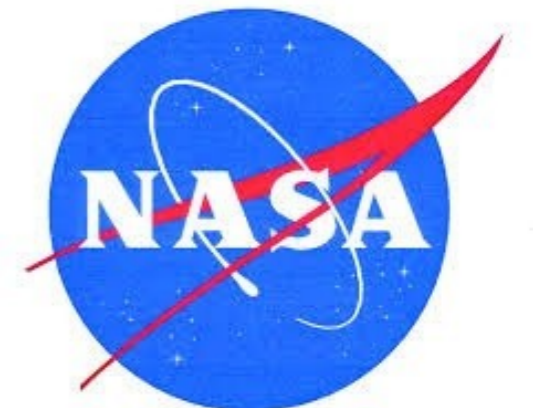
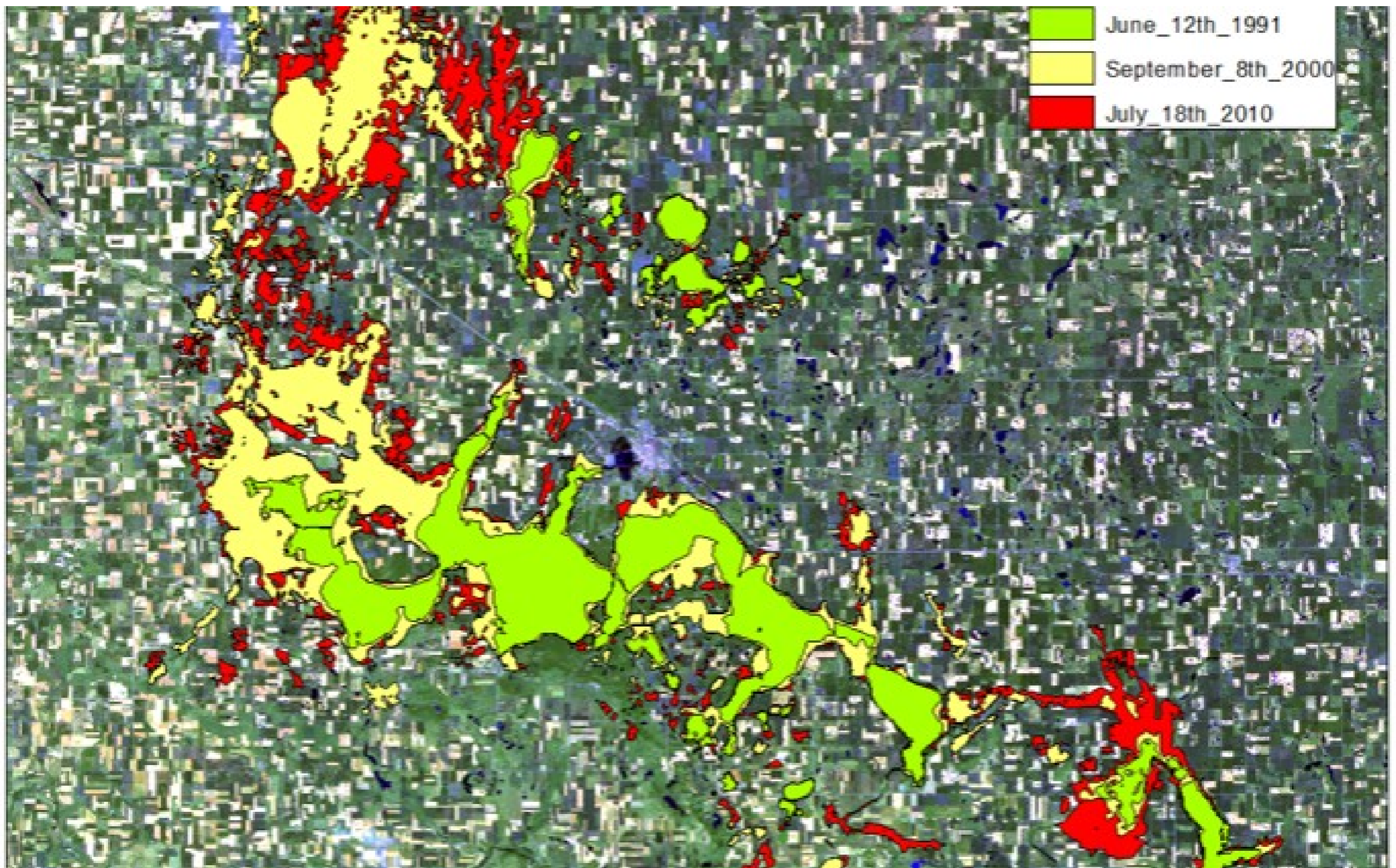


Monitoring Water Quality in Devils Lake

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Earth System Science & Policy
University of North Dakota





Devils Lake Expansion

How is water quality effected?



Water Quality

— Physical, chemical and biological characteristics of water relative to the requirements of some organism —



Characteristics

Salinity, Dissolved Oxygen, Chlorophyll, Turbidity

Important Water Quality ?' s

- To what extent does water quality vary on different time scales: daily, monthly, yearly
- How does water quality vary spatially



- How are changes in the surrounding land use mosaic linked to changes in water quality
- How important are time lags in hydrological systems
- How might various climate shifts influence water quality



