Characterization of storm event carbon, nitrogen, and phosphorus in the Lamprey River using in situ sensors.

W. M. Wollheim, G. Mulukutla

Department of Natural Resources and Environment
&
Complex Systems Research Center
University of New Hampshire

Acknowledgements

- UNH COLSA
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- Burley Demeritt Farm
- McDowell Lab
  - Jody Potter
  - Michelle Daley

Context

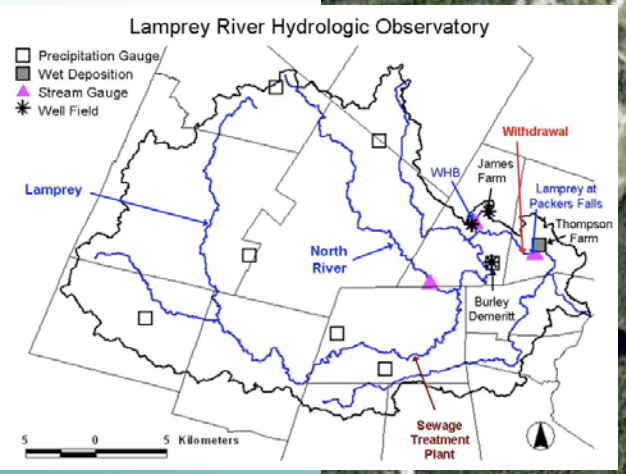
- Storm events mobilize nutrients.
- Flow conditions influence fate of nutrients in rivers.
- Most nutrient fluxes to coastal zone occur during storms.
  - Problems with nutrient enrichment (e.g. Great Bay)
- Quantifying fluxes and aquatic transformations during storm events has been difficult (logistical, methodological)
- BUT: New *in situ*, continuous sensor technology is now available to provide a window into storm event processes in aquatic ecosystems

Research Question

- How do nitrogen, phosphorus, and carbon fluxes vary during storms in the main stem of the Lamprey R.?

Methodology

- Simultaneous deployment of in situ sensors
  - Satlantic SUNA for nitrate
  - Wetlabs CycleP for phosphate
  - Turner C6 for CDOM (DOC), Turbidity, Chlorophyll
  - Hydrolab Sondes (D.O., Conductivity, pH) – deployed by McDowell Lab
- Grab Samples For Validation
  - Lab optical and nutrient chemistry – McDowell Lab
- October 29 through November 23, 2010
  - Four storms over the period
  - Lamprey @ Burley-Demerit Farm



Organic Dairy

Dairy Headwater Stream

Deployment Site

Field Near River Edge

Data SIO, NOAA, U.S. Navy, NGA, GEBCO
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Image USDA Farm Service Agency
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689 m

lat 43.090557° lon -70.994747°

Jul 5, 2009 Eye alt

Hauling Gear on the Farm

The Sensor Team

Wetlabs Cycle P

Turner C6 (CDOM)

Satlantic SUNA (NO3)

