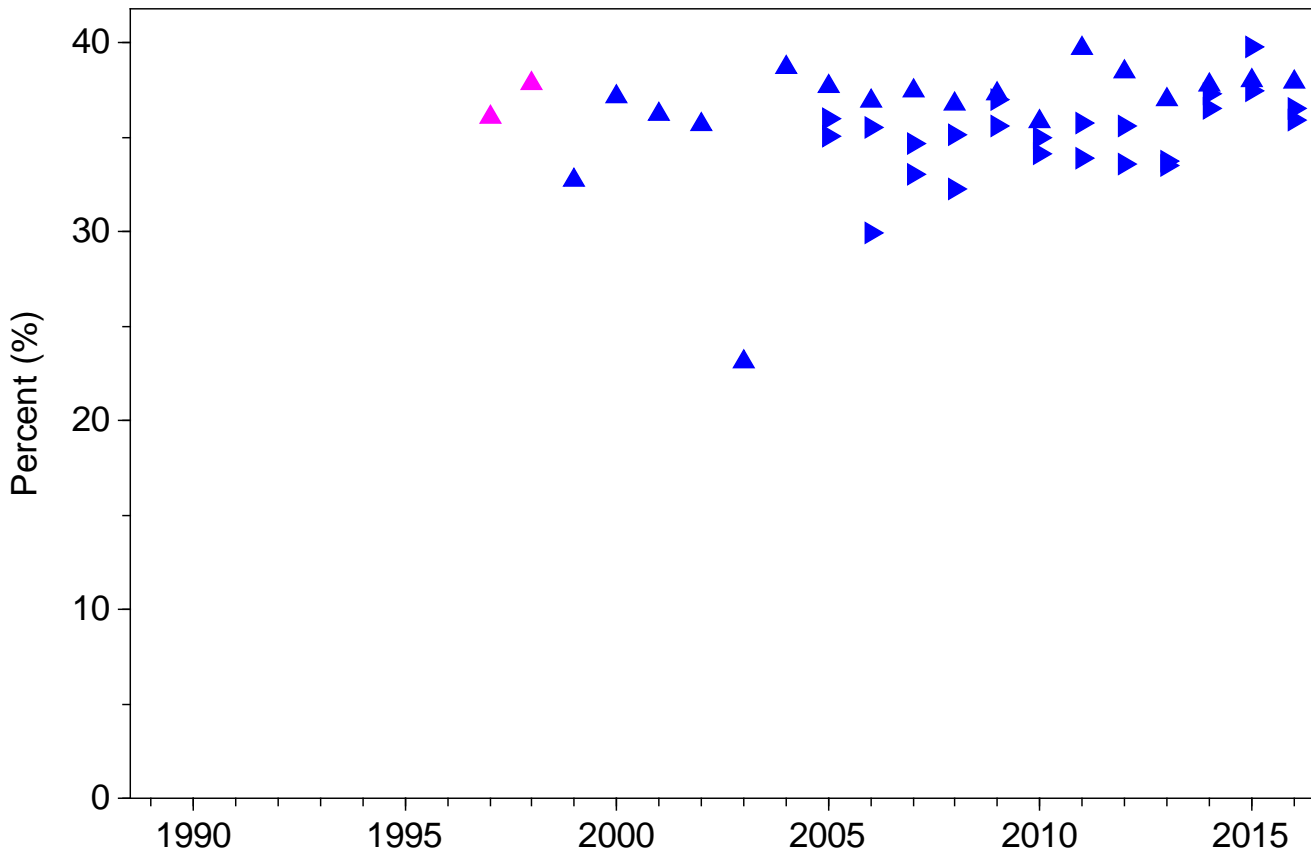
Very Fine Sand, Station 44



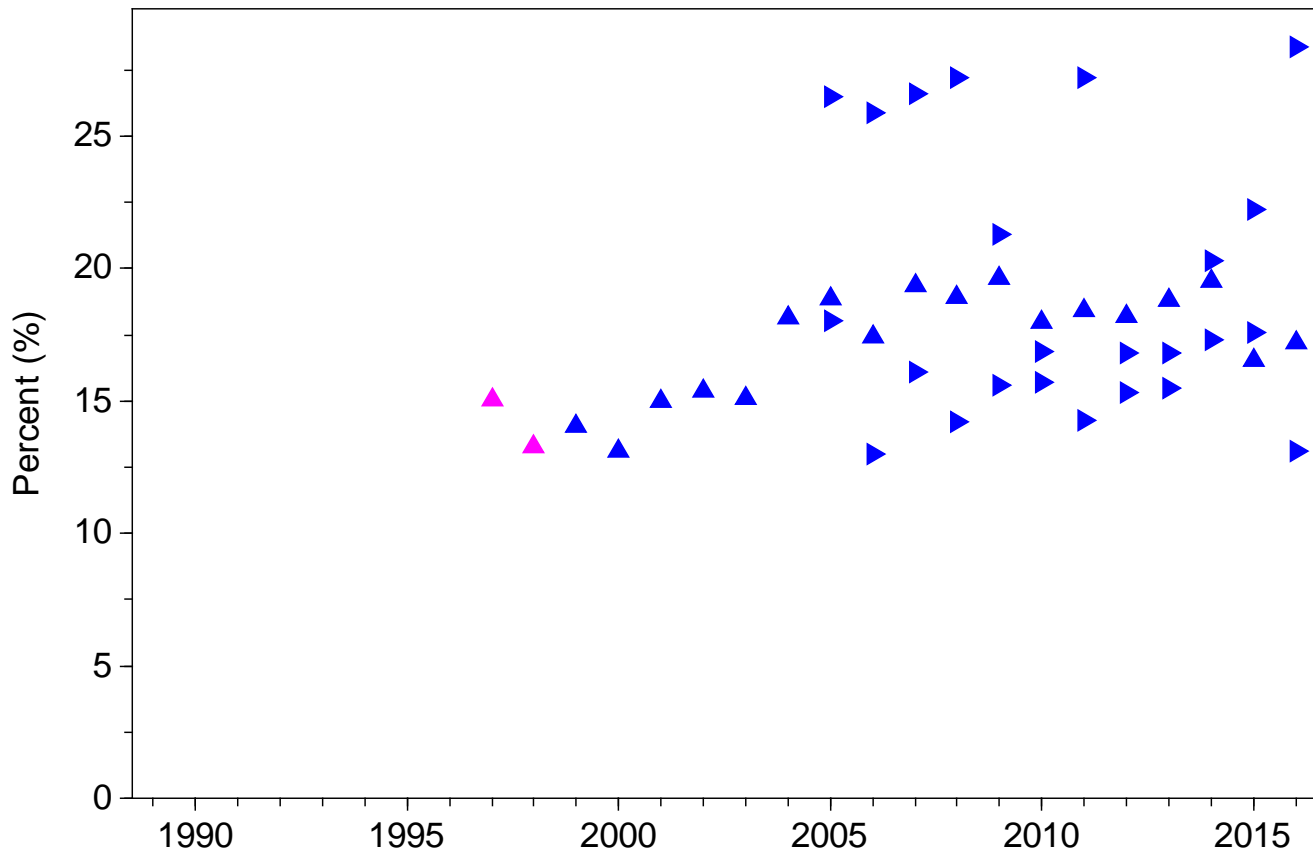
Coarse Sand, Station 44



