Publication No. 12-03-073

DEPARTMENT OF ECOLOGY State of Washington

Eyes Over Puget Sound

Field log | Weather | Water column | Aerial photos | Ferry and Satellite | Moorings

Surface Conditions Report

April 23, 2012

Special content:
Anomalies in 2011, p. 5-6

Start here

Up-to-date observations of visible water quality conditions in Puget Sound and the Strait of Juan de Fuca

Marine conditions from 4-23-2012 at a glance

LONG-TERM MARINE MONITORING UNIT

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Julia Bos

Personal flight impression p. 3-4

Much to see in the surface layer. The productive growth season is in full swing.

Weather conditions p. 7

Warm, sunny weather and higher-than-normal river flows for several days prior to the flight

Aerial photography p. 8-27

Abundant surface debris and algae blooms in river-fed inlets in South and Central Sound.

Ferry and satellite p. 28-32

Puyallup plume extends into Quartermaster Harbor. MERIS ocean color sensor lost contact. New thermosalinograph installed on ferry.

In-situ mooring data p. 33-35

The freshwater layer in Whidbey Basin increased by 2m following high precipitation and run-off.

Previous Eyes Over Puget Sound reports: www.ecy.wa.gov/programs/eap/mar_wat/eops/

Personal flight impression, 4-23-2012

Christopher Clinton, our BEACH Data Coordinator, helping with the flight and enjoying the sunny weather

Marine Flight 4 (South Sound)

The South Sound flight took place on a beautiful, warm and sunny day. As soon as we were airborne, we saw blooms everywhere, stimulated by the past weekend's calm and sunny weather. In Budd Inlet and Dana Passage we saw many patches of green and white algae blooms.

Bloom en route to Dana Passage

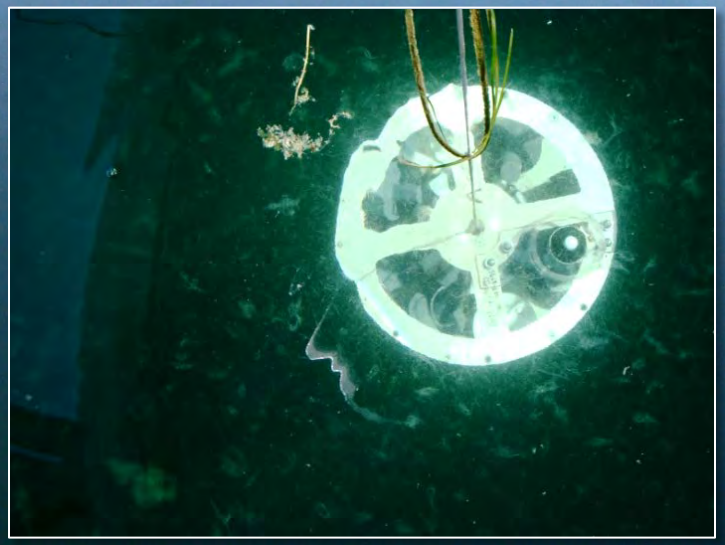
Bloom near Budd Inlet

Personal flight impression, 4-23-2012

School of fish near the floatplane

In the southern region of Hood Canal, there was a very interesting bloom. We saw filamentous clusters of phytoplankton floating in the water. Despite the bloom, the water was very clear and we could see a distinct layer of freshwater at the surface.

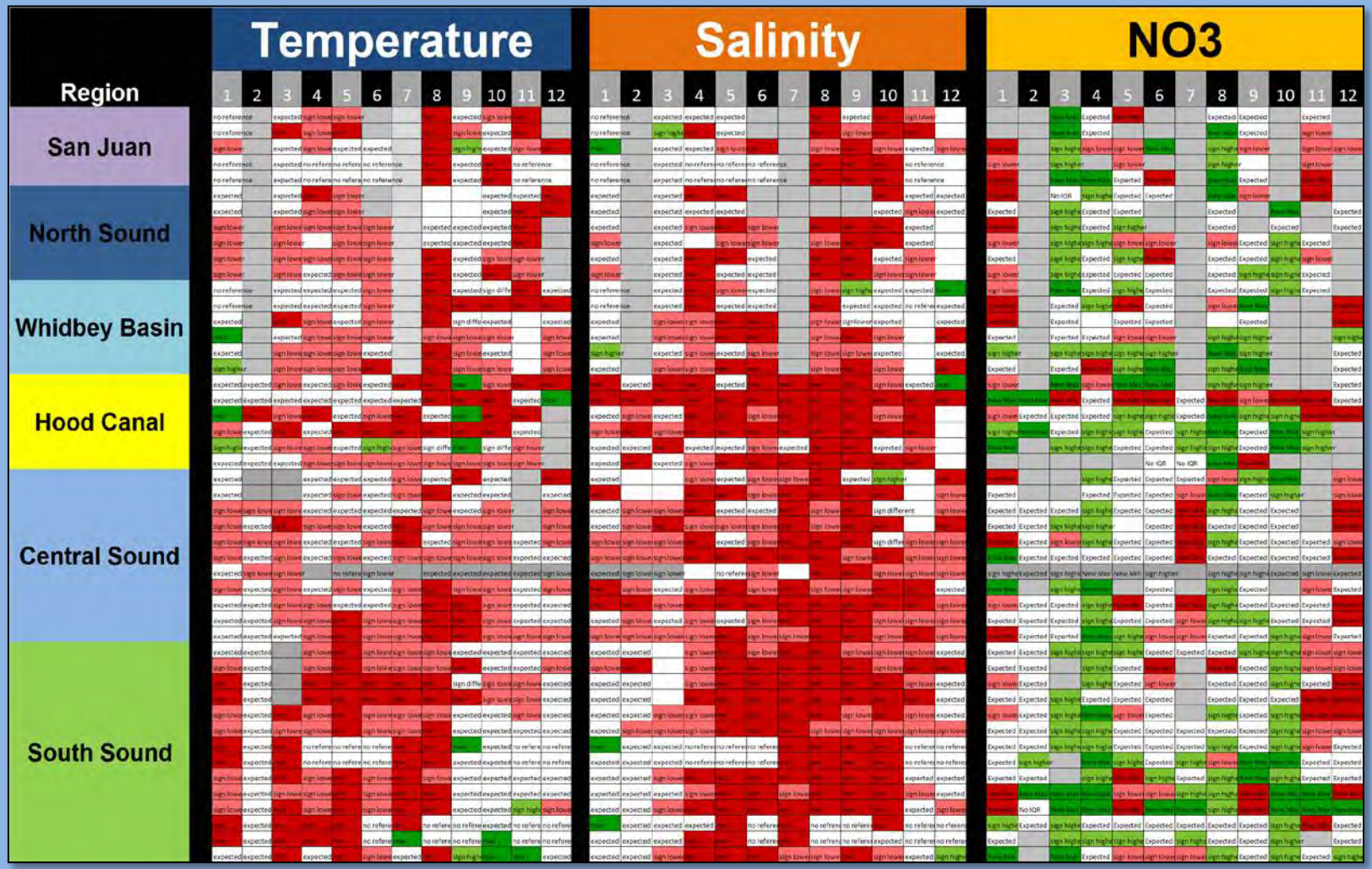
In Oakland bay the water was very green, and we saw a school of forage fish. It is always fun to go on a flight when the weather is nice and we see things we have never seen before.



Phytoplankton around the CTD in Hood Canal

2011 Year in review: Strong anomalies

Colder, fresher and more nutrients characterized the year 2011



Monthly anomalies for Ecology's marine monitoring regions in 2011

Color code: [expected, missing, higher, lower]

