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Changes of snow cover characteristics over Eurasia in the context of the ongoing climate changes

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Global changes of the surface air temperature have been well documented for the past 130 years (period of mass instrumental observations). In the past 50 years, global, hemispheric, Arctic, and continental temperatures have been rising {under}decade by decade{/under} and the last decade was the warmest for the past 130 years. Another feature of these changes is a stronger warming in high latitudes than in the tropics, over the continents than over the oceans, and in the cold season than in the warm season. But, in winter the variance of the surface air temperature over Northern Eurasia is about 10 times higher than in summer. This structure of the global warming has led to (a) reduction of meridional surface air temperature gradients, especially in winter, (b) weakening and northward shifts of the major storm tracks, and (c) retreat of the seasonal Arctic sea ice and its transformation from multiannual into a thinner seasonal sea ice cover of lesser concentrations. In the cold season the last feature, like a complete or partial removal of the boiling tea kettle lid, affects heat and water vapor fluxes from the Arctic Ocean into the atmosphere and may generate increases of the frequency of colder anticyclonic weather conditions in the interior of the mid-latitude continents and affect/interact with the seasonal snow cover characteristics, in particular over Eurasia.

Snow cover extent (SCE) over the Northern Hemisphere has not changed substantially in the early winter months and notably decreased in the late spring (especially over Eurasia and Russia). However (probably due to a further sea ice retreat in the Eurasian Sector of the Arctic), in the last two decades late spring SCE over the Russian Federation has stabilized (except the westernmost part of the nation) and several snow cover characteristics have increased. Our analyses show that over most of Russia: duration of the snow cover has decreased while maximum winter snow depth, maximum snow water equivalent, and the number of days with snow depth above 20 cm have increased. At the same time, maximum winter snowpack density has decreased. Thus, in the Russian Federation the tendencies of snow cover changes can be formulated as follows: in the cold season snowpack has become thicker, more porous, and moister but remained on the ground for a shorter period of time.

Associated with snow cover change climatic variables include: (a) the days with thaw defined as the days when the mean daily temperature is above -2 degrees Celsius while snow on the ground is above 5 cm; (b) spring onset characteristics such as the dates of the snowmelt completion, the dates of beginning of the vegetation and no-frost seasons; and(c) duration of the vegetation period. We show that all these characteristics have significantly changed over Belarus, Russia, and Kazakhstan during the post-World War II period.

Keywords: Snow cover, Eurasia, climatic change, snowpack