Strong squalls in Moscow region in 2017 and 2018

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The results of the analysis of a strong squall with a hurricane wind speed (more than 32 m/s) at 15.39 on May 29, 2017 were presented in [1]. This analysis was based on regular measurements of wind speed using an ultrasonic anemometer (50 Hz) at the Physics Faculty of the Lomonosov Moscow State University (PF MSU) on the Vorob'evy (Leninskie) Gory (55°42'00.28" N, 37°31'45.30" E) at an altitude of 50 m above the surface. Similar measurements were carried out on April 21, 2018, when a hurricane wind speed was also recorded at the time of the strongest squall at 17.04 PM. Here we present the results of the corresponding analysis of sudden changes in wind speed associated with the strong squall in Moscow in April 2018. The predictability of such strong squalls with great destructive power, which are among the most dangerous meteorological phenomena in mid-latitudinal regions, is of particular importance.

Figure 1 shows the variations of the zonal (U) and meridional (V) wind components, as well as the vertical velocity (W) for three hours (15.30-18.30 PM) on 21 April, 2018 by measurements (without filtering) at the PF MSU. The strongest fluctuations were noted during the squall at 17.04 PM for the V-component up to hurricane velocity values (up to 32 m/s and even more). Wavelet analysis reveals cyclic changes in the components of the wind during the analyzed 3-hour time interval - with periods of about 50-60 minutes and with shorter periods.

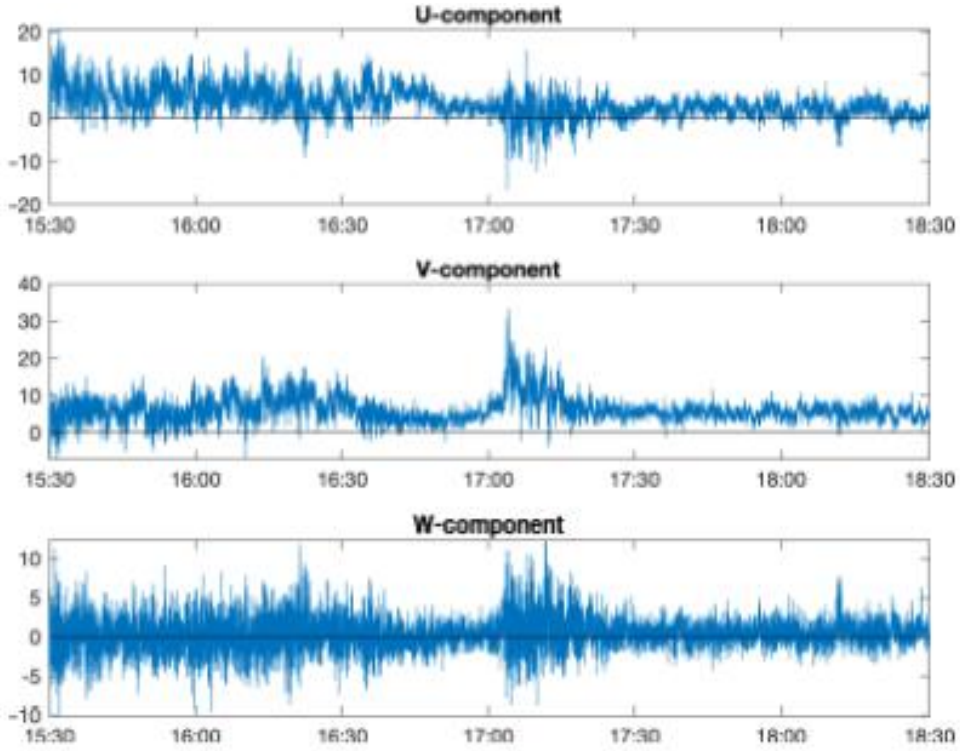

Fig. 1. Variations of the zonal (U) and meridional (V) components of the wind (m/s), as well as the vertical velocity (W) for three hours (15.30-18.30 PM) on 21.04.2018 by measurements at the PF MSU.

