Snow disappearance timing and its relationship with atmospheric conditions in eastern Siberia

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Interannual variation in the melting of seasonal snow cover over the Eurasian Continent strongly affects climate variation via snow-albedo feedbacks and subsequent soil moisture variation. In eastern Siberia, which contains vast areas of permafrost, snow meltwater directly contributes to the runoff of large rivers and evapotranspiration via soil moisture and boreal forest following snow disappearance. Studies of snow-atmosphere interactions tend to focus on regional snow cover disappearance over the central Eurasian Continent, which has a significant negative correlation with the intensity of Indian summer monsoon. However, few studies have investigated snow-climate interactions or snow melting climatology and related physical processes that are affected by atmospheric conditions in the eastern Siberia region.

In the present study we examined the climatological features and interannual variations in snow disappearance within the Lena River Basin, eastern Siberia, during a recent 15-year period (1986-2000), and the relationship of snow disappearance to atmospheric condition. We focused on the eastern Siberia region from longitude 90-160 E and latitude 40-80 N; this region contains the entire area of the Lena River Basin.

According to the climatology of the day of the year on which snow disappears, the boundary of snow disappearance within the Lena River Basin migrates rapidly northward from mid-April until early June, with minimum interannual variation occurring in the middle part of the basin. In addition, the preceding snow disappearance is apparent in the central Lena River Basin. Melting of snow within the Lena River Basin commonly occurs within 30 days of complete snow disappearance, under certain atmospheric conditions: daily mean air temperature in excess of -10 C, greater than 3 hPa of water vapor pressure, and diurnal variation in air temperature weakened.

Composite analysis using a reanalysis dataset demonstrates that the increase in air temperature and water vapor that accompanies snow melting is due to wet and warm air advection by south-westerly in conjunction with enhanced water vapor convergence over the central Lena River Basin during the 30-day period prior to snow disappearance. Corresponding with this timing, the area of high pressure that is part of the Siberian High is rapidly attenuated. In addition, interannual variation in snow disappearance timing in the central Lena river basin shows a strong coincidence with the hemispheric circulation pattern. The winter arctic oscillation is in a positive phase, snow disappears earlier in this area, and vice versa.