NSF Research Experiences for Undergraduates
Beyond Basic Science- Connecting Climate to Communities
Summer 2023

Contents

Undergraduate Projects
Identifying Effective, Community-Based Solutions To NYC Metro-Area Flood Risks

Background: The New York City metropolitan area faces increasingly serious flooding in the coming decades. According to projections by the New York City Panel on Climate Change, sea levels in the 2050s are likely to be 11 to 21 inches higher than they were in 2000. Heavy downpours like Hurricane Ida and enormous storm surges like those seen during Superstorm Sandy will also become more frequent, with the greatest impacts falling on communities that are already the most vulnerable due to a history of redlining, disinvestment and other inequitable land use policies. The US Army Corps of Engineers has identified over forty different coastal flood control techniques, including structural measures like seawalls, berms and surge barriers, non-structural approaches such as expanded street-level *green infrastructure* programs and combined sewer overflow reduction strategies, and nature-based solutions like restoring wetlands, aquatic vegetation and oyster reefs. The *Resilient Coastal Communities Project* (RCCP), a partnership between the Columbia Climate School and the New York City Environmental Justice Alliance, helps identify which of these strategies, implemented individually or in combination, will work best for New York and New Jersey's at-risk coastal communities. However, before effective flood protection measures can be crafted and put into place, planners need to confront their past failure to center the deep store of wisdom residing in front-line communities and enter into more effective partnerships with those communities. RCCP is deeply committed to helping redress this failure and support more equitable and empowered coastal protection planning.

Analysis Required: In 2022, RCCP interviewed nine local environmental and climate justice organizations to get their perspective on what a truly just and equitable flood protection planning process would look like and learn what resources they would need in order to participate fully and effectively in such a process. This Summer, RCCP seeks student support as we work, at the intersection of research and practice, to foster more effective and collaborative flood protection planning in partnership with community-based organizations and agencies like the NYC Mayor's Office of Climate and Environmental Justice and the US Army Corps of Engineers (each of which has promised greater community engagement and empowerment in coastal resilience planning and has requested assistance from the RCCP in connection with that commitment). Additionally, the student will help analyze the performance, to date, of select coastal flood protection projects utilizing "nature-based solutions" and help develop case studies of relatively successful environmentally just nature-based projects in the NYC area that could be used for wider learning in other contexts.

Prerequisites: Applicants should have an interest in conducting research involving climate adaptation, climate justice, stakeholder engagement in resilience policy planning, and ecosystem restoration. Coursework in climate science, urban planning or related fields is a plus. For more information about RCCP and its efforts to address the growing risks to our communities and ecosystems associated with climate change-driven flooding, see **Horizontal & Urban-scale Coalitions to Address The Wicked Problem of Coastal Flooding**.

Mentors: Paul Gallay, Resilient Coastal Communities Project Director (pag57@columbia.edu). Dr. Jacqueline Klopp, Co-Director of the Center for sustainable Urban Development (jk2002@columbia.edu)

Teaching with Maps: Instructional Strategies and User Research on Integrating GIS Maps in the Classroom to Enhance Climate Literacy and Equity

Background: The National Center for Disaster Preparedness (NCDP), Columbia University internship program offers the opportunity for pre-service/in-service K-12 teachers and undergraduate researchers to gain experience in designing curricula that leverages GIS Map technology as an instructional tool to address climate change, equity and disaster risk reduction education. NCDP works on research, curriculum development and delivery on climate literacy, equity, disaster preparedness, response, and recovery themes as part of a series of U.S. Federal grants. Utilizing existing NCDP curricula and GIS applications, educators will have the opportunity to gain skills in curriculum development, instructional design, user research, and evaluation. The interns will conduct user needs assessments by designing their own research protocol to gather information on how learners engage with the following maps 1) Resilience Analysis and Planning Tool (RAPT), 2) National Risk Index (NRI), 3) Climate and Economic Justice Screening Tool 4) The Environmental Justice Screening and Mapping Tool 5) Social Vulnerability Index (SoVI). The interns will develop instructional recommendations and lesson activities based on these findings. Recommendations will have implications for K-12 curriculum development and are encouraged to be repurposed for new classroom environments.

