Reconstruction of the Greenland ice sheet surface mass balance over 1900-2015 with the help of the regional climate MAR model.

X. Fettweis\textsuperscript{1}, C. Agosta\textsuperscript{1}, H. Gallée\textsuperscript{2}

1 University of Liège (Ulg), Belgium
2. LGGE, France

1. Reanalysis over present climate

Mean JJA Temperature differences at 700hPa over 1980-1999 in respect to ERA-Interim (°C)

Correction of +1° applied at the MAR boundaries

Correction of -1° applied at the MAR boundaries
2. MAR over present climate

Differences with the ERA-Interim forced MAR simulation (mmWE/yr)

Mean SMB (mm/yr)

20km
3. Validation

MAR vs 1862 SMB observations over 1958-2010

Ice cores from Bales et al. (2009)

From PROMICE data set

Regression line

SMB observations (mWE)

MAR based SMB (mWE)

Biais (mmWE/yr)

<table>
<thead>
<tr>
<th></th>
<th>Bias</th>
<th>RMSE</th>
<th>Corr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAR-ERA</td>
<td>0.14</td>
<td>0.46</td>
<td>0.93</td>
</tr>
<tr>
<td>MAR-NCEP1</td>
<td>0.13</td>
<td>0.45</td>
<td>0.93</td>
</tr>
<tr>
<td>MAR-20CRv2c</td>
<td>0.14</td>
<td>0.49</td>
<td>0.91</td>
</tr>
<tr>
<td>MAR-ERA-20c</td>
<td>0.22</td>
<td>0.52</td>
<td>0.92</td>
</tr>
</tbody>
</table>
### Comparison with 14 AWSs from PROMICE
(daily measurements over 2008-2010)

<table>
<thead>
<tr>
<th></th>
<th>Surf. pres.</th>
<th>3m-Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Correlation</td>
<td>Correlation</td>
</tr>
<tr>
<td>ERA-Interim</td>
<td>0.99</td>
<td>0.96</td>
</tr>
<tr>
<td>NCEP-NCARv1</td>
<td>0.99</td>
<td>0.95</td>
</tr>
<tr>
<td>ERA-20C</td>
<td>0.99</td>
<td>0.95</td>
</tr>
<tr>
<td>ERA-20C nocorr</td>
<td>0.99</td>
<td>0.95</td>
</tr>
<tr>
<td>20CRv2</td>
<td>0.98</td>
<td>0.92</td>
</tr>
<tr>
<td>20CRv2c</td>
<td>0.98</td>
<td>0.93</td>
</tr>
</tbody>
</table>

MAR forced by ...
3. Validation

MAR GrIS temperature vs DMI based composite SW Greenland temperature

Anomalies in respect to 1980-1999

Bad comparison

warm period of the 1930's

DMI
4. Time evolution

Diverging results!

Reference period 60-90: high SMB!!

Warm period over Greenland

Heavier snowfall

Run-off

Increasing melt

stable
4. Time evolution

Impact on sea level from 1900 in respect to 1980-1999

... by assuming no change in ice dynamics ...
Conclusions:

- Good comparison of MAR vs observations + independence of used reanalysis as forcing.
- Coherent results over 1930-2015. Improvements in reanalyses are needed before 1930!
- GrIS SMB changes have contributed to a sea level rise of ~ 15mm.
- 1960-1990 is not a good choice for a reference period.
- Coupling with an ice sheet model to study changes in ice dynamics.


Posters: Wed at 17h30  X4.184
Thu  at 17h30  X3.206