Understanding Climate Change

and

Not feeling hopeless
So many problems!

- Overpopulation
- Pollution
- Deforestation
- Resource exploitation
- Climate change
- Ocean acidification
- Alarmism / Denial / Confusion
- Dysfunctional government, ineffective policy…
Wrong approach to teaching this…

- People are paralyzed by fear and hopelessness
- Fearful people feel disempowered and less willing to act.

“Fear won’t do it” (O’Neil and Nicholson-Cole, 2009)
Some good news - Population

Global population growth rates are on the decline

Why? Changes in family planning, education, status of women, and reduce poverty
Some good news - Poverty

Global poverty rate was halved in the last 20 years.

Why? Global economy and UN MDG
Some good news - Ozone

A success story: CFCs, Ozone, and the Montreal Protocol. Ozone hole is slowly recovering.

Why? Take this course!
Some good news - Energy

Renewables are making advances.

This summer Germany produced 50% electricity from solar.

Why? Costs coming down, technologies improving, government support, investment.
Some good news - Solutions

Columbia is a leader in Carbon Capture and Storage Technology.

So-called “negative emissions” remove carbon from the atmosphere.
Some good news - you
You.

Personal engagement:

- **Education**: Know what you’re talking about
- **Activism**: Get involved
- **Behavior**: Footprint and handprint
- **Action**
Cultural and Climate
Lessons from the Past

V1003 Climate and Society
Climate & Society Theories

“Cultural Determinism”
- Culture alone determines cultural progress.
- Prevalent throughout 18th-19th century Europe

“Environmental determinism”
- Human culture is *determined* by the environment.
  - 5th century Hippocrates
  - Charles Darwin “Origin of Species”, 1870’s
Overview

Natural climate variability

Climate of the last 10,000 years (Holocene):

Cultural responses to past climate change:

We learn about our future by studying the past.
Introduction

• Water availability is critical to life, societies.

• Cultures can and do adapt to *interannual to decadal* changes in climate and water

• How have cultures responded to longer-term (decade to century-scale) changes?
The 1930s Dust Bowl

- Six year drought (1933-1938), well-documented.
- Crisis due to wanton farming practices and over-capitalization.
- Cost over $1 billion in 1930’s dollars, federal relief programs.
US Drought this summer
What do we know about the climate of the last 1,000 years?

- Instrumental climate records are too short (100-200 years).
- Longer records of past climate change (paleoclimate):
  - Glaciers
  - tree rings
  - corals
  - lake and ocean sediments
Tree rings and drought
Tree ring records of past drought

Thickness of tree rings in some species is sensitive to rainfall.

Narrow band = dry climate
Tree-ring record of drought in the American SW

- Wet
dry

~26 year drought
~22 year drought
~10 year drought

1280 AD
1584 AD
1956 AD

PDSI

-5 -4 -3 -2 -1 0 1 2 3 4 5
A Longer Perspective: Tree Ring Reconstructions

Past droughts have been longer and more severe

LONG-TERM CHANGES IN DROUGHT AREA IN THE 'WEST'

THE CENTRAL DATES OF THE SIGNIFICANT (p<0.05) EPOCHS ARE INDICATED WITH ARROWS

Medieval Droughts

Similar pattern as modern drought.

Conditions persisted **MUCH longer** (20-40yrs)

‘**Mega-droughts**’
Drought and the Anasazi (ancestral Pueblo)

Classic example of cultural impacts of climate change.

Studies of the Four Corners region show population crashes related to megadroughts

Number of habitation sites

Benson et al. (2006)
Anasazi depopulation of the SW US

The “Great Drought” spanned 1272-1298 AD (~26 years).

Other factors: Warfare, balkanization, religion.

Mesa Verde, CO
Interannual-Decadal Variability

Severe droughts lasting decades are common (many per millennium).

Cultures can (and do) readily adapt.

*Is this the full range of natural climate variability at socially-relevant timescales?*
Classic Maya Culture (300-900 AD)

Classic Maya culture ruled Mesoamerica from 250 to 850 AD.

Late Classic culture (550-850 AD) known for highly stratified society, vast trade networks, and widespread construction of urban centers and monumental stelae.

8-15 million people across Yucatan Peninsula

Tikal (Guatemala)
Classic Maya Collapse (800 AD)

Classic Maya empire collapsed at peak intellectual and cultural development at 900 AD.

Lowland urban abandonment
End of monument construction
Cultural disintegration

Factors cited: Deforestation, overpopulation, warfare, religious and social upheaval.

Largest urban center: Palenque
Cariaco Basin (Venezuela)

Annual laminations
Climate Change and Classic Maya Collapse

Cariaco Basin laminated sediments

Mayan collapse occurred during a 150-year drought!
What can we learn from these examples?

Complex societies are sensitive to climate change. Paleoclimate records document changes in climate which surpassed modern variability.

Other social factors in each case may have contributed to observed collapse.

Collapse occurred despite evidence that these cultures had large buffering capacities.
Conclusions

Modern and ancient cultures:
- Thrive in marginal environments.
- Plan for the future based on recent past (regrettably)
- Learn and adapt (fortunately).

Only ancient cultures experienced century-scale drought.

*Their* past as a guide for *our* future.
The “Big 5” mass extinctions

Climate and life are intertwined

Global Diversity

Age (millions of years ago)
Modified from "Walking With Dinosaurs" (BBC, 1999) and "When Dinosaurs Roamed America" (Discovery, 2001).