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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
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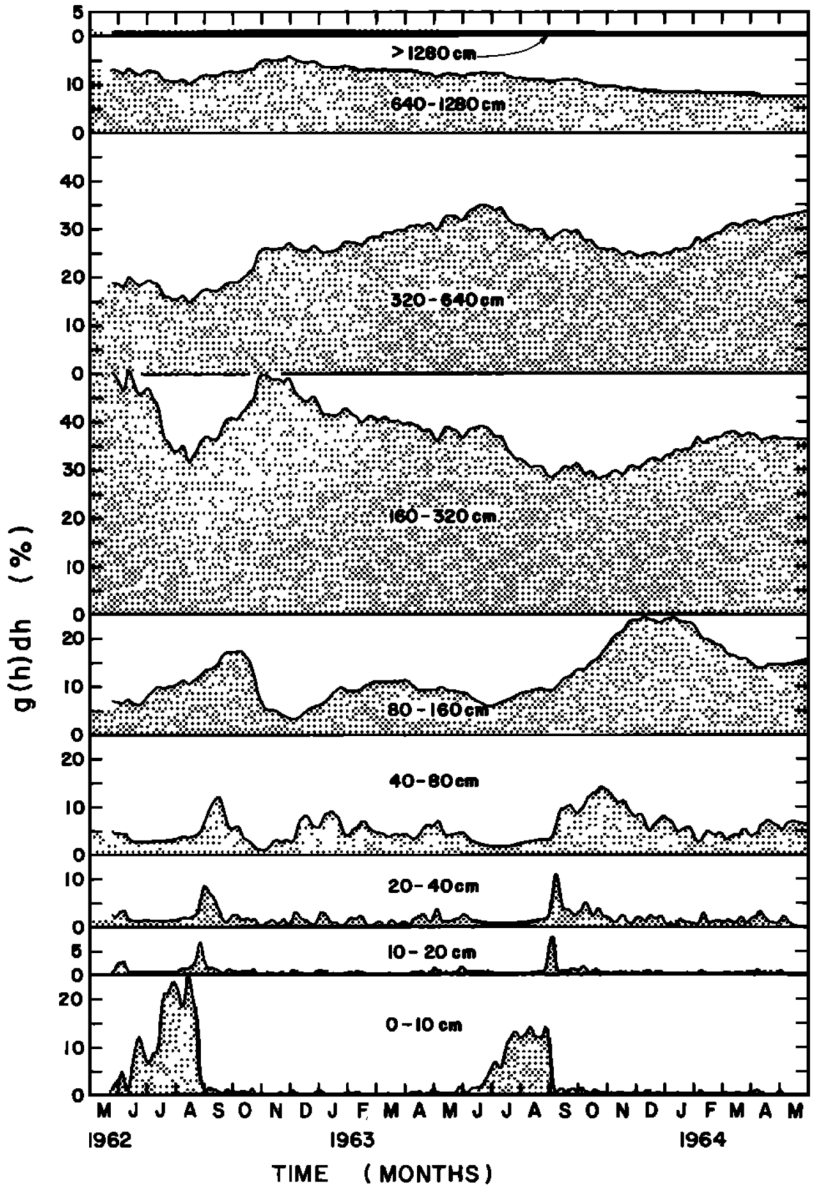
Real sea ice can be this complex …

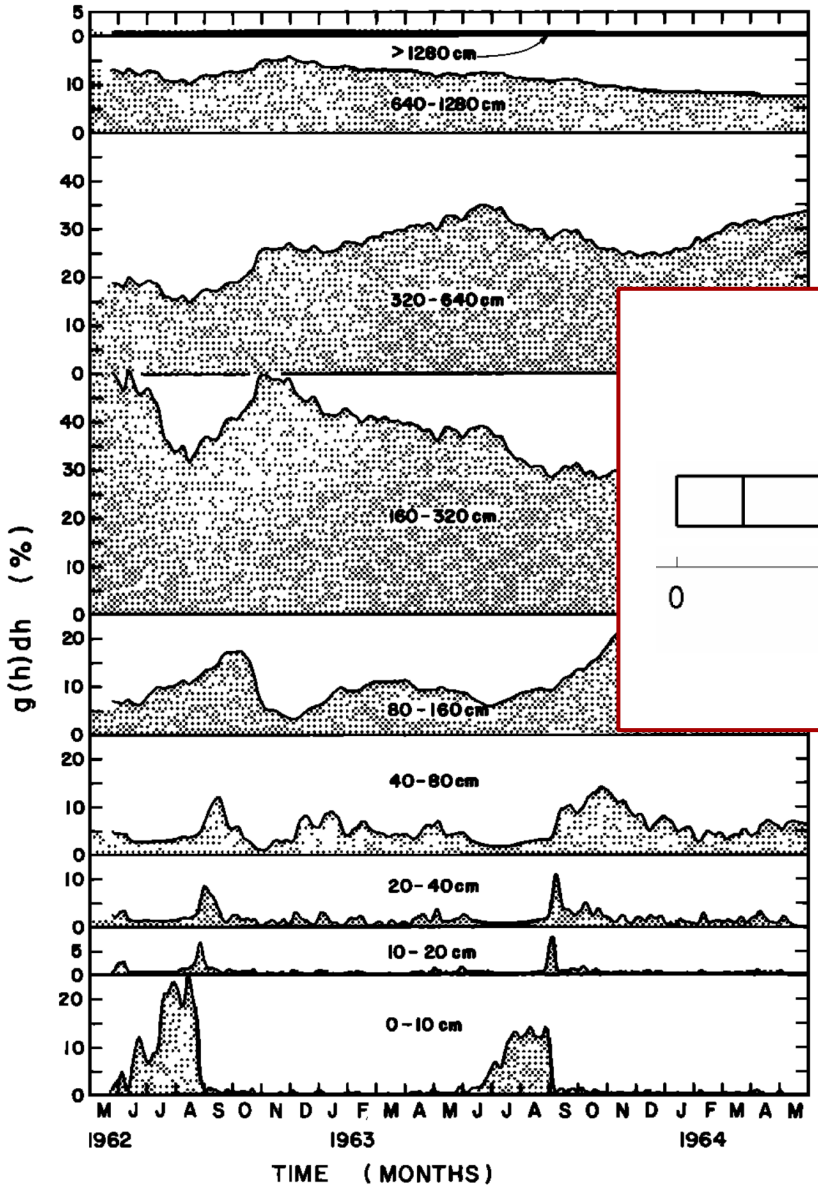
Das Eismeer
(Caspar David Friedrich)

Sea ice thickness distribution in climate models

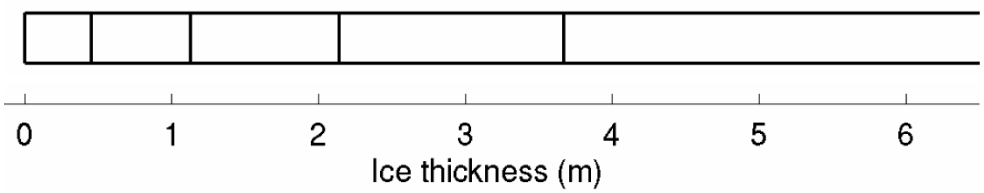


Thorndike et al. [1975]

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]

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

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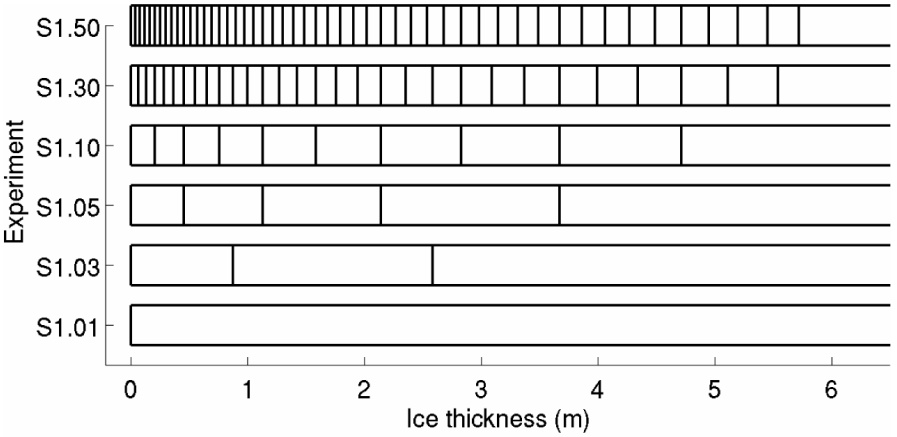
– Ocean–sea ice climate model: NEMO-LIM3.6

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?



