

Welcome to *ISAT420: Environmental Analysis and Modeling*. I am a climate scientist and work with environmental data all the time to understand climate change and extreme events such as drought. This experience shapes my understanding of the world and how we can use data to explore and communicate the environmental issues we face.

Why this course?

In the last few years, the world experienced [record-breaking heat](#), [drought, wildfires](#) and flooding. In fact, from at least 2020 [the effects of climate change are detectable every single day](#) through statistical analysis. While the situation seems dire, there is [reason for hope, but it will require transformative change in how we live and adapt to our environment](#). To be successful, we need to do this quickly and in a just and equitable way.

Solving climate change and other environmental problems – like air pollution – require the combination of natural science, technology, and the social sciences and humanities.

They also require environmental data that needs to be collected, analyzed, and communicated to increase our understanding of the natural systems that we disturb and to communicate these complex issues to a broad range of audiences. ***In short, this is what ISAT and complex problem solving is about.***

The purpose of this course is to introduce you to basic analysis and modeling concepts and skills useful for addressing various environmental problems by supporting sound decision-making. Applying such skills will give you a deeper understanding of the environmental systems you will explore. At the end of the course, students should be able to describe an environmental problem from a systems perspective, identify observational or model data needed to examine the problem and conduct appropriate analyses to understand the system and identify ways to address the problem.

1. About this Course

In this course, we will use a studio/ seminar approach with readings, in-class work, discussions, and project-work to engage with environmental data and models. A significant emphasis will be placed on hand-on-learning using analysis and modeling tools including the Sci-Py (Scientific Python) framework using Jupyter Notebooks. During the semester we will explore case studies using environmental data applied to a variety of environmental issues. You will learn the tools on how to find and access data, how to conduct scientific analysis so that data is useful and reliable, and how to communicate your findings with the audience in mind. In addition to these scientific, technical, and communication skills, we will also always be asking what the data reveals about the environmental issue and the underlying scientific processes.

This course is designed as a low-stakes environment to do difficult and likely new-to-you things, namely engaging with curated real-world data to learn about environmental processes. I am inviting you to participate and to take ownership of your learning.

Students are expected to bring to class a basic understanding of the most common environmental problems facing society. This includes not only knowledge of the chemical and physical aspects of such problems, but also remediation technologies and policies. Many of these concepts are covered in ISAT 320 and ISAT 321. Students who do not feel comfortable with their current environmental science and technology knowledge base should consult the instructor.

1.1. Course Goals

In this course, I invite you to pursue these learning objectives:

- Apply principles of open and responsible science to acquire, process, and visualize environmental data
- Understand different types of models and environmental data and how they can be used to characterize environmental issues
- Interpret environmental data to characterize causes and effects of environmental problems
- Evaluate complex environmental systems using computational tools to
 - Understand causes and effects of environmental problems
 - Realize limitations of data and models
 - Effectively communicate scientific and technological information
- Analyze, present, and defend the results and conclusions from projects that involve environmental data from observations and models

2. Course Information

ISAT 420: Environmental Analysis and Modeling, Section 1 (3 credits)

James Madison University is a community dedicated to diversity and inclusivity. As faculty, we believe that learning environments should support a diversity of thoughts, perspectives, experiences, and identities. We invite you to share anything with us that might help create a more inclusive and welcoming learning environment.

2.1. Class Schedule:

Lectures: Monday, Wednesday 3:25 - 4:40 PM in EnGeo 1207

An approximate schedule will be published on Canvas.

2.2. Teaching Faculty:

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| Dr. Tobias Gerken <i>Office:</i> EnGeo 2119 <i>Phone:</i> 568-4024 <i>Email:</i> gerkentx@jmu.edu | <i>Zoom:</i> https://jmu-edu.zoom.us/my/tobiasgerken <i>Office Hours:</i> See Canvas (Will be posted after first week of classes) |
|--|---|

Alternative Times: If you cannot meet during standard office hours, you may always e-mail to set up a mutually convenient time to meet. If the instructors need to make a change in office availability during the semester, an announcement will be made in advance.

3. Requirements and Policies

3.1. Text and Materials

Students are not required to purchase any textbooks for this course. Online access to assigned readings, laboratory descriptions, and supplemental materials will be made available through Canvas and/or Github.

To participate in in-class activities you are expected to bring a laptop computer. If you do not have a suitable device, please contact me and we will find a solution. You will work with freely available software, some of which will be installed onto your device. For using using [Google Collab](#), such that a free google account will be required.