Fine Sand, Station 44

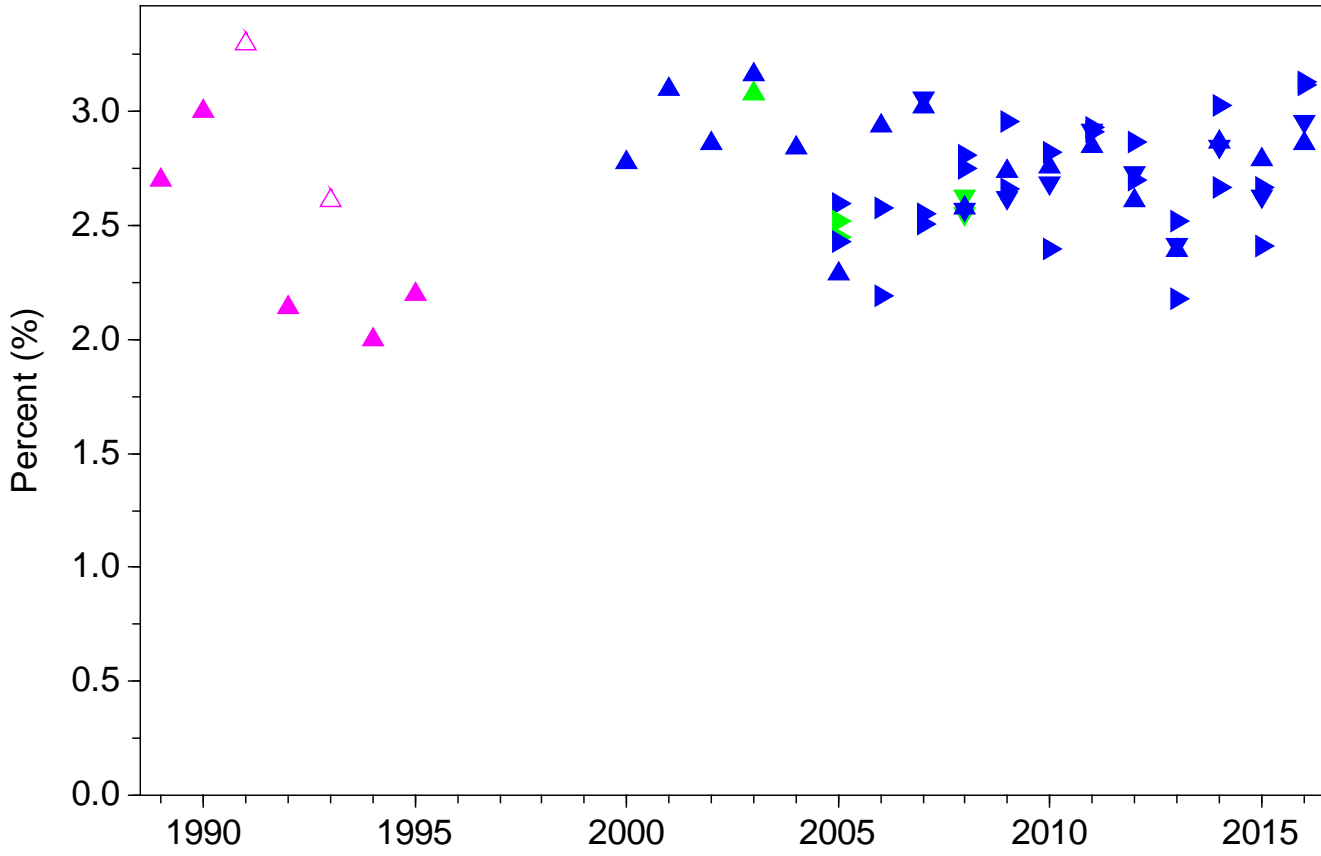


Medium Sand, Station 44

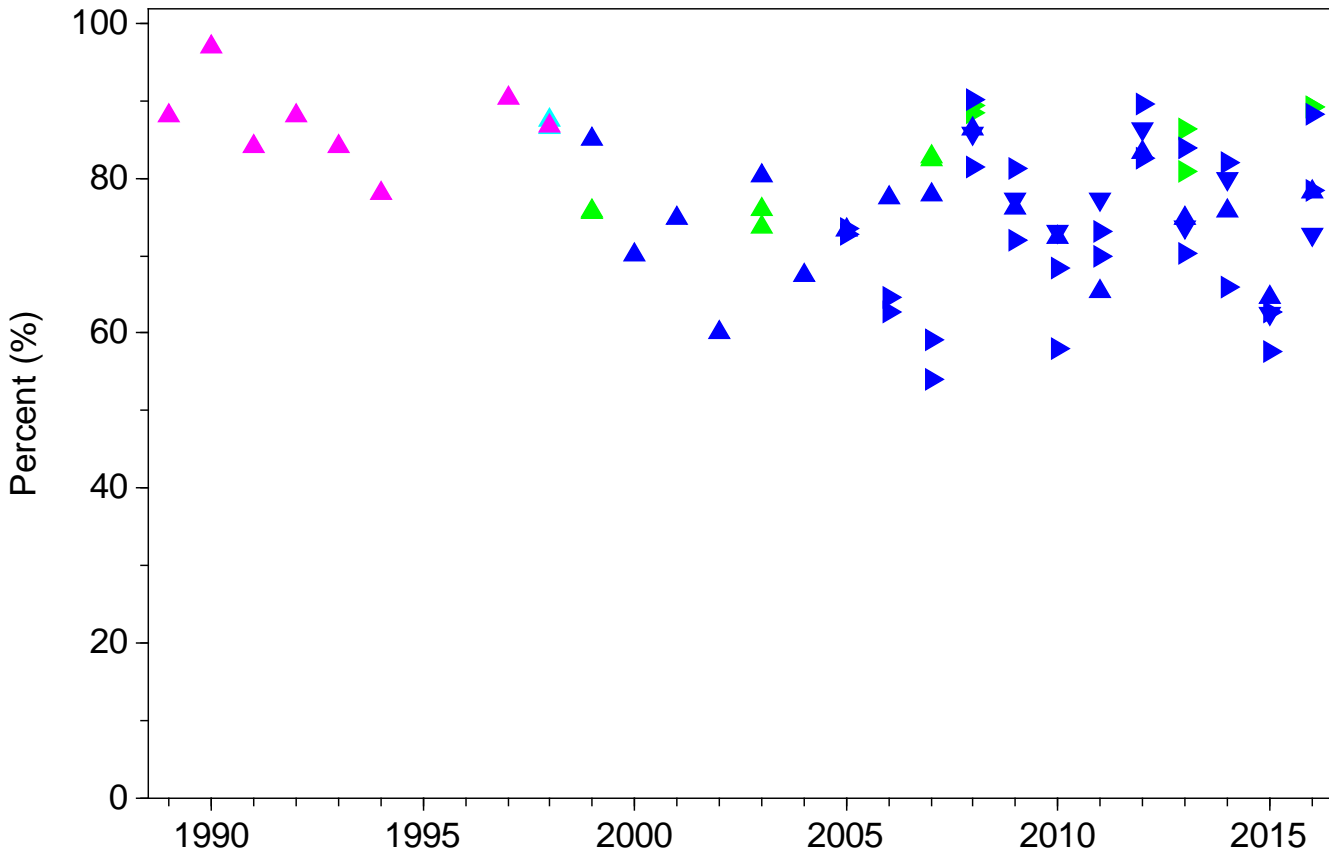


