

Deposition of Atmospheric Nitrogen to Coastal Ecosystems (DANCE): A study in seasonally oligotrophic waters off the eastern U.S.



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Ocean Carbon and Biogeochemistry Workshop, July 20-23, 2015

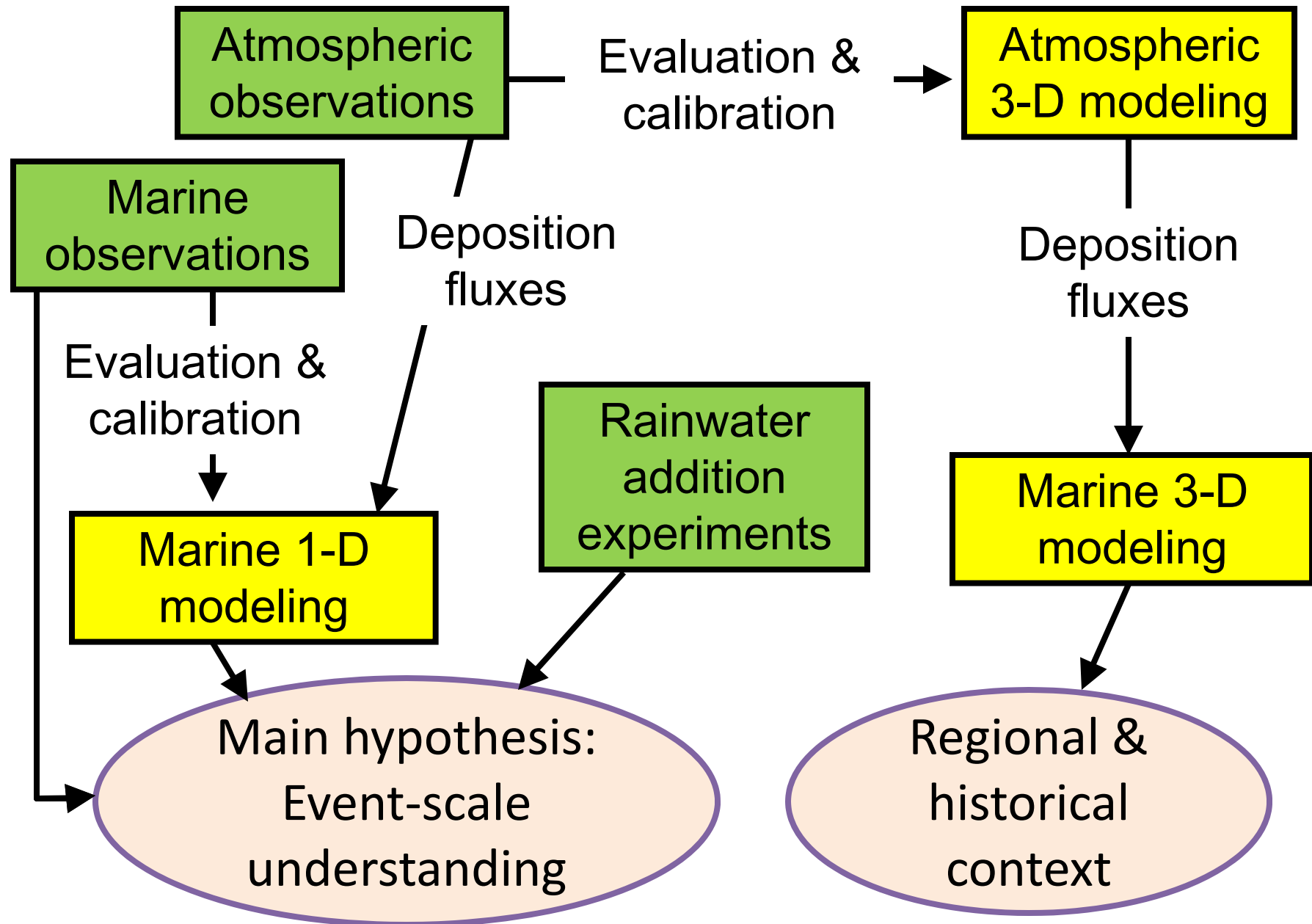
Main hypotheses

Wet deposition stimulates primary productivity and accumulation of algal biomass in coastal waters following summer storms.

This effect exceeds the associated biogeochemical responses to wind-induced mixing and increased stratification caused by surface freshening.

