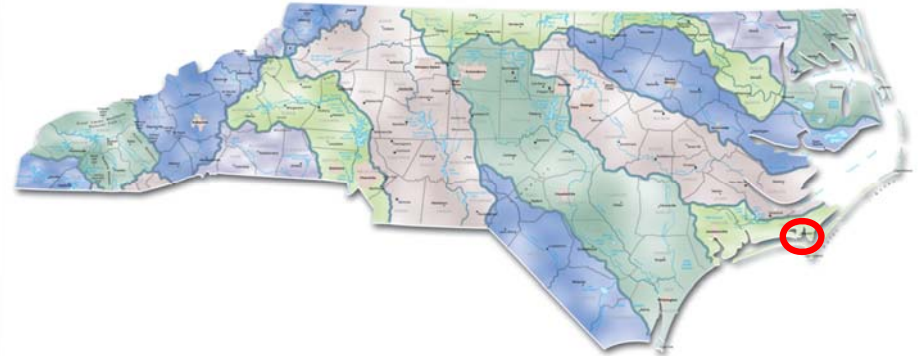


Intensive monitoring to develop a water and nitrogen balance for a constructed tidal stream

J. Randall Etheridge, François Birgand, Michael R. Burchell II



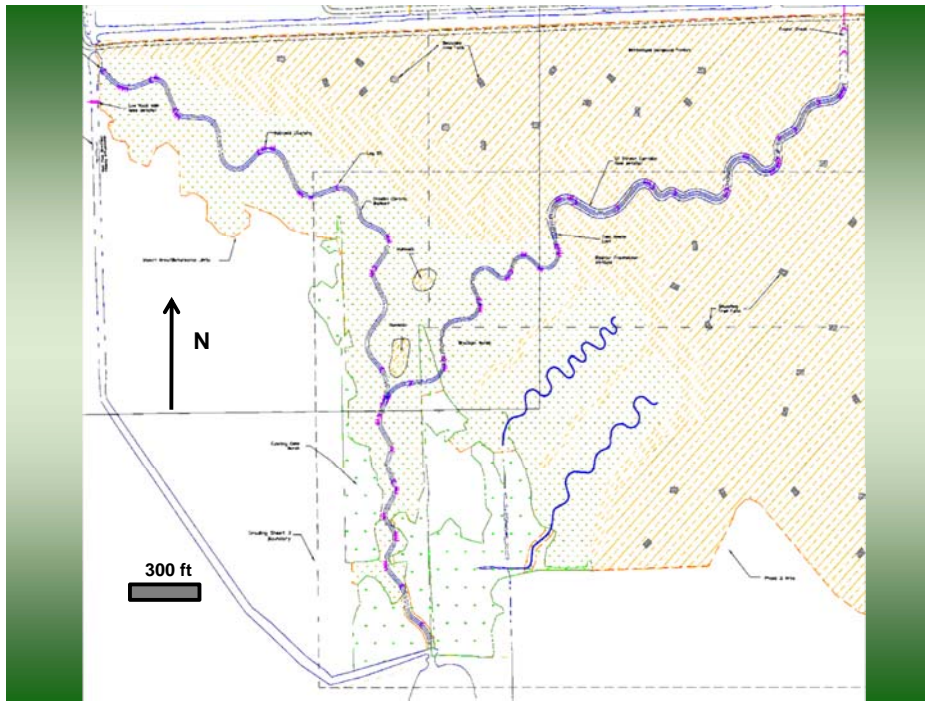
Site Location



Restoration Goals

- Improve water quality in the North River
- Restore habitat
- Provide design guidance for future salt marsh projects in coastal North Carolina





Construction



Restoration



Research Objectives

- Quantify the ability of a restored salt marsh to dissipate excess nutrients
- Quantify the timing and kinetics of nutrient dissipation and/or release
- Correlate the dissipation and/or release of nutrients to the type of organic matter