Analysis Required: Interns will engage in mixed-methods research (a combination of qualitative and quantitative research methods) to conduct user testing across mapping tools (see below). Interns will have access to use statistical analysis software such as Dedoose and SPSS, geospatial tools such as QGIS and ArcGIS, and qualitative research software. Interns are not required to have previous experience with data analysis tools. The interns and the supervisor will work closely together to design the research program, and therefore individual projects may contain variable amounts of data collection and data analysis. Multiple supplemental materials and learning opportunities will be available to educators, such as web-based courses on housing and economic recovery, training in ArcGIS, and access to expert researchers and staff at NCDP.

Mapping Tools for Summer 2023:
1. Resilience Analysis and Planning Tool (RAPT)
2. National Risk Index (NRI)
3. Climate and Economic Justice Screening Tool
4. The Environmental Justice Screening and Mapping Tool
5. Social Vulnerability Index (SoVI)

Prerequisites: Applicants should be interested in conducting research involving natural hazards, disaster recovery and preparedness, economic recovery, as well as housing and urban planning. We strongly encourage people from underrepresented groups to apply.

The program features a hands-on research project under the supervision of a Columbia-affiliated research scientist, special lectures, and workshops. Opportunities to participate in peer-reviewed conference presentations are also possible.

Mentors: Thomas Chandler, PhD (tec11@columbia.edu) and Joshua DeVincenzo, MEd, doctoral candidate (jld2225@columbia.edu), National Center for Disaster Preparedness

Rebutting False Arguments Against Renewable Energy Facilities

Background: Electric power plants are the second largest source of greenhouse gas emissions in the United States, only slightly behind the largest source, motor vehicles. Even after aggressive energy efficiency measures, the amount of electricity consumed in the U.S. will greatly increase – perhaps double – by 2050 as a result of the electrification of motor vehicles, building heating, and many industrial sources, as well as population and economic growth. At the same time, if we are to meet our climate targets, all the coal-fired power plants and most of the natural gas-fired power plants will need to be shut down. These two phenomena – growing demand for electricity and shrinking supply – will need to be met almost entirely by renewables, especially wind and solar, and the associated transmission and storage. An enormous amount of new renewables construction will thus be needed all around the country. These new facilities often meet with local opposition from neighbors who do not want them nearby, and by fossil fuel interests that do not want the competition. The Sabin Center for Climate Change Law has established a project, the Renewable Energy Legal Defense Initiative (RELDI), that provides pro bono legal assistance to community groups and others that support renewable facilities in their communities but that are facing local opposition. Opponents of renewable energy facilities have made effective use of several arguments, including that the facilities will consume an enormous amount of scarce minerals; that disposal of solar panels, wind turbines and other equipment at the end of their life will cause environmental hazards; that wind turbines kill large numbers of birds; that offshore wind facilities harm fishing; and many others. These claims have been amplified by commentators in the right wing media, by groups that have organized to fight renewables (often with funding from fossil fuel interests), and by a 2019 film by Michael Moore, *Planet of the Humans*. Most of these claims are false or overblown. While no construction project is without impacts, the adverse effects of renewable projects are far lower than those of the fossil fuel facilities they would replace, and mitigation measures have been developed to minimize them. Proponents of renewable energy facilities often have difficulty rebutting these claims. As part of this project, the student will draft a series of easy-to-read "fact sheets" or similar documents that debunk false claims about renewable energy. The student will also help to update and maintain two RELDI databases – one that documents local siting battles in which opposition to renewable energy has stopped or delayed a new project and a second that compiles evidence-based analysis of the impacts of renewable energy facilities to combat misinformation.