Evaluated
using
isotopes,
property-
property
relationships,
and modeling

Project components and linkages

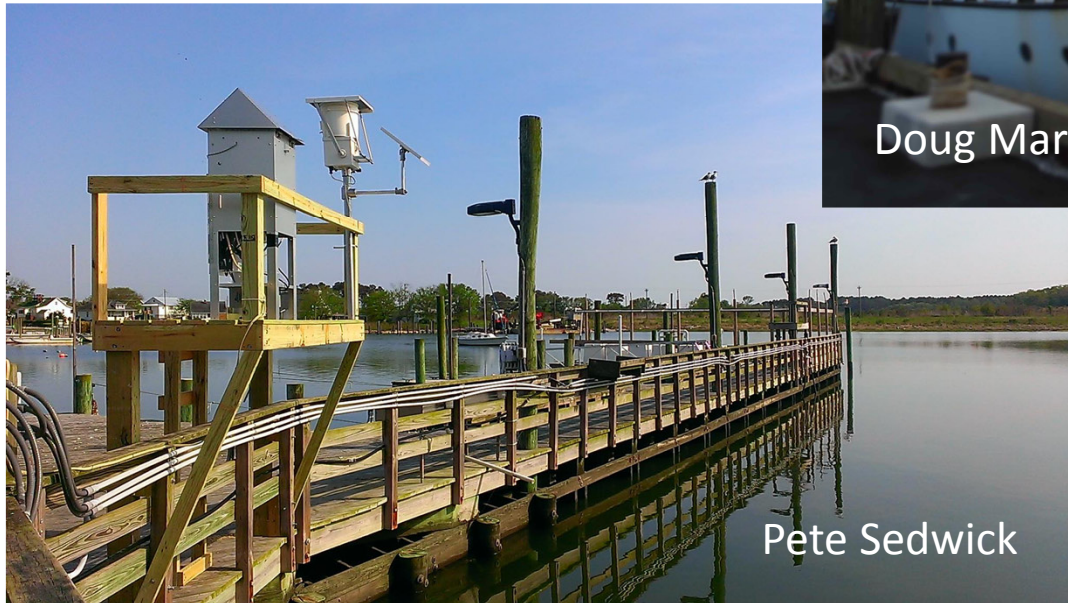


Measurement platforms

RV Hugh Sharp
cruise July 30 –
August 15, 2014



Doug Martins

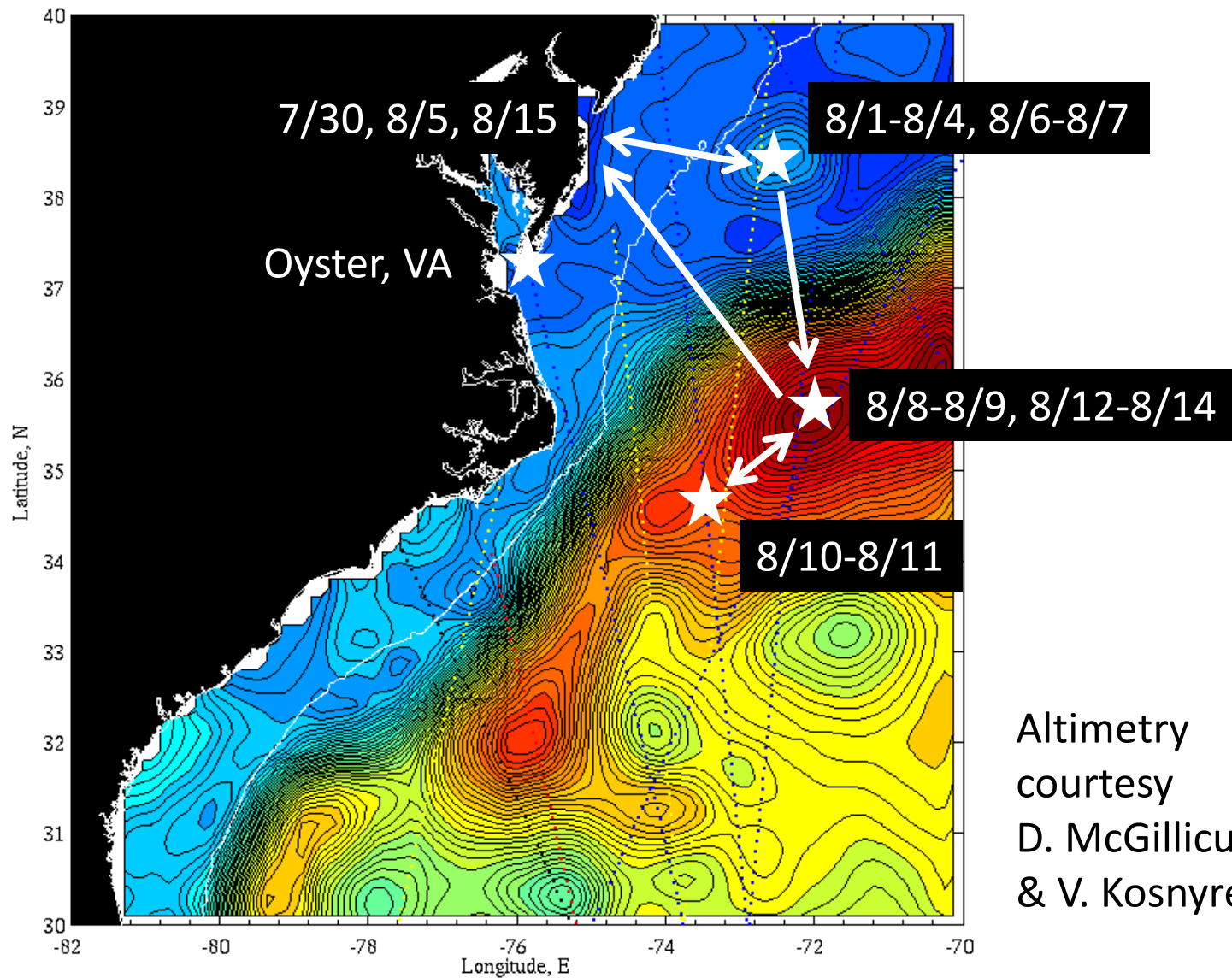


Pete Sedwick

Oyster, VA
deposition
measurements
2014-2015

Sampling locations

Contours and colors: Sea Surface height



Altimetry
courtesy
D. McGillicuddy
& V. Kosnyrev

Chasing rain at sea

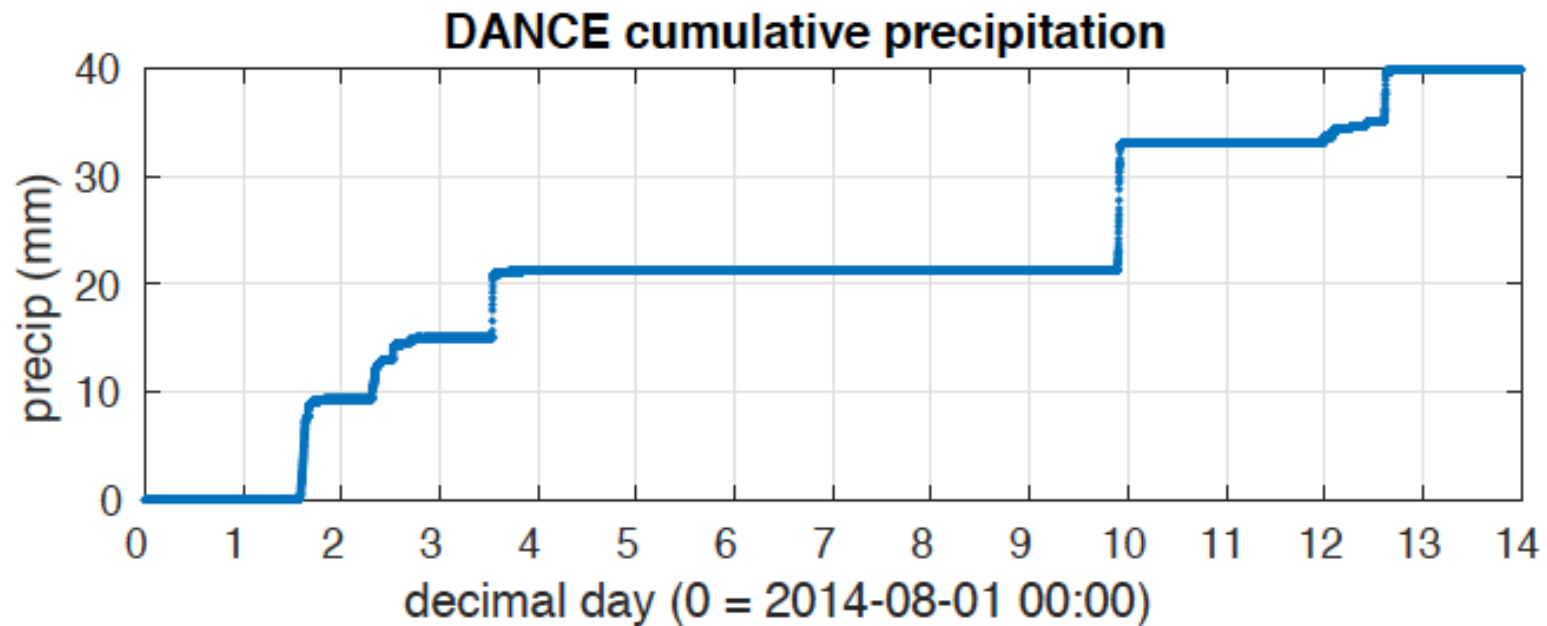
Ship's radar



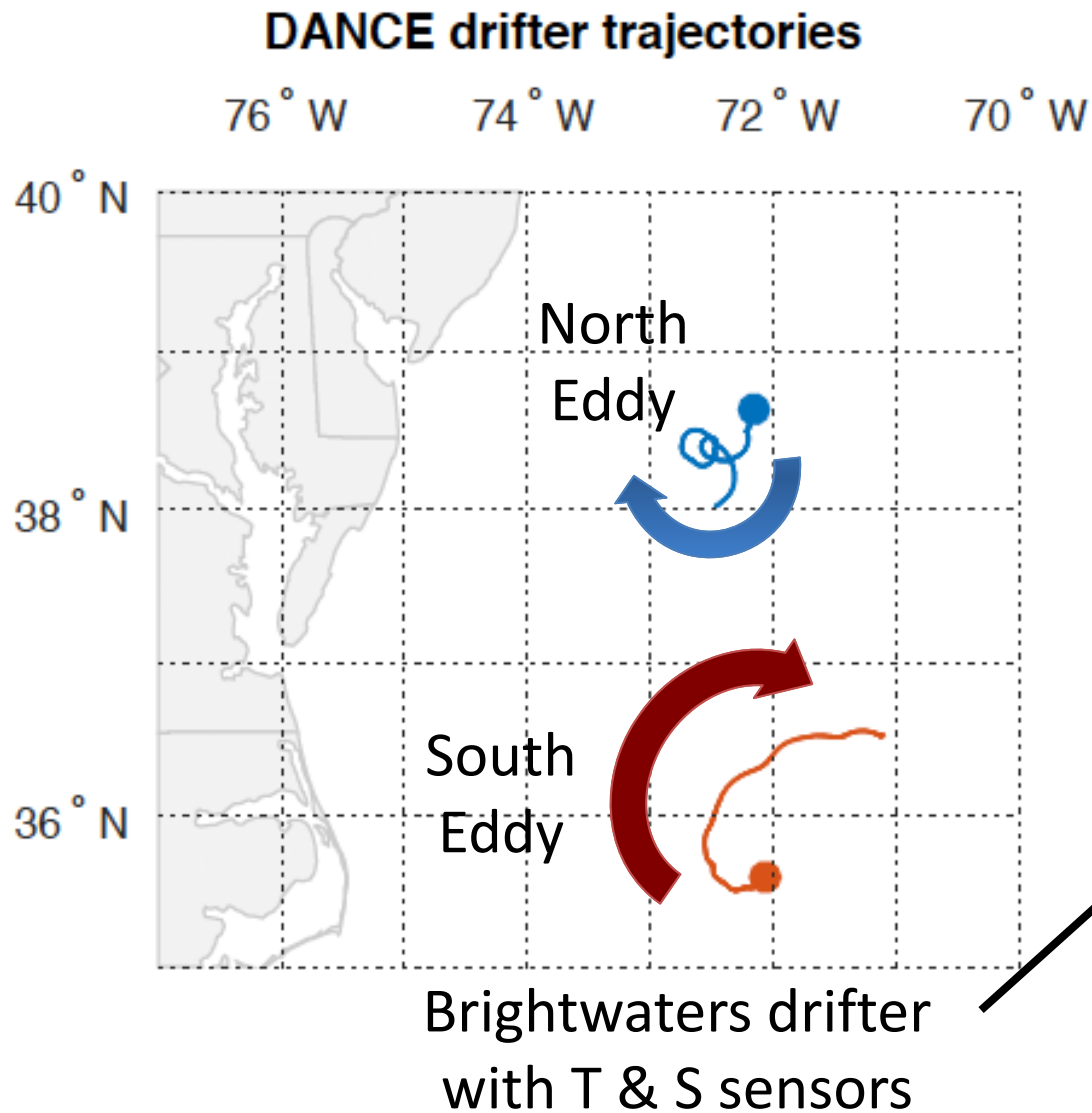
Forecaster



The target!

