2020 Summer I Dialogue: Climate Change Science and Policy Online

CIVE 4777 (Technical Elective, 4 SH), CIVE 4778 (General Elective, 4 SH); NU Path*

Focus on solutions for weather or compound extremes and global best practices in resilience

Instructor: Auroop R Ganguly, Professor, Northeastern University, Boston, MA

Duration: May 26 to June 26, 2020 (offered online but in Dialogue format)

Virtual Class Times (Tentative): Tuesday and Thursday: 11:00 AM to 12:30 PM (may need to adapt)

***Original Dialogue NU Path Compliant; Paperwork being processed for online versions**

Co-instructors and guest speakers (tentative):

- Prof. Udit Bhatia*, Civil Engineering, Indian Institute of Technology Gandhinagar, India
- Dr. Evan Kodra*, CEO, risQ Corporation, Boston, MA, USA
- Prof. Rajarshi Majumder, Department of Economics, Burdwan University, India
- Prof. Sourav Mukherji, Organizational Behavior, Indian Institute of Management, Bangalore, India
- Prof. Kemal Taruc*. Tarumanagara University, Jakarta, Indonesia
- Dr. Thomas J. Vandal*, NASA Ames Research Center, Moffett Field, CA, USA
- Ms. Rose Leopold*, Cadmus Group, Washington, DC, USA
- Ms. Shahed Najjar*, Embassy of Jordan, Washington, DC, USA
- Mr. Francisco Mendes*, Rio de Janeiro, Brazil
- …and others

*Northeastern alums

Cultural and educational global immersion (tentative):

- Joint virtual course work with undergraduate students from the Indian Institute of Technology
  - Group assignments and collaborative learning for developed and emerging economies
  - Social entrepreneurships and Climate War Games spanning US, India and global cities
  - Science, engineering and policy principles of climate change across cultures
- Case study with current Covid-19 pandemic
  - Global resilience and response to the Covid-19 pandemic and relation to weather/climate
  - Methods and tools for resilience and how they may generalize from climate to pandemics
  - Risk mapping, resilience, and recovery planning from urban climate to global pandemics
- Discussion on global cultures and resilience practices
  - Discussion with global leaders, as well as mid-career and early career individuals
  - Discussions on human, cultural and societal behavioral challenges across the globe
  - Possible opening of part of the course to the wider public for discussions

CIVE 4777: Climate Hazards and Resilient Cities Abroad *(May 26th to June 11th)*

This course will cover the basics of climate science and engineering. The deep uncertainties in climate change, from chaos theory and intrinsic variability to knowledge gaps in emissions scenarios as well as physics and biogeochemistry, will be discussed. The translation of uncertainties to risk-informed flexible design and policy principles will be covered. The students will learn about a range of climate models of diverse complexity as well as how to climate model simulations and observations into engineering principles. On the engineering side, the students will learn about interconnected systems, such as lifeline infrastructure networks and hydrological or ecological networks, to understand how they are impacted by climate. Weather and hydrological extremes and regional hydrological stresses under climate and global change, as well as urban resilience and sustainability despite such threats will be covered. Students will learn about the science of what has been sometimes been called “global weirding”: this refers to the possibility of unprecedented changes in weather and hydrological extremes or regional climate patterns caused by global warming and natural climate variability. The physical science basis of climate, and computer models of the earth system, will be introduced together with their uncertainties. Statistical tools for the analysis of climate model and remote sensor data will be presented. The concept of urban resilience will be introduced and developed, with a focus on the ability to prevent natural hazards from turning into catastrophic disasters in densely populated and vulnerable regions. The ability to prevent the disruption of critical functions, and recover these functions should they get disrupted, will be discussed. The multi-faceted aspect of resilience will be examined, and will include governance, emergency response, infrastructural, informational, social, and policy aspects. Decision support tools will be introduced. The course will have an emphasis on solutions that can be brought to bear to address climate adaptation, or managing the unavoidable, as well as climate mitigation, or avoiding the unmanageable. Computational models and data-driven analysis tools will be emphasized. The course will have a focus on tools that can be broadly categorized as Artificial Intelligence (AI) for climate resilience. The course will

culminate in the development of a technical socially-impactful startup, where the students will work in groups and bring together the skills and knowledge developed in climate science, engineering and policy, as well as data-driven and decision sciences and AI, to understand how solutions can be developed for climate impacts assessment, adaptation and mitigation. The students will work in groups to develop startup ideas which can be pitched to ventures, foundations and seed funds from agencies such as the National Science Foundation. Our experience with SDS Lab startup risQ (see here and here and here) will be leveraged. The students will get the unique opportunity to learn from and work with leaders of the startup risQ, a spinout from Northeastern, to understand how climate science and engineering can be translated to urban resilience. The students will get an opportunity to learn from Northeastern graduate students and undergraduate alumni/ae, as well as collaborators, who are at the frontlines of resilience.

