GLOBAL CHANGES

MIT JOINT PROGRAM ON THE SCIENCE & POLICY OF GLOBAL CHANGE

FALL 2017 NEWSLETTER

MIT JOINT PROGRAM ON THE SCIENCE AND POLICY OF GLOBAL CHANGE

OUR RESEARCH MISSION

At the Joint Program, our integrated team of natural and social scientists studies the interactions among human and Earth systems to provide a sound foundation of scientific knowledge. Such a foundation will aid decision-makers in confronting the interwoven challenges of future food, energy, water, climate and air pollution issues, among others.

Our mission is accomplished through:

- *Quantitative analyses of global changes and their social and environmental implications, achieved by employing and constantly improving an Integrated Global System Modeling (IGSM) framework;*
- *Independent assessments of potential responses to global risks through mitigation and adaptation measures;*
- *Outreach efforts to analysis groups, policymaking communities, and the public; and*
- *Cultivating a new generation of researchers with the skills to tackle complex global challenges in the future.*

In This Issue:

SAVE THE DATE: XLI (41st) GLOBAL CHANGE FORUM

March 26–28, 2018 • MIT Campus • Cambridge, MA

Theme: Science-Based Targets

More than 300 companies have committed to implementing science-based targets as a measurable, verifiable way to reduce greenhouse gas emissions at levels consistent with the aims of the Paris Agreement. The next Global Change Forum will explore the foundations of science-based targets and the challenges of implementing them.

JOINT PROGRAM SPONSORS' MEETING

March 26, 2018 • 2:00–5:00 pm EST

Forum attendance is by invitation only.

MIT JOINT PROGRAM ON THE SCIENCE AND POLICY OF GLOBAL CHANGE

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Science-based targets: Rationale and challenges

After the president announced his intention to withdraw the United States from the Paris Agreement, many U.S. companies and several states and cities pledged to do their part to reduce planet-warming greenhouse gas (GHG) emissions to levels consistent with the aims of the Agreement. The big question: How does one define such a pledge so that it meets this standard? That's where science-based targets come in.

Developed by the United Nations Global Compact, CDP, the World Resources Institute and the World Wildlife Fund in collaboration with We Mean Business, science-based targets are climate science-informed GHG emissions-reduction goals that align with the Paris Agreement's ultimate objective: to keep the rise in global average temperature since pre-industrial times below two degrees Celsius (2°C).

Science-based targets are derived from "2°C emissions paths," climate-model-generated results that chart how much GHG emissions must be reduced—and by when—in order to keep below the 2°C limit. Two-degree emissions paths produced by the Joint Program, similar to other projections, indicate that to meet this goal, the world will have to cut GHG emissions by approximately 80 percent from current levels by 2050. Because projections of 2°C emissions paths differ depending on the climate response to greenhouse gas levels, economic growth, and technology options for reducing emissions, pathways for emissions consistent with science-based targets can vary.

Understanding the 2°C emissions path

The shape of a 2°C emissions path is partly determined by how one models the global climate's response to atmospheric GHG concentrations. To be more certain that the global average temperature will stay below 2°C, one needs to account for the chance that the climate is more or less responsive to GHG forcing, resulting in a tighter or looser carbon budget that requires a more or less ambitious GHG emissions reduction target. Other considerations that will impact that target include how non-carbon GHG emissions, land-use change and other projected climate forcing processes are modeled.

Science-based emissions paths are also determined by choices in modeling human systems. For instance, long-term projections of technology options for de-carbonization of energy production will shape the 2°C emissions path, determining whether near-term reductions need to be abrupt or can fall more gradually. For instance, optimism for the development of low-cost, high-impact carbon reduction strategies two decades from now, such as biomass electric power with carbon capture and storage, gives less urgency to make dramatic cuts in carbon emissions in the near term.

Setting science-based targets

The Science-Based Target Initiative (SBTI) provides systematic instructions for companies to implement science-based targets based on 2°C scenarios (the SBTI website currently provides access to emissions scenarios produced by the Intergovernmental Panel on Climate Change and the International Energy Agency). Each target commits to a percentage reduction in GHG emissions with respect to a base year within a certain timeframe.

