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Assessment of the Seasonal Variation of Cloud Regimes in CMIP5 AMIP experiments

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We extend the cloud-clustering method of Williams and Webb (2009) to assess climate model performance in terms of the seasonal variation of clouds as well as the annual mean climatology. We applied the method to the tropical region [20S, 20N] in the two models available so far with daily ISCCP simulator data, HadGEM2-A, CNRM-CM5.

We investigate to what extent those regimes which have large climatological cloud radiative effects also tend to have a larger seasonal variation, i.e. the underestimate/overestimate of cloud radiative effects (CRE) of a regime in a model leads to an underestimate/overestimate of the magnitude of its seasonal variation. This is found to be the case for anvil cirrus and shallow cumulus. Both models significantly underestimate anvil cirrus and overestimate shallow cumulus, and this is the main source of the corresponding under- and overestimates of the magnitude of the seasonal variation in CRE.

However, this is not the case for stratocumulus and deep convective clouds. Despite its small magnitude in the climatological mean, stratocumulus has the largest magnitude of seasonal variation in shortwave cloud radiative effect. HadGEM2 reproduces the magnitude of the contribution to CRE from stratocumulus, both the climatological mean and the seasonal variation. CNRM-CM5 also reproduces the magnitude of CRE in the climatological mean, but underestimates the magnitude of the seasonal variation. CNRM-CM5 overestimates the magnitude of the climatological radiative effect of deep convective clouds but the magnitude of seasonal variation is comparable to observations.

We will also examine the ice-free and ice covered extra tropical regions defined by Williams and Webb (2009) and extend the analysis to include interannual variations. Our aim is to develop metrics which capture the important features of the models' cloud variations in the current climate and to assess their relevance to cloud feedbacks and climate change.