Temperate, macrotidal, turbid estuarine behavior of mercury species. The case of the Loire river

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INTRODUCTION:

Estuarine mercury biogeochemistry in the Loire is important to examine:

- Because toxic mercury's global and regional cycles are highly impacted by human activity,
- Because it is a trace element whose behavior and long-term evolution in this "model estuary" can be described.

Aims of this study:

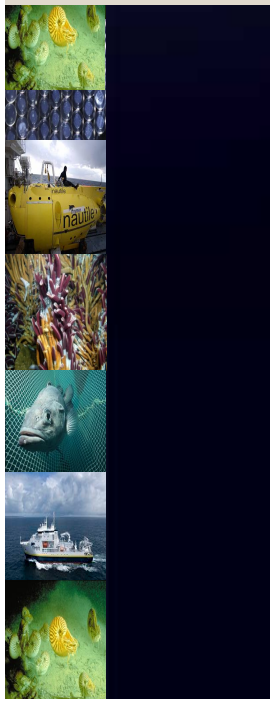
1. Describe the diversity of dissolved mercury behaviors in the Loire estuary,

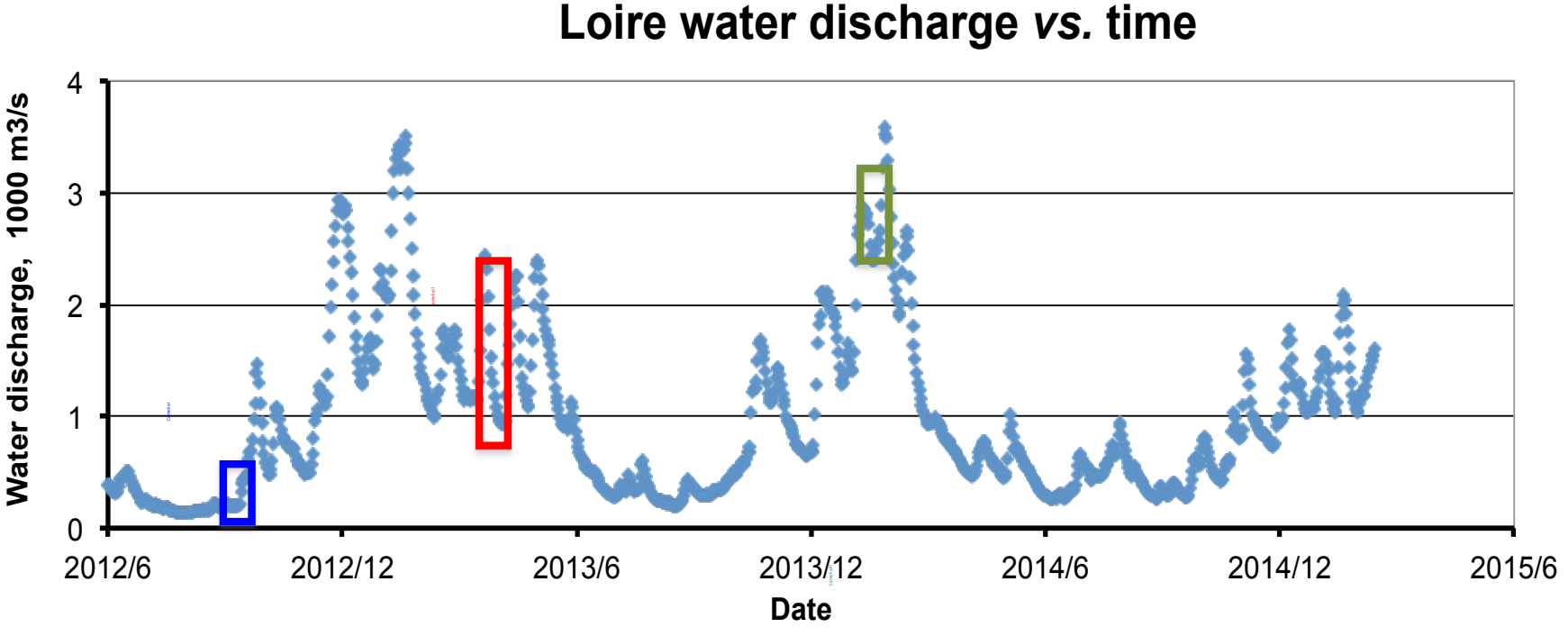
2. Evaluate decadal changes.

