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GCM intercomparison of global cloud regimes

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A cloud clustering methodology is applied to six contemporary GCMs in order to provide a detailed intercomparison and evaluation of the simulated cloud regimes. By analysing GCMs in the context of cloud regimes, processes related to particular cloud types are more likely to be evaluated. In this study, the mean properties of the global cloud regimes are evaluated, and the cloud response to climate change is analysed in the cloud-regime framework.

Most of the global-mean cloud response in the GCMs is found to be a result of changes in the cloud radiative properties of the regimes, rather than changes in the relative frequency of occurrence (RFO) of the regimes. Most of the variance in the global cloud response between the GCMs arises from differences in the radiative response of frontal cloud in the extra-tropics and from stratocumulus cloud in the tropics. This variance is largely the result of excessively high RFOs of specific regimes in particular GCMs. It is shown here that evaluation and subsequent improvement in the simulation of the present-day regime properties has the potential to reduce the variance of the global cloud response, and hence climate sensitivity, amongst GCMs. For the ensemble of models considered in this study, the use of observations of the mean present-day cloud regimes suggests a potential reduction in the range of climate sensitivity of almost a third.