

ERTH420 Beaches, Reefs, and Climate Change POST 723 - T, Th 1:30 ~ 2:45 pm

ERTH620 Coastal Geology POST 723 - T, Th 1:30 ~ 2:45 pm

Dr. Chip Fletcher, POST 802a, 294-0386 (text me), fletcher@soest.hawaii.edu

Office hrs usually after class, most days 5-6pm. Set up meeting by email, text my phone, or walk in and try any time.

Students in ERTH620 will be held to a high standard in all aspects of the course, especially class participation. You will provide reviews of selected papers I will require and take a different test on exam days.

Week	Weekly Topic		
Jan 14	Global Warming Basics	Mar 17	Spring Break
Jan 21	Climate Change Impacts	Mar 24	Holocene – Kapapa Stand
Jan 28	GHG projections	Mar 29	Goat Island Field Trip – 8am
Feb 4	Solutions, Rifkin & Sharing Economy	Mar 31	Coastal Processes
Feb 9	Kaena Point Field Trip – 8am	Apr 7	Coastal Processes
Feb 11	IPCC, U.N. Programs	Apr 14	Reefs
Feb 18	The Future	Apr 21	Reefs
Feb 25	Review, Exam I	Apr 26	Kailua Bay Field Trip – 8am
Mar 3	Paleoclimate, Tectonics	Apr 28	Coastal Management
Mar 10	Last Interglacial Cycle	May 5	Wrap-up, FINAL EXAM

Exams 2 exams 30% each; Talks 15% each; In Class Participation 15%; Field Trip Participation 10%

- This course includes physically demanding field trips, if you are not comfortable hiking in the Sun, wading in the ocean, or kayaking in the ocean, its ok to skip a trip with my permission.
- **In-Class Talks** There are lots of subjects to give a talk on, these are only a few:
 - Calculate your Carbon Footprint - walk us thru the process,
 - IPCC 1.5, Land, Ocean & Ice reports,
 - 4thNCA v. I and v.II,
 - Green New Deal,
 - Cultural history of coastal environments,
 - Reef ecology, reef management,
 - Fishery management in Hawai'i,
 - Tuna status,
 - Report on a paper,
 - Carbon sequestration, renewable energy, nuclear power, hydro power
 - Climate change-related events and impacts: suing the oil giants, permafrost melting, boreal forest, CA wildfires, food & water security, carbon sequestration, energy & emissions projections, hurricanes, invasive species, ocean impacts, impacts to Hawai'i, progress with Hawai'i energy/food security, etc.
 - Pacific meteorology
 - Clouds and their role and trends in climate change.
- **Field Trip Talks** there are many subjects, here are some examples:
 - Managing invasive coastal species, Carbonate sand origin, Weather patterns, Limestone history, Tsunami & Hurricane history of Hawai'i, Coastal erosion, Waves and winds of Hawai'i, Reef ecosystems and impacts, etc.
- **Participation, Attendance, Attitude** Trying/Participating matter to me and are part of your grade, "shyness" isn't an excuse.
- **Reading** There may be assigned readings. I've written two books w/ chapters on many subjects we discuss.
 - Fletcher (2010) Living on the Shores of Hawai'i, UH Press: <https://uhpress.hawaii.edu/product/living-on-the-shores-of-hawaii-natural-hazards-the-environment-and-our-communities/>
 - Fletcher (2018) Climate Change, 2nd Edition: What the Science tells us: <https://www.wiley.com/en-us/Climate+Change%3A+What+The+Science+Tells+Us%2C+2nd+Edition-p-9781119399391>
- **Recent Climate Change Reports**
 - Fourth National Climate Assessment (2017) v1, Climate Science Special Report <https://science2017.globalchange.gov>
 - Fourth National Climate Assessment (2018) v2, Impacts, Risks, and Adaptation in the U.S. <https://nca2018.globalchange.gov>