Study site:

Loire and its drainage basin

Estuarine cruise dates (low, med, hi flow).





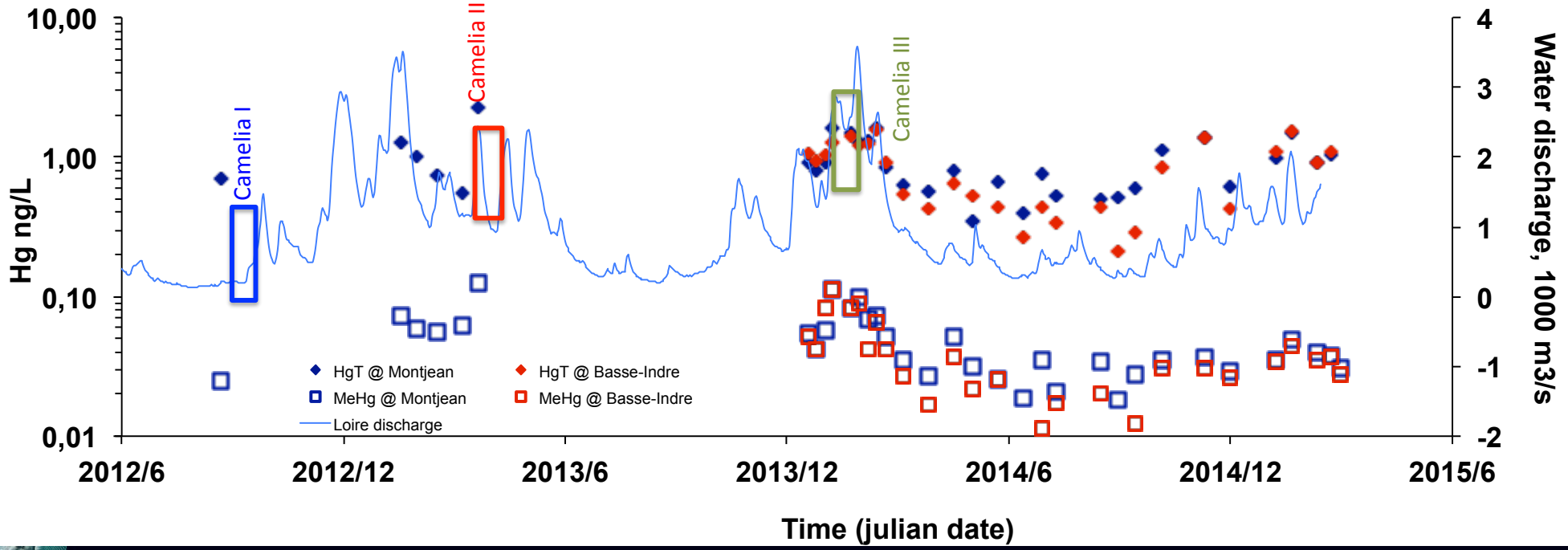
Analytics:

Water samples were drawn into a containerized clean-lab by an all-Teflon pump. Total dissolved mercury (HgT) was analyzed onboard immediately after 0.4µm filtration on cellulose Ac filters.
Detection limit for HgT is 5pg/L and precision is better than 8%. Bracketing analyses with ORMS CRM helps with accuracy …..

Results:

Temporal variations of Hg (log scale) in the Loire river Hg species.

