# Evidences on saltwater intrusion in a climate change impacted multiple-mouth delta: the Po Delta case.

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The Po Delta (Italy) represents an example of multiple mouth deltas and has complex dynamics within and in front of it. Saltwater intrusion (SWI) in deltas, estuaries, and other coastal areas represents a pressing problem affecting the sustainability of freshwater resources. Our study focuses on the identification of peculiar dynamics along the Po River branches and the delta lagoons due to saltwater intrusion (SWI) phenomena under low discharge conditions, investigated through modelling.
The model successfully reproduced the observed salinity variations along main river branches and in the delta lagoons and investigated fresh and saltwater dynamics during the entire summer 2017. The numerical model is used also to explore the hydrological response of the delta system to climate change. The relative effect of controlling factors on saltwater penetration, such as sea-level rise (SLR), air-sea fluxes, and reduction of river discharge, was evaluated. Results suggest that changes driven by climate and SLR will exacerbate SWI in the surface waters of the Po Delta system. Extent of SWI in the major river branch is projected to increase up to 80% further into the river. Persistence of SWI at the same site is expected to increase 100% longer. The dominant mechanisms of SWI are linked to advective and shear dispersion fluxes, although they act in opposite directions. Tidal oscillatory flux plays a role in pumping salt into the major river branches.
Moreover, additional synthetic simulations were used to investigate the sensitivity of SWI to several river discharges and relative SLR values, highlighting the effects of the two factors in the delta. Such results show different combinations of river discharge and relative SLR values that represent possible scenarios, and are important for managing SWI in river-sea systems affected by both climatic and anthropogenic factors such as discharge changes from dam construction, land use, and irrigation. River discharge reduction is expected to affect SWI more than SLR, while heat fluxes do not affect it. However, the additional contribution of subsidence can induce a faster rate of change in RSLR, increasing its effect on SWI. The relationship between SWI and river discharge identifies a tendency from a more diffusive to a more exchange-dominated system with increasing RSLR.
This modelling study allowed the investigation of more relevant processes in the inner parts of the delta, identifying the major drivers and the relative effects also in a climate change perspective.