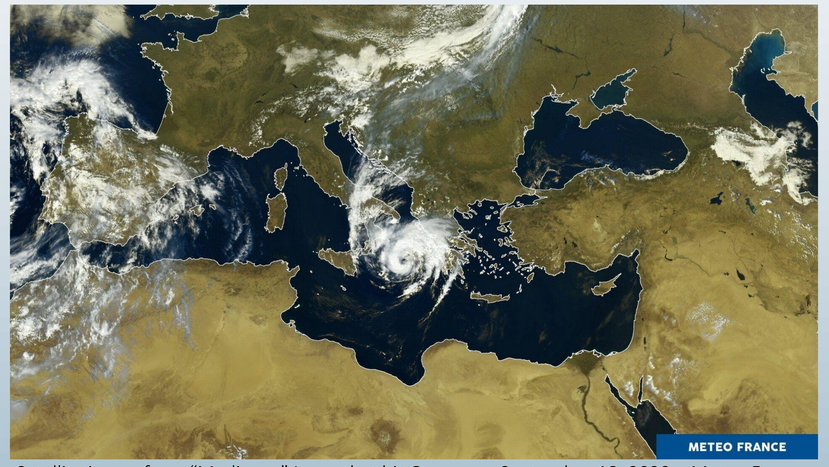
Coastal risks induced by Mediterranean hurricanes

T. Toomey, A. Amores, M. Marcos, A.Orfila, R. Romero

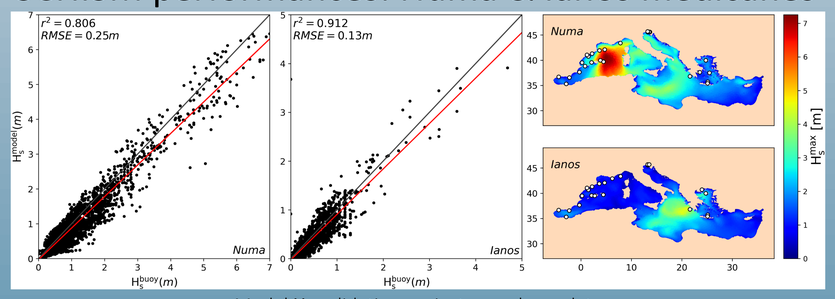
Overview

A Medicane is a hurricane-like perturbation in the Mediterranean Sea. With an average number of two or less events per year, the number of recorded medicanes is insufficient to perform robust statistics. In order to quantify the coastal impacts caused by medicanes along the Mediterranean coastlines, in present-day climate and under projected climate change scenarios for the 21st century, we use the outputs of *Romero and Emanuel (2016)*:* A medicane dataset obtained through a novel statistical-deterministic approach that generates thousands of synthetic medicane tracks from atmospheric fields. Ocean response, i.e. storm surge and wind-wave generation and propagation, is simulated using the fully-coupled hydrodynamic and wave model SCHISM (*Zhang et al. 2016**) on an unstructured grid (36078 nodes shared by 62415 elements) with a horizontal grid resolution varying from ~50km in the open ocean down to ~2km at the coast.

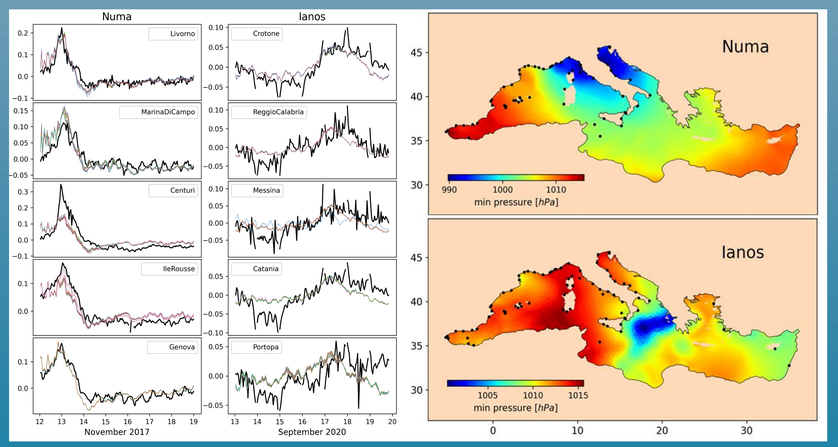


Satellite image from "Medicane" Ianos that hit Greece on September 18, 2020 – Meteo France