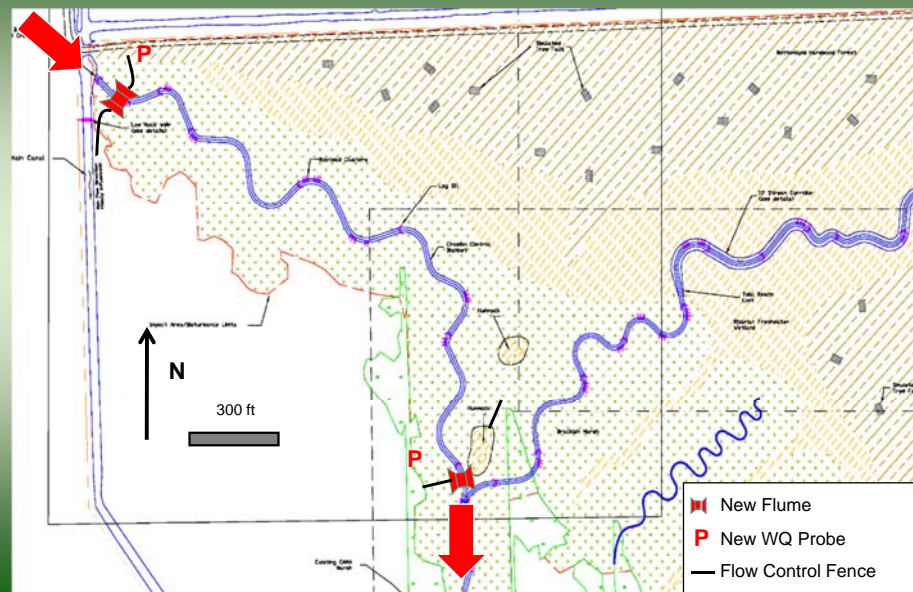
Methods

- Continuous nutrient mass balance between inlet and outlet
- Qualify nature of organic matter using fluorescence measurements

Methods

- Continuous nutrient mass balance between inlet and outlet
- Qualify nature of organic matter using fluorescence measurements

Upstream/Downstream Monitoring



Flow Monitoring in a Tidal Stream

- Cannot use normal rating curve due to bi-directional flow
- Flumes serve as a constant cross section – cross section area measurement creates the most error in flow monitoring

Downstream flume at high tide



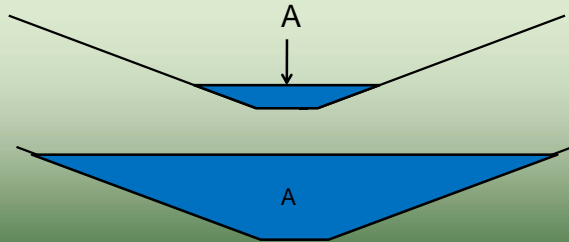
Downstream flume between tides



Flow Calculations

$$Q = V \times A$$

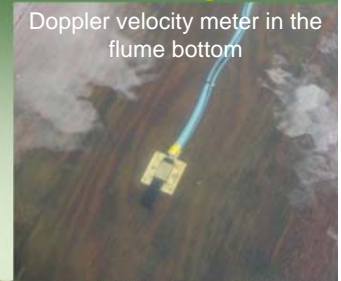
- Q: flow
- V: velocity
- A: cross-section area



Continuous Flow Monitoring

- Doppler velocity meter records velocity and water depth in flume
- Average velocity and water depth recorded every 15 minutes
- Use manual stream gaging to relate Doppler velocity to actual flow in the flume

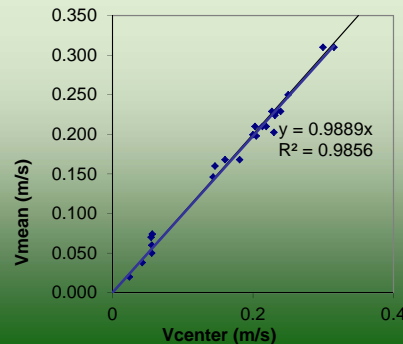
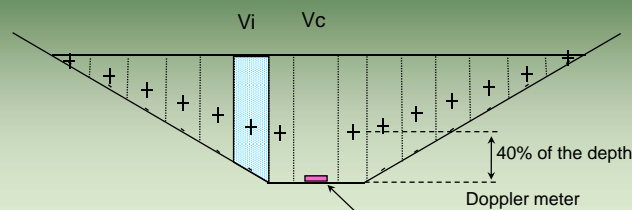
Doppler velocity meter in the flume bottom



