

**Department of Environmental Sciences  
Faculty of Environmental Sciences  
Master's Program in Environmental Sciences**

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**DEGREE:**

**Master of Science with a specialization in Environmental Sciences**

**TEACHING STAFF:**

**Christopher Nytch** . Ph.D. , University of Puerto Rico, Río Piedras Campus, 2018.  
Associate Professor of Forest Ecology, Ecosystem Services, Sustainable Resource  
Management ([christopher.nytch1@upr.edu](mailto:christopher.nytch1@upr.edu))

**Clifford Louime** , Ph.D. , Florida Agricultural and Mechanical University , 2005, Associate  
Professor, Sustainable Biofuel Production. ([clifford.louime@upr.edu](mailto:clifford.louime@upr.edu))

**Edwin Hernández** , Ph.D. , University of Puerto Rico, Río Piedras Campus, 2000,  
Research Associate. Marine Ecology. ([edwin.hernandez13@upr.edu](mailto:edwin.hernandez13@upr.edu))

**Elvia Meléndez-Ackerman** , Ph.D. , University of California , Berkeley of California-  
Irvine, 1995, Professor. Evolution and Bioconservation . ([elvia.melendez1@upr.edu](mailto:elvia.melendez1@upr.edu))

**Gabriel Moreno** , Ph.D., State University of New York-Stony Brook, 1990, Professor .  
Sustainable Urban Systems. ([gabriel.moreno@upr.edu](mailto:gabriel.moreno@upr.edu))

**Jess Zimmerman** , Ph.D. , University of Utah, 1989, Professor. Plant Ecology.  
([jess.zimmerman@upr.edu](mailto:jess.zimmerman@upr.edu))

**Jorge Ortiz** , Ph.D., University of Colorado-Boulder, 1998, Professor . Applied Limnology,  
Water Resources Management. ([jorge.ortiz23@upr.edu](mailto:jorge.ortiz23@upr.edu))

**Mei Yu** , Ph.D. , Chinese Academy of Sciences, 1998, Professor. Spatial Analysis,  
Modeling. ([mei.yu@upr.edu](mailto:mei.yu@upr.edu))

**Naftali Rios** , Ph.D. , University of Puerto Rico, 2007, Professor. Herpetofauna of Puerto Rico and the Caribbean. (neftali.rios@upr.edu)

**Omar Pérez-Reyes** , Ph.D. , Utah State University , 2014, Associate Professor, Ecology, Environmental Ecotoxicology, Invertebrate Zoology. (omar.perez15@upr.edu)

**Qiong Gao** , Ph.D., Cornell University, 1987, Professor . Ecosystem Modeling. ([qiong.gao@upr.edu](mailto:qiong.gao@upr.edu) )

**Rafael A. Ríos**, Ph.D., University of Texas at Austin, 1975, Professor . Drinking Water and Wastewater Treatment. Solid Waste Management. (rafaelrios00936@yahoo.com)

**Sirangi Bijmaragj** , Ph.D., CSIR National Physical Laboratory of India, 2016. Associate Professor, Aerosol-Cloud Interactions, Aerosol Instrumentation, and Air Quality Research. (bighnaraj.sarangi@upr.edu)

**Xiaoming Zou** , Ph.D. , Colorado State University , 1992, Professor. Soil Ecology. (xzou2011@gmail.com)

## Collaborators

## DEPARTMENT OF BIOLOGY

**José L. Agosto**, Ph.D. , Brandeis University , 2008, Associate Professor, Genetic Control of Sleep and Circadian Rhythms.

**Elvira Cuevas** , Ph.D. , Venezuelan Institute of Scientific Research, 1983, Professor. Ecology

**Tugrul Giray** , Ph.D. , University of Illinois, 1997, Professor. Animal Behavior.

**Steven E. Massey**, Ph.D., University of Kent at Canterbury, 2004. Professor. Bioinformatics; molecular evolution; genome evolution; origin of life; complexity.

## DEPARTMENT OF CHEMISTRY

**Néstor Carballeira** , Ph.D. , University of Würzburg , 1983, Professor. Natural Products Chemistry

**Liz Díaz Vázquez** , Ph.D. , University of Puerto Rico, Río Piedras Campus, 2005, Professor. Analytical Chemistry

**Arthur Tinoco** , Ph.D. , Yale University , 2007, Professor. Bioinorganic Chemistry , Proteomics , anticancer research, Metal-based therapeutics.