Cross-wavelet analysis of the mutual variations of various wind components revealed significant changes during the analyzed 3-hour time interval. Figure 2 shows the local coherence of the U- and V-components for three hours (15.30-18.30 PM) on 21 April, 2018 as measured at the PF MSU. A comparison of two strong squalls in Moscow in 2017 and 2018 revealed some differences. Figure 2 reveals a significant coherence of the U and V variations (with a negative correlation) with periods of about an hour, in contrast to the previous strong squall in Moscow. According to [1], the squall on May 29, 2017 initiated a chain of coherent variations in the U and V components of the wind speed with a positive correlation and with an increase in the characteristic period. This trend was also manifested in association with the squall in 2018, but it is less pronounced.

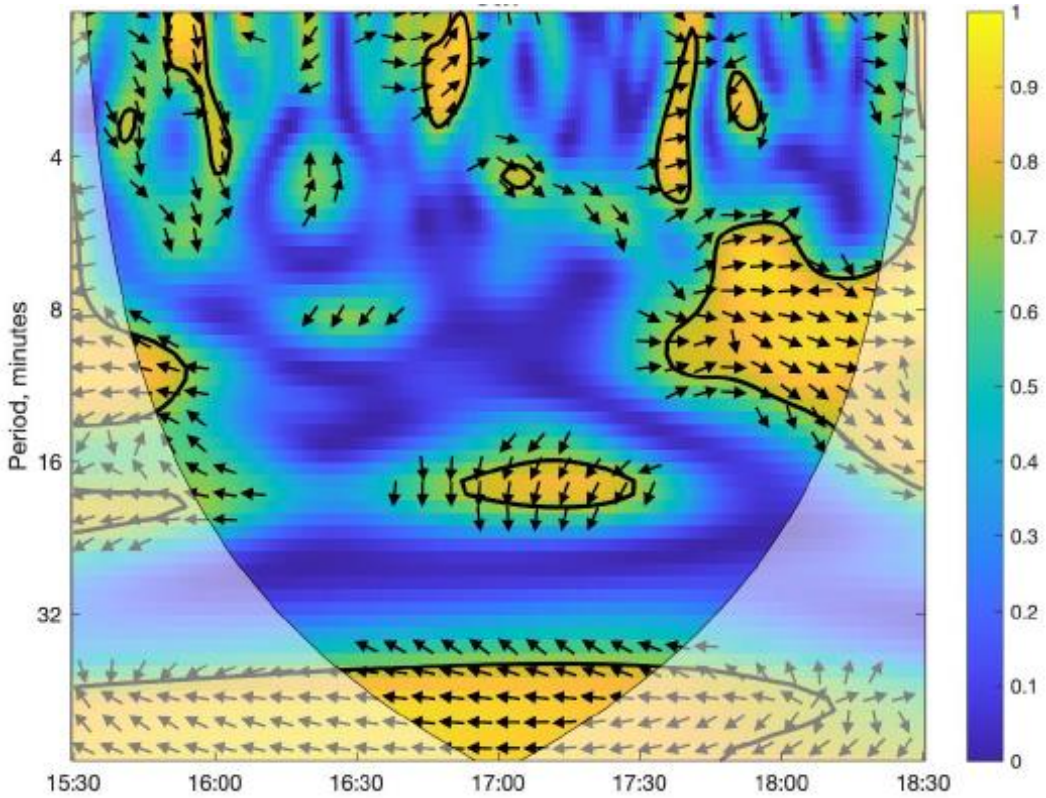

Fig. 2. Local coherence of U- and V-components for three hours (15.30-18.30 PM) on 21.04.2018 by measurements at PF MSU.

The extreme wind in Moscow in April 2018, as in May 2017, was associated with the atmospheric front. The strongest squalls noted in the spring of 2018 and 2017 are very unusual and rare in the Moscow region. The recurrence of such strong squalls within one year may be an indicator of regional weather and climate changes, especially in the spring. Also, the results indicate some predictive opportunities in assessing the risk of extreme squalls.

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References

1. Mokhov I.I., Timazhev A.V., Yushkov V.P. (2018) Squalls with a hurricane wind in Moscow. Research Activities in Atmospheric and Oceanic Modelling. E. Astakhova (ed.). WCRP Rep. No. 15/2018. S. 2. P. 21-22.