SMHI

Prediction skill of Arctic sea ice in decadal climate simulations of the EC-Earth3 model

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ARCPATH

Project description

Mission: to investigate the skill of decadal climate prediction simulations of the EC-Earth3 model with a focus on Arctic sea ice

This is a joint decadal climate prediction activity of DMI and SMHI as part of ArcPath- and EUCP-projects; contribution to CMIP6-DCPP (dcppA-hindcast, dcppB-forecast) and IPCC AR6.
Also check the presentation by Tian et al. EGU2020-13516.

Production of initialized decadal climate predictions:

EC-Earth 3.3.1 (AOGCM, T255L91, ORCA1L75)

- Initialized on 1 November 1960-2019 integrated for 10 years (+ 2 months) each

- 15 ensemble members total (10 at DMI, 5 at SMHI)

**Anomaly initialization for ocean and sea-ice**
- ocean temperature & salinity anomalies from ORA-S5 added to model climatology (over 1979-2014)
- sea-ice anomalies (concentration AND thickness) from ORA-S5 added to model climatology

Full-field initialization for atmosphere
fields of absolute values from ERA40/ERA-Interim/ERA5 directly used for model initialization
(1 unperturbed + 2 perturbed (3D-ta) states)

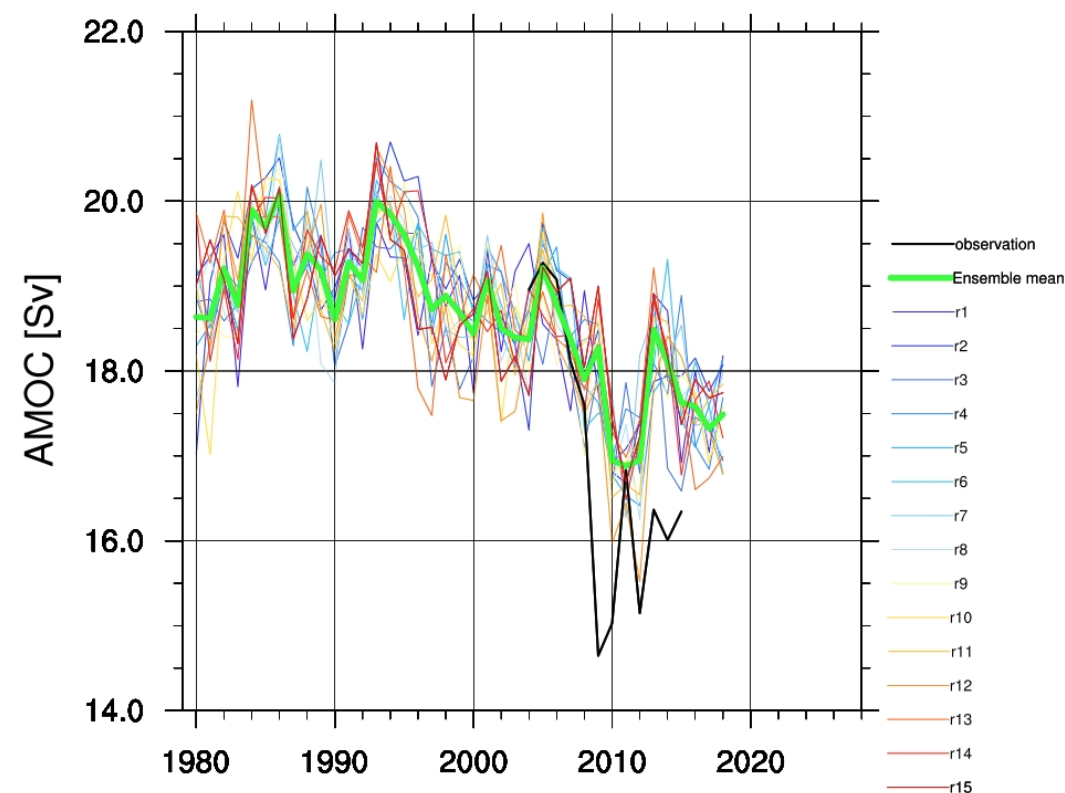# Qualitative comparison of hindcasts to observations

