Project: **474,** Project title: **Laptev**
Project lead: **Günther Heinemann,** Report period: **2019-01-01 to 2019-12-31**

The project focuses on simulations with the atmospheric climate model COSMO-CLM (CCLM) adapted for the Arctic (Gutjahr et al. 2016) with 15km (C15) and 5km (C05) and 1km (C01) for the Arctic (C15 being part of CORDEX-Arctic). Climate runs with C15 simulations for recent climate and for the end of the 21st century (RCP8.5) are nested in ECHAM6-CMIP5 using sea ice information from the sea-ice/ocean model FESOM of AWI-CM CMIP5/6 runs. Sea ice data are available with a resolution of 10/25km for the Arctic. These runs are evaluated together with the hindcast of C15 (ERAI), which is nested in ERA-Interim data for 1987-2017 and uses sea ice information from microwave satellite data and ice thickness from PIOMAS.

With the granted resources for 2019 part of the planned simulations were possible. C15 runs using AWI-CM CMIP5 and CMIP6 sea ice data are available for the winter periods 2002-2012 (C20) and 2088-2099 (FC85). In addition, high-resolution simulations for the Kara/Laptev Sea with 5km resolution (C05) have been performed for 2017/18, since continuous wind and temperature profiles at the Russian observatory Cape Baranov are available for this period.

Fig.1 shows the sea-ice area (SIA) from AWI-CM CMIP5 and CMIP6 for RC20 and FC85 as well as for the hindcast run ERAI. The SIA is underestimated (compared to ERAI) for the freeze-up period (Nov-Dec.) for RC20 for both CMIP5 and CMIP6, while a slight overestimation is seen for CMIP6 during the rest of the winter. For FC85, SIA is much lower than for RC20 until February, with CMIP6 being lower than CMIP5.

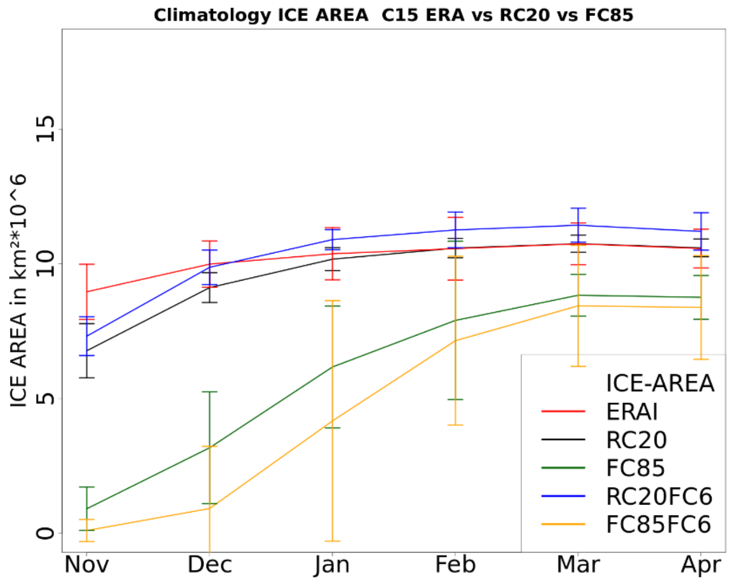
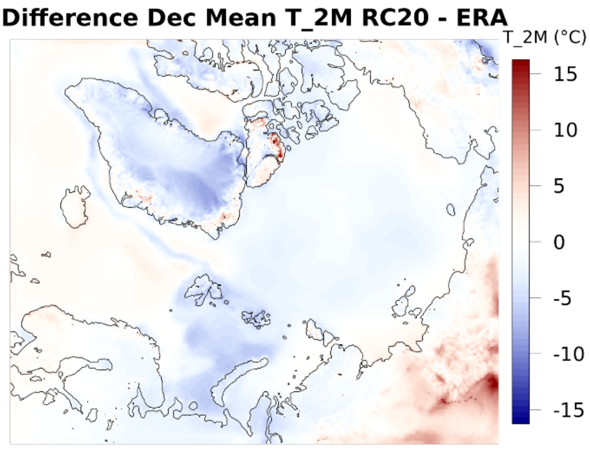


Fig.1: Sea-ice area for different winter months 2002-2012 (error bars = interannual STDV) for the hindcast run (ERAI), AWI-CM CMIP5 (RC20) and CMIP6 (RC20FC6) and for 2088-2099 for CMIP5 (FC85) and CMIP6 (FC85FC6).

