Modeling of Watershed Hydrology and Climate Change (3 Credits) **2022**

SPTPC ECO EVO NATRES ⟶ 11:216:407:01

Class Meets: Wed 10.20AM-11.40AM, Friday 3.50 PM to 5.10PM.

Environmental and Natural Resources (ENR) Building

Office Hours: Th 2-4.30 PM

Class Location: Room 123 ENR Building (Lecture) and Room 237 ENR Building (Lab)

Course Website: Through Rutgers Canvas

Instructor: Subhasis Giri (Subhasis.giri@rutgers.edu),

Objective: This course will introduce students to a physically based spatially distributed watershed scale model known as Soil and Water Assessment Tool (SWAT). Additionally, students will learn SWAT Calibration and Uncertainty Programs (SWAT-CUP) for SWAT model calibration and uncertainty analysis for different water fluxes and water quality parameters. After taking this course, students will understand the movement of water, sediment, and nutrients both in the terrestrial and aquatic systems under current as well as future climate condition. There will be guest lecture from industry to provide a different prospective of watershed modeling. Additionally, this course will consist of both lectures and labs. This course will culminate in a public presentation of term projects of individual groups to audiences including students, staff, and faculties. This course is designed in such a way that it will facilitate students to get jobs in industry, academia, and research institutes after graduation.

Textbook (optional):

- Design of Hydrology and Sedimentology for Small Catchments, C.T. Haan, B.J. Barfield, J.C. Hayes.
- Handbook of Hydrology, David R. Maidment.
- Water Resources Engineering 2009. Ralph A. Wurbs, Wesley P. James.
- There will be reading materials on the course website through Rutgers Canvas platform
- ArcSWAT interface for SWAT. USERS GUIDE. M. Winchell, R.Srinivasan, M. DiLuzio, J. Arnold, 2010.

Course Learning Goals:

- Recognize and understand the basic concepts of different watershed models
- Understand watershed delineation and characteristics as well as structure and function of watershed
- Learn where to download different SWAT model inputs data and process them in ArcGIS platform
- Learn how to download weather data from NOAA and process them in python to make it compatible to SWAT model
- Understand model calibration and uncertainty analysis concept
- Learn how to use SWAT-CUP for SWAT model calibration and uncertainty analysis

- Learn where to download climate data from different Global Climate Models(GCMs), how to perform bias correction, and process data in R in order to make compatible to SWAT model
- Able to demonstrate aforementioned concepts and knowledge to a New Jersey watershed through term projects
- Students will learn how to work in a group, be able to present their works to different audiences, able to learn writing report in scientific language appropriate to field of hydrology.

Lecture Outline

Jan 19	Introduction to Watershed (Lecture)
	Homework 1:
Jan 21	Watershed Hydrology (Lab)
	Homework 2:
Jan 26	Watershed Ecology (Lecture)
	Homework 3:
Jan 28	Watershed Models (Lecture)
	Homework 4:
Feb 2	Erosion and Sediment Yield (Lecture)
	Homework 5:
Feb 4	Water Quality (Guest Lecture from Clemson University) (Lecture)
	Homework 6:
Feb 9	Model Calibration and Uncertainty Analysis (Lecture)
	Homework 7:
Feb 11	Climate Change (Lecture)
	Homework 8:
Feb 16	Introduction to Soil and Water Assessment Tool (SWAT Model) (Lab)
	Homework 9:
Feb 18	Processing DEM/LULC/Soil/Weather data in ArcGIS (Lab)
	Homework 10:
Feb 23	Developing SWAT model for Neshanic Watershed (Watershed Delineation) (Lab)

	Homework 11:
Feb 25	Developing SWAT model for Neshanic Watershed (HRU Analysis) (Lab)
	Homework 12:
Mar 2	Mid Term
Mar 4	Developing SWAT model for Neshanic Watershed (Weather Inputs) (Lab)
	Homework 13:
Mar 9	Developing SWAT model for Neshanic Watershed (Model Simulation) (Lab)
	Homework 14:
Mar 11	Developing SWAT model for Neshanic Watershed (Calibration/Validation) (Lab)
Mar 16	Spring Recess
Mar 18	Spring Recess
	Homework 15:
Mar 23	Developing SWAT model for Neshanic Watershed (Calibration/Validation) (Lab)
	Homework 16:
Mar 25	Developing SWAT model for Neshanic Watershed (Downloading Climate data) (Lab)
	Homework 17:
Mar 30	Developing SWAT model for Neshanic Watershed (Processing Climate Data & Analysis) (Lab)
	Homework 18:
Apr 1	Term Project (Students will be divided into groups and will work towards their final project) (Lab)
Apr 6	Term Project (Students will be divided into groups and will work towards their final project) (Lab)
Apr 8	Term Project (Students will be divided into groups and will work towards their final project) (Lab)

Apr 13	Term Project (Students will be divided into groups and will work towards their final project) (Lab)
Apr 15	Term Project (Students will be divided into groups and will work towards their final project) (Lab)
Apr 20	Term Project (Students will be divided into groups and will work towards their final project) (Lab)
Apr 22	Term Project (Students will be divided into groups and will work towards their final project) (Lab)
Apr 27	Final Presentation (Lecture)
Apr 29	Final Presentation (Lecture)
May 6	Final Report due on Canvas11:59 PM

Prerequisite: Students should have working knowledge in GIS in order to enroll in this course.

Coursework Expectation: This course consists of both lecture and hands-on labs. Students will be provided background information on watershed, hydrology, water quality, climate change, and computer modeling in the beginning of this course. Reading materials will be posted in the class website through canvass platform and students are encouraged to go through the reading material before the class. After learning the background information, students will be working on the SWAT model in the lab in a step- by -step manner which will enable them to understand the building of a hydrological model through examples of watersheds in New Jersey. During the last part of this course, students will be divided into groups and they will work towards a real world projects in the lab. Finally, students will present this term project and submit the project report. During the lecture part of this course, there will be quizzes in the beginning of the class. Homeworks are prepared to supplement the students regarding different topical areas provided in the lecture. Students are expected to submit homeworks before deadline. Late submission of homeworks will be resulted into deduction of points. There will be one mid-term exam and the questions will be asked from materials covered in the lecture and the labs. The final exam for this course is replaced by Term Projects and students are expected to complete their projects by the deadline. Students are encouraged to ask questions regarding lecture or lab.

Grading:

- Quizzes 10%
- Homework 20%
- Class Participation 10%
- Midterm Exam 20%
- Term Project 40%

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Total	100%

Numerical Ranges for Grades:

A:	90-100%		
B:	80-85%	B^+:	86-89%
C	70-75%	C^+:	76-79%
D	60-69%		
F	Under 60%		

Attendance Policy: Students are required to attend all the classes. However, if there is a genuine reason for absence such as illness, family emergency, participation in extracurricular activities and others. Please, convey it to your instructor through email after coming to campus ASAP. Unexcused absences will be resulted into 5% reduction of your final grade.

Academic Integrity Policy: Students should avoid cheating, fabrication, facilitation of dishonesty, plagiarism, and academic sabotage. In this Watershed Modeling course, students can discuss with their friends regarding a problem they face while solving homework. However, please do not just copy and paste others works in your homework or lab work from others. As the goal is to develop your own problem-solving skills and confidence building through this course, therefore, students should follow University Policy on Academic Integrity and uphold the ethical standard and professional code of conduct. Students are encouraged to look more detailed Academic Integrity Policy of Rutgers University from the link below: http://academicintegrity.rutgers.edu/.