Added value of a regional climate model (MAR) for simulating the current surface mass balance of the Antarctic ice sheet compared to a general circulation model (ACCESS1.3)

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Introduction

Projet IMBIE (Shepherd et al., 2018, Nature)
Introduction

- General circulation model (GCM)
  - Climate projections
    - Inputs for ice sheet models for the next IPCC report
  
- BUT
  - Low resolution
  - Poor representation of polar climate specificities

Are we using the right tool for predicting the Antarctic surface climate?
Methods

- Comparing the SMB modelled by a RCM and a GCM
  - ACCESS1.3
    - 1.25°x1.25° resolution
    - Does not directly compute the SMB
      - \( \text{SMB} \approx \text{SF} + \text{RF} - \text{SU} \)

AC3 mean SMB (1980-2005) (kg/m²/yr)
Methods

- Comparing the SMB modelled by a RCM and a GCM
  - MAR
    - Polar-adapted physics
    - Correctly represents the Antarctic SMB \((dz/dt)\)
    - 35km x 35km
    - Forced by the ERA-Interim reanalysis and by ACCESS1.3
## Integrated values

<table>
<thead>
<tr>
<th>Gt/yr</th>
<th>SMB</th>
<th>SF</th>
<th>RF</th>
<th>SU</th>
<th>ME</th>
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<td>MAR-ERI</td>
<td>2557</td>
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<td>33</td>
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<td>MAR-AC3</td>
<td>2635</td>
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<td>ACCESS1.3</td>
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<td>2714</td>
<td>21</td>
<td>228</td>
<td>-</td>
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</tbody>
</table>
Comparison with SMB Observations

- Ice Shelves
- 0 - 1200 m
- 1200 - 2200 m
- 2200 - 2800 m
- 2800 - 3400 m
- 3400 m - Summit

Modelled SMB (log(10³) kg m⁻² yr⁻¹)

Observed SMB (log(10³) kg m⁻² yr⁻¹)

MAR-ERI, MAR-AC3, ACCESS1.3

Inset map: a) MAR-ERI
Spatial comparison
Discussion

- But what about the representation of the summer climate?

<table>
<thead>
<tr>
<th></th>
<th>°C</th>
<th>Mean Bias</th>
<th>RMSE</th>
<th>r</th>
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<tbody>
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<td>MAR-ERI</td>
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<tr>
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<tr>
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<td>0.97</td>
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</table>
Conclusion

• Using a RCM seems to be not required to represent the current mean SMB of the Antarctic Ice Sheet

• Better representation of the summer climate by MAR
  • Added-value of a RCM in a warmer climate?