Globsnow and JULES

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The truth?

Figure by Martin De Kauwe of CEH Wallingford
Snow water equivalent and the estimation uncertainty for 15 January 2008
Sites

Globally representative of lat, lon, elevation, topography, peak accumulation.
Taking pure MODIS as truth.
Hardest case for microwave sensors – don’t expect too much.

<table>
<thead>
<tr>
<th>Sensor</th>
<th>AMSR-E</th>
<th>SSM/I</th>
<th>Globsnow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snow start</td>
<td>-26 +/- 53</td>
<td>-3 +/- 40</td>
<td>-38 +/- 38</td>
</tr>
<tr>
<td>Snow end</td>
<td>4 +/- 48</td>
<td>-10 +/- 30</td>
<td>0.5 +/- 25</td>
</tr>
</tbody>
</table>
The “truth”

Comparison of Globsnow SWE to AMSR-E and SSM/I over Kevo, Finland and BERMS, Canada
SWE from AMSR-E, SSM/I, Globsnow and ground measurements at Kevo, Finland. Ground data from Jonathan Evans.
DEPTH HOAR
The Chang method was originally tested over three sites.

<table>
<thead>
<tr>
<th>Site</th>
<th>Peak SWE (mm)</th>
<th>Elevation (m)</th>
<th>Forest cover (%)</th>
<th>Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chang Russia</td>
<td>34 +/- 10</td>
<td>148 +/- 61</td>
<td>10 +/- 8</td>
<td>-4 +/- 3</td>
</tr>
<tr>
<td>Chang Canada</td>
<td>47 +/- 13</td>
<td>706 +/- 172</td>
<td>6 +/- 11</td>
<td>-11 +/- 4</td>
</tr>
<tr>
<td>Chang USA</td>
<td>51 +/- 7</td>
<td>723 +/- 245</td>
<td>3 +/- 3</td>
<td>-11 +/- 4</td>
</tr>
<tr>
<td>Global subset</td>
<td>86 +/- 33</td>
<td>394 +/- 647</td>
<td>30 +/- 31</td>
<td>-22 +/- 10</td>
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</tbody>
</table>
EO CONCLUSIONS

• Globsnow appears to be the best SWE product available.
  • Not collected over mountainous terrain
  • Some gaps
  • Spurious jumps (1%)

• SSM/I and AMSR-E appear to saturate and suffer from artefacts from forest correction and “depth hoar”.

Globsnow artefacts

About 1% of cases examined showed possibly spurious jumps.

Use with caution.
JULES runs (v2.1.2)

Globsnow
JULES Princeton
MODIS SCA (%)

SWE (mm)

Time (days)


55.5°N 64.5°E
Early melt?

Yenisey - WATCH

Repeating with MOD10C1
# Snowfall

![Snowfall Graph](image)

<table>
<thead>
<tr>
<th>Time</th>
<th>Globsnow</th>
<th>JULES</th>
<th>Cumulative snowfall</th>
<th>Cumulative precipitation</th>
<th>Temperature (K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/9/1993</td>
<td></td>
<td></td>
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<tr>
<td>31/10/1993</td>
<td></td>
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<tr>
<td>31/12/1993</td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>1/3/1994</td>
<td></td>
<td></td>
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<tr>
<td>1/5/1994</td>
<td></td>
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<tr>
<td>1/7/1994</td>
<td></td>
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</tbody>
</table>

**Graph Description:**
- The graph shows the cumulative snowfall, cumulative precipitation, and temperature over a period from 1/9/1993 to 1/7/1994.
- **Globsnow** and **JULES** lines indicate the simulated snowfall amounts.
- The cumulative snowfall line shows the total snow accumulation over time.
- The cumulative precipitation line indicates the total precipitation received.
- Temperature (K) line represents the temperature in Kelvin over the same period.
Using Globsnow, it was estimated that there should be an additional 35% snowfall on average over the Ob basin.

- Using this adjustment all models showed a reduced RMSE
- The new model with Globsnow adjusted snowfall demonstrates the best similarity of all runs

Using a spatially dependent adjustment factor could lead to even better results.
Winter melt

![Graph showing Winter melt](image)
Land cover
Future work

• Initial results suggest that driving precipitation is the limiting factor of model accuracy.
  • Use Globsnow to achieve correct peak accumulation – in progress

• See if that improves melt date, runoff and vegetation green-up.

• If not test sensitivity to land cover and temperature.
JULES bug?

• Outputting “snowGrCanMeltT” causes a seg fault
  • in both v2.1.2 and v3.0
WATCH bug?
AMSR-E

2002 – 4th October 2011
“True” snow cover
Comparison of Globsnow, AMSR-E and SSM/I SWE to Princeton meteorological data for Kevo and BERMS.