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Relationship of extreme wave climate with long-term patterns in the North Atlantic Ocean and Mediterranean Sea

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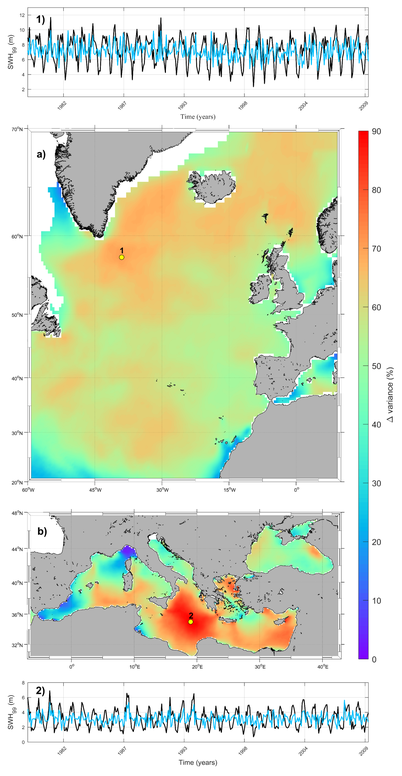
ABSTRACT

The spatial and temporal variability of extreme wave climate in the North Atlantic Ocean and the Mediterranean Sea is assessed using 3-hour output of wave model during a period of 31 years (1979-2009). The seasonality accounts for a 50% of the extreme wave height in the North Atlantic Ocean and for a 85% in the Mediterranean Sea. Once removed the seasonality, we found that the North Atlantic Oscillation and the Scandinavian Index mainly control the interannual variability of extreme waves during winters. To a lesser extent, the East Atlantic Oscillation also modulates extreme waves in some areas. In the Mediterranean Sea, the dominant modes regarding extreme waves, correspond to the East Atlantic and East Atlantic/Western Russia modes both in their negative phases.

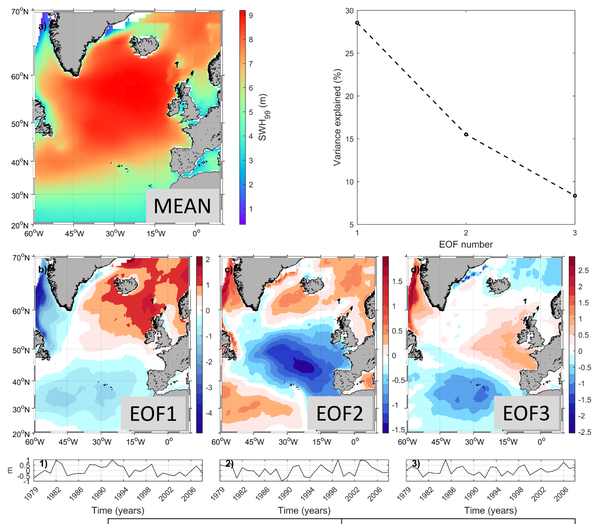
01 Data and Methods

High resolution hindcast wave data WAVEWATCH III from NCEP, wind and sea level pressure from NCEP-CFSR and climatic indexes from NOAA, free available.

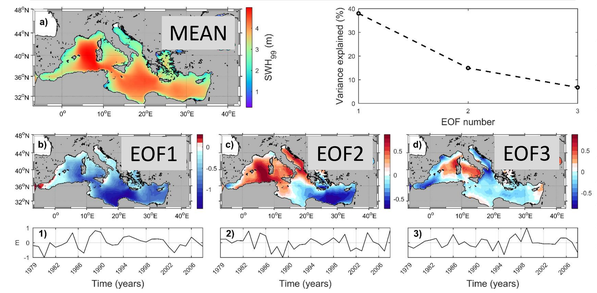


Seasonality in the **North Atlantic** accounts for a **50%** of the signal. In the **central basin** of the **Mediterranean Sea**, it can explain up to a **90%** of extreme waves, while in the **Gulf of Genova-Ligurian basin and Alboran Sea** seasonality explains less than **10%** of the signal.