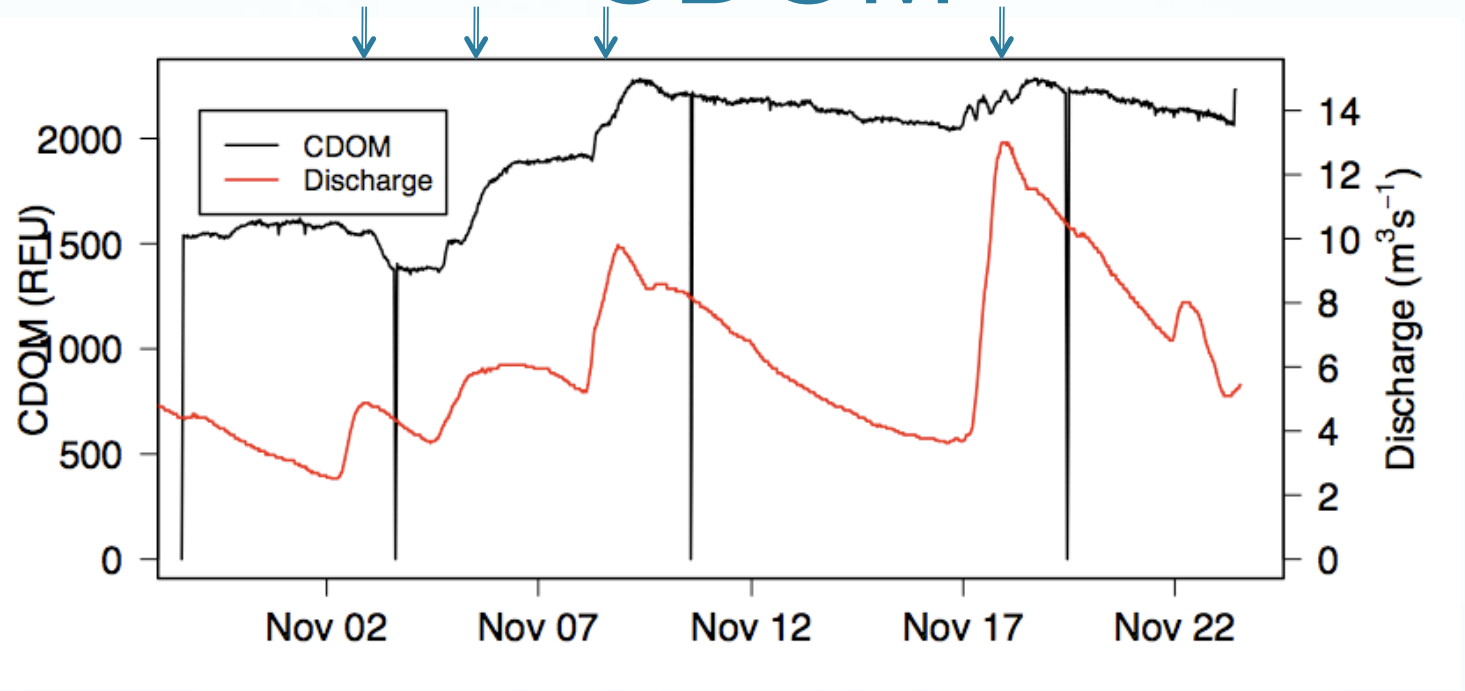
Wrestling with Technology

Interfacing SUNA with Campbell datalogger was not trivial

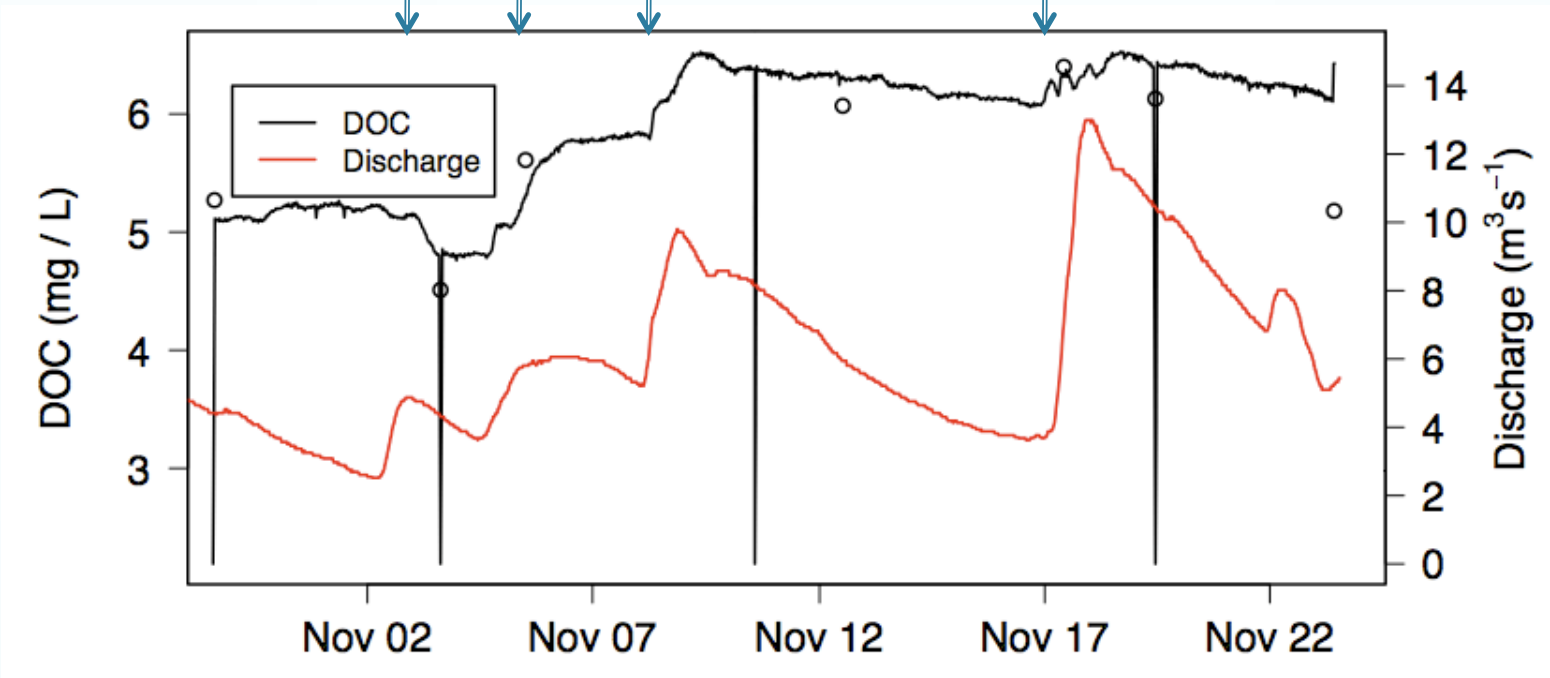
Sensors Deployed