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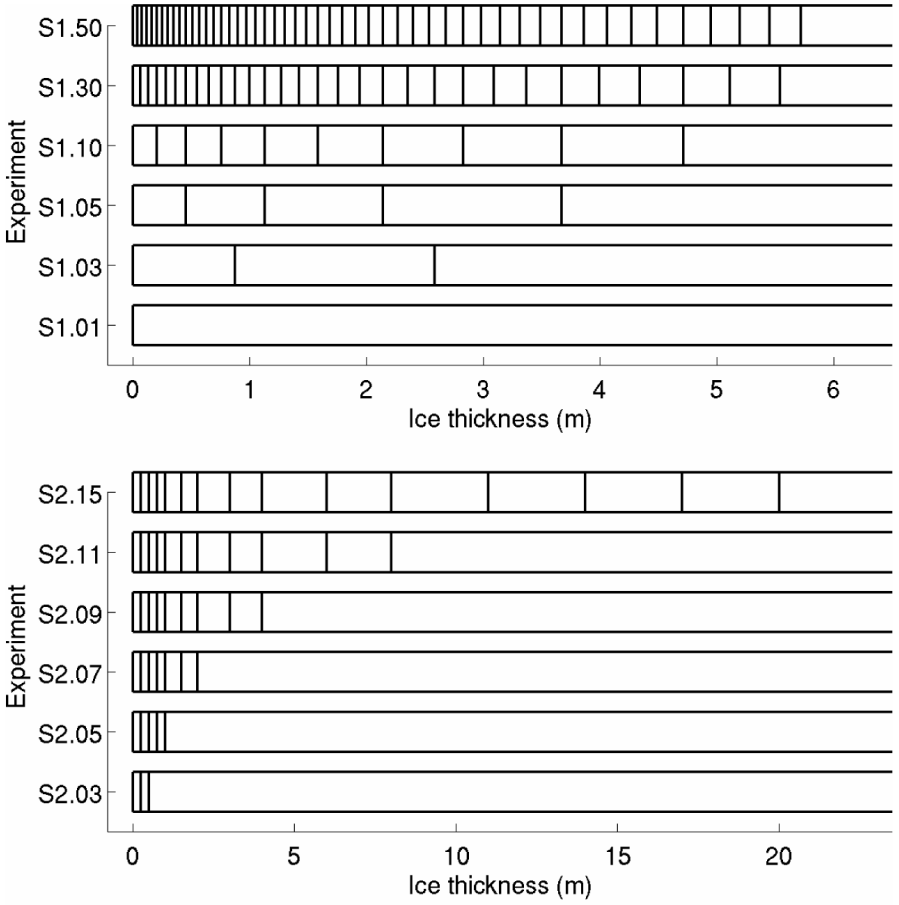

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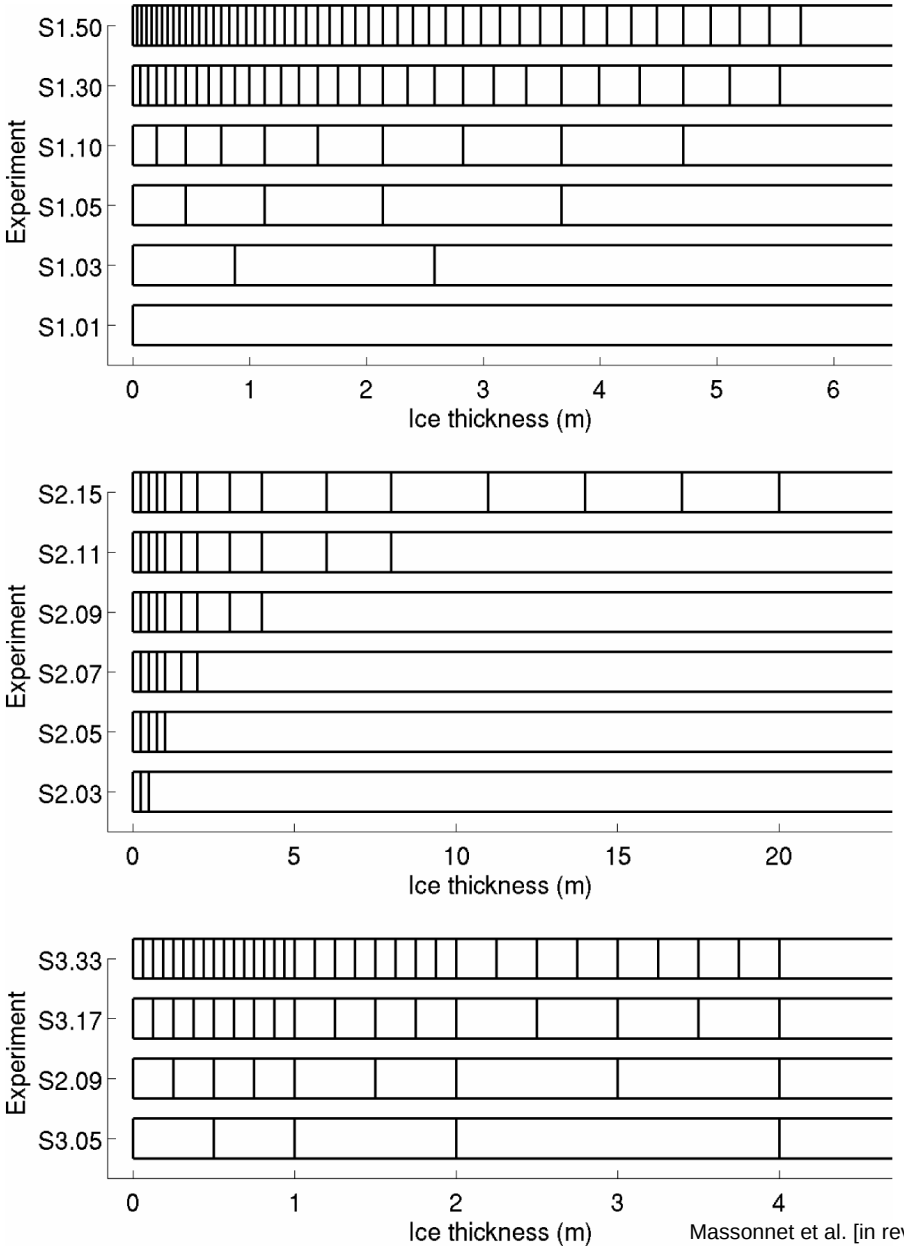

