The influence of climate change on global snow cover distribution: Using the DLR Global SnowPack to identify snow cover trends and extreme events

Andreas J. Dietz, Sebastian Rößler, Claudia Künzer

German Aerospace Center (DLR), German Remote Sensing Data Center (DFD), Department Land Surface Dynamics

Data Sources and processing steps for the DLR Global SnowPack

Snow cover is essential for water availability, vegetation, animal habitats, the radiation budget of the planet, and human interaction such as hydropower generation, irrigation, ground water availability, and tourism. Climate change is affecting snow cover worldwide, leading to changing snow cover durations, shifts in the seasonality and snow amount. It is important to observe these changes, to quantify them, and to analyse how they affect the environment and develop in the future.

For the years between 2000 and 2020, the MODIS daily snow cover products MOD10A1 and MYD10A1 are used as the basis for the calculation of the snow cover statistics. The MODIS products contain values for the Normalized Difference Snow Index (NDSI), which can be classified into presence/absence of snow relying on additional information such as underlying land cover, topography, and seasonality. Furthermore, to reduce the effect of cloud cover and polar darkness on the time series of snow cover information, the Global SnowPack processing chain contains several interpolation steps that sequentially remove all existing data gaps. These steps include combination of all available data for each calendar day, temporal interpolations, snow line detection and propagation, and the combination with available Snow Water Equivalent products which are independent from clouds.

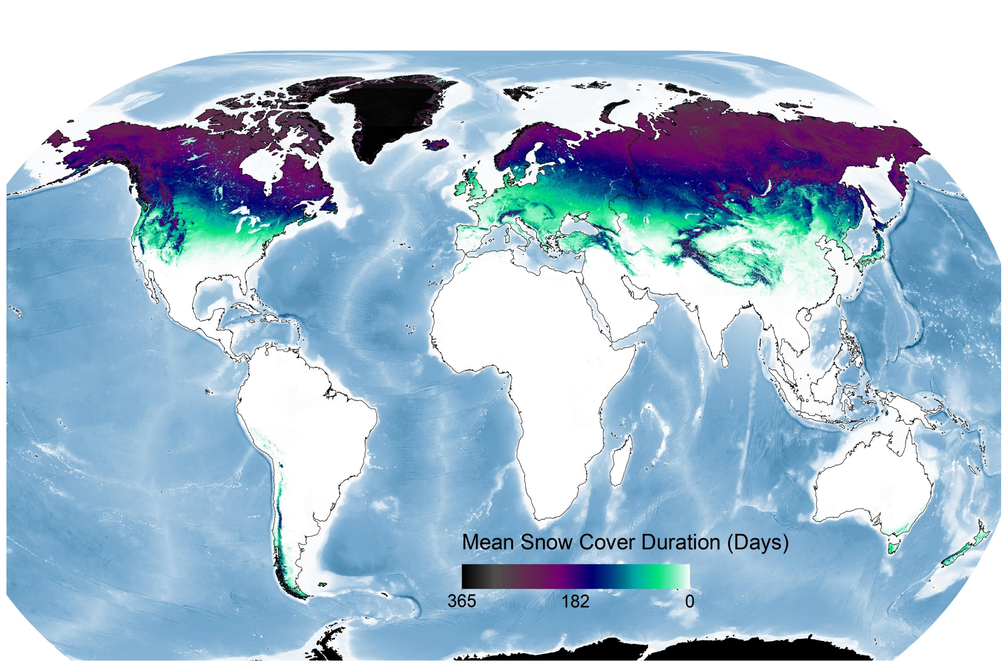


Fig. 1: Mean global Snow Cover Duration

Monitoring the variability of the annual snow cover

The comparison between the cumulative days with snow cover (snow cover duration - SCD) of a year with the long-term mean helps to identify trends and extremes. The winter of 2019/2020, for example, was characterized by lack of snow in most of Europe. However, the opposite also occurred in northern Scandinavia.

