Apr 6th, 9:00 AM - 9:15 AM

Nutrient dynamics and ties to environmental conditions and drivers in central Puget Sound

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King County

April 6th, 2018

Nutrient Dynamics & Ties to Environmental Conditions in Central Puget Sound

Highlights from 2016-2017

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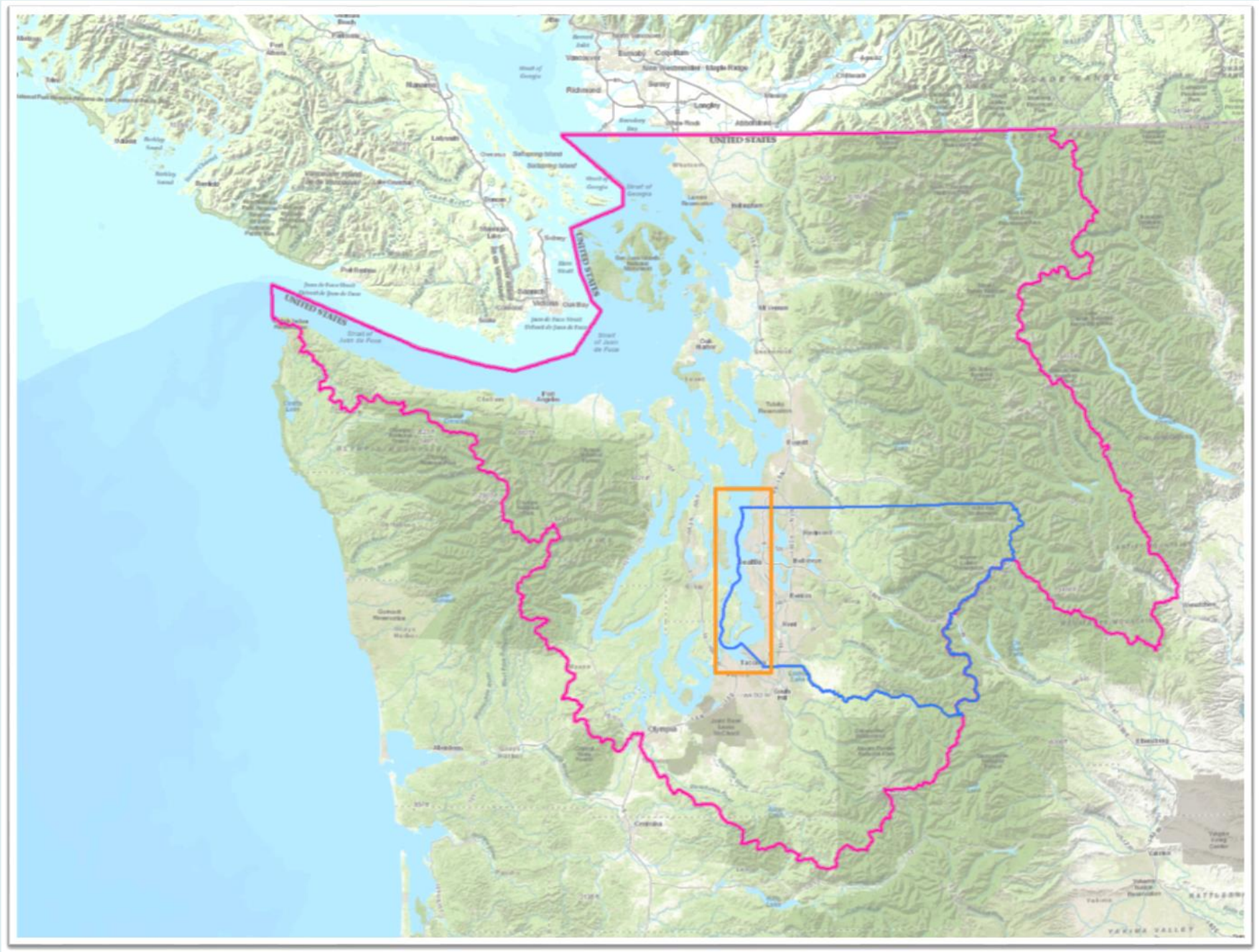
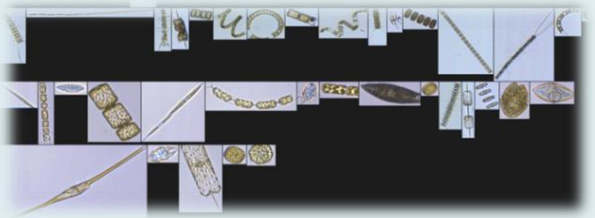
King County Dept. of Natural Resources & Parks
Water and Land Resources Division



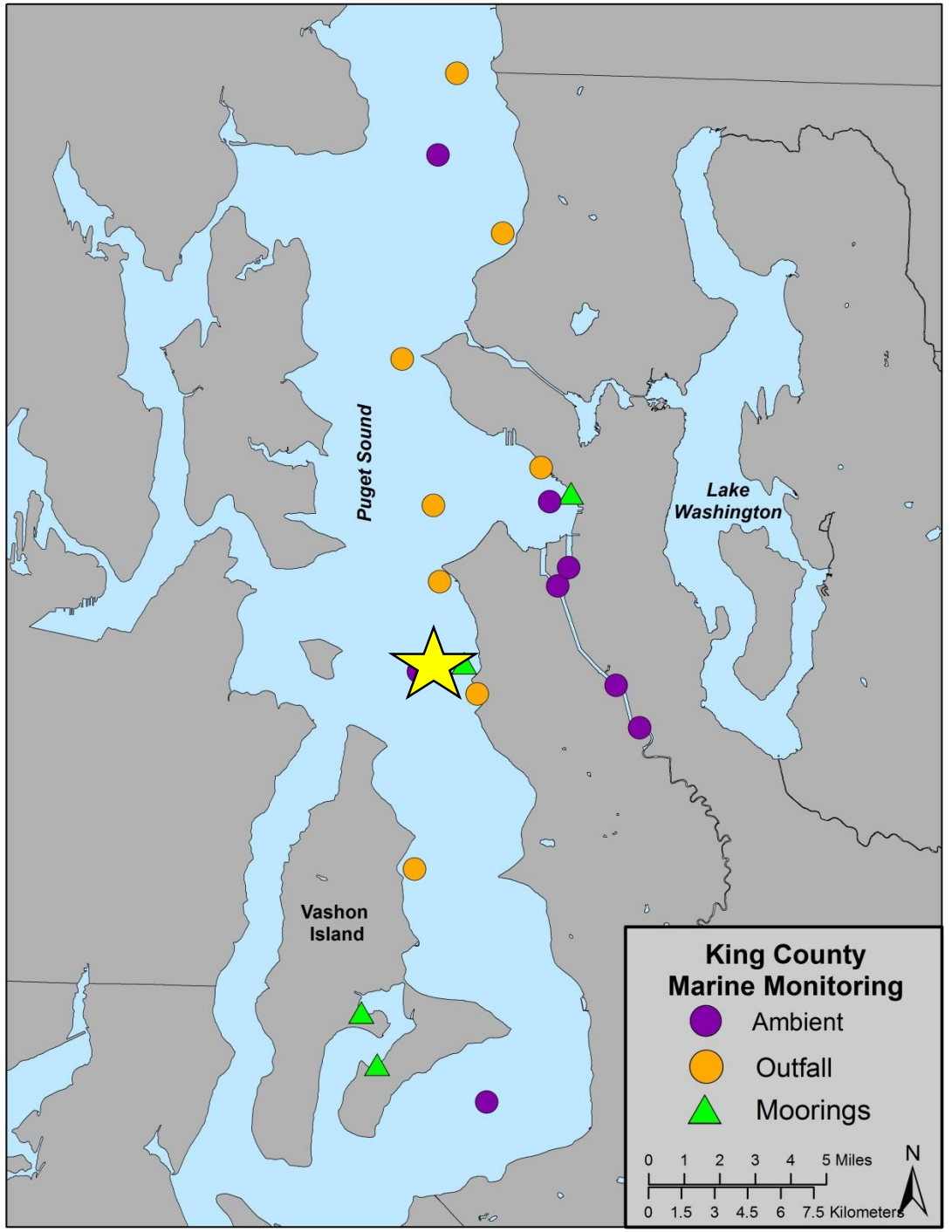
(Source: King County DNRP GIS Group)

How Do We Monitor Water Quality?



