Kruschke, Tim
on behalf of all T6.1 partners at BSC, NERSC, and SMHI

SMHI

Results from WP6
Applications towards stakeholders
T6.1: Improving skill of climate predictions

INTAROS

INTAROS General Assembly
12-13 Jan 2021

Background

- optimal knowledge of the initial state (observations) is crucial for the skill of any prediction
  - a unified iAOS has strong potential to improve our ability of predicting (modeling) the evolution of different Earth system components in the Arctic on timescales from days to decades
  - T6.1's mission is to test and prove this potential

Overview

T6.1 main recent activities:

- general demonstration of benefit for
  - seasonal (NorCPM; NERSC) and
  - decadal (EC-Earth3; SMHI) climate predictions

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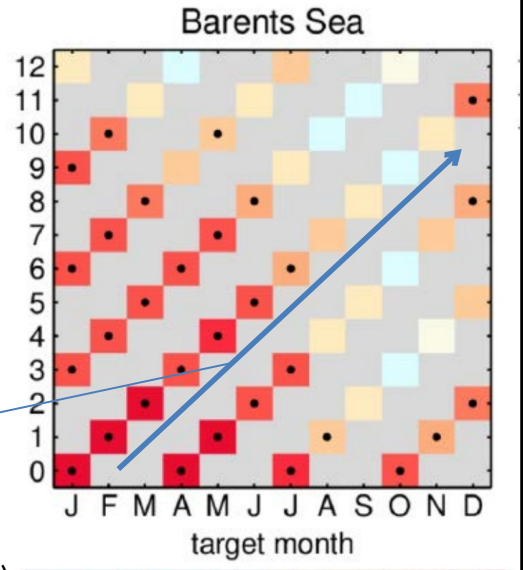
- benefit for seasonal climate predictions after assimilating iAOS dataset CERSAT SIC (EC-Earth3; BSC)
- Hydrological modelling use cases (Arctic-HYPE; SMHI)

Relevance of sea-ice for seasonal prediction

- assimilating sea-ice concentration for seasonal predictions (NERSC)

Skill of NorCPM for detrended sea-ice extent (SIE) after assimilating only SSTs
(Dai et al., 2020)



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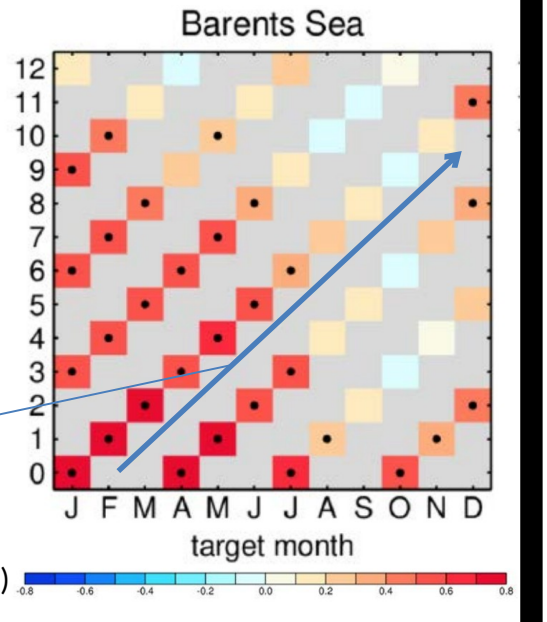
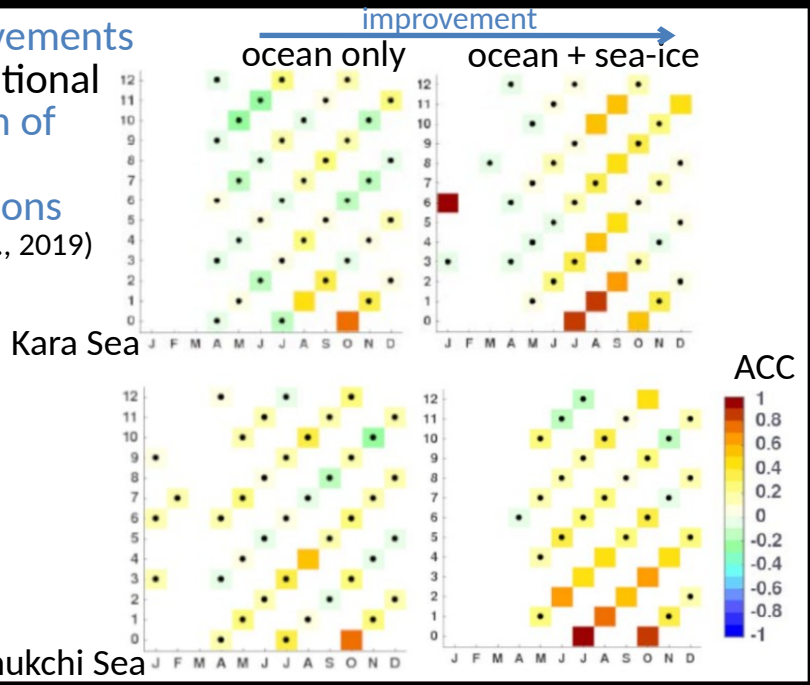


