Investigating the climate predictability in the Southern Ocean using global and regional coupled models

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The **PARAMOUR** project (2019-2022)

Decadal Predictability and vAriability of polar climate: the Role of AtMosphere-Ocean-cryosphere mUltiscale inteRactions

Main goals: 1. reveal fundamental drivers of **climate variability**
2. assess **decadal predictability** in polar regions

→ Using **coupled atmosphere-ocean-sea ice-ice sheet regional climate models (RCMs)** driven by global climate models (GCMs) over **3 domains**

Greenland & N. Atlantic  
Southern Ocean & Antarctica  
Totten Glacier
Results: predictability in the EC-Earth GCM (DCPP)

→ significant skill in some regions, also for long forecast times

→ some added-value of DCPP over historical runs

→ some skill beyond persistence, especially for long forecast times

Anomaly Correlation Coefficient (ACC) of model ensemble mean vs GHCN-ERSST-GISS surface temperature (combined SST-SAT) for the Southern Ocean (south of 40°S) evaluated over the period 1961-2018 using annual means. a-c) ACC of DCPP. d-f) ACC difference of DCPP with the historical simulations (DCPP-historical). g-i) ACC difference of DCPP with a simple persistence forecast (DCPP-persistence). Dots indicate significant correlation (a-c) and significant difference of correlations (d-i) at 95% level. Missing values in observations are masked in grey.
Results: predictability in the EC-Earth GCM (DCPP)

→ patchy significant skill in some regions
→ potential impact on ice-shelf predictability?

→ some added-value of DCPP over historical runs

→ some skill beyond persistence, especially for long forecast times

Anomaly Correlation Coefficient (ACC) of model ensemble mean vs EN4 potential ocean temperature at 300 m depth for the Southern Ocean (south of 40°S) evaluated over the period 1960-2016 using annual means. a-c) ACC of DCPP. d-f) ACC difference of DCPP with the historical simulations (DCPP-historical). g-i) ACC difference of DCPP with a simple persistence forecast (DCPP-persistence). Dots indicate significant correlation (a-c) and significant difference of correlations (d-i) at 95% level. Missing values in observations are masked in grey.
Work in progress

- Coupled atmosphere-ocean-sea ice-ice sheet RCM development over the Southern Ocean and Antarctica
  → Session CR5.4, [EGU2020-5647](https://doi.org/10.1002/2020EG000215)

  **A circumpolar coupled ocean – Antarctic ice sheet configuration for investigating recent changes in Southern Ocean heat content**

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- Totten Glacier configuration
  → Session OS1.13, [EGU2020-8075](https://doi.org/10.1002/2020EG000215) (not presented)

  **Investigating the climate variability in the Totten area using NEMO-LIM regional model.**

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Preliminary conclusions

- Some **skill** in EC-Earth DCPP in predicting $T^\circ$ at the surface and in the ocean at depth, in some regions, for short and long forecast times → Potential impact on the **predictability of sea ice and ice shelves**
- **Added-value** in some regions compared to uninitialised runs and persistence → impact of initialisation and specific physical processes/feedbacks
- Further analyses are required, especially using **coupled RCM simulations**

Thanks!

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