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Extreme winds in the Arctic coast of Russia: genesis, climatology, trends

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A joint analysis of observational data (both surface and upper-air), Arctic System Reanalysis version 2 (ASR2) and Synthetic Aperture Radar (SAR) wind data allowed to thoroughly investigate all the areas in the Russian Arctic where extremely strong winds (with the wind speed greater than 30 m s-1) are observed, as well as to investigate the genesis of these winds.

Special emphasis was made on downslope windstorms, which pose a particular danger, even if the wind does not reach hurricane strength (due to gustiness, potential for vessel icing, clear-air turbulence and sharp temperature fluctuations). In addition to the well-known Novaya Zemlya bora, the Spitsbergen foehn and the windstorm in Pevek (Chukotka), the lesser-known downslope windstorms in Tiksi, on Wrangel Island and on the north-eastern coast of the Gulf of Anadyr were analysed. Statistical estimates of the frequency, duration, wind speed and temperature fluctuations during windstorms, as well as long-term trends from the second half of the 20th century to the present, have been obtained. Noticeably, most of trends in the downslope windstorms characteristics is tied to the period August-October, which indicates the connection of these changes with changes in the Arctic climate system, namely, with the enhanced melting of sea ice during this period.

The ASR2 reanalysis greatly underestimates the frequency of strong winds in the Arctic coast of Russia and maximum wind speed during downslope windstorms, but for areas with a large horizontal scale of mountain ridges (on Svalbard, partly on Novaya Zemlya, in Tiksi and on Wrangel Island) it reproduces 70-80% of episodes of downslope windstorms, and the average wind speed bias is 1-2 m s-1. At the same time, the windstorm in Pevek, as well as the canyon-type winds in Anadyr and in Egvekinot (Kresta Bay, Chukotka Peninsula) are not reproduced by reanalysis. Strong wind climatology in the Russian Arctic is significantly improved in ASR2 reanalysis compared to CFSR reanalysis. The latter reproduces strong winds only in the north of Novaya Zemlya archipelago, while in the ASR2 areas with extreme wind appear in all the seas of the Russian Arctic, which in consistent with observational data.

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