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Evaluation of cloud properties in the NCAR CAM4 and CAM5 using the CFMIP observation simulator package

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Cloud feedback processes are recognized as being the largest source of inter-model differences in climate projections, which motivates a critical evaluation of the representation of clouds properties in current global climate models. Satellite observations provide detailed information about cloud properties with global or near-global coverage. Comparisons between models and observations, however, are challenging due to limitations in the instrument retrievals and the differing spatial (and temporal) scales between models and observations. In order to facilitate comparisons between model and observations, the CFMIP Observation Simulator Package (COSP) has been developed and is now being incorporated into climate models by many modeling centers. We use diagnostics produced by these simulators here to evaluate the representation of clouds in two recent versions of the Community Atmosphere Model (CAM4 and CAM5) developed by the National Center for Atmospheric Research (NCAR). Diagnostics include joint histograms of cloud height or pressure and optical depth from MISR, MODIS, and ISCCP and cloud occurrence statistics from CloudSat and CALIPSO. Our analysis shows that, in general, the changes in cloud parameterizations going from CAM4 to CAM5 significantly improve the representation of clouds in the model. This improvement occurs both in specific cloud types and by regions, as we demonstrate. In this presentation, we pay specific attention to the Southern Ocean. Comparisons of observations of cloud properties and top-of-atmosphere (TOA) radiation budget with current model projections show that the models have large errors in TOA radiation budget, presumably due to errors in cloud properties. Our preliminary analysis of CAM4 and CAM5 indicates that these problems continue to exist with the TOA radiation budget. We will explore the reasons for this differences and how cloud property errors project onto these TOA radiation budget errors. We expect that these diagnostic efforts will point towards required improvements in cloud parameterizations.