Climate Change Risk Analysis (Spring 2021)

16:107:572 / 16:218:602 / 34:970:655

Thursdays, 2:15pm-5:15pm via Zoom

Professor Robert Kopp
Email: Robert.Kopp@rutgers.edu / *Twitter:* @bobkopp

Professor Enrique Curchitser
Email: enrique@esm.rutgers.edu

Catalog Course Description: Science, economics and public policy of climate change risks. Extreme events, sea-level rise, agriculture, energy, health, labor, crime and violence, supply chain disruptions, ecosystem services, tipping points. Global and regional climate modeling, integrated assessment modeling, decision-making under uncertainty and with long time horizons. Climate change adaptation and resilience.

Extended Course Description (subject to revision): As climate change intensifies over the course of the century, climate models project that heat waves will become more frequent and intense and that intense downpours will become more common. Sea level rise will increase the flooding associated with storm events. If greenhouse gas emissions continue unabated through the end of the 22nd century, significant parts of the eastern United States may become physiologically uninhabitable during the hottest days of the summer. This graduate course will examine the natural science, impact science and economic literature on the uncertainties and risks associated with climate change, and the challenges of linking together research in these disciplines.

Student Expectations (subject to revision): Students are expected to (1) attend all class sessions and participate in discussions; (2) rotate through leading discussions; and (3) contribute to a team preparing a proposal for a climate risk assessment.

The leaders of each class session should look over candidate readings two weeks before their assigned date, and confer with the instructors to finalize the list. Note that the final list of selected readings should strike a balance between review articles and articles describing specific analyses.

Grading (subject to revision): 30% final proposal, 40% discussion participation, 30% discussion leading

Course Topics (subject to revision – may be adjusted based on student interests)

Week	Date	Topic
1	21 January	Introduction
2	28 January	Socio-economic projections
3	4 February	Global and regional climate and Earth system modeling
4	11 February	Concepts of risk and climate risk communication (GUEST: Prof. Rachael Shwom)
5	18 February	Health impacts of climate change
6	25 February	Sea-level rise and coastal impacts

7	4 March	Civil conflict and human migration
8	11 March	Ecosystem services (GUEST: Prof. Pam McElwee)
—	18 March	*SPRING BREAK*
9	25 March	Benefit-cost analysis and the social cost of carbon dioxide
10	1 April	Detection, attribution, and litigation (GUEST: Prof. Cymie Payne)
11	8 April	Decision-making under deep uncertainty
12	15 April	Making and using scientific assessments (GUEST: Prof. Michael Oppenheimer)
13	22 April	Financial risk
14	29 April	From assessment to application
15	6 May	Student proposal presentations *(EXAM PERIOD)*

Not currently planned to be covered in 2021: Energy, Agriculture and forestry, Supply chains, Tipping points

Academic Integrity: All students are responsible for upholding the highest standards of student behavior, as specified under the University Code of Student Conduct (http://studentconduct.rutgers.edu/), including but not limited to strict adherence to the terms of the University's Academic Integrity Policy (http://academicintegrity.rutgers.edu/). Plagarism is not acceptable on any assignment and on first occurrence will lead to a failing grade on the assignment. On collaborative assignments, all group members should be clearly identified and all are responsible for ensuring the integrity of all group products.

Accommodations for disabilities: Rutgers University welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: https://ods.rutgers.edu/students/documentation-guidelines. If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with a Letter of Accommodations. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. To begin this process, please complete the Registration form on the ODS web site at: https://ods.rutgers.edu/students/registration-form

