Syllabus: GEOL 450 Geosystems Fall, 2018

Catalogue Description: Geosystems, such as mantle convection, active faults, climate, and the carbon cycle, will be studied using numerical models and concepts such as chaos, universality, emergence, and intermittency. (Prereq: Math 125, Recommended: Math 126)

Overview:
Earth Sciences is becoming more focused on system-level approaches to understanding the behavior of the Earth. The course will consider geosystems from different disciplines of Earth Science and integrates them into a single systems-oriented perspective. The course also uses simple experiments and graphical imaging/visualizing/computer-modeling tools to develop and illustrate the systems concepts. Students will be expected to become familiar with use of excel spreadsheets, simple matlab codes, and use of some community platforms for running more sophisticated models.

Instructors:

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Lowell Stott:	stott@usc.edu	213-740-5120	zhs235
Alan Juarez (TA)	alanjuar@usc.edu	213-740-2556	zhs266

Lectures: TTh 2-3:20, **Lab:** M 8-9:50

Text: Material including assigned readings will be distributed with each teaching module.

Grading: A total of 800 points are available, based on the following components. Letter grades will be assigned based on the total point score.

Labs/Problem Sets will include weekly exercises, consisting of problem sets or experimental write-ups. Approximately 10 of these will be completed during the semester. While the point allocation for each may differ, the total for all exercises will be 500 points. Late submissions will be penalized 5% per day.

Student Project: Each student will do an independent investigation of a geosystem. This will include choosing a geosystem to explore, reading relevant literature, and working with a computational module to explore the system behavior. The computational work should allow the student to adjust parameters in the selected geosystem to explore possible behaviors. The project should be selected and carried out under the mentorship of one of the instructors. Results of the geosystem study will be presented to the class near the end of the term, or during the scheduled final exam period, in an illustrated talk of 15-20 minutes. The results will also be written up in a report of 10-20 pages (including figures, tables and references). This component will be worth 300 points. **Topic and mentor choice are due by Oct. 2. A one-page progress report is due Nov. 1. The write up is due December 4.**

Learning Objectives:

- An ability to view Earth processes as characterized by dynamics, allowing flow of energy and material through the system.
- An ability to describe these dynamics with equations that capture essential behaviors.
- An ability to read current literature critically and comprehend the usage of numerical models.
- An appreciation of the integration of cross-cutting disciplines for understanding Earth Systems behaviors.

POLICIES & GUIDELINES:

Attendance: is essential. Reading in the recommended texts or on line will augment, but not replace, class meetings and exercises—a missed class meeting is hard to make up. Please prearrange excused absences or let us know before class (via email) if you are going to be out with an illness. It will be difficult, or perhaps impossible to make up any missed exercises.

Academic Honesty: You are expected to observe the rules of academic conduct outlined in the Student Handbook. We encourage you to work together on labs and assignments; however, always turn in your own work (describe results in your own words). This helps you better learn the material and helps us see your individual progress.

Academic Accommodations: Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me as early in the semester as possible. DSP can be reached at ability@usc.edu and is open 8:30am-5:00pm Monday through Friday. The phone number for DSP is 213-740-0776.

Comments on Presentations:

Giving scientific presentations in front of an audience of your peers can be intimidating. But being well prepared and practicing your presentation prior to your formal presentation is an important method for reducing anxiety and working out any difficulties that can arise, particularly when presenting information that you are not completely familiar with or when there are aspects of your presentation that are complex. Be sure to practice your presentation ahead of time and perhaps ask a classmate to listen as you practice.

The slides you choose for your talk are as important as what you say in your presentation. There are numerous resources available on-line that provide good examples of Power Point presentations that you can learn from. Look for presentations from experts who have given talks on your subject to see how they organized their figures and how they conveyed the information within their slides.

In most cases (if time permits), it is a good idea to provide your audience with an outline slide following your title slide. This is a way to provide your audience a roadmap so that they can easily follow along as you work through each slide.

Importantly, make sure that each slide is as simple as possible. Sometimes, it not possible to simplify a slide. Therefore, it is essential that you walk your audience through the important elements of each slide by pointing to those things you wish them to see. And oftentimes, it is a good idea to tell the audience what they should take away from a slide. This requires that each element of the slide is clearly visible to everyone in the room. Make sure the fonts are large and highlight specific things that are important so that your audience doesn't miss it. For example, if you are showing a data slide that plots one variable against another, make sure to point to the axes and state what variable is plotted along with its units.

One of the most important things to remember when giving a scientific presentation is to engage your audience. You want them to stay engaged throughout your talk. To do this requires that you look directly at your audience when speaking. Do not use cue cards.

Finally, at the end of your talk, tell the audience what they should have learned. You began your presentation with an introduction with an outline. End your presentation with a conclusion slide (if time permits) and remind your audience what they should have learned from your talk.

General Comments on Papers:

Writing a scientific paper can be one of the most challenging things you'll do as a student. It often takes years of practice to become a good writer. And there are key elements of every well written scientific paper that you should remember. Most scientific journals follow a standard format (except for short venue articles such as Science or Nature). The format will include the following elements:

1: Title
2: Abstract
3: Introduction
4: Methods
5: Results
6: Discussion
7: Conclusion
8: Acknowledgements
9: Citations

This is a tried and true formula for presenting scientific information and it provides a reader with a roadmap, just as your outline slide does for your oral presentation. And you'll find that as you delve into a research topic, it will be necessary to read numerous papers, all focused on a common question or problem. Having papers organized with common sections allows you to swiftly move to those sections of a paper that contain the information you need. For example, if you are trying to piece together how two different papers may have come to different conclusions after analyzing the same data, you might turn directly to the Methods section of each paper and evaluate if and how the methodologies differed. Having each section broken out into a discrete section allows you as a reader to quickly find the information you need.

