REDOCCA

Regional High-Resolution Downscaling of Climate Change in the Antarctic

Principal investigator

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Areas of contribution

Polar atmospheric processes

Oceanic processes

Modelling and forecasting

Sea ice processes

Summary

The goal of the project is the improved understanding of atmosphere-ocean-ice interactions and their impact on ocean circulations in the Weddell Sea region by simulations using a high-resolution atmospheric model, which drives a sea-ice ocean model. For the recent climate, we perform simulations for the period 2002-2019 with resolutions of 5-15 km for the atmosphere (1 km for case studies) and down to 3 km for sea ice and the ocean. For the future climate end of the 21st century, we will perform dynamical downscaling of CMIP6 runs with 15 km/3 km (atmosphere/ocean).

Description

The Weddell Sea in the Atlantic sector of the Southern Ocean is one of the most dynamic air-ice-ocean interaction areas. Satellite-based studies show that during winter areas of open water and thin ice (polynyas)
occur frequently near the coast. The strong heat loss in these coastal polynyas leads to sea-ice production, brine release and the formation of High-Salinity Shelf Water (HSSW). This dense water mass contributes to the circulation in the large sub-ice shelf cavities beneath the Filchner-Ronne Ice Shelf. Studies with sea-ice/ocean models show that the atmospheric forcing has a large impact.

As many relevant mesoscale atmospheric processes in the Weddell Sea region such as coastal katabatic winds, barrier winds and mesocyclones are not resolved by global climate models and reanalyses, we want to use the high-resolution non-hydrostatic COSMO-CLM (CCLM) mesoscale atmospheric model in combination with a high-resolution version of the Finite Element Sea ice-Ocean Model (FESOM). CCLM is a unified weather forecast and regional climate model used for IPCC regional climate simulations of CORDEX. FESOM is the main sea-ice ocean model of the Alfred Wegener Institute (AWI) and is used in a lot of research projects in the Arctic and Antarctic.

For the recent climate, we perform atmospheric simulations using CCLM in a forecast mode for the period 2002-2019 (nested in ERA-Interim) with resolutions of 5-15 km (1 km for case studies), which include the YOPP-Special Observing Period (SOP) from Nov 2018 to Feb 2019 in the Antarctic. CCLM data are used to drive FESOM, which is run on a global grid with a resolution varying between roughly 250 km in the open ocean at subtropical latitudes and about 3 km along the coast of the Weddell Sea. In addition, we will run CCLM with 15 km resolution driven by the large-scale atmospheric and oceanic forcing taken from the AWI-CM CMIP6 runs for the recent climate (1989-2019) and the future climate period 2071-2100. A merged CCLM/CMIP6 forcing is then used for FESOM stand-alone simulations for the same periods. All model runs for the recent climate will be evaluated using observations including the additional YOPP data. The project is a joint effort of the University of Trier (UT) and AWI.

**Timeline**

2018-08-01 - 2020-07-31

**Regional emphasis**

Northern hemisphere: No

Southern hemisphere: Yes

**Further specification**

Weddell Sea
Key project deliverables

High-resolution forecasts for atmosphere, sea ice and ocean for the recent climate including the YOPP period. Quantification of changes of circulations in atmosphere and ocean for the end of the 21st century, including the circulation in the large sub-ice shelf cavities beneath the Filchner-Ronne Ice Shelf.

Data management

All model data will be stored at data servers of the University of Trier and at AWI. Selected raw data will be made available for Antarctic-CORDEX. Metadata and processed data will be stored and made publically available in the PANGAEA data base.

Is data provided to WMO Global Telecommunication System

No

Other information

The project is not yet funded. A project proposal is planned for November 2017.