

Earth System Initiative

The Earth System Initiative (ESI) was founded in 2002 to foster and facilitate multidisciplinary research and education efforts in the earth and environmental sciences and engineering at MIT, and to enhance strategic communication of the new knowledge and insights gained to citizens, policy makers, and corporate decision makers—those whose decisions and actions ultimately determine how humanity interacts with the global environment: the Earth System. Participating ESI faculty come primarily from the Departments of Civil and Environmental Engineering (CEE) and Earth, Atmospheric and Planetary Sciences (EAPS). However, ESI also draws from the Departments of Chemistry, Electrical Engineering and Computer Science, Mechanical Engineering, Biology, Biological Engineering, Anthropology, and Urban Studies and Planning.

Research Support

As of June 30, 2010, ESI's active portfolio of sponsored research totaled just over \$45.6 million spread over some 77 grants, with total FY2010 research volume reaching just over \$10 million. In the eight years since its inception, total research volume at ESI has totaled just over \$51 million, with steady increases each year and an annual average of almost \$6.4 million (see table). Currently funded research projects include collaborations among faculty in the School of Engineering and the School of Science and bridge the gap between fields such as biology, geology, chemistry, atmospheric sciences, and electrical engineering and computer science. Several projects are detailed in the sections below, as are additional sources of support.

Earth System Initiative Sponsored Research Volume, FY2003–FY2010

Fiscal year	Research volume (\$)
2003	880,284
2004	2,013,987
2005	5,028,797
2006	6,901,764
2007	7,486,815
2008	9,054,250
2009	9,646,973
2010	10,084,605
Total	51,097,475

Administration

Professor Dara Entekhabi (CEE and EAPS) has been the faculty director of ESI since July 2008. Entekhabi is also director of the Parsons Laboratory for Environmental Science and Engineering and chair of the Environmental Research Council (ERC) at MIT. Dr. Kurt Sternlof has been executive director of ESI since February 2009. The faculty director's office is located in Room 48-216G; the executive director's office is in Room 16-177C.

Highlights and Activities

Proposals Submitted and New Grants Awarded

During FY2010, six ESI-affiliated principle investigators (PIs) received nine awards for sponsored research, for a total of \$5,438 million in new funding from sources including the National Science Foundation, National Institutes of Health, NASA, US Department of Energy, and the Gordon and Betty Moore Foundation. Additionally, nine ESI-affiliated PIs submitted 20 new proposals to various funding agencies for a requested total of \$10,782 million.

Appreciation Dinner

A gala ESI appreciation dinner was held on October 29 in the Blue Wing of the Boston Museum of Science for all affiliated faculty, researchers, students, and friends. The third such community-building event hosted by longtime ESI benefactors Arunas and Pam Chesonis, more than 120 guests enjoyed a lovely relaxed evening of cocktails, dining amidst museum exhibits featuring the work of ESI scientists. The dinner was scheduled to coincide with the symposium on climate engineering the following day as a convenience for those coming from out of town.

Support of the Environmental Research Council

As chair of the Environmental Research Council, Professor Entekhabi has made supporting the ERC's work a major focus for ESI. During FY2010, Dr. Sternlof worked closely with Entekhabi and the ERC to create its report to provost Rafael Reif in fulfillment of his August 2008 charge to develop a prospectus for an environmental research initiative at MIT. This effort culminated on May 20, 2010, with the official release of the ERC's vision document, Prospectus for an Initiative on Global Environment at MIT: Global Challenges—Global Opportunities. Simultaneously, Provost Reif recharged the ERC with creating a detailed implementation plan for launching the new initiative in early 2011. On June 24, 2010, a faculty-wide call for concept papers went out to harvest the broadest range of substantive input. Continued close support of the ERC effort will remain a top priority for ESI through FY2011.

Young Faculty Seminars

A monthly seminar series held during the spring semester showcased assistant professors affiliated with ESI who presented their work to an audience outside their home department. The purpose of the ESI Young Faculty Seminars is to foster community and collaboration across disciplines by giving newer faculty a forum within which to reach out beyond their departments. The focus for spring 2010 was on CEE and EAPS, with each department's faculty presenting to the other department. Speakers from CEE included Janelle Thompson ("Land and Sea: Microbial Processes from Corals to Carbon Sequestration"), Jesse Kroll ("Oxidative Evolution of Organic Aerosols in Earth's Atmosphere"), and Ruben Juanes ("Non-equilibrium Physics of Multiphase Flow in Porous Media: Origin of Gravity Fingers"). Speakers from EAPS included Taylor Perron ("Pattern Formation in River Networks") and Tanja Bosak ("Growth Geometry of Modern and Ancient Photosynthetic Biofilms").