Safe Learning Environment: Discriminartion and Harassment: Rutgers faculty are committed to helping create a safe learning environment for all students and for the university as a whole. If you have experienced any form of gender or sex-based discrimination or harassment, including sexual assault, sexual harassment, relationship violence, or stalking, know that help and support are available. Rutgers has staff members trained to support survivors in navigating campus life, accessing health and counseling services, providing academic and housing accommodations, and more. The University strongly

encourages all students to report any such incidents to the University. Please be aware that all Rutgers employees (other than those designated as confidential resources such as advocates, counselors, clergy and healthcare providers as listed in Appendix A to Policy 10.3.12) are required to report information about such discrimination and harassment to the University. This means that if you tell a faculty member about a situation of sexual harassment or sexual violence, or other related misconduct, the faculty member must share that information with the University's Title IX Coordinator. If you wish to speak to a confidential employee who does not have this reporting responsibility, you can find a list of resources in Appendix A to University Policy 10.3.12. For more information about your options at Rutgers, please visit endsexualviolence.rutgers.edu

Readings (Subject to revision)

The leaders of each class session should look over these and other candidate readings two weeks before their assigned date, and confer with the instructors to finalize the list. Note that the final list of selected readings should strike a balance between review articles and articles describing specific analyses. Please see also the list of additional possible references later on in the syllabus.

Week 1: Introduction

Hsiang, S., & Kopp, R. E. (2018). An economist's guide to climate change science. *Journal of Economic Perspectives*, *32*(4), 3-32.

Auffhammer, Maximilian. 2018. "Quantifying Economic Damages from Climate Change." *Journal of Economic Perspectives*, 32 (4): 33-52.

Gillingham, K., & Stock, J. H. (2018). The Cost of Reducing Greenhouse Gas Emissions. *Journal of Economic Perspectives*, *32*(4), 53–72. https://doi.org/10.1257/jep.32.4.53

Hsiang, S., Kopp, R., Jina, A., Rising, J., Delgado, M., Mohan, S., ... & Larsen, K. (2017). Estimating economic damage from climate change in the United States. *Science*, *356*(6345), 1362-1369.

Optional readings: Supplement to Hsiang et al. (2017).

Week 2: Socio-economic projections

Edmonds, J., & Reilly, J. (1983). Global Energy and CO2 to the Year 2050. *The Energy Journal*, 4(3), 21-48.

Moss, R. H., Edmonds, J. A., Hibbard, K. A., Manning, M. R., Rose, S. K., van Vuuren, D. P., ... & Wilbanks, T. J. (2010). The next generation of scenarios for climate change research and assessment. *Nature*, 463(7282), 747-756.

O'Neill, B. C., Kriegler, E., Riahi, K., Ebi, K. L., Hallegatte, S., Carter, T. R., ... & van Vuuren, D. P. (2014). A new scenario framework for climate change research: the concept of shared socioeconomic pathways. *Climatic Change*, *122*(3), 387-400.

Peters, G. P., Andrew, R. M., Canadell, J. G., Fuss, S., Jackson, R. B., Korsbakken, J. I., ... & Nakicenovic, N. (2017). Key indicators to track current progress and future ambition of the Paris Agreement. *Nature Climate Change*, *7*(2), 118-122.

Optional readings:

> Edmonds, J., & Reilly, J. (1983). A long-term global energy-economic model of carbon dioxide release from fossil fuel use. *Energy Economics*, 5(2), 74-88
>
> Hausfather, Z., Drake, H. F., Abbott, T., & Schmidt, G. A. (2020). Evaluating the performance of past climate model projections. *Geophysical Research Letters*, *47*(1), e2019GL085378.
>
> Rogelj, J., Popp, A., Calvin, K. V., Luderer, G., Emmerling, J., Gernaat, D., ... & Tavoni, M. (2018). Scenarios towards limiting global mean temperature increase below 1.5 C. *Nature Climate Change*, *8*(4), 325-332.

Edmonds, J., Luckow, P., Calvin, K., Wise, M., Dooley, J., Kyle, P., ... & Clarke, L. (2013). Can radiative forcing be limited to 2.6 Wm− 2 without negative emissions from bioenergy and CO2 capture and storage?. *Climatic Change*, *118*(1), 29-43.