- **Offshore waters: *1994***
  - ***CTD Sensors & Discrete Data***
- **Beach waters: *1999***
  - ***Discrete Data***
- **Moorings: *2008***
  - ***Automated sensors sample every 15-min***
  - ***Point Williams buoy since 2013***
- **Phytoplankton: *2008***
  - ***Semi-Quantitative and FlowCam since 2014***
- **Zooplankton:*2014***
- **Sediments (offshore and beach)**

Offshore Water Column Sites and Moorings



- Optical continuous nitrate sensor added in April 2017 (with sensor loan and help from WA Dept. of Ecology)

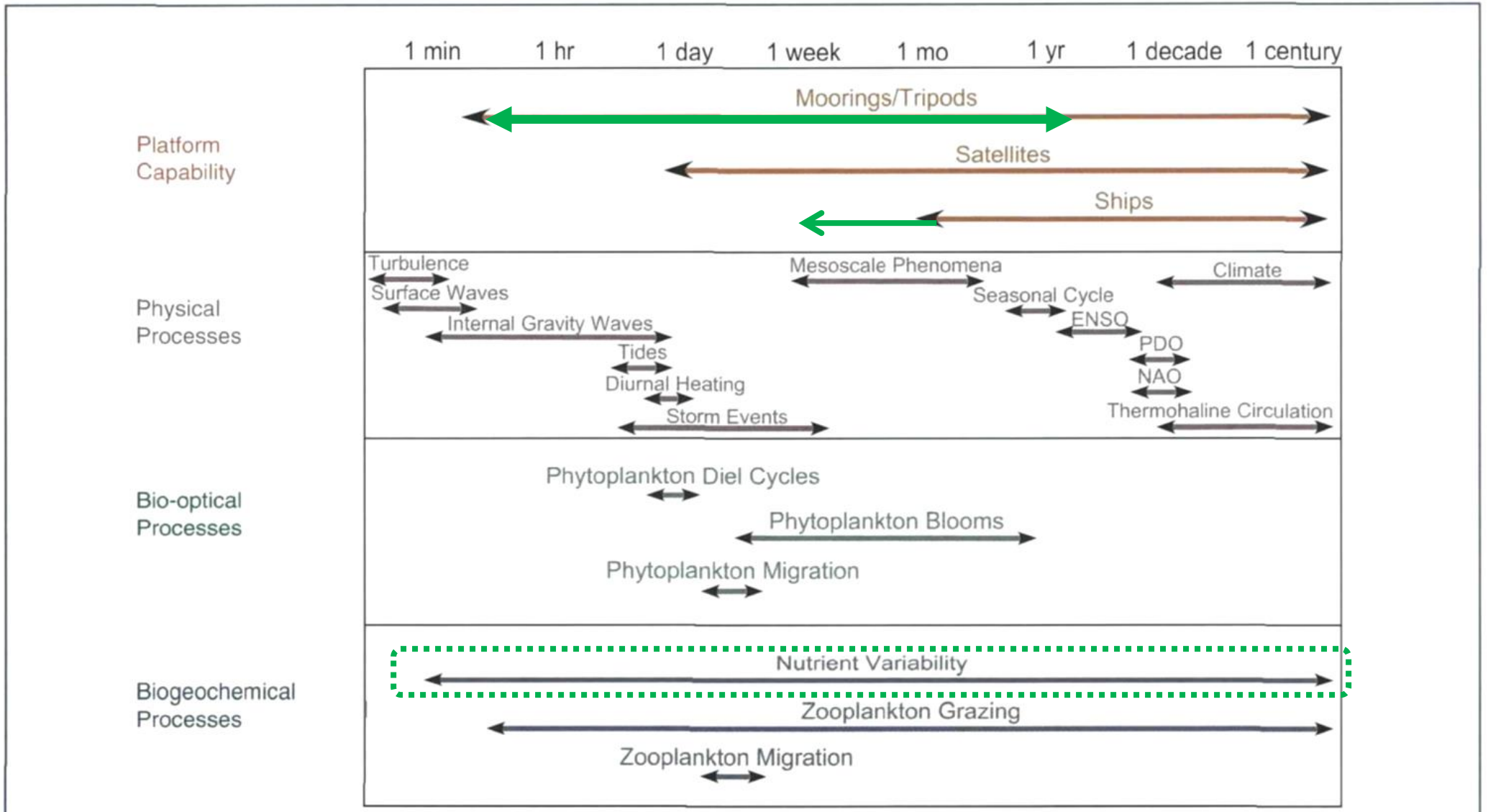
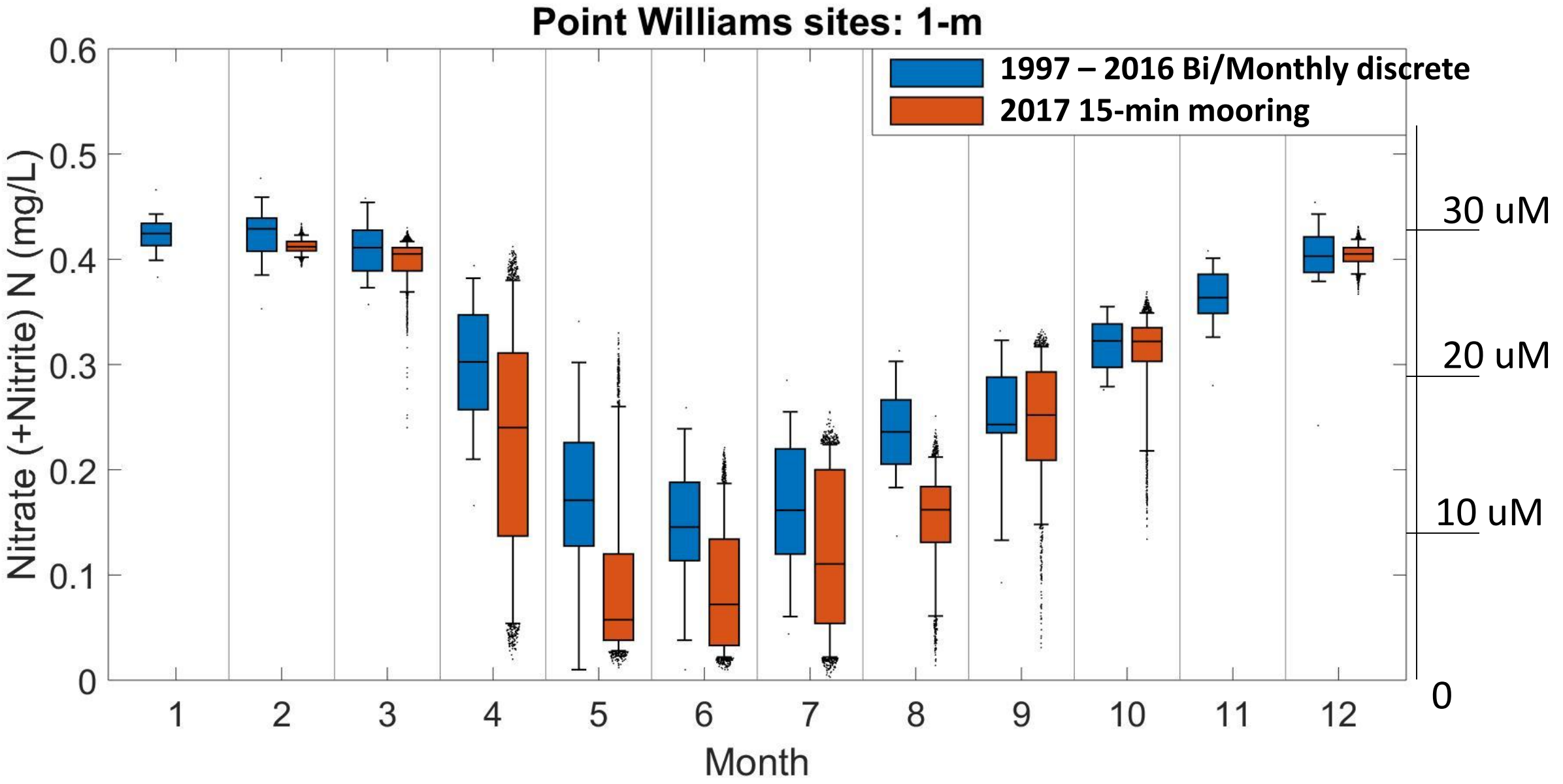
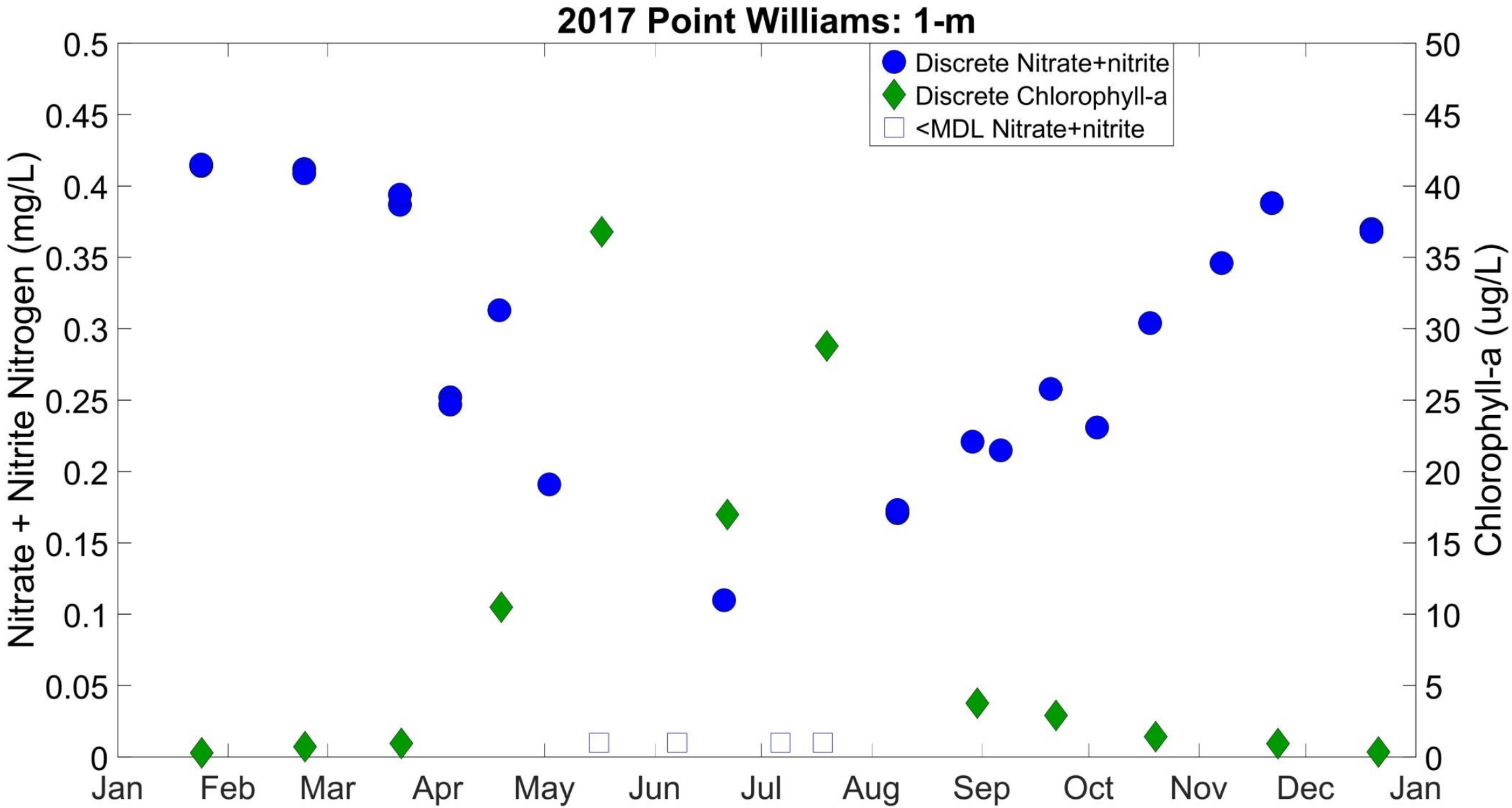


