Wave hindcast and climate change scenario simulations for the North Sea and the Baltic Sea

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# What is coastDat and why are we doing it?

i) coastDat is an approach/framework to use models
- Regional atmospheric
- Tide-surge
- Ocean waves (sea states)
- Lagrangian transport etc.

ii) to use them in a certain way, namely
- To provide detailed reconstructions of past conditions especially for data sparse regions
- To provide as homogeneous as possible descriptions of long-term changes
- To provide consistent descriptions of met-ocean conditions
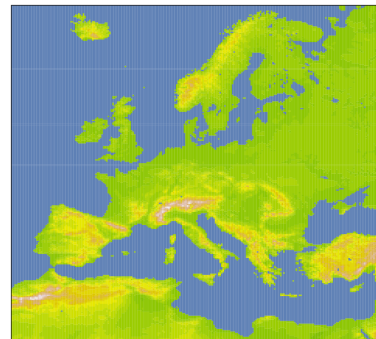- To provide consistent scenarios of potential future changes in met-ocean conditions

iii) coastDat is also a data base.
- Data are stored at high spatial and time intervals
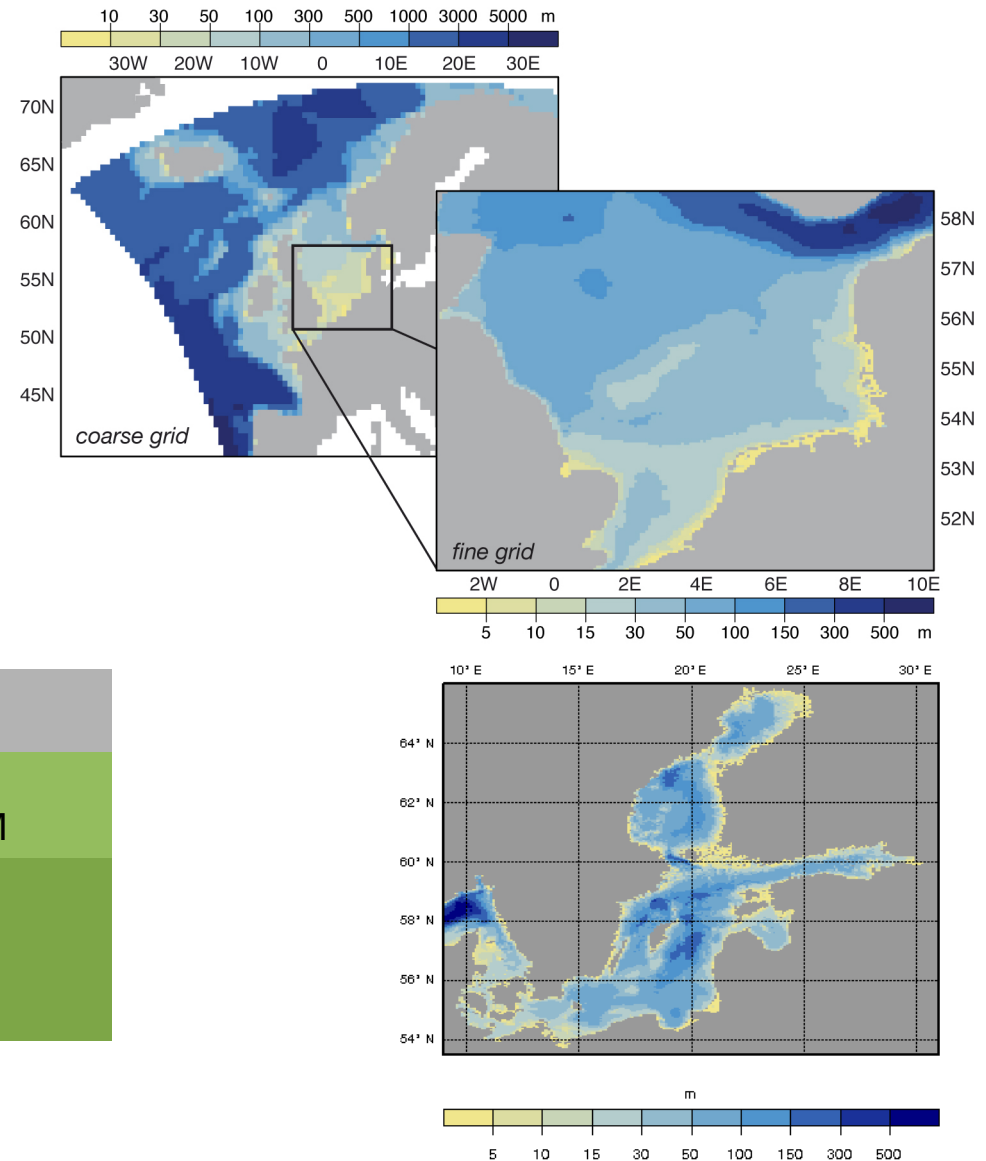- Useful for further external and internal use

coastDat model chain

GCM
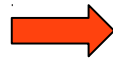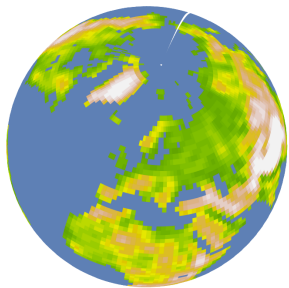
RCM

wave, 2D & 3D regional ocean models

	global	regional
hindcast simulation	reanalysis e.g. NCEP/NCAR	with spectral nudging e.g. SN-REMO ; CCLM
climate change scenario simulation	various IPCC scenarios + various GCMs e.g. ECHAM5	various RCMs: e.g. CCLM, REMO

