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Icing events over the Russian territory in changing climate

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Ongoing climate change manifests itself as changes in the most of the climate system parameters. Recent changes in temperature and precipitation regimes and thaw frequency, as well as the summer decrease in ice-covered area in the Arctic Ocean (which gives rise to the formation of the water vapor source for the dry polar atmosphere early in the cold season) affect the atmospheric humidity regime. The humidity regime change at high latitudes in cold seasons can alter the characteristics of icing events. In the high latitudes higher humidity causes higher ice condensation from the air (icing and hoar frost) in the absence of precipitation. Icing conditions, particularly in combination with wind, affect greatly the operation of overhead communication and transmission lines causing serious failures, which results in tremendous economic damage. Aircraft icing in flight is the most dangerous phenomenon that in some instances can cause aircraft crash. Icing formation is dangerous to agriculture and forestry.

Russian meteorological stations perform both visual and instrumental monitoring of icing deposits. Visual monitoring is ocular estimation of the type and intensity of icing and the date of ice appearance and disappearance. Observations are made at an instrument platform and in its visible vicinity. Instrumental monitoring is performed by ice accretion indicator in order to estimate not only the type, intensity and duration of ice deposits, but also their weight and size.

Observations at 958 Russian stations for the period 1977-2012 are used to analyze changes in the ice formation frequency at individual meteorological stations and on the territory of quasi-homogeneous climatic regions in Russia. On the Arctic coast of Russia, this phenomenon is even observed in summer months. In the cold season (November-March), icing events typically occur in the north of European Russia, Siberia and Yakutia. Trends of the number of days with the phenomenon under study are estimated by linear trend coefficient for the period 1977-2012. The analysis is conducted for the seasons of the year. In individual regions of Asian Russia, ice formation increase trends are obtained.

Major icing events characteristics and their changes in the recent decades are considered. Maps (climatology, trends) are presented mostly for visualization purposes. The area-averaging technique using station values converted to anomalies with respect to a common reference period (in this study, from 1977 to 2012). Anomalies were arithmetically averaged first within 1N x 2E grid cells and thereafter by a weighted average value derived over the quasi-homogeneous climatic regions. This approach provides a more uniform spatial field for averaging.