Time series of Arctic sea ice area in September for the 1st and 10th year of forecast which is fairly in agreement with observations.
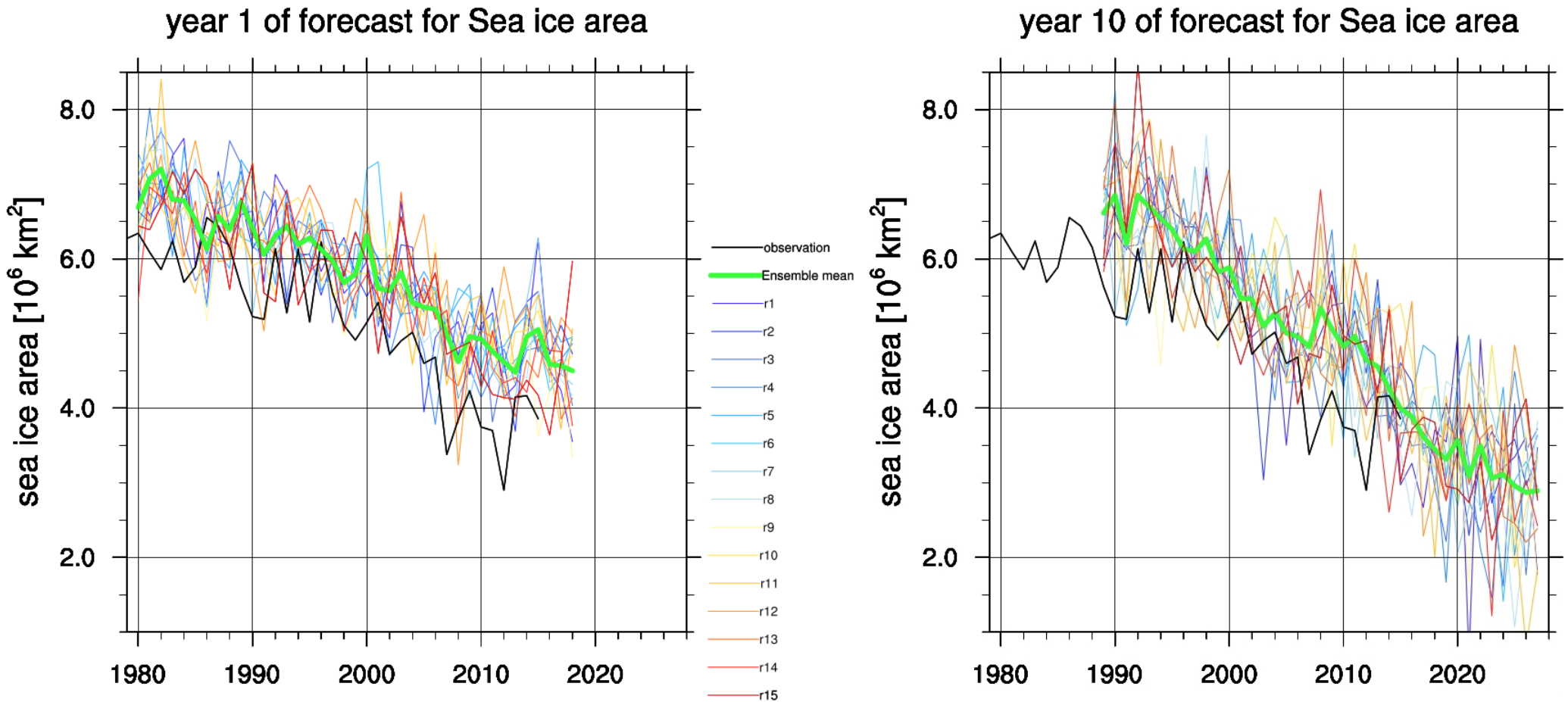
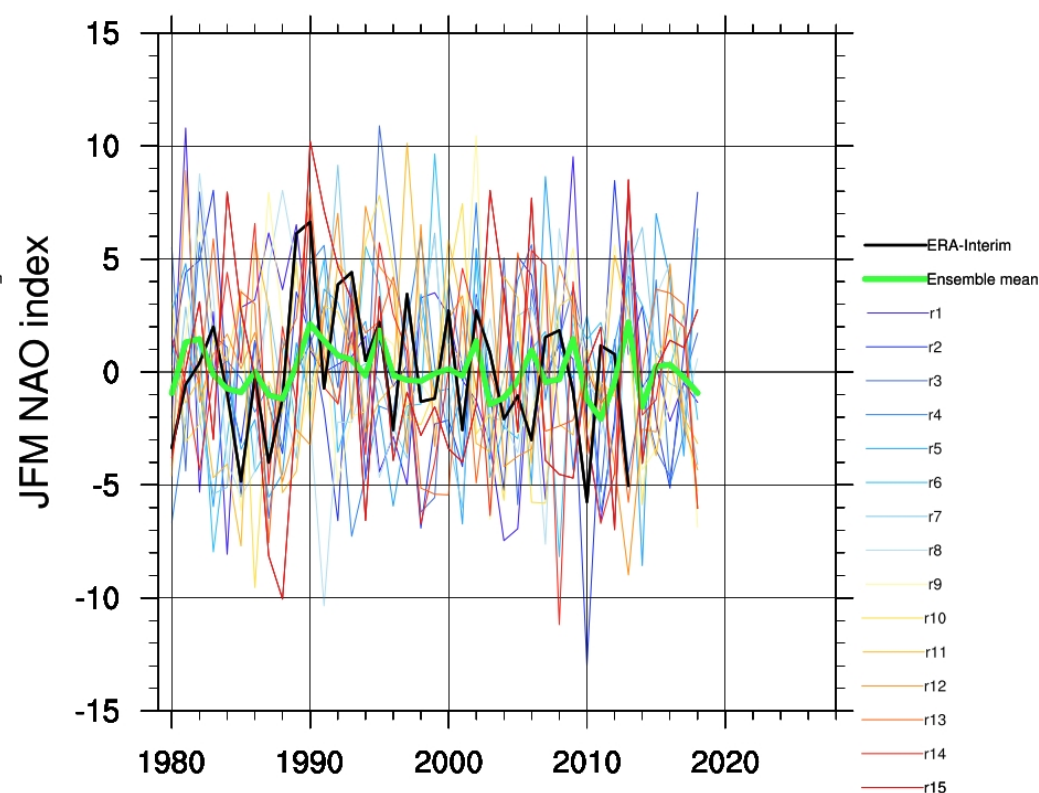Observation data is from OSI SAF (OSI-450 satellite product, 1979-2015)