Manual Stream Gaging

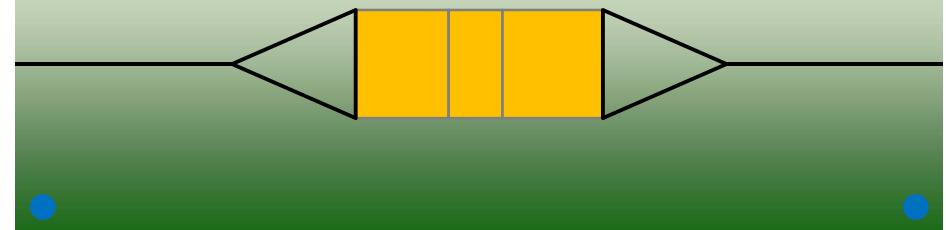


Flow Calibration



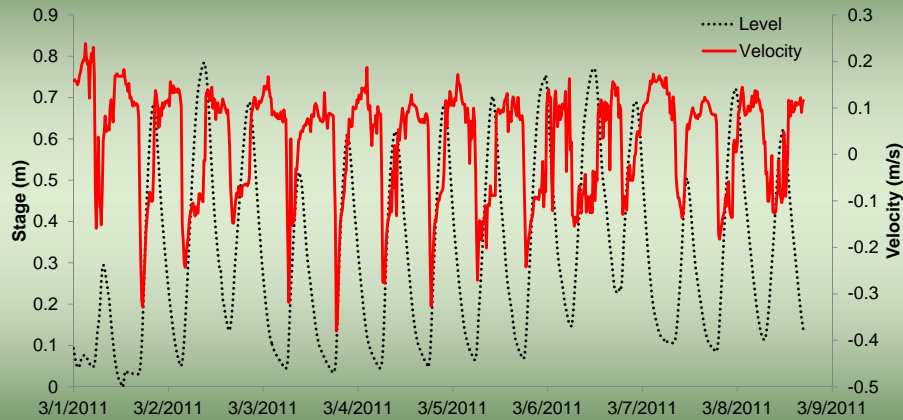
Flow Monitoring in a Tidal Stream

- One challenge presented in the marsh: high tide or water level above the flumes
- Solution: direct flow through the flume using impermeable fence

