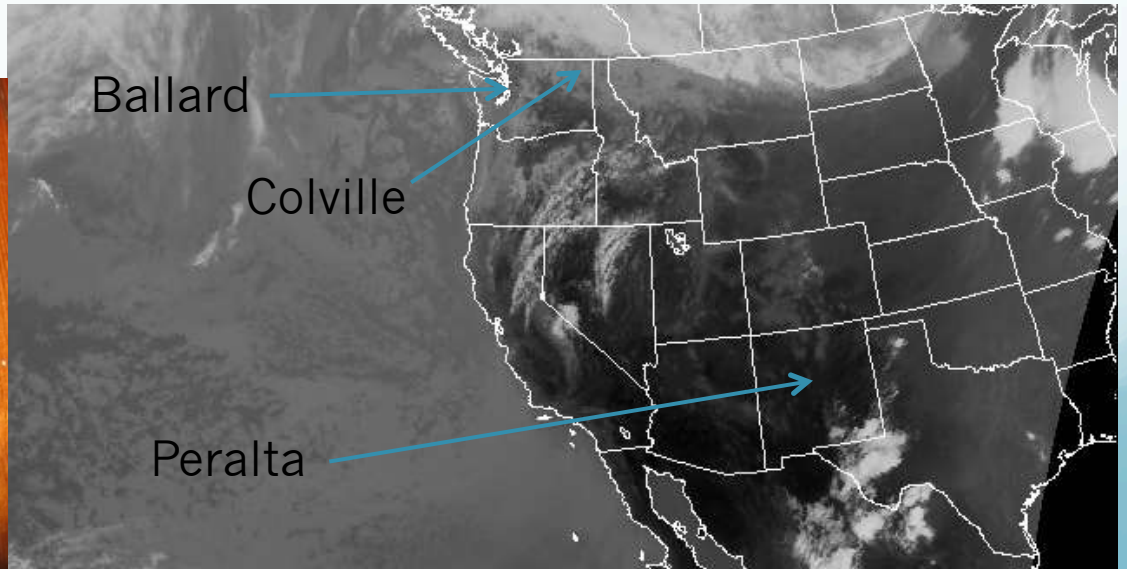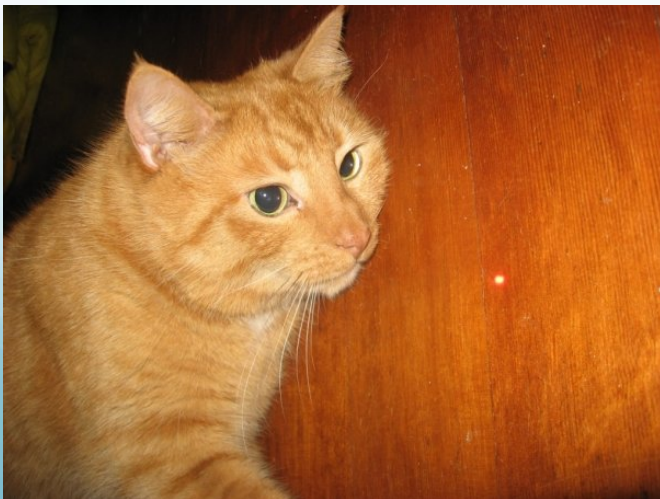# ATM S 111: Global Warming Class Overview

Jennifer Fletcher

Day 1: June 21 2010

About Me

- Jennifer Fletcher

- 4th year PhD student in atmospheric sciences

- Hometowns: Colville, WA; Peralta, NM; Seattle

- Currently live in Ballard with my husband and our cat

Ballard

Colville

Peralta

Class Info

- Office: Atmospheric Sciences/Geophysics (ATG) 724.

- Office Hours MW 1-2:30 or by appointment

- Nine week quarter: seven weeks on science, two weeks on debates and solutions.
  - Lecture M-Th, class discussion on Friday.
  - Six homework assignments during the science portion.
  - Comprehensive exam on the science August 5.
  - Paper on a topic of your choice due August 20.

