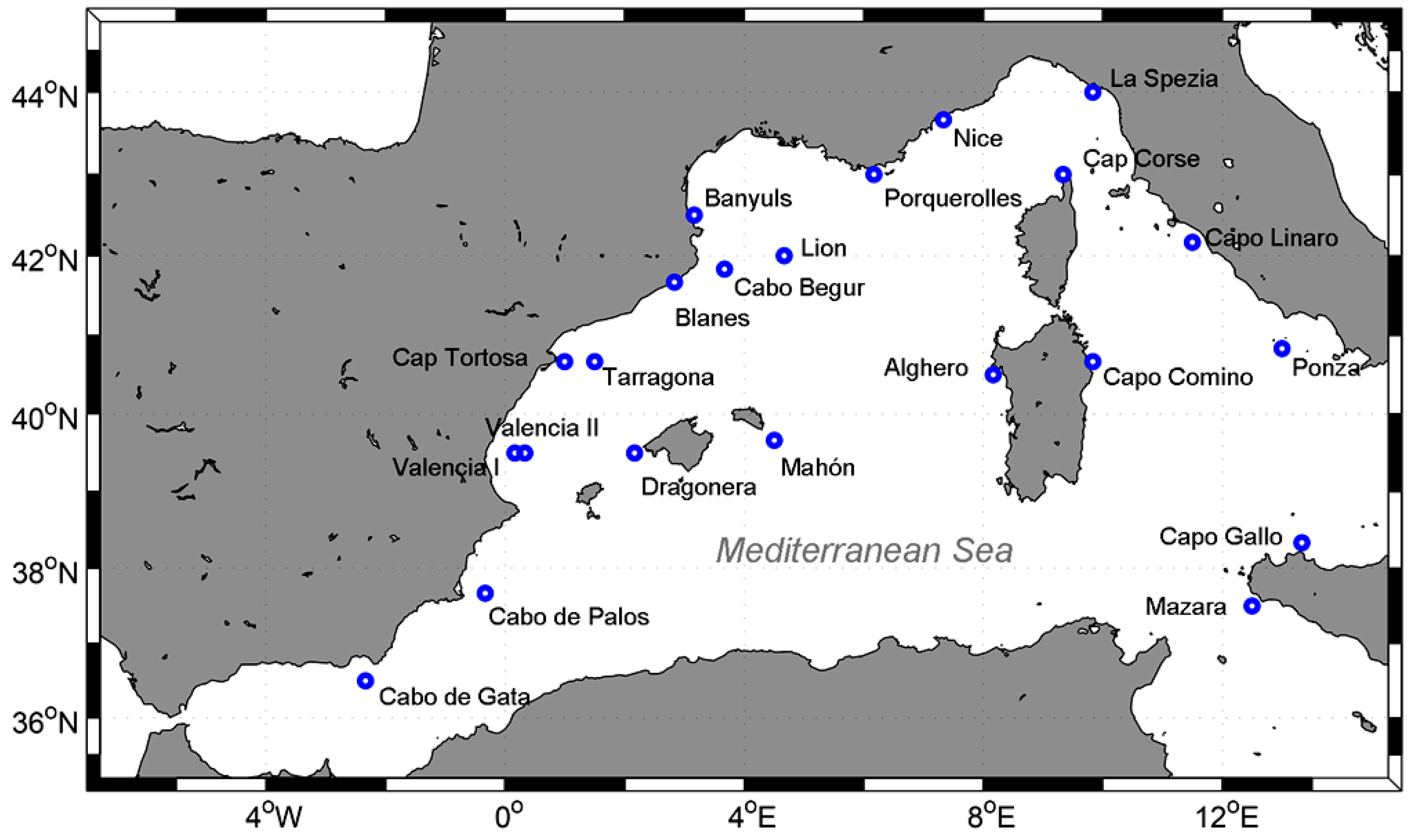
Calibration of a wind-wave hindcast in the Western Mediterranean

Adrian Martínez-Asensio, Marta Marcos, Gabriel Jordà, Damià Gomis and Marta Gómez
adrian.martinez@uib.es

IMEDEA · CSIC · Universitat de les Illes Balears · Puertos del Estado

Significant wave height (SWH) from an updated wind wave hindcast spanning the period 1958-2008 and covering the western basin of the Mediterranean Sea (Jordà et al 2012) is calibrated using buoy observations with the aim of improving the characterization of the wave climate over the region. The methodology is based on a **spatial calibration** of the statistical distribution of SWH performed through a non-linear transformation of the Empirical Orthogonal Functions of the modelled data that minimize the differences with observations. This allows the calibration to be implemented not only at buoy locations, but all over the model domain. The resulting fields have been validated against satellite observations showing an overall improvement in the bias and rms error.



