The coupled ROMS-CICE system

preliminary results, and some challenges

SPARSE kickoff, Tromsø,
8.-9. november 2016

Background

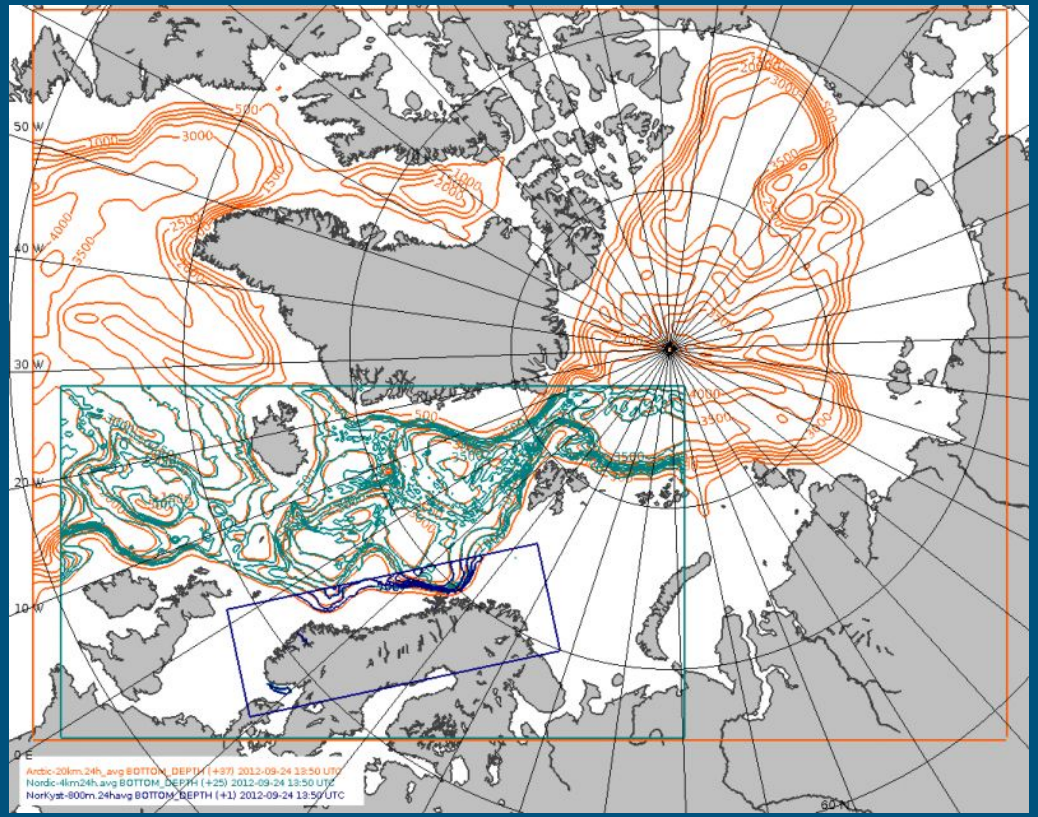
- ROMS is the main operational ocean model at MET Norway, since 2012
- We use Kate Hedstrom's branch of ROMS
  - contains a simple sea ice model by Paul Budgell
    - *The sea-ice component of ROMS is a combination of the elastic-viscous-plastic (EVP) rheology (Hunke and Dukowicz, Hunke) and simple one-layer ice and snow thermodynamics with a molecular sublayer under the ice (Mellor and Kantha).* https://www.myroms.org/wiki/images/3/3b/Manual_2010.pdf
  - assimilation using 4DVar does not work with this sea ice model/branch of ROMS
- Coupling of ROMS and CICE
  - developed through a cooperation between MET Norway and Akvaplan-NIVA

Operational ROMS models at MET Norway

- Arctic-20km (+240h)
- Nordic-4km (+120h)
- NorKyst-800m (+66h)

All domains have sea-ice model

SST correction and nudging of ice charts and OSISAF ice concentration in Arctic-20km and Nordic-4km

