

Geography 149B Climate Impacts and Risk Analysis

Time/Location: Mondays and Wednesdays, 12:10-1:30, 145 McCone Hall

Instructor: Norman Miller, 591 McCone, NLMiller@Berkeley.edu

Office Hours: Monday 11:00-12:00, 1:30-2:00, Wednesday 1:30-2:30, Appointments

Grading: 6 homework sets that are based on lectures and readings (12% each), a regional climate risk analysis project (25%) and class discussion participation (3%). All readings are posted in the Geog 149B bcourses under Files/Readings And Lecture Notes under Files/Lectures. Geog149A is not needed for Geog149B

Jan 19: Introduction to Climate Change Impacts and Risk Analysis

Defining climate attribution, climate risk, adaptation, mitigation
Beginning to quantify climate change risk and put climate impacts into an understandable geophysical, environmental-ecological, technological, economic, socio-cultural and institutional framework. Adaptation reduces Risk.

Reading:

.IPCC SR1.5 2018: Special Report 1.5°C, Chap.1. 53-65
.Emanuel 2016, Climate Science and Climate Risk: A Primer. 17pp

Jan 24-26: Introduction/Review of the Energy and Water Conservation Laws

Jan 24 Homework 1. Posted

Conservation of Energy, LW radiation and CO₂, Global and Regional temperature trends.
Conservation of Water, Precipitation, Evaporation, Runoff, Groundwater, Rivers, Glacier
Precipitation and Evaporation spatio-temporal patterns and changing trends

Reading:

.Trenberth et al. 2009, Earth's Global Energy Budget, BAMS, 311-323
.Trenberth et al. 2007, Global Water Budget and Its Annual Cycle. J. Hydromet, 758-769

Jan 31-Feb 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:

.IPCC SR1.5 2018: Special Report 1.5°C, Chap. 1, 68-70, 77
.IPCC WG2 AR5 2014, Emergent Risks and Key Vulnerabilities, 1042-1052
.UN Sustainable Development 2030, Sustainable Targets 14-28

Feb 7: Climate Change Detection and Attribution

Feb 7 Homework 1 Due, Homework 2 Posted

Definition and brief overview of attribution studies.
Discussion of model simulations with and without climate change warming and outcomes that can be quantified as due to a climate change response.

Reading:

.Trenberth et al. 2015, Attribution of Climate Extreme Events, Nature, 6pp
.Santer et al. 2012, Identifying human influences on atmospheric temperature, PNAS, 8pp
.Santer et al. 2013, Human and natural influences on the changing thermal structure of the atmosphere, PNAS, 6pp

Feb 9-14: Changes in Large Scale Circulation

Changes in Monsoons Patterns and Cyclonic Activity
Hadley and Walker Circulation (and precipitation) Change
Monsoon Patterns and Changes in Monsoon Precipitation
Changing Tropical Cyclone Intensity, Changing Tornado Cluster Frequency

Reading:

[Knutson et al. 2021](#), Climate change is probably increasing the intensity of tropical cyclones. Science Brief, 8pp
[Wang et al. 2020](#), Monsoons Climate Change Assessment, BAMS, 16pp

Feb 21: Holiday**Feb 16- 23: Precipitation climatology, extremes and trends****Feb 22 Homework 2 Due, Homework 3 Posted**

Mechanistic causes intense precipitation and floods
Clausius-Clapeyron Equation
Attribution and Detection of Extreme Precipitation
Case Studies of recent flood events: Ellicott City, LA, Boulder Flash Floods
Return periods, changes in rates of return.
Attributing flood risk based on return periods and adaptation strategies.

Reading:

[Zhang et al. 2013](#), Attributing intensification of precipitation extremes to human influence, GRL, 6pp
[Hirabayashi et al. 2013](#), Global flood risk under climate change, Nature, 6pp

Feb 28-Mar 2: Glacier Loss and Sea Level Rise.

Greenland, Antarctic and Equatorial glacier loss, analysis of rates of change and impacts on coastal inundation, hydropower and small island nation impacts

Reading:

[Zemp et al. 2015](#), Historically unprecedented global glacier decline in the early 21st century. J. Glaciology, 61:228, 745-761
[Bahr et al. 2009](#), Sea-level rise from glaciers and ice caps: A lower bound. *Geophys Res Let* **36**, 4pp

Mar 7: River System Changes and Impacts**Mar 7 Homework 3 Due, Homework 4 Posted**

Stationarity is Dead: Moving into a non-linear mode of prediction
Hydrologic impacts: Tibetan Plateau runoff. Glacial Lake Outburst Floods

Reading:

[Milly et al. 2008](#), Stationarity Is Dead: Whither Water Management?, Science, 3pp.
[Li et al. 2013](#), The impact of climate change on runoff in the southeast Tibetan Plateau., Journal of Hydrology, 505, 188-201.

Mar 9: Heat Waves, Impacts and Adaptation Strategies

Heat and Humidity Index, Persistent High-Pressure Patterns
Europe 2003, Chicago 1995, California 2006, NWUS/Canada 2021
Strategies for Risk reduction

Reading:

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

Mora et al. 2017, Global risk of deadly heat. Nature Climate Change, 7pp.

