SEA LEVEL RISE IMPACT ON NEAR-SHORE OCEAN DYNAMICS.

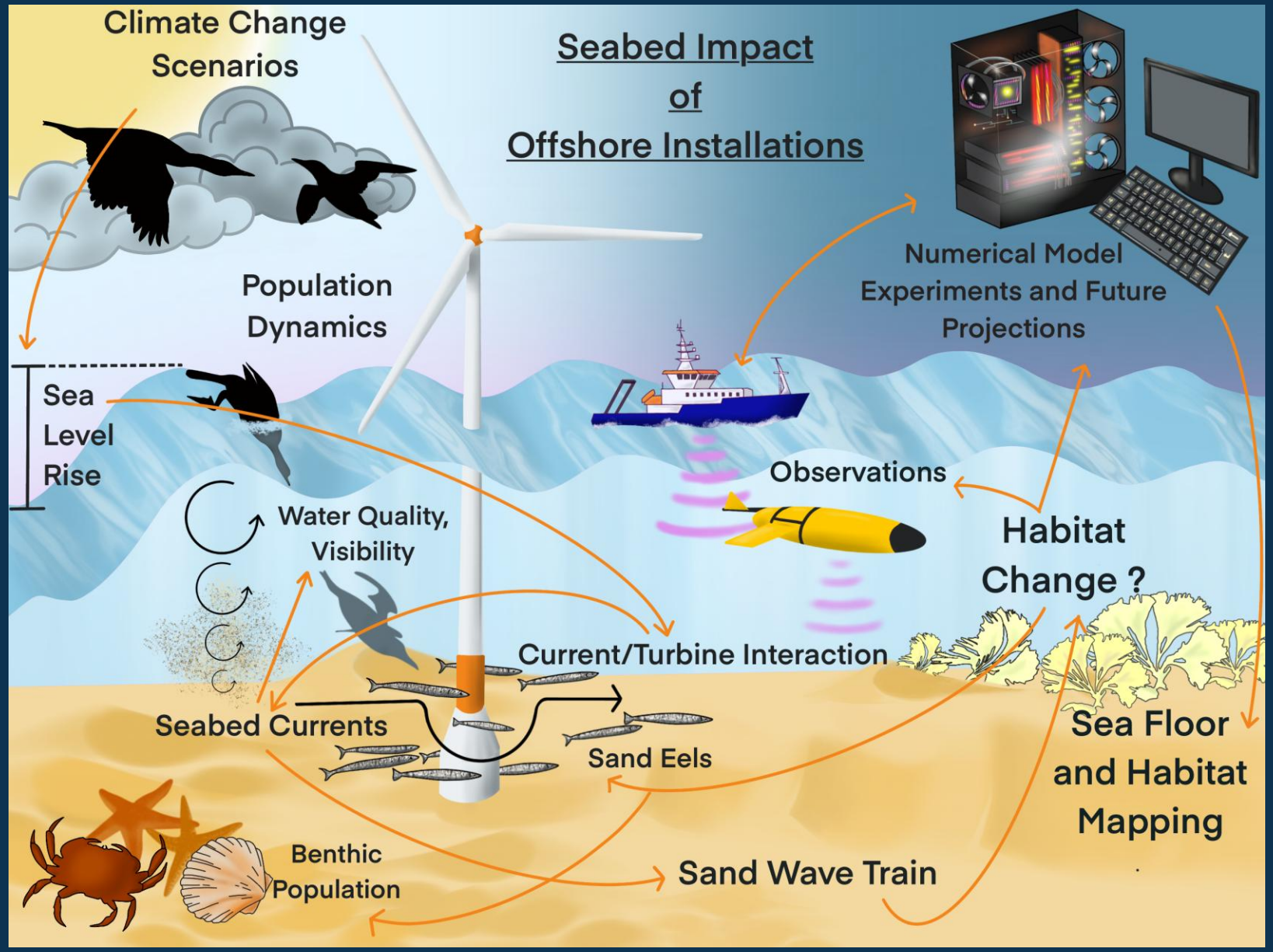
Julia Rulent [1], Lucy Bricheno [1], Connor McCarron [2], Chris Unsworth [3], Martin J. Austin [3], Richard Whitehouse [2], Nicholas G. Heavens [4], David P. Gold [5], Anthony Wise [1], Veerle A. I. Huvenne [6], Katrien J.J. Van Landeghem [3].

[1] Marine System Modeling, National Oceanography Centre, Joseph Proudman Building, 6 Brownlow Street, Liverpool, L3 5DA, United Kingdom
[2] Coasts and Oceans, HR Wallingford, Howbery Park, Wallingford, Oxfordshire OX10 8BA, United Kingdom
[3] School of Ocean Sciences, Bangor University, Askew Street, Menai Bridge, LL59 5AB, United Kingdom
[4] Viridien, Crompton Way, Crawley, RH10 9QN, West Sussex, United Kingdom
[5] Ecodetect Limited, Menai Science Park, Gaerwen, Anglesey, LL60 6AG, United Kingdom
[6] Ocean BioGeosciences, National Oceanography Centre, European Way, Southampton, SO14 3ZH, United Kingdom

