



**Barcelona
Supercomputing
Center**

Centro Nacional de Supercomputación

Improving the representation of sea ice variability and seasonal prediction

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APPLICATE.eu 

Advanced prediction in
polar regions and beyond

APPLICATE General Assembly

Reading, January 29, 2019

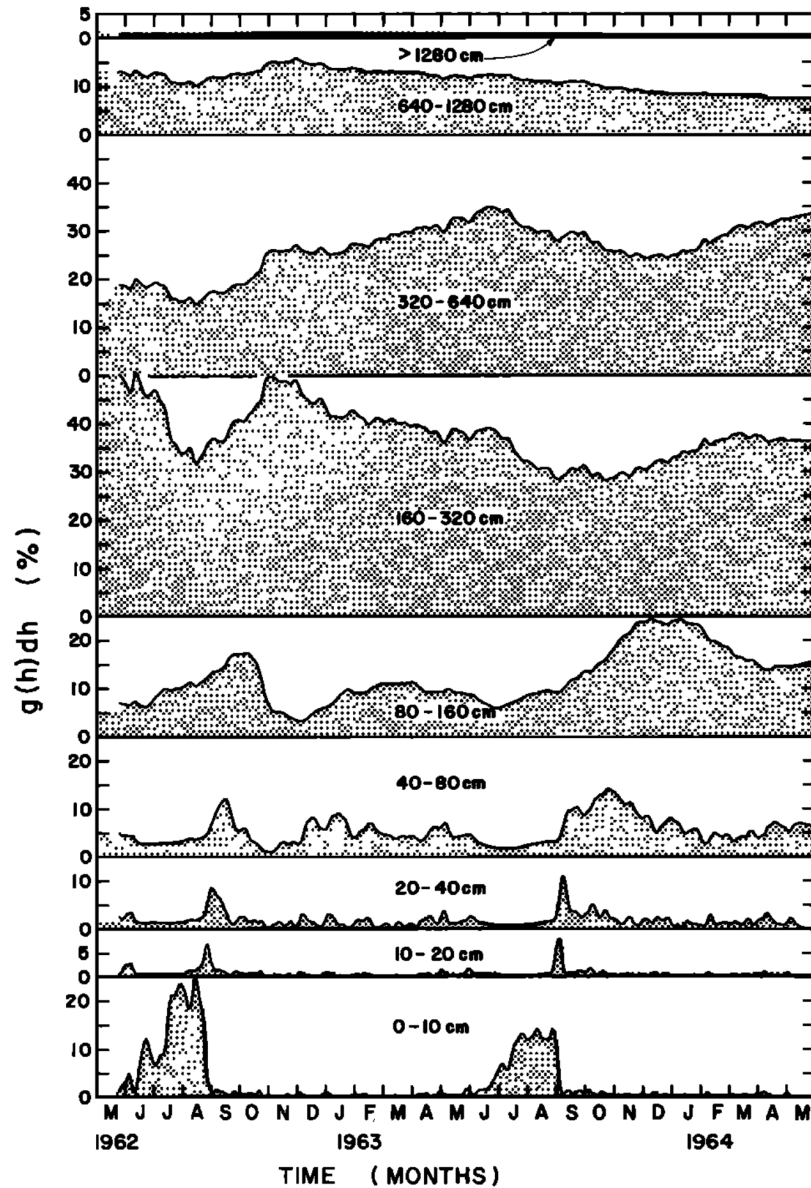
eduardo.moreno@bsc.es

Real sea ice can be this complex ...

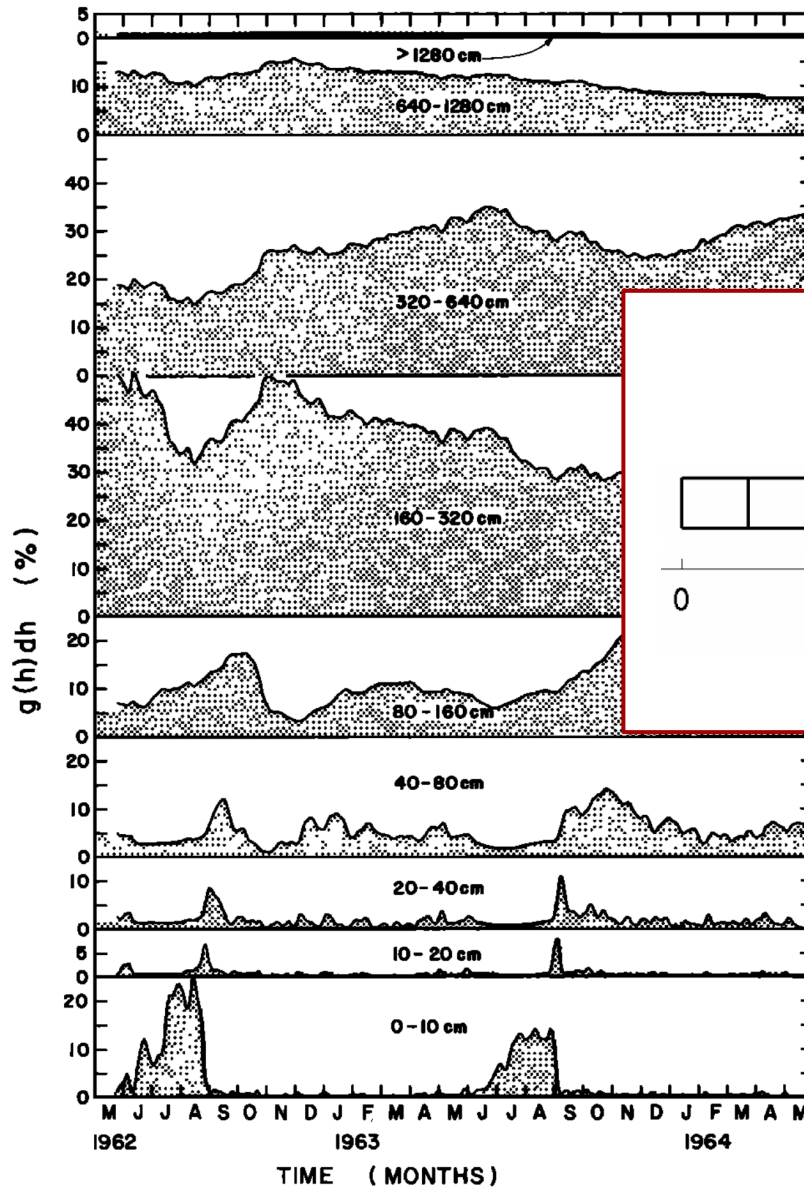


**Das Eismeer
(Caspar David Friedrich)**

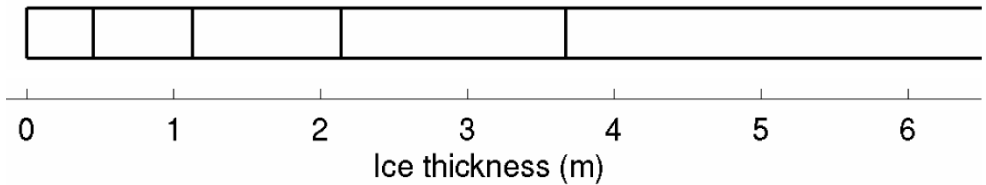
Sea ice thickness distribution in climate models



Sea ice thickness distribution in climate models



5 categories by default in LIM3,
the sea ice component of EC-Earth



Adapted from Massonnet et al. [in review]

To what extent does the thickness distribution shape the variability of the simulated sea ice?

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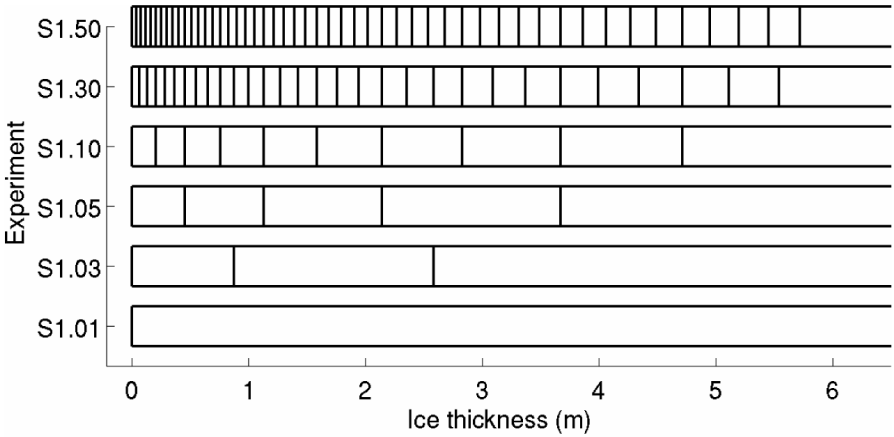
– Ocean–sea ice climate model: NEMO-LIM3.6

