# BIOL 6301-029

Terrestrial Ecosystem Modeling

Spring 2025

## 1 Course Description

Students in this course will learn the principles of terrestrial ecosystem modeling. This will include the core concepts behind systems thinking and model building. The ultimate goal of the course will be develop a terrestrial ecosystem model, with a focus on carbon and nutrient cycle dynamics. Through course-based model development, students will learn the skills necessary to develop their own model and to understand the workings of models developed by others. The course is primarily for biology graduate students with a background in plant physiological and ecosystem ecology.

### 1.1 Class Time and Location

Tuesdays and Thursdays 12:30-13:50

Science Building Room 204

### 1.2 Instructor

Dr. Nick Smith

Experimental Sciences Building II (ESBII) Room 402D

806-834-7363

nick.smith@ttu.edu

*Meetings by appointment*

### 1.3 rEcommended Texts

Climate Change and Terrestrial Ecosystem Modeling by Bonan `https://doi.org/10.1017/9781107339217`

Principles of Terrestrial Ecosystem Ecology (2nd Edition; 2011) by Chapin, Matson, and Vitousek

The book can be accessed from Springer here: `https://link.springer.com/book/10.1007/978-1-4419-9504-9`. Click on "Access this title on SpringerLink." It can also be accessed through the TTU library.

## 2 Course Materials

All course materials, including lecture slides, readings, activities, and code will be posted to a GitHub repository for the course. The primary repository address is `https://github.com/SmithEcophysLab/ecosys_modeling_sprin2025`. The repository will include the syllabus and all other miscellaneous class materials as the semester progresses. A README file will contain information on the repository, including links to different sections at `https://github.com/SmithEcophysLab/ecosys_modeling_sprin2025/README.md`.

## 3 Learning Objective

This course will broadly focus on understanding the principles underlying the development of process-based terrestrial ecosystem models. An emphasis will

be placed on how to build these models to understand the interactions between terrestrial ecosystems and drivers of global change, including climate change, changes in atmospheric gas concentration, and eutrophication. Course topics will be taught through the lens of classical and more contemporary primary and secondary literature. There will be a strong emphasis on hands-on modeling skill development. Topics will be flexible and modified to match student interests where possible.

# 4 Attendance Policy

Attendance will not be taken, but is strongly recommended. In class activity points will only be granted if students are in class. Makeups will not be granted.

# 5 Course Assessment

## 5.1 *Participation and Engagement*

Being an active and engaged participant in the class will benefit your understanding of material as well as your peers'. Examples include asking questions, providing feedback, and facilitating discussion.

## 5.2 *Quizzes*

Short quizzes will be given periodically to test student knowledge of core concepts and to stimulate discussion. In some cases, quizzes will be developed and administered by class discussion leaders.

## 5.3 *Weekly co-leads*

Throughout the semester, students will be asked to co-lead on the week's discussion topic with Dr. Smith. This will consist of answering class feedback questions from the Reading feedback. It will also consist of leading a 50 minute

discussion of a recent literature article of their choice and answering class questions from the Current literature feedbacks. Students will be evaluated on their ability to respond accurately to their peers' questions as well as their ability to summarize and generate discussion on a recent literature article.

## 5.4 *Model module development*

The primary semester project will be to develop a module for the class terrestrial ecosystem model based on the student's interest. The module will be written in R and must be able to run as a stand-alone module as well as in connection with the larger class model. The student will be required to write a full description of the module to coincide with the code in both README and manuscript style format.

# 6 Grading

Participation and Engagement: 25%

Quizzes: 10%

Weekly co-lead: 25%

Module proposal: 10%

Module presentation: 5%

Final module: 25%

Grades will be made available on Blackboard. All grades posted at the end of the course will be final, unless an error has been made in their calculation. Please contact Dr. Smith if you feel your grade has been calculated incorrectly.

# 7 Grading Scale

A: $\geq$ 90%

B: 80 – 90%

C: 70 – 80%

D: 60 – 70%

F: $\leq$ 59.9%

# 8 Missing In-class Activities

Students will be required to be in class to receive in-class activity points. Please contact Dr. Smith if you plan to miss class for a university function *prior to class*. If class is missed due to an illness, please let Dr. Smith know as soon as possible (see COVID illness based absence policy below).

