

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 involved come primarily from the Departments of Civil and Environmental Engineering (CEE) and Earth, Atmospheric and Planetary Sciences (EAPS), but 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, 2009, ESI's active portfolio of sponsored research totaled just over \$42 million spread over about 60 grants, with total FY2009 research volume reaching \$9.65 million. From its inception through the end of FY2009, total research volume at ESI has totaled just over \$41 million, with steady increases each year (Table 1). Currently funded research projects include collaborations among faculty in the Schools of Engineering and Science and bridge the gaps between fields that include biology, geology, chemistry, atmospheric sciences, and electrical engineering and computer science. Several projects are further detailed in the sections below, as are additional sources of support.

Table 1. ESI sponsored research volume

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
Total	41,012,870

Administration

The faculty director of ESI is professor Dara Entekhabi (CEE and EAPS), who is also director of the Parsons Laboratory for Environmental Science and Engineering and chair of the Environmental Research Council (ERC) at MIT. Professor Entekhabi took the helm at ESI from founding director Sallie "Penny" Chisholm (CEE and Biology) on July 1, 2008. The executive director of ESI is Dr. Kurt Sternlof, who was hired specifically for the position and came on board in February 2009 to replace Dr. Matthew Gardner, who had serving on a part-time basis since 2007.

The office of ESI's new faculty director is located at 48-216G; the office of the new executive director is located at 16-177C.

Highlights and Activities

Reinvigorating ESI Administration

The first priority of incoming faculty director Entekhabi was to hire a new executive director who would take the reins of ESI following a period of relative quiescence and guide it through difficult economic times to a bright future of increased activity and Institute-wide relevance. With new executive director Sternlof on board, ESI finished off the final five months of the year on a strong upward trajectory, reestablishing a regular spring seminar, attracting a surge in sponsored research proposals routed through it, and laying the foundations for a major symposium on climate engineering for fall 2009 to be cosponsored by the MIT Energy Initiative (MITEI) and the Center for Global Change Science (CGCS). Another important administrative improvement came in June 2009, when ESI acquired the part-time expertise of EAPS financial officer Mark Pendleton to assist with sponsored research grant proposals and award administration. This addition provides substantial value to active ESI faculty as well as an additional incentive to others considering routing their research proposals through ESI.

Collaboration with MITEI and CGCS

Since fall 2007, ESI has pursued collaborative relations with both MITEI and CGCS, as well as other important groups at MIT with stakes in the earth and environmental arena. The Earth System Initiative is committed to fostering collaborations that leverage our collective research strengths at MIT and amplify efforts in key strategic areas. We have held joint meetings with MITEI- and CGCS-affiliated faculty to discuss research topics to pursue jointly, and regularly interact with MITEI director Ernest Moniz and CGCS director Ronald Prinn. These relationships are continually evolving with great promise for the future of earth system science at MIT.

Support of the Environmental Research Council's Environmental Initiative at MIT

A natural outgrowth of ESI's outreach efforts within MIT is its close involvement with the Environmental Research Council, charged by provost Rafael Reif in August 2008 with developing a prospectus for an environmental research initiative at MIT. Professor Entekhabi also chairs the ERC, providing clear evidence of the continued importance of ESI as a founding pillar of the environmental initiative movement at the Institute. Consequently, Dr. Sternlof devoted significant energy toward supporting the ERC and helping to craft its report to the provost, which will likely be released in fall 2009.

Visibility and Additional Fundraising

Efforts to inform the MIT and broader research communities—as well as potential private, corporate, and foundation donors—about ESI activities are ongoing. In addition to our website (<http://web.mit.edu/esi/>) we have developed and disseminated a variety of materials that describe ESI research and education activities. The ESI Ignition Grant program, championed by MIT alumnus and benefactor Arunas Chesonis, has funded 10 separate \$50,000 ignition grants since 2007. These 10 seminal research projects have generated in excess of \$8 million in follow-on funding from more traditional sources for a leverage ratio of more than 16:1. They have also contributed to more than 25

peer-reviewed publications, 60 professional talks, and four PhD degrees awarded. The Ignition Grant program is one key to continue building a robust community of ESI-affiliated research faculty and students, and we hope to begin building a sustainable pool of funding during FY2010.

