

# Geophysical Exploration of the Cryosphere

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## Contact Information

### Instructor

Dr. Mickey MacKie

### Email

emackie@ufl.edu

### Office Hours

TBD

### Teaching Assistant

Michael Field (michael.field@ufl.edu)

You may communicate with the instructors over Canvas or email. The instructors will typically respond within a few hours during work hours (M-F 9-5) but will not necessarily be available outside of these hours.

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## Course Information

Synchronous CURE (Course-based Undergraduate Research Experience). Tue/Thurs 12:50-2:45 in Williamson 214

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## Course Description

This eight-person course will provide students with a unique research experience in the field of glaciology. This course is taught in a CURE format (Course-based Undergraduate Research Experience), where students will work with the instructors to conduct Antarctic research. The research objective is to use novel geophysical and machine learning techniques to map the cavities beneath Antarctica's ice shelves - critical constraints for ice-sheet and sea level rise models. Over the course of the semester, students will learn technical skills including how to visualize geospatial data sets, analyze geophysical data, model gravity anomalies, conduct geostatistical

analyses, and implement advanced statistical and machine learning workflows. All analytical work will be done in the Python programming language. This research is broken down into different lab activities and milestone assignments and will culminate in a poster presentation at the end of the semester. This course will also teach students about research ethics, data visualization, scientific communication, and navigating science and academia. This course is perfect for students who are interested in research and want to make an impact on climate change research! **There are no quizzes or exams in this course.**

Credit Hours: 3

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## Course philosophy and expectations

- **You are conducting real research with societal implications.** Transparency, rigor, and research integrity are essential.
- **Your instructors and fellow classmates are your collaborators,** which means we are all on the same team and we depend on each other. Ask for help when you need it, and assist others when you can. Do your best to meet deadlines, but be proactive and communicative when you can't. We are on this journey together!
- **Science is unpredictable!** You are venturing into the unknown, which means there will be unforeseen challenges. We may need to modify assignments and deadlines depending on how the research evolves - and that's okay!
- **Speak up if you are struggling or falling behind.** The course modules build on each other, so it is important that everything is done in a reasonable timeframe. We will work together with you to keep you on track. We have built buffer time into this course, so there is some flexibility if needed.

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## Course Requirements

### Required Textbook

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There is no textbook for this course.

### Prerequisites and Minimum Technical Skills

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Students must have taken (or currently be taking) some physics and either calculus or linear algebra. Programming proficiency is required, preferably in Python. Please contact the instructor if you have any questions or concerns about your ability to succeed in this course.

## Materials/Supply Fees

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There is no supply fee for this course.

## Course Objectives

By the end of this course, you will be able to:

1. Read scientific literature.
2. Process geophysical data, apply geophysical (gravity anomaly) modeling, perform geophysical inversions, and implement advanced data science/machine learning techniques in Python.
3. Explain how scientific research is conducted.
4. Make and present a scientific poster.
5. Describe how your research results contribute to the body of knowledge in glaciology

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## Attendance Policy

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>

[Links to an external site.](#)

. Personal travel plans are not excused absences. Forgetting to come to class is also not an excused absence.

Attendance at the lectures and discussion is an important part of preparing for assignments. Some assignments (e.g. discussion activities) will be completed in class. When possible, reasonable notice is required if you are unable to attend class so that we know to record the lecture and can create a makeup assignment, if applicable. The sooner you contact the instructors, the more options we can offer you. **Extensions and**

makeup assignments will not be considered if the instructors are not contacted until after the deadline or class, except under special circumstances.

## Grading Policy

I will make every effort to have each assignment graded and posted within one week of the due date.

Assignments will be marked down one point for every late day. All due dates/time zones are based on the time zone on campus.

Grade disputes happen, sometimes due to instructor error. If you would like to dispute a grade, you must send Dr. MacKie an explanation in writing within 48 hours of receiving the grade. Requests for reappraisal will not be considered if the statement includes references to how much effort was put into the assignment, or how this assignment impacts your final grade/grad school prospects. Grading is based solely on the assignment rubrics and late days. There are no extra credit opportunities in this course.