Qualitative comparison of hindcasts to observations

Time series of annual mean AMOC (maximum between 24.5-27.5 N) for the 1st year of forecast versus RAPID-MOCHA array observations (Smeed et al., 2017).
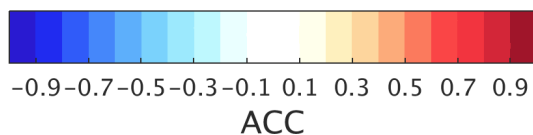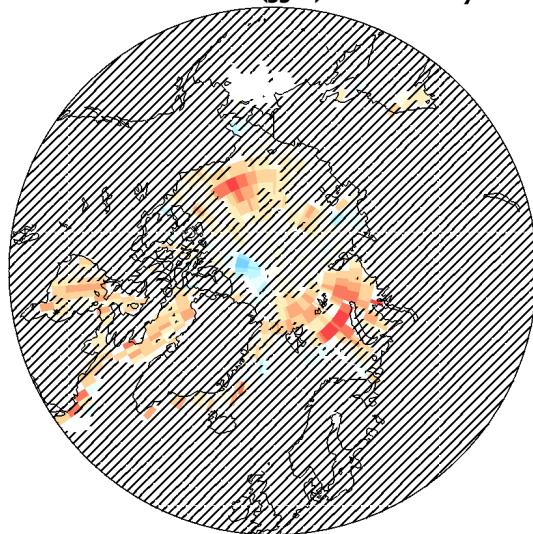
Time series of NAO index (1st principal component of JFM SLP over 20°-80°N, 90°W-40°E) for the 1st year of forecast versus ERA-Interim.
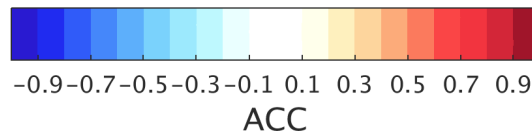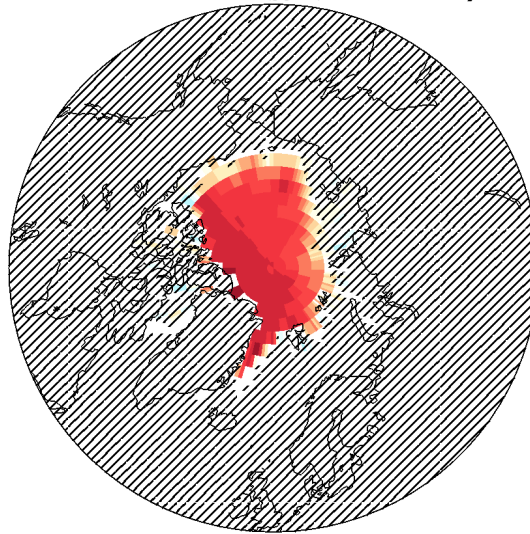
First skill assessments (s1979-s2005): Anomaly correlation coefficient (ACC)

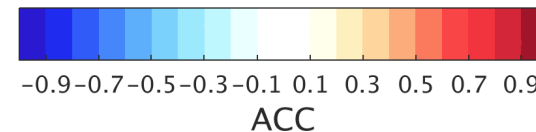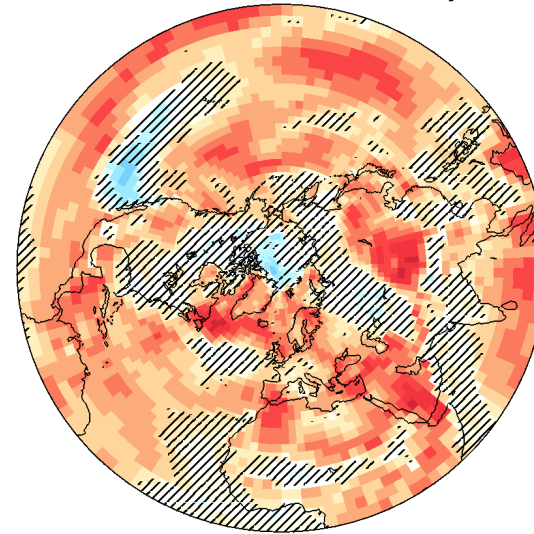Skills for 1st year of prediction

