
MMM SEMINAR NCAR

Characteristic Boundary-Layer Scales Defining the Vegetation-Cloud Interaction

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We study the interaction between grass and shallow cumulus cloud formation at diurnal scales. We place special emphasis on quantifying the changes in the characteristic length and time scales associated with thermals, shallow Cu and induced thermal circulation structures. A series of systematic numerical experiments are performed using a large-eddy simulation model coupled to an active vegetation model. We design four different experiments to disentangle the effects of shallow Cu on the surface and the response of clouds to these surface changes. The experiments include a 'clear case', 'transparent clouds', 'shading clouds' and a case with a prescribed uniform domain and reduced surface heat flux. Length and time scales are calculated using autocorrelation and two-dimensional spectral analysis.

We find that, in absence of background wind, shading controls by shallow Cu locally lowers surface temperatures and consequently reduces the sensible and latent heat fluxes, thus inducing spatial and temporal variability in these fluxes. The length scale of this surface heterogeneity is not sufficiently large to generate circulations that are superimposed on the boundary-layer scale, but the heterogeneity does disturb boundary-layer dynamics and generates a flow opposite to the normal thermal circulation. Besides this effect, shallow Cu shading reduces turbulent kinetic energy and lowers the convective velocity scale, thus reducing the mass flux. This hampers the thermal lifetime, resulting in a decrease in the shallow Cu residence time (from 11 to 7 min). This reduction in lifetime, combined with a decrease in mass flux, leads to smaller clouds. This is partially compensated for by a decrease in thermal cell size due to a reduction in turbulent kinetic energy. As a result, inter-cloud distance is reduced, leading to a larger population of smaller clouds, while maintaining cloud cover similar to the non-shading clouds experiment. We finish the presentation with preliminary results of the effect of a background wind in the vegetation-cloud system and an open discussion of how to integrate plant physiologic aspects in atmospheric boundary layer studies.

*This seminar will be webcast live at:
<http://www.fln.ucar.edu/it/mms/fl-live.htm>*

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<https://www.mmm.ucar.edu/events/seminars>*

Thursday, 1 October 2015, 3:30 PM
Refreshments 3:15 PM
NCAR-Foothills Laboratory
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Bldg 2 Main Auditorium, Room 1022

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