



# Wave Forecast Description (AEMET/OPPE)

The Organismo Público Puertos del Estado (OPPE) together with the Agencia Estatal de Meteorología (AEMET) run and distribute a twice-a-day wave and wind fields forecast for the Northern Atlantic and the Western Mediterranean area. Wind forecasts, used to force the wave models, come from the HIRLAM model, running operationally at the AEMET.

Wave forecast system starts a new execution twice a day, at 5 and 17 hours. Model output are available on Puertos del Estado web site one hour later (maps, plots and tables). The system is based on a set of model applications forced with HIRLAM forecasted wind fields provided by AEMET. The forecast horizon is 72 hours for all the domains. 1-hour-outputs are generated.

## Wind Fields

HIRLAM wind fields are used to force the wave applications. Fields represent 10-meter-height winds. To ensure good initial conditions, before the forecast starts, the model is forced using wind analyzed fields of the 12 hours prior to forecast initialization.

## WAM wave model

WAM wave generation model (WAMDI, 1988), version 4 (Günther et al., 1991), integrates the basic transport equation. This equation describes the evolution of a two-dimensional ocean wave spectrum without additional ad hoc assumptions regarding the spectral shape. The model was developed by a broad number of researchers from different institutions (WAMDI group), following 'Sea Wave Modeling Project' (SWAMP group, 1985) recommendations. One of the aims of the group was to develop an operational version of the model at the European Centre for Medium-Range Weather Forecasts (ECMWF). This was achieved in 1992 (Günther et al., 1992). In 1996 Puertos del Estado joined the group and has collaborated in different aspects of the work done (Carretero and Günther, 1992). The group final report was released in 1994 (Komen et al., 1994). Puertos del Estado developed and implemented a two-way nesting procedure in the model (Gómez Lahoz, Carretero Albiach, 1997) for the Spanish Coast. Using this system the equation is integrated in the same time step for all points. Since it is possible to define the spacing depending on the grid point location, it works as a variable spacing schema. The resolution is enhanced using intermediate grids, which are placed between the coarse and the fine grids.

The deep water WAM model is run for the Atlantic domains, therefore the shallow water effects are not performed. For the Mediterranean domain the shallow water version of the WAM model is used, therefore, refraction and attenuation effects are considered for those (few) grid points located in shallow waters. Nested to the Atlantic and Mediterranean domains, specific applications have been developed for the Cantabric Sea, the Gulf of Cadiz



and the Canary Islands.

The model produces the wave directional spectra for each grid point. Then, it is used to obtain further information, i.e.:  $H_s$ ,  $T_p$ ,  $T_m$ , mean direction, wind sea and swell components, etc.

### **Wave Wavewatch Model**

WAVEWATCH is a wave generation model especially developed for shallow waters and current interaction. It was developed by Hendrik L. Tolman from the Environmental Modeling Center, NOAA-NCEP.

WAVEWATCH solves the spectral action density balance equation by the integration of the basic energy transport equation. In this equation the source term has one term adding the wind energy contribution, a dissipation term and an energy spectrum components non-linear transfer term.

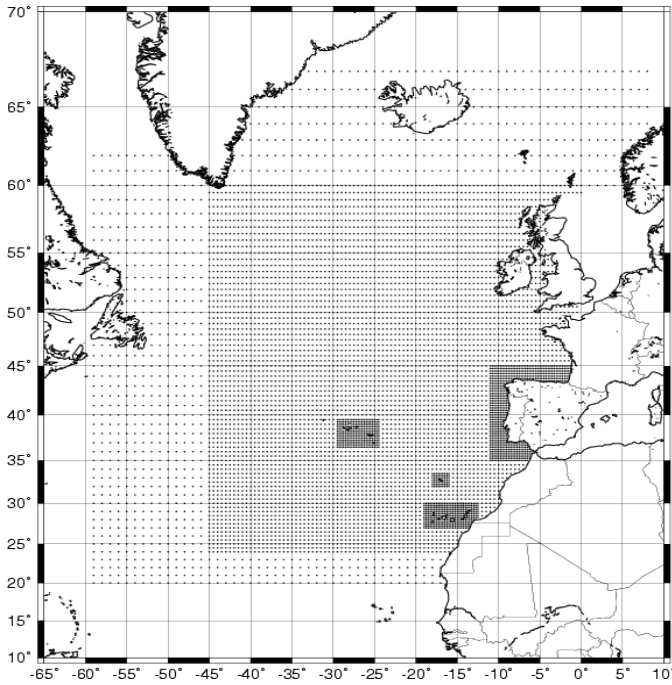
Puertos del Estado has developed a WAVEWATCH application for the Gibraltar Strait using WAM boundary conditions (Atlantic and Mediterranean applications). It is run twice-a-day as part of the operational forecast using the WAVEWATCH version 3.

