IMDC

International Marine and Dredging Consultants (IMDC) is an engineering and consultancy company specialized in a vast range of water related projects. Our highly qualified staff offers advice based on recent research results of leading universities and research institutes and hands-on experience acquired throughout the years.

Wave modelling offshore-nearshore @ IMDC is presented in this product sheet.

More information can be found on our: www.imdc.be

# Wave modelling offshore-nearshore @ IMDC

Wave characteristics from global-scale wave models are readily available from online databases. These global models are appropriate for deep-water, but they do not include intermediate and shallow-water physics or the local bathymetry.

IMDC employs both SWAN and TOMAWAC to make the offshore to nearshore transformation of wave characteristics, considering limited depth physics and local bathymetry.

## Processes & Software

SWAN (Simulating WAves Nearshore) is a third-generation wave model allowing realistic estimates of wave parameters in coastal areas, lakes and estuaries from given wind, bottom and current conditions. The model is based on the wave action balance equation with sources and sinks. The SWAN model has been developed by the University of Delft in the Netherlands (Delft University of Technology, 2014).

SWAN computations can be made on a regular, a curve-linear grid and a triangular mesh in a Cartesian or spherical co-ordinate system. Nested models can also be made with SWAN.

**SWAN** accounts for the following physics:

- Wave propagation in time and space, shoaling, refraction due to current and depth, frequency shifting due to currents and non-stationary depth;
- Wave generation by wind;
- Three- and four-wave interactions;
- White capping, bottom friction and depth-induced breaking;
- Wave-induced set-up;
- Transmission through and reflection (specular and diffuse) against obstacles;
- A module for diffraction approximation.

TOMAWAC (TELEMAC-based Operational Model Addressing Wave Action Computation) is a practical/scientific software which models the changes, both in the time and in the spatial domain, of the power spectrum of wind-driven waves and wave agitation for applications in the oceanic domain, in the intracontinental seas as well as in the coastal zone. The model uses the finite elements formalism for discretizing the sea domain; it is based on the computational subroutines of the TELEMAC system as developed by the EDF R&D's Laboratoire National d'Hydraulique et Environnement (LNHE) (HR Wallingford, 2015).

**TOMAWAC** accounts for the following physics:

- Wind-generated waves;
- Refraction on the sea bed;
- Refraction by currents;
- Dissipation through bathymetric wave breaking;
- Dissipation through counter-current wave breaking.

Both SWAN and TOMAWAC provide spectral output as well as integrated wave characteristics and other environmental characteristics. Other characteristics associated with waves are derived in the postprocessing, such as for example: the long-term average wave power as shown in figure 'Wave Atlas Turkey'.

## Products

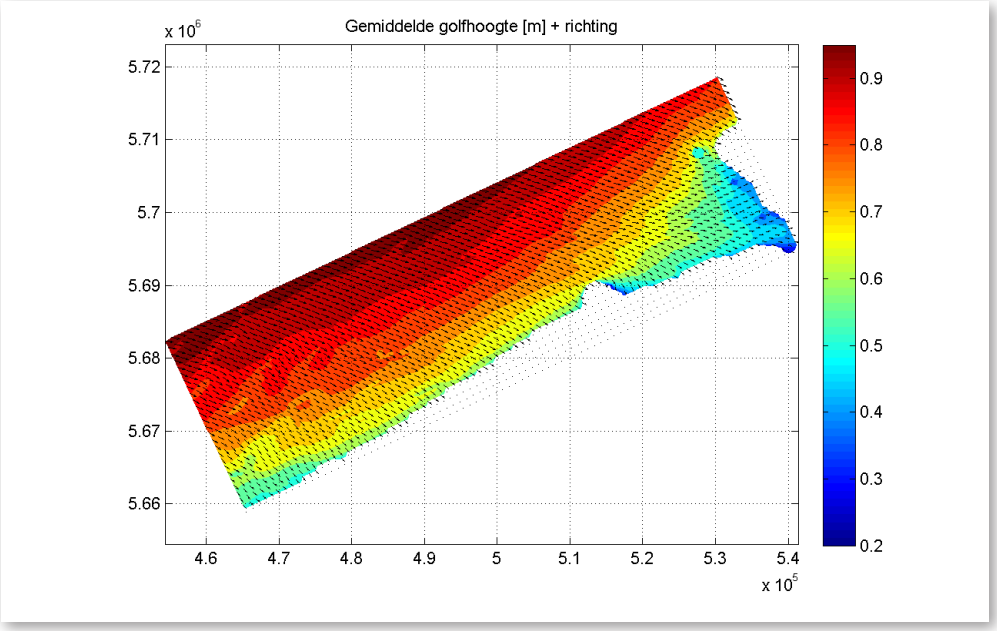
In general, wave transformation from offshore to nearshore are carried out to perform, among others, the following tasks:

- Determination of the wave climate
- Determination of design conditions
- Determination of workability/operability
- Wave energy yield
- Input for further modelling :
  - Morphodynamic modelling
  - Coastal modelling (ex. XBeach)
  - Port modelling (ex. Artemis)
- Input for empirical formula's such as breakwater dimensioning, …
- In conjunction with hydrodynamic modelling (ex. Telemac Suite)

## Applications and Clients

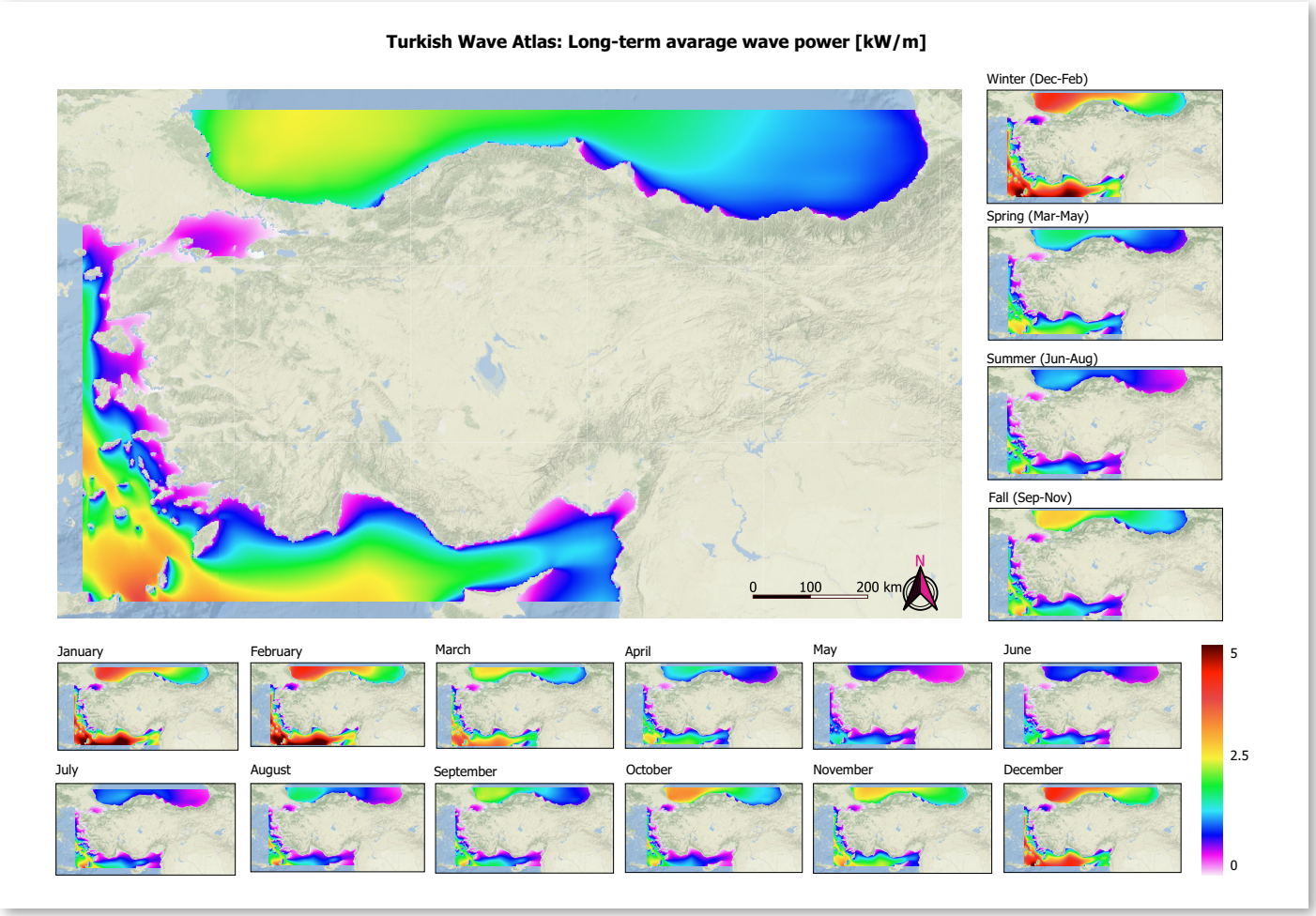
The model results are applied in the fields of

- **Offshore renewables** (wave energy yield atlas, design conditions, marine scour protection)
- **Shore protection** (dunes, breakwaters)
- **Dredging & reclamation** (workability, design conditions)




## EXAMPLES OF MODELS

Mean wave height and direction on the Belgian Continental Shelf. (SWAN + postprocessing)




Wave Atlas Turkey. (SWAN + postprocessing)