**Brad R. Weiner** , Ph.D., University of California, Davis, 1986, Professor . Physical Chemistry; Environmental and Physical Chemistry; Materials Chemistry. Reaction dynamics of gas-phase molecules, photochemistry and photophysics of lasers, kinetics of gas-phase reactive intermediates, nonlinear photoprocesses , molecular energy transfer.

## DEPARTMENT OF MATHEMATICS

**María Eglée Pérez** , Ph.D. , Central University of Venezuela, 1994, Professor. Bayesian Statistics; Biostatistics.

## INTERNATIONAL INSTITUTE OF TROPICAL FORESTRY

**Grizelle González** , Ph.D. , University of Colorado, 1999, Scientific. Soil ecology.

**William Gould** , Ph.D. , University of Colorado, 1999, Scientist. Geographic Information Systems

**Joseph Wunderle** , Ph.D. , University of Minnesota, 1980, Scientific. Ornithology.

**Tamara Heartsill-Scalley** . Ph.D. , Utah State University , 2005, Scientific. Ecology of Tropical Riparian Forests.

## INSTITUTE OF NEUROBIOLOGY, UPR

**Mark W. Miller** , Ph.D. , University of Connecticut, 1980, Professor . Environmental Neurobiology.

## UNIVERSITY OF PUERTO RICO, MAYAQUEZ CAMPUS

**José Dumas Rodríguez** , Ph.D. , University of Puerto Rico, Río Piedras Campus, 1999, Professor. Analytical Chemistry

**Luis A. Ríos Hernández** , Ph.D. , University of Oklahoma, 2003, Assistant Professor. Microbiology.

**Victor A. Snyder** , Ph.D. , Cornell University , 1980, Professor. Soils.

## ADMISSION REQUIREMENTS:

### General Requirements of the Río Piedras Campus

<https://graduados.uprrp.edu/estudiantiles/admisiones-graduadas22/>

## Specific Requirements of the Master's Program

To be considered for graduate admission, students must submit the following requirements:

1. A Bachelor of Science degree (or equivalent) with a concentration in Environmental Science, Biology, Computer Science, General Science, Physics, Mathematics, Chemistry, or Engineering from an accredited school.
2. Students with a bachelor's degree from an accredited university, but without a major in any of the aforementioned disciplines, may apply for admission to the graduate program through the [application.upr.edu platform](https://application.upr.edu). Once they have passed the following requirements with a minimum grade point average of 3.00: one year of General Biology, one year of General Chemistry, Calculus I, and an Introduction to Environmental Sciences course. However, successful completion of these courses does not guarantee admission to the program.
3. A minimum overall GPA of 3.00 (on a 4.00 scale) and a minimum science GPA of 3.00 at the undergraduate level.
4. Submit an official copy of your most recent academic record.
5. It is recommended that you have contacted (via email or in person) a professor in the department or a research associate who can serve as a mentor and establish a possible line of research. It is recommended that you explain the line of research you discussed with your potential mentor in your application essay.
6. Submit three letters of recommendation from professors with whom you have taken science courses.
7. Possess adequate knowledge of English and Spanish, both written and oral.
8. Submit your TOEFL scores (for foreign students only).
9. Attend an interview, if required by the Admissions Committee.

## GRADUATION REQUIREMENTS:

The completion of 38 graduate credits with a minimum GPA of 3.00 must be completed as follows: 18 credits in core courses, 6 credits in emphasis courses, 2 credits in graduate seminars, and 6 credits in elective courses. The completion of 6 research credits and the successful presentation and defense of a research-based thesis must be completed.

