Geophysical Research Abstracts
Vol. 20, EGU2018-5159, 2018
EGU General Assembly 2018

The Dynamics of Fine Mode Aerosol Optical Properties in South Korea from AERONET and Aircraft Observations with a Focus on Cases with Large Cloud Fraction and/or Fog During KORUS-AQ

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The focus of our investigation is of major fine mode aerosol pollution events in South Korea, particularly when cloud fraction is high. This work includes the analysis of AERONET data utilizing the Spectral Deconvolution Algorithm to enable detection of fine mode aerosol optical depth (AOD) near to clouds. Additionally we analyze the newly developed AERONET Version 3 data sets that have significant changes to cloud screening algorithms. Comparisons of aerosol optical depth are made between AERONET Versions 2 and 3 for both long-term climatology data and for specific 2016 cases, especially in May and June 2016 during the KORUS-AQ field campaign. In general the Version 3 cloud screening allows many more fine mode AOD observations to reach Level 2 when cloud amount is high, as compared to Version 2, thereby enabling more thorough analysis of these types of cases. Particular case studies include May 25-26, 2016 when cloud fraction was very high over much of the peninsula, associated with a frontal passage and advection of pollution from China. This is contrasted with the May 31 case of pollution transport from China with less cloud cover over the sites, yet with likely cloud influence up wind. Another interesting case is June 9, 2016 when there was fog over the West Sea, and this seems to have affected aerosol properties well downwind over the Korean peninsula. We investigate the meteorological factors involved in influencing the aerosol transport to Korea and possible cloud influences on aerosol properties. All of these days had KORUS-AQ research aircraft flights that provided observations of aerosol absorption, particle chemistry, particle size distributions and vertical profiles of extinction. AERONET retrievals and aircraft in situ measurements both showed high single scattering albedo (weak absorption) on these cloudy or cloud influenced days. We also investigate the relationship between aerosol fine mode radius and AOD and the relationship between aerosol single scattering albedo and fine mode particle radius from the AERONET almucantar retrievals for the interval of April through June 2016 for 17 AERONET sites in South Korea. Strongly increasing fine mode radius (leading to greater scattering efficiency) as fine mode AOD increased is one factor contributing to a trend of increasing single scattering albedo as fine AOD increased. Additionally, the new AERONET Hybrid sky radiance scan retrievals that allow for inversions to be made at much smaller solar zenith angles are analyzed and compared to almucantar retrievals.