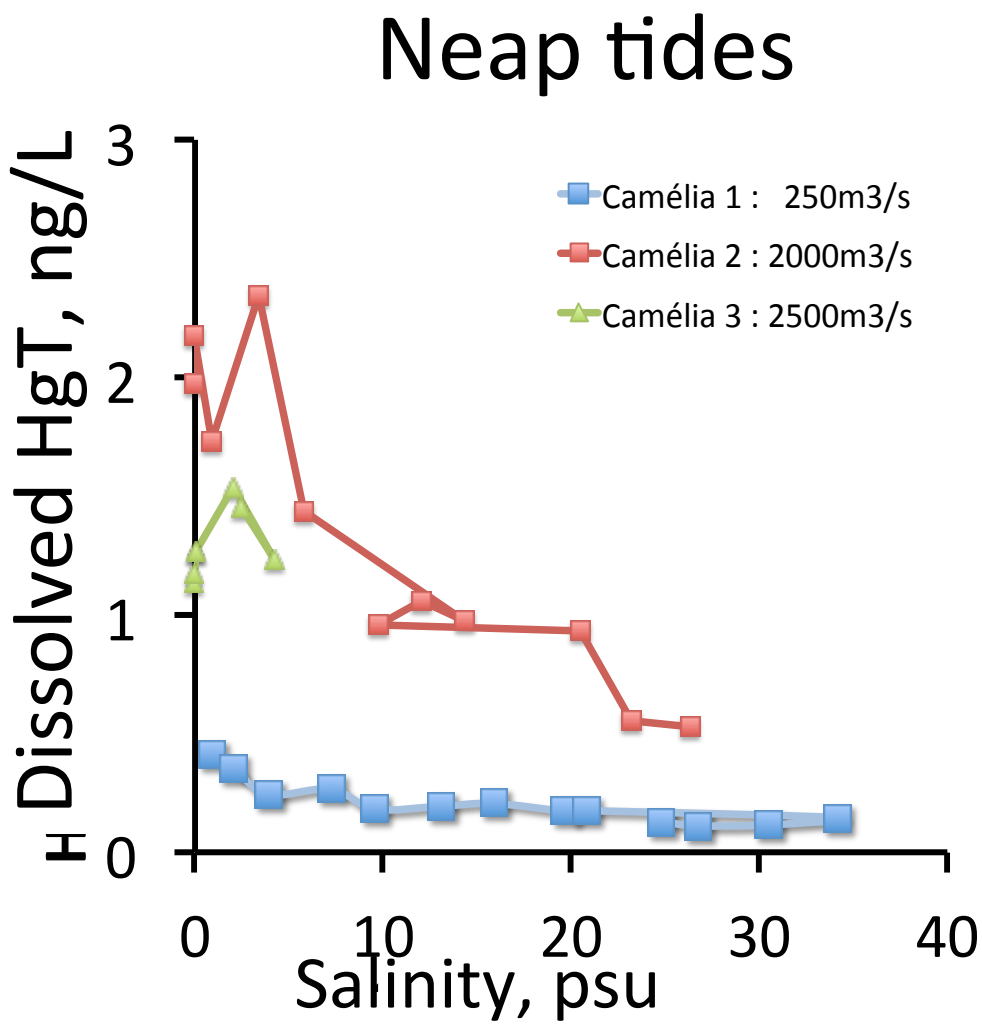
Temporal evolution of Hg species in the riverine end-member

