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Importance of a tidal flat-saltmarsh system as a source-sink of mercury in a contaminated coastal lagoon environment (northern Adriatic Sea)

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Introduction

Saltmarshes are important constituents of marine-coastal transitional environments that provide several services to the ecosystem and are essential to the sedimentary budget. Unfortunately, they are often **contaminated** by various chemical substances (e.g. heavy metals) coming from human activities. One of the most dangerous contaminants is **mercury** (Hg), due to the high toxicity of its organic form (methylmercury) within the food web.

The **Marano and Grado Lagoon** (Northern Adriatic Sea, Italy) **is mainly contaminated by Hg** (Covelli et al., 2001) coming from two sources: 1) from historical regional mining activities (Idrija, Slovenia), 2) from more recent industrial input due to a chlor-alkali plant (Torviscosa, Italy). Several studies have demonstrated the presence of Hg both in saltmarsh sediments (Covelli et al., 2017) and in their halophyte vegetation (Petranich et al., 2017; Pellegrini et al., 2017).
Due to intense human activities the Lagoon has been subject to a noticeable morphological change over time which has led to a negative sedimentary budget (Fontolan et al., 2012), as well as the loss of Hg associated with fine suspended sediments from the Grado inlet (Turritto et al, *in press*).

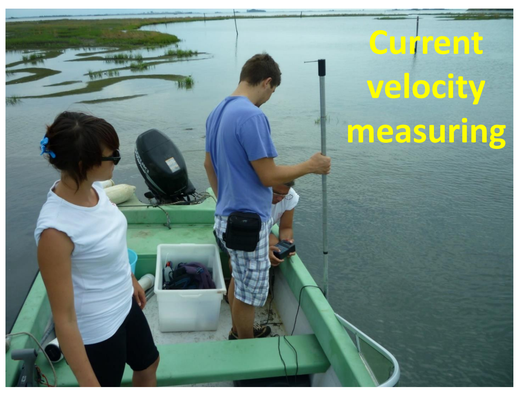
Objective

The present work was carried out **to investigate the potential role of a tidal flat-saltmarsh (TF-S) system as secondary source of Hg** in relation to the chemical-physical processes that lead to the **Hg remobilisation** following the periodic tidal inflow and outflow.

An evaluation of the exchange between the TF-S system and one of the main lagoon channels **caused by tidal fluxes (ebb and flood conditions)** was done.

Sampling operations

Seasonal sampling operations took place in July (summer), September (autumn) and December (winter) 2016. The collection of **water samples**, **current velocity** and **water chemistry** were measured at the mouth of the principal tidal creek, which collects the waters of a dense channel network draining a 5.5-ha TF-S system. **Water samples were collected during the flood and ebb tide** in each campaign to determine nutrients and particulate (**PHg**) and dissolved (**DHg**) mercury.



Tidal flux estimations

The **hourly flux** of Hg (**FHg_i**, mg hr^{-1}), was estimated by considering the instantaneous **water flow** ($Q_i = A_i \cdot v_i$) through the section of the tidal creek according to the following formula:

$$FHg_i = (Q_i * Hg_i) * 3600$$

where v_i is the average current velocity (m s^{-1}), A_i is the area of the flooding tidal creek section (m^2) estimated during each sampling and Hg_i is the concentration in the particulate or, alternatively, dissolved Hg fraction in the water sample.
The amounts of PHg and DHg (expressed as mg) were estimated by combining discrete hourly tidal flow measurements with Q. The Hg amounts obtained were then considered in order to calculate **the final budget (B_{PHg} and B_{DHg})** in each campaign:

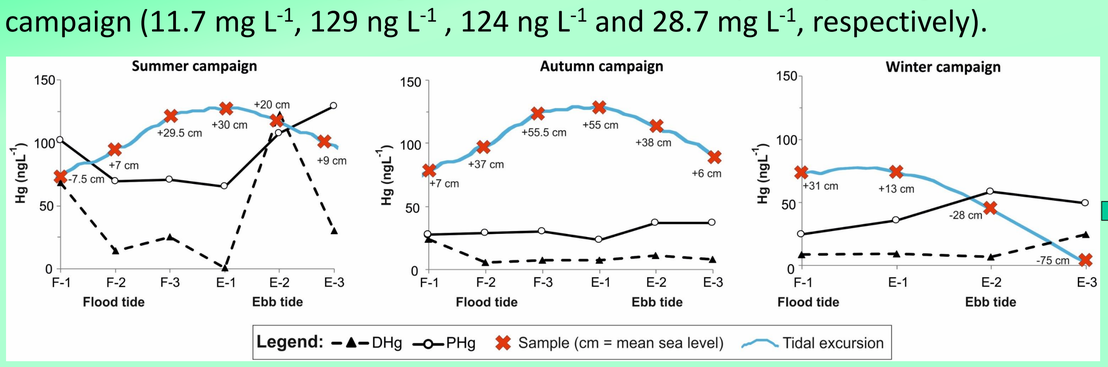
$$B_{Hg} = \Sigma\, FHg_{flood\ (n=1-3)} - \Sigma\, FHg_{ebb\ (n=1-3)}$$

