Assessment of decadal prediction skills and sensitivity to SIT initialization

Tian Tian[1], S. Yang[1], P. Karami[2], F. Massonnet[3], T. Kruschke[2] and T. Koenigk[2,4]

[1]DMI, [2]SMHI,[3]UCLouvain, [4] SU

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tian@dmi.dk

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Summary (wrt 1997-2016)

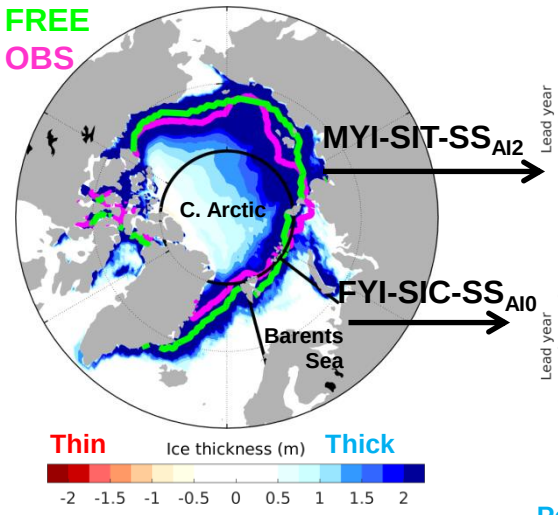
Bias: >2m ice thickness (SIT) along the Sept ice edge and the Arctic coastalines in **FREE (un-init)**, but multi-year ice (MYI) <50% Arctic sea-ice cover in OBS.

SS_{AI2}: thick MYI SIT skill improved greatly by **AI2 (all-init.)** in winter and, in turn constraining Sept min.

SS_{AI0}: thinner first-year ice (FYI) SIC skill mostly benefit from Atlantic heat transport by **AI0 (no-ice-init)**.

AS: skill increased in predicting Sept. min in FYI/MYI regions, and re-emerged in yr 5-7 due to advection of sea-ice anomalies

Sept bias ice edge & SIT

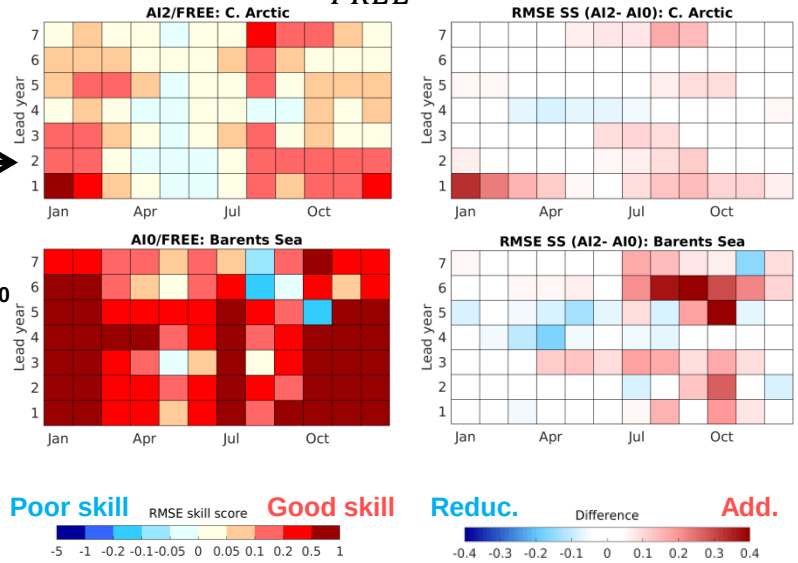


Skill score (SS)

$$SS_{AIx} = 1 - \frac{RMSE_{AIx}}{RMSE_{FREE}}$$

Added skill (AS)

$$AS = SS_{AI2} - SS_{AI0}$$



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Tian, T. et al (in prep). Geosci. Model Dev.: Sensitivity of regional Arctic sea-ice decadal prediction to sea-ice thickness initialization in EC-Earth3.

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EC-Earth3-CPSAI experiment set-up

contribution to
CMIP6 decadal climate prediction project (DCPP)

SMHI

Novelty@DMI	Introducing SIV anomaly to constrain SIT initialization with 5 categories
Model system	EC-Earth3 Climate Prediction System with Anomaly Initialization (**EC-Earth3-CPSAI**)
Configuration	**A**tm and **O**cn coupled **GCM** (atm:T255L91 + ocn: ORCA1L75)
Forcing	**CMIP6** historical + future scenario SSP2-4.5
Anomly init. to ocn + ice **(NEMO3.6+LIM3)**	5-member **ORAS5** (1979-2019) & single backward extension (1960-1978); anomaly wrt obs climate (1979-2014); initialized variables: ocean temperature & salinity, SIC, SIT and snow thickness
Full-field init. to atm **(IFS cycle 36r4)**	ERA40 (1960-1978), **ERAI** (1979-2018), ERA5 (2019) + 3D-T perturbation with random differences (to the order of 10^-5 K)
Init. hindcasts	yearly started on **1 November** over **1960-2019**, 10 yrs + 2 months long
Model climate	EC-Earth3 CMIP6 historical run **r5i1p1f1** (1979-2014)
Joint ensembles	**15** members labelled **r1-15i2p1f1**: DMI performing 10 members + SMHI performing 5 members
Sensitivity tests	5-member ens-mean comparison: **AI2** (all-init.), **AI1** (no-SIT-init.), **AI0** (no-ice-init.), **FREE** (no-init);

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BLUE ACTION

EUCP
European Climate Prediction system

ARCPATH

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