Class Info

- Grading:

- Homework: 45%

- Class participation: 15%

- Exam: 20%

- Final paper: 20%

Goals of the Class

- We're going to learn about:
  - The science behind global warming
  - Impacts of global warming
  - How to critically evaluate what you hear about climate and global warming
  - The role of science in formulating effective societal responses
  - Related issues such as energy alternatives

Tentative Schedule

- Week 1 : Introduction, Solar Radiation and the Greenhouse Effect

- Week 2: Global Warming Forcings and Feedbacks

- Week 3: Global Warming Impacts: Extreme Heat, Floods, and Droughts.

- Week 4: Impacts: Ice, Snow, and Oceans.

- Week 5: Impacts: Hurricanes, Ecosystems, and Agriculture

- Week 6: Climate Records, Paleoclimate, and Climate Models.

- Week 7: Who's Responsible?

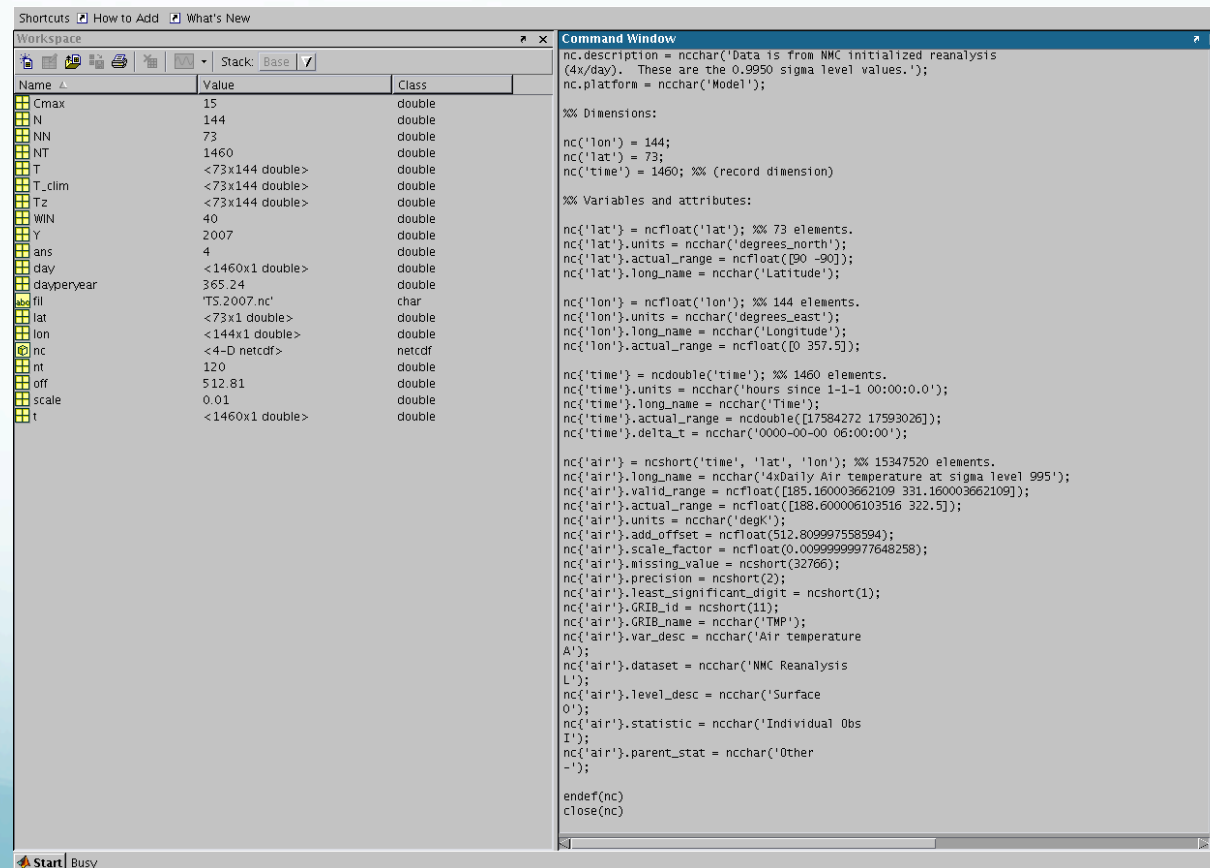- Week 8: Debates and Solutions.

- Week 9: Solutions continued.

First...

