MS in Sustainability Science
Fall 2020 Course Offerings

MS in Sustainability Science students complete the 36-credit degree requirements by taking courses in the following curriculum areas:

Area 1 – Integrative Courses in Sustainability Science (9 credits)
Area 2 – Observation of Earth Systems (9 credits)
Area 3 – Analysis and Modeling Environmental Conditions and Impacts (9 credits)
Area 4 –Responding to Sustainability Challenges (6 credits)
Area 5 – Sustainability Policy or Management (3 credits)

Curriculum Area	**Sustainability Science Course**	**Instructor**	**Day & Time**
Area 1 – Integrative Courses in Sustainability Science	SUSC PS5001 Fundamentals of Sustainability Science	Art Lerner-Lam	Wednesday, 6:10-8:00 PM **ONLINE**
Area 1 – Integrative Courses in Sustainability Science	SUSC PS5999 Capstone Workshop in Sustainability Science	Ben Bostick	Tuesday, 6:10-8:00 PM **HYBRID – some portions may be held in person depending on student preference**
Area 2 – Observation of Earth Systems	SUSC PS5020 Predicting the Effects of Climate Change on Global Forests	Brendan Buckley	Thursday, 6:10-8:00 PM **ONLINE**
Area 2: Methods of Earth Observation and Measurement	SUSC PS5190 Remote Sensing for Aquatic Environments	Ajit Subramaniam	Tuesday, 6:10-8:00 PM **IN PERSON, depending on the size and preferences of the class**
Area 2: Methods of Earth Observation and Measurement **OR** Area 3 – Analysis and Modeling Environmental Conditions and Impacts	SUSC PS5060 Statistics, Data Analysis, and Coding for Sustainability Science	James Davis and Michael Previdi	Monday, 6:10-8:00 PM **ONLINE**
Area 3 – Analysis and Modeling Environmental Conditions and	SUSC PS5010 Climate Science for Decision Makers: Modeling, Analysis, and Applications	Michael Previdi and Yutian Wu	Monday, 4:10-6:00 PM **ONLINE**

Impacts			
Area 4 – Responding to Sustainability Challenges	SUSC PS5120 The Technology of Renewable Energy	Jonathan Hollander	Thursday, 6:10-8:00 PM **ONLINE**

Area 1 – Integrative Courses in Sustainability Science (9 credits)

SUSC PS5001 Fundamentals of Sustainability Science
Offered by MS in Sustainability Science Program/ SPS
Area 1 – Integrative Courses in Sustainability Science (Required)
Call Number: 12282
Credits: 3
Instructor: Art Lerner-Lam
Day/Time: Wednesday, 6:10-8:00 PM
Course Description: This course provides an introduction to the major themes of sustainability science with a focus on the application of science to the practice of sustainability. Basic research, especially in the environmental and social sciences, explores the Earth as a system of systems, wherein the physical, chemical and biological systems interact with each other as well as human systems to affect our future. The results of this research are often difficult to apply in practice unless the research in translated into actionable advice for individuals, governments and private enterprise. Even so, the actual or perceived complexities of interactions between human and "natural" systems are often seen by decision makers as barriers to long-term planning, an essential element of pursuing sustainability. A simple definition of sustainability is based on intergenerational equity. Thus, the relationships between the here-and-now and possible global futures need to be understood. Students enrolled in this course will discuss: Definitions of sustainability, including environmental, cultural and socio-economic components; Technologies for observing natural systems and their impacts on human systems; Summaries of scientific understanding of global-scale climate dynamics, natural hazards, biodiversity, environmental stressors and anthropogenic inputs to coupled human-natural systems; An overview of the strengths and weaknesses of science-based prediction; An introduction to geoengineering; Developing the evidence base for sustainability decisions; An introduction to risk assessment, perception and management; Decision making under uncertainty; General principles of sustainability management. An undergraduate background in any field of science or engineering and mathematics through statistical and time-series analysis is required. An interest in coupled natural-human systems is desirable.

