**GEOG 463/563**

**Computational Tools for Environmental Science**

Lecture STAG 313, MW 8:30-10:00 AM |

Lab STAG 363, R 8:30-10:00 AM

| 4 credits

Dr. James Watson, Associate Professor

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**Office Location**: Strand Agriculture Hall 348B

**Virtual office hours**: TBD

**Course Description:** Explores data science tools used to gather, validate, organize, analyze, and summarize large amounts of geospatial and earth system science data. Focuses on developing workflows that are efficient, collaborative, reproducible, and modular using tools such as scientific coding languages, GitHub, and Google Earth Engine, and Earth System Model data portals (e.g., CESM). Examines case studies including atmospheric science, oceanography, geology, geography, remote sensing, climate change and earth system modeling, marine spatial planning, wildfire modeling, and natural resource management.

463 prerequisites: ST 314 with C- or better or ST 351 with C- or better or ST 351H with C- or better

563 recommendations: 9 credits of graduate coursework

**Learning Outcomes:** Upon completion of this course, all students will be able to:

1. Design and conduct a research project involving the analysis of geospatial and earth system data
2. Apply best practices in data collection, cleaning, wrangling, analysis, and visualization
3. Read and write code for scientific analysis
4. Manage complex geospatial projects using a version control system
5. In addition to the above, graduate students will be able to: a) Locate and cite relevant primary literature, b) Synthesize their findings within the broader environmental or scientific context

**Research Project:** The objective of the collaborative, term-long research project is to engage students in a detailed exploration of geospatial and earth system data, emphasizing data acquisition, analysis, and the formulation of actionable recommendations for stakeholders. Groups of 2 to 3 students will identify datasets related to chosen environmental topics, conduct quantitative analyses, and present their findings in an oral presentation and write a white paper report. Group members will collaborate to write a white paper as a persuasive, authoritative, in-depth report that presents a problem and provides a solution. Students will also provide peer reviews and revise their work based on reviews.

**Graduate-level Expectations:** One of the core skills that graduate students should develop is finding, reading, and citing literature. As part of their research project, students registered in GEOG 563 must write additional Discussion and References sections. The Discussion should place their findings or datasets in a broader environmental or scientific context, be between 500-750 words (not including citations), and reference at least 8 primary or secondary research articles. In addition, students enrolled in GEOG 563 are expected to present work that is significantly more rigorous in both depth of study and methodology than students enrolled in GEOG 463.

**Course Schedule Summary**

**- Week 1:**

- L1: Introduction to the course, learning how to learn, getting to know each other

- L2: Starting term projects

- Lab: 1) Weekly assignments, 2) GitHub version control, 3) Peer-review

**- Week 2:**

- L1: Terminals, IDEs, Shell scripting, scientific coding in Python

- L2: Geospatial data types, Geospatial data access

- Lab: the 1-page pitch, project management

**- Week 3:**

- L1: Geospatial exploratory data analysis, Geospatial data modeling

- L2: Earth System Models (ESM), ESM data, ESM data access

- Lab: Term-project data and analysis planning

**- Week 4:**

- L1: Plotting geospatial and earth system model data using code

- L2: Earth system data workflows

- Lab: making good short presentation

**- Week 5:**

- L1 + L2: 10-minute presentation on projects

- Lab: Independent work on projects

**- Week 6:**

- L1: Workflow visualization

- L2: Writing efficient reports collaboratively

- Lab: Independent work on projects

**- Week 7:**

- L1: High performance computing for geospatial analysis and earth system modeling

- L2: Google Earth Engine

- Lab: Independent work on projects

**- Week 8: machine learning I**

- L1: Introduction to Machine Learning I

- L2: Introduction to Machine Learning II

- Lab: Introduction to Machine Learning

**- Week 9:**

- L1: Independent work on projects

- L2: Independent work on projects

- Lab: Independent work on projects

**- Week 10:**

- End-term project reporting and presentations

**Evaluation of Student Performance**

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| --- | --- | --- | --- | --- | --- |
| Assessment | Due Date | Points | Total points | Weight | Learning Outcomes |
| Weekly challenges | Weeks 2,3,4,6,7 | 5 each | 25 | 22% | 2, 3, 4, 5, 6, 7 |
| Project GitHub README | Week 2 | 5 | 5 | 5% | 1, 4, 5 |
| Project pitch | Week 3 | 10 | 10 | 9% | 1, 2 |
| Project mid-term presentation | Week 5 | 15 | 15 | 13% | 2, 3, 4, 5 |
| Final presentation | Week 10 | 20 | 20 | 17% | 1, 2, 7 |
| Project GitHub repository | Week 10 | 20 | 20 | 17% | 1, 2, 3, 4, 5 |
| Project report | Week 10 | 20 | 20 | 17% | 1, 2, 6, 7 |

**Grading Scale**

100—93 = A

92—90 = A-

89—87 = B+

86—83 = B

82—80 = B-

79—77 = C+

76—73 = C

72—70 = C-

69—67 = D+

66—63 = D

62—60 = D-

0—59 = F

**Weekly Participation**

Students are expected to participate in all graded and non-graded assignments. Lab assignments are due on Wednesdays at 11:59 PM the week following lab.

**Late Work Policy**

Late work will be accepted after the deadline, but will be assessed a 5% penalty per day. Extensions may be granted on a case-by-case basis.

**Learning Resources**

All learning materials will be posted in Canvas and GitHub. There is no textbook required for this course.

**Academic Calendar**  
All students are subject to the registration and refund deadlines as stated in the Academic Calendar: <https://registrar.oregonstate.edu/osu-academic-calendar>

**Statement Regarding Students with Disabilities**  
Accommodations for students with disabilities are determined and approved by Disability Access Services (DAS). If you, as a student, believe you are eligible for accommodations but have not obtained approval please contact DAS immediately at 541-737-4098 or at [http://ds.oregonstate.edu](http://ds.oregonstate.edu/). DAS notifies students and faculty members of approved academic accommodations and coordinates implementation of those accommodations. While not required, students and faculty members are encouraged to discuss details of the implementation of individual accommodations.

**Student Conduct** **Expectations**: <https://beav.es/codeofconduct>

**Student Bill of Rights**  
OSU has twelve established student rights. They include due process in all university disciplinary processes, an equal opportunity to learn, and grading in accordance with the course syllabus: <https://asosu.oregonstate.edu/advocacy/rights>

**Reach Out for Success**  
University students encounter setbacks from time to time. If you encounter difficulties and need assistance, it’s important to reach out. Consider discussing the situation with an instructor or academic advisor. Learn about resources that assist with wellness and academic success at [oregonstate.edu/ReachOut](https://counseling.oregonstate.edu/reach-out-success). If you are in immediate crisis, please contact the Crisis Text Line by texting OREGON to 741-741 or call the National Suicide Prevention Lifeline at 1-800-273-TALK (8255)

**Student Learning Experience Survey**

During Fall, Winter, and Spring term the online Student Learning Experience surveys open to students the Wednesday of week 9 and close the Sunday before Finals Week. Students will receive notification, instructions, and the link through their ONID email. They may also log into the survey via MyOregonState or directly at <https://beav.es/Student-Learning-Survey>. Survey results are extremely important and are used to help improve courses and the learning experience of future students. Responses are anonymous (unless a student chooses to “sign” their comments, agreeing to relinquish anonymity of written comments) and are not available to instructors until after grades have been posted. The results of scaled questions and signed comments go to both the instructor and their unit head/supervisor. Anonymous (unsigned) comments go to the instructor only.