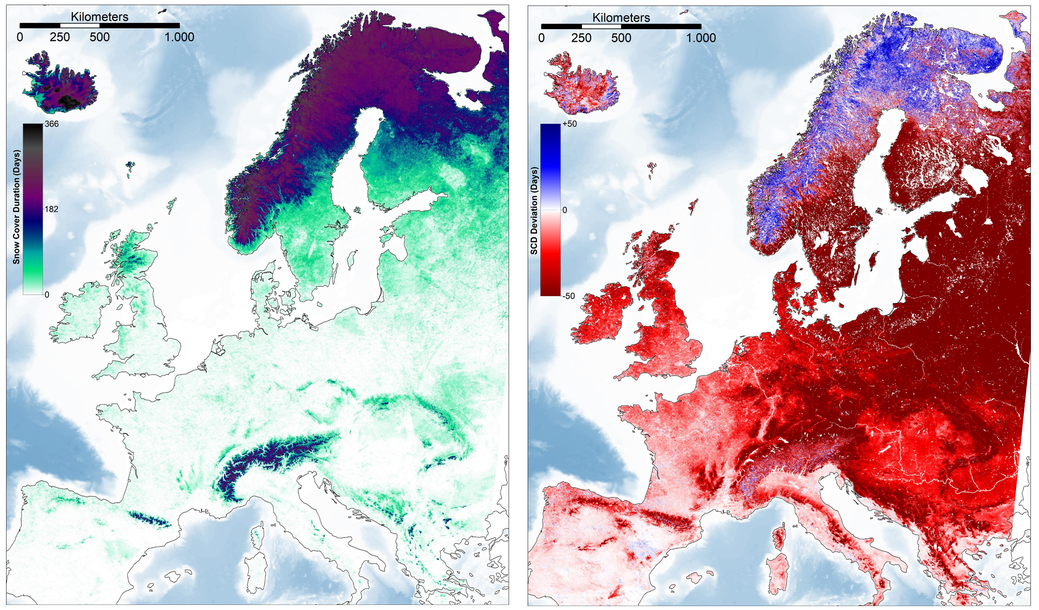
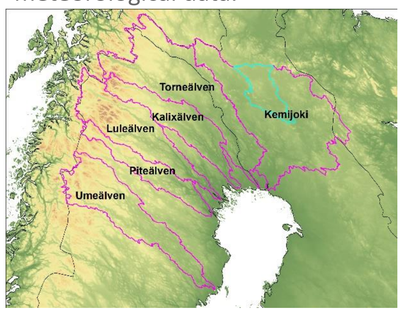


Fig. 2: European Snow Cover Duration 2019/20 (left) and deviation from longterm mean (right)

Investigation of extreme hydrological events

The snow situation in Lapland in winter 2019/2020 led to floods in many places. In a current study, the relationship between the snow situation (duration and beginning of melting) and the risk of flooding is being investigated with the aid of hydrological and meteorological data.



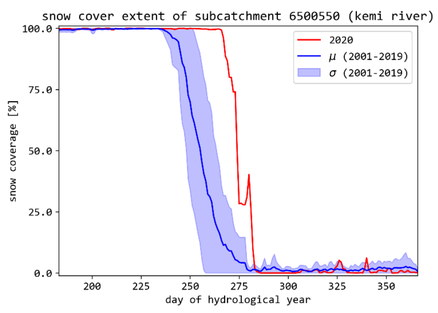


Fig. 3: Large river basins in Lapland (left) and selected snow cover extend for a subbasin (right, cyan shape)

Deutsches Zentrum für Luft- und Raumfahrt

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Dr. Andreas Dietz
German Aerospace Center (DLR)
Earth Observation Center (EOC)
German Remote Sensing Data Center (DFD)

Oberpfaffenhofen
82234 Weßling
Tel.: +49 8153 28-1511
E-Mail: andreas.dietz@dlr.de

Dr. Sebastian Rößler
German Aerospace Center (DLR)
Earth Observation Center (EOC)
German Remote Sensing Data Center (DFD)

Oberpfaffenhofen
82234 Weßling
Tel.: +49 8153 28-3156
E-Mail: sebastian.roessler@dlr.de