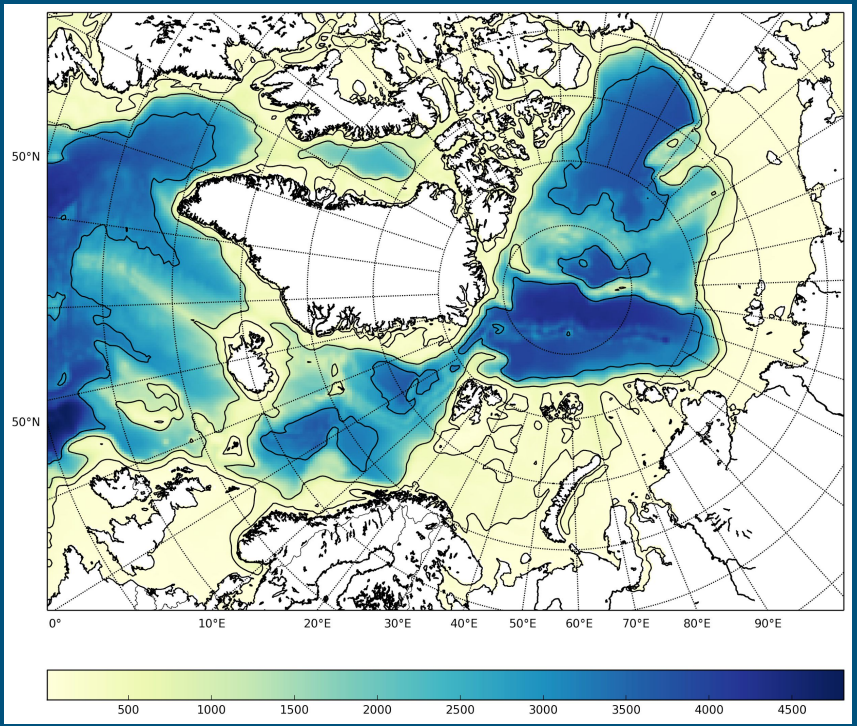


METROMS - Coupled ROMS-CICE

- Rutgers ROMS version 3.7 (current trunk version)
- Los Alamos CICE 5.1.2
- MCT 2.9
- Python framework for running experiments
- Two model domains have been set up and tested:
  - Arctic-20km
  - Arctic-4km
- Available at https://github.com/metno/metroms

METROMS in SPARSE

- Arctic-20km model area
- ERA Interim as atmospheric forcing
- FOAM reanalysis as initial and boundary conditions
- Climatological river and glacial runoffs



Coupling in METROMS

- cice2ocn:
  - sea ice concentration (aice, aice_u, aice_v)
  - fresh water flux
  - salt flux
  - nonradiative heat flux
  - radiative heat flux through ice
  - ice-ocean stress
- ocn2cice:
  - sst
  - sss
  - ssh
  - frazil ice production/melt potential (by Jens Debernard)
  - u/v