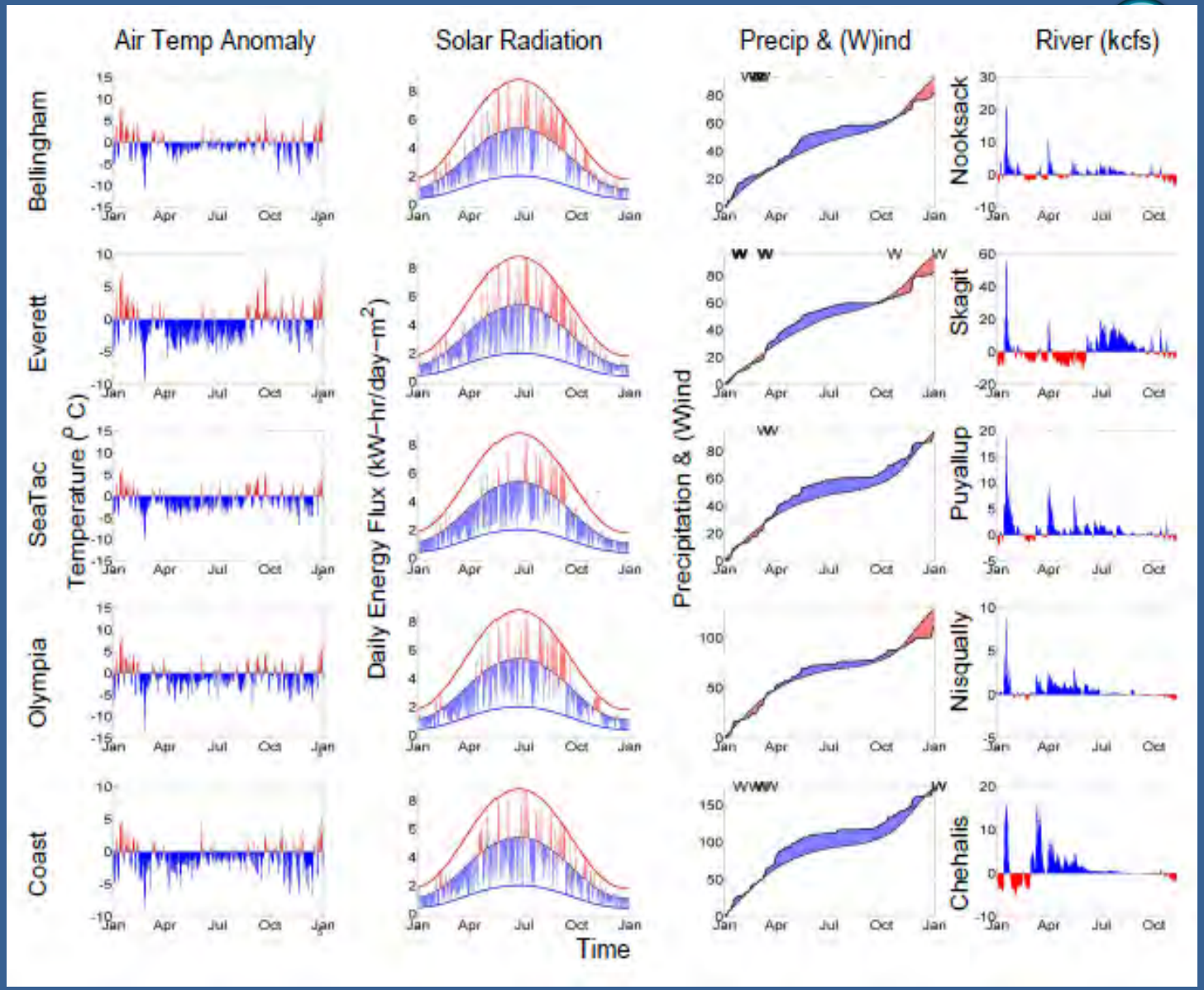
2011 Year in review: Strong anomalies

Year 2011 Summary:

Air temperatures were generally below normal

Rivers were generally above normal

Wind events were more frequent in the spring than in the fall.



Weather patterns from 4-9-2012 to 4-23-2012

Meteorological conditions typically explain up to half of the variance in observed marine variables (Moore et al. 2008), particularly in shallower waters like those of South Puget Sound. I summarized the specific conditions prevalent during the past two weeks, from north to south. Source: http://www-k12.atmos.washington.edu/k12/grayskies/nw_weather.html

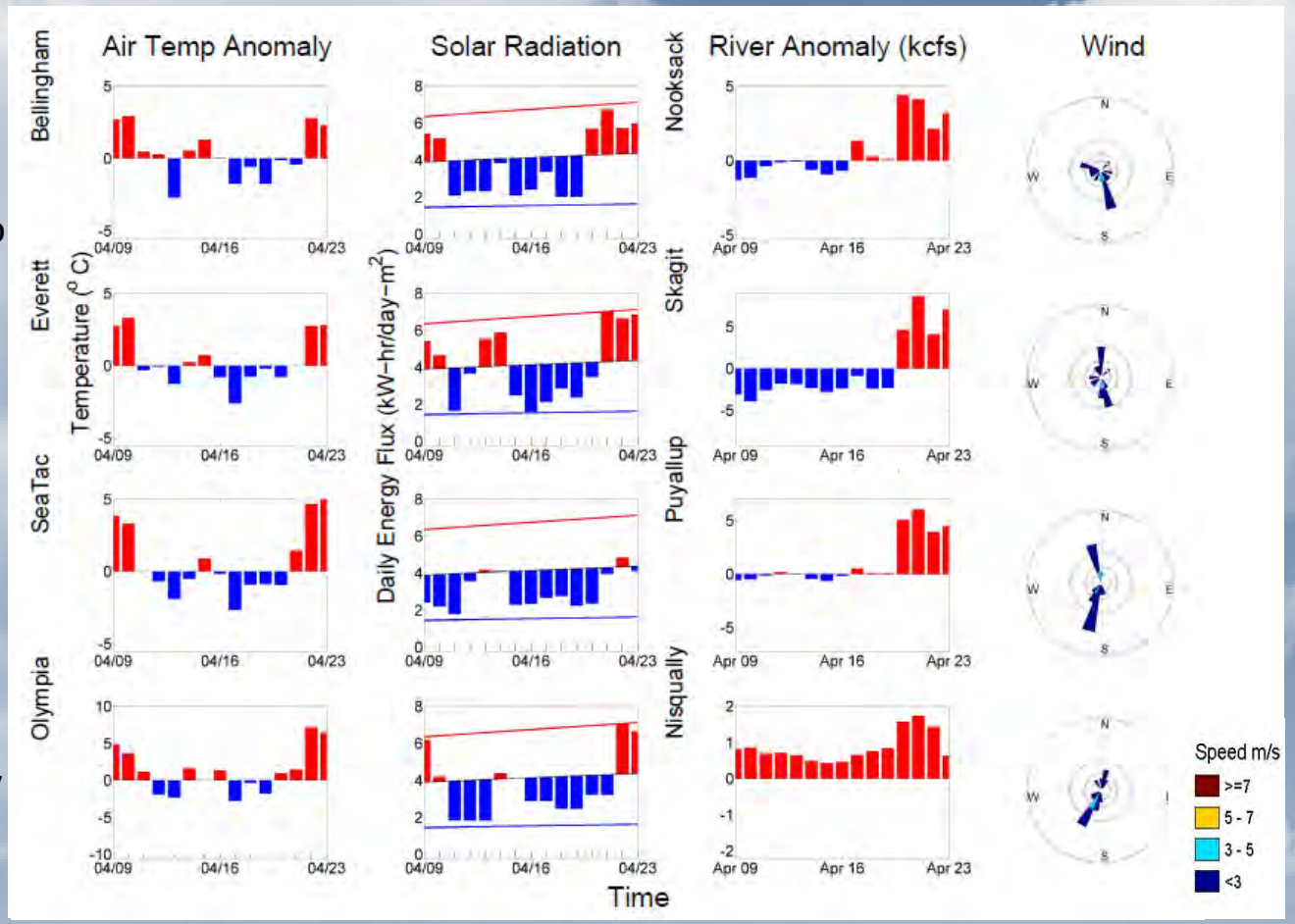
Summary:

Air temperatures during the past few days have been above average, but slightly cool prior to that.

Sunshine has been strong in the past three days, particularly outside the central region.

Rivers have been running above normal for the past several days, especially in the South Sound.

Winds have been predominantly from the north in past several days, and before that the south.



Moore et al. 2008. Local and large-scale climate forcing of Puget Sound oceanographic properties on seasonal to interdecadal timescales. Limnol. Oceanogr., 53(5), 1746–1758

Summary: Aerial photography 4-23-2012

Strong algal bloom in Inlets of South and Central Sound. Long debris lines in Case Island.

Start here

Bloom moving south (Bainbridge), 4:03 PM

Bloom north McNeil Island, 3:47 PM

Front

Mixing and Fronts: 2 3 4 5 11

Eddy in Sinclair Inlet, convergences in Case Inlet

Plume

Suspended sediment: 6 13 14 15

Extensive in Elliott Bay and Budd Inlet.

Bloom

Visible blooms: 1 6 7 8 9 10 11 12 15

First signs near Fox Island and Sinclair Inlet.