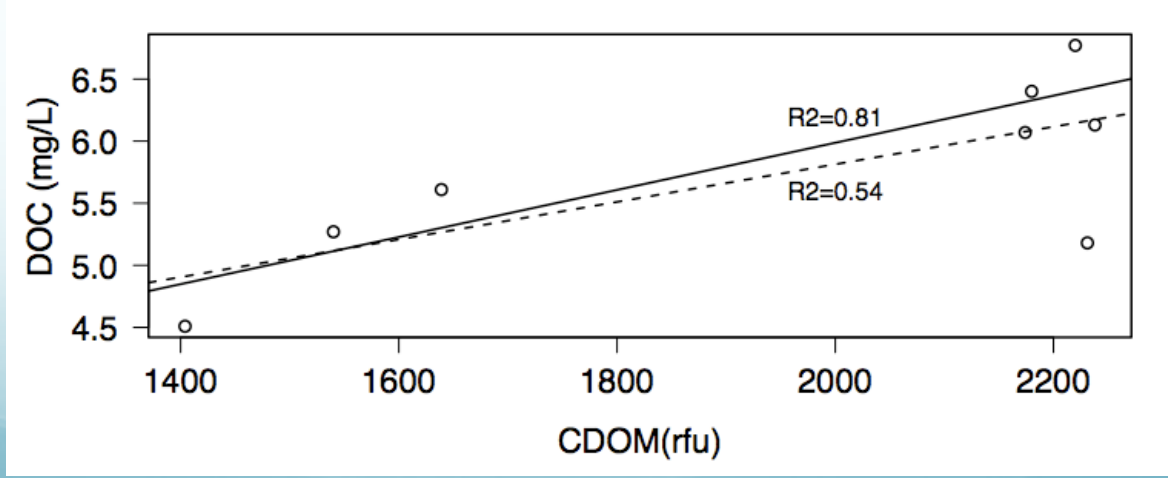
Results

CDOM

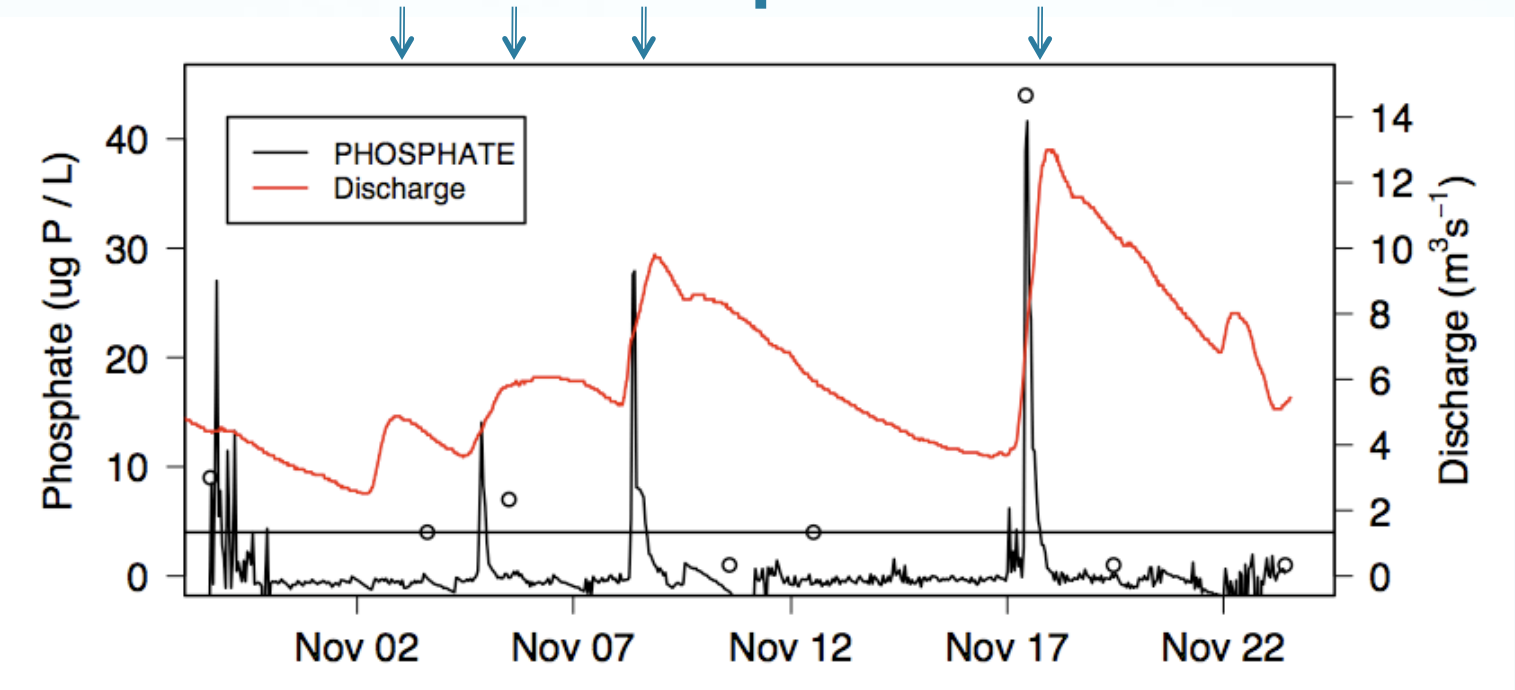

CDOM
Discharge
CDOM (RFU)
2000
1500
1000
500
0
Discharge (m^3s^{-1})
14
12
10
8
6
4
2
0
Nov 02
Nov 07
Nov 12
Nov 17
Nov 22