### Graded activities

Assignments	Description	Points
<b>Reading assignments</b>	Annotate papers using the Perusall app. 5 points per paper.	25
<b>Discussion activities</b>	In-class discussions related to science or navigating research. Graded for participation. 5 points each.	15
<b>Labs</b>	The research is broken up into several different lab assignments, worth 10 points each.	60

<b>Class video</b>	The class will work together to make a ~5 minute video on your research experience. The class will be graded as a group.	10
<b>Poster milestones</b>	Milestone assignments that build up to the final poster. 5 points each.	15
<b>Final poster</b>	A scientific poster and presentation on your research findings.	50
<b>GitHub repository</b>	You will make a well-documented GitHub repository with the final code for your analysis.	20

## Grading Scale

Percent	Grade	Grade Points
94-100%	A	4.00
90 – 93%	A-	3.67
87 – 89%	B+	3.33
84 – 86%	B	3.00
80 – 83%	B-	2.67
77 – 79%	C+	2.33

74 – 76%	C	2.00
70 – 73%	C-	1.67
67 – 69%	D+	1.33
64 – 66%	D	1.00
60 – 63%	D-	0.67
<60	E	0.00

See the [current UF grading policies](#)

[Links to an external site.](#)

for more information.

## Semester at a glance

Week	Topics and Assignments
Week 0	<ul style="list-style-type: none"> <li>● <b>Topic:</b> Course orientation</li> <li>● <b>Summary:</b> Introduce course and syllabus (Thursday only)</li> <li>● <b>Assignment:</b> n/a</li> </ul>
Week 1	<ul style="list-style-type: none"> <li>● <b>Topic:</b> Introduction to the cryosphere</li> <li>● <b>Summary:</b> Provide background glaciology and introduce research topic.</li> <li>● <b>Assignment:</b> Paper annotation 1. Discussion 1 on gravity inversion paper. Optional Python refresher assignment.</li> </ul>

Week 2	<ul style="list-style-type: none"> <li>● <b>Topic:</b> Geophysical measurements</li> <li>● <b>Summary:</b> You will gain familiarity with different types of geophysical data sets. By the end of this week, everyone will have downloaded, compiled, and plotted the data in their study area.</li> <li>● <b>Assignment:</b> Lab 1 - data visualization</li> </ul>
Week 3	<ul style="list-style-type: none"> <li>● <b>Topic:</b> Gravity modeling</li> <li>● <b>Summary:</b> You will learn about the principles of gravity measurements and learn how to model gravity anomalies in Python for a simple, synthetic example.</li> <li>● <b>Assignments:</b> Paper annotation 2. Lab 2 - gravity modeling</li> </ul>
Week 4	<ul style="list-style-type: none"> <li>● <b>Topic:</b> Gravity data processing</li> <li>● <b>Summary:</b> You will perform corrections to your gravity data.</li> <li>● <b>Assignments:</b> Lab 3 - gravity data processing</li> </ul>
Week 5	<ul style="list-style-type: none"> <li>● <b>Topic:</b> Scientific communication and data visualization</li> <li>● <b>Summary:</b> You will start making figures for your poster</li> <li>● <b>Assignments:</b> Poster milestone 1 - draft of data figures</li> </ul>
Week 6	<ul style="list-style-type: none"> <li>● <b>Topic:</b> Geostatistics introduction</li> <li>● <b>Summary:</b> You will be introduced to geostatistics and perform interpolations with kriging and sequential Gaussian simulation.</li> <li>● <b>Assignments:</b> Paper annotation 3. Lab 4 - geostatistics</li> </ul>
Week 7	<ul style="list-style-type: none"> <li>● <b>Topic:</b> Geostatistics continued</li> <li>● <b>Summary:</b> You will build your understanding of geostatistics and apply this to your study area. You will then examine how your geostatistical interpolation does or does not honor gravity constraints.</li> <li>● <b>Assignments:</b> Lab 5 - conditional random field, gravity forward model, and misfit calculation.</li> </ul>

