Wave Modeling

Waves are one of the main types of horizontal water movements in seas and oceans. The scale of potential wave generation is truly impressive, as the area of their propagation covers about 71 % of the Earth's surface. Waves are formed under the influence of various factors: the effect of wind, tectonic activity, atmospheric pressure fluctuations, and tides. Waves can have different spatiotemporal scales and can increase or decrease due to mutual superposition (wave interference mechanism).

Waves have the strongest impact on human activities at the sea and cause the greatest amount of material damage and loss of the human life on the water. Wind waves are predominant on the sea and ocean surface and, together with other factors, pose a potential threat to the sectors of the economy, coastal infrastructure, safety and efficiency of navigation, navy, transport and fishing fleets, as well as mining in the shelf zone.

The reliable and accurate forecast of various wave parameters (from generation to destruction) is required for the efficient and safe offshore operations, taking into account the influence of wind, currents, and topography (bathymetry) of the basin at different spatio-temporal scales.
MicroStep-MIS provides the wave forecasting services for the various sectors of the economy anywhere in the world, using modern scientific achievements in the field of marine modeling. The multifunctional platform includes a system for monitoring and predicting wave characteristics (taking into account the wind effects, the influence of sea currents and bottom topography), which makes it possible to obtain realistic estimates of wave parameters in the oceans and seas, in coastal areas, lakes and estuaries. The core of the forecasting system is the SWAN (Simulating WAves Nearshore) wave model.

Flexible and universal algorithms are used for adapting the model to any region, with the grid step varying from several kilometers to hundreds of meters and the time step from minutes to seconds. A prognostic system of the wave propagation can be built both on regular (rectilinear or curvilinear) and unstructured (triangular) grids, as well as on a grid combined into multi-grid mosaics (a set of grids on one grid). The model takes into account the effects that lead to the growth and decay of waves, the effects of the interaction of waves with the bottom, coast, ice and impurities, the deformation of the wave field when interacting with ocean currents, etc.

The SWAN model predicts the fields of the 4-wave modes output characteristics:

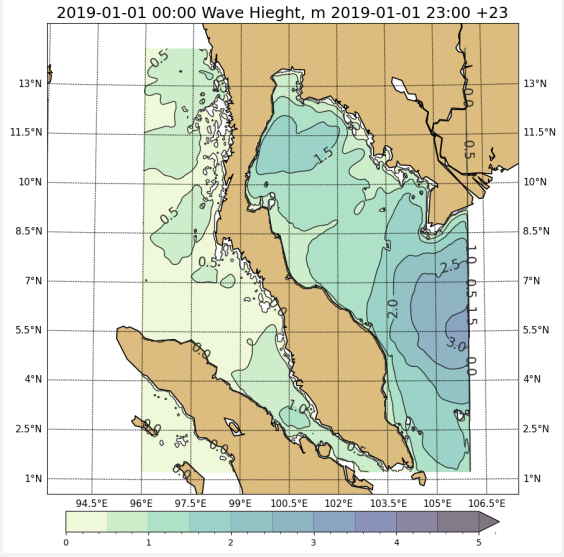
- wind (wave generation by wind)

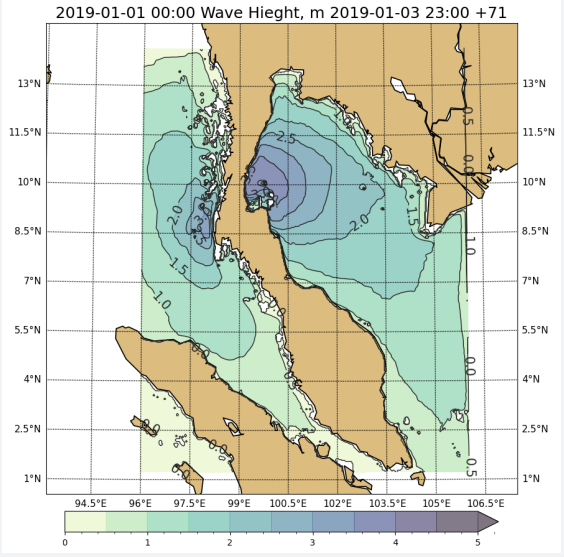
- primary and secondary swell (attenuation of wind waves)
- total wave state of the sea

The model allows to obtain a wide range of wave characteristics, which include:

- significant height
- period
- direction
- steepness
- length, etc.

Due to the possibility of the deep integration with other MicroStep-MIS products, in particular IMS4 CLDB, the numerical prediction system is able to assimilate the local measuring network data, which further improves the quality of monitoring and forecasts. In addition, in the IMS4 Maps module all forecasts and actual data can be visualized in a user-friendly way. To view, analyze and animate different levels of data, the module implements online display of maps on a dynamic background with a set of functions.





Tropical storm Pabuk, Malay Peninsula (2019) - track of the storm (above), wave height during the storm (below)