

# Dynamic Earth

## GEO3100, Spring 2023

### 3 credit hours

## Course Syllabus

**Prerequisites:** GEO 1100 OR GEO 1110 AND GEO 2100 AND PHYS 2210 (or PHYS 2010 for ESCT major). Recommended Pre/co-requisite: MATH 1220, PHYS 2220 (or PHYS 2020 for ESCT major), GEO 2500

**GenEd Endorsements:** Quantitative Intensive (QI)

**Lecture:** MWF 9:40-10:30 AM FASB 375, many workshops will be held in FASB 388

### Instructors:

Pete Lippert (pronouns: he/him/his; you are welcome to call me Pete, Dr. Lippert, or Professor Lippert)  
email: [pete.lippert@utah.edu](mailto:pete.lippert@utah.edu)

Tonie van Dam (pronouns: she/her/hers; you are welcome to call me Tonie, Dr. van Dam, or Professor van Dam)

email: [tonie.vandam@utah.edu](mailto:tonie.vandam@utah.edu)

We will rarely answer email or Canvas messages between 4:30 PM and 9 AM, nor on the weekends. You can also message us *via* Canvas. Use communication with your instructors and TAs as opportunities to practice professional written communication as you would with a client or vendor.

*Office:* Lippert: Sutton 325, can also meet *via* Zoom.

*Office:* van Dam: Sutton 347, can also meet *via* Zoom

*Office Hours:* Monday 11 AM-12 PM, Wednesday 10:30-11:30 AM, or by appointment (talk to us after class or email us).

### Teaching Assistants:

Kevin Mendoza, Ph.D. Graduate Student

*Office:* Mendoza: Sutton 279, can also meet *via* Zoom

email: [kevin.mendoza@utah.edu](mailto:kevin.mendoza@utah.edu)

*Office Hours:* TBA

### Textbook (not required)

Geophysics

- *Fundamentals of Geophysics*, Lowrie, (ISBN-13 978-0-521-67596-3 paperback)
- *Looking into the Earth*, Mussett and Khan, (ISBN: 0 521 78574 X) you can probably find this used
- *Introduction to Geophysics*, Garland

PYTHON resources

- PYTHON For Data Science, O’rielly: Available as a free e-Book
- Websites
  - <https://aaltoscicomp.github.io/python-for-scicomp/python/>

- <https://berkeley-stat159-f17.github.io/stat159-f17/lectures/09-intro-numpy/intro-numpy..html>
- <https://wesmckinney.com/book/preliminaries.html>
- We also highly recommend [stackoverflow.com](https://stackoverflow.com). Many common plotting, data loading/saving, and compute examples in python that directly relate to homework and lab assignments can be found on that site. Even seasoned programming professionals often reference stackoverflow in their day-to-day work.

### **Additional Resources**

Slides on Canvas

The internet

## Goals & Learning Objectives for Students

By engaging in this course students will be able to:

- Explain the physical laws underlying transfer and balance of energy, heat, force, and mass in Earth systems.
- Apply essential mathematical descriptions of dynamic phenomena to quantitatively analyze processes in the Earth system.
- Explain Earth processes across a large range of spatial and temporal scales.
- Use PYTHON to interpret and visualize data to describe the structure and properties of the Earth.
- Describe equilibrium conditions for key dynamic Earth processes and characterize transient disturbances.
- Identify and describe geological hazards associated with geological processes

## Structure of the Course

The course is based around two class periods and one workshop per week. Attendance is expected at all class periods. **Workshops** are an integral, important, and rewarding part of this course; they include additional lecture material that is covered only briefly (or not at all) in regular lecture and provide hands-on experience with geophysical processes and PYTHON. Come mentally prepared to engage your mind (skipping the workshop or regularly skipping out early or arriving late is not acceptable). You have exclusive access to the TA's help and guidance during the workshop period: make good use of that time. *Workshop assignments often require additional work outside of class time; do not expect to always complete your workshops within the allotted class session.*

In addition to lectures and labs, the course will comprise **online quizzes** and **homework assignments** intended to augment and enrich the material covered in class and to help you retain material covered in your readings. Two types of homework assignments will be given: problem set assignments, and daily reading assignments. All homework will focus on adding new dimensions to the material presented during lecture. Material from the homework assignments is part of the course and will be fair game on quizzes and examinations.

