

Совместная
гидродинамическая система
дельты реки Лена и
шельфовой зоны моря
Лаптевых: численные
эксперименты и
предварительные
результаты



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The coupled hydrodynamic system of Lena River delta and the Laptev Sea shelf zone: numerical tests and preliminary results



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System of model coupling

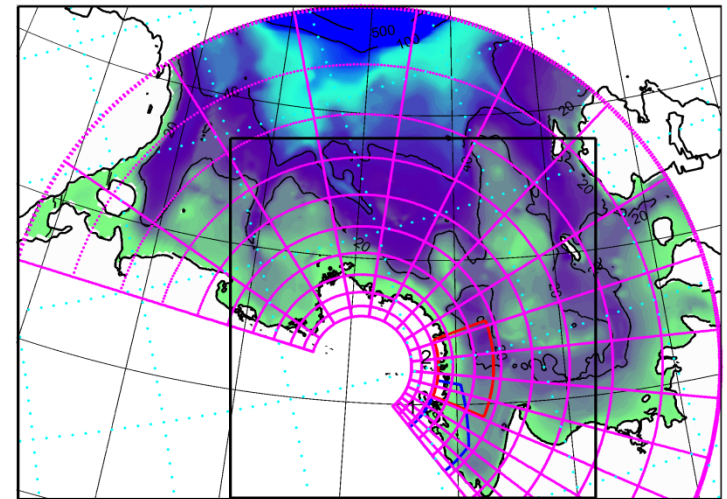
- NCEP/NCAR reanalysis



- **Coupled Ice-Ocean Model ICMMG**
(Kuzin1982, Golubeva at al.,1992, Golubeva,[2001], Golubeva and Platov,[2007])
- **Ice model-CICE 3.1** (elastic-viscous-plastic)
(W.D.Hibler ,1979, E.C.Hunke, J.K.Dukowicz,1997, G.A.Maykut 1971
C.M.Bitiz, W.H.Lipscomb 1999,J.K.Dukowicz, J.R.Baumgardner 2000, W.H.Lipscomb,
E.C.Hunke 2004)
 - North Atlantic and Arctic Ocean
 - Horizontal resolution: ~ 15 km (N.P.) ~ 50 km (equator and middle latitudes)
 - Forcing: NCEP/NCAR reanalysis



- POM (Princeton ocean model), nested model
 - Laptev Sea
 - Horizontal resolution ~ 100m-8km,
 - Time period of simulation – up to 1 year

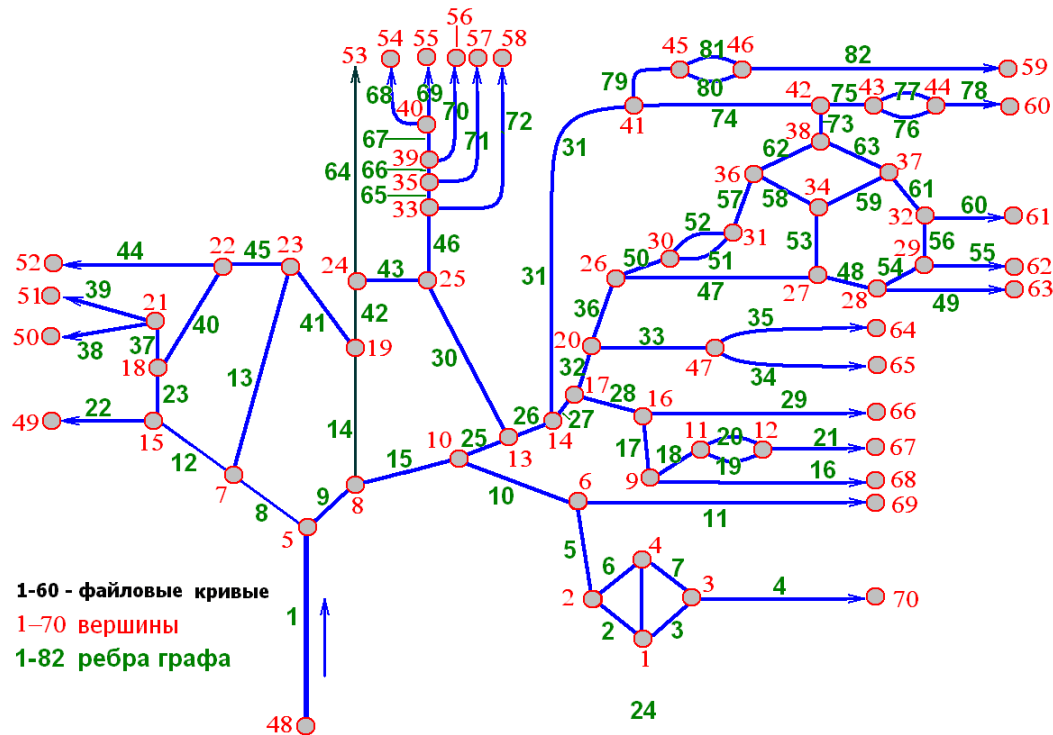
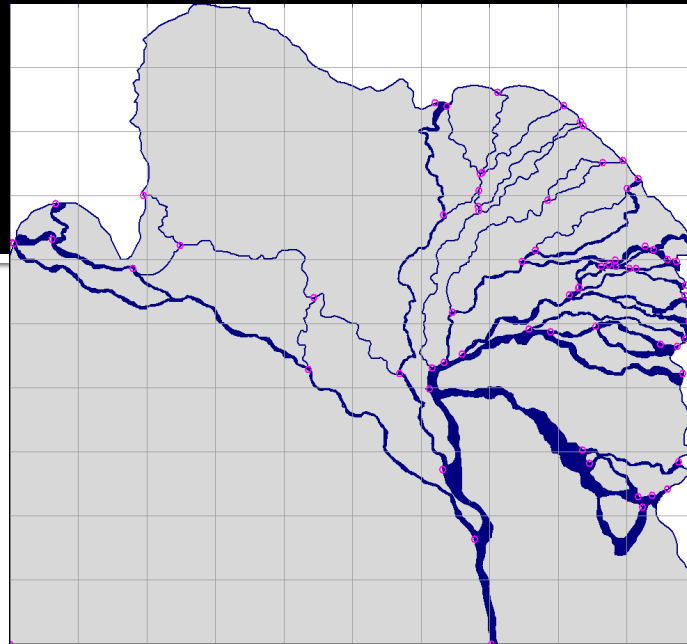


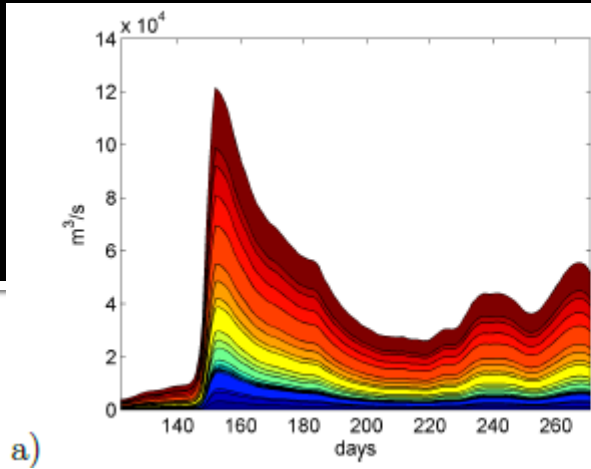
The Lena River Delta System

- 1-D Saint-Venant equations
- 82 selected segments of river channel network

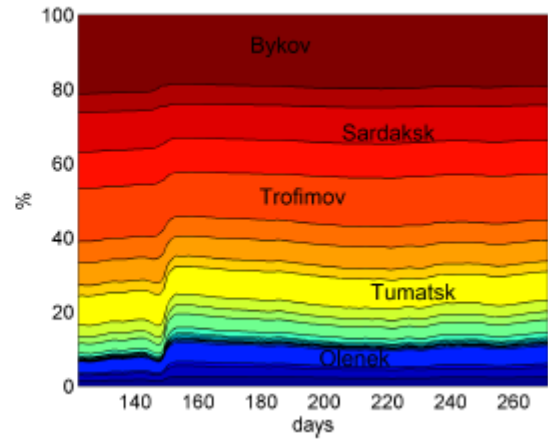
Data assimilation

- Vertical profiles of temperature and salinity –IPY-2008
- Skin temperature – AVHRR Pathfinder