Fig.2 shows the difference for the December 2m-temperature between RC20 (CMIP5) and ERAI. The RC20 run is colder over Greenland and over the Kara/Barents Sea. The latter is result of the fact, that the sea ice coverage is overestimated in that area. The climate change signal (Fig.3) shows a huge warming of more than 10K for all sea ice areas, which is a result of the sea ice retreat and the thinning of the ice in early winter.



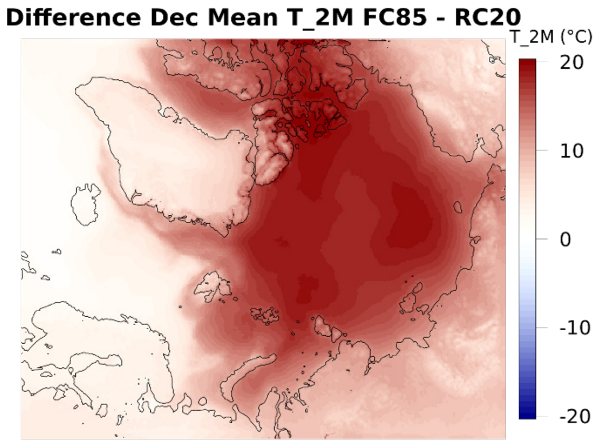


Fig.2: Difference for the 2m-temperature of December between RC20 (CMIP5) and ERAI for 2002-2012.

Fig.3: Difference for the 2m-temperature of December between FC85 and RC20 (both CMIP5).

The region around the Russian observatory Cape Baranov (Fig.4a) is of special interest in the project. The observatory is located at the coast of Shokalski Strait between two islands. For strong wind speeds from southwesterly directions a pronounced channeling effect occurs (Fig.4b). This is of large importance for the formation of polynyas in the western Laptev Sea and ocean currents (Preußer et al. 2019).

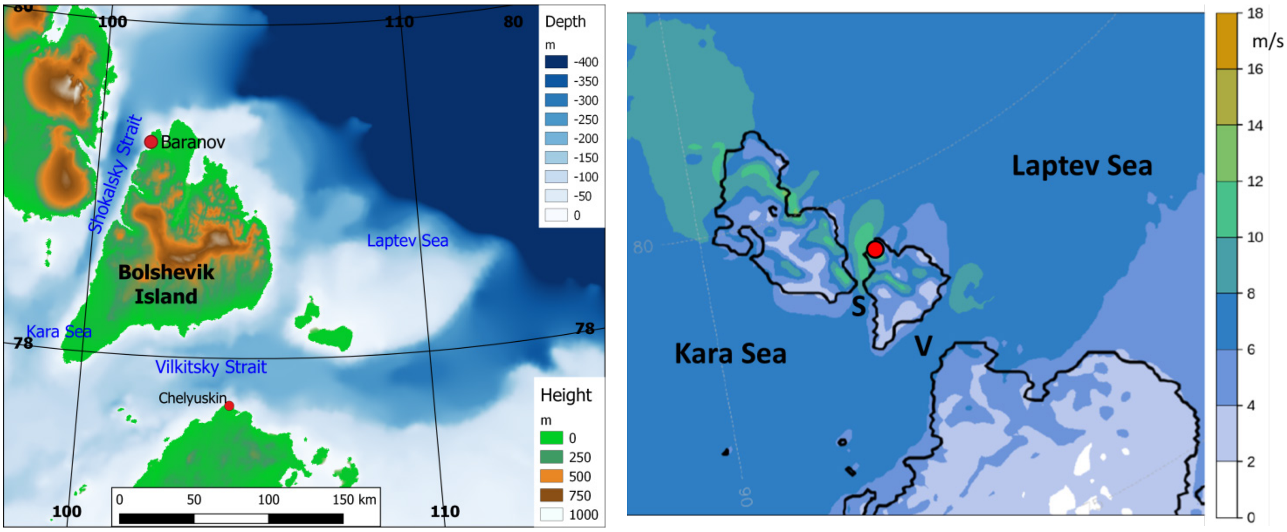


Fig.4: a) Left: map of the area of the western Laptev Sea with topography and bathymetry. b) Right: 5m-wind (C05) for cases with wind speed at Cape Baranov exceeding 10m/s with directions from 180 to 270° for 06/2017 – 05/2018. S = Shokalsky Street, V = Vilkitsky Street, red dot = Cape Baranov.

Literature

Preußer, A., Ohshima, K., Iwamoto. K., Willmes, S., Heinemann, G., 2019: Retrieval of wintertime sea-ice production in Arctic polynyas using thermal infrared and passive microwave remote sensing data. J. Geophys. Res. 124, 5503-5528, doi: 10.1029/2019JC014976.