

January, 2016

Advances in Ecological Modeling (BIOE 517) **Plant trait variation and prediction**

(T 14:00-16:00, Th lab 14:00-15:00, 309 Lewis Hall)

Instructor: Dr. Ben Poulter & Dr. Katie Renwick

Office Hours: 9-11 am Thursday, or by appointment, 117 AJM Johnson Hall

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Course D2L Website: papers will be made available on D2L but are also freely available online.

Course Objectives: Plant traits include a wide array of variables that govern growth, resource acquisition, carbon allocation and responses to disturbances such as fire and herbivory. These traits consequently play a key role in shaping biogeographic patterns, biogeochemical processes, and species interactions. The importance of plant traits has led to renewed interest among ecologists in utilizing traits such as specific leaf area, photosynthetic capacity, and structural or biochemical properties to characterizing and modeling plants across scales ranging from individuals to ecosystems.

This seminar course will explore i) the theory for why plants have traits and how these traits are coordinated and optimized across various biomes, ii) dig into existing global databases of plant traits, iii) evaluate how plant traits are being used in what is considered as 'next generation' ecosystem modeling to evaluate past and future climate impacts on ecosystem functioning and structure. This seminar course will be based on foundational and seminal literature on plant traits and students will develop their own plant trait based modeling approach to simulate trait coordination and optimization for biogeographic, biogeochemical or biodiversity purposes. Individual projects using R will be designed to create trait "hypercubes" to test the ideas discussed in class and in the literature.

Textbook: All the readings are from the primary literature – see the last page of this syllabus for the readings of the course.

Course Format: This course is mainly discussion based and there will be an individual project assignment.

Attendance: Your attendance is mandatory – please see me if you will be absent or miss a class to discuss on how to catch up on the topic.

What to expect: This will be a relatively fast paced course that will take students through multiple interdisciplinary plant traits concepts related to ecosystem modeling. Students should be motivated to stay engaged and think critically about the work and especially how it relates to their research interests.

Academic Misconduct: MSU Policy - academic honesty and integrity are fundamental to the mission of higher education. The University has a responsibility to promote academic honesty and integrity and to assure the highest ethical and professional standards and behavior in the classroom. MSU has developed procedures that address instances of academic dishonesty, and students who violate these standards are subject to academic and/or disciplinary sanctions. Sanctions range from a simple verbal reprimand (disrupting class) to separation from the University, and/or withdrawal of an academic degree (cheating/plagiarism).

Special needs: If you have a documented disability for which you are or may be requesting an accommodation(s), you are encouraged to contact me and the Disabled Student Services as soon as possible. I wish to fully include persons with disabilities in this course. It is in your best interest if you

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inform me as soon as possible regarding any special accommodations in the curriculum, instruction, or assessments of this course that may be necessary to enable you to fully participate in this course.

Grading: Participation is 50% of your grade. This includes reading the papers, asking questions, and leading 2 classes during the semester. You will be required to lead the discussion for two classes that will be assigned on the first class. An individual project, building your own trait-based model in R, will be the remaining 50% of the grade.

Advice for presentation of papers: Provide a 5 minute overview for each paper, and highlight the paper's context within the course and previous discussions, and also point out some of the key terminology in the paper. Plan to have approximately 3-5 questions per paper to help stimulate discussion. Feel free to look into papers beyond those assigned to you to help develop a deeper perspective of the issue.

Ideas for class project: Two components 1) selection of traits, (2) the type of filter. Ideas for filter include fire (pyromes), drought, habitat, climate, CO₂, precipitation. Examples include those presented in the Scheiter Pastorel approach.

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CLASS SCHEDULE

Week	Date	Day of Week	Topic	Assignments
1	1/16/16	Thurs	Modeling Introduction: Limitations of the current generation of ecosystem models	(Fisher et al., 2014) (Scheiter et al., 2013)
	1/19/16	Tues	Considerations for the next generation models	(Prentice et al., 2014b) (Harfoot et al., 2014) (Fisher et al., 2015)
2	1/21/16	Thurs	The role of parameters in ecosystem model predictions and uncertainties	(Zaehle et al., 2005) (Wramneby et al., 2008) (Poulter et al., 2010)
	1/26/16	Tues	Plant Trait Theory: Leaf economic spectrum	(Reich et al., 2015) (Reich et al., 1997) (Wright et al., 2004)
3	1/28/16	Thurs	Beyond the leaf economics spectrum	(Westoby and Wright, 2006)
	2/02/16	Tues	Root economics spectrum Review of economics spectrum concept	(Kong et al., 2015)
4	2/04/16	Thurs	Trait coordination	(Lachenbruch and McCulloh, 2014) (Mencuccini et al., 2015)
	2/09/16	Tues	Biogeographic patterns (PETER LEADS)	(Violle et al., 2014) (Angert et al., 2011) (Siefert et al., 2015) (Diaz et al., 2004)
5	2/11/16	Thurs	Scaling Laws and Plant Traits (Online lecture from Santa Fe Institute)	(Enquist et al., In Review) (Michaletz et al., 2014) Chu 2016 GCB (response to Enquist)
	2/16/16	Tues	Disturbance and Competition (KRISTEN LEADS)	(Caplat and Anand, 2009) (Higgins et al., 2012) (Kunstler et al., 2015) (Lavorel and Garnier, 2002)
6	2/18/16	Thurs	Optimality theory (lecture)	(Prentice et al., 2014a) (Lin et al., 2015; Medlyn et al., 2011)
	2/23/16	Tues	Nutrients/Productivity (GILBERT LEADS)	(Ordoñez et al., 2009) (Aerts and Chapin, 2000) (Walker et al., 2014)
7	2/25/16	Thurs	Optimality theory (Ben lecture)	(Prentice et al., 2014a) (Lin et al., 2015; Medlyn et al., 2011)
	3/01/16	Tues	Plant Trait Data Resources: (KATIE LEADS) TRY Database COMPADRE Database BIEN FRED	(Kattge et al., 2011) (Salguero-Gomez, 2015) (Lamanna et al., 2014)
8	3/03/16	Thurs	Class assignment discussion - 5 minute presentations of your class idea	See examples from Caplat and Anand 2009 Schieter et al. 2013
	3/08/16	Tues	Remote sensing of plant traits	(Ustin and Gamon, 2010) (Anderson, 2012) (Asner et al., 2015)

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				(McGill et al., 2006)
9	3/10/16	Thurs	Introduction to R -> distributions and parameter sampling	
	3/15/16	Tues	SPRING BREAK	---
10	3/17/16	Thurs	SPRING BREAK	---
	3/22/16	Tues	Model Parameterization :	(Yang et al., 2015)
11	3/24/16	Thurs	-> Intro to R	
	3/29/16	Tues	Acclimation (Emilie)	(Tjoelker et al., 1999)
12	3/31/16	Thurs	Plant trait based modeling applications: Implementation	(van Bodegom et al., 2014)
	4/05/16	Tues	Amazon forest dynamics (LEO LEADS)	(Fyllas et al., 2014)
13	4/07/16	Thurs	Leaf economics	(Sakschewski et al., 2015) (Reich et al., 2014)
	4/12/16	Tues	Global optimality (OR FIELD TRIP)	(Pavlick et al., 2013)
14	4/16/16	Thurs	Land sink implications	(Verheijen et al., 2015) (Verheijen et al., 2013)
	4/19/16	Tues	Radiation challenges	(Bonan et al., 2011)
15	4/21/16	Thurs	Uncertainties	(Ricciuto et al., 2011)
	4/26/16	Tues	Student Presentations	
16	4/28/16	Thurs	Student Presentations	

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