

# Eyes Over Puget Sound

[Field log](#)[Weather](#)[Water column](#)[Aerial photos](#)[Ferry and Satellite](#)[Moorings](#)

## Surface Conditions Report September 12, 2011

[Start here](#)[Start here](#)

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

## Present Conditions at a Glance

*Mya Keyzers  
Laura Friedenberg*



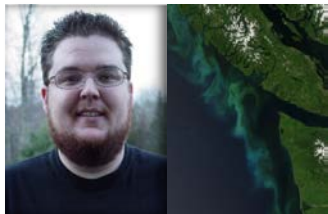
*Skip Albertson*



*Dr. Christopher  
Krembs*



*Dr. Brandon  
Sackmann*



*Ashley Carle  
David Mora*



Personal flight impression [p. 3-4](#)

Bright green algal mats, jellyfish, and the discovery of an oil spill in the South Sound

Weather conditions [p. 5](#)

Warm temperatures, sunlight, northerly (off land) breezes, all combine to give an impression of summer

Aerial photography [p. 7-26](#)

Brown-red blooms in Carr Inlet and Budd Inlet. Macro-algae aggregations in Central Sound. Green bloom NE of Bainbridge Island

Ferry and satellite [p. 27-32](#)

High surface fluorescence throughout northern Central Sound; highest values east of Port Madison

*In-situ* mooring data [p. 33-34](#)

Salinity and temperatures kept increasing while dissolved oxygen trends varies locally

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Mya and Laura in the field

## Jelly, oil and algae



Pilot Joe Leatherman, Kenmore Air

## Marine Flight 4 (South)

*The South Sound marine flight took place on a warm yet overcast day. We were discouraged by a few instrument problems in the beginning, but after everything started working, we were able to see many neat things. There were streaks of thick, green algal mats near Gordon Point, and the usual river plume in Commencement Bay. The river plume from the Puyallup river always looks different, and is usually a very cool sight to see. On this day, there were very defined streaks of river water entwined with salt water. We also saw a parasailor in commencement bay.*

*When we flew over Oakland Bay in Shelton, we discovered an oil spill which we were able to report to the Department of Ecology spills program. Sometimes oil spills or oil from runoff is hard to see from the ground, or may not be seen at all in unpopulated areas. This is yet another advantage of seeing the water from the air.*

*In Eld Inlet during a CTD cast we got an exciting surprise. A swarm of moon jellyfish floated under the plane, and the CTD caught quite a few of them. Needless to say that Mya had a very slimy sampling experience for that cast!*

# Personal flight impression 9-12-2011



Field log

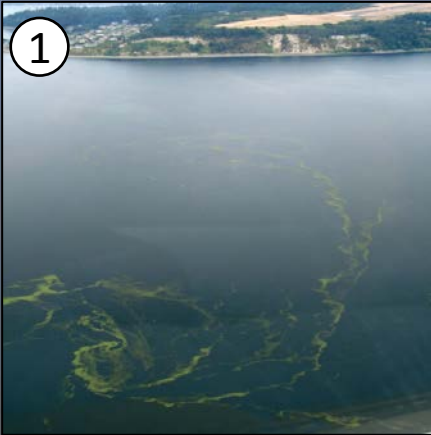
Weather

Water column

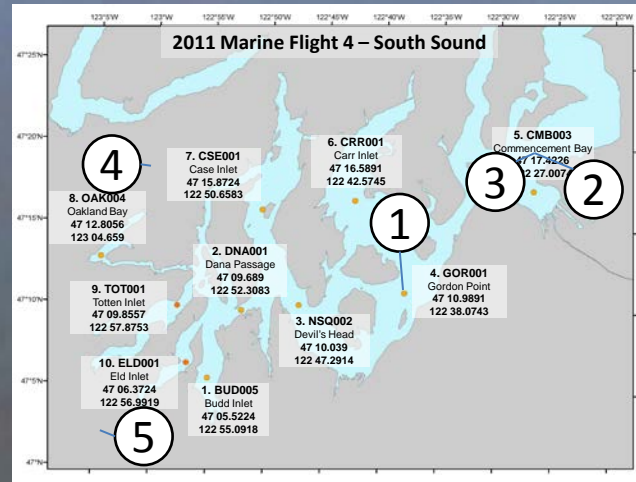
Aerial photos

Ferry and Satellite

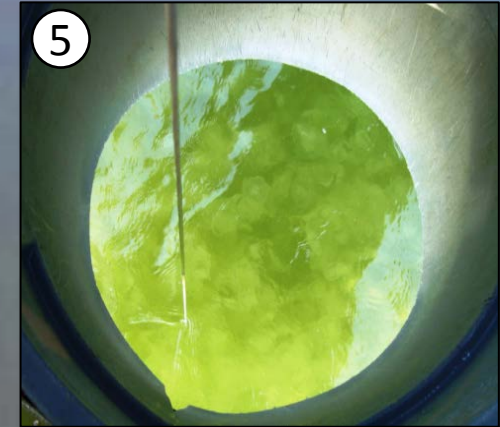
Moorings



*Algal mats in Gordon Point*



*Station map in South Sound (Flight 4)*



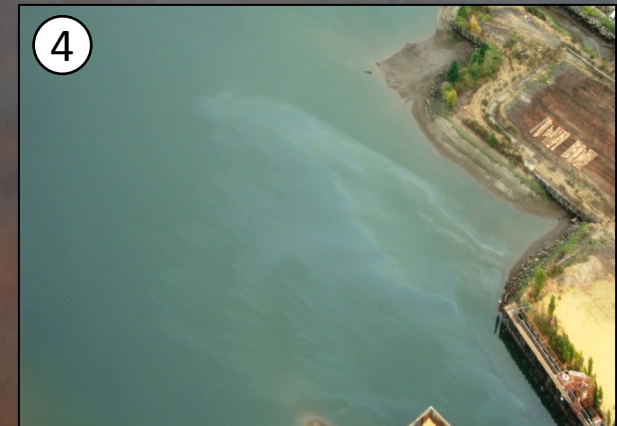
*Swarm of jellyfish in Eld Inlet*



*River Plume in Commencement Bay*



*Parasailing in Commencement Bay*



*Oil Spill in Shelton*



# Weather of the last two months 9-12-2011

[Field log](#)[Weather](#)[Water column](#)[Aerial photos](#)[Ferry and Satellite](#)[Moorings](#)

**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. The specific conditions prevalent during the past two weeks, from north to south, are shown below.

## Summary:

**Air temperatures** during the past week were finally above normal after a prolonged period of being anomalously cool. Sunlight was also abundant during the period.

**Coastal and northern rivers** have been running lower than normal, except in Central Sound where the Puyallup and Skagit have been high.

