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Robust and non-robust behavior of cloud feedback in coupled ocean-atmosphere models

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Uncertainty in cloud feedback is the leading cause of discrepancy in model predictions of climate sensitivity. Progress in reducing this uncertainty requires distinguishing those aspects of cloud feedback which are consistent across models from those aspects which are not. Towards this end we compare the cloud feedback simulated in 16 coupled ocean atmosphere models used for the IPCC Fourth Assessment Report. We find that the effect of cloud changes on the longwave fluxes provides a strong positive feedback that is broadly consistent among these models. In contrast, the effect of cloud changes on the shortwave fluxes ranges from a modest negative feedback to a strong positive feedback and is responsible for most of the intermodel spread in net cloud feedback. When segregated by their vertical distribution, we find the feedback from high clouds to be positive in all models and, over the tropics, similar to that anticipated by the FAT hypothesis. In contrast, we estimate that low cloud cover is responsible for roughly three-quarters of the difference in global mean net cloud feedback among models, with the largest contributions from regions associated with subtropical stratocumulus clouds.