## 8.1 Illness Based Absence Policy

If at any time during this semester you feel ill, in the interest of your own health and safety as well as the health and safety of your instructors and classmates, you are encouraged not to attend face-to-face class meetings or events. Please review the steps outlined below that you should follow to ensure your absence for illness will be excused. These steps also apply to not participating in synchronous online class meetings if you feel too ill to do so and missing specified assignment due dates in asynchronous online classes because of illness. If you are ill and think the symptoms might be COVID-19-related:

- Call Student Health Services at 806.743.2848 or your health care provider. After hours and on weekends contact TTU COVID-19 Helpline at [TBA].
- Self-report as soon as possible using the Dean of Students COVID-19 webpage. This website has specific directions about how to upload documentation from a medical provider and what will happen if your illness renders you unable to participate in classes for more than one week.
- If your illness is determined to be COVID-19-related, all remaining documentation and communication will be handled through the Office of the Dean of Students, including notification of your instructors of the period of time you may be absent from and may return to classes.
- If your illness is determined not to be COVID-19-related, please follow steps below.

If you are ill and can attribute your symptoms to something other than COVID-19:

- If your illness renders you unable to attend face-to-face classes, participate in synchronous online classes, or miss specified assignment due dates in asynchronous online classes, you are encouraged to visit with either Student Health Services at 806.743.2848 or your health care provider. Note that Student Health Services and your own and other health care providers may arrange virtual visits.
- During the health provider visit, request a “return to school” note;
- E-mail the instructor a picture of that note;
- Return to class by the next class period after the date indicated on your note.

# 9 COVID-19 Statement

The University will continue to monitor CDC, State, and TTU System guidelines concerning COVID-19. Any changes affecting class policies or temporary changes to delivery modality will be in accordance with those guidelines and announced as soon as possible. Students will not be required to purchase specialized technology to support a temporary course modality change, though students are expected to have access to a computer to access course content and course-specific messaging as needed.

If you test positive for COVID-19, report your positive test through TTU's reporting system: `https://www.depts.ttu.edu/communications/emergency/coronavirus/`. Once you report a positive test, the portal will automatically generate a letter that you can distribute to your professors and instructors.

The TTU COVD-19 resource page is here: `https://www.depts.ttu.edu/communications/emergency/coronavirus/`.

# 10 Special Considerations

## 10.1 ADA Statement

Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor's office hours. Please note: instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, please contact Student Disability Services in West Hall or call 806-742-2405.

## 10.2 Religious Holy Days

"Religious holy day" means a holy day observed by a religion whose places of worship are exempt from property taxation under Texas Tax Code §11.20. A student who intends to observe a religious holy day should make that intention

known in writing to the instructor prior to the absence. A student who is absent from classes for the observance of a religious holy day shall be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence. A student who is excused may not be penalized for the absence; however, the instructor may respond appropriately if the student fails to complete the assignment satisfactorily.

# 11 TTU Resources for Discrimination, Harassment, and Sexual Violence

Texas Tech University is committed to providing and strengthening an educational, working, and living environment where students, faculty, staff, and visitors are free from gender and/or sex discrimination of any kind. Sexual assault, discrimination, harassment, and other Title IX violations are not tolerated by the University. Report any incidents to the Office for Student Rights Resolution, (806)-742-SAFE (7233) or file a report online at `titleix.ttu.edu/students`. Faculty and staff members at TTU are committed to connecting you to resources on campus. Some of these available resources are: TTU Student Counseling Center, 806- 742-3674, `https://www.depts.ttu.edu/scc/` (Provides confidential support on campus.) TTU 24-hour Crisis Helpline, 806-742-5555, (Assists students who are experiencing a mental health or interpersonal violence crisis. If you call the helpline, you will speak with a mental health counselor.) Voice of Hope Lubbock Rape Crisis Center, 806-763-7273, `voiceofhopelubbock.org` (24-hour hotline that provides support for survivors of sexual violence.) The Risk, Intervention, Safety and Education (RISE) Office, 806-742-2110, `https://www.depts.ttu.edu/rise/` (Provides a range of resources and support options focused on prevention education and student wellness.) Texas Tech Police Department, 806-742-3931, `http://www.depts.ttu.edu/ttpd/` (To report criminal activity that occurs on or near Texas Tech campus.)

# 12 Student Support Statement

The Office of Campus Access and Engagement works across Texas Tech University to foster, affirm, engage, and strengthen all student communities. For more information about services, opportunities for participation, and ways in

which Texas Tech can support your success in college, please contact (806) 742-7025.

