MODELLING OF SEDIMENT TRANSPORT PATTERN IN THE ESTUARY OF THE PIAVE RIVER

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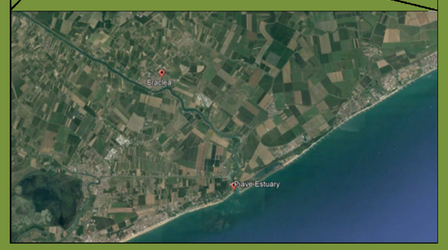
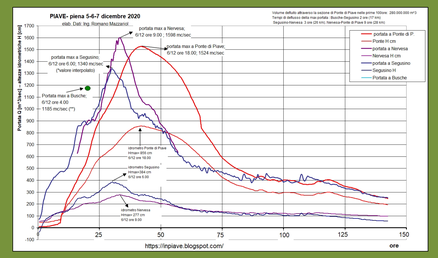
1. INTRODUCTION AND CASE STUDY

Sediment transport and the related sedimentary and suspension processes play a fundamental role in the dynamics of coastal environments (Holdaway et al., 1999) [1], such as lagoons and estuaries. Furthermore, it is of primary importance to understand and quantify the hydrodynamics driving the processes.
Historically, the traditional techniques used are based on the acquisition of precise in situ measurements of current velocity, water flow and concentration of suspended solids . The main limitation of this approach is, therefore, the poor spatial and temporal resolution, which is very often insufficient to describe the variability associated with highly dynamic coastal environments (Gartner, 2004) [2]. Over the last decades numerous models for sediment transport prediction have been proposed with application to fluvial transport or littoral transport. However, the morpho-dynamic interactions that occur at the river mouth are still difficult to predict given different concurring phenomena, deriving from both river hydrology. The present study analyses the sediment transport at the Piave estuary (Italy, Adriatic Sea)

A. Dataset

In order to qualitatively ascertain the plume of dispersed sediments, the most severe condition was considered. In fact, among the most recent flood events, that of December 2020 was considered. The flood event lasted several days from 5th to 7th December 2020, when the hydrometric level exceeded 1.5m at the hydrometric station of Eraclea (8.6 km from the mouth of the Piave River), peaking on 6th December at 20.00, when the hydrometric level reached 2.92 m.

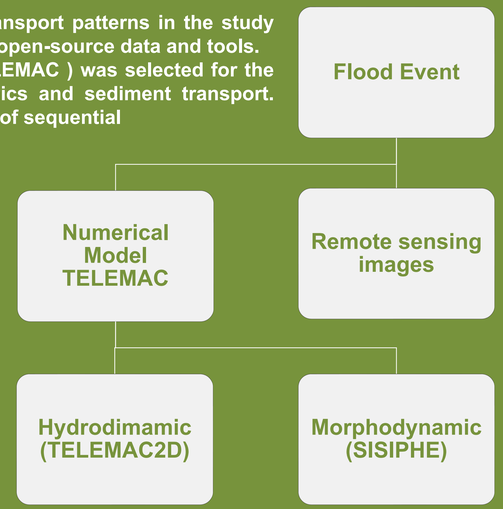




2. METHODOLOGY

The simulation of the sediment transport patterns in the study area was undertaken using mostly open-source data and tools. The numerical modelling suite TELEMAC) was selected for the computation of local hydrodynamics and sediment transport. The modelling approach consisted of sequential coupling between the modules TELEMAC-2D [3] and SISYPHE [4].

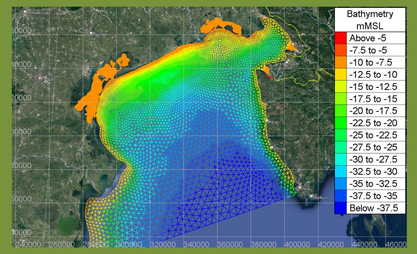
To validate the dispersion of the sediment plume, the images obtained by remote sensing are compared with the results extracted from the model. This procedure allows to use observed sediment plume as a representation of the estuarine hydrodynamic pattern that may be used as a model calibration target.



3. MODEL IMPLEMENTATION

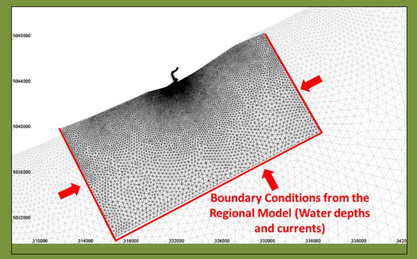
A. Regional Hydrodynamic Model Setup

A regional hydrodynamic model of the North Adriatic Sea was setup to compute the tidal-driven circulation in the region and inform the sea boundary conditions for the local hydrodynamic model in the proximities of the Piave River estuary.



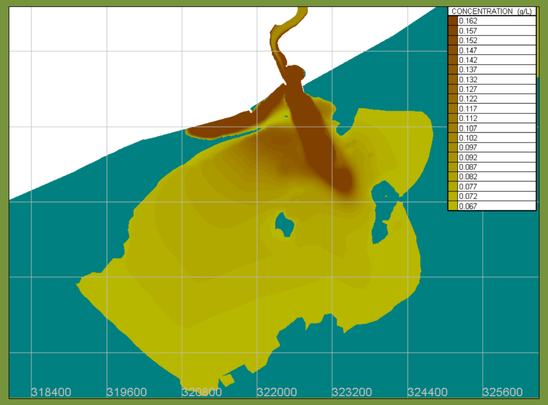
B. Local Hydrodynamic Model Setup

The local hydrodynamic model of the Piave River estuary and vicinities was setup to compute the interaction of sea currents and river currents. The nested approach was considered necessary due to the high requirements of the estuarine area in terms of spatial and temporal resolution. It is reasonable to assume that the river flow has no impact in the regional hydrodynamics.



4. MODEL RESULTS

The present study case aimed at reproducing the morpho dynamics of the flooding event occurred at the Piave River in the period of 5th to 10th December 2020. Numerical modelling of fluvial discharge, water circulation and sediment transport was undertaken using the open-source modelling system TELEMAC, namely the modules TELEMAC-2D and SISYPHE. The first results show potentiality in the use of satellite images of suspended sediment plume as a calibration target of numerical models.



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