Historical simulations, driven by DFS5.2 atmospheric forcing

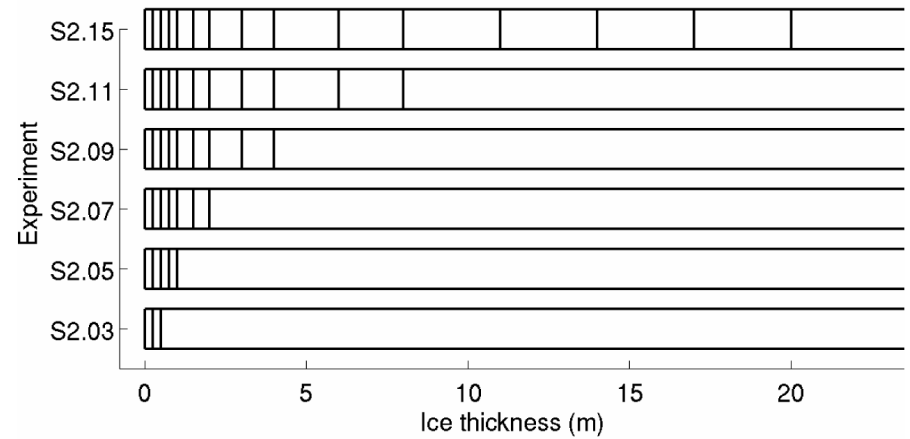
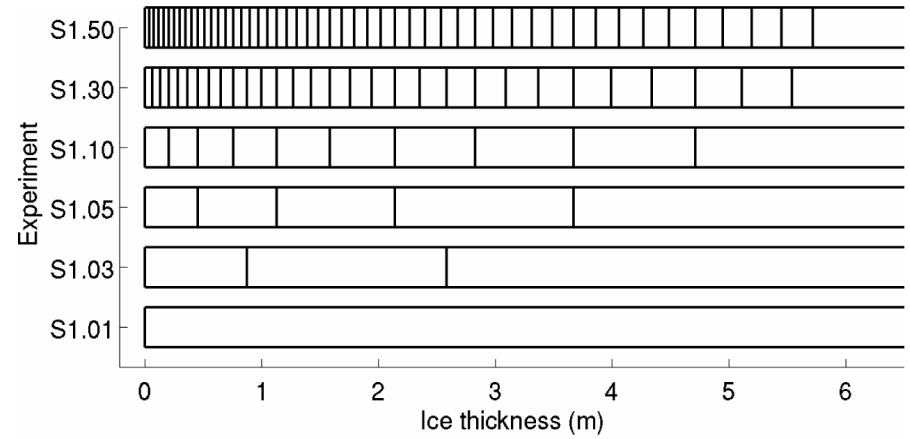
Three different ice thickness distribution:

→ number of categories // boundaries' positions

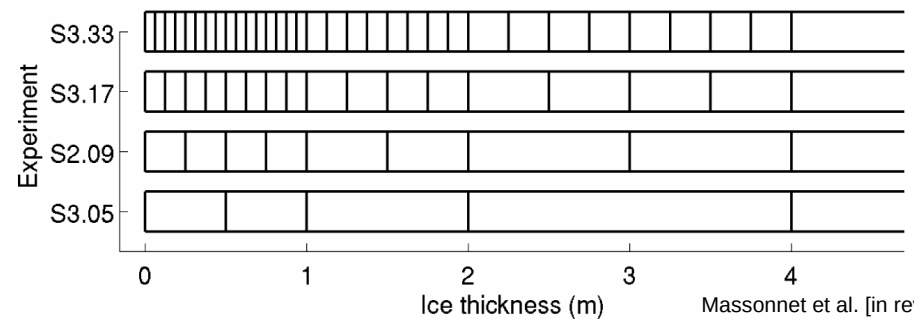
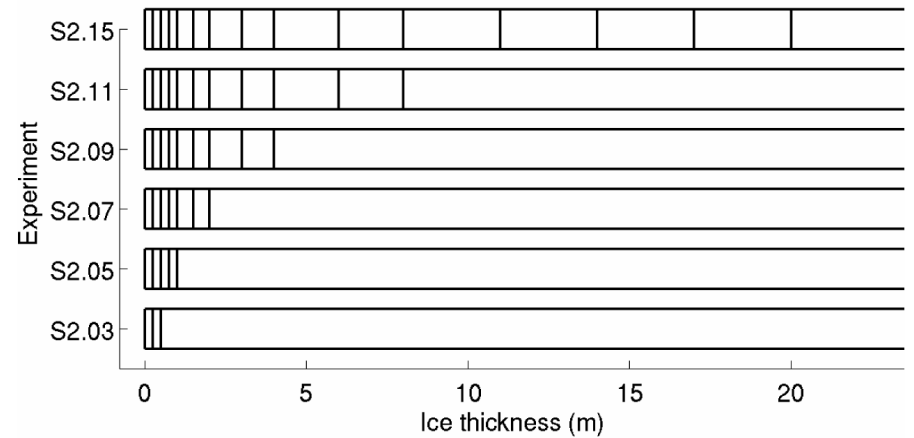
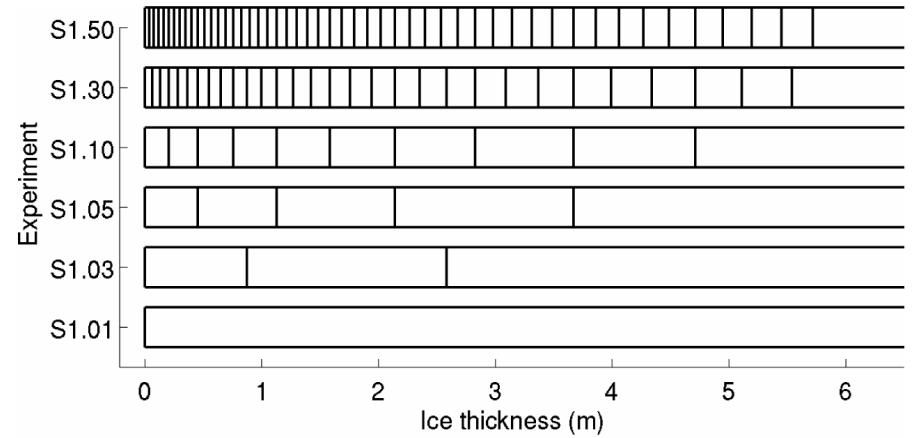
To what extent does the thickness distribution shape the variability of the simulated sea ice?



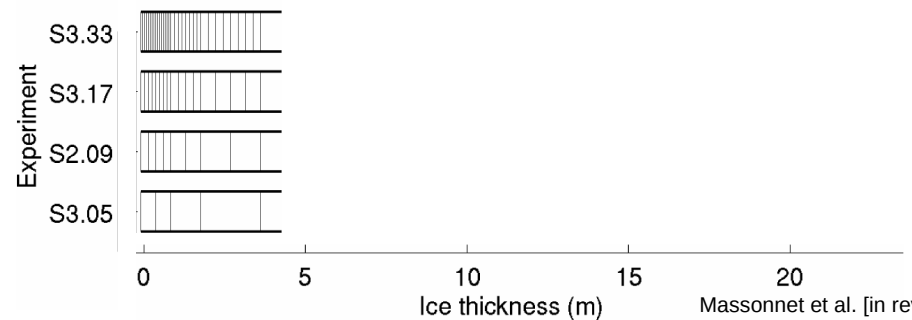
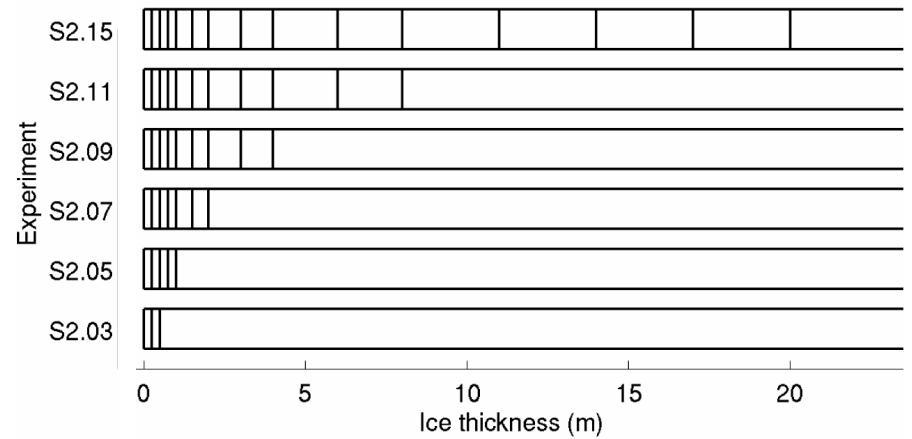
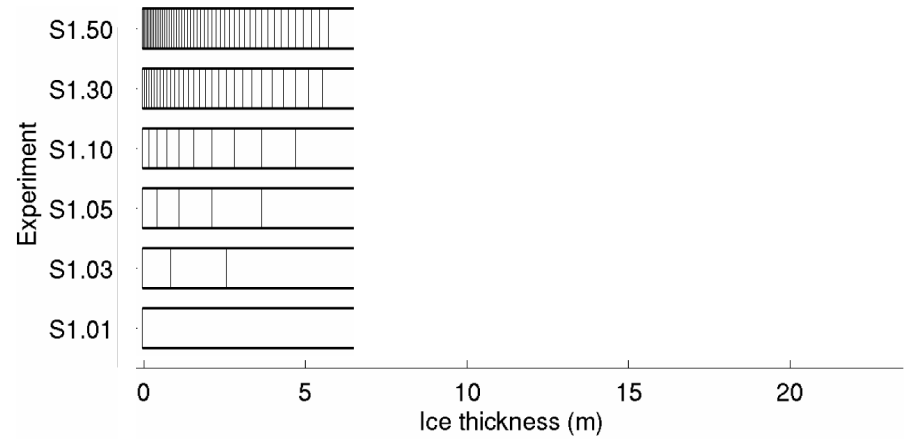
To what extent does the thickness distribution shape the variability of the simulated sea ice?