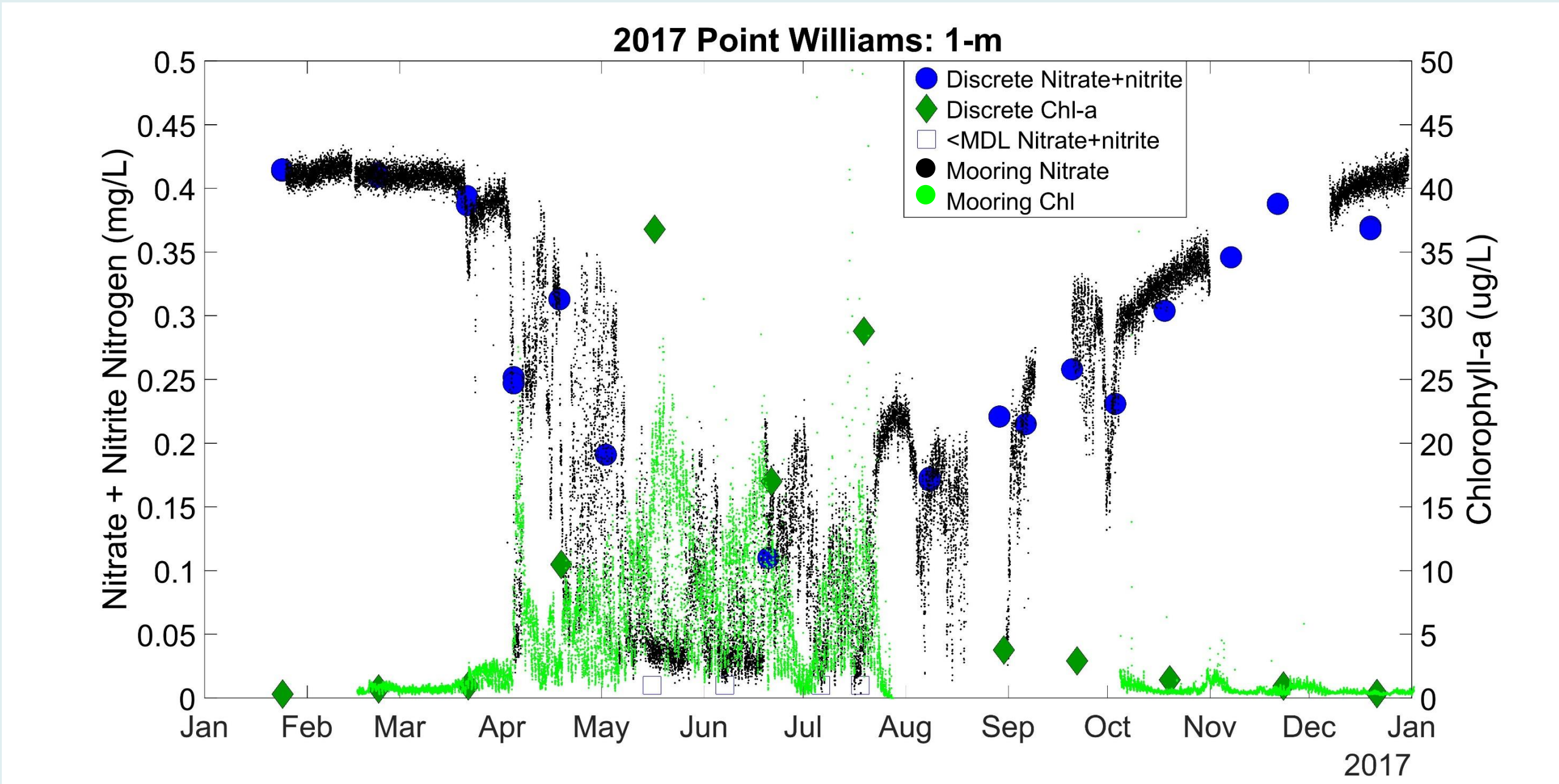
Figure 2. *Rough time scales of physical, bio-optical, and biogeochemical processes along with time scales that are accessible with different sampling platforms. Figure is a schematic and is not to scale. Note: The mooring designation refers to both fixed location and AUVs and gliders used as virtual moorings (Griffiths et al., 1999b).*

