THE HYDRO-METEO-MARINE SYSTEM TO FORECAST HIGH-TIDE EVENTS IN VENICE LAGOON: PRELIMINARY RESULTS

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I. INTRODUCTION

Flooding events in the city of Venice represent a real threat not only to the society, but also to the economy, the environment and the artistic heritage. Considerable efforts have been devoted, in the past, to the development of reliable forecasting systems, in order to reduce social and economic impacts. However, this is not such an easy task.

The Hydro-Meteo-Marine Forecasting System (Sistema Idro-Meteo-Mare – SIMM) (Accadia et al., 2003; Speranza et al., 2004) has been developed in order to forecast hydrological, meteorological and marine processes and - in particular - storm surges in the Venice Lagoon. It consists of a "cascade" of four models: a Limited Area Meteorological model (QBOLAM) (Buzzi et al., 1994; Nicastro and Valentinotti, 1998), combined with a Wave Model (WAM) (The WAMDI Group, 1988), a high resolution shallow-water model (Princeton Ocean Model, POM 2-D) (Blumberg and Mellor, 1987) of the Adriatic and Ionian sea, and a Finite Element Model to predict sea levels in the Venice Lagoon (VL-FEM) (Umgiesser et al., 1988). Water levels as computed by POM at the three inlets of the lagoon (fig.1) are given as an input to VL-FEM.

In the present work , we report preliminary results of VL-FEM and POM forecasts.

FIG.1: Overview of the Venice Lagoon with the three inlets: Chioggia (SC), Malamocco (NM), Lido Diga Nord (DN).

II. PRESENTATION OF RESEARCH

The main goal of this study is the validation of the forecasts of high-tide events in the Venice Lagoon achieved by SIMM. The present work is a comparison between forecasts of the hydrodynamic models of the Adriatic Sea and observations of the "Rete Telemareografica della Laguna di Venezia" (RTLV) (APAT, 2003).

In Fig. 2a, we show the time series of modelled and observed values for "Punta della Salute" (PS) , for the period between 21/11/2005 and 30/11/2005. Experimental data indicate that a high-tide event occurred on 27/11/2005, at 7.30 UTC, with a sea level of 0.92 m. In the following days as well, high-tide conditions persisted, with maximum values above 0.82 m. This event can be explained through the analysis of the meteorological situation of the preceding days. Wind Speed and Wind Direction, as measured at Lido Diga Sud (DS), are respectively reported in Fig.2 b,c and the Sea Level Pressure as measured at Lido Meteo (LM) is shown in fig. 2d. During the period before 27/11/2005 the intensity of the wind increased rapidly, reaching the maximum value of 38 m/s, while the direction changed from North-West to North–East (the so-called

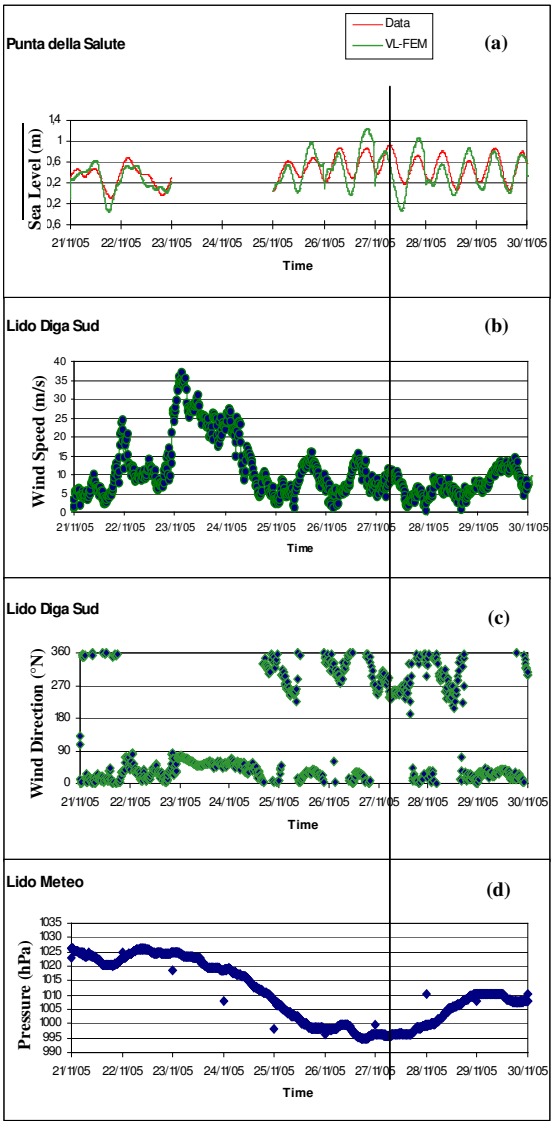

FIG.2: Time Series between 21/11/2005 and 30/11/2005 : a) Sea Level at Punta della Salute; b),c) Wind Speed and Wind Direction at Lido Diga Sud; d) Atmospheric Pressure at Lido Meteo.