- A basic summary of the science of global warming

- Reading assignment for the summary:
  - *Rough Guide* pp. 3-19, "Climate Change: A Primer"
  - If it's about restaurants in Prague, you've probably got the wrong Rough Guide

Weather versus Climate

- Weather varies from one day to the next

- Climate: averages of the weather over a longer period of time

- Examples:
  - Today was 60 and cloudy: weather
  - This winter was drier than usual: climate (not necessarily global warming, though)
  - Nine of the ten hottest years on record are the last nine years: climate (likely due to global warming!)

- Can we predict each of these examples?
  - Yes!

Weather versus Climate

- Weather varies a lot day-to-day

- Individual weather events should generally not be treated as evidence for or against global warming.

Weather versus Climate

- Weather varies a lot day-to-day

- Individual weather events should generally not be treated as evidence for or against global warming.

However, global warming can make some weather events more or less likely in a given region

Weather versus Climate
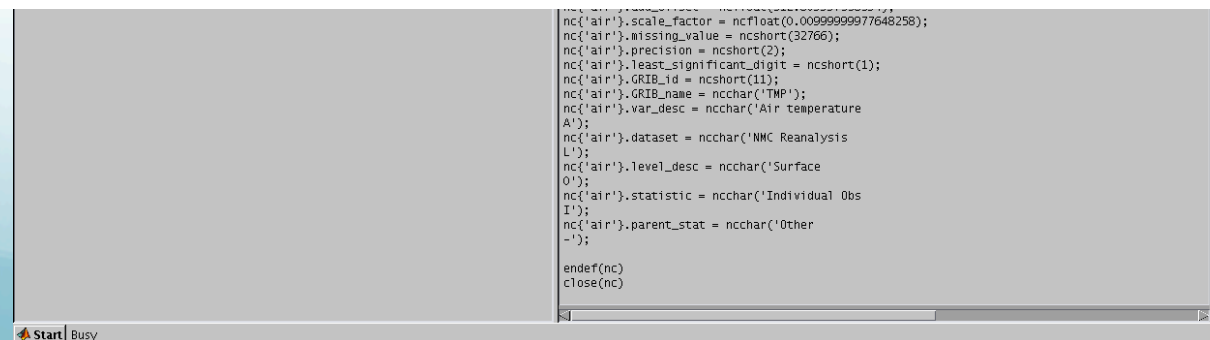
- Climate: definitions?

Weather versus Climate

- Examples:

- Chicago is windy, with cold winters and hot summers. Summertime has the most precipitation.

- Seattle is cloudy, with relatively mild winters and summers. Very little precipitation falls during July and August. November is the rainiest month.

- *Climatology*: The average temperature, winds, etc in a given location. Seattle's climatological temperature on June 21st is 71°F, with 0.05 inches of rainfall.

Weather versus Climate

- Climate example: This winter was drier than usual.

- Natural variability can cause seasonal anomalies like this.

- El Nino tends to make warmer, drier than average winters in the PNW.

- La Nina tends to make cooler and wetter PNW winters than average.

- In comparison this winter was colder than average on the East Coast.

- So, is this evidence for/against global warming?

Weather versus Climate

- Climate example: This winter was drier than usual.

- Natural variability can cause seasonal anomalies like this.

- El Nino tends to make warmer, drier than average winters in the PNW.

- La Nina tends to make cooler and wetter winters than average.

- In comparison this winter was colder than average on the East Coast.

- So, is this evidence for/against global warming?
  - Not really, though global warming could **affect** El Nino and other sources of natural variability.

Weather versus Climate

- Another climate example: nine of the ten warmest years on record – averaged over the entire globe – were the past nine years.

- (The tenth was 1998, the year of the strongest El Nino on record.)

- Is **this** evidence for global warming?

Weather versus Climate

- Another climate example: nine of the ten warmest years on record – averaged over the entire globe – were the past nine years.

- (The tenth was 1998, the year of the strongest El Nino on record.)