Buoy Measurements

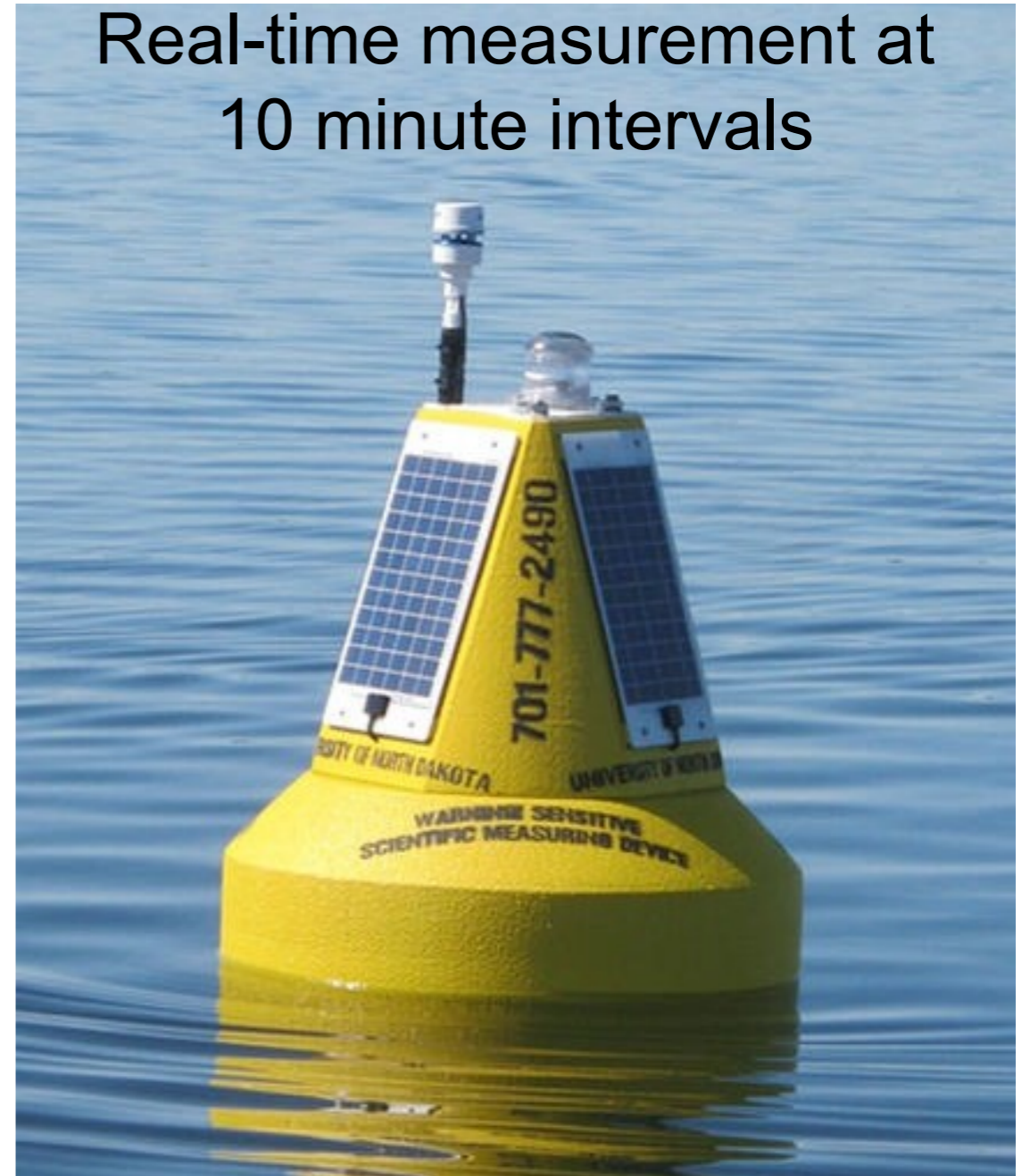
Weather parameters:

- Air temperature
- Wind speed / direction (Windsp)
- Atmospheric pressure

Water parameters:

- Total dissolved solids (TDS)
- Salinity (Sal)
- Turbidity (Turb)
- Chlorophyll concentration (Chlor)
- Water temperature (Wtmp)

Real-time measurement at
10 minute intervals



Buoy Adventures



ADVERTISEMENT

UND says buoy with scientific payload is missing from Devils Lake

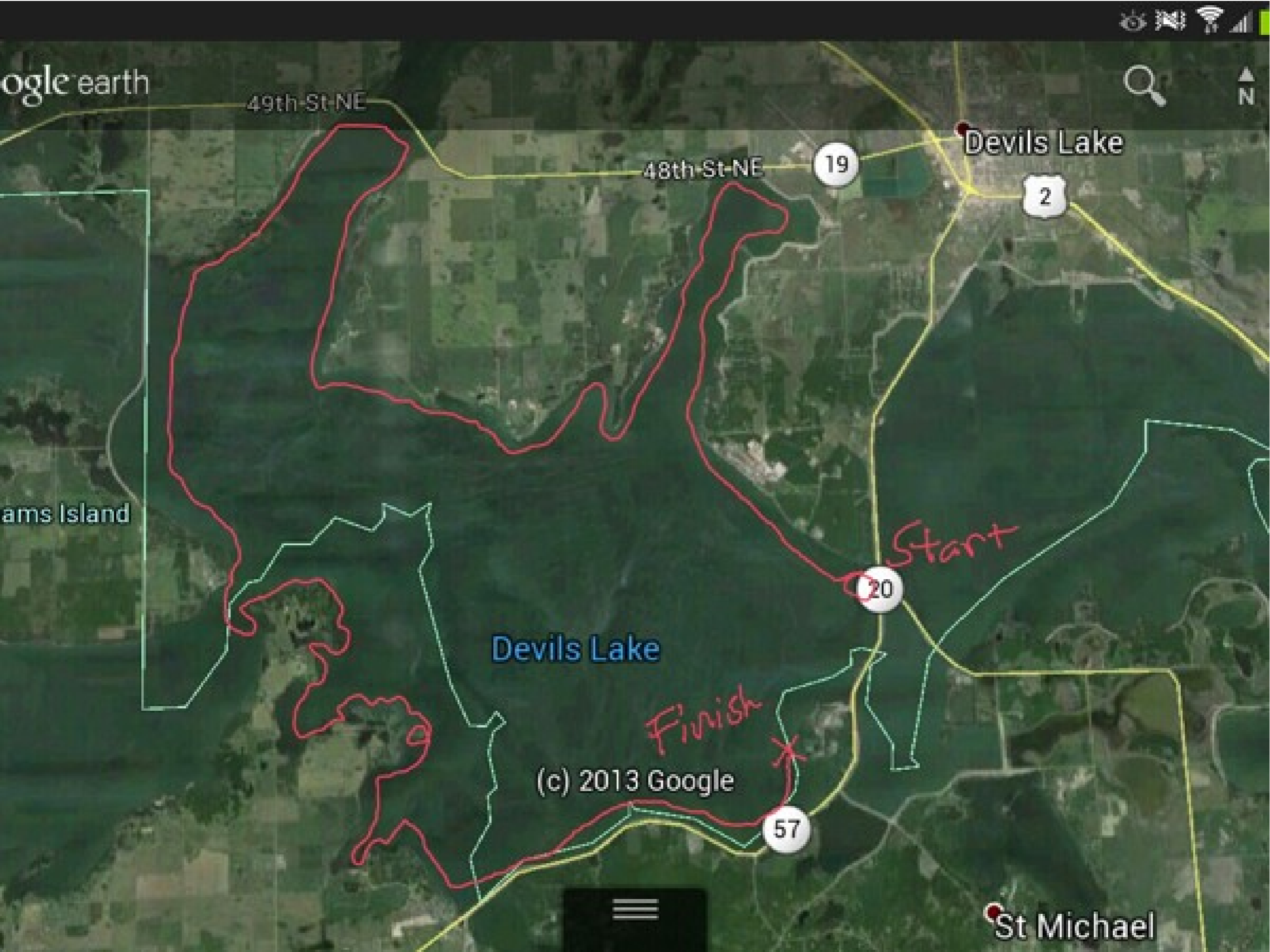
By [Tu-Uyen Tran](#) on Nov 20, 2013 at 7:30 p.m.

[Like](#) [Share](#) [0](#) [Email](#) [Tweet](#) [0](#)

UND is reporting a missing buoy.

Anchored in the middle of Devils Lake, the lonesome buoy would report water quality and its location every 10 minutes to scientists at UND.