To set a target, a company may reduce its GHG emissions by the same percentage as what's needed to achieve the 2°C goal: (1) at the global level (e.g., 80 percent emissions reduction from current levels by 2050); (2) at the industrial sector level (as a fraction of the global effort); or (3) at a level determined by the company's share of the global GDP.

To meet its target, a company must identify opportunities to reduce direct (Scope 1), indirect (Scope 2) and value chain (Scope 3) emissions. Scope 1 emissions are those a company's plants emit directly; Scope 2 are the indirect emissions related to its consumption of electricity; and Scope 3 are emissions produced across the company's supply chain and throughout its products' lifecycles.

Opportunities and challenges

Eager to help lower the planet's climate risk while remaining profitable and competitive, more than 300 companies have already committed to science-based targets. According to the SBTI, setting and implementing these targets is intended to place these businesses on track to develop innovative, efficient new technologies and practices that cut emissions and operational costs—and better position them to take advantage of economy-wide incentives and meet more stringent emissions control policies and regulations. Taking such a proactive stance on climate change also boosts companies' reputation among stakeholders, from customers to investors to communities.

There is a risk, of course, that some companies lead, but others do not follow, and governments fail to undergird developments with a supporting regulatory policy. However, if companies find good options for emissions reduction, then all of a sudden climate policy may seem less a threat than an opportunity.

We're now exploring the potential of the modeling capabilities that we have in the Joint Program—most notably the MIT Integrated Global System (IGSM) modeling framework—to provide guidance on the value and application of science-based targets. We look forward to continuing this discussion in the coming months and at our next MIT Global Change Forum on March 26–28, 2018.

—Ronald Prinn and John Reilly, Co-Directors

MIT Joint Program News Releases:
Latest research developments and their implications

MIT Joint Program in the Media:
Latest coverage of our research

The following summaries are listed by primary research focus area, but may span multiple research focus areas.

Food, Water & Forestry

Climate change may deplete some U.S. water basins, reducing irrigated crop yields

By 2050, the Southwest could produce significantly less cotton and forage, researchers report

An MIT Joint Program-led study finds that certain hotspots in the country may experience severe reductions in crop yields by 2050, due to climate change's impact on irrigation. According to the researchers' projections, the most adversely affected region will be the Southwest, and the most vulnerable crops include cotton and forage, but greenhouse gas mitigation efforts could prevent these impacts.

The future of forests under climate change

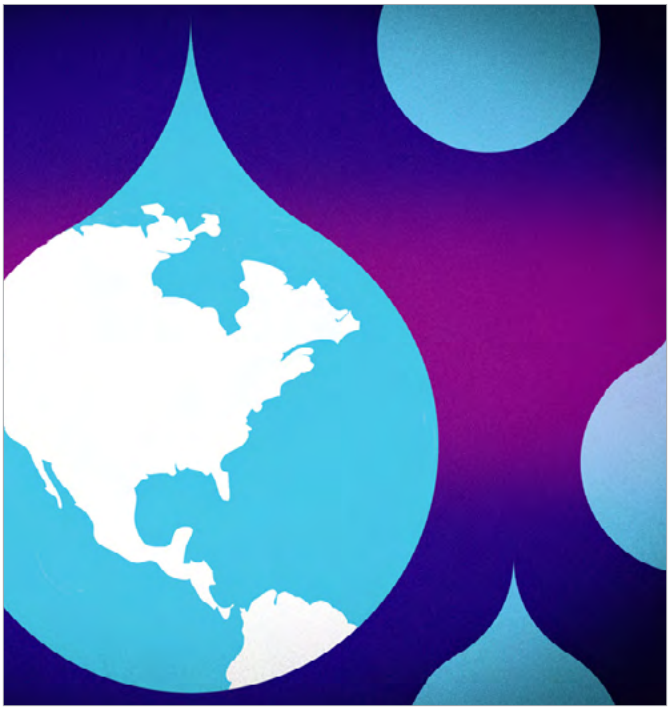
Study projects vast regional differences in forest productivity, migration and wildfire impacts

A study co-authored by MIT Joint Program Principal Research Scientist Erwan Monier indicated, using a combined global vegetation and climate model, that the impact of climate change on forests in the coming decades is decidedly mixed. While unconstrained climate change would likely benefit forests at the global level and in some regions, it would decrease forested areas in many others; and while climate mitigation would reduce carbon stocks globally, it would also reduce wildfire damages to forests and the adaptation costs associated with those damages.

