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Lifecycle analysis of cumulus clouds using a 3D virtual reality environment

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In this study a new method is developed to investigate the entire lifecycle of shallow cumulus clouds in Large Eddy Simulations. Although trained observers have little problem to distinguish the different lifestages of a cloud, this process proves hard to be automated, since cloud-splitting and cloud-merging events complicate the distinction between a single system divided in several cloudy parts and two independent systems that collided. Since the human perception is well equipped to capture and to make sense of these time-dependent three-dimensional features, a combination of automated constraints and human inspection in a 3D virtual reality environment is used to select clouds that are examplatory in their behaviour throughout their entire lifespan. In this way a rich dataset is obtained in which the time dependent dynamics of cumulus clouds and differences between developing, mature and decaying stages can be examined. The considerable number of selected clouds warrants reliable statistics of cloud properties conditioned on the phase in their lifecycle. Topics that have been analysed this way include e.g. 1) the relative amount of liquid water near the cloud edge, which influences the "sharpness" of the cloud interface, a property that is frequently used in observations as an indication for the stage in the lifecycle, 2) the periodic fluctuations of coherent thermal structures within clouds and 3) the mechanisms behind the onset of the decay phase of clouds.