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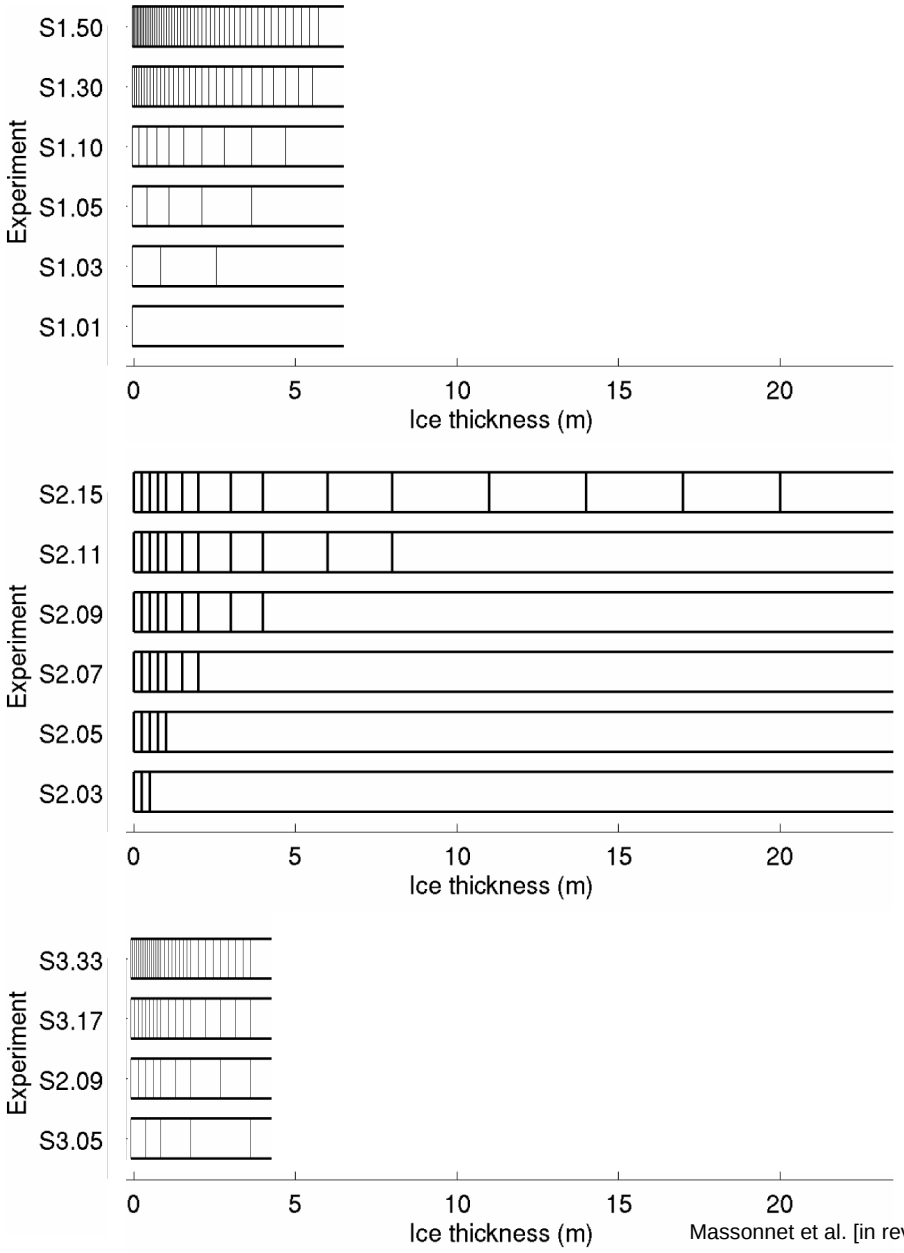

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To what extent does the thickness distribution shape the variability of the simulated sea ice?

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

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Three different ice thickness distribution:

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– Satellite observations of Arctic sea ice concentration

→ NSIDC (0051)

→ OSI SAF (reprocessing OSI-409)

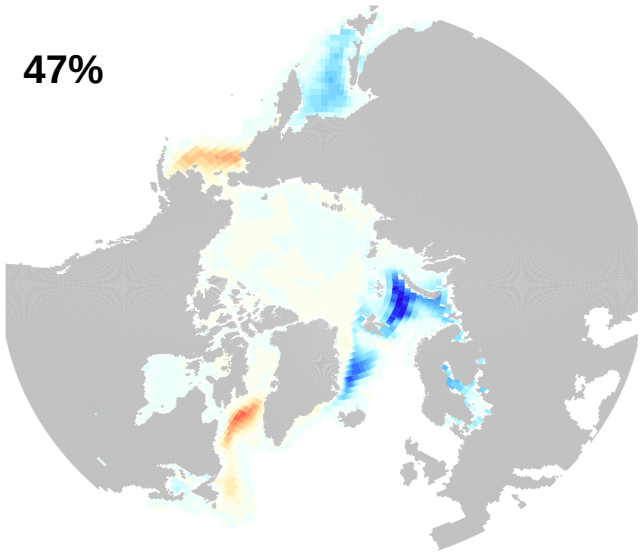
→ HadISST (v2.2)

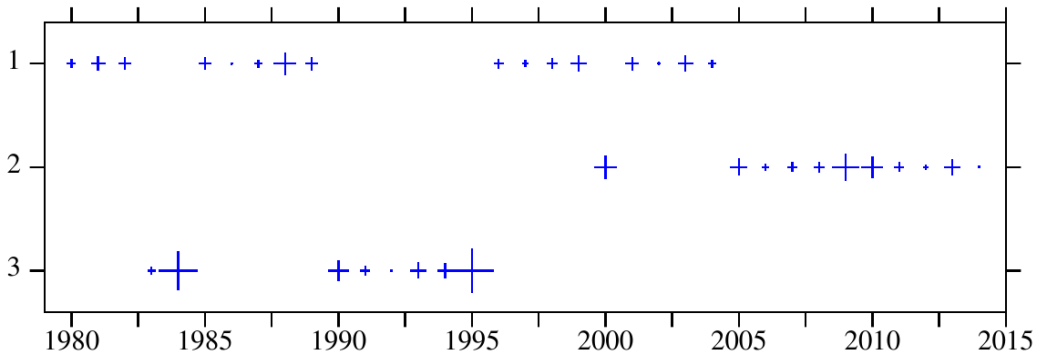
To what extent does the thickness distribution shape the variability of the simulated sea ice?

– Variability characterized through k-means clustering for the period 1979–2014

→ 3 modes as optimal number (based on 10 clustering validity indices)

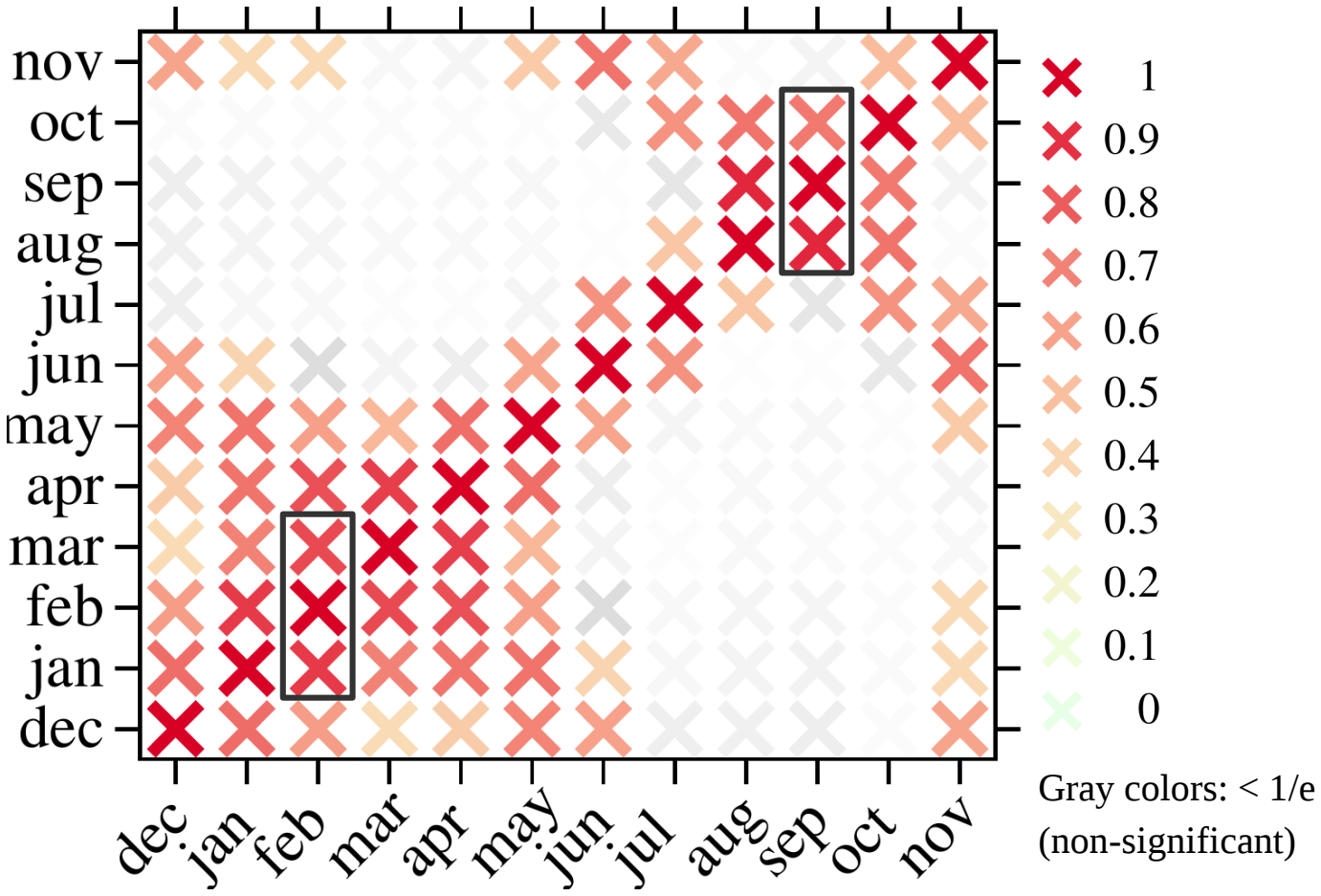
For example:



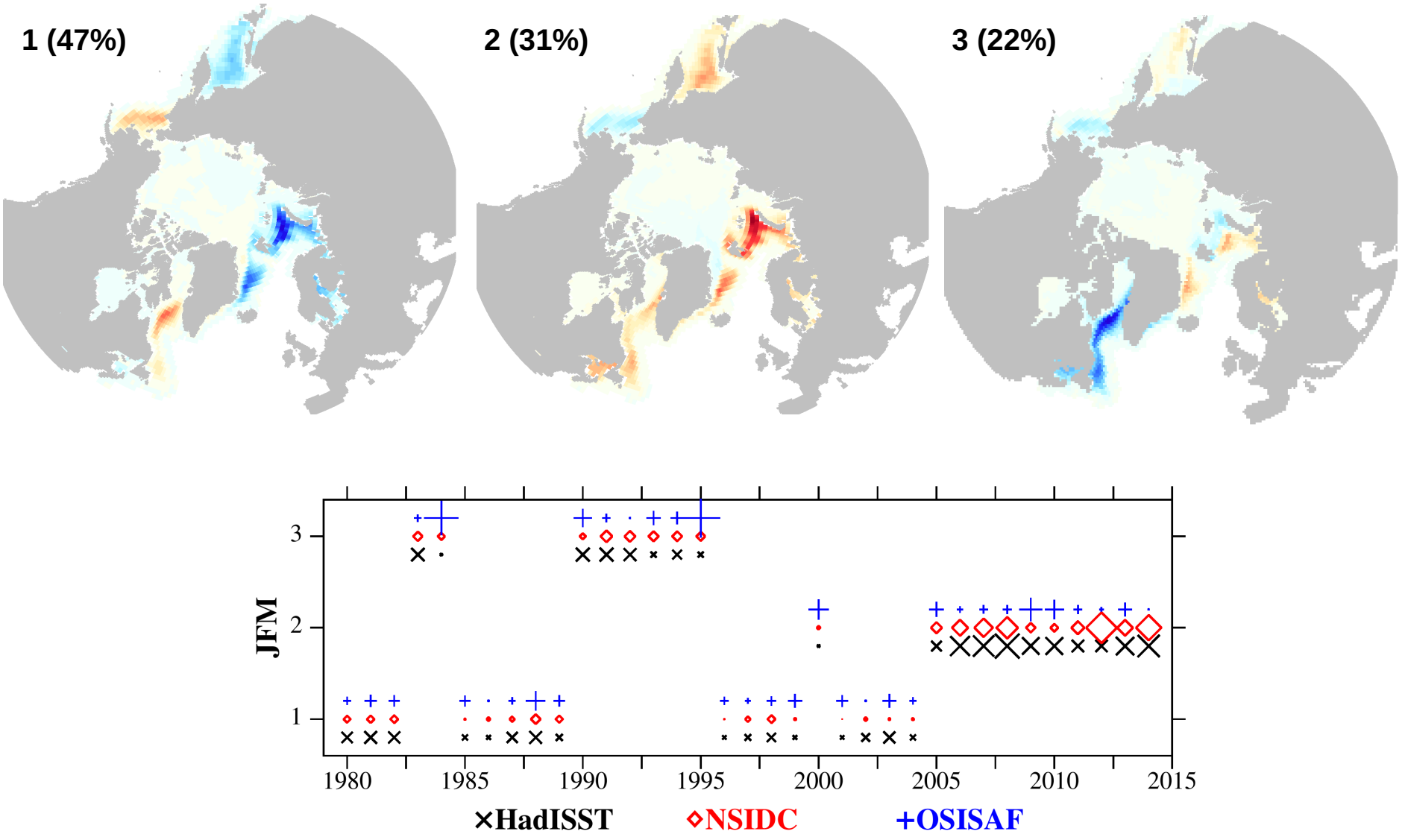


Searching for two 3-moth period (seasons) during which variability is the most persistent

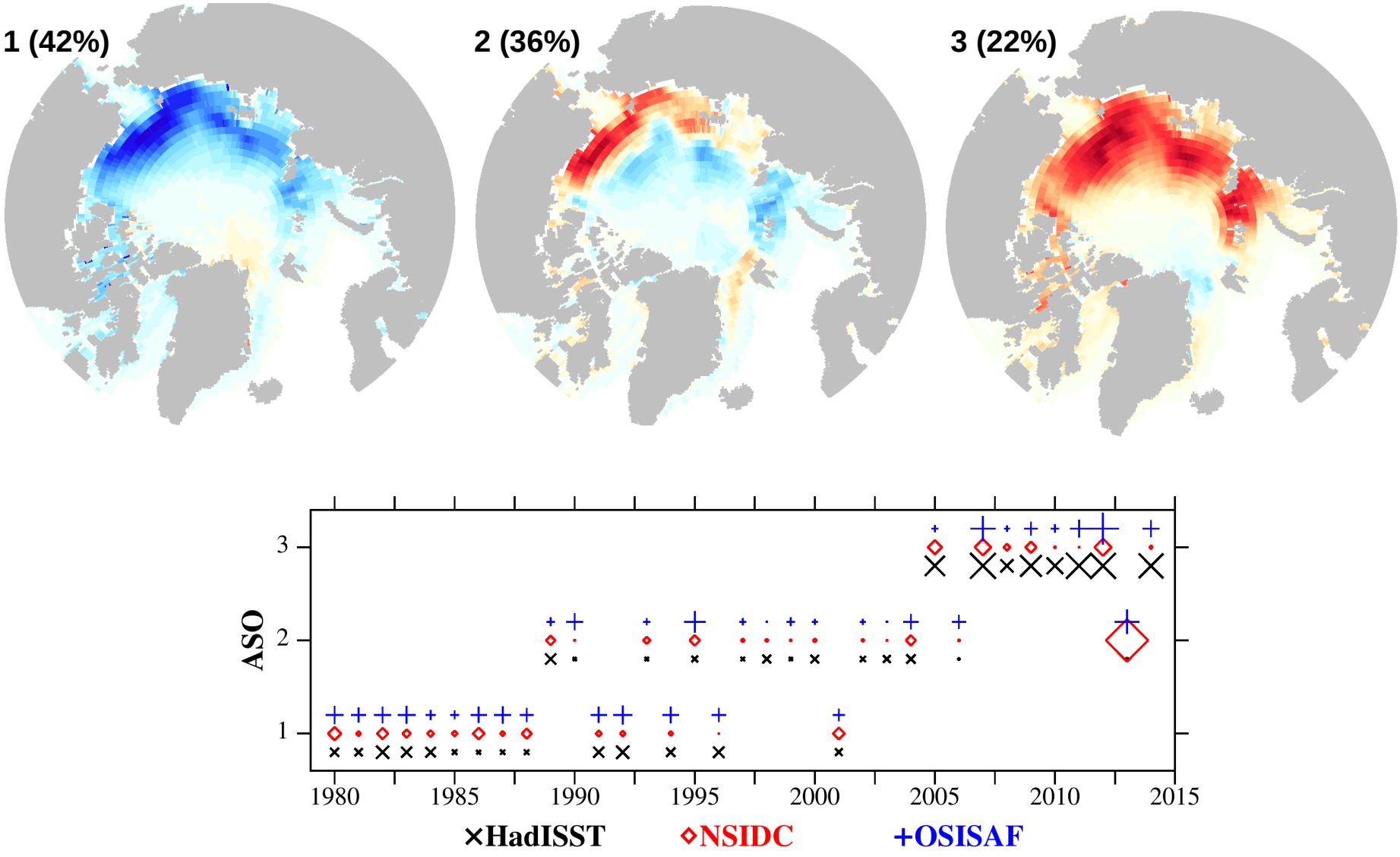
Maximum spatial correlation coefficient across the 3 clusters between 2 months (uppermost limit of cluster agreement)