Hindcast simulation

hindcast from Weisse&Günther 2007:

time period:1958-2002 (extended to 2007)

forcing: SN-REMO 50 x 50 km (Feser et al. 2001)

domain: 51-56N; 3W-10E (red box)

spatial resolution: 0.1x0.05 (lon x lat)

directional resolution: 15°

28 frequencies from 0.042 to 0.55Hz
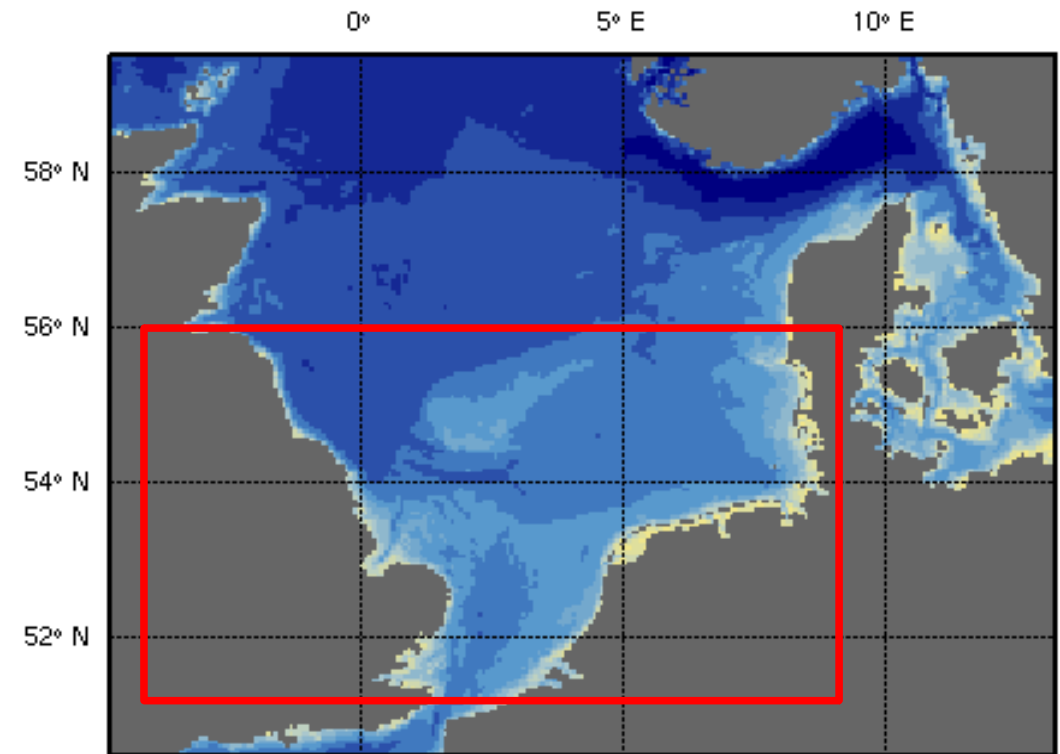
new hindcast :

time period:1948-2012

forcing: CCLM (with SN) 18 x 18 km (Geyer 2013 *in prep.*)

