EGU General Assembly 2020

Integrated extreme sea level events in the Mediterranean coast of Spain

Andrea Lira Loarca
Manuel Cobos
Agustín Millares
Giovanni Besio
Asunción Baquerizo

IISTA Andalusian Institute for Earth System Research

AquaClew

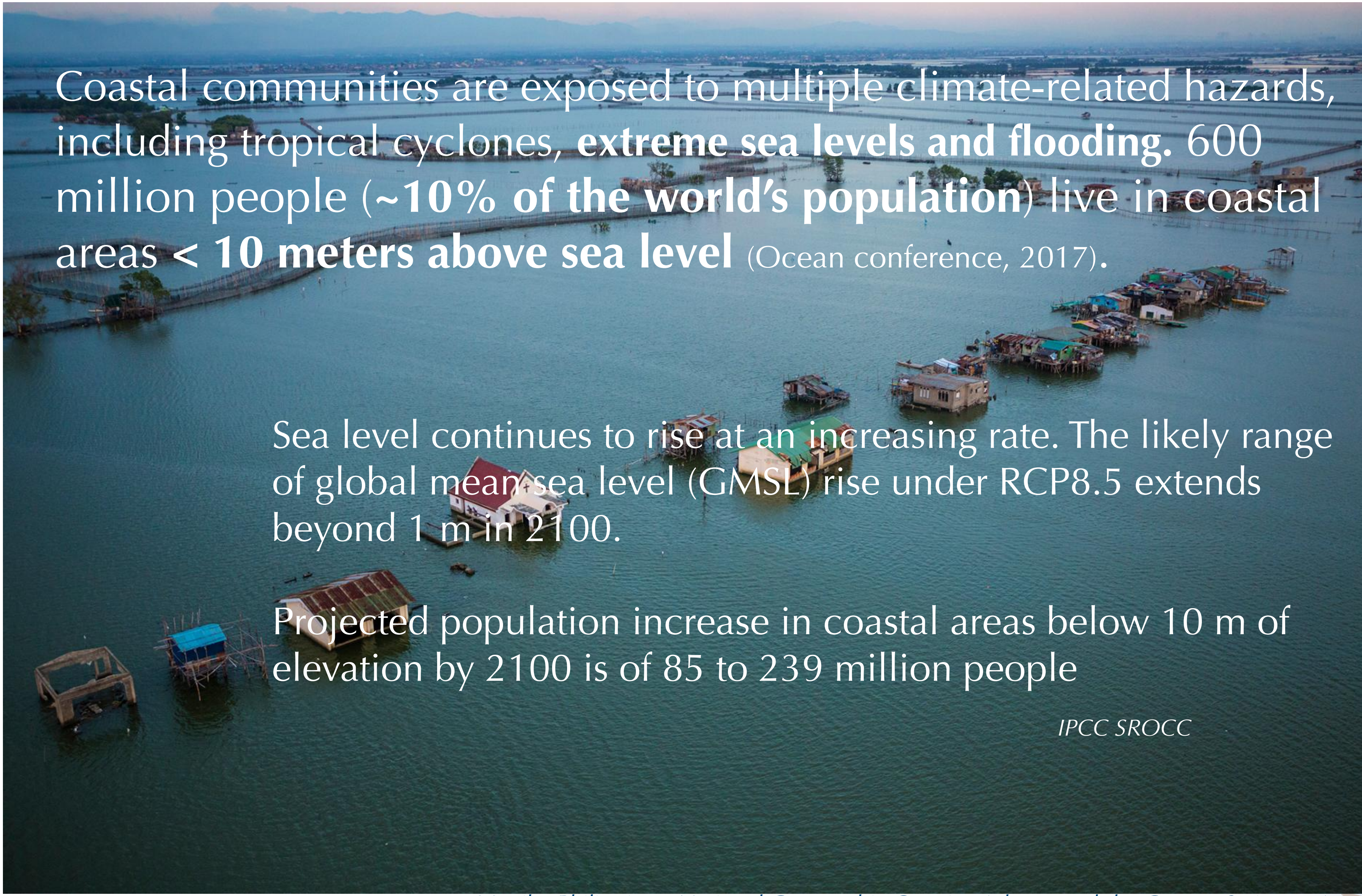
UNIVERSIDAD DE GRANADA

Coastal communities are exposed to multiple climate-related hazards, including tropical cyclones, **extreme sea levels and flooding.** 600 million people (**~10% of the world's population**) live in coastal areas **< 10 meters above sea level** (Ocean conference, 2017).

Sea level continues to rise at an increasing rate. The likely range of global mean sea level (GMSL) rise under RCP8.5 extends beyond 1 m in 2100.

Projected population increase in coastal areas below 10 m of elevation by 2100 is of 85 to 239 million people