3.2. Online Technology Requirements

You are required to have access to the necessary technologies in order to take this course, in part or in whole, online. For specific information about the technologies you will need to be successful, you should consult the JMU guidelines found here: <https://www.jmu.edu/online/resources/online-technology-requirements.shtml>

3.3. Dates and Deadlines for Course Changes

Students are responsible for registering for classes and for verifying their class schedules on MyMadison. Information about dates and deadlines for registering, dropping, and adding classes can be found at <https://www.jmu.edu/registrar/dates-and-deadlines.shtml>.

3.4. Attendance and Participation

This is a small class so your absences will be noticed. I also expect everyone to contribute to class activities and discussions, so we all need you there. I also understand that illness, family emergencies and life happen, but you need to contact and talk to me if you missed, or preferably, before you miss a class. Part of your grade is dependent on your attendance.

You are expected **to complete the assigned reading** prior to the date indicated in the class schedule, to do homework assignments, and to participate fully in all team work.

- **Illness:** Use mature judgment about attending class if you are ill.
- **Holidays:** Reasonable accommodation will be given to individuals to celebrate religious holidays. Please let your instructor know in advance if you will miss a class for a religious holiday.
- **Athletes:** Please discuss your athletic schedule with your instructor early in the semester.
- **Team Work:** Inform your team members of any absences, preferably in advance.

3.5. Make-up Policy

Please contact me prior to missing an assignment. I will work with you to find appropriate modifications if you have a valid reason for not being able to meet the original assignment deadline. Valid reasons include health-related situations or circumstances beyond the control of the student. If you contact me after the deadline, no make-up will be given.

3.6. Accessibility and Inclusion

JMU abides by Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act, which mandate reasonable accommodations be provided for students with documented disabilities. If you have not already done so, you will need to register with the Office of Disability Services, the designated office on campus to provide services for students with disabilities. The office is located in the Student Success Center, room 1202, and you may call (540) 568-6705 for more information.

If you have a documented disability that requires an accommodation or an academic adjustment, please let the instructor know within the first week of class.

3.7. Religious Accommodations

Reasonable accommodation will be made for religious observances that conflict with class meetings or assignments during the semester. Students wishing such accommodation must inform the instructor during the first week of class.

3.8. Submission of Work

All work must be submitted on the day that it is due. Assignments will specify how and through what mode assignments will be submitted. When submitting files online, be sure that you have uploaded your file in the appropriate place, and that the document can be opened on a PC (Mac users: be careful of this). Your names should be at the top of the document. All work is subject to review by JMU's plagiarism detection software.

3.9. Generative AI Policy

Large language models (LLMs) - like ChatGPT, Claude, or Co-Pilot - are an amazing tool for automating tedious tasks and improving the quality of your writing. We don't know yet whether they are good tools for learning new things. Your time at JMU, ISAT, and this course is about building a fundamental understanding of scientific and technological systems. This requires you to assemble all the building blocks and to make connections between concepts. Recent studies have shown that many students outsource brain work to LLMs rather than to do their own thinking, which reduced learning by LLM users compared to brain-only learners:

"Self-reported ownership of essays was the lowest in the LLM group and the highest in the Brain-only group. LLM users also struggled to accurately quote their own work. While LLMs offer immediate convenience, our findings highlight potential cognitive costs. Over four months, LLM users consistently underperformed at neural, linguistic, and behavioral levels. These results raise concerns about the long-term educational implications of LLM reliance and underscore the need for deeper inquiry into AI's role in learning." **Preprint:** Kosmyna et al. (2025): Your Brain on ChatGPT: Accumulation of Cognitive Debt when Using an AI Assistant for Essay Writing Task, <https://doi.org/10.48550/arXiv.2506.08872>

Another recent study showed that medical doctors who relied on AI for diagnosing colon cancer rapidly lost the ability to diagnose cancer without the assistance of AI¹. This might not be a problem if the AI is working as intended. However, AI is known to [hallucinate and to produce nonsensical results](#). This means you need to be able to understand and check all AI output, here and in your professional life. This is also a property inherent to LLMs, which means that this is not something that will be fixed any-time soon.

AI Honor Pledge

This course permits you to use generative artificial intelligence (genAI) tools, such as chatbots, text generators, paraphrasers, summarizers, or solvers, to get guidance on assignments, as long as you do so in an ethical and responsible manner. Essentially, you can think of these tools as ways to help you learn but not to entirely create work for assignments like discussion board posts, essays, presentation slides, and so on. Use AI like your tutor or TA, not a replacement for your independent thinking.