**Winds** have been from predominantly the north.

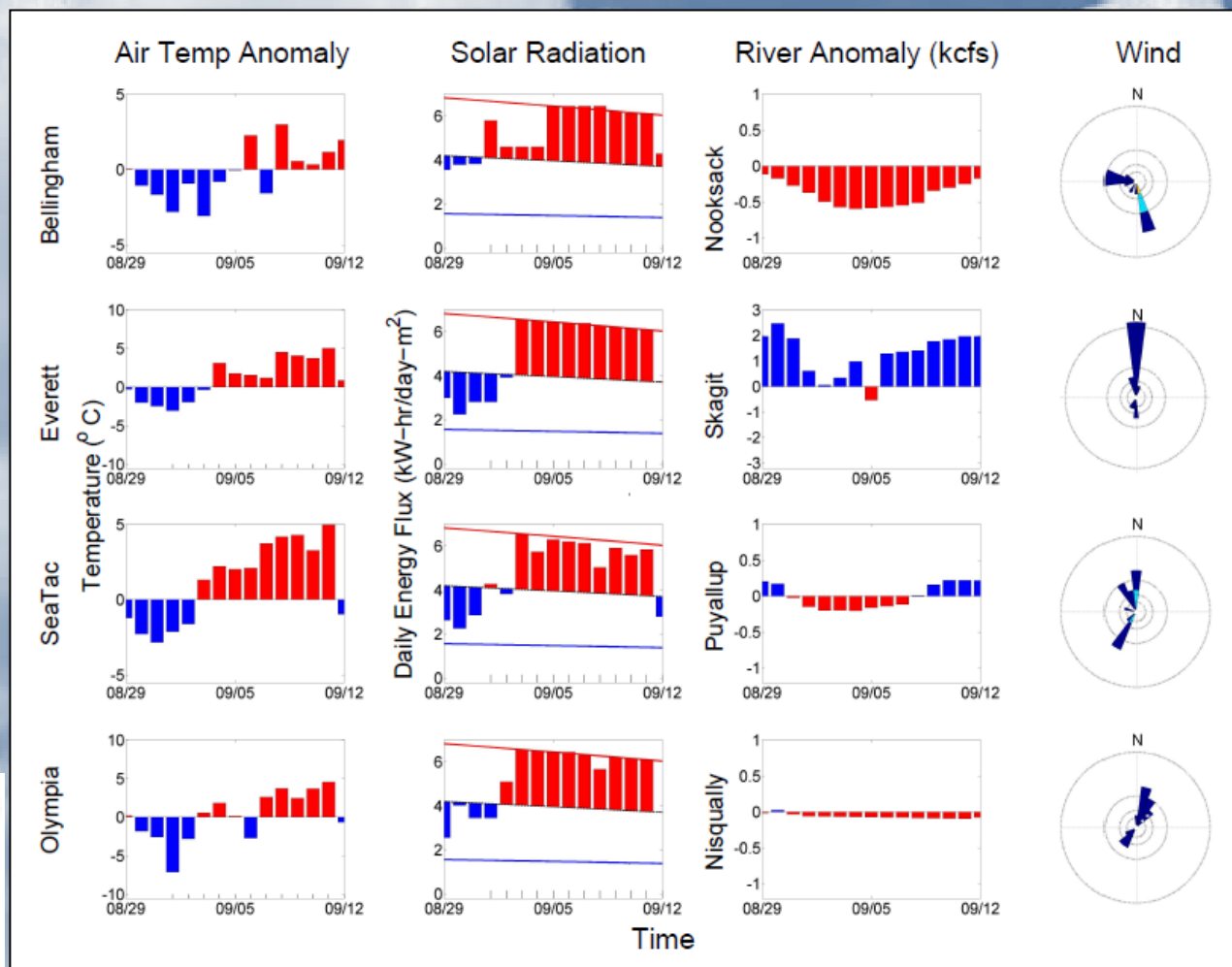
Speed m/s

■  $\geq 7$

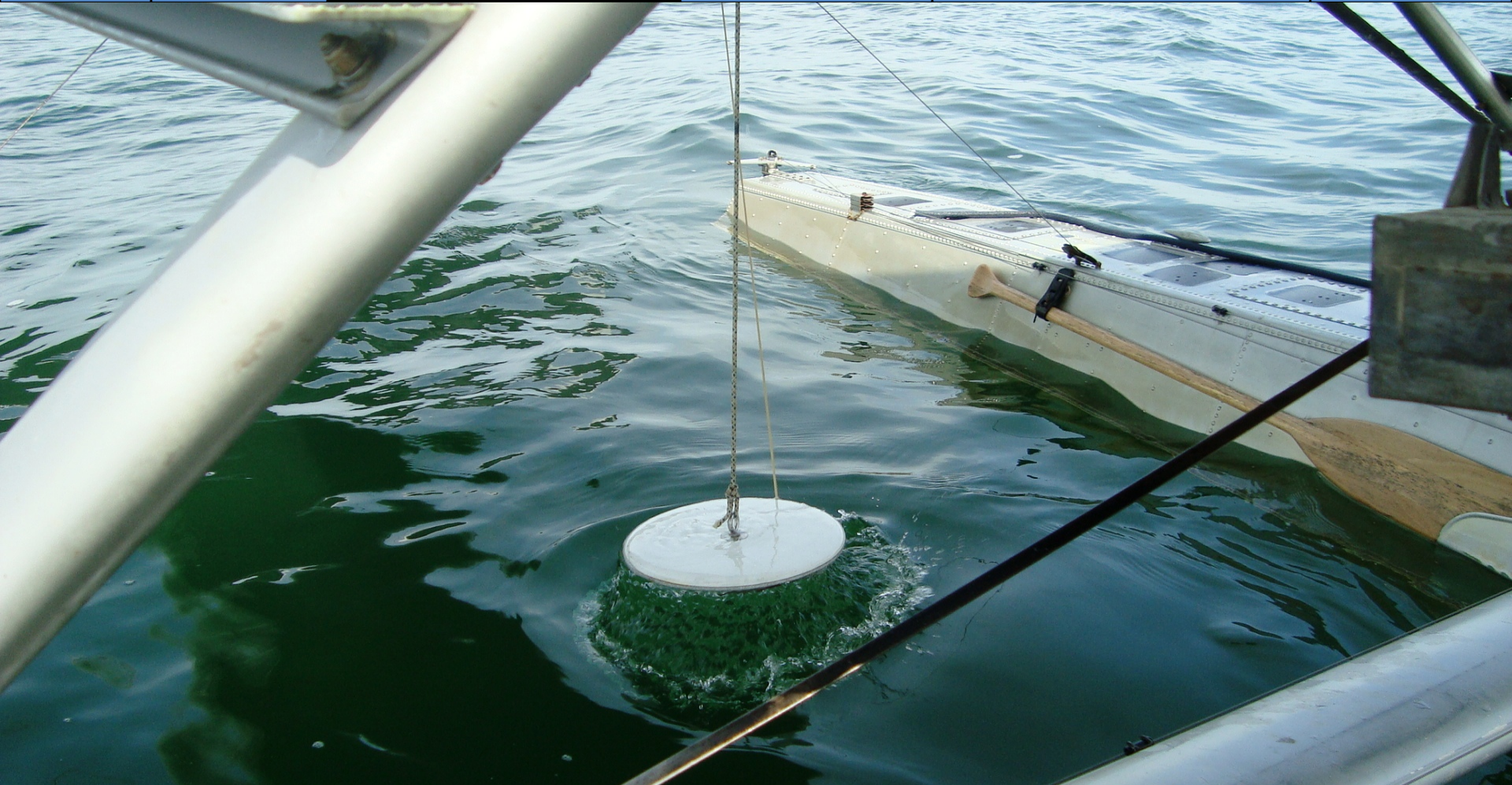
■ 5 - 7

■ 3 - 5

■  $< 3$



# Water Conditions of the Previous Month

[Field log](#)[Weather](#)[Water column](#)[Aerial photos](#)[Ferry and Satellite](#)[Moorings](#)

## Section is currently in development:

We will present CTD measurements from our Marine Flight Program and discuss observations in the temporal context of Ecology's Long-Term Marine Monitoring data. The focus will center primarily on anomalies of physical and optical variables throughout the water column.



# Aerial photography Summary 9-12-2011



Field log

Weather

Water column

Aerial photos

Ferry and Satellite

Moorings

Comment: Large red-brown blooms in Budd and Carr Inlet, macro-algae aggregations in Central Basin. Jelly fish mass aggregations in Budd and Eld Inlet

--- Start exploring aerial observations by clicking here! ---

Drifting debris in Budd Inlet



Cloud banks affected flight route

Front

## Mixing and Fronts:

Dana Passage, six parallel front lines in Carr Inlet.

Plume

## Suspended sediment:

Beach erosion south of Discovery Park (Seattle)

Bloom

## Visible blooms:

**Brown-red:** Budd Inlet, Carr Inlet (north west side)

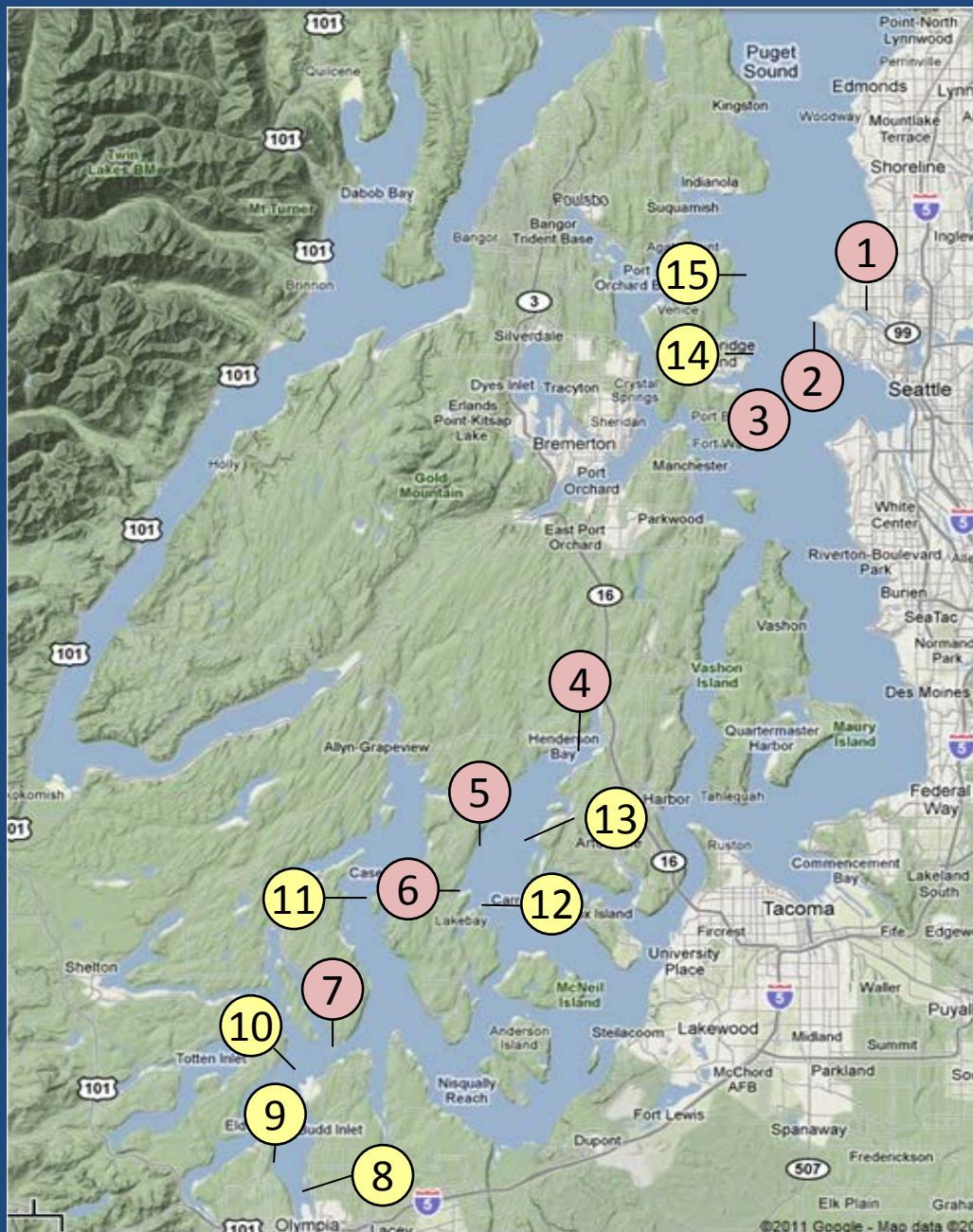
**Green:** East of Bainbridge Island

**Turquoise :** Budd Inlet near Swantown Marina.

Debris

## Debris (mainly associated with macro-algae mats):

Extensive filaments and multiple patches in Central Sound. Debris lines of mixed composition also in South Sound



# Aerial Photography Image Guide 9-12-2011



## Click on numbers

-  Morning Flight
-  Evening Flight

## Flight Information:

Morning flight:

Low clouds, altitude 1000ft, no wind  
(visibility limited, dark)

Evening flight:

Cloud banks affected flight route  
Visibility limited, altitude 2500ft

Observational maps Central Sound

Observational maps South Sound



Field log

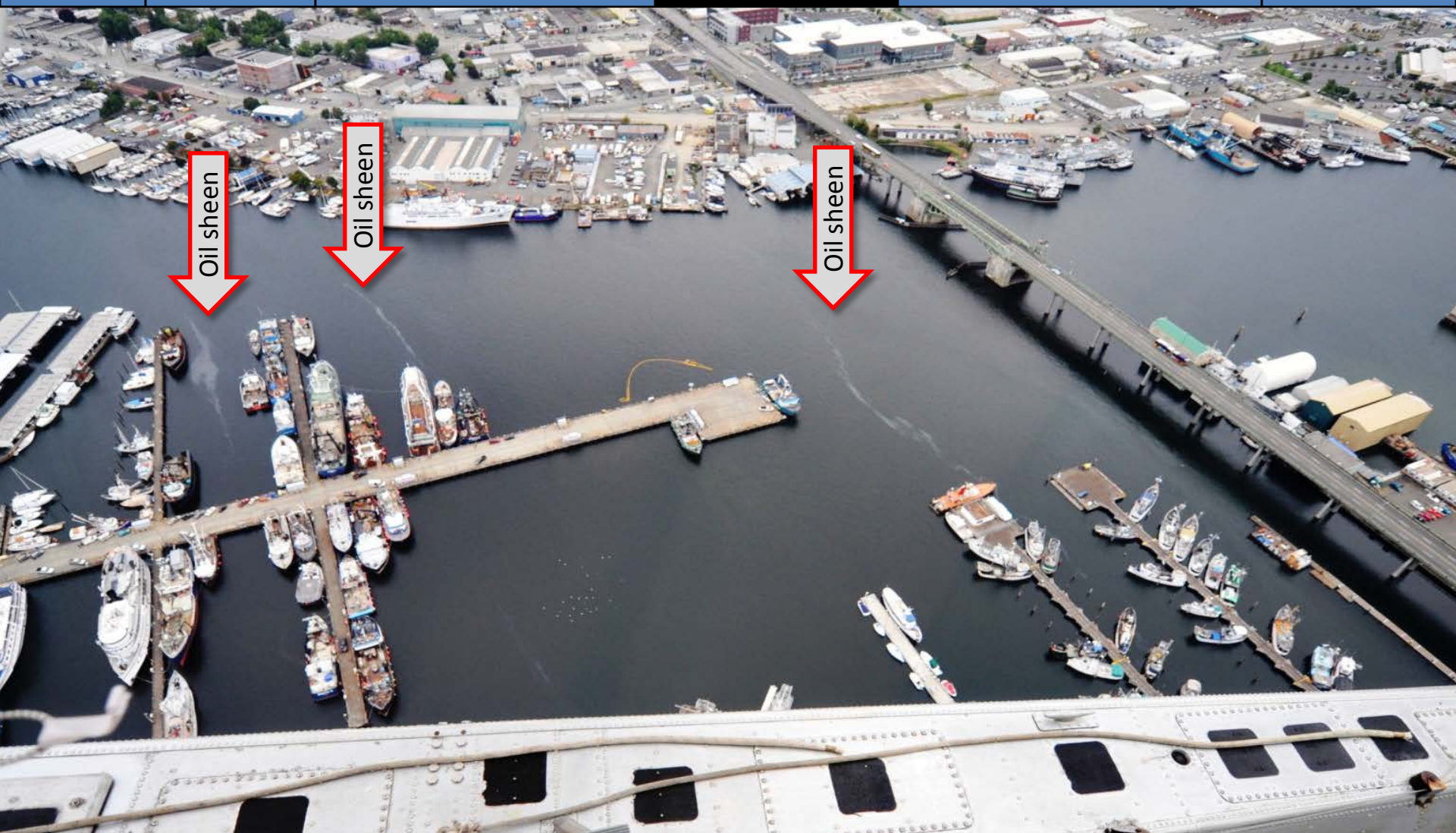
Weather

Water column

Aerial photos

Ferry and Satellite

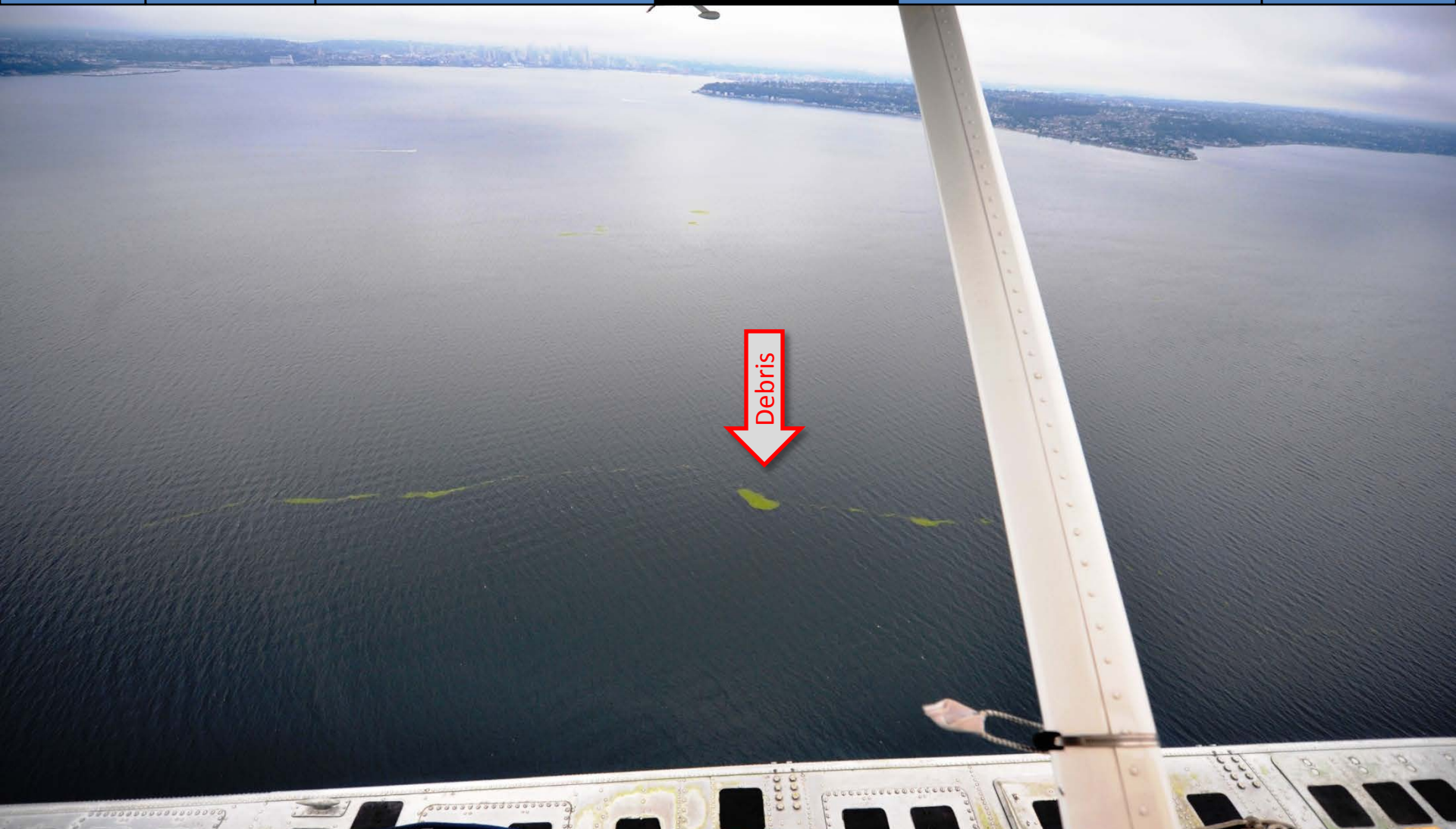
Moorings



Oil sheen. Location: Ballard Bridge, Seattle , 8:30 AM

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Beach erosion. Location: Off Discovery Park, Seattle, 7:32AM

[Field log](#)[Weather](#)[Water column](#)[Aerial photos](#)[Ferry and Satellite](#)[Moorings](#)

Macro-algae patches. Location: Central basin (Elliott Bay in Back), 8:35 AM



Field log

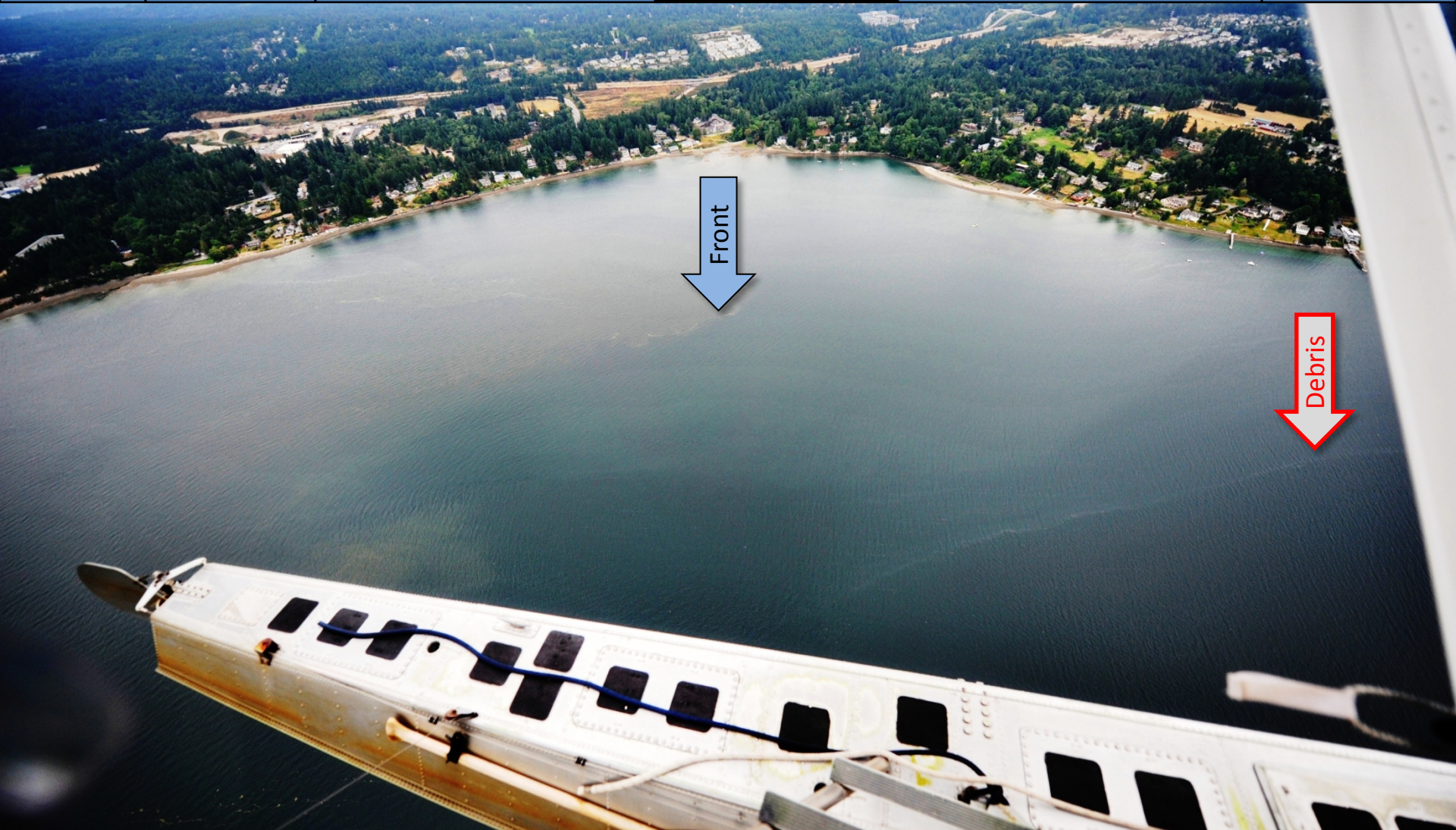
Weather

Water column

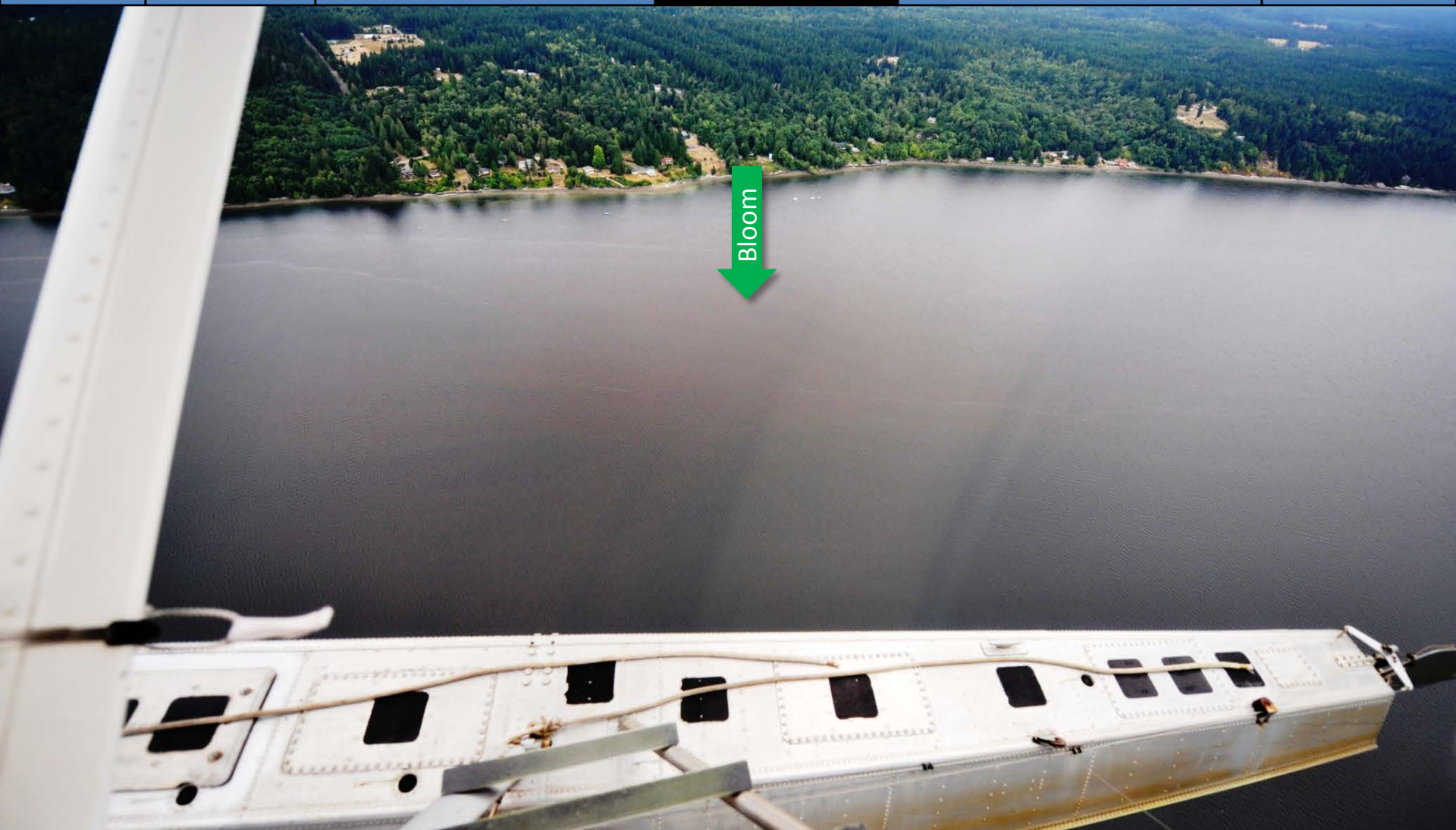
Aerial photos

Ferry and Satellite

Moorings



Stormwater and Algae Bloom. Location: Northern Carr Inlet (South Sound), 8:46 AM

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Red-brown bloom. Location: Carr Inlet (South Sound), 8:50 AM



Field log

Weather

Water column

Aerial photos

Ferry and Satellite

Moorings



Red-brown and turquoise blooms. Location: Von Geldern Cove, Carr Inlet (South Sound), 8:52 AM