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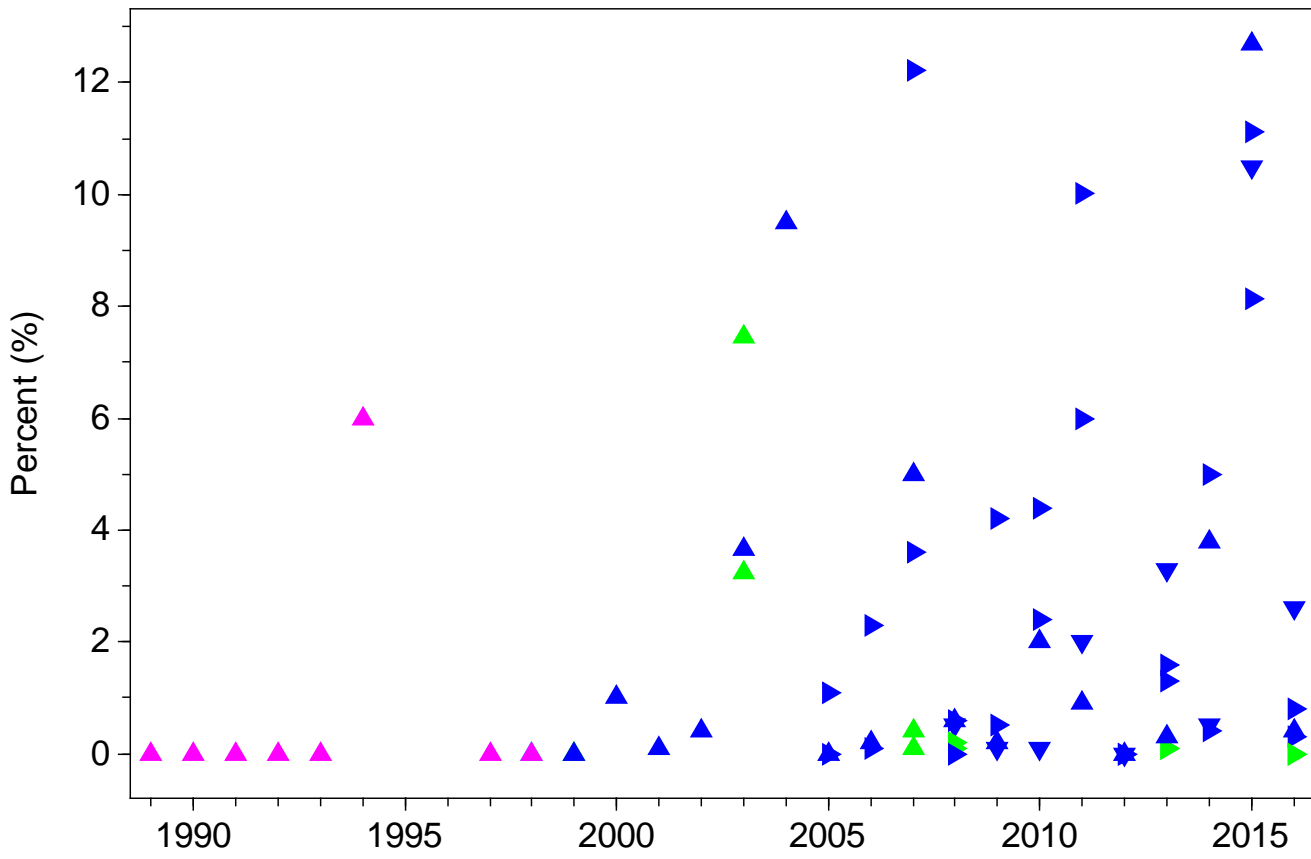
Total Organic Carbon, Station 49



