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Size-resolved Chemical Composition of Cloud and Rain Water Collected during the Puerto Rico African Dust and Clouds Study (PRADACS) Campaign

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The underlying physico-chemical processes of dust-aerosol interactions are poorly understood; even less understood is how aging impacts cloud properties and climate as the particles travel from Africa to the Caribbean region. Caribbean landmasses have tropical montane cloud forests (TMCFs) that are tightly coupled to the atmospheric hydrologic cycle. Small-scale shifts in temperature and precipitation could have serious ecological consequences. Therefore, this makes TMCFs an interesting ecosystem to see the effects African Dust (AD) might have on cloud formation and precipitation.
The first field measurements of the Puerto Rico African Dust and Clouds Study (PRADACS) were from July 22 to August 12, 2010. Measurements were performed at a TMCF, located at East Peak (EP) station in Luquillo, PR (1051 masl). At EP, two cloud collectors (i.e. single stage (Aluminum version) and 2-stage (Teflon version) Caltech Active Strand Cloudwater Collector (CASCC)), and a rainwater collector were operated. Chemical composition (water-soluble ions and carbonaceous, organic nitrogen and metals) and pH were determined for the cloud water and rainwater samples.
Hybrid Single Particle Lagrangian Integrated Trajectories (HYSPLIT) data and Saharan Air Layer (SAL) images confirmed that we were having frequent inputs from marine aerosols and African Dust. Preliminary results on the meteorological measurements showed a decrease in rainfall during African dust events, lower relative humidity and slightly higher temperatures. For cloud water and rainwater sampling, pH was 5.5 in average, but during dust events pH values were higher due to the presence of cations that form hydroxides in aqueous solution. Conductivity measurements ranged from 20 to 120 μs/cm; being higher on dust events and lower for rain samples. The values of pH and conductivity in the first stage (large droplets of approximately 15 μm are collected) showed a higher content of dust than in the second stage (small droplets of approximately 5 μm). This is consistent with the larger sizes of dust particles as well as their lower hygroscopicity which requires more water to serve as cloud condensation nuclei. The liquid water content values ranged from 0.2 to 0.4 g/m3. High concentrations of NO3-, nss-SO42-, and nss-Ca2+ suggest some anthropogenic influence that possibly came from Africa, or that was obtained during the transport of particles from Africa to the Caribbean region. The Na+ and Cl- concentrations were higher in the 1st stage indicating that it comes mainly from marine origin. Additional results on the chemical composition obtained for clouds, rainwater and aerosols from the summer 2010 test-period campaigns will also be presented together with results from the single-particle analysis from the aerosol time of flight mass spectrometer (ATOFMS).