



Identification of tornado tracks in Russian forests based on combining of Meteosat-8 and Sentinel-2 satellite images

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The possibility to obtain a representative data on the frequency of tornadoes in Russia is limited due to the low population density. However, a significant part of the territory in Russia (about 45%) is covered with forest, which makes it possible to successfully use data on tornado-related windthrows to improve tornado climatology.

To obtain more reliable statistics of tornado events, it is also necessary to use weather radar data, such as measurements of Base Reflectivity, Differential Reflectivity, Correlation Coefficient and storm relative velocity. However, in Russia such data are unavailable to the scientific community; moreover, most part of the country is not covered by radar observations. As an alternative to weather radars data, the images from geostationary meteorological satellites can be considered.

We attempted to obtain a satellite-based assessment of the number and spatial distribution of tornadoes in Russia on the example of 2017-2018. At the first stage, the analysis of the synoptic-scale environments (according to the reanalysis) and the mesoscale convective systems (MCSs) tracks from the images of Meteosat-8 images were carried out. According to the HRV and IR10.8 bands, the few types of signatures of potentially mesocyclones with tornadoes in the supercells and MCSs were found. Along of the tracks of these mesocyclones, a detailed analysis of the windthrows was carried out by multi-temporal Sentinel-2 images, Global Forest Change dataset and high-resolution Digital Globe images from Google Earth. Landsat-7/8 satellite images were used to determine the range of dates when the windthrows occurred. Also, the tornado statistics includes information from social networks and media.

In total, more than 100 previously unknown tornadoes were found in Russia for 2017. About 70% of them were identified by Sentinel-2 images, based on an analysis of windthrows. Most of the tornadoes identified by satellite images are F1-F3 intensity. Much of the mesocyclones that generated the tornadoes were detected by characteristic signatures in the HRV and IR108 bands of Meteosat-8.

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