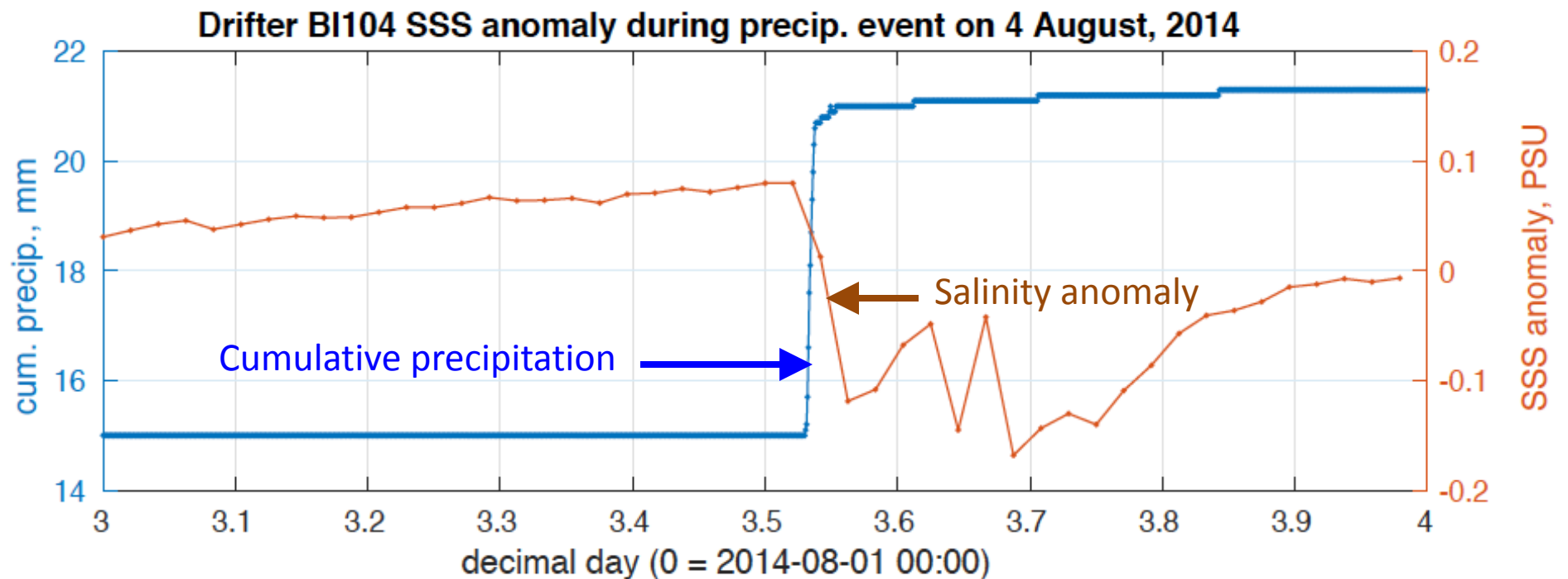


Lagrangian sampling

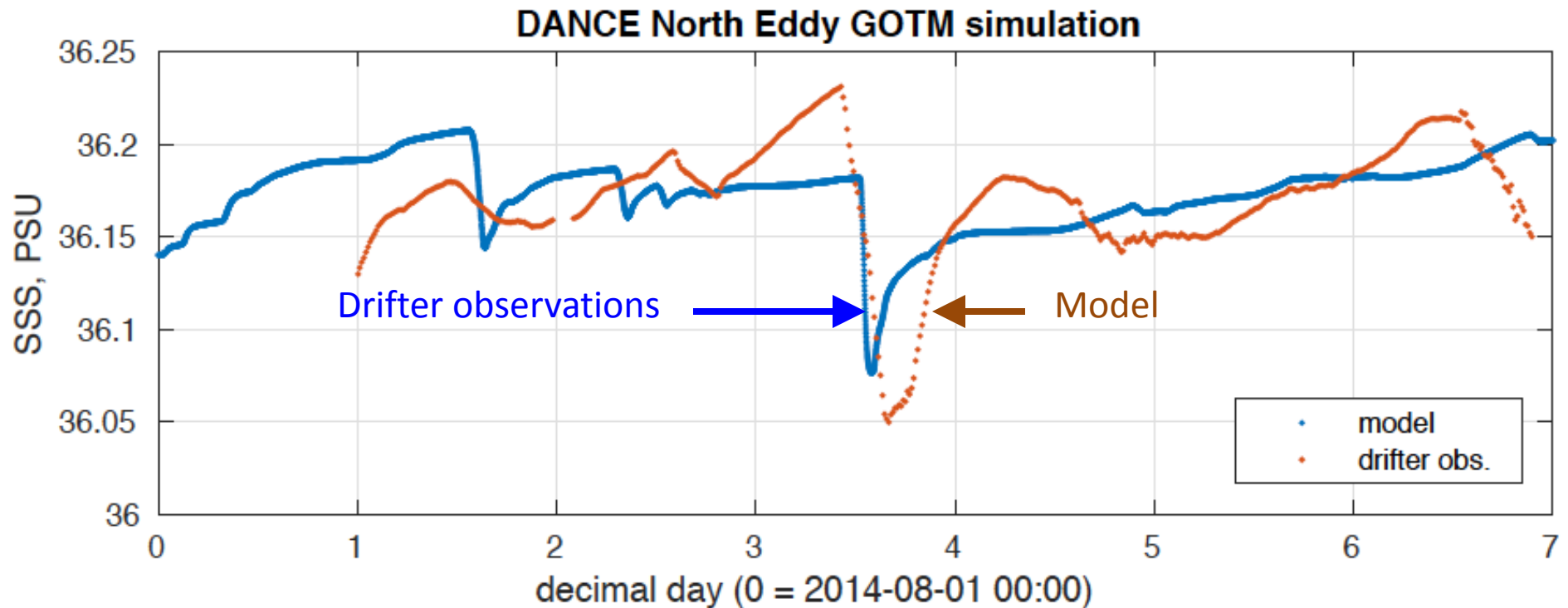


10 m drogue

Salinity response to precipitation event

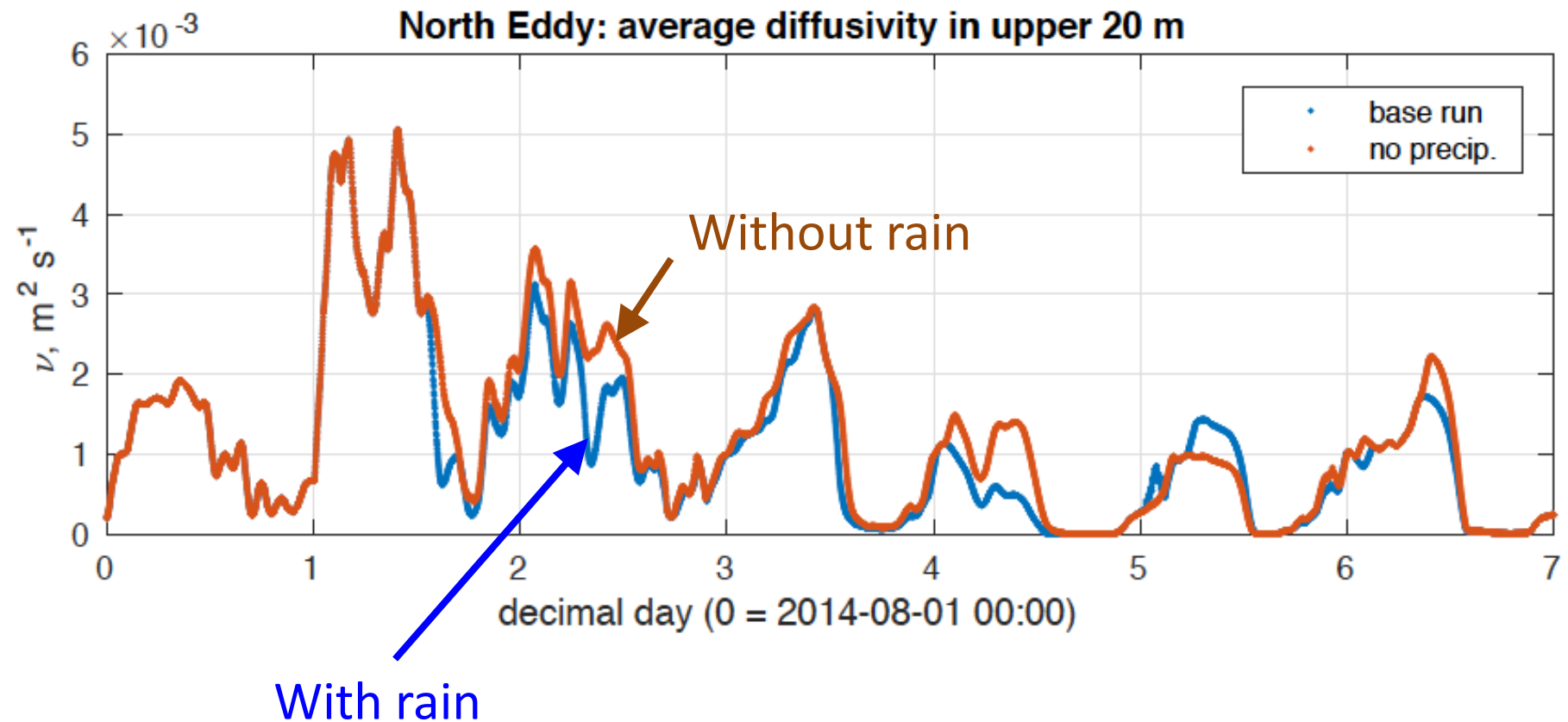


Modeling the impact of rain events on the upper ocean (1-D)



