1. Introduction

- The surface sea conditions (SSC) and more precisely Sea Ice Concentration (SIC) and Sea Surface Temperatures (SST) influence the (radiative) properties of the surface, the exchanges of gases, momentum and fluxes between ocean and atmosphere.

- SSC are often used as boundary conditions in regional climate models (RCM) as they are not coupled to an ocean model. Nonetheless, these RCM appear to be as one of the best tools in order to study Antarctic climate due to their high spatial resolution and their ability to resolve polar processes such as the drifting snow.

- Besides, SSC simulated General Circulation Models (GCM) show significant biases for both SIC and SST in comparisons to reanalyses (Agosta et al., 2015).

- Since, the implicit question is how SSC (SST and SIC) can influence the Antarctic Ice Sheet climate and by expansion the Antarctic Surface Mass Balance (SMB) simulated by a RCM.

2. Methods

- Simulations were performed with the MAR model (Fig. 1) at a resolution of 50km

- Reference run (MAR forced every 6 hours by ERA-Interim) compared to sensitivity experiments where SSC from ERA-Interim were modified (Fig. 2)

- Temperature anomalies, increase (resp. decrease) of SIC from the maximum (resp. minimum) value of neighbouring cells and combined experiments (following Noël et al., 2014),

- Temperature anomalies and correction of the SIC based on CMIP5 GCM biases (NorESM1, GISS-E2-H and CMIP5CESM1)

3. Results

- Evaluation of the reference run against the SAMBA database (Favier et al., 2013) (Fig. 3 and Tab.1)

- Simulations were performed with the MAR model (Fig. 1) at a resolution of 50km

- Cloud microphysics module

- Interactive snowpack module

- Hydrostatic approximation of primitive equations

- Interaction with sea-ice

- Fig. 1: Brief description of the MAR model (see Fettweis et al., 2017 for last improvements and a more detailed description)

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- Tab.4: Mean integrated SMB, its components (Snowfall, Rainfall, Water fluxes) and the melt water production in Gl.yr⁻¹. Anomalies are given in respect to the reference run. Red values indicate significant anomalies (evaluated by a one-sided Student’s t test with a 95% degree of confidence).

- Tab.4: Mean integrated SMB, its components (Snowfall, Rainfall, Water fluxes) and the melt water production in Gl.yr⁻¹. Anomalies are given in respect to the reference run. Red values indicate significant anomalies (evaluated by a one-sided Student’s t test with a 95% degree of confidence).

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4. Conclusion

- The SMB sensitivity is almost exclusively determined by the influence of the SSC on the snowfall.

- “Warmer ocean” increases the accumulation over the Ice Sheet while “colder ocean” decreases it.

- Significant anomalies caused by SSC are limited to margins and are mainly caused by “warm” biases.

- Warm ocean representative biases induces anomalies as large as anomalies simulated by other RCMs or GCMs for the end of the 21st century showing the importance of large-scale SMB in future projection.

References

- Agosta et al. 2015. Evaluation of the CMIP5 models in the aim of regional modelling of the Antarctic surface mass balance, Cryosphere, 9, 2311–2321.


- Noël et al. 2014. Sensitivity of Greenland Ice Sheet surface mass balance to perturbations in sea surface temperature and sea ice cover: a study with the regional climate model MAR, Cryosphere, 8, 1871–1883.