Riahi, K., Van Vuuren, D. P., Kriegler, E., Edmonds, J., O'neill, B. C., Fujimori, S., ... & Tavoni, M. (2017). The shared socioeconomic pathways and their energy, land use, and greenhouse gas emissions implications: an overview. *Global environmental change*, *42*, 153-168.

O'Neill, B. C., Tebaldi, C., Van Vuuren, D. P., Eyring, V., Friedlingstein, P., Hurtt, G., ... & Sanderson, B. M. (2016). The scenario model intercomparison project (ScenarioMIP) for CMIP6. *Geoscientific Model Development*, *9*(9), 3461-3482.

Climate Action Tracker. https://climateactiontracker.org/global/temperatures/

En-ROADS. https://en-roads.climateinteractive.org/scenario.html?v=22.3.0

GCAM documentation. https://jgcri.github.io/gcam-doc/

Week 3: Global and regional climate modeling

Hansen, J., Johnson, D., Lacis, A., Lebedeff, S., Lee, P., Rind, D., & Russell, G. (1981). Climate impact of increasing atmospheric carbon dioxide. Science, 213(4511), 957-966.

Hawkins, E., & Sutton, R. (2009). The potential to narrow uncertainty in regional climate predictions. *Bulletin of the American Meteorological Society*, 90(8), 1095-1107.

Deser, C., Lehner, F., Rodgers, K.B. *et al.* Insights from Earth system model initial-condition large ensembles and future prospects. *Nat. Clim. Chang.* 10, 277–286 (2020). https://doi.org/10.1038/s41558-020-0731-2

Lanzante, J. R., Dixon, K. W., Nath, M. J., Whitlock, C. E., & Adams-Smith, D. (2018). Some pitfalls in statistical downscaling of future climate. *Bulletin of the American Meteorological Society*, *99*(4), 791-803.

Spreadsheet energy-balance model.

Simple Climate-Carbon-Economic IAM. https://insightmaker.com/insight/30045/Simple-Climate-Carbon-Economic-Model

Week 4: Concepts of risk and climate risk communication (Guest: Prof. Rachael Shwom)

Cooke, Roger. 2009. "Brief History of Quantitative Risk Assessment" Resources: 8-9.

Kaplan, S., & Garrick, B. J. (1981). On the quantitative definition of risk. *Risk analysis*, 1(1), 11-27.

Fischhoff, Baruch, and Alex L. Davis. "Communicating scientific uncertainty." *Proceedings of the National Academy of Sciences* 111.Supplement 4 (2014): 13664-13671.

Rachael Shwom & Robert E. Kopp (2019) Long-term risk governance: when do societies act before crisis?, *Journal of Risk Research*, 22:11, 1374-1390, DOI: 10.1080/13669877.2018.1476900

IPCC AR5 WG3 2.1-2.5

Optional readings:

Kunreuther, Howard, and Paul Slovic. "Science, values, and risk." *The annals of the American academy of political and social science* (1996): 116-125.

Renn, O. 2008. "Concepts of Risk: An Interdisciplinary Review Part 1: Disciplinary Risk Concepts." GAIA-Ecological Perspectives for Science and Society : 50-66.

Week 5: Health impacts of climate change

Ebi, K. L., Balbus, J., Luber, G., Bole, A., Crimmins, A. R., Glass, G. E., Saha, S., Shimamoto, M. M., Trtanj, J. M., & White-Newsome, J. L. (2018). *Chapter 14: Human Health. Impacts, Risks, and Adaptation in the United States: The Fourth National Climate Assessment, Volume II*. U.S. Global Change Research Program. https://doi.org/10.7930/NCA4.2018.CH14

Carleton, T., Jina, A., Delgado, M., Greenstone, M., Houser, T., Hsiang, S., Hultgren, A., Kopp, R. E., McCusker, K., & Nath, I. (2020). *Valuing the global mortality consequences of climate change accounting for adaptation costs and benefits*.

