Assessment of seasonal snow cover mass in NH and the Arctic during satellite-era (1980-present)

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Reliable information on snow cover across the Northern Hemisphere and Arctic and sub-Arctic regions is needed for climate monitoring, for understanding the Arctic climate system, and for the evaluation of the role of snow cover and its feedback in climate models. In addition to being of significant interest for climatological investigations, reliable information on snow cover is of high value for the purpose of hydrological forecasting and numerical weather prediction. Terrestrial snow covers up to 50 million km² of the Northern Hemisphere in winter and is characterized by high spatial and temporal variability making satellite observations the only means for providing timely and complete observations of the global snow cover. The purpose of the ESA funded SnowPEx project has been to obtain a quantitative understanding of the uncertainty in existing Snow Extent (SE) and Snow Water Equivalent (SWE) products through an internationally coordinated and consistent evaluation exercise.

Based on the investigations in the ESA SnowPEx project, the GlobSnow SWE product [1] (which has shown good retrieval accuracy and consistency) was assessed and augmented with the JAXA JXAM5 daily SE product [2] (which shows a consistently accurate, daily time-series, starting from 1980). A cumulative SE mask was generated from the JXAM5 data by combining the available (cloud free) information from each observed day and filling the gaps (in observed daily product) from the previous day (gap filled) snow status – resulting in a cumulative binary snow mask (spanning from 1980 to present day). The outcome (daily gap filled snow mask) has the most recent observation recorded for each pixel. This cumulative snow mask was applied to correct the retrieved SWE products, which were assessed in regard to the amount of snow (SWE) during the winter season and the long term trends in Hemispheric SWE (i.e. total integrated snow mass).

The assessment shows that the total amount of snow decreases when the SWE product is constrained using SE data, especially during the melt season. The difference in the constrained and the original hemispheric SWE are varying from year to year. The daily SE-constrained SWE products were used to calculate the daily and monthly SWE masses and trends for years 1980 to 2016. The linear trends in the constrained SWE products are compared with the trends observed for the nominal GlobSnow SWE product. The assessments were carried out for the whole Northern Hemisphere, and for Eurasia, North America and the Arctic separately.

References

[1] 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 **(2011)**.

[2] JASMES (JAXA Satellite Monitoring for Environmental Studies) **(2014)** JASMES Binary snow cover extent product (GHRM5C), Available at: http://kuroshio.eorc.jaxa.jp/JASMES/index.html