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Investigating Snow Accumulation on Northern Hemisphere Using Globsnow Snow Water Equivalent Data

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The efforts of the European Space Agency (ESA) Data User Element (DUE) funded GlobSnow project has resulted in two new global records of snow parameters intended for climate research purposes. The datasets contain satellite-retrieved information on snow extent (SE) and snow water equivalent (SWE) extending 15 and 30 years respectively. The dataset on snow extent is based on optical data of Envisat AATSR and ERS-2 ATSR-2 sensors covering Northern Hemisphere between years 1995 to 2010. The record on snow water equivalent is based on the methodology by Pulliainen [1], utilizing satellite-based passive microwave measurements combined with ground-based weather station data, beginning from 1979 and extending to present day. This abstract presents the evaluations carried out with the 30-years GlobSnow SWE data for climate research purposes, including a brief validation of the SWE data with ground-based reference data and a first evaluation of the hemispherical scale SWE trends using the dataset.

The GlobSnow SWE product is the first satellite-based data set of snow water equivalent information on a daily basis at a hemispherical scale for 30 years. The SWE data is based on the time-series of measurements by three different space-borne passive radiometers (SMMR, SSM/I and AMSR-E) measuring in the microwave region. A notable feature of the GlobSnow SWE product, when compared with the previously available datasets, is the inclusion of a statistically derived accuracy estimate accompanying each SWE estimate (on a pixel level). In addition to the long term record of SE and SWE, an operational near-real time (NRT) snow information service has been implemented from the beginning of October 2010. Both the historical datasets and the NRT products have been made available through the GlobSnow web-pages (www.globsnow.info).

An evaluation of the GlobSnow SWE data record was carried out using ground-based snow path data collected from the former Soviet Union and the Russia extending from 1978 until 2000. The measurements, carried out at 1264 different snow path locations, range from 35° to 85° northern latitude and 14° to 179° of eastern longitude and contain 424,600 samples. The evaluations carried out for the GlobSnow SWE record utilized a weekly aggregate SWE product (sliding window average) compared with the Russian snow path data. The results show a very good agreement with the Russian data. The comparison show that the RMS error for SWE values ranging between 0–150 mm, for the years 1979–2000 (consisting of 178,554 samples) was 32.8 mm. The bias for the same dataset was +3.0 mm. Consideration of all the samples of the full dataset (all SWE values, consisting of 202,221 samples) showed a bias of -6.4 mm and RMS error of 46.7 mm (both values are a significant improvement over the previously available SWE records considering a hemispherical extent).

The 30-years GlobSnow SWE record was used to look at snow trends within the Northern Hemisphere. The hemispherical average snow mass for March, when the typical SWE maximum is annually observed, showed a notable decreasing trend. For Eurasia the decreasing trend was very modest, but for North America the decreasing trend in snow mass was pronounced. These trend-analyses are still preliminary and the time series statistics will be investigated in greater detail before quantitative trend values are derived.

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.