49th St NE

48th St NE

19

Devils Lake

2

ams Island

Start

20

Devils Lake

Finish

(c) 2013 Google

57

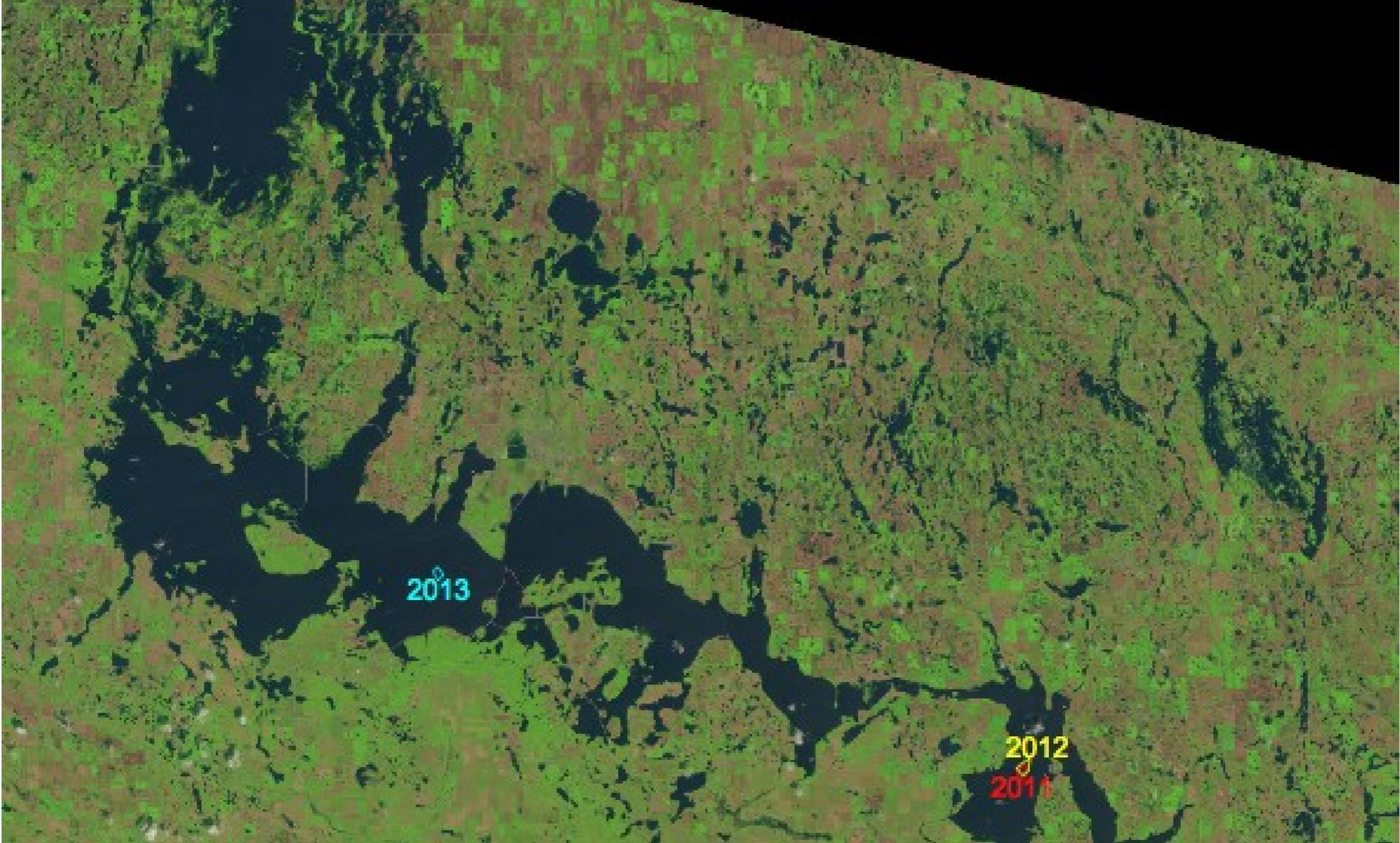
St Michael



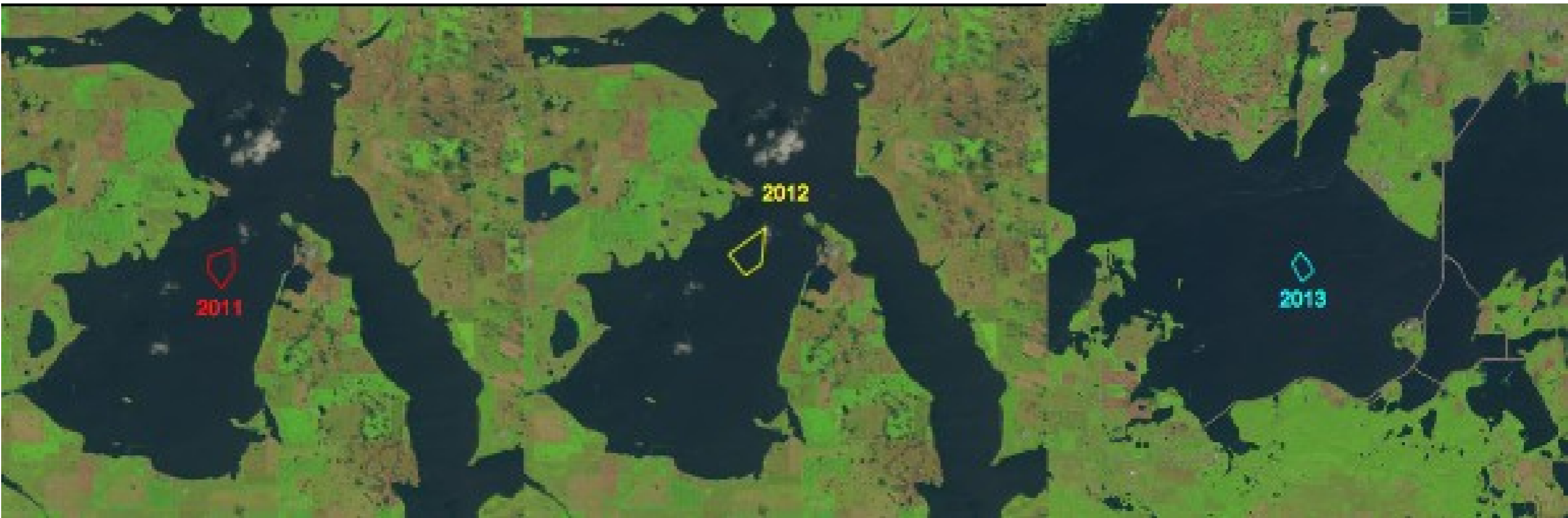


— Having been lost for more than a month, the lost was found





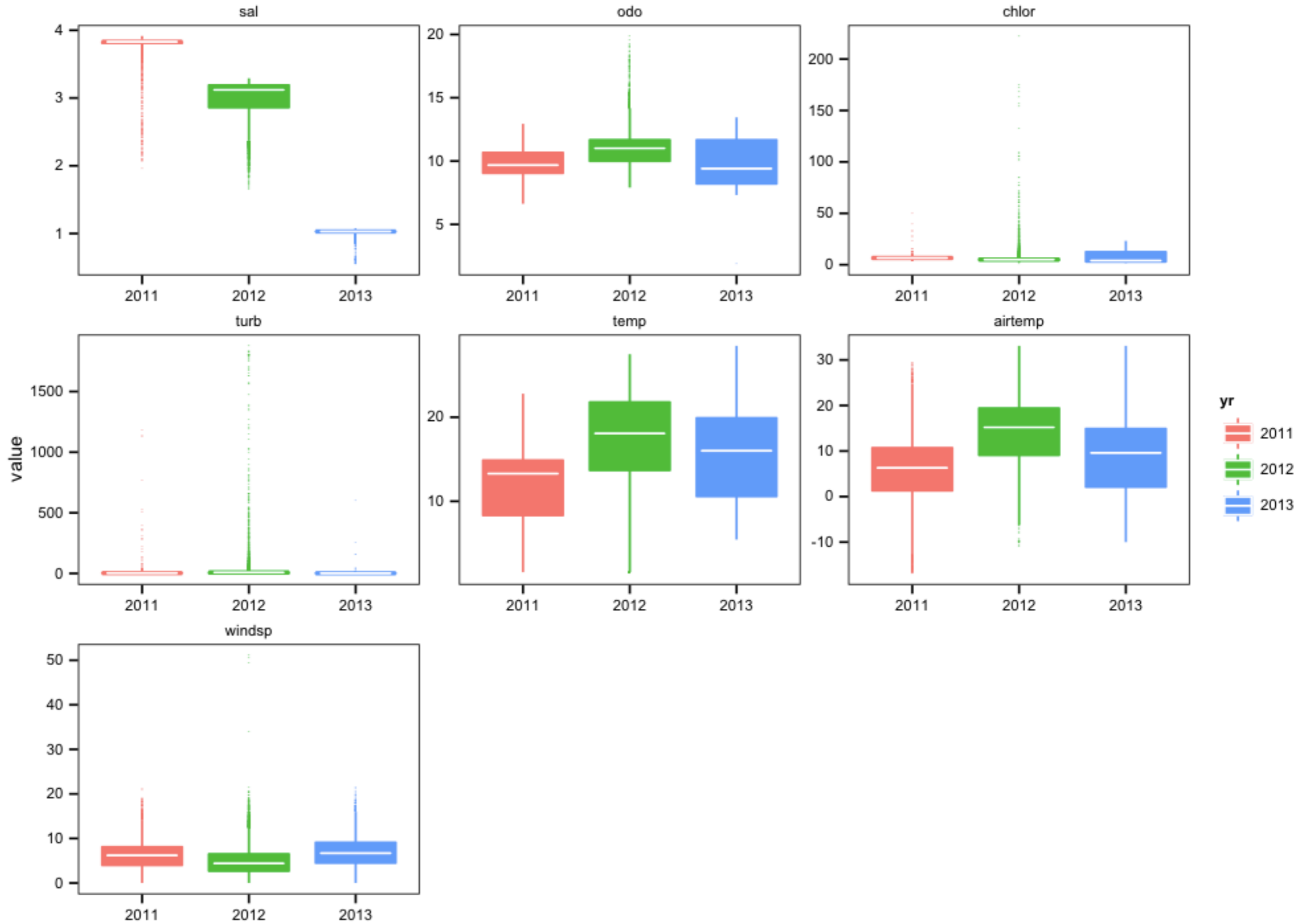