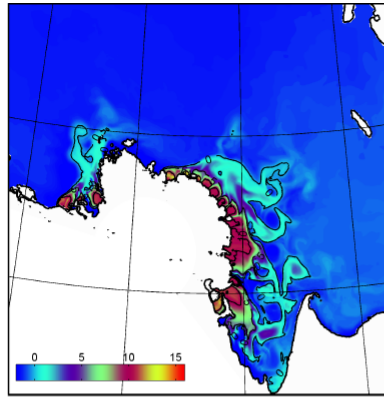




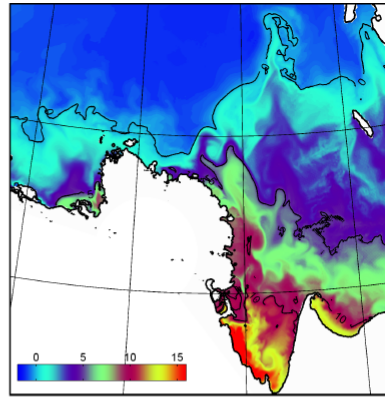
a)



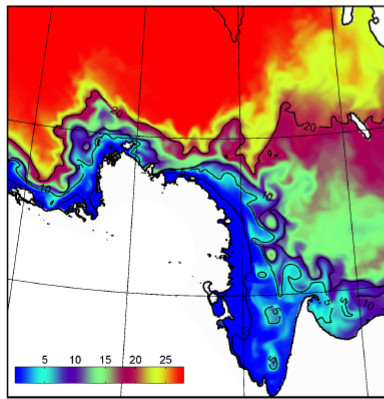
b)



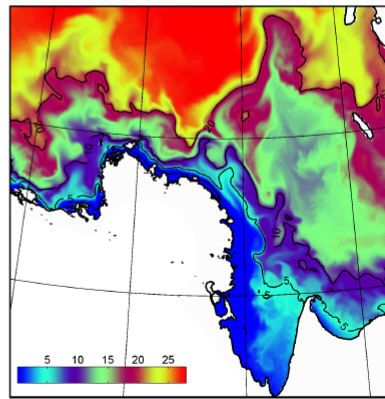
a)



b)



c)



d)

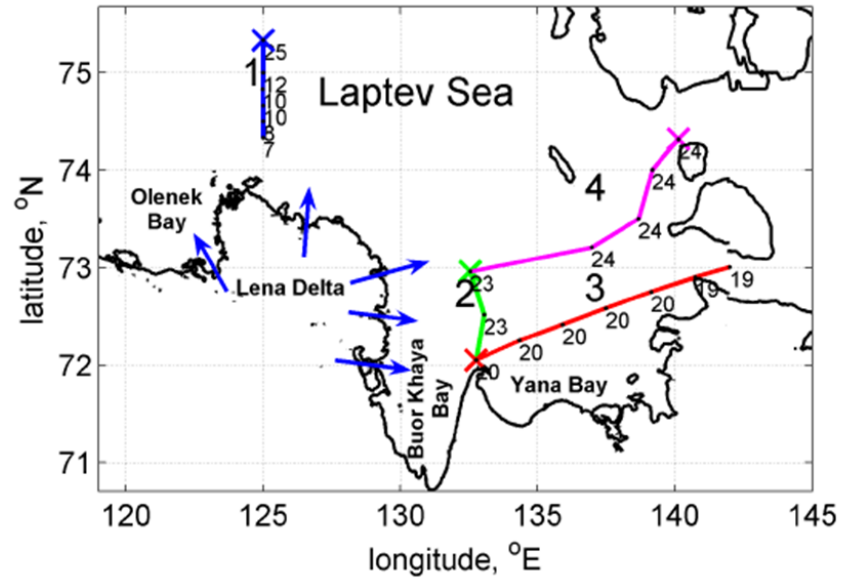
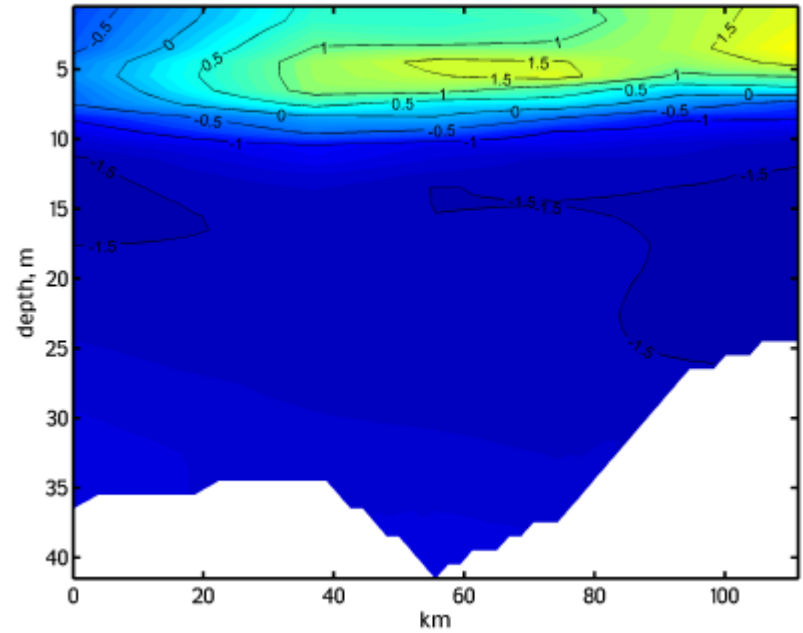
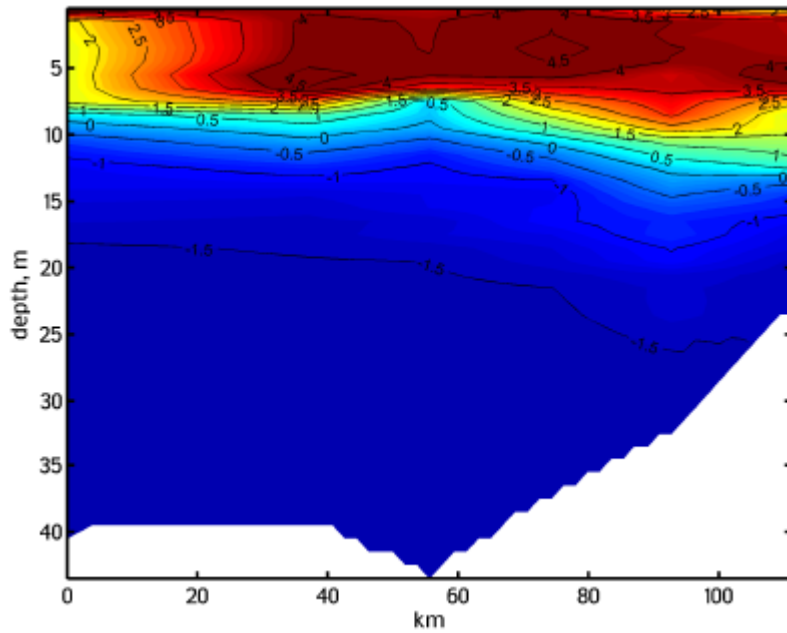
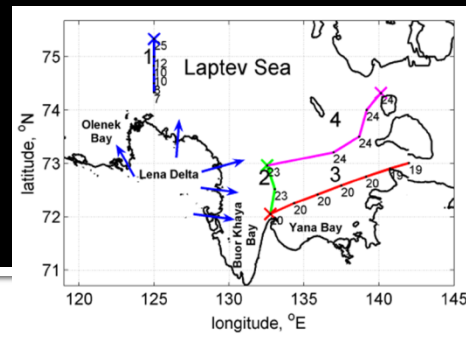


Figure 6. Resulting surface temperature (a,b) and salinity (c, d) in the end of June 2008 – day 180 (a, c) and in the end of August 2008 – day 240 (b, d).

