GT ES 339 &THE CLIMATE CRISIS: GLOBAL PERSPECTIVES, MEDITERRANEAN PRECEDENTS
IES Abroad Barcelona

DESCRIPTION:
This course provides the student with a comprehensive, multi-disciplinary introduction, for the engaged non-specialist, to the causes and consequences of, and responses to, the climate crisis.

We discuss in detail the science of climate breakdown and strategies to ameliorate its impacts. While climate change is a global phenomenon, its consequences are experienced locally. We will therefore focus particular attention on the Mediterranean, where the climate crisis is arriving at an accelerated pace, providing a sneak preview of what is to come. While discussing global processes, we will draw many of our examples from the Mediterranean.

We also explore the social and political context, focusing on the Mediterranean and peri-Mediterranean region – how climate breakdown impacts societies, and how the international polity is attempting to coordinate a global response to the challenge.

While the scope and detail of climate breakdown are almost endless in their complexities and consequences, the fundamental science is quite straightforward and well established. So too are the responses we need to take to minimize and manage the coming disruption. In the words of Jim Yong Kim, former president of the World Bank – Optimism in the face of seemingly intractable problems is a choice. For the seemingly intractable problem of climate breakdown, optimism remains, at least for the moment, a realistic choice.

GLOBAL PILLARS:
This course engages extensively with the IES Global Pillars, but particularly during our discussion of the Barcelona Climate Emergency Action Plan For 2030. This highly regarded strategy document sets out in detail Barcelona City's response to the climate emergency, putting equitability, sustainability, and the well-being of residents front and centre.

CREDITS: 3 credits

CONTACT HOURS: 45 hours

LANGUAGE OF INSTRUCTION: English

INSTRUCTOR:

PREREQUISITES: An introductory basic science course is recommended, but not mandatory.

ADDITIONAL COST: None

METHOD OF PRESENTATION:
- Lectures: presenting the core course content. The major themes of the course will be explored and the readings for the session placed in context, whether they be case studies illustrating important concepts, key research underpinning major topics, or review papers offering broad overviews of the current state of the art.
- Readings: required readings include case studies, review papers, and assessment reports. **Case studies** provide in-depth insight into specific topics covered in less detail during the lectures, presenting students with the responsibility to deepen their knowledge of a topic by pursuing independent study. **Review papers** provide broad overviews of large bodies of accumulated scientific knowledge. They provide a valuable opportunity to learn how science progresses. Where review papers are included in the readings, they will typically also be dealt with at some length during the lectures. Finally, **assessment reports** (we will use their Summaries for Policymakers - SPMs) are key documents produced by the IPCC and other organizations, and we will explore the contents and significance of several of the most important examples.
- Structured Reading Seminars: each session will begin with a 30-minute seminar discussing the readings for that class. This will be a structured and graded exercise, where specific students will make particular, prepared contributions to the activity.

- In the news: after the seminar, we will have a brief period for the class to discuss active news stories they have come across in the previous days. We will add headlines to a class document, and at the end of the course, we will review the document to see how perspectives have changed and knowledge has deepened as a result of the class.
- Field trip: students will participate in a self-guided exercise in the city of Barcelona, designed to connect course themes with the lived urban environment. This activity will engage students with local examples of climate adaptation and resilience, complementing class discussions and readings. Students will complete a short structured task during the exercise, which will be submitted for assessment.
- Wikipedia project: working in groups, and using the Wikiedu infrastructure, students will develop and publish a new Wikipedia page on a climate crisis topic.

REQUIRED WORK AND FORM OF ASSESSMENT:

- Course Participation - 5%
- Midterm Exam - 20%
- Final Exam - 20%
- Structured Reading Seminars - 20%
- Wikipedia project and Oral Presentation - 25%
- Field trip - 10%

Course Participation

Students are expected to invest a significant amount of time preparing for classes. The academic standard at IES specifies *at least* two hours' prep time for each hour of class time. As a minimum, all students must arrive at class already familiar with the material in the readings for that class, to enable them to participate effectively in the Reading Seminar activity. They should also pay attention to news sources and make note of climate breakdown stories they come across which we can discuss in class. A rubric for participation is available on Moodle and will be distributed on the first day of class.