— Preliminary Analysis —



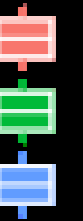
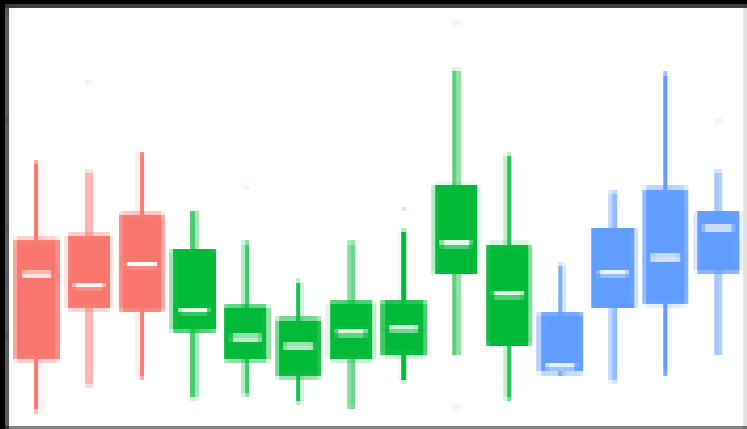
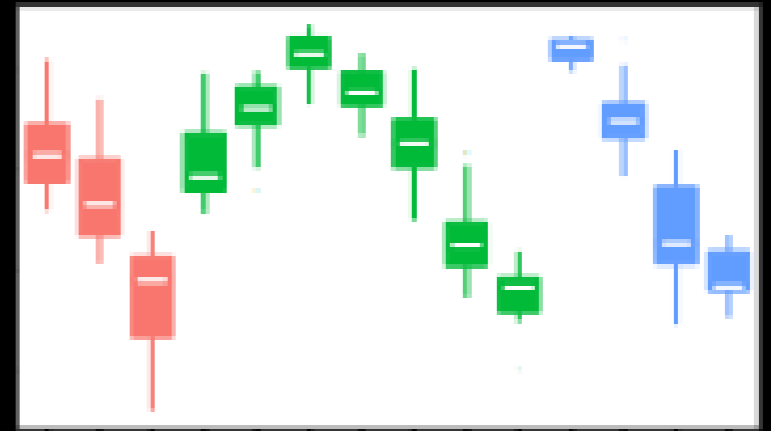
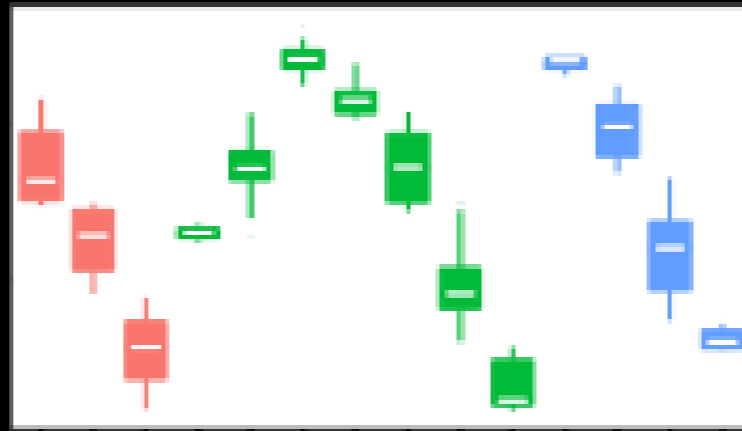
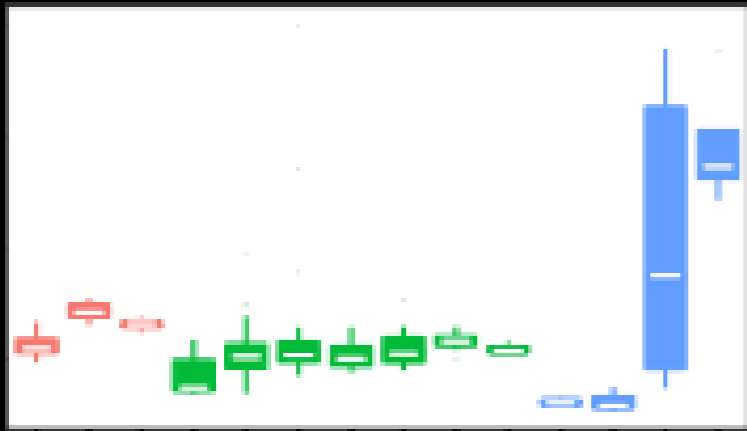
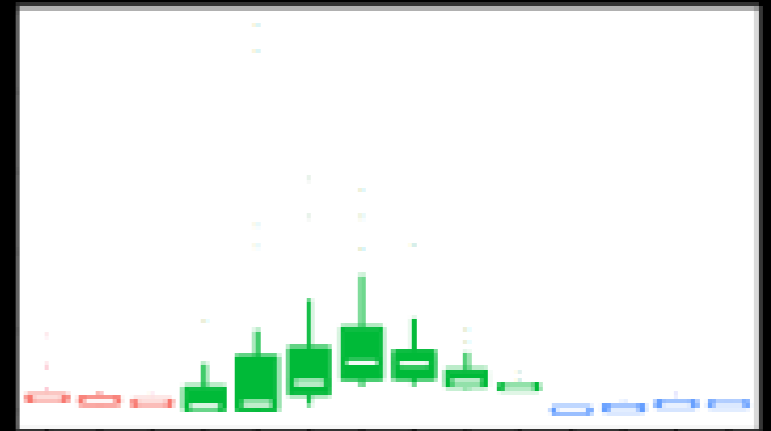