SUSC PS5999 Capstone Workshop in Sustainability Science
Offered by MS in Sustainability Science Program/ SPS
Area 1 – Integrative Course in Sustainability (Required; should be registered for during your final semester or after completing at least one course in all of the content areas)
Call Number: 12287
Credits: 3
Instructor: Benjamin Bostick
Day/Time: Tuesday, 6:10-8:00 PM
Course Description: Students study the sustainability science behind a particular sustainability problem, collect and analyze data using scientific tools, and make recommendations for solving the problem. The capstone course is a client-based workshop that will integrate each element of the curriculum into an applied project, giving students hands-on experience.

Area 2 – Methods of Earth Observation and Measurement (9 credits)

SUSC PS5020 Predicting the Effects of Climate Change on Global Forests
Offered by MS in Sustainability Science Program/ SPS
Area 2 – Observation of Earth Systems
Call Number: 22283
Credits: 3
Instructor: Brendan Buckley
Day/Time: Thursday, 6:10-8:00 PM
Course Description: Forests are often called the lungs of the earth, for their role in converting atmospheric CO2 into the life-sustaining Oxygen that we all breathe. Collectively, the global forests contribute to roughly 40% of the annual global carbon sink, and yet little is known about the drivers of terrestrial carbon sequestration, and the processes involved in these systems response to changes in climate. Forested landscapes also comprise some of the most critical habitats on planet Earth, by serving as refuge to diverse and often endangered flora and fauna, and as regulators of water and soils. These services are particularly important for highland regions where forests are heavily exploited and are often the primary source of water and food for marginalized human populations. This course takes an in-depth look into the current, primary literature on the direct and indirect effects of climate change on forest ecosystems around the globe, and examines some of the primary policy solutions to forest loss mitigation and sustainability. Because the instructor is from the LDEO Tree Ring Lab there will be an emphasis on using dendrochronology for understanding changes in biomass for forest environments, with emphasis on the broadleaf forests of eastern North America and the largely coniferous, fire-prone forests of the American West. Students will have access to multiple sources of data, including satellite, forest inventory, tree rings and eddy-flux measurements. The course will have a field component that will take place at the Black Rock Forest (BRF), about two hours north of NYC. Students will conduct primary research for a final project, with the goal being to develop a set of group projects related to forests and climate change. This course will prepare students to assess the impacts of climate extremes on forest systems and to understand the complexities of response possibilities from diverse ecosystems.

This course will combine lectures and assigned course readings to develop the framework for understanding global forest response to climate change. Each class will begin with a 5-question mini-quiz based upon the assigned readings and the previous lecture. This class will discuss the questions asked, techniques used and key findings of the papers, with discussions led by the students. The class includes a field trip to Black Rock Forest (dates TBD) where students will collect data for use in a class project, thereby providing the opportunity to develop skills in field research and data analysis.

SUSC PS5190 Remote Sensing for Aquatic Environments
Offered by MS in Sustainability Science Program/ SPS
Area 2 – Methods of Earth Observation and Measurement
Call Number: 12286
Points: 3
Instructor: Ajit Subramaniam
Day/Time: Tuesday, 6:10-8:00 PM
Course Description: Aquatic systems are critical for provisioning ecosystem services that have sustained human civilization as evidenced by the establishment of the earliest civilizations on banks of rivers or along a coast. Apart from regulating climate, aquatic systems provide food and transportation services,