Midterm Exam

The midterm will consist of a set of short-answer, multiple-choice, and short essay questions, to evaluate students' command of the topics discussed in class and in the required readings.

Final Exam

The final exam will consist of a set of short-answer, multiple-choice, and short essay questions, to evaluate students' command of the topics discussed in class and in the required readings.

Structured Reading Seminars

Confronting primary scientific literature is a significant intellectual challenge. The seminars will provide guidance and practice on how to assimilate such material. This activity also will expose students to highly effective study techniques (Mind Maps and Cornell Notes) which will be of value throughout their academic and later career. During the course, students will take on different tasks during at least five seminars, such as Presenter (once), Recorder (once), and Discussion Panel (at least three times). They will produce summary materials (both ahead of class and during the seminars in real time) that will be made available to the whole class as study aids for the mid-term and final exams. A grading rubric will be available to students to accompany this evaluated work.

Wikipedia Project and Oral Presentation

Working in groups, and using the Wikiedu infrastructure, students will develop and publish a new Wikipedia page on a climate crisis topic. They will learn how to write factual, neutral, citation-supported content for a general audience. Students will learn the technicalities of editing Wikipedia entries, a useful transferable skill for the future workplace. They will follow a structured, formal group-working process modelled on standard business practices such as organizing work around minuted meetings that address pre-prepared agendas. Their work product will be a new, live Wikipedia page with usage stats - a useful, real-world output, suitable for inclusion in a portfolio of work examples.

LEARNING OUTCOMES:

By the end of the course, students will be able to:

- Describe the main processes that control our climate
- Compare the mechanisms driving recent (anthropogenic) global heating with those that operated during episodes of climate change in the history of the earth
- Describe how the Mediterranean region is undergoing accelerated heating, provide examples of how that is affecting the region, and analyze responses to that challenge
- Analyze current and future impacts of climate change on natural systems and the implications for political, economic and social change
- Assess the options for mitigation of and adaptation to climate change
- Evaluate the achievements and shortcomings of the UNFCCC negotiation process
- Evaluate and synthesize material from primary scientific literature using effective techniques such as Mind Maps and Cornell Notes

ATTENDANCE POLICY:
As a member of our class community, you are expected to be present and on time every day. Attending class has an impact on your learning and academic success. For this reason, attendance is required for all IES Barcelona classes, including course-related excursions. If a student misses more than three classes in any course without justification, 3 percentage points will be deducted from the final grade for every additional absence. Seven unjustified absences in any course will result in a failing grade. Absences will only be justified, and assessed work, including exams, tests and presentations rescheduled, in cases of documented medical or family emergencies.

CONTENT:

Session	Content	Assignments
Session 1	**Introduction to the course**	● Introduction to the course.
Part 1: Perspectives		
Session 2	**Disinformation 1: Escape game**	● Lewandowsky, Stephan, et al. (2020). The debunking handbook 2020. DOI:10.17910/b7.1182 ● Tversky, A., & Kahneman, D. Judgment under Uncertainty: Heuristics and Biases, 1124–1131. (7 pages)
Session 3	**Disinformation 2**	● CCDH (2024). The New Climate Denial: how social media platforms and content producers profit by spreading new forms of climate denial. Center for Countering Digital Hate https://counterhate.com/research/new-climate-denial/ ● Hauser, O. P., Hendriks, A., Rand, D. G., & Nowak, M. A., Think global, act local: Preserving the global commons. (7 pages) ● Chenoweth, E., & Stephan, M. J. Drop your weapons: When and why civil resistance works, 94-106. (12 pages)