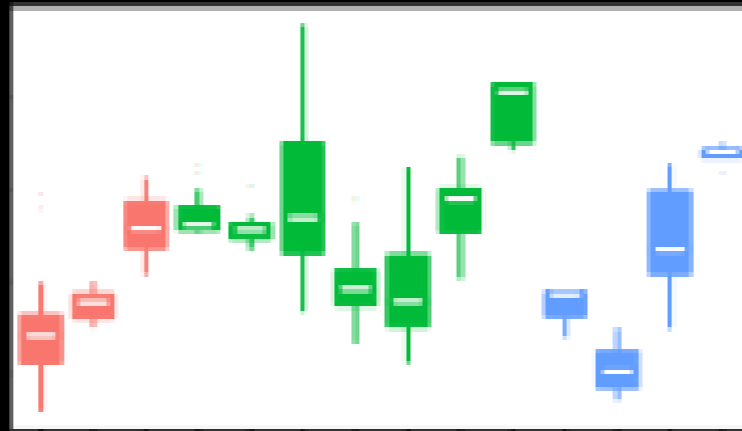
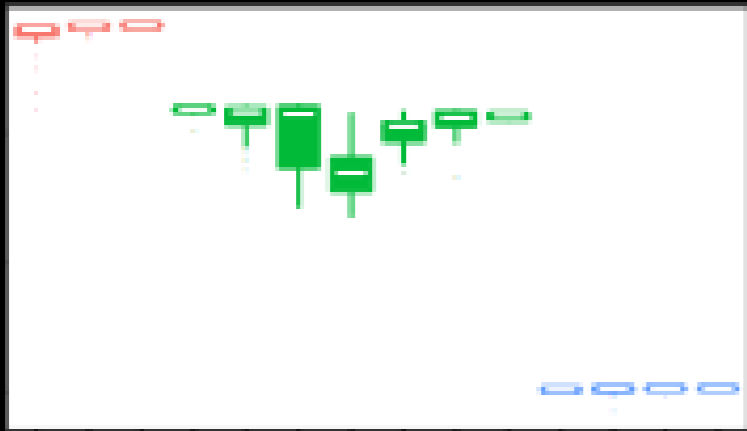
— Specific Questions —

- How temporally and spatially variable are water quality parameters...
- Are any trends detectable, and if so can they be attributed to understood processes...
- Where do we go from here...

