Dynamical Downscaling of Wind Surface Forcing with Application to the Wave Potential Estimation in the Aegean Sea

Georgios V. Kozyrakis (1), Katerina Spanoudaki (1) and Emmanouil A. Varouchakis (2)

(1) Foundation for Research and Technology – Hellas (FORTH), Coastal & Marine Research Laboratory (CMRL), Institute of Applied and Computational Mathematics (IACM), Greece, (2) School of Environmental Engineering, Technical University of Crete, Chania 73100, Greece

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Scope

- Using dynamical downscaling methodology, a nesting technique with 1/3 ratio is applied to downscale the raw ERA5 input wind data to a finer 3 x 3 Km results grid.

- This way, higher computational accuracy is achieved over the investigated regions, thus revealing finer wind scales phenomena.

- The current study aims at the estimation of the Significant Wave Height and corresponding Period for regions in the Aegean Sea by the use of numerical wave modelling as well as spatial statistical methods.

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Methodology

- Two different models have been used in order to generate meteo-climate parameters suitable for sea-wave results calculation:

a) A dynamical downscaling model (at regional scale), and a wave model. The first model performs the downscaling of the meteorological data in higher resolution grids for a wide area of the Aegean and Ionian Sea.

b) The produced fine grid output drives the later wave model in order to estimate the significant wave height and period over the areas of interest.