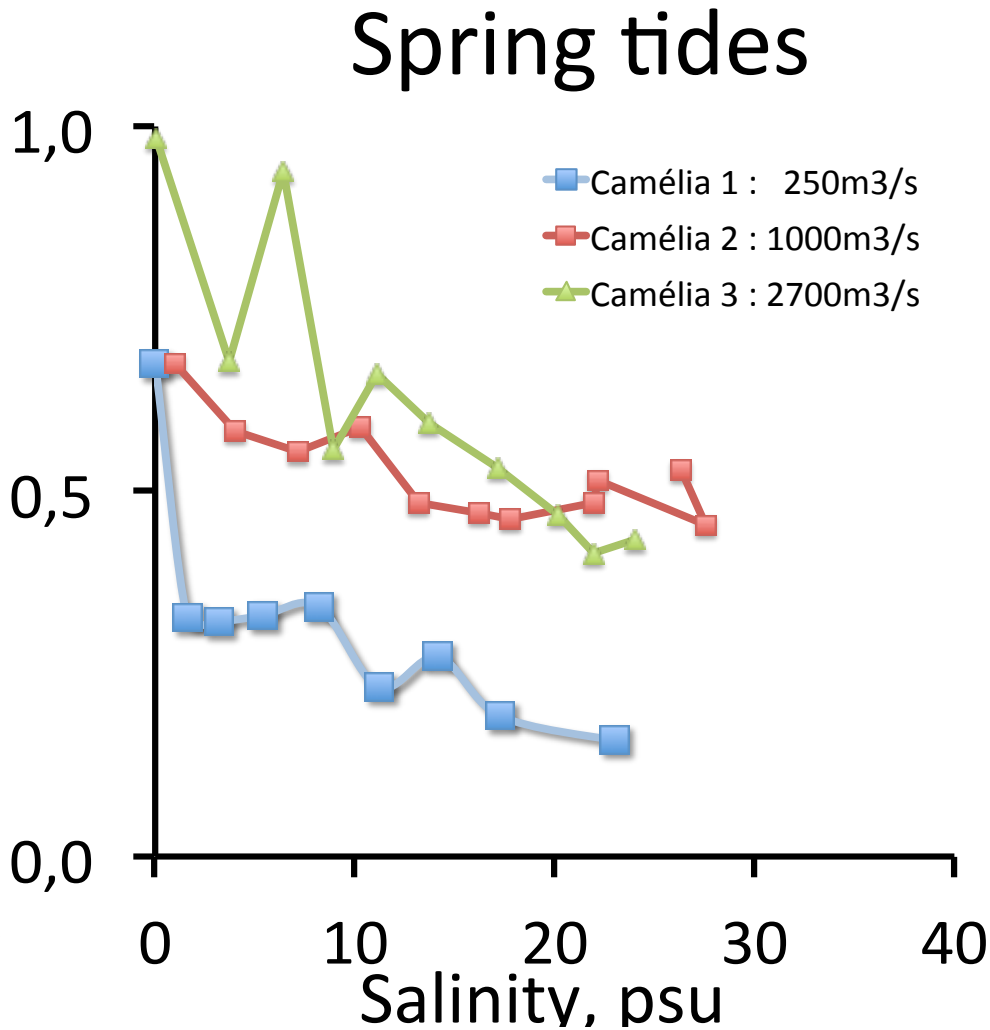


1 Results:

Some scavenging in upper estuary

Strong influence (control?) of mercury by tidal regime

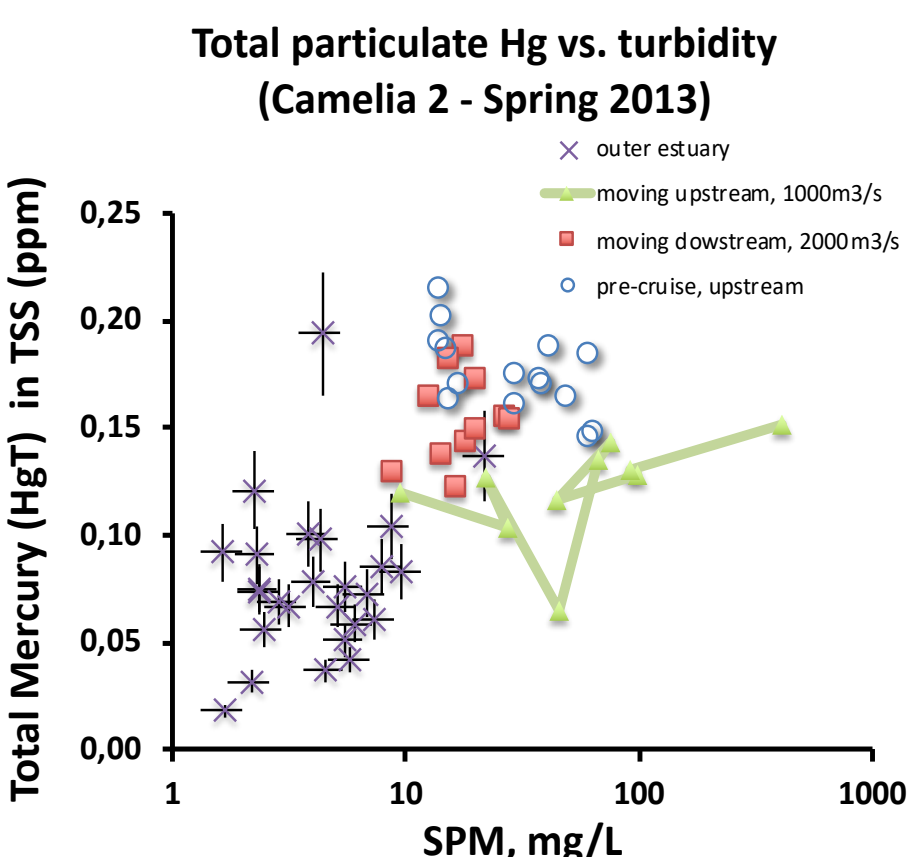


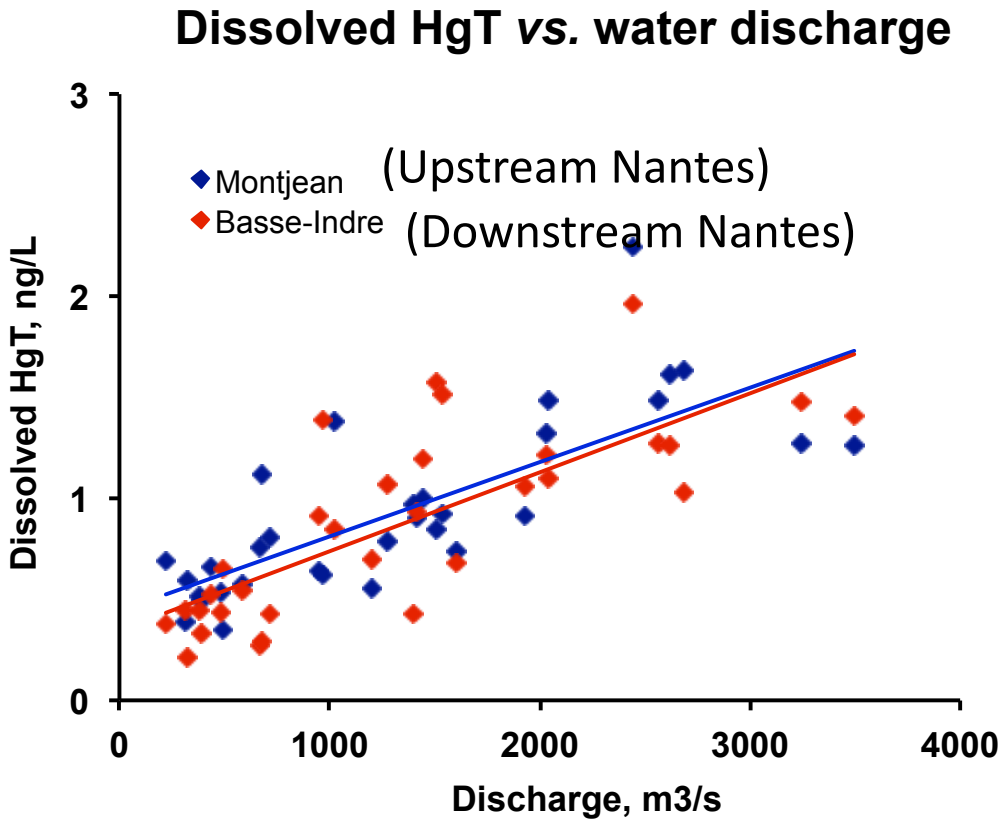


1 Results:

Particulate Hg is depleted in the organic-rich particulate matter (outer estuary)

Linear relation between dissolved HgT and discharge in the freshwater end-member is coherent with a dominant Hg source being atmospheric. A Nantes urban area source is NOT visible.

