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Principal investigator: **Dmitry Sein**
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The simulations based on 20th century CMIP5 MPI-ESM data for the period 1920-2005 were performed with regionally coupled ESM ROM (Sein et al., 2015, JAMES). Note that in contrast of Sein et al. (2015, JAMES) the atmospheric resolution was increased from 37 to 18.5 km. The results of these simulations were used to prescribe boundary conditions and atmospheric forcing for regional eco-hydrodynamic sea models of the Baltic Sea (SPBEM) and the Barents Sea (EHBARSEM). The run for the Barents Sea using the EHBARSEM was carried out for the entire period 1971-2005 and the run for the Baltic Sea using the SPBEM from 1971 to 1990 (simulations are in progress).

A comparison of the observed and calculated mean monthly ice thickness values in February and August (Fig. 1) shows that the EHBARSEM in general correctly reproduces spatial distribution and seasonal changes in sea ice in the model domain (Barents, Kara and White Seas). At the same time, the model underestimates the results of reanalysis, with the largest discrepancies occurring near the coasts of the islands, i.e. in areas where there is a fast ice. For the model basin as a whole, the mean annual calculated thickness and area of ice for 1990-2005 are less than their values according to PIOMAS data respectively by 3,9% and 1% .

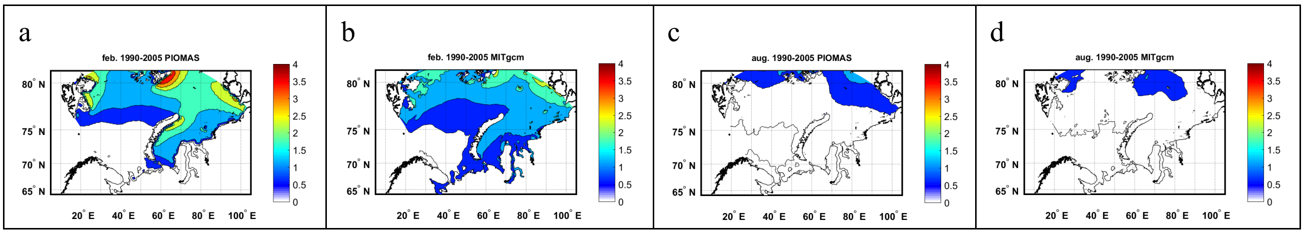

Fig.1 The mean monthly ice thickness in the model area (Barents, Kara and White Seas) averaged over the period 1990-2005, in February (a, b) and August (c, d): a, c - PIOMAS Arctic Sea Ice Volume Reanalysis data (Zhang and Rothrock, 2003; Schweiger et al., 2011); b, d – model results.

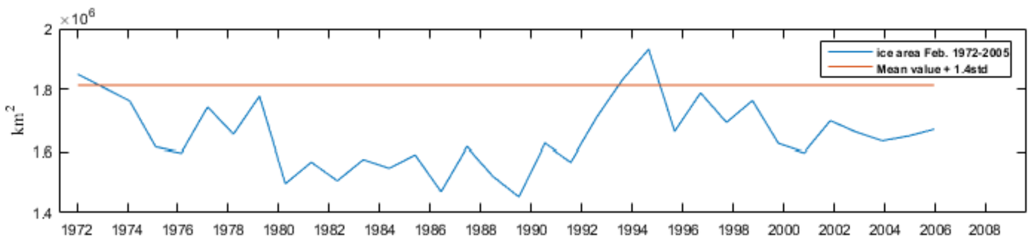

Fig.2. Mean monthly ice area in the Barents, Kara and White Seas in the period 1972-2005 in February. Red dashed lines show mean +/- 1.4 standard deviation of ice area for the period.

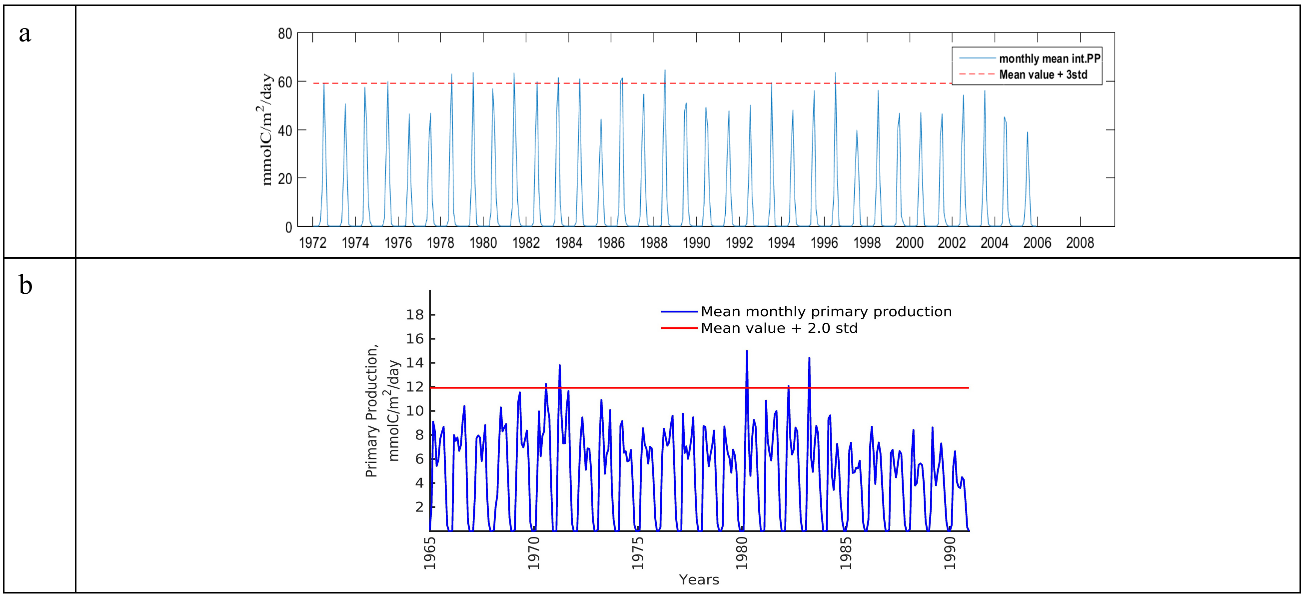

Fig.3. Mean monthly integrated primary production (IPP): (a) in the Barents, Kara and White Seas in the period 1972-2005; (b) in the Baltic Sea in the period 1965-1990.

Figures 2 and 3 allow one to compose a view on the frequency and intensity of extreme events in the study areas in the modern climate. As seen (Cf. Fig.2 and 3a), there is no pronounced correlation between the maximum/minimum values of ice area in the Barents, Kara and White Seas, and the integrated primary production (IPP) of this area (correlation coefficient R between the maximal during a year IPP and maximal and minimal ice area is -0.08 and -0.14, respectively). The IPP in the Barents, Kara and White Seas during the annual cycle has one pronounced spring-summer maximum in May-June (Fig. 3a), whereas the IPP in the Baltic Sea during the annual cycle has several maxima due to the blooming of various phytoplankton species, and these maxima are much smaller (Fig.3b). In this case there is also no pronounced correlation between the IPP and averaged over the Baltic Sea surface nitrogen and phosphorus concentration, sea ice area and sea surface temperature. The lack of correlation appears to be associated with spatial averaging: there are no considered correlations on a regional scale, but maybe they exist on smaller spatial scales. This issue is planned to investigate in 2018. The obtained estimates of the frequency and intensity of extreme values of the sea ice characteristics and primary production in modern climate are also planned to be used for comparison with similar estimates in the future climate.

References

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