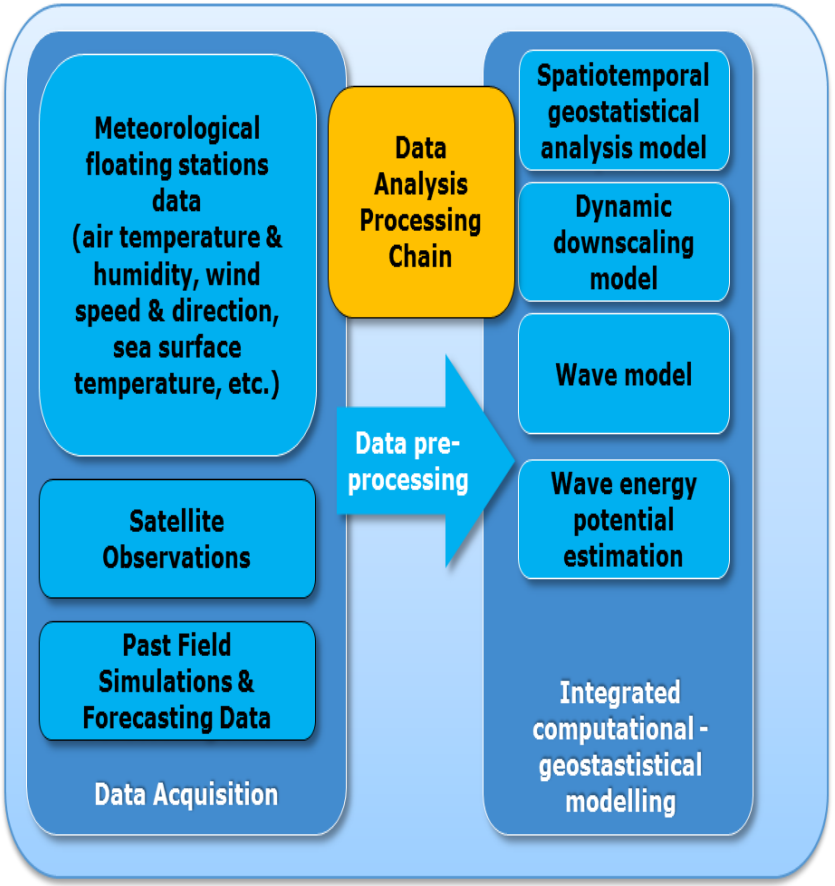

Fig. 1: Data Analysis and Processing Chain

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Results

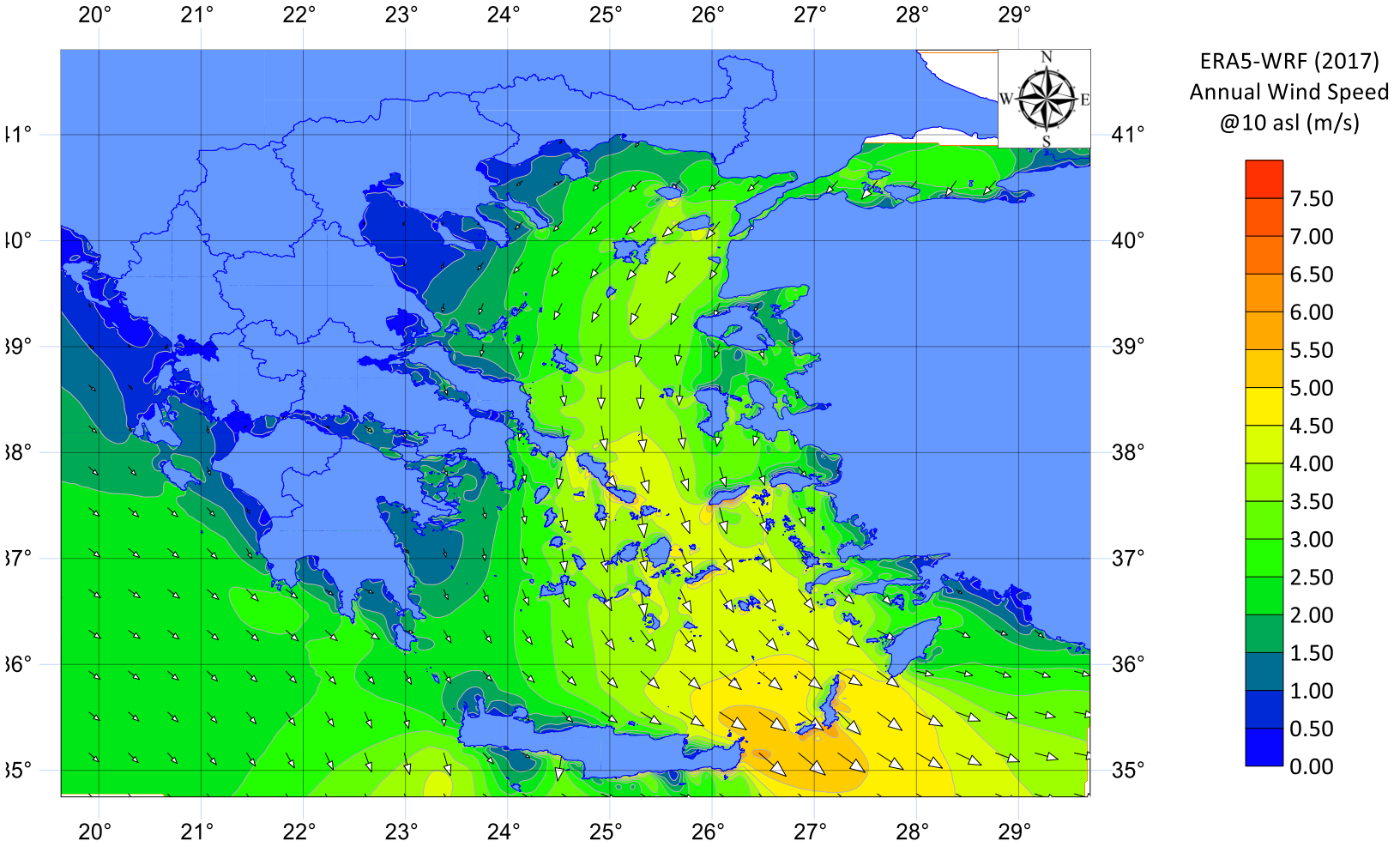

Fig. 2: Mean Annual (2017) Wind speed Distribution over sea surface and Wind Direction at 10m.a.s.l.

