Tania P. **Lopez-Cantu**

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Summary

I am interested in climate change, urban development, data analytics and sustainability. For my Ph.D., I have focused on infrastructure adaptation and resilience to climate change. Specifically, I have worked on characterizing observed and future changes in rainfall patterns. I have studied future changes using global climate models (GCM) projections and the associated uncertainties. Furthermore, I have worked on increasing infrastructure resilience using remotely sensed data and future projections to inform decisions under deep uncertainty through robust decision making methods. I mostly use Python and Geographical Information Systems (ArcGIS and QGIS) software for my daily research.

Research Interests

Sustainability, Climate Change Adaptation, Water Resources, Decision-Making under Deep Uncertainty, Climate Data Analytics

Education

Ph.D. in Civil and Environmental Engineering — *Pittsburgh, PA*

Carnegie Mellon University — *Expected February 2021*

Advisor: Dr. Constantine Samaras

M.S. in Civil and Environmental Engineering — *Pittsburgh, PA*

Carnegie Mellon University — *December 2016*

B.S. in Engineering Physics — *Monterrey, Mexico*

Monterrey Institute of Technology — *May 2014*

Physics International Exchange Program — *Lausanne, Switzerland*

École Polytechnique Fédérale de Lausanne — *July 2012 - July 2013*

Research Experience

Ph.D. Graduate Research Assistant

Carnegie Mellon University — *January 2017 - Present*

Advisor: Dr. Constantine Samaras

Spatial and temporal characterization of stormwater engineering standards across the United States

- Developed a framework to identify priorities by State to update their stormwater standards given acceptable risk failure preferences and rainfall information used for infrastructure design. Found that 8 U.S. States are in high priority to update their stormwater engineering standards and add capacity to existing infrastructure due to observed changes in rainfall extremes and infrequent updates in infrastructure design information.

Uncertainty in Observed and Future U.S. Extreme Rainfall Changes

- Proved that publicly available downscaled climate projections for the U.S. project widely different change rates (between 10% and 50% for high-end events) in rainfall extremes at the continental scale. Demonstrated that high-end events (e.g. 100-year) generally increasing more than low-end extremes (e.g. 5-year).
- Published an open-source dataset of national gridded change factors from more than 200 climate projections under a high-emissions (RCP 8.5) and moderate-emissions (RCP 4.5) scenarios to facilitate application of robust decision-making to increase water infrastructure resilience.

Use of climate information in U.S. cities climate change adaptation plans

- Created a database of the state of use of climate information for climate adaptation and resilience based on climate adaptation plans from cities with a population greater than 300,000 people, as well as the most populous city in each state.
- Proved that strategic planning for climate resilience can be influenced by the differences in methodological decisions taken throughout the climate data analysis.

Screening tools for assessing infrastructure resilience and identifying robust adaptation actions

- Building a screening tool to identify under- and oversized infrastructure that requires adaptation actions, and identify robust strategies under multiple scenarios of future climate change and land use uncertainty.

Research Intern

Capacity Center for Climate and Weather Extremes, National Center for Atmospheric Research — *June - August 2019*

Mentor: Dr. Andreas F. Prein

- Designed a framework for comparing several publicly available climate projections datasets for the continental United States.
- Characterized the differences in daily future rainfall extremes across four commonly used climate projections datasets for the United States
- Identified sources of uncertainty and quantified their contribution to the future change in daily rainfall extremes.

Research Intern

Hydrometeorological Applications Program, National Center for Atmospheric Research — *June - August 2018*

Mentor: Dr. David Yates

- Characterized changes in hourly rainfall extremes for Pennsylvania using a hierarchical Bayesian generalized Pareto model and sub-daily high spatial resolution climate projections.

Research Assistant

Carnegie Mellon University

Advisor: Dr. Constantine Samaras

June - July 2015

- Developed a database by state, drainage structure, highway class and climate region for current stormwater infrastructure design guidelines to analyze the resilience and robustness of the design procedures to future climate conditions.

