High-resolution projections of extreme sea levels along the coasts of western Europe

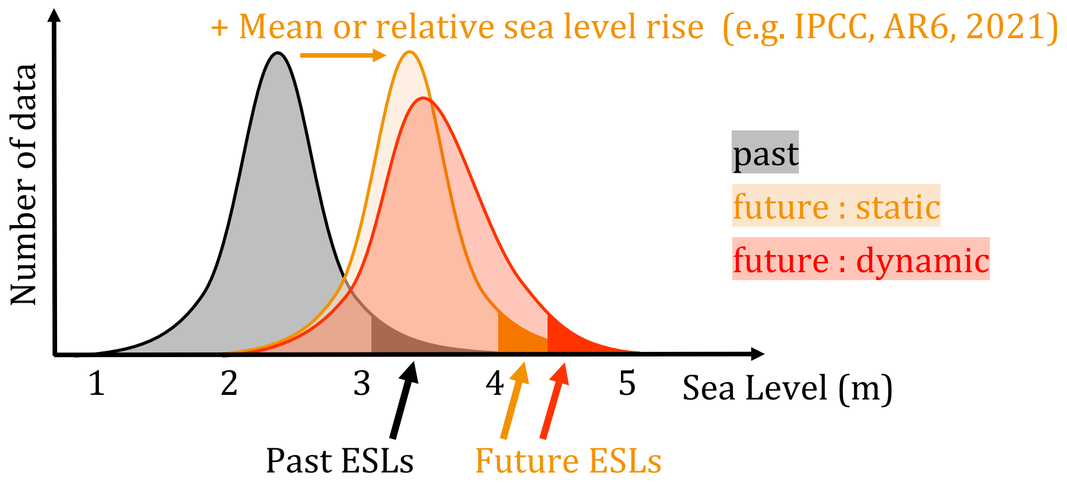
Alisée Chaigneau[1,2], Angélique Melet[2], Aurore Voldoire[1], Guillaume Reffray[2], Stéphane Law-Chune[2], Lotfi Aouf[3]

FLAME WORKSHOP
Liverpool, UK
21-23 February 2023

1. CONTEXT AND MOTIVATIONS

Projections of extreme sea levels (ESLs) have traditionally been studied :

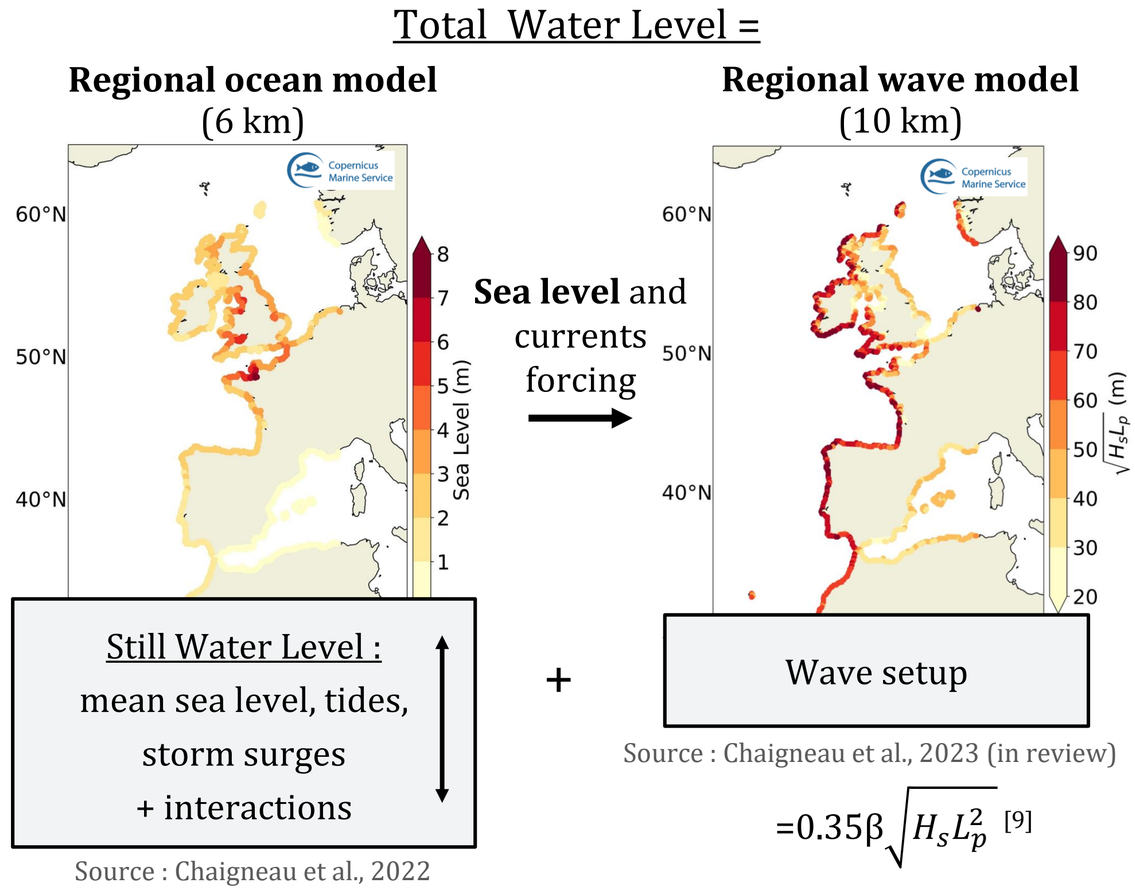
1. based on tide gauge records or tide-surge hydrodynamical models → **no wave contribution**[1-5]
2. with a static approach : the sea level distribution is **not affected by climate change**[4-8]