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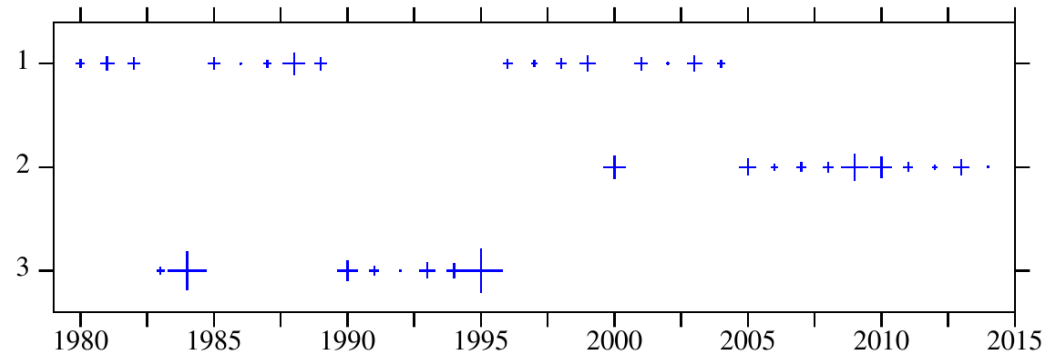
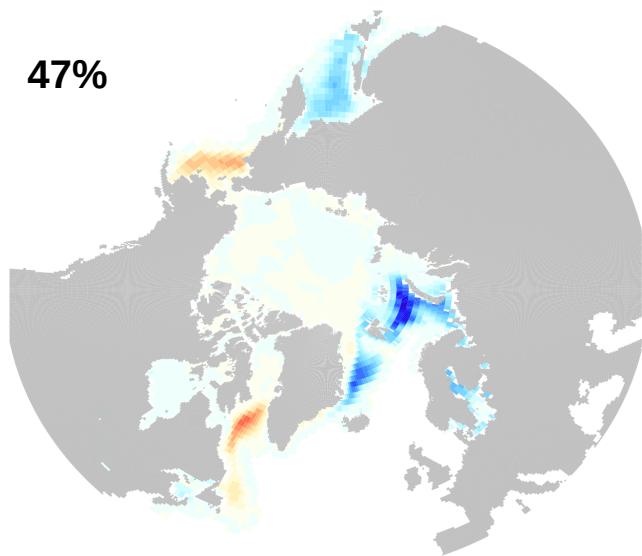
To what extent does the thickness distribution shape the variability of the simulated sea ice?

- Ocean–sea ice climate model: NEMO-LIM3.6
 - Historical simulations, driven by DFS5.2 atmospheric forcing
 - Three different ice thickness distribution:
 - number of categories // boundaries' positions
- Satellite observations of Arctic sea ice concentration
 - NSIDC (0051)
 - OSI SAF (reprocessing OSI-409)
 - HadISST (v2.2)

To what extent does the thickness distribution shape the variability of the simulated sea ice?

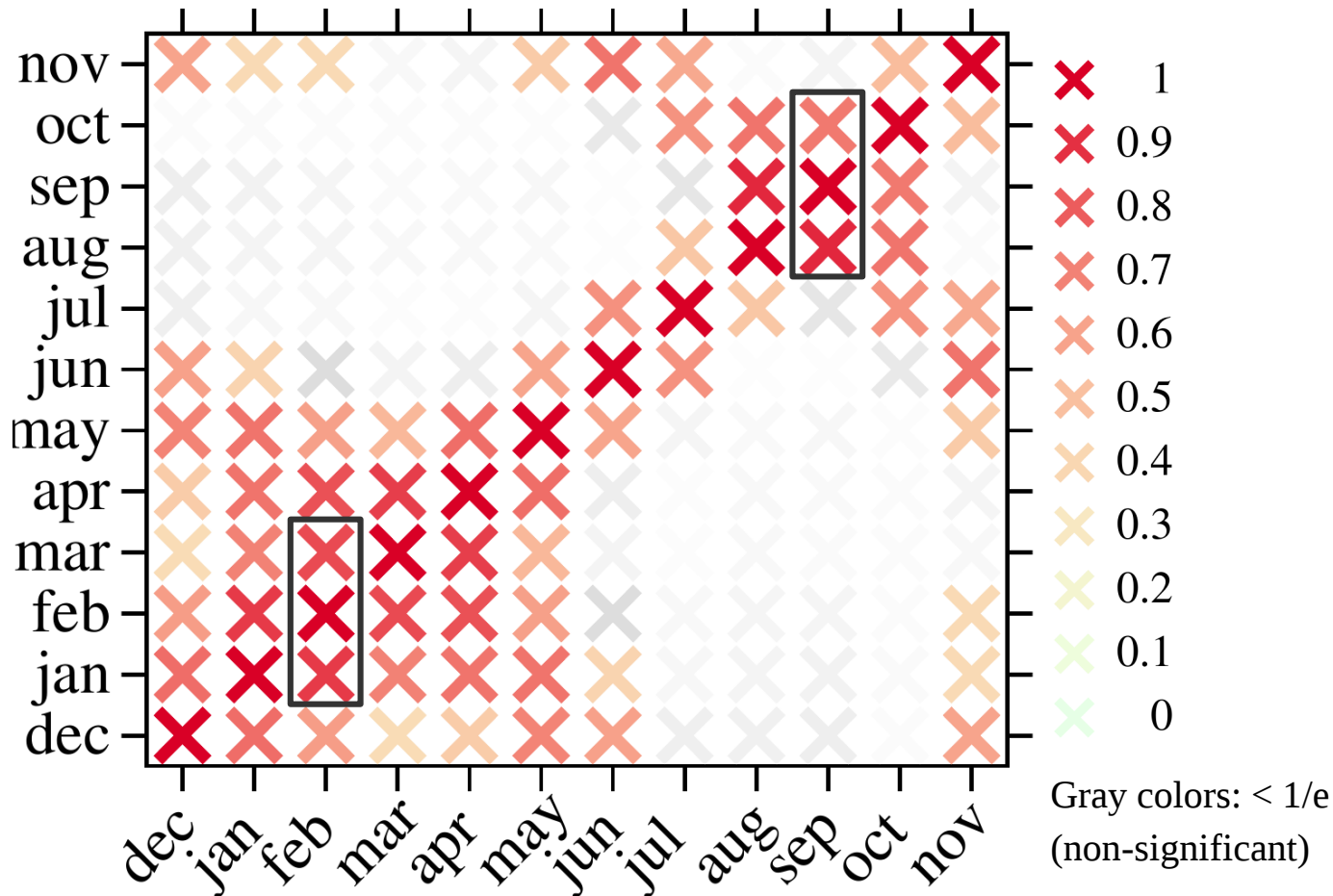
- Variability characterized through k-means clustering for the period 1979–2014
 - 3 modes as optimal number (based on 10 clustering validity indices)

For example:



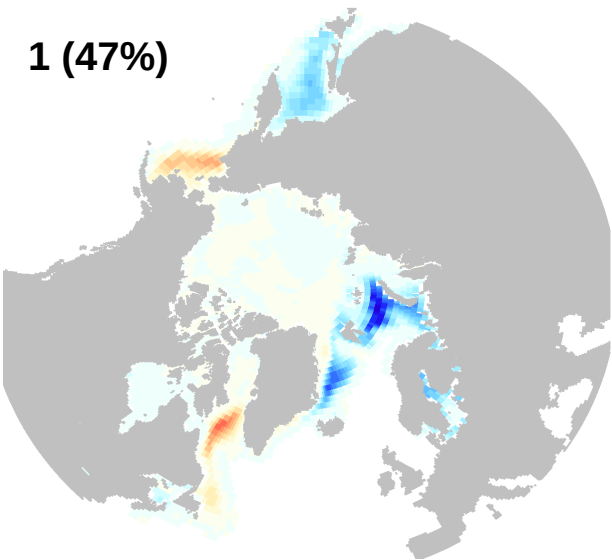
Searching for two 3-moth period (seasons) during which variability is the most persistent

Maximum spatial correlation coefficient across the 3 clusters between 2 months (uppermost limit of cluster agreement)

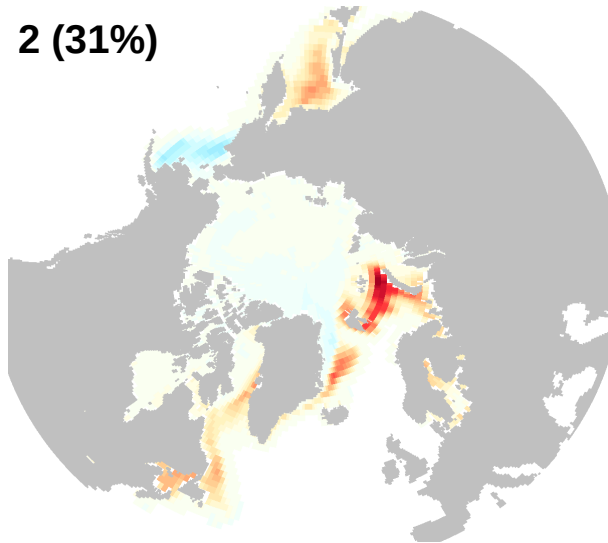


January–March clusters (OSI SAF):