Field log

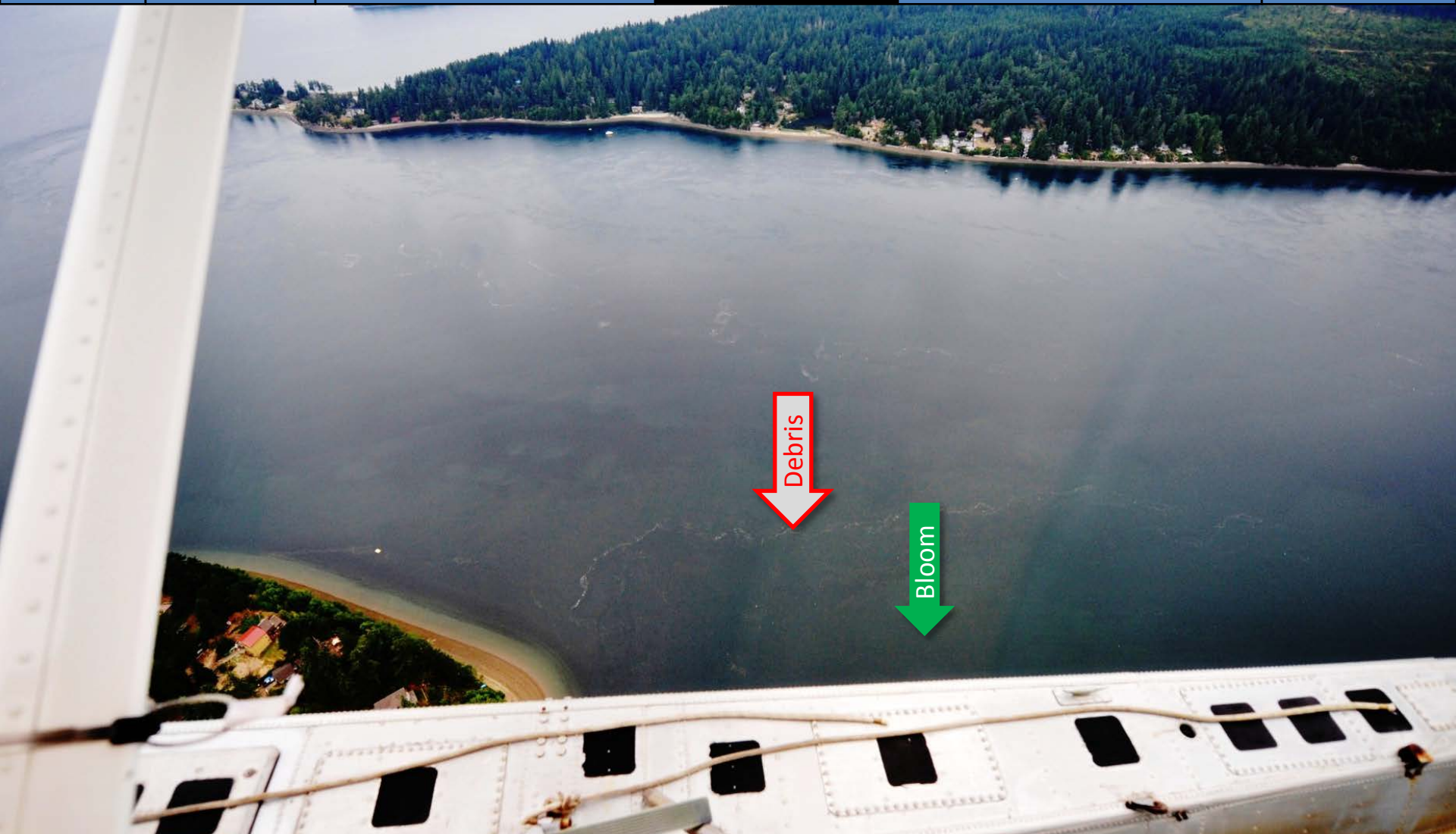
Weather

Water column

Aerial photos

Ferry and Satellite

Moorings



Mixing of different blooms and deeper water. Location: Dana Passage (South Sound) , 8:57 AM



Field log

Weather

Water column

Aerial photos

Ferry and Satellite

Moorings



Red-brown bloom. Location: Budd Inlet, Olympia (South Sound) , 4:38 PM



Field log

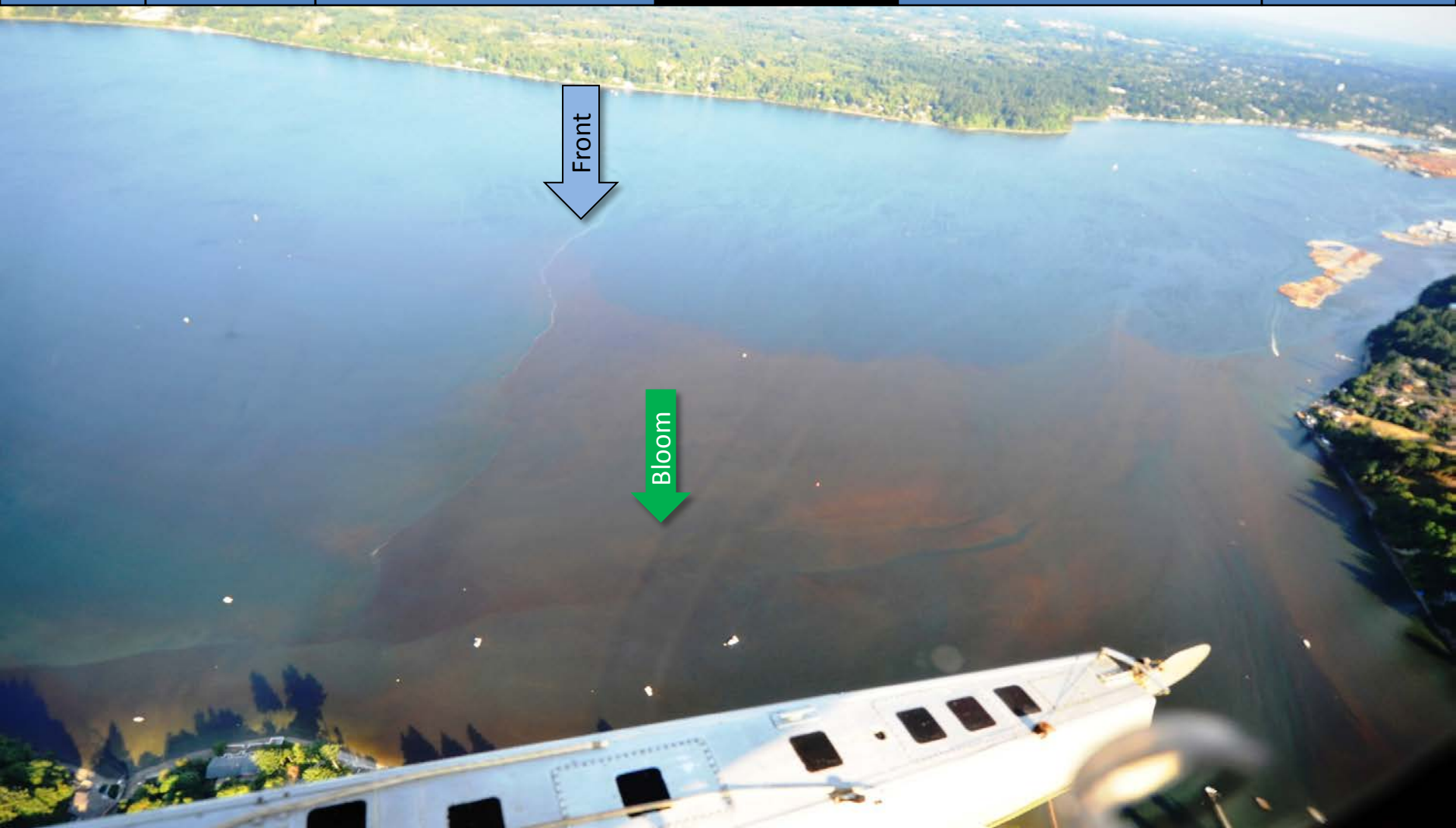
Weather

Water column

Aerial photos

Ferry and Satellite

Moorings



Red-brown bloom. Location: Budd Inlet (South Sound), 4:40PM



Field log

Weather

Water column

Aerial photos

Ferry and Satellite

Moorings



Green bloom mixing. Location: Boston Harbor (South Sound), 4:43 PM



Field log

Weather

Water column

Aerial photos

Ferry and Satellite

Moorings



Cloud banks affect flight route. Location: Case Inlet (South Sound), 4:46PM

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Red-brown bloom. Location: Mayo Bay, Carr Inlet (South Sound), 4:49 PM

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Red-Brown Bloom. Location: Carr Inlet (South Sound), 4:51 PM



Field log

Weather

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Moorings



Macro -algae aggregates. Location: East of Bainbridge Island , Seattle (Central Sound), 5:04 PM



Field log

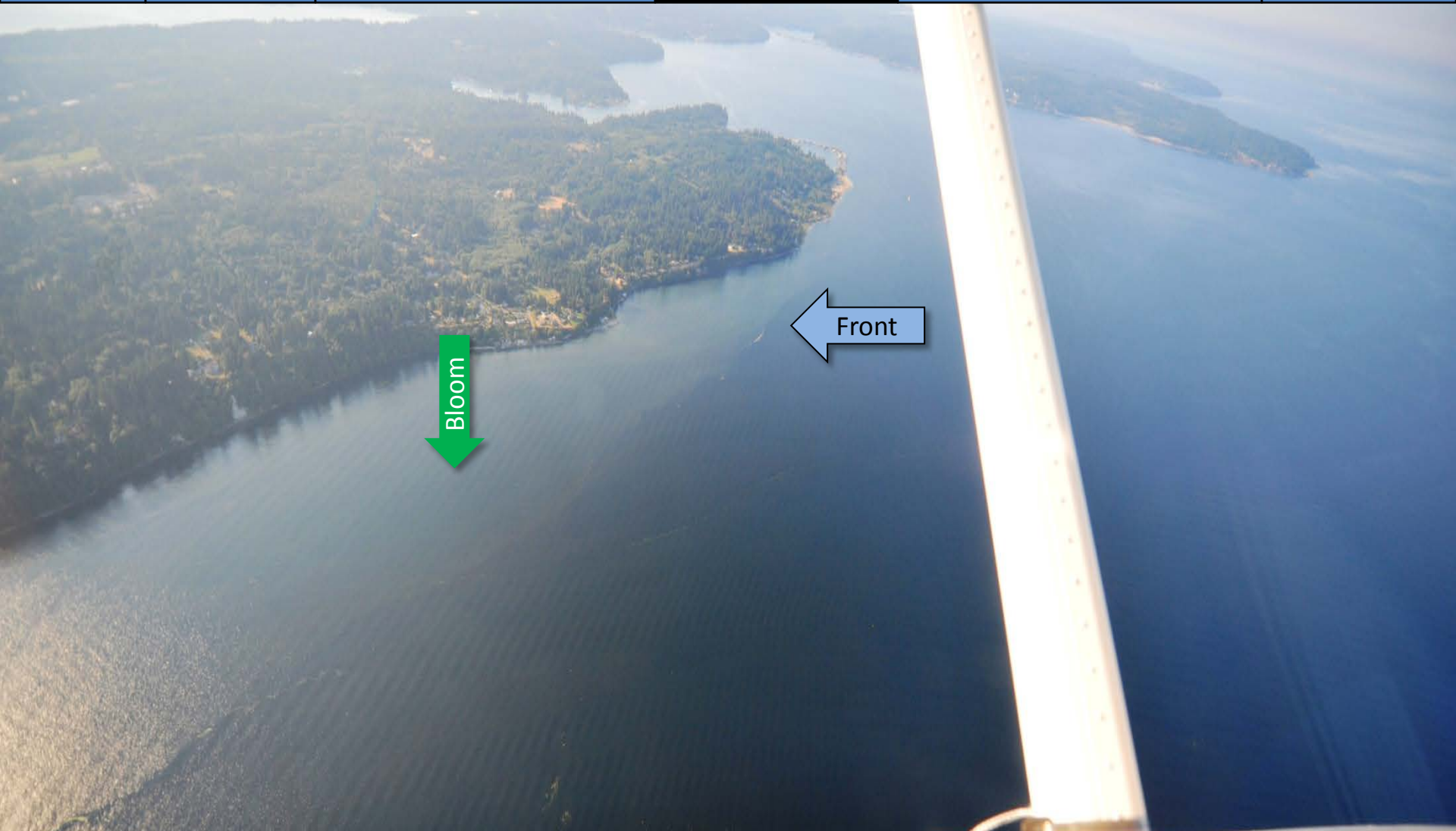
Weather

Water column

Aerial photos

Ferry and Satellite

Moorings



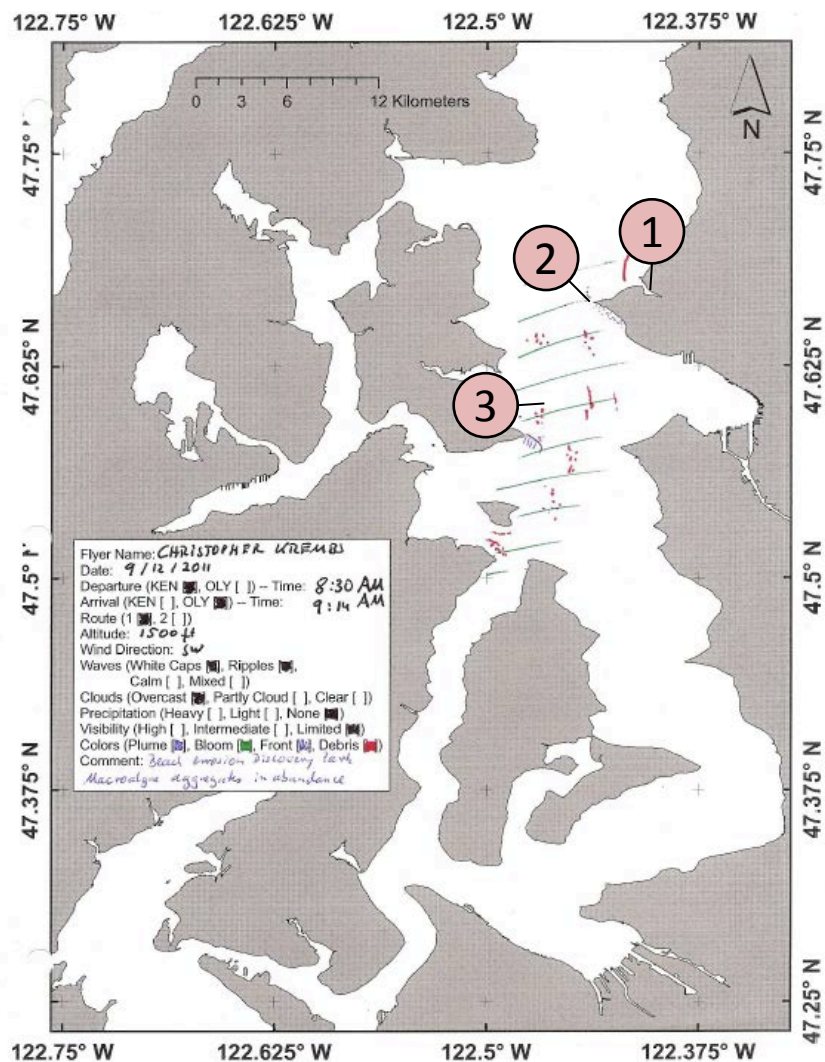
Bloom and plume. Location: East of Bainbridge Island , Seattle (Central Sound), 5:04 PM

