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Land-surface response to shallow cumulus

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Cloud feedbacks in the climate system are a major source of uncertainty in model projections of global warming. Analysis of satellite data and climate models suggests that much of this uncertainty is associated with low clouds. Due to their relatively small size and radiative impact, and their tendency not to produce rain, shallow cumulus clouds have received much less attention than the other cloud forms (\ie stratocumulus, deep precipitating convection, etc). That said, a significant portion of the research has focused on understanding and parameterizing the transport and mixing associated with shallow cumulus and their roots within the subcloud layer. However, even though the impact of cumulus convection on surface fluxes has been shown to significantly affect larger-scale circulations and the skill of medium-range weather forecasts, the coupling between shallow cumulus and the land surface has received very little attention.

Using the Large Eddy Simulation model developed at NCAR and coupled with the NOAH Land Surface Model, the local surface response to shallow cumulus passing overhead is studied. Using a CASES_99 case initial condition and forcing, we investigate the following questions surrounding the coupling between shallow cumulus and the land surface: 1) to what magnitude do shallow cumulus clouds over the continent affect the surface energy balance on average? 2) How does the surface react to locally varying sudden net radiation changes? 3) How do shallow clouds affect the entrainment rate? And, 4) How do shallow cumulus clouds impact measurement interpretation?