SWS 6804 MODELING SOIL, WATER AND ECOSYSTEM PROCESSES

TERM: Summer B

FORMAT: Hybrid or fully online

CREDITS: 3

CLASS TIME FOR ON-CAMPUS STUDENTS: Tuesday/Friday Period 3, 11a to 12:15p

CHAT SESSION FOR ONLINE STUDENTS: Tuesday/Friday 6pm, or as agreed in class

INSTRUCTOR: Stefan Gerber, 3179 McCarty Hall, sgerber@ufl.edu, Phone: 352-294-3174

OFFICE HOURS: Tuesday and Thursday 1-2:30 pm on zoom, other times can be arranged following students' request.

COURSE TA*: NA*

COURSE WEBSITE: http://elearning.ufl.edu

COURSE COMMUNICATIONS: For class-related questions please use discussion board (Weekly Discussion). For private questions use the CANVAS message tool.

PREREQUISITES: None

TEXTBOOK/READING: There is no Textbook. Reading assignments are scientific papers and available on the course website http://elearning.ufl.edu/ or provided via course reserves.

Reading List

El Mezouary, L., and B. El Mansouri. 2021. Groundwater flow equation, overview, derivation, and solution. (B. El Mansouri, A. Moumen, M. El Bouhaddioui, N. Mejjad, I. Elhassnaoui, L. El Mezouary, M. Ben-Daoud, et al., eds.)E3S Web of Conferences 314:04007.

Ellner, S.P, and Guckenheimer, J. An introduction to R for dynamic models in Biology, Lecture Notes, 2009,available online

Menge, D. N. L., S. W. Pacala, and L. O. Hedin. 2009. Emergence and maintenance of nutrient Limitation over multiple timescales in terrestrial ecosystems. The American Naturalist 173:164–175.

Parton, W., W. L. Silver, I. C. Burke, L. Grassens, M. E. Harmon, W. S. Currie, J. Y. King, et al. 2007. Global-scale similarities in nitrogen release patterns during long-term decomposition. Science 315:361–364.

Pianosi, F., K. Beven, J. Freer, J. W. Hall, J. Rougier, D. B. Stephenson, and T. Wagener. 2016. Sensitivity analysis of environmental models: A systematic review with practical workflow. Environmental Modelling & Software 79:214–232.

Runkel, R. L. 1996. Solution of the Advection-Dispersion Equation: Continuous Load of Finite Duration. Journal of Environmental Engineering 122:830–832.

Sihi, D., S. Gerber, P. W. Inglett, and K. S. Inglett. 2016. Comparing models of microbial–substrate interactions and their response to warming. Biogeosciences 13:1733–1752.

Wallis, S. 2007. The numerical solution of the Advection-Dispersion Equation: A review of some basic principles. Acta Geophysica 55:85–94.

MATERIALS AND SUPPLIES FEES: None

COURSE DESCRIPTION: An introduction into predictive modeling of soil, water, and ecosystem processes. Students learn from the ground up how to transform a conceptual model into a mathematical framework that then will be coded up in a simulation model. This hands-on experience serves the students to recognize how data can best serve models and how models can be used to interpret real world data.

COURSE GOALS AND/OR OBJECTIVES: By the end of this course, students will be able to

- Use their understanding of soil, water and ecosystem processes to create a conceptual model and subsequently convert into mathematical equations and numerical code.
- Effectively assess model results and troubleshoot model bugs and crashes.
- Critically evaluate models through exploration, sensitivity analysis and model-data comparison, and by analyzing and testing model code and equations.
- Identify what data is needed to generate and/or improve a dynamic model.

HOW THIS COURSE RELATES TO THE STUDENT LEARNING OUTCOMES IN THE SOIL WATER AND ECOSYSTEM SCIENCES PROGRAM: Dynamic models are increasingly used to interpret empirical data. Illustrative models will serve to as an introduction to basic modeling tenets, such as state/flow relationship, mass/energy balance, stability and attractors, and expected results. This course allows students to 1) conceptualize a research question and explore relationships among measurable variables to develop research hypotheses 2) discuss how data (e. g. students' research data) can specifically be used to develop and improve models 3) discover that building a dynamic model is attainable and can be integrated into a research project even if the focus is on laboratory and field work. Together, these skills form a pillar in the development and application of critical thinking and quantitative science in soil water and ecosystem sciences.

INSTRUCTIONAL METHODS: The course is taught in a hybrid fashion with online lecture videos and meetings with the instructor. Meetings are online chats (online sections) or in-person class meetings. Assignments serve to dive deeper into a subject, rather than testing learned material. Students are encouraged to interact and work together through discussion (online discussion board or in person meeting). The instructor's goal is to create a workshop environment for both online and in-person students.