SCHISM performances: Numa & Ianos medicanes



Model **Hs** validation against wave buoy data



Model **elevation** validation against tide gauges data

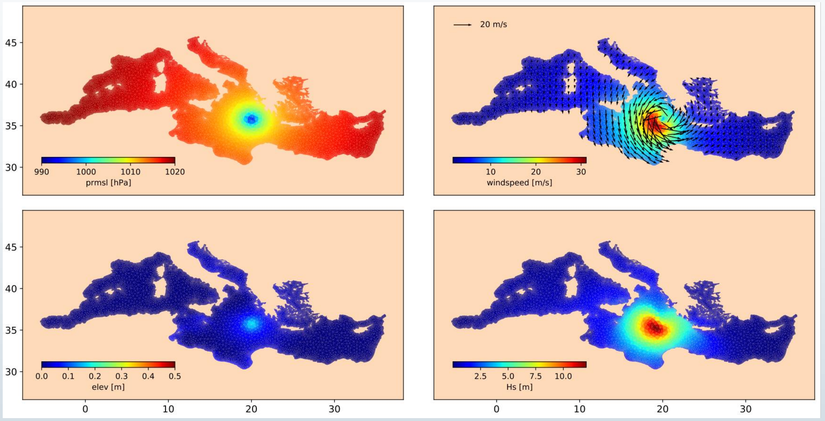
Synthetic data of medicanes

REAs		GCMs	
NCEP-NCAR	ERA-INTERIM	Hist	RCP 8.5
2000	2000	200/Model	200/Model
4000 Medicanes		8000 Medicanes	

Modelling coastal impacts of the total amount of medicanes in the entire dataset is unfeasible due to computational constraints. Therefore, we selected a subset of events ensuring representativeness of the original medicane distribution in terms of location and intensity. One of the statistical tests used is the Kolmogorov-Smirnov (KS), validating that our selection and the original dataset come from the same distribution (KS pvalue ≈ 0,9) in terms of intensity.

Within 60 computing days we simulated our final selection of 12000 Medicanes.

