Étude des mouvements impulsionnels de la mer Adriatique et de la prévision du niveau sur la côte

par

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The ordinary tide in the Adriatic Sea is occasionally overwhelmed by surges generated by winds or directly by pressure gradients. When the forcing has died out, the sea usually oscillates on its proper frequencies for many days (figure 1). These " seiches " (and the surges that started them) can be studied by extracting from the tidal records the purely " meteorological " tide, since its inter-action with the astronomical tide is shown to be irrelevant. A correct understanding of the dynamics of the sea is required since forecasting schemes have to be implemented for the flood warning. Also, estimates of the energy dissipation in such a shallow sea are very important for geophysics.

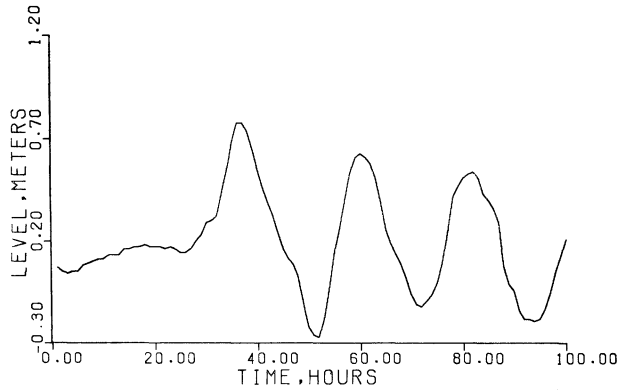

FIG. 1. — A case of surge, with following seiches, as recorded in Venice. Ordinary tide has been substracted. The time scale starts with February 11, 1972.

Two basic kinds of models are described here. They were mainly developed for the forecast of floods in the town of Venice.

This use of the models requires a scheme to very precise, but also as simple as possible from the computational point of view (to avoid time wasting). In addition, the required experimental parameters should be reduced to a minimum number. A satisfactory solution for these requirements was met with a one-dimensional, hydronumerical model : the Adriatic was described as a channel with varying depth and width, but such that for each cross section one value for the current and the level is used. Then the equations of Navier-Stokes and continuity (Coriolis forces are obviously disregarded) can be integrated numerically. If the forcing function is computed starting from the observed values of the atmospheric pressure, good results are obtained for the prediction (figure 2 gives an example).

Rapp. Comm. int. Mer Médit., **22**, 5, pp. 23-24, 3 fig. (1973).

On the other hand, a statistical approach was also pursued in order to forecast the sea level in Venice. As the solution of the linearized storm surges hydrodynamic equations can be expressed by the convolution of the forcing functions and the response functions, the prediction for a given point can be obtained with statistical methods, once the response function for that point had been evaluated from a large sample of experimental data.

Spectral analysis techniques were used to determine a physically consistent forecast interval (6 hours). An empirical model for the sea level in Venice was therefore built using data from 1966 to 1969 and including in the set of predictors both meteorological variables (linear and quadratic functions of the pressure gradients in the Adriatic) and mareographic variables (the past of the sea level itself).

As a result we could account for 87.5 % of the variance of the meteorological tide, leaving a standard error of 5.7 cm (figure 3 gives an example).

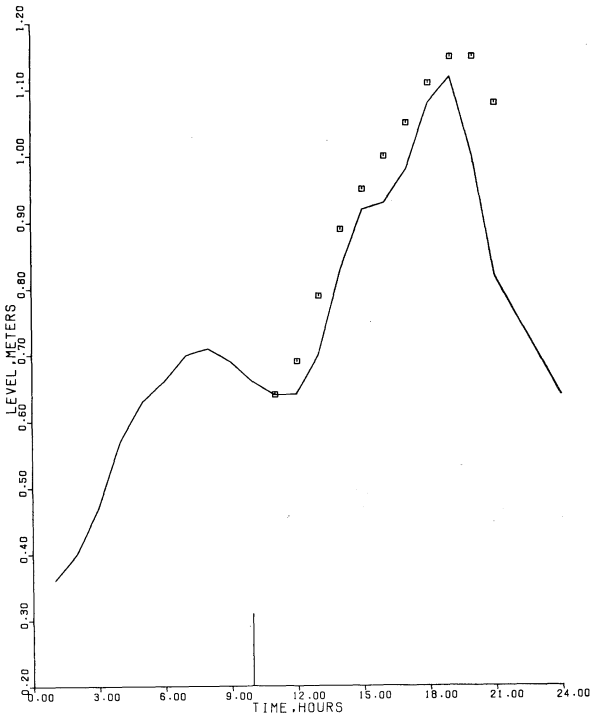

FIG. 2. — An example of prediction of floods in Venice by hydrodynamical numerical models. Using the meteorological reports of the time marked on the horizontal axis, a forecast was issued (square points) announcing the flood, as soon as the reports were made available (more than an hour later).

Both the solid line (observed values) and the prediction refer to the "total" tide, without astronomical substraction. The time scale begins at 9.0, November 9, 1971.

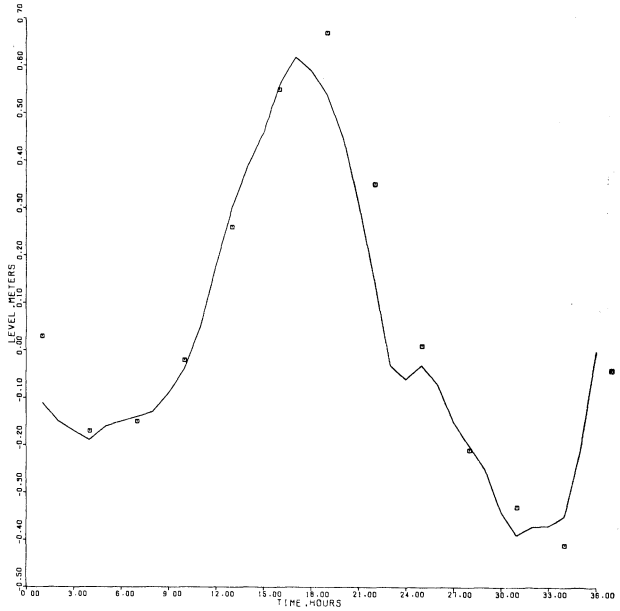

FIG. 3. — An example of surge forecasting by statistical methods. Here each predicted value (square points) was virtually computed six hours in advance, when a three-hourly weather report had been issued. Obviously, the statistical method also predicts the intermediate hours.

Here both the solid line (observed levels) and the forecast refer to the meteorological tide only.

The time scale starts with January 7, 1968.