ERTH 102 Quantifying Global & Environmental Change Spring 2021
Instructor: Greg Ravizza, POST 712 ravizza@hawaii.edu
Office hours: Open zoom call Monday Noon to 1 PM & Tuesday 11:30 AM to 12:30 PM. Use the class meeting link below. These are a great setting to get help with remembering math that we use in class that you may have forgotten.
Office Location: POST 712 (Should pandemic conditions allow I will be available for in person meetings during scheduled office hours.) These are a great setting to get help remember math that we will use in class that you may have forgotten.

Regular Class meetings: ERTH 102/SUST 113 meetings will be held on-line as synchronous zoom meetings on M, W, F from 9:30 AM – 10:30 AM. In addition, optional weekly section meetings to work on assignments will be scheduled after the start of the semester. These meeting will be capped at 15 students to ensure that students are able to actively participate and get their questions answered in full. The zoom link for these meetings is: **ERTH102/SUST113 Zoom Meeting https://hawaii.zoom.us/j/96867181176**

Posted Videos: Screenshot videos are an important resource for the class. They are posted in a shared google folder entitled ERTH 102/SUST 113 Videos on google drive. To access these files you will use you UH google username and password – the same ones you use to access your UH email.

Additional Resources and Reading required for the course: No textbook is required for this course. However, readings from open source textbooks will occasionally be assigned. These texts can be downloaded as ".pdf" files from the sites listed below. Also described below are additional resources for the course, including

- *Chemistry: Atoms First 2e, by Flowers et al. (2019)* is an open source introductory chemistry textbook. https://openstax.org/details/books/chemistry-atoms-first-2e
- *Introduction to Environmental Science (2nd Edition)* by Zhnder et al. (2018) is an open source Environmental; Science textbook. https://oer.galileo.usg.edu/biology-textbooks/4/
- Additional reading, some required and some optional, will be posted weekly on the Laulima course site under the "Resources" tab. The will be a folder for each week of the semester (1-16). Each week's reading will be posted within weekly folders in folders clearly labeled as "Required Reading" and "Optional Reading"
- The power point files used in lecture presentations will also be posted on the Laulima course site. The files will be named QG&EC SP21 WK#, where WK stands for week and the # will be replaced by the number for each week of the semester (Weeks 1-16).
- Recording of synchronous lecture meetings will be recorded via zoom and posted in the shared google folder entitled ERTH 102/SUST 113 Videos on google drive.

In ERTH102/SUST 113 we will use the cloud-based software "google sheets" as a tool to teach students to become proficient in a variety of practical applications of math by applying this software to analyzing some significant changes occurring in the Earth system. Note that google sheets is a computational tool that is very similar to Microsoft Excel. All UH students have free access to google sheets software. If you are already familiar with another spreadsheet program, it will be easy to adapt to using google sheets. However, if you have never used spreadsheets THAT IS OK. The screen videos mentioned above are intended to guide you through learning to use google sheets. The quantitative reasoning (QR) topics we will cover include: ratios, scientific

notation, basic statistics, unit conversions, linear functions, exponential functions, and fitting lines. Nearly all of you have already learned the math we will use in this course while you were in high school, or perhaps even in middle school. Each year there are always students who have forgotten the math they learned in years past. Regularly scheduled office hours (see above) are an ideal setting to get help with remembering/relearning these concepts from your earlier school days. You will learn and apply these QR concepts by working with some of the fundamental data relevant to understanding environmental and climate change on our planet. Most of these data sets will be presented to you as formatted as tables of numbers in google sheets.

Tentative Content by week: Primary topics are listed by week, below.