Klinenberg, E. (1999). Denaturalizing Disaster: A Social Autopsy of the 1995 Chicago Heat Wave. *Theory and Society*, *28*(2), 239–295.

Optional readings:

Gao, C., Kuklane, K., Östergren, P.-O., & Kjellstrom, T. (2018). Occupational heat stress assessment and protective strategies in the context of climate change. *International Journal of Biometeorology*, *62*(3), 359–371. https://doi.org/10.1007/s00484-017-1352-y

Graff Zivin, J., Hsiang, S. M., & Neidell, M. (2017). Temperature and Human Capital in the Short and Long Run. *Journal of the Association of Environmental and Resource Economists*, *5*(1), 77–105. https://doi.org/10.1086/694177

Graff Zivin, J., & Neidell, M. (2014). Temperature and the Allocation of Time: Implications for Climate Change. *Journal of Labor Economics*, *32*(1), 1–26. https://doi.org/10.1086/671766

Appendix to Carleton et al. (2020).

Solnit, R. (2010). *A paradise built in hell: The extraordinary communities that arise in disaster*. Penguin.

Week 6: Sea level rise and coastal climate change impacts and adaptation

Kopp, R. E. (2020). "Sea Level Rise, 1970–2070: A View from the Future". In: *Earth 2020: An insider's guide to a rapidly changing planet*. Ed. by P. D. Tortell. Cambridge, UK: Open Book Publishers. doi: 10.11647/OBP.0193.16.

Aerts, J. C. J. H., Lin, N., Botzen, W., Emanuel, K. and de Moel, H. (2013), Low-Probability Flood Risk Modeling for New York City. Risk Analysis, 33: 772–788. doi: 10.1111/risa.12008

Hsiang, S. M., & Jina, A. S. (2014). The causal effect of environmental catastrophe on long-run economic growth: Evidence from 6,700 cyclones (No. w20352). National Bureau of Economic Research.

Kopp et al. (2014). Probabilistic 21st and 22nd century sea-level projections at a global network of tide gauge sites. Earth's Future 2: 287-306.

Optional readings:

IPCC SROCC chapter 4

Bates, P. D., Quinn, N., Sampson, C., Smith, A., Wing, O., Sosa, J., ... & Krajewski, W. F. (2021). Combined modeling of US fluvial, pluvial, and coastal flood hazard under current and future climates. *Water Resources Research*, *57*(2), e2020WR028673.

Diaz, D. B. (2016). Estimating global damages from sea level rise with the Coastal Impact and Adaptation Model (CIAM). *Climatic Change*, *137*(1), 143-156.

Kopp, R. E., Gilmore, E. A., Little, C. M., Lorenzo-Trueba, J., Ramenzoni, V. C., & Sweet, W. V. (2019). Usable science for managing the risks of sea-level rise. *Earth's Future*, *7*(12), 1235-1269.

Week 7: Civil conflict and human migration

Wrathall, D. J., Mueller, V., Clark, P. U., Bell, A., Oppenheimer, M., Hauer, M., ... & Abel, K. (2019). Meeting the looming policy challenge of sea-level change and human migration. Nature Climate Change, 9(12), 898-901.=

Chen, J., & Mueller, V. (2018). Coastal climate change, soil salinity and human migration in Bangladesh. *Nature climate change*, *8*(11), 981-985.

Baysan, C., Burke, M., González, F., Hsiang, S., & Miguel, E. (2019). Non-economic factors in violence: Evidence from organized crime, suicides and climate in Mexico. *Journal of Economic Behavior & Organization*, *168*, 434-452.

Optional readings:

Hsiang, S. M., Burke, M., & Miguel, E. (2013). Quantifying the influence of climate on human conflict. Science, 341(6151), 1235367.

Burke, M., Hsiang, S. M., & Miguel, E. (2015). Climate and conflict. *Annu. Rev. Econ.*, *7*(1), 577-617.