Sea level rise affecting ocean dynamics

Nearshore waves depend on water depth

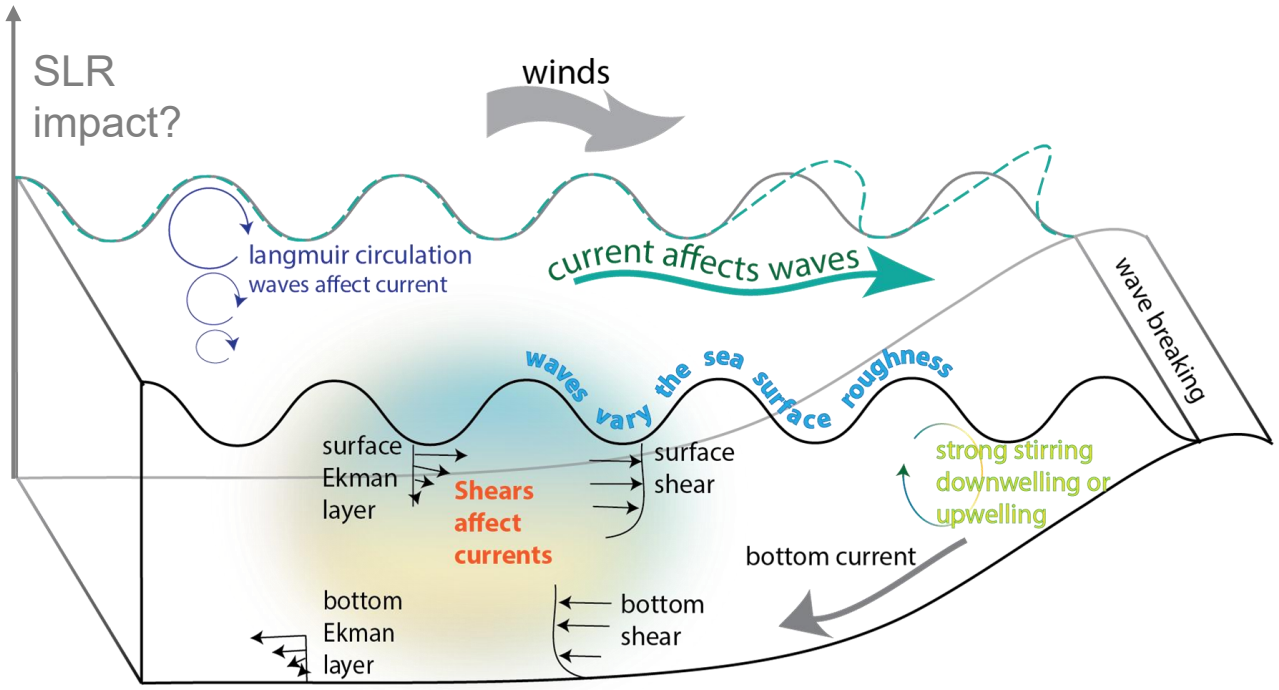
Orbital velocities and bottom stress affected



ECOWind

SEA LEVEL, OCEAN CURRENTS AND WAVES INTERACTION

- Ocean current can **refract** waves affecting they're **propagation**.
- Wave affect **surface stress** which can impact current.
- In **shallow water**, wave can impact **bottom currents and friction**.
- Wave can affect stirring and therefore **upwelling/downwelling** processes.

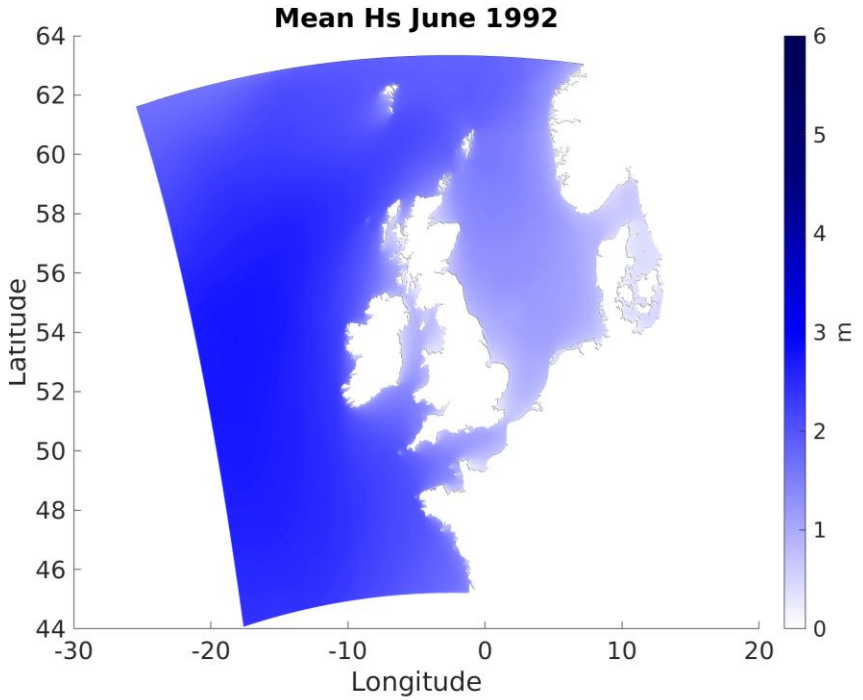


Processes strongly affected by water depth, what happens when the sea level rises?