# Aerial Photography Observations in Central Sound

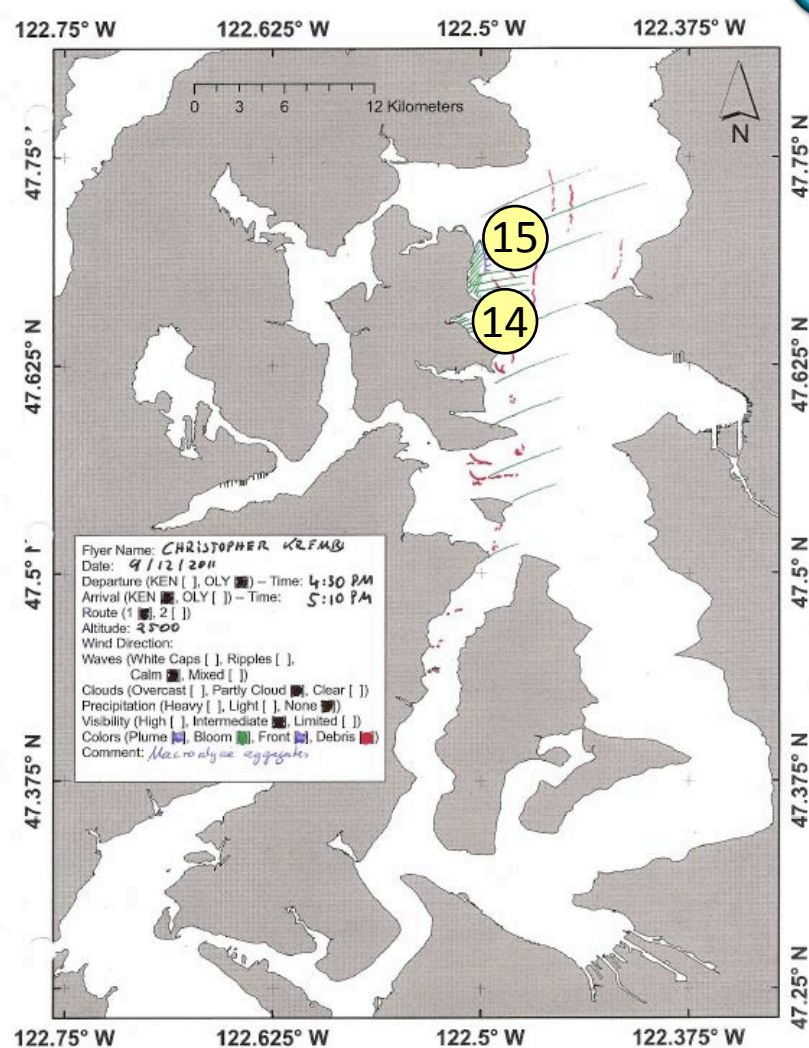
[Navigate](#)

Date: 9-12-2011

Morning



Evening



Numbers on map refer to picture numbers for spatial reference

Navigate



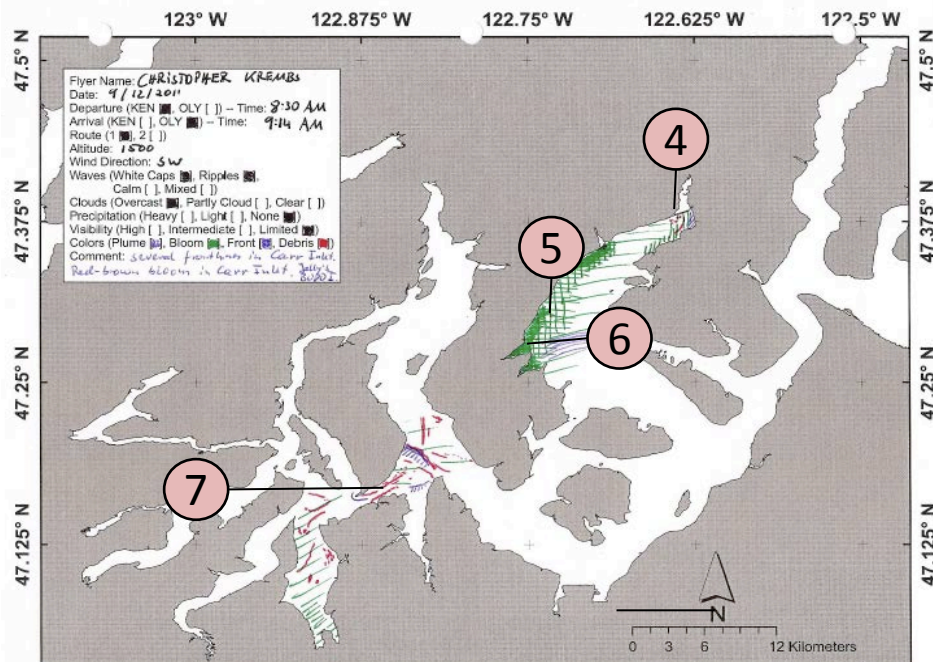
# Aerial Photography

Observations in  
South Sound:  
9-12-2011

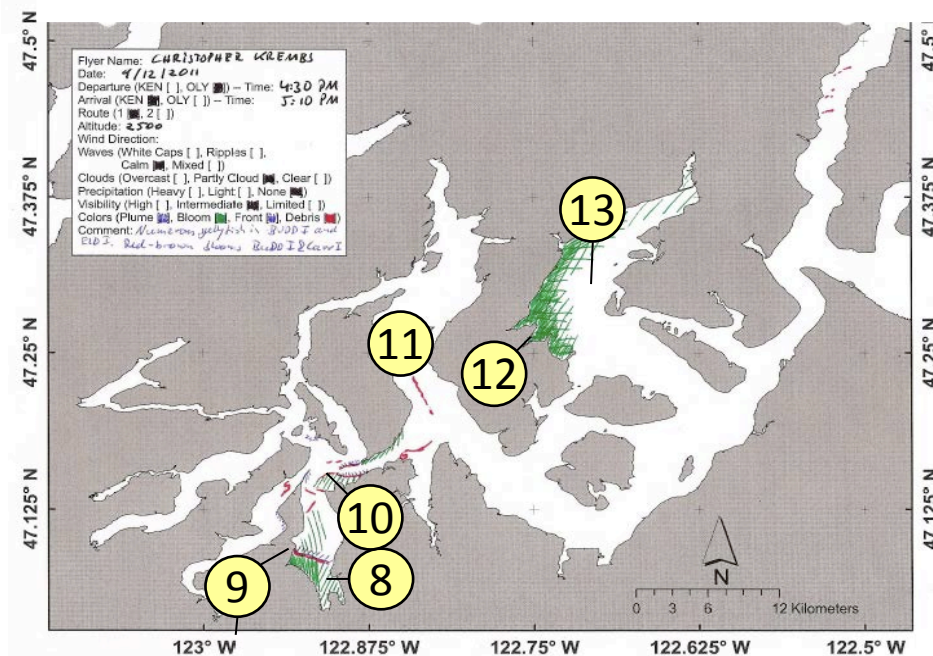


Numbers on map refer to picture  
numbers for spatial reference

Morning












Evening



# Legend to map annotations


[Navigate](#)

Plumes	
• Freshwater with sediment <b>solid</b>	
• Freshwater with sediment <b>dispersed</b>	
• 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 flight and intended to give an approximate reconstruction of surface conditions on scales that connect to and overlap with satellite images in the following section.



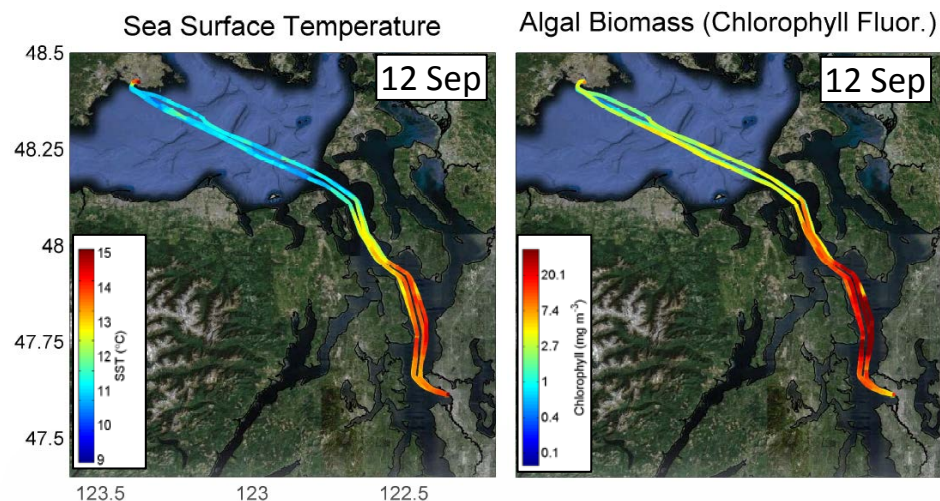
# Daily Ferry and Satellite observations in Central Sound, 9-12-2011

[Field log](#)[Weather](#)[Water column](#)[Aerial photos](#)[Ferry and Satellite](#)[Moorings](#)

Contact: [brandon.sackmann@ecy.wa.gov](mailto: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



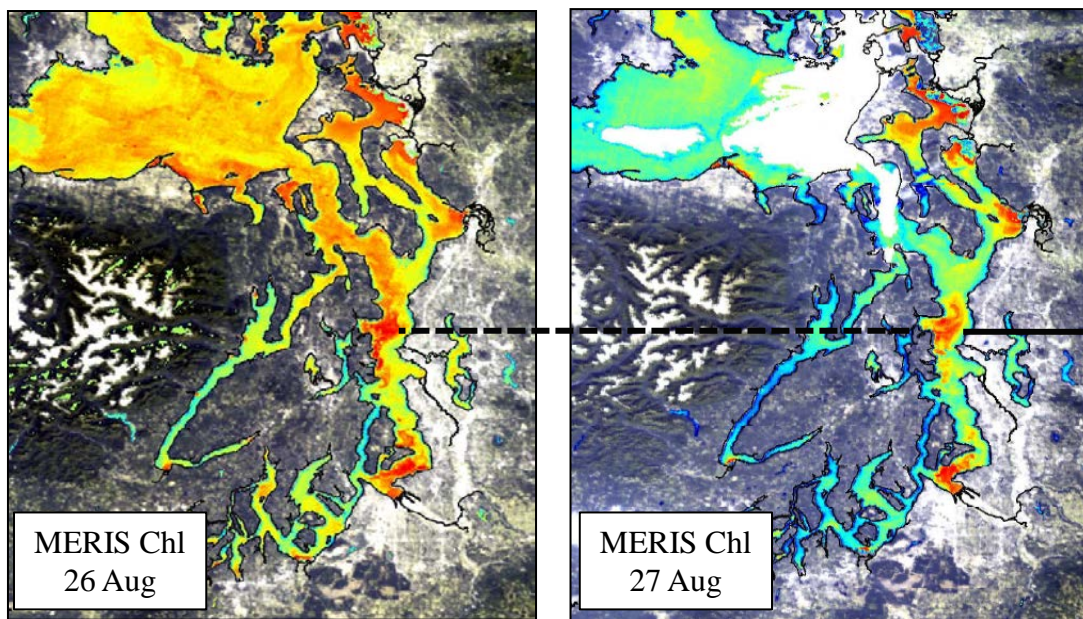
**Current Conditions:** High surface fluorescence throughout northern Central Sound; highest values east of Port Madison and south of Edmonds (47.7 N); surface temperatures in Central Sound range from 13-14 °C and 11-12 °C in Strait of Juan de Fuca.