Location of the buoys used for the calibration of the Western Mediterranean wind wave hindcast.

SPATIAL CALIBRATION

SWH fields from both buoy observations and model were monthly aggreated and fitted to a log-normal distribution for each calendar month τ:

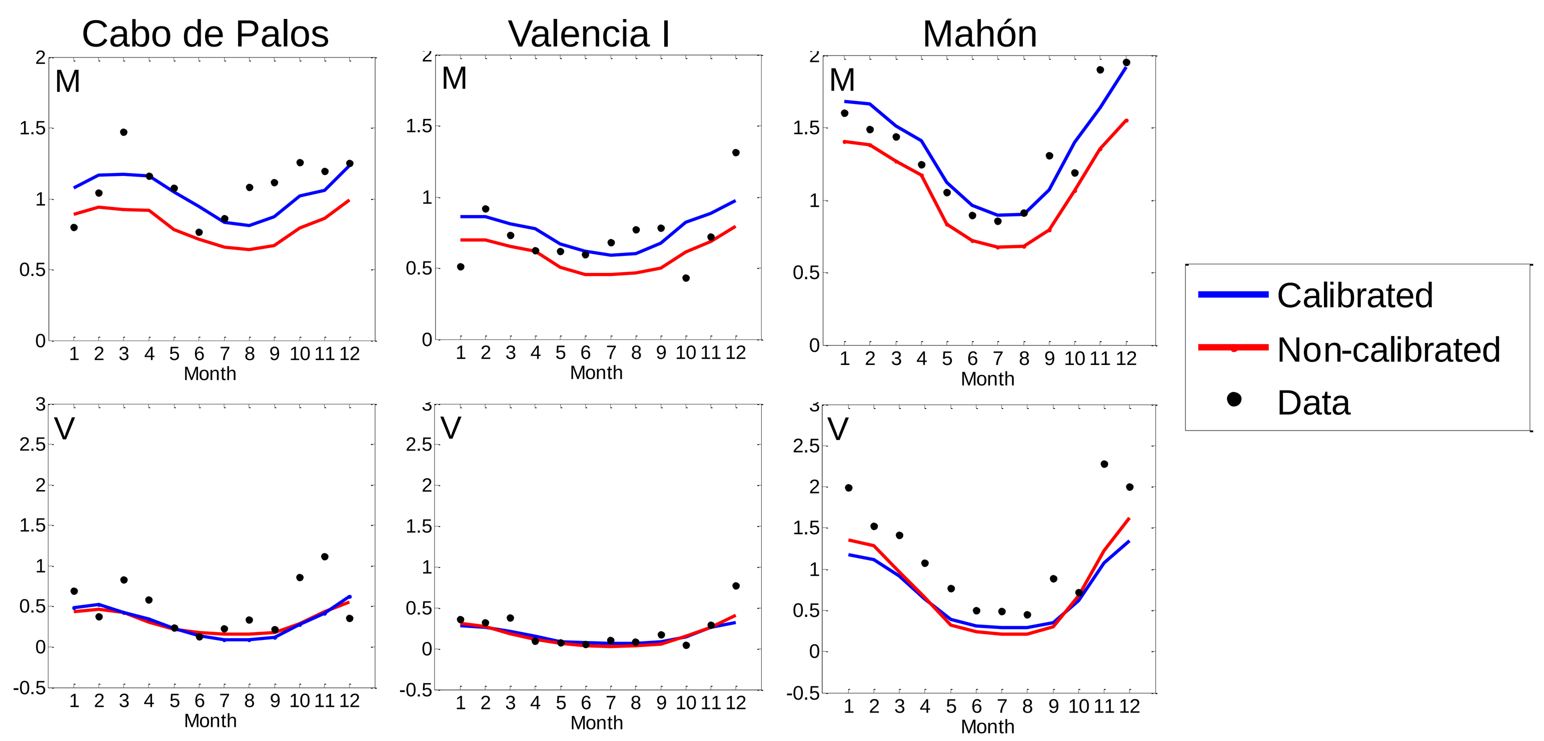
$$f(SWH) = \frac{1}{SWH\sigma\sqrt{2\pi}} \exp\left(\frac{-(\ln H_s - \mu)^2}{2\sigma^2}\right)$$