Questions : How projections of ESLs are impacted by :

1. **the inclusion of wave setup**
2. **the use of a dynamic approach i.e. a time evolving coastal sea level distribution ?**

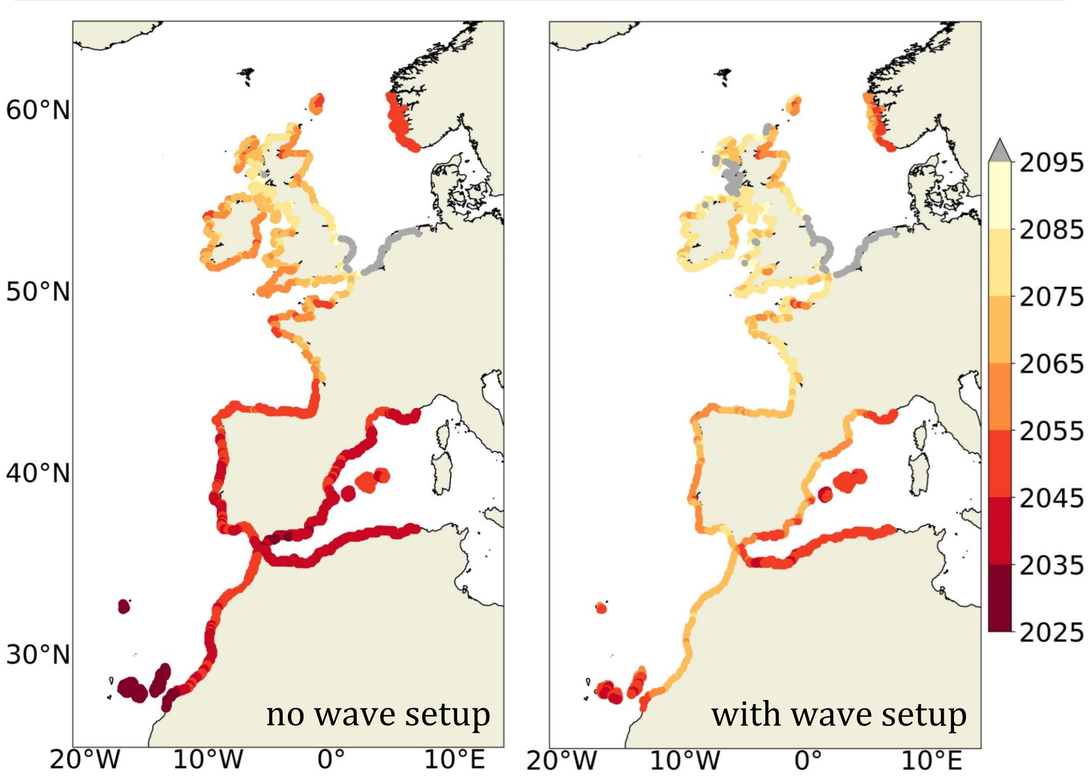
2. METHOD : DYNAMICAL DOWNSCALING



- Regional simulations over the 1970-2100 period
- Results to be taken with caution as based on a single forcing model
- Non-stationary extreme value analyses[10] applied with :
  - Peak over threshold selection of extremes
  - Fit with a GPD distribution