(GOTM = Generalized Ocean Turbulence Model)

Modeled effect of rain on upper ocean mixing



See more in St. Laurent et al. poster

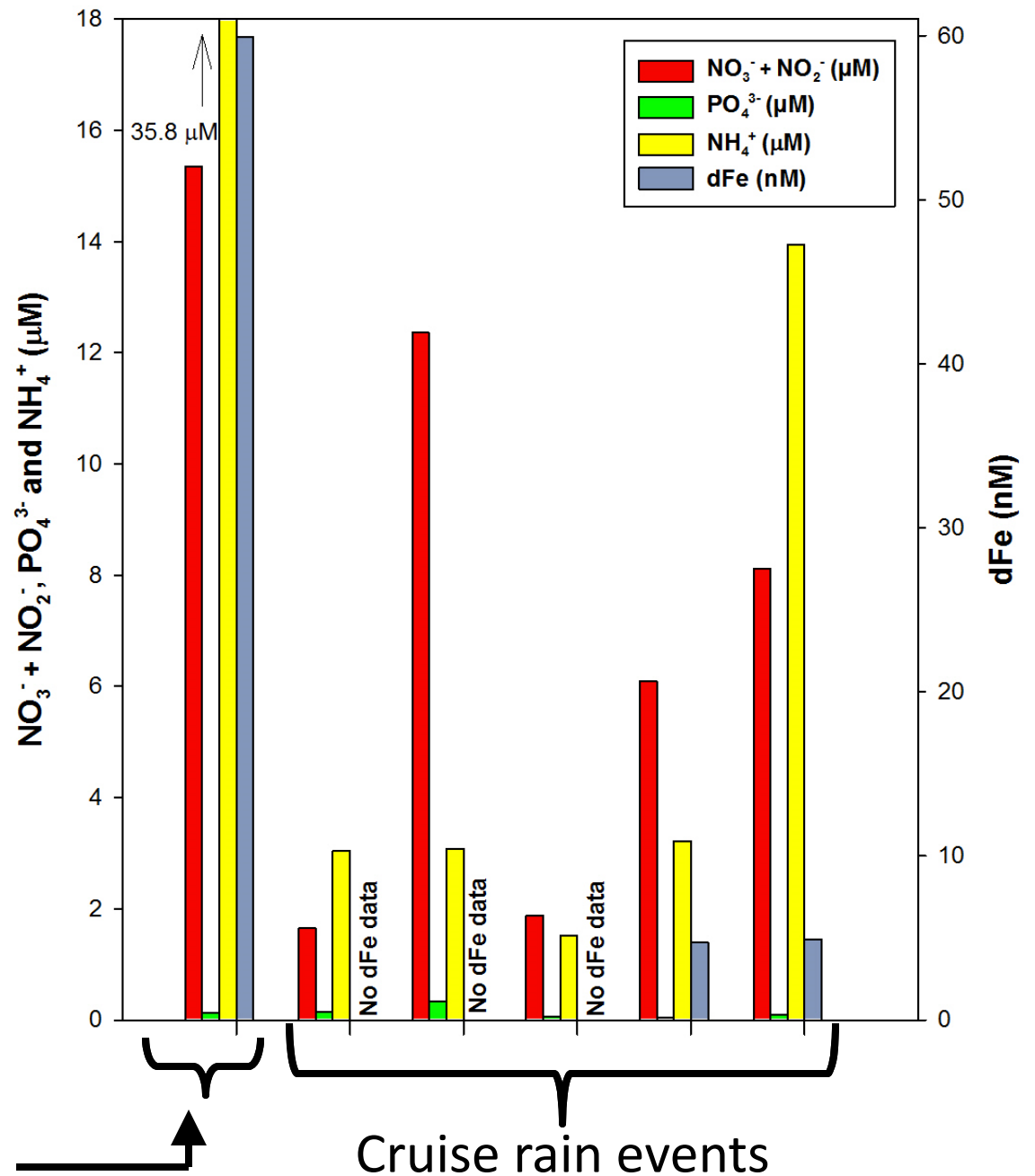
Nutrients in rain



Cruise levels:

Nitrate	1.6-12.3 μM
Ammonium	1.5-13.9 μM
Phosphate	0.01-0.31 μM
N:P	35-880
Amm.:Nit.	0.2-1.7
Fe	~ 4 nM

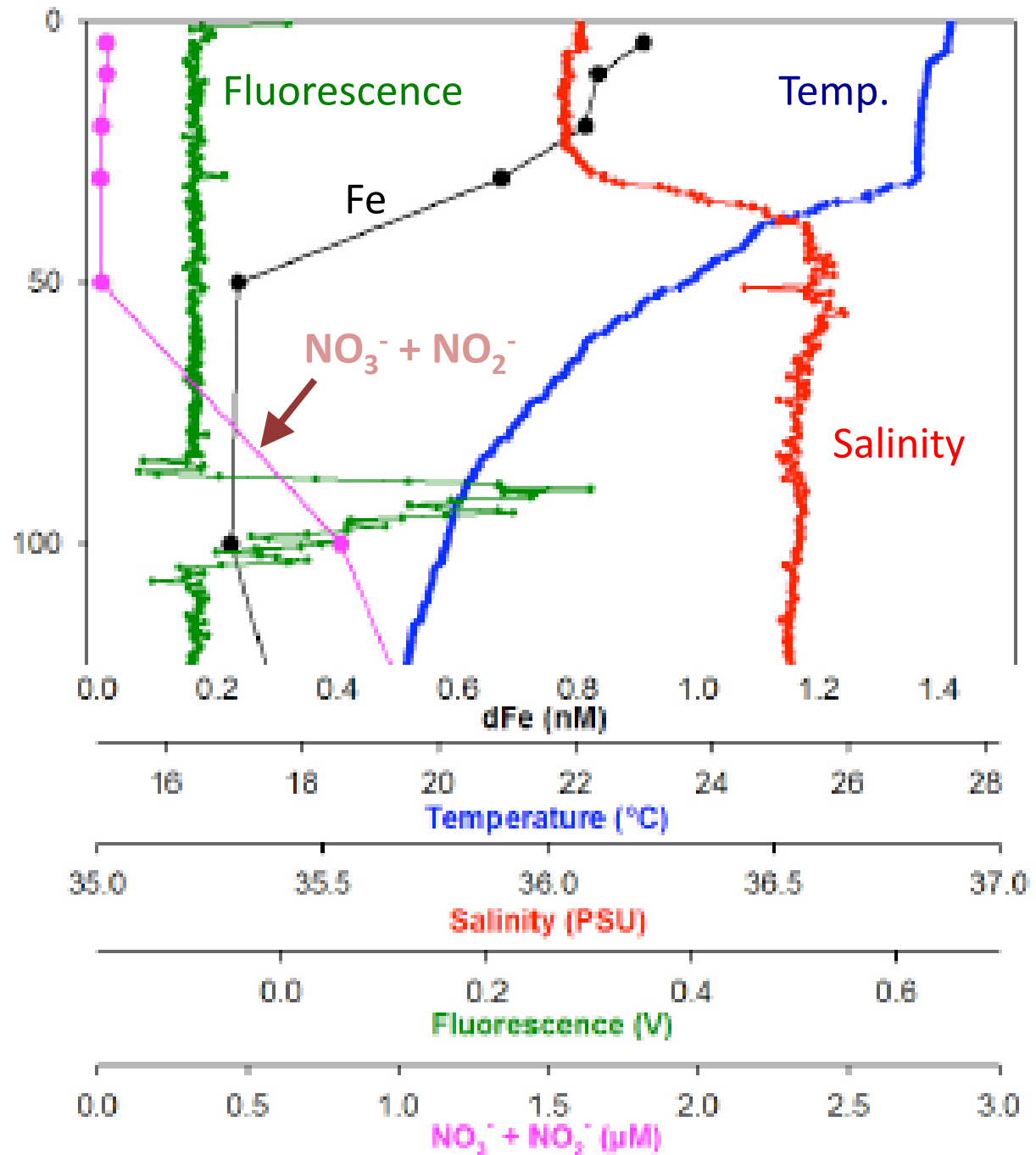
ODU campus composite



Hydrography

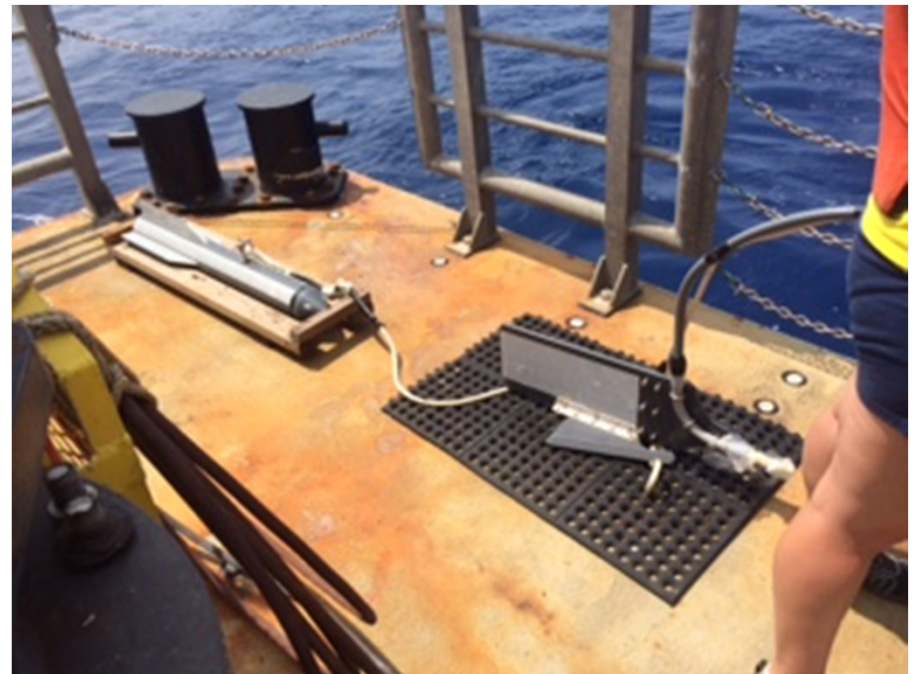
Depth
(m)

