Geophysical Research Abstracts
Vol. 20, EGU2018-5567, 2018
EGU General Assembly 2018

The effect of aerosol water on particle light scattering at low relative humidity

Elisabeth Andrews (1), Paul Zieger (2), Gloria Titos (3), Maria Burgos (2), and Matthew Salter (2)

(1) CIRES, University of Colorado, Boulder, United States (betsy.andrews@noaa.gov), (2) ACES, Stockholm University, Stockholm, Sweden, (3) University of Granada, Granada, Spain

Atmospheric aerosol particles contribute to radiative forcing by impacting how incoming solar radiation is scattered and absorbed. This influence is determined by the amount, size, shape and composition of the particles. The latter three factors are, in turn, affected by whether there is water associated with the particles. Thus, to truly understand how particles contribute to Earth's radiation budget, the influence of water on the aerosol optical properties needs to be assessed.

Because of the effect of water on aerosol optical properties, WMO/GAW has recommended that measurements of aerosol properties be made at low relative humidity (RH<30-40%; WMO, 2016). The logic for this protocol was that RH<40% was where associated aerosol water was assumed not to matter too much, and thus aerosol optical properties would be comparable across measurement sites. Further, RH<40% was considered a 'do-able' value both in terms of cost and relative ease to achieve. Currently, there are more than 60 surface sites in various international networks (e.g., NOAA's Federated Aerosol Network and ACTRIS) making long-term measurements of in-situ aerosol light scattering using integrating nephelometers. Most of these sites are also in the GAW network and strive to follow the GAW recommendations for aerosol sampling, although some sites are unable to satisfy the RH constraint due to sampling limitations or concerns about driving off volatile aerosol components.

Here, we explore the question of 'what is a valid definition of dry RH' in terms of aerosol scattering coefficient measurements. We statistically investigate the changes in in-situ aerosol scattering coefficient as a function of RH for low RH conditions (i.e. RH<40%) from a group of ∼50 surface sites. We look for patterns in the RH/aerosol scattering relationship as a function of temporal variability and other aerosol properties related to size and composition. We then further relate these field observations of aerosol scattering as a function of RH to laboratory studies of water uptake by sea salt aerosol which have shown that some water uptake can occur even at very low RH conditions (RH<20%).

Understanding what is dry will allow us to better constrain the contribution of water to aerosol radiative forcing. It is also an important aspect for interpreting the scattering enhancement factor which is the ratio of aerosol scattering coefficient at a high RH to scattering at a designated 'dry' RH. Historically, the enhancement factor has often been determined by assuming scattering below 40% RH is representative of dry aerosol. This work will play a key role in our future efforts to evaluate global model simulations of the aerosol scattering enhancement.

WMO/GAW (2016): Aerosol measurement procedures, guidelines and recommendations, Report No. 227, World Meteorological Organization, Geneva, Switzerland.