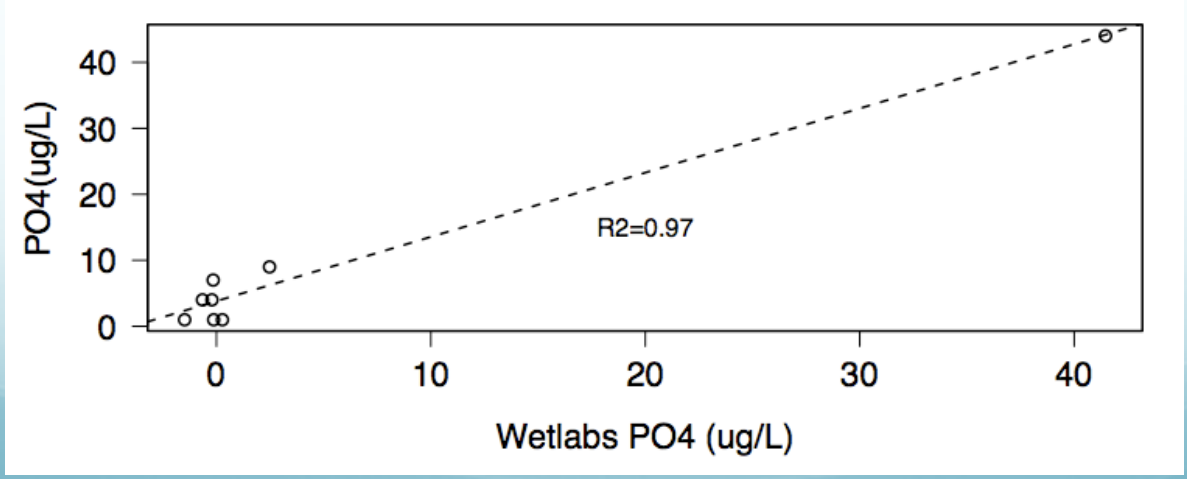
CDOM converted to DOC



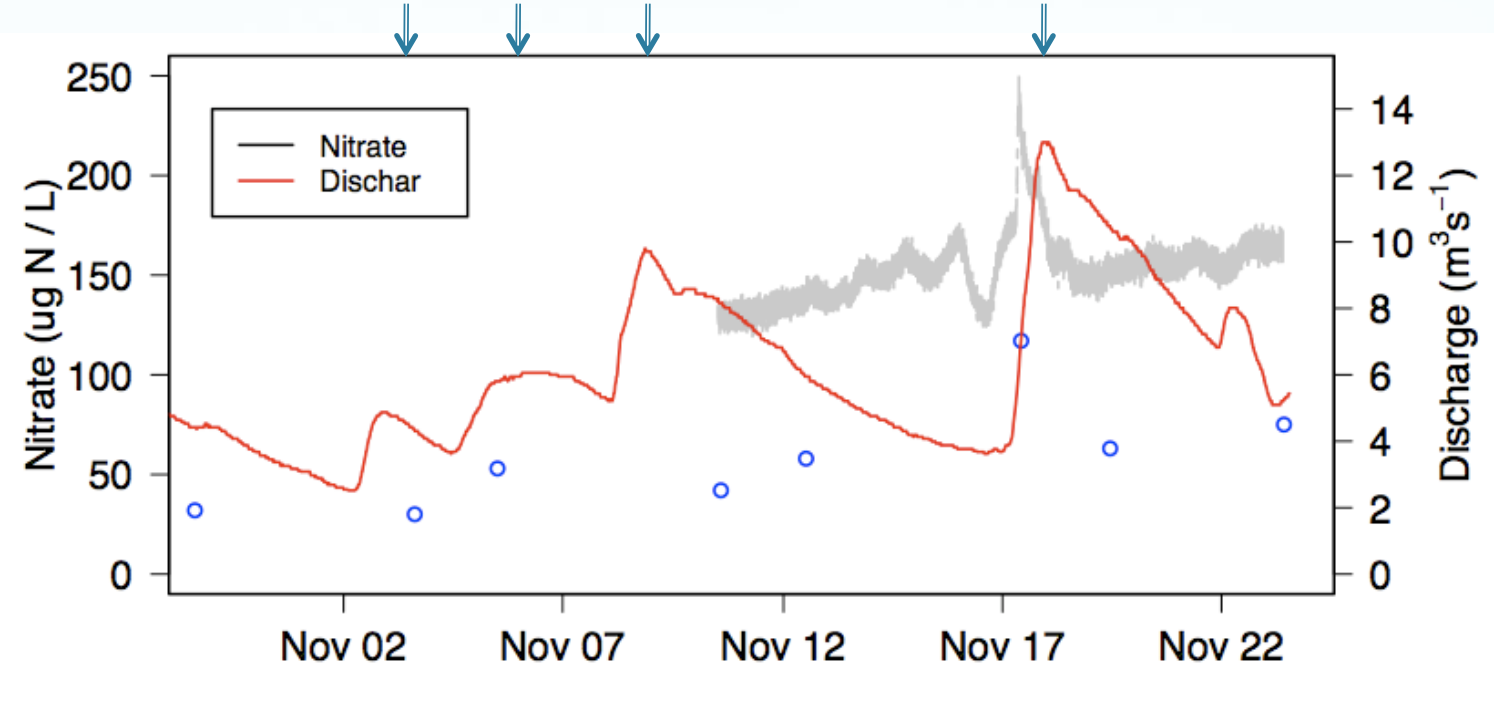


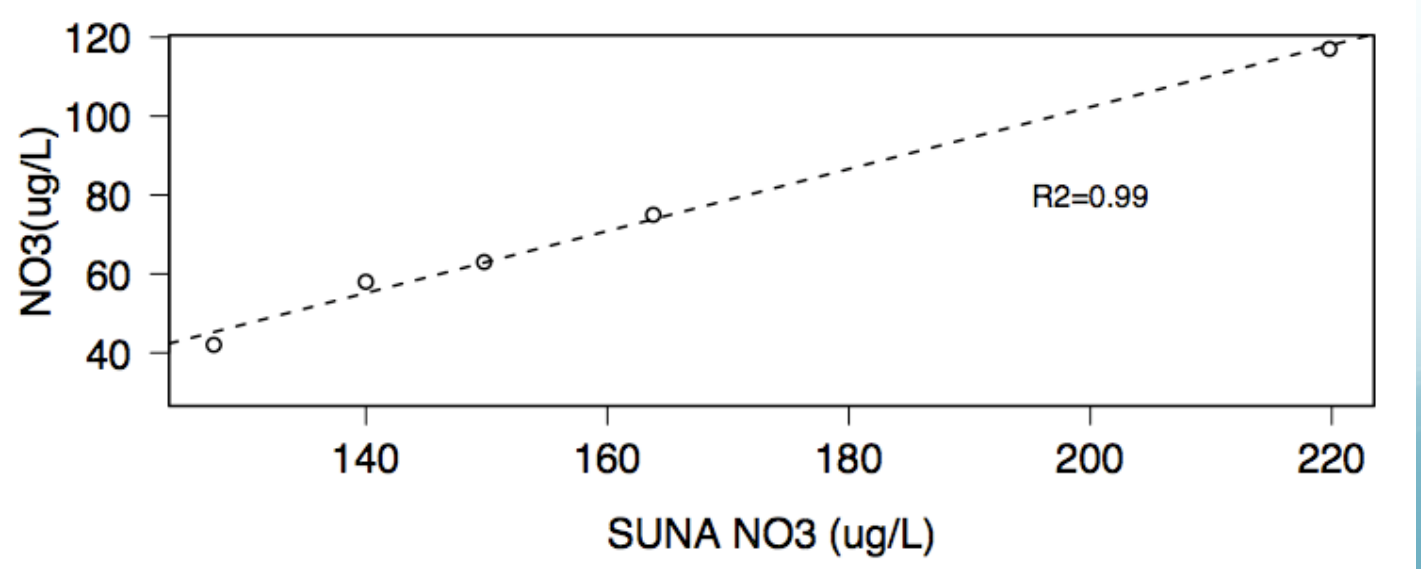
Phosphate


PHOSPHATE
Discharge
Phosphate (ug P / L)
Discharge (m^3s^{-1})
0
10
20
30
40
0
2
4
6
8
10
12
14
Nov 02
Nov 07
Nov 12
Nov 17
Nov 22