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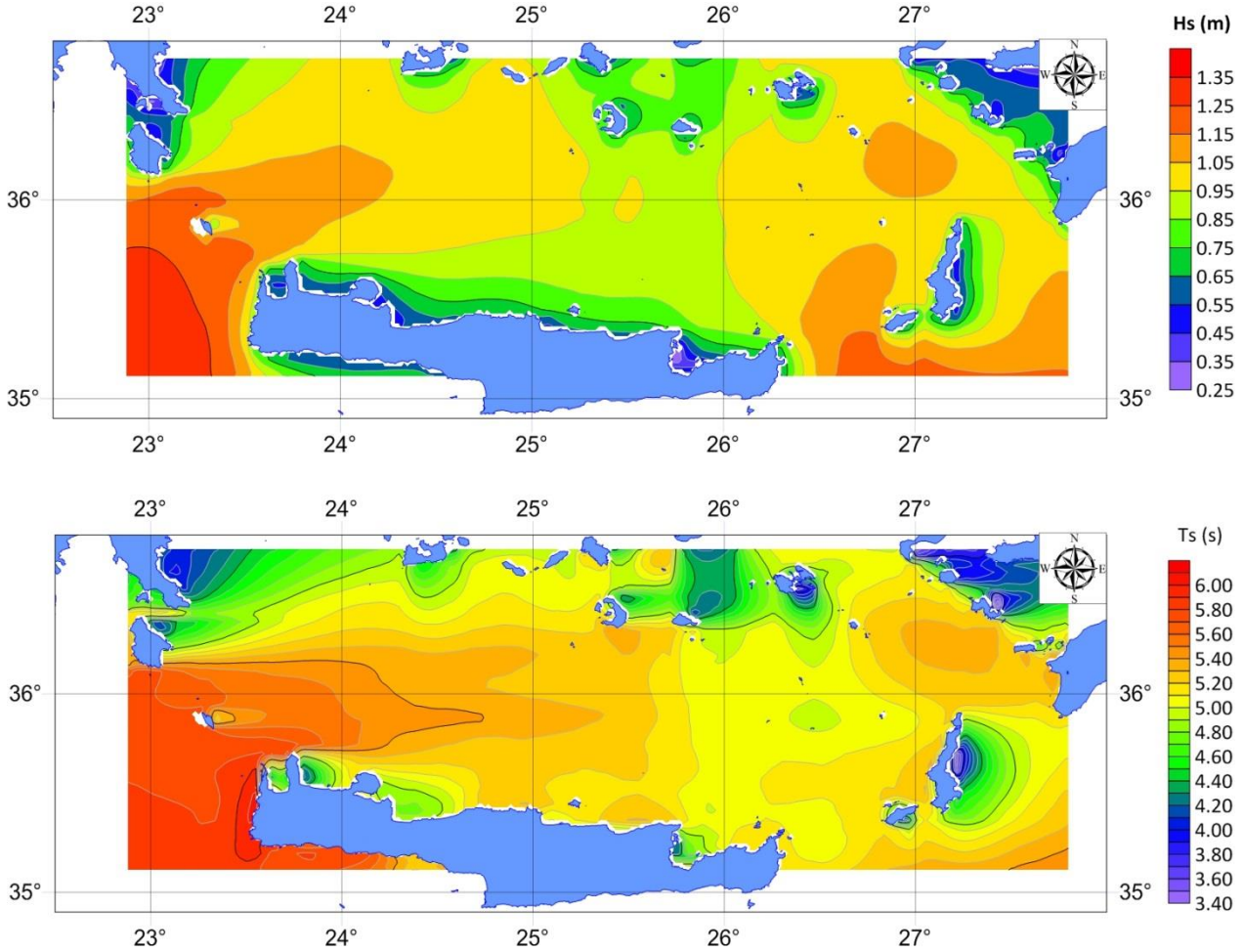

Fig. 3: Mean Annual (2017) Wave Height (top) and Wave Period (bottom) distribution close-up views.

