HYDRODYNAMIC AND WATER QUALITY MODELING OF GENOVA HARBOR

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INTRODUCTION

A contaminant is a chemical or biological substance in a concentration that can potentially cause adverse effects on the physical, chemical, or biological properties of a water body. Contamination of surface water bodies poses serious risks to both aquatic ecosystems and human health. In this respect, hydrodynamic modeling is an essential method to study scenarios for hydro-environmental problems, such as the impact of marine pollutants in coastal areas. In the framework of the Interreg Italy-France Maritime Cooperation Project Wastewater Management for the improvement of the harbor water quality, GEREMIA, this study numerically implements such a concept on Genova (Italy) harbor using a world-leading 3D modeling suite, Delft3D to investigate the hydrodynamics and transport process within these ports.

NUMERICAL MODEL

Delft3D consists of a variety of dynamically interfacing modules for the exchanging of data and results, each addressing a particular domain of interest such as flows, sediment transport, waves, water quality, morphological developments, and ecology. Figure 1 shows the nested grid along with bathymetry used in this study.

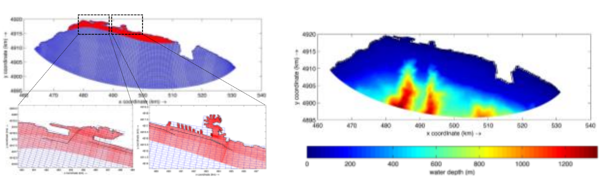

Figure 1- Grid and bathymetry

CLIMATE FORCINGS

The aim of modeling nearshore process and hydrodynamics is not only to get more insight into the transport and final destination (spatial distribution) of the contamination but also to construct a mathematical model of the water body in order to simulate variation in water quality with the variation in initial and boundary conditions. The climate forcing utilized in this study to characterize physical processes related to coastal circulation and dispersion is based on a four-decade analysis of hindcast data.

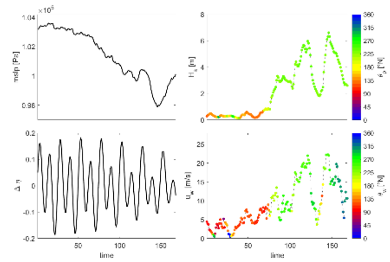

Figure 2 - An example of climate forcing-scenario 10

Based on these analyses, the environmental variables for numerical simulations were clustered using a statistical method, Maximum Dissimilarity Algorithm (MDA), and provided as a limited number of scenarios in order to identify and preserve the most significant modes of the variability of the relevant physical processes. Accordingly, through a re-analysis of atmospheric conditions, the developed database contains hourly wave, wind, and barometric field data defined on a grid with a resolution of around 10 km lon / lat, (Mentaschi et al ., 2013; Mentaschi et al., 2015) (Figure 2).

RESULTS

The characteristics hydrodynamic and advection-diffusion of 25 scenarios were developed. Figure 3 shows an example of the dominant velocity field and residence time for the inner gird of Genova harbor under scenario 10 meteo- marine forcing.

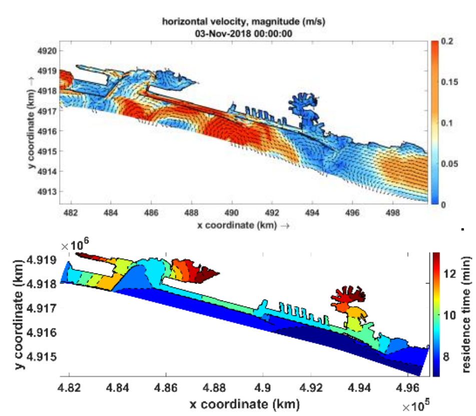

Figure 3 - Grid and bathymetry

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