COURSE SCHEDULE

WEEKLY SCHEDULE OF TOPICS, REEADINGS AND ASSIGNMENTS:

Note: *Readings will be available as pdfs or link to library reserves. Details and deadlines of assignments are available in CANVAS*

Week	Topics	Reading	Assignment
1	Diagramming conceptual models State variables and fluxes Formulate and solve first order differential equations	Menge et al., 2009	Develop conceptual models using insightmaker.com and predict behavior of: a) two pool terrestrial carbon cycle (plants and soil) b) three pool terrestrial nitrogen cycle model (plants, organic and inorganic nitrogen)
2	Introduction into programming using R	R modeling Lab	Complete R scripting exercises in reading assignment and program a litter decomposition model using Euler method in R
3	Resolving models with multiple state variables, Equilibria	Sihi et al., 2016	Transfer models from insightmaker.com (week 1 assignments) into R *Semester project: Conceptual Model*
4	Spatial dimensions, movement of matter and energy	El Mezouary,2021 Runkel, 1996	Model groundwater levels and flow along a continental slope Model dissolved fertilizer movement in soil and plant uptake *Semester Project: Preliminary Model*
5	Reaction/Transport Equation Sensitivity Analysis Off-the-shelf differential equation solver	Wallis,2007 Pianosi et al., 2017	Modeling of toxin advection/dispersion in a slow-moving river *Semester Project: Model tests and early analyses*
6	Concepts of model-data fusion	Parton et al., 2007	Parameter estimation in litter decomposition model developed in week 2 *Semester Project: Final Presentation and Final Report*

Due Dates: Assignments and project milestones are due by Friday of the respective week.

CRITICAL DATES: *Final project paper is due by midnight on the last exam. Project presentations are on the last day of class.*

Disclaimer: This syllabus represents plans and objectives as determined at the beginning of the semester. As we go through the semester, those plans may need to change to enhance the class learning opportunity and to adjust for class need. Such changes, communicated clearly, are not unusual and should be expected.

COURSE POLICIES

ATTENDANCE AND MAKE UP WORK: Requirements for class attendance and make-up exams, assignments and other work are consistent with university policies that can be found at: https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/.

EXAM POLICY: There will be no final exam. Grade will consist of course assignments and semester project.

ASSIGNMENT POLICY: Assignments and semester project milestones are expected to be completed in time and will be graded. Late assignments carry grade reductions, unless it is a University excused absence (see attendance policy above). Late assignments are 30 % reduction in grade, assignments more than 7 days late will not be accepted. Assignments missed for acceptable reasons (University excused absence) can be made up. Time for make-up is the duration of the absence and starts with the first day of the return. Best practice for make-up is to arrange the new deadline with the instructor. Make-up class presentations should be scheduled with the instructor. The content of make-up homework may or may not be different.

GRADING POLICY: Students will be graded based on a) their homework b) their project and c) their engagement during the class.

Homework Assignments (50% towards final grade): There are a total of 8 homework assignments, these are listed in the course schedule and are graded equally (i.e. each contributes 6.25 % towards the final grade).

Semester Project Model Analysis (40 % towards final grade) Students will devise (or adapt) a specific model to analyze data of their choice and with input from the instructor. The project encompasses a series of deliverables:

- Report on the conceptual model and goals for analysis 10%
- Preliminary model analysis (Informal presentation) 10%
- Model technical report (Model documentation) 10%
- Final presentation: Concise summary of findings (Oral presentation) 10%

Class Engagement (10 % towards final grade). The course lives by interactions among students. Students must be active and present during days of oral presentations and contributing the discussion on the CANVAS board. 5 meaningful discussion posts or responses are required per week.

GRADING SCALE: Final grade will result in weighted percentage points from assignments (50 %), semester project (40 %), and overall class engagement (10 %).

Course Percentage	≥95.0	≥90.0	≥85.0	≥80.0	≥75.0	≥70.0	≥65.0	≥60.0	≥55.0	≥50.0	≥45.0	<45.0
Letter Grade	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	E

Information on conversion between letter grade / grade points can be found and the University's grade policy can be found at https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

COURSE TECHNOLOGY: This course is facilitated 100% online through Canvas. You may access Canvas from UF's e-Learning webpage: http://elearning.ufl.edu/. Please contact the UF Help Desk, http://helpdesk.ufl.edu, if you have any technical difficulties with Canvas.

Zoom: The online section will conduct synchronous meetings using ZOOM. ZOOM is integrated into CANVAS. Please follow the 'Zoom Conferences' link on the right-hand side of the course menu. Recordings of the Chat's will also be posted there.