**STUDY PROGRAM:**

Program Requirements	Credits
<b>Courses Required</b>	<b>18</b>
CIAM 6115 The Terrestrial Environment	3
CIAM 6116 Ecosystems Tropicals *	3
CIAM 6117 The Environment Coastal	3
CIAM 6118 The Environment Urban	3
CIAM 6235 Perception Remote I *	3
CIAM 6256 Methods for the statistical analysis of environmental systems	3
<b>Areas of emphasis</b> . (At least two of the courses in the table below must be passed.)	<b>6</b>
<b>Seminars Graduates</b>	<b>2</b>
CIAM 6901 Graduate Seminar (May be repeated for a maximum of two credits)	1
<b>Investigation Graduated</b>	<b>6</b>
CIAM 6999 Master's Graduate Research *	6
CIAM 6896 Master's Thesis, Continuation *	0
<b>Free Electives</b> Students with prior authorization from the thesis committee may also take courses offered by other graduate programs.	<b>6</b>
CIAM 6910 Supervised Graduate Research (Rotation)	1
<b>Total Credits</b>	<b>38</b>
Program Courses	
CIAM 8225 Spatial Analysis Methods	3
CIAM 8226 Geospatial Techniques in Environmental Sciences	3
CIAM 8236 Perception Remote II	3
CIAM 8257 Techniques for building environmental models	3
CIAM 8405 Seminar on Sustainable Environmental Management Topics Islands and Tropical Regions.	2
CIAM 8425 Environmental Geology	3
CIAM 8435 Environmental Hydrology	3
CIAM 8115 Human Dimensions of Environmental Change	2
CIAM 8116 Environmental Policy and Ethics	2
CIAM 8117 Urban Environment, Design and Expansion	2
CIAM 8118 Ecological Informatics and Socio-Ecological Models.	2
CIAM 8119 Ecosystem Services and Ecological Economics.	2

CIAM 8120 Communication on the Environment	2
CIAM 8205 Seminar on Environmental Analysis Topics	2
CIAM 8206 Seminars on topics of environmental spatial analysis	2
CIAM 8775 Waste Management and Disposal	3
CIAM 8785 Power Generation	3
CIAM 8990 Special Topics in Environmental Sciences	3

Elective courses marked with \* may be substituted by elective courses approved by the Program.

### **COURSE DESCRIPTION:**

The course descriptions below are the most recent ones recorded in the Student Information System of the Registrar's Office at the Río Piedras Campus as of November 30, 2024, to be included in the 2024-2025 Graduate Catalog.

#### **CIAM 6115 The Terrestrial Environment**

Three credits. Three hours of lecture per week.

Study of the geological, geomorphological, hydrological, and climatological processes of mountainous, alluvial, and island regions and tropical regions. It focuses on the impact of human activities, the environmental problems resulting from these actions, and strategies to promote their sustainable development. Topics are discussed and analyzed within the context of general systems theory, using the watershed as the unit of study.

#### **CIAM 6116 Tropical Ecosystems**

Three credits. Three hours of lecture per week.

Prerequisite: Admission to the graduate program in environmental science or permission of the professor.

Study and spatial distribution of ecosystems characteristic of islands and tropical regions. The interaction between the various biotic and abiotic components of these ecosystems is systematically examined, as well as the impact of natural processes and human activities on them.

#### **CIAM 6117 The Coastal Environment**

Three credits. Three hours of lecture per week.

Study of the ecology and geological, geomorphological, hydrological, and climatological processes of the coastal and marine region, including the maritime-terrestrial zone, the storm surge zone, the littoral zone, estuaries, reefs, and others. It focuses on the study of the impact of human interactions on this environment, the environmental problems

resulting from these interactions, and strategies to promote sustainable development in these regions.

### **CIAM 6118 Urban Environment**

Three credits. Three hours of lecture per week.

Prerequisite: Admission to the graduate program in environmental science or permission of the instructor.

Study of the city from a systems perspective. It examines its structure and function, urban climatology and urban ecology; the environmental impact of transportation systems, energy generation, water distribution, wastewater and solid waste disposal; and the impact of human activities on environmental quality. It considers issues of urban planning, green spaces, natural hazards, urban noise, the distribution of pockets of poverty, and aspects of environmental justice. It discusses strategies to improve the quality of life in cities and promote sustainable development. It examines the characteristic pollutants of urban areas and their transport and diffusion mechanisms.

### **CIAM 6235 Remote Sensing I**

Three credits.

Theoretical and practical study of land cover and land use analysis methodologies using satellite imagery. The course examines the essential physical laws for studying remote sensing, image acquisition systems, image correction and classification, and interpretation of results. A project is developed in which the student performs an analysis to classify land cover and land use using satellite images of islands and tropical regions.

