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# Employing a shadowgraph imaging technique for cloud microphysical measurements on a mountain observatory

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Microphysical properties of cloud droplets, such as droplet size distribution and droplet number concentration have been studied after performing a series of field experiments in summer 2019 at Umweltforschungsstation Schneefernerhaus (UFS), an environmental research station located just below the peak of Zugspitze in the German Alps.
“VisiSize D30” manufactured by Oxford Laser Ltd. is a shadowgraph imaging instrument utilized for the first time to measure the size and velocity of cloud droplets during this campaign. It applies a method called “Particle/Droplet Image Analysis” (PDIA) which involves illuminating the region of interest from behind with an infrared pulse laser whilst collecting shadow images of droplets passing through the measurement volume with a high-resolution camera. Droplets detected inside the depth of field are then measured based on their shadow images, and size distribution is built by analyzing a series of images. Furthermore, while turbulent orographic clouds passing our measurement site at UFS observatory during the campaign, a Phase Doppler Interferometer (PDI) device, manufactured by Artium Tech. Inc., was also constantly measuring droplets passing through its probe volume.
Analysis of simultaneously collected data from the two instruments, and applying modifications to the original algorithms illustrate a reasonable agreement regarding the droplet sizing and velocimetry between VisiSize D30 and PDI, at least for diameters larger than 13 µm. Moreover, discrepancies have been observed concerning the droplet number concentration results, especially in smaller sizes. Further investigation by applying appropriate filters on data has allowed the attribution of discrepancies to the different optical performance of the sensors regarding small droplets, and to high turbulent velocity fluctuations relative to the mean flow resulting in an uncertain estimate of the volume of air passing through the PDI probe volume.