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Observing the atmosphere in moisture space

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Processes behind convective aggregation have mostly been analysed and identified on the basis of relatively idealized cloud resolving model studies. Relatively little effort has been spent on using observations to test or quantify the findings coming from the models. In 2010 the Barbados Cloud Observatory (BCO) was established on Barbados, which is on the edge of the ITCZ, in part to test hypotheses such as those emerging form the analysis of cloud resolving models. To better test ideas related to the driving forces of convective aggregation, we analyse BCO measurements to identify the processes changing the moist static energy flux, in moisture space, i.e. as a function of rank column water vapour. Similar approaches are used to analyse cloud resolving models. We composite five years of cloud- and water-vapor profiles, from a cloud radar, and Raman water vapour lidar to construct the structure of the observed atmosphere in moisture space. The data show both agreement and disagreement with the models: radiative transfer calculations of the cross-section reveal a strong anomalous radiative cooling in the boundary layer at the dry end of the moisture space. We show that the radiation, mainly in the long-wave, implies a shallow circulation. This circulation agrees generally with supplementary used reanalysis datasets, but the strength and extent vary more markedly across the analyses. Consistent with the modelling, the implied radiative driven circulation supports the aggregation process by importing net moist static energy into the moist regimes.