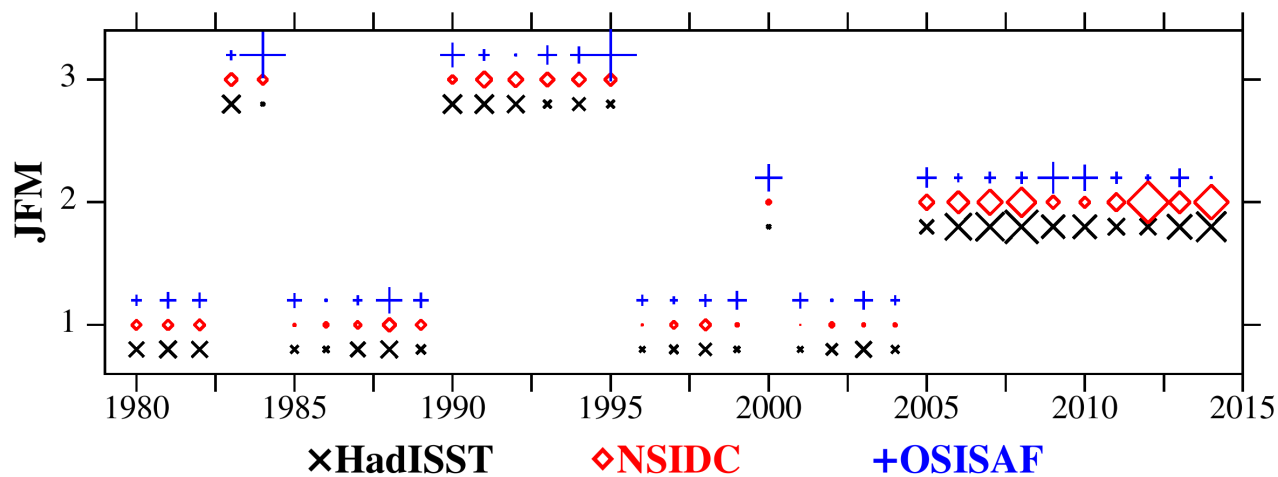
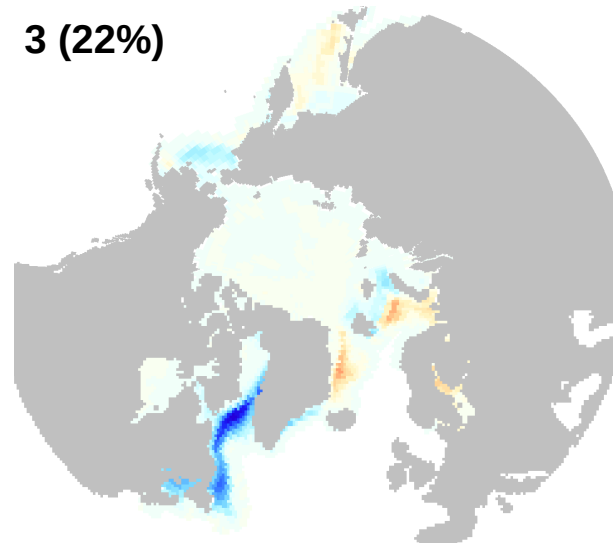
1 (47%)



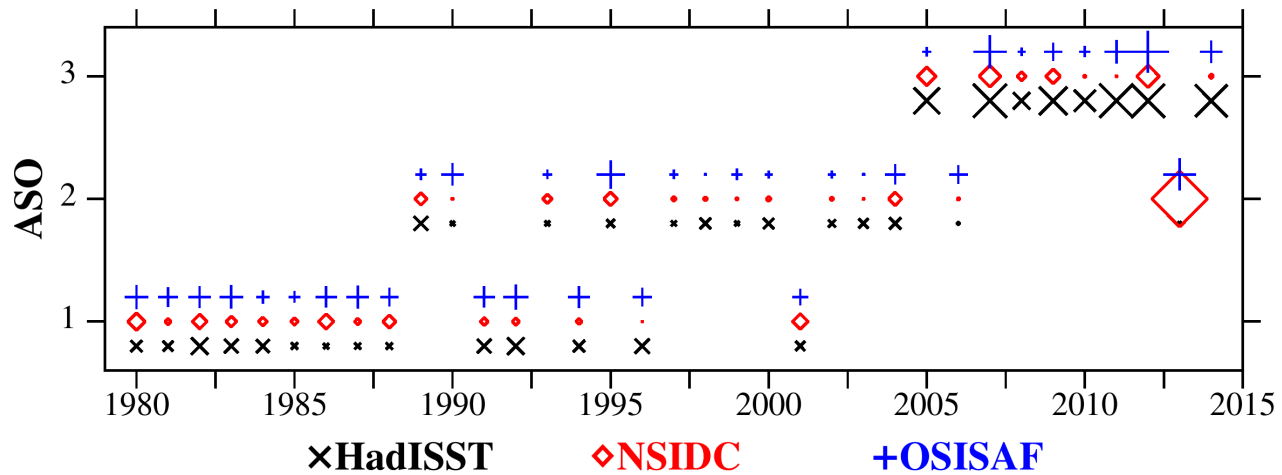
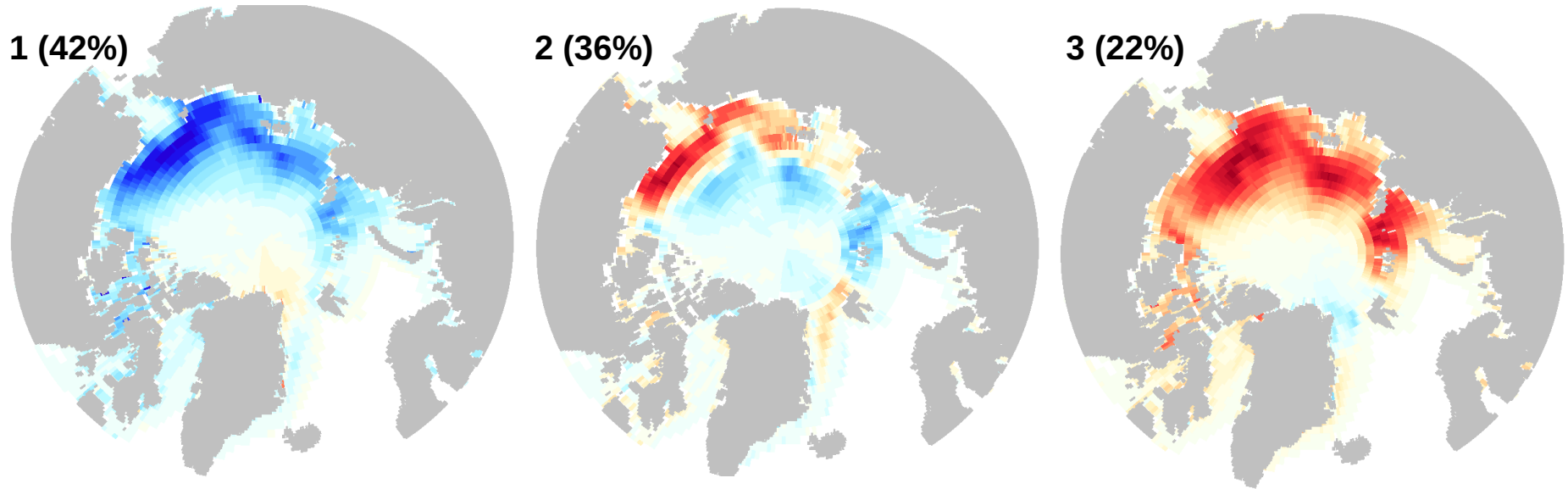
2 (31%)



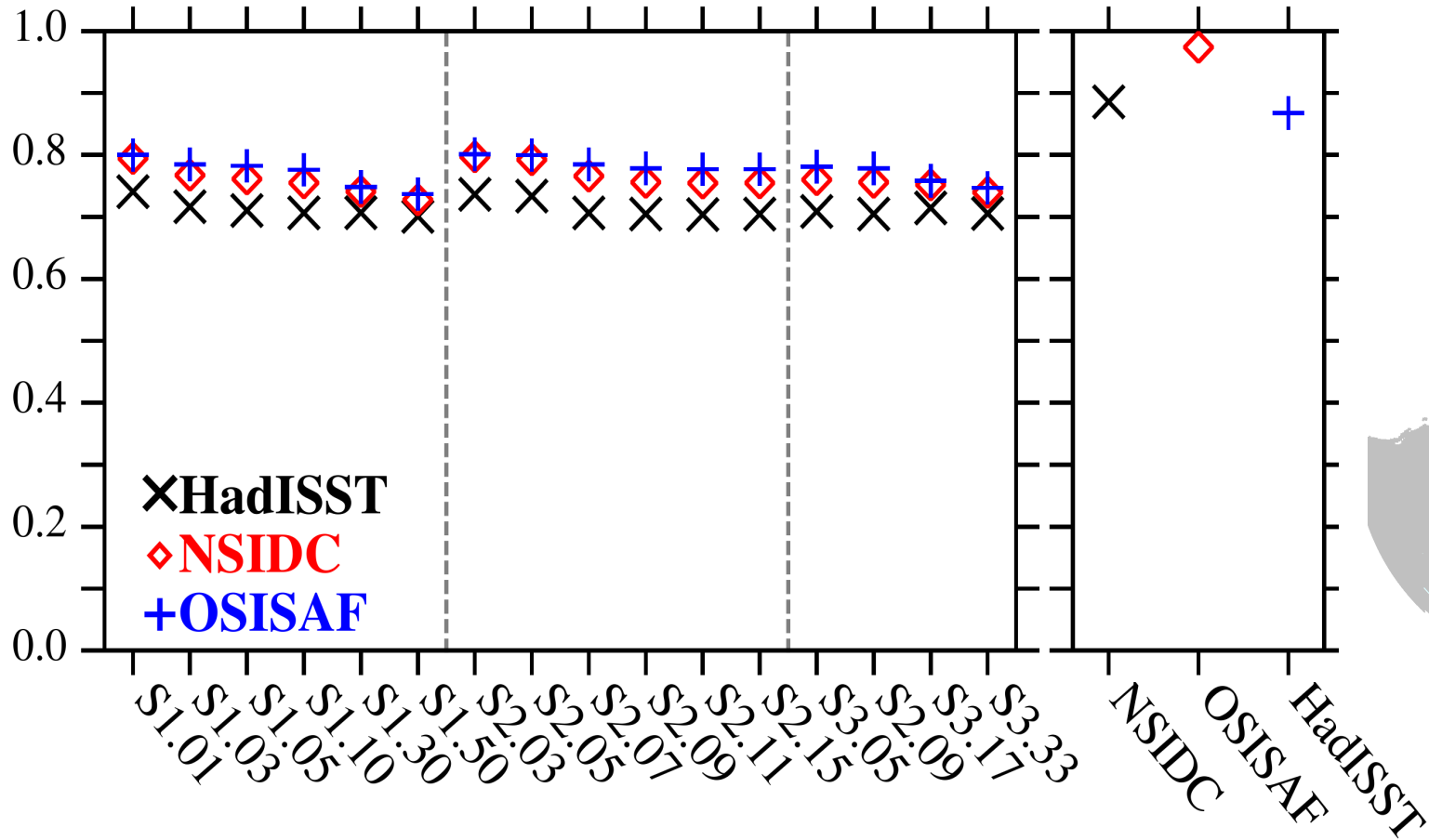
3 (22%)



