

Development and current S2D prediction skill of the Norwegian Climate Prediction Model (NorCPM)

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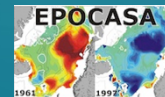
2 Geophysical Institute, University of Bergen, Norway

3 Uni Research Climate, Norway

4 Bjerknes Centre for Climate Research, Norway

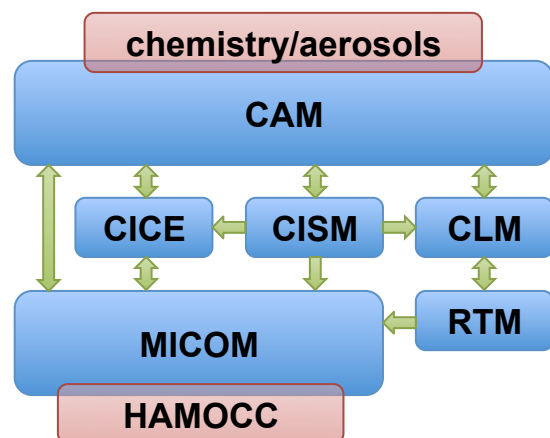
5 Norwegian Institute for Air Research, Norway

Bjerknes Climate Prediction Unit



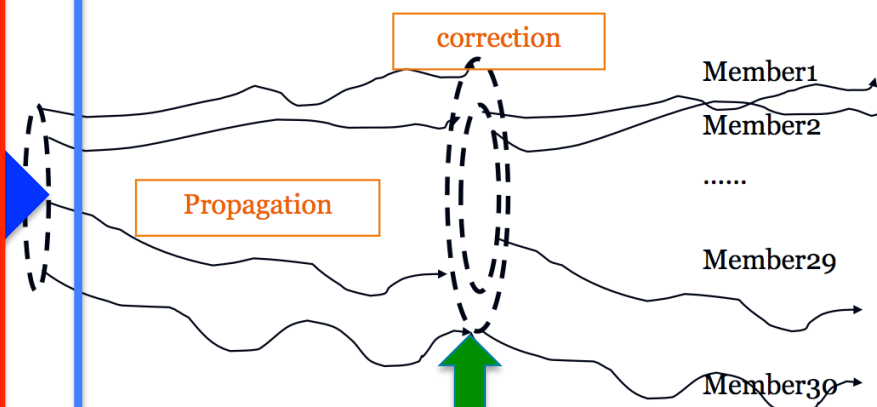
Norwegian Climate Prediction Model (NorCPM)

Norwegian Earth System model (NorESM)



30 members

Data assimilation (EnKF)

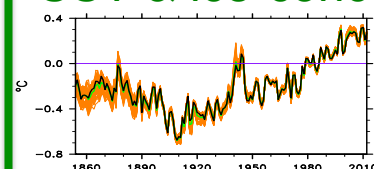


Data assimilation in NorCPM:

- We use **dynamical/flow-dependent** covariance.
- Covariance are constructed in **isopycnic** coordinate for oceanic variables.

Observations

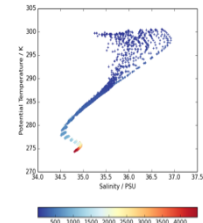
SST & ice-conc



SSH

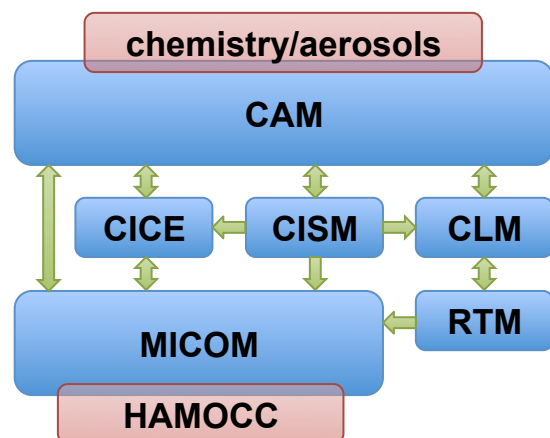


T-S profiles



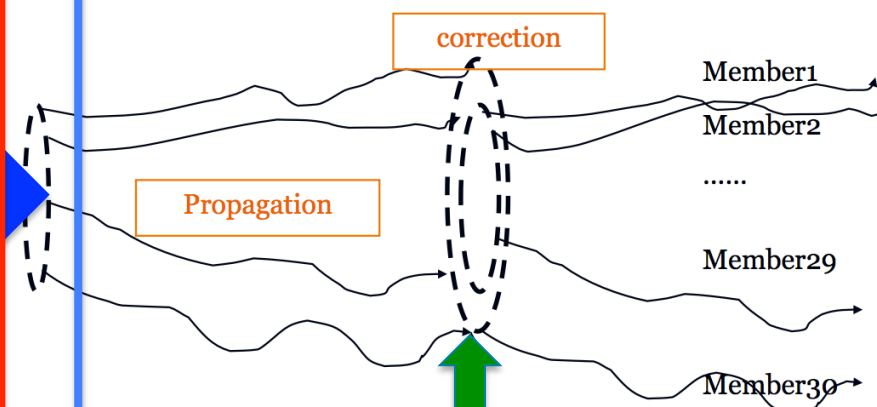
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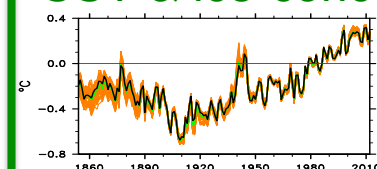