Skill improvements due to additional assimilation of sea-ice concentrations
(Kimmritz et al., 2019)



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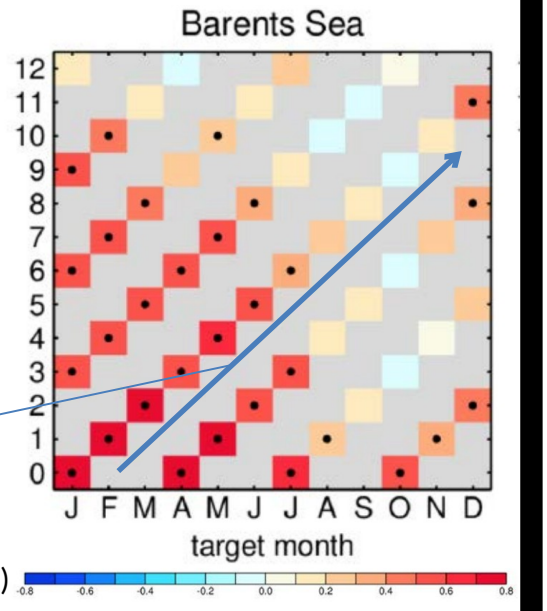

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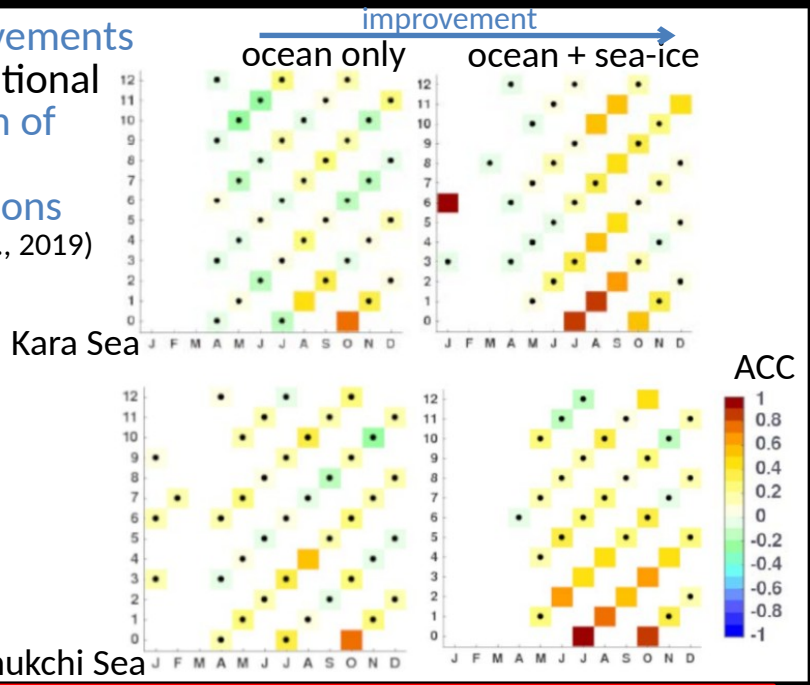
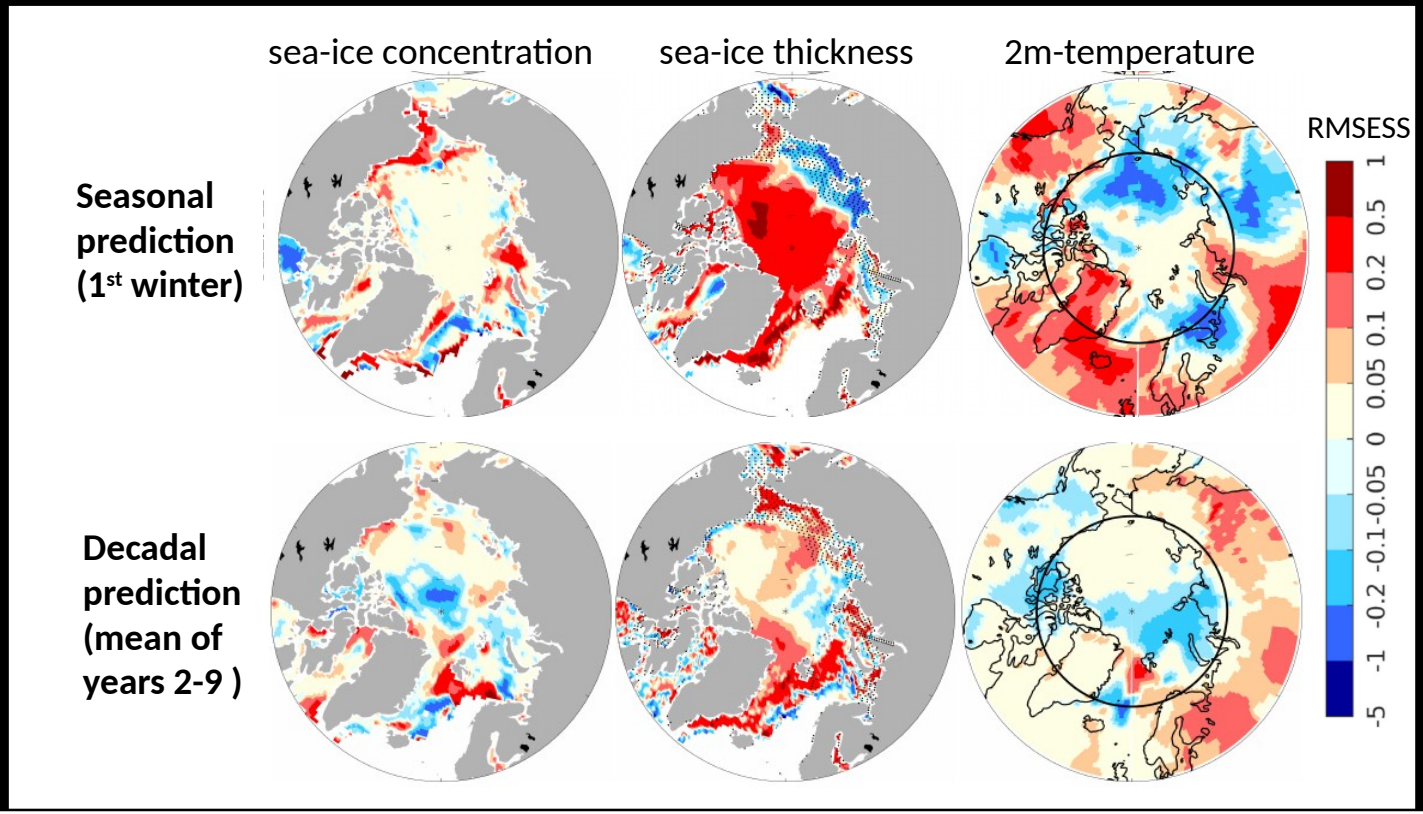


Strongly coupled data assimilation (ocean+sea-ice) yields potential for improved seasonal predictions

Relevance of sea-ice for S2D prediction

- initializing SIC & SIT for decadal predictions (joint SMHI/DMI effort)
  - **added predictive skill form sea-ice (SIC+SIT) initialization** wrt skill from ocean-only (T&S) initialization