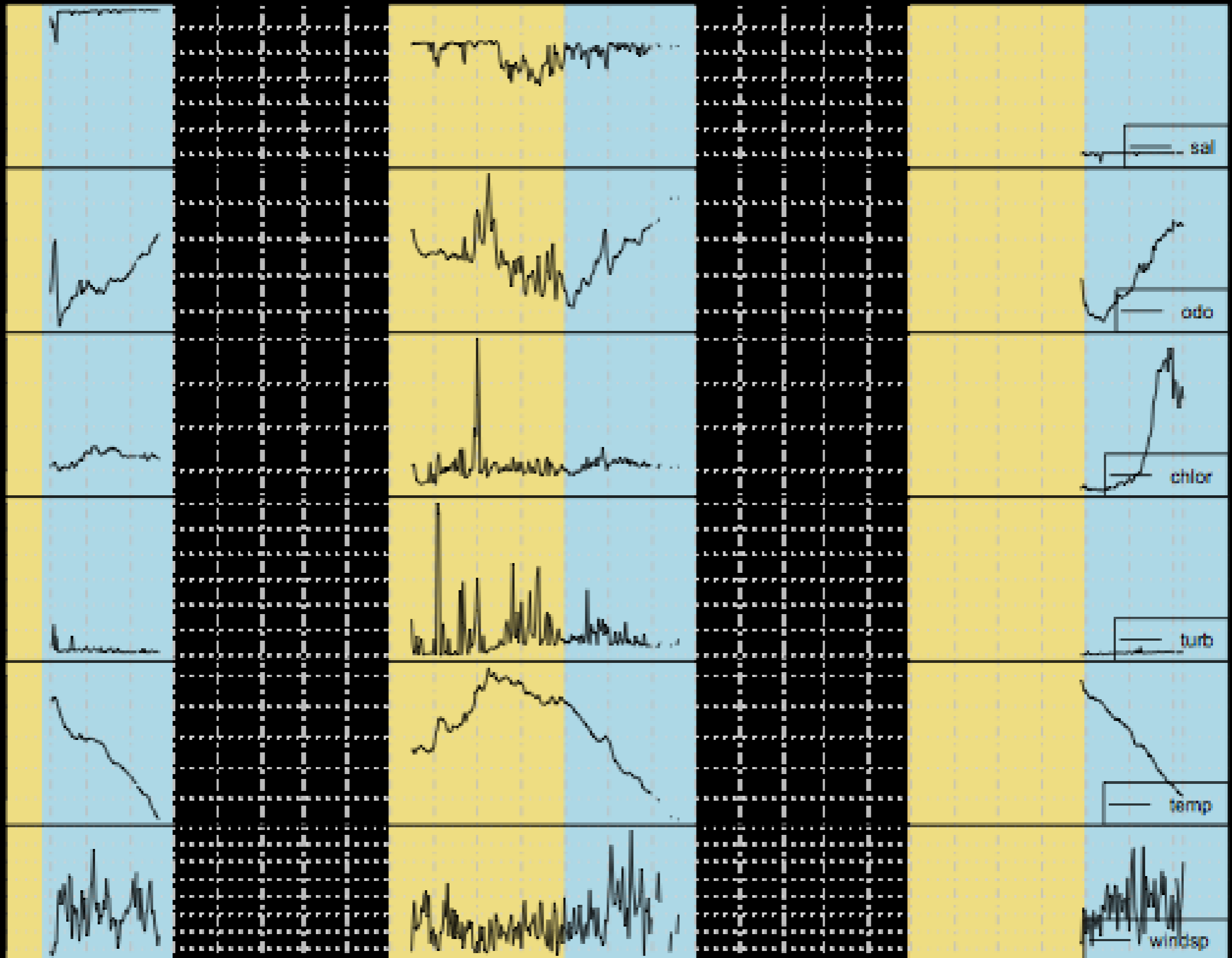
All values by year



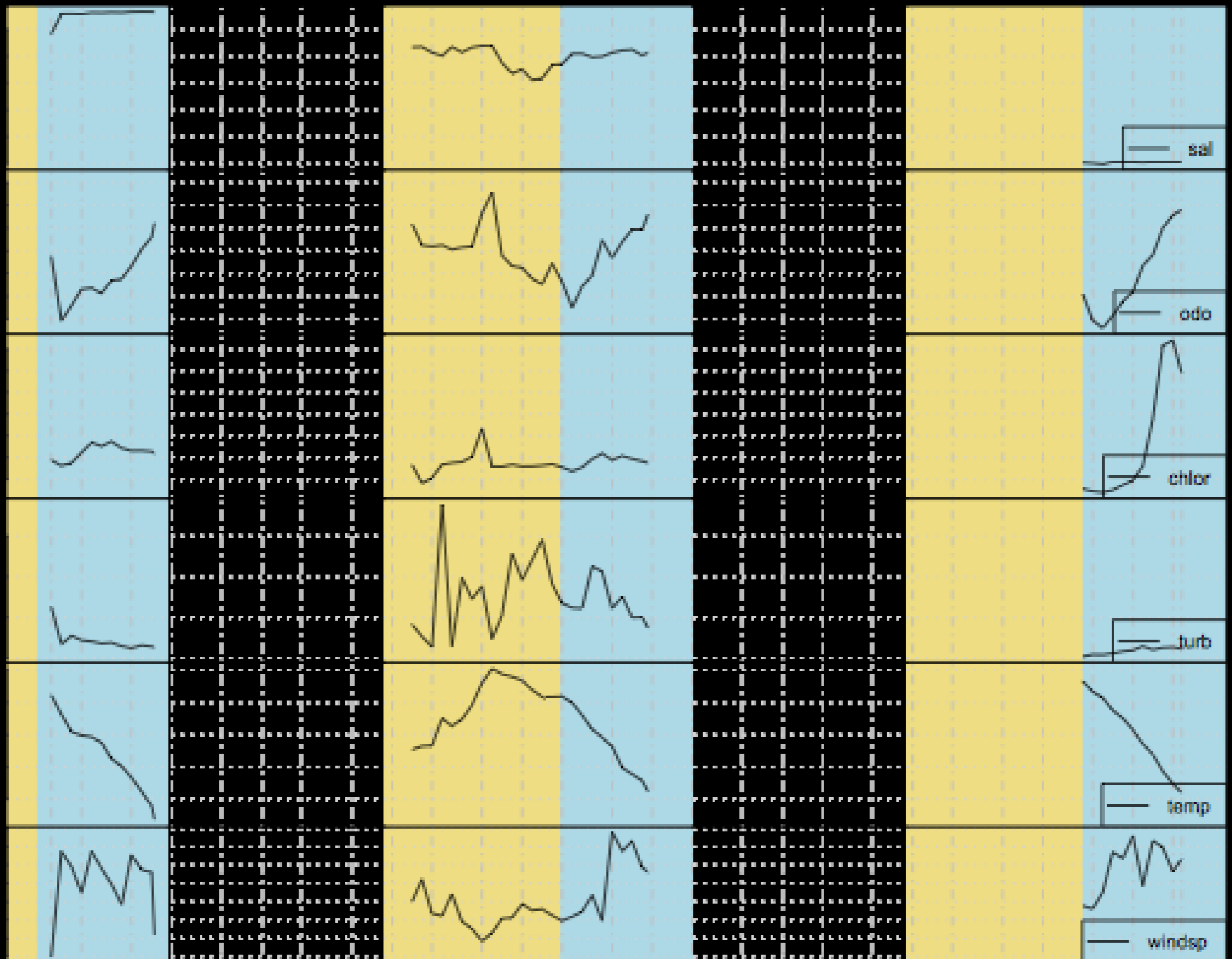
Mean daily aggregated values by Month-Year



