Seasonal variations in fluorescence properties of water-soluble organic carbon aerosols

HEEJUN HAN[1]* AND GUEBUEM KIM[1]

[1]School of Earth and Environmental Sciences, Seoul National University, Seoul, Korea (*correspondence: hanheejun@snu.ac.kr)

Atmospheric humic-like substance (HULIS), an index of brown carbon (BrC), is an important fraction of water-soluble organic carbon (WSOC) in aerosols due to its light-absorbing properties and higher abundances in the atmosphere. Although various sources of HULIS have been studied extensively, its removal mechanism such as ultraviolet (UV) or bacterial degradations was poorly constrained. In this study, we evaluated seasonal variations in optical and chemical properties of organic aerosols in order to determine the removal mechanism of light-absorbing organic aerosols in the atmosphere. A one-year observational study was conducted from March 2015 to January 2016 in Seoul, Korea. The collected aerosol samples (n=78) were fully representative of a wide range (>200 km) of geographical region in Korea. The optical property of HULIS was characterized using the fluorescence spectroscopy and parallel factor analysis (PARAFAC). The fluorescence intensity of HULIS decreased by approximately 80%, while the WSOC concentration decreased by approximately 30%, from the cold season (Nov–Jan) to the warm season (Jun–Aug) due to the enhanced UV radiations. This dominant role of photo-induced degradation of HULIS was further confirmed based on a laboratory experiment. Our results suggest that such significant seasonal changes should be considered in global climate modeling, the fate of atmospheric organic matter, and biogeochemical cycles in Earth's surface in the future.