REQUEST FOR A SPECIAL PROJECT 2020–2022

MEMBER STATE: ITALY

Principal Investigator[1]: Luciana BERTOTTI

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Project Title: Underestimate of modelled offshore blowing winds

If this is a continuation of an existing project, please state the computer project account assigned previously.	**SP** __ITWM	
Starting year: (A project can have a duration of up to 3 years, agreed at the beginning of the project.)	2020	
Would you accept support for 1 year only, if necessary?	YES ☒	NO ☐

Computer resources required for 2020-2022: (To make changes to an existing project please submit an amended version of the original form.)		**2020**	**2021**	**2022**
High Performance Computing Facility	(SBU)	600000	600000	600000
Accumulated data storage (total archive volume)[2]	(GB)	200	200	200

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1 The Principal Investigator will act as contact person for this Special Project and, in particular, will be asked to register the project, provide annual progress reports of the project's activities, etc.

[2] If e.g. you archive x GB in year one and y GB in year two and don't delete anything you need to request x + y GB for the second project year etc.

Extended abstract

The completed form should be submitted/uploaded at https://www.ecmwf.int/en/research/special-projects/special-project-application/special-project-request-submission.

All Special Project requests should provide an abstract/project description including a scientific plan, a justification of the computer resources requested and the technical characteristics of the code to be used.

Following submission by the relevant Member State the Special Project requests will be published on the ECMWF website and evaluated by ECMWF as well as the Scientific and Technical Advisory Committees. The evaluation of the requests is based on the following criteria: Relevance to ECMWF's objectives, scientific and technical quality, disciplinary relevance, and justification of the resources requested. Previous Special Project reports and the use of ECMWF software and data infrastructure will also be considered in the evaluation process.

Requests asking for 1,000,000 SBUs or more should be more detailed (3-5 pages). Large requests asking for 10,000,000 SBUs or more will receive a detailed review by members of the Scientific Advisory Committee.

1 – The underestimate of the modelled surface wind speed when blowing from land to sea

Luciana Bertotti (L.B.) and Luigi Cavaleri (L.C.) came across this problem when they started using the ECMWF surface (U10) wind fields to model wind waves in the Adriatic Sea (East of Italy, South-East to North-West direction, 750 km long, 150-200 km wide). It was soon clear, also by the wave model results, but mainly by direct comparison with wind measured data (from both scatterometers and the ISMAR oceanographic tower, 15 km offshore the coastline of the Venice lagoon), that the U10 values, correct in direction, were substantially underestimated. In the years, with the increasing resolution of the ECMWF model, it became also clear that 1) the required correction decreased with increasing resolution, 2) it depended on the fetch, i.e. on the path length of the wind over the sea. In the case of the elongated Adriatic Sea the across wind (typically from the North-East, i.e. bora) requires a much stronger correction than for the along-the-basin wind (sirocco, from South-East to North-West). At the present Tco1279 (9 km) resolution the bora correction factor is close to 1.20, while 1.11 for the case of sirocco.

A more extended study published in 2004 (Cavaleri and Bertotti, Tellus, 'Accuracy of the modelled wind and wave fields in enclosed seas') extended the study (although in a non-direction specific manner) to the whole Mediterranean Sea. The underestimate decreases (i.e. the results improve) moving from the north to the south part of the basin. This has been interpreted as due to the dominant North to South direction of the dominant winds. Interesting enough, a slightly underestimated (on the mean) area is the one on the Mediterranean coast of Morocco, probably associated to the local Atlas range.

The final piece of information is the one obtained evaluating the average ratio U10/Uscat as a function of the « fetch », the back-traced path length of the air particle from the coast. The decrease of the derived wave height underestimate with the « fetch » is unmistakable. See Figure 1.

