



Reproducing observational sampling in climate models for consistency in cloud radiative effect estimates

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The impact of clouds on the earth's radiation budget (the cloud radiative effect CRE) is usually quantified as the difference between fluxes in all skies and those in clear skies. This implies that estimates of CRE depend not only on cloud properties but on the definition of clear skies. But estimates of clear-sky fluxes are derived from observations by identifying cloud-free scenes, while estimates in models are made by removing any clouds from the radiative transfer calculation. To the extent that clouds and water vapor co-vary, model estimates will sample moister conditions than are observed; studies with very high resolution models suggest that this can change the value of CRE by 10%. We describe two methods for sampling climate models to produce clear-sky fluxes more consistent with the way observations are obtained. We demonstrate a simple way to reproduce the dependence of the likelihood of observing clear skies on cloud fraction and a second, somewhat more involved, method for partitioning of humidity in partly cloudy skies. We assess the impacts of both methods using the ECHAM6 climate model.