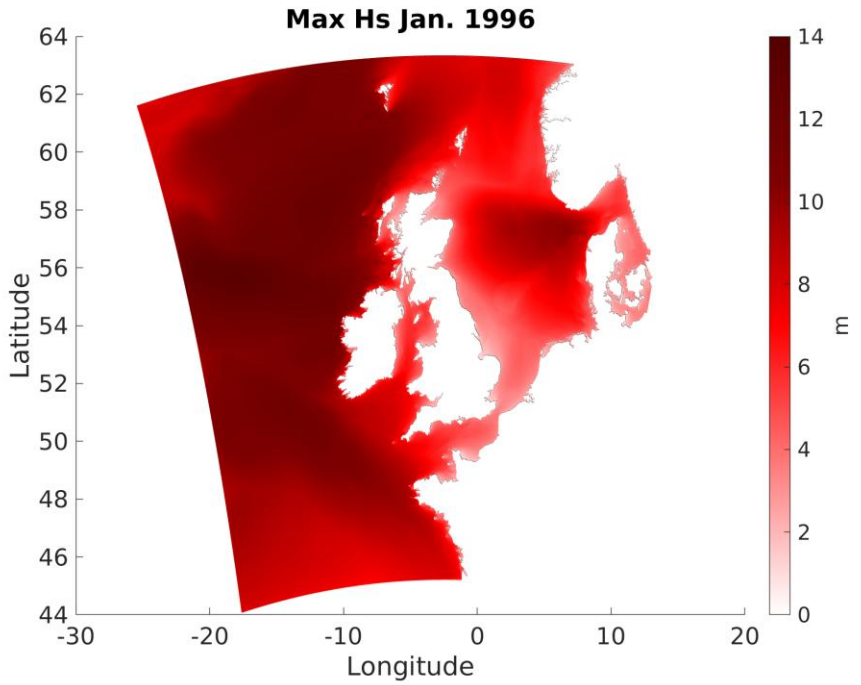
WW3 MODEL

WaveWatchIII configuration:

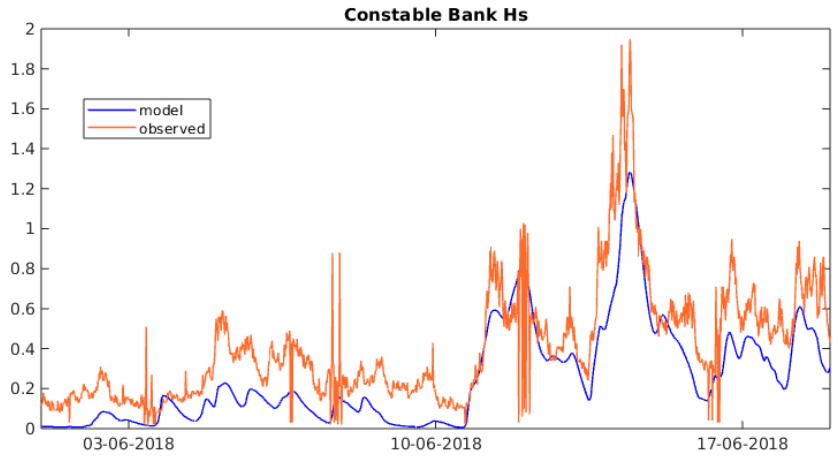
- 1.5km resolution.
- NWEU Shelf domain.
- 1) Present days and SLR experiment.
- 2) Projection forcing based on HADGEM3 GCM under RCP 8.5.

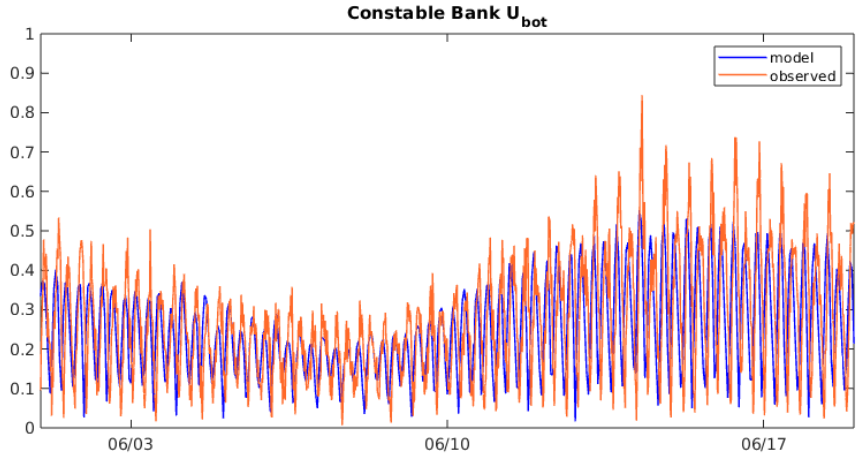


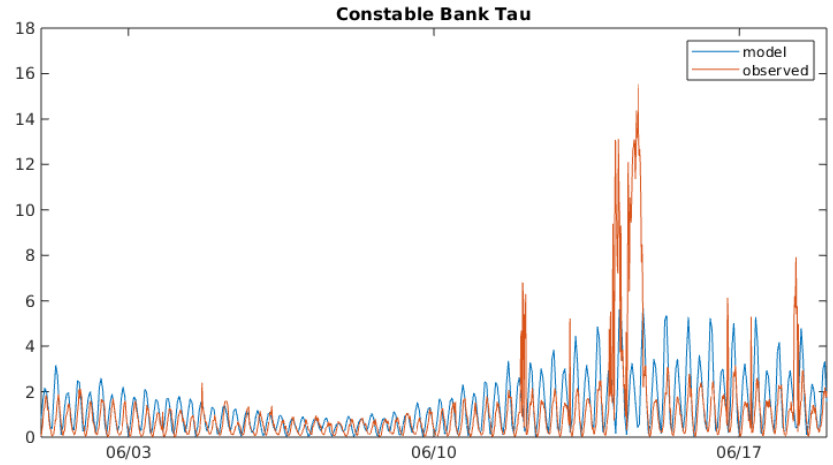
Present day baselines
mean and max Hs for 1990s