By Week	Topic
1	**Rising CO_2 in our atmosphere & introduction to spread sheets.** Formula entry, fixed and relative references, working with data in tabular form.
2	**Global patterns in energy consumption & introduction to spreadsheets.** *Context: How can population change affect energy demand and what are the implications for our climate?*
3	**Combustion reactions linking energy consumption to CO_2 emissions** Working with global energy consumption & introducing the concpt of carbon intensity. *Context: Visualizing resource consumption and environmental change as a function of time.*
4	**Radiative forcing and the energy flow in the Earth system. Circulation of the ocean and atmosphere.** *Context: Understanding the link between CO2 and warming AND the concept of steady state.*
5	**Simple models of growth & decay to introduce functions and equations.** *Context: Understanding simple links between population and energy consumption and the carbon cycle.*
6	**More complicated population models – including age distributions, fertility & immigration.** *Context: How can we check if more complex model output "makes sense"?*
7	**Mineral Resources and transformative technology.** Resources required to make batteries for electric vehicles, and an example of how resource consumption might change as we address climate change. *Context: A new application of "population modeling" – the time scale and resource base required for electric vehicle adoption.*
8	**Times scales of atmospheric methane variation. DP**: None. PDFs posted on the methane cycle. *Context: Methane as an example of complex feedbacks affecting an important greenhouse gas AND a simple mass balance model for atmospheric methane.***The carbon cycle revisited – seasonal changes in CO_2 levels.** *Context: Linear modeling of sedimentation rate and fossil shell chemistry as a function of temperature.*
9	**Carbon sequestration and negative carbon emissions – what is the likely cost.** Using fossil fuel consumption data and estimates of the cost of carbon capture and storage to project the cost of keeping the Earth average global temperature from exceeding 2°C. *Context: Keeping track of units and simple dimensional analysis.*

10	**Vulnerability to sea-level rise.** Proving the Pythagorean theorem & putting it to work (Pdf online) *Context: Using linear modeling to understand how rising temperatures influence the oxygen content of seawater and its density.*
11	**Ocean Acidification: CO_2 affects more than temperature.** Carbon dioxide dissolves in seawater and reacts with water to make carbonic acid. The resulting increase in acidity affects the growth of shells and coral skeletons. *Context: An example of using web programs to make more complex calculations.*
12	**Ocean Deoygenation: An emerging concern.** The temperature dependence of oxygen solubility in seawater & reading color contour maps. *Context: Putting data in geographic context.*
13	Open week to be used for catch-up.
14	**Uncertainty and decisions making – a very simple application of probability.** The game "Decisions for the Decades" is aimed at simulating how making policy decisions to allocate scarce resource might be affected by a changing climate. *Context: After using spreadsheets to simulate multi-sided dice and the random number function to simulate multiple rolls, the class will play a dice game developed by a UN group.*
15 &16	**Cap and trade as an approach to limiting greenhouse gas emissions.** An in-class game to illustrate how "cap & trade" laws can limit emissions from power plants. *Context: You will put your spreadsheet skills to work to track your profits as operate a hypothetical utility meeting electricity demand with a mix of renewable and fossil fuel generation capacity*

To succeed in this course you will:

1. Learn to recast written formulae as equations in spreadsheets, understanding both the inputs and outputs. This will be accomplished by comparing real environmental data to simple models, and assessing the usefulness of the models, as well as their short comings.
2. Learn how to make, read and interpret simple charts and graphs.
3. Demonstrate your ability to describe and explain graphs, and the associated data, using words.
4. Become proficient at converting among the varied units of measure used in Earth and environmental science so that meaningful comparisons can be made. (This is analogous to converting between different types of currency.)
5. Become proficient in using scientific notation to express very large and very small numbers.
6. Learn important ways in which human population, human activities (with energy use emphasized in this course), Earth's carbon cycle and Earth's climate system are interconnected.

Testing & Grading: Student grades will be determined as follows.

Homework & Quizzes	25%
In class uploads & attendance	17%
4 Spreadsheet Projects	28% @ 7% each
2 exams (Mid-term & Final)	30% @ 15% each

Any On-line Homework will be completed on the Laulima web site.

Spreadsheet homework assignment will be short, designed to take 30 to 45 minutes to complete. These assignments will typically consist of a computation reinforcing content from lecture &/or the reading. It will involve making one or two graphs or charts, and a single short answer question

On line quizzes will also be administered on Laulima students will have a single opportunity to answer these questions. On-line quizzes will be announce with a least 3 days notice before the quiz must be completed.

In class quizzes will be pop quizzes. They will be conducted via zoom during synchrous class meetings.

Spreadsheet projects will be started in discussion during Wednesday class meetings, but completed on the students own time. Students are also encouraged to work together on these projects during optional weekly section meetings, all students are required to complete and understand their own spreadsheet. While it is possible that copied files will not be detected students should be aware that they will likely fail in class quizzes &/or exams if they do not learn the content required to complete spreadsheet projects. All spreadsheet projects will be part of the course grade. Projects turned in late will be marked down.