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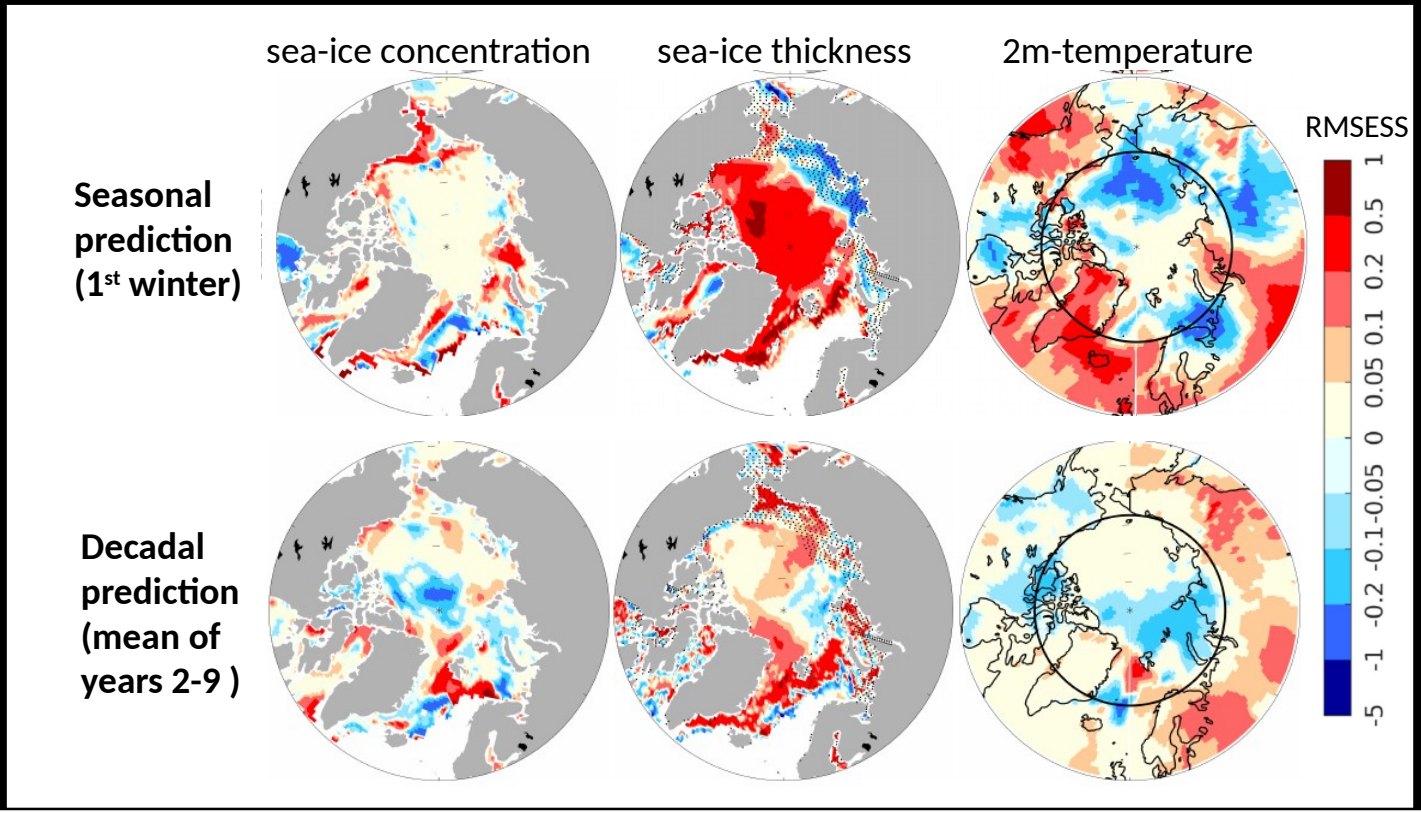
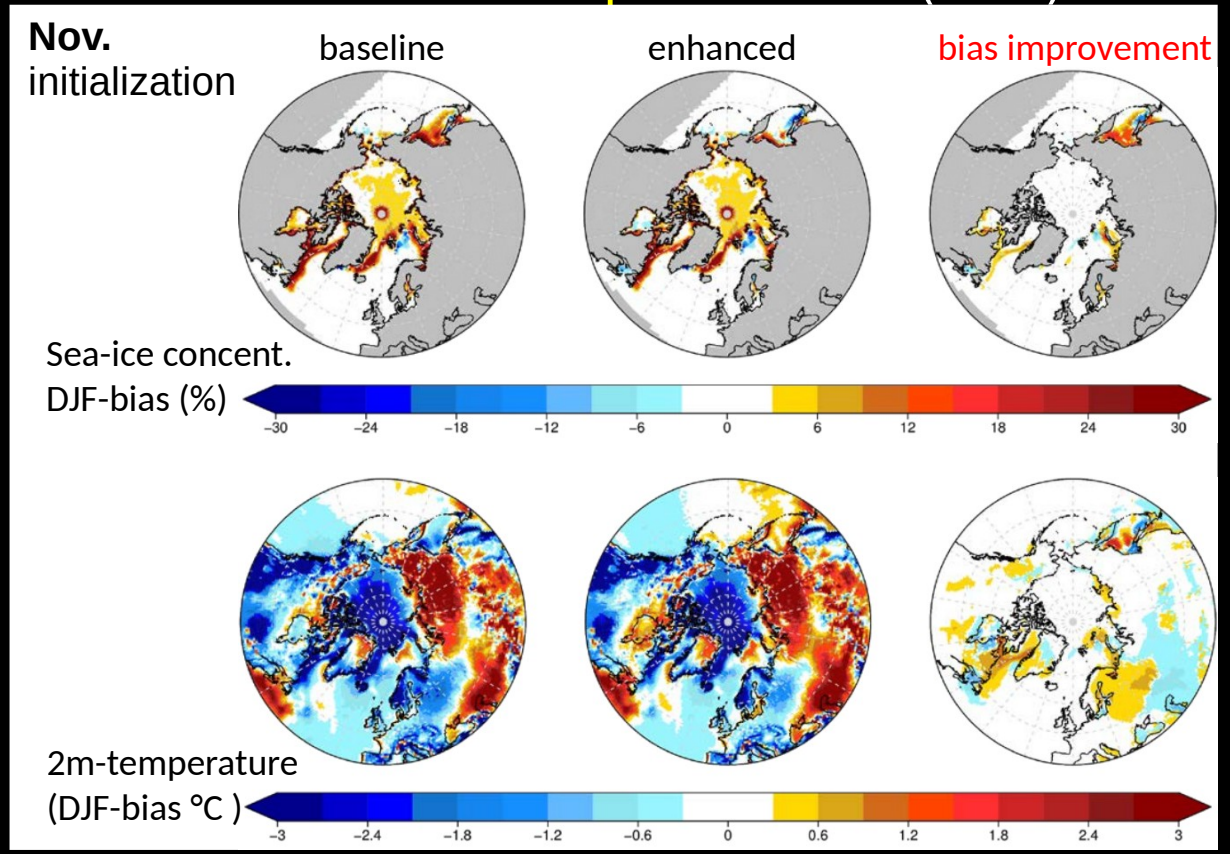


