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Impact of Convective Lifecycles and associated cloud microphysics of deep convections on drought

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Recent droughts over the different parts of the world including the Amazon rainforest and the United States have raised the concern to understand the cloud variability more clearly. Scientist have tried to explain droughts by linking them to teleconnections (Kripalini, 1998; Wolter,1999). However, drought prediction and mitigation is still in a crude shape and need further investigations to understand the other factors that might be important for the occurrences of the drought conditions. One such neglected factor could be the cloud formation and precipitating efficiencies. It is well known that aerosols can suppress the precipitation by changing the cloud microphysics (decreasing the cloud nuclei radius below 14 μ which is the precipitation threshold cloud droplet size) and can cause evaporation of the clouds (Albrecht, 1989).

Over the tropics (the Amazon, the Congo) forest fire and agricultural burning are the most prominent reasons for aerosol formation whereas over the States, the primary sources of aerosols could be the fossil fuel burning and forest fire. This polluted ambient atmosphere can directly affect the naturally occurring cloud formation process as well as they can also change the microphysics of the already formed cloud and reduce precipitation. Hence, apart from the ongoing researches regarding the influence of the global variability like El Niño and Atlantic meridional oscillation (Özger et al, 2012), influence of aerosols on drought could be countless and important.

To identify deep convective clouds and its maturity, we are using geostationary International Satellite Cloud Climatology Project (ISCCP) data. On the other hand, NASA A-Train satellites are gathering many measurements on pollution and different cloud properties. Hence to answer this question, identification of the collocated convection using geostationary satellite and the NASA A-Train satellites are important. After collocating convections, we identify different cloud properties from Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO), CloudSat, Moderate Resolution Imaging Spectroradiometer (MODIS), NASA Goddard Global Modeling and Assimilation Office (GMAO), and ISCCP. To measure pollutants and their properties and concentrations, we use Aerosol index (AI) and 388 nm scene Lambertian reflectivity from Ozone Monitoring Instrument (OMI), AURA Microwave Limb Sounder (MLS), CALIPSO, and MODIS.

Our preliminary analysis shows that interaction between the deep convection and the aerosols depend on the lifecycle of the convections. Convections in their active stages transport aerosols strongly than the decaying stages. Matured stages act in-between. Hence we separate clouds in terms of their maturity and perform analyzing the influence of the aerosols on deep convections. Furthermore, pixels with cloud particle ER less than 14 μ increase with the increase in the polluted ambient AOD pixels. Reduction in the cloud droplet size less than 14 μ inhibits rainfall. This causes more and stronger updraft to go on with increasing the cloud height and formation of more ice. Also, cloud liquid-ice ratio decreases with increase in the ambient AOD with values more than 0.3. Rainfall suppression is confirmed when rainrates measured from TRMM satellite show a decline with increasing ambient AOD and in-cloud ER pixels for active convections.

Keywords: Aerosol, Deep convection, Microphysics