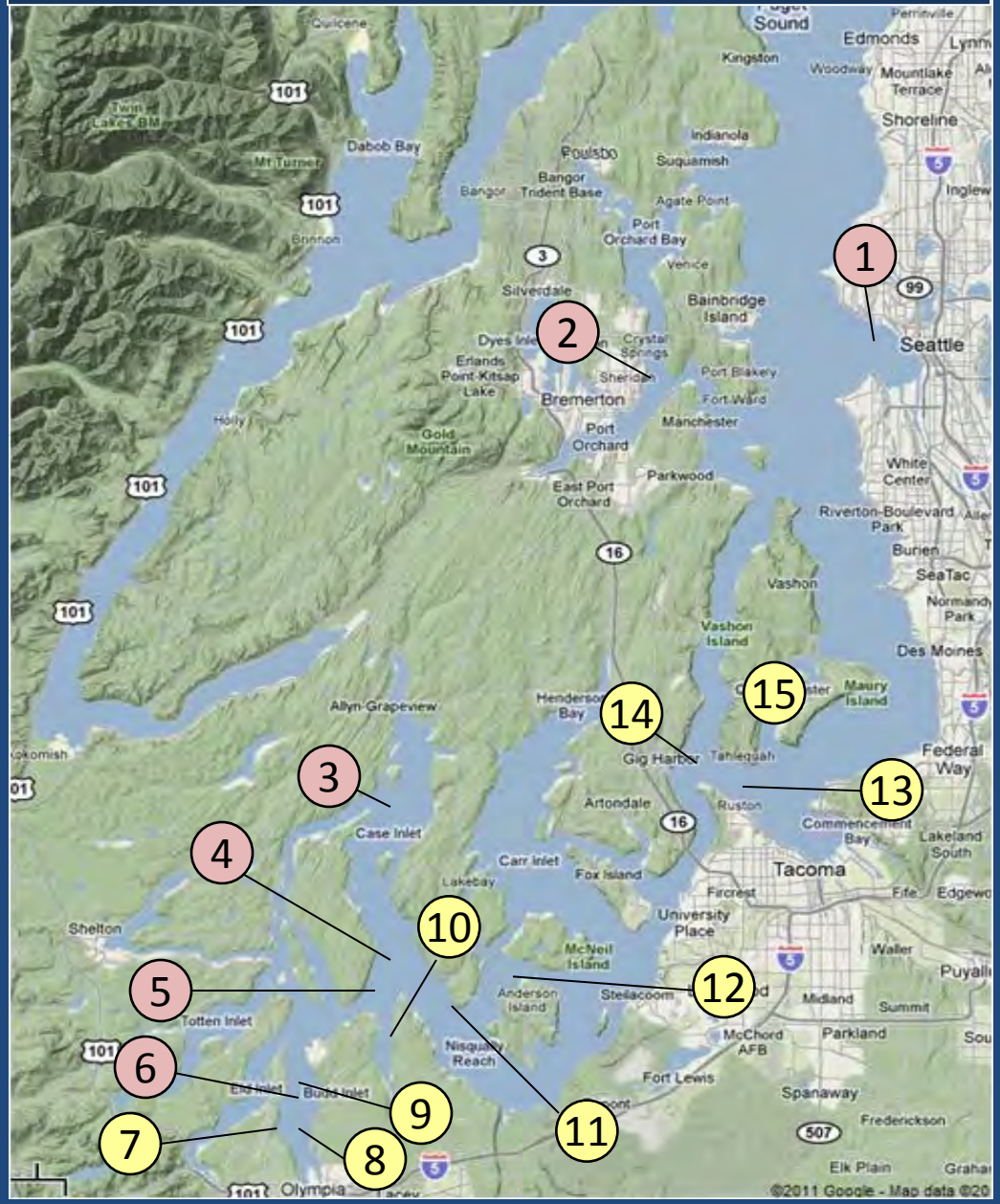
Debris

Debris 2 3 4 5 6 7 8 11

South Sound: Case Inlet, Dana Passage, Budd Inlet

Central Basin: Elliott Bay, off Bainbridge

High tides : 6:06 AM, 8:02 PM Low tides: 12:58 AM , 12:53 PM



Aerial photography image guide 4-23-2012

Click on numbers

Flight Information:

Morning flight:
Good visibility, calm

Evening flight:
Very good visibility, slight wind

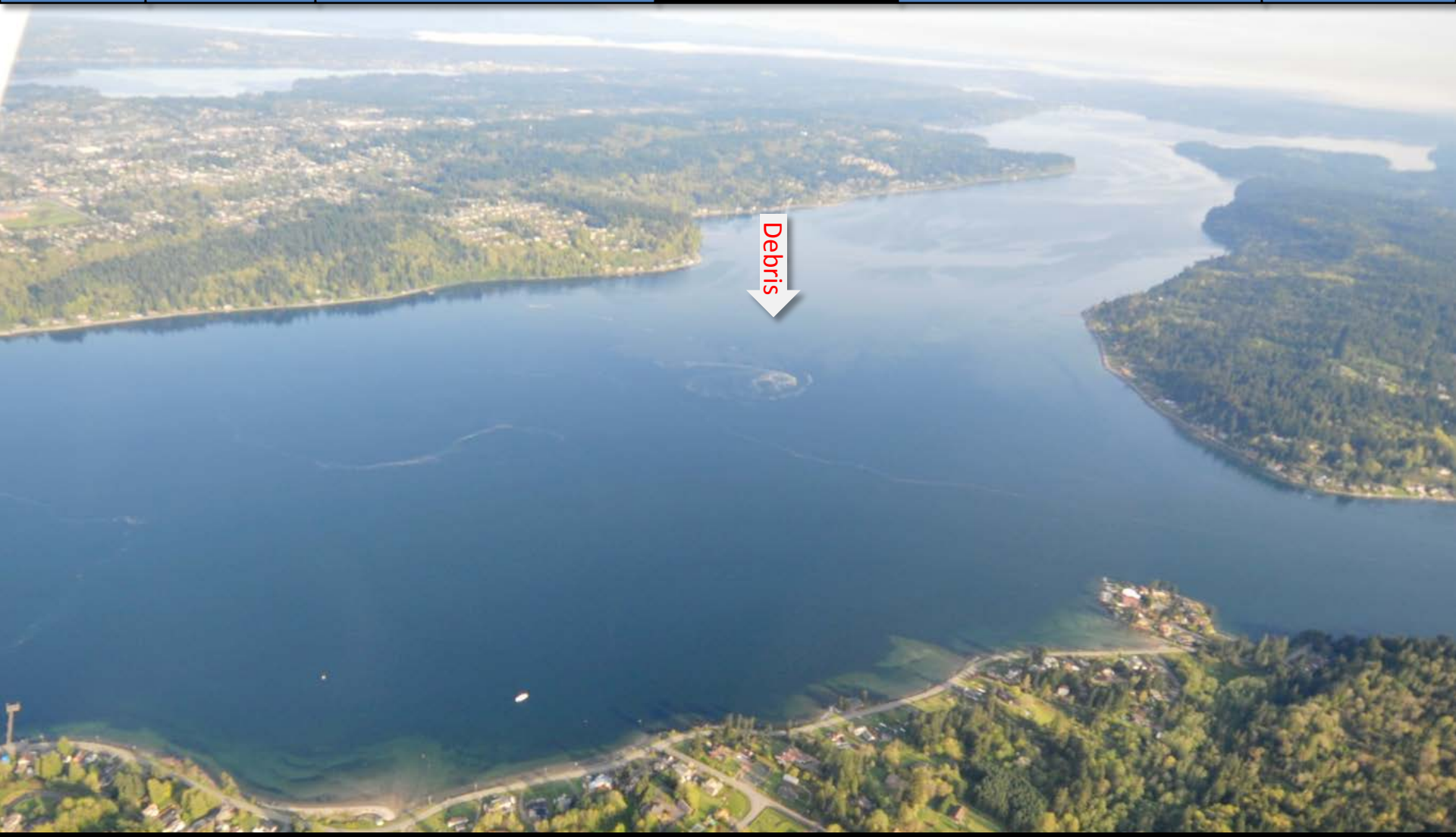
Observation Maps:

Central Sound

South Sound

Aerial photography 4-23-2012

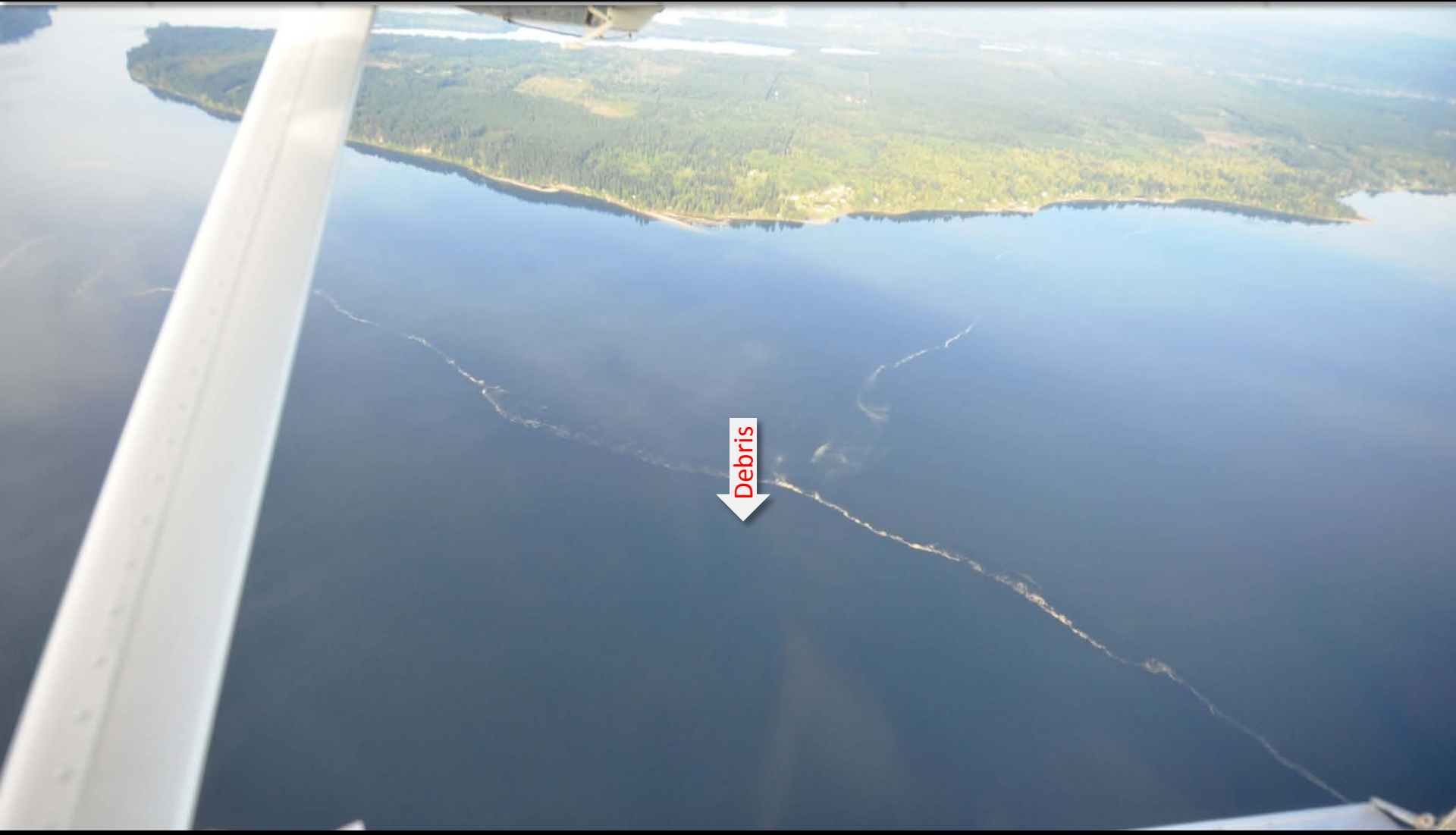
Near surface plume or bloom. Location: West of Elliott Bay looking south, 8:14 AM