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

Mar 16: Historical and Projected Wildfires, Wildfire Modeling

The 1910 Great Fire, Lessons learned.

Forest management adaptation strategies to reduce large fire occurrences.

Comparison of the Great Fire to the Camp Fire. 2020 and 2021 Wildfires

Congressional failure to provide funds for fire trails in 1910, the formation of the US

Forest Service and Fire Research. Movement toward forest management with burns

Reading:

Weinstein and Woodbury 2010, Review of Methods for Developing Probabilistic Risk Assessments, Part 1: Modeling Fire. 285-302.

PBS short films

<https://www.pbs.org/wgbh/americanexperience/films/burn/>

<http://time.com/5453710/california-camp-fire-deadliest-wildfires-us-history/>

March 21-25 Spring Break

Mar 28: Drought in the Western US

Mar 28 Homework 4 Due, Homework 5 Posted

Twenty years of mostly drought conditions

Model simulations of projected snow decline in California

Model simulations of groundwater decline, Impacts on sectors

Reading:

Miller et al. 2009, Drought resilience of the California Central Valley surface-ground-water-conveyance system. JAWRA, 857-866

Mar 30: Droughts and Famine: Definition, Impacts and Solutions

Drought: Meteorological, Hydrological, Agricultural and Societal.

How these definitions are changing in light of climate change

Droughts and Social Unrest. Historic drought and the collapse of cultures.

Drought and War: Arab Spring and Syrian war

Reading:

Wilnitsky 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.

Apr 4: Famine Continued, Climate shocks and impacts on food security

Apr 4 Project 1-page abstracts with references due

Agricultural impacts associated with warming and changes in precipitation patterns.

Monsoons and agriculture. Causes for changes in monsoon strength.

Reading:

Rosenzweig et al. 2014, Assessing agricultural risks of climate change in the 21st century in a global gridded crop model intercomparison. PNAS, 6pp.

Nelson et al., 2014, Climate change effects on agriculture: Economic responses to biophysical shocks, PNAS, 6pp.

Apr 6: Disease Vectors and Climate Change

Historical Perspective, Covid-19 and Climate Change

Projected impacts of climate on disease vectors

Reading:

Rocklöv and Dubrow 2020, Climate change: an enduring challenge for vector-borne disease prevention and control. Nature, 5pp
Ryan et al. 2022, Warming temperatures could expose more than 1.3 billion new people to Zika virus risk by 2050, Global Change biology, 27pp.

Apr 11: Mongolian Empire, Climate and Disease, Adaptation

Apr 11 Homework 5 Due, Homework 6 Posted

Ghinggis Khan and favorable climate conditions in 1206
Khubilai Kahn cross-fertilized East and West science, medicine and art.
Marco Polo brings the Bubonic Plague to Europe
Current and projected Mongolia climate and impacts by sector
Mongolia adaptation strategies

Reading:

Wang et al. 2013, Climate adaptation, local institutions, and rural livelihoods: A comparative study of herder communities in Mongolia and Inner Mongolia, China. Global Env. Change, 1673-1683.
<https://www.adaptation-undp.org/mongolia-achieves-milestone-national-adaptation-planning>

Apr 13: Afghanistan

History and Governance
Large-Scale Climate Drivers, Risks and Vulnerabilities
Historical and Projected Climate
Sectorial Analysis and Adaptation Strategies

Reading:

Outbudin et al. 2019, Seasonal Drought Pattern Changes Due to Climate Variability: Case Study in Afghanistan. MPDI Water, 20pp.

Apr 18: Arctic sea ice and environmental, economic, and political implications.

Shifting jet stream. Changes in trade routes and geopolitical strains
People and Climate
Historic and Projected Climate
Adaptation and Mitigation Strategies

Reading:

Stroeve et al., 2012, The Arctic's Rapidly Shrinking Sea Ice Cover: A Research Synthesis. Climatic Change, 110, 3-4, 1005-1027.
Flynn et al. 2018, Participatory scenario planning and climate change impacts, adaptation and vulnerability research in the Arctic. Env. Sci & Policy, pp. 45-53

Apr 20: Small Island Nations, Sea Level Rise and Storm Surge

Micronesia History and Governance
Risks and Vulnerabilities
Historical and Projected Climate
Sectorial Analysis and Adaptation Strategies

Reading:

Perkins and Krause 2018, Adapting to climate change impacts in Yap State, Federated States of Micronesia. Island Studies Journal, 14pp
<https://www.adaptation-undp.org/explore/asia-and-pacific/micronesia-federated-states>

Apr 25: Democratic Republic of the Congo (Zaire)

History and Governance
Risks and Vulnerabilities
Large-Scale Climate Drivers
Historical and Projected Climate
Sectorial Analysis and Adaptation Strategies

Reading:

Batumike et al. 2021, Climate change and hunter-gatherers in montane eastern DR Congo. CLIMATE AND DEVELOPMENT. 10PP.
<https://www.adaptation-undp.org/explore/middle-africa/democratic-republic-congo>

Apr 28: Summary of Climate Impacts and Risk

Reading:

The National Intelligence Council 2021, Global Trends 2040: A more contested world.
Structural Forces: Environment 30-42, Regional Forecasts: 120-140

May 4: Homework 6 Due

May 16: Projects are due