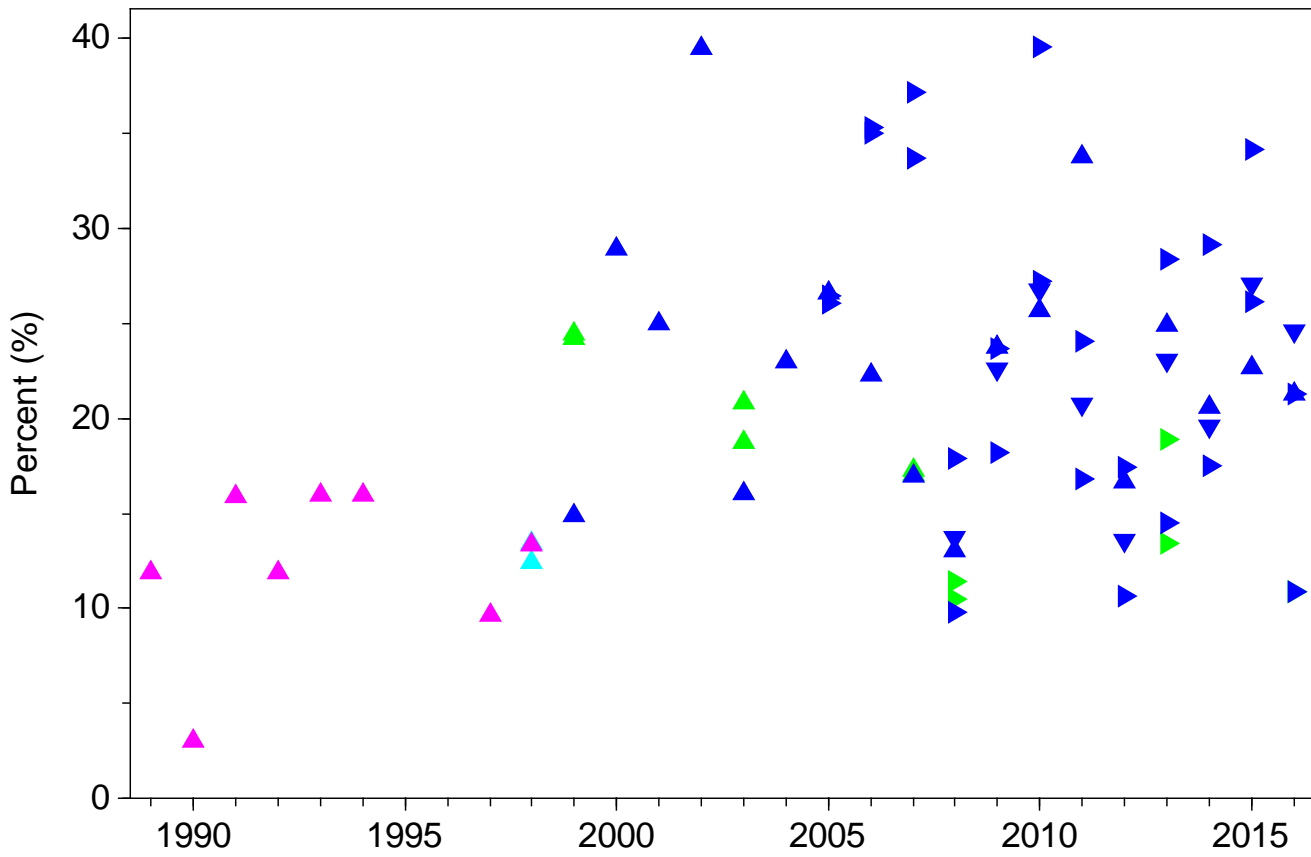
Percent Fines, Station 49



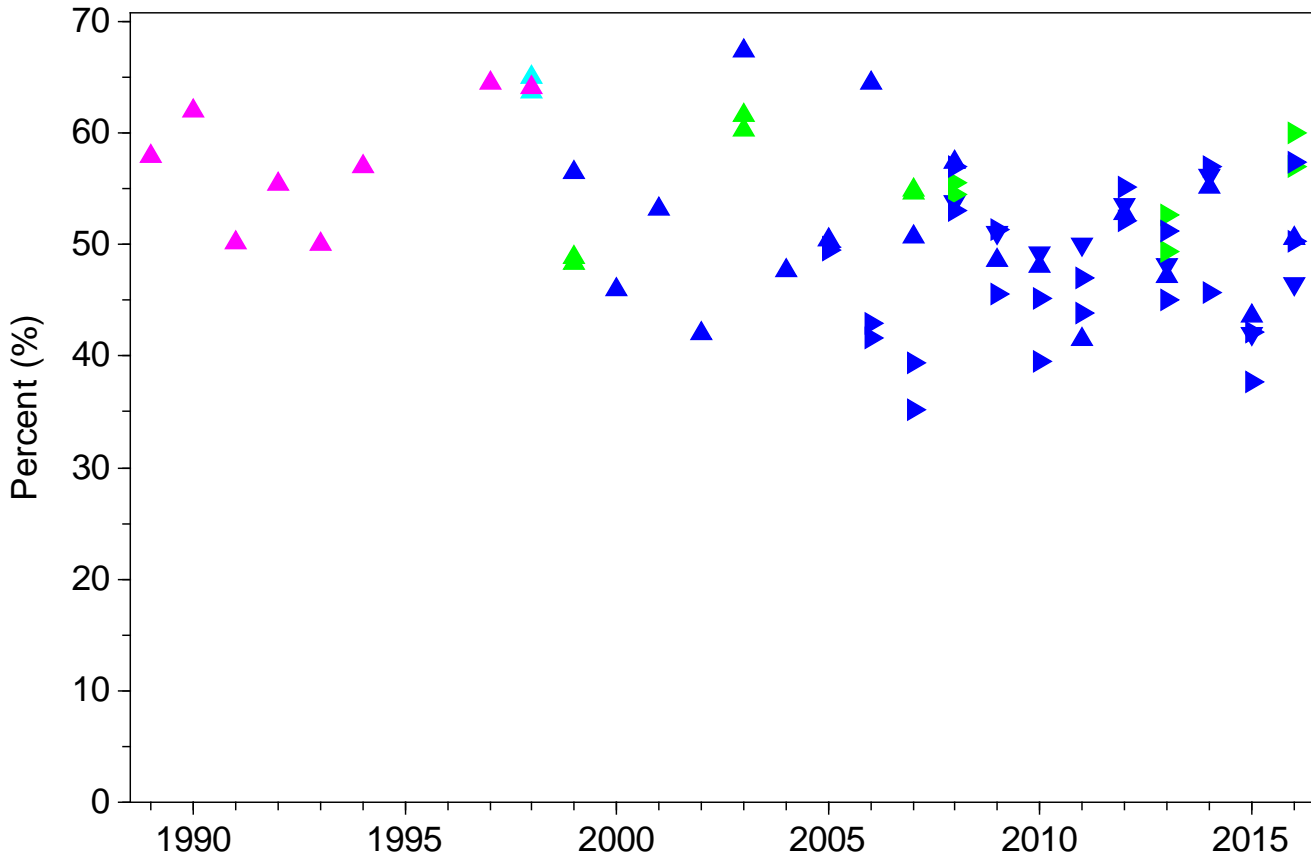
Gravel, Station 49