Debris and eddy entering Sinclair Inlet. Location: Sinclair Inlet, 8:19 AM

Surface debris (likely Noctiluca). Location: Case Inlet, 8:31 AM

Aerial photography 4-23-2012



Debris line along convergence. Location: Case Inlet/Dana Passage (South Sound), 8:35 AM

Debris lines. Location: Entrance to Dana Passage (South Sound), 8:36 AM

Aerial photography 4-23-2012

Debris, sediment and bloom. Location: Budd Inlet (South Sound), 8:39 AM

Bloom and debris. Location: Budd Inlet (South Sound), 3:39 PM

Aerial photography 4-23-2012

Debris with brown bloom and sediment. Location: Budd Inlet (South Sound), 3:39 PM

Aerial photography 4-23-2012

Brown bloom and ship track. Location: Budd Inlet (South Sound), 3:40 PM

Aerial photography 4-23-2012

Brown-red bloom. Location: Henderson Inlet (South Sound), 3:43 PM

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Aerial photography 4-23-2012

Tidal current, front and debris lines. Location: Nisqually Reach (South Sound), 3:44 PM

Aerial photography 4-23-2012

Mixing of water during flood. Location: Anderson Island (South Sound), 3:46 PM

Puyallup river plume and algae bloom? Location: Vashon Island/Tacoma, 3:53 PM

Aerial photography 4-23-2012

Puyallup plume flowing into Tacoma Narrows. Location: Point Defiance (Tacoma), 3:53 PM

Aerial photography 4-23-2012

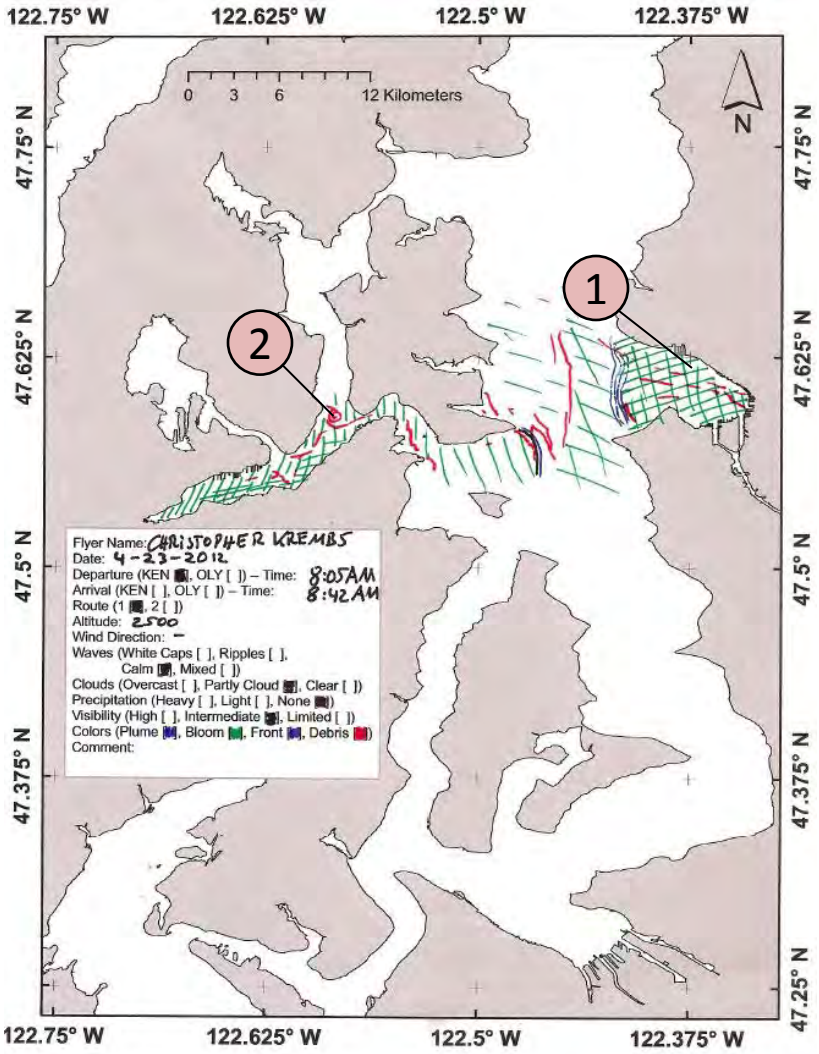
Quartermaster Harbor in bloom. Location: Vashon Island (Central Sound), 3:56 PM

Aerial observations in Central Sound, 4-23-2012

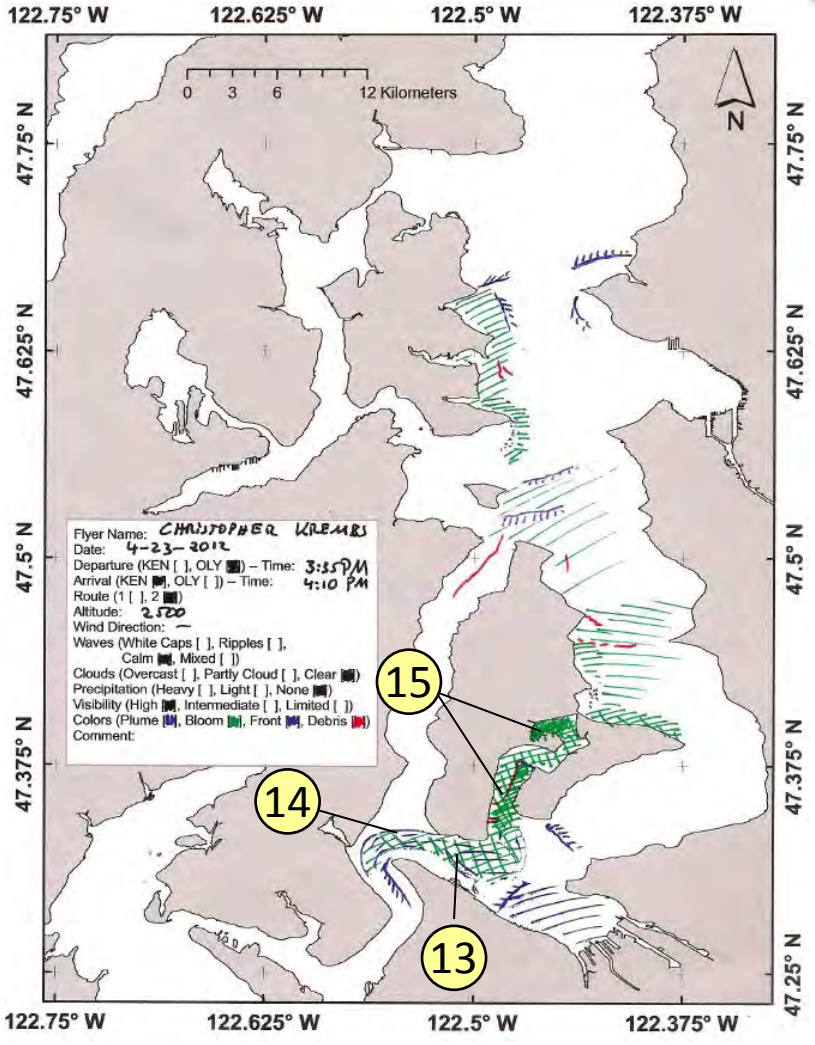
Navigate

Field log | Weather | Water column | Aerial photos | Ferry and Satellite | Moorings