*Surface waters
very low in
chlorophyll,
DIN, & DIP;
enriched in Fe*



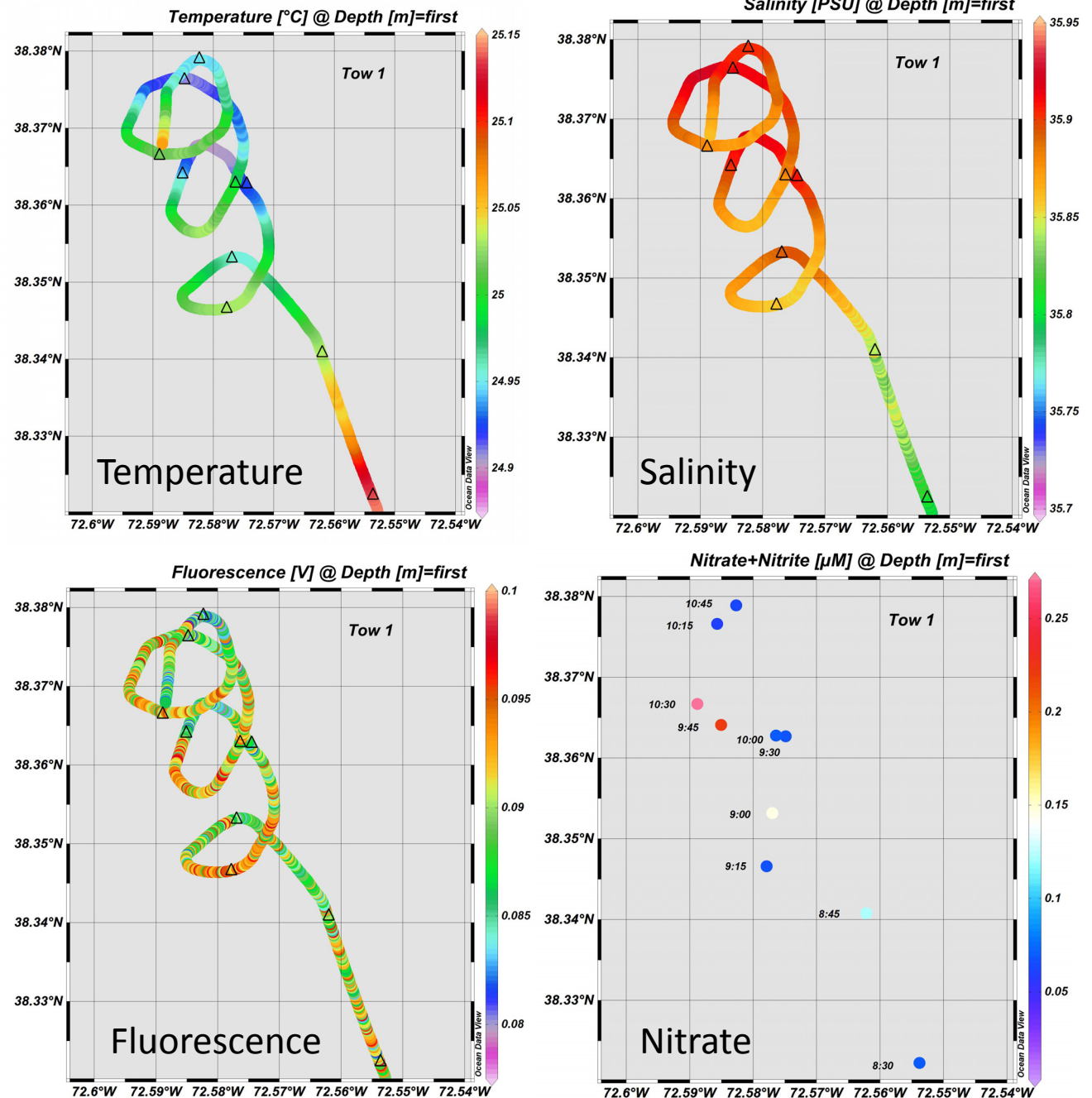
Additional water column measurements

- Rates of C and N uptake by phytoplankton
- Isotopes of nitrate
- Surface water mapping of T, S, chlorophyll, nutrients and iron with the Towfish



Results of Surface water mapping

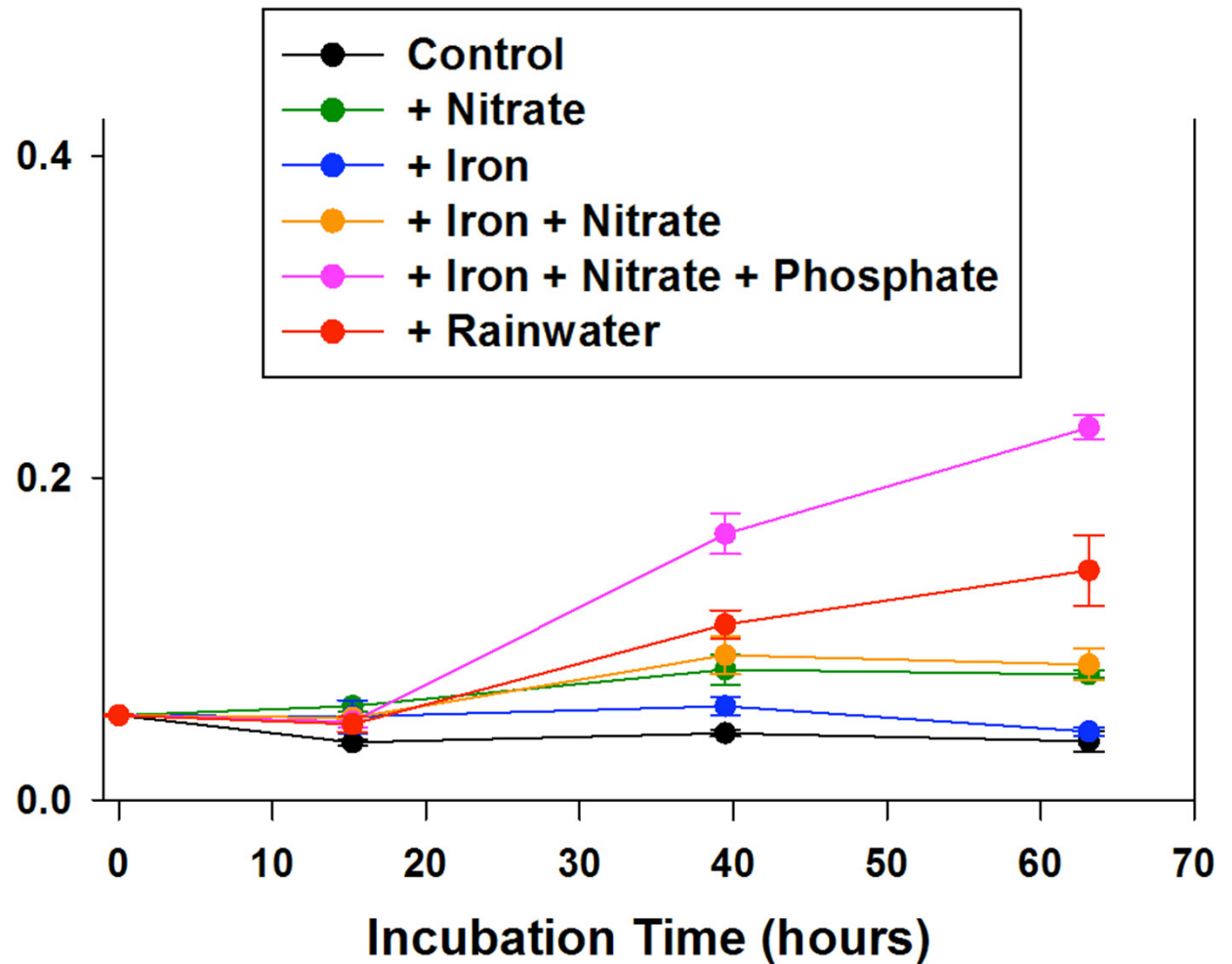
Patchiness apparent in all underway parameters