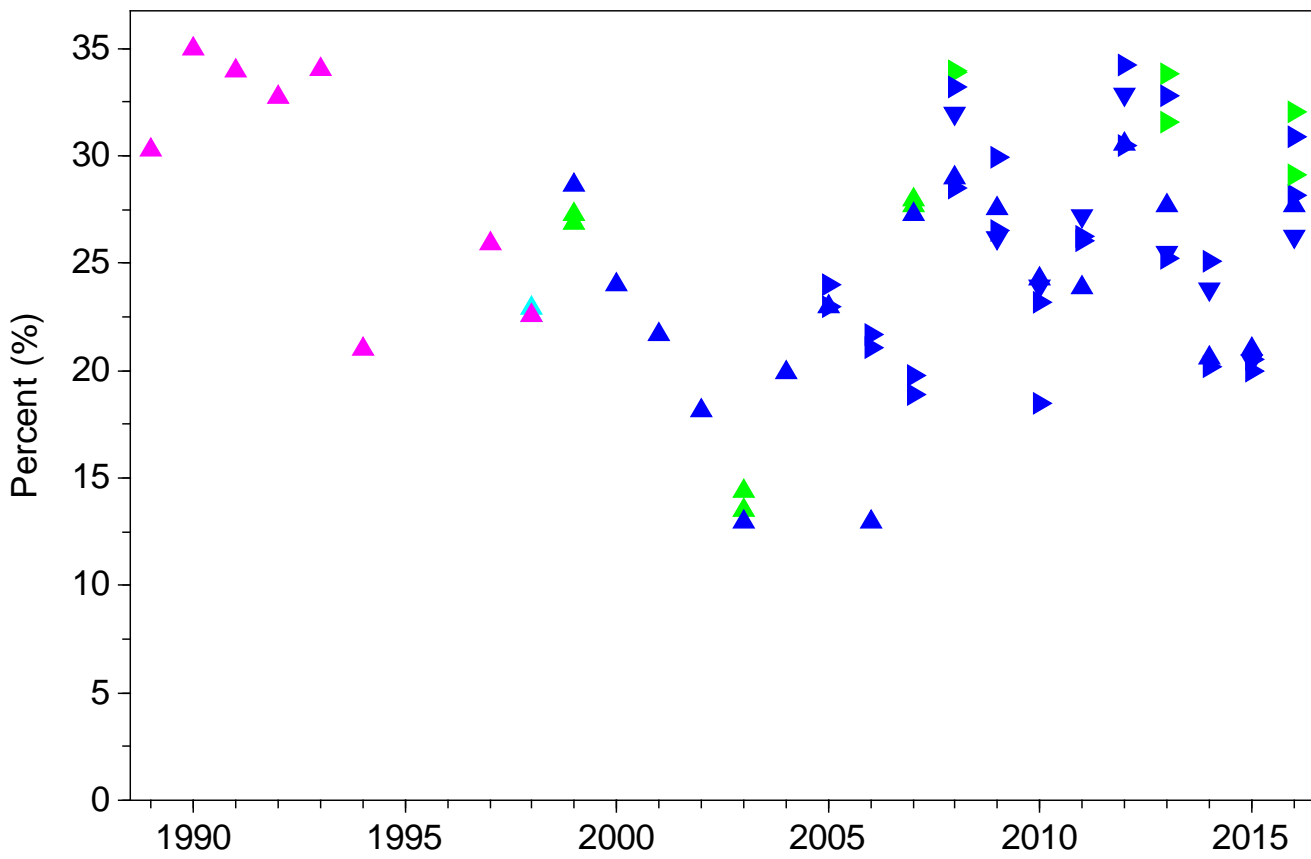
Total Sand, Station 49



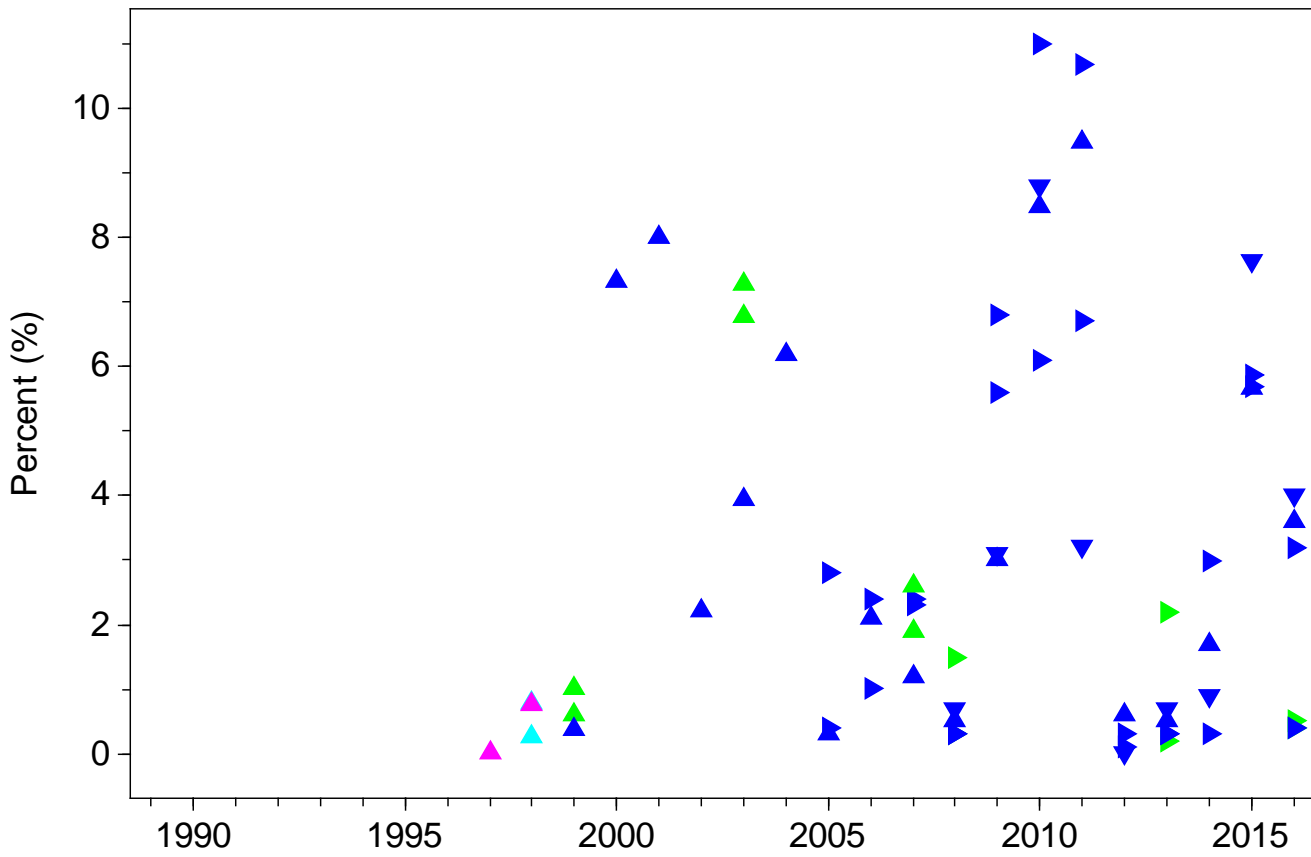
Total Silt, Station 49