Morning



Evening



Numbers on map refer to picture numbers for spatial reference

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State of Washington

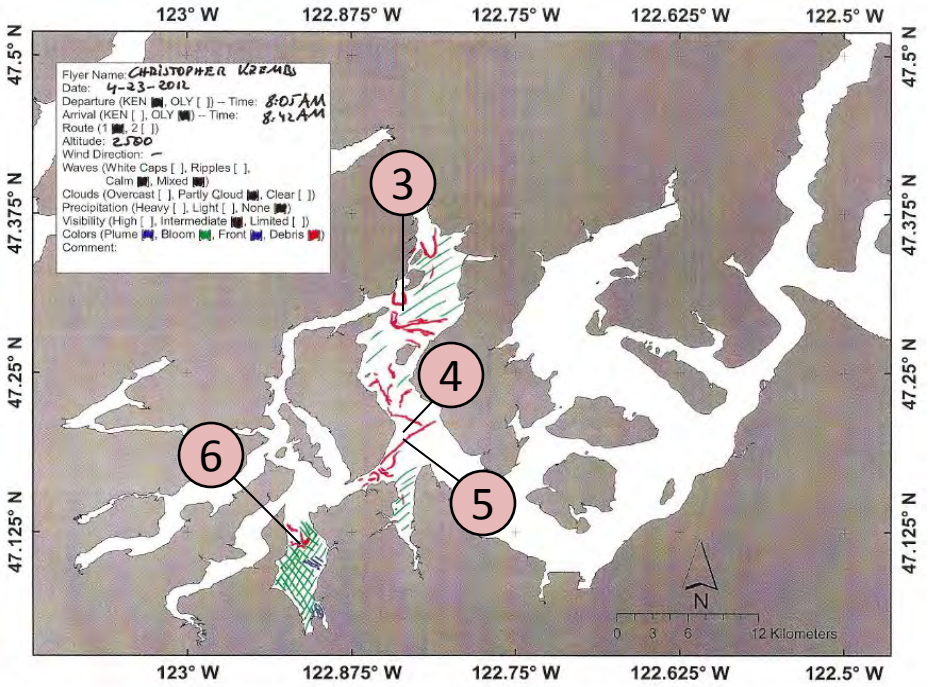
Aerial photography

Observations in South Sound: 4-23-2012

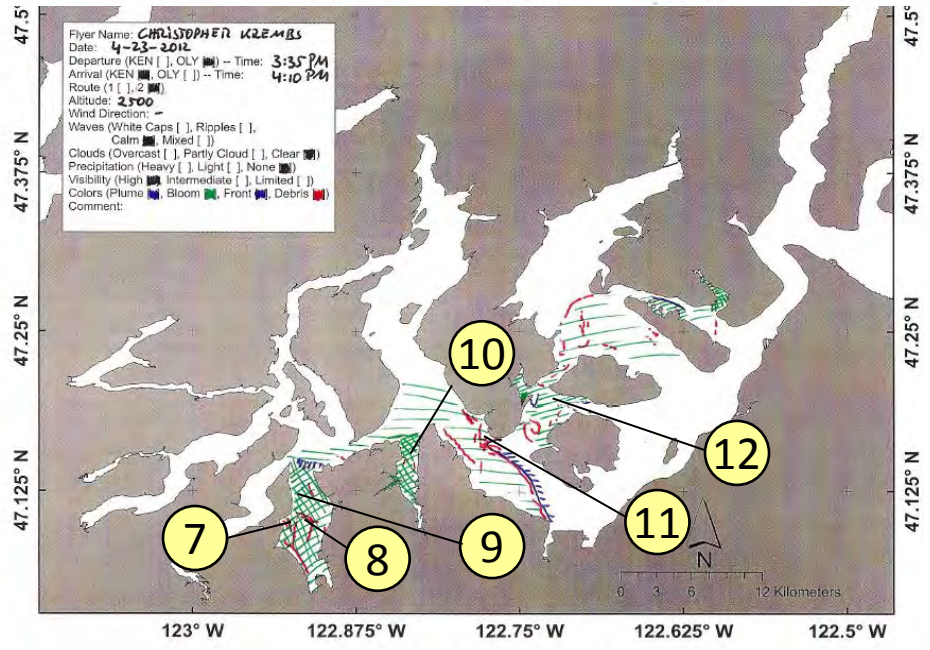
Navigate

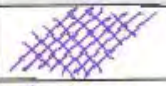
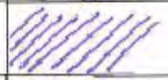
Numbers on map refer to picture numbers for spatial reference

Morning



Evening



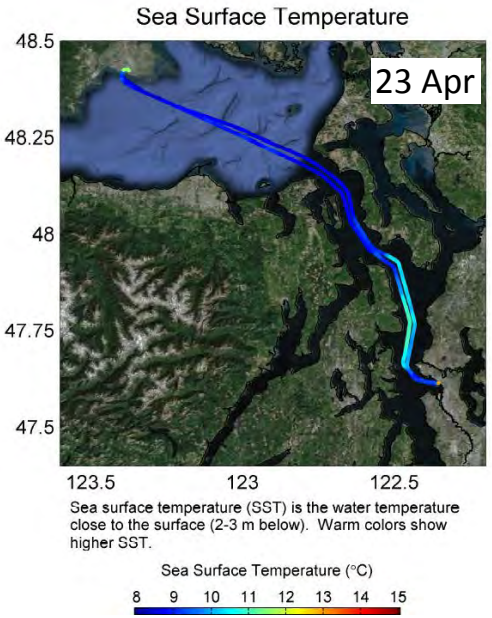
Plumes	
• Freshwater with sediment **solid**	
• Freshwater with sediment **dispersed**	
• Coastal erosion with sediment	
Blooms	
• Dispersed	
• Solid	
Debris	
• Dispersed	
• Solid	
Front	
• Distinct water mass boundaries	
• Several scattered	

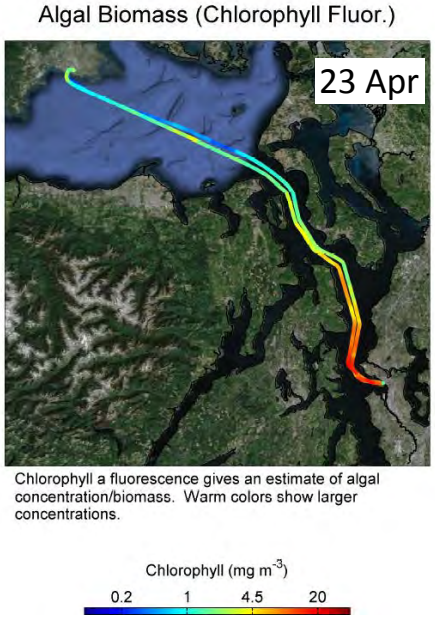
Comments:
Maps are produced by observers during and after flights. They are intended to give an approximate reconstruction of the surface conditions on scales that connect to and overlap with satellite images in the section that follows.

Daily ferry and satellite observations in Central Sound, 4-23-2012

Contact: brandon.sackmann@ecy.wa.gov

MERIS True Color image used for spatial context (19 February 2011). Image is not coincident with ferry data shown on right





Current Conditions: Moderate fluorescence in Central Sound; lower levels through Admiralty Inlet and the Strait of Juan de Fuca.

Temperatures > 10 °C are associated with freshwater entering Central Sound from Whidbey Basin.

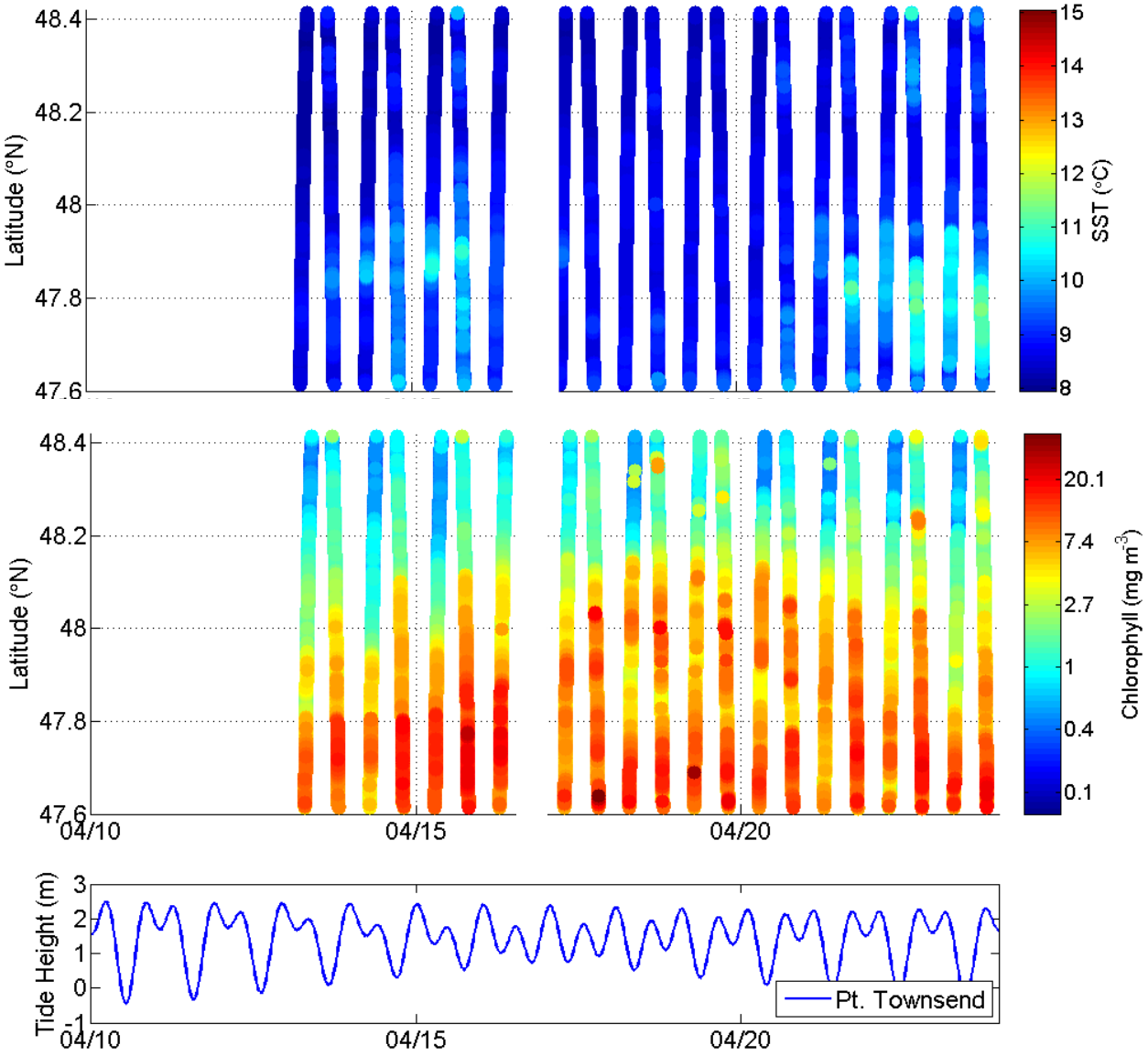
--- Daily 'Quick-Look' Products Available ---