fresh water lakes and reservoirs provide water for consumption and irrigation, and coastal systems offer recreational services. But growing human population, especially along the coast, has endangered the quality of ecosystem services. The primary finding of the Millennium Ecosystem Assessment was that 15 out 24 ecosystem services examined are being degraded or being used unsustainably (MEA 2005). Monitoring the aquatic ecosystem and understanding how to distinguish between anthropogenic and natural variability is an essential aspect of sustainability science. This course will provide an introduction to the use of remote sensing techniques that can be used to study the aquatic environment. There are several space-based sensors that provide information relevant to sustainable management of aquatic resources. Depending on the sensor, observations are made as frequently as every day and spatially covering the entire globe. Understanding the spatial and temporal context around an issue can help discriminate between local and far field effects and time series of remote sensing data can be constructed to investigate causes and consequences of environmental events. Thus knowledge of the basic science of remote sensing, understanding how to select the appropriate sensor to answer a question, where to find the data and how to analyze this data could be critical tools for anyone interested in oceanic, coastal, and freshwater resource management. The course will follow active learning techniques and will consist of a lecture to introduce concepts followed by a discussion and lab time for hands on activities to learn and use tools for analysis of remote sensing data. After the introduction of the basic principles of remote sensing, a series of case studies will be used to explore concepts in sustainability such as water quality, nutrient loading and hypoxia, coral reefs. Remote sensing tools that are used to investigate and address environmental questions such as the effects of shutting down a sewage treatment plant, mapping of suspended sediment concentrations will be demonstrated and used by the students. Each case study will be briefly introduced at the end of the previous class and students will be encouraged to come prepared with scenarios relevant to their interest and work that they can explore with relevant remote sensing tools. Time will be set aside during the "lab-time" hands-on session for students to develop a project where a question of interest can be progressively investigated through the semester using the tools learnt, culminating in a final presentation. The use of computers to download and analyze data is required for this course.

SUSC PS5060 Statistics, Data Analysis and Coding for Sustainability Science
Offered by MS in Sustainability Science Program/ SPS
Area 2 – Methods of Earth Observation and Measurement OR Area 3 – Analysis and Modeling Environmental Conditions and Impacts
Call Number: 12284
Credits: 3
Instructor: James Davis and Michael Previdi
Day/Time: Monday, 6:10-8:00 PM
Course Description: Students in the Master of Science in Sustainability Science will encounter a range of scientific problems throughout their Science-specific courses that require a strong foundational level of mathematical and statistical knowledge. In addition, course-work will involve computer coding to read, analyze, and visualize data sets. This course provides an overview of essential mathematical concepts, an introduction to new concepts in statistics and data analysis, and provides computer coding skills that will prepare students for coursework in the Master of Science in Sustainability Science program as well as to succeed in a career having a sustainability science component. In addition to an overview of essential mathematical concepts, the skills gained in this course include statistics, and coding applied to data analysis in the Sustainability Sciences. Many of these skills are broadly applicable to science-related professions, and will be useful to those having careers involving interaction with scientists, managing projects utilizing scientific analysis, and developing science-based policy. Students enrolled in this course will learn through lectures, class discussion, and hands-on exercises that address the following topics:

Review of mathematical concepts in calculus, trigonometry, and linear algebra; Mathematical concepts related to working on a spherical coordinate system (such as that for the Earth); Probability and statistics, including use of probability density functions to calculate expectations, hypothesis testing, and the concept of experimental uncertainty; Concepts in data analysis, including linear least squares, time-series analysis, parameter uncertainties, and analysis of fit; Computer coding skills, including precision of variables, arrays and data structures, input/output, flow control, and subroutines, and coding tools to produce basic X-Y plots as well as images of data fields on a global map.

Area 3 – Analysis and Modeling Environmental Conditions and Impacts (9 credits)

SUSC PS5060 Statistics, Data Analysis and Coding for Sustainability Science
Offered by MS in Sustainability Science Program/ SPS
Area 2 – Methods of Earth Observation and Measurement OR Area 3 – Analysis and Modeling Environmental Conditions and Impacts
Call Number: 12284
Credits: 3
Instructor: James Davis and Michael Previdi
Day/Time: Monday, 6:10-8:00 PM
Course Description: Students in the Master of Science in Sustainability Science will encounter a range of scientific problems throughout their Science-specific courses that require a strong foundational level of mathematical and statistical knowledge. In addition, course-work will involve computer coding to read, analyze, and visualize data sets. This course provides an overview of essential mathematical concepts, an introduction to new concepts in statistics and data analysis, and provides computer coding skills that will prepare students for coursework in the Master of Science in Sustainability Science program as well as to succeed in a career having a sustainability science component. In addition to an overview of essential mathematical concepts, the skills gained in this course include statistics, and coding applied to data analysis in the Sustainability Sciences. Many of these skills are broadly applicable to science-related professions, and will be useful to those having careers involving interaction with scientists, managing projects utilizing scientific analysis, and developing science-based policy. Students enrolled in this course will learn through lectures, class discussion, and hands-on exercises that address the following topics: Review of mathematical concepts in calculus, trigonometry, and linear algebra; Mathematical concepts related to working on a spherical coordinate system (such as that for the Earth); Probability and statistics, including use of probability density functions to calculate expectations, hypothesis testing, and the concept of experimental uncertainty; Concepts in data analysis, including linear least squares, time-series analysis, parameter uncertainties, and analysis of fit; Computer coding skills, including precision of variables, arrays and data structures, input/output, flow control, and subroutines, and coding tools to produce basic X-Y plots as well as images of data fields on a global map.