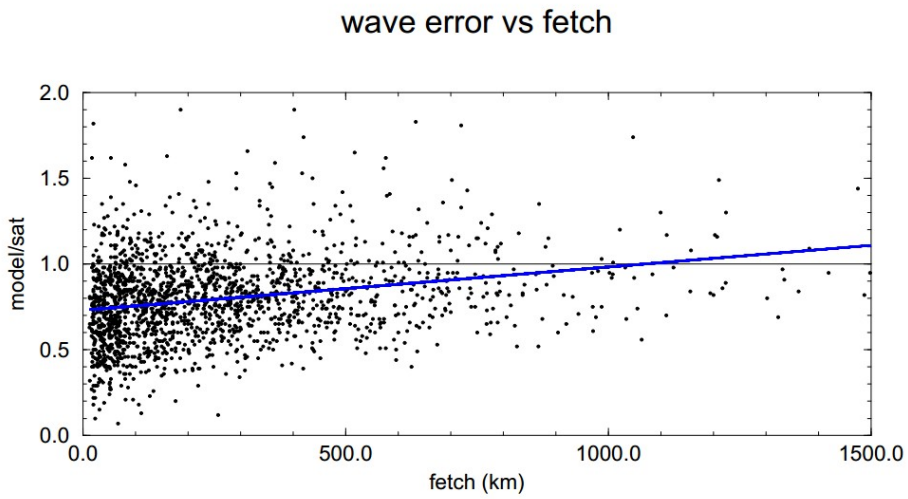

Figure 1 – Modelled/measured wave height ratios according to ‘fetch’ (from Cavaleri and Bertotti, 2004).

Apart from the present correction (enhancement) adopted for the Adriatic Sea (sea above), all the other results are quite old and not up to the level with the present physics and resolution of the meteorological models. It is therefore necessary to revisit the problem with the double purpose of a) assessing the situation, b) from the a)-derived results and some devoted experiments determine the reasons of the underestimate and look for possible solutions-improvements. The planned actions are detailed in the next Section.

Section 2 – Assessment of the situation and actions to be taken

a) Assessment of the situation

The first action is to fully frame the present situation, i.e. to make an extended comparison of U10 model values versus measured data, the latter in practice for the most part scatterometer data. The ratio U10/Uscat is to be explored as a function of the « fetch » previously defined. The orography of the inland area must be available, as also air and sea temperature for the possible influence of air-sea stability conditions. The resolution of the model is a crucial piece of information. Therefore different resolutions need to be considered. In this respect we can explore complementary model results.

b) Actions to be taken

Areas – Two areas of interest have been identified : the Mediterranean Sea and the North Sea, with particular attention to its southern part, off East Anglia. The former offers suitable data for all the possible geographical conditions, i.e. strong orography for most of its northerly side, flat land for large part of its southern border. The latter (off East Anglia) is an ideal area where to explore the U10 underestimate off a strongly flat land with frequent winds from the « right » direction (for our present purposes).

Periods – The attention will be focused on the last three months (October, November, December) of 2018.

Fields – U10 fields (two components) at 0.1 deg resolution need to be made available for the specified areas, plus air and sea temperature. Forecast fields will be used in the, twice a day (00 and 12 forecasts), +12 - +23 hr range. This is to make comparison with measured data meaningful. Monthly files (to be specified with specific examples) will be used, going from day 1 (00 UTC field, i.e. the 12 hr forecast of the day before 12 forecast) till the last day of the month at 23 UTC (hence the 23 hr forecast of the same day 00 forecast). This is to make comparison with measured data meaningful.

Resolutions – Being this one of the factors determining the problem, different resolutions are to be used (explored). Therefore the mentioned fields need to be made available (with the specified 0.1 deg resolution) for the following original model resolutions: operational (9 km), ensemble (control run, 18 km), ERA-5 (25 km – for this one the forecast fields are available in the +7 - +18 hr forecast range).

The above actions will provide a general idea of the situation. More in detail, it will provide information about in which area, in practice if montainous or flat, the underestimate is more manifest. Once this has been defined, specific cases are to be identified to be explored in detail and with subsequent devoted experiments.

References

Cavaleri, L., and L.Bertotti, 2004. Accuracy of the modelled wind and wave fields in enclosed seas, Tellus, 56A, pp.167-175.