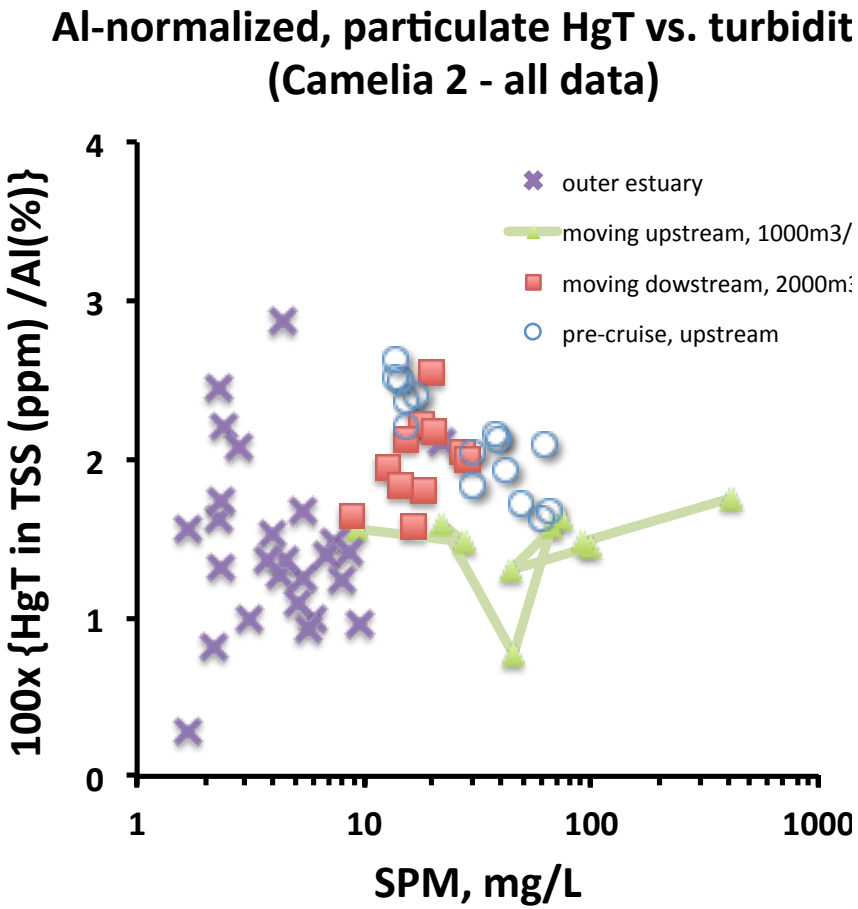


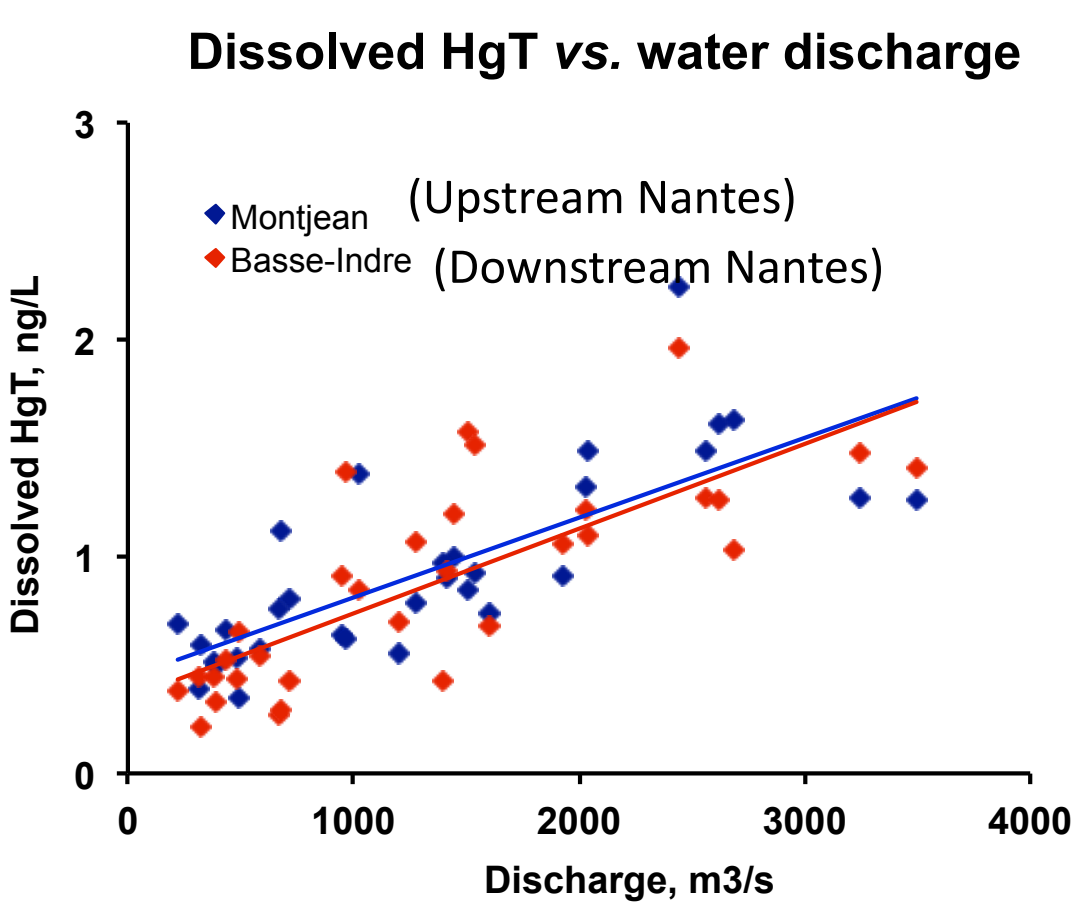


1 Results:

Al-normalized particulate Hg is stable at 0.003—0.03ppm over a <2 to >400 mg/L SPM range

