Understanding global changes brought on by climate, urbanization or pollution and how these changes affect large ecosystems requires lots of data. Biologist William Fagan relies heavily on complex data sets to investigate the spatial distributions of species, the movement of animal populations and determining the drivers of animal movement. Maryland has a long-standing interest in the ecological impacts of altering the geography of river networks in India.

"I’m working at the interface of data and theory to develop an improved understanding of complex, coupled phenomena," says Fagan, who is assistant director at the NSF-funded Socio-Environmental Synthesis Center. "These processes include species movements across hundreds or even thousands of kilometers, as we need to look at these issues using large-scale syntheses.

That synthesis—now as spatial ecology combines environmental, geographic and mathematical data and requires familiarity in the use of high-end computers for crunching data and complex mathematical models to interpret the information—has become a popular topic for undergraduate students and post docs working in the Fagan Lab.

"We have students who include biologists, physicists, computer scientists and high-end computers for crunching data and complex mathematical models to interpret the information. This gives them the opportunity to discuss the curriculum—undergraduate or postdoc—working in the Fagan Lab.\"
resources, capabilities & partnerships

UMD resources, programs and partnerships that enhance environmental science research and ecosystem restoration or preservation include:

• the University of Maryland as well as other UMD centers and research thrusts expected to complement the center’s mission.

• Agricultural and Environmental Health
  The Maryland Institute for Applied Environmental Health, led by David Miller, is investigating how biological, chemical, physical and other factors influence the incidence and severity of diseases in the environment.

• Biotechnology and Energy
  The Maryland Institute for Biotechnology in Agriculture and the Environment, led by electrical engineer Anthony Ephremides, is working on "green" electronics that can reduce carbon emissions and conserve energy. The Maryland scientists, led by electrical engineer Anthony Ephremides, are working on "green" electronics that can reduce carbon emissions and conserve energy.

• Chemosphere
  Michael Waple, an expert on nuclear energy and low-carbon technologies, who is investigating how biological, chemical, and other factors influence the incidence and severity of diseases in the environment.

• Climate Change
  The Maryland Institute for Climate Systems Science, led by Dr. Jennifer Over, is investigating how biological, chemical, and other factors influence the incidence and severity of diseases in the environment.

• Environmental Science and Policy
  The Maryland Institute for Environmental Science and Policy, led by Dr. Jennifer Over, is investigating how biological, chemical, and other factors influence the incidence and severity of diseases in the environment.

• Environmental Sustainability
  The Maryland Institute for Environmental Sustainability, led by Dr. Jennifer Over, is investigating how biological, chemical, and other factors influence the incidence and severity of diseases in the environment.

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• Environmental Assessment
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The Socio-Environmental Synthesis Center, known as SeSynC, uses data and knowledge gleaned from various scientific disciplines to address large-scale environmental challenges. SeSynC, located in Annapolis, Md., is supported primarily by a nearly $30 million, five-year grant from the National Science Foundation, or NSF. Founded in 2014, the center is led by Margaret Palmer, a noted UMD environmental scientist and executive director of SeSynC.

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SeSynC features the latest advanced computing and visualization tools that puts meaningful, complex information accessible to scientists and policymakers on a computer monitor, not just on pages of research papers or in the minds of experts. These tools can synthesize information technology needs. SeSynC also promotes collaboration and innovation. These joint projects include nearly $1.8 million worth of research partnerships with other Maryland agencies, such as the University System of Maryland and the National Oceanic and Atmospheric Administration. It also offers smart environmental health policies in areas like microbial contamination of foods and the relationship between air pollution and asthma. The National Center for Smart Growth Research and Education, led by Donald Milton, joins Maryland researchers with national experts to study issues related to land use and the environment, transportation and public health and both local and international urban development. It also offers smart growth research to federal, state and local government officials as well as private-sector policymakers.

Researchers at SeSynC hold UMD resources, programs and partnerships that enhance environmental science research and ecosystem restoration on national and international levels. Prominent Maryland faculty involved in environmental public policy include:

- Christopher Justice, director of the National Center for Smart Growth Research and Education, led by Donald Milton, joins Maryland researchers with national experts to study issues related to land use and the environment, transportation and public health and both local and international urban development.
- Anthony Ephremides, a biological scientist, is assistant director of the Joint Global Change Research Institute, a university-federal partnership that investigates practical and cost-effective solutions for addressing climate change.

**SYNTHESIZING NEW ENVIRONMENTAL KNOWLEDGE**

**STAKEHOLDER SUPPORT**

SeSynC is dedicated to cultivating a community of partners who believe that the challenges facing today’s ecosystems cannot be addressed by traditional research and the traditional boundaries between disciplines. SeSynC’s model is one of engagement and collaboration that involves scientists, policy makers and representatives from government, industry and non-profits.

Leadership in addressing large-scale environmental challenges like clean water, sustainable food production and adaption to climate change.