SUSC PS5010 Climate science for Decision Makers: Modeling, Analysis, and Applications
Offered by MS in Sustainability Science Program/ SPS
Area 3 – Analysis and Modeling Environmental Conditions and Impacts
Call Number: 12283
Credits: 3
Instructor: Yutian Wu and Michael Previdi
Day/Time: Monday, 4:10-6:00 PM

Course Description: Both human and natural systems are growing more vulnerable to climate variability (e.g., the anomalous weather induced by the El Nino-Southern Oscillation, or the increase in hurricanes that occurs when ocean currents warm the Atlantic) and to human-induced climate change, which manifests itself primarily through increases in temperature, precipitation intensity, and sea level, but which can potentially affect all aspects of the global climate. This course will prepare you to estimate climate hazards in your field thereby accelerating the design and implementation of climate-smart, sustainable practices. Climate models are the primary tool for predicting global and regional climate variations, for assessing climate-related risks, and for guiding adaption to climate variability and change. Thus, a basic understanding of the strengths and limitations of such tools is necessary to decision makers and professionals in technical fields.

This course will provide a foundation in the dynamics of the physical climate system that underpin climate models and a full survey of what aspects of the climate system are well observed and understood and where quantitative uncertainties remain. Students will gain a fundamental understanding of the modeling design choices and approximations that distinguish Intergovernmental Panel on Climate Change (IPCC)-class climate models from weather forecasting models and that create a diversity of state-of-the-art climate models and climate projections.

This course will provide an overview of the ways in which climate model output and observations can be merged into statistical models to support applications such as seasonal and decadal projections of climate extremes, global and regional climate impacts, and decision-making. Students will develop the skills to visualize, analyze, validate, and interpret climate model output, calculate impact-relevant indices such as duration of heat waves, severity of droughts, or probability of inundation, and the strategies to characterize strengths and uncertainties in projections of future climate change using ensembles of climate models and different emission scenarios.

Area 4 –Responding to Sustainability Challenges (6 credits)

SUSC PS2010 The Technology of Renewable Energy
Offered by MS in Sustainability Science Program/ SPS
Area 4 –Responding to Sustainability Challenges
Call Number: 29275
Credits: 3
Instructor: Jonathan Hollander
Day/Time: Thursday, 6:10-8:00 PM
Course Description: Renewable energy is generated from natural processes that are continuously replenished. Aside from geothermal and tidal power, solar radiation is the ultimate source of renewable energy. In order to have a sustainable environment and economy, CO2 emissions must be reduced (and eventually stopped). This requires that the fossil fuel based technologies underlying our present electricity generation and transportation systems be replaced by renewable energy. In addition, the transition to renewable technologies will move nations closer to energy independence and thereby reduce geopolitical tensions associated with energy trading. This course begins with a review of the basics of electricity generation and the heat engines that are the foundation of our current energy systems. This course will emphasize the inherent inefficiency associated with the conversion of thermal energy to electrical and mechanical energy. The course then covers the most important technologies employed to generate renewable energy. These are hydroelectric, wind, solar thermal, solar

photovoltaic, geothermal, biomass/biofuel, tidal and wave power. The course ends with a description of energy storage technologies, energy markets and possible pathways to a renewable energy future.
Advising Note: *Students are expected to have completed a year of high school physics and chemistry. It would be best to have also taken college level physics and chemistry.*

EAEE E4550 Catalysis of Emissions Control
Offered through Earth and Environmental Engineering, The Fu Foundation School of Engineering and Applied Science
Call Number: 12840
Points: 3
Instructor: Robert Farrauto
Day/Time: Mondays and Wednesdays 2:40pm-3:55pm
Course Description: Prerequisites: One year of general college chemistry. Fundamentals of heterogeneous catalysis including modern catalytic preparation techniques. Analysis and design of catalytic emissions control systems. Introduction to current industrial catalytic solutions for controlling gaseous emissions. Introduction to future catalytically enabled control technologies.