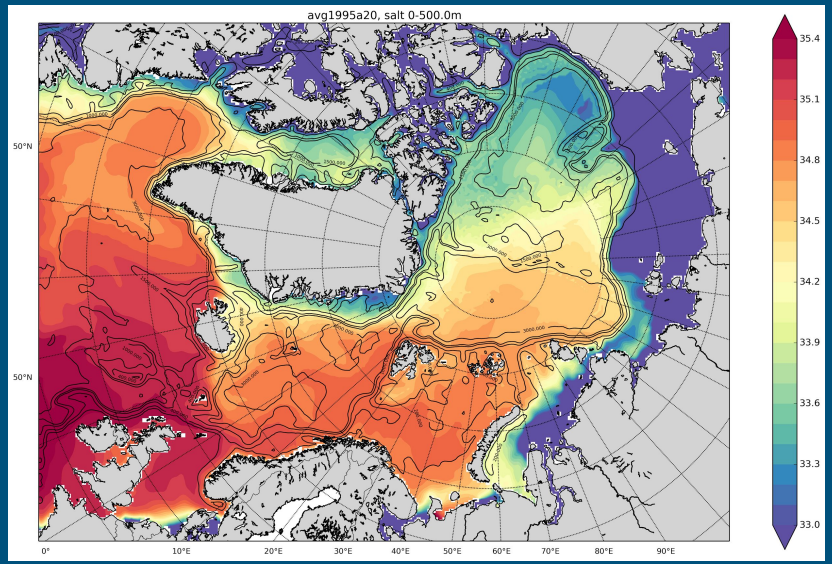
Assimilation in ROMS @ MET Norway

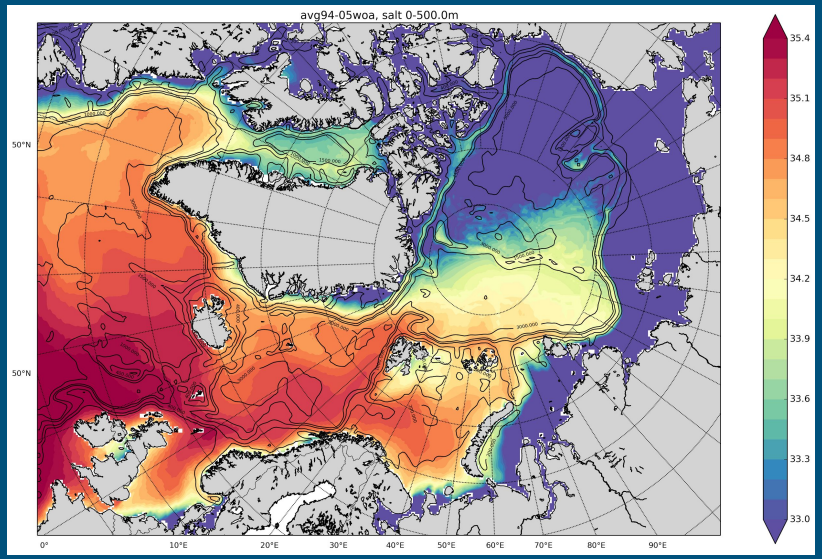
- LoVe-2.4km (Lofoten and Vesterålen)
  - surface currents from HF radars
  - CTD - in situ
  - remote sensed SST
- KASK-1km (Kattegat and Skagerrak)
  - surface currents from HF radars
  - CTD - in situ
  - OSISAF high resolution SST
- NorShelf-2.4km (Norwegian coastal/shelf model)
  - Retrospect project
  - surface currents from HF radars
  - CTD - in situ
  - OSISAF high resolution SST

Preliminary results from METROMS

Preliminary results - ROMS

Salinity 0-500m, Arctic-20km (1995) vs World Ocean Atlas (1994-2005)