domain: 50.5-59.5N; 4.75W-13.25E
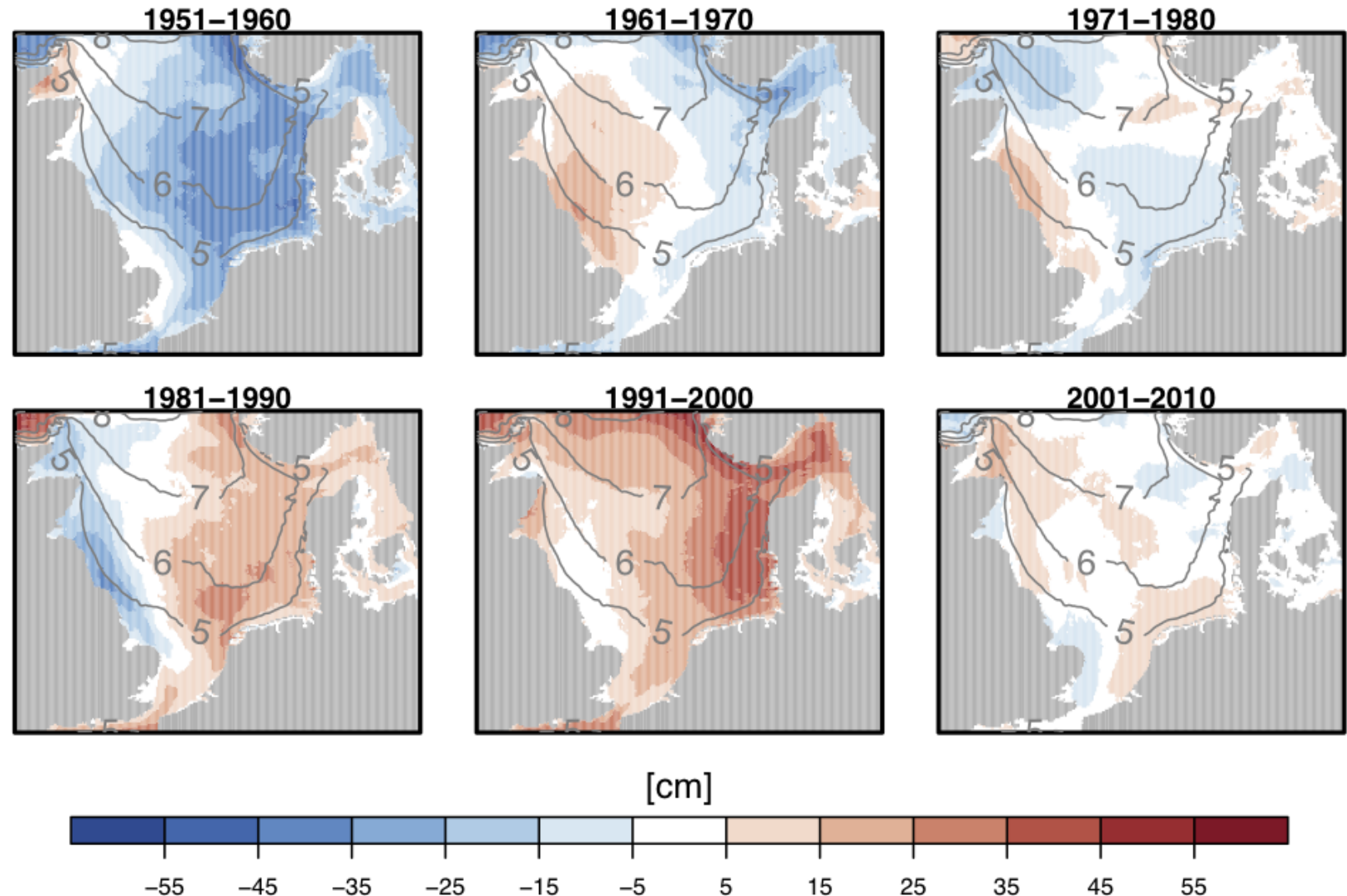
spatial resolution: 0.075x0.05 (lon x lat)

directional resolution: 15°

35 frequencies from 0.042 to 1.05Hz

Decadal variability of the 99%ile **significant wave height** relative to 1951-2010

