EGU24-7675, updated on 12 Mar 2024
https://doi.org/10.5194/egusphere-egu24-7675
EGU General Assembly 2024

Growth rate of deep convective system cloud shields: satellite observations and km-scale radiative convective equilibrium simulations

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Deep convection gives rise to large upper level clouds that strongly interact with radiation and are important to the climate energy budget. From an object-oriented perspective, these individual deep cloud systems are characterized by a well depicted cloud shield life cycle, starting with small cloud extents that grow at varying rates before decaying and vanishing. A simple formulation of the growth rate of the cloud shield has been proposed that links together the growth rate on the convective part of the cloud, the mass flux of both the convective and stratiform parts of the cluster and a simple removal sink term (Elsaesser et al., 2022). In this presentation we first show using a suite of satellite observations (infrared from geostationary satellites, GPM radar, etc.) that the functional form of the proposed equation is well suited to quantify the shield growth rate. We then focus on RCE simulations, with deep cloud system objects post processed, to explore the relative role of each term of the growth rate budget. Three different models are used in the same RCEMIP-like configurations. The results show that the budget equation works very well for each model, although the time constants require model-dependent adjustments. We will further show in Vienna the commonalities and the specificities of each model.