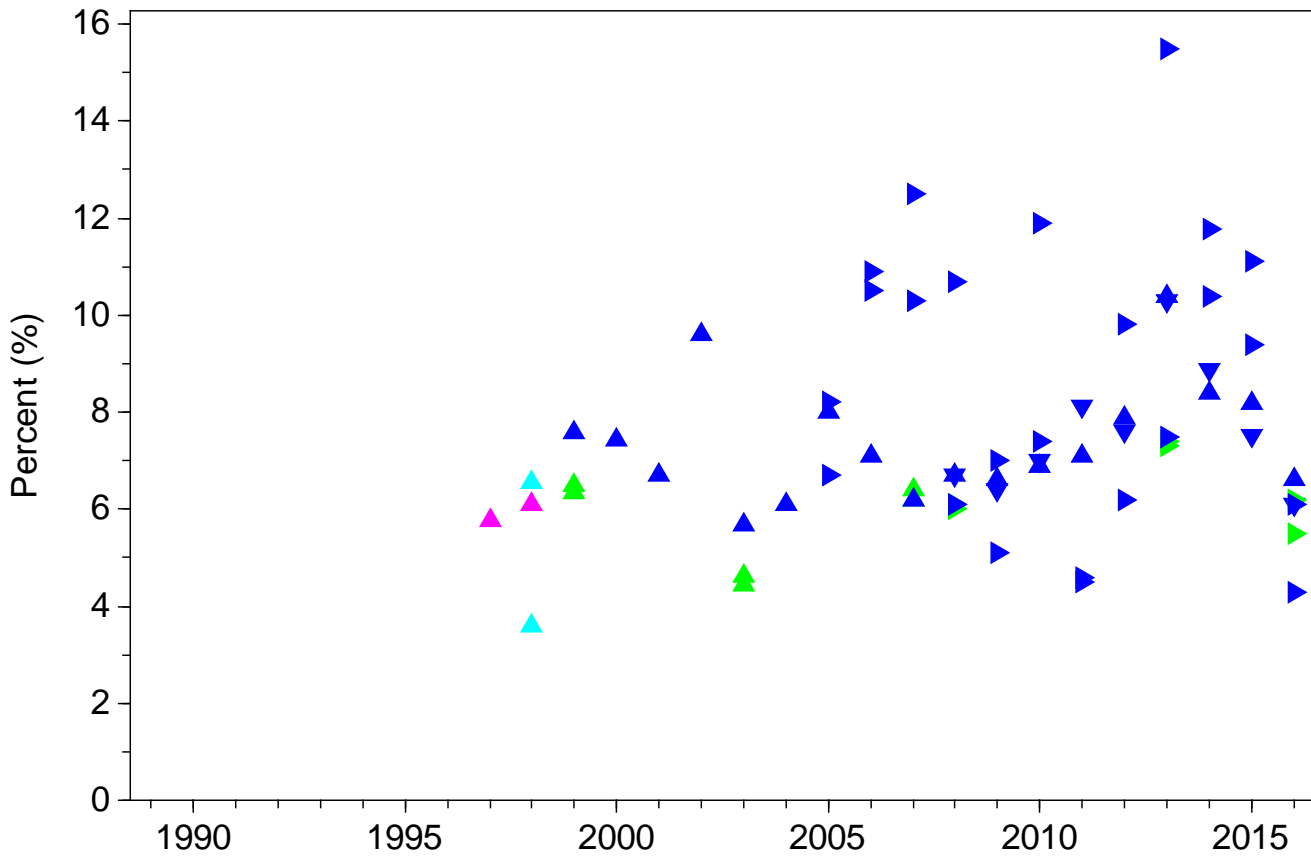
Total Clay, Station 49



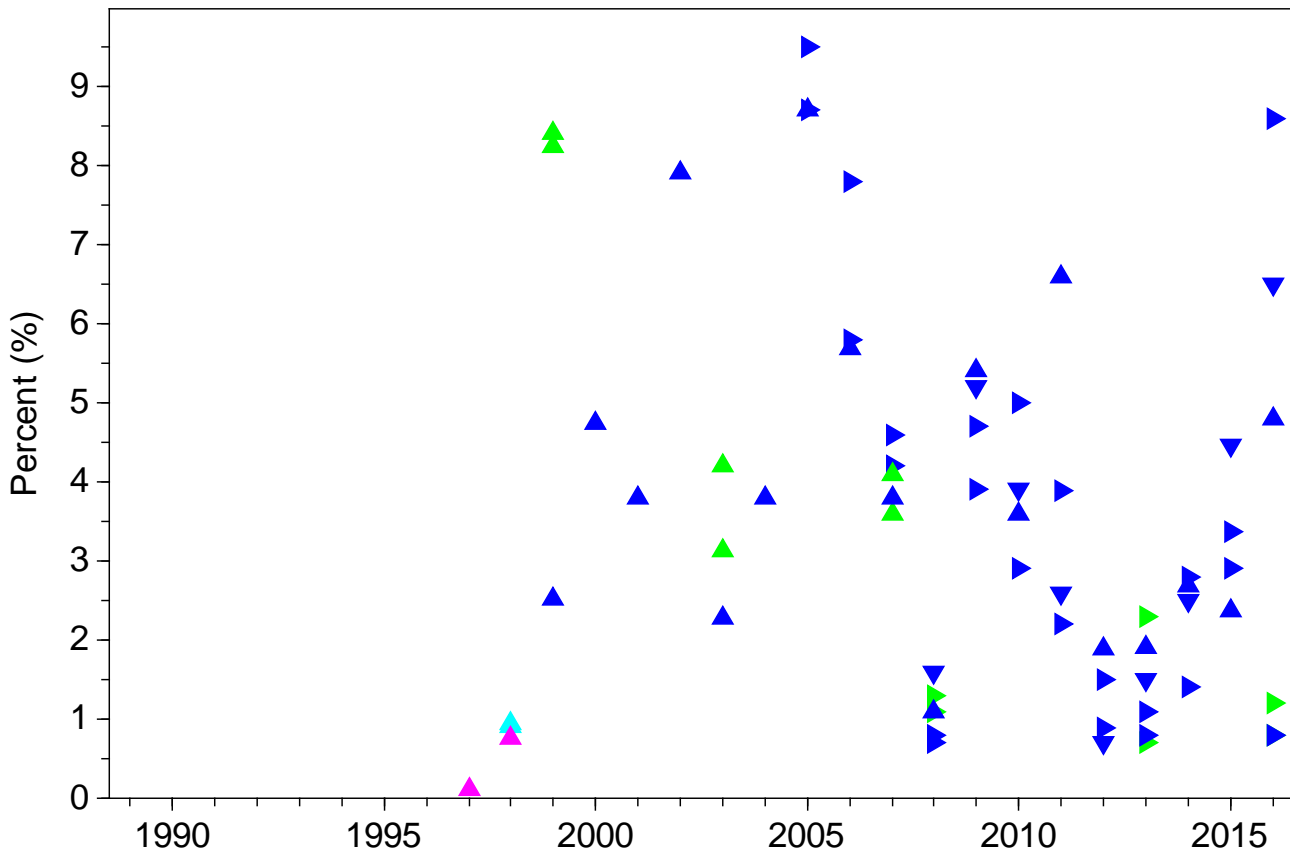
