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Scanning Mobile Lidar for Aerosol Tracking and Biological Aerosol Identification

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Optical properties of non-biological aerosols containing aromatic hydrocarbons, such as industrial chemicals and engine exhausts, have already been thoroughly studied using remote sensing techniques. However, because of their complex composition and characteristics, the identification of biological aerosols, such as fungi, pollen and bacteria that are present in the environment remains a rather difficult task. The collection of information on both non-biological and biological aerosols is of great importance for understanding their interrelation, physical and chemical properties and their influence on human health and the environment.

Biological and non-biological aerosols can be simultaneously detected, tracked and identified by a scanning mobile Mie-fluorescence lidar. The device developed at the University of Nova Gorica can perform azimuth and zenith angle scans with an angular resolution of 0.1°, as well as operate in both day and night-time conditions. Aerosols of biological origin are identified through the detection of the fluorescence of the amino acid tryptophan which is present in almost all substances of biological origin.

In our system, the transmitter is a solid state Nd:YAG laser which is capable of simultaneous emission of light at a base wavelength of 1064 nm (IR) and its quadrupled wavelength of 266 nm (UV) at a maximum repetition rate of 10 Hz. Tryptophan contained in biological aerosols is excited by the 266 nm laser pulses and the returning fluorescence signals are detected in the spectral band centered at 295 nm. The receiver is a Newtonian telescope which uses a 300 mm parabolic mirror to direct received light into three detection channels – two elastic backscatter channels (IR and UV) and a fluorescence channel.

First experiments show that the detection range of the lidar reaches 10 km in the IR channel and 3 km in the UV channel. Based on the preliminary simulations of the signal-to-noise ratio, the detection range for biological fluorescence signals at 295 nm is estimated to be 2 km. The measurements of the time-series indicate that the mobile lidar is capable of detecting and profiling clouds and aerosols in its detection range. Our future plans include establishing an automated, unattended environmental monitoring system that will allow full time continuous measurements in the desired solid angle around the lidar station.