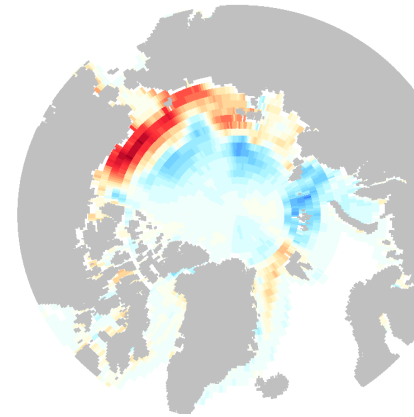
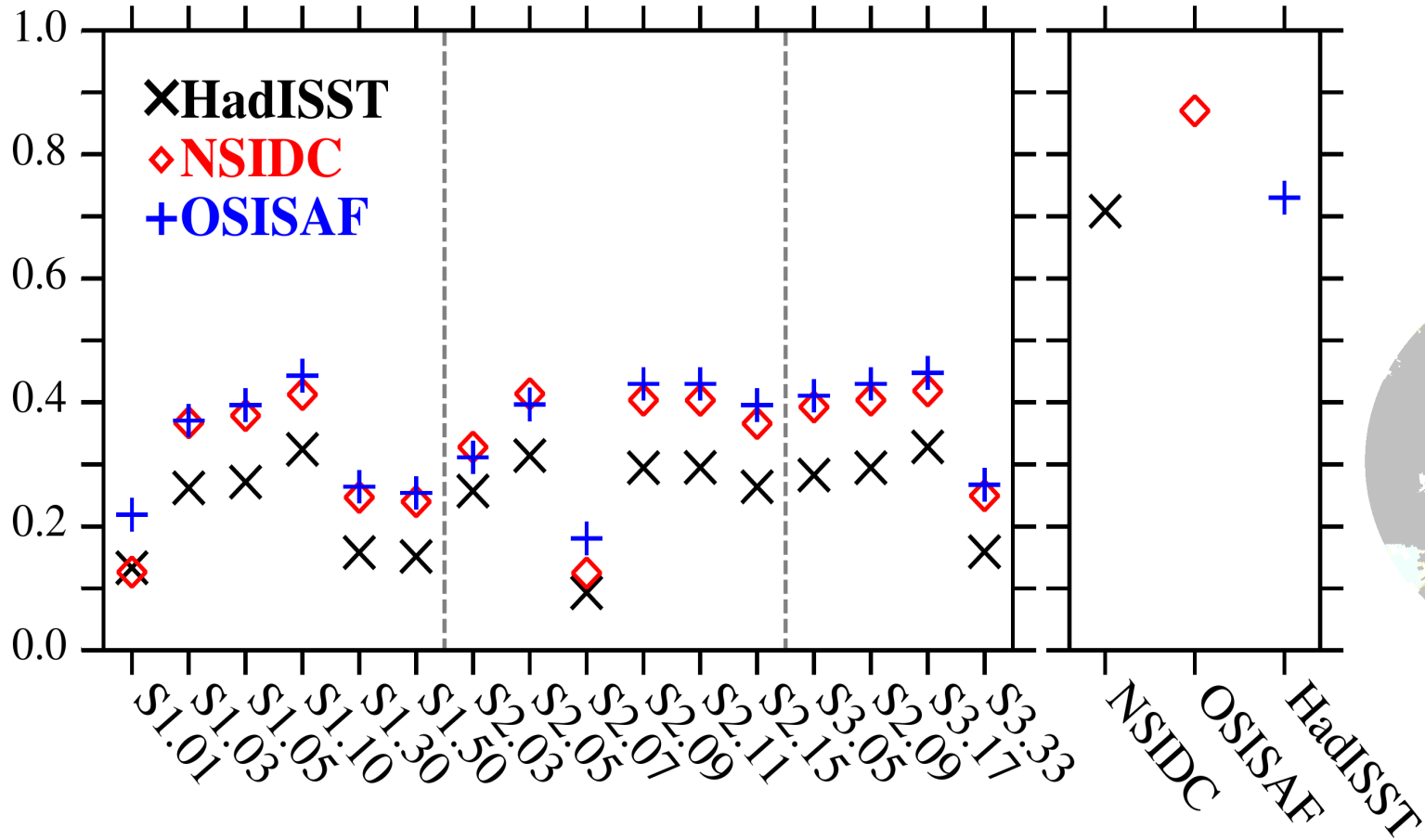
August–October clusters (OSI SAF):



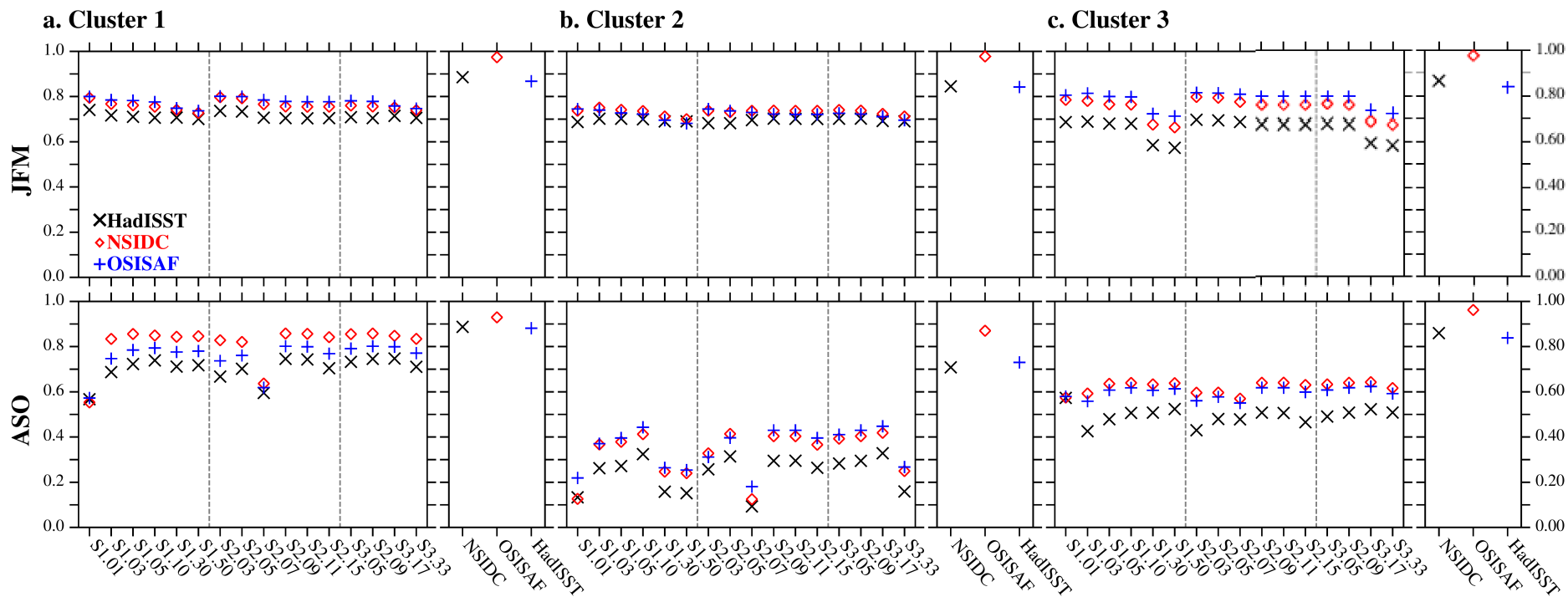
Spatial correlation between simulations and observations: JFM first cluster