MIT Joint Program joins Field to Market

Pledges to catalyze opportunities for continuous improvement in sustainability of commodity crop production

The MIT Joint Program has joined Field to Market®: The Alliance for Sustainable Agriculture, a leading multi-stakeholder initiative working to unite the agricultural supply chain in defining, measuring and advancing the sustainability of food, fiber and fuel production in the United States. "Combining the Joint Program's advanced modeling capabilities—on land-use change, carbon sequestration and agricultural vulnerability to global change—with other Field to Market members' field-level tools will greatly enhance our efforts to ensure that our food system is sustainable," says Rod Sneider, president of Field to Market.



Estimating impacts of climate change on agriculture

*MIT Joint Program researchers organize, co-edit symposium on the topic in **Review of Environmental Economics and Policy***

A symposium on "Estimating the Impacts of Climate Change on Agriculture" coordinated by MIT Joint Program Co-Director John Reilly and co-edited by Joint Program Research Scientist Élodie Blanc appears in the Summer 2017 issue of the journal *Review of Environmental Economics and Policy*. The Symposium introduces the three main approaches to assessing impacts of climate change on agriculture, and describes advantages, challenges and findings associated with each assessment method.

Climate change could curb crop yields by 2050, MIT study says (*Boston Globe*)

Study is one of the first to examine how the warming climate could affect the availability and distribution of the water basins that farmers depend on for irrigation

Researchers predict that absent action to reverse climate change, by 2015 several U.S. river basins used to irrigate crops may experience increased water stress. Their findings could lead farmers to implement preventative adaptation measures.

Air Quality & Health

Tackling air pollution in China

How combining climate policy and vehicle emissions standards could pack a one-two punch

An MIT Joint Program-led study shows that implementation of China's current vehicle emissions standards—or more stringent versions thereof—will likely considerably reduce road transportation's contribution to the nation's total air pollution, while an economy-wide carbon price will significantly lower air pollution from other sectors of the economy. The researchers maintain that combining the two approaches would be a viable strategy to reduce air pollution from both transportation and non-transportation sources.

Environmental Science & Technology's 2016 Best Policy Paper co-authored by Joint Program researchers

Study projected long-lasting health, economic impacts of lead emissions from U.S. general aviation flights

MIT researchers conducting the first assessment of the nationwide annual costs of IQ losses that can be attributed to aviation lead emissions found that each year, these IQ losses will likely result in about $1 billion in damages from lifetime earnings reductions, with an additional $0.5 billion in economy-wide losses due to decreases in labor productivity.

A one–two punch to tackle China's air pollution problems (*Scientific American*)

New research shows how climate and air quality policies can work together to clean up China's air

Using an energy-economic model, a team of researchers led by MIT Joint Program research assistant Paul Natsuo Kishimoto determined that combining vehicle emission standards and an economy-wide carbon price could "form a highly effective coordinated policy package that supports China's air quality and climate change mitigation goals."

Additional coverage: The Energy Collective

Infrastructure Resilience

Case study suggests new approach to urban water supply

One drought remedy: Keep infrastructure fast, cheap and under control

A study led by an MIT Joint Program-affiliated graduate student shows that during a prolonged drought in Australia, smaller, modular desalination plants could have met Melbourne's needs at a lower price than the $5 billion facility that was built—suggesting there is a strong case for building relatively modest, incremental additions to water infrastructure in advanced countries, rather than expensive larger-scale projects that may be needed rarely.

Natural Ecosystems

Climate change projected to significantly increase harmful algal blooms in U.S. freshwaters

Tufts University-led study—co-authored by three MIT Joint Program researchers—predicts growth of cyanobacteria in lakes and reservoirs due to global warming

"Harmful algal blooms known to pose risks to human and environmental health in large freshwater reservoirs and lakes are projected to increase because of climate change, according to a team of researchers led by a Tufts University scientist. The team developed a modeling framework that predicts that the largest increase in cyanobacterial harmful algal blooms (CyanoHABs) would occur in the Northeast region of the United States, but the biggest economic harm would be felt by recreation areas in the Southeast." –*Tufts*

Study predicts the Northeast will see greatest spike in toxic algae blooms due to climate change (*WGBH*)

Researchers project the largest effect in the northeast U.S., where levels of nitrogen and other nutrients in water bodies are expected to increase due to growing population and industrial activity.