Koubi, V. (2019). Climate change and conflict. *Annual Review of Political Science*, *22*, 343-360.

Week 8: Ecosystem services (Guest: Prof. Pam McElwee)

Podcast: "How do you put a price tag on nature?", Radiolab, http://www.radiolab.org/story/what-dollar-value-nature/.

Bennett, E. M., Cramer, W., Begossi, A., Cundill, G., Díaz, S., Egoh, B. N., Geijzendorffer, I. R., Krug, C. B., Lavorel, S., Lazos, E., Lebel, L., Martín-López, B., Meyfroidt, P., Mooney, H. A., Nel, J. L., Pascual, U., Payet, K., Harguindeguy, N. P., Peterson, G. D., … Woodward, G. (2015). Linking biodiversity, ecosystem services, and human well-being: Three challenges for designing research for sustainability. *Current Opinion in Environmental Sustainability*, *14*, 76–85. https://doi.org/10.1016/j.cosust.2015.03.007

Lau, J. D., Hicks, C. C., Gurney, G. G., & Cinner, J. E. (2019). What matters to whom and why? Understanding the importance of coastal ecosystem services in developing coastal communities. *Ecosystem Services*, *35*, 219–230. https://doi.org/10.1016/j.ecoser.2018.12.012

Spangenberg, J. H., Görg, C., Truong, D. T., Tekken, V., Bustamante, J. V., & Settele, J. (2014). Provision of ecosystem services is determined by human agency, not ecosystem functions. Four case studies. *International Journal of Biodiversity Science, Ecosystem Services & Management*, *10*(1), 40–53. https://doi.org/10.1080/21513732.2014.884166

Optional readings:

McElwee, P. (2017). The metrics of making ecosystem services. *Environment and Society*, *8*(1), 96-124.

Ainscough, J., Wilson, M., & Kenter, J. O. (2018). Ecosystem services as a post-normal field of science. *Ecosystem Services*, *31*, 93–101. https://doi.org/10.1016/j.ecoser.2018.03.021

Chan, K. M. A., Guerry, A. D., Balvanera, P., Klain, S., Satterfield, T., Basurto, X., Bostrom, A., Chuenpagdee, R., Gould, R., Halpern, B. S., Hannahs, N., Levine, J., Norton, B., Ruckelshaus, M., Russell, R., Tam, J., & Woodside, U. (2012). Where are Cultural and Social in Ecosystem Services? A Framework for Constructive Engagement. *BioScience*, *62*(8), 744–756. https://doi.org/10.1525/bio.2012.62.8.7

Chan, K. M. A., & Satterfield, T. (2020). The maturation of ecosystem services: Social and policy research expands, but whither biophysically informed valuation? *People and Nature*, *2*(4), 1021–1060. https://doi.org/10.1002/pan3.10137

Comberti, C., Thornton, T. F., Wyllie de Echeverria, V., & Patterson, T. (2015). Ecosystem services or services to ecosystems? Valuing cultivation and reciprocal relationships between humans and ecosystems. *Global Environmental Change*, *34*, 247–262. https://doi.org/10.1016/j.gloenvcha.2015.07.007

Díaz, S., Pascual, U., Stenseke, M., Martín-López, B., Watson, R. T., Molnár, Z., Hill, R., Chan, K. M. A., Baste, I. A., Brauman, K. A., Polasky, S., Church, A., Lonsdale, M., Larigauderie, A., Leadley, P. W., van Oudenhoven, A. P. E., van der Plaat, F., Schröter, M., Lavorel, S., … Shirayama, Y. (2018). Assessing nature's contributions to people. *Science*, *359*(6373), 270–272. https://doi.org/10.1126/science.aap8826

Granek, E. F., Polasky, S., Kappel, C. V., Reed, D. J., Stoms, D. M., Koch, E. W., Kennedy, C. J., Cramer, L. A., Hacker, S. D., Barbier, E. B., Aswani, S., Ruckelshaus, M., Perillo, G. M. E., Silliman, B. R., Muthiga, N., Bael, D., & Wolanski, E. (2010). Ecosystem Services as a

