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REGIONAL AND SEASONAL VARIATIONS IN MARINE BOUNDARY LAYER CLOUD PROPERTIES FROM MODIS OBSERVATIONS

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ABSTRACT

Marine boundary layer clouds are important to the planetary energy balance because they cover large regions of the oceans and possess an albedo that is considerably larger than the underlying ocean surface. General circulation models (GCMs) typically ignore the horizontal variability of cloud liquid water path within these clouds, and previous studies differ on the importance that this variability has on the solar albedo and, therefore, its possible impact on the simulated climate. We use four full years of cloud data from MODIS for five prominent marine stratus regions to compile statistics of cloud micro- and macro-physical properties. We employ a rigorous, automated quality control procedure that determines the presence of stratus and removes portions of scenes that are affected by sunglint, contain cirrus or frontal clouds, or contain other retrieval errors. We also investigate the possible effects of partially cloudy pixels by compiling statistics both including and excluding cloud edge pixels. We identify more than 31,000 GCM-grid-sized regions for which we define measures of central tendency and variability of important cloud parameters (e.g. optical depth, liquid water path and cloud particle effective radius), and bulk scene properties including the cloud fraction and a measure of mesoscale structure. For each scene with the area of a GCM gridbox, the probability density function of the MODIS pixel-scale optical depths is fit using a gamma distribution. Radiative transfer calculations using DISORT are used to determine the differences in cloud albedo when the variability is treated versus when it is ignored. We find that, when the cloud regions are carefully screened, the effects of the albedo differences are generally small and ignoring the variability in models does not present a large radiative effect.