Publications

Journal Articles

- **Tania Lopez-Cantu** and Constantine Samaras. Temporal and Spatial Evaluation of Stormwater Engineering Standards Reveals Risks and Priorities Across the United States. *Environmental Research Letters*. 13(7):1748-9326, 2018. doi:10.1088/1748-9326/aac696.
  URL: https://doi.org/10.1088%2F1748-9326%2Faac696
- Daniel B. Wright, Christopher D. Bosma and **Tania Lopez-Cantu**. U.S. Hydrologic Design Standards Insufficient Due to Large Increases in Frequency of Rainfall Extremes. *Geophysical Research Letters*. 46(14):8144-8153, 2019. doi:10.1029/2019GL083235.
  URL: http://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2019GL083235
- B. Shane Underwood, Giuseppe Mascaro, Mikhail V. Chester, Andrew Fraser, **Tania Lopez-Cantu** and Constantine Samaras. Past and Present Design Practices and Uncertainty in Climate Projections are Challenges for Designing Infrastructure to Future Conditions. *Journal of Infrastructure Systems*, 26(3), 2020. doi:10.1061/(ASCE)IS.1943-555X.0000567
- **Tania Lopez-Cantu**, Andreas F. Prein and Constantine Samaras. Uncertainties in Future U.S. Extreme Precipitation from Downscaled Climate Projections. *Geophysical Research Letters*, 47(9), 2020. doi:10.1029/2019GL086797.
  URL: https://doi.org/10.1029/2019GL086797.
- Yuchuan Lai, **Tania Lopez-Cantu**, David A. Dzombak and Constantine Samaras. Framing the Use of Climate Model Projections in Infrastructure Engineering – Practices, Uncertainties, and Recommendations. 202X. **Submitted**.
- **Tania Lopez-Cantu**, Marissa Webber and Constantine Samaras. Incorporating extreme rainfall uncertainty from downscaled climate projections can improve resilience of climate adaptation plans in U.S. cities. 202X. **In preparation**.
- **Tania Lopez-Cantu** and Constantine Samaras. A robust screening tool for evaluating the performance and resilience of stormwater infrastructure under climate change and land use uncertainty. 202X. **In preparation**.

Oral Presentations

- **Tania Lopez-Cantu** and Constantine Samaras. *Applying robust decision-making to increase the resilience of major stormwater infrastructure under deep uncertainty* in 2020 Annual Meeting of the Society for Decision Making Under Deep Uncertainty, 2020. (Online)
- **Tania Lopez-Cantu** and Constantine Samaras. *Climate-resilient Stormwater Infrastructure: Improving Engineering Decisions Under Deep Uncertainty* in ASCE Women-Water Nexus Fourth Short-Conference Session, 2020. Invited presentation. (Online)
- **Tania Lopez-Cantu** and Constantine Samaras. *Using Robust Decision-Making to Improve Engineering Decisions for Resilience Under Deep Uncertainty* in AGU Fall Meeting 2019 (San Francisco, CA)
- **Tania Lopez-Cantu** and Constantine Samaras. *Evaluating the Performance and Resilience of Major Stormwater Infrastructure Systems Under Climate Change and Land Use Uncertainty* in 2nd International Conference on Resilience to Natural Hazards and Extreme Weather Events 2019 (Washington, D.C.)
- **Tania Lopez-Cantu** and Constantine Samaras. *Supporting Stormwater Infrastructure Decisions under Uncertainty through a Spatial and Temporal Analysis of Engineering Standards* in 2nd International Conference on Resilience to Natural Hazards and Extreme Weather Events 2019 (Washington, D.C.)
- **Tania Lopez-Cantu** and Constantine Samaras. *A Risk Index For Stormwater Infrastructure in U.S. States Based on Observed and Projected Precipitation Changes* in AGU Fall Meeting 2018 (Washington, D.C.)

