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Climatology of mesoscale convective systems in Russia obtained with convolutional neural networks: first results

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Mesoscale convective systems (MCS) yield hazardous convective weather events such as heavy showers, tornadoes, squalls, hailstorms. In Russia over the past 10 years, passages of MCSs and formation of hazardous convective weather events have led to an economic loss of several tens of billions of rubles and the death of more than 200 people. At the same time, there is a lack of comprehensive climatology of MCSs in Russia.

Here, we present the first results of the project that aimed to obtain the spatiotemporal structure of MCSs in Russia by utilizing satellite data in a model of machine learning. On the first stage, we concentrated on axisymmetrical MCS, primarily on mesoscale convective complexes (MCC) and supercells (SC) over the European part of Russia, Ural, and West Siberia.

We collected several dozens of well-known cases of MCCs and SCs for 2012-2018 years and verified them with radar data. Further, using 15-minutes data from Meteosat, we constructed a dataset with satellite images in various spectral channels for all the cases containing various characteristic signatures of MCS (e.g., overshooting tops, cold-U/V and cold ring signatures).

For automating the data acquisition for MCC and SC climatology, a convolutional neural network (CNN) was trained based on this dataset. Previously, CNN showed its skills in obtaining climatology of polar mesocyclones in the Southern Ocean.

First results of the obtained climatology of axisymmetrical MCS using convolutional neural networks will be presented at the ECSS-2019 conference.

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