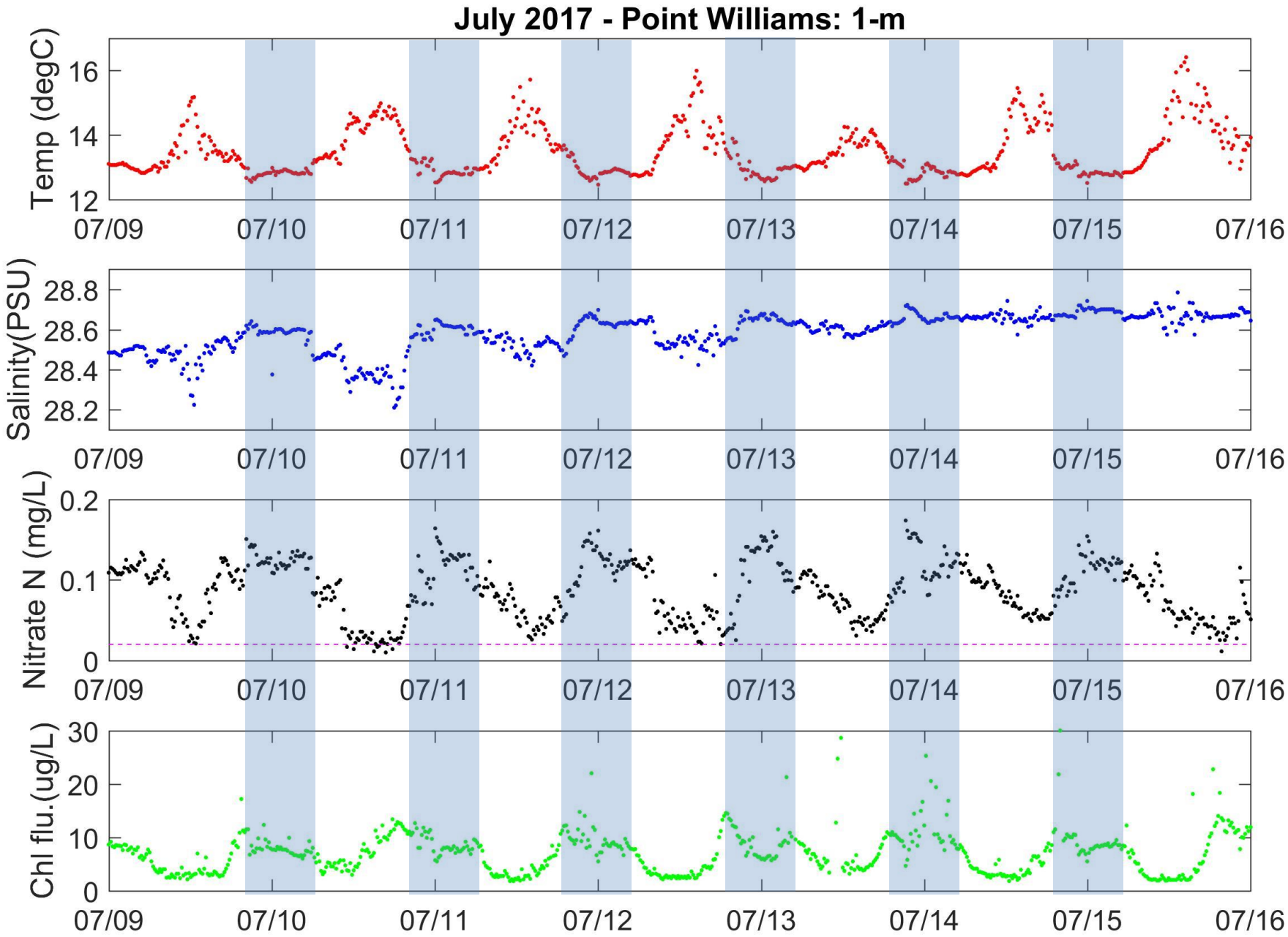
From Dickey & Chang, 2001

Variability in short and long time scales

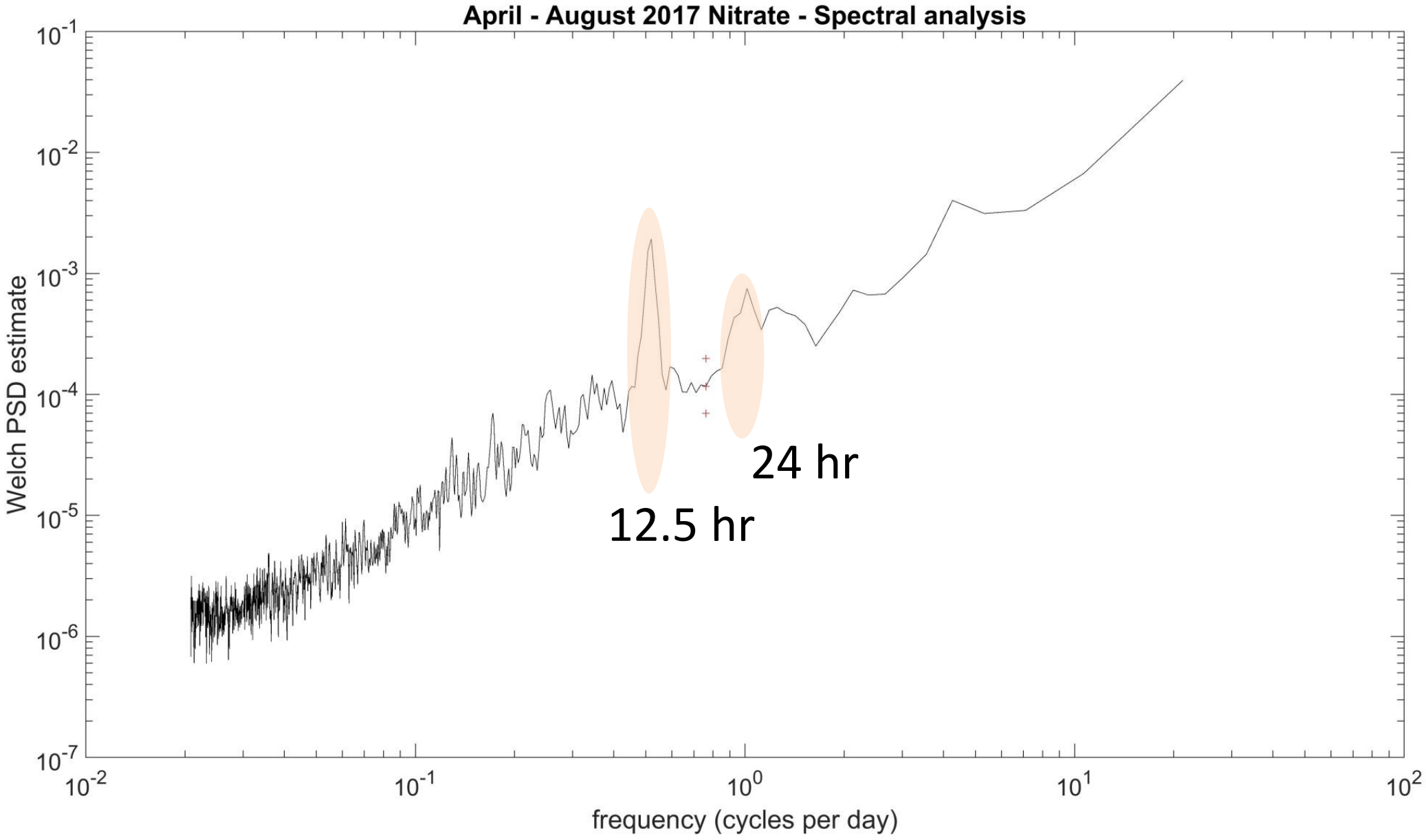



2017 Point Williams: 1-m
Discrete Nitrate+nitrite
Discrete Chlorophyll-a
<MDL Nitrate+nitrite
Nitrate + Nitrite Nitrogen (mg/L)
Chlorophyll-a (ug/L)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
0
5
10
15
20
25
30
35
40
45
50
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan

