CA04

PREDANTAR

Understanding and predicting Antarctic sea ice variability at the decadal timescale

DURATION OF THE PROJECT
15/12/2010 – 31/03/2015

BUDGET
722 054 €

KEYWORDS
Sea Ice, Southern Ocean, Prediction, Reconstruction, Model Output Corrections

CONTEXT

Despite the progresses achieved over the last decade, many gaps in our knowledge of the processes that rule the variability of the sea ice extent in the Southern Ocean are still remaining. In particular, the recent positive trend in sea ice extent appears puzzling in a global warming context associated with a large temperature increase over the last 30 years and a strong decrease of the extent and volume of the large majority of the components of the cryosphere (snow cover, glaciers, Arctic sea ice, etc.). Several hypotheses have been proposed to explain this positive trend, partly attributing it to changes in the atmospheric circulation or in the oceanic stratification that would impact on the sea ice transport and the heat exchanges between the atmosphere, the ocean and sea ice. However, no clear conclusion has been obtained yet regarding the relative importance of various mechanisms.

PROJECT DESCRIPTION

Objectives

The goal of this project is firstly to improve our understanding of the mechanisms responsible for the recent changes in the Antarctic sea ice cover. Secondly, based on this improved understanding, we will be able to perform more accurate predictions and projections of the sea ice changes. Both predictions for the next decades and the projections for the end of the 21st century will be investigated. Decadal-scale is the main theme of this project but our results will also bring some new light on the longer term projections.

Methodology

A first step will be to obtain a dynamically consistent estimate of the state of the Antarctic sea ice system over the last 30 years thanks to improved techniques of data assimilation applied in the sea ice-ocean model NEMO-LIM. Such techniques combine observations and model in order to have an optimal reconstruction of the past changes. The method will enable us to obtain additional constraints on the atmospheric forcing of the sea ice cover and on the value of poorly known parameters of the sea ice model.
This new state estimate will be analyzed and compared to simulations performed with different types of models (ocean-sea ice models forced by atmospheric fields derived from observations and coupled atmosphere-ocean-sea-ice general circulation models) in order to determine the processes responsible for decadal variability of the sea ice cover in the Southern Ocean. In those analyses, a particular attention will be paid to the forcing of sea ice changes by the variations in the atmospheric circulation, which impacts on both sea ice transport and thermodynamic exchanges, as well as on the variations in the vertical oceanic heat flux and their causes. The mechanisms proposed on the bases of those analyses will then be tested by means of sensitivity studies, focused on the processes that appear as the most important.
In parallel to those investigations, we will implement and adapt Model Output Statistics techniques to asses and correct models errors in simulated Antarctic sea ice characteristics and their potential corrections in future projections. The major development will be related to the adaptation of existing techniques to sea ice variables and to take adequately into account that the state of the system will change between the calibration and validation period of the technique (i.e. the last 30 years) and the period over which it will be applied (the next decades)

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INTERACTION BETWEEN THE DIFFERENT PARTNERS

The GHER group of the Université de Liège (ULg) is performing the reconstructions of the state of the sea ice cover that will be used by the partner of the Centre de recherches sur la terre et le climat Georges Lemaître (UCL-TECLIM) to analyse the mechanisms responsible for past changes. UCL-TECLIM helps the GHER group to perform those simulations thanks to its expertise in sea-ice modelling.
The Royal Meteorological Institute of Belgium (RMI) is developing a new technique to correct model outputs that will be applied by both RMI and UCL-TECLIM to study future change in the ice cover. UCL-TECLIM is helping the RMI to test the methodology.
All the partners strongly interact to determine the main model biases.

EXPECTED RESULTS AND/OR PRODUCTS

1/ An optimal state estimation of the changes in the Antarctic sea ice cover over the last 30 years
2/ Improved MOS techniques adapted for sea ice
3/ A better understanding of the mechanisms responsible for sea ice variability
4/ An assessment of the quality of model in the Souther Ocean and of the projections at decadal to centennial timescales
5/ Improved projections.

PARTNERS

Activities

The RMI has a strong expertise in MOS through the application of standard techniques and the development of new approaches and thus is the leader for the adaptation of the technique required in the present project.

The GHER group of the ULg has a strong expertise in numerical ocean modeling and data assimilation and is in charge of the simulations with data assimilation.

UCL-TECLIM leads the analysis of the processes responsible for past changes in the sea ice cover.

UCL-TECLIM and RMI will jointly analyse the projections of future changes in the sea ice cover

CONTACT INFORMATION

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Follow-up Committee

For the complete and most up-to-date composition of the Follow-up Committee, please consult our Federal Research Actions Database (FEDRA) by visiting
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