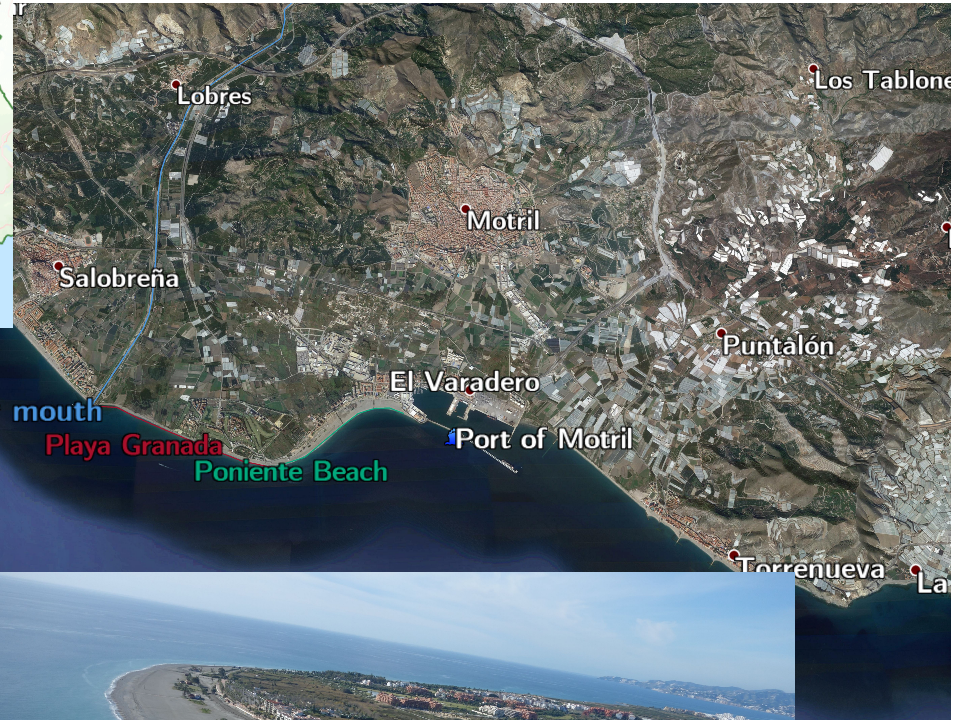
IPCC SROCC

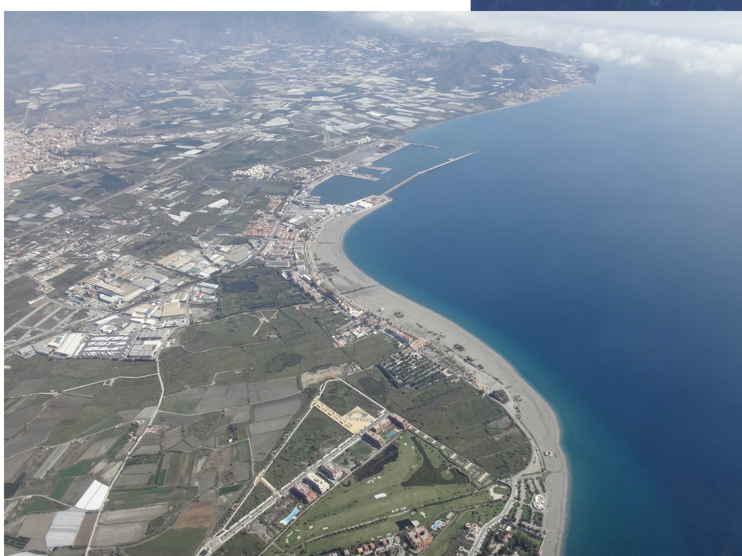


Manila, Philippines. National Geographic Creative (photograph by George Steinmetz)