initializing
NH SIC & SIT
from observations
improves S2D-predictions
of sea-ice locally
as well as
2m-temperature
in lower latitudes
(Tian et al., 2020; Karami et al., in prep.)

Benefit from iAOS for seasonal climate prediction

- assimilating iAOS dataset CERSAT SIC for seasonal predictions (BSC)
  - Focus: determining the impact of sea-ice assimilation on local and remote biases
  - Set-up:
    - Baseline forecast (assimilating ocean T&S only)
    - Enhanced forecast: assimilating new CERSAT SIC



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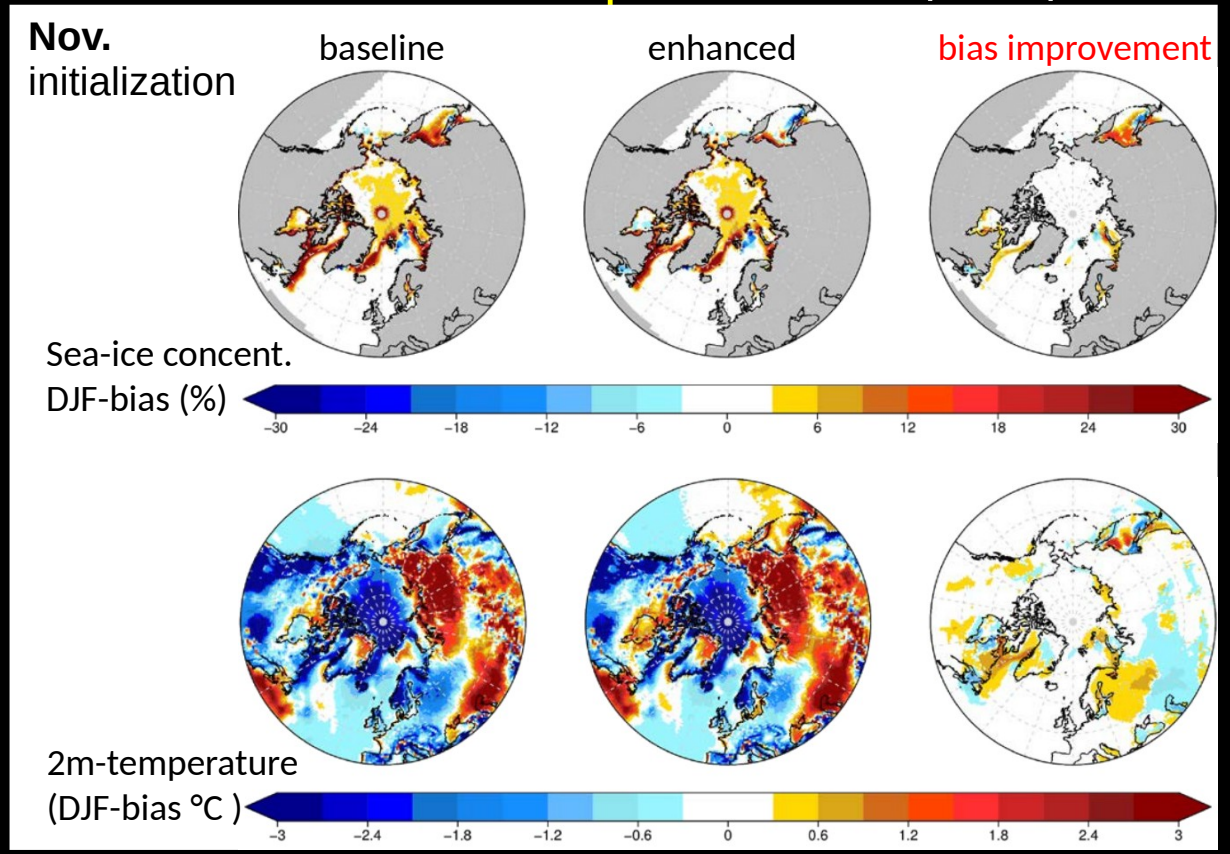
clear improvement of sea-ice concentration bias along the ice-edge

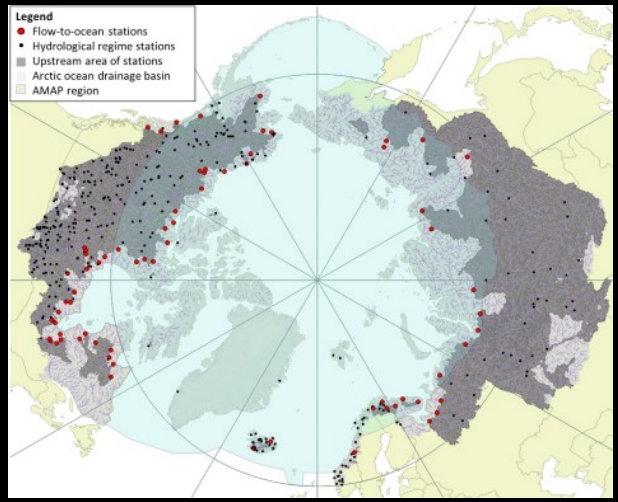
improvement of temperature-bias matching sea-ice changes but also over some land areas

(Acosta-Navarro et al., in prep.)



