

Clouds play a key role in Earth's radiation budget. Aerosols serve as the seeds upon which cloud droplets form. Aerosols alter cloud density, which leads to changes in cloud microphysics and atmospheric stability, which can either suppress or foster the development of precipitation. Measurements of different aerosol and cloud types, properties and mixed-phased clouds are important for a better understanding of cloud processes and parameterization for weather and climate models. Especially important properties like number concentration and size distribution of water droplets and ice particles in mixed phased clouds are needed.

Anthropogenic activity led to a global increase in aerosol particle concentrations, which results in increase of cloud condensation nuclei and ice nucleating particles. The effect of increase of aerosol on cloud optical properties is the most uncertain component of radiative forcing of Earth's climate caused by aerosols. This uncertainty hampers predictions of climate change.

Satellites provide excellent global platform for study of aerosols and clouds, still products derived from air-borne and space-borne platforms have limited resolution. Surface-based remote observations, with better resolution and sensitivity, are vital for studying aerosols and clouds at the process scale. Radars provide information on cloud and precipitation particles and cloud dynamics. Lidars are capable of measuring aerosols and optically thin clouds. Radars are more sensitive to larger particles and can fail to detect clouds composed with particles of a small size. Lidar signal does not penetrate optically thick clouds, due to strong signal attenuation. Combination of lidar-radar measurements provides not only more complete cloud macrophysical properties but also more accurate cloud microphysical properties.

In the frame of this project, simultaneous retrieval of aerosol and cloud properties, types and phase using first ever combined lidar-radar observations in Poland will be preformed.

The results of this research have potential to be regarded as parameter/reference for regional weather forecasting, radiative transfer model and climate modeling.