Trans-Atlantic Transport and Deposition of Dust: A Perspective from CALIPSO Seven Years of Observations

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African dust can transport across the tropical Atlantic and reach the Americas, exerting far-reaching impacts on climate and air quality. The transported dust influences the surface-atmosphere interactions and cloud and precipitation processes through perturbing the surface radiative budget and atmospheric radiative heating and acting as ice nuclei. Dust also influences biogeochemical cycle and climate through providing nutrients vital to the productivity of ocean biomass and Amazon forests. Assessing these impacts relies on an accurate quantification of dust transport and deposition. Currently model simulations show extremely large diversity, which calls for a need of observational constraints. Kaufman *et al*. (2005) estimated from MODIS that about 144 Tg of dust is deposited into the tropical Atlantic and 50 Tg of dust into the Amazon in 2001. However, several studies have argued that the oversimplified characterization of dust vertical profile would have introduced large uncertainties. In this study we assess the trans-Atlantic dust transport and deposition using 7 years (2007-2013) observations from CALIPSO lidar. CALIPSO acquires high-resolution aerosol extinction and depolarization profiles in both cloud-free and above-cloud conditions. The unique CALIPSO capability of profiling aerosols above clouds offers an unprecedented opportunity for examining uncertainties associated with the use of MODIS clear-sky data. Dust is separated from other types of aerosols using the depolarization measurements. We found that on the basis of 7-year average, 118~142 Tg of dust is deposited into the tropical Atlantic and 38~60 Tg of dust into the Amazon basin. Substantial interannual variations are observed during the period. Previous MODIS-based estimate appears to fall within the range of CALIPSO-based estimates; and the difference between MODIS and CALIPSO estimate is largely attributed to the interannual variability, which is corroborated by long-term surface dust concentration observations in the tropical Atlantic. Considering that CALIPSO tends to underestimate the aerosol loading, our flux estimate is likely to represent a low bound for the dust deposition estimate.