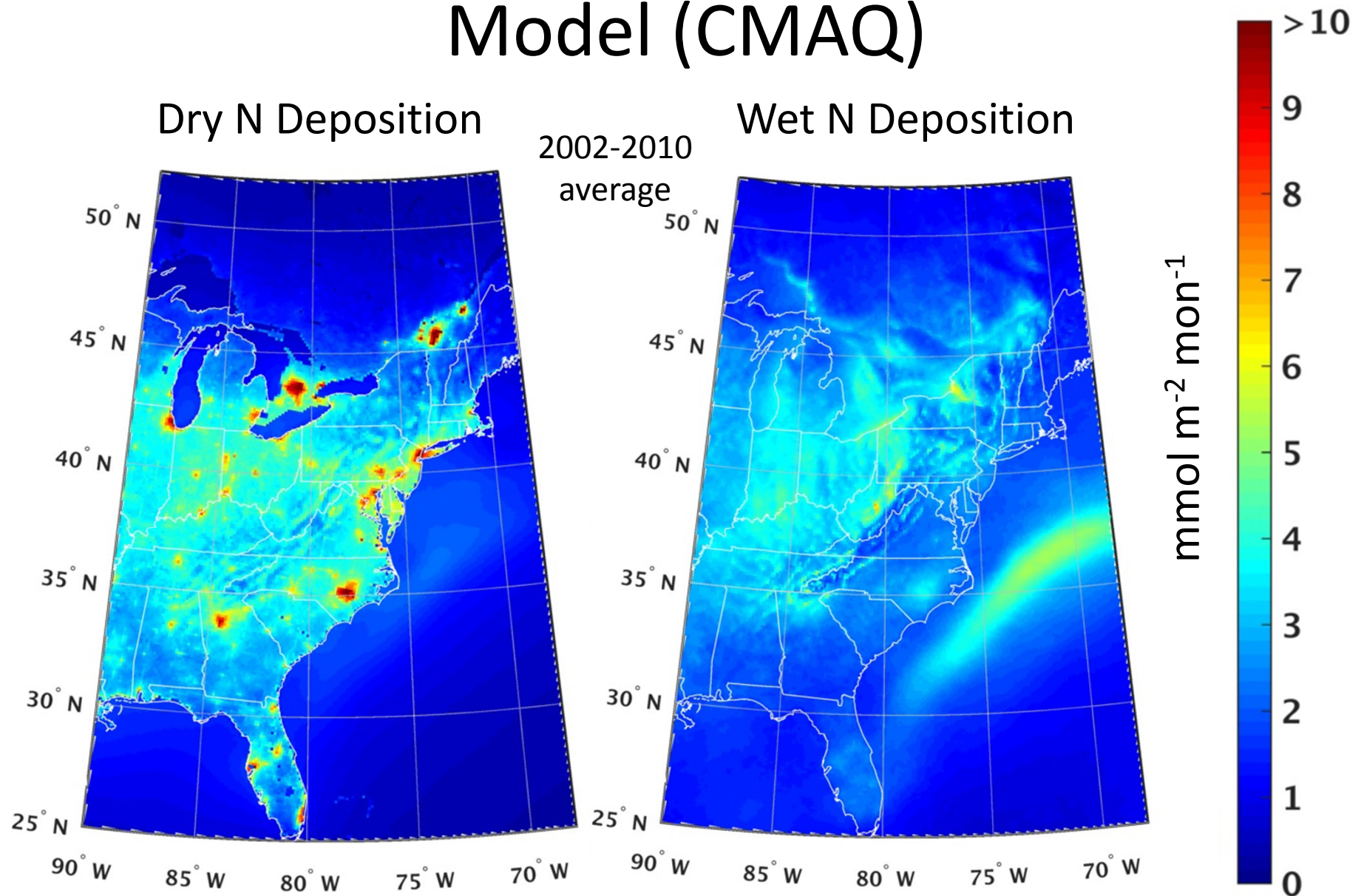
Shipboard incubations

Chlorophyll
(mg m^{-3})



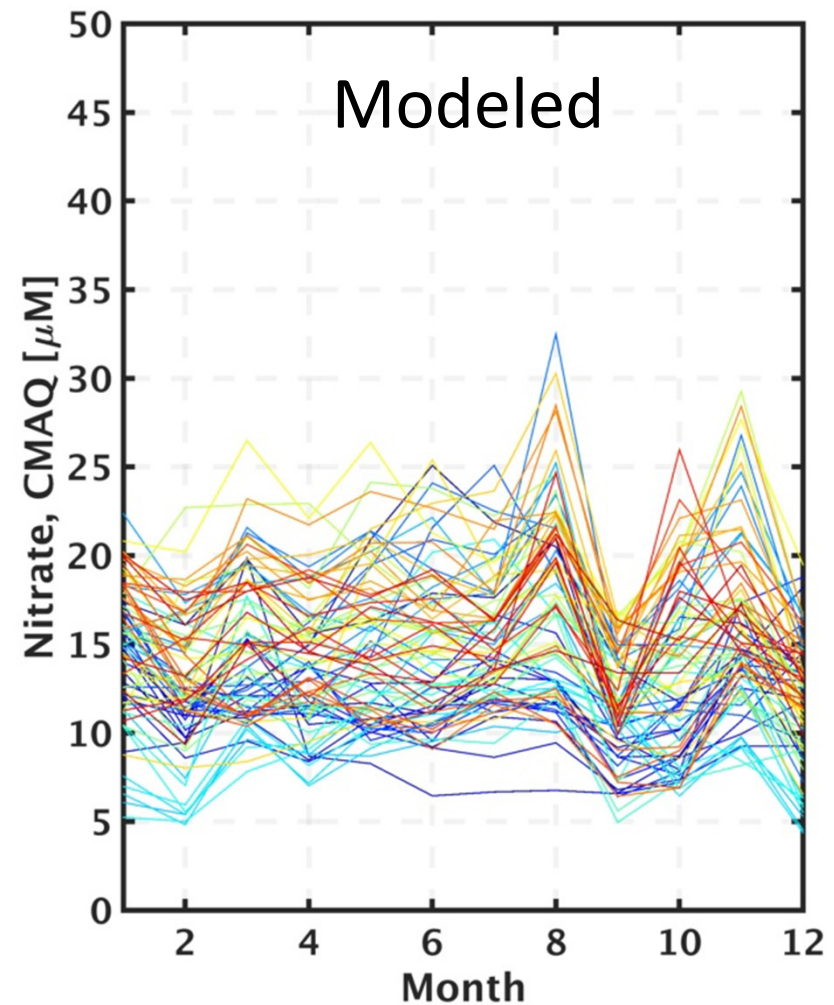
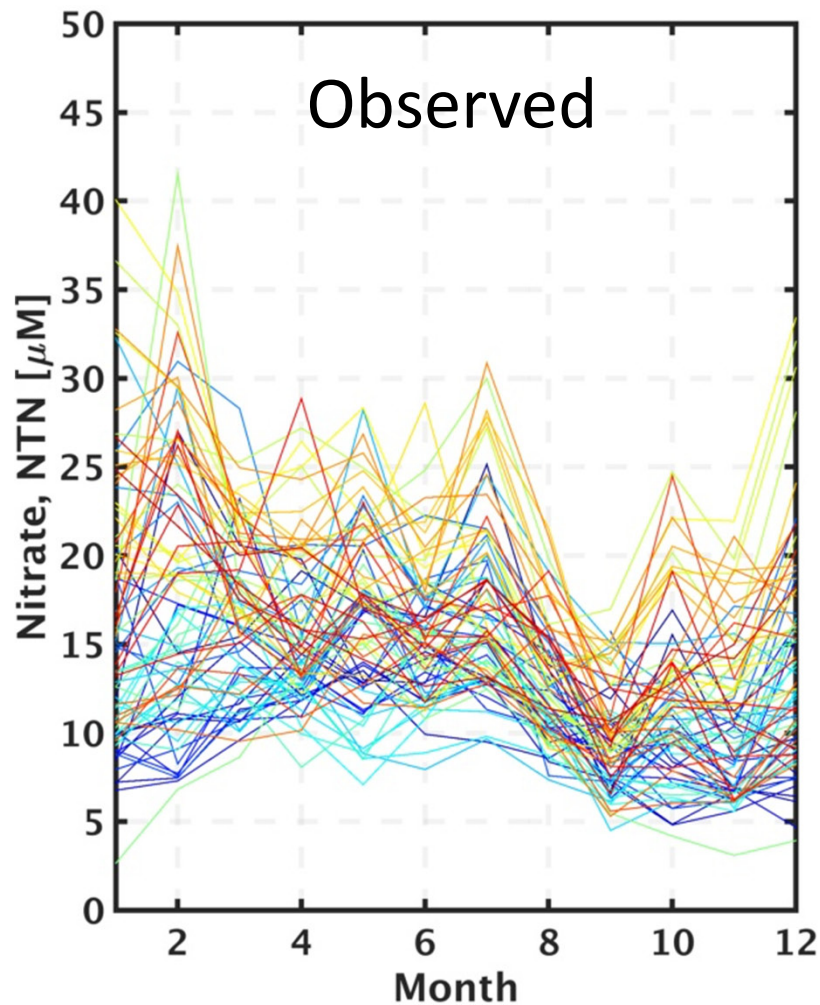
- *N & P limitation*
- *No Fe limitation*
- *Rainwater stimulation*
- *See Sedwick et al. poster*