Session	Content	Assignments
Session 4	**The Great Dying(s)** ● Mass extinction events ● The Great Dying	● Penn, J. L., Deutsch, C., Payne, J. L., & Sperling, E. A., Temperature-dependent hypoxia explains biogeography and severity of end-Permian marine mass extinction (8 pages) ● Kump, L. (2018). Climate change and marine mass extinction, pgs. 1113-1114. ● Benton, M. J. (2018). Hyperthermal-driven mass extinctions: killing models during the Permian–Triassic mass extinction. (19 pages)
Session 5	**The Great Acceleration & the Anthropocene** ● The Great Acceleration ● Welcome to the Anthropocene ● The 6th Mass Extinction	● Newbold, T., Hudson, L. N., Arnell, A. P., Contu, S., De Palma, A., Ferrier, S. & Burton, V. J., Has land use pushed terrestrial biodiversity beyond the planetary boundary? A global assessment. *Pgs.* 288-291. (3 pages) ● Steffen, W., Rockström, J., Richardson, K., Lenton, T. M., Folke, C., Liverman, D., & Donges, J. F. Trajectories of the Earth System in the Anthropocene, 8252-8259. (7 pages)
Session 6	**The 1.5°C target** ● https://interactive.carbonbrief.org/impacts-climate-change-one-point-five-degrees-two-degrees/	● Urban, M. C. (2015). Accelerating extinction risk from climate change, pgs. 571-573. (2 pages) ● Lambers, J. H. R. (2015). Extinction risks from climate change, 501-502. ● Bestion, E., Teyssier, A., Richard, M., Clobert, J., & Cote, J., Live fast, die young: experimental evidence of population extinction risk due to climate change (19 pages)
Session 7	**Pathways to 1.5°C** ● IPCC Special Report on warming of 1.5°C (2018) ● IPCC AR6 Synthesis Report (2023)	● Lister, B. C., & Garcia, A. Climate-driven declines in arthropod abundance restructure a rainforest food web. *(*10 pages) ● Hallmann, C. A., Sorg, M., Jongejans, E., Siepel, H., Hofland, N., Schwan, H., & Goulson, D. More than 75 percent decline over 27 years in total flying insect biomass in protected areas. *(*21 pages)
Part 2: Climate Science		
Session 8	**Major climate drivers 1 - the atmosphere** ● Heat; solar radiation; radiative heat balance; seasonality ● Atmospheric circulation; Hadley, Ferrel & polar cells ● The jet streams (polar vortex & subtropical jet) ● Rotational systems; Coriolis effect ● The water cycle ● https://earth.nullschool.net	● Francis, J. A., & Vavrus, S. J., Evidence for a waiver jet stream in response to rapid Arctic warming. (12 pages) ● Cohen, J., Screen, J. A., Furtado, J. C., Barlow, M., Whittleston, D., Coumou, D., & Jones, J., Recent Arctic amplification and extreme mid-latitude weather. (11 pages)

Session	Content	Assignments
Session 9	**Major climate drivers 2 – thermohaline circulation** ● Mediterranean thermohaline circulation ● Global thermohaline circulation ● Atlantic meridional overturning circulation ● Heat transport ● Nutrient uplift ● Oxygen, carbon and nitrogen cycles	● Roether, W., Klein, B., & Hainbucher, D., The Eastern Mediterranean Transient, pgs. 75–83. (8 pages) ● Schmidtko, S., Stramma, L., & Visbeck, M., Decline in global oceanic oxygen content during the past five decades, pgs. 335-339. (4 pages) ● Rahmstorf, S. (2024). Is the Atlantic overturning circulation approaching a tipping point?. *Oceanography*, 37(3), 16-29.

