**GEOG 463/563**

**The Fundamentals of Doing Earth Systems Science**

Lecture STAG 313, MW 4:00-5:20 PM | Lab STAG 363, R 10:00-11:50 AM

Spring 2025 | 4 credits

Dr. James Watson, Associate Professor

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Strand Agriculture Hall 348B

Virtual office hours: W 10-11 AM, [Zoom](https://oregonstate.zoom.us/j/95392088727?pwd=0XtNVoqXARE5UaresUVLUJKEW2VCdP.1&from=addon)

**Course Description**

Explores data science methods used to gather, validate, organize, analyze, and summarize large amounts of earth system science information. Focuses on developing workflows that are efficient, collaborative, reproducible, and modular using tools such as scientific coding languages, GitHub, and JupyterLab. Examines case studies including remote sensing, climate change, biodiversity assessments, marine spatial planning, wildfires, 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 earth system data
2. Apply best practices in data collection, cleaning, wrangling, analysis, and visualization
3. Read and write code for scientific analysis
4. Implement best practices in scientific programming to promote collaborative and reproducible research
5. Manage complex research projects using a version control system
6. 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 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**

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| ***Module 1: Running quantitative and collaborative projects in the earth sciences*** | | | | |
| Week 1 |  |  |  |  |
| Lecture | NA | NA | Wed, Sep 24 | Course overview & motivation |
| Lab | Thu, Sep 25 | Identify topics & groups for research project | | |
| Week 2 |  |  |  |  |
| Lecture | Mon, April 7 | From idea to proposal | Wed, April 9 | Thinking algorithmically |
| Lab | Thu, April 10 | Working with RStudio & GitHub, **README due 4/16** | | |
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| ***Module 2: Working with big environmental data*** | | | | |
| Week 3 |  |  |  |  |
| Lecture | Mon, April 14 | Data sourcing | Wed, April 16 | Data validation |
| Lab | Thu, April 17 | Cleaning messy data, **R notebook due 4/23** | | |
| Week 4 |  |  |  |  |
| Lecture | Mon, April 21 | Data formatting | Wed, April 23 | Coding best practices |
| Lab | Thu, April 24 | Analyzing marine heatwaves, **R notebook due 4/30** | | |
| Week 5 |  |  |  |  |
| Lecture | Mon, April 28 | Check-in meetings & group work | Wed, April 30 | Check-in meetings & group work |
| Lab | Thu, May 1 | **Proposal presentations** | | |
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| ***Module 3: Analyzing, visualizing, and modeling environmental data*** | | | | |
| Week 6 |  |  |  |  |
| Lecture | Mon, May 5 | Descriptive & confirmatory statistics | Wed, May 7 | Figure & table design |
| Lab | Thu, May 8 | Assessing biodiversity, **R notebook due 5/14** | | |
| Week 7 |  |  |  |  |
| Lecture | Mon, May 12 | Time series data | Wed, May 14 | Spatial data & remote sensing |
| Lab | Thu, May 15 | Creating time series & spatial plots, **R notebook due 5/21** | | |
| Week 8 |  |  |  |  |
| Lecture | Mon, May 19 | Machine learning for earth science | Wed, May 21 | Types of models |
| Lab | Thu, May 22 | Environmental modeling, **R notebook due 5/28** | | |
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| ***Module 4: Completing and evaluating projects*** | | | | |
| Week 9 |  |  |  |  |
| Lecture | Mon, May 26 | MEMORIAL DAY HOLIDAY | Wed, May 28 | Check-in meetings & group work |
| Lab | Thu, May 29 | Check-in meetings & group work | | |
| Week 10 |  |  |  |  |
| Lecture | Mon, June 2 | **Peer review** | Wed, June 4 | **Peer review** |
| Lab | Thu, June 5 | **Final presentations** | | |

**Evaluation of Student Performance**

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| --- | --- | --- | --- | --- | --- |
| Assessment | Due Date | Number | Ind. Weight | Total Weight | Learning Outcomes |
| Lab summaries | Weds. after lab | 5 | 10% | 50% | 2, 3, 4, 5, 6, 7 |
| GitHub README | April 16 | 1 | 5% | 5% | 1, 4, 5 |
| Proposal presentation | May 1 | 1 | 5% | 5% | 1, 2 |
| Peer reviews | June 2-4 | 2 | 5% | 10% | 2, 3, 4, 5 |
| Final presentation | June 5 | 1 | 5% | 5% | 1, 2, 7 |
| GitHub repository | June 10 | 1 | 15% | 15% | 1, 2, 3, 4, 5 |
| Project white paper | June 10 | 1 | 10% | 10% | 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.