

# GLOBAL SNOWPACK

## PROCESSING AND ANALYSIS OF SNOW COVER TIME SERIES FOR CLIMATE CHANGE ASSESSMENT ON A GLOBAL SCALE

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### Global SnowPack background information

The Global SnowPack is a set of snow cover products derived from medium resolution remote sensing data. Daily snow cover maps are combined and analysed to produce information about early season ( $SCD_{ES}$ ), late season ( $SCD_{LS}$ ), and overall snow cover duration (SCD) within a hydrological year.

$$SCD = \sum_{i=1}^n (s_i) \quad SCD_{ES} = Fd - SCD_{bFd} \quad SCD_{LS} = Fd + SCD_{aFd}$$

(Eq. 1) (Eq. 2) (Eq. 3)

- n: number of observations for a hydrological year
- s: cloud-free dataset of snow cover for a given day
- Fd: Fixed date of maximum snow cover extent (Jan 15 for Northern, Jul 15 for Southern Hemisphere)
- bFd/aFd: SCD before (bFd) and after (aFd) the fixed date

### Data Sources and processing

For the years between 2000 and 2014, the MODIS daily snow cover products MOD10A1 and MYD10A1 are used as the basis for the calculation of the Global SnowPack. For years prior to 2000, AVHRR was selected as the primary data source. While the MODIS snow maps are available as thematic Level 3 products, the AVHRR data come as Level 1B and require additional pre-processing. This is performed relying on Terascan and the AVHRR Processing Over Land, cCloud and Ocean (APOLLO) scheme.

