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Towards a long term global snow climate data record from satellite data generated within the Snow Climate Change Initiative

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Seasonal snow is an important component of the global climate system. It is highly variable in space and time and sensitive to short term synoptic scale processes and long term climate-induced changes of temperature and precipitation. Current snow products derived from various satellite data applying different algorithms show significant discrepancies in extent and snow mass, a potential source for biases in climate monitoring and modelling. The recently launched ESA CCI+ Programme addresses seasonal snow as one of 9 Essential Climate Variables to be derived from satellite data.

In the snow_cci project, scheduled for 2018 to 2021 in its first phase, reliable fully validated processing lines are developed and implemented. These tools are used to generate homogeneous multi-sensor time series for the main parameters of global snow cover focusing on snow extent and snow water equivalent. Using GCOS guidelines, the requirements for these parameters are assessed and consolidated using the outcome of workshops and questionnaires addressing users dealing with different climate applications. Snow extent product generation applies algorithms accounting for fractional snow extent and cloud screening in order to generate consistent daily products for snow on the surface (viewable snow) and snow on the surface corrected for forest masking (snow on ground) with global coverage. Input data are medium resolution optical satellite images (AVHRR-2/3, AATSR, MODIS, VIIRS, SLSTR/OLCI) from 1981 to present. An iterative

development cycle is applied including homogenisation of the snow extent products from different sensors by minimizing the bias. Independent validation of the snow products is performed for different seasons and climate zones around the globe from 1985 onwards, using as reference high resolution snow maps from Landsat and Sentinel- 2as well as in-situ snow data following standardized validation protocols.

Global time series of daily snow water equivalent (SWE) products are generated from passive microwave data from SMMR, SSM/I, and AMSR from 1978 onwards, combined with in-situ snow depth measurements. Long-term stability and quality of the product is assessed using independent snow survey data and by intercomparison with the snow information from global land process models.

The usability of the snow_cci products is ensured through the Climate Research Group, which performs case studies related to long term trends of seasonal snow, performs evaluations of CMIP-6 and other snow-focused climate model experiments, and applies the data for simulation of Arctic hydrological regimes.

In this presentation, we summarize the requirements and product specifications for the snow extent and SWE products, with a focus on climate applications. We present an overview of the algorithms and systems for generation of the time series. The 40 years (from 1980 onwards) time series of daily fractional snow extent products from AVHRR with 5 km pixel spacing, and the 20-year time series from MODIS (1 km pixel spacing) as well as the coarse resolution (25 km pixel spacing) of daily SWE products from 1978 onwards will be presented along with first results of the multi-sensor consistency checks and validation activities.