

One method for determining the humidity of air in the troposphere is to measure of the depth of liquid water vapor content column (Precipitable Water - PWAT), which determines the thickness of the layer of water in the liquid state throughout the condensation of water vapor present between the substrate and the upper limit of the atmosphere. Because of the residual content of water vapor above the troposphere, the atmospheric layer between the substrate and the target of 300 hPa is assumed as the reliable for calculation of the total PWAT.

Use of PWAT is of great importance in the study of atmospheric processes. However, due to the lack of information on the quality and resolution (8 soundings per day in Poland), PWAT has so far not been taken into account when analyzing the atmospheric processes occurring over the area Poland. In the United States, Japan and several European countries, PWAT is routinely used to optimize forecasts, explaining the course and the occurrence of extreme weather events (eg. intense precipitation, violent storms, super-cell thunderstorms, Mesoscale Convective Systems, tornadoes, hail, downdrafts – squall and downburst).

This project is a proposal to use two new sources of information about the column water vapor content over the territory of Poland, which are characterized by a very high quality and temporal and spatial resolution. The first source is the GNSS signal (Global Navigation Satellite System) with the differential method of calculating the atmospheric propagation delay of the satellite signal, caused by the water vapor content. The second source of information is the WRF (Weather Research and Forecasting) mesoscale numerical model and data from the database ERA-Interim. With a PWAT high temporal and spatial resolution, in this project the following research problems are to be undertaken:

- Integration of PWAT measured from three sources: high-quality balloon-borne sondes, high-resolution GNSS signal and WRF digital mesoscale model.
- Detailed characteristics of PWAT in terms of climatology: transport of water vapor over Poland, average and extreme PWAT values, analysis of daily and seasonal cycles.
- It will be possible to verify a number of hypotheses aimed to describe patterns in the temporal and spatial course of extreme events, with particular emphasis on widespread and torrential rainfall.

The main objective of the project is to demonstrate that high-resolution information about the PWAT in Poland is necessary to describe thoroughly the state of the atmosphere during severe weather events, which will enable us to clarify formation mechanism of such events and to explain with high accuracy their spatial distribution. In the light of the available literature proposed studies are in the global mainstream work on improving the quality of forecasts and explaining the course, intensity and spatial differentiation frequency of extreme events (mainly rainfall). The proposed method in obtaining information about PWAT is to create more and more opportunities due to the rapidly increasing number of operational satellite systems.

Attempts at explaining the origin of the emergence of extreme precipitation in Poland have repeatedly been made in the existing literature, and have tended more towards describing the synoptic conditions. It was pointed out on a number of characteristics of the field barometric and air traffic, but so far, no coherent concept explaining the mechanism for the creation and regularity of the spatial distribution of rainfall extremes, has been created. The initial PWAT is one of driving factors of the thermodynamic aspect associated with the latent heat release during the air ascent - both within convective cells and frontal zones. The amount of heat released in this way has a crucial impact on the extent of vertical ascending motion, the intensity of thunderstorms including the strength of downbursts, squalls and tornadoes as well as the intensity of rain-forming processes, and consequently, the scale of the observed rainfall and hydrological effects like flooding.