- relatively steady increase towards 2000

- relatively mean condition in the last decade

Helmholtz-Zentrum Geesthacht

Centre for Materials and Coastal Research
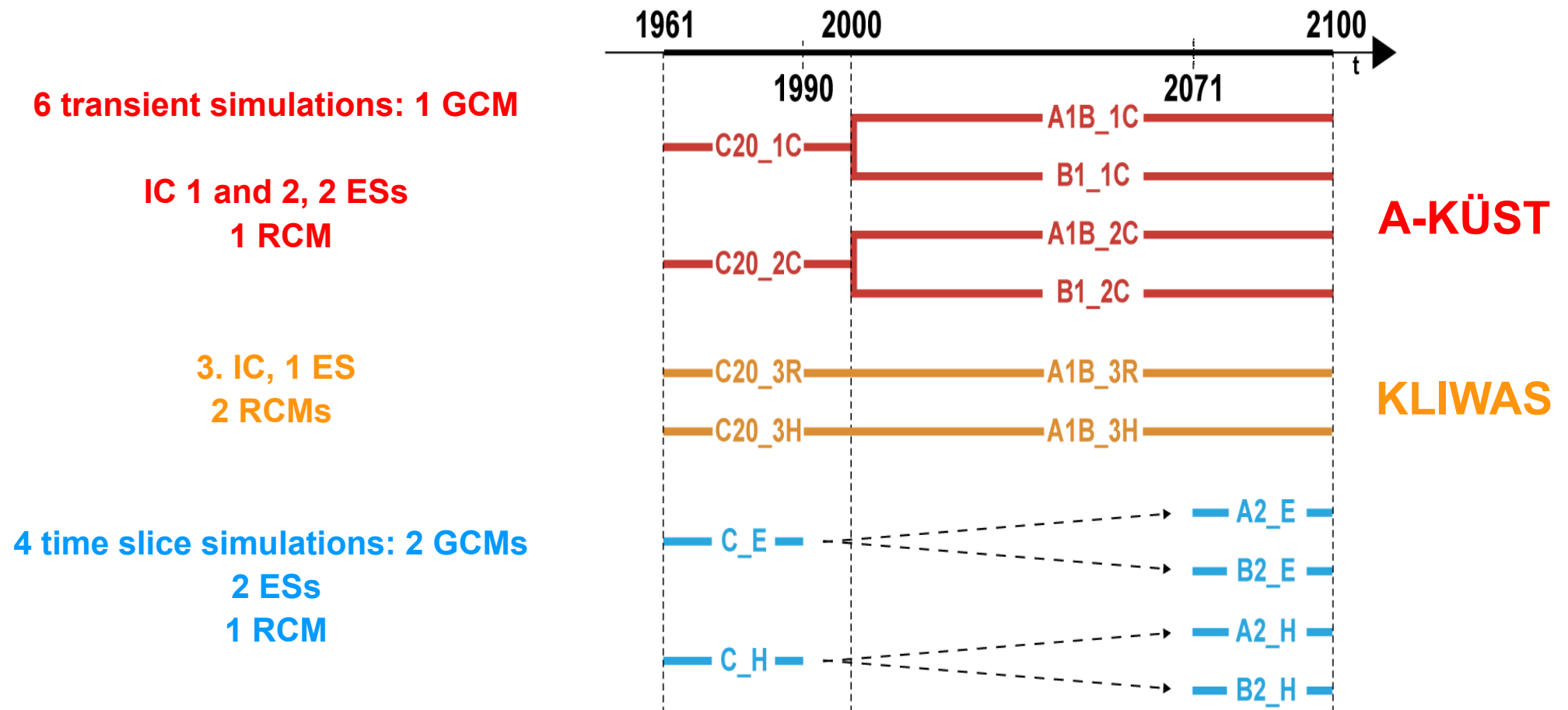
e.g. Hochtief Solutions AG

→ **coastDat in operational use**

wind and sea state statistics & data
currents, water levels

→ **design & installation**

knowledge of frequency distributions, 50yr
return values

→ **weather windows**

periods of calm weather to enable
installation and maintenance; differenet
concepts for maintenance (ship or
helicopter)

→ **Insurance**

risk assesment for bad weather condtions
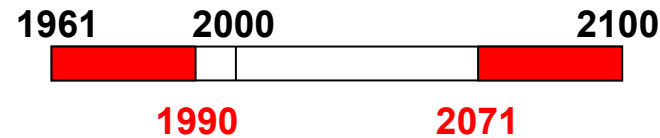
periods for Hs < 1,5m
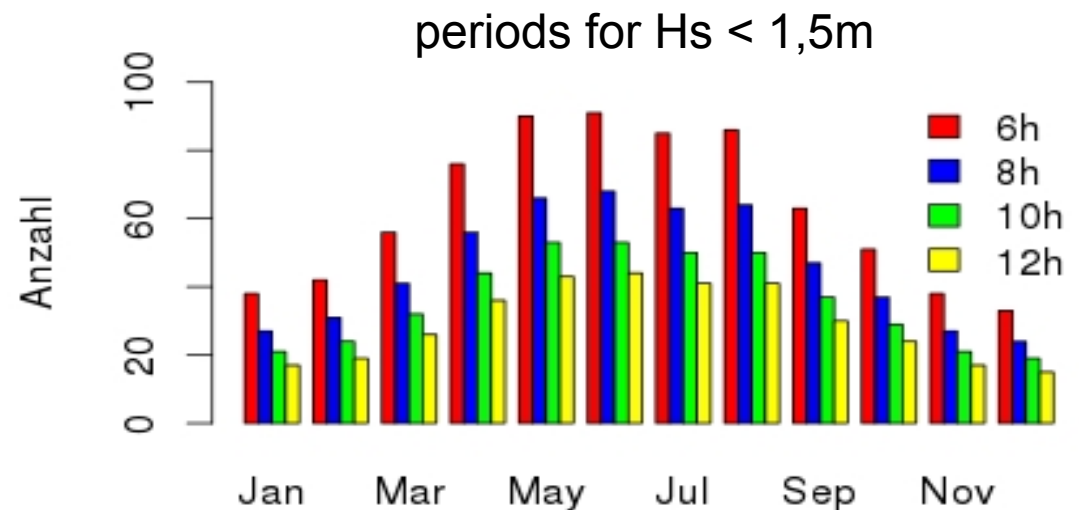
Climate projections for the North Sea

set of 10 projections: different combinations of different models (3 GCMs, 4 RCMs), 4 emission scenarios (A1B, B1, A2, B2) and different initial conditions