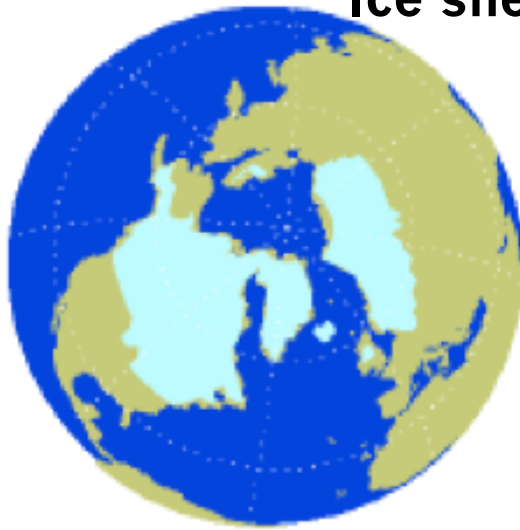- Is **this** evidence for global warming?
  - Yes!!

What Factors Influence Climate?

- Sunshine
  - And relatedly, latitude

- Topography/mountains

- Proximity to oceans and large lakes

- Ocean currents

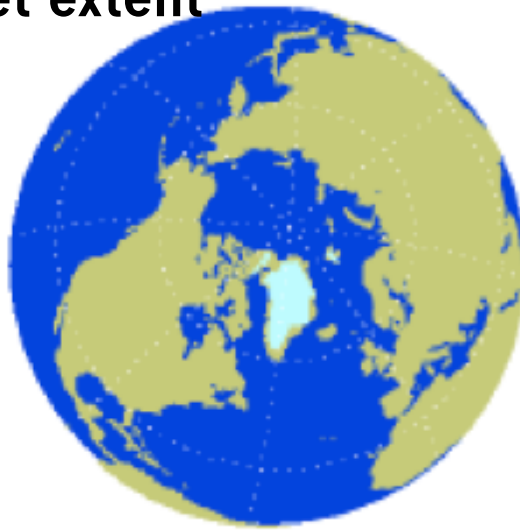- Presence of trees/vegetation

- Etc.

A Sampling of Future Topics

- "Paleoclimate":
  - **Ice Ages** and hot climates of the past like the **Cretaceous**
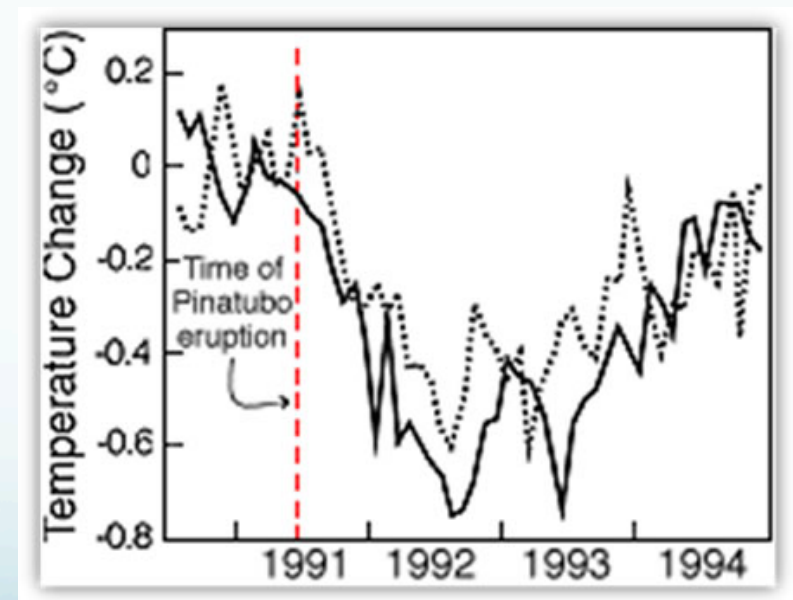

Ice sheet extent

Last Glacial Maximum   **Present**

**The Cretaceous Seaway**

Volcanoes and Climate

- How the Earth cools after certain types of volcanoes…

Eruption of Mount Pinatubo in June 1991 and its effect on global temperatures

And Human-Made Volcanoes!

