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Fluorescing aerosol from Siberian forest fires in the lowermost stratosphere

F. Immler and O.Schrems (1)
Alfred Wegener Institute, Bremerhaven, Germany, fimmler@awi-bremerhaven.de

During a measuring campaign in Lindenberg/Germany (14.5° E, 52.5° N), we observed in June 2003 an extended aerosol layer at 13 km altitude in the lowermost stratosphere with a mobile Aerosol Raman Lidar (MARL). The stratospheric layer created an inelastic backscatter signal that we detected with a water vapour Raman channel, but that was not produced by Raman scattering. Also, we find evidence for inelastic scattering by a smoke plume from a forest fire that we observed in the troposphere. We interpret the unexpected properties of these aerosols as fluorescence induced by the laser beam at organic components of the aerosol particles. Fluorescence from ambient aerosol had not yet been considered detectable by lidar systems. However, organic compounds such as polycyclic aromatic hydrocarbons sticking to the aerosol particles, or bioaerosol such as bacteria, spores or pollen fluoresce when excited with UV-radiation in a way that is detectable by our lidar system. Therefore, we conclude that fluorescence from organic material released by biomass burning creates, inelastic backscatter signals that we measured with our instrument and thus demonstrate a new and powerful way to characterize aerosols by a remote sensing technique.

In spring 2003 heavy fires burned around 18 million hectares of boreal forest in Siberia, the smoke plume from these fires travelled eastwards around the globe and was detected in Europe in late May 2003. The stratospheric aerosol layer that we have observed in Lindenberg for three consecutive days is likely to be a remnant from these Siberian forest fire plumes that was lifted across the tropopause.