Very Coarse Sand, Station 49



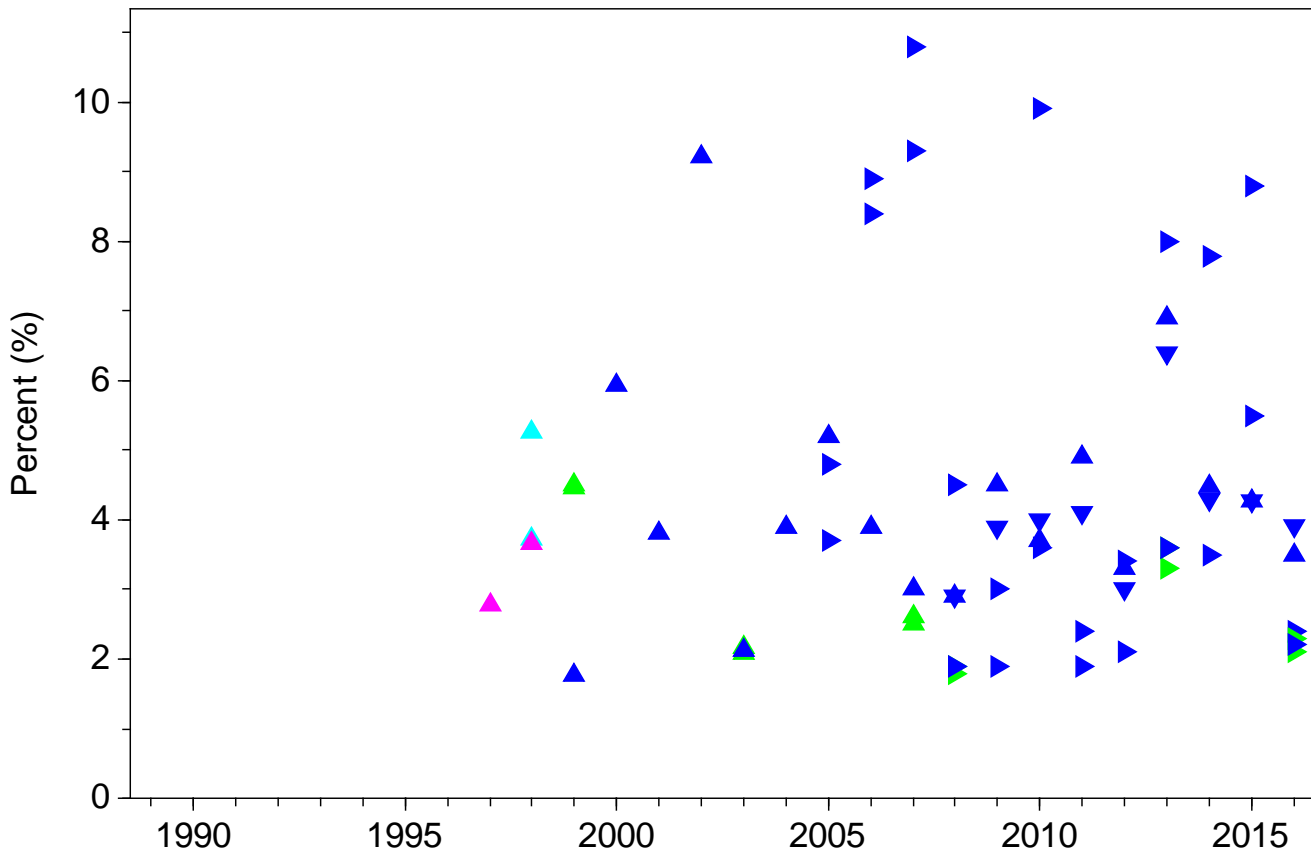
Very Fine Sand, Station 49



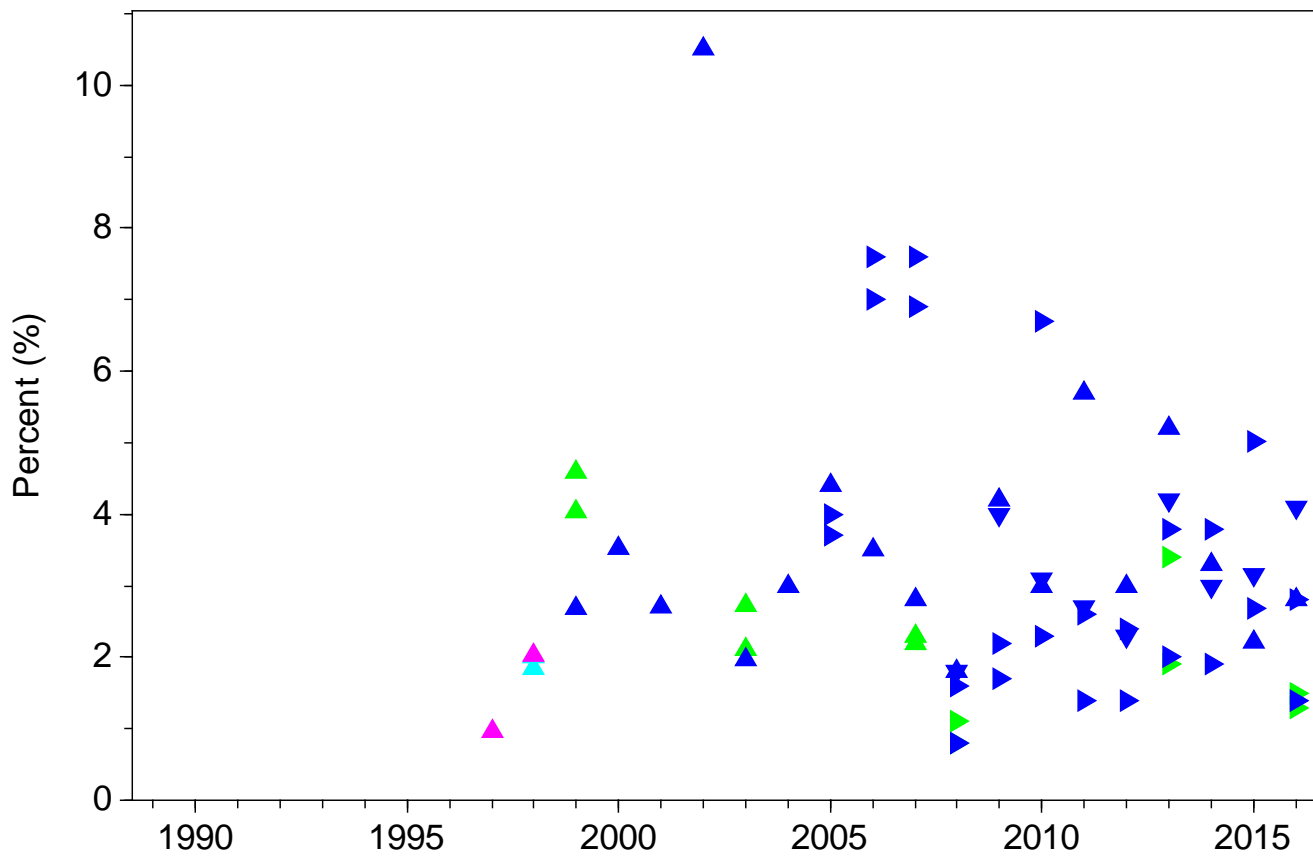
Coarse Sand, Station 49



Fine Sand, Station 49



Medium Sand, Station 49



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