Area 5 – Sustainability Policy or Management (3 credits)

SUMA PS4100 Sustainability Management
Offered by MS in Sustainability Management Program
Area 5 – Sustainability Policy or Management
Call Number: 12248 (section 1), 12249 (section 2)
Points: 3
Instructor: Steve Cohen (section 1), George Sarrinikolaou (section 2)
Day/Time: Tuesdays, 6:10pm-8:00pm (section 1); Mondays, 6:10pm-8:00pm (section 2)
Course Description: The introductory course will provide an overview of sustainability concepts and practices and how they are applied in real-world contexts. This course will begin by clearly defining what sustainability management is and determining if a sustainable economy is actually feasible. Students will learn to connect environmental protection to organizational management by exploring the technical, financial, managerial, and political challenges of effectively managing a sustainable environment and economy. This course is taught in a case-based format and will seek to help students learn the basics of management, environmental policy and sustainability economics. The literature and case material focus on lessons learned in government, non-profits and the private sector. The course will emphasize management in public and nonprofit organizations and the role of public policy in sustainability, but it will also explore how these two sectors interact with private interests to promote sustainable practices.

SUMA PS4734 Earth Institute Practicum
Offered by MS in Sustainability Management Program
Area 5 – Sustainability Policy or Management
Call Number: 12253
Points: 3 (Sustainability Management students should select 3 credits when registering)
Instructor Jeffrey Schlegelmilch
Day/Time: Wednesdays, 4:10-6:00 PM
Course Description: Within the Earth Institute, many centers use their expertise to approach the multifaceted problems currently facing the planet. Students taking this course will have the opportunity

to attend lectures and presentations given by prominent researchers from the following centers from across the Earth Institute: Center for Climate Change Systems Research; Roundtable on Sustainable Mobility; Center for Sustainable Urban Development; Water Center; Center for International Earth Science Information Network; Millennium Villages Project/Tropical Agriculture and Rural Environmental Program; International Center for Cooperation and Conflict Resolution; Center for Global Health and Economic Development.

SUMA PS5720 Policy and Legal Context of Sustainability Management
Offered by the MS in Sustainability Management Program
Area 5 – Sustainability Policy or Management
Call Number: 12275
Points: 3
Instructors: Rick Horsch
Day/Time: Monday, 6:10pm-8:00pm
Course Description: Public policy shapes how the man-made and natural environments are managed and regulated. Sustainability practitioners must be able to understand public policy and its effects on what they are charged to do. This course will provide students with an understanding of environmental sustainability policy and the resulting law and regulations in order to strengthen their ability to understand, interpret, and react to future developments.

SUMA PS5701 Water Governance
Offered by MS in Sustainability Management Program
Area 4: Public Policy
Call Number: 12274
Points: 3
Instructor: Michael Puma
Day/Time: Thursday, 6:10pm-8:00pm
Course Description: Water is widely recognized as the most essential natural resource for Earth's ecosystems and human society. Yet the relationship between water and society is complex. Water is a multifaceted resource that is important to all economic sectors and across a range of spatial scales from local to global. Water is also frequently a hazard; flooding, droughts, and contaminated water are formidable threats to human well-being. To deal with this seemingly dual nature of water, people have long modified the water cycle through engineering schemes like dams, reservoirs, irrigation systems, and interbasin transfer systems as well as through land use and land-cover change. To even the casual observer, a clear and robust plan is needed to manage and govern water given the multitude of ongoing human activities impacting the water cycle. This course will provide an overview of the political, social, economic, and administrative systems that affect the use, development, and management of water resources. Students will be introduced to current themes that influence water governance including sustainable development, integrated water resource management, water rights and pricing, corruption, and equity for marginal groups. These themes will be explored at the local, national, and international levels to provide students with a holistic understanding of water governance issues.