Objectives:

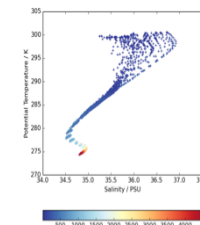
- **Climate reconstructions** (long-term reanalyses)
- **Skilful and reliable climate predictions**
 - CMIP6 decadal climate prediction project
 - Climate services

Observations

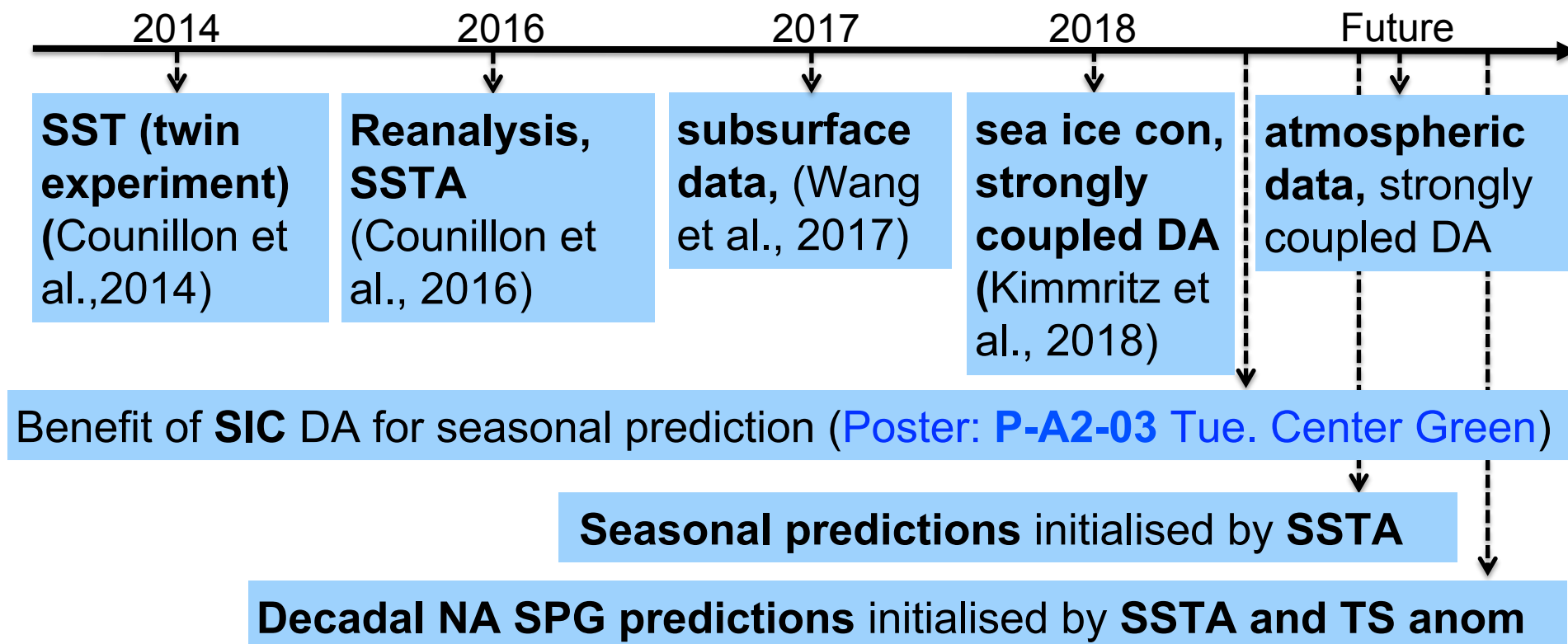
SST & ice-conc



T-S profiles

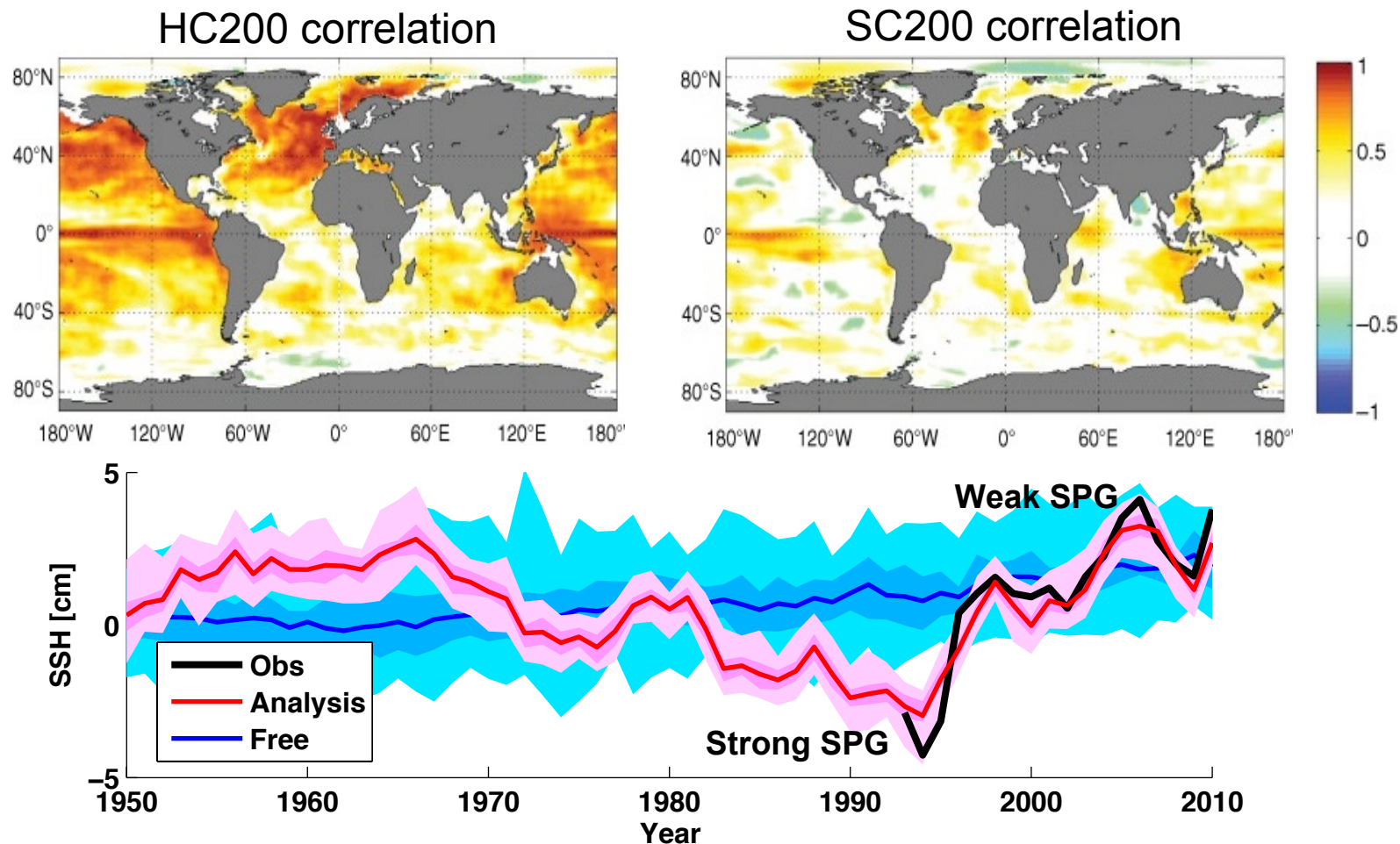


Strategy plan of NorCPM



1. Include more and more observation types into the system
