EGU22-8819, updated on 14 Aug 2022
https://doi.org/10.5194/egusphere-egu22-8819
EGU General Assembly 2022

Observed relationships between circulation and cloud feedbacks in the tropics

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Significant challenges in modelling clouds render observational data an important resource for quantifying cloud feedbacks. Here, we use data from satellite and reanalysis products to estimate tropical cloud feedbacks over a wide range of circulation regimes. We use two distinct methods, month-to-month variability and linear multi-decadal trends, to gain insight as to whether short-term feedbacks are representative of feedbacks associated with CO_2-induced warming. We also investigate the extent to which cloud feedbacks are circulation-driven by decomposing the relative contributions of circulation versus thermodynamic changes to the feedbacks in each regime. The influence of thermodynamic processes on cloud feedbacks has been shown to be dominant at large spatial scales in global climate models (Byrne and Schneider, 2018), but it is unclear whether observed feedbacks are consistent with model behaviour. A particular focus of our analysis is the effect of circulation on the tropical anvil cloud area feedback in ascending regions, as this feedback constitutes the largest source of uncertainty in the overall cloud feedback yet is relatively understudied (Sherwood et al. 2020).

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