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Evaluating the feasibility of global climate models to simulate cloud cover effect controlled by Marine Stratocumulus regime transitions

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Marine stratocumulus clouds (MSC) occur in two main cloud regimes of open and closed cells that differ significantly by their cloud cover. Closed cells gradually get cleansed of high CCN concentrations in a process that involves initiation of drizzle that breaks the full cloud cover into open cells. The drizzle creates downdrafts that organize the convection along converging gust fronts, which in turn produce stronger updrafts that can sustain more cloud water that compensates the depletion of the cloud water by the rain. In addition, having stronger updrafts allow the clouds to grow relatively deep before rain starts to deplete its cloud water. Therefore, lower droplet concentrations and stronger rain would lead to lower cloud fraction, but not necessary also to lower liquid water path (LWP). The fundamental relationships between these key variables derived from global climate model (GCM) simulations are analyzed with respect to observations in order to determine whether the GCM parameterizations can represent well the governing physical mechanisms upon MSC regime transitions. The results are used to evaluate the feasibility of GCM's for estimating aerosol cloud-mediated radiative forcing upon MSC regime transitions, which are responsible for the largest aerosol cloud-mediated radiative forcing.