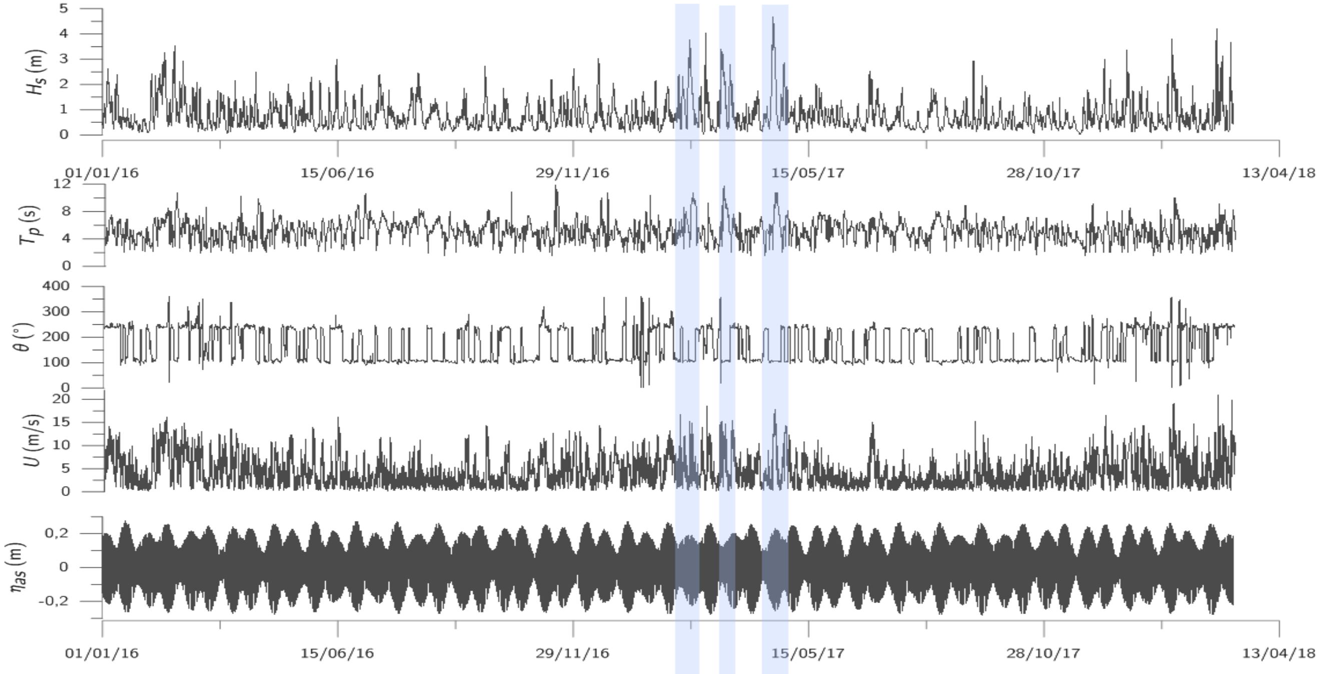
EGU General Assembly 2020

Coast of Granada, Spain





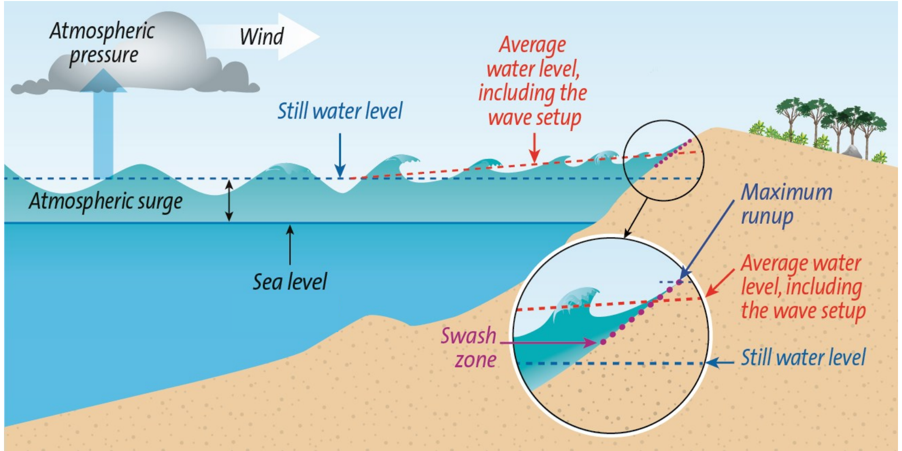

Motril
Salobreña
El Varadero
river mouth
Playa Granada
Port of Mot
Poniente Beach


H_s (m)
T_p (s)
θ (°)
U (m/s)
η_{as} (m)
01/01/16
15/06/16
29/11/16
15/05/17
28/10/17
13/04/18