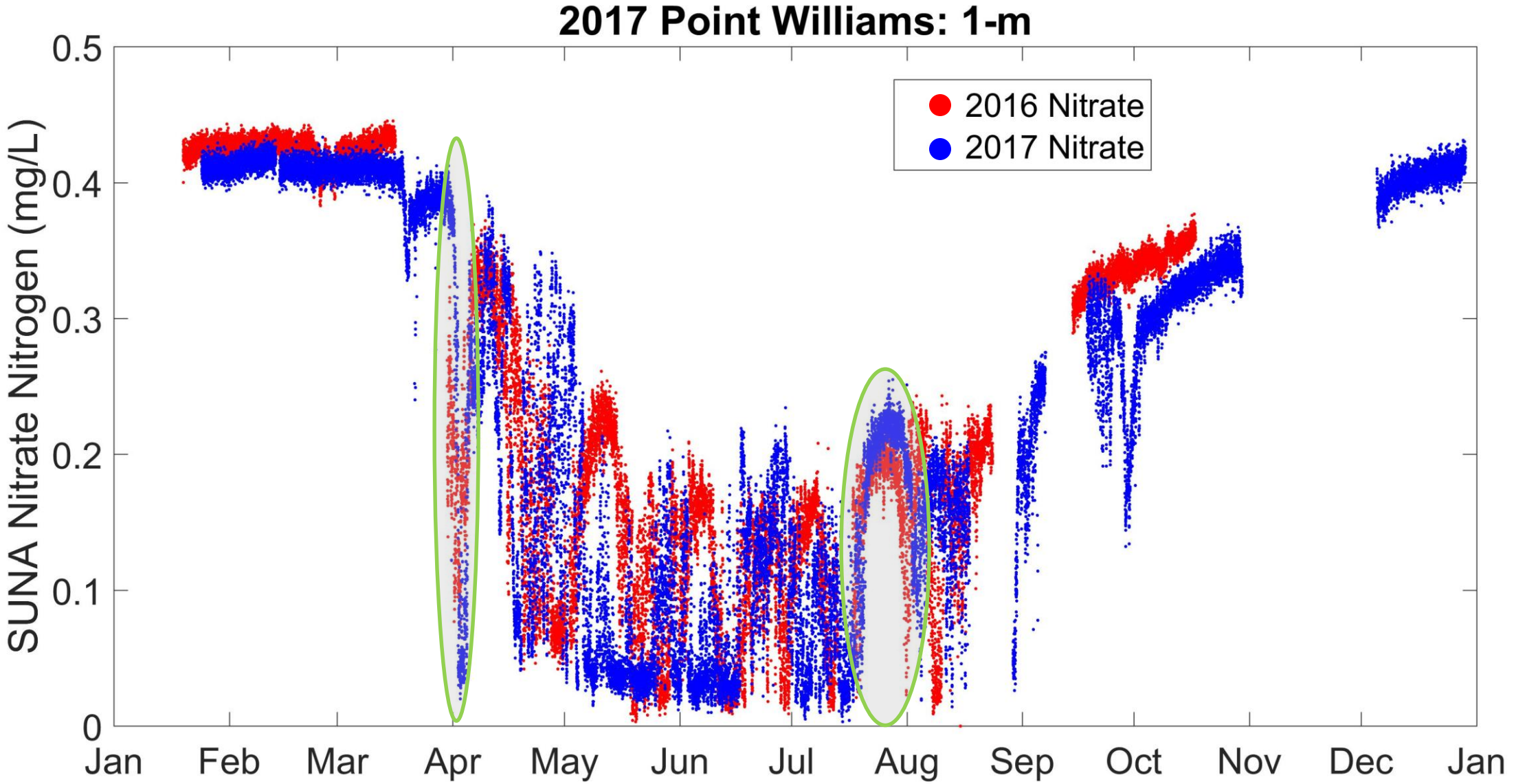

2017 Point Williams: 1-m
Discrete Nitrate+nitrite
Discrete Chl-a
<MDL Nitrate+nitrite
Mooring Nitrate
Mooring Chl
Nitrate + Nitrite Nitrogen (mg/L)
Chlorophyll-a (ug/L)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
0
5
10
15
20
25
30
35
40
45
50
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
2017


July 2017 - Point Williams: 1-m
Temp (degC)
16
14
12
Salinity(PSU)
28.8
28.6
28.4
28.2
Nitrate N (mg/L)
0.2
0.1
0
Chl flu.(ug/L)
30
20
10
0
07/09
07/10
07/11
07/12
07/13
07/14
07/15
07/16

Tidal and daily signals are significant



Surface Nitrate between years: 2016 vs. 2017



July – early August 2017

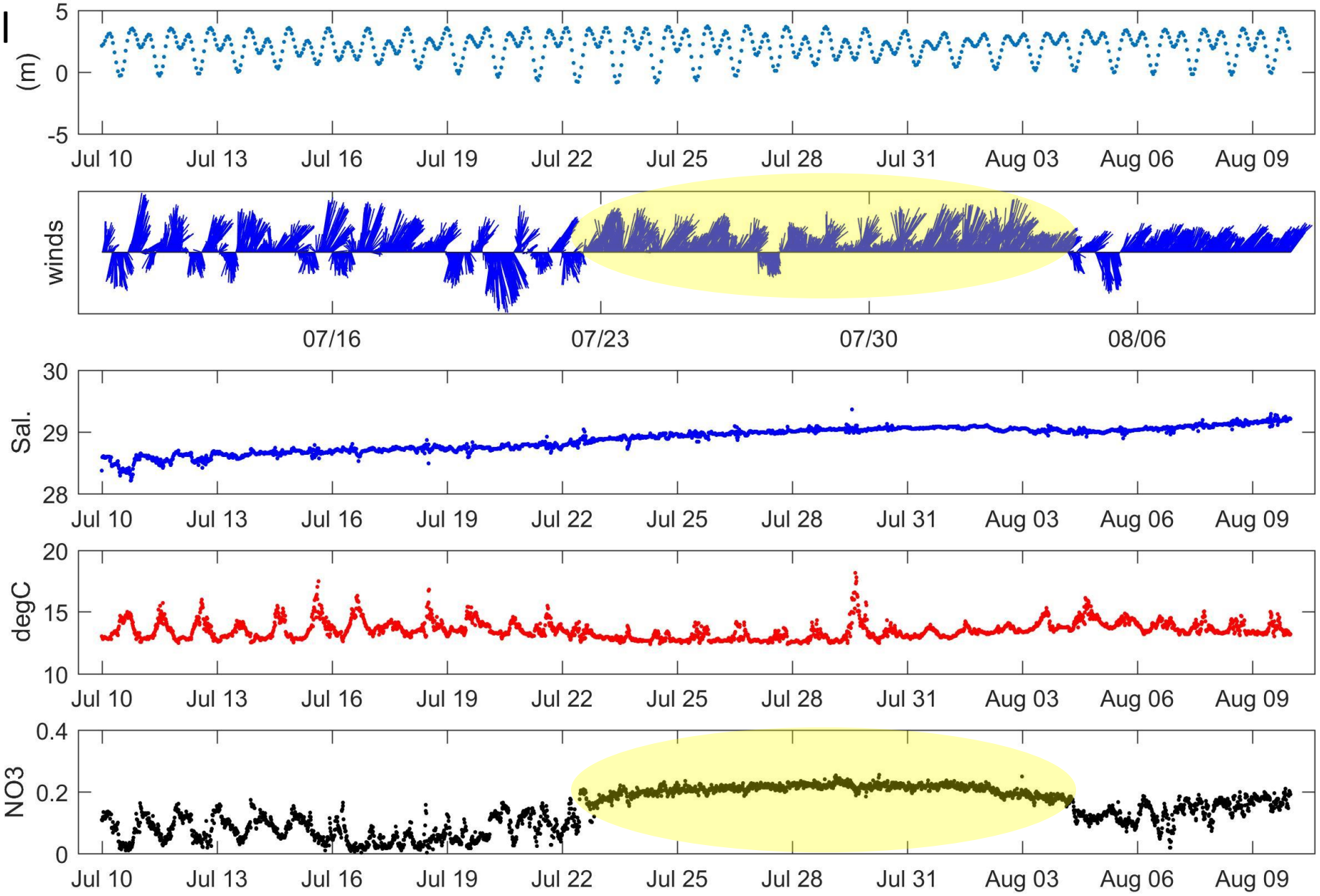
Water level (NOAA)

Winds at WP light (NOAA)