### **CIAM 6256 Statistical Analysis Methods for Environmental Systems**

Three credits.

Prerequisite: Admission to the graduate program in environmental sciences.

Study of statistical methods for the analysis of environmental data involving multiple variables. Multiple linear regression models, principal components analysis, cluster analysis, multidimensional surface analysis, canonical analysis, discriminant analysis, and others are studied. Variables are analyzed to quantitatively understand the behavior of environmental processes. Various computer statistical programs are discussed and applied, as are scientific research projects where these programs have been used.

### **CIAM 6901 Graduate Seminar in Environmental Sciences I**

One credit. One hour of seminar per week .

Lecture and discussion on special topics in the field of environmental sciences, usually led by invited speakers or based on recent literature in the field. The course may be repeated up to a maximum of 2 credits.

### **CIAM 6910 Graduate Research**

One to three credits. One to three hours of research per week.

Prerequisite: Authorization of the Coordinator of the Graduate Program in Environmental Sciences.

Environmental Science research supervised by a faculty member in their laboratory, to introduce incoming graduate students to the concepts, procedures, and techniques used to conduct their research in a specific area. The course may be taken up to two times for a maximum of six credits by a master's student and up to four times for a maximum of nine credits by a doctoral student.

### **CIAM 6999 Graduate Research for the Master's Degree in Environmental Sciences**

One to three credits. 5-15 hours of research.

Prerequisite: Authorization of the Director or Coordinator of the Graduate Program in Environmental Sciences.

Thesis research leading to a Master's degree in Environmental Sciences. (Up to a maximum of 6 credits).

### **CIAM 6896 Continuation of Master's Thesis**

Zero credits.

Prerequisite: CIAM 6999 and authorization from the director or coordinator of the Graduate Program in Environmental Sciences.

Continuation of thesis research leading to a Master's degree in Environmental Sciences

### **CIAM 6990 Special Topics in Environmental Sciences**

One to three credits. One to three hours of lecture per week.

Prerequisite: Admission to the Graduate Program in Environmental Sciences or permission of the professor.

A detailed study of one or more specific topics in the field of environmental science, usually taught by visiting professors or specialists in some area of environmental science. The course is designed to offer practical and theoretical experience on specific and current topics in environmental science. The topics vary each year. The course format encourages invited experts in the selected topic to dedicate a week or more to their lectures and empirical experiences. (Maximum 12 credits)

## **OTHER COURSE DESCRIPTIONS:**

### **CIAM 8115 Human Dimensions of Environmental Change**

Two credits. Two hours of lecture per week.

Prerequisite: Authorization of the director or coordinator of the graduate program in environmental sciences.

The relationship between human beings and the environment, with an emphasis on the social, political, economic, and cultural factors that contribute to the conservation of natural resources and environmental degradation. A variety of topics will be explored, such as the social construction of nature, environmental justice, and environmental



movements. It presents a broad and panoramic perspective to contextualize decision-making processes (at the state, community, organizational, and individual levels) regarding natural resource management. It promotes the application of concepts learned through collaborative projects with constituents to contemporary environmental issues in Puerto Rico.

### **CIAM 8116 Environmental Policy and Ethics**

Two credits. Two hours of lecture per week.

Prerequisite: Authorization of the director or coordinator of the Graduate Program in Environmental Sciences.

This course focuses on how environmental policy evolves and on the ethical positions of various stakeholders, especially in relation to selected environmental problems in Puerto Rico. Students will explore "environmental capacity," defined as the possession of adequate resources necessary for the implementation of activities related to environmental protection, as well as the willingness to utilize those resources. Environmental issues are related to questions about the management of the commons, which means that conflicting values are involved. Therefore, students will be required to apply an ethical perspective to environmental issues, health promotion issues, and policy solutions. Students will apply the principles of environmental policy to selected group projects.

### **CIAM 8117 Urban Environment, Design and Expansion**

Two credits. Two hours of lecture per week.

Prerequisite: Authorization of the director or coordinator of the Graduate Program in Environmental Sciences.

