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Statistical analysis on the properties of deep convective clouds under the influence of increased forest fire aerosols in the summer of 2012

Azusa Takeishi and Trude Storelvmo
Yale University, Department of Geology and Geophysics, New Haven, United States (azusa.takeishi@yale.edu)

While the impacts of aerosols on deep convective clouds (DCCs) have been intensely discussed in recent years, the impacts of forest fire aerosols are especially not well understood. Forest fires emit vast amounts of aerosol particles into the atmosphere, episodically in space and time. Especially the year of 2012 observed an unusually high number of forest fires in the U.S. Aerosols emitted from forest fires are often observed to serve as cloud condensation nuclei, but their hydrophobic nature also suggests their high ability as ice nuclei as well. Since some studies show a projected increase in the frequency of forest fires in the future, it is of critical importance to assess how forest fire aerosols may modify the microphysics of DCCs, and in turn, that may lead to changes in dynamical and radiative properties of DCCs.
Our study uses the WRF-CHEM model to investigate the changes in DCC properties in the summer of 2012 due to the increased forest fire aerosols. The horizontal resolution of the simulations is as fine as 4 km, which enables us to run simulations without convective parameterizations. Also, the simulation domain covers the entire continental U.S. for the whole two months of the simulation period in 2012, in order to obtain data from a number of DCCs and statistically analyze the changes in their properties. By comparing simulations with and without the forest fire aerosol input, fire effects on the mass and number of all hydrometeors, vertical velocities, anvil cloud properties, and the amount of precipitation are discussed.