Exams: There will be one midterm exam and one final exam. These exams will be remotely administered and proctored via zoom. The final exam will be comprehensive. Make-up exams will only be given in unusual circumstances and a legitimate reason for missing the exam must be documented. Students caught cheating on any exam will zero credit for the exam.

Submitting your work: All assignments should be posted to a google folder named as follows: "your-last-name" ERTH102-SUST113. This folder must be shared with the instructor (ravizza@hawaii.edu).

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Attendance: Attendance in all class meetings is required and counts as part of your grade. This includes both lecture and discussion section because unannounced quizzes can be given at any time.

Computers & tablets: *Students are required to bring a laptop for the Wednesday section, but preferably on every day the class meets. NOTE ABOUT TABLETS: Experience from last term suggests doing this course working with a tablet is cumbersome. I do not recommend using one*. Please let me know if you have problems bringing a laptop.

Lecture images: Lecture images (as .pdf or powerpont) will be posted on the Laulima course web site. You are encouraged to download these files before lecture an bring either printed or electronic version to class. Taking notes directly on these images can be very helpful.

Relationship to student learning objectives (SLO): The primary goal of this course is

give students a strong foundation in quantitative reasoning, meeting the UHM FQ (Quantitative Reasoning Foundations) hallmarks (http://blog.hawaii.edu/quantitativereasoning/definition-hallmarks/). This course is designed primarily for students who are currently pursuing a non-science/non-technical.

The examples used to develop quantitative reasoning skills will familiarize students with observations of Earth and environmental change using graphics, tables and text-based presentations. Students will also gain an appreciation for the various ways in which human activities impact the Earth system and develop quantitative skills to better evaluate the many societal issues that intersect with Earth and environmental science. This is one of our own GG SLOs (See below.). At many points throughout the course you will see that the quantitative skills you are learning are broadly applicable to making informed choices in everyday life. In addition, if you successfully complete this course you will be proficient in the use of spreadsheets, an ability that is valued in a wide array of jobs.

The Earth Science Department student learning objectives:

Student Learning Objectives (SLOs)
1. Students can explain the relevance of geology and geophysics to human needs, including those appropriate to Hawaii, and be able to discuss issues related to geology and its impact on society and planet Earth.
2. Students can apply technical knowledge of relevant computer applications, laboratory methods, field methods, and the supporting disciplines (math, physics, chemistry, biology) to solve real-world problems in geology and geophysics.
3. Students use the scientific method to define, critically analyze, and solve a problem in earth science.
4. Students can reconstruct, clearly and ethically, geological knowledge in both oral presentations and written reports.
5. Students can evaluate, interpret, and summarize the basic principles of geology and geophysics, including the fundamental tenets of the sub-disciplines, and their context in relationship to other core sciences, to explain complex phenomena in geology and geophysics.

Title IX: The University of Hawai'i is committed to providing a learning, working and living environment that promotes personal integrity, civility, and mutual respect and is free of all forms of sex discrimination and gender-based violence, including sexual assault, sexual harassment, gender-based harassment, domestic violence, dating violence, and stalking. If you or someone you know is experiencing any of these, the University has staff and resources on your campus to support and assist you. Staff can also direct you to resources that are in the community. Here are some of your options:

As members of the University faculty, your instructors are required to immediately report any incident of potential sex discrimination or gender-based violence to the

campus Title IX Coordinator. Although the Title IX Coordinator and your instructors cannot guarantee confidentiality, you will still have options about how your case will be handled. Our goal is to make sure you are aware of the range of options available to you and have access to the resources and support you need.

If you wish to remain ANONYMOUS, speak with someone CONFIDENTIALLY, or would like to receive information and support in a CONFIDENTIAL setting, use the **confidential resources available here**: http://www.manoa.hawaii.edu/titleix/resources.html#confidential

If you wish to directly REPORT an incident of sex discrimination or gender-based violence including sexual assault, sexual harassment, gender-based harassment, domestic violence, dating violence or stalking as well as receive information and support, contact: Dee UwonoTitle IX Coordinator (808) 956-2299 t9uhm@hawaii.edu.