

Geography 149A: **Changing Climates of the World, Prof. Norm Miller**

Mondays and Wednesdays, 12:30 – 2:00

3 Credits, 2 Exams (20% each), 6 homework Sets (10% each)

Online Text: Atmosphere, Weather & Climate by Roger Barry and Richard Chorley

Office Hours: After class 2:00-2:30 and by Appointment via zoom

591 McCone Hall; NLMiller@Berkeley.EDU [Test, Papers and Lecture Notes on BSPACE]

Note: This schedule may change slightly as the semester proceeds.

We'll begin with a simple description of atmospheric dynamics and physics at the large scale, followed by region-specific climate systems. We'll look at regional responses to climate change and the inter-relationships between the role of climate variations and impacts. Each week's reading will be integrated into class participation. Class will usually begin with a weekly weather in review that focuses on a specific geographic region. There will be six homework sets that are mostly lecture review and two take home time-limit exams based on homework, reading and discussions. Guest Lectures will be on extreme weather. *There is ~2 hours outside effort for each lecture hour.* This course is geared toward students with minimal backgrounds in math and physics. *All material is posted on bspace. Syllabus may slightly change some during the course of the semester.*

25 Aug: **Welcome Back! Introductions, Course Outline, Goals and Expectations**

Climate Change: Historic Heat waves, Fires, Drought, Floods
A very brief history of Meteorology, Earth-Sun Relationship

Read: Pages 1-8

30 Aug: Atmospheric Composition

Atmospheric composition, mass, vertical structure
Introduction to High and Low Pressure, Rate Change (☒)
Montreal Ozone Protocol & Lessons Learned

**Read: Pages 9-28
HW1 (handout)**

1 Sept: Conservation of Energy/Discussion

Earth heat budget, short-wave and long-wave radiation,
Arrhenius' GHG calculation, Keeling's CO₂ observations
Weather Charts and Symbols

Read: Pages 32-60

8 Sept: Global Energy Budget & Climate Assessment

Geographic Energy Distribution
Highlights of the IPCC Sixth Assessment Report, August 2021
California Extreme Heat and Energy Demand

**IPCC Report1.5
(17 pages, figures)
Santer, Human Influence
Miller, CA Heat and Energy**

13, 15 Sept: Atmospheric Moisture and Conservation of Water

The Water Cycle and the Planetary distribution of water.
Water States – Solid, Liquid, Vapor; Polar regions
Geographic Distribution of Precipitation

**Read: 64-85
HW1 (13 Sep due)
HW 2 (handout)**

20, 22 Sept: Atmospheric Stability and Lapse Rates

Stable, Unstable and Neutral Air Mass, Bouyancy
Climate Projected Convectively Available Potential Energy (CAPE)

**Read: 89-102
N. Diffenbach, CAPE Paper
Lapse Rate Handout**

27 Sept: Guest Lecture, Dr. Michael Wehner, Berkeley Lab

2021 IPCC Co-Author on Chapter on Extremes

29 Sept: Precipitation Types and Formation

Thunder and Lightning, Field Experiments Triggering Lightning
Cloud Seeding and the Bay of Pigs
California Temperature and Precipitation Change

Read: 103-109
Pierce, Miller et al.

HW 2 (29 Sep due)
HW 3 (handout)

4, 8, Oct: Conservation of Mass and Momentum

Pressure Gradient Force, Coriolis Force, Friction Force
Divergence and Convergence (Basics)

Read: 112-125

Study Guide Part I

13 Oct: Exam I *****

HW 3 (15 Oct due)

18, 20, 25, 27 Oct: Atmospheric Circulation

More on Momentum and Atmospheric Circulation
Upper Atmosphere Jets, Jet slowdown due to Global Warming
ENSO-Walker, monsoonal flow patterns and precipitation.
Sea Breeze

Read: 127-155
HW 4 (handout)

1 Nov: Monsoons

Major monsoon regions, Monsoon dynamics (simple version)

Read: 276-298

3 Nov: Southeast Asia and the Third Pole

Himalayas and early snowpack melt implications on streamflow.
Asian monsoons, water and energy budgets, groundwater.

Missimo & Bollasina
Jin & Miller

8 Nov: Palaeoenvironmental, epigraphic and archaeological evidence of total warfare among the Classic Maya. Guest Lecture: Prof. David Wahl

<https://www.nationalgeographic.com/culture/2019/08/ancient-maya-practiced-total-war-before-drought/>

Reading: Wahl et al. 2019

10 Nov: Equatorial Trade wind and precipitation in Brazil

Drought, Amazon Basin role as the "Lungs of the Planet"
UN REDD (Reduced Emissions by Decreased Deforestation) Agreement

Read: 299-302

15, 17 Nov: Africa

Wind, Rain, Drought and Famine
Harmattan Winds, Long and Short Equatorial Rains
Congo convective systems, lightning, introductory cloud physics
Lake Victoria hydroclimate and impacts. Somalia Famine, Syria

Read: 302-308
Somalia Famine
Kelly et al., Syria Conflict
HW 4 (31 Oct due)
HW 5 (handout)

22 Nov: Extreme Weather and Hurricanes

Present and projected tropical cyclones and hurricanes.
diagnosing component of the hydrologic cycle.

Read: 262-275

24 Nov: Antarctic Climate Trends

Antarctic Weather, Global Glacier Decline
Short movie from my trip to the Antarctic

HW 5 (14 Nov due)
HW6 (handout)
STUDY GUIDE Part 2

29 Nov: Review and Discussion

1 Dec: Exam 2 *****

HW 6 (1 Dec due)