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A new approach for the estimation of rain-drop size-distributions using Doppler lidar and cloud radar

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New commercially available scanning lidar and radar systems allow new combined measurement approaches. Due to the different wavelengths, the instruments are sensible to atmospheric scatterers of different sizes. Whereas the radar scatters in the Rayleigh regime, the Mie and for larger particles the optical characterization is applicable to the lidar. We present an idea for an advanced application of these measurement differences.

Using a 2 μm Doppler lidar (Windtracer) and a 35.5 GHz cloud radar (Mira 36-S) vertical-stare measurements during periods of light rain were investigated. The two instruments measured during these events significantly differing fall velocities.

In the lidar Doppler spectrum double peaks occurred and could be identified applying a 2-component Gauss model. The two peaks could be interpreted as synchronously measured air and rain velocity.

Adopting the theories of Rayleigh and optical scattering and an empirical formula for size dependent terminal fall velocity of rain droplets, we developed an approach to estimate rain-drop size spectra from the different velocities obtained by lidar and radar. Comparisons with measured spectra using a distrometer show satisfying results.

Due to the use of remote-sensing instruments, the introduced method provides in comparison to in-situ measurements (e.g. distrometer), the potential to measure size distributions even of rain, that doesn't reach ground.