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Assessment of total cloud cover climatologies in the Mediterranean region as obtained from satellite and surface observations, reanalysis, and CMIP5 simulations: a 22-year comparison.

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Clouds are an important regulator of climate due to their influence on the water balance of the atmosphere and their interaction with solar and infrared radiation. At any time, clouds cover a great percentage of the Earth's surface but their distribution is very irregular along time and space, which makes the evaluation of their influence on climate a difficult task. In this study, monthly cloud cover databases provided by different sources have been compared among them for the Mediterranean region, and for the 1984-2005 period. First, global databases built from observational sources have been selected as potential references. Specifically, databases from several satellite projects (ISCCP, CLARA, PATMOS-x), from two reanalyses products (ERA-Interim, NCEP-DOE), and from surface observations (CRU) have been chosen. Equally, additional surface observations directly obtained from different meteorological offices have been used for specific areas. Then, the output of the Coupled Model Intercomparison Project Phase 5 (CMIP5) climate models corresponding to the "historical" scenario has been compared against the references. The study covers a total of 44 model runs, and the performance of cloud cover estimations at seasonal basis has also been studied. To quantify the agreement between the databases we have used the mean bias and the skill score, the latter being based on the probability density functions of the databases. We have also used Taylor diagrams to visualize other statistics. Overall, we find a good agreement between the mean values of cloud cover estimated by ISCCP, CLARA and surface observations, while the reanalysis products show much lower values across the region. Nevertheless, all datasets show a similar behavior regarding the annual cycle of the cloud cover. In addition, our results indicate an underestimation of cloud cover from the climate model simulations as compared to the reference observations. These differences highlight the limitations of most climate models when reproducing the cloud cover in the Mediterranean, in line with previous findings reported in the literature for other regions of the world. As the models that more accurately describe the past behaviour of the analysed variable in the study area are expected to describe the best future projection of this variable, a ranking of models, based on the results of the comparison, is proposed.