CIVE 4778: Climate Adaptation and Policy Abroad *(June 12th to June 26th)*
This course will cover the basics of climate adaptation and policy. will focus on developing best practices in climate and disaster resilience, based on lessons learned from across the world. Ranging from technological and nature inspired solutions from world leaders in resilience to lessons in frugal innovation from emerging countries, the course will cover a range of geographies, economies and functions. Our prior work in these areas (see here, here and here) will be leveraged.
The course will get into coupled natural-built-human systems, how these can often be described with network science or system dynamics, as well as on regulatory principles and socioeconomic challenges. The economics of climate change and the possibility of social entrepreneurships will be discussed. Co-instructors and guest speakers across the globe will discuss about the best practices in societal and engineering resilience, as well as the possibility of generalizing lessons learned across countries and cultures. The students will learn about climate adaptation and policy based on discussions with the instructor, as well as possible interactions with guests from academia, private industry, and government agencies.
A climate change war game described adaptation as “managing the unavoidable” and mitigation as “avoiding the unmanageable”. Irrigation planning and flood control in rural areas are important for food security and can save the lives of human beings at maximum risk. However, flash floods in cities like Mumbai or Jakarta or Miami, caused by a combination of heavy rain and high tides, can cause havoc on the economy, and put lives at stake. Reducing fossil-fuel emissions may limit global warming and hence climate change consequences but may be perceived as disruptions to growth. Balancing these constraints is a clear and present need for developing nations across the globe, and increasingly, for the developed world such as the United States.
The lessons learned will be condensed into a Climate War Game adapted for this class involving role playing exercises from representatives of global cities to discuss climate change adaptation and mitigation as well as to develop commitments, policy statements and resource allocations. The virtual war games will benefit from cross-disciplinary, cross-cultural and cross-country and cross-institutional team formations where appropriate.

Textbooks and Reading Notes:

1. Critical Infrastructures Resilience: Policy and Engineering Principles: By Auroop Ratan Ganguly, Udit Bhatia and Stephen E Flynn. Routledge (Taylor & Francis). 132 pages. March 2018.
2. What we know about climate change: By Kerry Emanuel. Second Edition. MIT Press.
3. IPCC SREX 2012: “Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX)” a Special Report by the Intergovernmental Panel on Climate Change (IPCC), 2012: Downloadable from http://ipcc-wg2.gov/SREX/ http://usatoday30.usatoday.com/weather/climate/globalwarming/story/2012-03-28/climate-change-global-warming-weather-disasters-floods-droughts-storms/53826590/1

Articles and Read-ahead:

UNA-UK Climate 2020:

1. Climate 2020: Degrees of Devastation: https://www.climate2020.org.uk/
2. https://www.climate2020.org.uk/we-cannot-ignore-climate-risk/
3. https://www.climate2020.org.uk/data-driven-solutions/

Independent Advisory Committee Report on Applied Climate Assessment

1. IAC Report and SCAN website: https://www.climateassessment.org/
2. BAMS Summary: https://www.ametsoc.org/index.cfm/ams/publications/bulletin-of-the-american-meteorological-society-bams/a-framework-for-sustained-national-climate-assessment-in-the-united-states/
3. Full Report: https://journals.ametsoc.org/doi/full/10.1175/WCAS-D-18-0134.1

Climate Change War Games, Center for a New American Security

1. CNAS website: http://www.cnas.org/node/149
2. CNAS Participant Briefing Book: http://www.cnas.org/files/documents/publications/Clout%20and%20Climate%20Change%20Briefing%20Book%20%5BFor%20Release%5D.pdf
3. Nature News: http://www.nature.com/news/2008/080805/full/454673a.html