Week 8	<ul style="list-style-type: none"> <li>● <b>Topic:</b> Geophysical inversion</li> <li>● <b>Summary:</b> Introduce geophysical inverse modeling, and why it's so complicated. We will discuss how this course approaches this challenge. There will also be time to catch up on data processing and labs.</li> <li>● <b>Assignments:</b> Paper annotation 4. Discussion 2 activity on reading and design experiment for the remainder of this course.</li> </ul>
Week 9	<ul style="list-style-type: none"> <li>● <b>Topic:</b> Bayesian statistics and Markov Chain Monte Carlo (MCMC)</li> <li>● <b>Summary:</b> Introduce Bayesian statistics and MCMC, and how you will use it to solve a gravity inversion.</li> <li>● <b>Assignments:</b> Lab 6 - MCMC gravity inversion for a synthetic example</li> </ul>
Week 10	<ul style="list-style-type: none"> <li>● <b>Topic:</b> Putting the experiment together</li> <li>● <b>Summary:</b> You will continue gaining familiarity with the different technical components and begin implementing the full MCMC inversion workflow.</li> <li>● <b>Assignments:</b> n/a</li> </ul>
Week 11	<ul style="list-style-type: none"> <li>● <b>Topic:</b> Project work time</li> <li>● <b>Summary:</b> Continue working on project.</li> <li>● <b>Assignments:</b> Poster milestone 2 - Poster outline.</li> </ul>
Week 12	<ul style="list-style-type: none"> <li>● <b>Topic:</b> Project work time</li> <li>● <b>Summary:</b> Continue working on project and discuss research ethics.</li> <li>● <b>Assignments:</b> Paper annotation 5. Discussion 3 on research ethics</li> </ul>
Week 13	<ul style="list-style-type: none"> <li>● <b>Topic:</b> Project work time</li> <li>● <b>Summary:</b> Continue working on project.</li> <li>● <b>Assignments:</b> Poster milestone 3 - Drafts of figures and poster</li> <li>● Thanksgiving break next week</li> </ul>



Week 14	<ul style="list-style-type: none"><li>● <b>Topic:</b> Project conclusion and presentation</li><li>● <b>Summary:</b> Poster presentation (Tuesday only).</li><li>● <b>Assignments:</b> Class video</li></ul> <p>Posters due Tuesday December 3, 2024. GitHub repository due December 4.</p>
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## UF Policies

### University Policy on Accommodating Students with Disabilities

Students with disabilities requesting accommodations should first register with the [Disability Resource Center](#)

[Links to an external site.](#)

(352-392-8565) by providing appropriate documentation. Once registered, students will receive an accommodation letter that must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester. **Any needs for accommodation must be communicated to the instructor by August 30, 2024.**

### UF Religious Observances Policy

Students upon **prior** notification of their instructors, shall be excused from class or other scheduled academic activity to observe a religious holy day of their faith. Students shall be permitted a reasonable amount of time to make up the material or activities covered in their absence. Students shall not be penalized due to absence from class or other scheduled academic activity because of religious observances. The UF Religious Holidays Policy is available at:

<https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/#religiousholidays>

[Links to an external site.](#)

## University Policy on Academic Conduct

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UF students are bound by The Honor Pledge, which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity by abiding by the Honor Code." On all work submitted for credit by students 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." The [Student Honor Code and Student Conduct Code](#)

[Links to an external site.](#)

specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

## Plagiarism

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The [Student Honor Code and Student Conduct Code](#)

[Links to an external site.](#)

states that:

"A Student must not represent as the Student's own work all or any portion of the work of another. Plagiarism includes but is not limited to:

- Stealing, misquoting, insufficiently paraphrasing, or patch-writing.
- Self-plagiarism, which is the reuse of the Student's own submitted work, or the simultaneous submission of the Student's own work, without the full and clear acknowledgment and permission of the Faculty to whom it is submitted.
- Submitting materials from any source without proper attribution.
- Submitting a document, assignment, or material that, in whole or in part, is identical or substantially identical to a document or assignment the Student did not author."

## AI policy

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AI tools such as ChatGPT are now widely used. You are encouraged to learn more about their strengths and limitations. We do not prohibit the use of AI tools in this

course. In fact, ChatGPT can be very useful for debugging code or checking for grammatical errors. However, we caution students against relying too heavily on these tools for writing. ChatGPT does not write at the level of precision required in academia, and it is not well-versed in the content in this course. You are responsible for taking ownership of the quality of your work - whether or not you use AI. We will not check assignments for ChatGPT origins. Ultimately, assignments will be graded solely on quality according to their rubrics. Please cite tools like ChatGPT if they are used in your work.