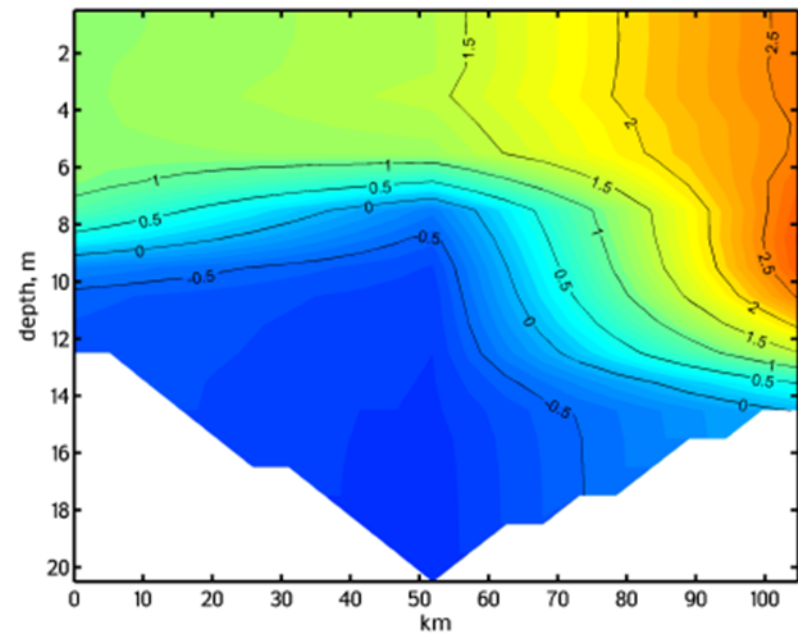
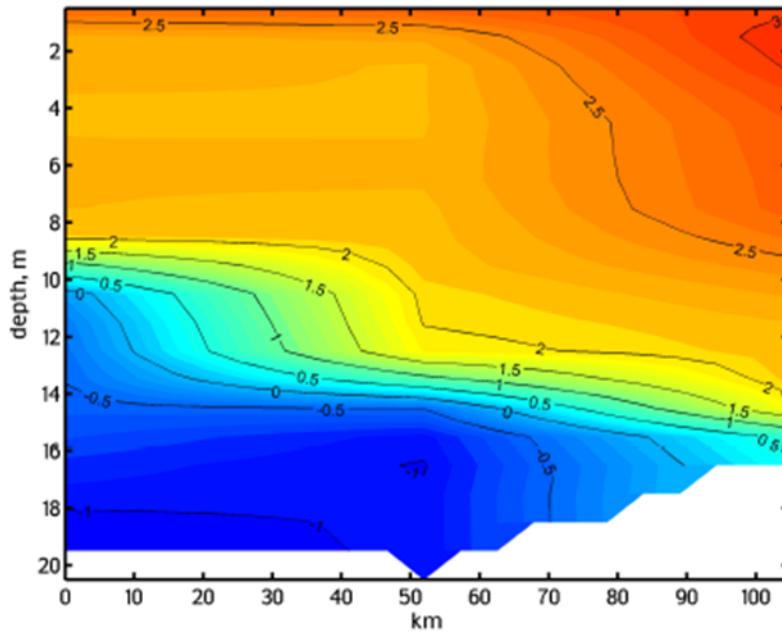
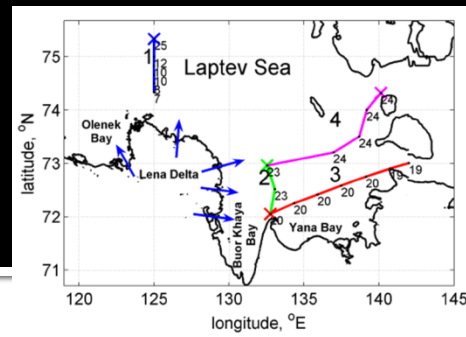
Steps undertaken towards better description

- Reduction of minimum turbulent thermal and salinity coefficients
- Vertical distribution of solar radiation flux instead of upper boundary conditions
- Satellite ice compactness instead of model simulation to form heat flux

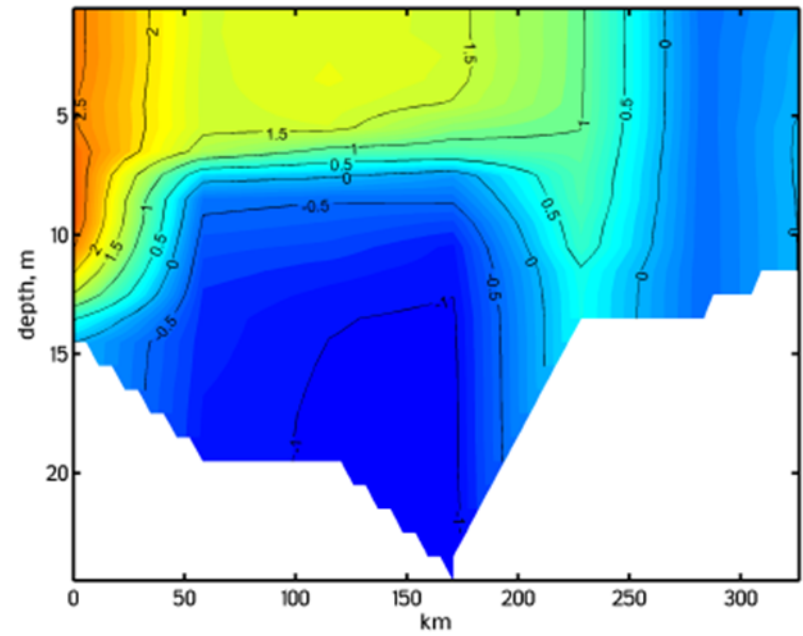
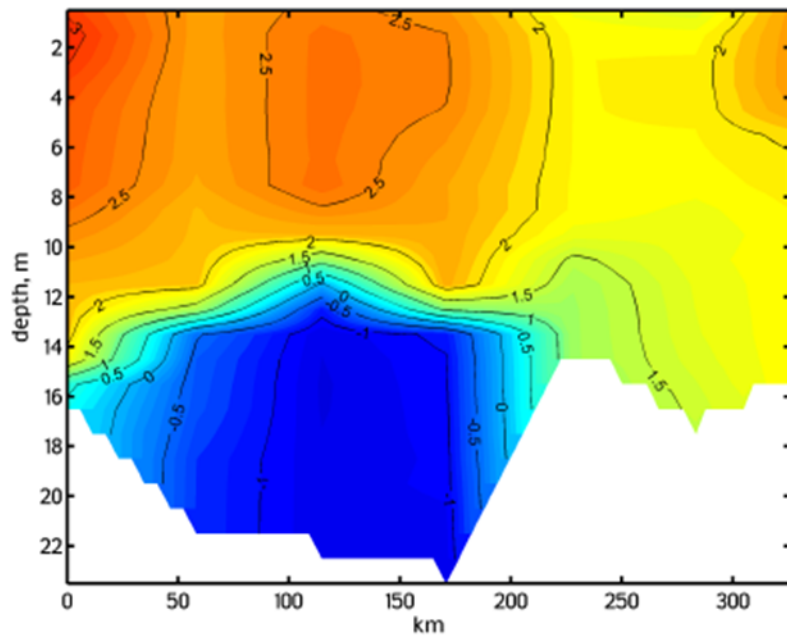
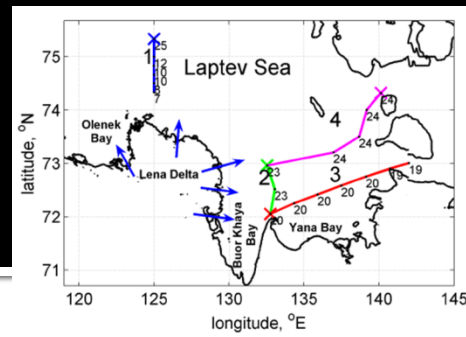
Section 1