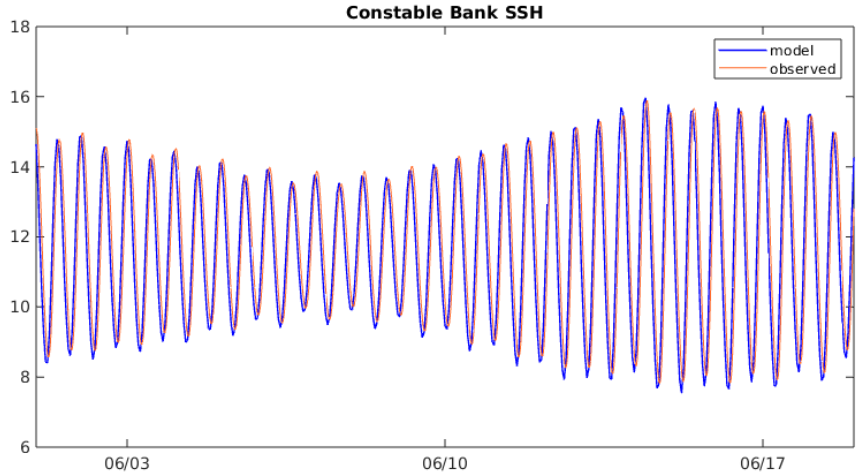


VALIDATION









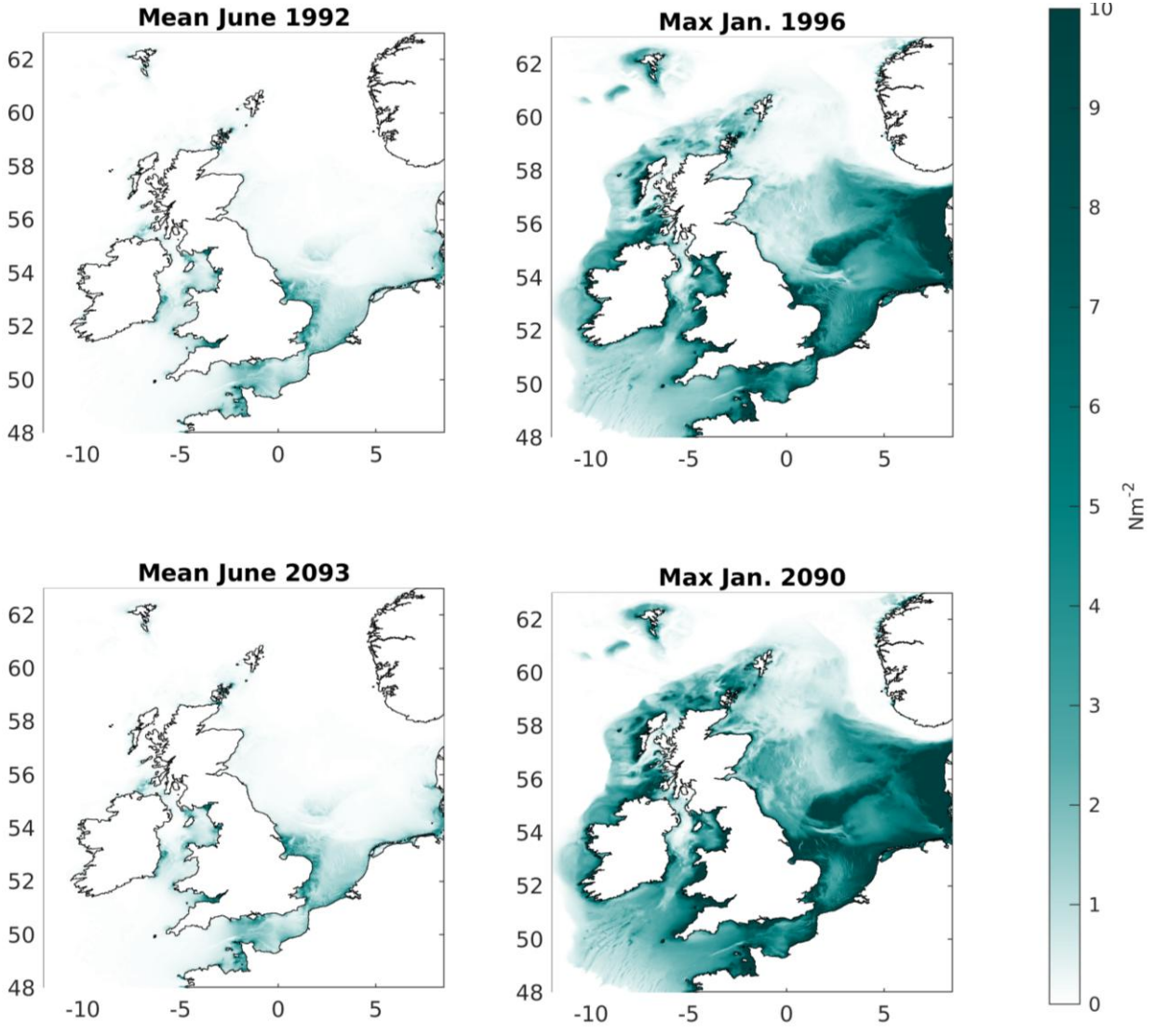
Validating the configuration:

Wave buoys

TGs

Sea bed stress
derived from currents observations, ECOWind field campaign

SEA BEAD STRESS



Seabed stress estimated from:

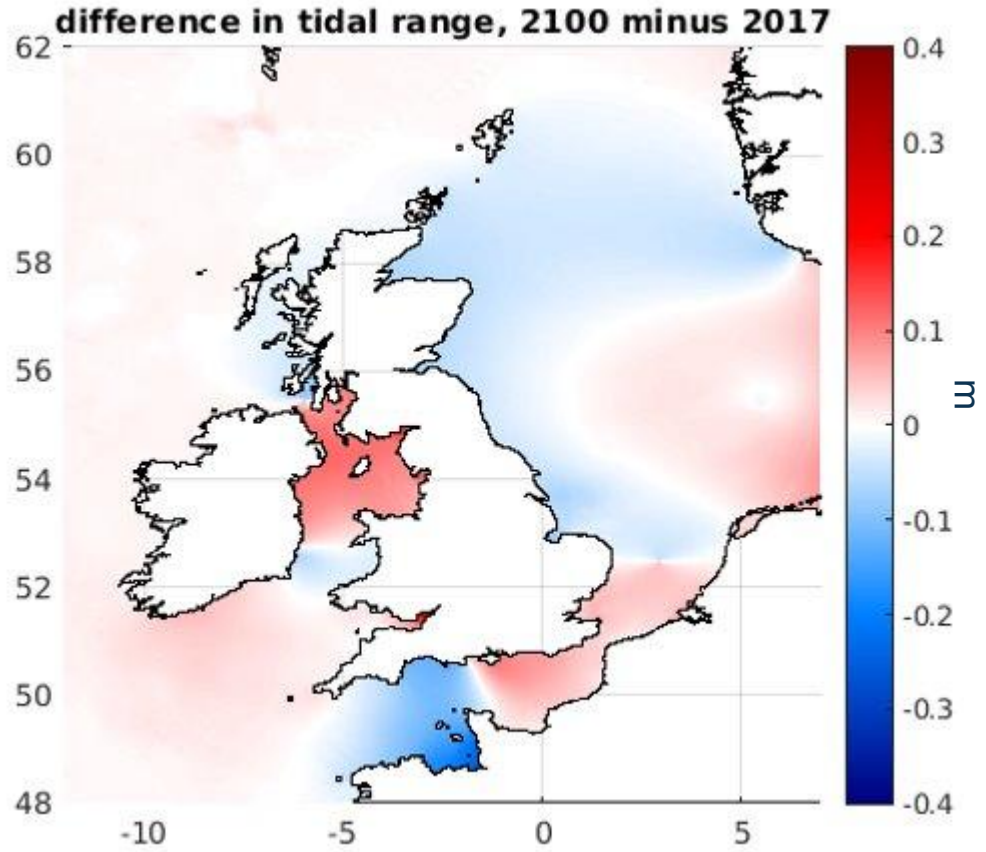
bottom **ocean current** (NEMO)
+
wave orbital velocities deriver **current** (WWIII)

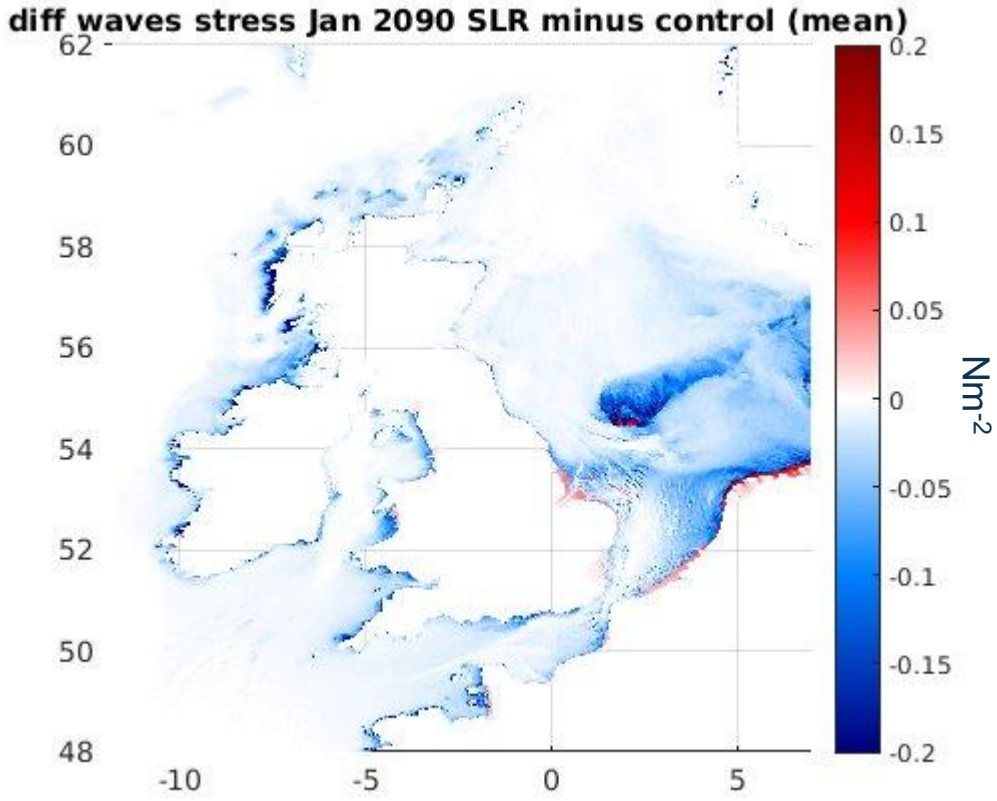
SLR results in an **overall reduction** in energy reaching the sea floor