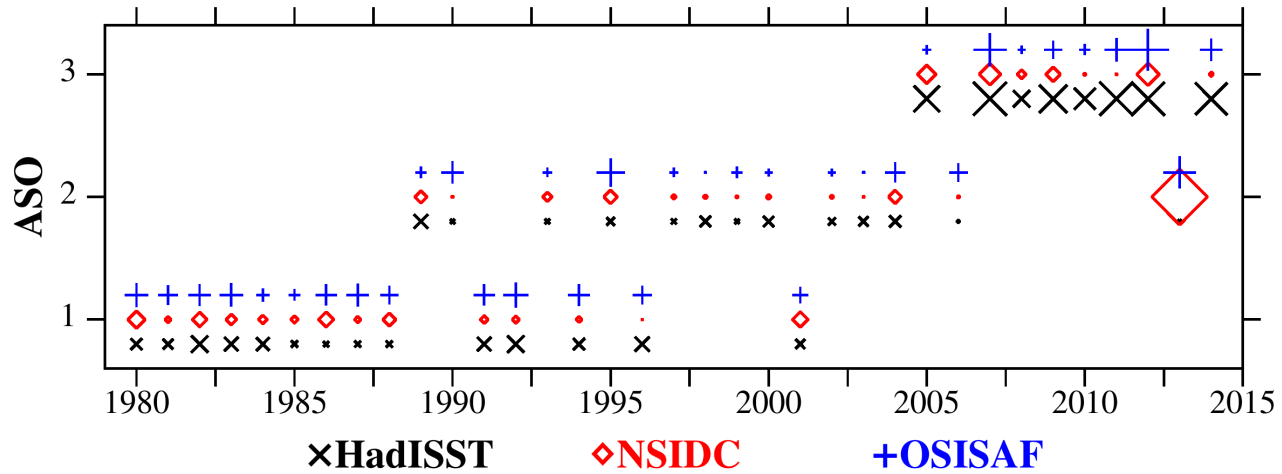
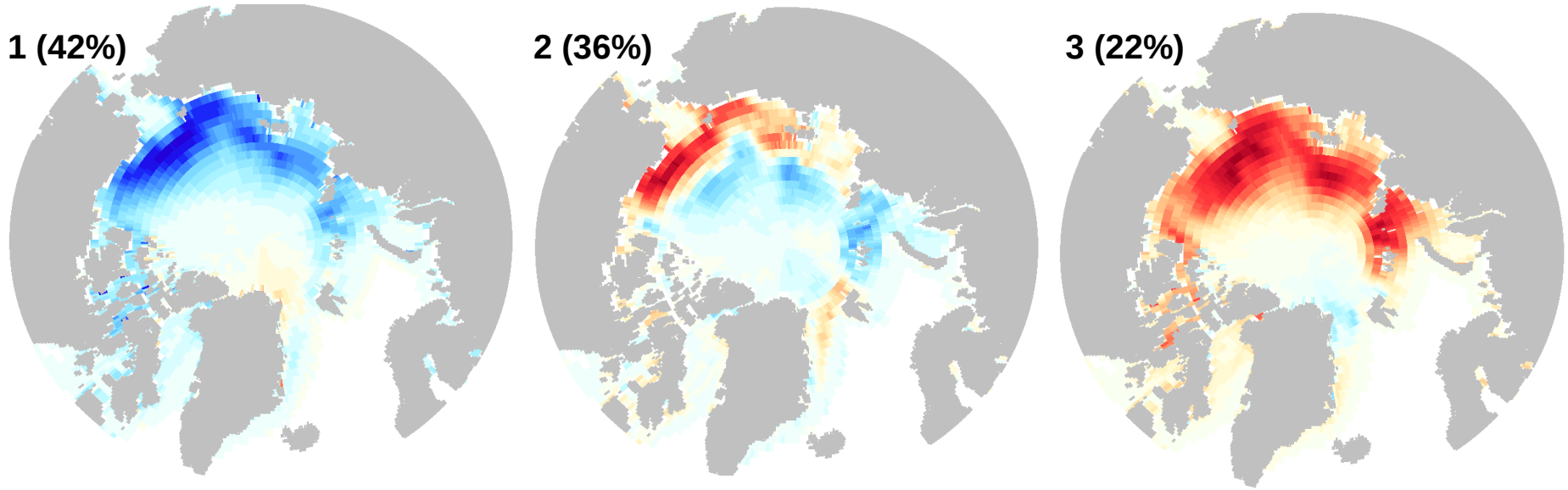
Spatial correlation between simulations and observations: ASO second cluster



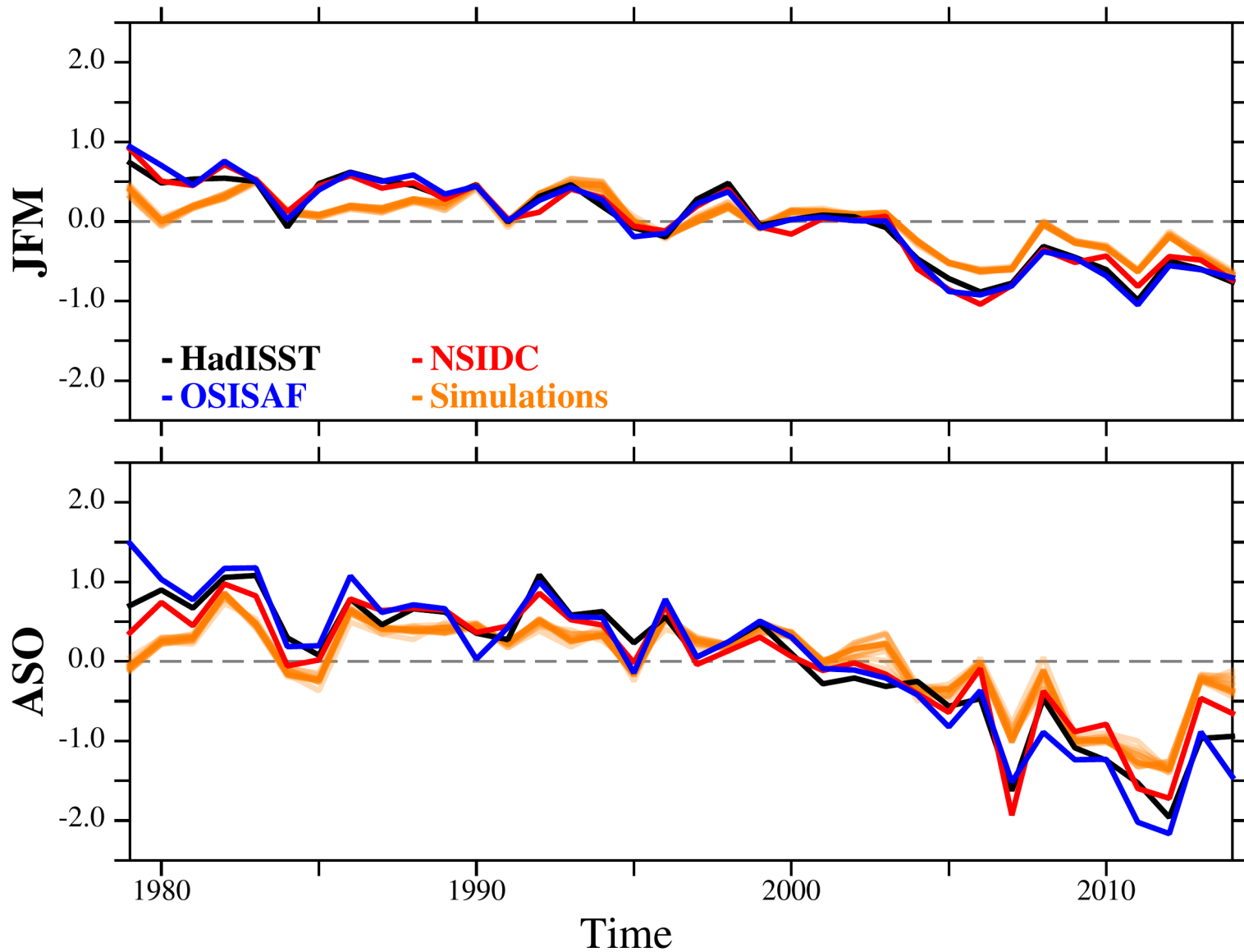
Spatial correlation between simulations and observations: all clusters and all seasons