¹ Budzyń et al. (2025): Endoscopist de-skilling risk after exposure to artificial intelligence in colonoscopy: a multicentre, observational study, *Lancet Gastroenterol Hepatol*. Online first, DOI: [10.1016/S2468-1253\(25\)00133-5](https://doi.org/10.1016/S2468-1253(25)00133-5)

As a student in this course, you pledge to:

- I will not use genAI to replace my own thinking or analysis to avoid engaging with the course content.
- I will not accept genAI output unless I fully understand the underlying principles and science and will compare genAI output with content from reliable sources (such as literature, lecture slides, etc.)
- I will not accept that genAI output replaces my own written voice and style and shapes how I think about course content.
- I will be transparent and honest about how I you used genAI tools and how they contributed to your assignment.
- I understand that I am responsible for any errors in genAI output.

Using AI tools in an unethical or irresponsible manner, such as copying or paraphrasing the output without citation or transparency, using the output as your own work without verification or integration, or using the output to misrepresent your knowledge or skills, is considered a form of academic dishonesty and will result in a zero grade for the assignment and possible disciplinary action. If you have any questions about what constitutes ethical and responsible use of AI tools, please consult with the instructor before submitting your work.

3.10. Academic Honesty

All students are expected to comply fully with the JMU Honor Code, as presented in the *Student Handbook* and at www.jmu.edu/honor/. It is a violation of the Honor Code to collaborate in an unauthorized manner with one or more other students on an examination or any work submitted for academic credit. Each student has a duty to become familiar with the Honor Code and the provisions of the honor system. Ignorance of what constitutes an Honor Code violation cannot be used as a defense in an honor hearing.

- Collaboration on team quizzes, labs, and projects is encouraged, provided that it is done in the spirit of mutual learning and shared ideas and effort. This means that everyone in a group should contribute physically and intellectually to a common deliverable. If a group member has not contributed to a given deliverable, that person's name should not appear on the deliverable. Taking credit for someone else's work or ideas and representing them as your own is unethical and prohibited.
- When writing project reports, electronic cutting and pasting from ANY source *without citing that source in an appropriate manner* is considered plagiarism and is a violation of the Honor Code. Please ensure proper citations in all of your work.
- It is a violation of the Honor Code to discuss the content of an exam before all sections have completed taking the exam.

3.11. Electronic Communication

The best way to contact your instructor is through email. I recommend either using Canvas to send messages to me or contacting me directly at my email address listed earlier in this document. I expect appropriate e-mail etiquette from you; do not send cryptic text messages. Begin with a salutation, identify yourself, and clearly state the reason for your e-mail. Always "sign" your full name. Normally I will respond to any messages within 24 hours.

All handouts, lecture presentations, and lab materials will be available through Canvas. For assistance with Canvas, contact the Computing Helpdesk at (540)568-3555 or www.jmu.edu/computing/helpdesk/

3.12. Inclement *Weather*

If the university schedule is affected by weather, I follow university policy regarding rescheduling. Makeup work may take place either during an official makeup day or at another time agreed upon by the class. Check the JMU homepage (www.jmu.edu) for information about closings, delays, and official makeup policies.

3.13. Professionalism

Consistent attendance, attentiveness, enthusiasm, and knowledgeable participation (from readings and integrating and thinking about the material) are hallmarks of engagement and motivation to learn. Participation includes discussion and engagement while in class and lab.

As a corollary, effective learning takes place within an atmosphere of mutual respect. Acting professionally includes being responsible, using appropriate communication tools, and acting in ways consistent with the JMU Honor Code. **Do not use cell phones or other electronic devices for personal business or entertainment during class or lab.** You will be asked to leave if your use of electronic devices or your behavior in class is disruptive.

3.14. Lecture Recordings

Lectures (or portions thereof) may be recorded for your benefit (e.g., to make worked examples available to you after class). Recordings will be made available through Canvas. I will not make them public and I will limit recordings to slides, whiteboard, docucam, and myself. During class, I may pause recording at times to allow for everyone to feel comfortable discussing sensitive topics. I encourage you to contact me directly with any concerns about recordings.

Students may not redistribute these audio or video recordings or comments from the course to individuals who are not students in the course without the express permission of the faculty member and of any students who are recorded.

3.15. Discipline

Instructors and students are equally responsible for creating an environment that will facilitate learning within the JMU community. Disruptive conduct disrupts the process of teaching and learning, and such behavior will not be tolerated in the classroom, lab, online discussion or other place of student learning.