2. Distinguish the benefit of adding different observation types
3. Weakly coupled DA -> strongly coupled DA
4. Assimilate **SST and subsurface data anom** for CMIP6 DCPD

Validation for the reanalysis over 1950-2010



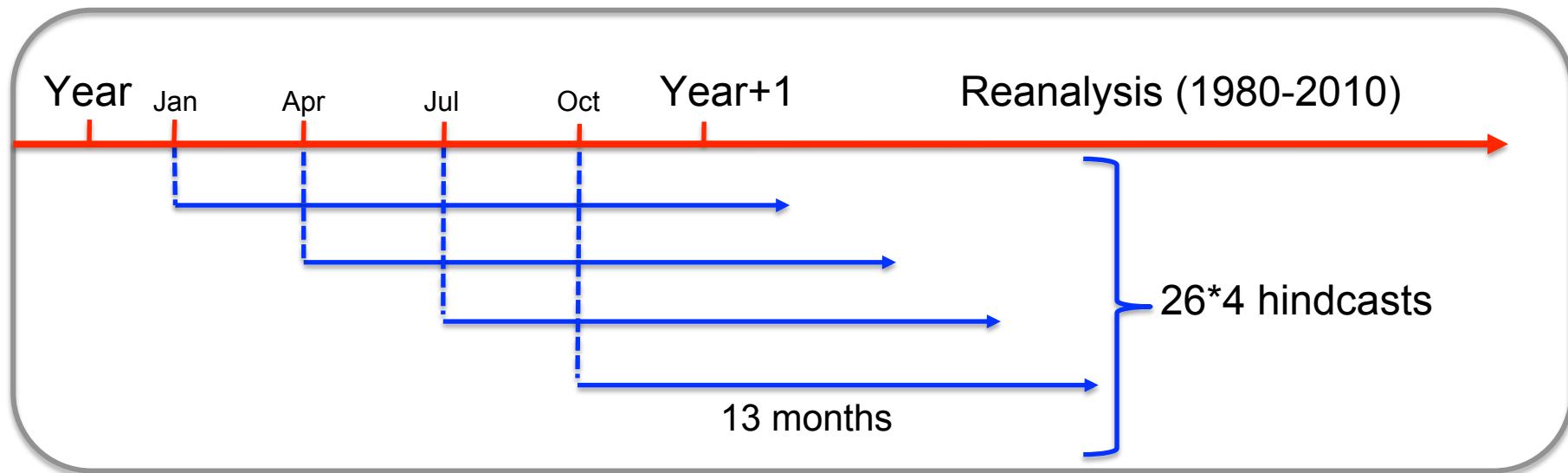
- Good match with independent observations for HC/SC and SPG
- **Potential to reconstruct the climate variability from 1850-present**

