Geophysical Research Abstracts
Vol. 20, EGU2018-881, 2018
EGU General Assembly 2018

First Steps Towards Retrieving Relative Humidity from Lidar Measurements Using The Optimal Estimation Method (OEM): Lower Atmospheric OEM Temperature Retrievals from Pure Rotational Raman Lidar Measurements.

Shayamila Mahagammulla Gamage (1), Robert Sica (1,2), Alexander Haefele (2,1)

(1) University of Western Ontario, Physics and Astronomy, Canada (smahagam@uwo.ca), (2) Federal Office of Meteorology and Climatology MeteoSwiss, Payerne, Switzerland

Humidity is a key parameter in the description of the physical state of the atmosphere. It plays an important role in life on Earth, planetary radiation balance, cloud formation, weather, atmospheric transport and climate change. Atmospheric humidity distribution is strongly affected by atmospheric dynamics, but it also influences atmospheric circulation and temperature structure due to condensation- evaporation processes. Sica and Haefele (2016) used a first-principle Optimal Estimation Method (OEM) to retrieve water vapor mixing ratio from the measurements of the MeteoSwiss RAman Lidar for Meteorological Observations (RALMO) located in Payerne, Switzerland. Sica and Haefele showed that the OEM had many advantages over the traditional lidar water vapor mixing ratio retrieval method, including allowing a detailed calculation of systematic and random uncertainties, vertical resolution and averaging kernels (weight functions). Here we present a forward model to retrieve temperature, dead time, lidar overlap function, and background simultaneously from the pure rotational Raman (PRR) backscatter lidar measurements from RALMO. The RALMO system is automated and has measurements since 2008 with up-time on the order of 50%. We have been successful in retrieving temperature profiles from the surface to 20 - 25 km using multiple PRR channel measurements with different height ranges. The OEM temperature retrievals we present are consistent with retrievals from the traditional method. The OEM has many advantageous over the traditional Raman lidar temperature retrieval algorithm such as not requiring smoothing, filtering or correction to the raw lidar measurements, determination of the temperature without assuming an analytic form of the lidar calibration function coefficients. OEM also allows us to retrieve multiple parameters along with the temperatures such as the lidar overlap function.

Successful application of the OEM to retrieve lower atmospheric temperatures will be followed by the creation of a temperature climatology to study long-term temperature trends. Also we will then combine the forwards models for the OEM water vapor mixing ratios retrievals with the rotational temperatures forward model to directly determine relative humidity in the troposphere and lower stratosphere.