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

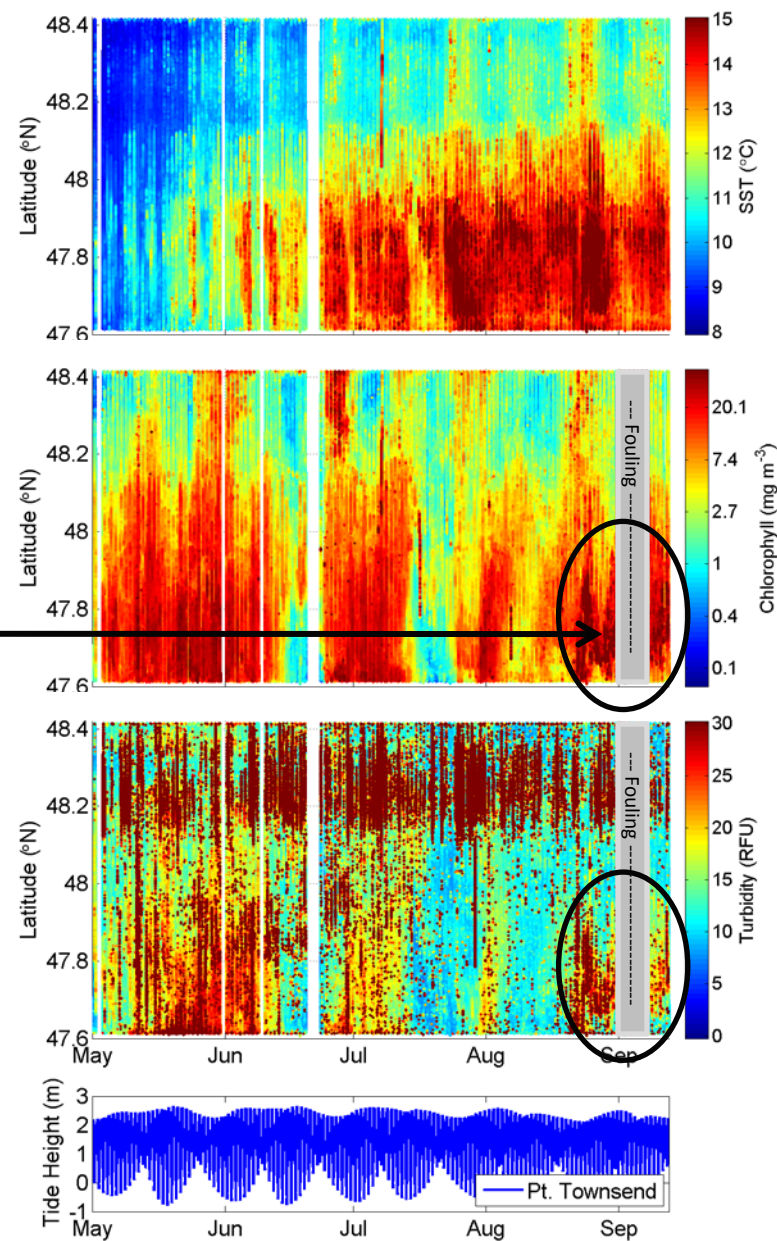
[http://www.ecy.wa.gov/programs/eap/mar\\_wat/eops/clipper.html](http://www.ecy.wa.gov/programs/eap/mar_wat/eops/clipper.html)

## Near-surface Observations of Phytoplankton Bloom Off Bainbridge Island 22-12 September 2011

Victoria Clipper fluorescence and turbidity data corroborate satellite ocean color imagery from late August - September suggesting that an intense phytoplankton bloom has formed off Bainbridge Island (~47.7 N). Daily ferry transects indicate that the latest bloom began around 22 August and is still present.



## Victoria Clipper ferry data through 1 May - 12 Sept. 2011





### \*\*\* Food for Thought \*\*\*

## Optical Properties of Seagrass, Plastic, and Fish?

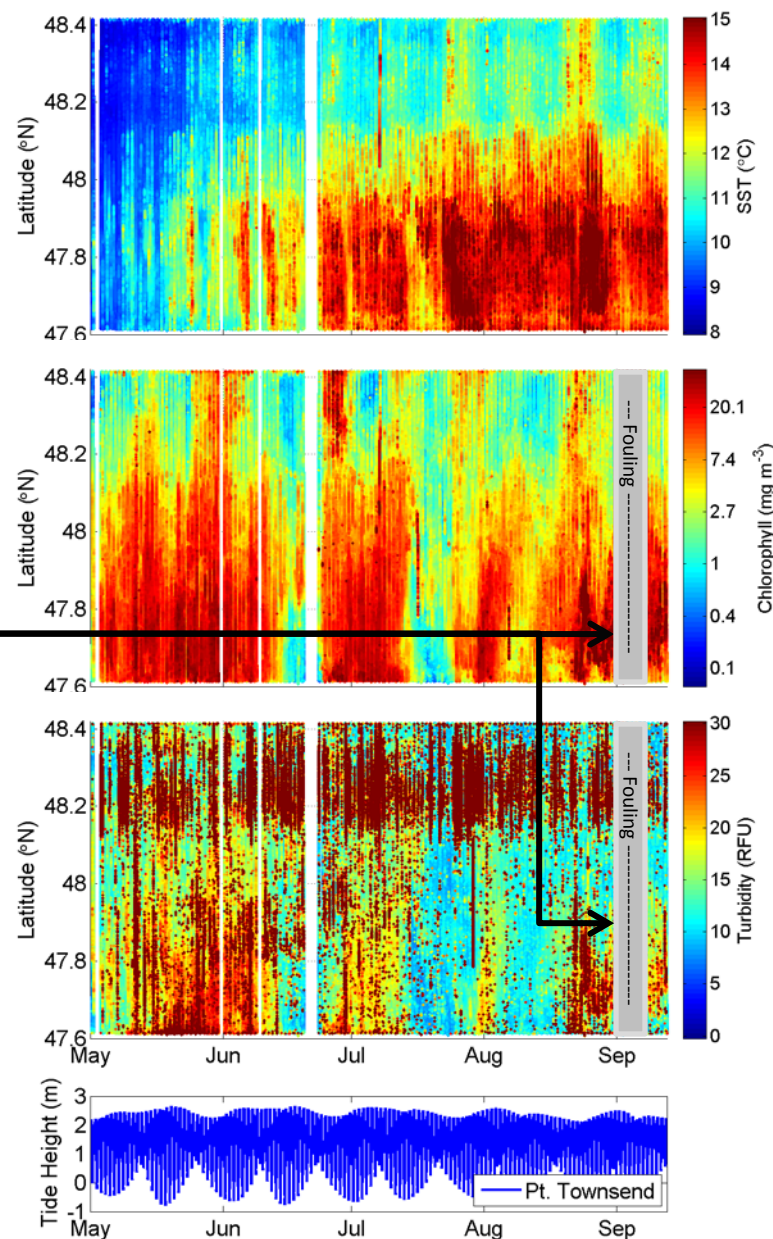
While not a deliberate part of our 'sampling program' the debris encountered in the Victoria Clipper IV's seachest does provide a *unique* perspective on the cleanliness of Puget Sound and its harbors. The routine sensor servicing on 7 September revealed an abundance of foreign material; unlike anything we have seen over the past 16 months...



**Above:** Debris embedded on seachest filter included bits of plastic, fabric, seagrass, and (unfortunately) fish.

**Left:** Fabric that became entangled on the sensor's thermistor, thereby compromising fluorescence and turbidity readings.

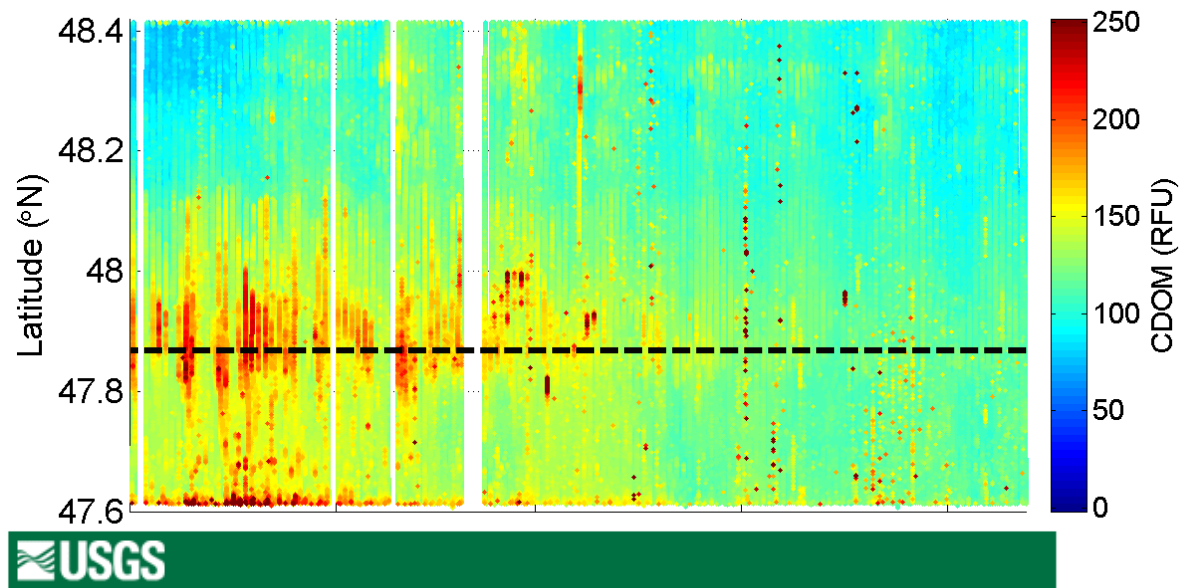
## Victoria Clipper ferry data through 1 May - 12 Sept. 2011



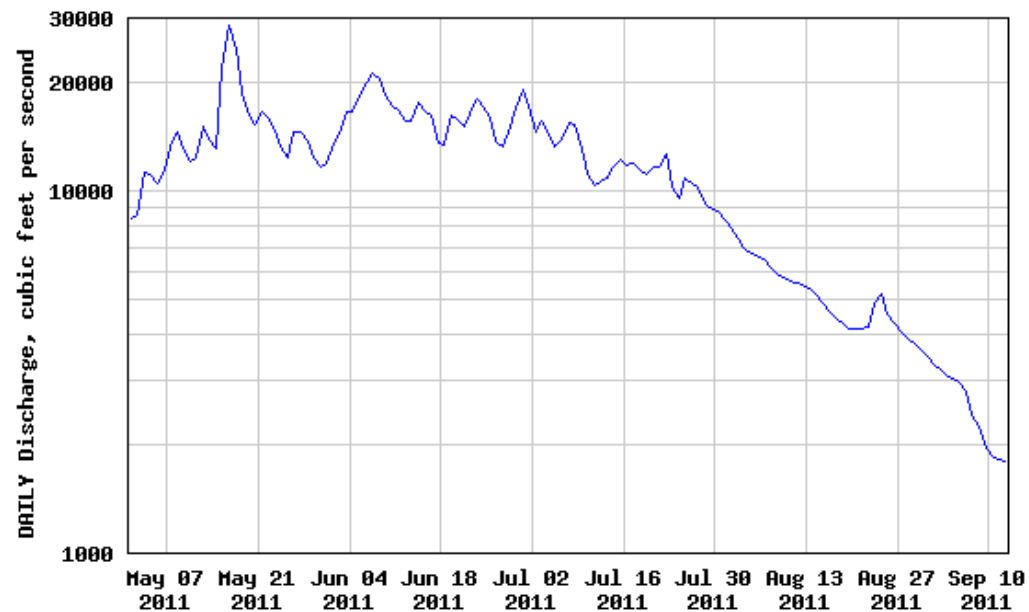
## CDOM Fluorescence as an Indicator of Freshwater Influence in Central Sound

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

Combined river discharge from Whidbey Basin enters Central Sound at the Triple Junction (47.87 N). Higher CDOM concentrations were associated with higher river flows in May – July; CDOM concentrations and river flow have steadily decreased in August – September.



