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Spring snowmelt variability in northern Eurasia 2000-2007

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Snowmelt dynamics play an essential role in the hydrological cycle of northern latitudes. Entire northern Eurasia is seasonally covered by snow. It instantaneously impacts not only surface hydrology and the energy budget but also terrestrial biota and thus the carbon cycle. Scatterometer such as SeaWinds Quikscat (Ku-band) are sensitive to changes at snow surfaces due to thaw and provide several measurements per day at high latitudes. Diurnal differences (frozen in the morning, thawed in the evening) are investigated in a range of studies since they indicate exactly when snowmelt is taking place. The actual number of dates of snow thaw is of most interest for glacier mass balance studies but the final disappearance of snow together with the length of spring thaw is required in regions with seasonal snow cover. Clusters of consecutive days of diurnal cycling of freeze/thaw are characteristic for the final snowmelt period in boreal and tundra environments. The start, end and duration of such periods give insight into spring CO2 emissions, vegetation fire prediction and river runoff behaviour. Results of the clustering of diurnal thaw and refreeze days as detected from active microwave satellite data over polar Eurasia is presented in this paper. The aim is the monitoring of spring snowmelt variability for assessment of impact of climate change on hydrology and energy budget.

SeaWinds Quikscat measurements are available since 1999. The first entire snowmelt period on the northern hemisphere is covered in 2000. Large changes in backscatter between morning and evening acquisitions are characteristic for the snowmelt period, when freezing takes place over night and thawing of the surface during the day. A change from volume to surface scattering occurs in case of melting. When significant changes due to freeze/thaw cycling cease, closed snow cover also disappears. The exact day of year of beginning and end of freeze/thaw cycling can be clearly determined with consideration of long-term noise in order to exclude unnatural effects and changes in soil moisture and snow pack characteristics.

The end of snowmelt timing varied by less than a month in most regions during the eight years of data availability (2000-2007). There has been only a difference of up to two weeks in eastern Siberia. Central and western Siberia, especially the European part experienced more variability. This constrains an assessment whether there is a trend of earlier spring or not. A comparison with historical data (before 1980) from interpolated meteorological datasets (IIASA Russia database) showed that earlier snowmelt occurs in regions with the highest variability.