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Changes in Hemispheric Snow Accumulation Based on CMIP5 Simulations and Satellite-Based Data

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The European Space Agency (ESA) GlobSnow project has produced a daily hemisphere-scale satellite-based snow water equivalent (SWE) data record spanning more than 30-years. The GlobSnow SWE record, based on methodology by Pulliainen [1] utilizes a data-assimilation based approach for the estimation of SWE which was shown to be superior to the approaches depending solely on satellite-based data [2]. The GlobSnow SWE data record is based on the time-series of measurements by three different space-borne passive radiometers (SMMR, SSM/I and SSMIS) measuring in the microwave region, spanning from 1980 to present day at a spatial resolution of approximately 25 km. We briefly introduce the GlobSnow hemispherical dataset on SWE produced using a variational assimilation scheme combining satellite data with ground-based observations that has been used to construct a 30+ years daily time-series of terrestrial snow cover.

We present the comparison of GlobSnow SWE dataset with climate model simulations from the CMIP5 archive. The objective of this work is to investigate the performance of the CMIP5 models in capturing the evolution of hemispheric scale snow conditions for the period of 1980 to 2013. The climate model simulations on snow cover extent, snow depth and snow water equivalent are assessed against an ensemble of GlobSnow SWE datasets compiled from different GlobSnow product versions. The future projections of the CMIP5 model simulations on snow cover are also investigated.

The assessment indicates a decreasing trend in spring time hemispherical snow mass for the period of 1980 to 2013 in remote-sensing based data record. The inter-comparison of satellite-based record and climate model simulations show large differences in autumn, winter and spring time Hemispherical scale snow conditions. Similar trends of decreasing snow cover are also seen in the investigated CMIP5 models, although there is a notable variance between different models. Some of the models capture the overall hemispherical snow mass more accurately than others. In general the winter months (December, January and February) seem to be rather well captured, while the spring season, (March, April and May) appears more challenging for the climate models.

The results show that the CMIP5 ensemble average is rather close to the satellite-based data record for the overlapping time period during the winter months on January and February. For March the CMIP5 ensemble average is clearly higher than that of the satellite-based record. For April, the CMIP5 ensemble average shows a significant over estimation when compared with the satellite-based data. This indicates that the satellite-based and CMIP5 based data are agreeing relatively well regarding the overall hemispherical snow mass for the winter months, but a vast majority of the CMIP5 models are over estimating the hemispheric snow mass during the spring snow melt season. Also the inter-annual variability of snow cover is clearly higher in the observation-based record, compared with climate models.

REFERENCES

[1] Pulliainen, J. Mapping of snow water equivalent and snow depth in boreal and sub-arctic zones by assimilating space-borne microwave radiometer data and ground-based observations. Remote Sensing of Environment. 101: 257-269. DOI: 10.1016/j.rse.2006.01.002.
[2] Takala, M., Luojus, K., Pulliainen, J., Derksen, C., Lemmetyinen, J., Kärnä, J.-P, Koskinen, J., Bojkov, B., "Estimating northern hemisphere snow water equivalent for climate research through assimilation of space-borne radiometer data and ground-based measurements", Remote Sensing of Environment, Vol. 115, Issue 12, 15 December 2011, Pages 3517-3529, ISSN 0034-4257, DOI: 10.1016/j.rse.2011.08.014.