Earth System Science

Indian monsoons strengthened over past 15 years

A 50-year dry spell has reversed, with more rain to come

An MIT Joint Program study published in *Nature Climate Change* finds that the Indian summer monsoons, which bring rainfall to the country each year between June and September, have strengthened in the last 15 years over north central India. This heightened activity has reversed a 50-year drying period during which the monsoon season brought relatively little rain to northern and central India.

Correcting the records

Climate data analyst Thomas Karl lectured on global temperature/precipitation measurement and interpretation.

Throughout the the 16th Henry W. Kendall Memorial Lecture, co-sponsored by the MIT CGCS, Karl discussed the reality of translating imperfect data into calculations of how global average surface temperature and precipitation levels have changed in the late 20th and early 21st century. "Our ability to detect changes [in the climate system] is related to our ability to better understand why those changes are occurring," he said. "We know a heck of a lot, but there's still much more to learn."

Indian monsoon has recovered from 50-year dry spell: Scientists (*Economic Times*)

A shift in India's land and sea temperatures may partially explain this increase in monsoon rainfall

Stronger monsoons may have resulted from a sharp gradient in temperatures—high over land, and low over surrounding waters—notes MIT Joint Program Senior Research Scientist Chien Wang.

Energy

Can Big Oil make way for biofuels?

How the price of crude may shape the future of a low-carbon alternative

On first glance, it seems intuitive that the higher the oil price, the more opportunity for bioenergy to break through, but a study by MIT Joint Program researchers shows that under certain conditions, a higher oil price can lead to lower bioenergy production—and less deforestation to clear land for the cultivation of bioenergy crops. Using the MIT Economic Projection and Policy Analysis (EPPA) model, the study examines the influence of oil price on the penetration of bioenergy, greenhouse gas emissions (GHGs) and land use.

Clean power planning

New study details why it's prudent to invest in carbon-free electricity now

Using a novel framework that incorporates a computable general equilibrium model of the U.S. economy into a computer program that evaluates decisions in the electric power sector under policy uncertainty, MIT Joint Program researchers determined that based on sampled policy scenarios, the optimal electricity sector investment for the next decade would allocate 20–30 percent of new generation to non-carbon sources.

The political economy of clean energy transitions

MIT Joint Program/Energy Initiative researchers co-author two chapters in new UNU-WIDER book

MIT Sloan Assistant Professor Valerie Karplus and IDSS PhD student Michael Davidson have co-authored chapters in the open-access book The Political Economy of Clean Energy Transitions, a publication of the United Nations University World Institute for Development Economics Research (UNU-WIDER). Spurred on by the 2015 Paris climate negotiations' emphasis on achieving global climate stability through myriad national greenhouse gas-reduction policies, the book explores political economic challenges and successes in country-level efforts to transition to a clean energy economy.

MIT Energy Initiative study explores future of transport

MIT Joint Program to support study through global economic and policy modeling

MIT Joint Program researchers will apply their expertise in global economic and policy modeling to support the MITEI "Mobility of the Future" study, which aims to determine how developments in technology, fuel, infrastructure, policy and consumer preference will impact the transportation sector. Their main task is to assess how the vehicle fleet and fuel mix will evolve in response to various transportation, energy and climate policy scenarios, and the likely costs of different policy options.

COMMENTARY **Communicating science-based pathways to policymakers (*IIASA Options Magazine*)**

"Even if we cannot predict the climate and its impacts with precision, that does not mean that the best strategy is to do nothing."

"[Our research] shows that even limited actions towards reducing GHG emissions results in a substantial reduction in the risk of exceeding a certain temperature threshold," writes MIT Joint Program Deputy Director Sergey Paltsev.

COMMENTARY **Thinking beyond Trump (*The Conversation*)**

Why power companies should be investing now in carbon-free electricity

"We found that for a broad range of assumptions, the optimal investment strategy for the coming decade is for 20 to 30 percent of new generation to be from non-carbon sources," writes MIT Joint Program Research Scientist Jennifer Morris. "Our model identified this as the best level because it best positions the United States to meet a wide range of possible future policies at a low cost to the economy."