Participation in the Faculty Environmental Network for Sustainability

Entekhabi and Sternlof both attended a number of luncheon meetings of the Faculty Environmental Network for Sustainability (FENS). The purpose of these meetings was to discuss and advance the FENS initiative to create undergraduate minor and graduate certificate programs in sustainability at MIT. At one meeting, Entekhabi gave a presentation to FENS on the ERC process, followed by a discussion of how FENS and the ERC might collaborate productively.

Symposium on Climate Engineering

On October 30, 2009, ESI hosted its fourth major topical symposium: Engineering a Cooler Earth: Can We Do It? Should We Try? This one-day event showcased 12 experts from around MIT and the world grappling with the pressing question: Do we understand our climate system well enough to purposefully manipulate it with desirable, or even predictable consequences? Participants included professors Kerry Emanuel, Judith Layzer, and Carl Wunsch of MIT, David Battisti of the University of Washington, Timothy Lenton of the University of East Anglia, David Keith of the University of Calgary, and science writer Cornelia Dean of the *New York Times*. To the degree that a consensus opinion surfaced, it was that we do not know enough about how the climate system works to reliably engineer it, but that the impending potential for engineered interventions to be pursued anyway makes it imperative to quickly ramp up research in this area.

A video archive of the 2009 symposium, cosponsored by the MIT Energy Initiative and the Center for Global Change Science, can be found on the ESI website at <http://web.mit.edu/esi/symposia/symposium-2009/symposium2009-presentations.html>.



Screening of *Sizzle: A Global Warming Comedy*

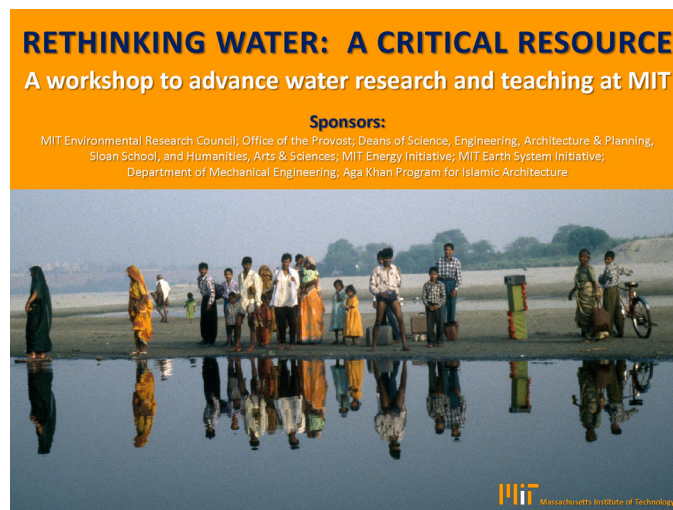
On April 21, 2010, ESI hosted a screening of science mockumentary filmmaker and former University of New Hampshire marine biology professor Randy Olson’s latest movie, *Sizzle: A Global Warming Comedy*, followed by a question-and-answer session between Olson and the audience. This well-attended event, cosponsored by the MIT Sloan Sustainability Initiative and the Manomet Center for Conservation Sciences was fun, irreverent, and thought provoking.

Science Communication Panel

As part of MIT’s celebration of Earth Day, ESI hosted a special panel discussion, “Talking Science in an Age of Sound Bites,” on the evening of April 22, 2010—the 41st Earth Day. A panel that included professors John Sterman and Judith Layzer, Randy Olson, and *Boston Globe* reporter Beth Daley dissected the issues of communicating science to the public and policymakers in an entertaining debate moderated by Dr. Sternlof. Cosponsors included the MIT Sloan Sustainability Initiative, the Department of Urban Studies and Planning, and the Manomet Center for Conservation Sciences.

Rethinking Water Workshop

ESI played a central role in sponsoring, planning, and convening a special one-day workshop on water-oriented research. “Rethinking Water: A Critical Resource—A Workshop to Advance Water Research and Teaching at MIT” was held on May 21, 2010, with an opening keynote address given the evening before by Charles Duhigg of the *New York Times*, author of the recent article series “Toxic Waters.” The goal of the workshop was to capture the full breadth of current and future research and education at MIT in areas such as water in urban design and regional planning; water, technology, engineering, and innovation; scientific problems in water; and water policy, economics, and business. MIT president Susan Hockfield opened the workshop by noting the central importance of water, both as a global resource and a central pillar of ERC’s vision for an initiative on global environment at MIT. Following the workshop, the conveners immediately began work on a “rethinking water” concept paper for submission to ERC’s implementation process.



Science Communication Panel

As part of MIT's celebration of the 40th anniversary of Earth Day, ESI hosted a special panel discussion entitled Talking Science in an Age of Sound Bites on the evening of April 22, 2010—the 41st Earth Day. The flyer for the event read—"In the face of ever more complex and pressing global environmental issues, broad scientific literacy has never been more vital. Yet in this polarized, populist world of IT overload—this Age of Sound Bites—communicating science to the public and policymakers alike has never been more challenging. Who's responsible and what's to be done? Our distinguished and lively panel will dive in and dig for answers."