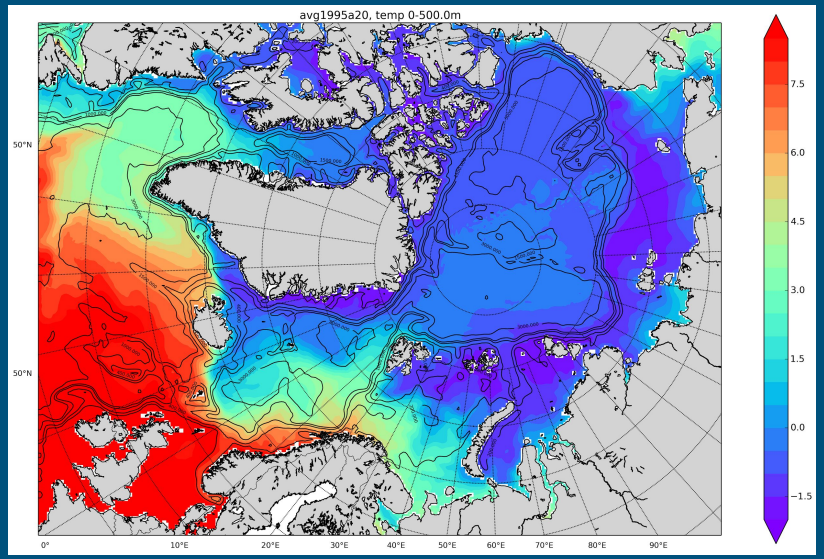


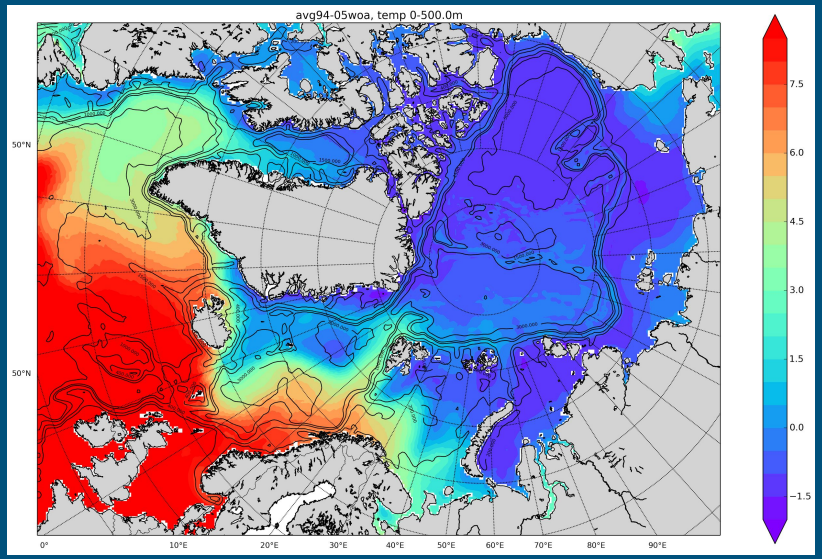


Yearly means

Preliminary results - ROMS

Temperature 0-500m, Arctic-20km (1995) vs World Ocean Atlas (1994-2005)