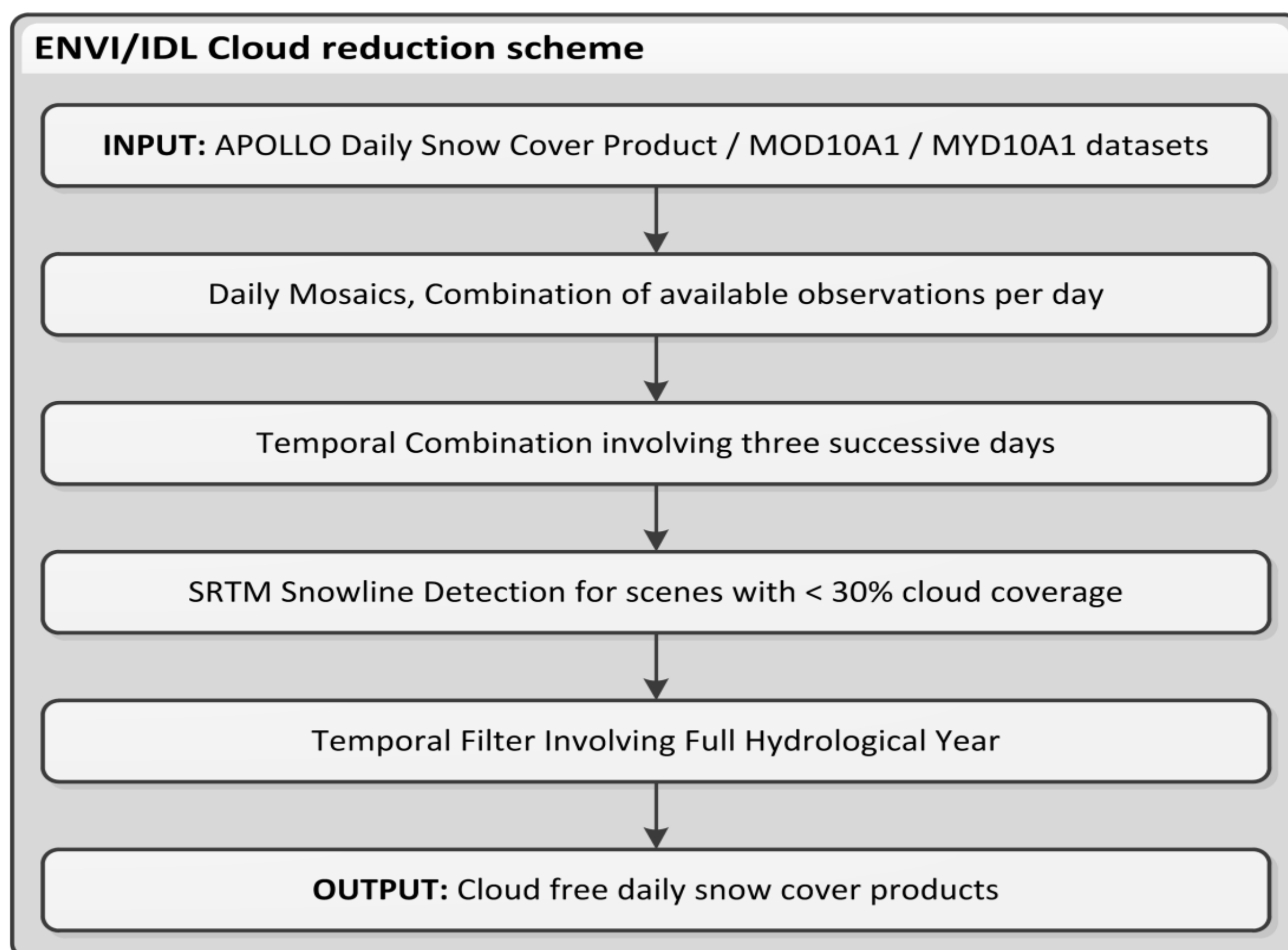


Fig. 1: Post-processing of AVHRR (and MODIS) snow maps

After pre-processing of AVHRR data both AVHRR and MODIS snow cover maps are post-processed to eliminate cloud covered pixels using four successive steps. Figure 1 gives an overview about the post-processing workflow. After these steps have been performed the snow maps are completely cloud free and contain information about snow cover presence for each day of the time series. SCD parameters are then calculated based on these datasets and equations 1-3.

### Results, status of processing, and outlook

Figure 2 illustrates the SCD for the hydrological year 2012/2013. ~100.000 MODIS tiles are processed per year. As of today, the full global archive of MODIS data has been processed to derive SCD,  $SCD_{ES}$ , and  $SCD_{LS}$ . The analysis of AVHRR on the other hand is only finished for selected study sites in Central Asia and constitutes a challenging task for the future.