Students will study the environmental characteristics of cities and suburbs, the impacts of urban development on the environment, especially in the tropics, and improved design principles for the sustainability of urban and suburban areas, especially as they relate to environmental issues in Puerto Rico, the U.S., and elsewhere. Economic agents, the environment, and society have the capacity to create and transform the urban space where they occur. The long-term sustainability of the urban development process relies on the ability to reconcile the interests of growth (economic and urban), conservation, and social equity. This course will analyze "urban space" as an arena where economic agents, the environment, and society interact. In turn, these elements have the capacity to create and transform the urban space where they occur.

### **CIAM 8118 Ecological Informatics and Socio-Ecological Models**

Two credits. Two hours of lecture per week.

Prerequisite: Authorization of the director or coordinator of the Graduate Program in Environmental Sciences, provided that the student has the appropriate mathematical background.

Informatics and modeling have become even more important tools for environmental scientists. Students will be taught the basic components of environmental informatics and socioecological models. Topics covered include types and uses of models; distinguishing between models and hypotheses; data structures; metadata and data interpretation; information theory; hypothesis formation and testing; modeling methodologies and when to use them; relational databases and web-based data services; and examples of complex systems with parameterization and validation. Students will apply these techniques to components of natural and social systems in their selected group project.

### **CIAM 8119 Ecosystem Services and Ecological Economics**

Two credits. Two hours of lecture per week.

Prerequisites: Authorization of the director or coordinator of the Graduate Program in Environmental Sciences.

According to the Millennium Ecosystem Assessment, the course will focus on the support, provisioning, and regulation of ecosystem services as the link between the economies of natural and human systems and the increasing pressures these systems face. The fair allocation and sustainability of these services will be considered through different economic perspectives, including regulated and open markets, the tragedy of the commons, and ecological economics. Conflicts between growth and sustainability will be examined, as well as possible solutions, such as valuations that include the true ecological and social costs of resource exploitation and incentive structures. Students will apply the principles of ecological economics to selected group projects.

### **CIAM 8120 Communication on the Environment**

Two credits. Two hours of lecture per week.

Prerequisites: Authorization of the director or coordinator of the Graduate Program in Environmental Sciences.

To engage diverse community members in environmental science and policymaking, students will develop formal debate and argumentation skills. Special emphasis will be placed on the ethical dimensions of natural resource allocation and sustainability. The course will analyze how the media presents environmental science and provide feedback on national and international initiatives. Through selected topics, students will explore the ethical foundations of different points of view, with an emphasis on clarity and precision in communicating science that supports diverse community members.

### **CIAM 8205 Seminar on Environmental Analysis Topics**

Two credits. One hour of seminar and one hour of lecture per week.

Prerequisite: Authorization of the director or coordinator of the Graduate Program in Environmental Sciences.

Advanced seminar aimed at analyzing and discussing the literature and recent developments in the area of spatial environmental analysis, with an emphasis on islands and tropical regions.

### **CIAM 8206 Seminar on Topics in Spatial and Environmental Analysis**

Two credits.

Prerequisite: Authorization of the director or the Coordinator of the Graduate Program in Environmental Sciences.

Advanced seminar aimed at the analysis and discussion of the literature and recent developments in the area of spatial environmental analysis, particularly with regard to islands and tropical regions.

### **CIAM 8225 Methods for Spatial Environmental Analysis**

Three credits.

Prerequisite: CIAM 5235

Advanced methods in geospatial analysis. Issues of scaling, spatial autocorrelation, spatial interpolation, spatial point pattern analysis, patch analysis, hydrologic analysis, and image analysis will be discussed, along with their uses in environmental science. These topics will be addressed in lectures and through analysis of key articles. Students will develop and present detailed projects, applying techniques to a chosen environmental problem.

### **CIAM 8226 Geospatial Techniques in Environmental Sciences**

One credit. Three hours of lab time per week.

Prerequisite: CINA 4995

A laboratory course in which the applications of cutting-edge geospatial techniques will be discussed and implemented. Students will apply the knowledge and techniques learned to solve environmental problems through the use of case studies. Topics will cover applications in community clusters, hydrological dynamics, landslides, epidemics, land-use change, and global carbon dynamics. It will include oral presentations of cutting-edge articles, workflows for solving environmental problems, and written reports on the topics.

### **CIAM 8236 Remote Sensing II**

Three credits.

