SEA STATE MODELLING

The **Sea State** is the description of the properties of the sea surface waves at a given time and place. This might be given in terms of the wave spectrum or more simply in terms of the significant wave height, wave direction, mean and peak period; these information can be obtained by means of numerical models. For this purpose the Hydro-Meteorological Service of the ARPA Emilia-Romagna, ARPA-SIM, uses the SWAN model operationally (www.arpa.emr.it/sim/?mare/).
ARPA-SIM Sea State numerical modelling is supported by the contribution of the National Civil Protection Department (www.protezionecivile.it).

SWAN (Simulating WAve Nearshore)

The SWAN model is a non-stationary third-generation phase-averaged wave model for the simulation of waves in waters of deep, intermediate and finite depth.

SWAN is supported by Rijkswaterstaat (as part of the Ministry of Transport, Public Works and Water Management, The Netherlands) and was developed at Delft University of Technology, Delft (the Netherlands) and where it is undergoing further enhancements. The SWAN model has been released under public domain.

The resolution and the bathymetry precision are of primary importance to achieve a really good estimation of the wave height in the coastal area and in the surf zone.

The advantage of using this model is related to the following functionalities:

- Wave propagation processes
  - propagation through geographic space,
  - refraction due to spatial variations in bottom and current,
  - shoaling due to spatial variations in bottom and current,
  - blocking and reflections by opposing currents,
  - transmission through, blockage by or reflection against obstacles.
- Wave generation and dissipation processes:
  - generation by wind,
  - dissipation by whitecapping,
  - dissipation by depth-induced wave breaking,
  - dissipation by bottom friction,
  - wave-wave interactions (quadruplets and triads)
- Nesting with WAM, WAVEWATCH III and SWAN itself.

The operative system characteristics

The model is driven by the speed and direction of the 10 m wind computed by the Italian implementation of the meteorological model COSMO.
The operative system is designed in three steps, the first one is a run over the Mediterranean Sea, with a 25 Km horizontal resolution (1/4°), that produces the boundaries conditions for the following run over the Italian domain, whose resolution is about 8 Km (1/12°) that is approximately equal to the meteorological model one (7 Km horizontal resolution). This run produces the hotstart files necessary

for the wave field set-up of the following run and the boundary conditions necessary for nesting run over the Emilia Romagna area with a computational resolution of about 800 m. This nesting technique allows to achieve good results in limited areas where a really high forecast accuracy is needed.

Technical specifications.

Italian scheme (SWAN-ITA).

- geographic domain: 6°-20° (longitude East), 34°-46° (latitude North);
- 10 m wind from COSMO-I7 as forcing;
- computational grid (regular): 1/12 of degree, about 8 Km;
- one forecast each day at 00 UTC. To warm-up the model the hotstart files from the previous run (or a stationary run if they are not available), in order to set-up the wind field, and 24 hours of wind analysis are used;
- forecast range: +72 hours with three-hourly output;
- outputs variables: significant wave height, mean direction, mean and peak period;

Scheme of nesting over the Emilia Romagna sea (SWAN-EMR).

- geographic domain: 12°-13° (longitude East), 43.8°-45° (latitude North);
- 10 m wind from COSMO-I7 as forcing;
- computational grid (regular): 1/120 of degree, about 800 m;
- one forecast each day at 00 UTC. To warm-up the model the hotstart files from the previous run (or a stationary run if they are not available), in order to set-up the wind field, and 24 hours of wind analysis are used;
- forecast range: +72 hours with hourly output;
- outputs variables: significant wave height, mean direction, mean and peak period;

For further information or data requests please contact: Andrea Valentini at ARPA-SIM.

To know more about the model visit the SWAN web site: http://fluidmechanics.tudelft.nl/swan/

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