The occurrence of supercell thunderstorms across Poland and their accompanying environments

Thunderstorms are one of the greatest meteorological hazards and every year they affect thousands of people in Poland. It is estimated that losses from these phenomena over Europe and the United States alone exceed $30 billion per year. The strongest but local phenomena are associated with supercell thunderstorms - they are responsible for heavy rainfall, large hail, damaging wind gusts and strong tornadoes. The characteristic feature of the supercell is the deep, persistent rotating updraft and its separation from the downdraft. Formation a supercell requires an unstable air mass allowing the development of convective updrafts, a strong vertical wind shear and an isolated convective mode. In this way, the developing updraft is brought into rotation and the increased airflow allows for adequate separation from the downdraft.

Most of the supercell thunderstorms are observed across the United States, where conditions conducive to their development are by far the most common. For this reason, the country is at the forefront of research on them, and on tornadoes in particular (about 1,200 per year). However, supercells also occur in other parts of the world (especially in temperate climate zone), including Europe. Despite on that, their prediction and detection procedures are primary based on the research results from the United States, and the availability of Doppler radar data (which is not common across Europe). Supercell research in Europe is limited and primarily based on short-time series and case studies. In Poland research publications focusing on supercells are also limited to only a few selected cases.

The project involves the use of remote sensing POLRAD radar data to create a database of likely supercell thunderstorms in Poland over a 15 year period (2007-2021). In addition, hazards accompanying them will be also examined. The European Severe Weather Database (ESWD) will be used for this purpose. The developed supercell database will consist of tabular data and spatial vector data. Finally, data from the ECMWF 5th generation meteorological reanalysis (ERA5) will be used to develop a climatology of atmospheric conditions conducive to the development of supercells in Poland, with particular emphasis on vertical wind profiles (hodographs).

Development of the supercell database will enable preparation of comprehensive climatological characteristics of their occurrence in Poland. This will include the period and frequency of their appearance, duration, hours of development and disappearance, intensity, accompanying phenomena, length and width of the track. Area and periods predisposed to their formation will also be indicated. Supercell database, together with the ERA5 meteorological reanalysis, will also enable the development of conditions for their occurrence. Thus, the project will contribute to the current state of knowledge on the occurrence of supercells severe storms in Poland and supplement the limited European literature on this subject. The results of this research will have a positive impact on improving operational forecasts of severe storms in Poland and better risk management.