## **Expected Classroom Behavior and Fostering a Diverse and Inclusive Learning Environment**

Ask questions. Be engaged. Please turn off ALL electronic devices, including laptops and smart phones unless instructed otherwise. Taking notes for this class comprises making annotated illustrations and writing equations, in addition to regular notes. *I provide handouts to guide your note taking.* You do not need your laptop or smartphone to take notes (but rather a notebook and pen; or tablets in note-taking mode) and using these devices during class is often very distracting to your peers and instructors. Do not disrupt the lecture in other ways, either, such as regularly arriving late, talking while someone else is talking, or displaying threatening or intimidating behavior toward your peers and instructors. Repeated offense will result in disciplinary action. For more information, please see: [www.hr.utah.edu/employeeRelations/Dealing-with-Disruptive-and-Threatening-Behavior.pdf](http://www.hr.utah.edu/employeeRelations/Dealing-with-Disruptive-and-Threatening-Behavior.pdf)

We reiterate the mission of the Office for Inclusive Excellence (<http://inclusive-excellence.utah.edu/>) whose mission is to ‘engage, support, and advance a living, learning, and working environment that fosters respect, diversity, equity, inclusivity, and academic excellence for students in our increasingly global campus community.’ We will ask all members of the class to participate in lecture and lab, which at times means you will need to explain ideas or concepts that you may not be particularly confident about initially. The success of this aspect of the course depends on developing a classroom environment in which everyone becomes more at ease taking intellectual risks, knowing that their questions and contributions will be respected. Do your part to foster that environment. If you feel you are being disrespected by your peers or the instructors, please bring this to our attention (or to a staff member in the office above if you are uncomfortable speaking to either the instructor or TA) so that it can be addressed immediately. Another great resource on campus is the cadre of student success coaches, who can help you navigate all sorts of communication and course challenges. See their website (<https://ssc.utah.edu>) for more information.

Harassment or violence based on sex, gender, race, national origin, color, religion, age, status as a person with a disability, veteran’s status, or genetic information will not be tolerated. If you or someone you know has been harassed or assaulted, you are encouraged to report this to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS).

The Department of Geology & Geophysics, as well as the American Geophysical Union, the largest professional organization of Earth and space scientists, have **professional codes of conduct** to set and maintain standards for the integrity of science and the scientific enterprise. You can read them here:

Univ. Utah Dept. of Geology & Geophysics (copy available on Canvas, too): <https://tinyurl.com/55fjd4mj>

American Geophysical Union: <https://www.agu.org/Learn-About-AGU/About-AGU/Ethics>

## Assessment & Grading Policy

Substantive assessment comprises **in-class and online quizzes, homework assignments, and two exams.**

The course grade is based on the following weighting:

- |             |     |
|-------------|-----|
| 1. Quizzes  | 20% |
| 2. Homework | 60% |
| 3. Exam 1   | 10% |
| 4. Exam 2   | 10% |

Final marks will be awarded based on the final percentage (calculated from the weightings above) and converted to a letter grade according to the following scale:

A	A-	B+	B	B-	C+	C	C-	D+	D	D-	E
100-90	89-88	87-86	85-81	80-79	78-76	75-70	69-60	59-58	57-53	52-51	<50

There will also be an assignment to attend at least one Distinguished Lecture (DLS) this semester (Thursdays at 12:30-1:30). We are still in discussion about the Grading Rubric for this assignment. This assignment will be counted as two quizzes. DLS Lectures start the 19-January.

