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Cloud cover comparisons between satellite observations and climate models

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This work evaluates the performance in simulating the cloud cover fraction (CF) of 21 climate models, included in the Intergovernmental Panel on Climate Change - 4th Assessment Report (IPCC models), using products from the International Satellite Cloud Climatology Project (ISCCP).
Monthly means of the ISCCP D2 dataset are compared, for the time frame January 1984 - December 1999, that overlaps the 20th century simulations of the IPCC models. Since not all models have a cloud vertical structure with the different cloud types (high, middle and low clouds), only the global and zonal means of total CF is studied. Moreover the average over the time frame of CF with its interannual variability and the amplitude of the seasonal cycle with its interannual variability are presented for the tropical area and mid latitudes.
The global CF analysis shows that the total global mean of the IPCC models, averaged over the time frame, is different from model to model and most models underestimate the ISCCP value.
The zonal analysis shows the largest differences over the poles, in particular the South Pole, where the models and the satellite observations are less reliable. For this reason a detailed analysis is focused over the region 60°S–60°N, analyzing separately the two hemispheres to show the variation of the amplitude of the seasonal cycle. This analysis highlights that models agree more with the satellite observations in the tropical area rather than at mid latitudes. This is an expected result since models are required to perform better in the tropical area, where the largest convective energy production rate occurs.
The study shows the heterogeneous behavior of the climate models considered in simulating the CF over different areas of the Globe: some models agree better with observations in the tropical area, others perform better at mid latitudes. Not a single model agrees with satellite observations on all areas, simulating reasonably well the average over the time frame of CF with its interannual variability and the amplitude of the seasonal cycle with its interannual variability.
The comparison of only a single parameter is merely the first step of our analysis which aims to clarify the accuracy of climate models to simulate clouds. A comparison accounting for the various cloud types and for their integrated water and ice amounts is the next step.