Session: C33 Poster: W250A

Observational evidence for systematic relationship between convective aggregation and large-scale atmospheric state and climate implications

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In the Tropics, deep convection is characterized by a wide variety of organizations at all scales, ranging from isolated, scattered thunderstorms cells, throughmesoscale convective systems, to large coherent synoptic to planetary convectives envelopes such as Madden Julian Oscillation. To investigate in observations what are the implications of the spatial variability of convection for the mean atmospheric state, a simple convective aggregation index (SCAI) is defined. Applied to CLAUS brightness temperature over tropical oceanic domains of about 1000 by 1000 km, it enables to sort the mean atmospheric states, associated with a given mean convective activity, by the degree of aggregation of convection. The analysis is carried out mainly with long-time series of satellite observations and reanalyses. Systematic relationships between the aggregation state of convection and the large-scale atmospheric state emerge : free tropospheric and convective aggregation are anti-correlated ; the surface fluxes are found highly correlated with convective aggregation ; in addition, the aggregation state of convection strongly affect the cloud cover and so the radiative fluxes. Thus, these findings suggests a potential effect of convective organization on large-scale climate state. Then, examination of the SCAI evolution at different timescales reveals a variability of the aggregation state of convection : at seasonal and interannual scales, SCAI variations are in phase with those of Sea Surface Temperature, humidity and large-scale dynamics, which amplifies the variations of Outgoing Longwave Radiation. At longer timescales, SCAI turns out to exhibit some trends, which are opposite to other variables as SST or dynamics. From these results, some implications for water vapor feedback and climate sensitivity are suggested.