Voies hivernales de transport des éléments nutritifs dans l’estuaire moyen du St.-Laurent

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Inaugural Odyssée St-Laurent field campaign
February 2018

Context:

- Turbulence profiling VMP-500 & CTD-Rosette
- Other sampling (sediments, plankton nets, CTD, and ice)

Water SS figures from Cyr, Bourgault, Galbraith, and Gosselin. 2015. JGR
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Nutrient supply in the St-Lawrence’s lower estuary fairly well documented during summer.

**Nutrient input from upstream?**

**Tidal forcing**

**High tide at Tadoussac**

The barotropic tidal currents forced on the sill cause vertical displacements and internal tides generation.

Nitrate upwelled towards the strong mixing zone.

F ~ 95 mmol m⁻² d⁻¹

Colour is qualitative nutrient concentrations

*Figures from Cyr, Bourgault, Galbraith, and Gosselin. 2015. JGR*
Sampling was temporally-limited

◁ CTD-Rosette (in-situ water) ○ Turbulence
Turbulence operations to estimate vertical fluxes of nutrient and oxygen

\[ \text{Flux} = -K \frac{\partial C}{\partial z} \]

- **K** diapycnal mixing
- **\( \frac{\partial C}{\partial z} \)** background gradient

**Sampling & analysis**

- VMP-500 microstructure shear + CTD (temperature & salinity)
- CTD — oxygen, salinity, temperature
- In-situ water — nitrite, nitrate, silicate, phosphate
Nutrient concentrations correlated with salinity as nutrient-rich river water enters the estuary

Bluteau, Galbraith, Bourgault, Tremblay, & Villeneuve, in prep.
Nutrient concentrations correlated with salinity as nutrient-rich river water enters the estuary

Bluteau, Galbraith, Bourgault, Tremblay, & Villeneuve, in prep.
Water becomes progressively saltier towards the Gulf except at the the head.
Subsurface nutrient minima in lower estuary and upwelling at the head

Bluteau, Galbraith, Bourgault, Tremblay, & Villeneuve in prep.
Surface nutrients a few weeks later during heli survey missed the upwelling event at HLC
Nutrient fluxes highest near the head

Max $F_N = 4 \text{ mmol/(m}^2\text{d)} \times 10$ at HLC

HLC area 10% of lower estuary (100-m isobath)
Winter nutrient fluxes compared to summer at the HLC

“Tidally-averaged” summer
$F_N \approx 40 \text{ mmol/(m}^2\text{d)}$

Context
Sampling & analysis
Results
Summary
Winter nutrient fluxes compared to summer at the HLC

X-sectional averaged using $\approx 0.2 \text{ mmol/(m}^2\text{d)}$ outside HLC

- 2h before high tide $F_N \approx 0.6 \text{ mmol/(m}^2\text{d)}$
- Max at high tide $F_N \approx 10 \text{ mmol/(m}^2\text{d)}$
Fluvial input can create the nutrient inventory but vertical fluxes at HLC are non-negligible

▶ Time/spatially-averaged $F_N \approx 4$ mmol/(m$^2$d)
▶ Fluvial input: $q = 10600$ m$^3$/s at 20 mmol/m$^3$ into LSLE

Bluteau, Galbraith, Bourgault, Tremblay, & Villeneuve, in prep.
Summary

Fluvial input
\approx 3 \text{ mmol/(m}^2 \text{ d)}

Vertical flux \approx 0.2\text{ to } 4 \text{ mmol/(m}^2 \text{ d)}