Session 10	**Major climate drivers 3 – regional effects, cycles, trends and events**
	
	● Coastal and continental climates
	● The Mediterranean climate and its evolution
	● Oscillations – ENSO; NAO; AO
	● Glaciation; the Younger Dryas
	● Volcanism
	● Warming and cooling events during human history & pre-history
	  ○ Medieval Warm Period
	  ○ Little Ice Age
		● Tapley, B. D., Watkins, M. M., Flechtner, F., Reigber, C., Bettadpur, S., Rodell, M., & Reager, J. T. Contributions of GRACE to understanding climate change. *(*12 pages)
		● DeMenocal, P. B. Cultural responses to climate change during the late Holocene, pgs. 667-673. (6 pages

Session 11	**Greenhouse Earth 1** ● The greenhouse gas effect ● CO_2; CH_4; NO_4 etc. ● IPCC WGI Physical Science Basis SPM 2021	● Chadburn, S. E., Burke, E. J., Cox, P. M., Friedlingstein, P., Hugelius, G., & Westermann, S. An observation-based constraint on permafrost loss as a function of global warming, 340-344. (4 pages) ● Schuur, E. A., McGuire, A. D., Schädel, C., Grosse, G., Harden, J. W., Hayes, D. J., ... & Natali, S. M. Climate change and the permafrost carbon feedback, 171-179. (8 pages)
Session 12	**MIDTERM EXAM**	
Session 13	**Greenhouse Earth 2** ● Natural sources ● Anthropogenic sources incl. LUC ● Triggered sources incl. methane hydrates in permafrost ● Sinks ● The past and future of atmospheric CO_2 and methane	● Mestdagh, T., Poort, J., & De Batist, M. The sensitivity of gas hydrate reservoirs to climate change: Perspectives from a new combined model for permafrost-related and marine settings. 104-131. (27 pages)

Session	Content	Assignments
Session 14	**Impacts and signals 1: a menagerie of extremities** ● Attribution science ● Climate models ● The temperature record ● Extreme weather events ● The Beast from the East and the polar vortex ● Hurricane formation and decapitation ● Cyclone Idai ● Midwest floods of 2019 ● Australia's Angry Summer 2012/13 ● Thermal stress ● Ocean acidification ● Sea level rise	● Sully, S., Burkepile, D. E., Donovan, M. K., Hodgson, G., & van Woesik, R. A global analysis of coral bleaching over the past two decades. *(*5 pages) ● Yi, S., Heki, K., & Qian, A. Acceleration in the global mean sea level rise: 2005–2015. (8 pages) ● Lo, Y. T., & Roberts, W. Increasing mitigation ambition to meet the Paris Agreement's temperature goal avoids substantial heat-related mortality in US cities. (9 pages)

Session 15	**Impacts & signals 2: global ice**
	
	● Retreating icecaps and glaciers
	● The end of the Arctic is nigh
	● Faster than the speed of science (retreat is much more pronounced than predicted)
	● 10,000 tonnes per second
	● Mediterranean ice & the Little Ice Age
	● Impacts and feedbacks
	  ○ albedo
	  ○ sea level
	  ○ global thermohaline circulation
		● Malyarenko, A., Robinson, N. J., Williams, M. J. M., & Langhorne, P. J. A Wedge Mechanism for Summer Surface Water Inflow Into the Ross Ice Shelf Cavity, 1196-1214. (18 pages)
		● Knudsen, E. M., Orsolini, Y. J., Furevik, T., & Hodges, K. I. Observed anomalous atmospheric patterns in summers of unusual Arctic Sea ice melt, 2595-2611. (16 pages)

Session 16	**Impacts & signals 3: the Mediterranean** ● The EMT ● 1.5°C is already here (1.6°C in Catalunya) ● European wildfires ● Water shortages ● Droughts and floods ● Desertification ● Catalunya ● MedECC	● Peñuelas, J., Sardans, J., Filella, I., Estiarte, M., Llusià, J., Ogaya, R., & Peguero, G. Assessment of the impacts of climate change on Mediterranean terrestrial ecosystems based on data from field experiments and long-term monitored field gradients in Catalonia, 49-59. (10 pages) ● Cramer, W., Guiot, J., Fader, M., Garrabou, J., Gattuso, J. P., Iglesias, A., & Penuelas, J. Climate change and interconnected risks to sustainable development in the Mediterranean, 972-980. (8 pages) ● Guiot, J., & Cramer, W. Climate change: The 2015 Paris Agreement thresholds and Mediterranean basin ecosystems, 465-468. (3 pages)
Part 3: Political and policy responses		