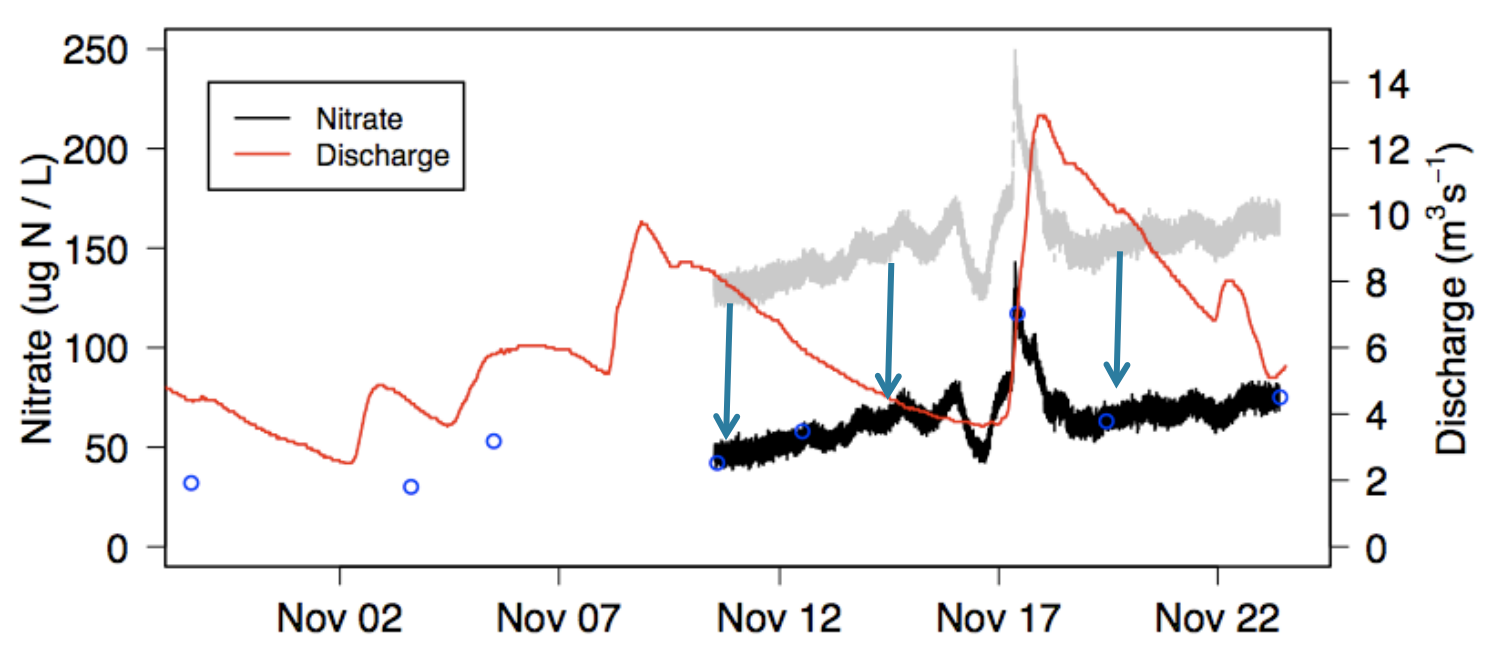

PO4(ug/L)
Wetlabs PO4 (ug/L)
R2=0.97
0
10
20
30
40

Nitrate

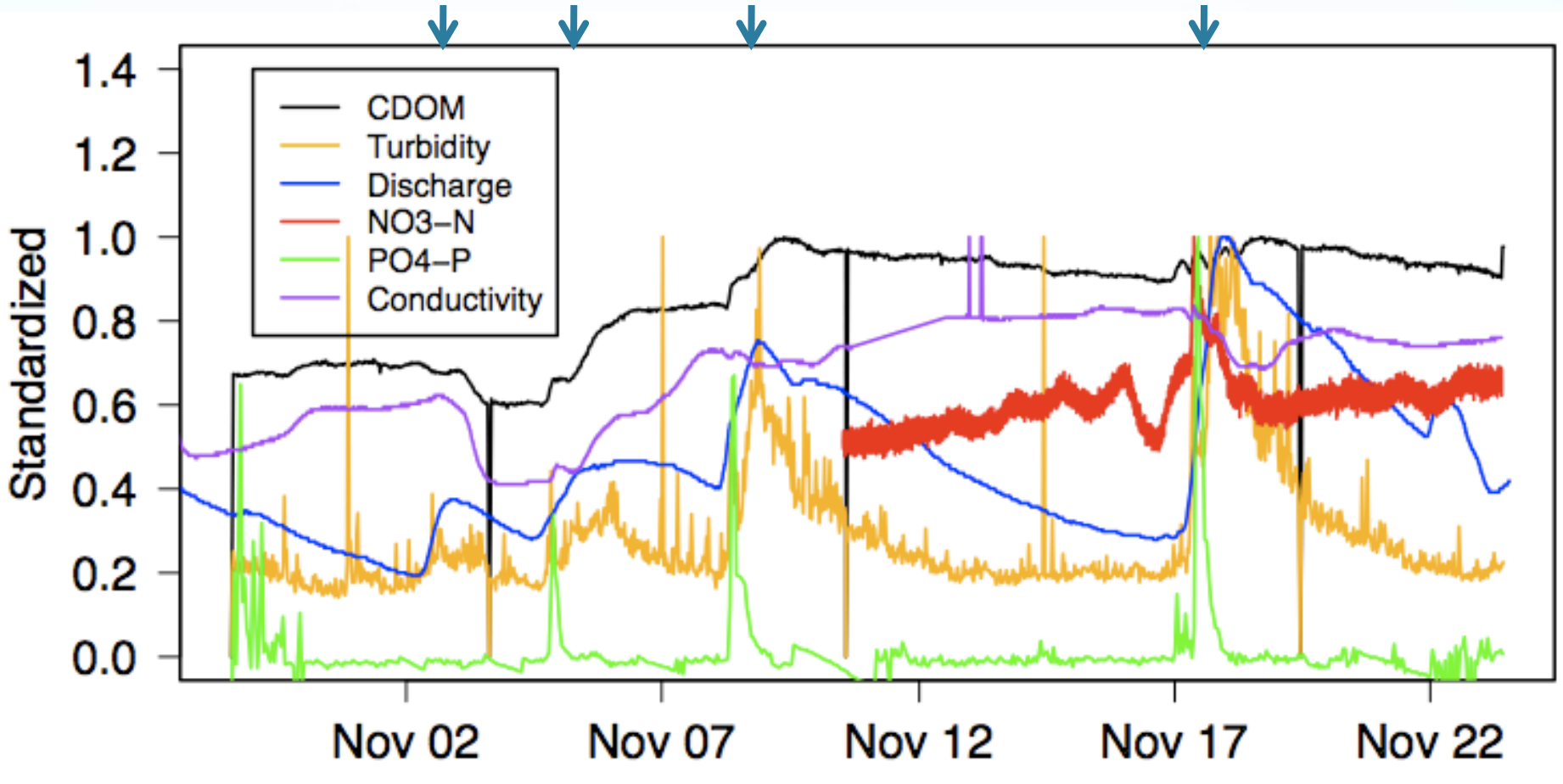

Nitrate
Dischar
Nitrate (ug N / L)
Discharge (m^3s^{-1})
250
200
150
100
50
0
14
12
10
8
6
4
2
0
Nov 02
Nov 07
Nov 12
Nov 17
Nov 22


NO3(ug/L)
120
100
80
60
40
R2=0.99
140
160
180
200
220
SUNA NO3 (ug/L)