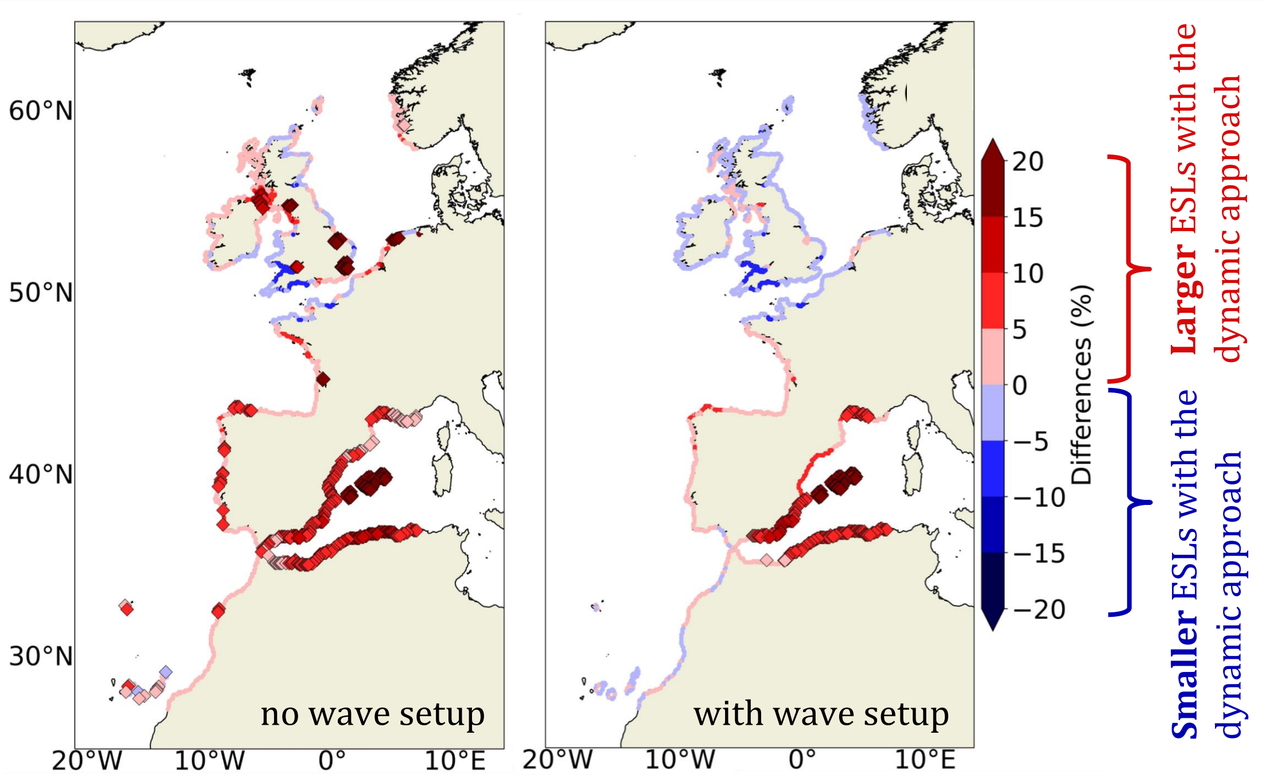
3. RESULTS

Fig. 1 | Year when the historical 1-in-100-year level will occur once a year (SSP5-8.5)



- **Large increase in the frequency** of ESLs in the future especially in the Mediterranean Sea
- Overestimated increase when wave setup is not taken into account, up to 30 years along the Atlantic and Mediterranean coasts

Fig. 2 | Differences between dynamic and static approaches for the 1-in-10-year level for 2081-2100 (SSP5-8.5)



- Rather small impact of future changes in coastal sea level components on future ESLs

KEY POINTS

★ Importance of including all processes and their non-linear interactions to estimate the amplifications of ESLs

★ Projected changes of ESLs dominated by mean sea level rise but it's :
- region dependent (compensations between components, forcing)
- model dependent

[1]CNRM, Université de Toulouse, Météo-France, CNRS, Toulouse, France
[2]Mercator Ocean International, Toulouse, France
[3]Météo-France, Toulouse, France

Contact : alisee.chaigneau@gmail.com

REFERENCES

[1] Wahl et al., 2017
[2] Muis et al., 2020
[3] Woodworth et al., 2021
[4] Oppenheimer et al., 2019
[5] IPCC, AR6, 2021
[6] Kirezci et al., 2020
[7] Lambert et al., 2020
[8] Almar et al., 2021
[9] Stockdon et al. 2006
[10] Mentaschi et al., 2016