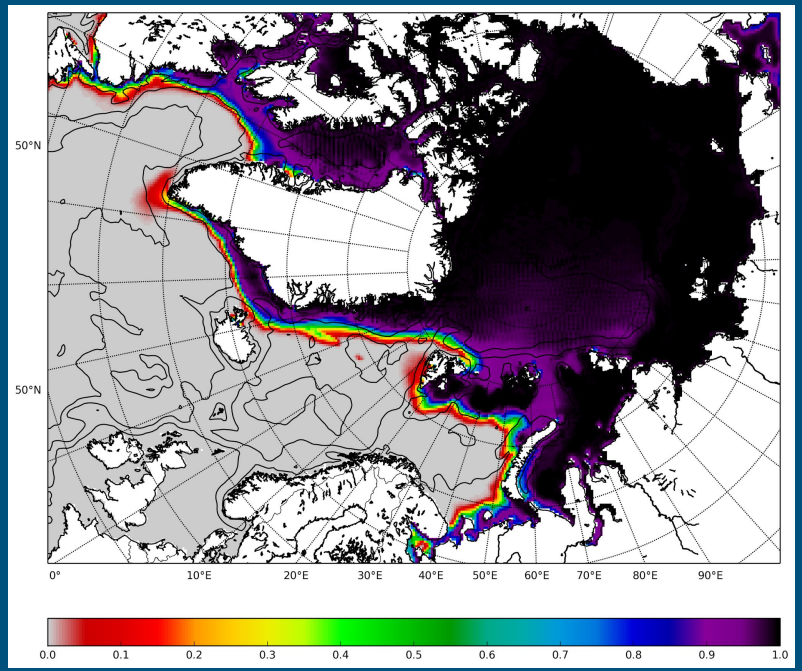


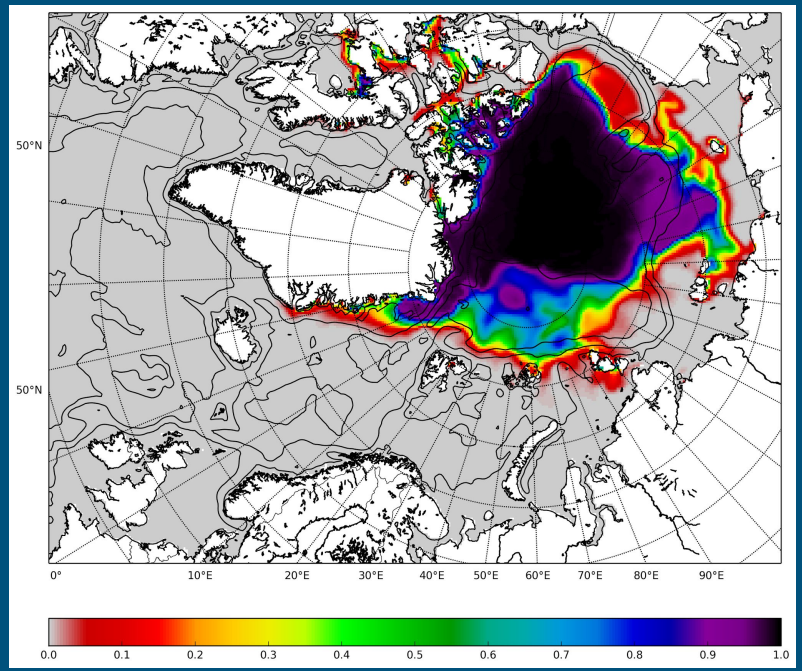


Yearly means

Preliminary results - CICE

Sea ice concentration (1995), March vs September

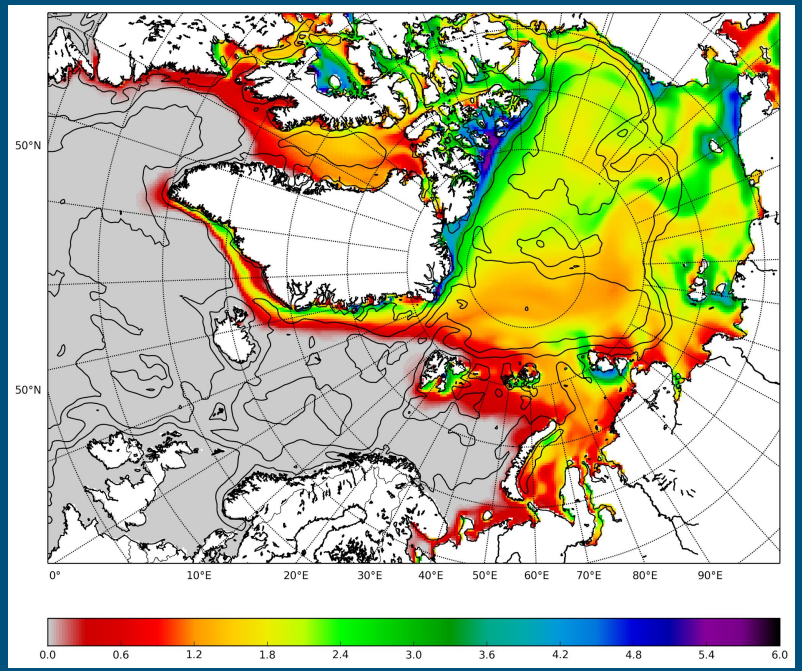


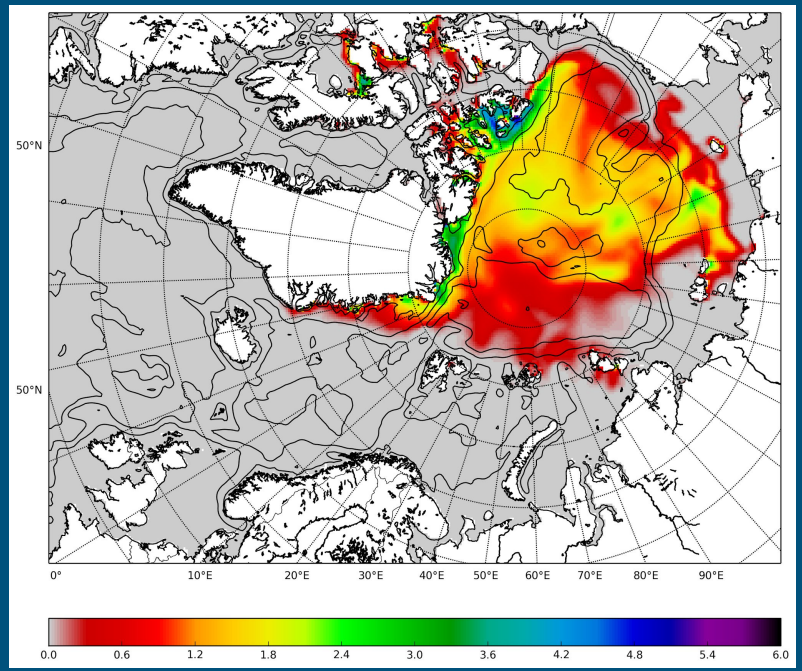


Monthly means

Preliminary results - CICE

Sea ice thickness (1995), March vs September

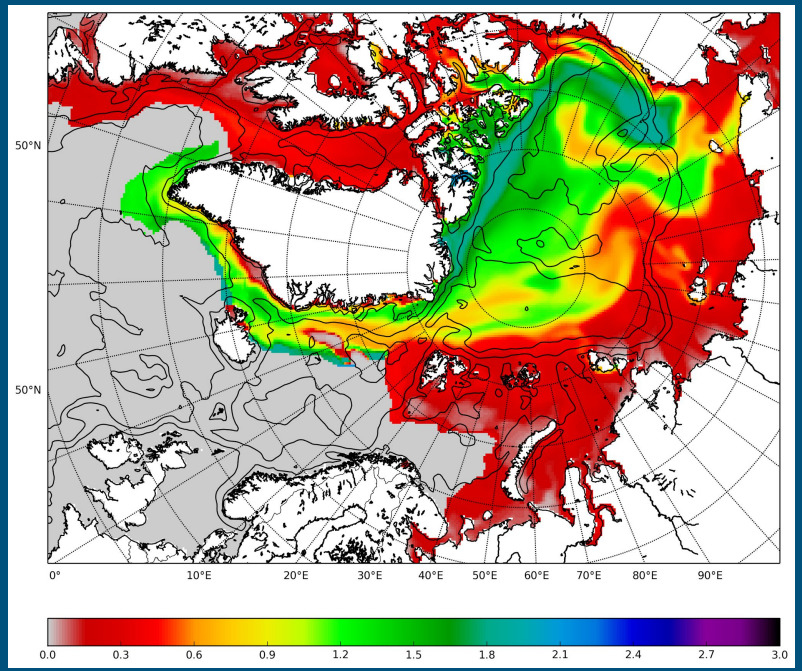


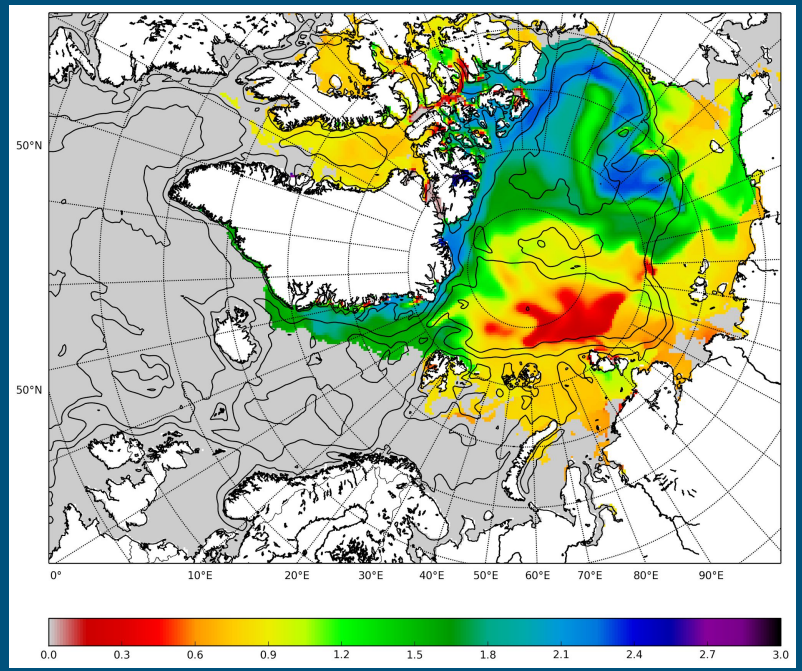