Analysis required: With the guidance of the mentors, the student will compile a list of the arguments that are most frequently used to attack renewable energy projects, and for each of these arguments, assemble technical information about their validity. The student will then write brief rebuttals of the arguments, with links to supporting documentation.

Prerequisites: Applicants should have excellent writing skills; good familiarity with online research techniques; and the ability to translate technical material into easy-to-understand prose. Applicants should have a strong interest in energy systems and their environmental impacts, but background in these issues is not assumed.

Mentors: Romany Webb, Associate Research Scholar at Sabin Center for Climate Change Law (rmw2149@columbia.edu)

Analysis of Climate Change Induced Migration and Displacement

Background: The Center for International Earth Science Information Network (CIESIN) at the Columbia Climate School manages the School's Climate Mobility Network (CMN) and has multiple projects on climate change induced mobility, which encompasses forced displacement, voluntary migration, and planned relocation, among other things. A common element of these research projects is identifying and analyzing current climate stressors and their impact on mobility, and modeling future pressures that could induce movement of people. Currently we have projects focusing on the following: (1) climate mobility and its projected impacts on Latin American urbanization; (2) projections of climate mobility in the Greater Caribbean region based on a general equilibrium model; and (3) a comparative analysis of the drivers of international migration out of Central America and West Africa, which includes secondary data analysis, field data collection and modeling components.

Analysis Required: With guidance of the mentor(s), the student will be expected to develop an independent research project using data collected or produced by one of the aforementioned projects. The project must entail some quantitative data analysis (either spatial or statistical) along with a literature review, and the formulation of a set of original hypotheses examining climate mobility. Results of the research project may contribute towards the goals of one of the projects. In developing its project, the student will have access to members of the CMN, a multidisciplinary network of members from six schools of Columbia University, for consultations and guidance.

Prerequisites: Applicants should have an interest in conducting research involving climate impacts, adaptation, and/or social vulnerability, and a demonstrated ability to conduct spatial or statistical analysis. Prior exposure to the topic of climate mobility (e.g., voluntary/forced migration in relation to climate impacts) is a plus. The applicant should ideally have prior exposure to Geographic Information Systems (GIS) (e.g., ArcGIS, QGIS) and a statistical package (e.g., R, SPSS, Stata or similar). Familiarity with Python or R coding language is a bonus.

Mentors: Alex de Sherbinin, Deputy Director and Senior Research Scientist at Center for International Earth Science Information Network (adesherbinin@ciesin.columbia.edu) , Fabien Cottier, Postdoctoral Research Scientist at Center for international Earth Science Information Network (fcottier@ciesin.columbia.edu), Susana Adamo, Research Scientist at Center for International Earth Science Information Network (sadamo@ciesin.columbia.edu)

Youth, Peace and Security

Background: In December of 2015 the UN adopted resolution 2250 on Youth, Peace, and Security, underscoring "the role of youth in preventing and resolving conflict, as well as in building and maintaining peace, encouraging Member States to include young people in decision-making processes across these areas" (from the 2250 Resolution on YPS, https://www.un.org/youthenvoy/2020/12/un-security-council-youth-peace-security-resolution-2250/). This heightened role of youth in local and international policy making makes it critical to identify ways to support the inclusion of youth in policy processes and good practices in youth led initiatives.

The Youth, Peace and Security (YPS) Program at Columbia University is designed to identify and then act on the linkages between social conflicts and violence, as well as the peaceful responses by youth to the phenomena of conflict and violence; our approach seeks to elicit, further develop, and disseminate best practices among youth leaders. Throughout the years of work in the field, learning from youth community leaders that have historically responded peacefully to violent conflicts, the YPS program has developed its own variation of praxis, i.e., fieldwork and archival research for peacebuilding and social transformation.

