Climate Change: Science, Solutions, and Sustainability
MIT Professional Education
1-5 June 2026 (online)

Course summary: *The objective of this course is to provide participants with a thorough understanding of the scientific drivers behind anthropogenic climate change, its impacts, mitigation and adaptation strategies, and its connections to broader sustainability goals. The course introduces the fundamental physical and human drivers that shape past, present, and future climate change. Impacts of climate change on human societies and Earth's life support systems will be highlighted, including effects on temperature, precipitation, ocean acidity, sea level, severe storms, agriculture, biodiversity, and air quality. Mitigation approaches and adaptation strategies, including technology development, will be introduced, discussed, and critiqued, with concrete examples from specific contexts. The course will conclude with an overview of policy and governance considerations in a changing climate. Non-lecture activities will comprise at least 25% of the course, and will address the contemporary science of climate measurements, models of climate change and impacts, mitigation and adaptation strategies, and climate change policy and negotiations. Lecturers drawn from MIT's Center for Sustainability Science and Strategy (CS3) will highlight work on integrated analysis of climate science, policy, and responses.*

The course will run for one week, with each day comprising 4 hours of active online (synchronous) instruction, and one hour of a flexible (asynchronous) activity which is optional. Each day, there will be an additional hourlong networking hour (scheduled at different times to accommodate time zone and schedule differences) where students can meet each other and talk to guest lecturers about topics of individual interest. Each of the first four days will focus on a different aspect of the climate problem (science, impacts/adaptation, technology/mitigation, policy), while the final day will integrate all by addressing practical ways forward in the context of sustainability for individuals, organizations, and governments.

All times are local to MIT (US-Eastern Daylight Time).

Monday, June 1: Introduction: A Changing Climate. *The first day provides basic information on anthropogenic climate change and the mechanisms behind it. How do scientists know that the climate is changing, and how much? What are the different lines of evidence? Lectures will cover basic climate science (concepts of radiative forcing, greenhouse gases, heat uptake in atmosphere and ocean), historical evolution of the Earth's climate, measurement and modeling techniques. A virtual laboratory tour will be arranged to highlight cutting-edge climate research. Participants will be able to further explore online climate models on their own.*

10:00-10:55 AM: Intro & The Science of Climate Change: An Introduction
(Profs. Selin & Cziczo)

Background reading: K. Emanuel, “Climate Science, Risks, and Solutions” (MIT Climate Primer) https://climateprimer.mit.edu

[ten minute stretch break]

11:05 AM - 12:00 PM: Climate Change through History: a paleoclimate perspective (Prof. McGee)

[Break: 12:00-12:30 PM]

12:30 PM - 1:25 PM: Activity: Virtual Lab Tour – Climate Change Measurements (Prof. Cziczo)

[ten minute stretch break]

1:35 PM - 2:30 PM: Climate Change Models and Future Projections (Prof. Selin)

2:30 PM - 3:30 PM: Networking and Q&A

2: Tuesday, June 2: Climate Impacts and Adaptation. *What present and potential future risks does climate change pose, and to whom? We will start with an overview of potential scenarios used for understanding potential future trajectories and planning, where participants will be able to identify the assumptions underlying often-used climate scenarios, and better understand the limitations of different products available to assess future climate risk. We will use simplified climate models coupled with an interactive visualization platform, developed at MIT, to explore how climate risk intersects with other multi-sector risks, allowing participants to choose their own impact scenarios to explore online. Deep dives into sectoral impacts and adaptation will be include impacts on agriculture and land use, water, infrastructure and adaptation, and air quality. Participants will further explore online MIT-designed tools to quantify climate impacts and design adaptation strategies with an independent assignment targeted to a sector or region of their interest.*

9:00 AM – 10:00 AM Networking and Q&A

10:00 AM -10:55 AM Ocean Effects: acidity and sea level rise (Prof. Bodner)

[ten minute stretch break]

11:00 AM-11:55 AM Temperature, Air Quality and Wildfires (Prof. Fiore)

[Break: 12:00-12:30 PM]

12:30 PM -1:25 PM Activity: Compounding and Intersecting Landscapes of Physical and Societal Impacts (Dr. Schlosser)

[ten minute stretch break]

1:35 PM -2:30 PM Infrastructure and Adaptation (Prof. Strzepek)

Reading: World Bank. 2023. Climate Resilient Investment in Sub-Saharan Africa Compendium Volume: A Focus on Infrastructure Project Design in Key Sectors. World Bank. http://hdl.handle.net/10986/40309