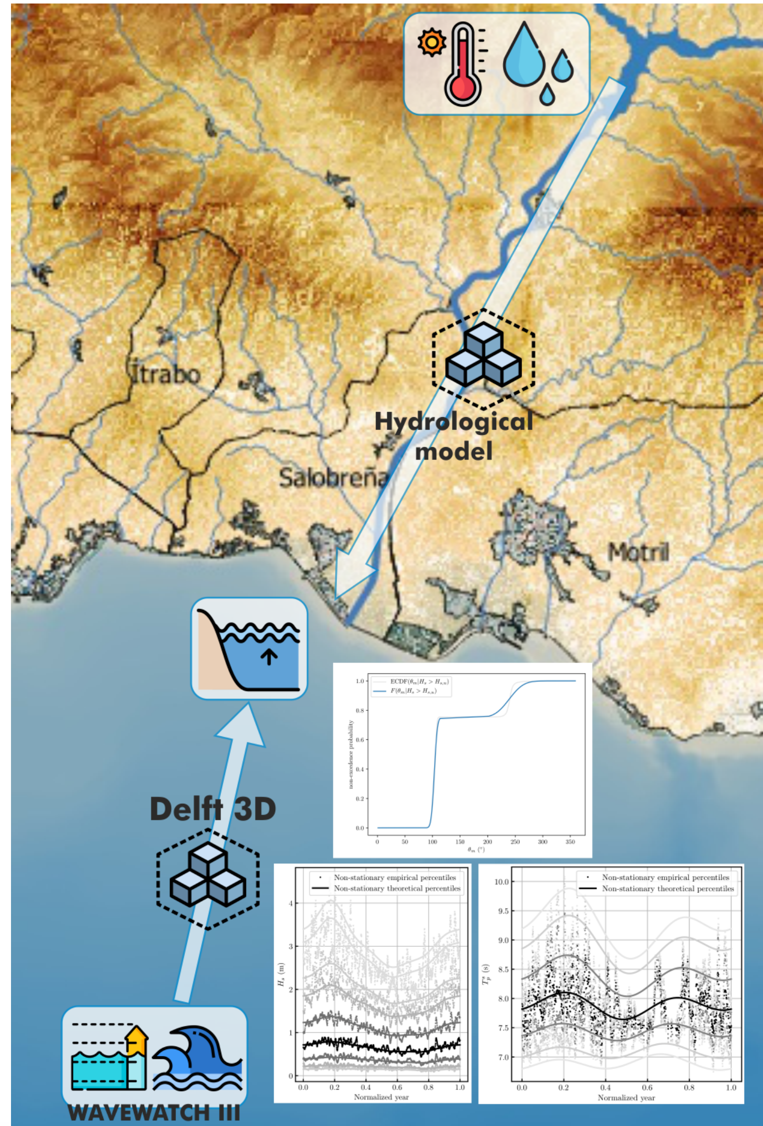
Risk flooding and erosion events →

Relative sea level + {Storm surges, waves, tides} →

Extreme Sea Level (ESL) events



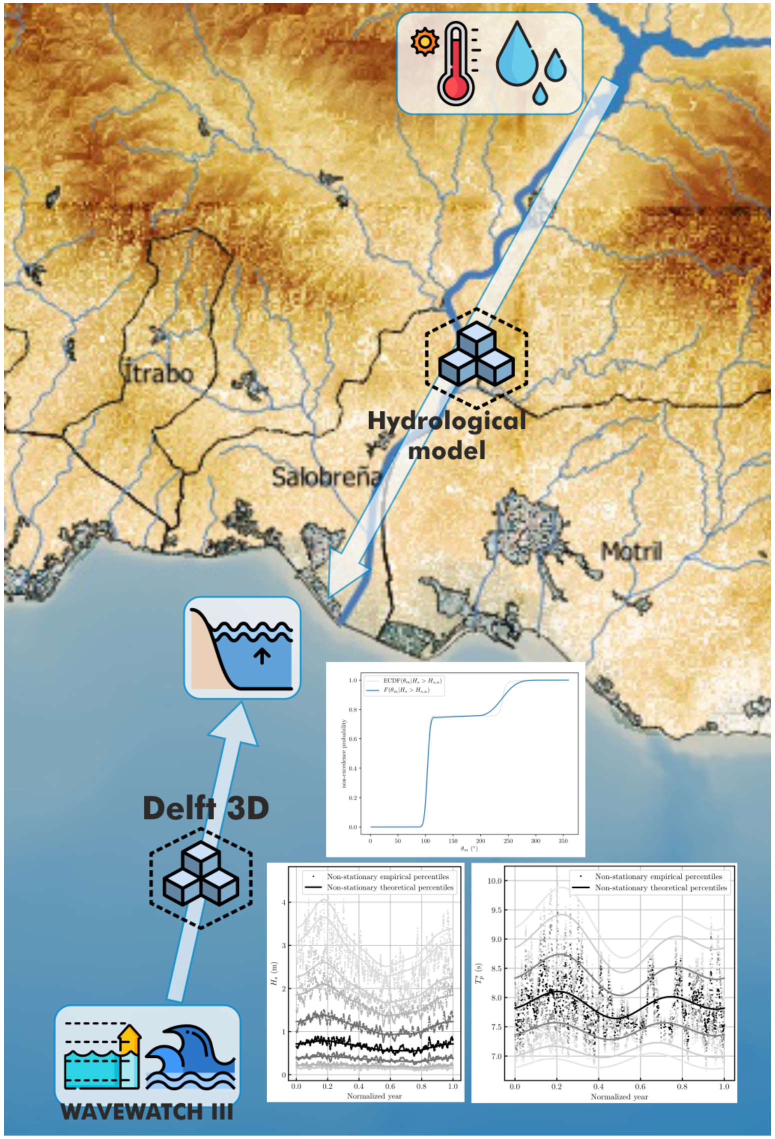
Le Cozannet, 2018

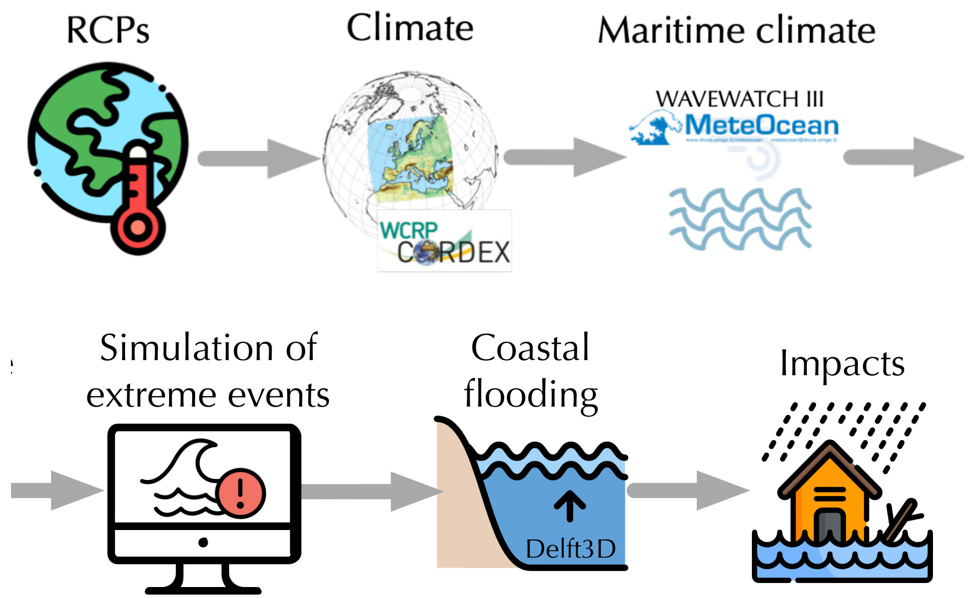


Coastal planning & decsion making

→

Analysis of current and future ESL events