(http://www.ecy.wa.gov/programs/eap/mar_wat/eops/clipper.html)

Ferry & satellite observations, 4-12-2012 to 4-23-2012

Warmer sea surface temperatures seen in Central Sound over the last week. This pulse of warm/fresh water is associated with higher flows from rivers draining into Whidbey Basin.

Phytoplankton begin to bloom in Central Sound!

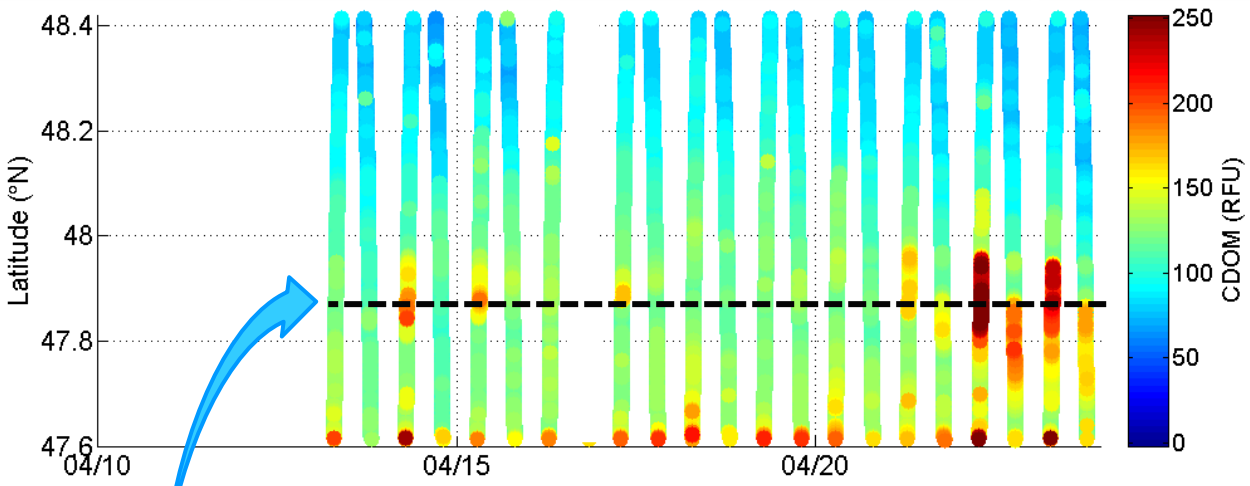


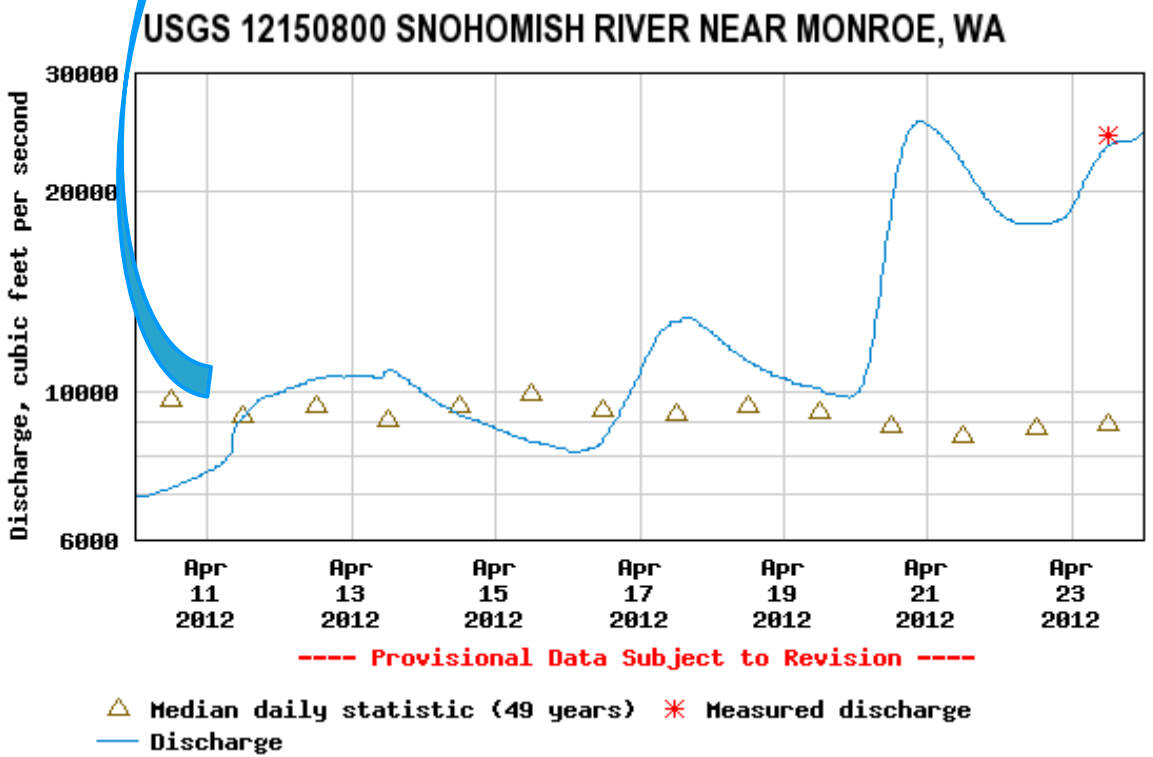
Ferry & satellite observations, 4-12-2012 to 4-23-2012

CDOM fluorescence as an indicator of freshwater influence in Central Sound

A primary source of Colored Dissolved Organic Matter (CDOM) to Puget Sound is from rivers.

Highly colored water is making its way into Puget Sound, associated with higher river flows into Whidbey Basin.





Ferry & satellite observations, 4-12-2012 to 4-23-2012

News & Announcements

Hello, Goodbye?

For the past 2 years Ecology has been using the MERIS ocean color sensor, flown on ESA's Envisat satellite, to monitor water quality in Puget Sound. On April 8, after 10 years of service, Envisat stopped sending data to Earth. ESA's mission control is working to re-establish contact with the satellite.

Read more…

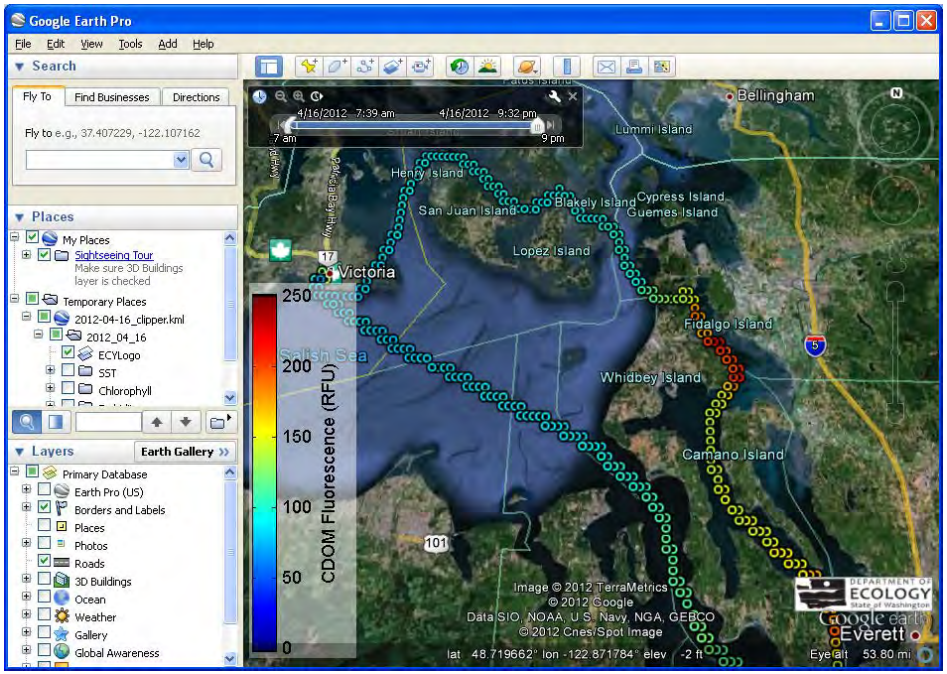
New Sensor!

