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Investigating the evolution of tropical cirrus clouds from deep convection

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Tropical convective clouds, particularly their large cirrus outflows, play an important role in modulating the energy balance of the Earth's atmosphere. Understanding the evolution of these clouds, and how they change in response to anthropogenic emissions is therefore important to understand past and future climate change. Previous work has focused on tracking individual convective cores and their evolution into anvil cirrus and subsequent thin cirrus clouds in satellite data.

In this work we have introduced a novel approach to investigating the evolution of tropical convective clouds by creating a 'Time Since Convection' (TSC) dataset. Using reanalysis windspeeds, the time since the air at each location last experienced a convective event (as defined by the presence of a deep convective core) is calculated. Used in conjunction with data from the DARDAR and CERES products, we can build a composite picture of the radiative and microphysical properties of the clouds as a function of their time since convection.

As with previous studies, we find that cloud properties are a strong function of time since convection, with decreases in the optical thickness, cloud top height, and cloud fraction over time. These changes in in cloud properties also have a significant radiative impacts, with the longwave and shortwave component of the cloud radiative effect also being a strong function of time since convection. In addition, using the DARDAR product, a combination of CloudSat radar and the CALIPSO lidar measurements, we build composite cross sections of convective clouds, characterising their vertical evolution and how it is influenced by external meteorological and initial conditions flagged in the TSC dataset.