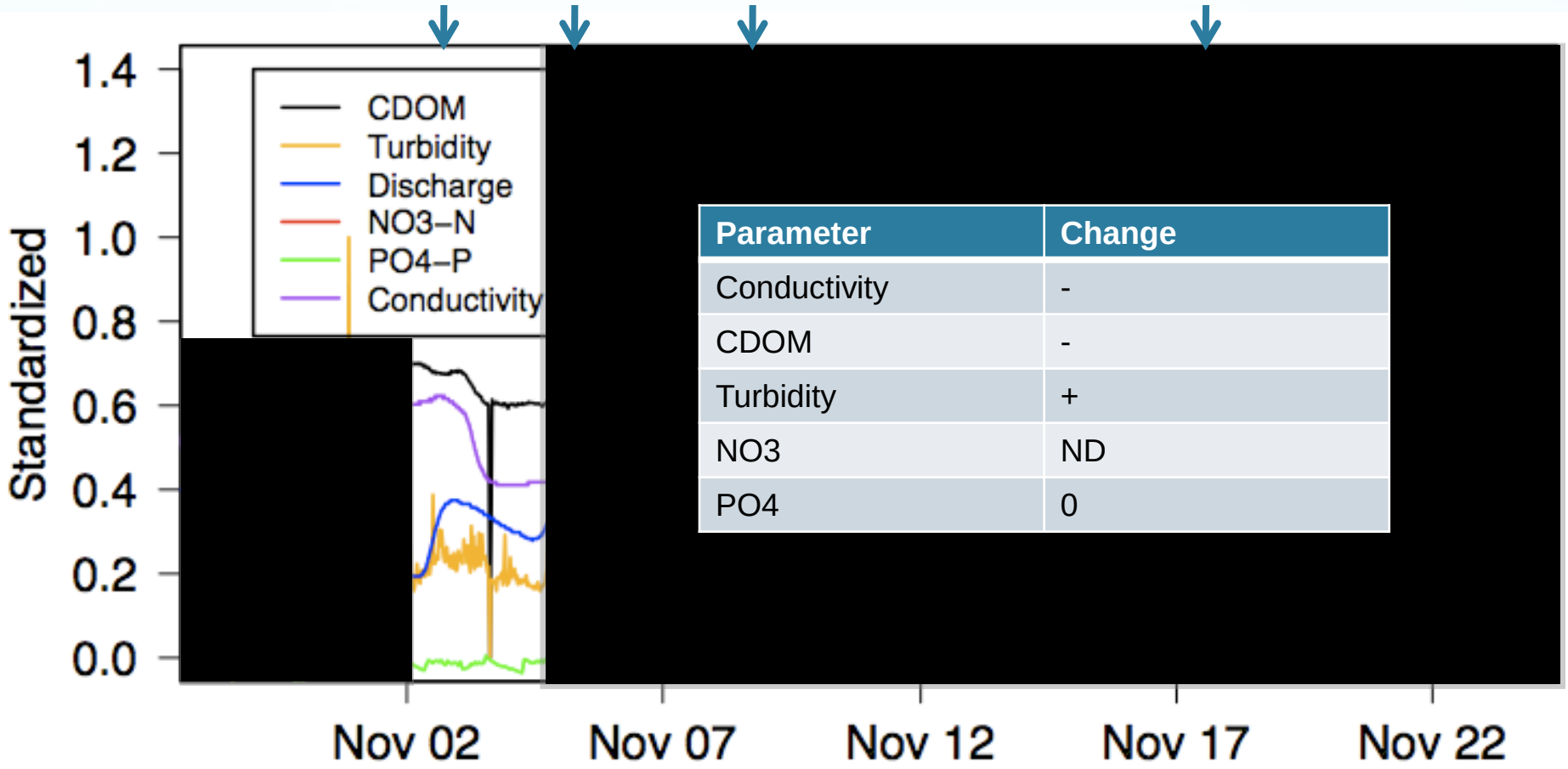
Corrected nitrate



Standardized Values

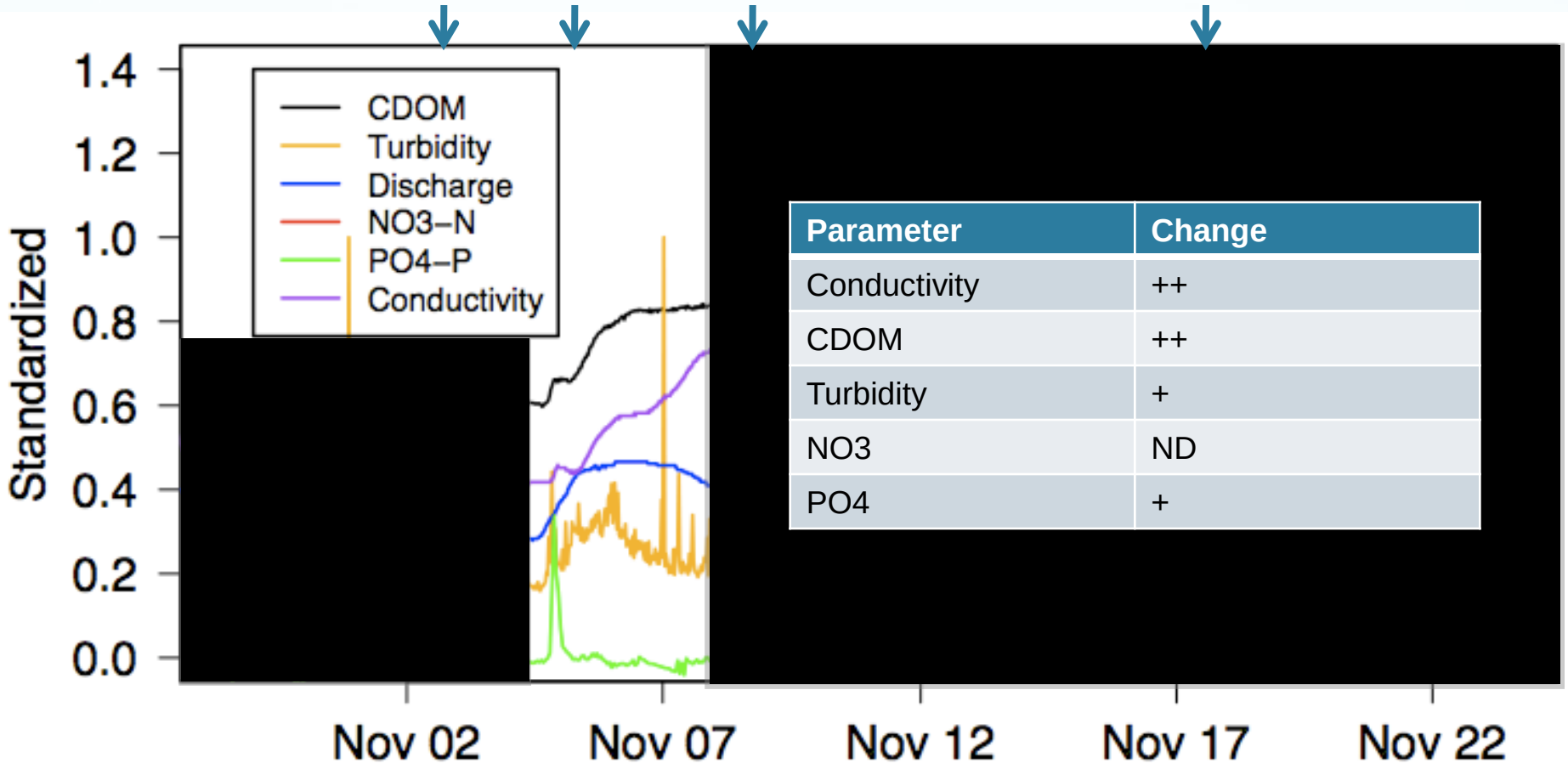


Standardized Values – Storm 1



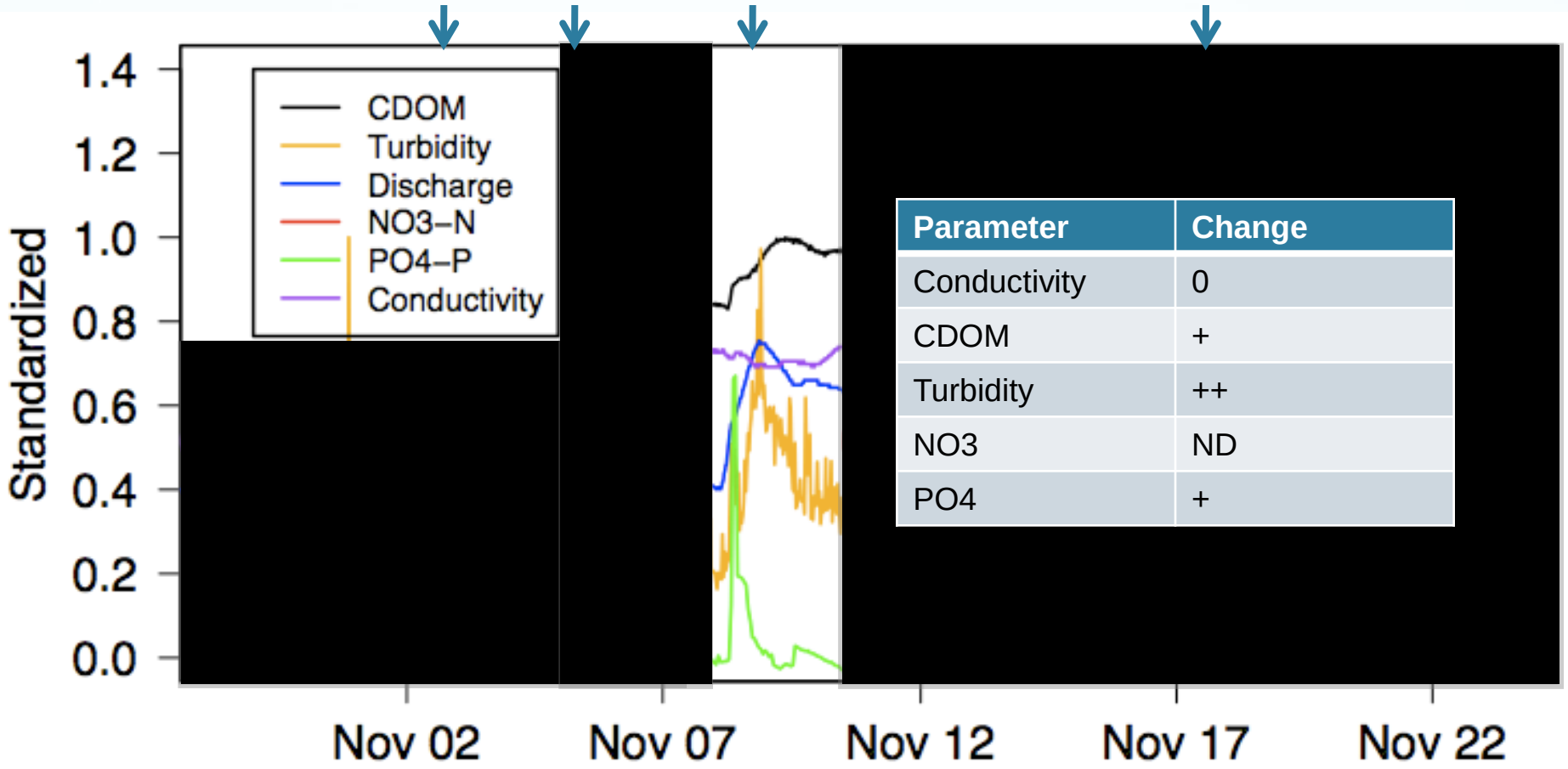
Parameter	Change
Conductivity	-
CDOM	-
Turbidity	+
NO3	ND
PO4	0