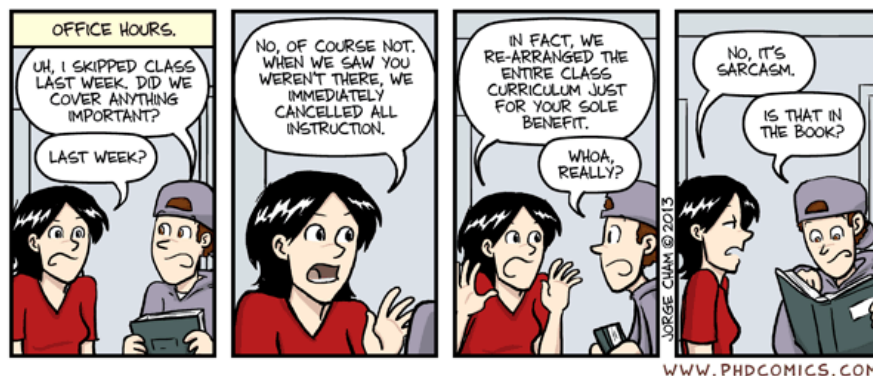
Note that the way grades are reported on **Canvas is not always correct or is easy to misinterpret because of incomplete information:** *your grade as reported on Canvas at any given time may not provide an accurate portrayal of your current standing in the course.* Ask Professors Lippert or van Dam if you have questions about your current grade.

All workshop assignments must be submitted through canvas digitally. Make sure to show your work. Assignments involving algebra should be solved algebraically before calculating the result.

**Lateness Policy:** Workshop exercises are due at the **beginning** of your Workshop session on Friday or the lecture at which they are due unless otherwise specifically stated by the instructors. Turning in the assignment at the end of lecture or a workshop session results in the assignment being marked 1 day late. Your maximum possible score on the assignment will be discounted at a rate of 15% the first day late and 5% each successive day. The grade is calculated using  $G = G_o * (1 - 0.15 - 0.05 * (t - 1))$ , where  $t$  is the number of *weekdays* late and  $G_o$  is your starting actual score. For example, if you earn 80% on your lab, but turn it in 3 days late, then your recorded grade is 60%. *Work that is more than one week late will not be accepted for credit (but will be assessed for understanding).* If you have circumstances that prevent you from turning in an assignment on time, then you must notify either your TA (for workshops) or Professors Pete Lippert or Tonie van Dam (for everything else) *before* the assignment is due and make appropriate arrangements with us.

**Absence Policies:** Lecture and workshops: attendance is required for success in this course. All holiday or special events observed by organized religions will be honored for those students who have affiliation with that religion. If you must miss class or the workshop for another reason, please contact your instructors well in advance to see what make-up opportunities might be available. If you are sick or starting to feel unwell, please give yourself the space to get rested and healthy and protect your peers from also getting sick. Please let your instructors know as soon as possible that you will be missing class or the workshop so that we make arrangements to keep you engaged in the course.

University Policy states (PPM, Policy 6-100III-O): "The University expects regular attendance at all class meetings. Instructors must communicate any particular attendance requirements of the course to students in writing on or before the first class meeting. Students are responsible for acquainting themselves with and satisfying the entire range of academic objectives and requirements as defined by the instructor."



**Academic Integrity (i.e. cheating and plagiarism):** Dynamic Earth is a challenging class and we fully expect (and encourage) students to share their thoughts about problems and concepts. However, we also fully expect that solutions and work with your name on it ultimately reflect your own careful thought, wording, and illustration. Cheating is any attempt to represent someone else's work (on exams, homework, quizzes...you get the idea) as your own. You are expected to follow all University policies regarding academic integrity, including any form of cheating, plagiarism, and fabrication. We and the TA have zero tolerance for cheating. Cheating can (and often does) result in a failing grade for this course, and it may even lead to additional university discipline. **RESPECT YOURSELF AND YOUR COLLEGE DEGREE: DO NOT CHEAT!** Do not plagiarize. For further details, please refer to the University's Policy and Procedures Manual: <http://regulations.utah.edu/academics/6-400.php>

**ADA Americans with Disabilities Act:** The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you will need accommodations in this course, reasonable prior notice needs to be given to the Center for Disability & Access, 162 Olpin Union Building, (801) 581-5020. CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in an alternative format with prior notification to the Center for Disability & Access. Please contact us at the **beginning** of the semester to discuss accommodations for this course.

