Earth System Initiative

The Earth System Initiative (ESI) was formed in 2002 to encourage and coordinate multidisciplinary research and education efforts in earth sciences and engineering at MIT and to develop strategies to communicate this new knowledge to citizens, policymakers, and corporate decision makers whose actions determine how Earth's resources are managed. Faculty involved in the Initiative are drawn primarily from the departments of Civil and Environmental Engineering (CEE) and Earth, Atmospheric, and Planetary Sciences (EAPS), but ESI also has representation from Chemistry, Electrical Engineering and Computer Science, Biology, Biological Engineering, and even Anthropology.

Research Support

ESI currently has a research portfolio that includes approximately $42 million in funded projects (an average of approximately $6 million per year). These projects include collaborations among faculty in the schools of Engineering and Science at MIT and bridge the gaps between fields that include biology, geology, chemistry, atmospheric sciences, and electrical engineering and computer science. Some are detailed in the sections below, as are additional sources of support.

Administration

The director of ESI is Professor Penny Chisholm (CEE and Department of Biology), and the executive director is Dr. Matthew Gardner (part-time). ESI occupies part of the suite at 16-177.

Highlights and Activities

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 Ed 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 (CSBi) 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 almost $20 million in funding from the Moore Foundation.

Center for Microbial Oceanography: Research and Education

ESI researchers including Penny Chisholm, Ed Delong, and Ed 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.

Visibility and Additional Fundraising

Considerable effort has been expended to inform the broader MIT community, as well as potential corporate and foundation donors, about ESI activities. In addition to our website, we have developed and disseminated a variety of materials that describe ESI research and education activities. The ESI Ignition Grant Program, which has been championed by MIT alumnus Arunas Chesonis, has funded 10 separate $50,000 ignition grants in the past year. These funds, which come from individual donors, are intended to be used to support new areas of research that may not be ready for full support from traditional sources. Already, one ignition grant has been leveraged into a successful proposal for more than $600,000 in funding from a federal agency. Even more important, these ignition grants have been instrumental in helping us continue to build a community of affiliated faculty and research staff.

Chesonis has also sponsored two faculty appreciation dinners: one at the American Academy of Arts and Sciences in 2006 and the other at the Isabella Stewart Gardner Museum in the fall of this year. These events were rousing successes and were extremely well received by our faculty and students.

Linden Earth System Fellowship Program

ESI received a donation from the Lawrence and Dana Linden Family Foundation to create the Linden Earth System Fellowship program. These fellowships provide support for outstanding new graduate students who plan to pursue graduate studies in the environmental sciences and engineering. The program is funded annually, and the sixth class of fellows will arrive on campus in the fall of 2008.

Partnership with the Center for Global Change Science

In the fall of 2007 we initiated a series of conversations with Professor Ron Prinn, director of the Center for Global Change Science (CGCS), regarding ways that we can leverage our collective research strengths and combine efforts in key strategic areas. We have held joint meetings with ESI and CGCS-affiliated faculty to discuss research topics we could jointly pursue. This relationship is evolving and is a promising development in the environmental research portfolio at MIT.

Symposia, Workshops, and Seminar Series

On October 9, 2007, ESI hosted a major symposium, "Earth System Revolutions—Key Turning Points in the History of our Planet," in collaboration with CGCS. The symposium was a major success, as indicated by the strong turnout and favorable comments from students and colleagues. The next symposium, planned for April 24, 2009, will focus on the geoengineering of our planet.

ESI sponsors regular seminar series, faculty retreats, and workshops in order to continue to raise the profile of ESI within MIT and the broader academic community.

Future Directions

ESI is currently undergoing significant changes. A new faculty director, Professor Dara Entekhabi, will replace Penny Chisholm as of July 1, 2008. With this shift, there will be a recasting of ESI's research agenda. We anticipate that new efforts will be focused on developing research programs in the areas of geoengineering, energy, and sustainability. In 2008–2009, we will seek to expand and solidify our relationship with the MIT Energy Initiative, as much of the research conducted within ESI is directly applicable to this important effort.

ESI is also well positioned to investigate the challenge of large-scale Earth system engineering projects. Should we as a society consider undertaking efforts to reverse the damage that human societies have inflicted on the Earth? Do we sufficiently understand the interconnections of the various systems that make up our planet? Another area of research that we will explicitly focus on is biomimicry. The natural systems of this planet may contain many possible paths to sustainable human societies. We need to research and understand their basic function and then work to apply that knowledge to the challenges we face today.

Our fundraising and strategic directions for 2008–2009 will focus on extending these ideas and continuing to expand the ESI research portfolio.

Penny Chisholm
Director
Lee and Geraldine Martin Professor of Environmental Studies and Professor of Biology

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