- "Geoengineering": using technology to cool the Earth

- People are considering things like
  - Putting volcanic-type particles into the stratosphere
  - Space mirrors
  - Cloud machines
  - Fake trees
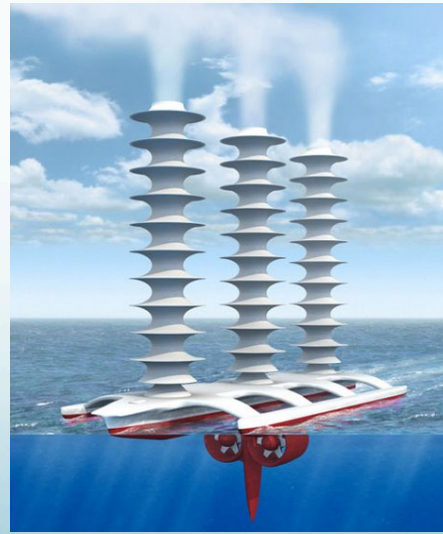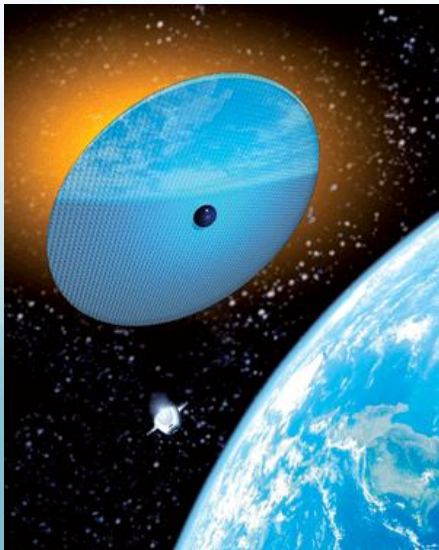
Right picture from Rolling Stone article "Can Dr. Evil Save the World?"

The Effect of Climate on Nature

- Cute animal pictures!!

Climate and the Rainforests

- The effect of burning tropical rainforests on climate

- And the effect of climate change on rainforests

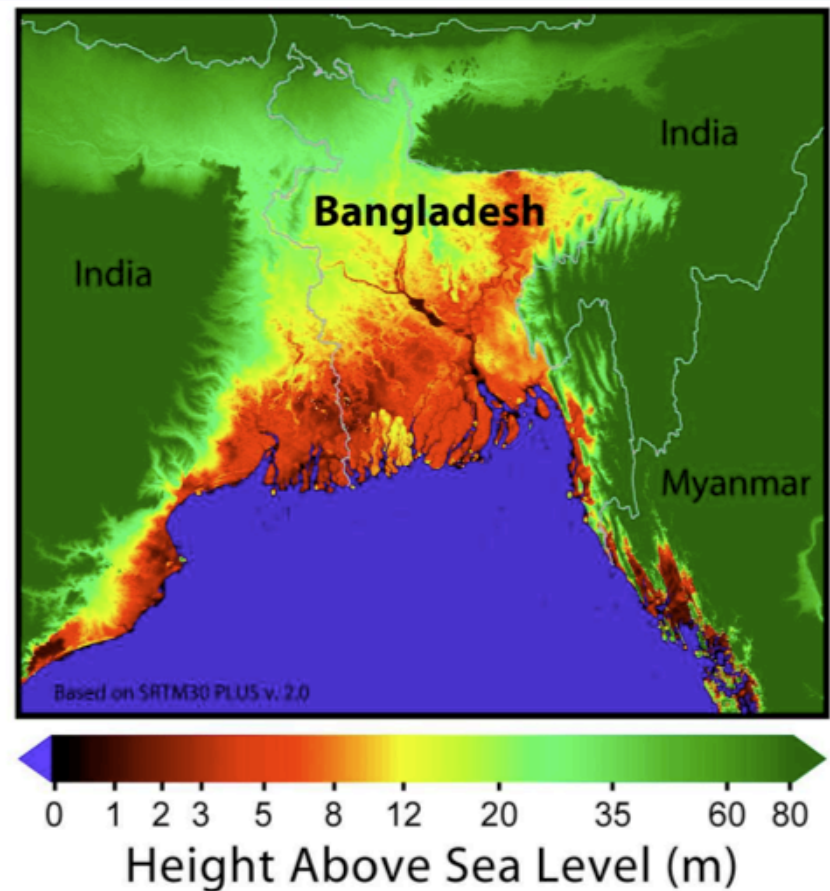Rainforests burning over the Brazil-Bolivia border

Satellite photo from NASA (MODIS):
Locations of fires marked by (enhanced) red dots