6 transient simulations: 1 GCM

IC 1 and 2, 2 ESs
1 RCM

3. IC, 1 ES
2 RCMs

4 time slice simulations: 2 GCMs
2 ESs
1 RCM

A-KÜST

KLIWAS

Climate projections:
changes **2071-2100** ./. **1961-1990**

climate change signals (CCS)
of significant wave height
(m, long-term 99 percentiles)
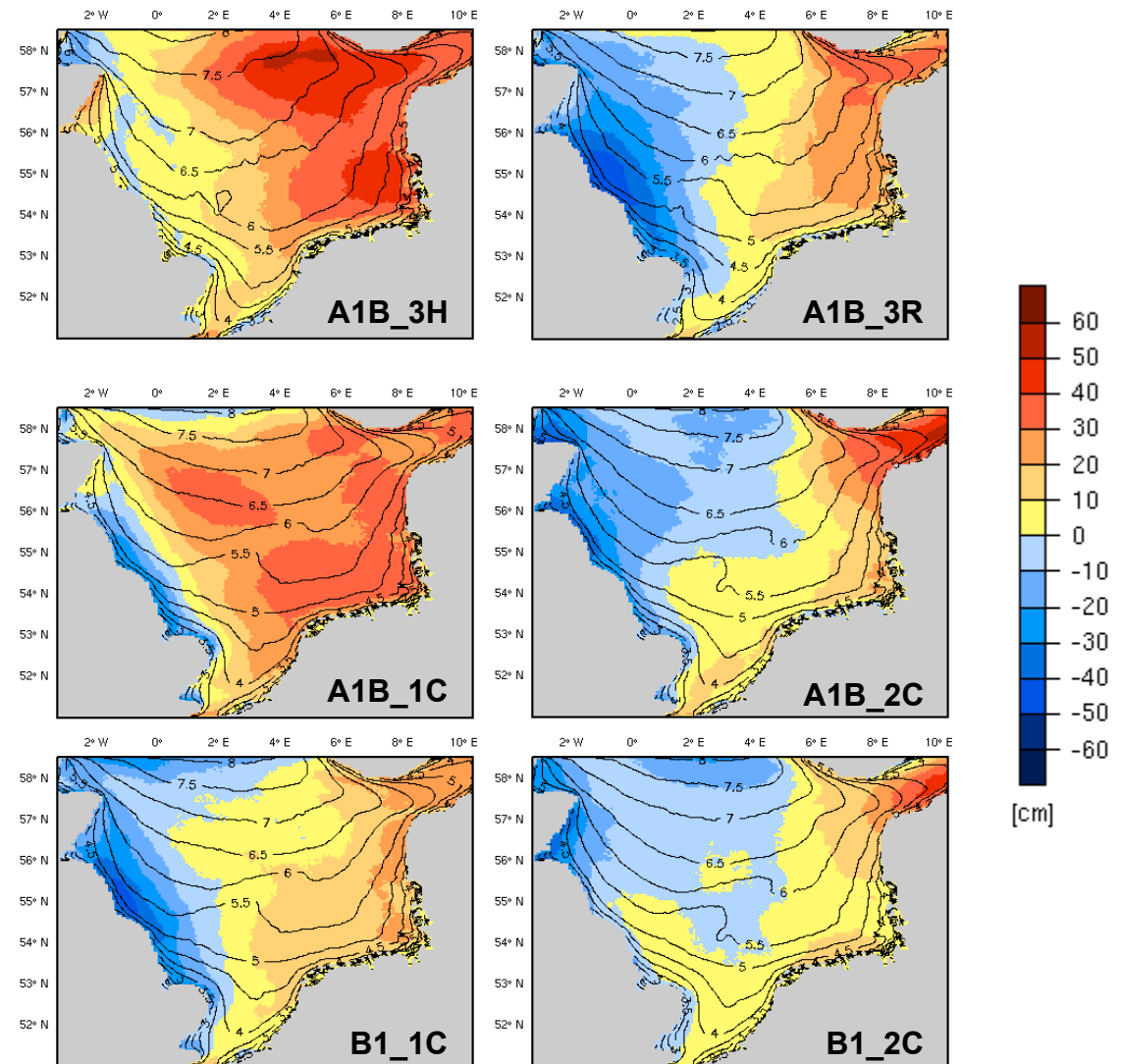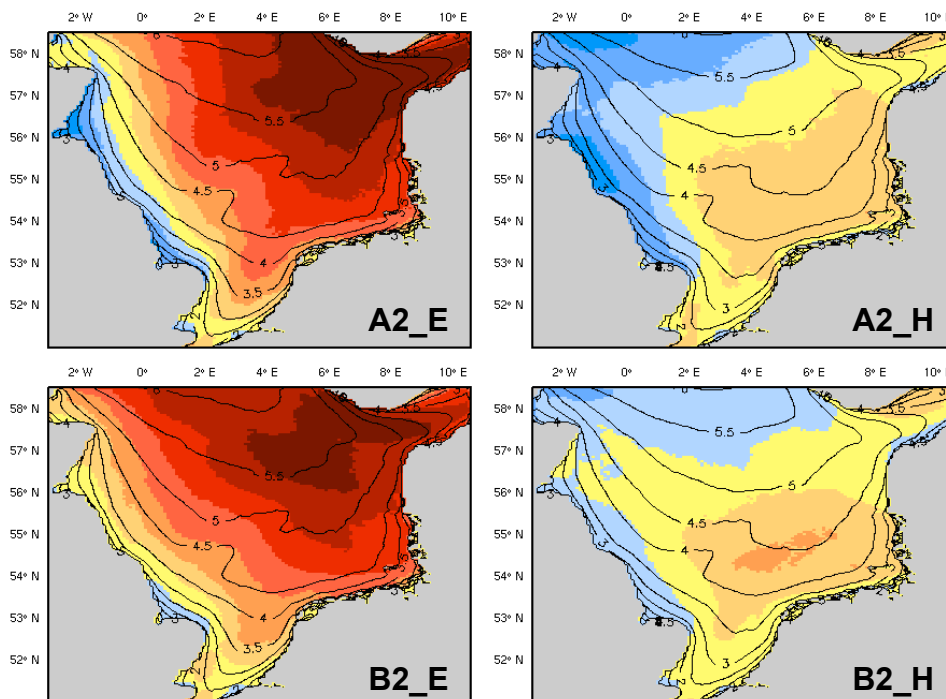
- general pattern
  increase of HS from W / NW to E / SE
  often decrease of HS in the N and W parts

