WaveExtremesDT – high resolution forecasts of wave and vessel icing conditions

Aleksi Nummelin[1], Konstantinos Christakos[2], Juha-Pekka Puska[1], Niko Sokka[1], Eirik Samuelsen[2], Øyvind Breivik[2], Lauri Uusi-Hakala[1]

1. Finnish Meteorological Institute (FMI) 2. Norwegian Meteorological Institute (MET Norway)

Introduction

The green transition and the recent changes in Europe's geopolitical situation are pushing the energy infrastructure to high latitudes and offshore. One of the prime examples of such an area is the Barents Sea, where the energy sector (oil & gas, offshore wind) is currently expanding to. This region is also actively used by fisheries and aquaculture. However, the year round operations in the region are being challenged by harsh climate, and especially the combination of cold temperatures, strong winds, and possible sea ice cover. In extreme events, such as those created by cold air outbreaks and polar lows, the region suffers from high seas and dangerous vessel icing.

The WaveExtremes Digital Twin (DT), produced by the Finnish Meteorological Institute (FMI) and the Norwegian Meteorological Institute (MET Norway provides short term forecasts of the extreme wave and vessel icing conditions in the Barents Sea to support the operations of our key users (Equinor). Currently existing models are still too coarse to provide them with the best possible decision making support. Data streams available from the DestinE platform lack key variables that are important for maritime operations (no high resolution wave data).

Figure 1. FMI's marine service warnings for the Baltic Sea on Jan 3rd 2019, including warnings for 'potentially dangerous ship icing' for the Gulf of Finland

The WaveExtremes DT supports the EU Mission on Adaptation to Climate Change by building tools for maritime safety that can help both local communities as well as large corporations to operate safely in harsh environments. As such, it builds pathways to be better prepared for climate change and the extreme events it brings with it, delivering stakeholders weather information with life saving potential. By building tools that enhance maritime safety and help avoid maritime accidents, we also contribute to the EU Mission "Restore our Ocean and Waters".

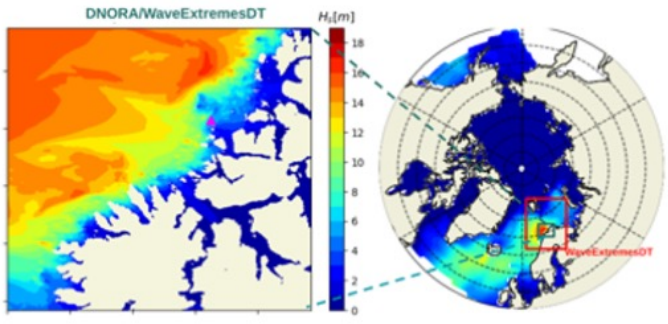

Figure 2: Dynamical downscaling of WaveExtremesDT (red) to a high-resolution (200 m) offshore Tromsø (blue) using the open-source tool DNORA.

Methods

The WaveExtremes DT will go beyond the state-of-the-art using a 1 km resolution wave model setup that utilises the Extremes DT global component waves as boundary conditions and the wind forcing from Extremes DT global or on-demand component as the wind forcing. WaveExtremes DT will provide a daily <1 km resolution wave and ship icing forecast for the Barents Sea region where our key stakeholders operate. However, the system we produce could be easily deployed to other regions.

The workflow is presented in Figure 3. and the more detailed setup of the wave data downscaling in Figure 4. The ExtremesDT data is downloaded using the Polytope API. Wave data is downscaled using the DNORA package [1]. Ship icing is computed with the MINCOG model [2].

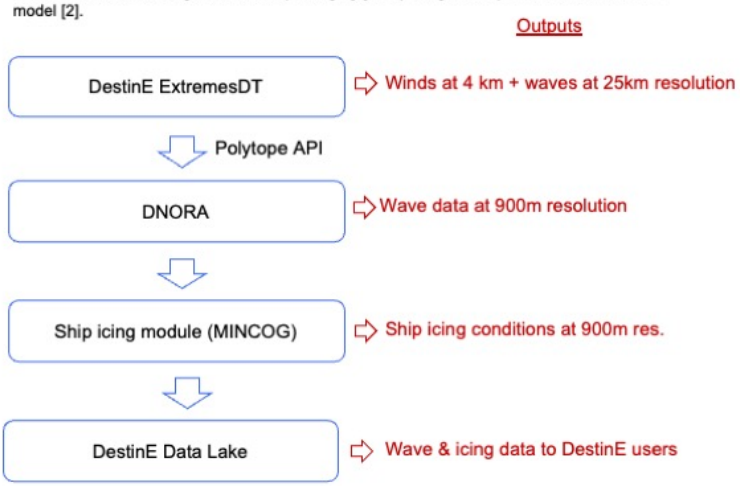

Figure 3: Workflow for the WaveExtremesDT.

Challenges

The data API exposes only a limited amount of wave variables, which limits accuracy of the wave model. Making the wave-spectra available would give better accuracy for downscaling. Also the API currently does not support extraction by area for wave data which increases data transfer.

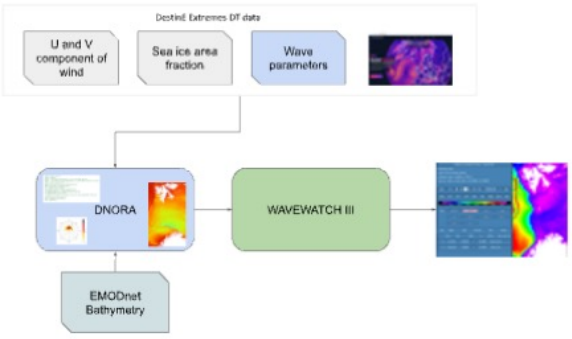

Figure 4: Diagram of the components of the wavemodel setup.

Acknowledgments

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References

1. https://github.com/MET-OM/dnora
2. Samuelsen, E. M., Edvardsen, K., & Graversen, R. G. (2017). Modelled and observed sea-spray icing in Arctic-Norwegian waters. *Cold Regions Science and Technology*, *134*, 54-81.

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