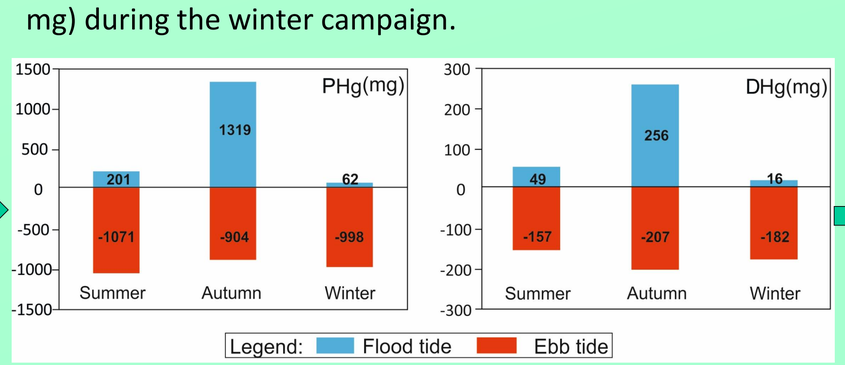
where **$\Sigma\, FHg_{flood}$** is the overall amount of estimated Hg transported in flood conditions and **n** is the number of the sample.

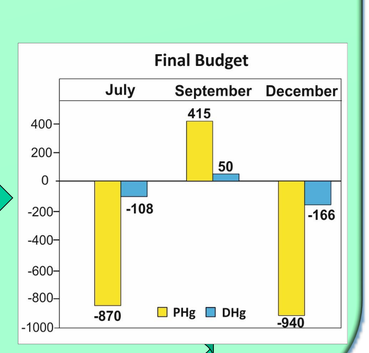
Results

1) The highest values of **dissolved O_2**, **PHg, DHg** and **SPM** (suspended particulate matter) were recorded during **ebb tide conditions**, especially during the summer campaign (11.7 mg L^{-1}, 129 ng L^{-1} , 124 ng L^{-1} and 28.7 mg L^{-1}, respectively).

2) **The final budget (B) almost always presents as negative** for both Hg physical forms (excluding the autumn season), with the maximum values of B_{PHg} (-936 mg) and B_{DHg} (-166 mg) during the winter campaign.







An EXPORT of Hg was seen.

Conclusions

Our conclusions highlight **the tendency of Hg to be exported from the TF-S system** to the open lagoon **during ebb tide conditions**. Indeed, a simple estimation provides a **negative sedimentary budget for the TF-S system**, which loses Hg towards the main lagoon channel during a tidal semi-cycle.

These outcomes can confirm other evidence of morphological deterioration of this critical coastal environment.

References

Covelli S, Faganeli J, Horvat M, Brambati A. **2001**. *Mercury contamination of coastal sediments as the result of a long-term cinnabar mining activity (Gulf of Trieste, northern Adriatic Sea)*. Appl Geochem 16:541-558.
Covelli S, Petranich E, Langone L, Emili A, Acquavita A. **2017**. *Historical sedimentary trends of mercury and other trace elements from two saltmarshes of the Marano and Grado lagoon (northern Adriatic Sea)*. J Soils Sediments 17:1972-1985.
Fontolan G, Pillon S, Bezzi A, Villalta R, Lipizer M, Triches A, D'Aietti A. **2012**. *Human impact and the historical transformation of saltmarshes in the Marano and Grado Lagoon, northern Adriatic Sea*. Est Coast Shelf Sci 113:41-56.
Petranich E, Acquavita A, Covelli S, Emili A. **2017**. *Potential bioaccumulation of trace metals in halophytes from saltmarshes of a northern Adriatic coastal lagoon*. J Soils Sediments 17:1986-1998.
Pellegrini E, Petranich E, Acquavita S, Canário J, Emili A, Covelli S. **2017**. *Mercury uptake by halophytes in response to a long-term contamination in coastal wetland salt marshes (northern Adriatic Sea)*. Environ Geochem Health 39:1273–1289.
Turritto A, Acquavita A, Bezzi A, Covelli S, Fontolan G, Petranich E, Piani R, Pillon S. *Suspended particulate mercury associated with tidal fluxes in a lagoon environment impacted by cinnabar mining activity (northern Adriatic Sea)*. J Environ Sci doi.org/10.1016/j.jes.2017.12.009.