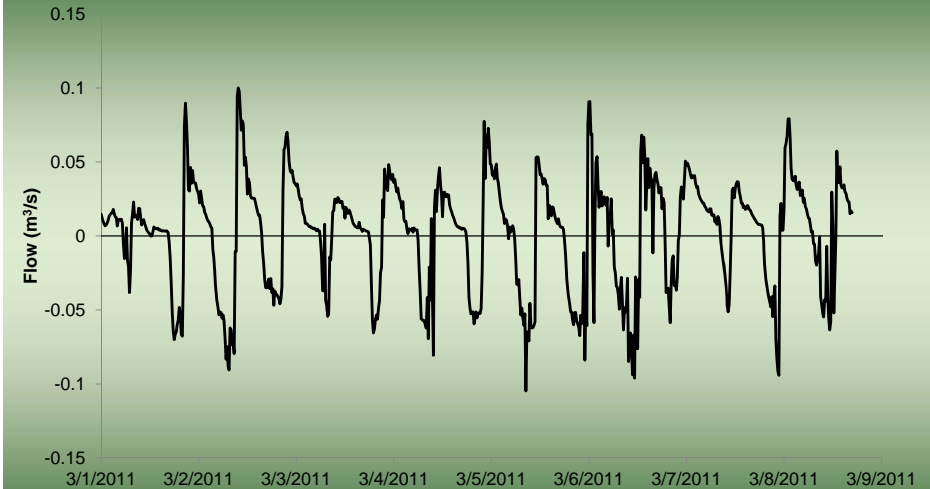


Downstream Flume

Stage and Velocity



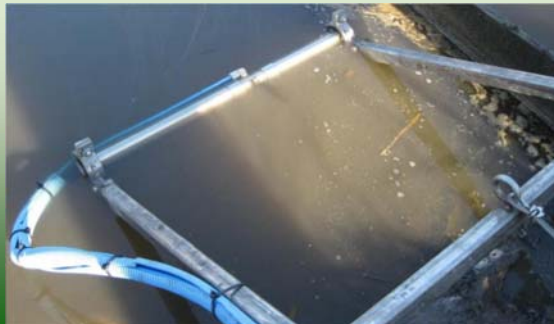
Downstream Flume Flow



Continuous Water Quality Monitoring

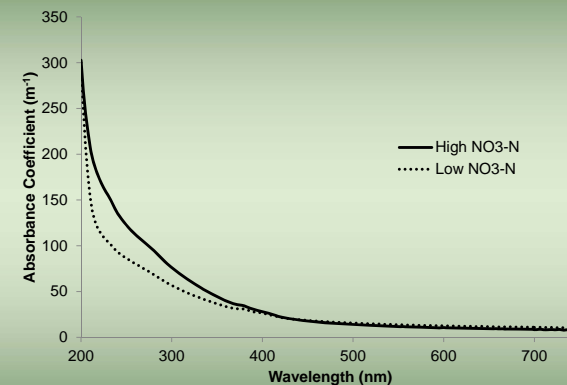
- Monitored using UV-visual spectrophotometer placed in the stream
- Absorption spectrum and parameters measured every 15 minutes

Parameter	Maximum	Resolution
NO ₃ -N	70 mg/L	0.1 ±mg/L
TOC	150 mg/L	0.2 ±mg/L
DOC	90 mg/L	0.2 ±mg/L
Turbidity	1400 FTU	1.3 FTU