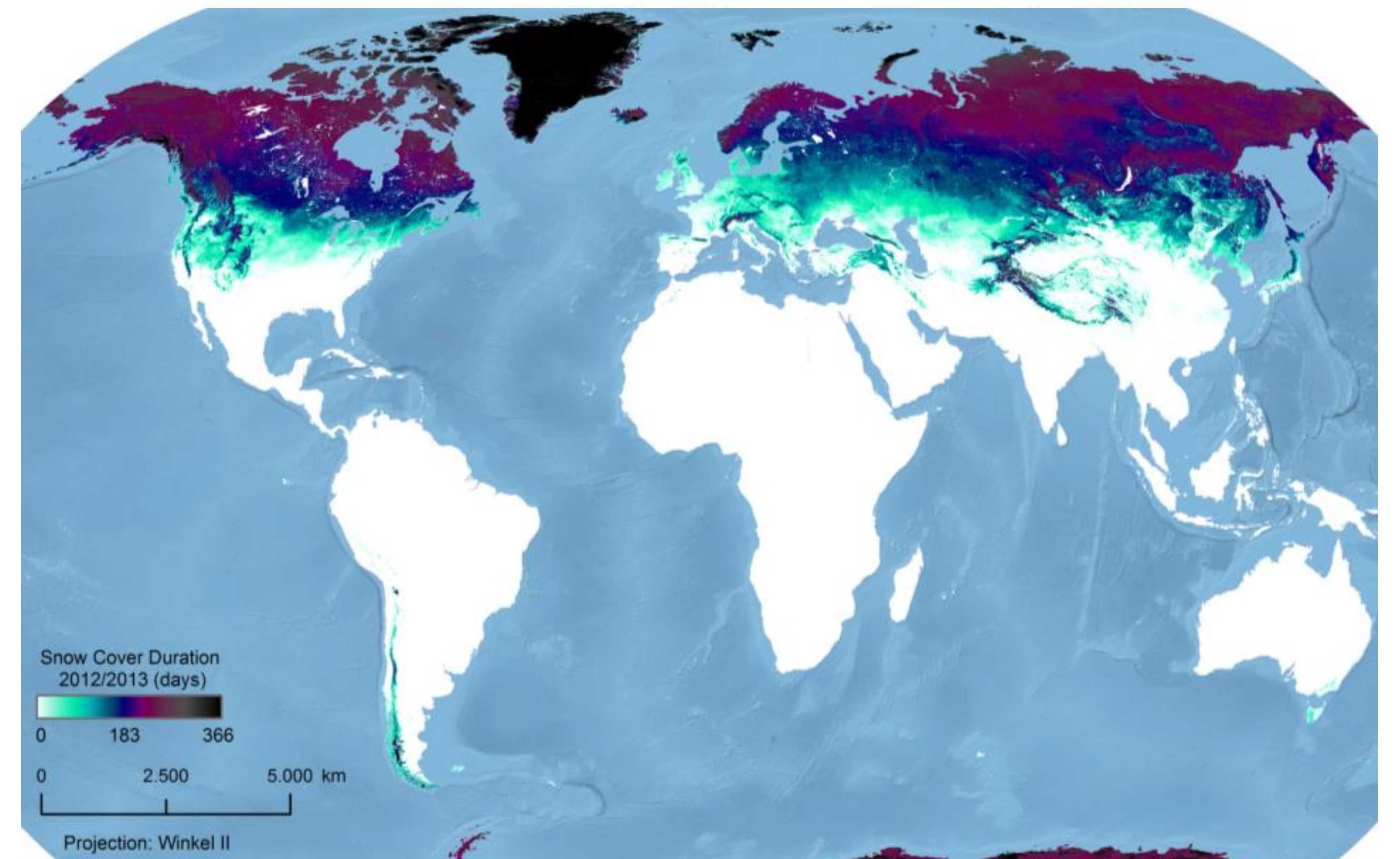


Fig. 2: SCD for hydrological year 2012/2013

Figure 3 shows an example for a possible application: Snow cover percentage within major hydrological catchments over time. Such information are valuable in terms of flood forecasting or the identification of climate change impacts on the hydrology of a drainage basin. While the processing for years after 2000 is finished, the AVHRR time series is still incomplete.

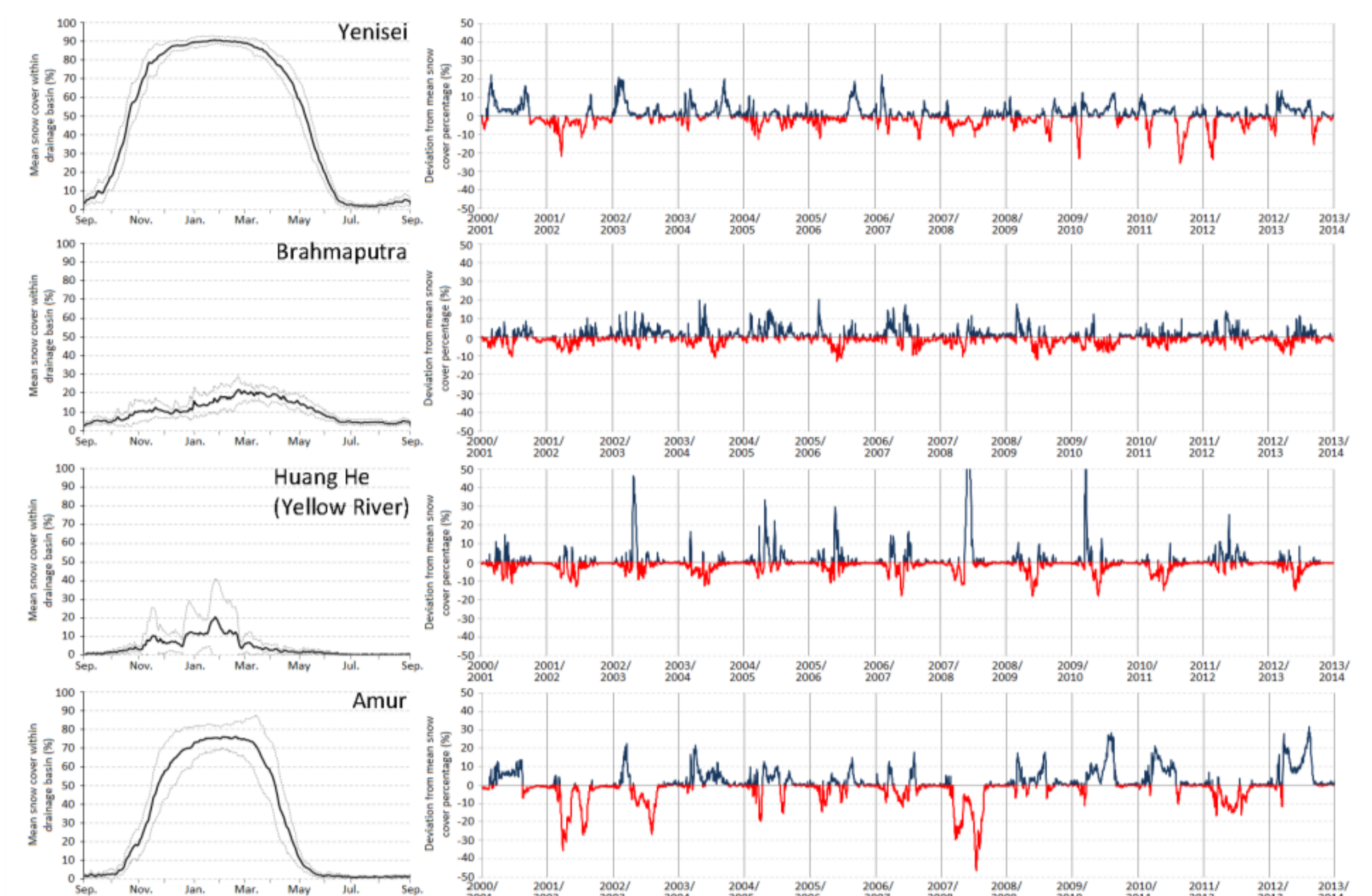


Fig. 3: Mean snow cover percentage (left) and annual deviations (right) for selected drainage basins of Eurasia