3: Wednesday, June 3: Adaptation, Technologies and Mitigation. *To what extent can future technological development mitigate or address climate risks? Focusing on the prospects for new technologies, we will address the economics of different decisions, the impacts on different sectors, and the role of research and innovation. We will also cover the science and economics behind commonly discussed climate "solutions" including carbon offsets, carbon capture and geoengineering/solar radiation management, introducing key criteria of how to evaluate proposed solutions. We will also discuss new technologies that can contribute to efforts to mitigate climate change, including monitoring and verification.*

9:00 AM – 10:00 AM Networking and Q&A

10:00 AM - 10:55 AM Technology Development (Activity) (Prof. Cziczo)

[ten minute stretch break]

11:05 AM -12:00 PM

Risk and Uncertainty in Mitigation and Adaptation (Dr. Morris)

Reading: Morris, J., Chen, Y.H.H., Gurgel, A., Reilly, J. and Sokolov, A., 2023. Net zero emissions of greenhouse gases by 2050: Achievable and at What Cost?. *Climate Change Economics*, *14*(04), p.2340002.

[Break: 12:00-12:30 PM]

12:30 PM - 1:25 PM Land, Agriculture, and Sustainability Strategies (Dr. Gurgel)

[ten minute stretch break]

1:35 PM - 2:30 PM Methane monitoring and verification (Prof. Varon)

4: Thursday, June 4: Policies and Responses: Global to Local. *What is being done to address climate change on local, regional, national, and international levels? How do current goals set by countries and regions (including under the Paris Agreement) match with scenarios? What are the key institutions at different scales that are involved in setting climate policies, and what are the current areas of agreement and disagreement? We will cover the past, present, and future of climate action, and what different requirements in different regions and jurisdictions might mean for companies and individuals who live or do business in those regions.*

Participants will conduct an interactive activity exploring an energy simulator originally developed and widely used at MIT (En-ROADS), with extensions and additional options from ongoing research at MIT that are not yet widely available publicly, to understand how different decisions affect global and regional climate.

10:00 AM - 12:00 PM Activity: Energy planning and investment (Prof. Selin)
[including a 10-minute stretch break, timing TBA]

[Break: 12:00-12:30 PM]

12:30 PM - 1:25 PM Geoengineering: Reasonable Concepts or Science Fiction? (Prof. Cziczo)

[ten minute stretch break]

1:35 PM -2:30 PM Regulatory Politics and Climate Negotiations (Prof. Henrik Selin)

2:30 PM – 3:30 PM Networking & Q&A

5: Friday, June 5: Integrating Climate and Sustainability: Local to Global. In the final day of the class, we will address climate in the context of sustainability, thinking about the connections between climate change and objectives for human well-being that are of importance for class participants. Starting by discussing the United Nations Sustainable Development Goals (SDGs) and the importance to individuals and industries, one of which focuses on climate action, we will review research that identifies linkages between goals. Examples will be drawn from current MIT work identifying the sustainability impacts of CO_2 mitigation pathways on related SDGs, including air quality and economic impacts on different populations. Participatory activities include targeted activities integrating climate and SDGs from participants own experience, and a role-playing simulation on climate and sustainability planning.

9:00 AM – 10:00 AM Networking and Q&A

10:00 AM - 12:00 PM Activity: Coastal zone planning (Profs. Selin and Cziczo)
[including a 10-minute break, timing TBA]

[Break: 12:00-12:30 PM]

12:30 PM -1:25 PM Connections between Climate and Sustainability (Prof. Selin)

1:35 PM - 2:30 PM Wrap-up and adjourn (Prof. Selin, Prof. Cziczo)

Instructor Bios:

Noelle Selin is Professor in the Institute for Data, Systems and Society (IDSS) and the Department of Earth, Atmospheric and Planetary Sciences (EAPS) and the director of the MIT Center for Sustainability Science and Strategy. She also co-leads the Bringing Computation to the Climate Challenge research project. Noelle served as director of MIT's Technology and Policy Program from 2018-2023, and as Interim Director of IDSS from 2023-2024. Her research uses modeling and analysis to inform sustainability decision-making, focusing on issues involving air pollution, climate change, and hazardous substances such as mercury.

Dan Cziczo is Professor in the Department of Earth, Atmospheric and Planetary Sciences (EAPS) and the School of Aeronautics and Astronautics at Purdue University. He is an atmospheric scientist interested in the interrelationship of particulate matter and cloud formation. His research utilizes laboratory and field studies to elucidate how small particles interact with water vapor to form droplets and ice crystals which are important players in the Earth's climate system. His group uses small cloud chambers in the laboratory to mimic atmospheric conditions that lead to cloud formation and observing clouds in situ from remote mountaintop sites or through the use of research aircraft. Dan's current research interests include the chemical composition of atmospheric aerosols, Earth's radiative budget, and meteoritic, spacecraft debris and launch vehicle emissions in the atmosphere.