(Counillon et al., 2016)

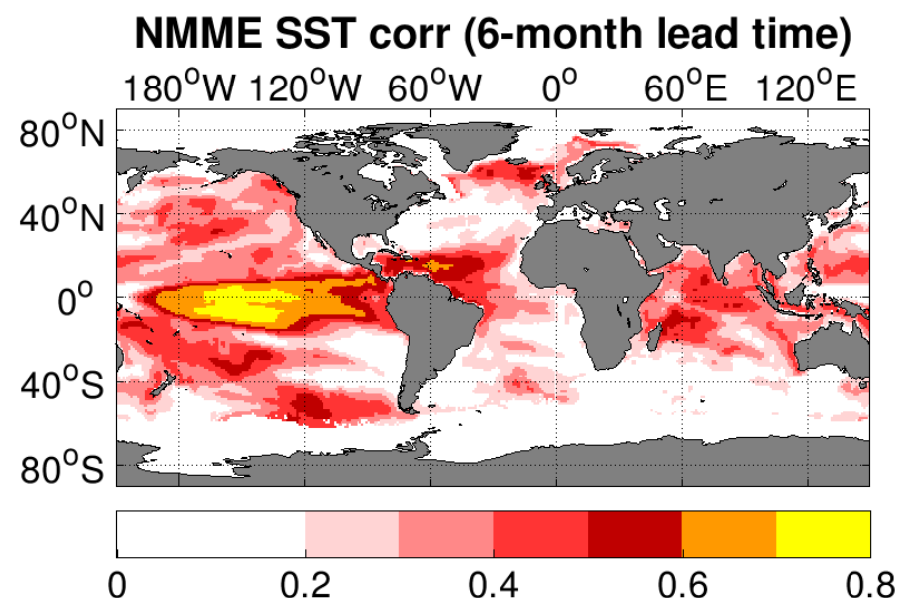
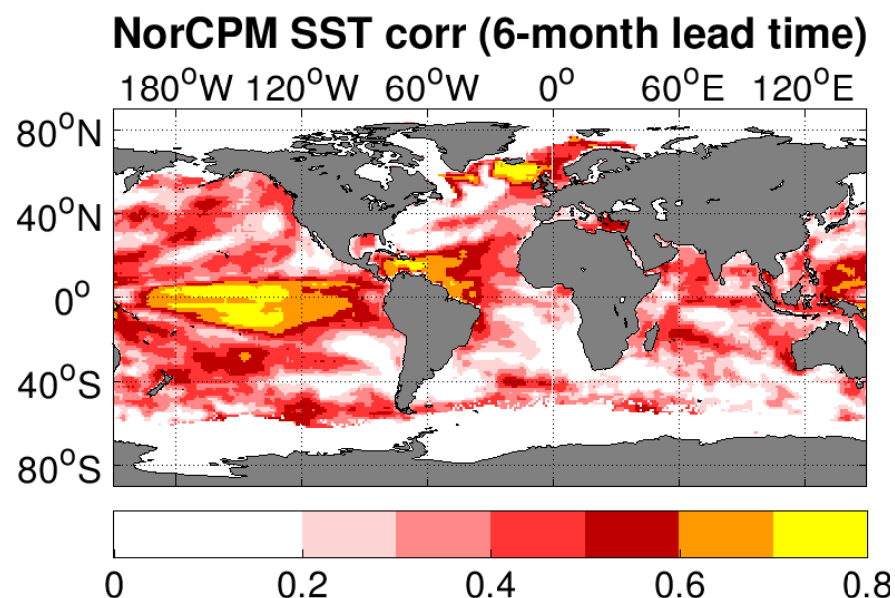
Experimental design of seasonal predictions