**USF INVOLVEMENT**

Other strong support for SeSynC comes from the University of Maryland as well as the Maryland General Assembly, which in 2014 approved $5 million in annual state support for the Maryland Center for Environmental Science as well as Resources for the Future, a non-profit organization.

**RESOURCES & PARTNERSHIPS**

UMD resources, programs and partnerships that enhance environmental science research and ecosystem restoration on national and international levels.

- The University—particularly led by its departments of geography and the university system of Maryland, including UMD—has a rich history of research partnerships with federal scientists at NASA and the National Oceanic and Atmospheric Administration.
- Other strong support for SeSynC comes from the University of Maryland as well as the Maryland General Assembly, which in 2014 approved $5 million in annual state support for the Maryland Center for Environmental Science as well as Resources for the Future, a non-profit organization.
- SeSynC comes from the University System of Maryland's UMCES, says SeSynC looks to answer urgent questions on climate change. It also offers smart environmental health policies in areas like microbial contamination of foods and the relationship between air pollution and asthma. The National Center for Smart Growth Research and Education, led by Donald Milton, joins Maryland researchers with national experts to study issues related to land use and the environment, transportation and public health and both local and international urban development. It also offers smart growth research to federal, state and local government officials as well as private-sector policymakers.
- Investigators in the Institute for Systems Research are working on “green” electronics, led by electrical engineer Anthony Ephremides, which can reduce carbon emissions and conserve energy. The Maryland scientists, who work at SeSynC include:

- James Carton, an expert on nuclear energy and low-carbon technologies, who is assistant director of the Joint Global Change Research Institute, a university-federal partnership that investigates practical and cost-effective solutions for addressing climate change.
- Nathan Hultman, who is an expert on nuclear energy and low-carbon technologies, who is assistant director of the Joint Global Change Research Institute, a university-federal partnership that investigates practical and cost-effective solutions for addressing climate change.

- Matthieu Nubé, director of the Institute for Systems Research, studied renewable energy production and how they can be part of the solution.

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**PUBLIC POLICY**

This close relationship and the strong contributions of scientists and policymakers to addressing local and global environmental challenges, is central to SeSynC. This includes SeSynC’s work at the national and international levels. Prominent Maryland faculty involved in environmental public policy include:

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SYNTESIZING NEW ENVIRONMENTAL KNOWLEDGE

The synthesis of new environmental knowledge is critical to addressing the complex challenges that our planet faces. This requires a comprehensive understanding of the interconnections between human activities, ecosystems, and environmental health. The Socio-Environmental Synthesis Center (SeSynC), located in Annapolis, Maryland, is dedicated to synthesizing innovative solutions to these challenges.

SeSynC is a collaborative effort involving University of Maryland (UMD) faculty, Maryland Center for Environmental Science (UMCES), and private-sector partners. As a Washington, D.C.-based nonprofit, SeSynC is led by Margaret Palmer, a noted environmental scientist and policy expert. SeSynC is designed to bring together experts in various fields, including biologists, economists, social scientists, and policy experts, to address questions that are not traditionally seen.”

Located in Annapolis, Md., SeSynC is supported primarily by a nearly $10 million National Science Foundation (NSF) grant. This grant is expected to provide national leadership in addressing large-scale environmental challenges, particularly related to clean water, sustainable food production, and the vitality of large, running-ecosystems.

The center is supported by a team of over 70 researchers, including faculty from the University of Maryland, the Maryland Center for Environmental Science, and Resources for the Future. SeSynC’s mission is to synthesize innovative solutions, resulting in actionable information that can be used by researchers, policymakers, and the public.

SeSynC features the latest tools and visualization capabilities, including high-end computing and data visualization tools that put complex information accessible to researchers in a way that promotes collaboration and innovation. These tools can synthesize data from disparate fields like economics and biology, making it possible to answer urgent questions on both local and national levels.

SeSynC’s partnerships with federal agencies, universities, and private-sector organizations provide substantial support for its operations, including grants from the NSF, the National Oceanic and Atmospheric Administration, and the National Science Foundation.

PUBLIC POLICY

SeSynC’s goal is to provide policymakers with the knowledge and tools needed to make informed decisions. This involves working with federal agencies like the Environmental Protection Agency, the National Oceanic and Atmospheric Administration, and the National Science Foundation to provide science-based policy information on regional and local issues, as well as national dilemmas like climate change.

RESEARCH AND PARTNERSHIPS

UMD resources, programs, and partnerships that enhance environmental science research and ecosystem restoration are critical to SeSynC’s success. These include the University of Maryland’s vast research capabilities, its strong connections with federal agencies, and its partnership with the Maryland Center for Environmental Science.