Common Language for Coastal Ecosystem-Based Management. *Conservation Biology*, *24*(1), 207–216. https://doi.org/10.1111/j.1523-1739.2009.01355.x

Hicks, C. C., & Cinner, J. E. (2014). Social, institutional, and knowledge mechanisms mediate diverse ecosystem service benefits from coral reefs. *Proceedings of the National Academy of Sciences*, *111*(50), 17791–17796. https://doi.org/10.1073/pnas.1413473111

Week 9: Benefit-cost analysis and the social cost of carbon

IPI Social Cost of Greenhouse Gases fact sheet. https://policyintegrity.org/files/publications/Social_Cost_of_Greenhouse_Gases_Factsheet.pdf

RFF Social Cost of Carbon 101. https://www.rff.org/publications/explainers/social-cost-carbon-101/

IPI Social Cost of Greenhouse Gases and State Policy. https://policyintegrity.org/files/publications/SCC_State_Guidance.pdf

Nordhaus, W. D. (1992). An Optimal Transition Path for Controlling Greenhouse Gases. *Science*, 258, 1315-1319.

Arrow, K., Cropper, M., Gollier, C., Groom, B., Heal, G., Newell, R., ... & Weitzman, M. (2013). Determining benefits and costs for future generations. Science, 341(6144), 349-350.

Interagency Working Group on Social Cost of Carbon, United States Government (2010). Appendix 15a. Social cost of carbon for regulatory impact analysis under Executive Order 12866. In: Final Rule Technical Support Document (TSD): Energy Efficiency Program for Commercial and Industrial Equipment: Small Electric Motors, U.S. Department of Energy.

Council of Economic Advisors (2017). Discounting For Public Policy: Theory And Recent Evidence On The Merits Of Updating The Discount Rate

Optional:

Bloustein Practicum Report (2018). At What Cost? Incorporating the Social Cost of Carbon into State-Level Policies in New Jersey. https://bloustein.rutgers.edu/2018atwhatcost/

National Academies of Sciences, Engineering, and Medicine. (2017). *Valuing climate damages: updating estimation of the social cost of carbon dioxide*. National Academies Press.

Week 10: Detection, attribution, and litigation (Guest: Prof. Cymie Payne)

Trenberth, K. E., Fasullo, J. T., & Shepherd, T. G. (2015). Attribution of climate extreme events. *Nature Climate Change* 5, 725-730.

Doelle, M., & Seck, S. (2020). Loss & damage from climate change: From concept to remedy? *Climate Policy*, *20*(6), 669–680. https://doi.org/10.1080/14693062.2019.1630353

Setzer, J., & Vanhala, L. C. (2019). Climate change litigation: A review of research on courts and litigants in climate governance. WIREs Climate Change, 10(3), e580. https://doi.org/10.1002/wcc.580

Optional:

Committee on Extreme Weather Events and Climate Change Attribution, Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies, & National Academies of Sciences, Engineering, and Medicine. (2016). *Attribution of Extreme Weather Events in the Context of Climate Change* (p. 21852). National Academies Press. https://doi.org/10.17226/21852

Huggel, C., Wallimann-Helmer, I., Stone, D., & Cramer, W. (2016). Reconciling justice and attribution research to advance climate policy. Nature Climate Change, 6(10), 901-908.

Pfrommer, T., Goeschl, T., Proelss, A., Carrier, M., Lenhard, J., Martin, H., ... & Schmidt, H. (2019). Establishing causation in climate litigation: admissibility and reliability. *Climatic Change*, *152*(1), 67-84.

Payne, C. R. (2021). Valuation of climate change loss and damage. In *Research Handbook on Climate Change Law and Loss & Damage*. Edward Elgar Publishing.