NorESM–ME version (CMIP5): atmosphere: $1.9^\circ \times 2.5^\circ$, 26 levels; ocean: 1° , 53 levels, historical external/RCP8.5 forcing

- **Reanalysis (1980-2010):**
 - › SST data from **HadISST2** dataset
 - › Monthly assimilate anomalies
 - › 30 ensemble members
- **Hindcast (1985-2010):**
 - › Start from **Jan, Apr, Jul** and **Oct**
 - › 9 ensemble members
 - › Last for 13 months
- Validation dataset: OISST dataset, EN4 dataset, HadISST2 sea ice dataset

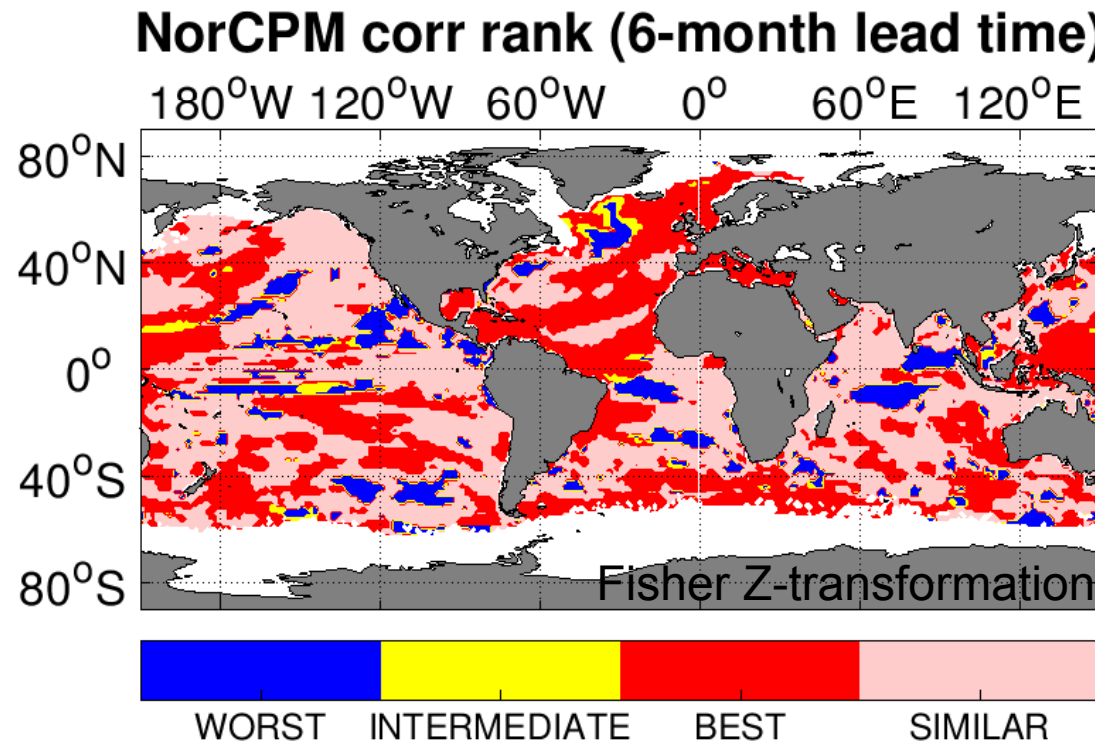


Seasonal predictions for SST



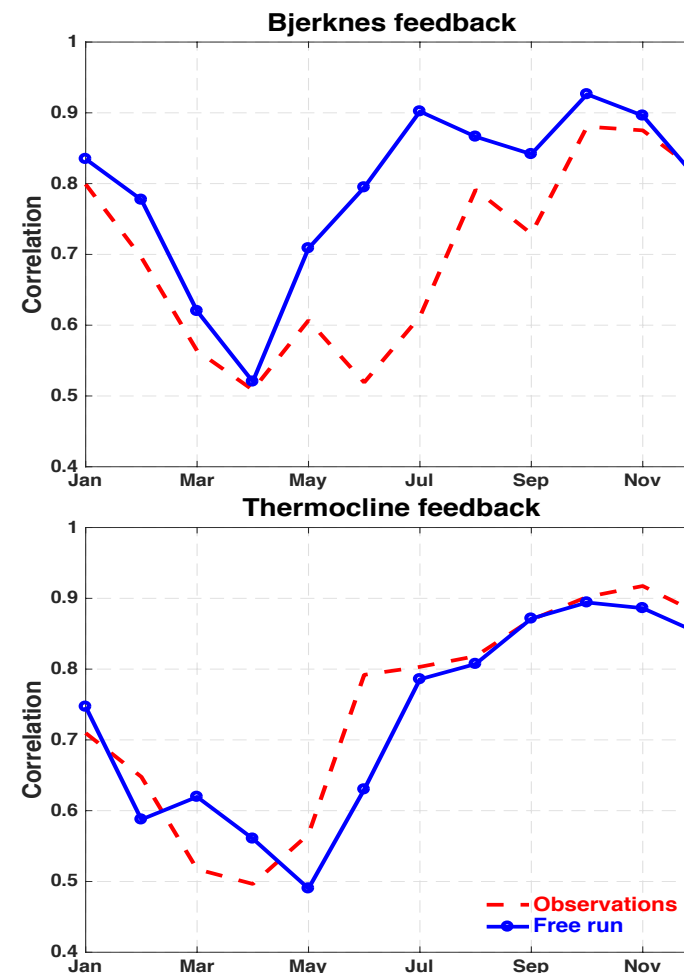
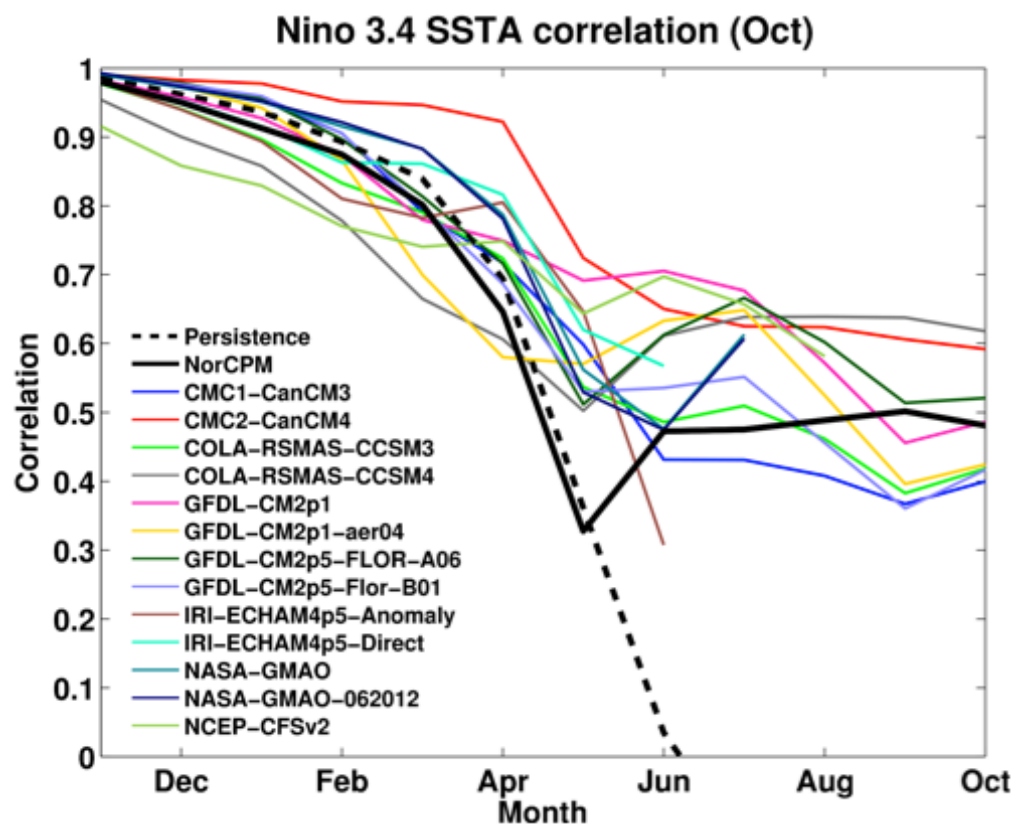
- Skilful as NMME in the tropical Pacific (due to initialisation).
- Skilful in the Iceland basin and western tropical Atlantic (due to both initialisation and global warming trend).