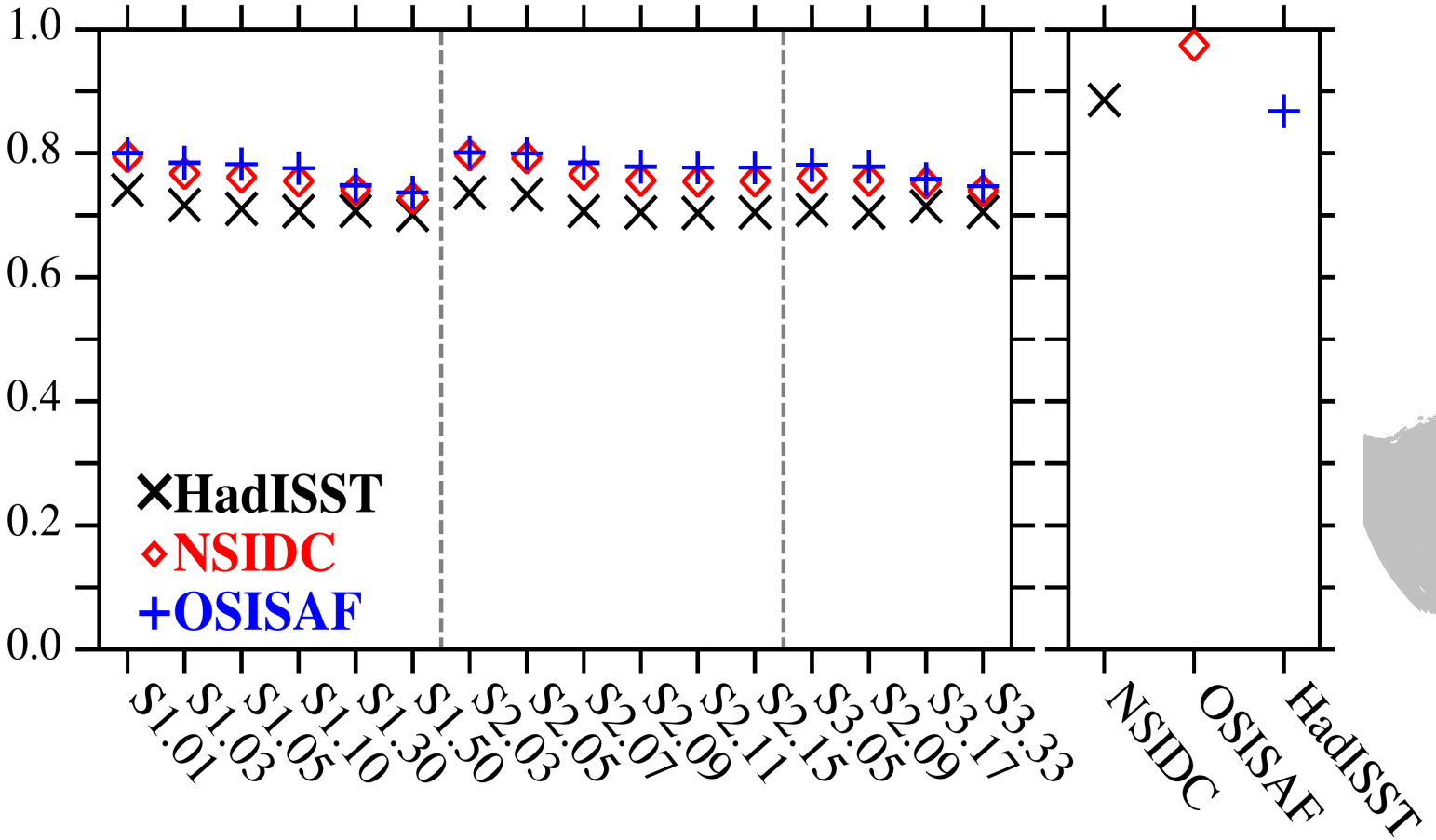
January–March clusters (OSI SAF):

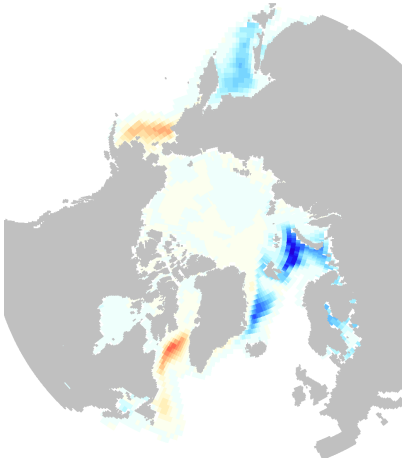


August–October clusters (OSI SAF):