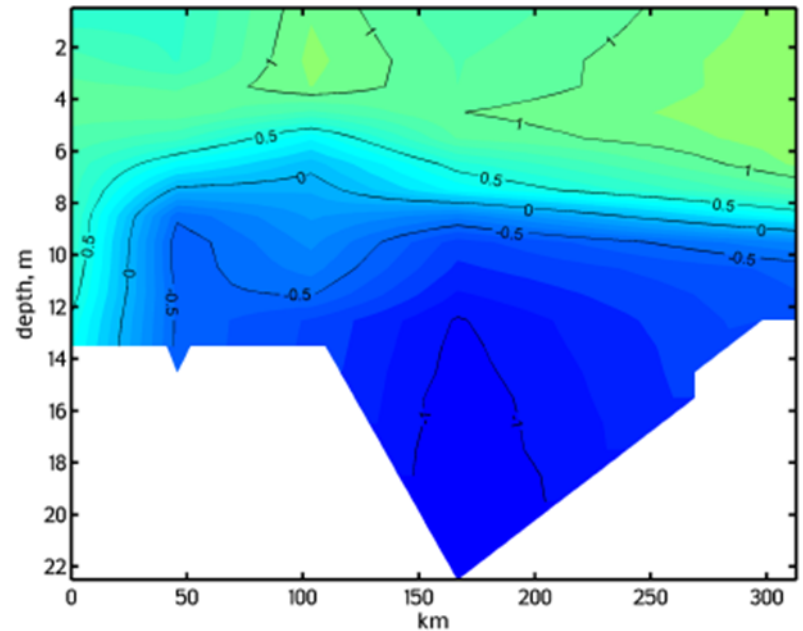
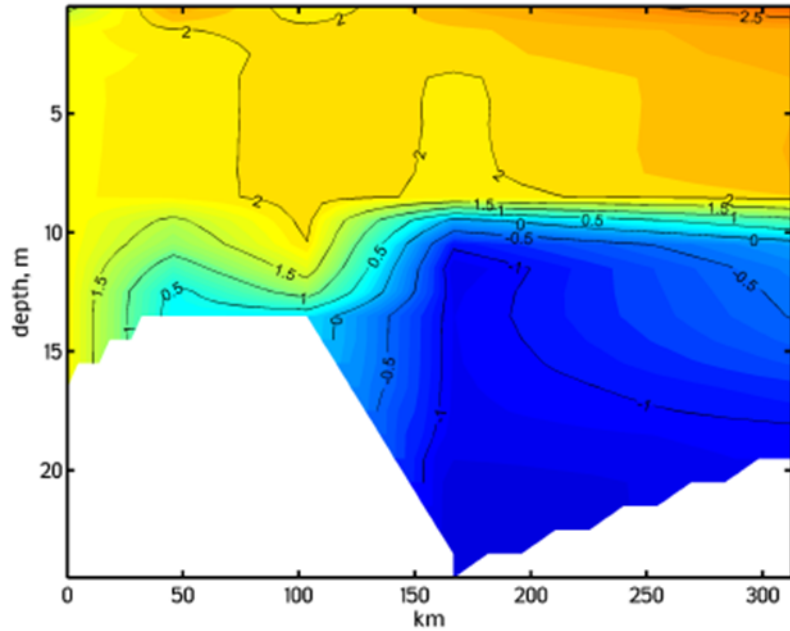
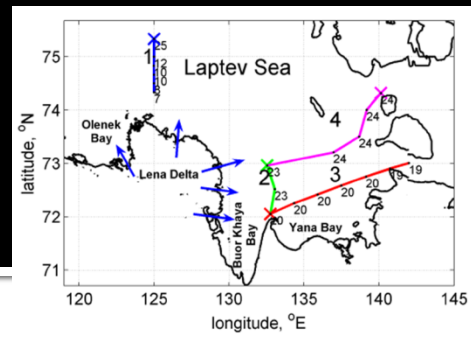
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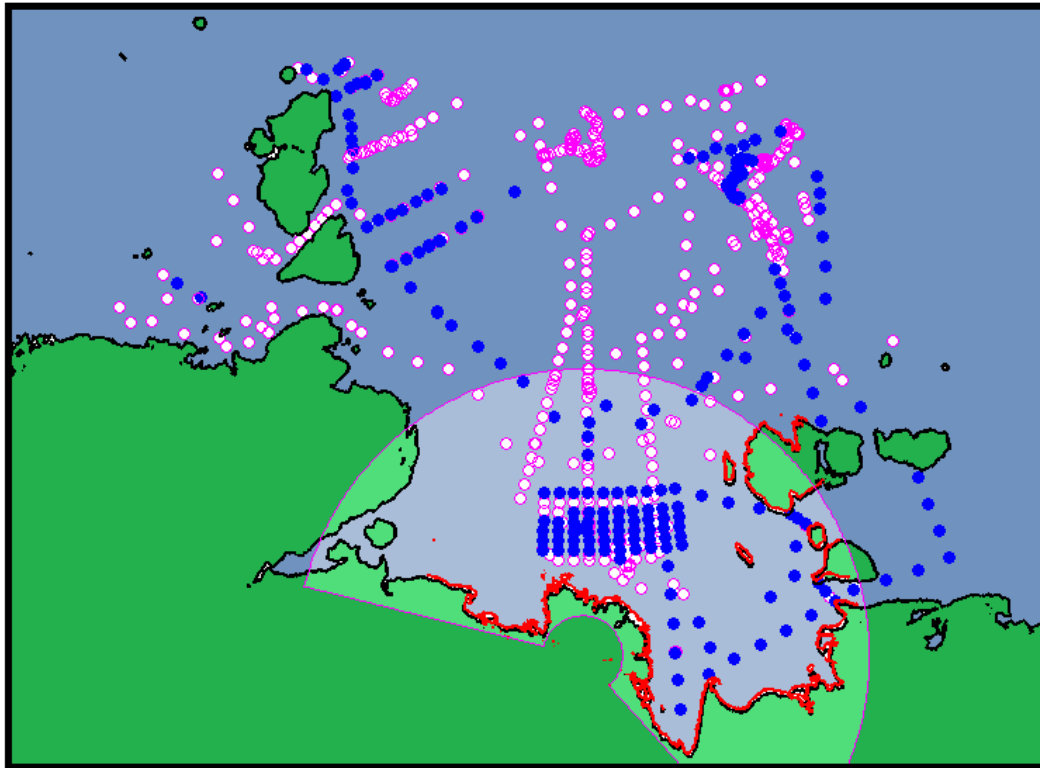
Section 3



