Project title: REDOCCA (REgional DOwnscaling of Climate Change in the Antarctic)
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Report on achievements and results

In 2021, we further evaluated existing AWI-CM CMIP6 simulations from the DKRZ project DICAD (DKRZ project identifier bk0988) around the Antarctic to investigate how realistic these simulations are regarding water mass characteristics in this area and to create an interpretation basis for comparison with future planned simulations.

The ocean resolution around Antarctica and in the Southern Ocean generally is between 10 and 20 km. The mesh that was used for the AWI-CM CMIP6 simulations does not include ice shelf cavities. Nevertheless, current patterns and water masses in the southern Weddell Sea and on the continental shelf capture the main features of known hydrography and circulation.

The Surface Water Mass Transformation (WMT) on the continental shelf of the southern Weddell Sea is dominated by densification through freshwater flux caused by sea ice formation (Fig. 1). The surface heat flux only plays a minor role in comparison. The Filchner Trough and the Ronne Trough on the continental shelf are filled by High Salinity Shelf Water (HSSW) created this way. The water masses transported onto the shelf consist of modified Warm Deep Water originating from the Weddell Gyre, while HSSW leaves the shelf.

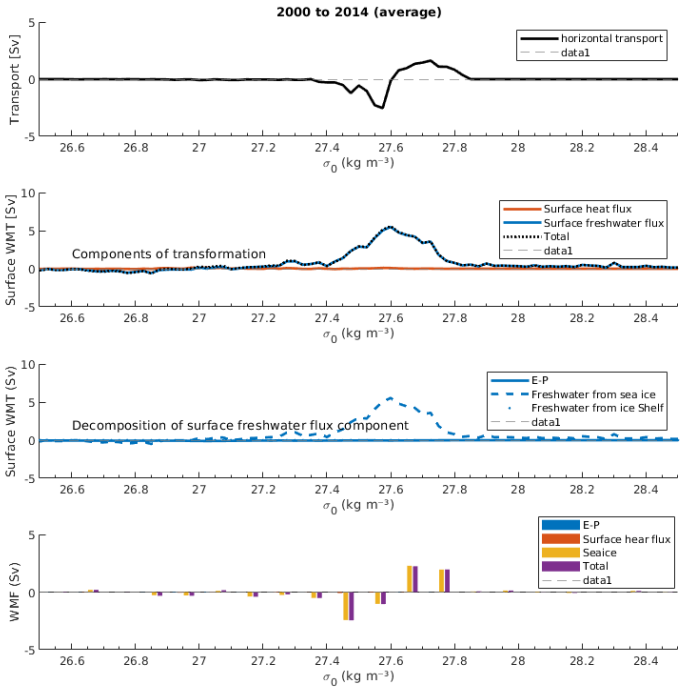

Figure 1: Average volume transport across the shelf edge of the southern Weddell Sea (positive values northward), surface WMT and Water Mass Formation rates south of the shelf edge (>0: densification) in the first ensemble member of the historical simulation of AWI-CM averaged over 2000 to 2014.

For the future scenarios of the AWI-CM CMIP6 simulations the Filchner Trough experiences pulses of modified Warm Water intruding into the trough (Fig. 2). For the scenarios SSP1-2.6 and SSP2-4.5, the Filchner Trough returns to its cold state filled with HSSW. In contrast, in SSP3-7.0 (5 ensemble members) and SSP5-8.5 the Filchner Trough is continuously filled with modified WDW

starting in ca. 2075. It remains to be seen how this warm intrusion on the shelf develops in the FESOM simulations (ocean component of the coupled AWI-CM) planned within this project with a changed geometry when ice shelf cavities are included.

The computing time and work space in 2021 that we applied for, has been used to prepare the atmospheric AWI-CM output and CCLM output so it can be used to drive the planned FESOM simulations, as well as preliminary test simulations to confirm the functionality of the model configuration, including the creation of the new mesh, which includes ice shelf cavities in Antarctica.

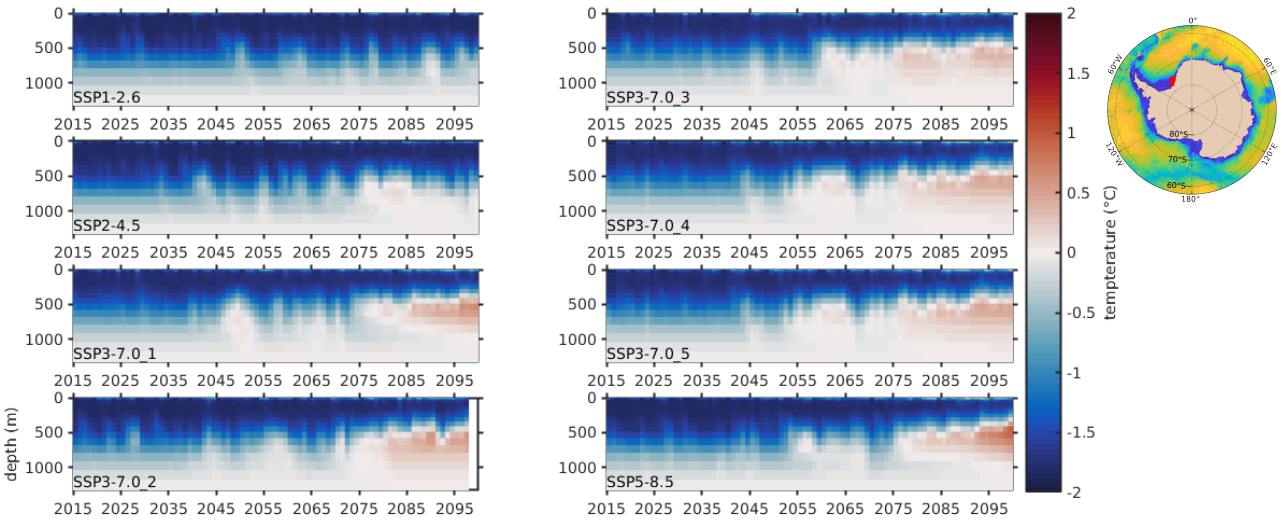

Figure 2: Development of horizontally averaged potential temperature in the Filchner Trough (red area) in the future climate scenarios of the AWI-CM CMIP6 simulations.