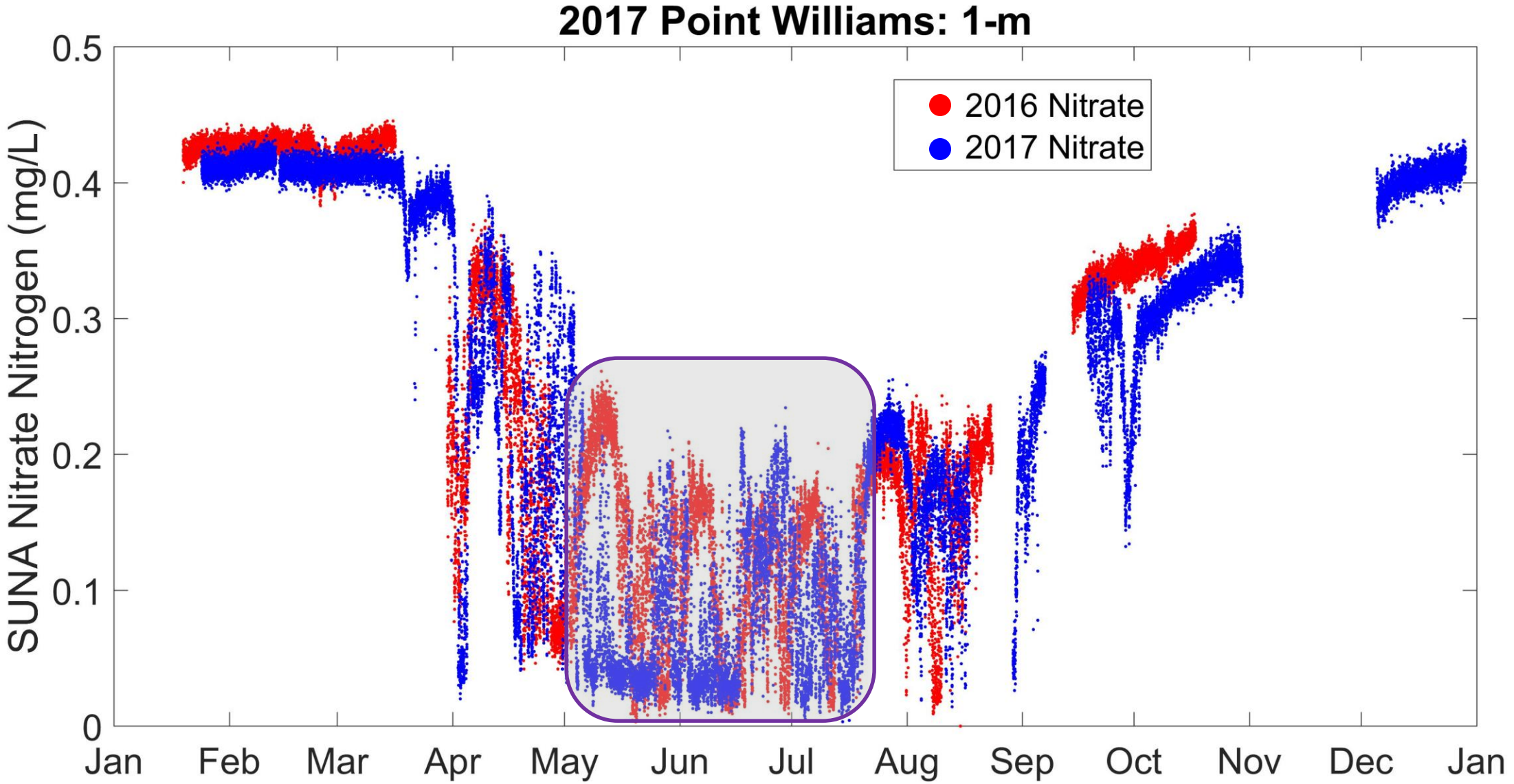
Surf. Salinity

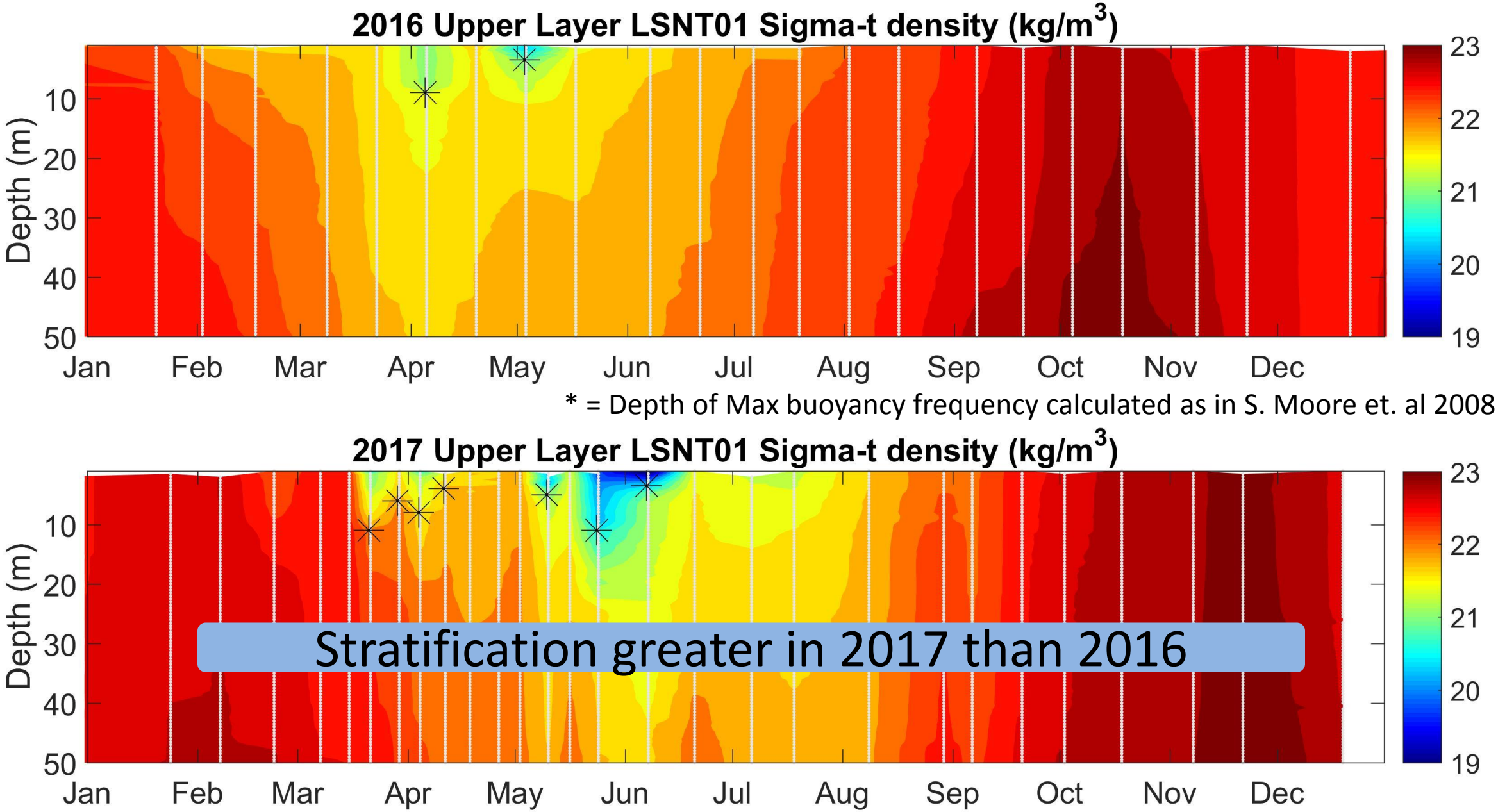
Surf. Temp.

