The Accuracy of Retrieved Cloud Properties Impacted by Systematic Error

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For this project I looked at the accuracy of cloud optical property retrievals, focusing on the biases induced by an overlying aerosol layer above the cloud. Solar Spectral Flux Radiometer (SSFR) cloud retrievals are made by comparing measured to modeled cloud albedo (the ratio of upwelling to downwelling irradiance) at wavelengths that avoid main gas absorption bands. The forward modeling takes into account the physics of liquid water absorption to create a look up table of cloud albedo defined by a cloud optical thickness and droplet effective radii pair. However, this forward modeling does not typically consider sources of systematic error, such as aerosols, that can result in differences between measured and modeled albedo and a biased retrieval.

Using a statistical program known as GENRA (Generalized Nonlinear Retrieval Analysis), I was able to characterize the bias induced by an overlying absorbing aerosol layer above the cloud for different cloud types. GENRA is an efficient way of characterizing inverse problems because it simulates the probability that a certain cloud retrieval will be made depending on varying degrees of measured and modeled errors. By studying the systematic model error, defined as the decrease in spectral cloud albedo induced by an overlying absorbing aerosol, I found that clouds of large optical thickness experienced a large, low bias and the cloud droplet effective radii had a large, low bias for clouds of small optical thickness. By continuing to use GENRA many more outside factors that can bias cloud retrievals, such as 3D cloud effects, can be studied and characterized.