Hydrological modeling use cases

- **Arctic-HYCOS:** observation network of selected river discharge stations operated by national hydrological services in the Arctic countries
  - representing ~60% of the pan-arctic drainage basin of the Arctic ocean (PADB); assessment in INTAROS WP2



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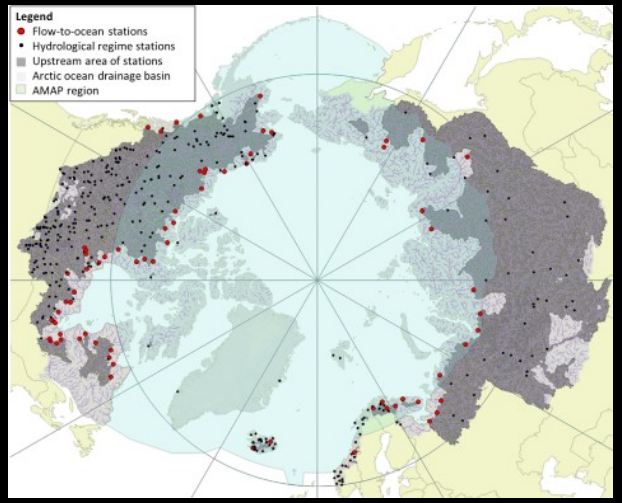
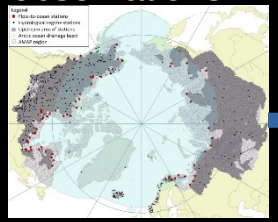
- **Arctic-HYPE:** pan-arctic hydrological model for the PADB, developed to support Arctic-HYCOS in un-gauged basins
  - Hindcasts produced operationally on daily basis for last 3 months plus 10 day forecast (hypeweb.smhi.se)



Hydrological modeling use cases

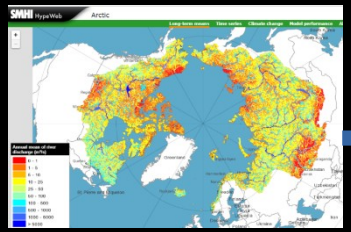
Arctic-HYCOS observations



GRDC and National data services

iAOS

Arctic-HYPE model

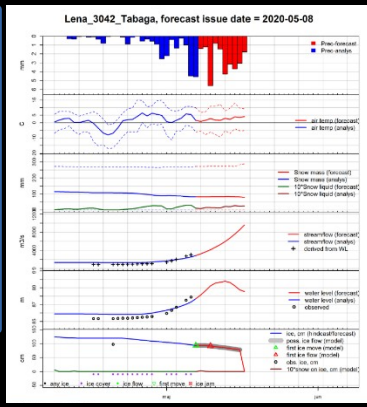


SMHI OPENDAP server

Pan-arctic iAOS use case:
Collect Arctic-HYCOS observations from GRDC and national data services:
Data for assimilation in Arctic-HYPE (user: SMHI)

Collect Arctic-HYPE data from SMHI opendap server:
Aggregate river discharge data into coastal grid
(user: ocean modeller IMR)

Regional Yakutia iAOS use case:
Collect Arctic-HYPE data from SMHI opendap server:
River discharge, ice, water level, etc
at selected river forecast points
Time-series of selected forecast variables
(user: HYPE-ERAS project, local knowledge purveyors, river basin authorities.)



Formal notes, exploitation, outlook

- all works in T6.1 approx. according to plan
- D6.1 provided in May 2020

- Climate modeling efforts in close context to contributions to CMIP6-DCPP (data available via ESGF) and WMO Exchange of Annual-to-Decadal Climate Predictions (https://hadleyserver.metoffice.gov.uk/wmolc/)

- discussions and final development of iAOS use cases (hydrological modeling) together with WP2 in February
- scientific workshop of T6.1-partners in February
  - also to coordinate final works and contributions to D6.11 (due in Sep 2021), further making use of iAOS products

Thank you!

Bilbao et al. (2020): Assessment of a full-field initialised decadal climate prediction system with the CMIP6 version of EC-Earth, Earth Syst. Dynam. Discuss. [preprint], DOI: 10.5194/esd-2020-66, in review

Dai et al. (2020): Seasonal to decadal predictions of regional Arctic sea ice by assimilating sea surface temperature in the Norwegian Climate Prediction Model, Clim. Dyn., pp. 1–16, DOI: 10.1007/s00382-020-05196-4, 2020

Kimmritz et al. (2019): Impact of ocean and sea ice initialisation on seasonal prediction skill in the Arctic. Journal of Advances in Modeling Earth Systems, 11, 4147– 4166, DOI: 10.1029/2019MS001825

Tian et al. (2020): Benefits of sea ice thickness initialization for the Arctic decadal climate prediction skill in EC-Earth3, Geosci. Model Dev. Discuss. [preprint], DOI:10.5194/gmd-2020-331, in review