

Application of the optimal estimation method (OEM) to retrieve relative humidity from Raman Lidar backscatter measurements

Accurate measurements of relative humidity (RH) vertical profiles in the atmosphere is important for understanding the earth's weather and the climate system. RH represent the current state of the water vapor in the atmosphere with respect to the ambient air related to saturation. Even minor changes of the RH in the lower atmosphere has a large impact of the global circulation and cloud formation. Due to its high variability RH measurements in the lower atmosphere is significantly challenging. Raman lidar is one of the potential tools that can provide vertical profiles of RH. Typically, temperature and water vapor mixing ratios need to be estimated separately from the Raman lidar measurements to calculate RH. We have successfully implemented the optimal estimation method (OEM) to retrieve not only vertical profiles of RH but also vertical profiles of temperature, particle extinction and other instrumental parameters from the Raman backscatter measurements obtained by the Raman Lidar for Meteorological Observations (RALMO) located in Payerne, Switzerland. Unlike the traditional method the OEM provides a full uncertainty budget with both random and systematic uncertainties on profile by profile basis. The OEM is also capable of retrieving RH from the Raman lidar measurements in different sky conditions and the OEM retrieved RH agree the radiosonde measured RH within 10-15%.