The **stress** on the bed is slightly **reduced** on **average** (mean 1992 vs mean 2093).

In **winter**, now and in future, the biggest **waves** (storms) are a **dominant signal**.

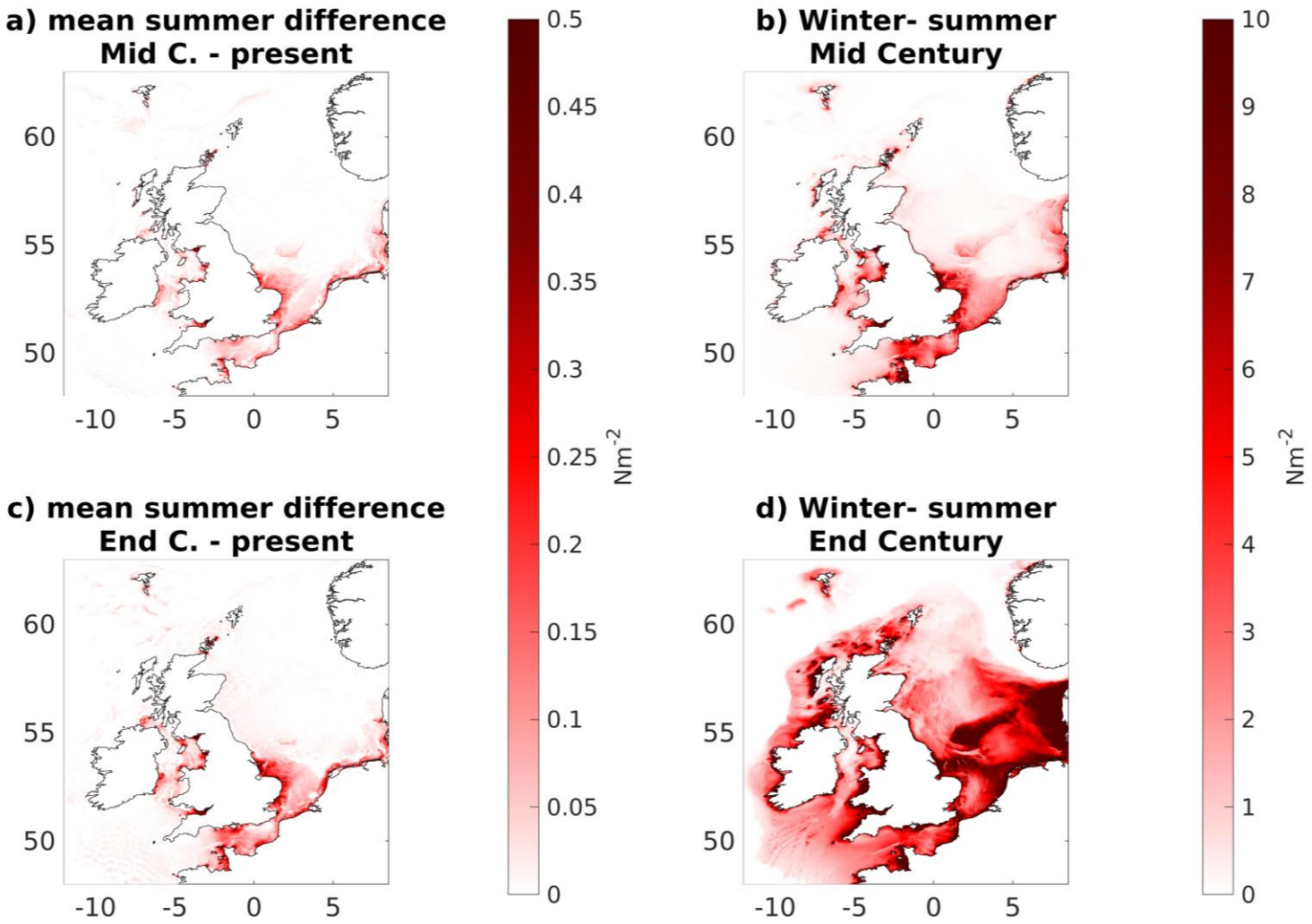
WAVE STRESS CHANGES (WINTER)





•SLR will alter tidal amplitude and phase, and lead to an overall reduction in tidal current driven bed stress
•deeper water decouples waves from the bed, so overall impact on the seabed stress is small.
•NB decoupling also means more energy reaches some coasts (e.g. North Norfolk, German Bight)

IMPORTANCE OF STORM WAVES



This a case study, it is not a representative statistic of future conditions

Winter **storm** waves have a **big impact** over the bed.