Figure 4 finally illustrates the tendency of SCD between 2000 and 2014: It gives an outlook to what will be possible once AVHRR processing is finished: Trend analyses of SCD for 30-year lasting time series of medium resolution daily snow cover data for the whole globe.

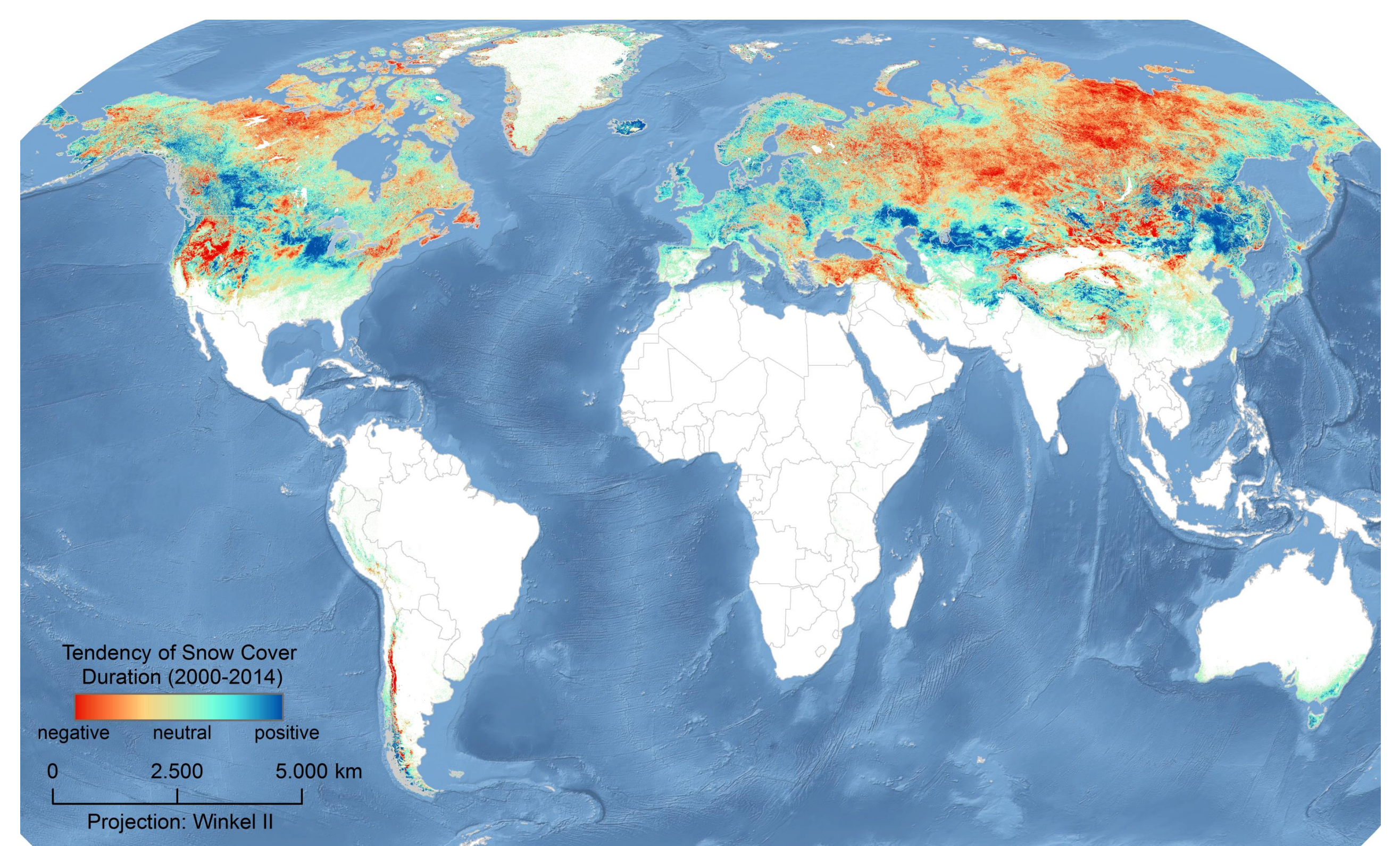


Fig. 4: Tendency of SCD between 2000 and 2014



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