USGS 12150800 SNOHOMISH RIVER NEAR MONROE, WA

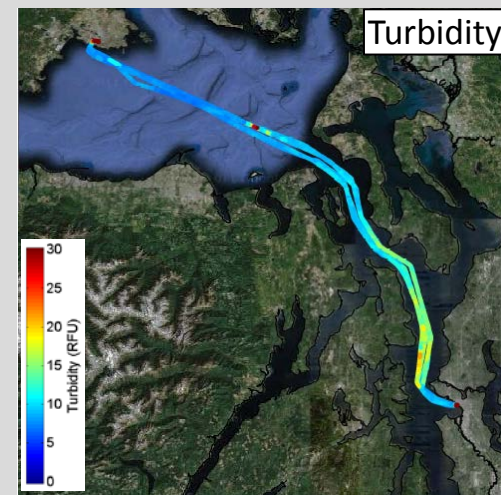
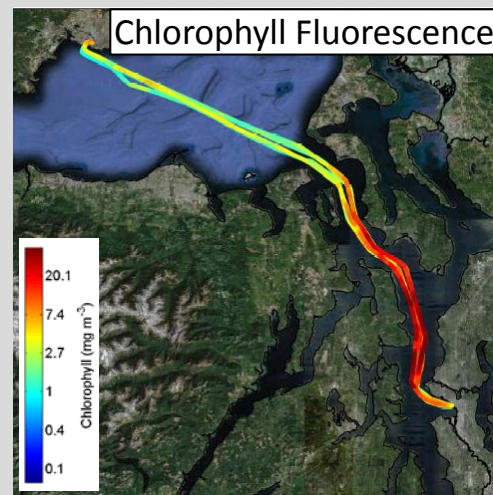
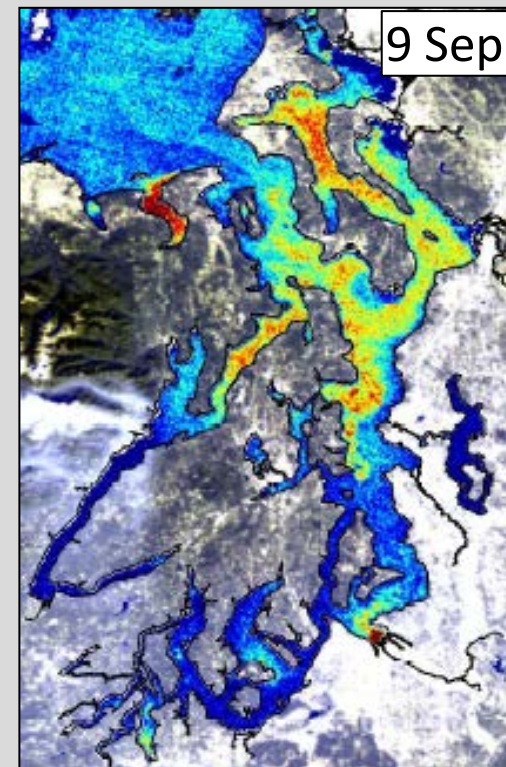
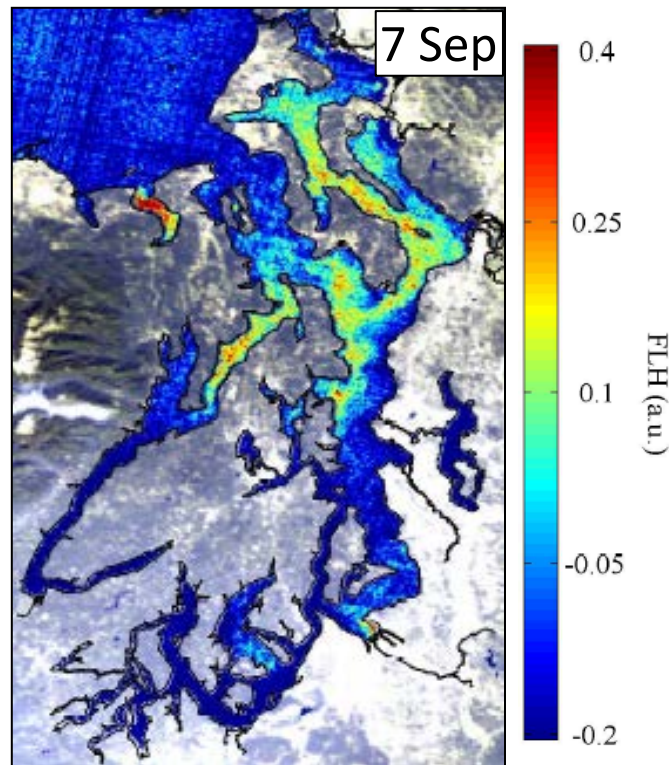


----- Provisional Data Subject to Revision -----

## MERIS Fluorescence Line Height (FLH)

Satellite-derived estimates of chlorophyll fluorescence (FLH) is a quantity that is related both to the concentration and physiological condition of phytoplankton.

FLH images from 7 and 9 September corroborate ferry observations indicating a widespread bloom in northern Central Sound. The images also reveal that the bloom likely extends throughout Whidbey Basin and northern Hood Canal.





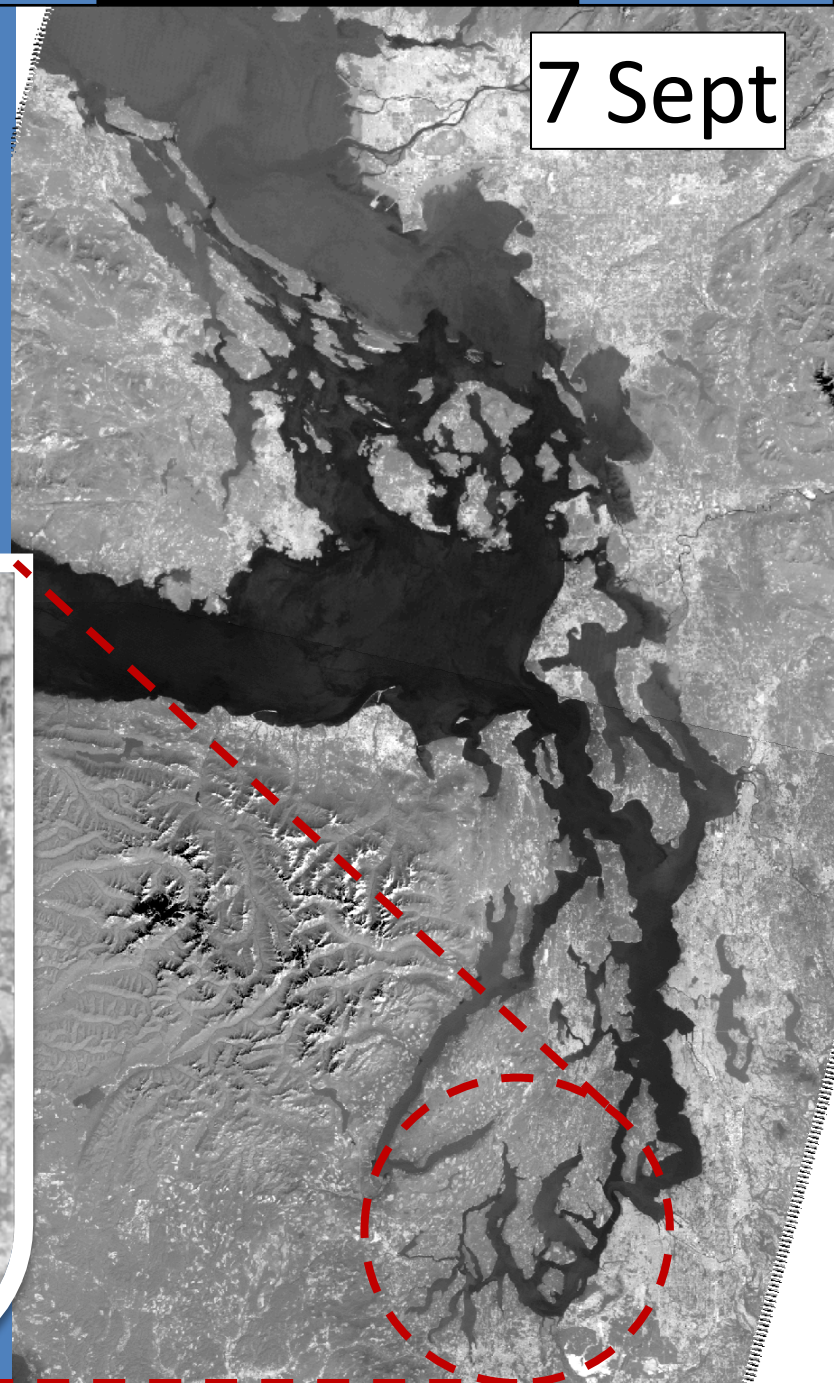
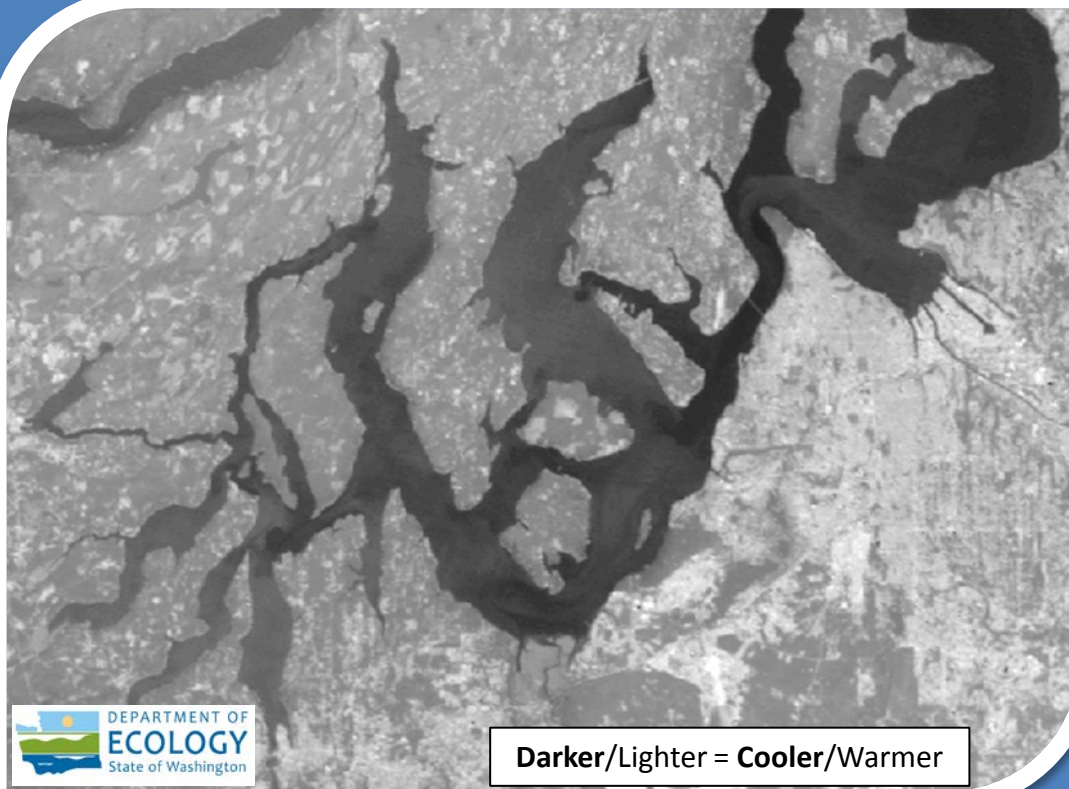
# Landsat

(120m Thermal Band)

*Relative Temperatures (approx. °C):*

Strait of Georgia	16-17	South Sound	15-18
Strait of Juan de Fuca	12	Carr Inlet	16
Central Puget Sound	12-14	Case Inlet	15-16
Hood Canal	12-17	Budd Inlet	17-18
North	12-13		
Dabob Bay	17-19		
Central/South	17		

7 Sept





# Mooring observation from 8/30-9/12/2011

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Go to our mooring site at: [http://www.ecy.wa.gov/programs/eap/mar\\_wat/moorings.html](http://www.ecy.wa.gov/programs/eap/mar_wat/moorings.html)

**Mukilteo, Whidbey Basin near Everett** over the last two weeks: DO, temperature, and salinity values at depth (14-18 m) increased. Surface salinity values increased, temperatures remained unchanged, and stratification weakened. Mean daily values:

NB DO: 7.1 mg/L (up 0.8 mg/L)

