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Abstract: **Effect of Gradients in Biomass Burning Aerosol on Shallow Cumulus Convective Circulations**

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This study examines the effect of spatial gradients in biomass burning (BB) aerosol on mesoscale circulations and clouds in the Amazon through high-resolution numerical modeling over areas of 30 km – 60 km. Inhomogeneous horizontal distribution of BB aerosol results in differential surface heat fluxes and radiative heating of the air, which generates circulation patterns that strongly influence cloud formation. The influence on air circulation and cumulus cloud formation depends on the BB aerosol loading, its vertical location, and the width of the plume. Plumes that reside at higher altitudes (~ 1.5 km altitude) produce monotonic responses to aerosol loading whereas the response to plumes close to the surface changes non-monotonically with plume width and aerosol loading. Sensitivity tests highlight the importance of interactive calculations of surface latent and heat fluxes with a coupled land surface model. In the case of the plume residing at higher altitude, failure to use interactive fluxes results in a reversal of the circulation whereas for the plume residing nearer the surface, the interactive surface model weakens the circulation. The influence of the BB aerosol on heating patterns, circulations, and surface fluxes is significant, and of more importance than the BB aerosol-cloud microphysical interactions themselves.