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Tropical and subtropical cloud regimes in reanalysis data using an ISCCP simulator

Justin Stachnik[†]; Courtney Schumacher
[†] Texas A&M University, USA
Leading author: stachnik@tamu.edu

Considerable debate remains whether reanalyses can be used to identify long-term dynamical and physical climate trends given the nature of discontinuous data assimilation and the uncertainty associated with analysis fields prior to the epoch of global satellite coverage. Significant variability may also exist among datasets, particularly for those regions constrained by fewer observations (e.g., the tropical Hadley circulation). Whereas radiative feedbacks from simulated clouds often explain much of the sensitivity in global climate models (GCMs), no studies exist that document the variability of simulated cloud types and frequency using reanalyses. This study presents a climatology of simulated cloud regimes derived from multiple next-generation reanalysis datasets (including the CFSR, ERA-Interim, JRA25 and MERRA) using an International Satellite Cloud Climatology Project (ISCCP) simulator. Physically meaningful cloud types from reanalysis data are predicted using a clustering algorithm on joint histograms of simulated cloud-top pressure and optical thickness and verified with those weather states identified in the observed ISCCP dataset. The ability of reanalysis to predict the full range of observed tropical and subtropical clouds is evaluated, with comparisons made to previous simulations using GCM data and climate trends regarding the tropical circulation from reanalysis studies. Composite soundings corresponding to each weather state are also generated for each dataset to better elucidate the causes of mean-state variability in the reanalysis ensemble.