SeSynC comes from the university’s strong history in environmental science, led by Christopher Diffenbaugh, a strategic advantage in that it can access large amounts of data acquired through UMD’s remote sensing research. Researchers at SeSynC hold expertise in environmental policy and ecosystem restoration or preservation include:

- Michael Blaue, director of the National Center for Smart Growth Research and Education, who focuses on strategies to improve environmental outcomes and mitigate the impacts of climate change.
- Donald Milton, an expert on nuclear energy and low-carbon technologies, who studies the potential emissions from nuclear and fossil fuels.
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Other strong support for SeSynC comes from Maryland’s university systems, including the NSF, the National Oceanic and Atmospheric Administration, and the National Science Foundation.

STUDENT INVOLVEMENT

Other student support for SeSynC includes students from universities like the University of Maryland, who are offered internships and opportunities to gain valuable experience in the field. SeSynC’s partnerships with federal agencies, universities, and private-sector organizations provide a strategic advantage in that it can access large amounts of data acquired through UMD’s remote sensing research.

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Spatial Ecology: Biology, Geography and Math

Understanding global changes brought about by climate, urbanization or pollution and how these changes affect large ecosystems requires data. Lots of data. 

Biology professor William Fagan relies heavily on complex data sets to investigate the spatial distributions of species movements across hundreds or even thousands of kilometers, such as the movement in Mongolia and predicting the ecological impacts of altering the sea surface temperature. 

Fagan is assistant director at the NSF-funded Socio-Environmental Synthesis Center, or SeSynC, that brings together leading scientists across disciplines to understand the social component of environmental issues. “Society is going to be the push that makes most any [environmental] policy work,” he says.

One of Fagan’s projects is an analysis of community interactions with university policies at New York City College of Technology. The research is funded by the Economic Research and Social Science Initiative, a division of the National Science Foundation, and is in other cases exploring environmental impacts of federal legislation or high-impact policy questions addressed by the National Science Foundation’s lifetime science and engineering preparation program.

“SeSynC is, as I see it, running head first into the uncharted territory,” Fagan says. “The long-term goal is teaching and training the next generation of environmental experts, who must be more than just scientists. They need to be policy makers, educators, and communicators too.”

“Synthesizing solutions is one of our top priorities,” says Dana R. Fisher, assistant director at the NSF-funded SeSynC, which is part of the University of Maryland’s College Park-based Spatial Ecology: Biology, Geography and Math program.

Fisher says she’s looking for innovative solutions to environmental issues through large-scale synthesis. “I am sure they will be excited about this new direction in the early planning stages,” she adds.

Fagan agrees, saying, “SeSynC is an analysis of community interactions with university policies at New York City College of Technology. The research is funded by the Economic Research and Social Science Initiative, a division of the National Science Foundation, and is in other cases exploring environmental impacts of federal legislation or high-impact policy questions addressed by the National Science Foundation’s lifetime science and engineering preparation program.”

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Spatial Ecology: Biology, Geography and Math

Understanding global change is brought on by climate, urbanization or population growth. And these changes affect large ecosystems—requires lots of data.

William Fagan relies on complex data sets to investigate the spatial distributions of species and to determine the drivers of animal movement. He says, “In my view, these huge data sets are the most exciting part of ecology today.”

“Understanding the interface of data and theory to develop an improved understanding of complex, ecological processes,” says Fagan, who is assistant director at the NSF-funded Socio-Environmental Synthesis Center. “These processes include species movements across hundreds or even thousands of kilometers, so we need to look at these issues using large-scale synthesis.”

That synthesis—known as spatial ecology—combines environmental biology, geography and mathematics and requires high-end computers for crunching the large amount of data. Lots of data.

“I’m working at the interface of the scientific disciplines that are involved in contemporary ecology—combines environmental biology, physics, applied mathematics and computational biology. Spatial ecology is a large umbrella that requires a diversity of disciplines,” Fagan says.

Environmental Synthesis in Higher Education

Many colleges and universities have developed inter- and multidisciplinary programs to advance understanding of complex social and environmental systems. Yet they face challenges in their efforts to train future scientists, policymakers, or environmentalists. How can we train tomorrow’s leaders of the sustainable society?”

Sharon Krupp, a policy analyst for the Keystone Center in Colorado, says that training the future workforce in the SoS approach is an interdisciplinary effort that requires collaboration across disciplines. “It is of critical importance that the competency of the environmental science workforce be continually evaluated and improved,” says Krupp.

The NSF-funded Socio-Environmental Synthesis Center (SeSynC) at the University of Maryland is providing a transformative new curriculum to help train environmental synthesis professionals. “In the next generation of environmental synthesis professionals, we need leaders that can bridge disciplines and bring those skills and more, with varied backgrounds that include zoology, physics, applied mathematics and computational biology,” says William Fagan, the center’s executive director. 

The dozen doctoral students and post docs working in the Fagan Lab bring with them a diverse skill set, varied backgrounds that include zoology, physics, applied mathematics and computational biology. Spatial ecology is a large umbrella that requires a diversity of disciplines,” Fagan says.

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