VoiceThread Information: In this course, you will create several narrated presentations. In order to share these presentations with your classmates and instructor, you will utilize VoiceThread. First, you will need to sign in to https://ufl.voicethread.com/ with your Gatorlink username and password. Next, join the VoiceThread Course Group (the link is provided in Canvas). You MUST join the course group! Once you join the group you will receive a confirmation message

R/RSTUDIO. We will use R as a model development environment. R is freely available online. You may download Rstudio from https://posit.co/downloads/. Alternatively, students may access Rstudio through UF Apps (https://info.apps.ufl.edu/).

Electronic Devices: In person students are expected to bring a laptop to class with the software needed to run these applications (web browser, Rstudio). If this is not possible, the instructor will work with the student for solution (tablet, use of classroom PC, computer room usage).

Software Use: All faculty, staff and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against university policies and rules, disciplinary action will be taken as appropriate.

Recording: Our class sessions may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image

recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited. class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. Please share your privacy concerns with your instructor he will take precautions such as not call on you or ask for screen or video camera. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

Use of AI and Generative AI in Assignments and Projects: The ethics for using AI is adapted from Elsevier addressing scientific writing: https://www.elsevier.com/about/policies/publishing-ethics**.** Where students use generative AI and AI-assisted technologies, AI assistance needs to be documented and described. In the process of writing and preparing a presentation, these technologies should only be used to improve readability and language of the work. Applying the technology should be done with human oversight and control and students should carefully review and edit the result, because AI can generate authoritative-sounding output that can be incorrect, incomplete, or biased. Students are ultimately responsible and accountable for the contents of their work. Students should not list AI and AI-assisted technologies as cited references; I maintain that discovery is fundamentally human and must be attributable to human work.

There are exciting possibilities for AI to write code, which is not discouraged in this class. However, students should disclose in their homework and project work the use of AI and AI-assisted technologies, and document and explain how they approached AI support. AI is a new frontier in the classroom. Declaring and describing the use of these technologies supports transparency and trust between students and teacher, will help understanding the value and the limits of AI, both from a teacher and student perspective.

CLASS DEMEANOR OR NETIQUETTE: All members of the class are expected to follow rules of common courtesy in class interactions, email messages, threaded discussions and chats. Please be respectful of other's opinions and avoid rude, insulting or inappropriate comments. Email correspondence should be considered professional communication and be composed accordingly.

ONLINE COURSE EVALUATION PROCESS: Student assessment of instruction is an important part of efforts to improve teaching and learning. At the end of the semester, students are expected to provide feedback on the quality of instruction in this course using a standard set of university and college criteria. Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via

GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at: https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at: https://gatorevals.aa.ufl.edu/public-results/.

UF POLICIES

UNIVERSITY POLICY ON ACCOMMODATING STUDENTS WITH DISABILITIES: The Disability Resource Center coordinates the needed accommodations of students with disabilities. This includes registering disabilities, recommending academic accommodations within the classroom, accessing special adaptive computer equipment, providing interpretation services and mediating faculty-student disability related issues. Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation

0001 Reid Hall, 352-392-8565, https://disability.ufl.edu/.

UNIVERSITY POLICY ON ACADEMIC CONDUCT: As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following pledge: “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.” You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." It is assumed that you will complete all work independently in each course unless the instructor provides explicit permission for you to collaborate on course tasks (e.g. assignments, papers, quizzes, exams). Furthermore, as part of your obligation to uphold the Honor Code, you should report any condition that facilitates academic misconduct to appropriate personnel. It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For more information regarding the Student Honor Code, please see: http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code.

GETTING HELP

TECHNICAL HELP For issues with technical difficulties for Canvas, please contact the UF Help Desk at:

- http://helpdesk.ufl.edu
- (352) 392-HELP (4357)

- Walk-in: HUB 132

Any requests for make-ups due to technical issues MUST be accompanied by the ticket number received from the Help Desk when the problem was reported to them. The ticket number will document the time and date of the problem. You MUST e-mail your instructor within 24 hours of the technical difficulty if you wish to request a make-up.

CAMPUS HELPING RESOURCES Students experiencing crises or personal problems that interfere with their general wellbeing are encouraged to utilize the university's counseling resources. The Counseling & Wellness Center provides confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance.

• University Counseling & Wellness Center, 3190 Radio Road, 352-392-1575, www.counseling.ufl.edu
Counseling Services
Groups and Workshops
Outreach and Consultation
Self-Help LibraryWellness Coaching

• U Matter We Care, http://umatter.ufl.edu/

• Career Connections Center, First Floor JWRU, 392-1601 https:/career.ufl.edu/

• Student Success Initiative, http://studentsuccess.ufl.edu.

STUDENT COMPLAINTS:

• Residential Course: https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/

• Online Course: https://pfs.tnt.aa.ufl.edu/state-authorization-status/#student-complaint