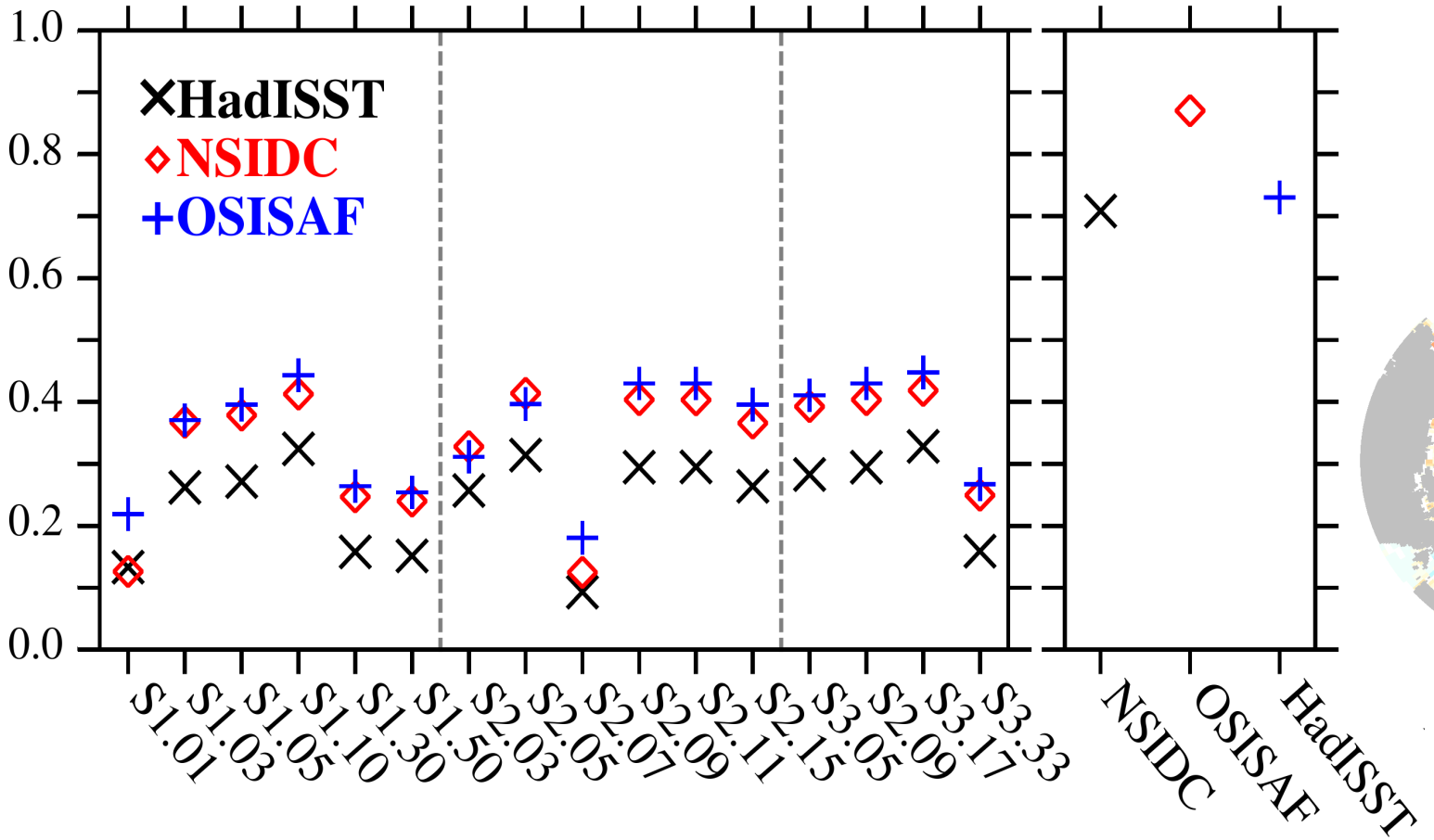


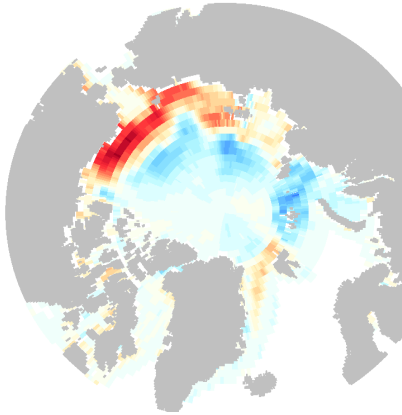
Spatial correlation between simulations and observations: JFM first cluster