**University Safety Statement:** The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-2677(COPS). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit [safeu.utah.edu](http://safeu.utah.edu).

**Addressing Sexual Misconduct:** Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity and expression) is a Civil Rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran's status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS). If you are not comfortable contacting these offices on your own or would like support, please see us, your TA, or department staff, and one of us can help you contact them.

**Student Names & Personal Pronouns:** Class rosters are provided to the instructor with the student's legal name as well as "Preferred first name" (if previously entered by you in the Student Profile section of your CIS account). While CIS refers to this as merely a preference, we will honor you by referring to you with the name and pronoun that is best for you in class, on papers, exams, group projects, *etc.* Please advise us of any name or pronoun changes (and update CIS) so we can create a learning environment in which you, your name, and your pronoun is respected. If you need assistance getting your preferred name on your UIDcard, please visit the LGBT Resource Center Room 409 in the Olpin Union Building, or email [bpeacock@sa.utah.edu](mailto:bpeacock@sa.utah.edu) to schedule a time to drop by. The LGBT Resource Center hours are M-F 8 AM-5 PM, and 8 AM-6 PM on Tuesdays.

**Wellness:** Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural differences, *etc.*, can interfere with a student's ability to succeed and thrive at the University of Utah. For resources contact the Center for Student Wellness at [www.wellness.utah.edu](http://www.wellness.utah.edu) or 801-581-7776.

**Veterans:** If you are a student veteran, the U of Utah has a Veterans Support Center located in Room 161 in the Olpin Union Building. Hours: M-F 8-5pm. Please visit their website for more information about what support offered, a list of ongoing events and links to outside resources: <http://veteranscenter.utah.edu>. Please also let me know if you need any additional support in this class for any reason.

**Learners of English as an Additional/Second Language:** If you are an English language learner, or want more practice improving your English language skills, please be aware of several resources on campus that will support you with your language and writing development. These resources include: the Writing Center (<http://writingcenter.utah.edu>); the Writing Program (<http://writing-program.utah.edu>); the English Language Institute (<http://continue.utah.edu/eli>).

**Undocumented Student Support:** Immigration is a complex phenomenon with broad impact—those who are directly affected by it, as well as those who are indirectly affected by their relationships with family members, friends, and loved ones. If your immigration status presents obstacles to engaging in specific activities or fulfilling specific course criteria, confidential arrangements may be requested from the Dream Center. Arrangements with the Dream Center will not jeopardize your student status, your financial aid, or any other part of your residence. The Dream Center offers a wide range of resources to support undocumented students (with and without DACA) as well as students from mixed-status families. To learn more, please contact the Dream Center at 801.213.3697 or visit [dream.utah.edu](http://dream.utah.edu).

**COVID-19 Statement:** The University of Utah has implemented reasonable health and safety protocols, taking into account recommendations by local, state and national public health authorities, in response to the COVID-19 pandemic. For the most up-to-date information on COVID-19 protocol, please refer to <https://coronavirus.utah.edu>. Other resources include 1) [Student Guidance: What Steps to Take for a Possible or Confirmed COVID-19 Exposure](#) 2) [Registrar's Office COVID-19 Information and FAQ's](#) 3) [Housing & Residential Education](#)

**Please also refer to the College of Mines & Earth Sciences Guidelines for additional information about:**

- Additional health, counseling, and student support services
- Adding, withdrawing, and repeating courses
- Appealing grades and other academic actions
- Academic advisors