Seasonal predictions for SST



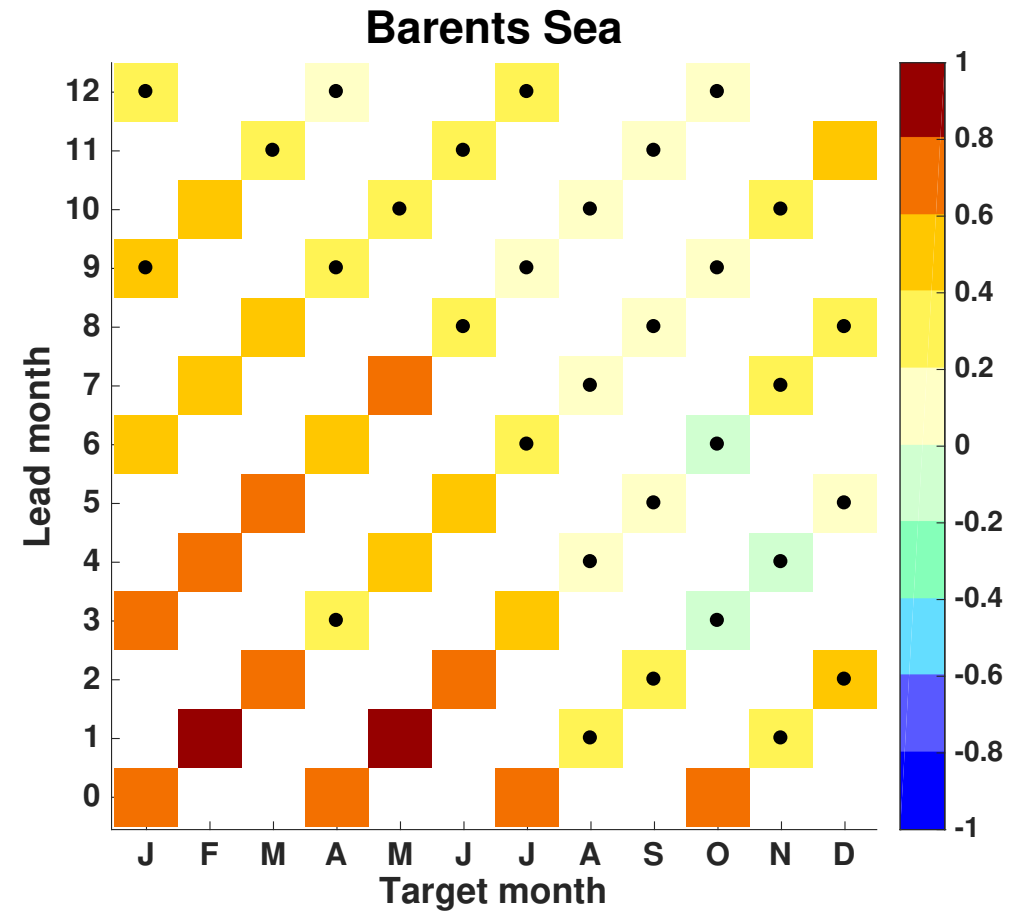
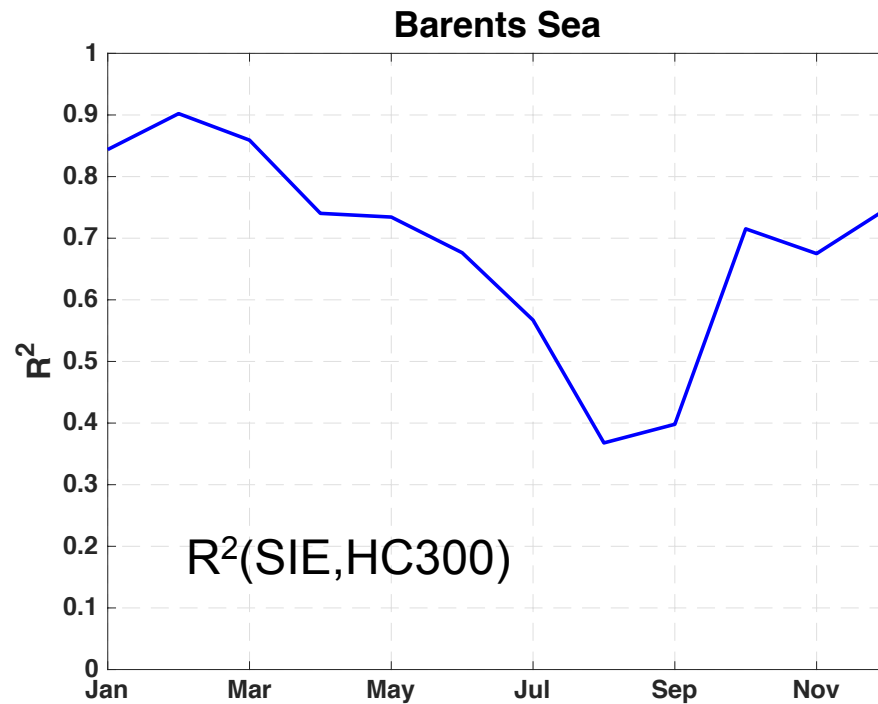
- NorCPM ranks in the SIMILAR or BEST bins in most region.
- NorCPM is among the best systems in the region extending from the Iceland Basin to the Barents Sea.

ENSO predictions (Nino 3.4 index)



- NorCPM is skillful and generally in the range of the NMME
- **May skill drop:** model deficiencies in thermocline and Bjerknes feedbacks.