Many journals have strict rules for formatting and you should look to the guidelines of a journal for specific 'rules' to follow, including how citations should be formatted properly within the text.

Typically, the Abstract must be short and concise. It must convey to the reader what your paper is about in a sentence or two. And that must be stated clearly enough that an editor and reader know exactly what to expect by reading further. You must also concisely state what you did (Methods) and then what you found (Results) and end with a Conclusion or summary of findings. Abstracts can be a challenge to write when all of these elements must be fit into a short paragraph. So again, practice writing a short abstract and look to journals for good examples to learn from.

The Introduction section is often where you will engage your reader in your study. Although you are typically writing for an informed audience, the introduction must convince your informed reader that they have something to learn by reading further. So, use the introduction to lay a compelling case that entices the reader to see what you have to offer on a subject. If your paper involves a hypothesis that is being tested, be sure to state what that hypothesis is in the Introduction. There are general rules to follow when testing a hypothesis and it is a good idea to familiarize yourself with how the 'scientific method' tests or rejects hypotheses.

The Methods section will typically follow a 'recipe' that has standard elements, which vary with the type of study you have conducted. Follow the guidelines of a journal.

The Results section is the 'heart' of the paper. This is where your words and your figures must be precise and rigorous. The figures can be the difference between a convincing discussion and one that is not convincing to the reader. You may spend as much time making good figures as you spend writing sections of the paper. This is time well spent and you should look again turn to examples from journals to see what makes for good visuals, particularly when the data is complex. As you do for an oral presentation, you want to make sure that each important element of a figure is easily seen and convincing.

The Discussion section is where you can convey your interpretations and your evaluation of the results. In this section you either 'win over' the reader or the reader will reject your interpretations. So be sure that you are rigorous as well as thoughtful. Don't expect the reader to do the work of interpreting your results if you wish them to accept your interpretation.

The Conclusion section, like the abstract, will typically be a short summary and statement of your conclusions. This should return to your original hypothesis, if you put one forth. Or, it should return to the question you posed in the introduction so that you convey to the reader how your results informed your decision to accept or reject the hypothesis or have answered the question.

The Acknowledgements may seem less important, but they are very important. It is a truism that science is community. That community involves colleagues, funding agencies and reviewers of your work. Make sure that you give credit to anyone who has helped or influenced your findings.

With these general comments about your presentation and papers, we'd like to encourage you to talk with us if you have any questions or need further guidance.

Geosystems GEOL450 Schedule 2018				
Date	**Module**	**Lead Instructor**	**Lecture**	**Lab**
Lab 20-Aug		**Hammond**		Leaky Bucket Dynamics
21-Aug	Introduction to Geosystems	ALL	Geosystems as dynamical Systems/Conceptualization	
23-Aug		Vidale	Geosystem: Practical Earthquake Legislation	
Lab 27-Aug				Discussion of Geosystem Concepts
28-Aug		Hammond	Overview and Box Model Construction	
30-Aug	Climate System & Radiation Balance	Stott	Conceptualization of the Climate System	
Lab 3-Sep	Labor Day			No Lab
4-Sep		Stott	Laws of Thermodynamics, Electromagnetic Radiation	
6-Sep		Stott	Earth and Sun Radiation Exchanges	
Lab 10-Sep				Radiation, Visualization and Analysis
11-Sep		Stott	Energy and Mass Transfers within Earth's Climate System	
13-Sep		Stott	Large Scale Atmospheric and Ocean Circulation	
Lab 17-Sep		Stott		Greenhouse Gas and Albedo
18-Sep		Stott	Global Warming/Cooling, Modeling the Climate System	
20-Sep		Stott	Presentations and Written Reports	
Lab 24-Sep				Feedbacks or.....IPCC
25-Sep	Carbon Cycle	Hammond	Overview of the Carbon Cycle	
27-Sep		Hammond	Carbon Transport	
Lab 1-Oct				Fish Tank Oceanography
2-Oct		Hammond	4 Box Model; **Project Topic Due**	
4-Oct		Hammond	4 Box Model	
Lab 8-Oct				Atm pCO2 simulation
9-Oct		Hammond	Atmospheric pCO2: Short term	
11-Oct		Hammond	Atmospheric pCO2: Long tern	
Lab 15-Oct				Friction
16-Oct		Vidale	Dynamic instability and earthquake cycles	
18-Oct		Vidale	Andersonian faulting	
Lab 22-Oct				Stress and strain
23-Oct		Vidale	Heat flow paradox	
25-Oct		Vidale	Some solutions	
Lab 29-Oct				Spring-slider and chaos
30-Oct		Vidale	Deterministic chaos; **Project Progress Report Due**	
1-Nov		Vidale	Spring-slider model	
Lab 5-Nov				Earthquake prediction
6-Nov		Vidale	Real world behavior	
8-Nov		Vidale	Linear dynamical systems I	
Lab 12-Nov				Harmonic oscillators
13-Nov		Vidale	Nonlinear dynamical systems I	
15-Nov	Civilization as a Geosystem	Vidale, Stott or Ha	Energy Systems	
Lab 19-Nov				Lorenz system
20-Nov		Stott or Hammon	Energy Systems	
22-Nov			Thanksgiving	
Lab 26-Nov				Preparation for Presentations
27-Nov		All	**Student Presentations**	
29-Nov		All	**Student Presentations**	
4-Dec	**Stop Day**		**Student Paper Due**	
6-Dec	No Final Exam but Reserve for Presentations 2-4pm			