- differences in both magnitude and details of spatial patterns

isolines: long-term 99 percentiles
of reference period

8

Changes of the 30yr annual distribution of significant wave height relative to 1961-1990
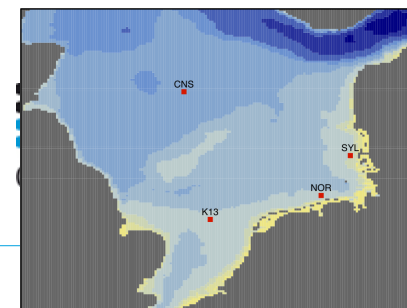

- **CNS:** more smaller waves and less higher waves towards 2100

- **NOR & SYL:** more higher waves and less smaller waves towards 2100 for most of the realizations (except A1B_1 and B1_1for NOR)

- **general:** strong decadal variations within each realization and between the realizations

Groll et al. (accepted)
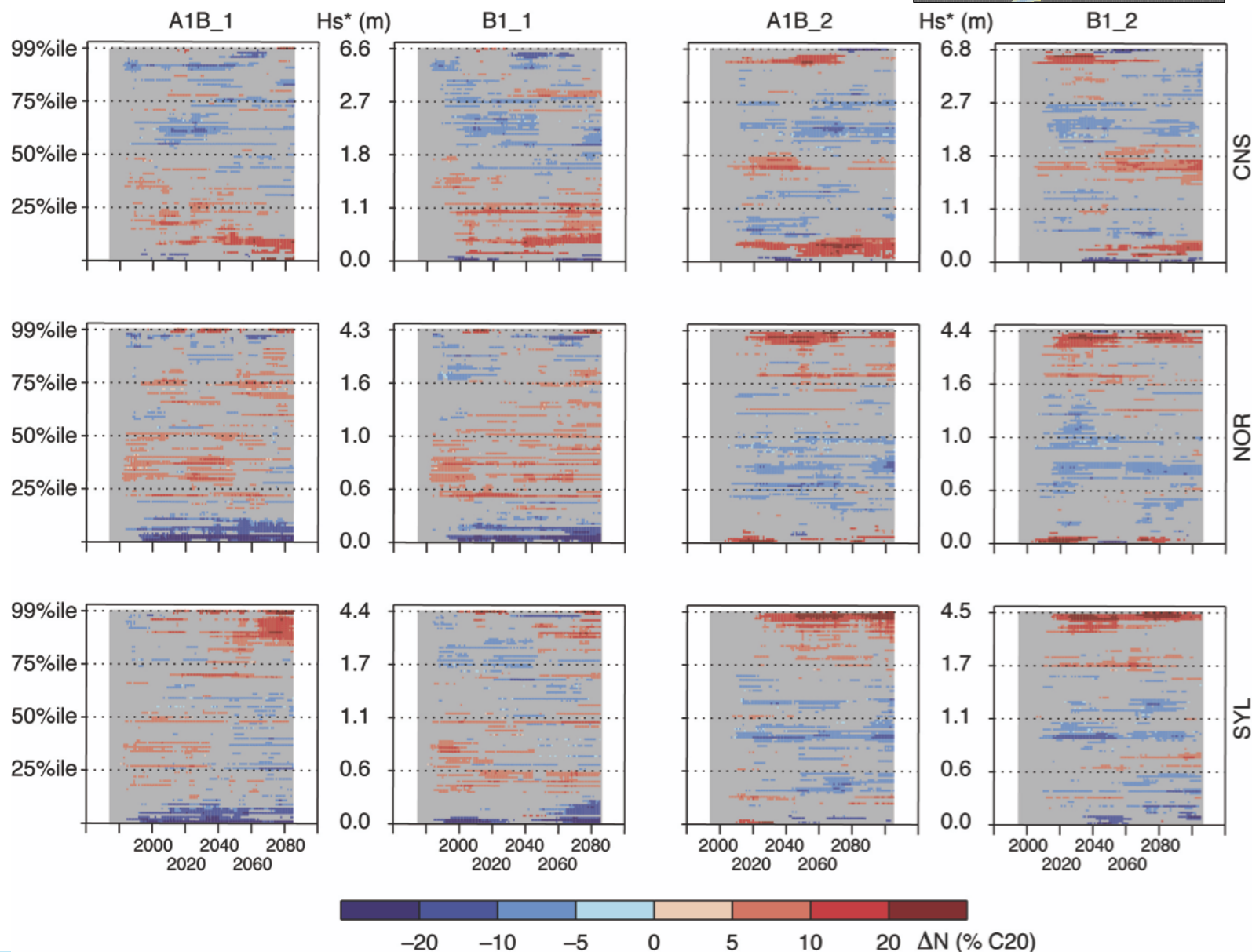
Climate change signals of the 99%ile **significant wave height** in four realizations (2x A1B, 2x B1)
2011-2040; 2041-2071; 2071-2100 ./. 1961-1990
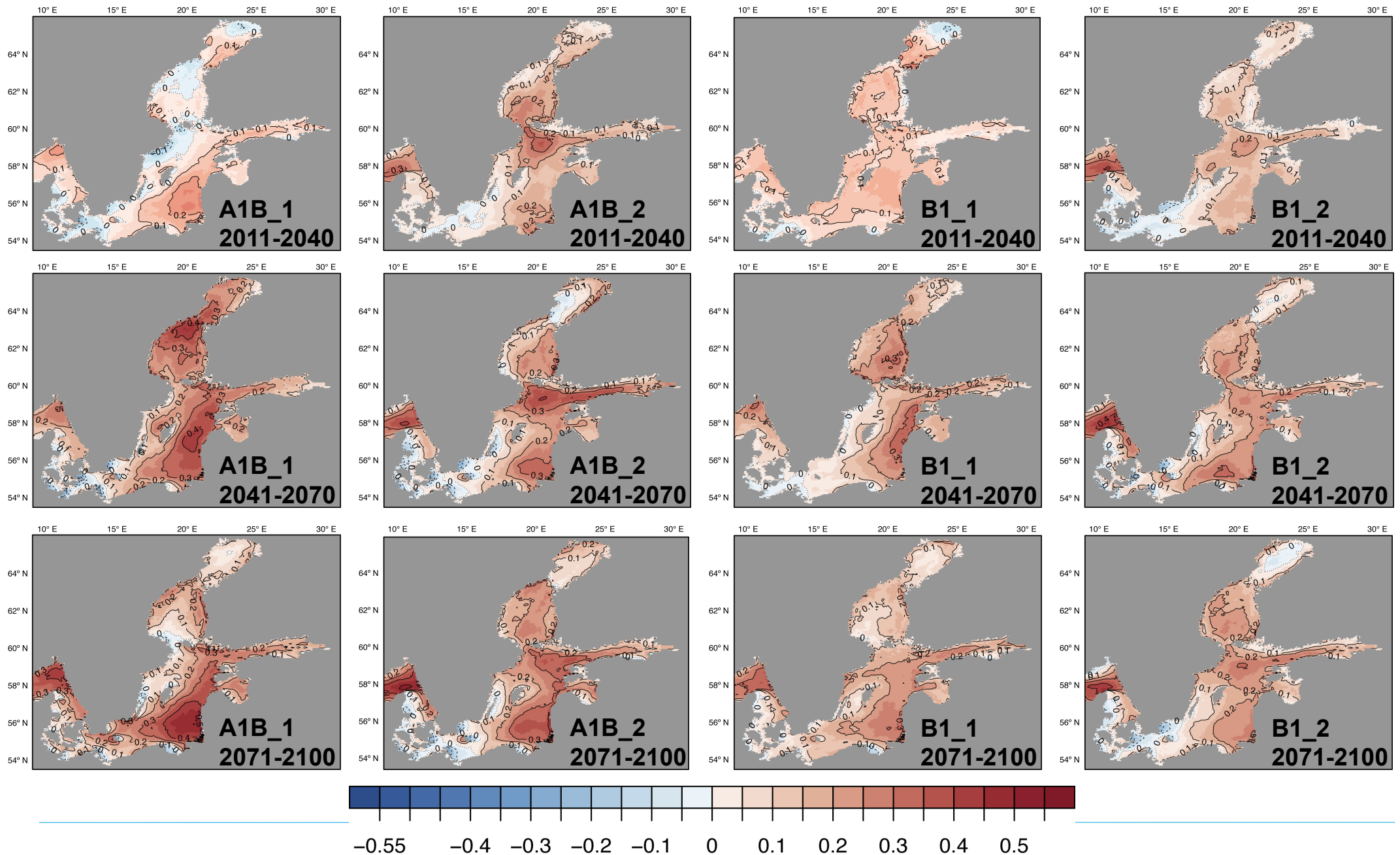
Common climate change signal of the annual maxima **significant wave height** in four realizations (2x A1B, 2x B1) 2071-2100 ./. 1961-1990
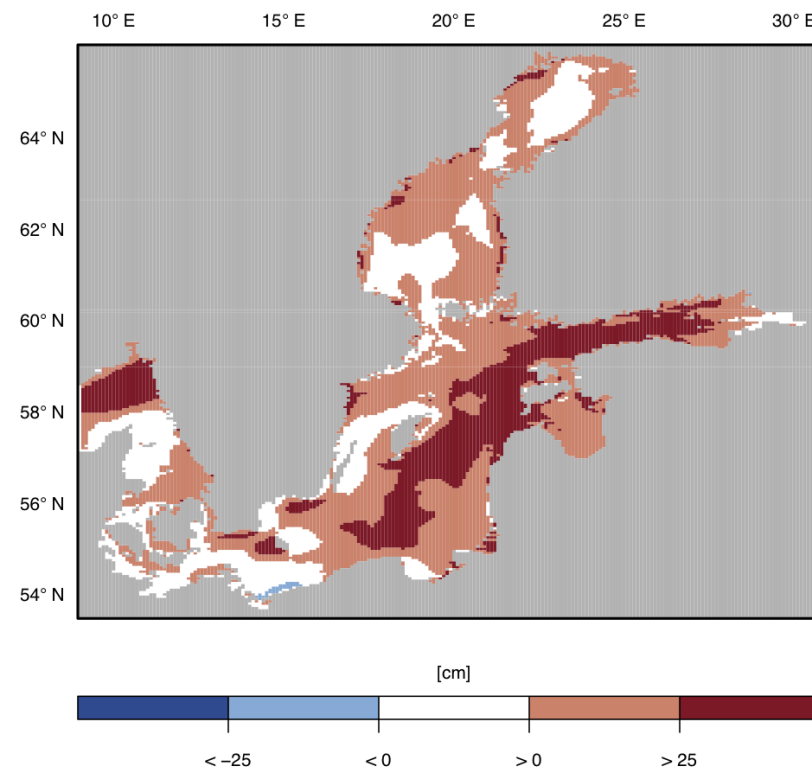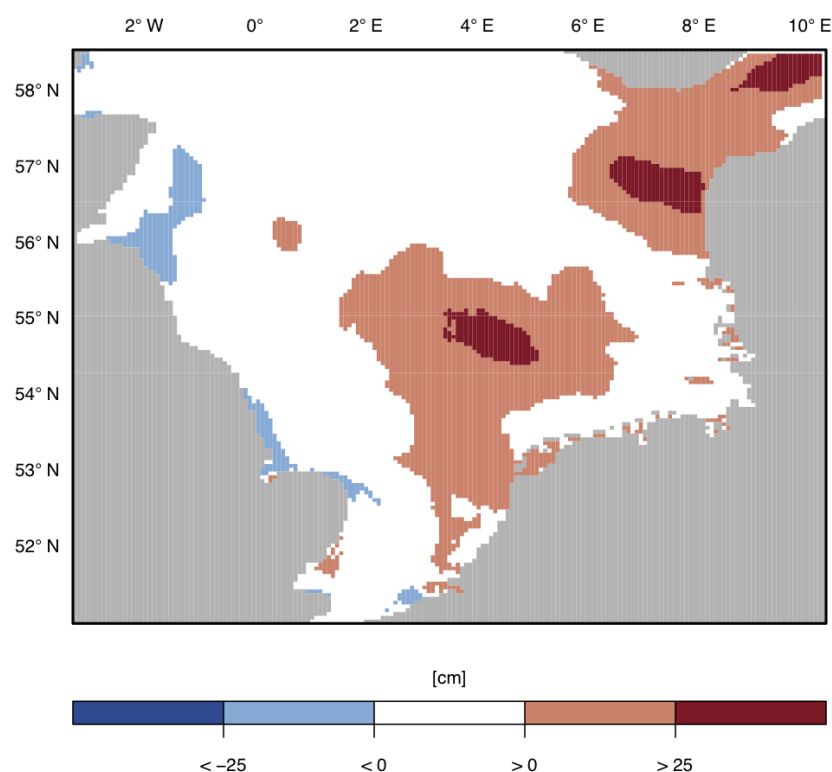
The four realizations show the same range of changes over larger areas in the Baltic Sea than in the North Sea .

Summary

$\rightarrow$ new hindcast, covering the whole North Sea from 1948 to today and will be available at www.coastdat.org

$\rightarrow$ climate change scenario simulations for the North Sea and the Baltic Sea

$\rightarrow$ spatial and temporal differences between different periods and realizations

$\rightarrow$ realizations agree in an increase of wave height over large areas but not in the magnitude of the change

Thank you for your attention