The parameters of the distribution were transformed into mean (**M**) and variance (**V**) fields as:

$$M(x,\tau) = e^{(\mu+\sigma^2/2)}$$

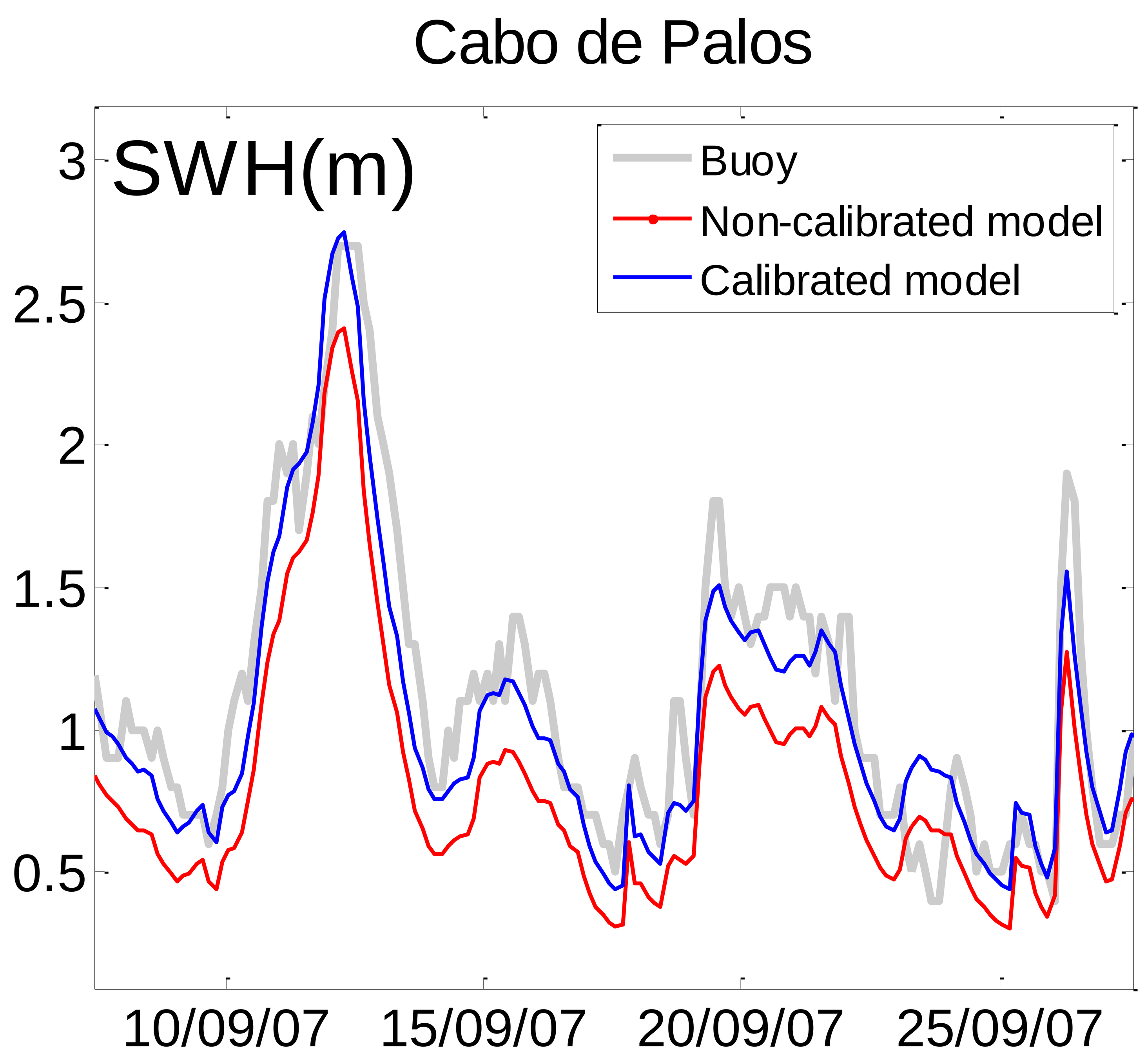
$$V(x,\tau) = e^{(2\mu+\sigma^2)}(e^{(\sigma^2)} - 1)$$

Both M and V fields were decomposed in EOFs. A transformation based on a linear and potential parameterization of the EOFs that best fits the observed parameters at the buoy locations was selected as the calibration of the modelled data (Tomás et al., 2008). The major advantage of the method is that it allows a calibration over the whole domain using time series observed at a limited number of points. Examples of the fit of the parametes are shown below for 3 buoys.

