Geography 149B Climate Impacts and Risk Analysis
3 Credits, Mondays and Wednesdays 11:00-12:30
145 McCone
Instructor: Norman Miller Office Hours: Monday and Wednesday 12:30-2:00

SYLLABUS

Week 1 Introduction to Climate Change Risk
To what extent is climate changing?
What is climate attribution and climate risk?
How do we begin to quantify climate change risk and put climate impacts into an understandable framework that can be used for developing adaption and mitigation strategies?
Framing strategies: Geophysical, Environmental-ecological, technological, economic, socio-cultural, and institutional

Reading:
Intergovernmental Panel on Climate Change 1.5 Report: pp. 1-1 to 1-25
NLM Notes on Risk and Adaptation Definitions 20 pp.

Week 2 Uncertainty, Risk and the Sustainable Development Goals
Definitions of confidence, uncertainty and risk.
Drivers of Impacts, Uncertainty and Non-Linear Impacts
Risks in a 1.5C increase, 2.0 increase by 2040.
Sustainable Development Goals (2015-2030). and its predecessor, the Millennium Development Goals. What worked, what did not, and why.

Reading:
Intergovernmental Panel on Climate Change 1.5 Report: 1-26 to 1-46

Homework 1.
Define uncertainty and risk types, write a one page summary of risk probability associated with a catastrophic climate event, such as crop failure due to a weak monsoon, in Sub-Saharan and/or Equatorial Africa, discuss the probability of occurrence and suggest an adaptation strategy.

Week 3 Climate Change Impacts Attribution
Definition and brief overview of attribution studies.
Discussion of studies showing model simulations with and without climate change warming and outcomes that can be quantified as due to a climate change response.
Summary of Climate assessment reports on attribution 1995-presnt.

Reading:
Santer et al. 2012, Identifying human influences on atmospheric temperature, PNAS, 8 pp.
Santer et al. 2013, Human and natural influences on the changing thermal structure of the atmosphere, PNAS, 6pp.
Intergovernmental Panel for Climate Change, 2015, Summary for Policymakers,

30pp.

Week 4 Energy and Water conservation Laws

Conservation of Energy, LW radiation and CO2
Global and Regional temperature trends.
Conservation of Water, Precipitation, Latent Energy and evaporation, runoff, groundwater, rivers, glacial storage.
Precipitation and evaporation spatio-temporal patterns and trends

Reading:

Barry and Chorley: Atmospheric Moisture Budget 64-8
NLM Summary Notes on Conservation Laws. 20pp.

Week 5 Changes in Precipitation climatology, extremes and trends

Clausius-Clapeyron Equation and global warming.
Intense precipitation and floods.
Increasing evaporation.
Case Studies of recent flood events: Ellicott City, LA, Boulder Flash Floods
Mechanistic causes of flooding, e.g. Arctic Amplification of the Jet Stream.
Return periods, changes in rates of return.
Attributing flood risk based on returns and adaptation strategies.

Reading:

Intergovernmental Panel on Climate Change 1.5 Report: 3-21 to 3-36,
Stuecker et al. Nature Climate Change, Polar amplification dominated by local forcing and feedbacks. 8,1076-10817

Homework 2:

Write a 2-4 page analysis of the role of arctic amplification on an extreme weather event. Explain how the jet stream influences weather systems and how stalling occurs as a result. Use illustrations.

Week 6 Definition of Droughts and Famine

Meteorological, Hydrological, Agricultural and Societal.
What defines 100-, 500-, 1000-year droughts?
How are these definitions changing in light of climate change?
Droughts and Social Unrest. Historic drought and the collapse of cultures.
Drought contributes to the collapse of Anasazi culture
Drought and Famine: Somalia
Drought and War: Arab Spring and Syrian war
US drought

Reading: Wilnite, 2000, Drought as a natural hazard, 20pp.
Kelley, et al. 2015, Climate change in the Fertile Crescent and implications of the recent Syrian drought. PNAS, 112(11), 3241-3246.

