ATS 761: Land-Atmosphere Interaction
Fall 2018

Instructor: Prof. Scott Denning
Meeting times: 9:00 to 9:50 AM, Tuesdays & Thursday, ATS-West 121 (CMMAP)

Catalog Description: Exchange of radiation, energy, water, momentum, and carbon between the vegetated land surface and the atmosphere. Energy & water budgets, turbulent fluxes, eddy covariance, ecosystem physiology, carbon-climate feedback.

Course Description:

The course considers processes and phenomena of the exchanges of radiation, energy, water, momentum, and carbon between the atmosphere, soil, and vegetation, which determine the climate of the land surface and profoundly affect atmospheric energetics and circulation. We'll consider the surface energy balance and the processes that control its partition, and the fate of precipitated water on and in the land surface. Energy transfer by radiation within vegetation canopies will be presented for direct-beam solar fluxes, diffuse light, and thermal radiation. Surface layer turbulence and fluxes will be considered in the context of atmospheric boundary-layer processes. We will visit an eddy covariance field experiment and analyze real data collected there. Plant canopy structure and physiology will be considered from both biological and physical points of view. Ecosystem dynamics including disturbance, succession, and responses to climate change. We'll examine land-surface parameterization in climate models, including seasonal-to-interannual variability and long term coupled climate change.

Student Learning Objectives:

Students will learn about two-way exchanges of energy, water, momentum, and carbon between the atmosphere and the vegetated land surface that constitute much of terrestrial climate.

Instructional Method:

Two meetings per week, consisting of multimedia lectures with occasional "hands-on" demonstration activities. Reading in textbook and primary literature. Discussion and reflection in the classroom. Month long written projects to explore concepts in depth, and a final project consisting of both a term paper and a brief presentation during Finals week.

Grading:

- Homework Projects: 4 @ 20%
- Term paper: 20%

Required Text: *Ecological Climatology: Concepts and Applications,* 3rd Edition, Gordon Bonan. Cambridge University Press.

ATS 761: Land-Atmosphere Interaction
Fall 2018

Outline (30 lectures total):

1. Introduction (1 lecture)
2. Soil processes and soil moisture (2 lectures)
3. Land surface water balance (2 lectures)
4. Surface energy budget (3 lectures)
5. Surface layer turbulence and turbulent fluxes (3 lectures)
6. Canopy radiation and energy fluxes (2 lectures)
7. Photosynthesis (2 lectures)
8. Canopy physiology, micrometeorology, and energy (2 lectures)
9. Terrestrial ecosystems and plant ecology (3 lectures)
10. Vegetation dynamics (2 lectures)
11. Seasonal to interannual variability (2 lectures)
12. Land surface processes in climate models (2 lectures)
13. Coupled climate-vegetation dynamics (2 lectures)
14. Carbon-Climate feedback (2 lectures)
15. Student final presentations (Finals week)