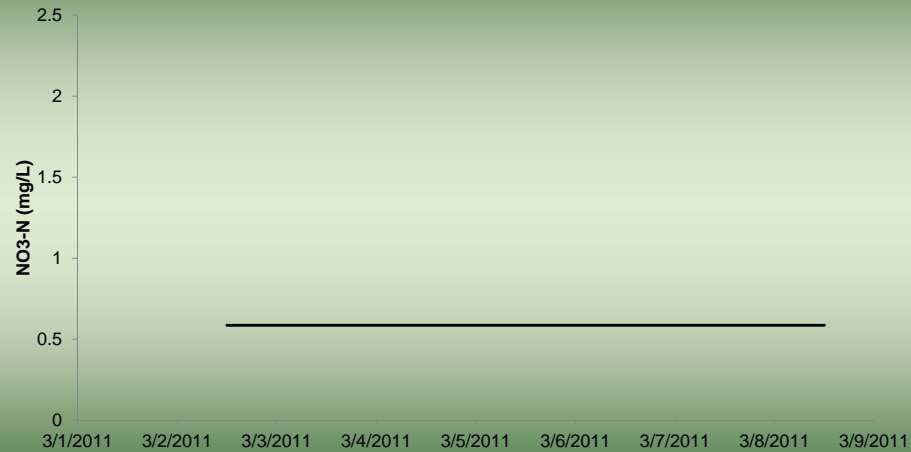
Continuous Water Quality Monitoring

Absorption Spectra



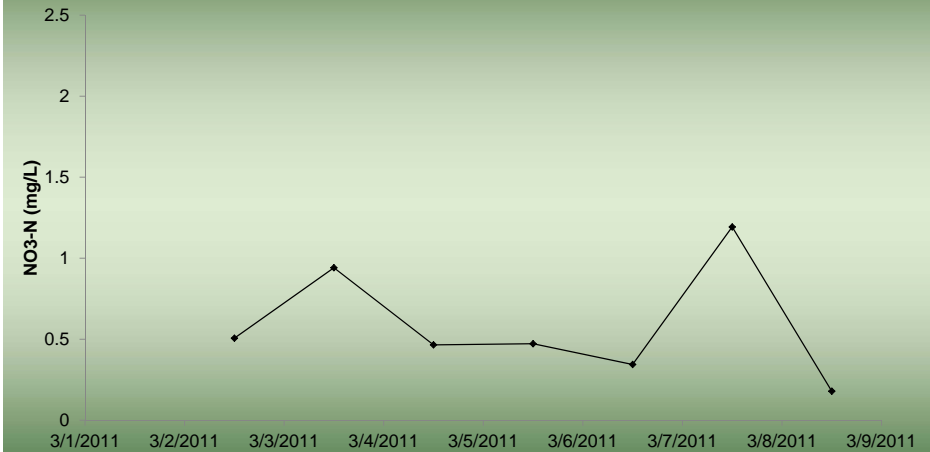
Downstream Flume – Weekly Sample

Nitrate Concentration



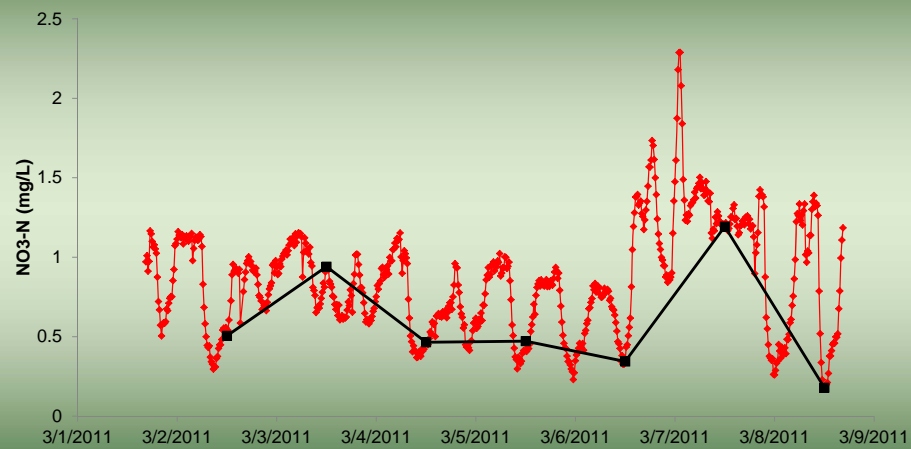
Downstream Flume – Daily Sample

Nitrate Concentration



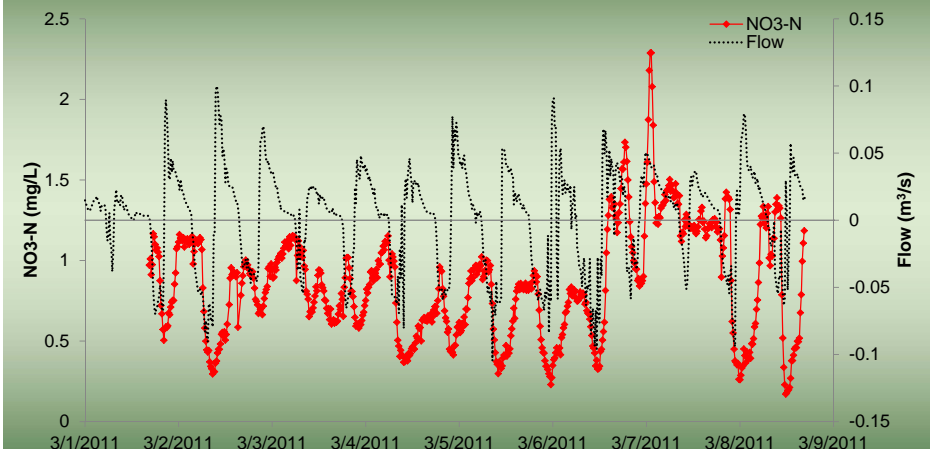
Downstream Flume – 15 minute sample interval