Changes in wave height and period have large effects on coastal flooding

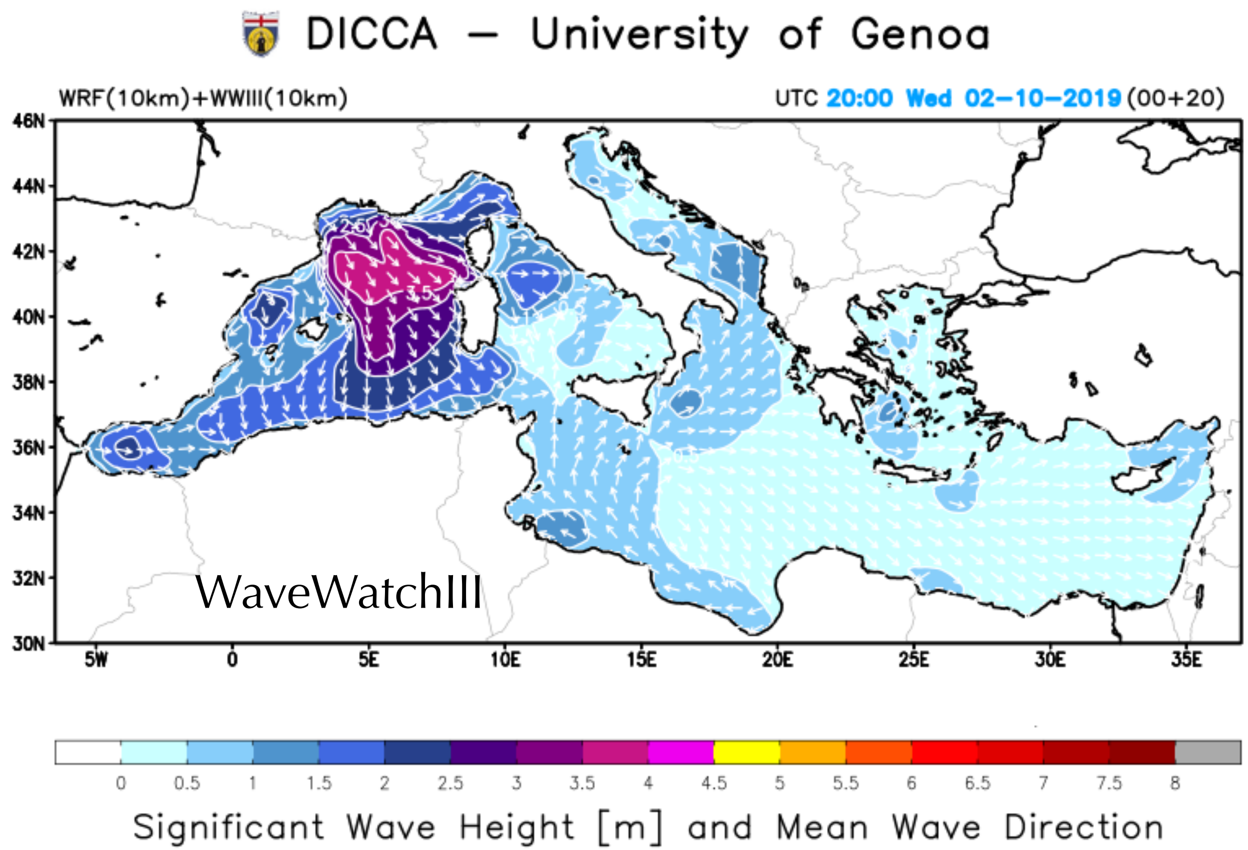
Maritime climate projections

RCP8.5 EURO-CORDEX

MeteOcean
www.dicca.unige.it/meteocean meteocean@dicca.unige.it

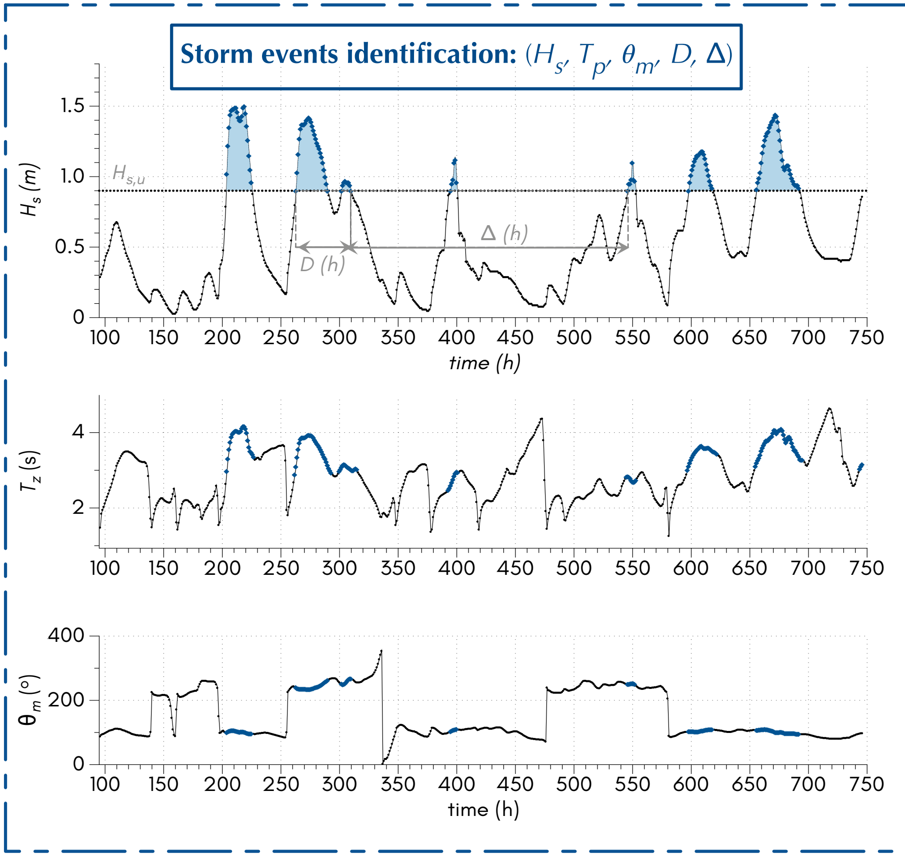
1. CLMcom_CanESM2
2. CLMcom_MIROC5
3. SMHI_MPI-ESM-LR
4. SMHI_NorESM1-M
5. SMHI_CNRM-CM5
6. SMHI_IPSL-CM5A-M
7. SMHI_HadGEM2-ES