Climate Attribution Database. https://climateattribution.org/

Climate Case Chart. http://climatecasechart.com/climate-change-litigation/

Week 11: Decision-making under deep uncertainty

Kwakkel, J. H., Walker, W. E., & Haasnoot, M. (2016). Coping with the wickedness of public policy problems: approaches for decision making under deep uncertainty.

Heal, G., & Millner, A. (2014). Reflections uncertainty and decision making in climate change economics. *Review of Environmental Economics and Policy*, *8*(1), 120-137.

Haasnoot, M., Kwakkel, J. H., Walker, W. E., & ter Maat, J. (2013). Dynamic adaptive policy pathways: A method for crafting robust decisions for a deeply uncertain world. *Global environmental change*, *23*(2), 485-498.

Haasnoot, M., Kwadijk, J., Van Alphen, J., Le Bars, D., van den Hurk, B., Diermanse, F., ... & Mens, M. (2020). Adaptation to uncertain sea-level rise; how uncertainty in Antarctic mass-loss impacts the coastal adaptation strategy of the Netherlands. *Environmental Research Letters*, *15*(3), 034007.

Optional readings:

Keller, K., Helgeson, C., & Srikrishnan, V. (2021). Climate risk management. *Annual Review of Earth and Planetary Sciences*, *49*, 95-116.

Kwakkel, J. H., Haasnoot, M., & Walker, W. E. (2016). Comparing robust decision-making and dynamic adaptive policy pathways for model-based decision support under deep uncertainty. *Environmental Modelling & Software*, *86*, 168-183.

Lawrence, J., Bell, R., & Stroombergen, A. (2019). A hybrid process to address uncertainty and changing climate risk in coastal areas using dynamic adaptive pathways planning, multi-criteria decision analysis & real options analysis: a New Zealand application. *Sustainability*, *11*(2), 406.

Haasnoot, M., van Aalst, M., Rozenberg, J., Dominique, K., Matthews, J., Bouwer, L. M., ... & Poff, N. L. (2020). Investments under non-stationarity: economic evaluation of adaptation pathways. *Climatic Change* 161, 451-463.

Kopp, R. E., Shwom, R. L., Wagner, G., & Yuan, J. (2016). Tipping elements and climate–economic shocks: Pathways toward integrated assessment. *Earth's Future*, *4*(8), 346-372.

Week 12: Making and using scientific assessments (Guest: Prof. Michael Oppenheimer)

IPCC SROCC Summary for Policymakers.

Brysse, K., Oreskes, N., O'Reilly, J., & Oppenheimer, M. (2013). Climate change prediction: Erring on the side of least drama?. Global environmental change, 23(1), 327-337.

Beck, S., & Mahony, M. (2018). The IPCC and the new map of science and politics. *Wiley Interdisciplinary Reviews: Climate Change*, *9*(6), e547.

Keohane, R. O., Lane, M., & Oppenheimer, M. (2014). The ethics of scientific communication under uncertainty. Politics, Philosophy & Economics, 13(4), 343-368.

Optional:

Vardy, M., Oppenheimer, M., Dubash, N. K., O'Reilly, J., & Jamieson, D. (2017). The intergovernmental panel on climate change: challenges and opportunities. Annual Review of Environment and Resources, 42, 55-75.

Moss, R. H., Avery, S., Baja, K., Burkett, M., Chischilly, A. M., Dell, J., ... & Knowlton, K. (2019). Evaluating knowledge to support climate action: A framework for sustained assessment. Report of an independent advisory committee on applied climate assessment. *Weather, Climate, and Society*, 11(3), 465-487.

Week 13: Financial risk

Fiedler, T., Pitman, A. J., Mackenzie, K., Wood, N., Jakob, C., & Perkins-Kirkpatrick, S. E. (2021). Business risk and the emergence of climate analytics. *Nature Climate Change*, *11*(2), 87-94.

