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Derecho in Poland on August 11, 2017 – monitoring of the severe weather event using dense network of GNSS receivers

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Global warming affects climate change, which causes more and more frequent occurrences of weather anomalies and severe events. Each of them can cause great damage and be a direct threat to people. One of such phenomena, which can be classified as derecho, occurred on August 11, 2017 in Poland. It was a 300 km length bow echo storm, characterized by gust of about 150 km/h, strong rain and hail drops. Monitoring of such dynamic event using standard synoptic stations is usually insufficient. This results from the low temporal and spatial resolution of performed measurements and availability of only surface parameters. Vertical profiles of meteorological parameters obtained from radio sounding observations are also insufficient for this area, because they are performed only twice a day, and there are only three such stations. Also weather radar measurements are not without flaws. One of the complementary source of tropospheric state can be GNSS receivers included in local/regional permanent networks. Because there are used to support real time positioning, their precise positions together with tropospheric delays, are estimated constantly. Therefore, they can be used to monitoring the troposphere status and hence, extreme weather phenomena.

In this presentation we show the usage of dense network of GNSS receivers to monitoring direction, speed, spatial range, and magnitude of the derecho in Poland on August 11, 2017. For this purpose, we used observation from more than 250 GNSS receivers located in Poland, on the basis of which we estimated tropospheric delays with 5 minutes interval. Calculation were made using precise point positioning (PPP) method with Vienna mapping function 1 (VMF1). Thanks to this, we obtained high spatial and temporal distribution of troposphere state which allowed us to investigate this phenomenon. We compared our results with the high-resolution numerical weather model (WRF) simulation, as well as with microwave radiometer observations. In this study we also show the advantages of using double GNSS stations to monitor severe weather event.