Project: 958 Title: **Weddell Sea Ice**

Project lead: **Günther Heinemann,** Report period: **2023-01-01 to 2023-10-31**

The regional climate model COSMO-CLM (CCLM) is used with a horizontal resolution of 15km the whole Antarctic continent. CCLM is run with a new turbulence parametrization for the stable boundary layer (Zentek and Heinemann 2020) and a new sea ice model (Heinemann et al. 2021). CCLM is nested in AWI-CM (100km resolution for the atmosphere) and uses the AWI-CM sea ice data (10km resolution). CCLM data are used to drive the sea ice/ocean model FESOM for these periods.

In the report period, new simulations with a new sea ice albedo parameterization have been performed for the historical run for 2000-2014 and two time slices for the SSP3-7.0 scenario (2036-2050 and 2086-2100). The evaluations focus on the atmospheric boundary layer and our activities within the SCAR research programme AntclimNow. We contribute to AntclimNow by quantifying the melt days distribution during climate change. The CCLM runs are also part of Polar CORDEX. Relevant data sets were published in the DKRZ long-term archive.

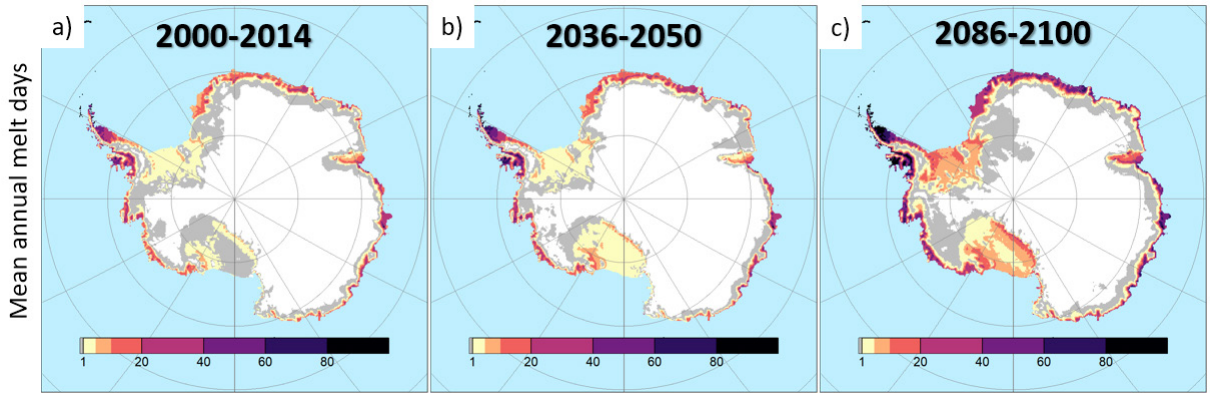

Fig. 1 Mean annual melt days for the beginning (a), mid (b) and end (c) of century.

Results of the CCLM for melt days on land are shown in Fig.1. We define melt days as days when the 2m-temperature was greater than 0°C for at least one hour. For the recent climate (2000-2014) we find similar values as detected by satellite observations (Johnson et al. 2022). Lowest values are found over the Ross and Ronne Ice Shelf with less than 5 days per year. The highest values are found at the northern part of the Antarctic Peninsula and especially the Larsen Ice Shelf, with 40 days per year and more. Like the temperature trends (not shown), the melt days increase only a bit in the first half of the century, but the rate of increase is approximately doubled in the second half of the century. By the end of century, melt days over the Ross and Ronne Ice Shelf increase up to 10 days per year and approximately also double for the other coastal regions when compared to the beginning of the century. The Larsen Ice Shelf shows over 80 melt days per year in at the end of century. This shows that destabilizing factors from thermal atmospheric forcing will further destabilize the Larsen Ice Shelf with an increasing rate over this century.

In contrast to temperature, the climate change signal of the near-surface wind is relatively small (Fig.2). Over the inland ice, changes are smaller than 0.5 m/s. Slightly. larger changes are only found associated with sea ice changes over the ocean, where a wind increase by about 1 m/s at the end of the century is found. For mesoscale processes, we focused on low-level jets (LLJs) during present and future climate. The analysis of LLJs in the Weddell Sea region of the Antarctic for the period 2002–2016 of the hindcast run showed that LLJs are most frequent in the katabatic wind regime over the ice sheet and in barrier wind regions (Heinemann and Zentek 2021). During winter, katabatic LLJs occur with frequencies of more than 70% in many areas. During climate change the LLJ frequency is found to decrease over ocean/sea ice areas. There is a slight decrease in katabatic wind areas, but an increase over the Antarctic plateau.

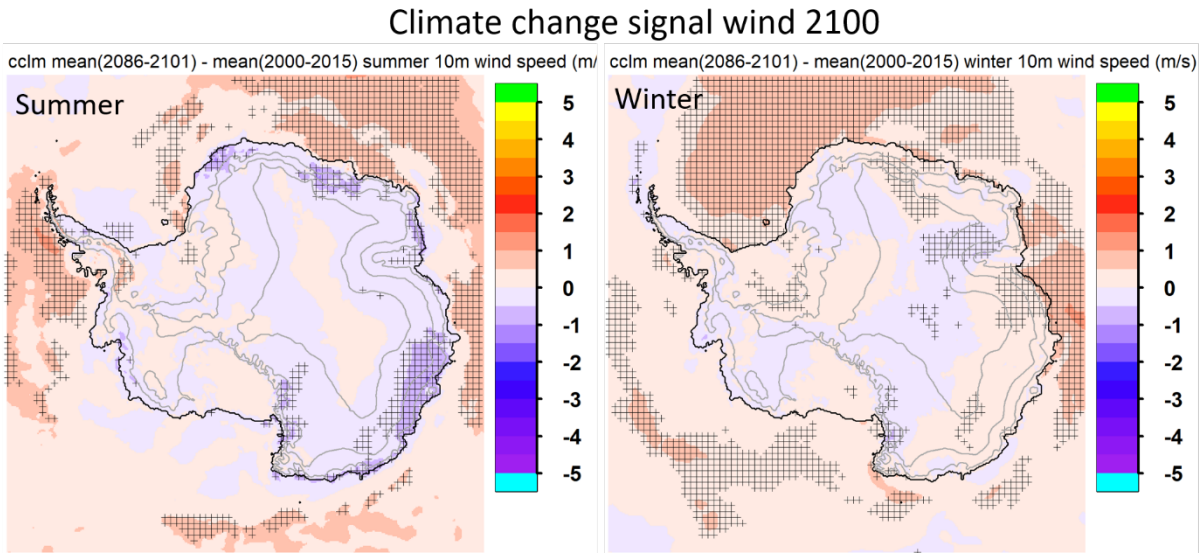

Fig. 2: Climate change signal (2086-2100 minus 2000-2014) for the 10m-wind (crosses: significant at the 95% level).

References

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Data publications

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