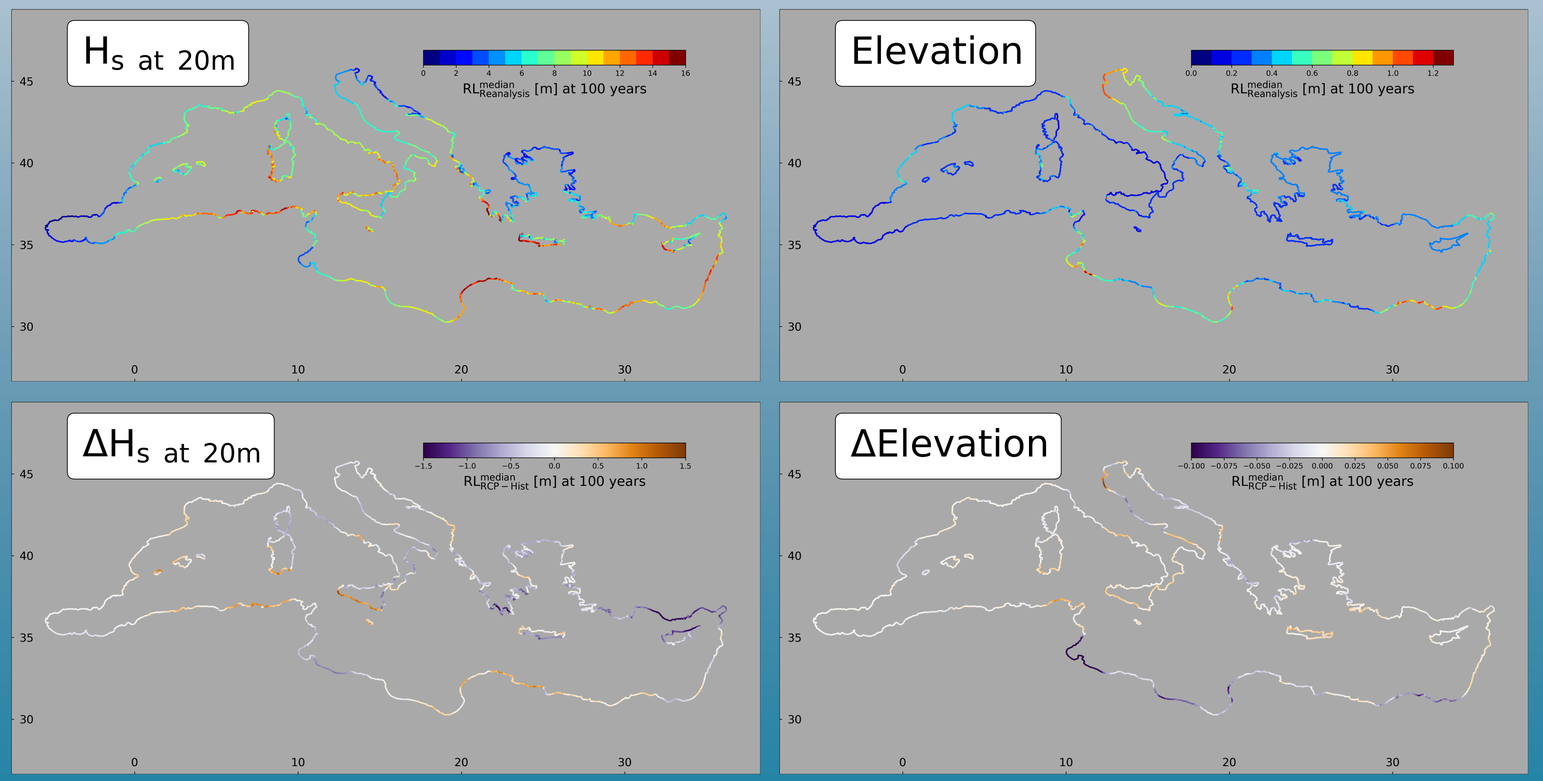
The original synthetic medicane dataset consists of around 6000 tracks derived from each of two atmospheric reanalyses, namely ERA-INTERIM and NCEP-NCAR (REAs), and the same number from each run of 20 GCMs from CMIP5 best reproducing track densities generated from REAs.



Highlights

Using a large distribution of medicanes from two reanalyses, a robust assessment of medicane induced coastal risks is performed for the present climate. For significant wave height (Hs) at 20m depth and for coastal elevation, 100-year return levels are computed for the whole basin showing spatially varying intensities, thereby highlighting most vulnerable coasts to medicane impacts.

For both Hs and coastal elevation, results found for future changes globally show amplitudes smaller than the associated uncertainty due to relatively poor agreement among models. Though, at several coastal locations, a model consensus is reached where relative intensity change is significant (5–20%) and with 60 to 75% agreement on the sign of change. As a result, Hs is expected to increase for some stretches of coast in the Central and Western Mediterranean (e.g. Sicilian south coast Δ > 1m), while it decreases in some parts of the Eastern Mediterranean (e.g. north Cyprus and south Turkish coasts |Δ|>1m).



* • *Romero, R., and K. Emanuel, 2016: Climate change and hurricane-like extratropical cyclones: Projections for north atlantic polar lows and medicanes based on cmip5 models. Journal of Climate, doi:10.1175/JCLI-D-16-0255.1.*
• *Zhang, Y. J., F. Ye, E. V. Stanev, and S. Grashorn, 2016: Seamless cross-scale modeling with SCHISM. Ocean Modelling,102, 64–81, doi:10.1016/j.ocemod.2016.05.002.*