David McGee joined the MIT Earth, Atmospheric and Planetary Sciences (EAPS) faculty in 2012. In 2020, he was named Associate Department Head for Diversity, Equity, and Inclusion and served in that role until his 2025 appointment as head of the department. He has also served since 2015 as director of the Terrascope first-year learning community—a program that engages an average of 50 students each year in exploring environmental challenges through project-based classes. McGee holds a BA in geology from Carleton College, as well as an MA in teaching and environmental education from Chatham College and an MS in earth and environmental sciences from Tulane University. He went on to earn a PhD from Columbia University in 2009, and was awarded a NOAA Climate and Global Change Postdoctoral Research Fellowship with a joint appointment at the University of Minnesota and the Lamont-Doherty Earth Observatory. Prior to his graduate studies in earth science, McGee taught middle and high school math and science for seven years. At MIT, McGee's commitment to teaching and mentorship has earned recognition including an Excellence in Mentoring Award in 2018 for his work advising first-year students and a 2024 School of Science Teaching Prize for Undergraduate Education. In 2022, McGee was named a MacVicar Faculty Fellow—one of MIT's most prestigious teaching honors awarded for innovative and sustained contributions to undergraduate education. He has also helped steer numerous Institute initiatives focused on environment, climate, and sustainability, including co-chairing both the Climate Nucleus Education Working Group and the Sustainability Leadership Steering Committee, as well as serving on the Climate and

Sustainability Consortium Faculty Steering Committee and the Climate Action Through Education (CATE) Faculty Review Committee.

Abigail Bodner joined the EAPS faculty in 2024, with a shared appointment in Electrical Engineering and Computer Science (EECS). Bodner earned a BSc and MSc from Tel Aviv University studying mathematics and geophysics, atmospheric and planetary sciences. She then went on to Brown University, earning an ScM in applied mathematics before completing her PhD studies in 2021 in Earth, environmental and planetary science. Prior to coming to MIT, Bodner was a Simons Society Junior Fellow working with Dr. Laure Zanna at the Courant Institute of Mathematical Sciences, New York University. Her research interests span climate, physical oceanography, geophysical fluid dynamics, and turbulence. She investigates turbulence in the upper ocean using a combination of theory, high-resolution numerical simulations, climate models, and machine learning, and has a growing interest in understanding drivers of coastal sea level.

Arlene Fiore joined the MIT Earth, Atmospheric and Planetary Sciences (EAPS) faculty in 2021 as the Peter H. Stone and Paola Malanotte Stone Professor of Earth, Atmospheric and Planetary Sciences. She attended Harvard University, earning an AB in environmental geoscience in 1997 and completing her PhD studies in Earth and planetary sciences in 2003. Fiore spent seven years as a research scientist in the NOAA Geophysical Fluid Dynamics Laboratory before being appointed to the faculty at Columbia University's Department of Earth and Environmental Sciences and Lamont-Doherty Earth Observatory in 2011. In 2025, Fiore was appointed as Associate Department Head for EAPS. Fiore has a long history of professional service, including serving on the National Academy of Sciences Board on Atmospheric Sciences and Climate, multiple NCAR (National Center for Atmospheric Research) advisory panels and committees, and has authored or co-authored numerous reports on issues of air quality and climate for policymakers and government agencies. As a principal investigator and member of the NASA Health and Air Quality Applied Sciences Team, she partners with air and health management groups to address emerging needs with applications of satellite and other Earth science datasets. Among other honors, Fiore has been recognized by the American Geophysical Union with the James R. Holton Junior Scientist Award in 2005 and the James B. Macelwane Medal in 2011.

Adam Schlosser is a Senior Research Scientist and Deputy Director at the MIT Center for Sustainability Science and Strategy. His primary interests are the modeling, prediction, and risk assessment of the natural, managed, and built water-energy-land systems. Dr. Schlosser has also undertaken studies of hydrology, weather, and climate and their predictability and limits-to-prediction. In doing so, he has worked with a wide range of numerical models, ranging from process-level to global-scale models, as well as observational data for evaluation and complementary analyses. He also has participated in and led international experiments aimed to assess the performance of Earth-system model components and predictions. Other collaborative research activities include extreme events; water-resource risk assessments to inform mitigation and

adaptation strategies; biodiversity; global soil sinks of hydrogen, and renewable-energy resource and intermittency assessments.