Community Multiscale Air Quality Model (CMAQ)



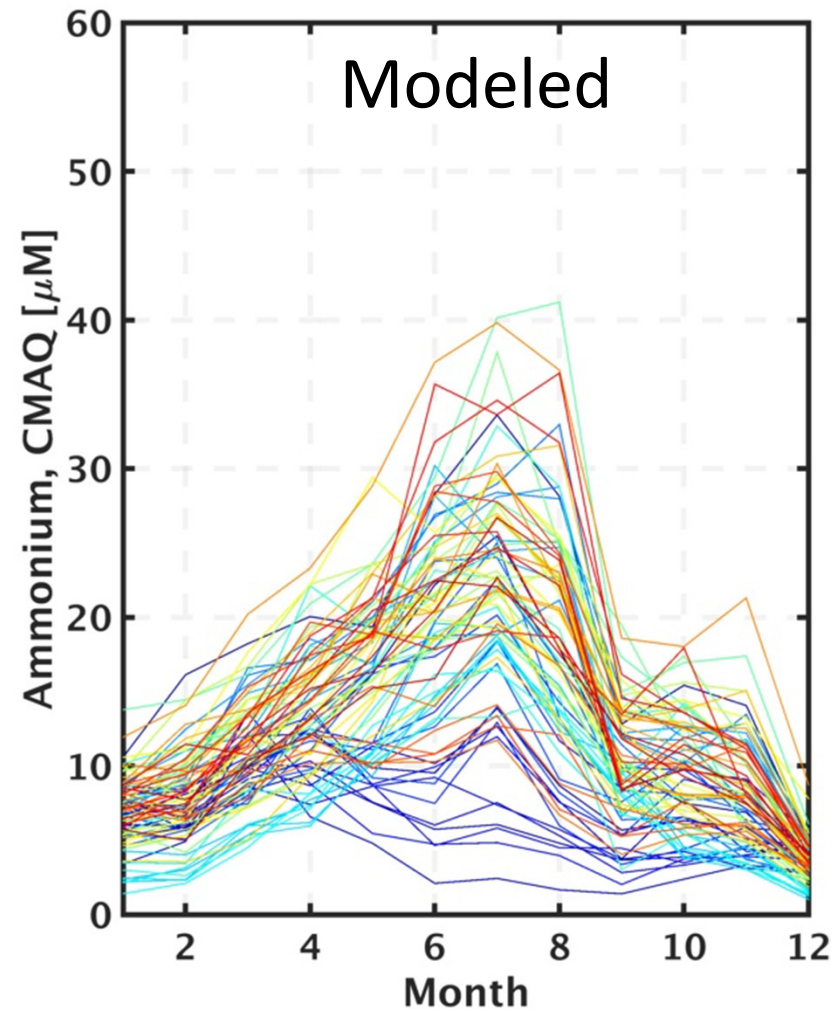
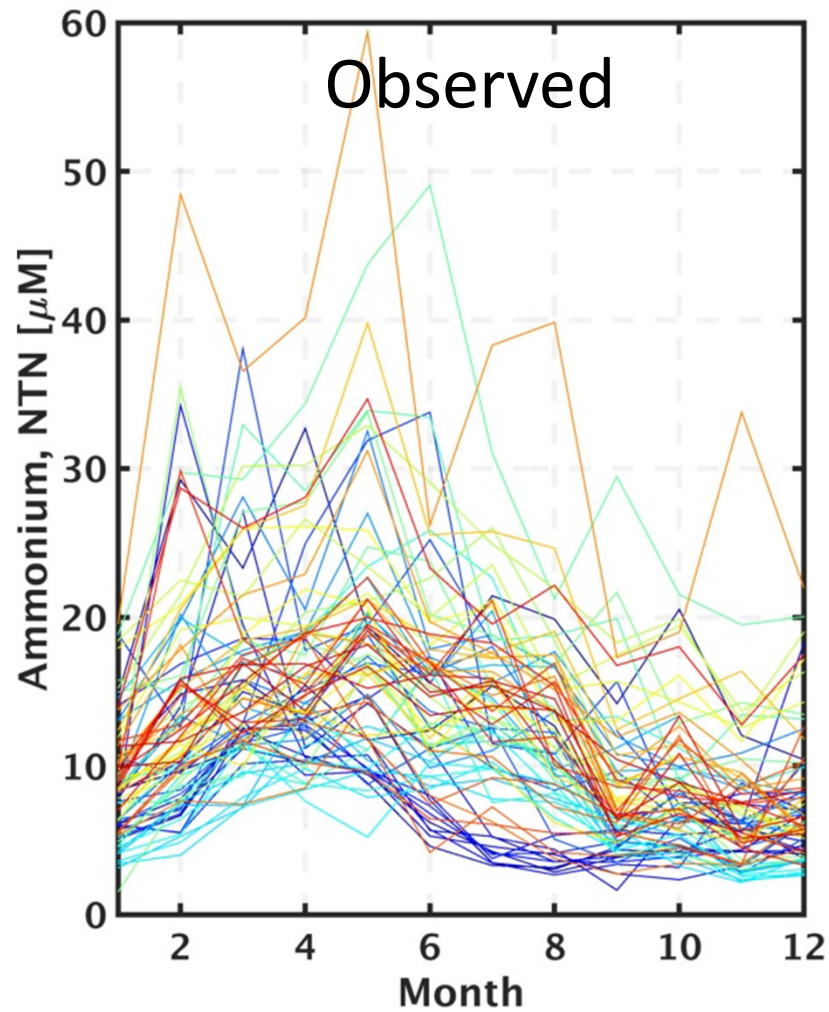
CMAQ evaluation in Atlantic coastal states