Where should electricity investment go?

An OurEnergyPolicy.org online discussion

Using MIT Joint Program Research Scientist Jennifer Morris's *Energy Journal* paper "Hedging Strategies: Electricity Investment Decisions under Policy Uncertainty" as the basis for discussion, *OurEnergyPolicy* asks: "Is it appropriate for investors to hedge against market exposure by placing capital into technologies that result in cleaner burning fossil generation? Will private and public investors accept the risk and continue on a path of cheap fossil fuels, or increase holdings toward the 20–30 percent non-carbon source allocation?"

Limiting global warming (*Energy Futures*)

More aggressive measures are needed

MIT Joint Program Co-Director John Reilly and colleagues used a comprehensive set of linked models to demonstrate how dramatically the world's energy system needs to change—within the next few decades—to prevent excessive global warming by 2100.

Climate Policy

MIT statement on Paris Agreement research

U.S. president's reference to MIT research: correcting the record

The statement explains that the MIT Joint Program's 0.2 degree Celsius figure (reduction of warming by 2100) reflects the incremental impact of the Paris Agreement compared with the earlier Copenhagen agreement, and that its analysis accounted only for nations' pledges under the Paris Agreement with no further strengthening after the year 2030. A comparison of the Paris Agreement to no climate policy shows a temperature reduction of about 1°C by 2100.

Monitoring implementation of the Paris Agreement

Study explores steps needed to measure each nation's climate progress

Using the MIT Economic Projection and Policy Analysis (EPPA) model to construct sample analyses, MIT Joint Program researchers explore how economic modeling conducted outside official channels can support three aspects of a transparent implementation of the Paris Agreement: credibility, effectiveness and fairness. This level of transparency will be needed to support decision-makers as they determine whether to renew or intensify national pledges every five years.

MIT letter regarding U.S. withdrawal from Paris climate agreement

"The longer we hesitate, the lower the odds of success"

"A global problem demands a global solution. With the Paris Agreement, for the first time in history, 190+ nations agreed to work together to do something about it. In signing it, the U.S. was acting in concert with other nations, with the U.S. setting its own level of carbon reductions. The truth is that unless every nation joins in the solution, every nation will join in the suffering." –MIT President L. Rafael Reif

Risk Analysis

Climate change: Invoking uncertainty can be perilous (*The Energy Collective*)

New book draws on MIT Joint Program research on climate probability and uncertainty

David Hone, an MIT Joint Program sponsor representative who is Chief Climate Change Advisor for Royal Dutch Shell, and author of *Putting the Genie Back: Solving the Climate and Energy Dilemma*, writes that MIT Joint Program research has "demonstrated that even a modest attempt to mitigate emissions could profoundly affect the risk profile for equilibrium surface temperature."

Regional Analysis

Understanding climate change's ground zero

Study highlights need to improve modeling of carbon-rich Northern Eurasia

To better understand the long-term impacts of climatic, environmental and socioeconomic changes on Northern Eurasia and how these impacts may affect the rest of the world, an MIT Joint Program-led team of researchers from multiple institutions in the U.S., Russia and Germany recently assessed the state of global change modeling for the region. A key finding was that a significant number of past studies focused on Northern Eurasia's land system, without reference to interactions with the oceans, atmosphere and cryosphere—or to the planet as a whole.

MIT Technology and Policy Program's Best Thesis for 2017 maps out a clean energy future for India

Award-winning paper by Arun Singh shows how one of the world's fastest-growing economies might expand its energy consumption while limiting emissions

In his master's thesis, MIT Joint Program research assistant/IDSS graduate student Arun Singh analyzed climate policy options for India by building and applying a model of the Indian economy with detailed representation of the electricity sector. Singh determined that compared to a reference scenario of no policy constraints, an economy-wide emissions intensity reduction policy (simulated as a carbon price) would likely cost at least 43 times less per ton of carbon dioxide than a mandated expansion of non-fossil-based electric power capacity.

MIT News Office reporters Jennifer Chu and Peter Dizikes; IFPRI Research Fellow Emily Schmidt; and Tufts University reporter Kalimah Redd Knight contributed to selected news summaries.