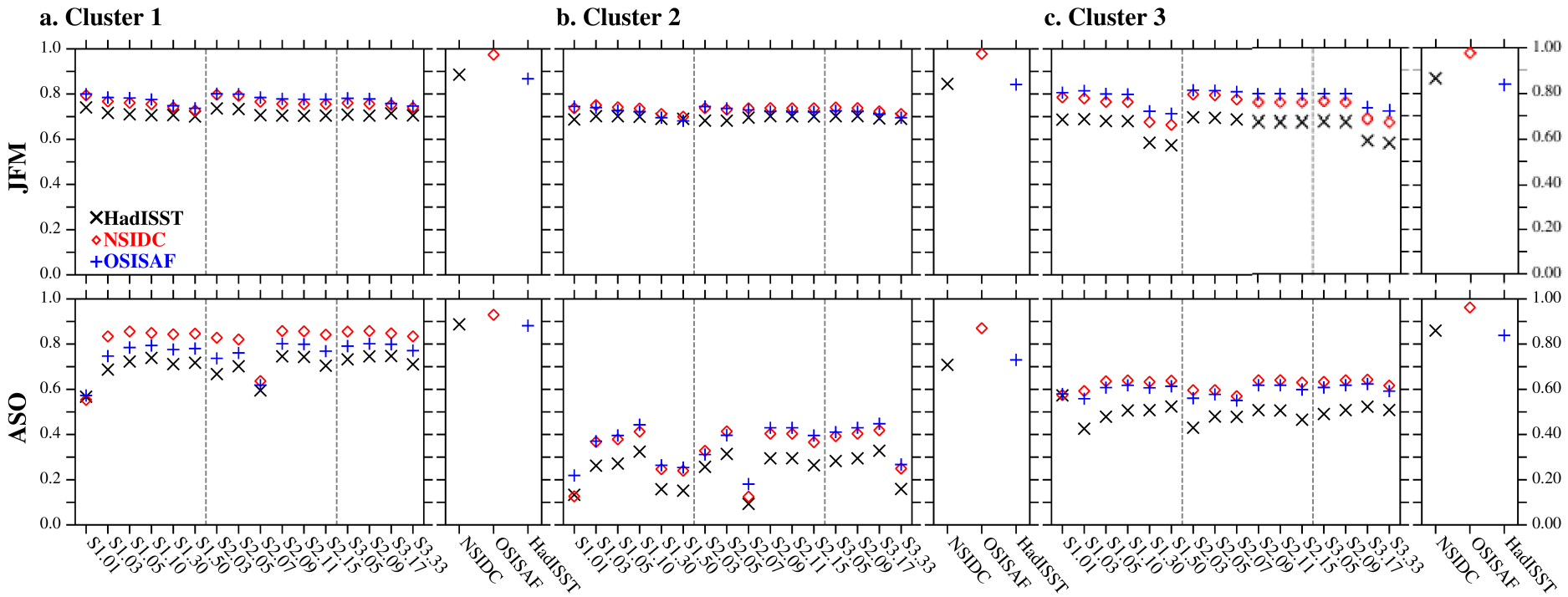


Spatial correlation between simulations and observations: ASO second cluster

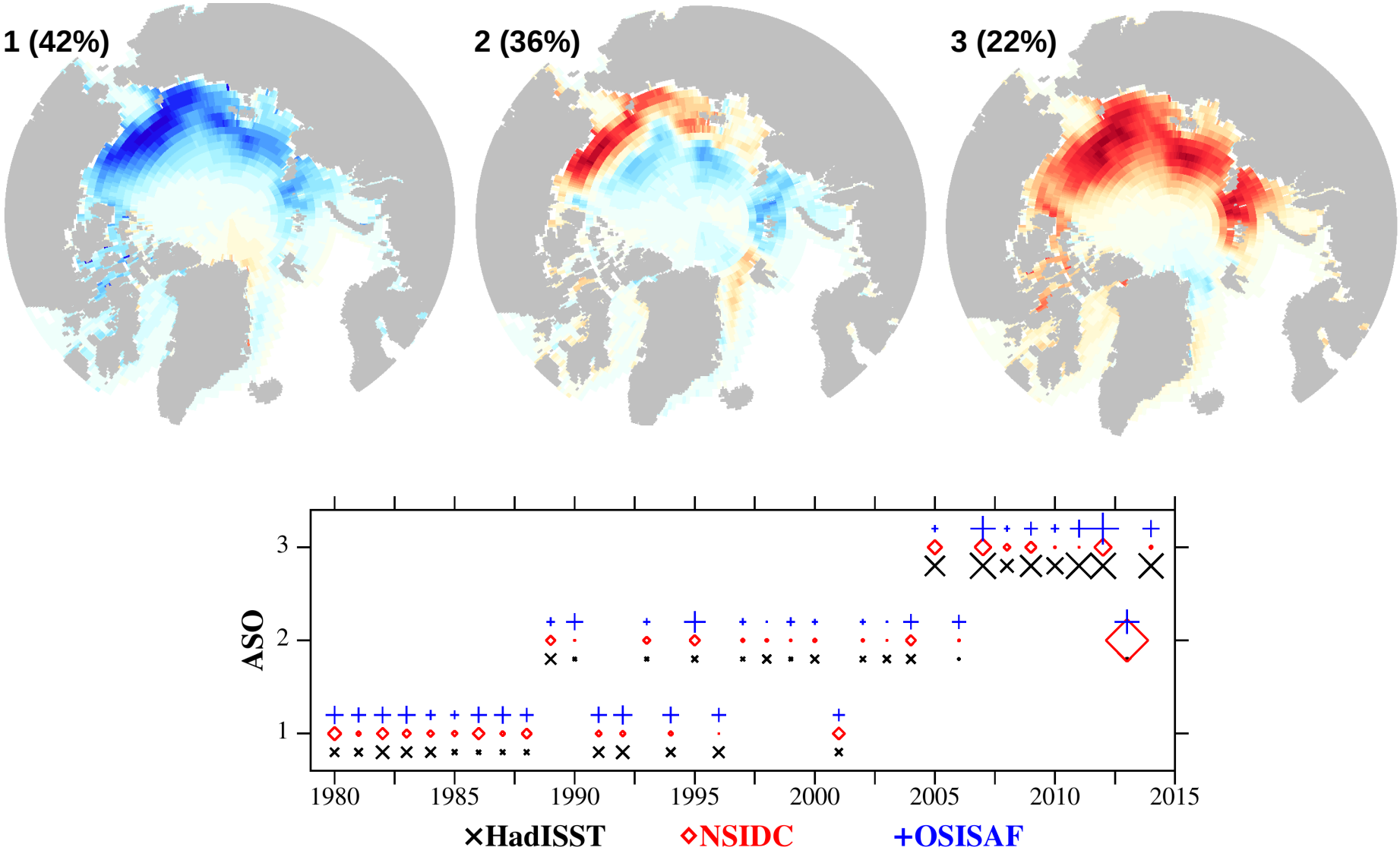




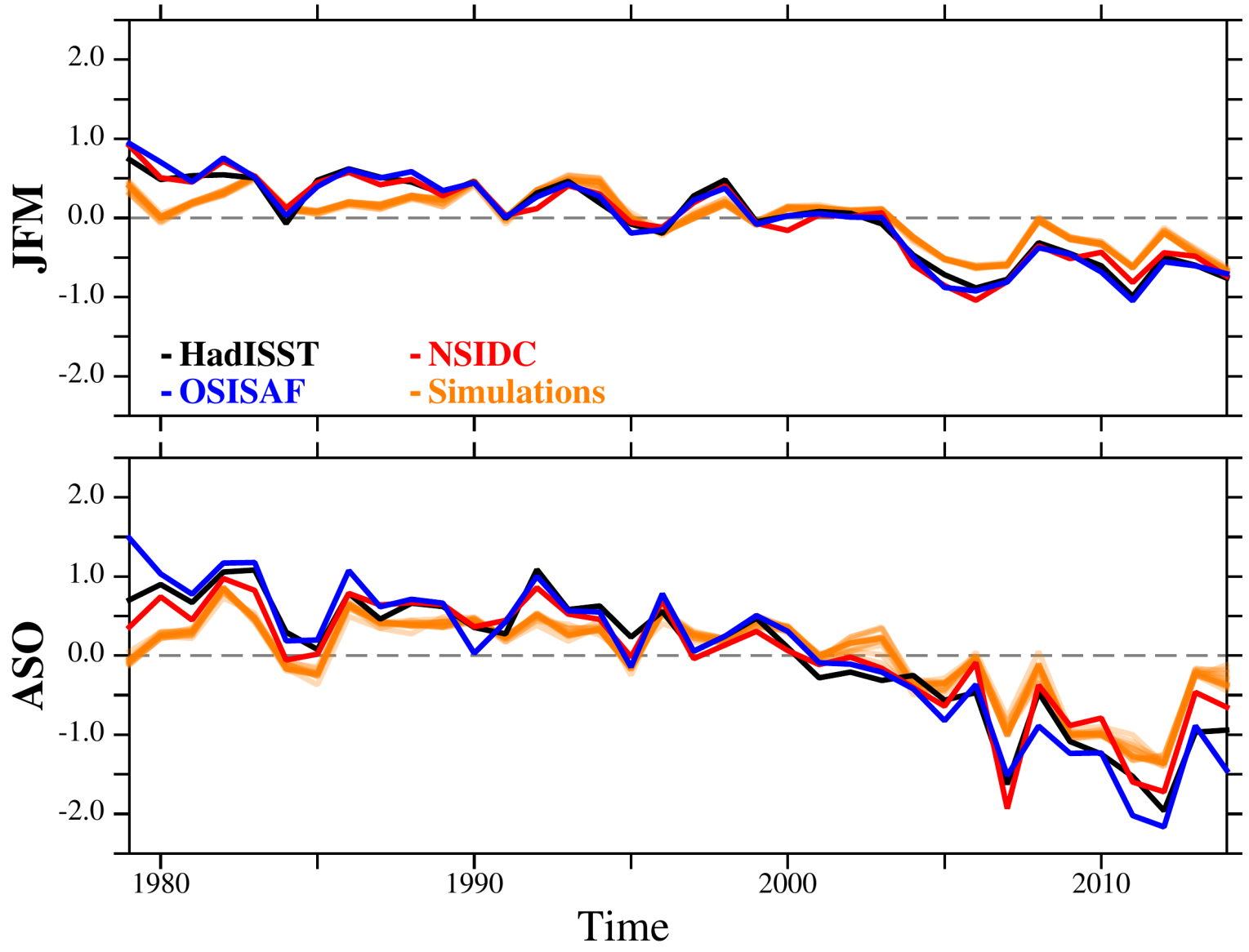
Spatial correlation between simulations and observations: all clusters and all seasons



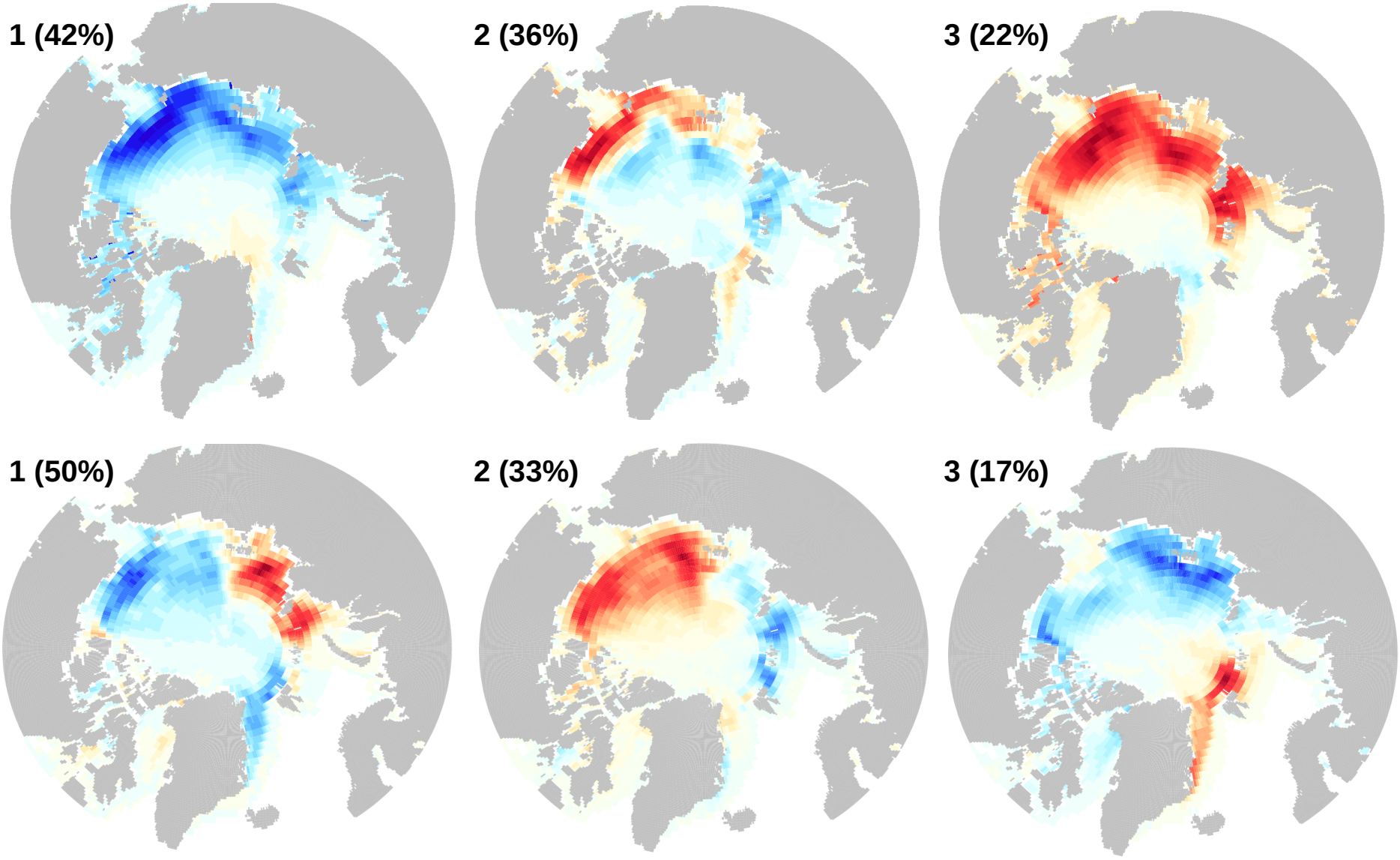
August–October clusters (OSI SAF) show a trend



