Geophysical Research Abstracts
Vol. 18, EGU2016-6263, 2016
EGU General Assembly 2016

Exploring microphysical, radiative, dynamic and thermodynamic processes driving fog and low stratus clouds using ground-based Lidar and Radar measurements

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Radiation fog formation is largely influenced by the chemical composition, size and number concentration of cloud condensation nuclei and by heating/cooling and drying/moistening processes in a shallow mixing layer near the surface. Once a fog water layer is formed, its development and dissipation become predominantly controlled by radiative cooling/heating, turbulent mixing, sedimentation and deposition. Key processes occur in the atmospheric surface layer, directly in contact with the soil and vegetation, and throughout the atmospheric column. Recent publications provide detailed descriptions of these processes for idealized cases using very high-resolution models and proper representation of microphysical processes.

Studying these processes in real fog situations require atmospheric profiling capabilities to monitor the temporal evolution of key parameters at several heights (surface, inside the fog, fog top, free troposphere). This could be done with in-situ sensors flown on tethered balloons or drones, during dedicated intensive field campaigns. In addition Backscatter Lidars, Doppler Lidars, Microwave Radiometers and Cloud Doppler Radars can provide more continuous, yet precise monitoring of key parameters throughout the fog life cycle.

The presentation will describe how Backscatter Lidars can be used to study the height and kinetics of aerosol activation into fog droplets. Next we will show the potential of Cloud Doppler Radar measurements to characterize the temporal evolution of droplet size, liquid water content, sedimentation and deposition. Contributions from Doppler Lidars and Microwave Radiometers will be discussed. This presentation will conclude on the potential to use Lidar and Radar remote sensing measurements to support operational fog nowcasting.