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, focussing 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

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 organisations, 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.
- Course-related trip: a mandatory, full-day course-related trip to the Delta d'Ebro. This will take place on a Friday. The Delta d'Ebro is a UNESCO World Heritage site. The landscape faces a range of threats related to climate change. During our visit we will explore the ecological, social, and economic impacts of accelerated climate change in a fragile landscape.
- 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%
- Course-related 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 organising 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 analyse responses to that challenge
- Analyse 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.
Session 2	**Part I: Perspectives** **It is, I promise, worse than you think** • Scientific reticence • The climate change baseline • The A-bomb metric • What to expect: temperatures – food – plagues – air pollution – conflict – economic collapse – oceanic death – mass extinction – Hothouse Earth – ecological panic – genocide • *Introduction to the Structured Reading Seminars, and the Cornell Notes and Mind Maps study technique*	• Vittecoq, M., Thomas, F., Jourdain, E., Moutou, F., Renaud, F., & Gauthier-Clerc, M., Risks of emerging infectious diseases: Evolving threats in a changing area, the Mediterranean basin, 17-27, 2014. (10 pages) • Hauser, O. P., Hendriks, A., Rand, D. G., & Nowak, M. A., Think global, act local: Preserving the global commons. (7 pages)

Session	Content	Assignments
Session 3	**The Great Dying(s)** ● Mass extinction events ● The Great Dying ● The Great Acceleration ● Welcome to the Anthropocene ● The 6th Mass Extinction	● 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) ● 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)
Session 4	**1.5°C** ● IPCC Special Report on warming of 1.5°C (2018) ● 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 5	**Part II: Climate Science** **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 6	**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., Box, J. E., Feulner, G., Mann, M. E., Robinson, A., Rutherford, S., & Schaffernicht, E. J. (2015). Exceptional twentieth-century slowdown in Atlantic Ocean overturning circulation, 475-480. (5 pages)

Session 7	**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 8	**Greenhouse Earth** ● The greenhouse gas effect ● CO_2; CH_4; NO_4 etc. ● Natural sources ● Anthropogenic sources incl. LUC ● Triggered sources incl. methane hydrates in permafrost ● Sinks ● The past and future of atmospheric CO_2 and methane ● IPCC WGI Physical Science Basis SPM 2013	● 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) ● 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 9	**Impacts and signals 1** ● 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)
Course-related trip	Full-day excursion to the Delta d'Ebro	Takes place on a Friday, date tbc.

Session 10	**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 11	**Impacts & signals 3: the Mediterranean** ● The EMT ● 1.5°C is already here (1.6°C in Catalunya) ● European wildfires 2018 ● 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)

Session	Content	Assignments
Session 12	**MIDTERM EXAM**	
Session 13	**Abrupt climate change** ● Positive and negative feedbacks ● Non-linearity, thresholds, interactions and tipping points ● Hothouse Earth ● Abrupt climate change in the geological record ● Recent and historical abrupt changes in the Mediterranean climate	● 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) ● Schroeder, K., Chiggiato, J., Bryden, H. L., Borghini, M., & Ismail, S. B. Abrupt climate shift in the Western Mediterranean Sea. *(*7 pages)
Session 14	**Wildlife and ecosystems** ● Ecosystem services ● The values of wildlife ● Drivers of change: ○ changes in land and sea use ○ direct exploitation of organisms ○ climate change ○ pollution ○ invasive alien species ● UN Global assessment report on biodiversity and ecosystem services (2019) ● WWF Living Planet Report – 2018	● 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)
Session 15	**Part III: Social, political and policy responses** **UNFCCC, IPCC, and the global treaty process** ● The Convention – The Kyoto Protocol – The Paris Agreement – Bodies – Parties & Non-Party Stakeholders – Conferences ● Negotiating groups (G-77, African Group, EU, EIG, LDCs etc.) ● The IPCC and the SBSTA ● Mitigation targets, commitments, and horse-trading ● Minilateralism and climate clubs	● Ciplet, D., & Roberts, J. T. Climate change and the transition to neoliberal environmental governance, 148-156. (8 pages) ● Hjerpe, M., & Nasiritousi, N. Views on alternative forums for effectively tackling climate change, 864 -867. (3 pages) ● Falkner, R. Towards minilateralism, 805–806. **(*)** ● Falkner, R. A minilateral solution for global climate change? On bargaining efficiency, club benefits, and international legitimacy, 87-101. (14 pages)

Session	Content	Assignments
Session 16	**Mitigation policies & flexibility mechanisms** ● Gender equity ● Climate Smart Agriculture (CSA) ● EU policy development ● Carbon trading (cap and trade) ● Clean Development Mechanism ● Carbon trading in the European Union (EU ETS) ● Carbon pricing (trading scheme vs. carbon tax) ● The Social Cost of Carbon (SCC)	● Clapp, J., Newell, P., & Brent, Z. W. The global political economy of climate change, agriculture and food systems, 80-88. (8 pages) ● 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 17	**Mitigation technologies** ● CCMTs ● Geoengineering – CDR & SRM ● Renewables in Europe ● Nuclear ● Carbon Capture Technologies ● Artificial photosynthesis ● Decarbonising the economy ● Climate restoration	● 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	**Adaptation planning in Barcelona** ● Barcelona Climate Emergency Action Plan For 2030	● 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	**Wikipedia Presentations 1**	
Session 20	**Wikipedia Presentations 2**	