Seasonal predictions for Barents sea ice extent

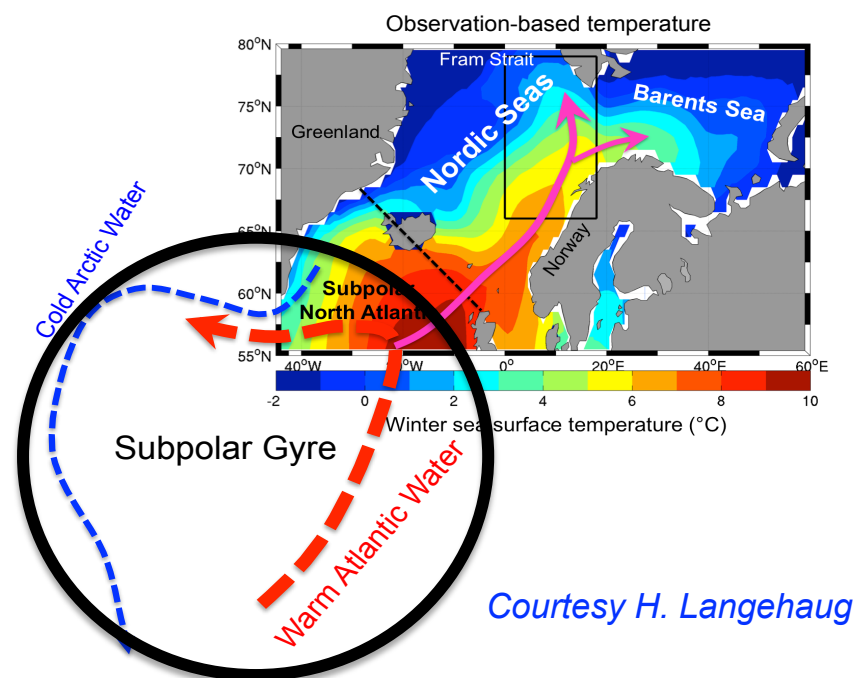
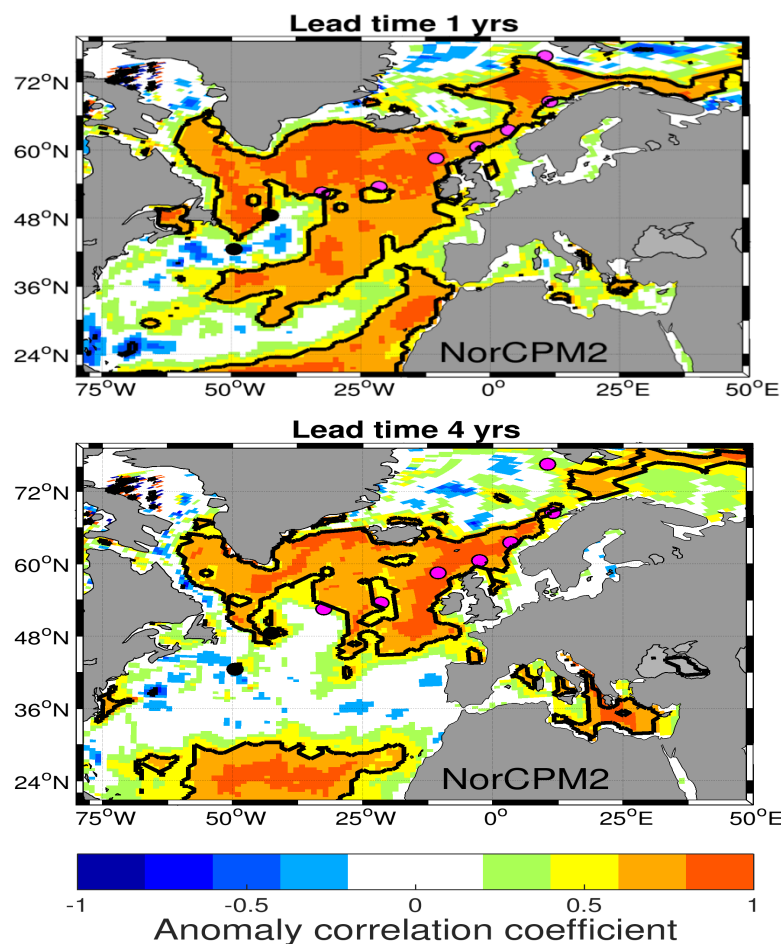


Skilful in the boreal winter-spring, highly related to the initialisation of the upper ocean heat content (Bushuk et al., 2017)

Decadal predictions initialised by SST and T/S

Starts every two years over 1985-2010

Skilful winter SST predictions up to 4 yrs



- We attribute the skill to the skilful **subpolar gyre (SPG)** predictions.
- **Warm** water: the North Atlantic Current, the Irminger Current and the Norwegian Current.
- **Cold** water: the East Greenland Current and the Labrador Current
- **Bethke, Ingo:** *Subtropical North Atlantic preconditioning key to skilful subpolar gyre prediction* (Oral presentation: B2-10).

Summary

- NorCPM will contribute to CMIP6 DCP, including assimilation of SST and subsurface data.
- Assimilating SST reproduces well the climate variability in particular in the north Atlantic, showing a potential of SST data (HadISST2) to reconstruct the climate back to 1850.
- At seasonal timescales, NorCPM can successfully predict the variability of SST and Arctic SIE 8 months in advance.
- At decadal timescale, NorCPM can predict winter SST in the NA SPG region several years ahead (up to 4 yrs in northern part of SPG).