Nitrate Concentration



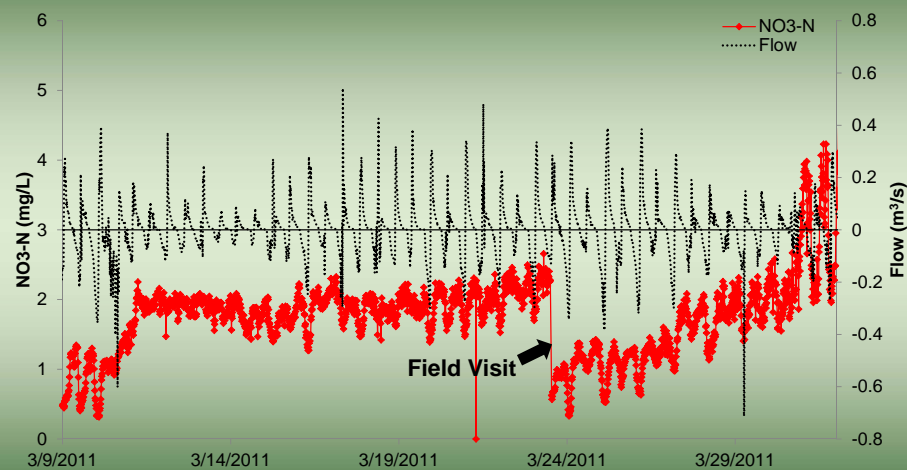
Downstream Flume

Nitrate Concentration and Flow



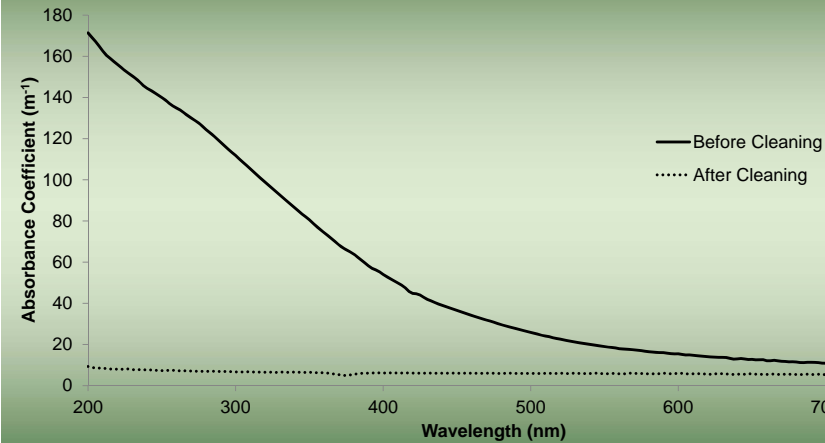
The Problem

Nitrate Concentration and Flow



The Problem

Absorption Spectra



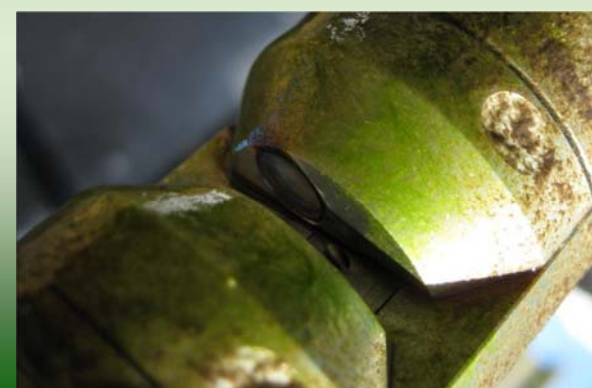
After Installation



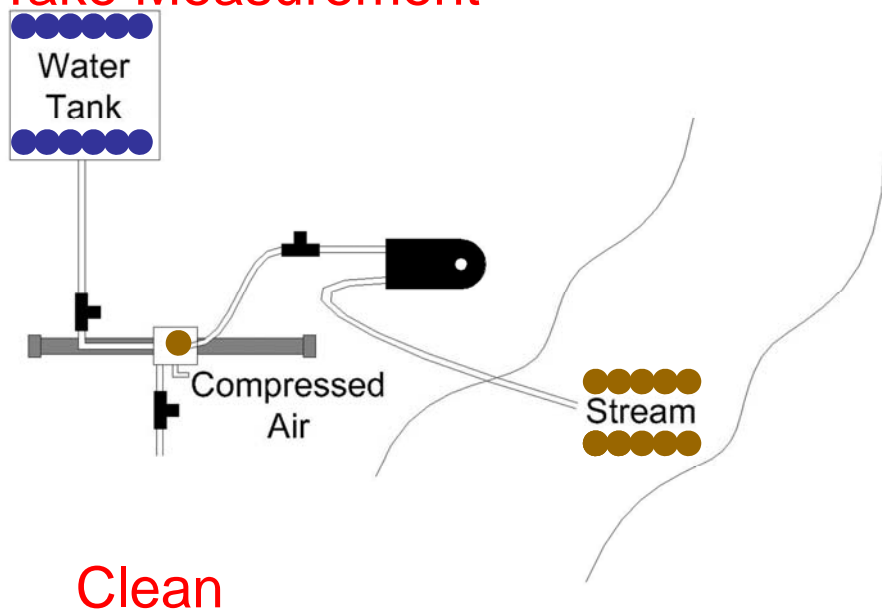
Two Weeks Later



Fouling



Take Measurement



Challenges of Continuous Water Quality Monitoring

- Calibration
- Preventing/reducing window fouling
- Solar power



Future Research

- Continuously monitor:
 - DOC
 - pH
 - Conductivity/Salinity
 - Dissolved Oxygen
 - DOM Fluorescence
- Gas fluxes



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