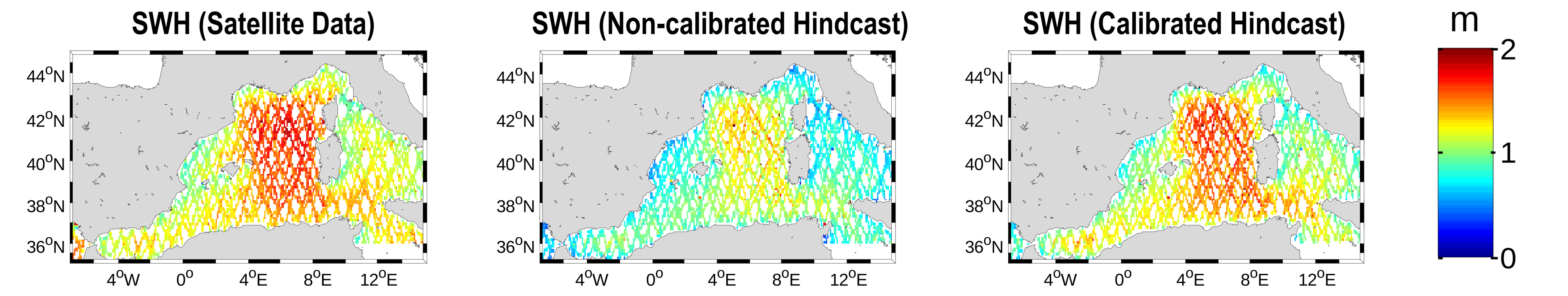


RESULTS

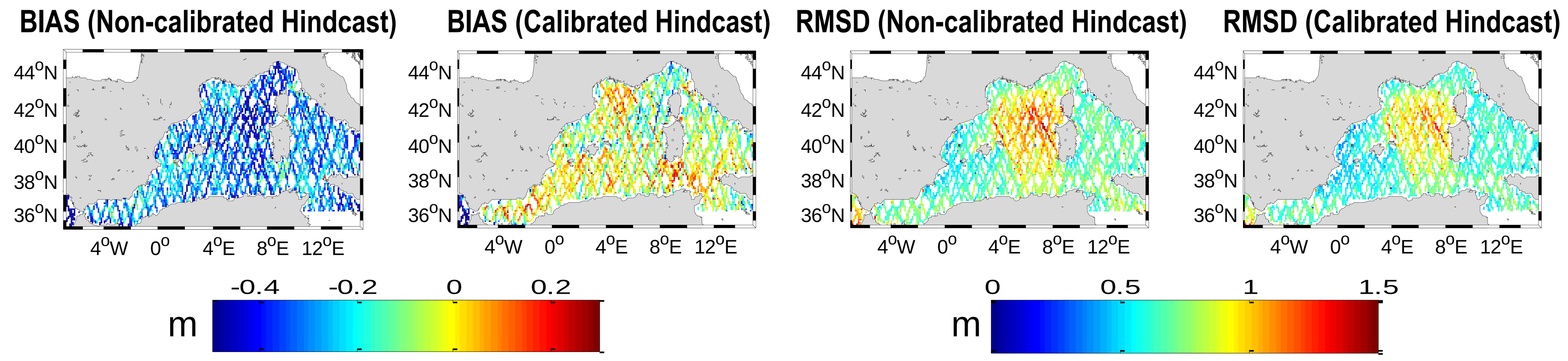
All the available buoy records in the region were used in the calibration, as it was found that increasing the number of observations generally improves the performance of the calibration. The overall improvement resulting from the calibration process is illustrated for the buoy of Cabo de Palos (below). The better agreement between the calibrated SWH and observations is well aparent for the whole period.



VALIDATION WITH ALTIMETRY



Modelled SWH data is compared with satellite altimetry observations (from T/P, ERS-1, ERS-2, GFO, ENVISAT, JASON-1 and JASON-2) at the satellite tracks before and after calibration. Averaged SWH fields demonstrate the improvement when calibrated hindcast is used (above). Bias and root mean squared errors between observations and modelled data indicate that when calibrated SWH are used the improvement is 80% and 9%, respectively (below).



CONCLUDING REMARKS

The calibration procedure followed in this work has proven to be useful in reducing the differences between hindcasted and observed SWH, at least for the mean wave regime (represented by the bias). The best calibration is reached when a maximum number of buoys is used; however, if was found that a smaller number of records with an optimized spatial distribution could lead to a comparable improvement.

The ultimate result of this work is a more realistic characterization of the wave climate of the Western Mediterranean during the last five decades, which is intended to substitute the previous hindcast obtained in the framework of the HIPOCAS project.

The use of statistical distributions other than a log-normal one, in an attempt to better account for extremes, could be further explored in future applications.

REFERENCES

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