Week 7 Heat Waves
Heat and Humidity Index
Persistent High Pressure Patterns

Europe 2003, Chicago 1995, California 2006
Causes and Strategies for Risk reduction

Reading:

Meehl, G.A. and Tebaldi, C. (2004) More Intense, More Frequent, and Longer Lasting Heat Waves in the 21st Century. Science, 305, 994-997.

Miller, et al. 2008, Climate, Extreme Heat and Energy Demand in California. JAMC,47.6 1834-1844.

Lewis and Karoly. 2013, Anthropogenic contributions to Australia's record summer temperatures of 2013. *GRL*, **40**: 3705–3709.

Heatwave in Northern Europe, summer 2018.
https://www.worldweatherattribution.org/attribution-of-the-2018-heat-in-northern-europe/

Homework 3: Describe 1,3, and 5 day heat wave impacts on children and elderly. What is considered high risk, plot a temperature-humidity heat risk and categorize risk reduction based on this plot. Why is nighttime cooling more critical than daytime, explain in the context of humans and agriculture.

Week 8 Climate impacts on food security.

Agricultural impacts associated with warming and changes in precipitation patterns.
Causes for changes in monsoon strength.

Reading:

Parry et al., 2004, Effects of climate change on global food production under SRES emissions and socio-economic scenarios. Global Environmental Change, 14, 53-67.

Li et al., 2015, Mechanisms of Asian Summer Monsoon Changes in Response to Anthropogenic Forcing in CMIP5 Models. J. Climate, 4107-4125 *https://doi.org/10.1175/JCLI-D-14-00559.1*

Week 9 Wildfires

The 1910 Great Fire, Lessons learned.
Why was is it so hot with so many fires in Sweden during July 2018?
Forest management adaptation strategies to reduce large fire occurrences.
Comparison of the Great Fire to the Camp Fire.
Why are these trends so different now?
Discussion of Congressional failure to provide funds for fire trails in 1910, the formation of the US Forest Service and Fire Research.

Reading:

Weinstein and Woodbury, Review of Methods for Developing Probabilisitic Risk Assessments, Part 1: Modeling Fire. 285-302.
PBS short film https://www.pbs.org/wgbh/americanexperience/films/burn/
Time short film
http://time.com/5453710/california-camp-fire-deadliest-wildfires-us-history/

Week 10 Developing projects on climate impacts and risk
Quantifying weather and climate risk.
Storms, Cyclones and Tornadoes: Watches and Warnings
Class exercise on risk and adaptation. (TBD)
Reading:
Monirul and Mirza, 2003, Climate change and extreme weather events: Can developing countries adapt?, Climate Policy, 3:3, 233-248.

Week 11 Glacier loss and sea level rise.
Case studies of Greenland, Antarctic and Equatorial glacier loss,
analysis of rates of change and types of impacts, including coastal inundation and hydropower impacts
Impacts to Small Island Nations
Reading:
Zemp et al., 2015, Historically unprecedented global glacier decline in the early 21st century. J. Glaciology, 61:228, 745-761, https://www.igsoc.org/journal/61/228/j15j017.pdf
Bahr *et al*., 2009, Sea-level rise from glaciers and ice caps: A lower bound. *Geophys Res Let* **36**, 4.

Homework 4: TBD
Reading of specific case studies and prepare discussion talking points

Week 12 Arctic sea ice and what ice free summers will lead to.
Shifting jet stream. Changes in trade routes and geopolitical strains
Reading:
Stroeve at al., 2012, The Arctic's Rapidly Shrinking Sea Ice Cover: A Research Synthesis. Climatic Change, 110, 3-4, 1005-1027.

Week 13 Tibetan Plateau and its river systems
Hydrologic impacts in Bangladesh, India Pakistan, and other neighboring countries.
Societal response to shifting agriculture
Reading:
Li et al., The impact of climate change on runoff in the southeast Tibetan Plateau., Journal of Hydrology, 505, 188-201.

Week 14 Review and Discussion. No Readings

Week 15 Class presentations