AdelieHRM

Influence of small-scale processes on the dynamics of the coupled atmosphere-cryosphere-ocean system on daily to seasonal timescales in the region of Adélie Land, Antarctica.

Principal investigator

Thierry Fichefet

thierry.fichefet@uclouvain.be

Université catholique de Louvain (UCL) Earth and Life Institute Georges Lemaître Centre for Earth and Climate Research

Other contact

Other PI: Xavier Fettweis, Université de Liège (ULg), Department of Geography, Laboratory of Climatology, xavier.fettweis@ulg.ac.be

Areas of contribution

Polar atmospheric processes

Oceanic processes

Modelling and forecasting

Sea ice processes

Summary

A high-resolution coupled atmosphere-cryosphere-ocean model will be developed and used in the Adélie Land area, Antarctica to evaluate the impacts of the high spatial and temporal resolution, explicit treatment of small-scale processes usually neglected or highly parameterized in global climate models, and coupling on the sea ice characteristics, the air-ice-ocean interactions, and the surface mass balance of the Antarctic ice sheet on daily to seasonal time scales. The effect of initial conditions on the model prediction skill will also be assessed.

Description

The overall objective of this research project is to quantify the influence of small-scale processes on the dynamics of the coupled atmosphere-cryosphere-ocean system on daily to seasonal timescales in the Antarctic region. To reach this goal, a high-resolution coupled atmosphere-cryosphere-ocean model will be developed and applied to the Adélie Land area, Antarctica. This sector is selected because it is one of the windiest areas of the world, with frequent and strong katabatic winds that erode the snowpack and lead to coastal polynyas, and because of the relatively large amount of observational data available for model validation. The model will consist of the regional climate model MAR (Modèle Atmosphérique Régional) running at a 4 km horizontal resolution coupled to an updated version of the sea ice–ocean model NEMO-LIM3 (Nucleus for European Modelling of the Ocean – Louvain-la-Neuve sea ice model, version 3) with a 2 km horizontal resolution. Several simulations will be performed over two seasonal cycles to evaluate the impacts of the high spatial and temporal resolution, explicit treatment of small-scale processes usually neglected or highly parameterized in global climate models (polar cloud microphysics, blowing snow, ocean tides, ice shelf–ocean interactions, ocean mixing/convection, landfast sea ice, and sea ice rheology), and coupling on the sea ice characteristics (including coastal polynyas), the air-ice-ocean interactions, and the surface mass balance of the Antarctic ice sheet. The effect of initial conditions on the model prediction skill will also be assessed, as a first step towards the application of the model to operational purposes.

The project directly addresses the following YOPP objectives :

- develop improved representation of polar key processes in uncoupled and coupled models used for prediction, including those which are a particular hindrance to high-quality prediction for the polar regions;
- explore the predictability of sea ice on time scales from days to a season.

Timeline

2016-10-01 - 2020-09-25

Regional emphasis

Northern hemisphere: No

Southern hemisphere: Yes

Key project deliverables

(i) Improved version of NEMO-LIM3, which can be used by the NEMO community.
(ii) High-resolution model of the coupled atmosphere-cryosphere-ocean model in the Adélie Land area, Antarctica.
(iii) Improved understanding of the physical processes responsible for the Antarctic climate system variability

and predictability.
(iv) Assessment of the influence of initial conditions on coupled model prediction skill at the local scale in Antarctica.

Data management

No data produced. Model output available upon request.

Is data provided to WMO Global Telecommunication System

No

Real-time provision

No data produced.

Timelines

Location	Latitude	Longitude	Start date	End date	Activity
UCL + ULg	-	-	2016-10-01	2019-02-25	Coupling of MAR with an updated version of NEMO-LIM3 at high resolution in the Adélie Land area and coupled model validation.
ULg	-	-	2019-02-01	2019-12-25	Study of the effects of the coupling frequency, spatial variability of the coupling fields and small-scale atmospheric processes on the coupled system dynamics.
UCL	-	-	2019-02-01	2019-12-25	Study of the effects of small-scale sea ice and ocean processes on the coupled system dynamics.
UCL+ULg	-	-	2020-01-01	2020-09-25	Study of the influence of initial conditions on the coupled model prediction skill.