- IPCC: Global Warming of 1.5°C (2018) <https://www.ipcc.ch/sr15/>
- IPCC: Climate Change and Land (2019) <https://www.ipcc.ch/report/srcl/>
- IPCC: Special Report on the Ocean & Cryosphere in a Changing Climate (2019) <https://www.ipcc.ch/srocc/home/>
- Honolulu Climate Change Commission White Papers. <https://www.resilientoahu.org/about-the-commission/>
- **Some Websites**
 - Carbon Brief: <https://www.carbonbrief.org/>
 - Center for Climate and Energy Solutions: <https://www.c2es.org/>
 - Climate Central: <http://www.climatecentral.org/>
 - Climate Change Impacts in Hawai'i: <http://seagrant.soest.hawaii.edu/climate-change-impacts-in-hawaii/>
 - Climate Denial Crock of the Week: <http://www.youtube.com/user/greenman3610>
 - Climate Interactive: <https://www.climateinteractive.org/>
 - Global Warming Photos: <http://www.worldviewofglobalwarming.org/>
 - Hawai'i Climate Adaptation Portal: <http://climateadaptation.hawaii.gov/>
 - UH Mānoa SOEST on Climate: <https://www.soest.hawaii.edu/soestwp/research/themes/climate/>
 - Intergovernmental Panel on Climate Change: <http://www.ipcc.ch/>
 - NASA on Climate: <https://www.nasa.gov/subject/3127/climate/>
 - NOAA's Climate.gov: <https://www.climate.gov/#climateWatch>
 - Real Climate: <http://www.realclimate.org/>
 - Skeptical Science: <http://www.skepticalscience.com> (also available as a free smartphone app)
 - Smithsonian's Forces of Change: <http://forces.si.edu/index.html>
 - Grist's How to Talk to a Climate Skeptic: <http://www.grist.org/article/series/skeptics/>
 - Union of Concerned Scientists on Global Warming: http://www.ucsusa.org/global_warming/
 - United Nations Environment Program on Climate Change: <http://www.unep.org/climatechange/>
 - U.S. Global Change Research Program: <https://www.globalchange.gov/health-assessment>
 - Yale Program on Climate Change Communication: <http://climatecommunication.yale.edu/>
- **Department Learning Objectives** The Department of Earth Sciences has established the following undergraduate student learning objectives.
 - Students can explain the relevance of Earth Sciences to human needs, including those appropriate to Hawai'i, and be able to discuss issues related to geology and its impact on society and planet Earth.
 - Students can apply technical knowledge of relevant computer applications, laboratory methods, and field methods to solve real-world problems in geology and geophysics.
 - Students use the scientific method to define, critically analyze, and solve a problem in earth science.
 - Students can reconstruct, clearly and ethically, geological knowledge in both oral presentations and written reports.
 - Students can evaluate, interpret, and summarize the basic principles of Earth Science, 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.

Sexual Harassment 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. As members of the University faculty, your instructors (including me) 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 have options about how your case will be handled. Our goal is to make you aware of the range of options available to you & have access to the resources & 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 (and see below). <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, intimidation, dating violence or stalking as well as receive information and support, contact: Dee Uwono Title IX Coordinator (808) 956-2299 t9uhm@hawaii.edu; or contact me and I will take you to the Title IX office. Confidential Reporting University of Hawai'i students, faculty and staff have a [whistleblower hotline](#) to confidentially report violations of laws, rules, regulations and UH policies. The hotline advances the university's commitment to encourage and enable any member of UH or the general public to make good faith reports of misconduct. University of Hawaii Whistleblower website:

<https://secure.ethicspoint.com/domain/media/en/gui/40480/index.html>

UH Whistleblower Hotline: 1-855-874-2849

For more information go to UH News at <http://go.hawaii.edu/coj>

READING LIST - EARTH420/620

Texts

- 1) Fletcher, C.H. (2018) *Climate Change: What the Science Tells Us* (2nd Ed.) Wiley & Sons, Hoboken (you can rent the book for \$40) <https://www.wiley.com/en-us/Climate+Change:+What+The+Science+Tells+Us,+2nd+Edition-p-9781118793060>
 - 2) Fletcher, C.H. (2010) *Living on the Shores of Hawaii: Natural Hazards, the Environment, and Our Communities*, (University of Hawai'i Press); <https://uhpress.hawaii.edu/product/living-on-the-shores-of-hawaii-natural-hazards-the-environment-and-our-communities/>
- **Recent Climate Change Reports**
 - Fourth National Climate Assessment (2017) v1, Climate Science Special Report <https://science2017.globalchange.gov>
 - Fourth National Climate Assessment (2018) v2, Impacts, Risks, and Adaptation in the U.S. <https://nca2018.globalchange.gov>
 - IPCC: Global Warming of 1.5°C (2018) <https://www.ipcc.ch/sr15/>
 - IPCC: Climate Change and Land (2019) <https://www.ipcc.ch/report/srccl/>
 - IPCC: Special Report on the Ocean & Cryosphere in a Changing Climate (2019) <https://www.ipcc.ch/srocc/home/>
 - Honolulu Climate Change Commission White Papers. <https://www.resilientoahu.org/about-the-commission/>
 - **Impacts of Global Warming and Climate Change**
 - 1) The Economist, September 21, 2019
 - 2) Marra, J.J., and Kruk, M.C. (2017) *State of Environmental Conditions in Hawai'i and the U.S. Affiliated Pacific Islands under a Changing Climate*: https://coralreefwatch.noaa.gov/satellite/publications/state_of_the_environment_2017_hawaii-usapi_noaa-nesdis-ncei_oct2017.pdf.
 - 3) <https://www.forbes.com/sites/sergeiklebnikov/2019/10/24/stopping-global-warming-will-cost-50-trillion-morgan-stanley-report/#502a8f8651e2>
 - 4) Marcott, S.A. (2013) A Reconstruction of Regional and Global Temperature for the Past 11,300 Years, *Science*, 08 Mar: 1198-1201.
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 - 6) Centre for Research on the Epidemiology of Disasters, UN International Strategy for Disaster Reduction: <http://reliefweb.int/report/world/human-cost-weather-related-disasters-1995-2015>
 - 7) NOAA, Weather Disasters, US (2019) <https://www.ncdc.noaa.gov/billions/time-series>
 - 8) Lehmann, J., et al. (2015) Increased record-breaking precipitation events under global warming, *Climatic Change*, doi: 10.1007/s10584-015-1434-y
 - 9) Does Global Warming Make Hurricanes Stronger? <http://www.realclimate.org/index.php/archives/2018/05/does-global-warming-make-tropical-cyclones-stronger/>

- 10) Kitzberger T, et al. (2017) Direct and indirect climate controls predict heterogeneous early-mid 21st century wildfire burned area across western and boreal North America. *PLoS ONE* 12(12).
<https://doi.org/10.1371/journal.pone.0188486>
- 11) Abatzoglou, J.T., Williams, A.P. (2016) Impact of anthropogenic climate change on wildfire across western U.S. forests. *Proceedings of the National Academy of Sciences*; 201607171 doi: 10.1073/pnas.1607171113
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- 13) Giambelluca, T.W., Diaz, H.F., Elison Timm, O., Takahashi, M., Frazier, A.G., and Longman, R. 2011. Regional climate trends in Hawai'i. American Geophysical Union Fall Meeting, San Francisco, December 2011.
- 14) Trauernicht, C., E. et al. 2015 The contemporary scale and context of wildfire in Hawaii. *Pacific Science* 69:427-444
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- 16) <https://www.wunderground.com/cat6/Hawaii-Warmest-Summer-Record-and-Alaskas-Second-Warmest>
- 17) McKenzie, M.M., Giambelluca, T.W., and Diaz, H.F. Accepted. Regional temperature trends in Hawai'i: a century of change, 1917-2016. *International Journal of Climatology*.
- 18) The IMBIE team (2018) Mass Balance of the Antarctic Ice Sheet, *Nature*, 558, pages219–222,
<https://doi.org/10.1038/s41586-018-0179-y>
- 19) Trusel, et al., 2018 Nonlinear rise in Greenland runoff in response to post-industrial Arctic warming, 104, *Nature*, v564, 6 December: <https://doi.org/10.1038/s41586-018-0752-4>
- 20) Cheng, L., et al. (2019) How fast are the oceans warming? *Science*, 2019 DOI: 10.1126/science.aav7619
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- 22) Glecker, P.J., et al. (2016) Industrial era global ocean heat uptake doubles in recent decades. *Nature Climate change*. doi:10.1038/nclimate2915
- 23) Habel, S., et al. (in review) Compound Flooding Related to Sea-Level Rise and Urban Infrastructure. *Scientific Reports*.
- 24) Habel, S., et al. (2019) Comparison of a simple hydrostatic and a data-intensive 3D numerical modeling method of simulating sea-level rise induced groundwater inundation for Honolulu, Hawai'i, USA. *Environ. Res. Commun.* 1, 041005. doi:10.1088/2515-7620/ab21fe
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<https://www.nature.com/articles/s41598-018-32658-x>
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- 31) Deutsch, C.A., et al. (2018) Increase in crop losses to insect pests in a warming climate, *Science*, 31 August, v. 361, Iss. 6405, p. 916-919
- 32) Springmann, M. et al. Global and regional health effects of future food production under climate change: a modelling study. *The Lancet*, March 2, 2016 DOI: 10.1016/S0140-6736(15)01156-3.