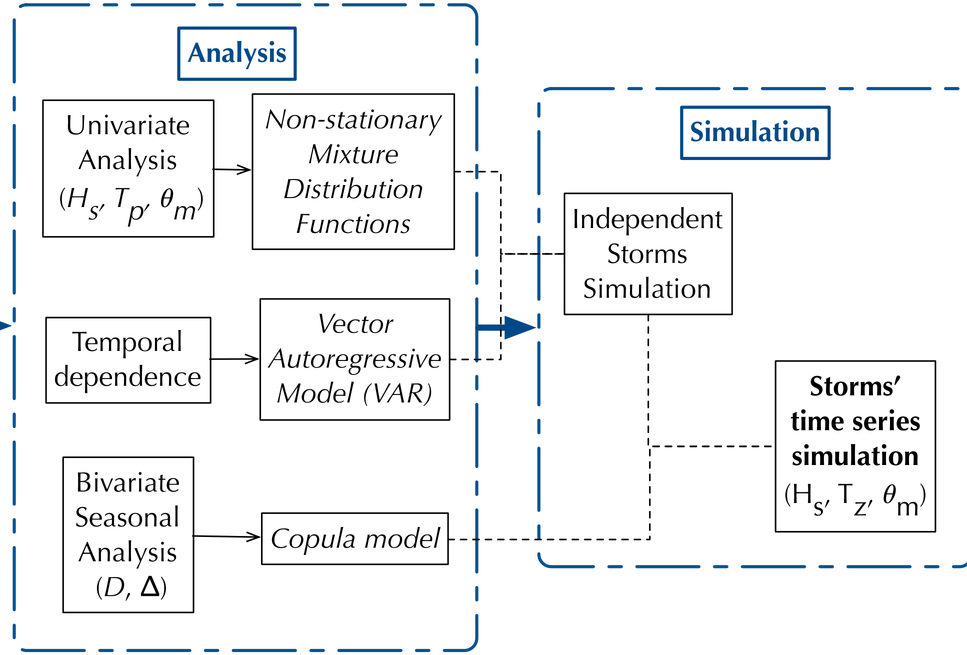
Mentaschi et al., 2015
Besio et al., 2019



→ Wave climate time series (H_s, T_p, θ_m) 2005-2100

Multivariate statistical characterization of storm events





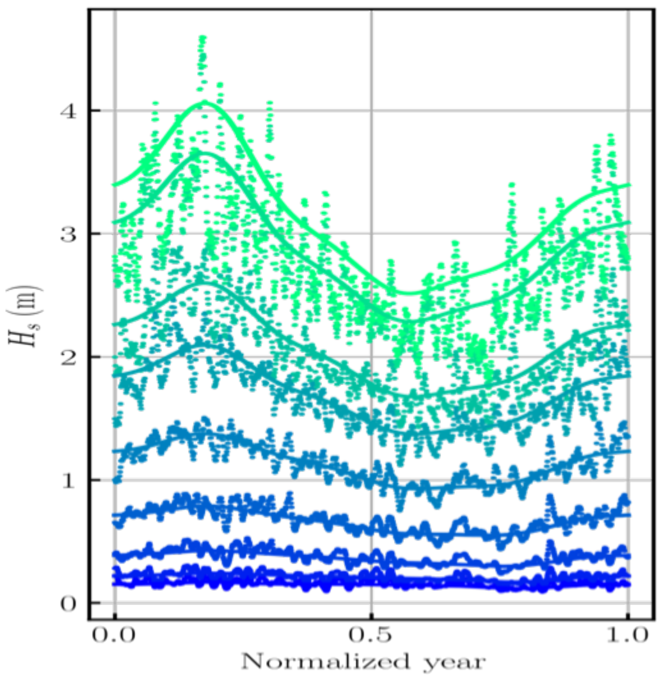
Lira-Loarca et al., 2019, 2020

H_s: GPD-LN-GPD non-stationary model
T_p: LN non-stationary model
θ_m: 2-TN stationary model

