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Applications with ceilometer with depolarization ratio measurement

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Ceilometers are robust, standalone, and cost-effective lidar-based remote sensing instruments. Conventionally, ceilometers are used in aviation to detect cloud base heights. Ceilometers can also be used for atmospheric profiling, and the applications using profile information are becoming more common, as well as operative networks of profiling instruments. Development of new ceilometers with additional measurement capabilities enables more thorough sensing of the atmosphere, covering a variety of applications. The focus of this presentation is on the different application possibilities that a new lidar ceilometer with a depolarization measurement capability offers.

High-quality attenuated backscatter profiles are used for cloud, boundary-layer, and elevated aerosol-layer profiling. The further addition of the depolarization ratio profiling allows more straightforward and detailed analysis of the current atmospheric conditions. With these measurements, it is not only possible to increase the public safety operationally, but also to investigate atmospheric phenomena in more detail. The newly developed instrument operates with 910.55 nm wavelength and can measure both attenuated backscatter and depolarization ratio.

The differentiation of liquid cloud droplets and ice crystals and the differentiation of rain/drizzle and snowfall is now more accurate and easier with the depolarization measurement. In addition, the detection of the melting layer and potential icing conditions are easier to identify. The structure of the boundary layer and elevated aerosol layers can be monitored in more detail and for example the detection of volcanic ash is a new and potentially very beneficial application with ceilometer with depolarization. The depolarization ratio measurement using a new wavelength can be also used to investigate other different aerosol characteristics and type, and for example to group different pollen types.

In this presentation, we show how different conditions can be distinguished – from hydrometeor and precipitation type analysis to measurement examples of wildfire smoke and dust. Specifically, we will show results of ceilometer measurements in La Palma, Spain, during the volcanic eruption that occurred in the end of 2021. In addition, more accurate identification of potential icing conditions is discussed.