Linear relation between dissolved HgT and discharge in the freshwater end-member is coherent with a dominant Hg source being atmospheric fallout. NO CONTRIBUTION from Nantes urban area

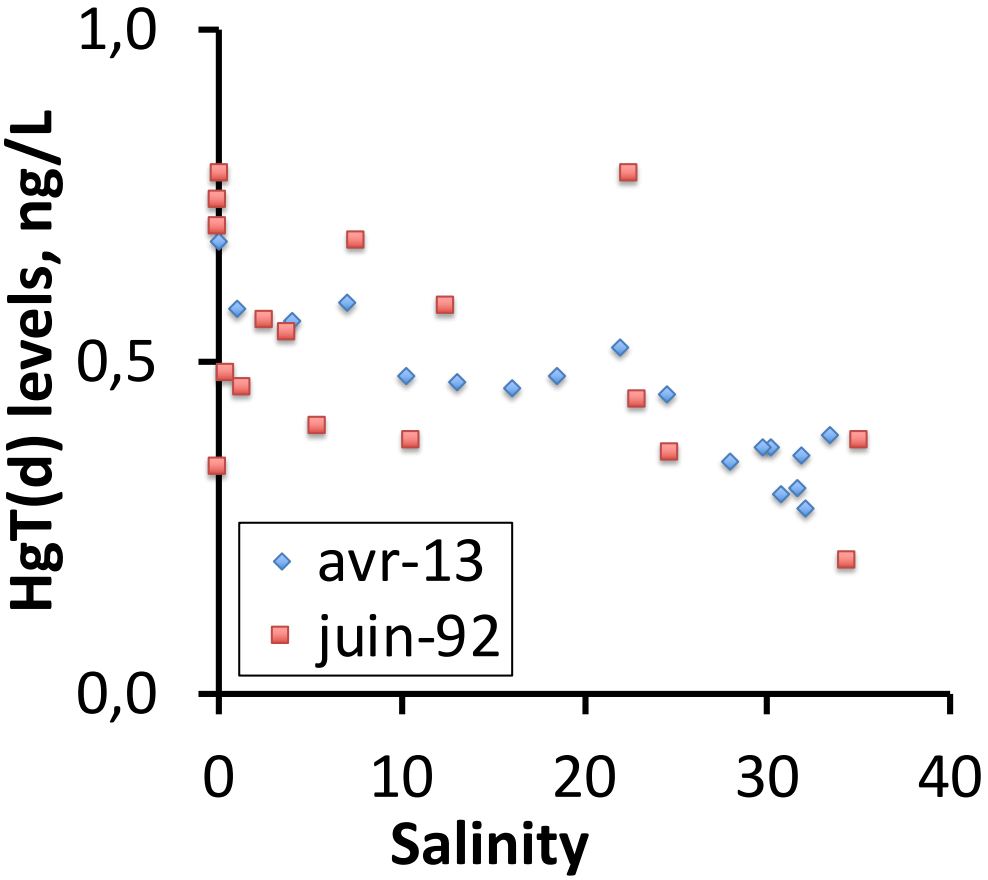




2 Results:

The early reference data is from Coquery et al. (1997) and uses identical analytical principles to enable direct comparison between datasets.

Total dissolved mercury Springs of 1992 & 2013



1992:
Tidal coef. 75-77,
freshwater discharge: 1560m3/s

2013:
Tidal coef. 92,
freshwater discharge : 1000m3/s

Conclusions

1. Sampling and shipboard analyses can describe the diversity of riverine and estuarine Hg behaviors.
2. High freshwater flow leads to high mercury levels in the upper estuary,
3. Tidally-driven processes (resuspension, …) drives estuarine mercury levels,
4. Urban contribution to Hg inventories /fluxes is not apparent
5. No major decrease in Hg levels in 1990-2010's, indicating that abatement policies designed to stop environmental mercury increases are working, and those designed to diminish mercury levels are not yet producing their effects….