Decadal predictability of sea ice in the North Atlantic sector in three CMIP5 models

H. R. Langehaug, K. Lohmann, T. Eldevik, D. Matei, Y. Gao
WHAT IS THE ROLE OF SEA SURFACE TEMPERATURE FOR THE PREDICTABILITY OF SEA ICE?

Decadal predictability of sea ice in the North Atlantic sector in three CMIP5 models

H. R. Langehaug, K. Lohmann, T. Eldevik, D. Matei, Y. Gao
The research leading to these results has received funding from:

**RCN-EPOCASA** Enhancing seasonal-to-decadal Prediction Of Climate for the North Atlantic Sector and Arctic

**EU-NACLIM** North Atlantic climate
CMIP5 models are initialized every fifth year.

Nine 10yrs-hindcasts for the period 1961-2010.

- MPI-ESM-LR
- IPSL-CM5-LR
- CNRM-CM5

CMIP5 hindcasts compared with HadISST data.
Questions to answer…

› Are hindcasts of SST significantly correlated with observations (HadISST)?

› Are hindcasts doing a better job than non-initialized runs (historical + rcp4.5)?

› Is the correlation skill high/low in the Nordic Seas compared to the Barents Sea?

› Which season gives the highest correlation skill?

› Is the spatial pattern predictable?

Std of March sic from NSIDC
High variability in sea ice in North Atlantic sector…
Correlation skill for three models...

- Time series are detrended
- Winter season (Nov-Mar)
- Ensemble mean

**Winter SST**

**MPI-ESM-LR**

**CNRM-CM5**

**IPSL-CM5**

- **hindcast**
- **historical**
Correlation skill for three models…

- Time series are detrended
- Winter season (Nov-Mar)
- Ensemble mean

Winter SST

- MPI-ESM-LR
- CNRM-CM5
- IPSL-CM5
Correlation skill for three models…

- **Fisher transformation**: add together correlation skill for each ensemble member

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**MPI-ESM-LR**

**CNRM-CM5**

**IPSL-CM5**

- **Winter SST**
Correlation skill for three models...

- Fisher transformation: add together correlation skill for each ensemble member

- MPI-ESM-LR
- CNRM-CM5
- IPSL-CM5
Significance level = 0.67 (9 data points in the constructed time series)

- HadISST (1°x1°) is interpolated to ocean model grid
- Correlation is done in each grid point for the ensemble mean
- Time series are detrended

Correlation skill for MPI-ESM-LR

March SST

Lead time 1 - 3 yrs

Nordic Seas east
HadISST (1°x1°) is interpolated to ocean model grid
Correlation is done in each grid point for the ensemble mean
Time series are detrended

Significance level = 0.67 (9 data points in the constructed time series)
Correlation skill for MPI-ESM-LR

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- HadISST (1°x1°) is interpolated to ocean model grid
- Correlation is done in each grid point for the ensemble mean
- Time series are detrended

Correlation skill for MPI-ESM-LR

March SST

Lead time 6 - 8yrs

Significance level = 0.67 (9 data points in the constructed time series)
Is the spatial pattern predictable at each time step?

**Time 1:** hindcast = 2 & lead time = 6-8yrs → mean 1971-1973

**Time 2:** hindcast = 3 & lead time = 6-8yrs → mean 1976-1978

Vectors are constructed from a map of SSTs at a specific time

Polynom is removed from time series

MPI-ESM-LR
Is the spatial pattern predictable at each time step?

Hindcast is initialized in...

60  Good
65  Good
70  Good
75  Good
80  Good
85
90
95  Poor
100 Poor

March SST for MPI-ESM-LR

All correlations are significant
Questions to answer…

› Are hindcasts of **SST** significantly correlated with observations (HadISST)?

› Are hindcasts doing a better job than non-initialized runs (historical + rcp4.5)?

› Is the correlation skill high/low in the **Nordic Seas** compared to the **Barents Sea**?

› Which season gives the highest correlation skill?

› Is the spatial pattern predictable?

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› Are hindcasts of **SST** significantly correlated with observations (HadISST)?

**At some lead times for MPI-ESM-LR and IPSL-CM5**

› Are hindcasts doing a better job than non-initialized runs (historical + rcp4.5)?

**At some lead times for MPI-ESM-LR and IPSL-CM5**

› Is the correlation skill high/low in the Nordic Seas compared to the Barents Sea?

**Similar shape for MPI-ESM-LR**

› Which season gives the highest correlation skill?

**Winter season**

› Is the spatial pattern predictable?

**Yes, in some periods…**

Hindcast is better than historical when initialized in 1960-1980.
A taste of sea ice…

To be continued…