Session	Content	Assignments
Session 21	**Political analysis** ● The Five Horsemen of the Modern Day Apocalypse ● Geopolitics of the coming energy transition ● Big Oil spends $1Bn lobbying since Paris ● Psychology & politics of denial ● Misinformation & how to debunk it	● Lewandowsky, S., Ecker, U. K., & Cook, J. Beyond misinformation: Understanding and coping with the post-truth era, 353-369. (16 pages) ● Hodges, A. How to Counter Misinformation, 263–266. (3 pages) ● Scheufele, D. A., & Krause, N. M. Science audiences, misinformation, and fake news, 7662-7669. (7 pages) ● Tversky, A., & Kahneman, D. Judgment under Uncertainty: Heuristics and Biases, 1124–1131. (7 pages)

Session 22	**Public perceptions & activism**
	
	● Human cognitive biases – problems of scale, risk, and abstraction
	● Global commons vs. human scales
	● Giving up on the UNFCCC?
	● Crowds are not power
	● Designing social movements:
	  ○ Civil disobedience
	  ○ The civil resistance model: lots of people – go to the capital city – break the law – strictly non-violent – persist – have fun
	  ○ Extinction Rebellion
		● de Moor, J. The 'efficacy dilemma' of transnational climate activism: the case of COP21, 1079-1100. (21 pages)
		● Chenoweth, E., & Stephan, M. J. Drop your weapons: When and why civil resistance works, 94-106. (12 pages)

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	● Wang, J., Vanga, S., Saxena, R., Orsat, V., & Raghavan, V. Effect of climate change on the yield of cereal crops: A review. (19 pages) ● Kelley, C. P. et al. Climate change in the Fertile Crescent and implication of the recent Syrian drought, 3241–3246. (5 pages) ● Zhang, H., & Li, M. Hunting for Food: A New Driver in Chinese Foreign Policy, 259–291. (32 pages)

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*	● Van der Linden, S., Maibach, E., & Leiserowitz, A. Improving public engagement with climate change: Five best practice insights from psychological science, 758-763. (5 pages) ● Moser, S. C. Reflections on climate change communication research and practice in the second decade of the 21st century: what more is there to say? 345–369. (24 pages)

(*) *These papers are short commentaries on the immediately preceding paper. The two should be read together. The commentaries interpret the broader significance of the main paper and generally provide very useful insights.*

COURSE RELATED TRIPS:

- Delta d'Ebro

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.
- 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.
- Ciplet, D., & Roberts, J. T. (2017). Climate change and the transition to neoliberal environmental governance. *Global environmental change*, 46, 148-156.
- Clapp, J., Newell, P., & Brent, Z. W. (2018). The global political economy of climate change, agriculture and food systems. *The Journal of Peasant Studies*, 45(1), 80-88.
- 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.
- de Moor, J. (2018). The 'efficacy dilemma' of transnational climate activism: the case of COP21. *Environmental politics*, 27(6), 1079-1100.
- 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.
- Falkner, R. (2015). Towards minilateralism. *Nature Climate Change*, 5(9), 805–806.
- Falkner, R. (2016). A minilateral solution for global climate change? On bargaining efficiency, club benefits, and international legitimacy. *Perspectives on Politics*, 14(1), 87-101.
- 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.
- Hjerpe, M., & Nasiritousi, N. (2015). Views on alternative forums for effectively tackling climate change. *Nature Climate Change*, 5(9), 864 -867.
- Hodges, A. (2018). How to Counter Misinformation. *Anthropology News*, 59(4), 263–266.
- 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, S., Ecker, U. K., & Cook, J. (2017). Beyond misinformation: Understanding and coping with the post-truth era. *Journal of Applied Research in Memory and Cognition*, 6(4), 353-369.
- 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.
- Moser, S. C. (2016). Reflections on climate change communication research and practice in the second decade of the 21st century: what more is there to say? *Wiley Interdisciplinary Reviews: Climate Change*, 7(3), 345–369.
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RECOMMENDED READINGS:

- Cook, J. & Lewandowsky, S. (2011). *The Debunking Handbook*. **University of Queensland,** St. Lucia, Australia. 9 pp.
- *Useful lessons in an easy-to-use format from psychological research into how to correct people's misconceptions about factual information.*
- Diamond, J. (2005, 2011). *Collapse: How Societies Choose to Fail or Succeed.* **Viking Press**, USA. 608 pp.
- *A review of how some societies have successfully responded to environmental challenges and survived for millennia, and how others have failed.*
- Extinction Rebellion (2019). *This Is Not a Drill: An Extinction Rebellion Handbook*. **Penguin**. 160 pp.
- *An expanded version of the handbook by Hallam.*
- Hallam, R. (2019). *Common Sense for The 21st Century: Only Non-violent Rebellion Can Now Stop Climate Breakdown and Social Collapse.* 62 pp.
- *The handbook of Extinction Rebellion, inspired by Henry Thoreau and informed by social science research into how successful social movements are organized.*
- 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.*