Soil-Plant-Atmosphere Interactions (GEOG 607)

Spring 2018, 4 credits, Friday 2-4:50pm, Condon Hall 207

Instructor: Lucas Silva
Office: 249 Columbia Hall
Office Hours: Wednesdays 3pm - 5pm

Overview: In this graduate seminar we will take an interdisciplinary look at processes that govern carbon, nutrient, and water cycles at the Earth's surface to explore their importance for environmental sustainability. Students will learn about soil-plant-atmosphere (SPA) feedbacks that connect individual organisms to landscapes and the globe, using examples from natural and managed systems to develop their own research questions. Our primary focus will be to understand mechanisms through which terrestrial ecosystems affect and are affected by changes in atmospheric composition and climate. Our secondary focus will be to explore connections between ecosystem transformations and socioeconomic forces that shape the development of human systems. Taken together, the topics covered in this course will provide a comprehensive view of emerging themes of interest to multiple disciplines including environmental and social sciences and the humanities.

Grades: This seminar is a Pass/No-Pass only course. The determination of Pass/No-Pass will be based on two criteria: ***(I) class participation*** – measured in terms of quality of presentations and active engagement with weekly readings and discussion in class; and ***(II) term project*** – research proposal or review paper (10 pages long) developed by individual students or small teams of class members using materials related to those discussed in class. Both criteria must be met with satisfactory effort for a "Pass" in this course.

Note: Late work will not be accepted and make-up work will not be assigned except in extreme circumstances. If you must miss a deadline due to illness or other unavoidable circumstances you must notify the instructor prior to missing if possible.

Required readings: The topics covered in this seminar are complex and span multiple fields of active research. To ensure a common ground for discussion required readings for this course will include selected chapters from two recent textbooks as well as peer-reviewed journal articles. Each week one or more peer-reviewed journal articles will be covered through student-led presentations and discussion. Students will be responsible for searching and selecting recent articles related to the main topic of discussion with help from the instructor (see tentative schedule below). The textbooks are available for copy at 107 Condon Hall:

- ***Ecological Climatology: Concepts and Applications***
  by Gordon Bonan (2015)

- ***Scale: The Universal Laws of Growth, Innovation, Sustainability, and the Pace of Life in Organisms, Cities, Economies, and Companies***
  by Geoffrey West (2017)

Tentative schedule

Date	Topic	Required and suggested readings
6-Apr	Course introduction	No readings
13-Apr	SPA interactions: A link between ecosystem & Earth system science (+ humans)	***Eco Clim Chapter: 1*** ***Suggested articles for discussion*** -Terrestrial biosphere: Modeling at scales from the leaf to the globe https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2001GB001403 -Interactions Between Biosphere, Atmosphere, and Human Land Use in the Amazon Basin: An Introduction https://link.springer.com/chapter/10.1007/978-3-662-49902-3_1 -Projecting regional climate and cropland changes using a linked biogeophysical-socioeconomic modeling framework https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2016MS000712
20-Apr	SPA & ecosystems: key concepts and challenges of thinking systemically	***Eco Clim: Chapter 20*** ***Suggested articles for discussion*** -Why global scenarios need ecology https://www.jstor.org/stable/3868093?seq=1#page_scan_tab_contents -Ecosystem Assembly: A Mission for Terrestrial Earth System Science https://link.springer.com/article/10.1007/s10021-016-0054-3 -Ecological Systems as Complex Systems: Challenges for an Emerging Science http://www.mdpi.com/1424-2818/2/3/395 See also: Eco Clim Chapters 16 & 17
27-Apr	Water stories: SPA-mediated fluxes and their importance across scales	***Eco Clim Chapters: 10 and 11*** ***Suggested articles for discussion*** -Regional climate change caused by pasture and cropland expansion https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2007GL030612 -Transpiration in the global water cycle https://www.sciencedirect.com/science/article/pii/S0168192314000203 -Resolving rapid dynamics of soil–plant–atmosphere interactions https://nph.onlinelibrary.wiley.com/doi/full/10.1111/nph.13936 -SPA conditions regulating cloud formation above southeastern US pine plantations https://onlinelibrary.wiley.com/doi/abs/10.1111/gcb.13221
4-May	Interdependent hydrological - biogeochemical cycles at the SPA interface	***Eco Clim Chapters: 2 and 3*** ***Suggested articles for discussion*** -The increasing importance of atmospheric demand for ecosystem water and carbon fluxes https://www.nature.com/articles/nclimate3114 -Large emissions from floodplain trees close the Amazon methane budget https://www.nature.com/articles/nature24639 -Representation of nitrogen in climate change forecasts https://www.nature.com/articles/nclimate2538 -Inter-annual variability of net and gross ecosystem carbon fluxes: A review https://www.sciencedirect.com/science/article/pii/S0168192317301806 -NASA Reveals How Much Saharan Dust Feeds Amazon's Plants https://www.nasa.gov/content/goddard/nasa-satellite-reveals-how-much-saharan-dust-feeds-amazon-s-plants
11-May	The simplicity unity and complexity of life: scaling rules and SPA function	***Scale: Chapter 3*** ***Suggested articles for discussion*** -Biological stoichiometry of plant production: metabolism, scaling &ecological response to global change. https://nph.onlinelibrary.wiley.com/doi/abs/10.1111/j.1469-8137.2010.03214.x -Universal scaling in tree and vascular plant allometry: toward a general quantitative theory linking plant form and function from cells to ecosystems https://www.ncbi.nlm.nih.gov/pubmed/12414366 -Toward a metabolic theory of ecology https://esajournals.onlinelibrary.wiley.com/doi/abs/10.1890/03-9000 See also: Scale Chapters 2 & 4
18-May	SPA-based ecosystem and Earth system models	***Eco Clim Chapter: 25*** ***Suggested articles for discussion*** -Using ecosystem experiments to improve vegetation models https://www.nature.com/articles/nclimate2621 -Plant functional types in Earth system models: past experiences and future directions for application of dynamic vegetation models https://academic.oup.com/aob/article/114/1/1/225169 -U.S. National Academy of Sciences. Climate modeling 101 http://nas-sites.org/climate-change/climatemodeling/
25-May	SPA from the Anthropocene to the Urbanocene	***Eco Clim Chapter: 2 and Scale Chapter: 5*** ***Suggested articles for discussion*** -Human and biophysical legacies shape contemporary urban forests https://www.sciencedirect.com/science/article/pii/S1618866717307665 -Agriculture is a major source of NO_x pollution in California http://advances.sciencemag.org/content/4/1/eaao3477 -Increasing CO_2 threatens human nutrition https://www.nature.com/articles/nature13179 -The role of trees in urban stormwater management https://www.sciencedirect.com/science/article/pii/S0169204617300464 -Carbon Sequestration by Urban Trees https://link.springer.com/content/pdf/10.1007/978-3-319-50280-9_4.pdf
1-Jun	The vision of a grand unified theory of sustainability	***Scale Chapter: 10*** ***(and citations therein)***
8-Jun	Concluding discussion and course evaluation	Final projects *

***Final projects are due for peer review on Jun 3rd.**