Poster Presentations

- **Tania Lopez-Cantu** and Constantine Samaras. *A robust screening tool for evaluating the performance and resilience of stormwater infrastructure under climate uncertainty* in AGU Fall Meeting 2019 (San Francisco, California)
- **Tania Lopez-Cantu**, Andreas Prein and Constantine Samaras. *Intercomparison of Publicly Available Downscaled Climate Projections: Planning for Future Extreme Rainfall* in AGU Fall Meeting 2019 (San Francisco, California)
- **Tania Lopez-Cantu** and Constantine Samaras. *Impact of Spatial Scale Choice on Informing Decision-Makers on Changing Characteristics of Rainfall in the United States* in AGU Fall Meeting 2018 (Washington, D.C.)
- **Tania Lopez-Cantu**, David Yates and Laura Read. *Testing validity of stormwater infrastructure design methods under changing climate conditions: analysis of changes in homogeneous sub-daily rainfall intensity regions in Pennsylvania* in AGU Fall Meeting 2018 (Washington, D.C.)
- **Tania Lopez-Cantu** and Constantine Samaras. *Stormwater Design Return Period Standards for U.S. Transportation Infrastructure: Spatial and Temporal Characterization of Climate Risk* in ASCE Congress on Technical Advancement 2017 (Duluth, MN)
- **Tania Lopez-Cantu** and Constantine Samaras. *Incorporating flexibility into stormwater infrastructure design under climate change* in ICNet Workshop 2017 (New Castle, NH)

Skills

Programming Languages: Python, R

Software: ArcGIS, QGIS, LINGO, GAMS

Languages: Spanish (native), English (fluent), French (business level), Japanese (daily conversation level, JPLT N4)

Teaching

Content TA, Climate Change Adaptation (Graduate), Carnegie Mellon University *Spring '20*

Lab/Content TA, Water Resources Systems Engineering (Graduate), Carnegie Mellon University *Spring '18, Spring '19*

TA, Climate Change Adaptation (Graduate), Carnegie Mellon University *Spring '17*

TA, Fluid Mechanics (Undergraduate), Carnegie Mellon University *Fall '16*

Professional Engagement and Community Service

Civil and Environmental Engineering Diversity and Inclusion Committee *Pittsburgh, PA*

Member *August 2020 - Present*

- Support short- and long-term planning of strategies to increase diversity and foster inclusion at the Civil and Environmental Engineering Department at Carnegie Mellon University.

Environment and Water Resources Institute Graduate Student Chapter at Carnegie Mellon University *Pittsburgh, PA*

Chapter Chair *January 2019 - August 2020*

- Organize activities that connect graduate students in Civil Engineering with professionals across the U.S. (e.g. networking seminars and round-tables)
- Manage and distribute resources to carry out the planned activities for each semester.

Graduate Student Association at Carnegie Mellon University *Pittsburgh, PA*

Department Representative *January 2016 - December 2017*

- Planned and carried out various activities to build community across graduate students in the Civil and Environmental Engineering Department
- Managed and distributed resources to carry out the planned activities for each semester.

Honors and Distinctions

Civil and Environmental Engineering Outstanding Teaching Assistant Award *Spring 2020*

Carnegie Mellon University *Pittsburgh, PA*

Earth System Science Fellow, UCAR Next Generation Fellowship (40,000USD) *2018-2019*

University Corporation for Atmospheric Research *Boulder, CO*

Jared and Maureen Cohon Graduate Fellowship in Civil and Environmental Engineering *2017-2018*

Carnegie Mellon University *Pittsburgh, PA*

National Council of Science and Technology Fellowship (50,000USD per year) *2015-2020*

Consejo Nacional de Ciencia y Tecnologia *Mexico City, Mexico*

Civil Engineering Graduate Student Scholarship (8,000USD per year) *2015-2016*

Carnegie Mellon University *Pittsburgh, PA*

Harold Allen Thomas Memorial Scholarship *2015-2016*

Carnegie Mellon University *Pittsburgh, PA*

Undergraduate Scholarship (Top 1% Students) *2009-2014*

Monterrey Institute of Technology *Monterrey, Mexico*