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- 34) Dangerous new hot zones are already appearing:
<https://www.washingtonpost.com/graphics/2019/national/climate-environment/climate-change-world/>
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- 44) Farquharson, et al. (2019) Climate change drives widespread and rapid thermokarst development in very cold permafrost in the Canadian High Arctic, *Geophysical Research Letters*, <https://doi.org/10.1029/2019GL082187>
- 45) Summary for policymakers of global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, 6 May (2019)
http://www.ipbes.net/sites/default/files/downloads/spm_unedited_advance_for_posting_htn.pdf?utm_source=Nature+Briefing&utm_campaign=ef727151d6-briefing-dy-20190507&utm_medium=email&utm_term=0_c9dfd39373-ef727151d6-43423877
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- 50) Global Energy Outlook 2019, The Next Generation of Energy:
https://media.rff.org/documents/GEO_Report_7-19-19.pdf
- 51) Energy Information Administration (2019) <https://www.eia.gov/todayinenergy/detail.php?id=41493>
- 52) Global Carbon Project: <https://www.globalcarbonproject.org>
- 53) Bloomberg News, Morgan-Stanley Report: <https://www.bloomberg.com/news/articles/2019-10-24/-50-trillion-is-needed-to-stop-global-warming-morgan-stanley>
- 54) <https://climatecrocks.com/2019/07/03/battery-costs-shocking-the-system/>
- 55) <https://e360.yale.edu/features/why-chinas-renewable-energy-transition-is-losing-momentum>

- **Coastal Geologic Framework Studies in Hawai'i and across the Pacific**

- 1) Dickinson, W.R. (2001), Paleoshoreline record of relative Holocene sea levels on Pacific islands, *Earth Science Reviews.*, 55, 191 - 234.
- 2) Dickinson, W. R. (2004), Impacts of eustasy and hydro-isostasy on the evolution and landforms of Pacific atolls, *Paleogeography, Paleoclimatology, Paleoecology.*, 213, 251 – 269.
- 3) Dickinson, W.R. (2009), Pacific Atoll Living: How Long Already and Until When?, *GSA Today.*, 19, 4 – 10
- 4) Easton, W.H., and Olson, E.A., 1976. Radiocarbon profile of Hanauma Reef, Oahu, Hawaii. *Geol. Soc. Amer. Bull.*, v. 87, p. 711-719.

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- 6) Fletcher, C.H., and Jones, A.T., 1996. Sea-level highstand recorded in Holocene shoreline deposits on Oahu, Hawaii: *Journal of Sedimentary Research*, v. 66, p. 632-641.
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- 8) Fletcher, C.H., Murray-Wallace, C., Glenn, C., Popp, B., Sherman, C. (2005) Age and Origin of Late Quaternary Eolianite, Kaiehu Point (Moomomi), Molokai, Hawaii. *Journal of Coastal Research*, SI 42, p. 97-112.
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