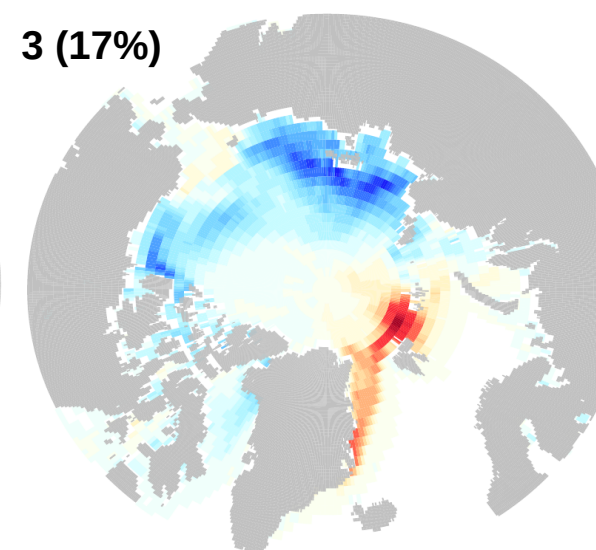
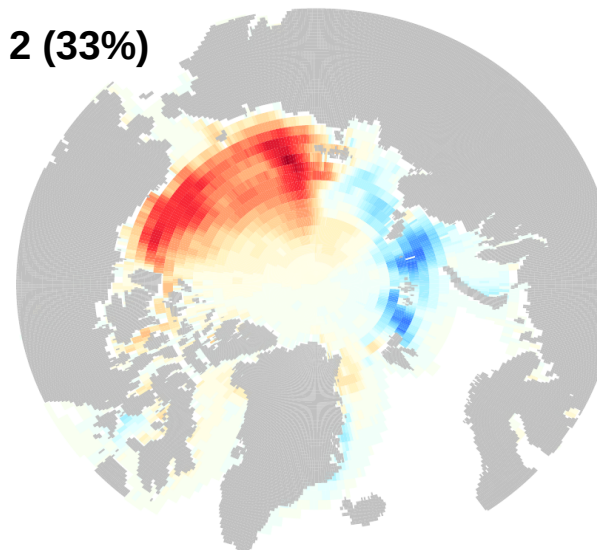
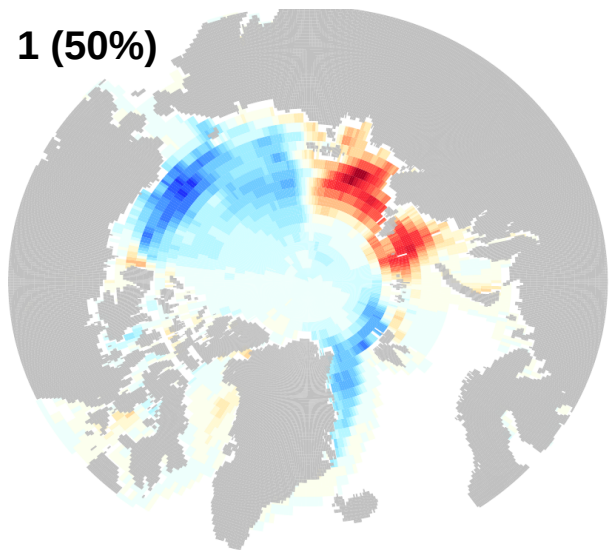
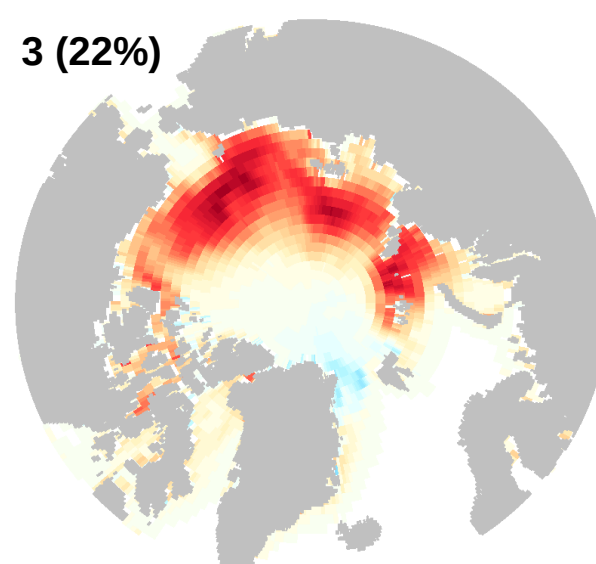
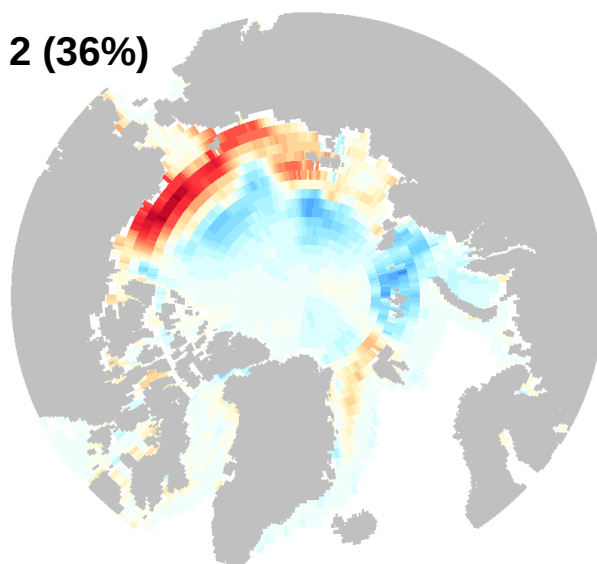
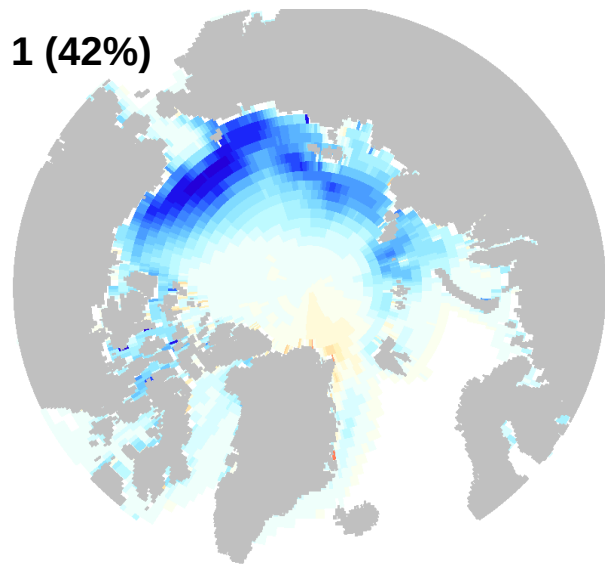
August–October clusters (OSI SAF) show a trend



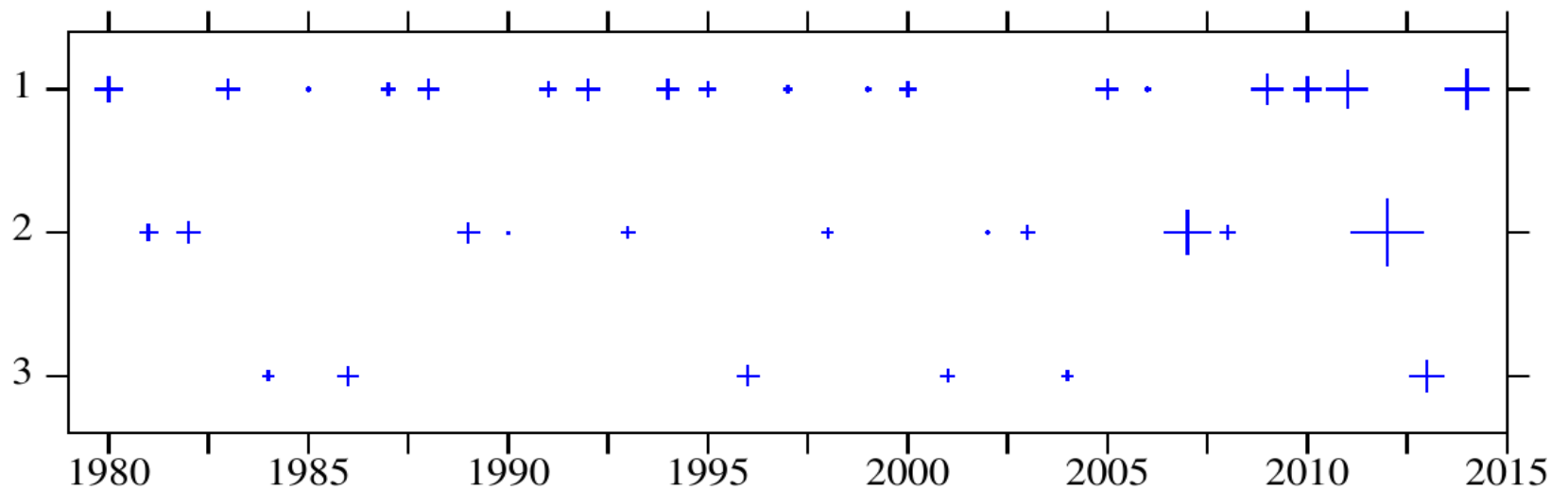
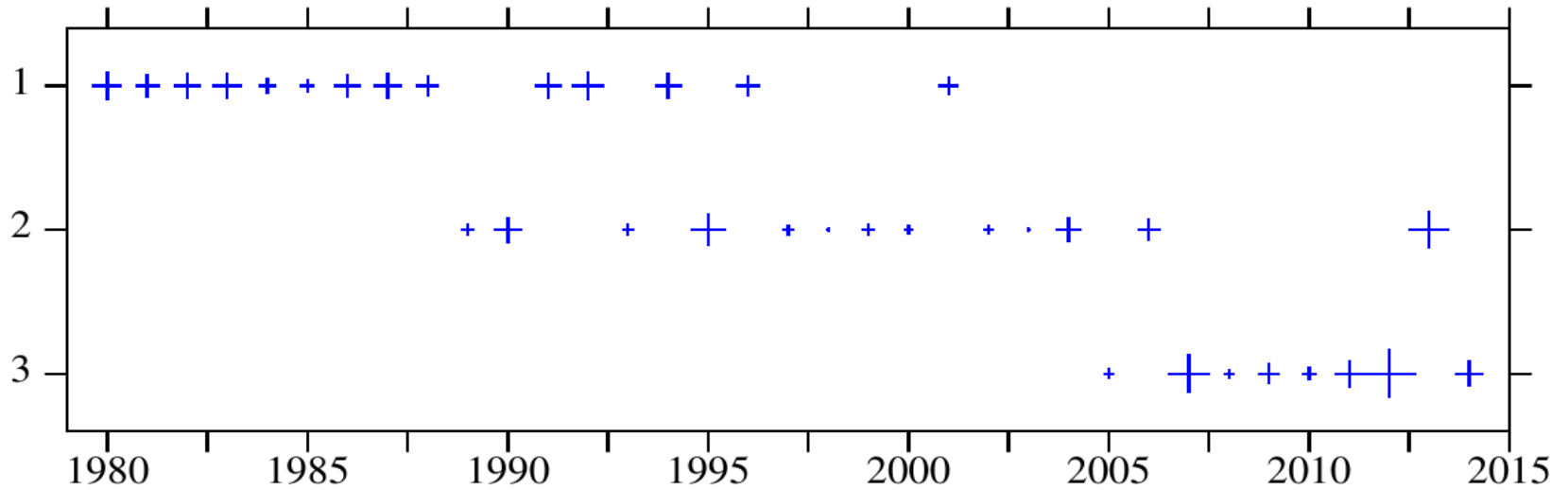
Trend in the pan-Arctic sea ice extent in both seasons