Surface Temp: 13.6°C

NB Temp: 12.2°C (up 0.5°C)

Surface Salinity: 28.2 PSU (up 0.4 PSU)

NB Salinity: 29.5 PSU (up 0.3 PSU)

**Manchester, Central Sound** over the last two weeks: DO values at depth (11 m) remained similar with a sharp peak on 9/3, while salinity and temperature increased slightly. Near surface salinity values increased while temperatures remained similar. Mean daily values:

NB DO: 6.6 mg/L

Surface Temp: 13.0°C (up 0.2°C)

NB Temp: 12.8°C (up 0.2°C)

Surface Salinity: 29.5 PSU (up 0.2 PSU)

NB Salinity: 29.7 PSU (up 0.3 PSU)

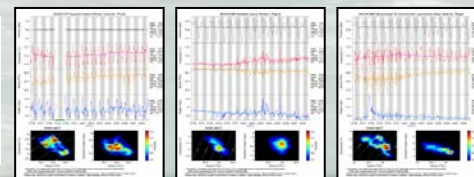
**Squaxin Passage (South Sound) near Olympia** over the last two weeks DO values at depth (5 m) decreased, while salinity and temperature increased. Mean daily values:

DO: 8.2 mg/L (down 0.9 mg/L)

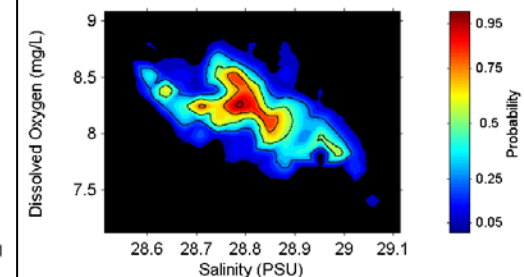
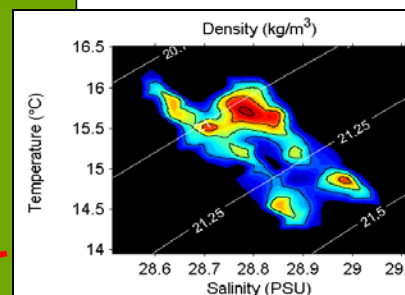
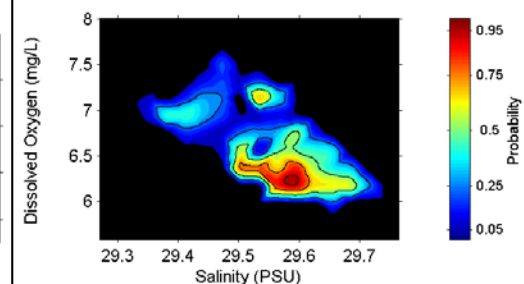
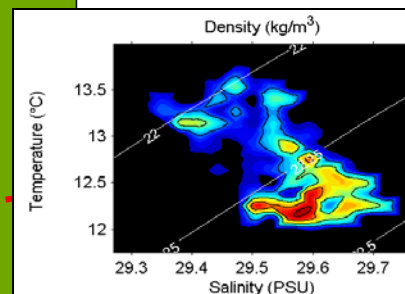
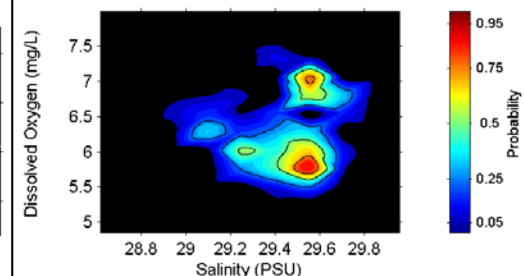
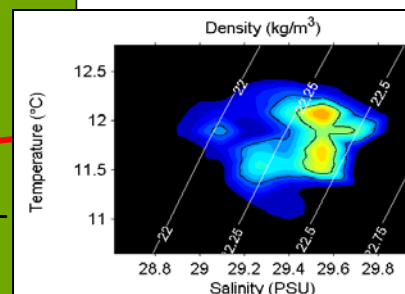
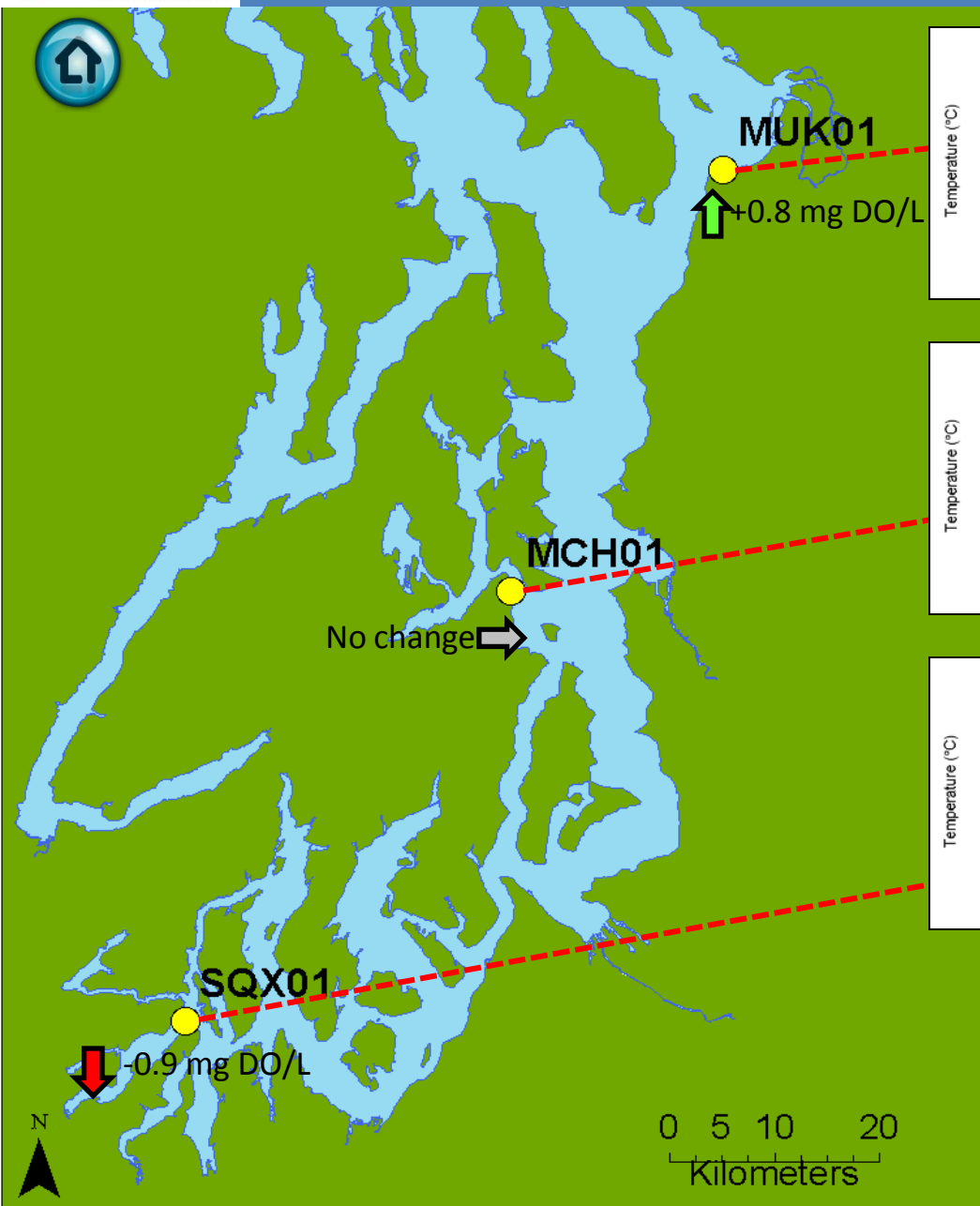
Temp: 15.4°C

Salinity: 28.4 PSU (up 0.2 PSU)

Real-time data  
now online (click)



# Water Masses and DO from our Moorings: 8/30-9/12/2011



**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 your data from Ecology's Environmental Assessment Program

## Long – Term Monitoring Network

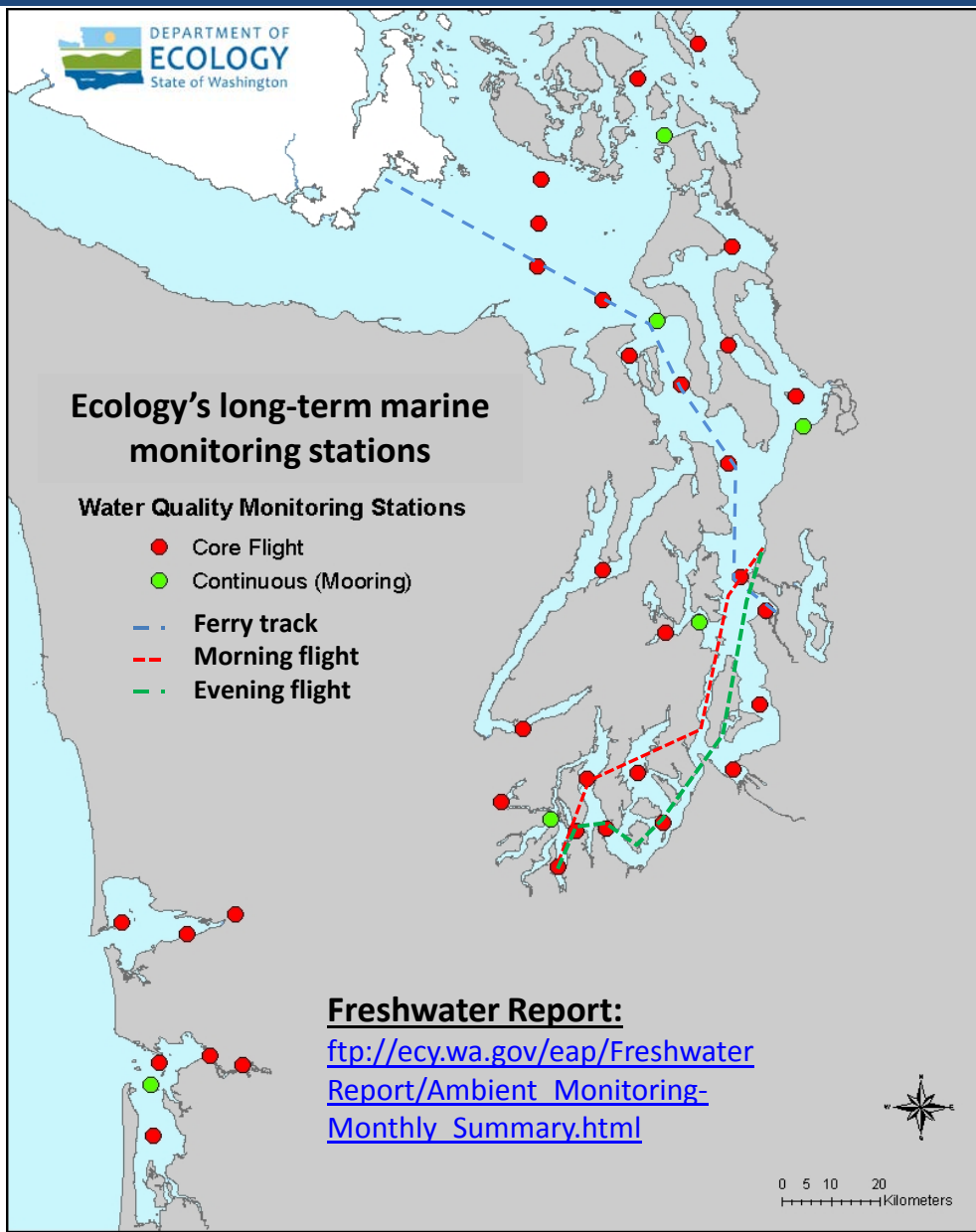


[ftp://www.ecy.wa.gov/eap/Flight\\_Blog/](ftp://www.ecy.wa.gov/eap/Flight_Blog/)



## Access core monitoring data:

<http://www.ecy.wa.gov/apps/eap/marinewq/mwdataaset.asp>



## Real – Time Sensor Network



[brandon.sackmann@ecy.wa.gov](mailto:brandon.sackmann@ecy.wa.gov)



## Access mooring data:

<http://www.ecy.wa.gov/programs/eap/marinewq/mooring.html>



You may subscribe or unsubscribe to the Eyes Over Puget Sound email listserv by going to this link:

<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](mailto:ckre461@ecy.wa.gov)

**Marine Monitoring Unit  
Environmental Assessment Program  
WA Department of Ecology**