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



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



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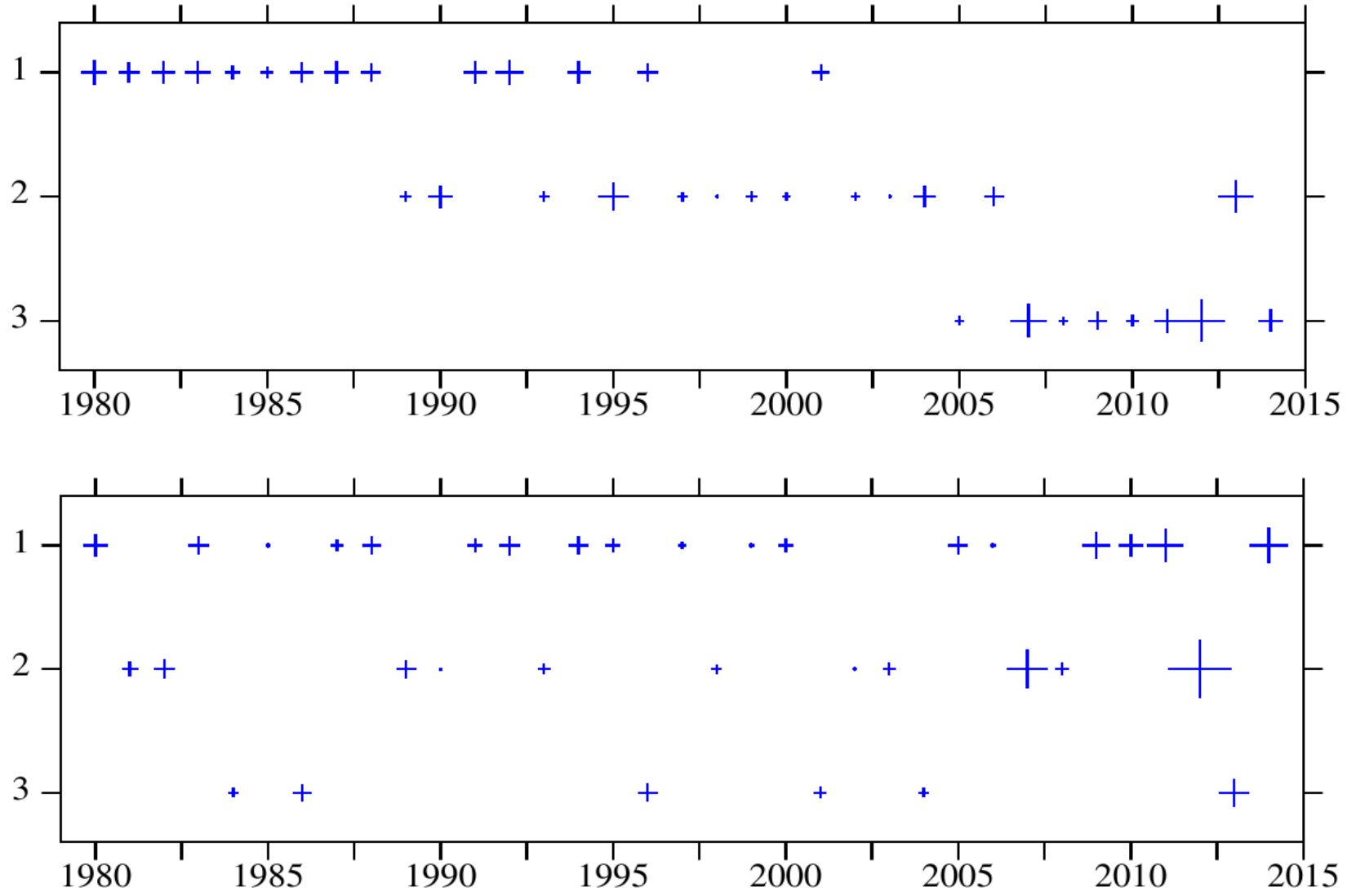
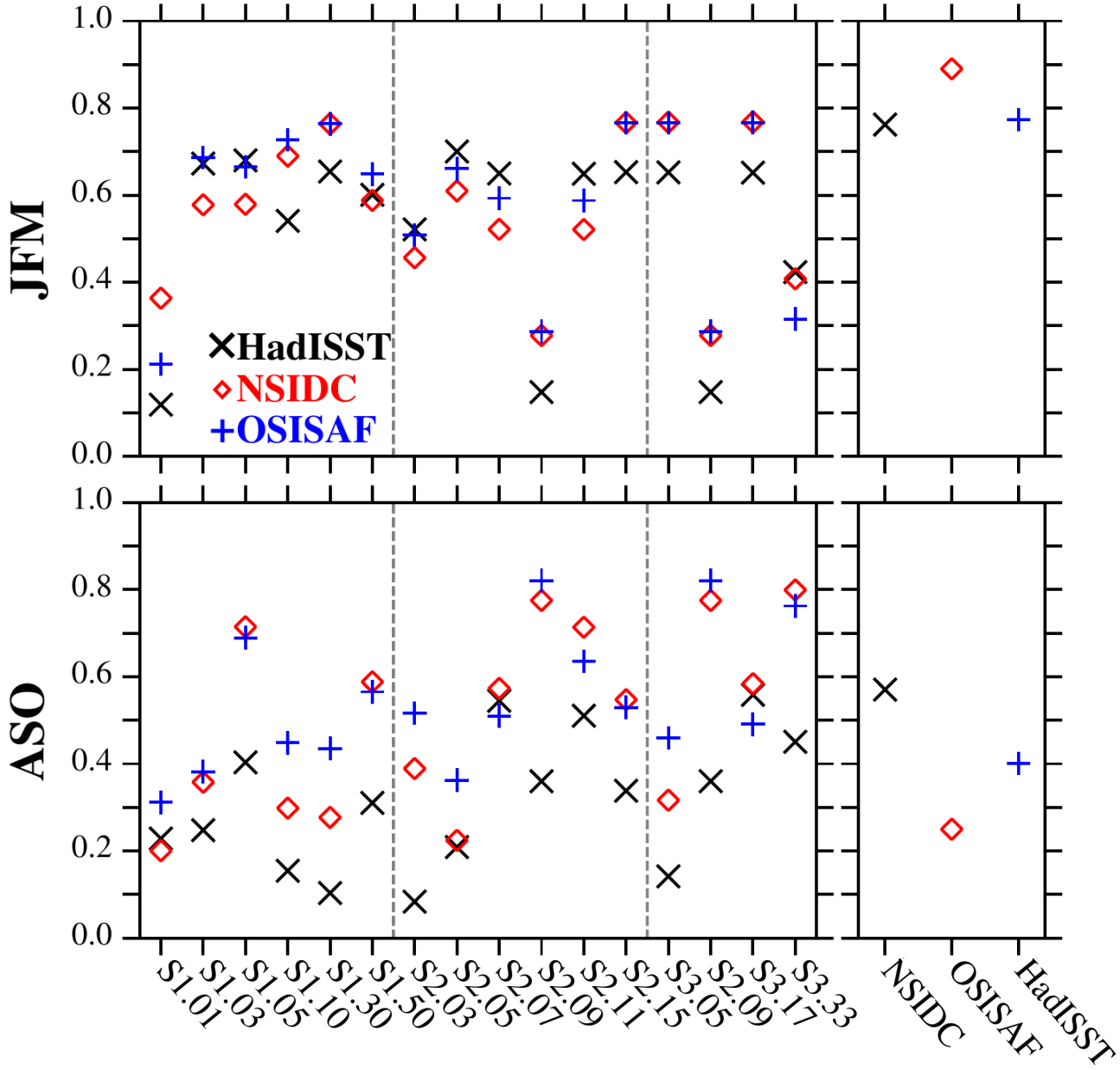


Spatial correlation between simulations and observations: JFM and ASO first clusters after detrending



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