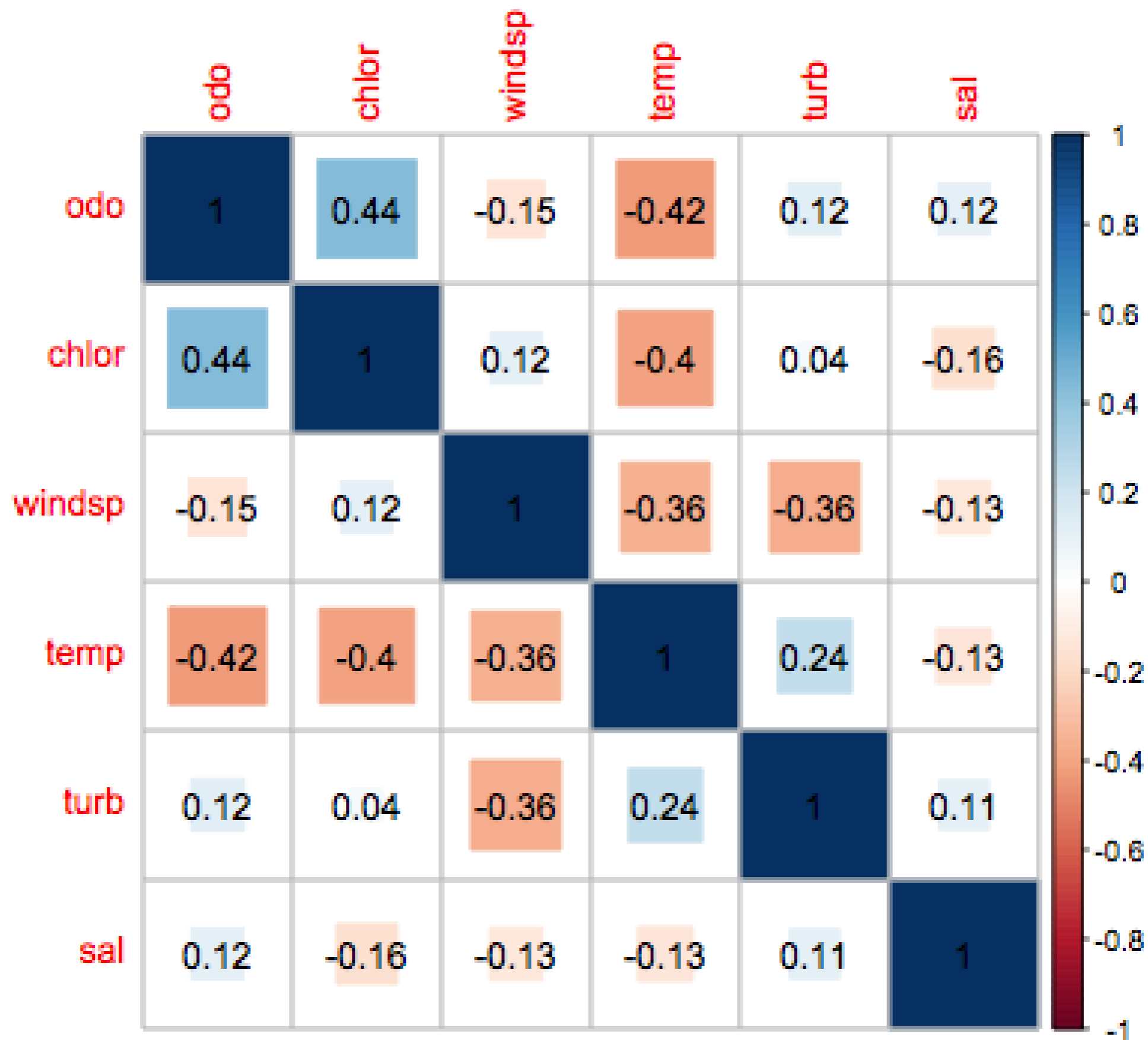
Mean daily aggregated time series



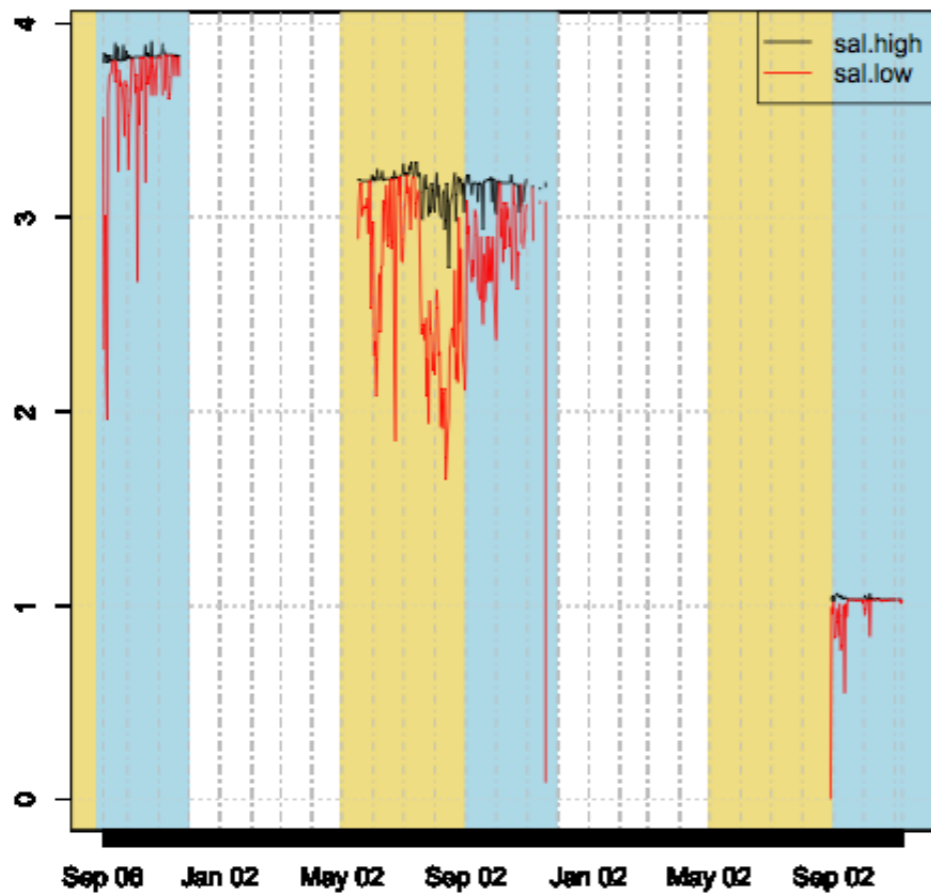
Mean weekly aggregated time series



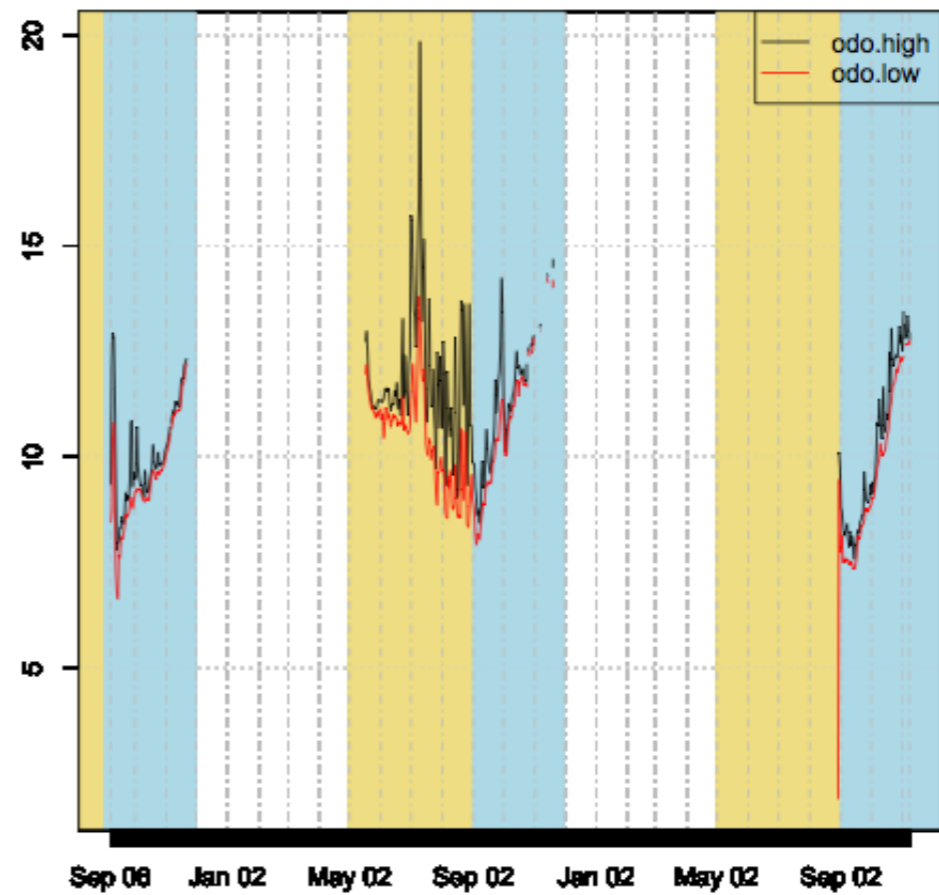
Correlation plot of all water quality parameters