Will sustainable land management mitigate Ethiopia's land degradation challenges?

Only if the government provides subsidies to farmers who invest in the practice, suggests study co-authored by MIT Joint Program Research Scientist Kenneth Strzepek

"A new study in the journal *Agricultural Economics* evaluates how investments in SLM and several complementary interventions affect household income. . . . Results from this study strongly suggest that without some form of subsidy to compensate farmers for the opportunity costs of investing in SLM, land degradation will persist throughout Ethiopia." –*IFPRI*

A new dam on the Nile reveals threats from warming (*ClimateWire*)

The need for flexibility in water-sharing agreements in the Nile basin

"The climate will change over time, it's not going to be an abrupt change. What that means is that any sharing agreements are going to have to be monitored constantly," says MIT Joint Program Research Scientist Kenneth Strzepek. "There has to be a mechanism there for the site to be able to easily adjust the changing future—and for them to be able to even agree on the nature of change, how it's changing and how it will affect the agreement."

COMMENTARY **Calling China's carbon market 'ambitious' shows how low the bar has fallen (*Climate Home*)**

China is planning the world's biggest carbon market, but with little detail given for its design, praise for the scheme is premature

"China has released limited information about the market's most essential design features," writes MIT Joint Program research assistant/IDSS graduate student Emil Dimantchev. "It is an open question whether its carbon market will rectify or repeat the failures of similar policies around the world."

New Research Projects

Signatures of the Multiple Scales of Motion in Shaping Marine Phytoplankton Biogeography

Sponsor: NASA Interdisciplinary Research in Earth Science (IDS) program

Collaboration: Led by MIT, involving California Institute of Technology/ Jet Propulsion Laboratory and University of Washington

Leader: Stephanie Dutkiewicz

Duration: 3 years

Phytoplankton play key roles as the base of the marine food web and as a crucial component in the Earth's carbon cycle. Understanding how ocean dynamics influence plankton ecology will add to basic knowledge and inform studies of higher-level marine organism habitat. This project will examine how ocean dynamics across an unprecedented range of scales set, transport and re-organize phytoplankton communities. An interdisciplinary team of researchers will combine satellite data, extensive flow cytometry observations, other existing in-situ measurements, and modeling to achieve these goals. The team will study the combination of physical mechanisms on scales from ones to thousands of kilometers that control the dynamic phytoplankton community biogeography; the observable signatures of these multiscale biogeographical patterns in satellite and in-situ data; the consequences of physical processes of different scales on biogeography, biogeochemistry, higher trophic levels and implication for vulnerability of ecosystems; what's missed when the various scales are not resolved in observations and models; and how observable signatures can be systematically exploited to best monitor the transport and reorganization of marine phytoplankton biogeography. The work will leverage and bolster existing NASA investments in innovative observations and modeling of physical and biological ocean processes, and help advance systematic approaches for exploiting next-generation remote sensing missions.

Pathways to Paris: ASEAN (Association of Southeast Asian Nations)

Sponsor: General Electric (via the MIT Energy Initiative)

Collaboration: Led by MIT Joint Program, involving MIT Center for Energy and Environmental Policy Research (CEEPR)

Leader: Sergey Paltsev

Duration: 16 months

Most signatories of the Paris Agreement are refining their Nationally Determined Contributions (NDCs) for the 2018 Facilitative Dialogue that will be held at the 24th session of the Conference of the Parties (COP24) in Katowice, Poland in December 2018. National strategies for compliance with NDCs are evolving: countries can deploy a wide range of policies to bridge the gap between current emission trajectories and NDC goals. Applying its robust modeling framework capable of assessing the viability of technology options, and policies that would promote them, MIT will conduct a gap analysis between current emission levels and NDC targets at a national level for the ten-member Association of Southeast Asian Nations (ASEAN). As part of this assessment, MIT will identify key challenges to compliance and suggest regionally applicable policy and technology solutions, with a focus on the electricity sector. Based on its modeling and insights, and expertise on low-carbon technologies from General Electric and partners including the ASEAN Center for Energy, MIT will produce a Pathways to Paris: ASEAN report. The report will clearly identify recommendations on technology pathways countries can take, and policy reforms they should consider, which are relevant for ASEAN countries and which provide insight to enable them to reduce emissions from their baseline trajectory as well as improve energy security in the electric power sector. Findings from the study will be delivered at the 2018 Facilitative Dialogue.