On Canvas and available at: <https://www.cmes.utah.edu/semester-guidelines>

**This syllabus is meant to serve as an outline and guide for our course. Please note that we may modify it with reasonable notice to you. We may also modify the Course Schedule to accommodate the needs of our class. Any changes will be announced in class and posted on Canvas under Announcements.**



Date	Lecture WS #	Topic	Readings See Canvas
<b>Week 1: Preliminaries</b>			
Jan 09	1	Preliminaries	Syllabus on Canvas
Jan 11	2	Intro to Tectonics; Earth Structure	Read Lowrie Sec. 1.2
Jan 13	<b>WS1</b>	<i>Dynamic Earth Assessment</i>	
<b>Week 2: Seismology</b>			
Jan 16		Martin Luther King Jr Day	NO CLASS
Jan 18	3	Data, Computing, and Inference in the Earth Sciences	
Jan 20	<b>WS2</b>	<i>Intro to PYTHON</i>	
<b>Week 3: Stress, Strain, &amp; Elasticity</b>			
Jan 23	4	Stress & Strain	
Jan 25	5	Elasticity & Young's Modulus	
Jan 27	<b>WS3</b>	<i>GPS &amp; Elastic Strain</i>	
<b>Week 4: Seismology</b>			
Jan 30	6	Seismic waves and sources	
Feb 1	7	Quantifying earthquakes	
Feb 3	<b>WS4</b>	<i>Interpreting seismograms: Where was that Earthquake?</i>	
<b>Week 5: Gravity</b>			
Feb 6	8	Gravitational acceleration and potential	
Feb 8	9	Isostasy	
Feb 10	<b>WS5</b>	<i>Gravitational Corrections</i>	
<b>Week 6: Heat Flow</b>			
Feb 13	10	Fourier's law & thermal conductivity	
Feb 15	11	Advective heat transport	
Feb 17	<b>WS6</b>	<i>TBD</i>	

<b>Week 7: Fluids I</b>			
Feb 20		President's day	NO CLASS
Feb 22	12	Convection in the Earth	
Feb 24	13	Convection on the Earth	
<b>Week 8: Exam 1</b>			
Feb 27	14	Exam Review	
Mar 1	15	Exam 2	
Mar 3	<b>WS7</b>	<i>python coding camp &amp; catch-up</i>	
<b>Week 9: Spring Break</b>			
Mar 6			
Mar 8			
Mar 10			
<b>Week 10: Geomagnetism</b>			
Mar 13	16	Geomagnetism I	
Mar 15	17	Geomagnetism II	
Mar 17	<b>WS8</b>	<i>Structure of Earth's Magnetic Field</i>	
<b>Week 11: Global Tectonics</b>			
Mar 20	18	Plate Motions: kinematics	
Mar 22	19	Plate Motions: dynamics	
Mar 24	<b>WS9</b>	<i>Plate &amp; Hotspot Motions</i>	
<b>Week 12: Rheology</b>			
Mar 27	20	Rock Strength & Deformation	
Mar 29	21	Deformation Mechanisms	
Mar 31	<b>WS10</b>	<i>Rock strength vs. depth in the lithosphere</i>	
<b>Week 13: Fluids II - Groundwater</b>			
Apr 3	22	Darcy's law & hydraulic conductivity	
Apr 5	23	Water in the landscape	
Apr 7	<b>WS11</b>	<i>Aquifers and groundwater migration</i>	

<b>Week 14: Surface Processes</b>			
Apr 10	24	Diffusive equilibrium forms: hillslopes	
Apr 12	25	Advective equilibrium forms: river profiles	
Apr 14	<b>WS12</b>	<i>Exploring the convexity of hillslopes</i>	
<b>Week 15: Hazards</b>			
Apr 17	26	Mass movements	
Apr 19	<b>WS13</b>	<i>Predicting landslide time of failure</i>	
Apr 21	27	Exam 2 Review	
<b>Week 16: Exam</b>			
Apr 24	28	<b>Exam 2</b>	