Modern numerical models used in operations and research can achieve resolutions high enough that explicit treatments of the dynamics of some cloud and moisture processes are possible. Models with horizontal grid spacing of order 1 km, so-called convection-permitting models, have been shown to produce realistic representations of many deep convective processes. Nevertheless, uncertainties still remain concerning the treatment of microphysical processes and the influence of model resolution. Thus, continued validation efforts are required that focus on comparing the statistics of modeled and observed convection, which can ultimately be used for further model development and improvements.

Here we describe a powerful method for validating convection-permitting models that determines the statistical properties of the modeled cloud population using an automated and objective convective-cell tracking algorithm, TITAN (Thunderstorm Identification Tracking Analysis and Nowcasting). The approach is demonstrated using simulations of tropical convection that was observed during the Tropical Warm Pool – International Cloud Experiment (TWP-ICE). Specifically, multi-day simulations using the Weather Research and Forecasting (WRF) model are used. The statistics of the modeled cloud properties identified by TITAN are compared to a similar analysis of the radar observations, which illustrates some systematic differences between cloud depth, convective cell size, and system lifetime. The sensitivities of these differences to microphysics and model resolution are also discussed.