The solar absorptivity of organic carbon and its impact on Asian summer monsoon

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Light absorbing aerosols not only contribute to Earth’s radiative balance but also influence regional climate by cooling the surface and warming the atmosphere. Despite growing evidence of light-absorbing organic aerosols (OAs), their contribution to the Earth’s radiative budget is still poorly understood. In this presentation, we will show an evidence of solar absorption of OA and its impact on Asian summer monsoon. In the first part, we derive an algorithm that empirically determine OA solar absorptivity in terms of single-scattering albedo (SSA) mostly using the ground-based Aerosol Robotic Network (AERONET) observation over biomass burning regions. Our best estimate of OA SSA over the tropical biomass burning regions is 0.91 at 550 nm. The results imply that most aerosol models as well as climate models, which commonly use OA SSA of 0.96–1.0, have so far ignored light absorption by OAs. In the second part, we examine the role of light absorbing properties of OA on Asian summer monsoon rainfall redistribution using observational data and an atmospheric general circulation model (AGCM) experiment. Both observation and the model experiment suggest that the enhanced light absorption by OA in Southeast Asia and Northeast Asia are associated with the advance of the Indian summer monsoon in May and the southward shift of East Asian summer monsoon rainband in June. We further find that the rainfall redistribution of the Indian summer monsoon is induced by a so-called “elevated heat pump (EHP) effect” with formation of a warm-core upper-level anticyclone and surface warming of 1-2°C over the Tibetan Plateau whereas that of the East Asian summer monsoon is formed by stable conditions associated with surface cooling and atmospheric warming around 30°N.

Keywords: Organic aerosol light absorption, light absorbing aerosol, Asian summer monsoon and aerosol interaction

