Assessment of Snow Water Equivalent Estimates of CMIP5 Climate Model 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 two different space-borne passive radiometers (SMMR and SSM/I) measuring in the microwave region, spanning from 1980 to present day at a spatial resolution of approximately 25 km.

We briefly present the GlobSnow hemispherical scale observational dataset on SWE. This SWE dataset utilizes 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 2012. The climate model simulations on snow cover extent, snow depth and snow water equivalent are evaluated against the GlobSnow SWE record. The future projections of the CMIP5 model simulations on snow cover are also investigated.

The results indicate a decreasing trend in spring time hemispherical snow mass for the period of 1980 to 2012 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. Also the inter-annual variability of snow cover is higher in the observation-based record, compared with climate models.