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ESTABLISHMENT OF CLOUD REGIMES FOR SYSTEMATIC EVALUATION OF CLOUD MODELING

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ABSTRACT

Distinct cloud regimes can exist locally and globally. Such cloud regimes usually have close association with meteorological conditions, but not necessarily with a one-to-one correspondence. For this reason, the classification of cloud regimes may be based on cloud properties and/or meteorological conditions. This study aims to establish a cloud regime database with robust physical and dynamical consistency for systematic cloud modeling evaluation. A multi-step classification approach has been employed that begins with a top-down approach by classifying cloud measurements at the DOE Atmospheric Radiation Measurement (ARM) Program's Southern Great Plain (SGP) site, using the K-means clustering method and both satellite and ground-based cloud measurements. Three sets of cloud parameters derived from the International Satellite Cloud Climatology Project (ISCCP) D1 product are evaluated for the classification; the set based on equivalent classical cloud morphology is adopted, which gives the best physical and dynamical consistency. The classification is then extended into night time, using the matching ARSCL profiles to provide a continuous classification, which enables the derivation of additional cloud regime properties to depict the cloud life cycle and the transition between cloud regimes. It is also found that cloud regimes under stormy environments may have drastically different dynamical conditions. This poses another challenge for cloud modeling and the multi-step classification approach is particularly helpful in isolating such distinct regimes based on their dynamical properties. A suite of single- column model simulations of the cloud regimes are further analyzed to systematically quantify the models' skills in representing different cloud regimes.