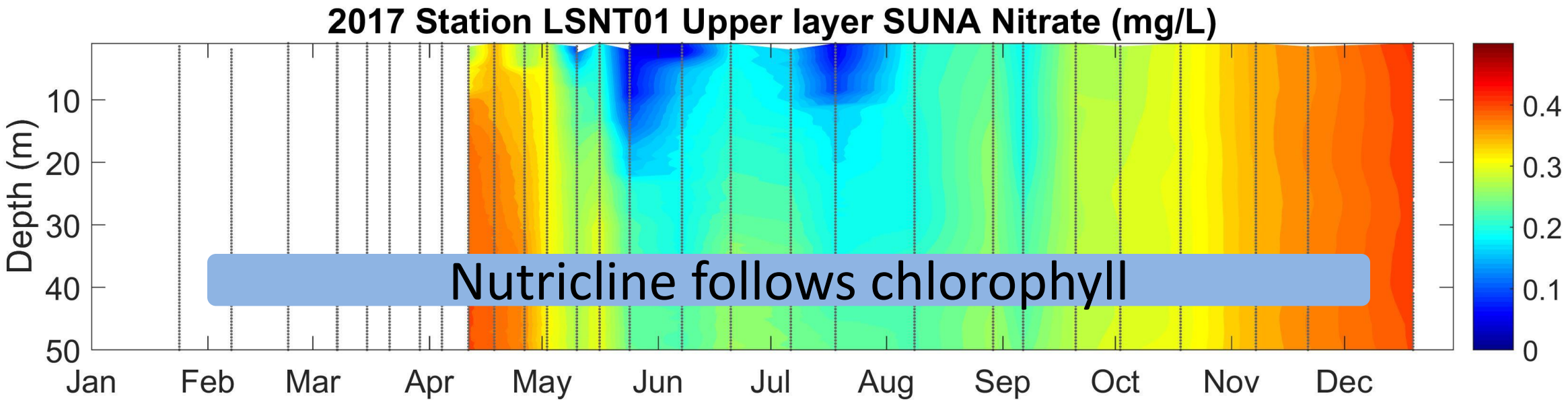
Surf. Nitrate



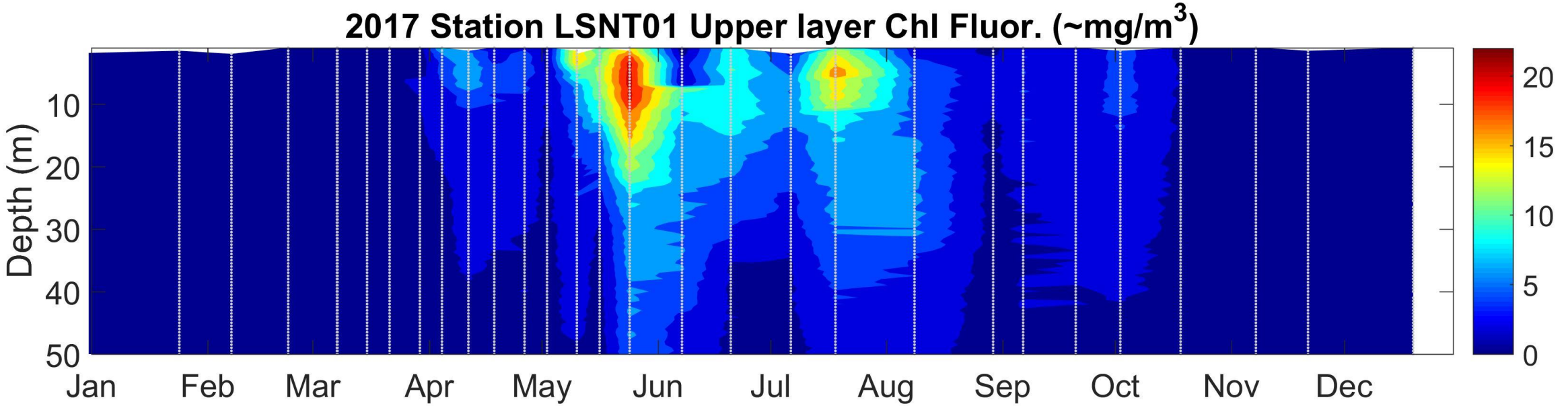
Surface Nitrate between years: 2016 vs. 2017

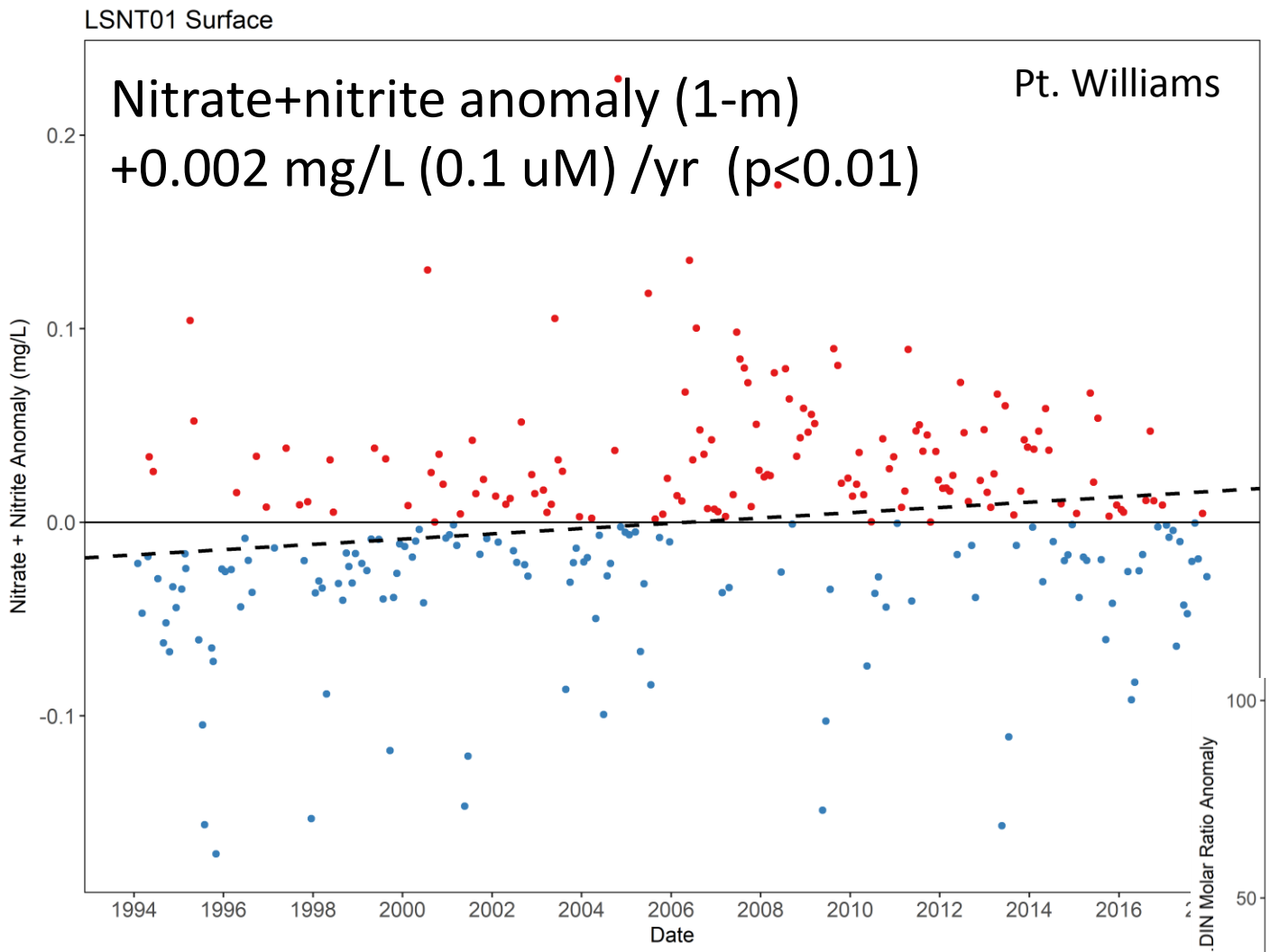


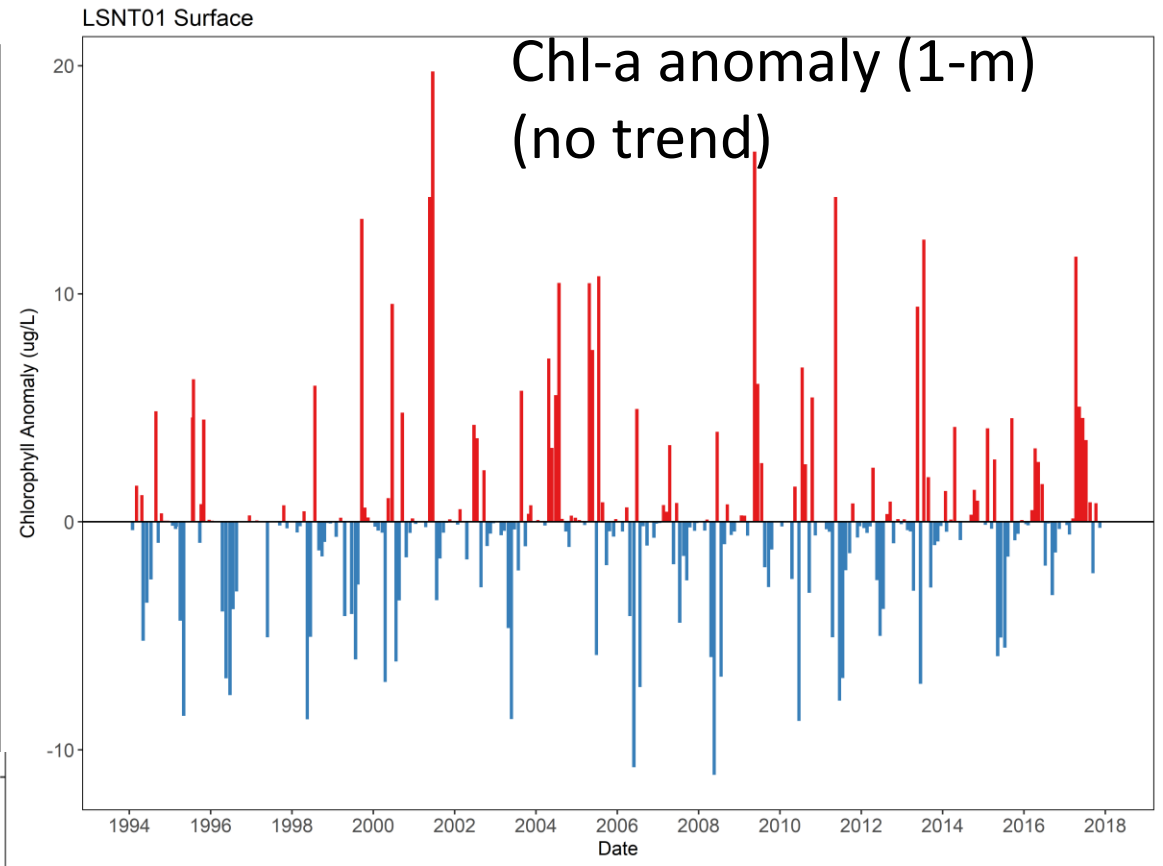

2016 Upper Layer LSNT01 Sigma-t density (kg/m3)
Depth (m)
10
20
30
40
50
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
23
22
21
20
19
* = Depth of Max buoyancy frequency calculated as in S. Moore et. al 2008
2017 Upper Layer LSNT01 Sigma-t density (kg/m3)
Depth (m)
10
20
30
40
50
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
23
22
21
20
19
Stratification greater in 2017 than 2016

