Geophysical Research Abstracts
Vol. 14, EGU2012-13277, 2012
EGU General Assembly 2012

Impacts of deforestation on locally-generated rainfall

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Ensembles of 2D large-eddy model (LEM) simulations were used to determine the impact of different mesoscale deforestation patterns on the amount and location of locally-generated rainfall.

Rainfall was found to be 4-6 times higher over the cropland, particularly when located close to forest, whereas rainfall over the remaning forest was reduced to half or less compared to a run with a homogeneous surface. This was a result of increased warming over the cropland initiating vegetation-breezes (analogous to sea-breezes), which converge over the cropland boundaries. The increased vertical velocities from the convergence, as well as an increase in the convective available potential energy (CAPE) as a result of the advection and vertical mixing of cool air from the forest, produces an increase in the initiation and development of convection over the cropland boundaries, enhancing the rainfall amounts at these locations. The resulting subsidence over the forest acts to suppress clouds, and thus rainfall. These results were consistent for a number of randomly-generated surface flux anomalies.

The suppression of rainfall tended to occur over all the forest, whereas the exact location of the peak in rainfall was less predictable, although it always occurred at the cropland edges. The peak rainfall depended on a combination of the strength of the heat-flux gradient (and thus the vegetation-breeze), the size of the deforested patches (as vegetation-breezes tend to organize in certain preferred length-scales) and the distance from other patches.

The presence of surface heterogeneity also increased total rainfall in the domain by an average of 13%, with higher increases in the presence of more pronounced surface anomalies.