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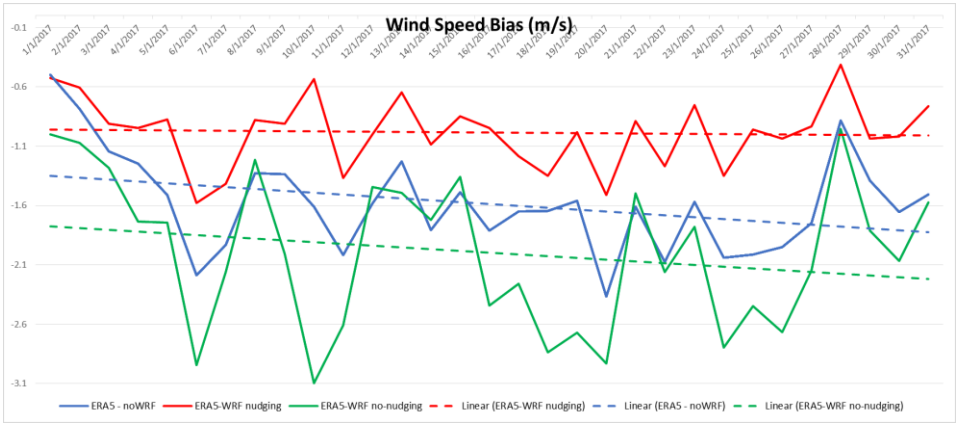
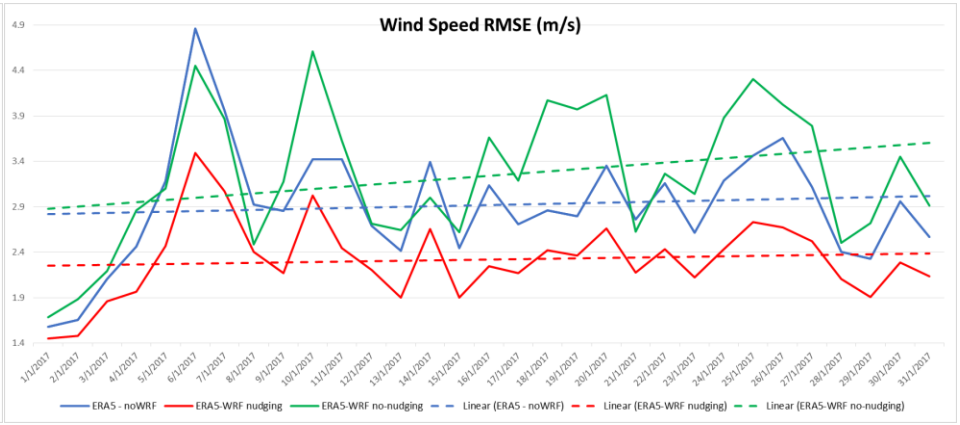
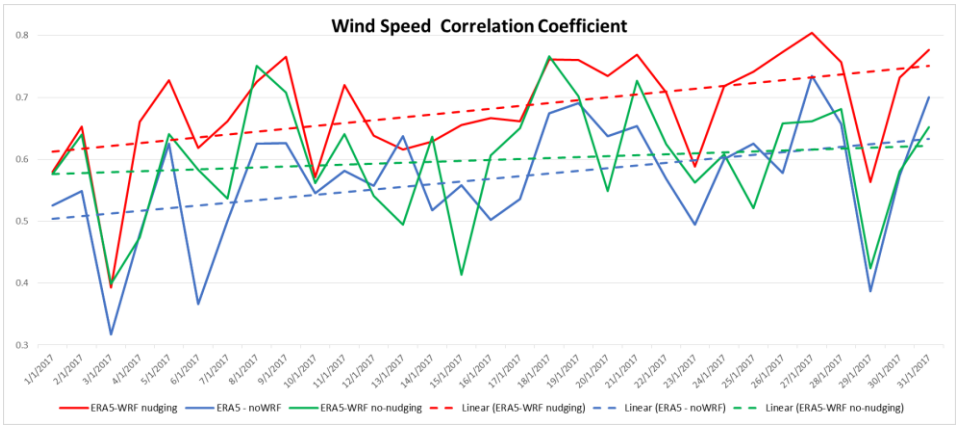
Validation

Results were validated based on 26 near-coast stations(1) (elevation ≤ 15m.asl) surrounding the Aegean and Ionian Sea.







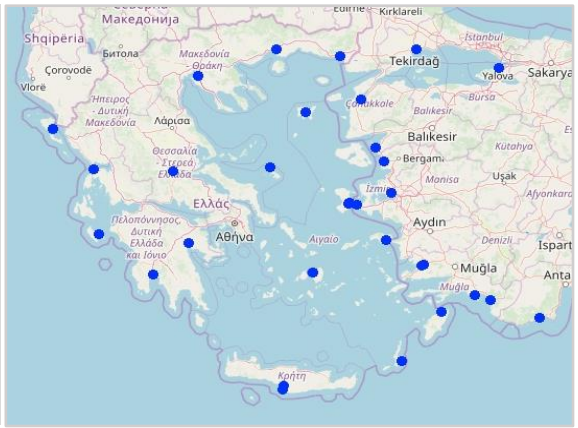


Fig. 4: Result validation for a one month period based on the NOAA ISD/ISH METAR near-Coast Stations for the Area of Interest (1)

1. NOAA National Centers for Environmental Information (2001): Global Surface Hourly [indicate subset used]. NOAA National Centers for Environmental Information. [2016-2017].

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Discussion - Synopsis

- Using ERA5 data as input for the WRF model we obtained fairly good results for the wind distribution during the reference period (2017).
- The results were compared to the NOAA ISD/ISH METAR near-Coast stations, effectively showing that using grid-nudging improves the values of the correlation coefficient. Increased wind-speed Bias and RMSE values are expected and well documented in the literature (timing errors in synchronization, etc.), (Mass et al. 2002), (Lorenz, Barstad 2016).
- The current validating system will support the downscaling methodology, by providing in an efficient way, reliable and quality controlled forecasting data.
- The yearly wind and wave results are in good agreement with those provided in relevant bibliography for the surrounding region (Soukissian, et al. 2007).

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