YPS researchers have come to understand that peacebuilding is not an event, nor a lineal process, but rather a complex social and historical development. During the spring of 2023, YPS researchers will devote some of their research to understanding the way peacebuilding practices let by youth in Latin America are addressing climate change including its effects on migration. Because we have been paying attention to the ways youth in the global south think about social conflicts, we have evidenced that most believe that peace must be achieved not only between humans but also between humans and the natural environment that surrounds them. The complex relationship between natural and social environments are part of indigenous cosmologies, and we are interested in shedding light on how youth are applying these epistemologies to their work both in urban and rural settings. Thus, our research question for this project is twofold: What are some of the alternative epistemologies about natural and social environments, and in what ways are youth utilizing them to contribute to global peace and to mitigating some of the negative effects of climate change such as forced migration?

Analysis Required: Conduct a systematic review of relevant literature on alternative epistemologies about nature and society and write an annotated bibliography. In addition, the student/intern will participate in the organization and categorization of the data collected, as well as participate in the preparation leading to an academic publication. The student/intern will be credited in the acknowledgments page of the publication.

Prerequisites: A deep interest on matters concerning youth, as well as on conflict and peace studies. Some experience in doing literature reviews and data analysis. The student must be proficient in Spanish (speaking and writing), with fluency or native proficiency preferred.

Mentors: Joan Lopez, Program Manager of Peace and Security Program at Advanced Consortium on Cooperation, Conflict, and Complexity (jl4736@columbia.edu), Beth Fisher-Yoshida, Executive Director at Advanced Consortium on Cooperation, Conflict, and Complexity and Professor of Professional Practice in Negotiation and Conflict Resolution at the School of Professional Studies (bf2017@columbia.edu)

Educator Projects

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Sustainability Education Curriculum for High School Students

Background: The Research Program on Sustainability Policy and Management is engaging in a five-year project funded by the Tencent Foundation (China) to develop a series of sustainability education curriculum modules for secondary school students in China.

A total of seven curriculum modules will be developed (in English), with topics covering the environmental, economic, and social aspects of sustainability. Each module is designed to be implemented as a full-semester course with between 60 to 80 class-hours. For each module, the project team creates a document which contains all relevant educational content, case studies, links to additional resources, and student activities as well as instructions for teachers. This document is the key deliverable for each module and serves as both the textbook and the teaching manual.

So far, three modules - *Introduction to Sustainability*, *The Science of Climate Change*, and *Ocean Sustainability* – have been developed and implemented in a pilot international school in China for students in Grades 9 and 10. Another module, *Sustainable Agriculture and Food System,* is currently being developed, intended for Grade 10, with three more modules – *Renewable Energy, Green Economy,* and *Sustainable Cities* to be completed next year for grades 11 and 12.

Once all the modules have gone through pilot implementation and are finalized, the Tencent Foundation will work with research partners in China to further localize the curriculum to facilitate wider adoption by local schools, while the finalized English version of the curriculum will be released online as open resource for educators.

The intern's role: The intern will be intensively involved in the module development along with the mentor. Depending on the project progress, as the team develops one module at a time, the intern will participate in the development of one of the three upcoming modules (*Renewable Energy, Green Economy,* or *Sustainable Cities*). The intern will assist in conducting literature review to collect resources for educational content, drafting of module sections/chapters, compiling case studies, or designing in-class/after-school student activities. Depending on the specific task the intern chooses to take, the eventual deliverable for the internship would be a written document containing a textbook chapter or sections, or case studies with discussion questions and suggested answers, or detailed instructions for student activities with supplementary materials if necessary.

Prerequisites: Educators with previous experience on sustainability education are strongly preferred. However, other candidates, including student candidates, who are enthusiastic about sustainability education are all welcomed. The intern candidate should have proficient writing skill, particularly with regards to explaining knowledge content or concepts in ways that can be effectively understood by high school students. Lastly, given the topics of the three potential modules the intern will be working on, familiarity with either renewable energies, green economy, or sustainable cities will be considered a plus.

Mentor: Anyi Wang (aw2544@columbia.edu), Research Program on Sustainability Policy & Management.