Session	Content	Assignments
Session 17	**Barcelona Climate Adaptation Plan 1**	● Harrison, D. P. Global negative emissions capacity of ocean macronutrient fertilization. *(*10 pages) ● Hauck, J., Köhler, P., Wolf-Gladrow, D., & Völker, C. Iron fertilisation and century-scale effects of open ocean dissolution of olivine in a simulated CO2 removal experiment. *(*12 pages)
Session 18	**Barcelona Climate Adaptation Plan 2**	● Garrote, L., Iglesias, A., Granados, A., Mediero, L., & Martin-Carrasco, F. Quantitative assessment of climate change vulnerability of irrigation demands in Mediterranean Europe, 325-338. (13 pages) ● Ferrise, R., Trombi, G., Moriondo, M., & Bindi, M. Climate change and grapevines: A simulation study for the Mediterranean basin, 88-104. (16 pages)
Session 19	**Non-state actors/AFR 100 case study**	● Dirix, J., Peeters, W., & Sterckx, S. Is the clean development mechanism delivering benefits to the poorest communities in the developing world? A critical evaluation and proposals for reform, 839-855. (16 pages)
Session 20	**Wikipedia Presentations 1**	
Session 21	**Wikipedia Presentations 2**	
Session 22	**Fire management in the Mediterranean**	
Session 23	**Climate, food & conflict in the Mediterranean** ● Food production – historical growth, future requirements, and constraints ● Wheat yield and global heating ● Water conflicts – local, regional & international ● Fertile crescent drought, Arab spring, Syria, Sudan, Libya, North Africa, Lake Chad basin ● Climate migration ● The climate-conflict nexus ● Ecological panic & the next genocide ● The security community response	● Kelley, C. P. et al. Climate change in the Fertile Crescent and implication of the recent Syrian drought, 3241–3246. (5 pages) ● Xie, X., Hao, M., Ding, F., Scheffran, J., Ide, T., Maystadt, J. F., ... & Jiang, D. (2024). The impacts of climate change on violent conflict risk: a review of causal pathways. *Environmental Research Communications*.

Session	Content	Assignments
Session 24	**Reasons to be cheerful** ● Lessons from history are valuable, ideas are important ● Technological horizons ● Scientific knowledge base ● Political developments ● Military/security community involvement ● Social, ecological and economic dividends of mitigation and adaptation policies ● Is optimism helpful? ● *Review of the In the news items discussed throughout the course*	

REQUIRED READINGS:

- Benton, M. J. (2018). Hyperthermal-driven mass extinctions: killing models during the Permian–Triassic mass extinction. *Phil. Trans. R. Soc. A*, 376(2130), 20170076. 19 pp.
- Bestion, E., Teyssier, A., Richard, M., Clobert, J., & Cote, J. (2015). Live fast, die young: experimental evidence of population extinction risk due to climate change. *PLoS Biology*, 13(10), e1002281. 19 pp.
- CCDH (2024). The New Climate Denial: how social media platforms and content producers profit by spreading new forms of climate denial. Center for Countering Digital Hate https://counterhate.com/research/new-climate-denial/
- Chadburn, S. E., Burke, E. J., Cox, P. M., Friedlingstein, P., Hugelius, G., & Westermann, S. (2017). An observation-based constraint on permafrost loss as a function of global warming. *Nature Climate Change*, 7(5), 340-344.
- Chenoweth, E., & Stephan, M. J. (2014). Drop your weapons: When and why civil resistance works. *Foreign Aff.*, 93, pp. 94-106.
- Cohen, J., Screen, J. A., Furtado, J. C., Barlow, M., Whittleston, D., Coumou, D., ... & Jones, J. (2014). Recent Arctic amplification and extreme mid-latitude weather. *Nature Geoscience*, 7(9), 627. 11 pp.
- Cramer, W., Guiot, J., Fader, M., Garrabou, J., Gattuso, J. P., Iglesias, A., & Penuelas, J. (2018). Climate change and interconnected risks to sustainable development in the Mediterranean. *Nature Climate Change 8*: 972-980.
- DeMenocal, P. B. (2001). Cultural responses to climate change during the late Holocene. *Science*, 667-673.
- Dirix, J., Peeters, W., & Sterckx, S. (2016). Is the clean development mechanism delivering benefits to the poorest communities in the developing world? A critical evaluation and proposals for reform. *Environment, development and sustainability*, 18(3), 839-855.
- Ferrise, R., Trombi, G., Moriondo, M., & Bindi, M. (2016). Climate change and grapevines: A simulation study for the Mediterranean basin. *Journal of Wine Economics*, 11(1), 88-104.
- Francis, J. A., & Vavrus, S. J. (2015). Evidence for a waiver jet stream in response to rapid Arctic warming. *Environmental Research Letters*, 10(1), 014005. 12 pp.
- Garrote, L., Iglesias, A., Granados, A., Mediero, L., & Martin-Carrasco, F. (2015). Quantitative assessment of climate change vulnerability of irrigation demands in Mediterranean Europe. *Water resources management*, 29(2), 325-338.
- Guiot, J., & Cramer, W. (2016). Climate change: The 2015 Paris Agreement thresholds and Mediterranean basin ecosystems. *Science*, 354(6311), 465-468.
- Hallmann, C. A., Sorg, M., Jongejans, E., Siepel, H., Hofland, N., Schwan, H., & Goulson, D. (2017). More than 75 percent decline over 27 years in total flying insect biomass in protected areas. *PloS one*, 12(10), e0185809. 21 pp.
- Harrison, D. P. (2017). Global negative emissions capacity of ocean macronutrient fertilization. *Environmental Research Letters*, 12(3), 035001. 10 pp.
- Hauck, J., Köhler, P., Wolf-Gladrow, D., & Völker, C. (2016). Iron fertilisation and century-scale effects of open ocean dissolution of olivine in a simulated CO2 removal experiment. *Environmental Research Letters*, 11(2), 024007. 12 pp.
- Hauser, O. P., Hendriks, A., Rand, D. G., & Nowak, M. A. (2016). Think global, act local: Preserving the global commons. *Scientific Reports*, 6(1). 7 pp.
- Kelley, C. P. et al. (2015). Climate change in the Fertile Crescent and implication of the recent Syrian drought. *Proc. Natl Acad. Sci. USA* 112, 3241–3246.