Two ESI appreciation dinners, sponsored by Mr. Chesonis and held in 2006 and 2007, were rousing community-building successes extremely well received by our faculty and students. The third edition of this popular event, planned for AY2010, is eagerly anticipated by the ESI community.

Moore Foundation Relationship

We are continuing efforts to broaden the scope of ESI's research portfolio. Our biggest success in this regard is the growing relationship with the Moore Foundation. ESI's conversations with the Moore Foundation early on contributed to the foundation setting up its Marine Microbiology Initiative. As Moore investigators, Professor Chisholm and professor Edward DeLong are beneficiaries of this initiative, receiving \$5 million each over five years for their research in marine microbial genomics. These awards were renewed in the spring of 2008 for an additional four years. The foundation also supports the research of professor Martin Polz on marine *Vibrio* bacteria. The foundation has supported the Darwin Project as well. This flagship ESI project, directed by Dr. Mick Follows of EAPS, brings together colleagues from CEE, EAPS, and the Computational and Systems Biology Initiative to build models of microbial ecosystems in the global oceans from the genome scale to the biome scale. In addition to funding Professor Follows' research, the Darwin grant supported the installation of the Darwin Cluster, a supercomputer facility that is used in a variety of environmental research programs, as well as the installation of the Visualization Wall for genomics and global simulations. This 60-panel LCD wall, measuring 22 feet wide and 10 feet tall and installed in the Stata Center, is one of the largest computer monitors in the world.

In summary, ESI has played a direct role in generating nearly \$20 million in funding from the Moore Foundation.

Center for Microbial Oceanography: Research and Education

ESI researchers including Penny Chisholm, Ed DeLong, and professor Edward Boyle play a prominent role in the Center for Microbial Oceanography: Research and Education (C-MORE). This National Science Foundation Science and Technology Center, funded by \$20 million over five years, is based at the University of Hawaii, with partners at Oregon State University, the Monterey Bay Aquarium Research Institute, Scripps, and other major research institutions.

National Aeronautics and Space Administration Astrobiology Grant

ESI researcher Roger Summons is the principal investigator for a National Aeronautics and Space Administration Astrobiology Award, a collaboration among MIT; Harvard; the University of California, Los Angeles; and the Marine Biological Laboratory. The research of this team will focus on the requirements for the development and evolution of multicellular life on Earth.

Successful Conclusion of the Linden Earth System Fellows Program

After seven fruitful years funding a total of 25 exceptional graduate students, the Linden Earth System Fellows program at ESI came to close at the end of May 2009 with a special lunch to honor dedicated benefactor Larry Linden (SM '70, PhD '76) and the final class of four fellows: Jia Har, Charuleka Varadharajan, Holly Moeller, and Philipp Reist. We look forward to the potential of restarting this program in the near future.

Symposia, Workshops, and Seminar Series

Since its inception, ESI has hosted three major symposia: “Was...Is...Might Be...: Perspectives on the Evolution of the Earth System” in 2004; “Vital Signs: The Diagnostics of Earth System Evolution” in 2005; and “Earth System Revolutions—Key Turning Points in the History of our Planet” in 2007 (a collaboration with CGCS). These symposia were all very successful, as indicated by strong turnout and favorable comments from attendees. Following a hiatus this year, a new symposium focused on the issue of climate engineering is planned for October 2009, with MITEI and CGCS as cosponsors.

A semiregular seminar series, periodic workshops, and faculty retreats are also planned and hosted by ESI in order to continue raising its profile both within MIT and the wider academic community.

Future Directions

A reevaluation and evolution of both ESI’s research agenda and its role at MIT has begun, most notably in terms of its founding role within the nascent environmental initiative, and its ongoing collaborative relationships with MITEI, CGCS, and the Joint Program on the Science and Policy of Global Change. This evolving landscape notwithstanding, the core mission and strength of ESI as an incubator and facilitator of both fundamental and applied Earth System-oriented research remains robust—as evidenced by its ever-growing sponsored research volume. As such, our fundraising and strategic directions for ESI during 2009–2010 will focus on continuing to expand its core research portfolio, while seamlessly integrating its operations within the Institute’s new initiative for global environment.

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/>.