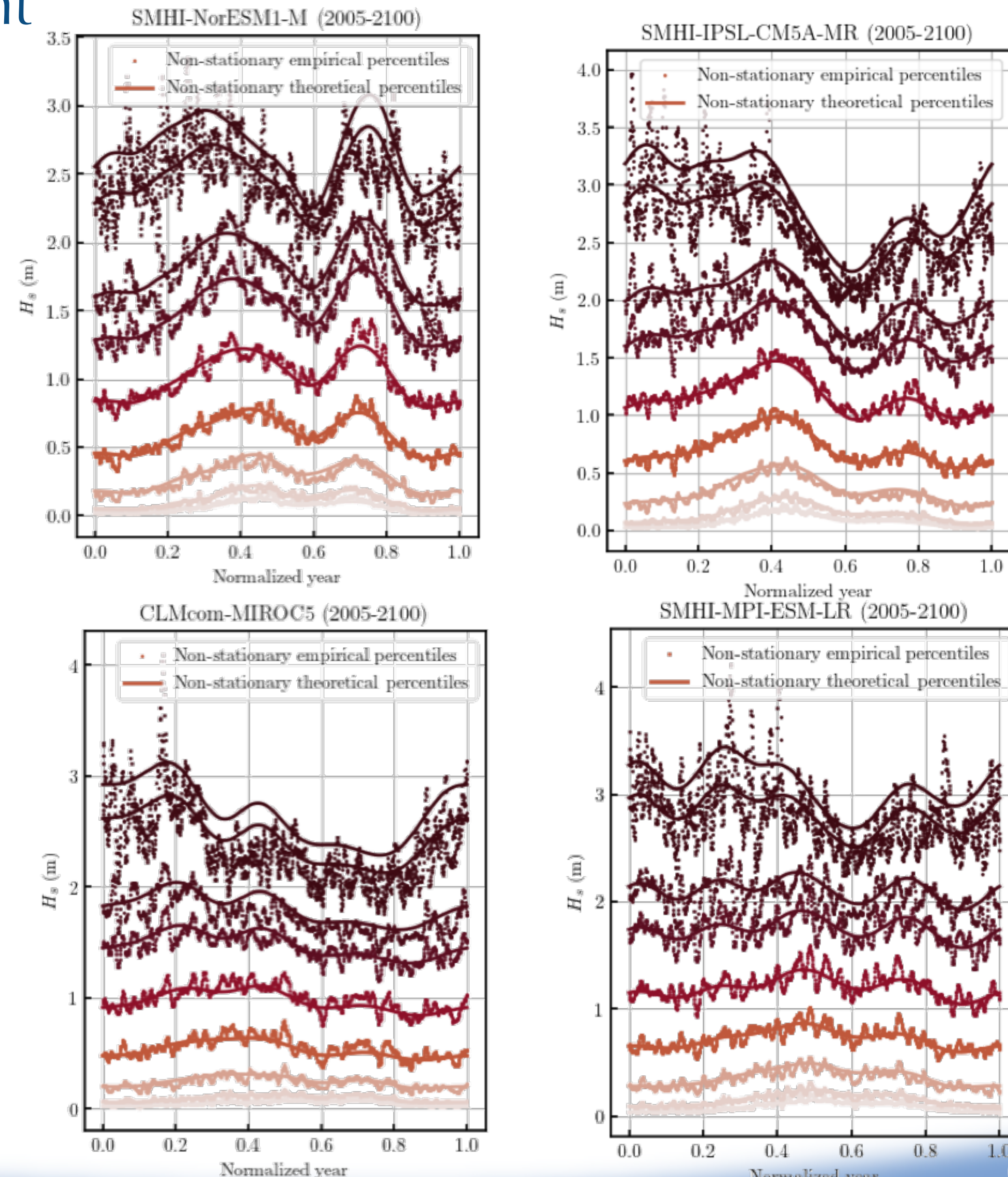
Significant wave height

GPD-LN-GPD
non-stationary model

Hindcast 1979-2018



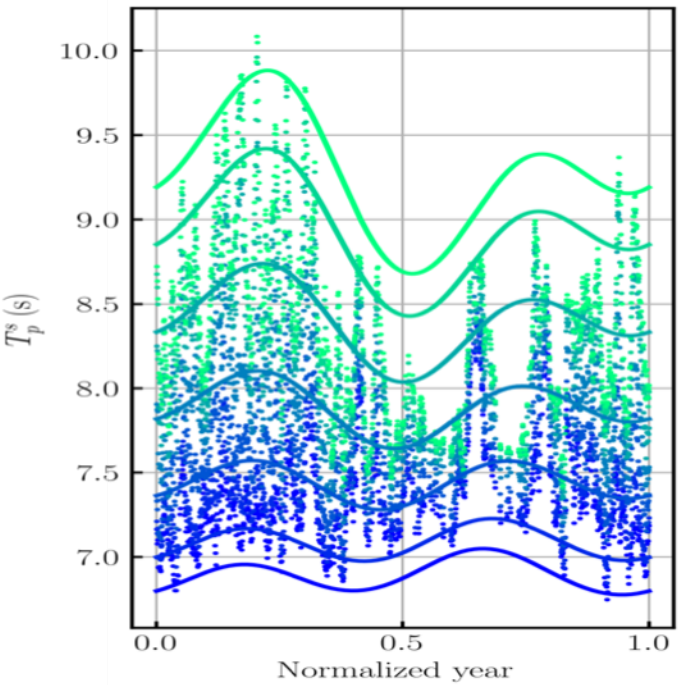
Iso-probability percentiles
5, 10, 25, 50, 75, 90, 95, 99, 99.5



