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Abstract:

Estuaries are complex transfer areas of water masses and suspended particulate matters (SPM).. From a physical point of view, estuaries are exchange areas between fresh brackish continental water and salty marine waters, mainly driven by river run-off, tides and wind forcing. Density gradients generated by the continental waters inter-playing with marine waters, and interactions between tides and estuarine morphology have been shown to be the major mechanisms governing the estuarine dynamics. The vertical density stratification, which results from the competition between density gradient and velocity/bottom shear, plays a major role in the transfer and mixing of water masses and the transport of dissolved and particulate matters. Its precise reproduction is therefore one of the cornerstones of estuarine numerical modeling.

The present study has been specifically designed to provide a detailed insight on hydrodynamics in a man-engineered channel-shape estuary, subjected to strong tidal and fluvial forcing, with few intertidal area and small watershed; as very few is known about such estuaries. The selected field site is the Adour river estuary, located at the bottom of the Bay of Biscay. It is a highly developed estuary with several kilometres of its downstream part completely channelised in order to secure the Bayonne harbour operations. This specific morphology is reinforced by a man-engineered reduction of the section at the last reach, in order to ease the expulsion of water and sediment. The Adour estuary morphology combined with the competition between the tide and the river flow result in a time-dependent salt-wedge estuary.

A numerical model has been developed based on the open source code TELEMAC-3D to investigate the interaction between light continental waters and heavy salty marine waters, focusing on the salt-wedge intrusion inside the estuary. A major issue of our numerical study is to reproduce the stricking variability of the Adour lower estuary in terms of hydrological regimes, ranging from salt-wedge to partially mixed regimes depending on tidal and discharge conditions. These features are strongly related to the variations of turbulent properties and salinity structure, with higher turbulent mixing when stratification is minimal. The model is tested against a series of field campaigns performed inside the lower estuary between September 2017 and September 2018, to cover contrasted conditions of river discharge and tidal range. Velocity profilers and high frequency point current-meters were moored, at two different stations inside the estuary, during one month. The correct representation of density stratification processes by the numerical model remains, as expected, a challenging issue. The choice of the turbulence model is of the foremost importance for a good representation of the interaction between water masses. A comparison between constant viscosity, mixing length with damping function and k-epsilon turbulence models will be discussed within the physical framework provided by field measurements.

Proposed session: *River, estuaries, maritime, coastal sediment processes*
Key words: TELEMAC3D, stratification, turbulence, salt-wedge estuary
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