DCPP siconc (JJA) lead 1–1y

DCPP sithick (JJA) lead 1–1y
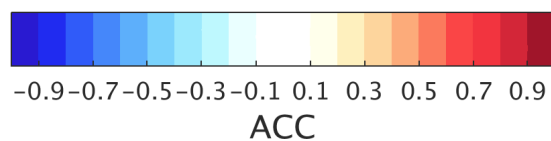
DCPP tas (JJA) lead 1–1y
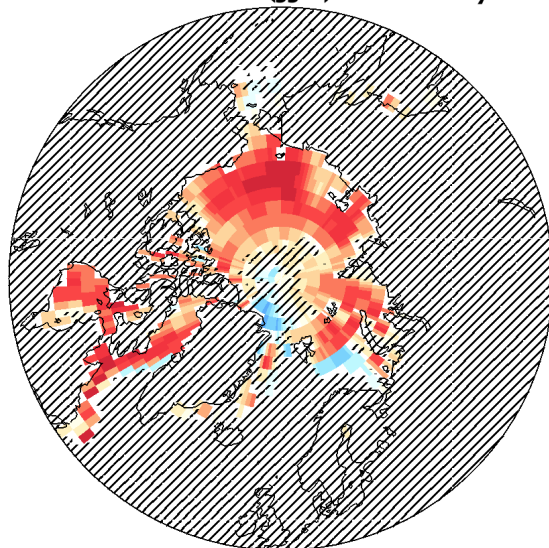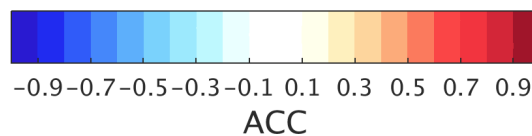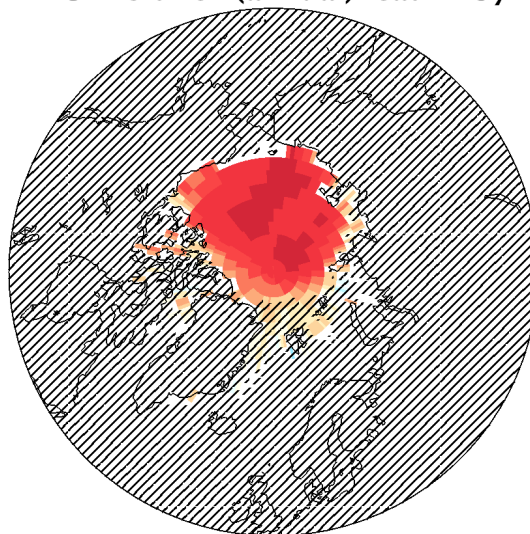
hatched areas: ACC not significant (p>5%)

First skill assessments (s1979-s2005): ACC

Skills for year 2-5 of prediction

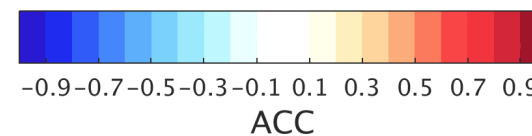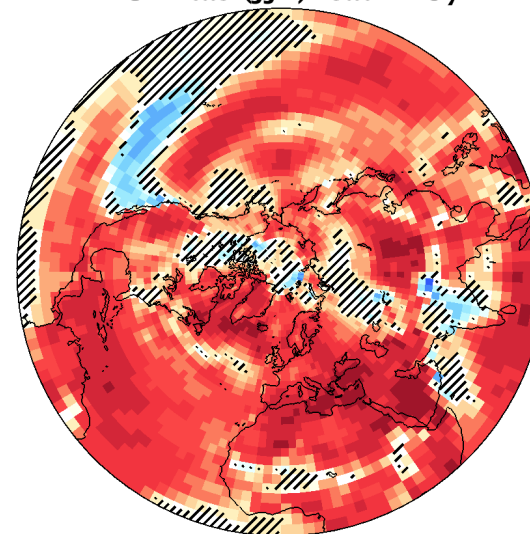

DCPP siconc (JJA) lead 2-5y

DCPP sithick (annual) lead 2-5y

DCPP tas (JJA) lead 2-5y

hatched areas: ACC not significant (p>5%)

Summary

First assessments of prediction skill (so far for temperature, sea ice concentration and thickness based on ACC):

- initialization of sea-ice thickness beneficial for first forecast year(s)
- Regions with skill beyond externally forced component for 1st forecast year (figure not shown): Tropical Pacific, North Pacific and North Atlantic
- Hardly any skill beyond externally forced component for longer lead-times

In-depth analyses to be done: focus on sub-basins of the Arctic, other variables, specific phenomena and variability patterns