Campiglio, E., Dafermos, Y., Monnin, P., Ryan-Collins, J., Schotten, G., & Tanaka, M. (2018). Climate change challenges for central banks and financial regulators. Nature Climate Change, 8(6), 462-468.

CFTC (2020). Managing Climate-Risk in the US Financial System.

Optional readings:

Monasterolo, I. (2020). Climate change and the financial system. *Annual Review of Resource Economics*, *12*, 299-320.

Solana, J. (2020). Climate litigation in financial markets: a typology. *Transnational Environmental Law*, *9*(1), 103-135.

Week 14: From assessment to application

NJ Protecting Against Climate Threats (2020). https://www.nj.gov/dep/workgroups/docs/njpact-20210115-real-pres.pdf

NYC Climate Resiliency Design Guidelines (2020). https://www1.nyc.gov/assets/orr/pdf/NYC_Climate_Resiliency_Design_Guidelines_v4-0.pdf

Optional:

New Jersey Scientific Report on Climate Change (2020). https://www.nj.gov/dep/climatechange/docs/nj-scientific-report-2020.pdf

NJ Future (2019). Resilience Strategies Case Studies. https://www.nj.gov/dep/bcrp/resilientnj/docs/local-options-local-actions.pdf

State of California (2018). Sea Level Rise Guidance. https://opc.ca.gov/webmaster/ftp/pdf/agenda_items/20180314/Item3_Exhibit-A_OPC_SLR_Guidance-rd3.pdf

Kopp, R.E., C. Andrews, A. Broccoli, A. Garner, D. Kreeger, R. Leichenko, N. Lin, C. Little, J.A. Miller, J.K. Miller, K.G. Miller, R. Moss, P. Orton, A. Parris, D. Robinson, W. Sweet, J. Walker, C.P. Weaver, K. White, M. Campo, M. Kaplan, J. Herb, and L. Auermuller. New Jersey's Rising Seas and Changing Coastal Storms: Report of the 2019 Science and Technical Advisory Panel. Rutgers, The State University of New Jersey. Prepared for the New Jersey Department of Environmental Protection. Trenton, New Jersey.

Illustrative Final Project

Request for Proposals: Regional Climate Change Risk Assessment Grants

The Curchitser-Kopp Foundation is pleased to announce the Regional Climate Change Risk Assessment Competitive Grant Program, which will support projects to assess growing climate risks in regions of interest to the Foundation.

There is $5 million in funding available to support proposals under this RFP. Applicants may request funding of up to the full $5,000,000. We expect to make between one and five awards. Proposals will be reviewed, evaluated and scored on the extent to which they:

- Identify key climate change risks to the region
- Describe a plausible suite of physical and socio-economic scenarios of relevance to the region, including projected physical changes associated with each scenario
- Generate knowledge to guide climate adaptation and motivate greenhouse gas mitigation in the region of interest
- Have a clear plan for engaging key stakeholders throughout the conceptualization and research process
- Are technically sound and feasible, and set forth a clear, logical, and achievable work plan

Your proposal will be reviewed by the Foundation's Board of Director and its Scientific Advisory Board. Successful proposals must be highly ranked by both boards.

Proposals must be fully cited and are encouraged to be well-illustrated with explanatory figures. Proposal should include:

1) A 1-page project summary
2) A 15 page project description
3) A list of references cited, with full authors, title, and journal names
4) A budget and budget justification
5) 1-2 page CVs for each team member

The proposal should be in 11 pt Times New Roman font with 1" margins, single-spaced. They must be submitted via Canvas as a single PDF file. Proposals not meeting the formatting and style specifications will be automatically rejected without review.

Proposals are due by COB on **May 1, 2021**. Each applicant will also have the opportunity to present their proposals to a joint meeting of the Boards and the Board of Visitors on **May 6, 2021**. Presentations should be limited to 10 minutes of prepared remarks and 20 minutes for discussion.

Alternative proposals by single investigators are allowable if they better fit the needs of the investigator's thesis.

Please see Canvas for the final version of this RFP.