The impact of extreme storm waves is **an order of magnitude higher** than the background signal.

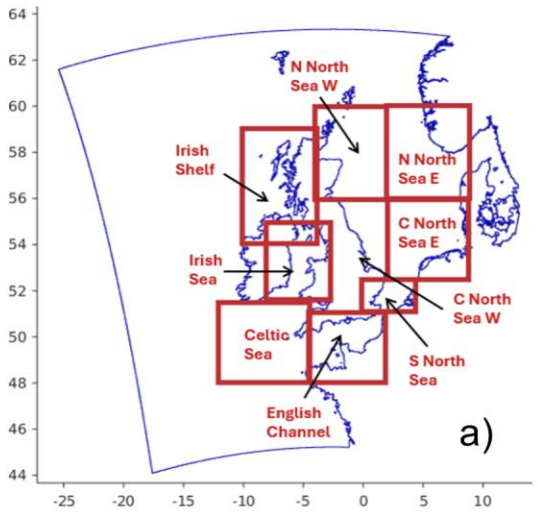
In this scenario, the effect **increase** with storms intensifying in future.

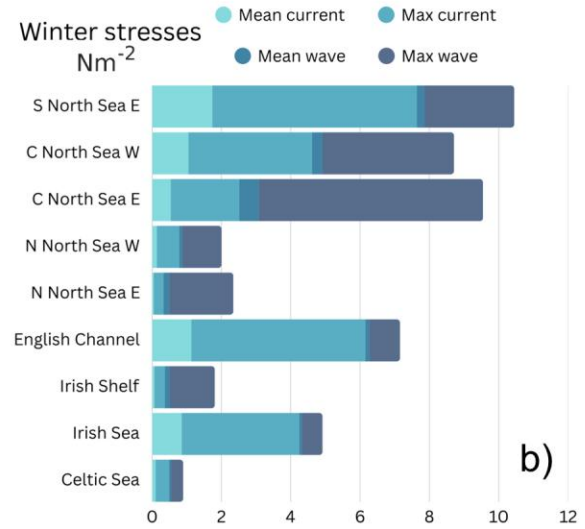
CONTROLLING PROCESSES

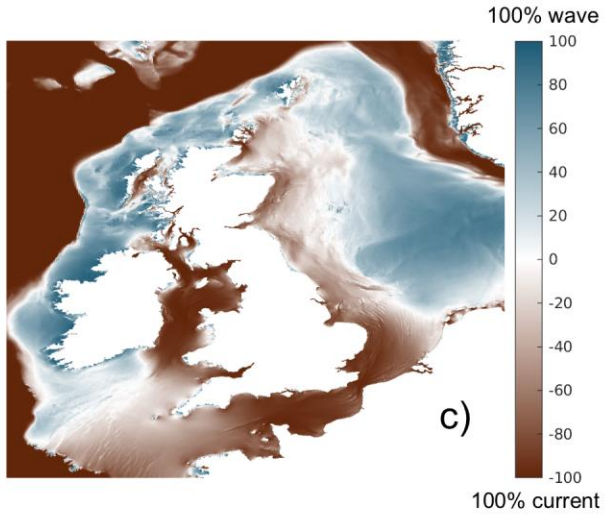
Where will waves matter the most ?

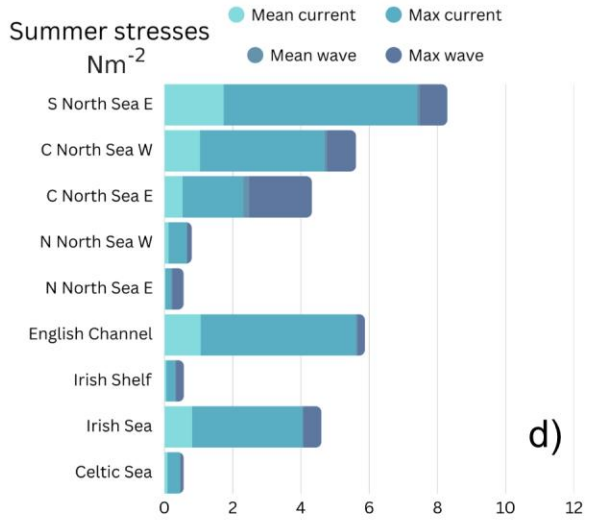
Different **controlling processes** are **dominant** in **different regions**.

The impact of waves will be particularly important over UK's **Atlantic facing coasts** and **shallow water** regions.