Standardized Values – Storm 2



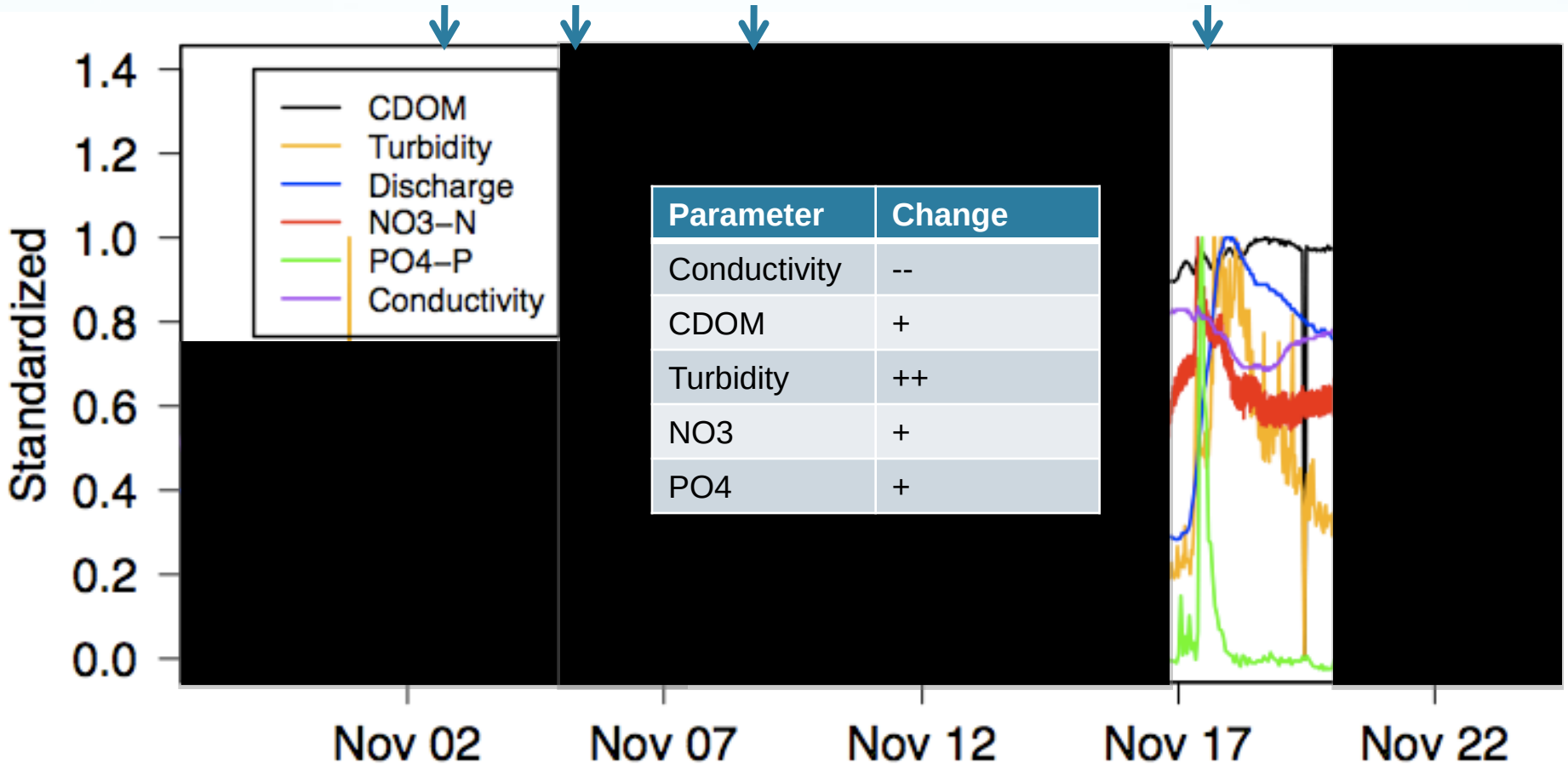
Parameter	Change
Conductivity	++
CDOM	++
Turbidity	+
NO3	ND
PO4	+