Nitrate at NTN Sites
Annual Cycle; 2002–2010



CMAQ evaluation in Atlantic coastal states

Ammonium at NTN Sites
Annual Cycle; 2002–2010

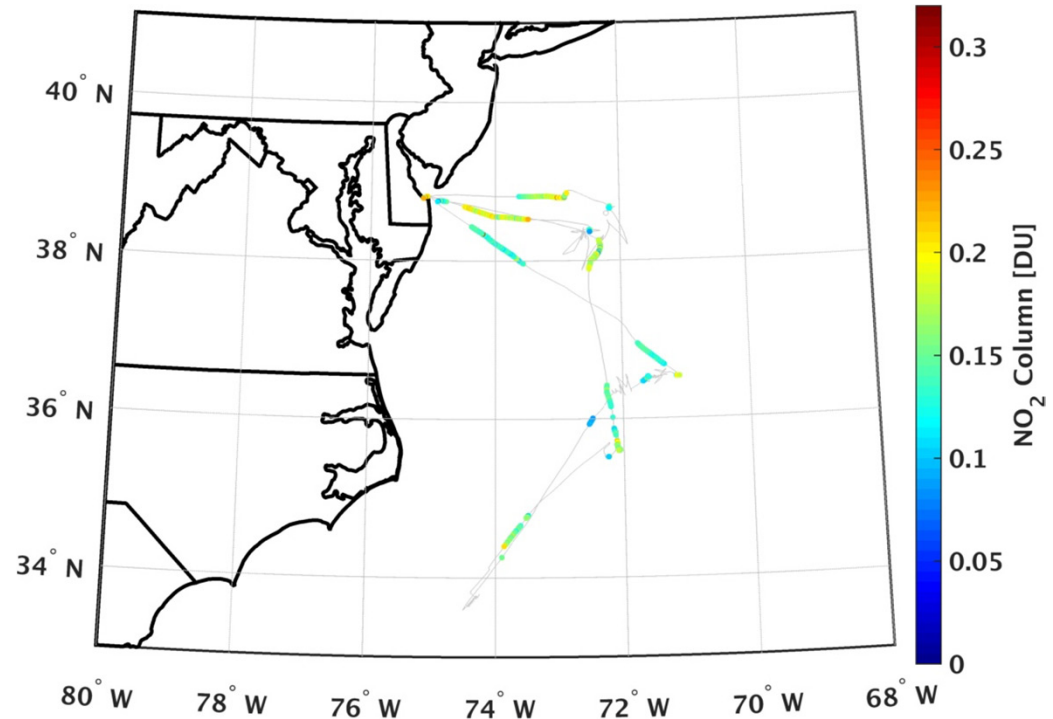


DANCE measurements for CMAQ evaluation

- Deposition
- *In situ* air chemistry
- Remote sensing of NO_2 and O_3



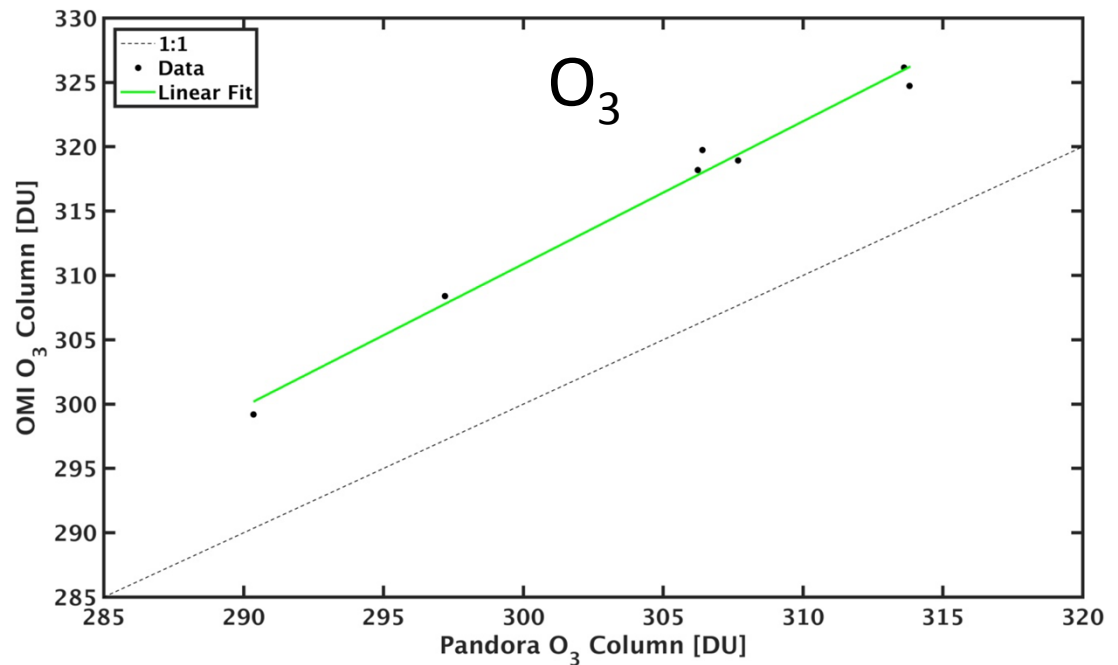
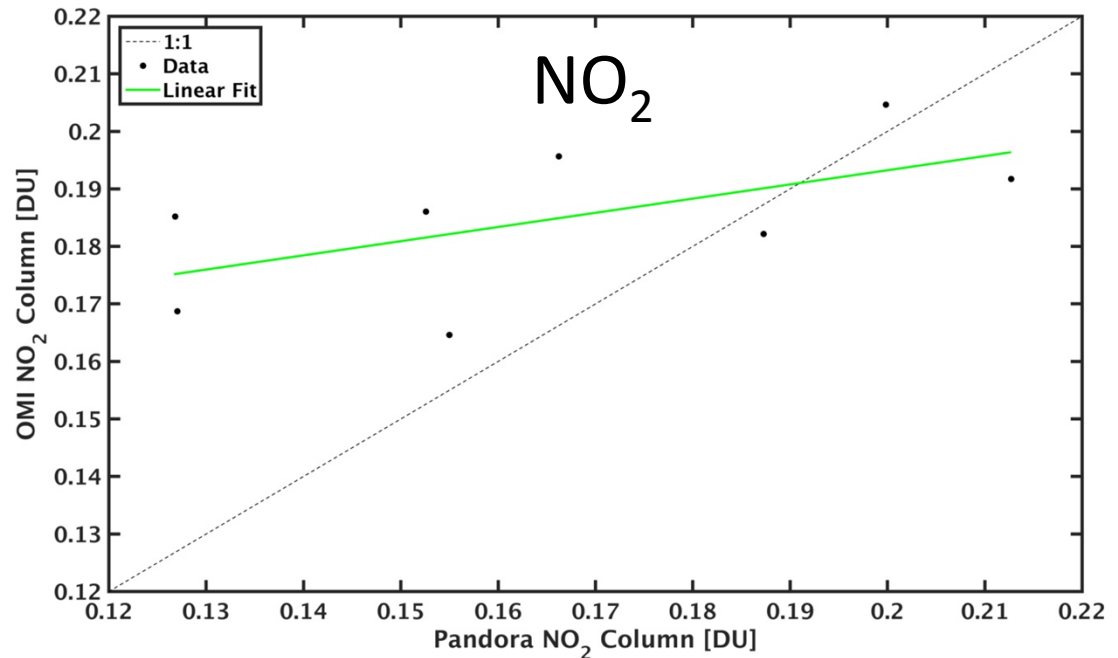
Pandora



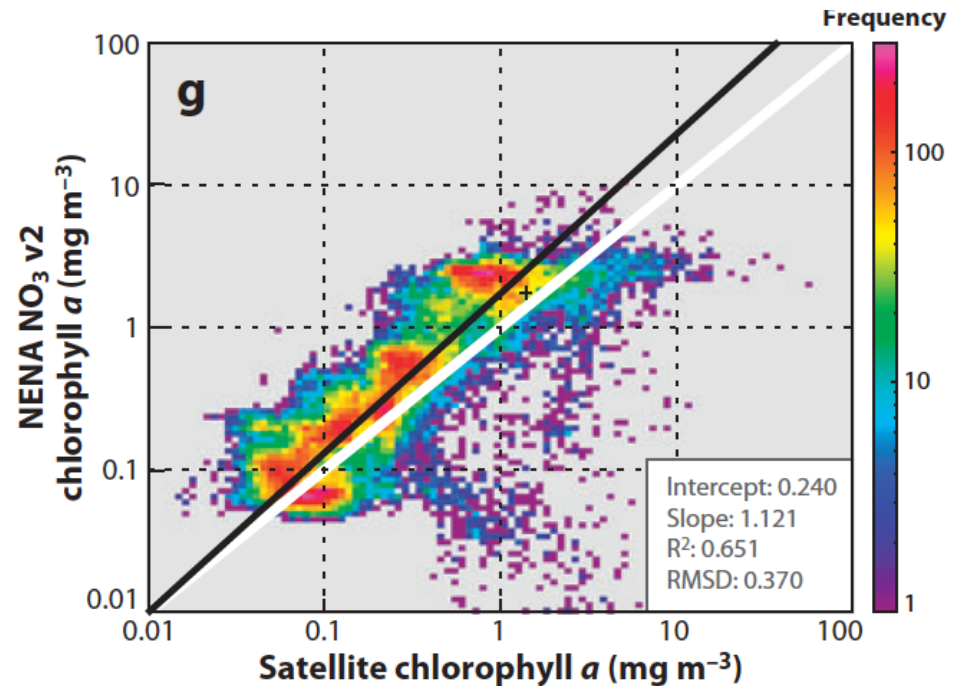
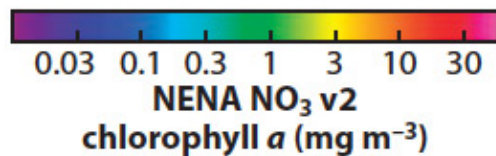
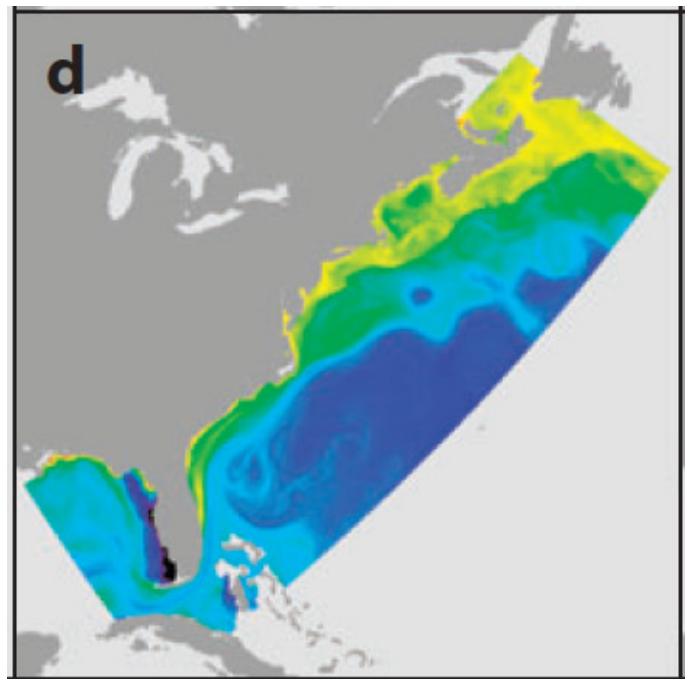
Comparison
between
Pandora and
satellite

NASA's OMI =
Ozone
Monitoring
Instrument

*First blue-water
comparison*



3-D ocean modeling: USECoS



Hofmann et al. (2011)

Next steps

- Detailed analysis of water column data (isotopes, surface mapping, rates)
- CMAQ simulation of cruise period & region
- Inclusion of N deposition to USECoS 3-D ocean model
- Continued 1-D ocean modeling

Thank you