### **Local Wave Forecasting System at the Harbour Authorities (SAPO)**

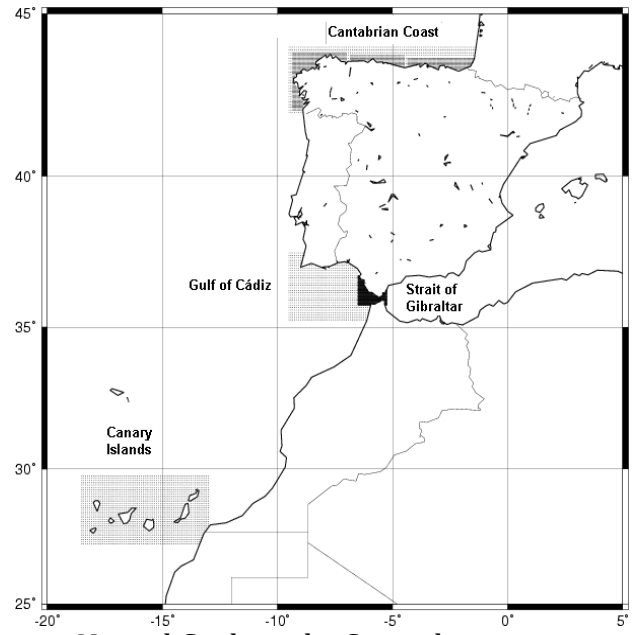
The local wave forecast system at the Harbour Authorities (**SAPO** System) is formed by 72-hour local-scale forecast systems developed specifically for the harbour and its nearest surroundings. The system is based on the SWAN model considering waves transformations when they get near to the coast. In some cases an agitation forecast module inside the harbour is included in the system.



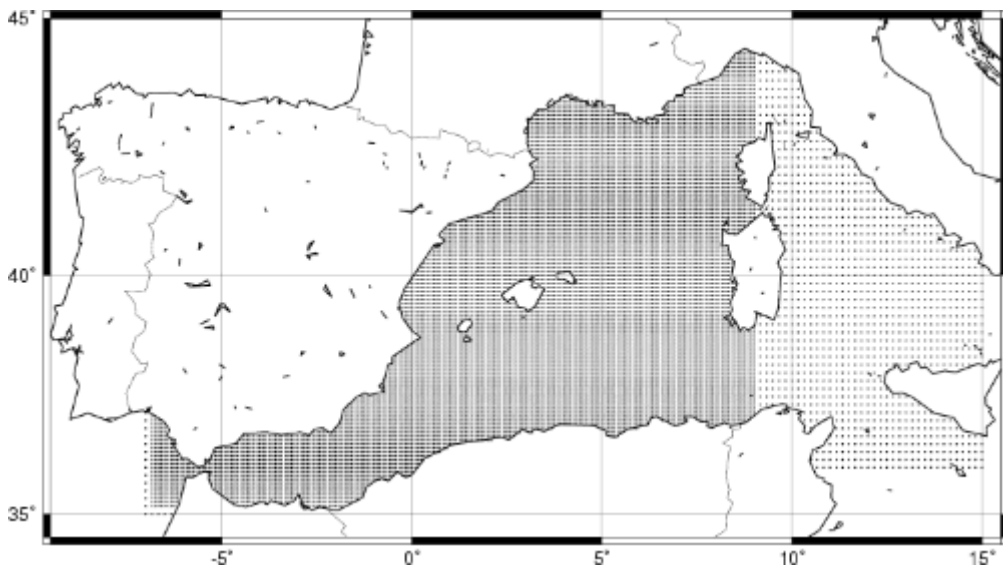
### WAM Domains



Atlantic WAM grids



Nested Grids in the Spanish waters



Mediterranean Grid