The full policy regarding class disruptions is available from: <https://www.jmu.edu/academic-affairs/documents/policies/aapolicy-12.pdf>

3.16. Reporting Resources for Students

Students have the right to access information and support when they experience negative interactions, microaggressions, harassment or discrimination. Several campus offices are available to respond to your concerns:

- If you have experienced an accessibility challenge or have questions about disability services, contact the [Office of Disability Services](#).
- If you have experienced sexual misconduct or have questions about sex or gender discrimination, contact the [Title IX Office](#).
- If you have experienced harassment or discrimination, contact the [Office of Equal Opportunity](#).
- To report a violation of JMU community standards or for questions about student accountability, contact the [Office of Student Accountability and Restorative Practices](#) (OSARP).

- To report a concern or for questions about access, contact the [Office of Access, Compliance, and Engagement](#).

4. Methods of Evaluation

There will be no exams or graded quizzes. This course is designed as a low-stakes environment. You are invited to participate in new to you and difficult things including data analysis using computational tools, data visualization and communications. I am expecting that students have a wide range of different experiences and backgrounds as it comes to these.

However, this means that I am expecting you to take ownership of your own learning and to critically examine what you learn and how. I am expecting you to actively engage with all course work and to keep a journal of your own learning and questions.

4.1. Learning Notes

- **Why:** Because you will experience and deal with many new concepts, it is important to keep timely and regular notes on the concepts you learned. These notes are designed to help you engage with the material and to create structure in your learning. They also serve as regular practice for the developed workflows.
- **How:** You are expected to keep regular and timely notes on your own learning and the questions that you encounter, while you engage with the materials. In addition to regular notes, I will supply you with guiding questions about specific topics. The journal will serve as a basis for class discussions and feedback to me.
- **Grading:** These reflections will be reviewed periodically and will be graded for completion and adherence to submission requirements.

4.2. Learning Reflections

- **Why:** In addition to granular and weekly notes, learning reflections are designed to engage with material from several weeks in a more integrated way and to keep track of your overall learning and experience in this class. They also serve as a check-in for me to assess whether you and the class as a whole is making progress towards the learning outcomes.
- **How:** Because I am expecting diverse backgrounds and experiences at the beginning of class you will not be evaluated based on the content you learned/ mastered but rather on whether you are actively working towards making progress on your own learning and what steps you are taking to be as successful as possible in this course.
- **Grading:** These reflections will be graded using a rubric that assesses depth of engagement with the course material, depth of personal reflections, and evidence for making progress towards course objectives.

4.3. Class Participation

- **Why:** Because this is a small class and most activities will be team-based, active class participation is expected and will be part of your grade.
- **How:** The assigned grade will include instructor-, peer-, and self-assessment of your participation as well as completion of activities.

- **Grading:** In most cases grades will be assigned based on evidence for active participation with an appropriate depth of engagement. This does not mean that you have to do everything right but show effort and take ownership of your learning. Frequently, assignments will have a content component (e.g. specific things you are supposed to learn) and a practice component for using the tools that we introduced. Therefore, it is important that you follow the instructions carefully regarding submission, tools to use, etc. Remember that learning is a process and that the final product (e.g. the submitted assignment) is less important than what you learned in the process.

4.4. Class Project and Presentation

- **Why:** The course project provides an opportunity to apply your skills as a team to tackle a data analysis project of your choice. This allows you to integrate and practice what you learned.
- **How:** You will complete a multi-week team project on an environmental problem/ question of your choice that will involve the entire environmental data analysis process, including defining a problem, finding data, analyzing and visualizing environmental datasets and communicating your findings with a specific audience in mind. In addition to a written report, you will complete a visual presentation that highlights your key findings.
- **Grading:** Your project will be graded based on completion of intermediate milestones, quality of final report and presentation, and evidence for critical engagement with the research topic.

4.5. Grading Scale

| | PLUS (+) | | MINUS (-) |
|----------|----------------|----------|------------|
| A | | 100-90.0 | <90.0-89.5 |
| B | 89-87 | 86-84 | 83-80 |
| C | 79-77 | 76-74 | 73-70 |
| D | 69-67 | 66-64 | 63-60.0 |
| F | Less than 60.0 | | |

I reserve the right to adjust these percentages if deemed necessary.

A note on posting grades to Canvas: Your grades will be regularly posted to Canvas, but this is not the official record of your course grade and may not reflect grade weighting for different types of assignments

4.6. Course Components

| | |
|--------------------------------|-------------|
| Learning Notes | 15% |
| Learning Reflections (3) | 30% |
| Class Participation | 20% |
| Class Project and Presentation | 35% |
| TOTAL | 100% |

4.7. Extra Credit

This class will not offer extra credit.