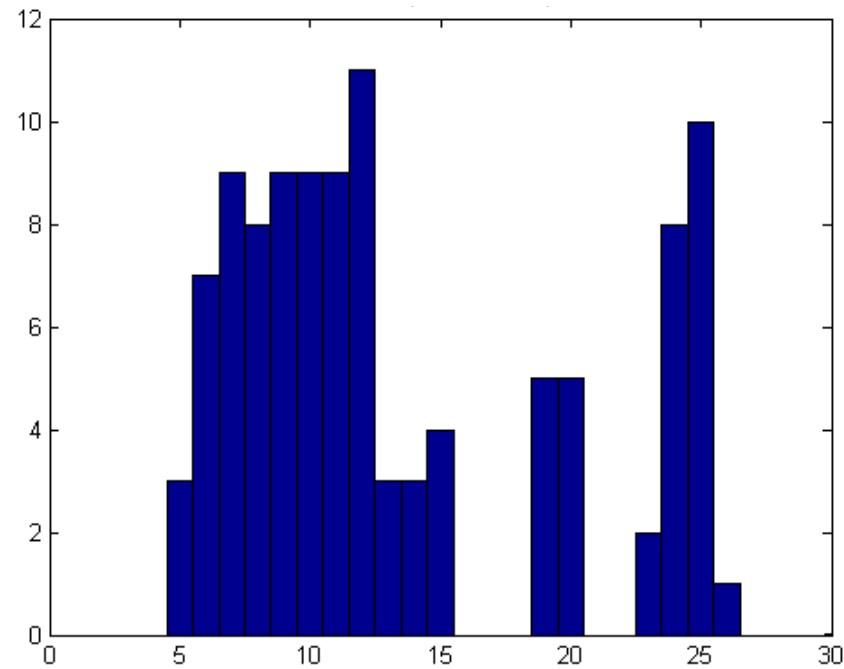
Section 4



IPY data (International Polar Year) 2008: September

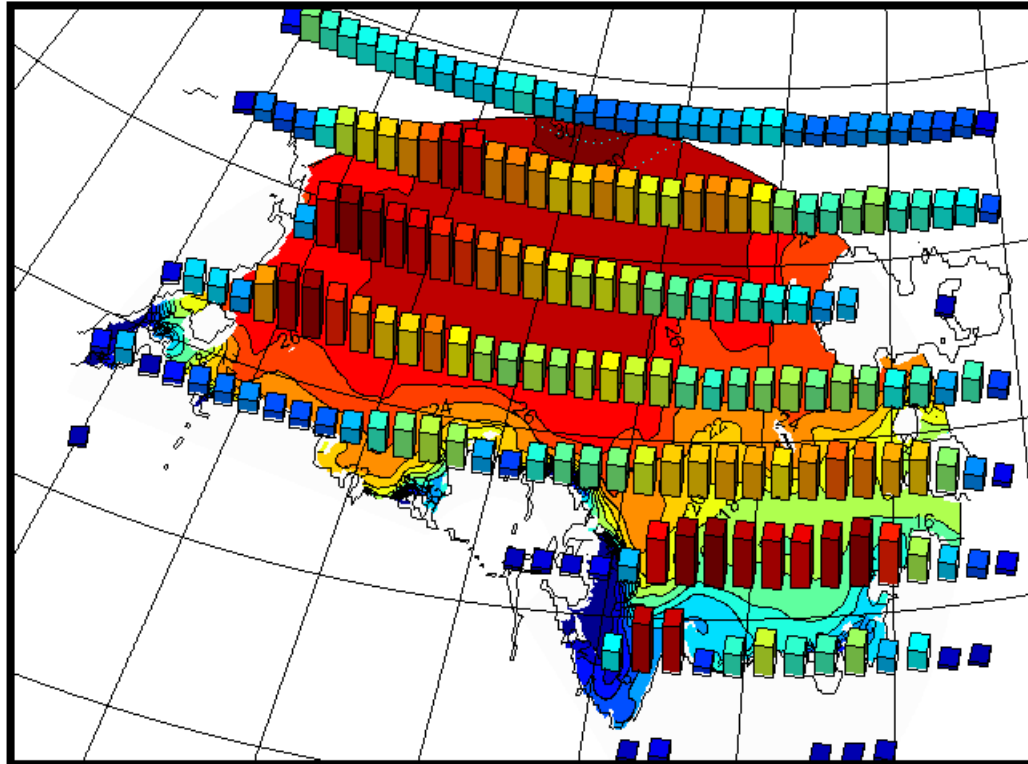


Observation sites in 2008 (blue circles – in September)



Daily measurements in specified region – September 2008

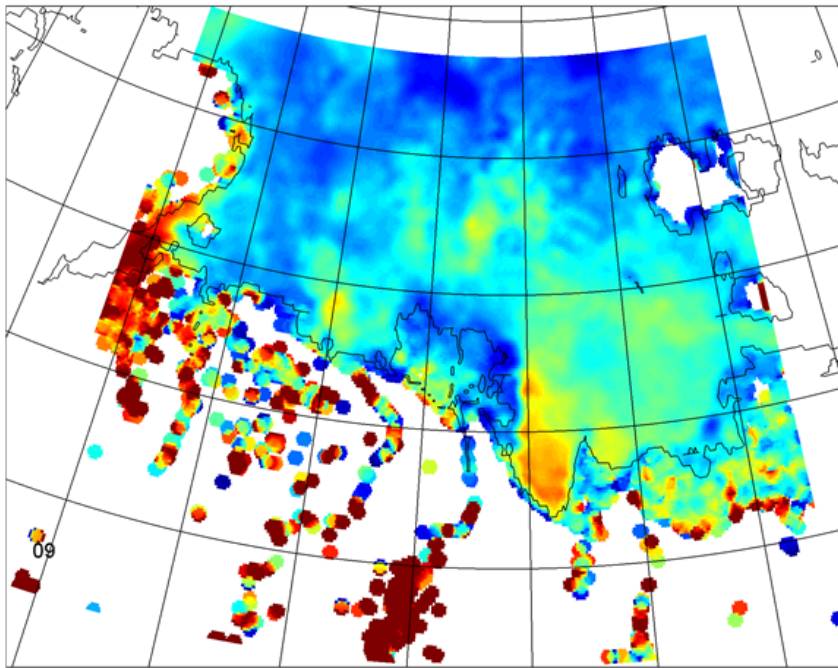
Satellite data: Pathfinder – September 2008



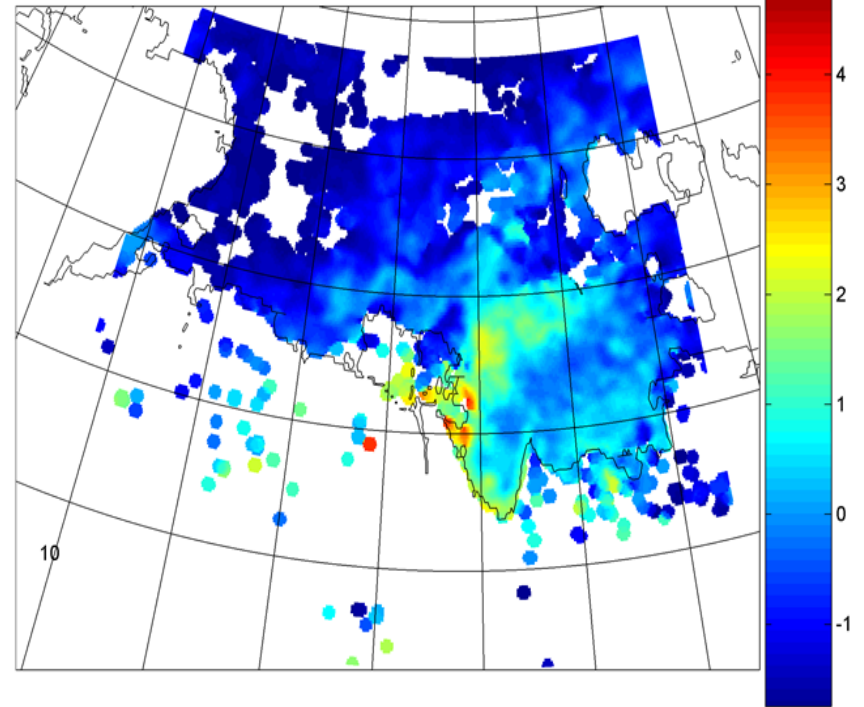
Number of measurements available in each 10x10 box (max=8250). Most of data are off eastern Taimyr peninsula and to the east of Lena delta in the direction of river water circulation.

