



## **Towards the best approach for wind wave modelling in the Red Sea**

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While wind and wave modelling is nowadays quite satisfactory in the open oceans, problems are still present in the enclosed seas. In general, the smaller the basin, the poorer the models perform, especially if the basin is surrounded by a complex orography. The Red Sea is an extreme example in this respect, especially because of its long and narrow shape. This deceptively simple domain offers very interesting challenges for wind and wave modeling, not easily, if ever, found elsewhere. Depending on the season, opposite wind regimes, one directed to southeast, the other one to northwest, are present and may coexist in the most northerly and southerly parts of the Red Sea. Where the two regimes meet, the wave spectra can be rather complicated and, crucially dependent on small details of the driving wind fields.

We explored how well we could reproduce the general and unusual wind and wave patterns of the Red Sea using different meteorological products. Best results were obtained using two rather opposite approaches: the high-resolution Weather Research Forecasting (WRF) regional model and the slightly enhanced surface winds from the global European Centre for Medium-Range Weather Forecasts (ECMWF) model. We discuss the reasons why these two approaches produce the best results and the implications on wave modeling in the Red Sea. The unusual wind and wave patterns in the Red Sea suggest that the currently available wave model source functions may not properly represent the evolution of local fields. However, within limits, the WAVEWATCH III wave model, based on Janssen's and also Ardhuin's wave model physics, provides in many cases very reasonable results. Because surface winds lead to important uncertainties in wave simulation, we also discuss the impact of data assimilation for simulating the most accurate winds, and consequently waves, over the Red Sea.