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Combining Satellite-Based Optical and Passive Microwave Radiometer Observations for Northern Hemisphere Snow Cover Estimation

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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 km^2 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 is 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. Synergy of SE and SWE products were also studied in the project, augmentation of SWE retrieval using SE data and its effect to estimated snow conditions on hemispherical scale are presented here.

It is generally well known that moderate to high resolution optical-based satellite observations are better suited to determine the extent of snow cover in the marginal snow regimes (shallow/discontinuous snow) and during the melt period, compared to coarse resolution and passive microwave based satellite data. For that reason, the impact of constraining the snow area of satellite-based SWE products, with optical-based SE data was assessed. Daily snow area extent was determined using optical SE data and that information was used to correct the snow area in each corresponding daily SWE product.

Based on the investigations in the ESA SnowPEx project, the GlobSnow SWE product [1] (which has shown good retrieval accuracy and consistency) was chosen to be 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 applied for each pixel. This spatially and temporally complete snow mask was applied to correct the retrieved SWE products. The SWE data, which were augmented with the daily optical-based snow mask, 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).

Based on this study, it is evident that the total amount of snow decreases when the SWE product is constrained using SE data, especially towards the end of the winter 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 Northern Hemisphere SWE masses for the years 1997 to 2013 (the data for the whole intended 1980-2015 period was not available at the time of abstract submission). The time series available for now (1997-2013) was used to calculate linear trends in SWE changes and compared with the trends observed with the nominal GlobSnow SWE product. The results in the observed trends for January through May show rather small differences, between the SE-constrained and the nominal GlobSnow SWE products. For January, February and April the trends show minimal changes. For March, the observed negative trend in the 17-year SE-constrained SWE time series is slightly smaller. For May, the trend in the SE-constrained SWE time series is slightly higher (than that of the original). A full assessment will be carried out for 1980-2015 before final conclusions are drawn.

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, Issue 12, 15 December 2011, Pages 3517-3529, ISSN 0034-4257, DOI: 10.1016/j.rse.2011.08.014.

[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