A new Citadel Thermosalinograph has been installed on the Victoria Clipper IV to provide measurements of sea surface salinity. Data collection to begin in May.

A Glimpse into the San Juan Islands and Whidbey Basin

A few times each year the Victoria Clipper IV makes its way through the San Juan Islands and Whidbey Basin on its way to/from Victoria, BC. This non-standard route allows us to collect observations in less frequently sampled regions.

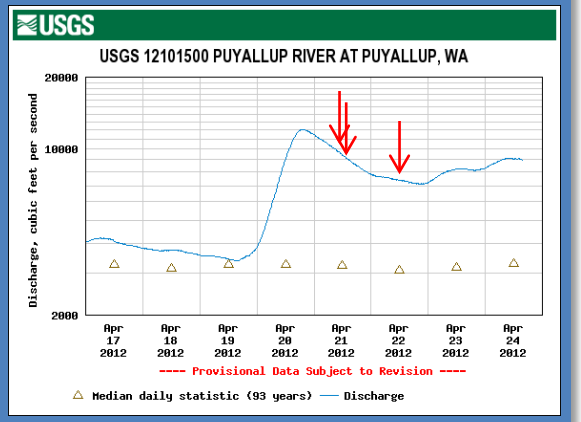
Follow the Victoria Clipper through the San Juans!
Download the Google KML layer…



Ferry & satellite observations, 4-12-2012 to 4-23-2012

Puyallup River Plume

A series of MODIS scenes from 21-22 April show the spatial extent of the Puyallup River plume, following a large rise in river discharge on 20 April. The plume encompasses much of the area south of Maury Island and stretches across Commencement Bay into Quartermaster Harbor.



RGB True Color

(A) MODIS-Terra
21 Apr 2012 @ 12:00 PDT

(B) MODIS-Aqua
21 Apr 2012 @ 13:45 PDT

(C) MODIS-Terra
22 Apr 2012 @ 12:40 PDT

Rrs(645 nm); Turbidity Proxy

Mooring observation and trends 4-09-2012 to 4-22-2012

Summary: Over the past 2 weeks, we observed warmer and more oxygenated waters in the Whidbey Basin. In Central Sound, we observed warmer and slightly decreased oxygenated waters.

Mukilteo, Whidbey Basin near Everett: At near-bottom (12-16 m), the overall trend was toward higher DO levels and warmer water. Lower DO levels correlated with higher salinity and colder water.

Mean values & trend over past 2 weeks:

NB: DO: 9.6 mg/L (↑ 1.4 mg/L)
Temp: 8.3°C (↑ 0.8°C)
Salinity: 28.7 PSU (↓0.13 PSU)

Surface: Not reporting for full period

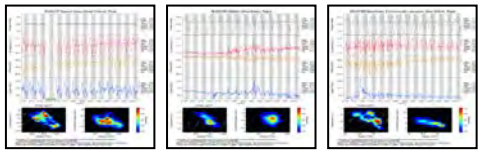
Manchester, Central Sound: At near-bottom (8.3-12.9 m), the overall trend was toward lower DO levels and warmer water. Lower DO levels correlated with higher salinity. Near-surface (1.1-5.7 m) water temperature increased.

Mean values & trend over past 2 weeks:

NB: DO: 9.2 mg/L (↓ 0.4 mg/L)
Temp: 8.3°C (↑ 0.7°C)
Salinity: 28.9 PSU

Surface: Temp: 8.3 °C (↑ 0.3°C)
Salinity: 28.9 PSU

Squaxin Passage (South Sound) near Olympia: Station decommissioned



Real-time data online (click)

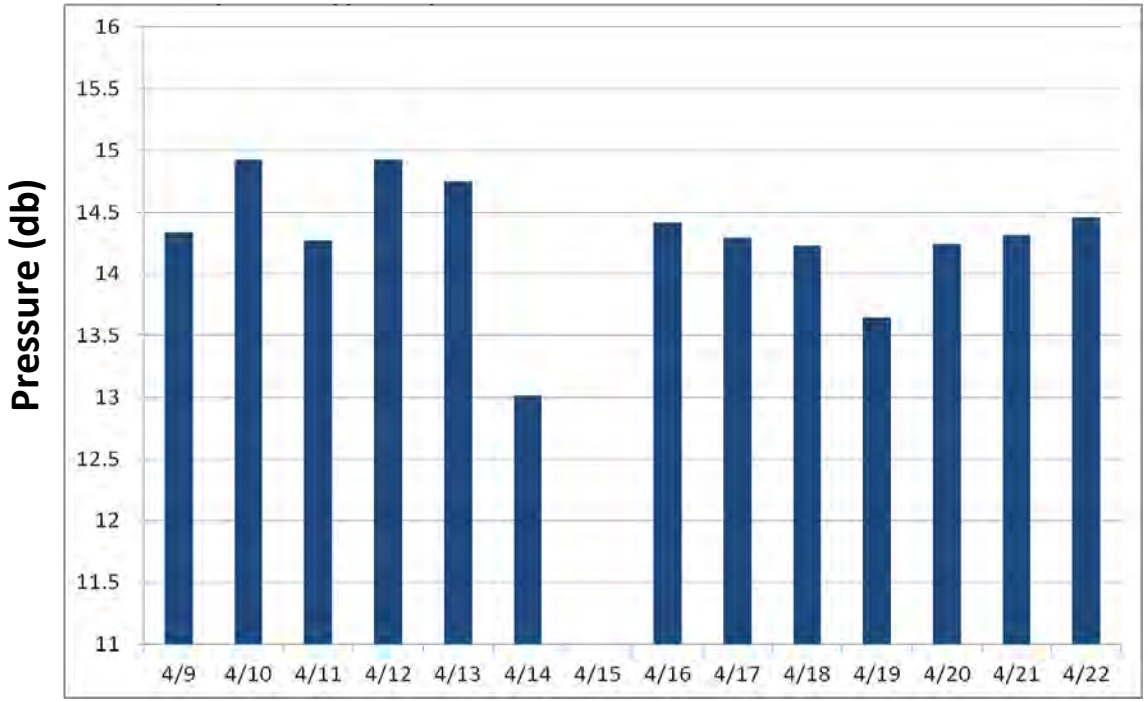
Mooring observation and trends 4-09-2012 to 4-22-2012

Go to our mooring site at: http://www.ecy.wa.gov/programs/eap/mar_wat/moorings.html

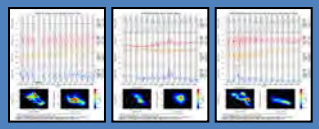
Summary: The thickness of the 28.55 isohaline fluctuated around 14.5 meters, which is approximately 0.75 meters deeper than the previous month. This means that the freshwater layer is thicker.

We currently report the thickness of the freshwater layer between Whidbey Basin and Central Basin to understand freshwater input to Puget Sound.