Winners and Losers

- Who will benefit...
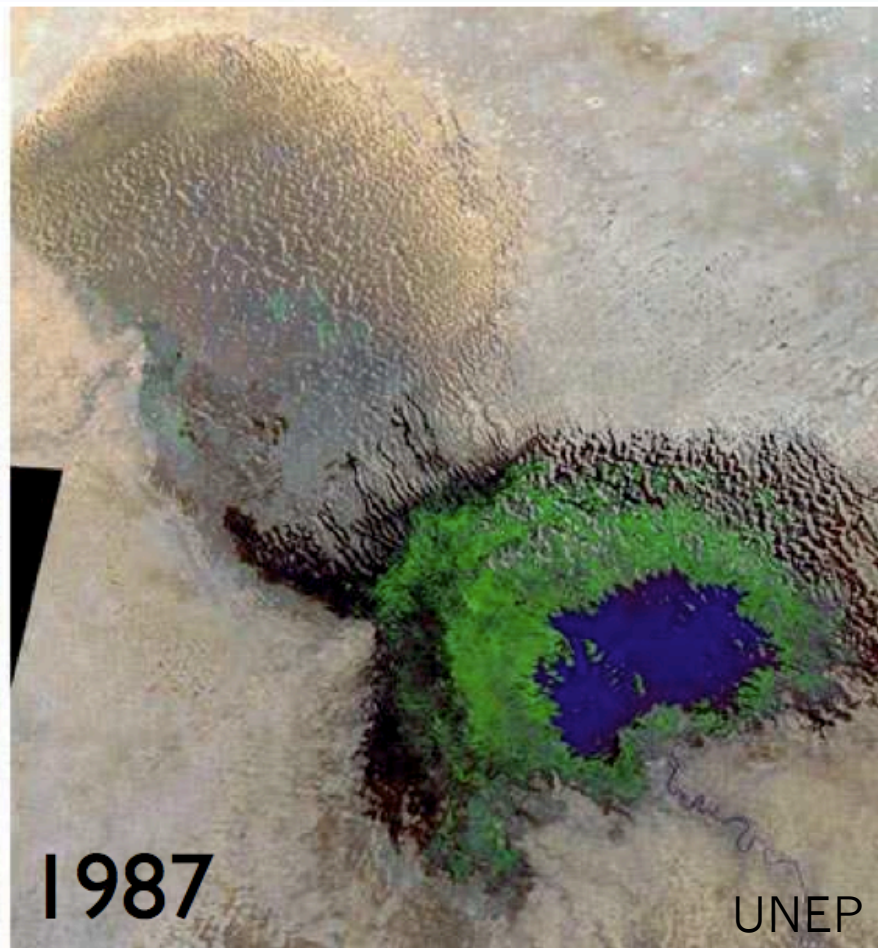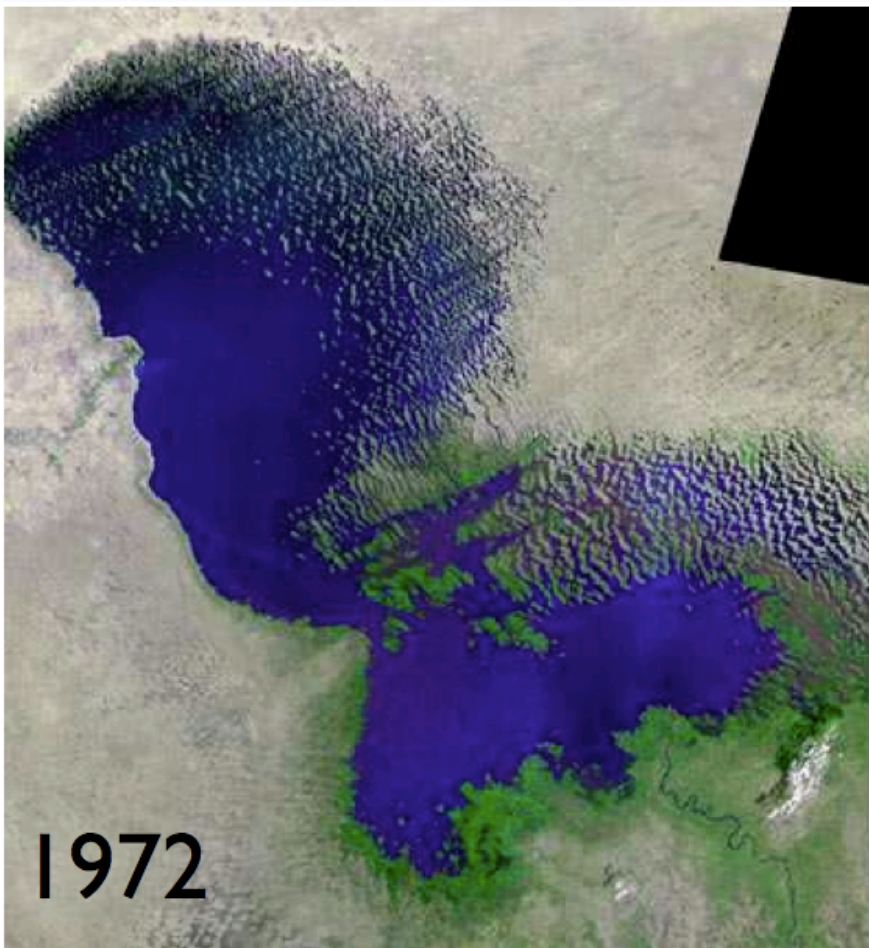
- And who will it hurt the most?