Milestones

Noelle Selin promoted to the rank of associate professor with tenure. Selin, an Institute for Data, Systems and Society (IDSS) and Department of Earth, Atmospheric and Planetary Sciences (EAPS) faculty member, is also a research scientist affiliated with the MIT Joint Program. Selin uses atmospheric chemistry modeling to inform decision-making on air pollution, climate change and hazardous substances such as mercury and persistent organic pollutants.

Susan Solomon among winners of United Kingdom Royal Society annual award. MIT EAPS Professor and Joint Program affiliate Solomon has been awarded the prestigious Bakerian Medal "for her outstanding contributions in atmospheric science, in particular to the understanding of polar ozone depletion." Solomon will deliver her Prize Lecture in London in the spring of 2018. Meanwhile, she presents the 7th Annual John H. Carlson Lecture "A Brief History of Environmental Successes" at the New England Aquarium on October 26, 2017.

–Helen Hill, EAPS; IDSS; MIT School of Engineering

Joint Program Reports

311. A Review of and Perspectives on Global Change Modeling for Northern Eurasia

312. Can Tariffs be Used to Enforce Paris Climate Commitments?

313. Global Economic Growth and Agricultural Land Conversion Under Uncertain Productivity Improvements in Agriculture

314. Modeling the Income Dependence of Household Energy Consumption and its Implications for Climate Policy in China

315. The Future Water Risks Under Global Change in Southern and Eastern Asia: Implications of Mitigation

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317. Application of the Analogue Method to Modeling Heat Waves: A Case Study With Power Transformers

318. A Win-Win Solution to Abate Aviation CO_2 Emissions

319. Estimating the Potential of U.S. Urban Infrastructure Albedo Enhancement as Climate Mitigation in the Face of Climate Variability

320. Probabilistic Projections of the Future Climate for the World and the Continental USA

321. New Data for Representing Irrigated Agriculture in Economy-Wide Models

322. Mid-Western U.S. Heavy Summer-Precipitation in Regional and Global Climate Models: The Impact on Model Skill and Consensus Through an Analogue Lens

Peer-Reviewed Studies & Pending Reprints

A review of and perspectives on global change modeling for Northern Eurasia (*Environ Res Lett*)

A revival of Indian summer monsoon rainfall since 2002 (*Nature Climate Change*)

Approaches to assessing climate change impacts on agriculture: An overview of the debate (*REEP*)

Determinants and impact of sustainable land management (SLM) investments: A systems evaluation in the Blue Nile Basin, Ethiopia (*Agricultural Economics*)

Hedging strategies: Electricity investment decisions under policy uncertainty (*Energy*)

Informing transparency in the Paris Agreement: The role of economic models (*Climate Policy*)

Is current irrigation sustainable in the United States? An integrated assessment of climate change impact on water resources and irrigated crop yields (*Earth's Future*)

The role of atmospheric oxidation in recent methane growth (*PNAS*)

The use of panel models in assessments of climate impacts on agriculture (*REEP*)

Towards a political economy framework for wind integration: Does China break the mould? (*UNU-WIDER Working Paper Series*)

Joint Program Reprints

2017-6 The impact of coordinated policies on air pollution emissions from road transportation in China (*Transportation Research Part D*)

2017-7 The impact of oil prices on bioenergy, emissions and land use (*Energy Economics*)

2017-8 The economic viability of Gas-to-Liquids technology and the crude oil-natural gas price relationship (*Energy Economics*)

2017-9 Impact of canopy representations on regional modeling of evapotranspiration using the WRF-ACASA coupled model (*Agricultural and Forest Meteorology*)

2017-10 The calibration and performance of a non-homothetic CDE demand system for CGE models (*Journal of Global Economic Analysis*)

2017-11 Climate model uncertainty in impact assessments for agriculture: A multi-ensemble case study on maize in sub-Saharan Africa (*Earth's Future*)

2017-12 Assessing climate change impacts, benefits of mitigation, and uncertainties on major global forest regions under multiple socioeconomic and emissions scenarios (*Environ Res Lett*)

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