# 13 Classroom Civility

Texas Tech University is a community of faculty, students, and staff that enjoys an expectation of cooperation, professionalism, and civility during the conduct of all forms of university business, including the conduct of student–student and student–faculty interactions in and out of the classroom. Further, the classroom is a setting in which an exchange of ideas and creative thinking should be encouraged and where intellectual growth and development are fostered. Students who disrupt this classroom mission by rude, sarcastic, threatening, abusive or obscene language and/or behavior will be subject to appropriate sanctions according to university policy. Likewise, faculty members are expected to maintain the highest standards of professionalism in all interactions with all constituents of the university (`www.depts.ttu.edu/ethics/matadorchallenge/ethicalprinciples.php`).

# 14 Academic Integrity

Academic integrity is taking responsibility for one's own class and/or course work, being individually accountable, and demonstrating intellectual honesty and ethical behavior. Academic integrity is a personal choice to abide by the standards of intellectual honesty and responsibility. Because education is a shared effort to achieve learning through the exchange of ideas, students, faculty, and staff have the collective responsibility to build mutual trust and respect. Ethical behavior and independent thought are essential for the highest level of academic achievement, which then must be measured. Academic achievement includes scholarship, teaching, and learning, all of which are shared endeavors. Grades are a device used to quantify the successful accumulation of knowledge through learning. Adhering to the standards of academic integrity ensures grades are earned honestly. Academic integrity is the foundation upon which students, faculty, and staff build their educational and professional careers. [Texas Tech University ("University") Quality Enhancement Plan, Academic Integrity Task Force, 2010].

# 15 Plagiarism Statement

Texas Tech University expects students to "understand the principles of academic integrity and abide by them in all class and/or course work at the University" (OP 34.12.5). Plagiarism is a form of academic misconduct that involves (1) the representation of words, ideas, illustrations, structure, computer code, other expression, or media of another as one's own and/or failing to properly cite direct, paraphrased, or summarized materials; or (2) self-plagiarism, which involves the submission of the same academic work more than once without the prior permission of the instructor and/or failure to correctly cite previous work written by the same student. Please review Section B of the TTU Student Handbook for more information related to other forms of academic misconduct, and contact your instructor if you have questions about plagiarism or other academic concerns in your courses. To learn more about the importance of academic integrity and practical tips for avoiding plagiarism, explore the resources provided by the TTU Library and the School of Law.

# 16 Statement about Food Insecurity

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact the Dean of Students for support. Furthermore, please notify the professor if you are comfortable in doing so. The TTU Food Pantry is in Doak Hall room 117. Please visit the website for hours of operation at`https://www.depts.ttu.edu/dos/foodpantry.php`.

# 17 Creating Livable Futures

This class is part of a campus-wide initiative called Creating Livable Futures, which is sponsored in part by the Texas Tech Center for Global Communication. As such, one of our objectives is to prepare you to communicate, in a fully interdisciplinary and global way, the challenges posed by pressing issues that speak to our collective wellbeing and sustainability. You will be asked to translate and communicate the work of leading thinkers on sustainability, and to expand discussing those materials through research experience and experi-

ential learning. These objectives will be met through discussion leads and the review paper.

Your progress in communicating about global issues will be evaluated according to the Center for Global Communication rubric, so you will be invited to participate in one or more Creating Livable Futures activities outside of class that will complement class content. Planned Creating Livable Futures activities include participating in and attending speaker events and conferences, edit-a-thons, blogging and publication opportunities, student organizations, a book club, and even small scholarship opportunities for research.

You'll be informed of relevant opportunities and activities as they arise over the course of the semester.

## Schedule of Topics by Week

01/13/2023 – Systems Thinking

01/20/2023 – Terrestrial Ecosystem C  N cycling

01/27/2023 – NO CLASS

02/03/2023 – Terrestrial Ecosystem Models

02/10/2023 – 3 R's of Terrestrial Ecosystem Modeling

02/17/2023 – Integrating Ecology into Models

02/24/2023 – Eco-evolutionary Optimality Theory

03/03/2023 – Model development: Carbon In

03/10/2023 – Model Development: Plant Carbon Allocation

03/17/2023 – NO CLASS

03/24/2023 – Model Development: Plant Nutrient Demand

03/31/2023 – Model Development: Plant Nutrient Acquisition

04/07/2023 - Model Development: Soil Carbon Cycling

04/14/2023 – Model Development: Soil Nutrient Cycling

04/21/2023 – Model Development: Vegetation Dynamics

04/28/2023 – **Module presentations**

05/06/2023 – **No class Thursday**; **Module presentations**; **Final module due**

## General Weekly Schedule

TBD