Satellite data

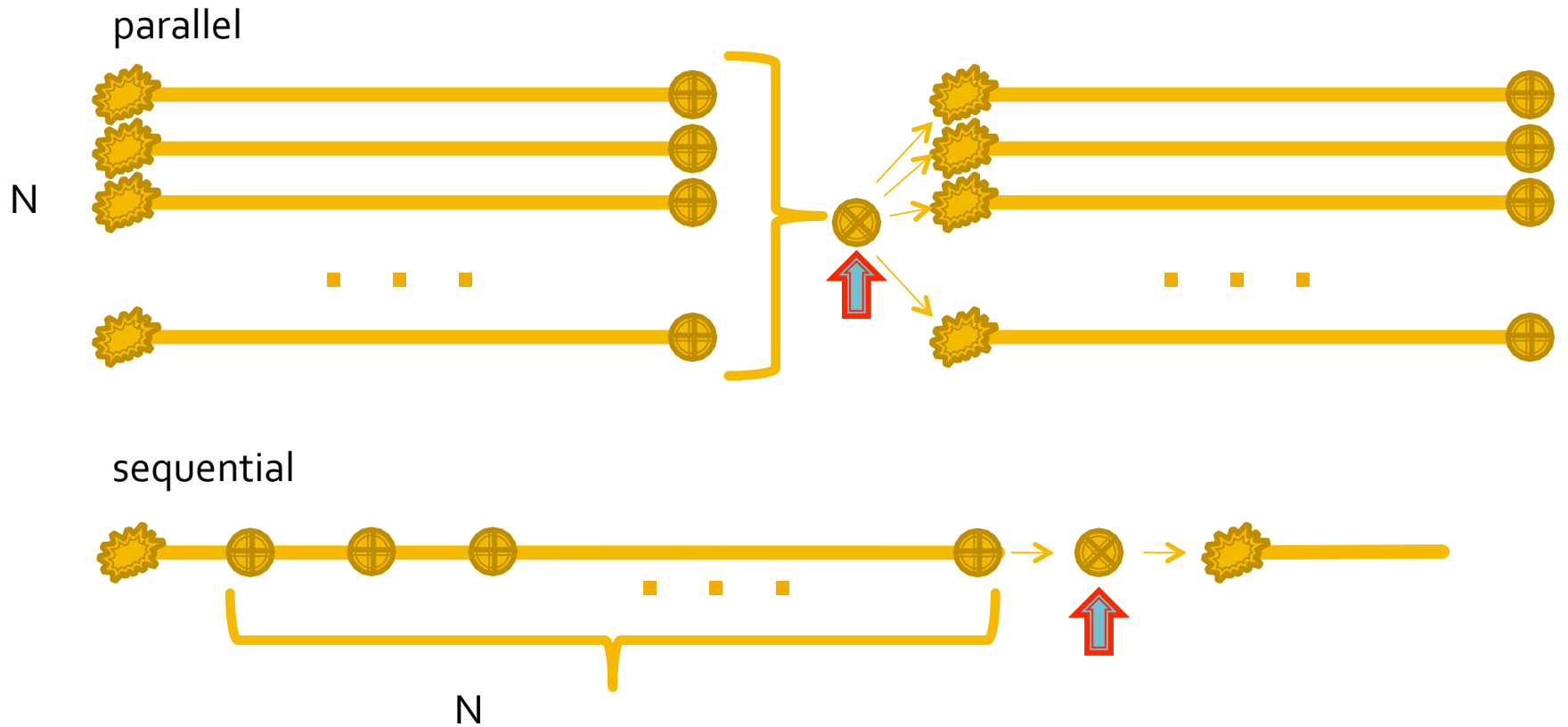
September



October



Data assimilation scheme – Ensemble Kalman filter



— modeling thread

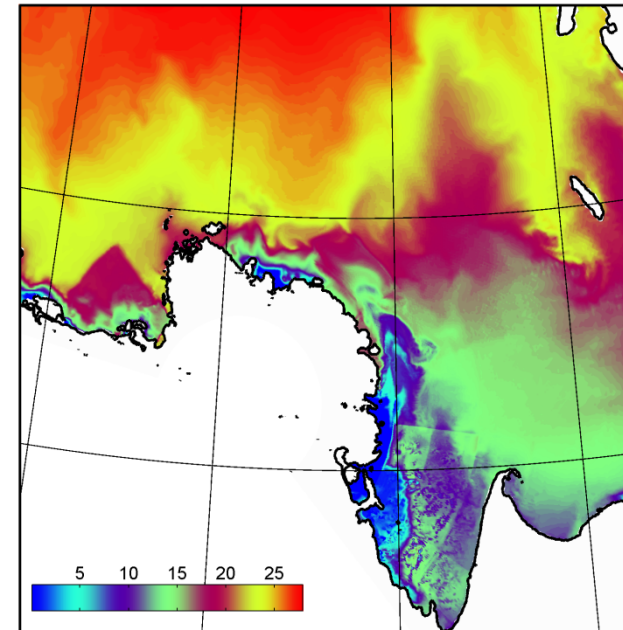
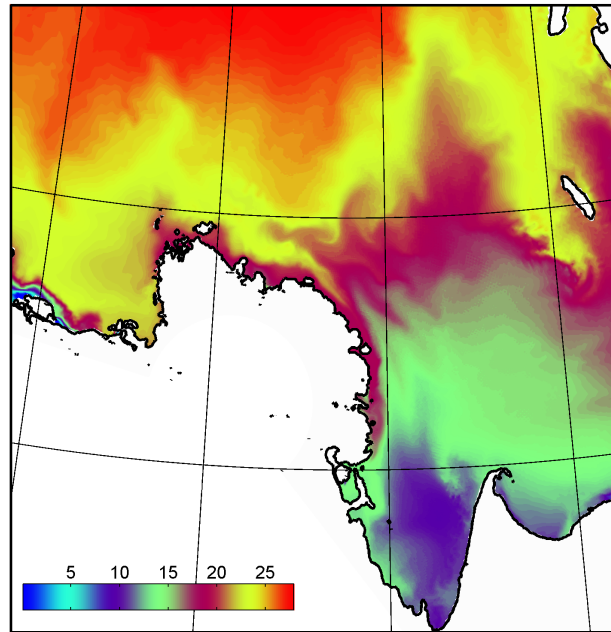
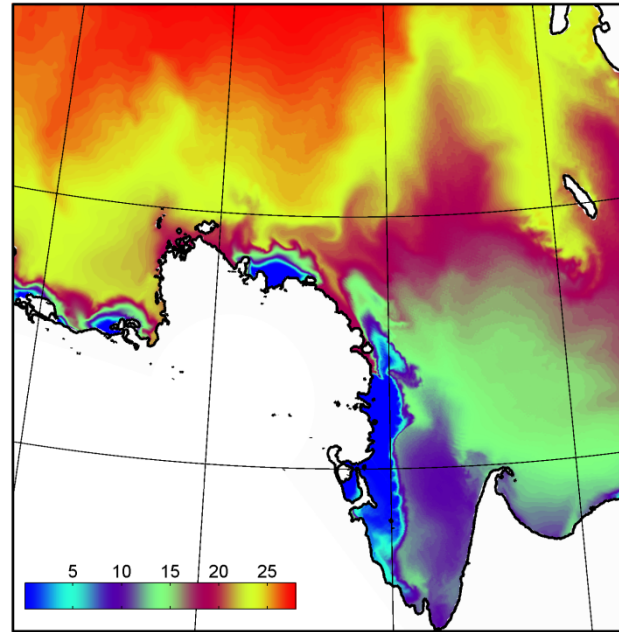
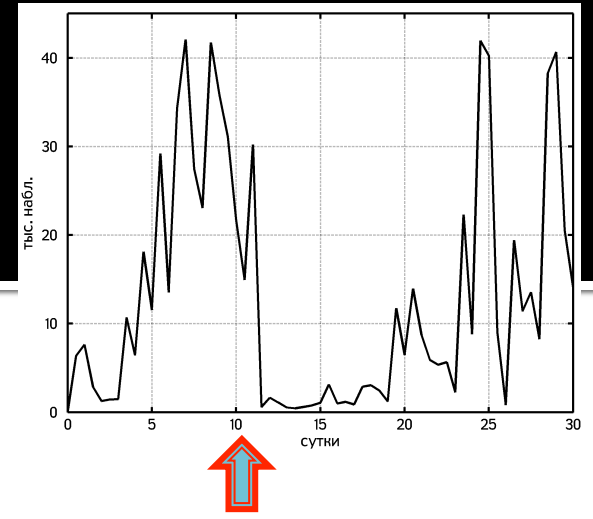
⊕ – analyzed state