The evening lived up to its billing, as a panel including professors John Sterman and Judith Layzer, filmmaker Randy Olson and Boston Globe reporter Beth Daley dissected the issue in an entertaining debate moderated by Dr. Sternlof. Co-sponsors included the MIT Sloan Sustainability Initiative, the Department of Urban Studies and Planning, and the Manomet Center for Conservation Sciences.

Screening of Sizzle: A Global Warming Comedy

On April 21, 2010, leveraging the presence on campus of science mockumentary filmmaker, and former University of New Hampshire Marine Biology Professor Randy Olson for the Talking Science panel (see Science Communication Panel above), ESI hosted an early evening screening of his latest movie *Sizzle: A Global Warming Comedy*, followed by a Q & A with the audience. This well-attended event was fun, irreverent and thought-provoking. Co-sponsors included the Sloan Sustainability Initiative and the Manomet Conservation Sciences.



Support for Terrascope

Terrascope is a yearlong program for freshman designed to impart an appreciation for the complexity of global sustainability issues and a can-do approach to tackling them. Originally the educational component of ESI, the two programs were split around 2006, leaving ESI to focus on research. The two programs still share a suite of offices. In FY2010, Sternlof began to again focus ESI's attention on supporting Terrascope through such activities as cosponsoring the annual spring Terrascope Alumni Dinner, working with the Office of the Vice President for Resource Development to advance Terrascope's fundraising efforts, and initiating a relationship between Terrascope and the Earthwatch Intsitude.

Earthwatch Engagement

In July 2009, Sternlof embarked on conversations with the Earthwatch Institute (<http://www.earthwatch.org/>) about establishing an ongoing relationship. Earthwatch specializes in promoting global environmental and sustainability awareness through experiential opportunities for laypeople to participate as “citizen scientists” in real field research. Many ESI-affiliated scientists would be a perfect match for such programs, which could provide them opportunities to receive assistance in their research and to conduct public outreach. While no MIT-Earthwatch engagements have yet been solidified, Earthwatch founder Brian Rosborough did provide the keynote address at the Terrascope Alumni Dinner in May 2010, and discussions are under way for an Earthwatch-facilitated Terrascope class trip in March 2011.

Ignition Grant Program

The ESI Ignition Grant program—which matches startup funding with innovative earth system research efforts not yet ready to attract external support—awarded 10 grants of \$50,000 each during 2007 and 2008, but has since gone dormant for lack of money. During FY2010, a new portfolio of Ignition Grant opportunities was created and provided to the Resource Development office in an effort to reinvigorate the program. The new portfolio also presents the results to date of the first 10 grants—which boast more than \$8 million in follow-on external funding, 30 peer-reviewed publications, and five PhD degrees awarded. Difficult economic times have thus far thwarted efforts at renewed Ignition Grant fundraising, but ESI remains prepared to move forward as conditions allow.

US Arctic Research Commission Briefing

ESI was invited to participate in the 91st regional meeting of the US Arctic Research Commission (USARC), held on November 10, 2009, by virtue of Dr. Sternlof’s acquaintance with USARC’s then-chair Mead Treadwell. Hosted by the Harvard University Center for Environment, the USARC meeting came just 11 days after ESI’s successful symposium on climate engineering. Professor Entekhabi presented a talk on this topic with particular reference to Earth’s polar regions, and discussed the results of the symposium with regard to the risks of climate engineering.

Support for Marine Microenvironments Meeting

In April 2010, ESI-affiliated faculty member Roman Stocker (CEE) sought help in raising funds for a special meeting to be held in January 2011 on the central role that marine microenvironments play in modulating biological interactions in the oceans. This is a very new area of science for which no established meeting exists. Professor Stocker and his collaborators from around the world won a competition to hold their inaugural meeting at the Aspen Center for Physics in Aspen, Colorado, and hope to establish a regular semi-annual event. Through the end of FY2010, ESI helped to raise \$30,000 in funds to help offset the attendance costs of graduate students and postdocs to the meeting.

Future Directions

As part of the planned launch of the aforementioned initiative on global environment at MIT during FY2011, it is anticipated that ESI's mission, organizational structure, and operations will be restructured to ensure that its core research agenda and portfolio continue to flourish. It is further anticipated that ESI will persist under a new name as a key component or "hub" of the new initiative. Successfully navigating the implementation of this transition is the central task for ESI in FY2011.

Dara Entekhabi

Director

Bacardi and Stockholm Water Foundations Professor

Civil and Environmental Engineering, and Earth, Atmospheric and Planetary Sciences

Director, Ralph M. Parsons Laboratory for Environmental Science and Engineering

More information about the Earth System Initiative can be found at <http://web.mit.edu/esi/>.