Monthly means

Preliminary results - CICE

Sea ice age (1995), March vs September

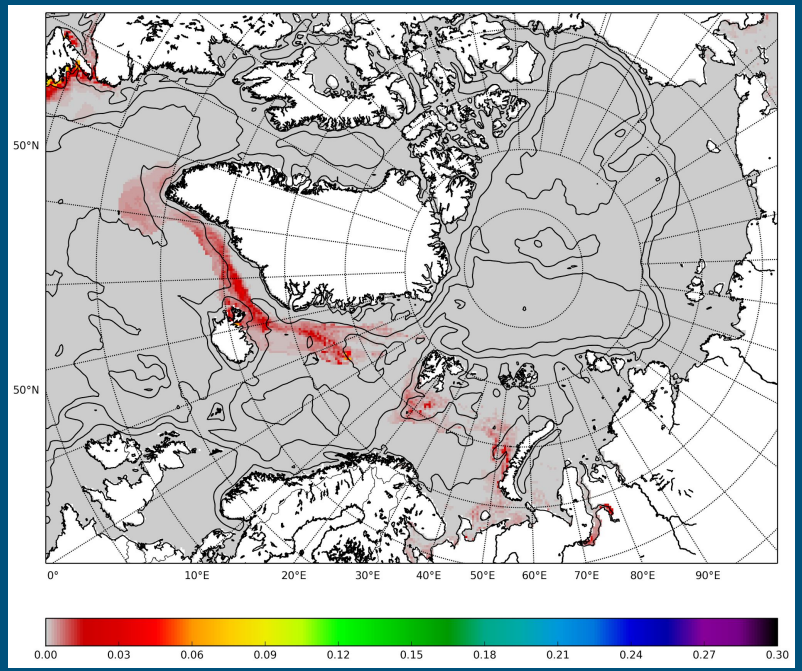


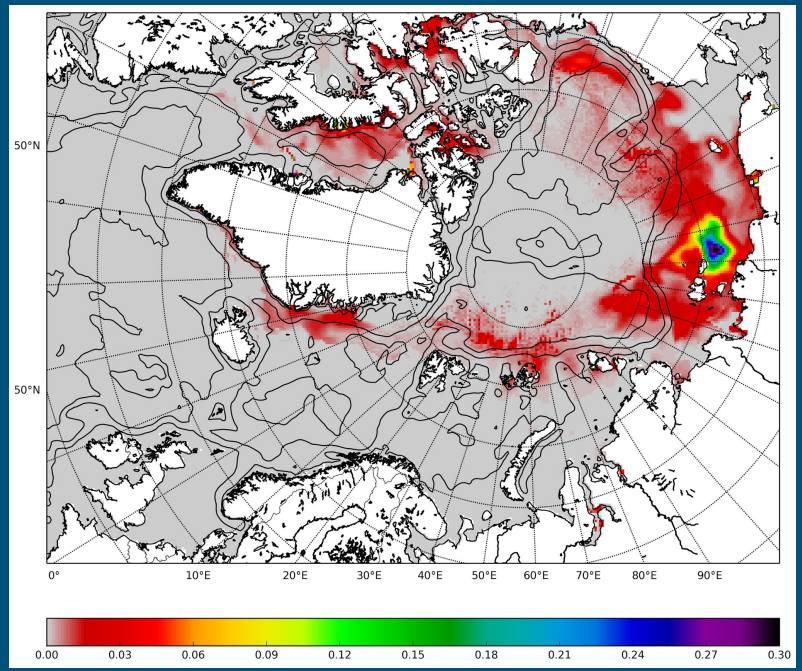


Monthly means

Preliminary results - CICE

Melt pond fraction of sea ice (1995), March vs September





Monthly means

Challenges

- Unable to reproduce correct climatology in Arctic-20km
  - Too little Atlantic water into the Arctic
  - Strong topographic steering in ROMS
  - Salinity drift in the model?
- Can this be sorted through nudging, or flux corrections?
- Assimilation in ROMS in ice infested waters is an issue
  - Must run 4DVar without ice, forced by fluxes from coupled system
  - Ice cannot change during assimilation window?
  - Same challenge applies to the CIRFA project
    - the aim here is to develop a 2.5km model covering Svalbard and parts of the Arctic