⊗ – resulting state

↑ – data assimilation

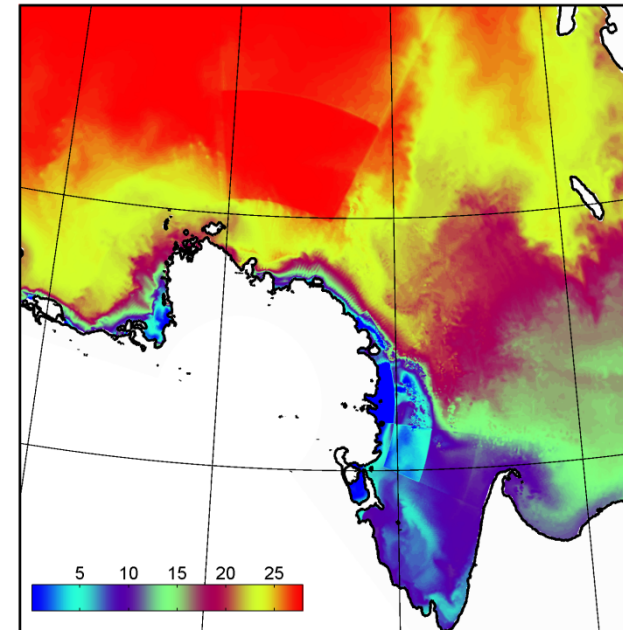
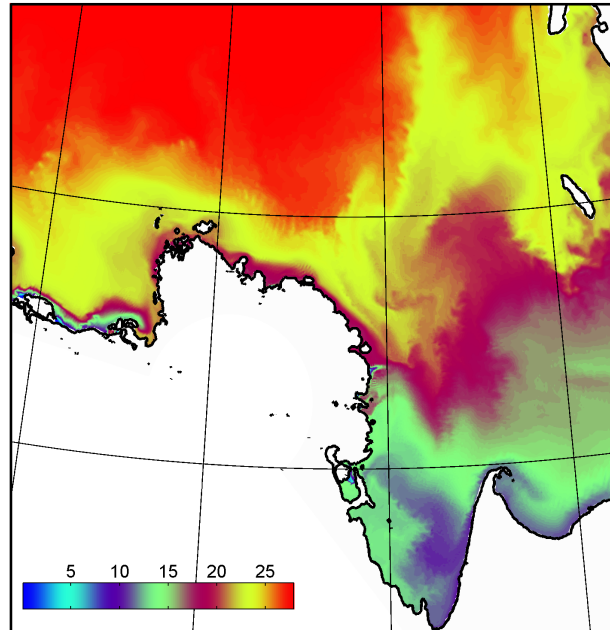
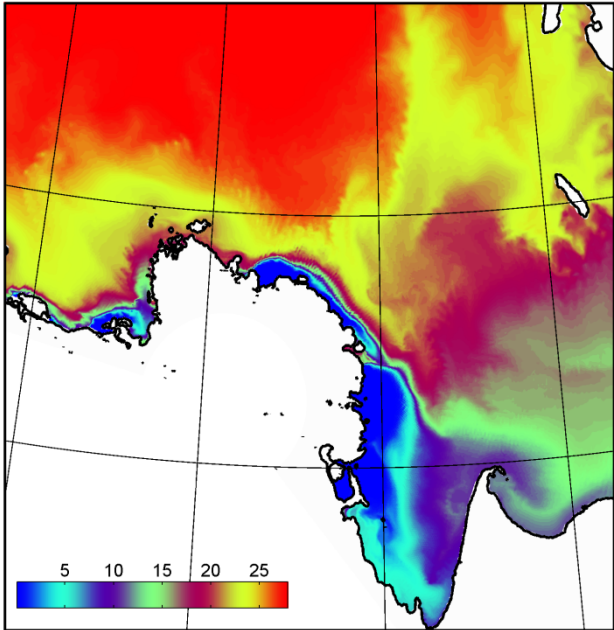
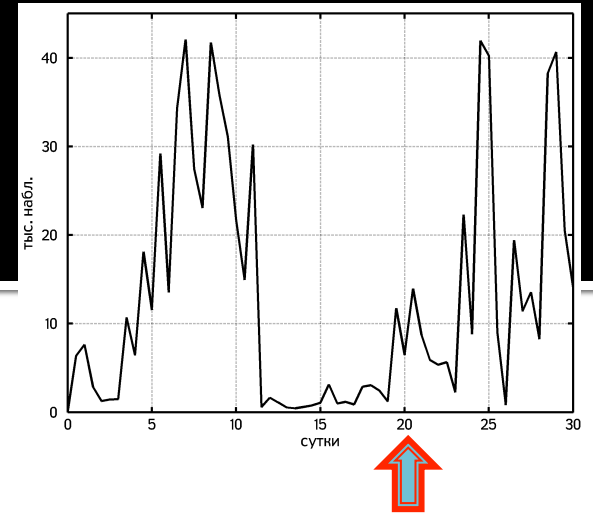
Data assimilation test