Standardized Values – Storm 3



Parameter	Change
Conductivity	0
CDOM	+
Turbidity	++
NO3	ND
PO4	+

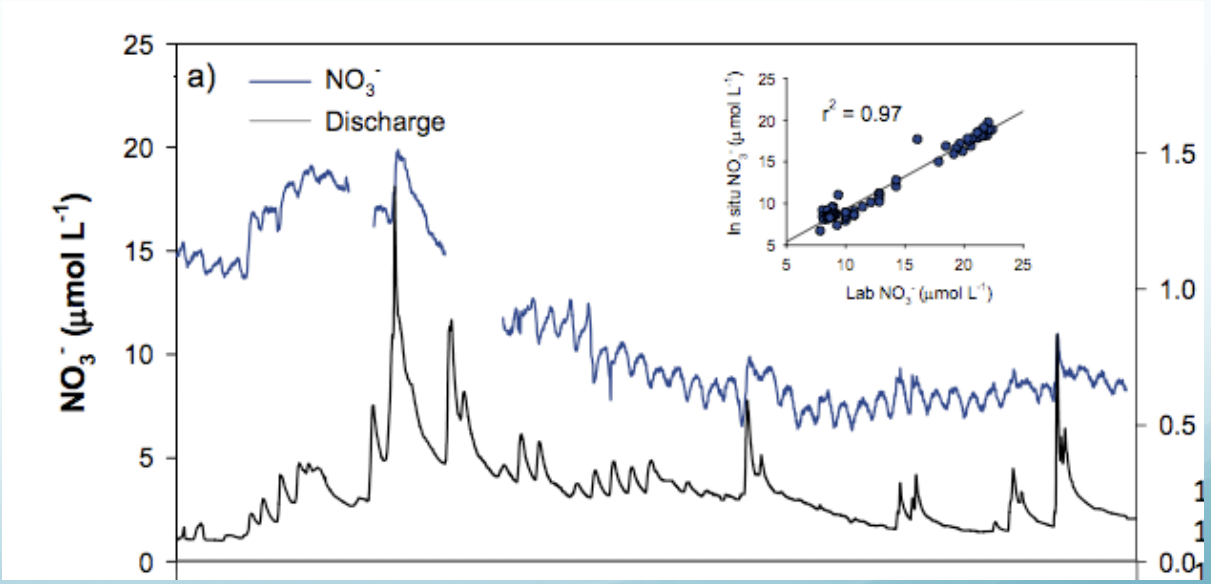
Standardized Values – Storm 4



Parameter	Change
Conductivity	--
CDOM	+
Turbidity	++
NO3	+
PO4	+

Possible Applications

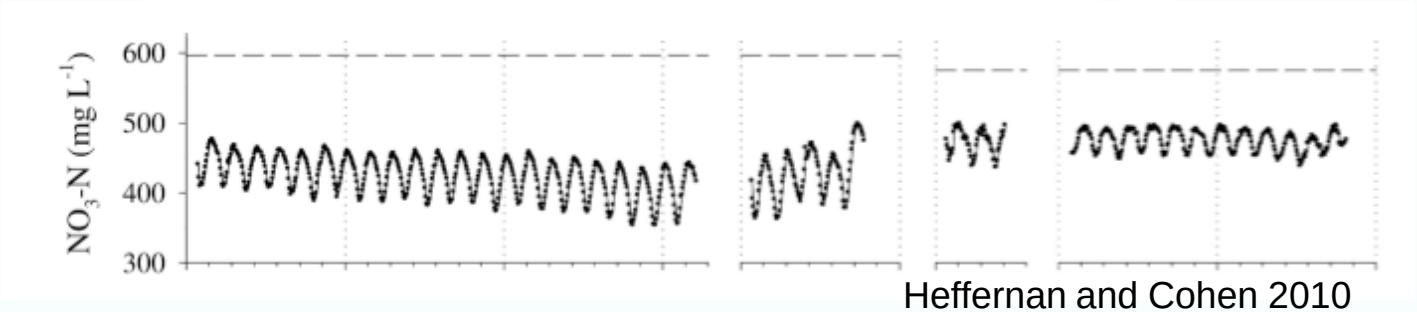
- Storm event loading:
  - Land use
  - Land management
  - Season
  - River size
  - Storm Size



Snowmelt at Sleepers R. (Pellerin et al. In Review)

Possible Applications

- In stream transformations
  - E.g. Nitrate metabolism



Heffernan and Cohen 2010

- Longitudinal Surveys along river lengths – Canoe Trips!
- Support in situ experiments
  - E.g. solute injections
- For River Network Model Calibration/Validation

Conclusions

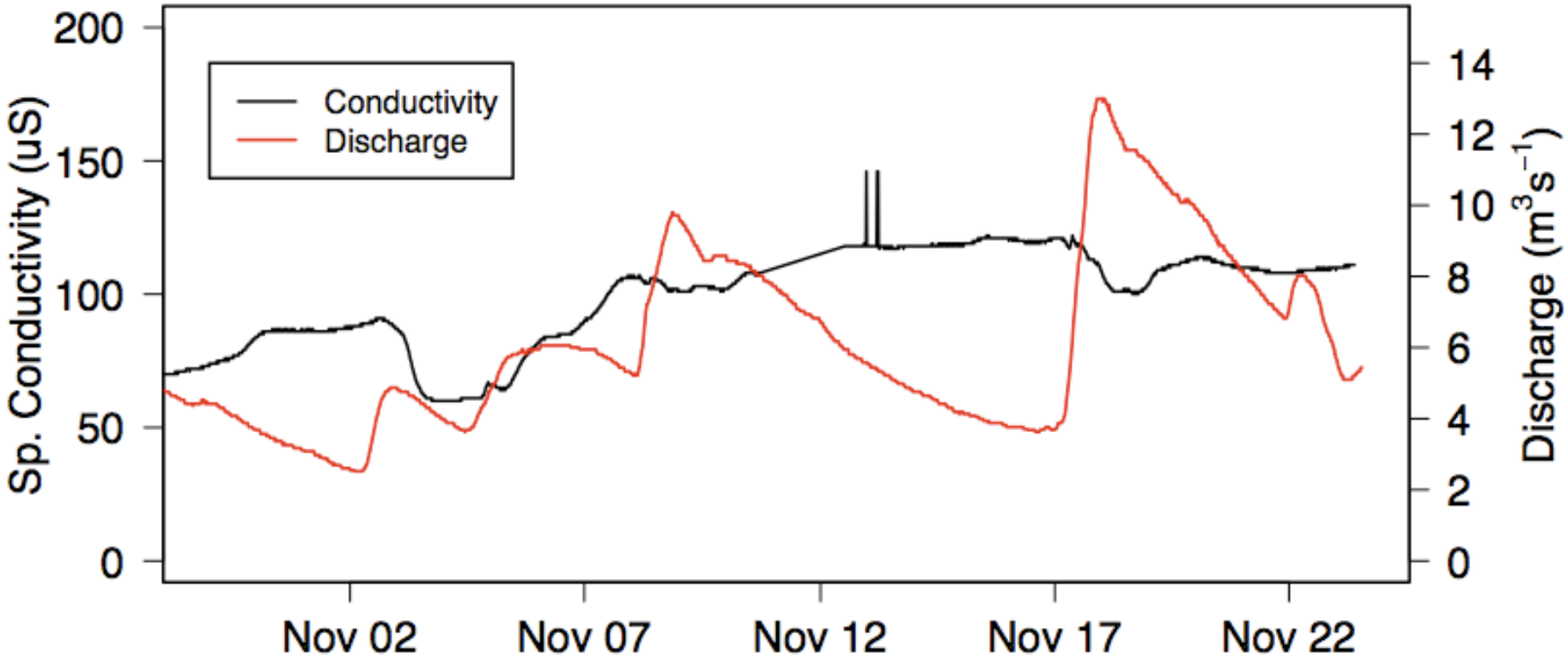
- Short term flux events during storms common.
  - Monthly/weekly sampling not always captures.
- Storm event patterns not always consistent
  - Challenge to understand processes that create.
  - Elements coupled at some times, but not always.
  - Location/timing of precip. relative to land use and management?
- Multiple sonde types and information streams provide complementary and corroborating evidence for patterns.
- Issues remain for using new sensor technology
  - Fouling, offsets, secure deployments, stream depth, turbidity interference.


Thank You!

Issues

- Is river mixed at sample location?
- Deployment when water levels change a lot
- Deployment in shallow streams
- Fouling
  - Instruments with wipers
  - Regular cleaning
  - Regular grab samples

Conductivity



Deployment Site