"Bora" Wind). In the same period, the atmospheric pressure decreased, reaching the minimum value between the 26th and the 28th of November. These meteorological conditions can cause high-tide events (Pirazzoli, 1981; Canestrelli et al., 2001; Ferla et al., 2005).

The comparison between the model results and the measurements (fig. 2a) shows that the long-period level oscillation is well reproduced by the simulation results. However, the daily excursion of the signal induced by meteorological conditions is generally underestimated by the numerical outputs, so that the predictions sometimes shift with respected to the observed data.

The influence of POM results on VL-FEM predictions has also been investigated, since the POM computed levels at the three inlets of the Venice Lagoon are the input of VL-FEM. In figs. 3 a, b and c, we can see the scatter-plots of measured level vs. POM predicted levels for the three inlets of the lagoon. They show that POM underestimates the measured sea levels. Since POM is forced by both wind and pressure data, simulated by QBOLAM, this results can be due to differences between the data input (model forcing) and the meteorological observations (Giannini et al., 2006).

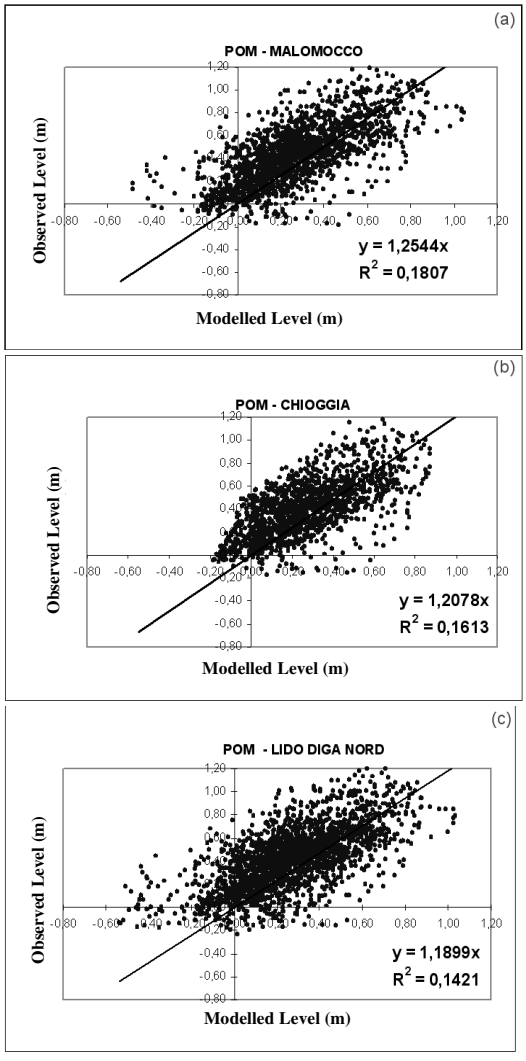

FIG. 3: Scatter – plot of Observed Level *vs* Modelled Level (POM). Releted to Malamocco (a), Chioggia (b) and Lido Diga Nord (c).

III. RESULTS AND CONCLUSIONS

The frequency of flood events in Venice has strongly increased since the last century (Camuffo, 1993). In order to forecast high-tide events in the Venice Lagoon, the SIMM forecasting system is operational within APAT and produces daily forecasts. Preliminary results of this work show that, in general, VL-FEM accurately reproduces sea-level oscillations, whereas the model predictions (VL-FEM, POM) underestimate the real data. It probably depends on the accuracy of meteorological model forcing, which are computed by QBOLAM.

Our future goal consists in testing VL-FEM by using the sea-level observations recorded by RTLV. On the basis of this investigation, the second step will be the study of a method to compute corrective factors in order to improve QBOLAM wind simulations.

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