

**OVERVIEW**

- A Cloud Regime (CR) approach is used to study aerosol-cloud-precipitation relationships.
- 10 years of MODIS Terra-Aqua C5.1 daily joint (2D) histograms of Cloud Top pressure (CTP) vs Cloud Optical Thickness (COT) and Cloud Effective Radius (CER, liquid and ice phase) vs COT are used to derive global CRs using clustering analysis.
- We composite CR properties, namely COT, CTP, Cloud Fraction (CF), and CER, as well as TRMM precipitation.
- The AI (Ångström exponent) parameter from MODIS, thought to correlate better with CCN than AOD, is used to examine relationships between aerosols and clouds.
- The seasonal AI distribution for each 1°x1° gridcell is broken into vigilites (5% increments). *High* and *low* AI are defined as the highest and lowest AI quartile, respectively.
- TRMM Multi satellite Precipitation Analysis TMPA-3B42 rainfall is composited for each CR, and separately for each AI vigilite.

**MAIN FINDINGS**

- We find that ice- and liquid-dominated regimes have different characteristics under high and low aerosol loadings, which are two different types of MODIS cloud regimes.
- There are clear signals of precipitation increase from low to high AI for ice-dominated CRs over land, which is consistent with the hypothesized aerosol-driven convective invigoration. 1st and 2nd aerosol indirect effect appear for liquid dominated CRs.
- We suggest that microCRs may be a better basis for studying cloud-aerosol interactions rather than dynamical CRs.

**The MODIS cloud regimes**

[Dynamical regimes]

[Microphysical regimes]

**Regime changes from low to high AI**

[Dynamical regimes]  
[Microphysical regimes]

**Summary**

This table attempts to summarize our findings. The CRs are separated into those of primarily liquid and primarily ice phase. CR10 (dynamical CRs) and CR8 (microCRs) are listed separately as the contribution of each of the two phases is about the same. The arrow indicates the direction of change (up for increase, down for decrease) when moving to high aerosol (3Q) conditions. Red arrows indicate changes consistent with the invigoration hypothesis, while blue arrows changes consistent with 1st and 2nd indirect effects in liquid clouds. Red arrows indicate either statistically insignificant changes, or results that are inconsistent among the members of the CR group. For CR10 and CR8, we do not attempt to categorize the change, but rather only document its direction (increase for all cloud properties under heavier aerosol loading). We can see that invigoration can be better discerned for ice-dominated CRs over land. 1st and 2nd indirect effects can be seen in liquid CRs.