- Knudsen, E. M., Orsolini, Y. J., Furevik, T., & Hodges, K. I. (2015). Observed anomalous atmospheric patterns in summers of unusual Arctic Sea ice melt. *Journal of Geophysical Research: Atmospheres*, 120(7), 2595-2611.
- Kump, L. (2018). Climate change and marine mass extinction. *Science*, 362(6419), 1113-1114.
- Lambers, J. H. R. (2015). Extinction risks from climate change. *Science*, 348(6234), 501-502.
- Lewandowsky, Stephan, et al. (2020). The debunking handbook 2020. DOI:10.17910/b7.1182
- Lister, B. C., & Garcia, A. (2018). Climate-driven declines in arthropod abundance restructure a rainforest food web. *Proceedings of the National Academy of Sciences*, 115(44), E10397-E10406. 10 pp.
- Lo, Y. T., & Roberts, W. (2019). Increasing mitigation ambition to meet the Paris Agreement's temperature goal avoids substantial heat-related mortality in US cities. *Science Advances*. 9 pp.
- Malyarenko, A., Robinson, N. J., Williams, M. J. M., & Langhorne, P. J. (2019). A Wedge Mechanism for Summer Surface Water Inflow into the Ross Ice Shelf Cavity. *Journal of Geophysical Research: Oceans*, 124(2), 1196-1214.
- Mestdagh, T., Poort, J., & De Batist, M. (2017). The sensitivity of gas hydrate reservoirs to climate change: Perspectives from a new combined model for permafrost-related and marine settings. *Earth-science Reviews*, 169, 104-131.
- Newbold, T., Hudson, L. N., Arnell, A. P., Contu, S., De Palma, A., Ferrier, S., & Burton, V. J. (2016). Has land use pushed terrestrial biodiversity beyond the planetary boundary? A global assessment. *Science*, 353(6296), 288-291.
- Penn, J. L., Deutsch, C., Payne, J. L., & Sperling, E. A. (2018). Temperature-dependent hypoxia explains biogeography and severity of end-Permian marine mass extinction. *Science*, 362(6419), eaat1327. 8 pp.
- Peñuelas, J., Sardans, J., Filella, I., Estiarte, M., Llusià, J., Ogaya, R., ... & Peguero, G. (2018). Assessment of the impacts of climate change on Mediterranean terrestrial ecosystems based on data from field experiments and long-term monitored field gradients in Catalonia. *Environmental and Experimental Botany*, 152, 49-59.
- Rahmstorf, S. (2024). Is the Atlantic overturning circulation approaching a tipping point?. *Oceanography*, 37(3), 16-29.
- Roether, W., Klein, B., & Hainbucher, D. (2014). The Eastern Mediterranean Transient. *Geophysical Monograph Series 202*, 75–83.
- Schmidtko, S., Stramma, L., & Visbeck, M. (2017). Decline in global oceanic oxygen content during the past five decades. *Nature*, 542(7641), 335-339.
- Schuur, E. A., McGuire, A. D., Schädel, C., Grosse, G., Harden, J. W., Hayes, D. J., & Natali, S. M. (2015). Climate change and the permafrost carbon feedback. *Nature*, 520(7546), 171-179.
- Steffen, W., Rockström, J., Richardson, K., Lenton, T. M., Folke, C., Liverman, D., & Donges, J. F. (2018). Trajectories of the Earth System in the Anthropocene. *Proceedings of the National Academy of Sciences*, 115(33), 8252-8259.
- Sully, S., Burkepile, D. E., Donovan, M. K., Hodgson, G., & van Woesik, R. (2019). A global analysis of coral bleaching over the past two decades. *Nature Communications*, 10(1), 1264. 5 pp.
- Tapley, B. D., Watkins, M. M., Flechtner, F., Reigber, C., Bettadpur, S., Rodell, M., & Reager, J. T. (2019). Contributions of GRACE to understanding climate change. *Nature Climate Change*, 1. 12 pp.
- Tversky, A., & Kahneman, D. (1974). Judgment under Uncertainty: Heuristics and Biases. *Science*, 185(4157), 1124–1131.
- Urban, M. C. (2015). Accelerating extinction risk from climate change. *Science*, 348(6234), 571-573.
- Xie, X., Hao, M., Ding, F., Scheffran, J., Ide, T., Maystadt, J. F., ... & Jiang, D. (2024). The impacts of climate change on violent conflict risk: a review of causal pathways. *Environmental Research Communications*.
- Yi, S., Heki, K., & Qian, A. (2017). Acceleration in the global mean sea level rise: 2005–2015. *Geophysical Research Letters*, 44(23). 8 pp.

RECOMMENDED READINGS:

- Snyder, T. (2016). *Black Earth: The Holocaust as History and Warning*. **Seal Books**, USA. 480 pp.
  This masterful re-interpretation of the Holocaust by one of today's most prominent historians may be a surprising recommendation for a course on the climate crisis. Snyder explains how the Nazis manufactured an ecological panic (known as Lebensraum) that led to a war of colonisation in Eastern Europe. With the coming of the climate crisis and real ecological panics, he provides an advance warning of the potential scale of the upheavals to come and how we may head them off.
- Thoreau, H.D. (1849). *Resistance to Civil Government (Civil Disobedience)*. 23 pp.
  The original essay on civil disobedience, thought to have been read by up to 10% of the US population prior to the civil war.
- Wallace-Wells, D. (2017). The Uninhabitable Earth. *New York Magazine*, July.
  An essay (which went viral) about the worst-case scenarios of the climate crisis that nobody was talking about.