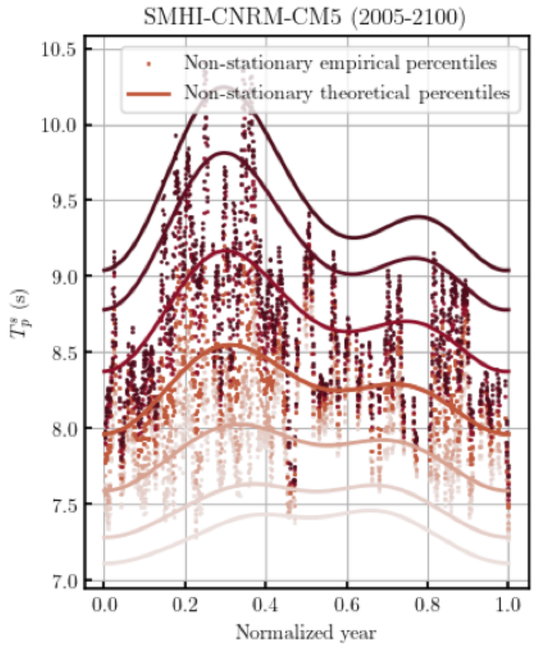
Peak period

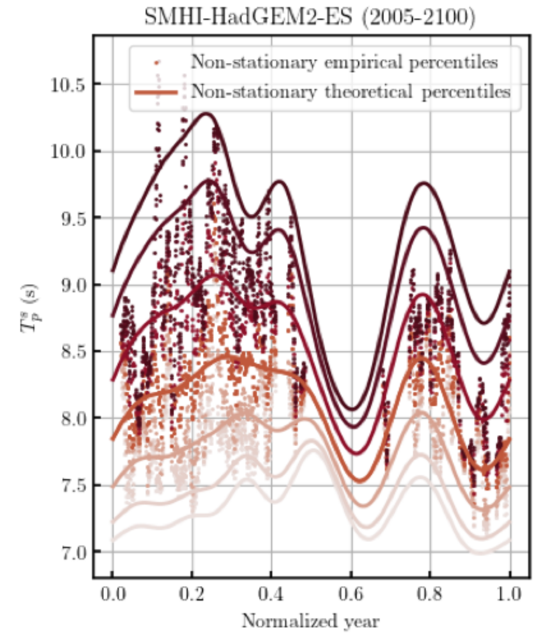
LN non-stationary model

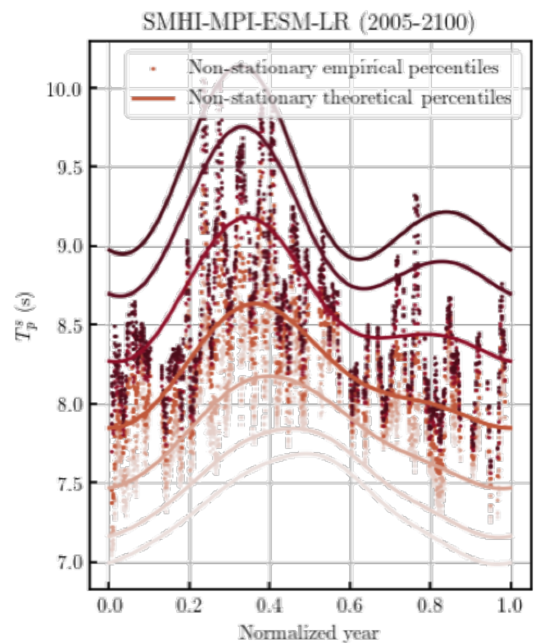
Hindcast 1979-2018

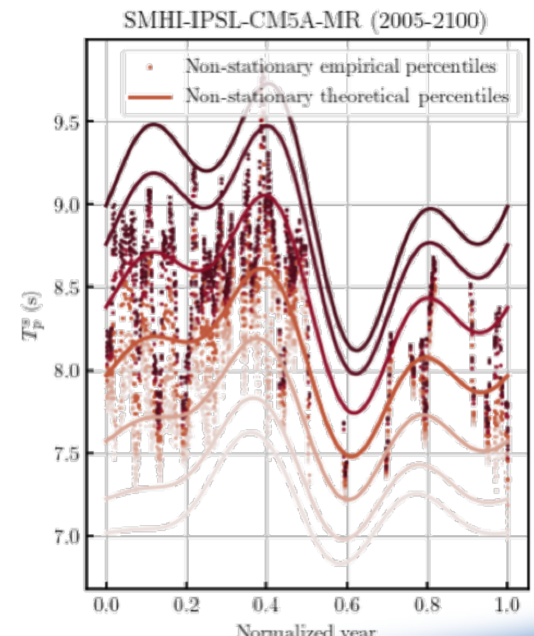


Iso-probability percentiles
5, 10, 25, 50, 75, 90, 95









Conclusions

- EUR-11 6hr atmospheric data from 7 models are used to simulate wave climate in the Mediterranean.
- The multivariate statistical characterization and simulation models (non-stationary mixture fits, VAR, copula) used on Lira-Loarca et. al, 2020 are applied to wave projections under RCP8.5.
- The models provide a good fit for the hindcast and projections data.
- There is a variation in the semiannual and seasonal temporal behavior of the parameters of the mean and upper part of Hs as well as in the magnitude values of the mean and semiannual oscillation.

aliraloarca@ugr.es
andrealiralo

UNIVERSIDAD DE GRANADA

References

- Besio, G., Mentaschi, L. and De Leo, F. (2019). Trends and variability of waves under scenario RCP8.5 in the Mediterranean Sea. 2nd Workshop on Waves, Storm Surges and Coastal Hazards. November, Melbourne, Australia.
- Hinkel, J., van de Wal, R., Magnan, A. K., Abd-Elgawad, A., Cai, R., Cifuentes-Jara, M., et al. (2019). Sea Level Rise and Implications for Low Lying Islands, Coasts and Communities. IPCC Special Report on the Ocean and Cryosphere in a Changing Climate (chap. 4). Cambridge University Press.
- IPCC. (2019). Summary for Policymakers. IPCC Special Report on the Ocean and Cryosphere in a Changing Climate (chap. SPM). Cambridge University Press.
- Le Cozannet, G. (2018) Understanding And Managing Coastal Hazards. CLIVAR Summer School. Qingdao, China.
- Lira-Loarca A., M. Cobos, G. Besio, and A. Baquerizo, (2019). Coastal flooding due to extreme events in the mediterranean coast of spain," in Proceedings of the International Conference on Regional Climate ICRC-CORDEX19, Beijing, China.
- Lira-Loarca A., M. Cobos, M. Ángel Losada, and A. Baquerizo, (2020). Storm characterization and simulation for damage evolution models of maritime structures, Coastal Engineering, vol. 156, p. 103620.
- Mentaschi, L., Besio, G., Cassola, F., & Mazzino, A. (2015). Performance evaluation of Wavewatch III in the Mediterranean Sea.Ocean Modelling, 90, 82–94.
- United Nations. (2017). The Ocean Conference, New York 5-9 June 2017. https://www.un.org/sustainabledevelopment/wp-content/uploads/2017/05/Ocean-fact- sheet-package.pdf