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Employing daily gridded MODIS data to study the impact of morning aerosol to afternoon clouds, precipitation and radiation

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The presentation will examine whether the diagnostic relationships between aerosol and cloud-affected quantities (precipitation, radiation) obtained from sparse temporal resolution measurements from polar orbiting satellites can potentially demonstrate actual aerosol effects on clouds with appropriate analysis. The analysis relies exclusively on gridded (Level-3) daily data and comprises systematic cloud classification in terms of "cloud regimes" (CRs, derived by clustering cloud top pressure – cloud optical thickness joint histograms), aerosol optical depth (AOD) variations relative to a region's local seasonal climatology, and exploitation of the 3-hour difference between Terra (morning) and Aqua (afternoon) overpasses. Specifically, our presentation will assess whether Aerosol-Cloud-Precipitation-Radiation interactions (ACPRI) can be diagnosed by investigating: (a) The dependence on morning AOD percentile of afternoon cloud-affected quantities composited by afternoon or morning CRs; (b) CR transition diagrams composited by morning AOD percentiles; (c) whether clouds represented by ensemble cloud top pressure – cloud optical thickness joint histograms look distinct under low and high AOD conditions when preceded by specific CRs. We will explain how our approach addresses long-standing aspects of the ACPRI problem such as the optimal ways to decompose the problem by cloud class, the prevalence and detectability of 1st/2nd aerosol indirect effects and invigoration, and the effectiveness of aerosol changes in inducing cloud modification at different segments of the AOD distribution.