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## Professionalism and communication

Professionalism and collegiality are important in the scientific community and make for better collaborations. Here are some general guidelines for your in-person and online communication in this course.

### General Guidelines

When communicating online:

- Treat the instructor with respect, even via email or in any other online communication.
- Address the instructor as Mickey or Dr. MacKie (not Ms., etc.)
- Be respectful of your classmates. Support each other and try not to dominate the conversation.
- Approach different viewpoints with curiosity, not judgment.
- Be mindful not to say anything over email that you wouldn't say to your instructors or classmates in person.
- Be careful with personal information (both yours and others).
- Do not send confidential information via email.

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## Getting Help

### Technical Difficulties

For help with technical issues or difficulties with Canvas, please contact the UF Computing Help Desk at:

- <http://helpdesk.ufl.edu>

- [Links to an external site.](#)
- 
- 352-392-HELP (4357)
- Walk-in: HUB 132

Any requests for make-ups (assignments, exams, etc.) due to technical issues should be accompanied by the ticket number received from the UF Computing Help Desk when the problem was reported to them. The ticket number will document the time and date of the problem. You should email your instructor within 24 hours of the technical difficulty if you wish to request a make-up.

## Health and Wellness

- **U Matter, We Care:** If you or someone you know is in distress, please email [umatter@ufl.edu](mailto:umatter@ufl.edu), call 352-392-1575, or visit [U Matter We Care](#)
- [Links to an external site.](#)
- to refer or report a concern, and a team member will reach out to the student in distress.
- **Counseling and Wellness Center:** Visit the [UF Counseling & Wellness Center](#)
- [Links to an external site.](#)
- website or call 352-392-1575 for information on crisis services and non-crisis services.
- **Student Health Care Center:** Call 352-392-1161 for 24/7 information to help you find the care you need, or visit the [UF Student Health Care Center](#)
- [Links to an external site.](#)
- website.
- **University Police Department:** Visit the [UF Police Department](#)
- [Links to an external site.](#)
- website or call 352-392-1111 (or 9-1-1 for emergencies).
- **UF Health Shands Emergency Room/Trauma Center:** For immediate medical care in Gainesville, call 352-733-0111, or go to the emergency room at 1515 SW Archer Road, Gainesville, FL 32608; Visit the [UF Health Shands Emergency Room/Trauma Center](#)
- [Links to an external site.](#)
- website.

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## Academic and Student Support

- **Career Connections Center:** For career assistance and counseling services, visit the [UF Career Connections Center](#)
- [Links to an external site.](#)
- website or call 352-392-1601.
- **Library Support:** For various ways to receive assistance concerning using the libraries or finding resources, visit the [UF George A. Smathers Libraries Ask-A-Librarian](#)
- [Links to an external site.](#)
- website.
- **Teaching Center:** For general study skills and tutoring, visit the [UF Teaching Center](#)
- [Links to an external site.](#)
- website or call 352-392-2010.
- **Writing Studio:** For help with brainstorming, formatting, and writing papers, visit the [University Writing Program Writing Studio](#)
- [Links to an external site.](#)
- website or call 352-846-1138.

## Course Evaluations

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 on the GatorEvals [Providing Constructive Feedback](#)

[Links to an external site.](#)

FAQ page. 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 the [GatorEvals](#)

[Links to an external site.](#)

website. Summaries of course evaluation results are available to students at the [GatorEvals Public Results](#)

[Links to an external site.](#)

page. More information about UF's course evaluation system can be found at the [GatorEvals Faculty Evaluations](#)

[Links to an external site.](#)

website.

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## Privacy and Accessibility Policies

For information about the privacy policies of the tools used in this course, see the links below:

- Perusall
  - [Perusall Privacy Policy](#)
  - [Links to an external site.](#)
  - 
  - [Perusall Accessibility](#)
  - [Links to an external site.](#)
  -
- Zoom
  - [Zoom Privacy Policy](#)
  - [Links to an external site.](#)
  - 
  - [Zoom Accessibility](#)
  - [Links to an external site.](#)
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