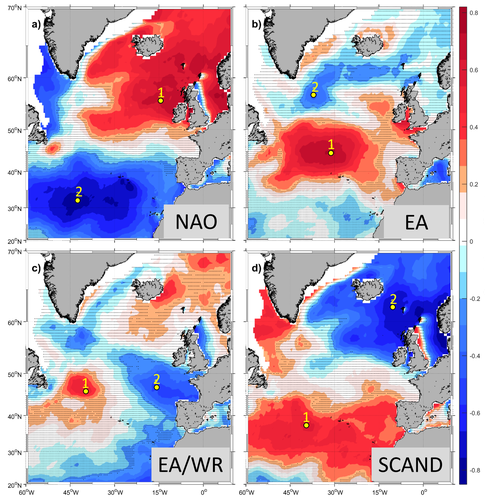
02 Results and Discussions



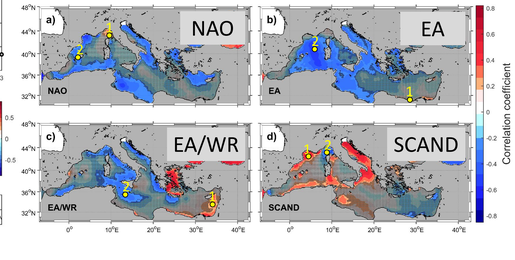
	North Atlantic Ocean			Mediterranean Sea		
	PC1	PC2	PC3	PC1	PC2	PC3
NAO	**0.826**	-0.138	**0.323**	**0.242**	-0.193	**0.297**
EA	-0.120	**-0.459**	-0.042	**0.298**	**-0.361**	0.026
EA/WR	0.057	0.171	-0.127	0.093	**-0.342**	**0.366**
SCAND	**-0.633**	0.126	0.165	0.091	**0.347**	**0.390**



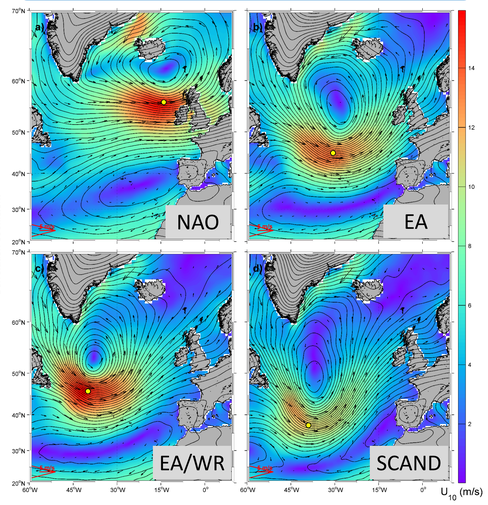
Correlations

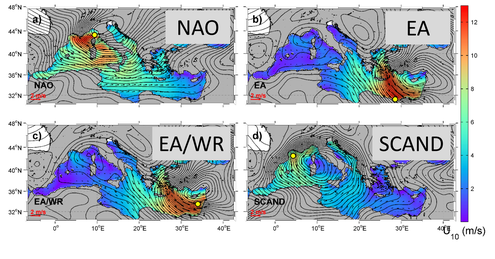


Comparison Correlations/EOFs maps	
N. Atlantic Ocean	*Mediterranean Sea*
NAO→EOF1	They are not clearly linked
EA→EOF2	
SCAND→EOF1	

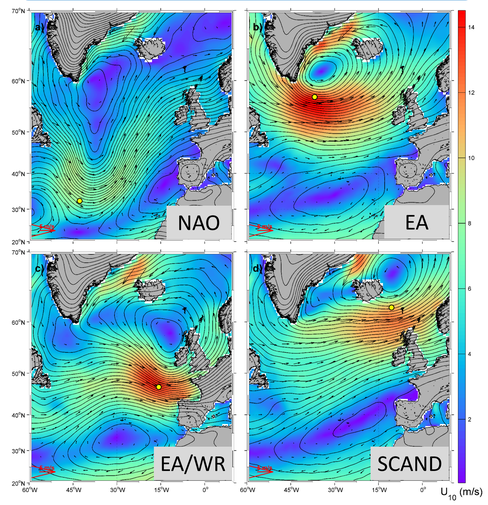


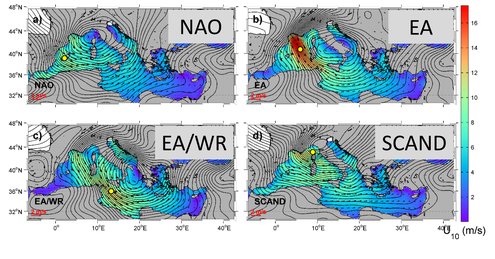
Positive phase composites





Negative phase composites





1. Select locations with highest correlations (1 positive, 2 negative).
2. Collect the records presenting larger values than SWH_{99} (monthly) from the 3-hourly time series.
3. Compute the composite for SWH, U10 and SLP in all the domain for the dates that meet the previous criteria

03 Conclusions

- This study applies to present-day climate but also to a large extent to projected climate.
- The NAO and the SCAND indices are the leading modes affecting extreme waves in the North Atlantic Ocean during winters.
- The interannual variability for winters in the Mediterranean Sea is dominated by the negative phase of EA and the positive phase of NAO index.
- The most reliable synoptical atmospheric situations related to the positive or negative phase of climatic indices are reproduced using its correlation with the temporal SWH series.
- This methodology would be able to use for describing patterns of any other variable which the extreme waves are correlated with.

04 References

Caires, S., Swail, V. R., and Wang, X. L. (2006). Projection and analysis of extreme wave climate. Journal of Climate, 19(21):5581-5605.

Martnez-Asensio, A., Tsimplis, M.N., Marcos, M., Feng, X., Gomis, D., Jorda, G., Josey, S.A. (2016). Response of the North Atlantic wave climate to atmospheric modes of variability. International Journal of Climatology, 36(3):1210{1225.