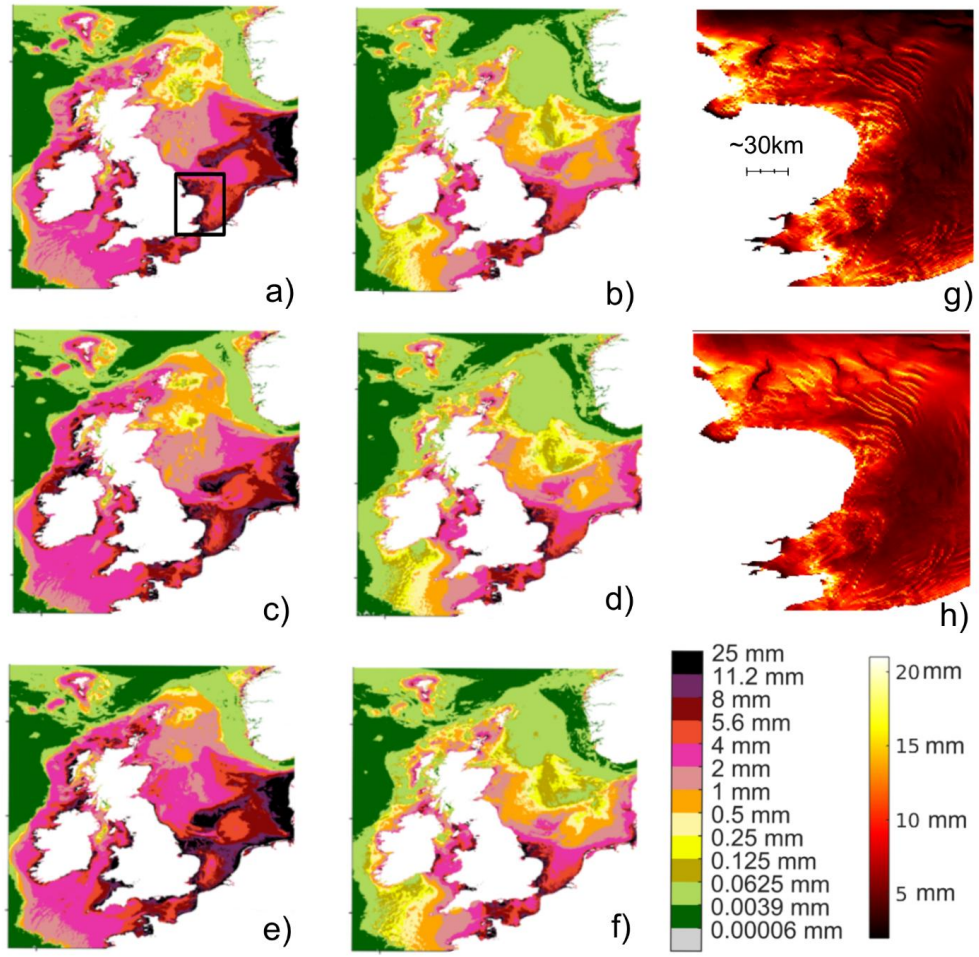


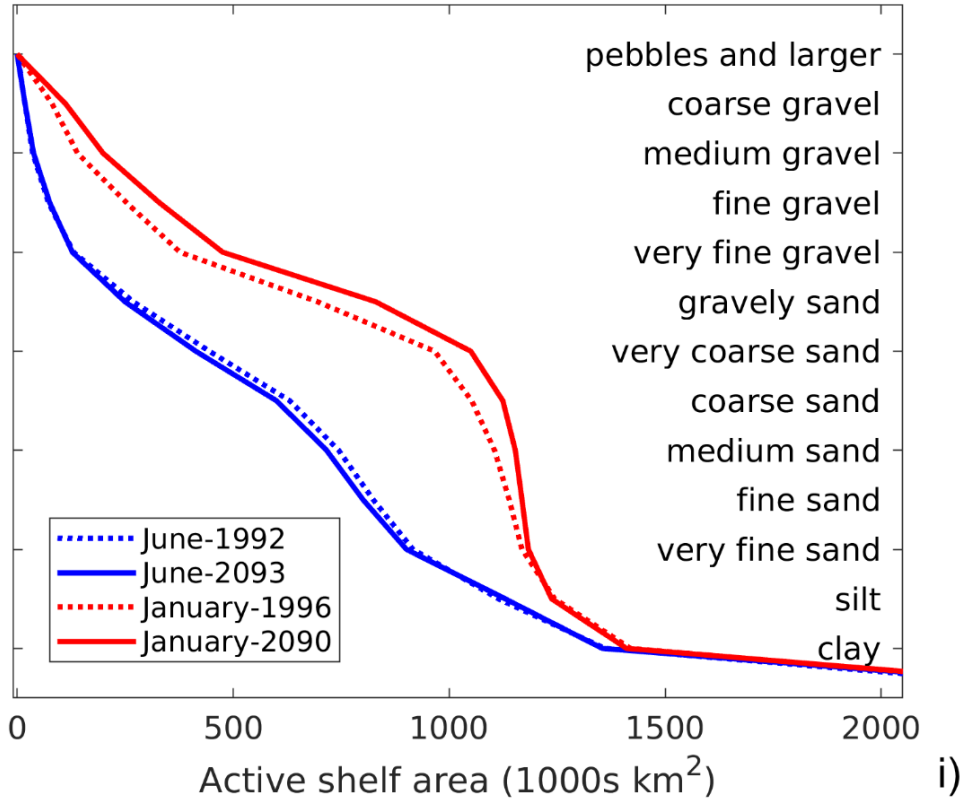






SEABED MOBILISATION





Rulent et al. 2025, in preparation

CONCLUSIONS:

The effects of waves onto the sea floor will change with sea level rise.

An increased water level will decouple wave from the seabed, leading to an overall reduction of seabed stress.

The impact of storms (bigger waves) can be up to an order of magnitude higher than that of the background signal, having a much bigger impact on the seabed.

National Oceanography Centre

THANK YOU