10 СУТОК



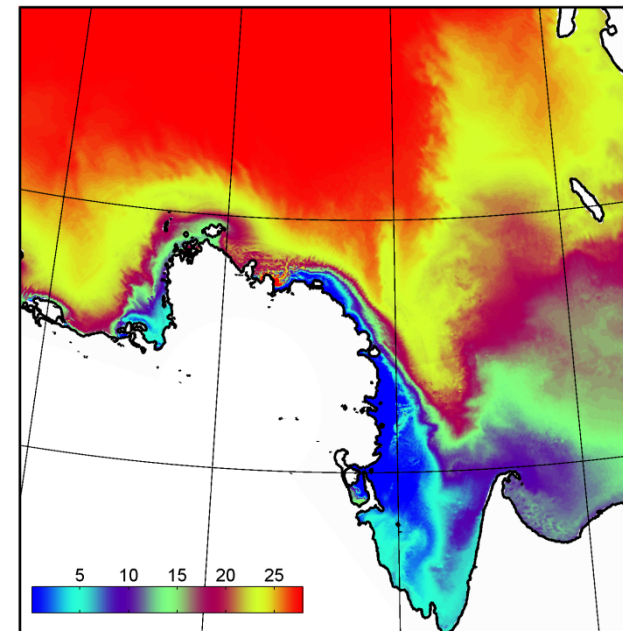
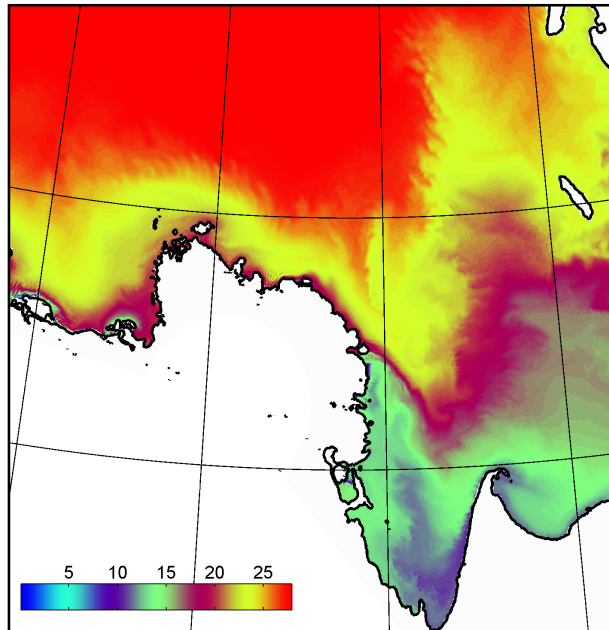
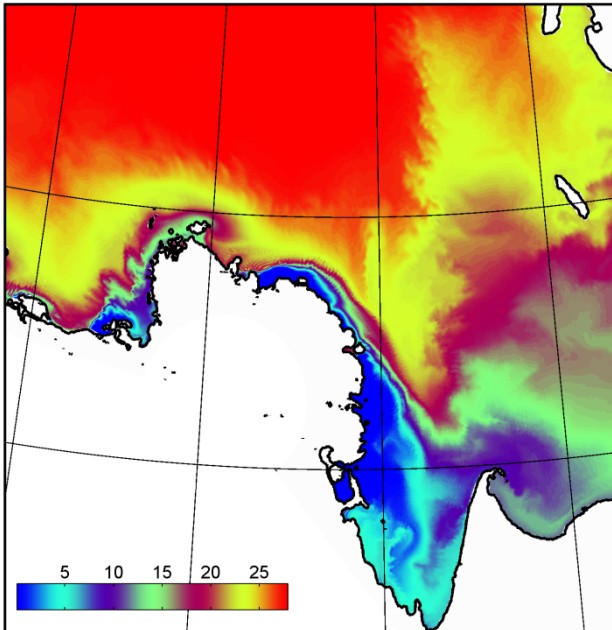
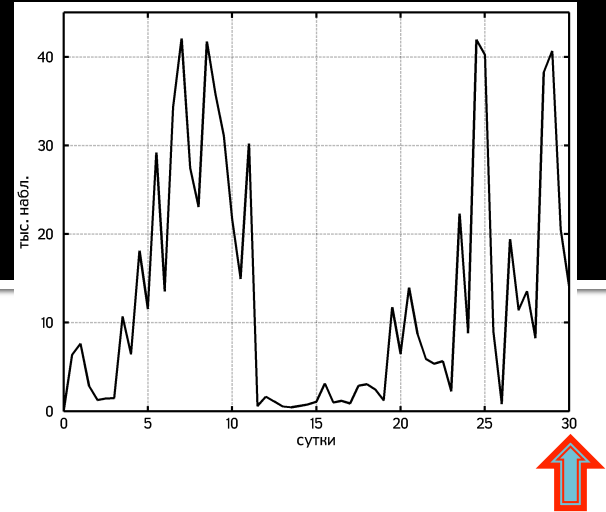
Data assimilation test

20 СУТОК

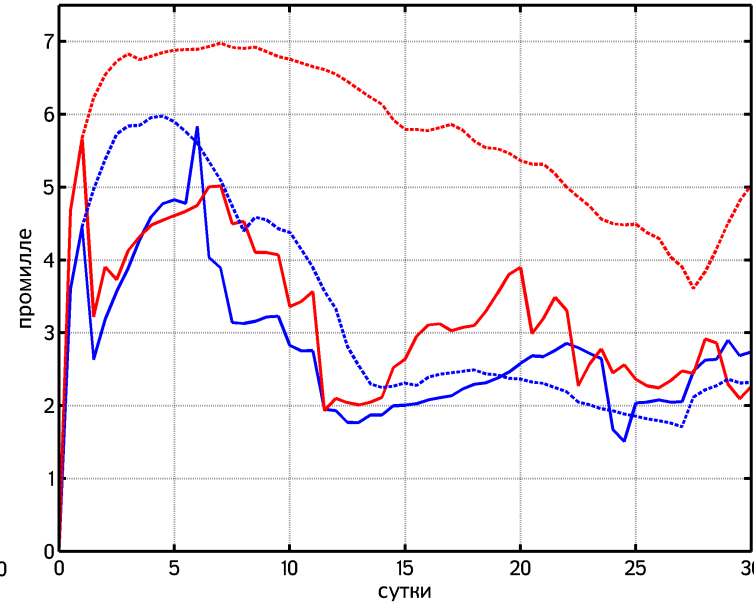
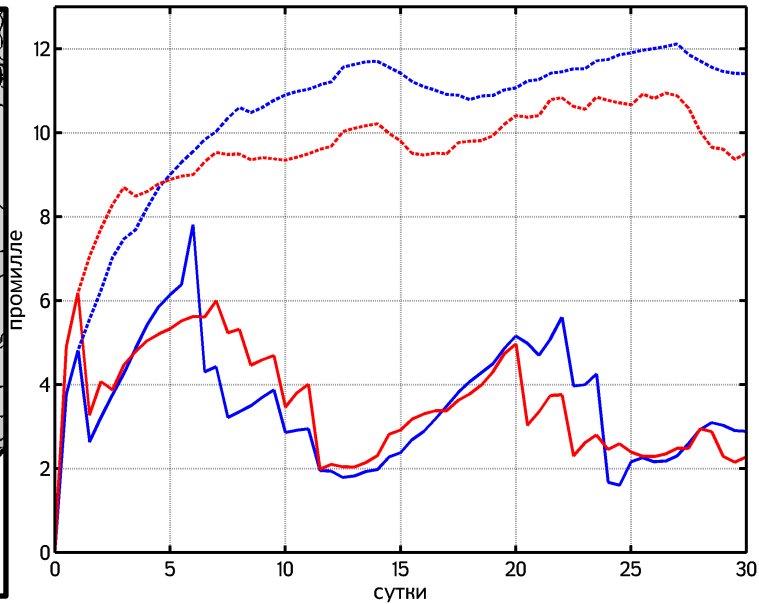
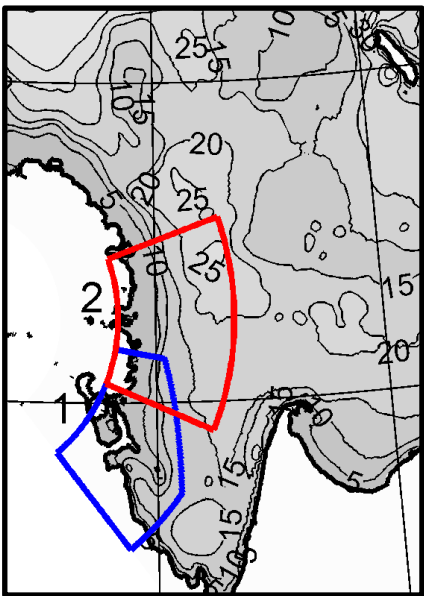


Data assimilation test

30 суток



Data assimilation test



Conclusions

- Several steps were undertaken to improve model results, but more steps to be done.
 - Ice compactness – surface fresh water flux
 - Data assimilation