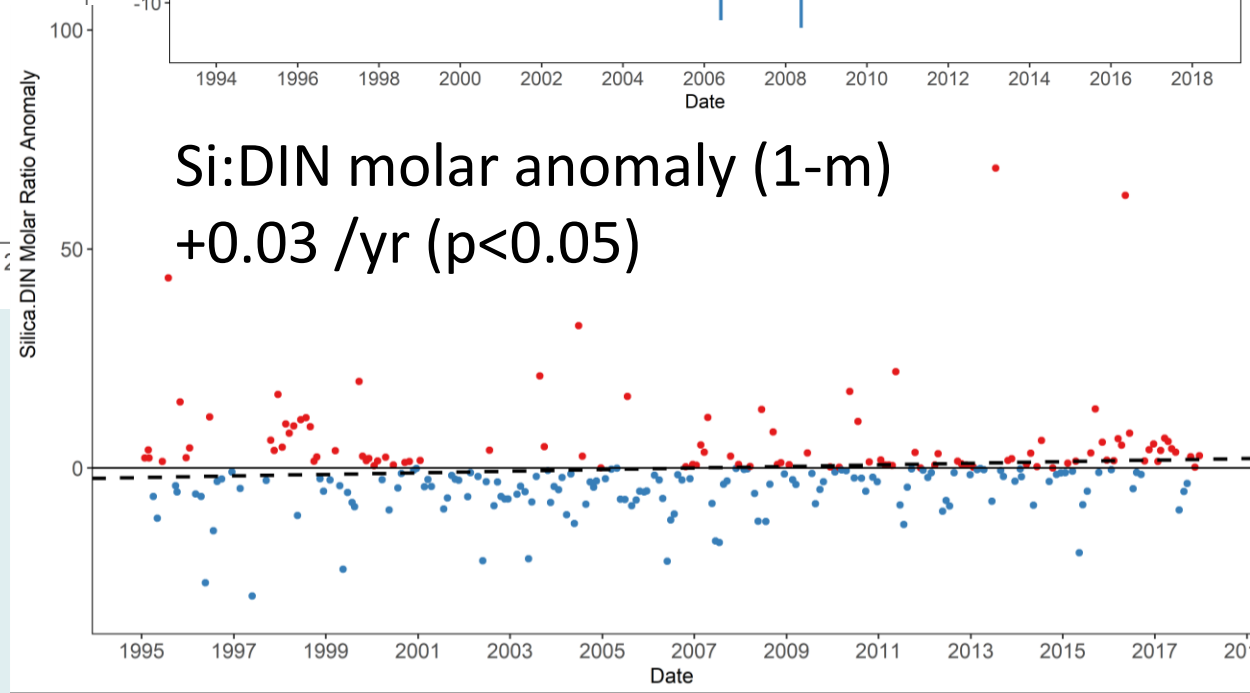


* = Depth of Max buoyancy frequency calculated as in S. Moore et. al 2008









Consider drivers when evaluating change over time

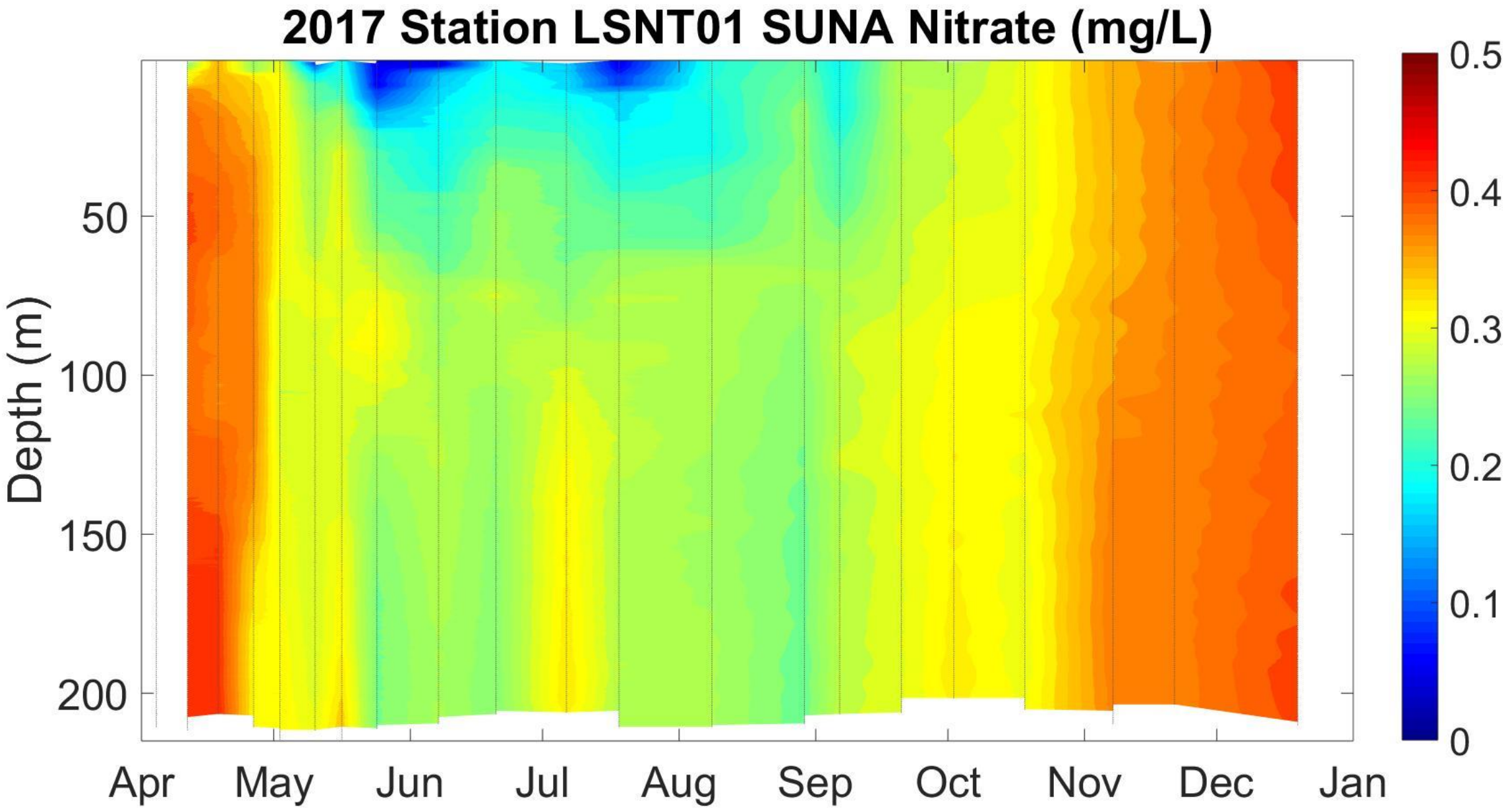
Summary Points

- Scales are important when looking at drivers of change, and can impact inter-annual variability, along with large scale climate drivers.
  - These can impact sensitivity to eutrophication
  - Different processes can arise between basins
- Large short-term variability in surface nitrate conditions at times during growing season, higher at night.
- Nutricline depth provides information on where waters could be most sensitive to local inputs
- Range of nitrate variability and understanding of drivers can be applied to models to better characterize the natural system

Thank you!

Contributors:

- King County Environmental Lab staff for year-round field sampling and lab analysis
- WA Dept. of Ecology Marine Monitoring Unit for use of SUNA nitrate sensor


2017 Station LSNT01 SUNA Nitrate (mg/L)
Depth (m)
50
100
150
200
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
0.5
0.4
0.3
0.2
0.1
0