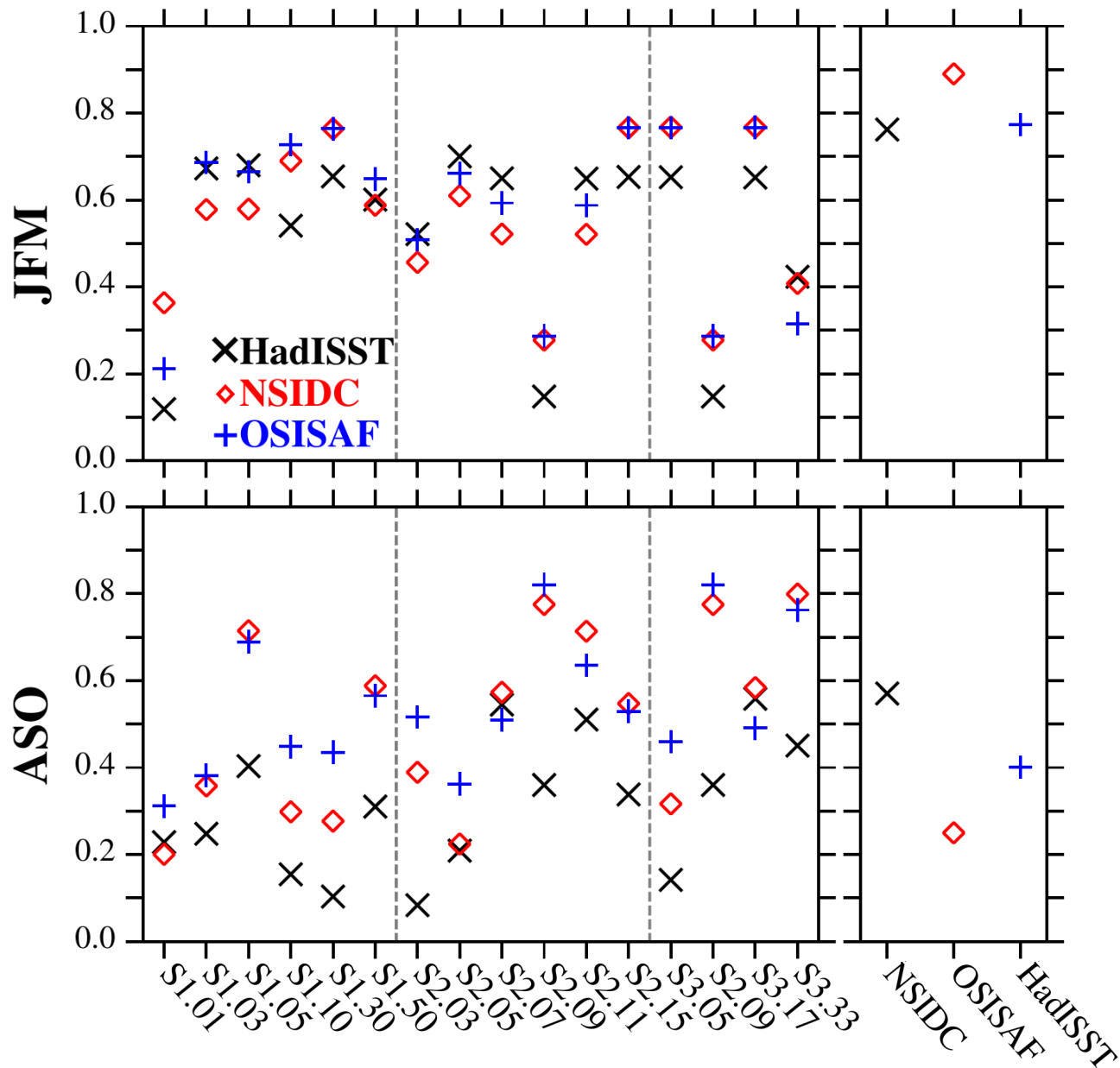
August–October clusters (OSI SAF): undetrend vs. detrend with a 2nd degree polynomial



August–October clusters (OSI SAF): undetrend vs. detrend with a 2nd degree polynomial



Spatial correlation between simulations and observations: JFM and ASO first clusters after detrending

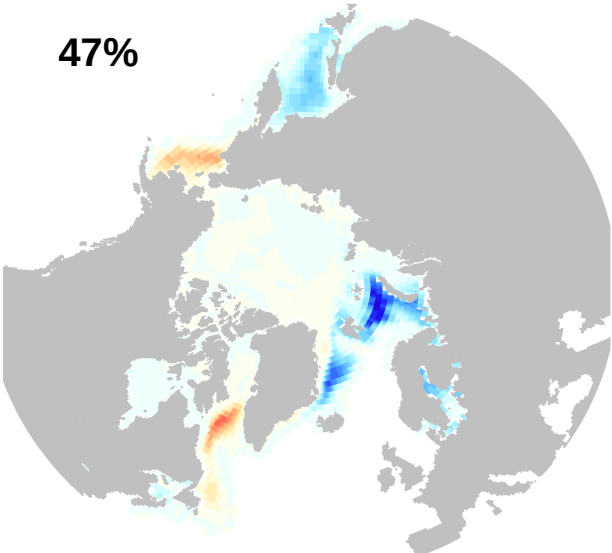


Summary: to what extent does the thickness distribution shape the variability of the simulated sea ice?

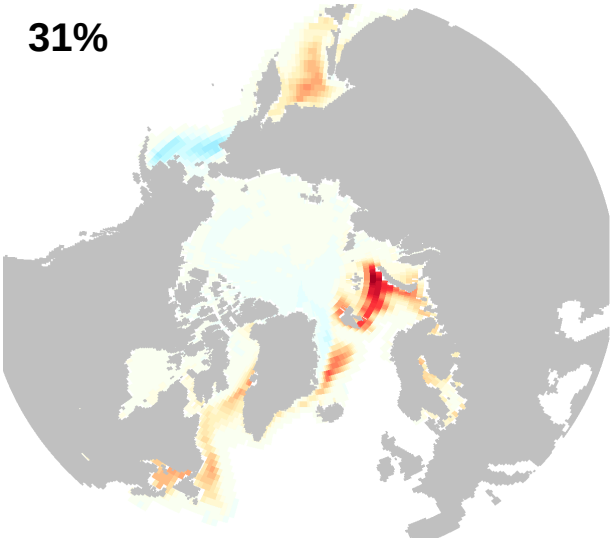
- Sea ice concentration variability characterized by k-means clustering
 - NEMO3-LIM3.6 simulations
 - Period 1979–2014
- Two seasons, JFM and ASO, of maximum variability coherence across months
- No big impact of the ice thickness distribution in winter/summer for undetrended data
- Detrending highlights differences across simulations (*work in progress*)
- Uncertainty in the observed variability affects model–data comparison

January–March clusters (OSI SAF): undetrended vs. detrended with a 2 degree polynomial

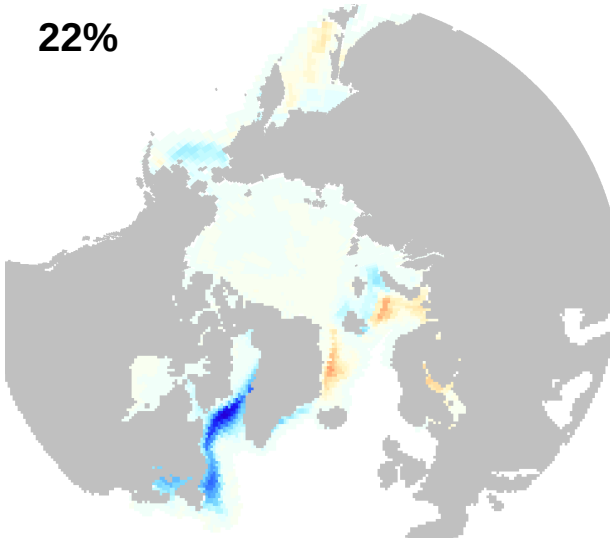
47%



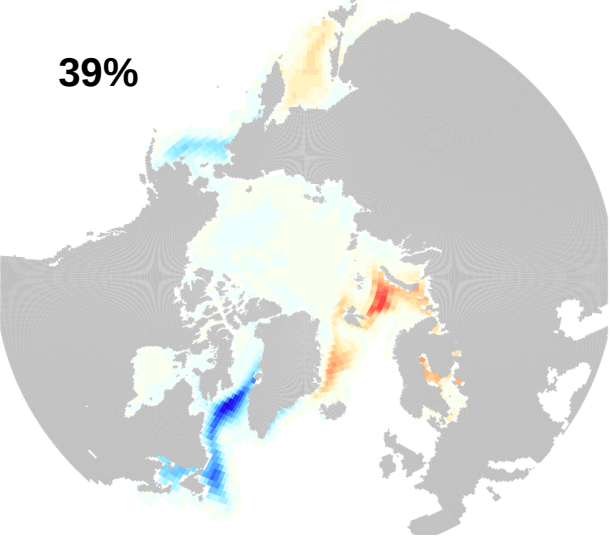
31%



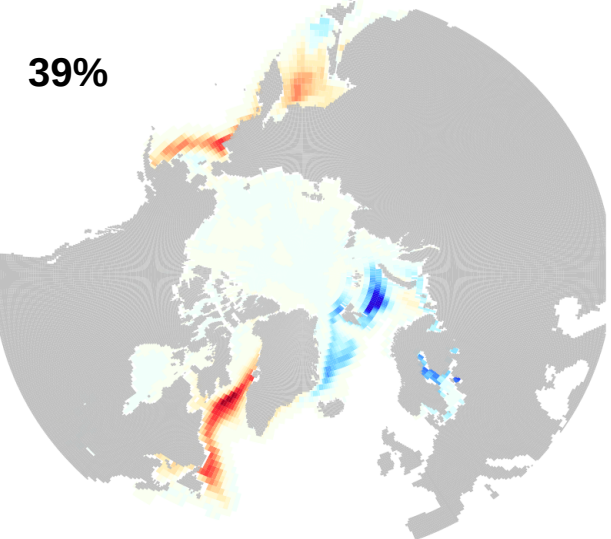
22%



39%



39%



22%

