Probable weather modification of aerosol effect on clouds and precipitation over Korea during the January 2013 severe haze episode

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Aerosols effects on clouds and precipitation are one of the key components of the climate system and hydrological cycle. However, the level of scientific understanding concerning aerosol-cloud-precipitation interactions is still low, because these processes are linked to many factors like cloud regime (Stevens and Feingold, 2009) or meteorological condition (Loeb and Schuster 2008, Su et al., 2010; Kim et al., 2008; 2012), leading to a high process complexity (Andersen and Cermak, 2015).

In January 2013, heavy air pollution was observed over most parts of northern and central China (Tao et al., 2014; Uno et al., 2014). It was also identified in Korea with a time lag of a couple of days (12 January 2013). The episode has synoptic setting such as weak trough at 850hPa moving through the northern Korean peninsula during 11-12 January, leading to the dominant westerly winds over Korea. PM10 mass concentrations increased significantly over Korea since early 12 January with its average value in excess of 200mg/m^3. Interestingly, Korea Meteorological Administration (KMA) forecasted precipitation would end at noon of 12 January, but it lasted until 21 LST. In contrast, there was no precipitation over the southern part of the Korean peninsula.

Based on the above observation, to understand the aerosols effects on clouds and precipitation in Korea, we have analyzed the relationship of PM10 to MODIS cloud properties (Cloud Optical Depth; COD, Cloud effective radius; re, Liquid Water Path; LWP) in terms of north-south gradient. We found the smaller effective radius in the mid-Korean peninsula, with an increase in COD, whereas a larger effective radius and reduced COD shown in the southern-Korean peninsula. It implies the increased aerosol loadings transported from China can modify cloud microphysical properties over middle Korean peninsula. Meteorological environment condition will be also checked out especially including water vapor along with variations in cloud properties. The quantitative evaluations of its modification need more detailed modeling works.

Key words: weather modification, haze, aerosol effect, cloud and precipitation, Korea