Kenneth Strzepek has spent 30 years as a researcher and practitioner at the nexus of engineering, environmental and economics systems, primarily related to water resource planning and management, river basin planning, and modeling of agricultural, environmental, and water resources systems. His work includes applications of operations research, engineering economics, micro-economics and environmental economics to a broad range applications: from project scale to national and global investment policy studies. He has worked for a range of national governments as well as the United Nations, the World Bank, the USAID. He is Professor Emeritus of Civil, Environmental and Architectural Engineering at the University of Colorado at Boulder, and recently a Visiting Professor of Economics and Affiliated Professor in College of Architecture and Planning at the University of Colorado at Boulder. He is a Visiting Senior Research Fellow at the International Food Policy Research Institute as well as an International Fellow at the Center for Environmental Economics and Policy for Africa and Examiner in the Department of Agricultural Economics at the University of Pretoria, South Africa. He has been a contributing author to the Second IPCC assessment, the Millennium Ecosystem Assessment, the World Water Vision, and the UN World Water Development Report. He is currently the USAID Scientific Liaison Office on Water and Climate Change to the CGIAR. Prof. Strzepek has a PhD in Water Resources Systems Analysis from MIT, an MA in Economics from the University of Colorado and is currently a PhD candidate in the Department of Economics at the University of Hamburg, Germany.

Jennifer Morris is a Principal Research Scientist at the MIT Center for Sustainability Science and Strategy and the MIT Energy Initiative. Her research focuses on energy-economic modeling and linkages between human and natural systems to explore multi-sector feedbacks and implications of different development, decarbonization and investment pathways. She also focuses on uncertainty, risk analysis, and decision-making in energy and environmental systems. This work involves quantifying key uncertainties, and applying different methodological approaches to formally model such uncertainties and explore how they impact near-term decisions. Dr. Morris is a key contributor to the development of the MIT Integrated Global System Modeling (IGSM) framework, focusing on the human system component, the Economic Projection and Policy Analysis (EPPA) model. With this modeling framework, she develops integrated economic and climate scenarios, generates large ensembles, analyzes policy impacts, explores technology and mitigation pathways, and examines multi-sector dynamics. Jennifer holds a PhD in Engineering Systems and a M.S. in Technology and Policy from MIT.

Angelo Gurgel is a Principal Research Scientist at the MIT Center for Sustainability Science and Strategy and the MIT Energy Initiative. His research has focused on understanding the interactions of natural resources, technological constraints, and human systems with a goal of identifying sustainable future development pathways. He has been developing socio-economic-environmental modeling and applied research on

climate change, land-use changes, climate policy, bioenergy, climate change mitigation technologies, agricultural and environmental economics. He contributes to the development of the MIT Economic Projection and Policy Analysis (EPPA) model, the MIT U.S. Regional Energy Policy (USREP) model, and the MIT Integrated Global System Modeling (IGSM) framework. Dr. Gurgel was a professor and coordinator of the master's program on Agribusiness at the Sao Paulo School of Economics, Fundacao Getulio Vargas (FGV), Brazil (2012-2020), and professor at the University of Sao Paulo, Brazil (2004-2011). He holds a Ph.D. in Applied Economics and a B.S. in Agricultural Engineering from University of Viçosa - Brazil.

Daniel Varon is Boeing Assistant Professor of Aeronautics and Astronautics and Assistant Professor in the Institute for Data, Systems, and Society at MIT. He is an atmospheric scientist interested in greenhouse gases, air pollution, and satellite remote sensing. His work revolves around using satellite observations of atmospheric composition to better understand human impacts on the environment and identify opportunities to reduce them. A major focus has been on quantifying atmospheric methane emissions and trends across a range of scales. More recently, he's started investigating new ways of observing nitrogen oxide air pollution from space. He received a PhD in atmospheric chemistry from Harvard University in 2020 along with an MSc in applied mathematics. He continued as a postdoctoral research fellow at Harvard and held a visiting postdoctoral fellowship at the Princeton School of Public and International Affairs from 2021 to 2023.

Henrik Selin is a Professor of International Relations in the Frederick S. Pardee School of Global Studies at Boston University. His research focus on international environmental cooperation and policy-making in a broader context of advancing sustainable development. His interdisciplinary research contributes to scholarly and policy debates about understanding ways in which states and other actors engage each other and shape international environmental policy-making and institution-building. It also focuses on efforts to analyze and advance sustainability on a human-dominated planet. He is the author of *Mercury Stories: Understanding Sustainability through a Volatile Element* (MIT Press, with Noelle Eckley Selin), *European Union Environmental Governance* (Routledge, with Stacy VanDeveer) and *Global Governance of Hazardous Chemicals: Challenges of Multilevel Management* (MIT Press). He is the co-editor of *Changing Climates in North American Politics: Institutions, Policy Making and Multilevel Governance* (MIT Press, with Stacy VanDeveer) and *Transatlantic Environment and Energy Politics: Comparative and International Perspectives* (Ashgate, with Miranda Schreurs and Stacy VanDeveer). In addition, he is the author and co-author of sixty peer reviewed journal articles and book chapters as well as over fifty reports, reviews, and commentaries.