



## **Sensitivity of aerosol direct radiative forcing to aerosol vertical profile**

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Aerosol vertical profile significantly affects the aerosol direct radiative forcing at the TOA level. The degree to which the aerosol profile impacts the aerosol forcing depends on many factors such as presence of cloud, surface albedo, and aerosol SSA. Using a radiation model, we show that for absorbing aerosols (with an SSA of 0.7–0.8) whether aerosols are above cloud or below induces at least one order of magnitude larger changes of the aerosol forcing than how aerosols are vertically distributed in clear skies, above cloud or below cloud. To see if this finding also holds for the global average aerosol direct radiative effect, we use realistic AOD distribution by integrating MODIS, MISR and AERONET observations, SSA from AERONET and cloud data from various satellite observations. It is found that whether aerosols are above cloud or below controls about 70–80% of the effect of aerosol vertical profile on the global aerosol radiative effect.