Floods
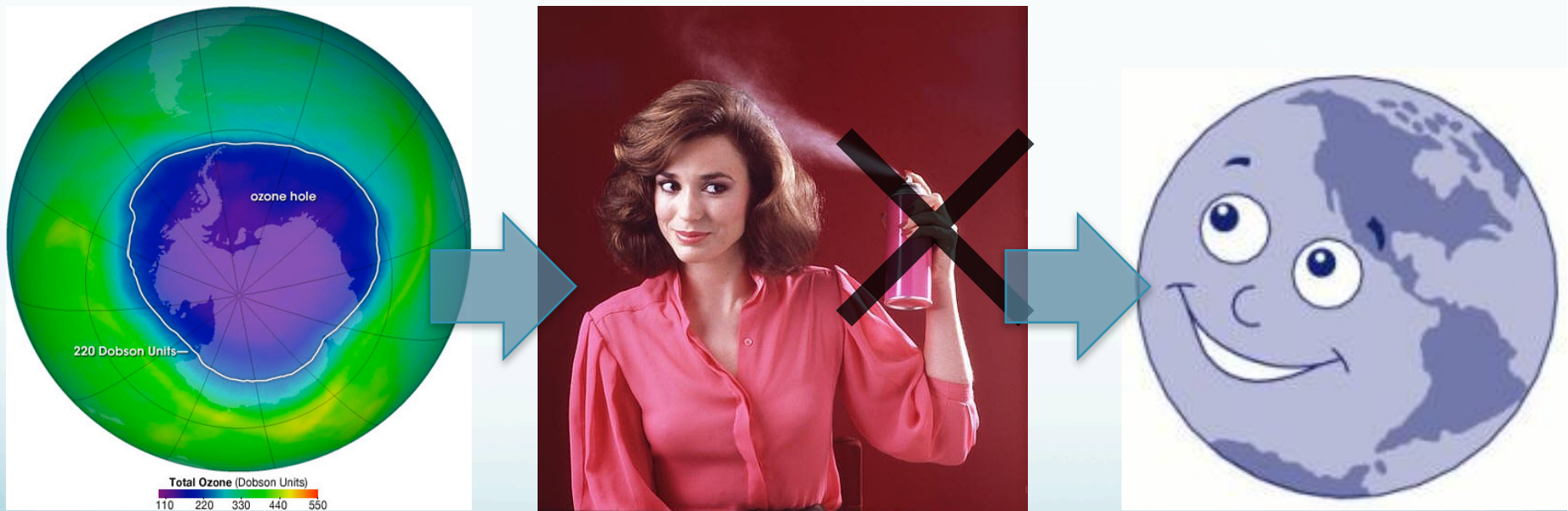
- Floods in Yemen, October 2008

And Droughts...

- Lake Chad

1972   1987   UNEP

Science and Policy

- The **ozone problem**
  - This was **solved** by the most efficient interaction between **science and policy** to date

Discovery of the ozone hole led to a ban on all CFCs

Why is global warming so much more difficult from a policy perspective?

Global Warming Solutions

Kyoto Protocol, participation (2005)