Daily average depth of the 28.55 isohaline at Mukilteo

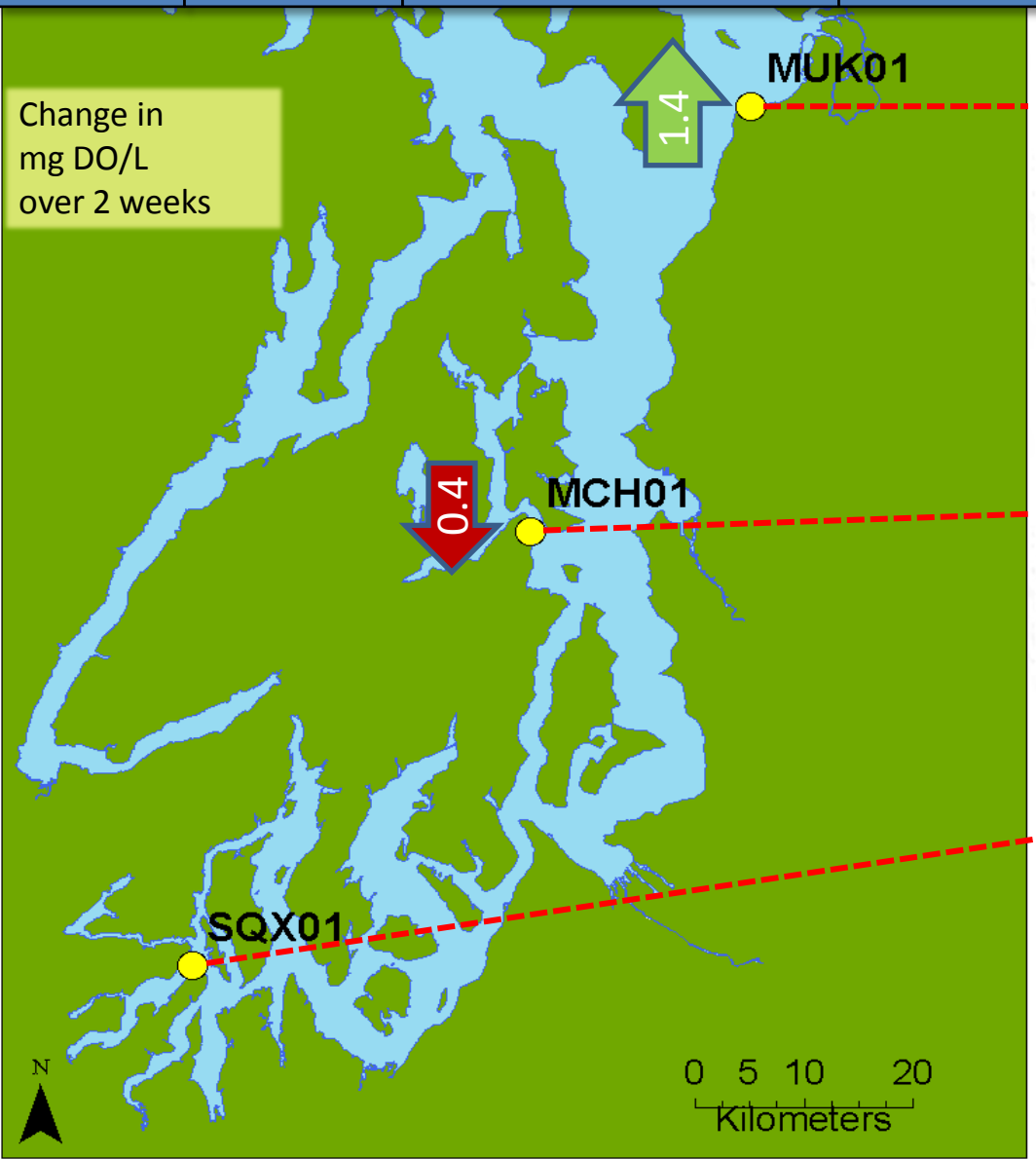


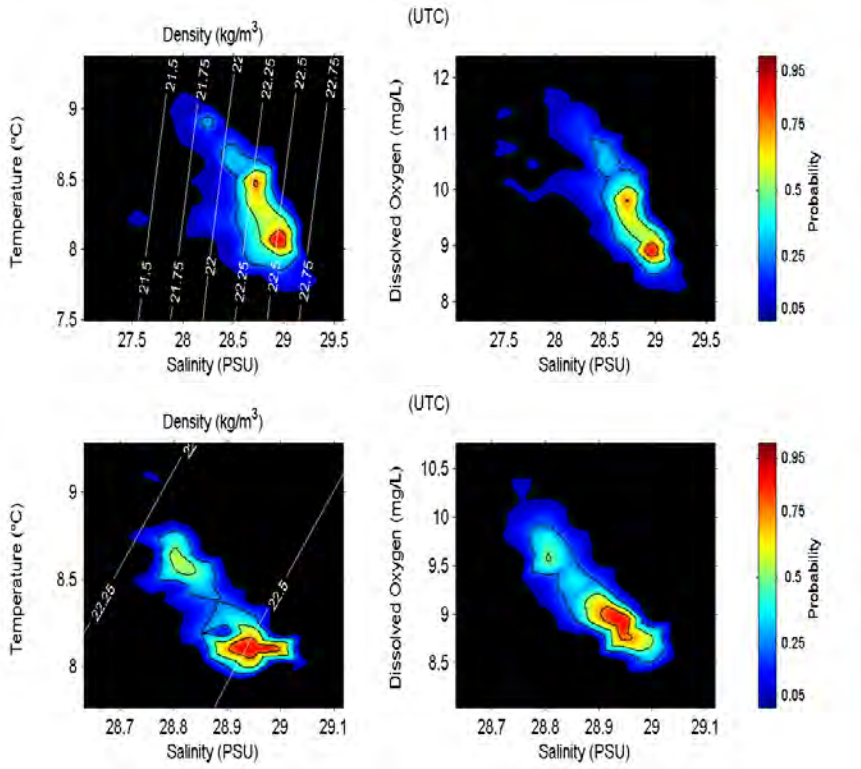
We track the depth of the isohaline where salinity is 28.55 (±0.05) to measure the thickness of the freshwater layer at our Mukilteo station. The sensor experiences tidal pressure variations of 11.8 to 15.6 meters (or dbar).



Real-time data online (click)

Mooring observation and trends 4-09-2012 to 4-22-2012





Station SQX01 decommissioned

Left Panel: Probability of finding a specific density over the past two-week period. High probability shown in warm colors.

Right Panel: Dissolved oxygen concentration in relation to salinity. High probability shown in warm colors.

Get data from Ecology's Environmental Assessment Program

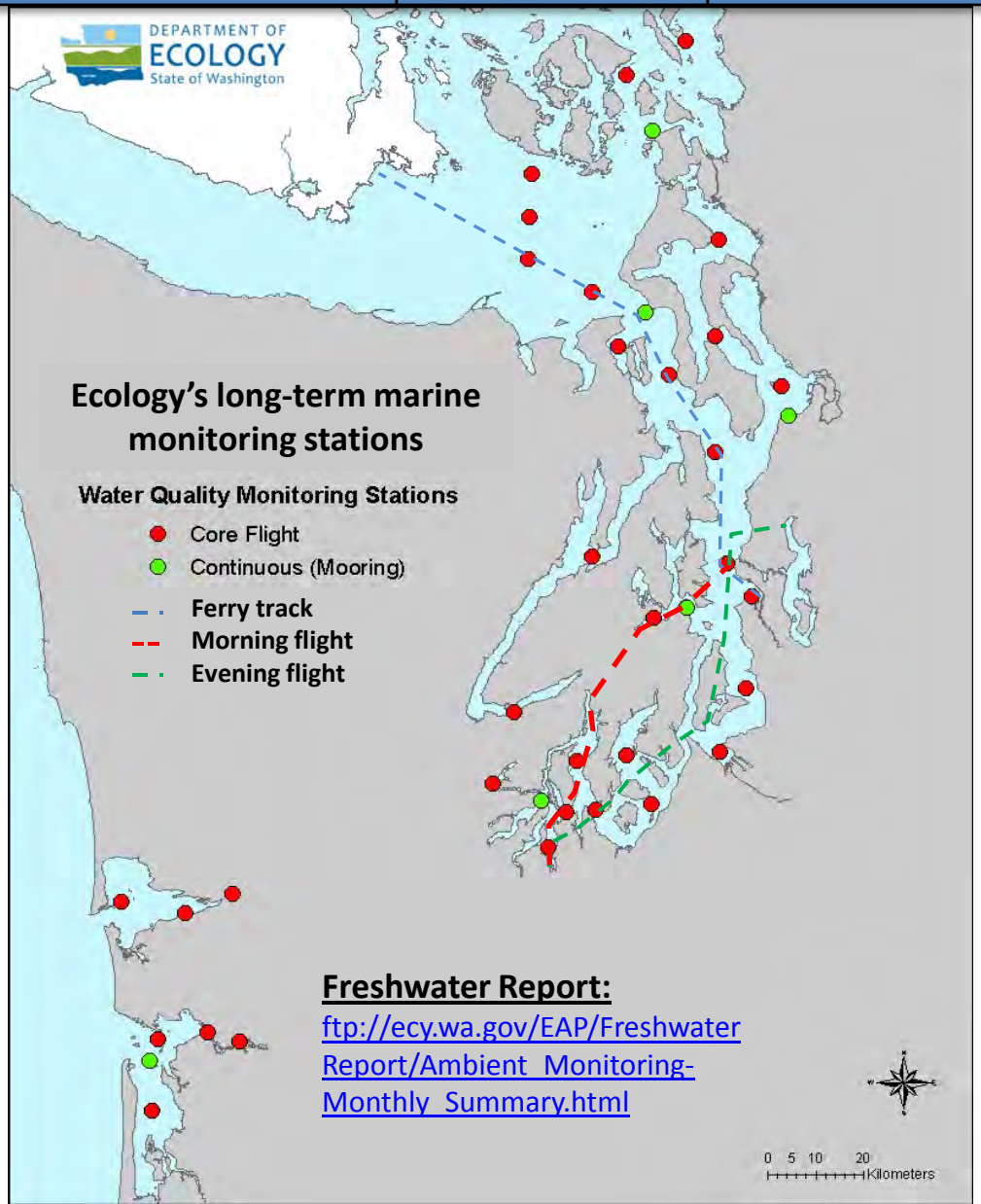
Field log	Weather	Water column	Aerial photos	Ferry and Satellite	Moorings

Long – Term Monitoring Network

christopher.krembs@ecy.wa.gov

Access core monitoring data:

http://www.ecy.wa.gov/apps/eap/marinewq/mwdataset.asp



Real – Time Sensor Network

brandon.sackmann@ecy.wa.gov

Access mooring data:

http://www.ecy.wa.gov/programs/eap/mar_wat/moorings.html

You may subscribe or unsubscribe to the Eyes Over Puget Sound email listserv by going to:
http://listserv.wa.gov/cgi-bin/wa?A0=ECOLOGY-EYES-OVER-PUGET-SOUND

We are looking for feedback to improve our products.

Dr. Christopher Krembs
ckre461@ecy.wa.gov

Marine Monitoring Unit
Environmental Assessment Program
WA Department of Ecology

Many thanks to our business partners: Clipper Navigation, Swantown Marina and Kenmore Air.