Requirements: CIAM 6235

Practical study of advanced satellite image analysis methodologies and the theory underlying these techniques. Emphasis is placed on the use and application of programs such as Imagine, ENVI, and Idrisi for the study and analysis of environmental processes and problems in islands and tropical regions, given their ability to analyze images with shadows caused by clouds and mountains. At the end of the course, the student will have completed a research paper that could be presented at a regional scientific conference.

### **CIAM 8257 Environmental Modeling Techniques**

Three credits.

Prerequisite: Admission to the Graduate Program in Environmental Sciences or permission of the professor.

The course is designed to train students at the intermediate level of environmental resource systems modeling, incorporating system dynamics. Students will work with models such as population-resource models, lake conservation models, automobile air pollution models, the nitrogen cycle, and others, using software that handles most of the mathematical computations (such as STELLA or its equivalent) so that students can focus on developing the model structure and obtaining or identifying key parameters in real-world systems.

### **CIAM 8405 Seminar on Sustainable Environmental Management Issues in Islands and Tropical Regions**

Two credits. Two hours of seminar per week.

Prerequisite: Authorization of the director or coordinator of the Graduate Program in Environmental Sciences.

Advanced seminar aimed at the analysis and discussion of the literature and recent developments in the area of sustainable environmental management of islands and tropical regions.

### **CIAM 8425 Environmental Geology**

Three credits. Three hours of lecture per week.

Prerequisite: CIAM 6115, 6117, 6118.

Study of the interaction between human activities and geological processes. Problems of slope stability, erosion, transport, and sedimentation processes, and the measurement of the physicochemical properties of geological materials are analyzed. Chemical equilibria and contaminant transport and fate mechanisms characteristic of the soil matrix are examined, as well as hydrogeology, diffusion, and transport of contaminants through soils and aquifers, sampling techniques, strategies for remediating contaminated sites, and geological hazards induced by natural phenomena. Geological problems are studied in the context of the impact of human infrastructure development on mountainous, Arctic, floodplain, and coastal regions.

### **CIAM 8435 Environmental Hydrology**

Three credits. Three hours of lecture per week.

Prerequisites: CIAM 6115, 6115, 6118.

Study of hydrological processes and water pollution. The course examines chemical balances and the mechanisms of transport and fate of contaminants characteristic of the water matrix. The course discusses the measurement of water budgets, the determination of physical and chemical parameters for natural waters, sampling and contaminant analysis techniques, the processes of diffusion and transport of contaminants in surface and groundwater, the impact of various human activities on hydrological balances and water quality, as well as strategies for the prevention, remediation, and mitigation of surface and groundwater pollution.

### **CIAM 8775 Waste Management and Disposal**

Three credits. Three hours of lecture per week.

Prerequisite: Authorization of the director or coordinator of the Graduate Program in Environmental Sciences. CIAM6115, 6117, 6118.

Analysis of the problem of waste disposal of all types on islands and tropical regions, focusing on Puerto Rico, and a study of the different alternatives and technologies available. Strategies for reduction, reuse, recycling, disposal in local and regional landfills, gasification plants, incineration, and others are examined. The environmental impact of various alternatives to the problem of waste management on islands and tropical regions is discussed, focusing on solutions consistent with sustainable development.

### **CIAM 8785 Power Generation**

Three credits. Three hours of lecture per week.

Prerequisite: CIAM6115, 6117, 6118.

Study of the fundamental concepts of energy, the laws of thermodynamics, and their practical applications. Analysis of energy demand and alternatives for its generation within the context of sustainable development. The environmental impact of different generation alternatives and the measures that can be used to minimize this impact are discussed.

### **CIAM 8901-8902 Graduate Seminar in Environmental Sciences I and II**

A credit.

Lecture and discussion on special topics in the area of environmental sciences, usually led by invited speakers or based on recent literature in the field.

### **CIAM 8990 Special Topics in Environmental Sciences**

One to three credits. One hour of lecture and two hours of research per week.  
Prerequisite: Authorization of the director or coordinator of the Graduate Program in Environmental Sciences.

A detailed study of one or more specific topics in the field of environmental science, usually taught by visiting professors or specialists in one of the areas of environmental science. The course is designed to offer practical and theoretical experience on specific current topics in environmental science. Topics vary each year. The course format encourages invited experts in the selected topic to dedicate a week or more to their lectures and empirical experiences. (Up to a maximum of 18 credits). This course requires a full academic load.