Biosphere-Atmosphere Exchange: Turbulence Unlike that over Rough Walls

Edward G. Patton
Project Scientist III
National Center for Atmospheric Research
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Time: 9:00 – 10:00 AM
Location: 22 Deike Building
Coffee and donuts will be provided

Abstract: Forests cover a significant fraction of Earth’s land surface and play a critical role in Earth’s climate through their influence on energy, water, and carbon cycles, as well as through exchanges of reactive species that place stringent controls on the atmosphere’s oxidative capacity [or cleansing ability]. For these reasons, understanding the processes controlling turbulent exchange of energy, momentum, and scalars between the vegetation and the atmosphere has never been more important.

Vegetation canopies produce turbulence that is qualitatively different to that over a rough surface, which ultimately results from canopies absorbing momentum over a distributed height range rather than at the ground surface. Current theory describing canopy exchange largely hinges on the hydrodynamic instability associated with the inflection point in the vertical profile of the horizontal wind at canopy top induced through the canopy’s distributed momentum absorption. Parameterizations built upon this theory are showing great promise in predicting flux–gradient relationships in a canopy’s vicinity. However because the theory relies on the presence of wind speed shear at canopy top, its applicability across the broad stability variation that occurs outdoors remains uncertain.

Utilizing a combination of measurements and models, this talk will: 1) present our current understanding of biosphere-atmosphere exchange, 2) highlight some new insights into atmospheric stability’s role in determining the spatial structure and distribution of motions controlling turbulent transfer at the canopy-atmosphere interface, and 3) discuss implications for parameterization of biosphere-atmosphere exchange in weather and climate models.

Biography: Dr. Edward (Ned) Patton received his Ph.D from the University of California at Davis in 1997. He then took a three-year post-doctoral position at both the University of Minnesota and The Pennsylvania State University. Since finishing his post-doc, he has worked at the National Center for Atmospheric Research where he uses a mix of turbulence-resolving numerical simulations, wind tunnel experiments, and field observations to investigate atmospheric and oceanic boundary layers.