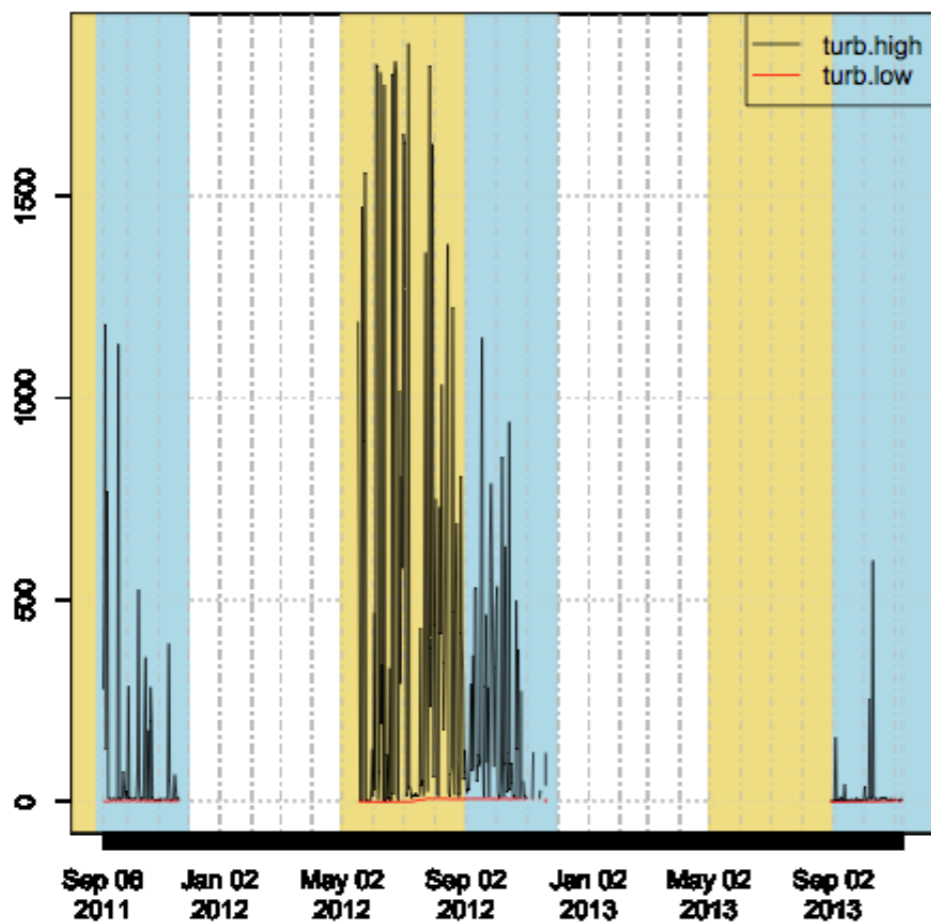
Daily High/Low sal



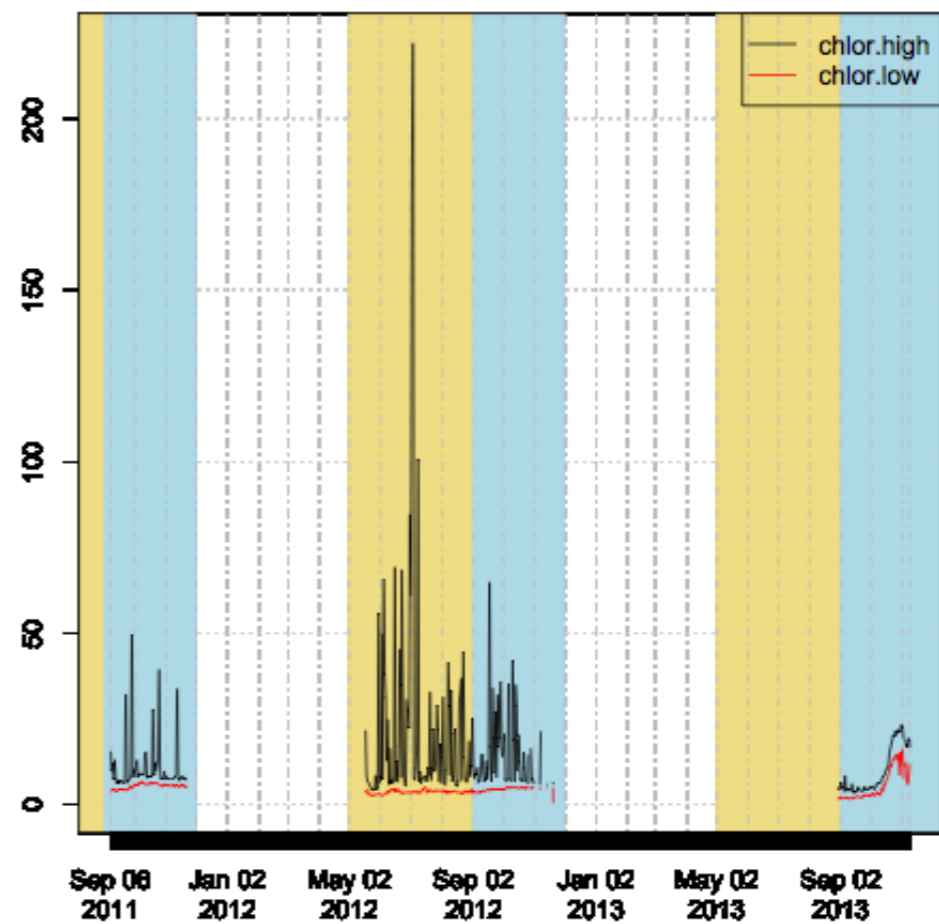
Daily High/Low odo



Daily High/Low turb



Daily High/Low chlor



Summary

- How temporally and spatially variable are water quality parameters?
 - *Water quality parameters exhibit a wide degree of both temporal and spatial variability linked to temperature, precipitation and wind speed*
 - *Daily Low/High readings suggest water quality parameters are highly variable even in short time frames*
- Are any trends detectable, and if so can they be attributed to understood processes
 - *Salinity appears relatively stable throughout the season but exhibits a high degree of spatial and temporal sensitivity*
 - *Dissolved oxygen is most concentrated when water temps are cool*
 - *Chlorophyll concentrations appear somewhat bimodal*
 - *Late season increase in windspeed is linked to decreased turbidity due to greater vertical mixing which also increases dissolved oxygen and cycles nutrients to the surface causing increased biological activity subsequently increasing chlorophyll concentrations*

Where do we go from here?

- Continue gathering data specifically focusing on increasing seasonal resolution
- Examine statistical association between observed variation in water quality parameters and climate components and changes in the surrounding land use matrix
- Develop models that allow water quality forecasting based on various climatic and land use scenarios



Acknowledgments

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- *Mike Ell, Peter Wax, Joe Nett and others for providing boat access*

UND John D Odegard School of Aerospace Science

- *Logistical support and flight time*

NASA

- *Funding and support*

