Surface Conditions Report
April 23, 2012

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

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

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#### Personal flight impression
Much to see in the surface layer. The productive growth season is in full swing.

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

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

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

#### In-situ mooring data
The freshwater layer in Whidbey Basin increased by 2m following high precipitation and run-off.

Previous Eyes Over Puget Sound reports:
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.
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.
### Monthly anomalies for Ecology's marine monitoring regions in 2011

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

#### Reporting Regions
- San Juan
- North Sound
- Whidbey Basin
- Hood Canal
- Central Sound
- South Sound

#### Field log
- Weather
- Water column
- Aerial photos
- Ferry and Satellite
- Moorings

#### 2011 Year in review: Strong anomalies

Colder, fresher and more nutrients characterized the year 2011.
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.
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](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.

Summary: Aerial photography 4-23-2012

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

Mixing and Fronts: 2 3 4 5 11
Eddy in Sinclair Inlet, convergences in Case Inlet

Suspected sediment: 6 13 14 15
Extensive in Elliott Bay and Budd Inlet.

Visible blooms: 1 6 7 8 9 10 11 12 15
First signs near Fox Island and Sinclair Inlet.

Debris 2 3 4 5 6 7 8 11
South Sound: Case Inlet, Dana Passage, Budd Inlet
Central Basin: Elliott Bay, off Bainbridge
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

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High tides: 6:06 AM, 8:02 PM
Low tides: 12:58 AM, 12:53 PM
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
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
Debris, sediment and bloom.  Location: Budd Inlet (South Sound), 8:39 AM
Bloom and debris.  Location: Budd Inlet (South Sound), 3:39 PM
Debris with brown bloom and sediment. Location: Budd Inlet (South Sound), 3:39 PM
Brown bloom and ship track. Location: Budd Inlet (South Sound), 3:40 PM
Brown-red bloom. Location: Henderson Inlet (South Sound), 3:43 PM
Tidal current, front and debris lines. Location: Nisqually Reach (South Sound), 3:44 PM
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
Puyallup plume flowing into Tacoma Narrows. Location: Point Defiance (Tacoma), 3:53 PM
Quartermaster Harbor in bloom.  Location:  Vashon Island (Central Sound), 3:56 PM
Aerial observations in Central Sound, 4-23-2012

Numbers on map refer to picture numbers for spatial reference.
Aerial photography

Observations in South Sound:
4-23-2012

Numbers on map refer to picture numbers for spatial reference
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.
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)
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!
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.
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...

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.
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.

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

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

Ferry & satellite observations, 4-12-2012 to 4-23-2012
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)
We currently report the thickness of the freshwater layer between Whidbey Basin and Central Basin to understand freshwater input to Puget Sound.


**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 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).

**Daily average depth of the 28.55 isohaline at Mukilteo**

Real-time data online (click)
Mooring observation and trends
4-09-2012 to 4-22-2012

- **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.

**Change in mg DO/L over 2 weeks**

- **MUK01**
- **MCH01**
- **SQX01**

**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

### Long – Term Monitoring Network

Access core monitoring data:

christopher.krembs@ecy.wa.gov

### Real – Time Sensor Network

Access mooring data:

Brandon.sackmann@ecy.wa.gov

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**Ecology’s long-term marine monitoring stations**

- Core Flight
- Continuous (Mooring)
- Ferry track
- Morning flight
- Evening flight

**Freshwater Report:**
We are looking for feedback to improve our products.

Dr. Christopher Krembs
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Marine Monitoring Unit
Environmental Assessment Program
WA Department of Ecology

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

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