Mission 2015 : Whole Earth Triage: securing the future

Biodiversity. Are we really on the brink of a great extinction like the so called Big Five mass extinctions that occurred in the last 500 million years? Extinction has occurred throughout the history of life, and episodically, large fractions of biodiversity have disappeared. We are now able to crudely inventory earth's biodiversity and it is clear that over the past few hundred years, human activities are often the cause of extinction, but not always. At the same time we have become keenly aware of the fragility of many of our ecosystems and human impact on them. We as a species need a plan for the future. We can't and probably shouldn't try to save all species and ecosystems. Is saving the Blue whale more important than the rain forests or deep marine microbial ecosystems? Is minimizing global warming by limiting greenhouse gas emissions central to any plan forward? How do we decide? In other words what can we afford to do, what is the price of inaction, and how do we choose? Should preserving the biodiversity of the planet be subject to cost-benefit analysis?

Your mission (Mission 2015) will focus on prioritizing the biggest issues facing our planet and how to develop scientific, social, and economic approaches to addressing them.

The Biodiversity Crisis

http://www.foreignpolicy.com/articles/2010/08/26/the_coming_food_crisis?page=0,1

Terrascope – Guiding Principles

- The Earth system provides a context for learning basic science and engineering concepts
- Students put those concepts to use in creative ways to understand the interdependency of physical, chemical, and biological processes that shape our planet
- Students explore how these concepts may be used to design protocols to ensure a sustainable environment
- Program emphasizes both theory and practice, and puts a premium on active learning

Terrascope – Structure

First Semester

- Solving Complex Problems--Mission 2015

Second Semester

- 1.016
- Terrascope Field Experience (Spring Break)
- Terrascope Radio

Solving Complex Problems

- Multidisciplinary, project-based learning experience
- Students work toward a solution to a deceptively simple problem related to Earth's environment
- Each year's theme is different and referred to as "Mission XXXX", where XXXX refers to the graduation year of the class involved

Solving Complex Problems--Motivation

- To build in you the capacity to tackle the “big” problems that confront society
- To encourage you to take charge of the learning process
- To show you how to do independent research, to evaluate the quality of information sources, and to synthesize different information streams

Solving Complex Problems--Motivation

- To encourage you to think about optimal solutions rather than correct solutions
- To help you learn how to work effectively as part of a team
- To improve your communication skills using two media: the web site and the formal oral presentation
- To convince you of your potential!!

Past Missions

- Develop a viable plan for the exploration of Mars with the aim of finding evidence for life

- Design permanent, manned, underwater research laboratories and develop detailed research plans for the first six months of their operation

- Design the most environmentally sensitive strategy for hydrocarbon resource extraction from the Arctic National Wildlife Refuge and determine whether or not the value of the resource exceeds its financial and environmental cost

Past Missions

- To develop strategies for developing countries in the Pacific basin to cope with tsunami hazards and disasters. Due to the unique needs of each country, we specifically focused on developing plans for Peru and Micronesia.

- To develop a plan for the reconstruction of New Orleans and the management of the Mississippi River and the Gulf coast. The reconstruction of New Orleans and the management of the Mississippi River and the Gulf coast.

Past Missions

- To develop strategies to deal with the collapse of the global fisheries and the general health of the oceans
- To develop a plan to ensure the availability of fresh clean water for western North America for the next 100 years.
- Propose an integrated global solution to the rapid rise in atmospheric CO_2 that will stabilize concentrations at an economically viable and internationally acceptable level.

Subject Structure

Problem divided into approximately ten tasks; students divided into teams

Each team assigned a Teaching Fellow, Alumni Mentors, and Disciplinary Mentors

Four meeting styles:

- Presentations on methodology
- Case-study discussions
- Team workshops
- Coordination meetings

Subject Deliverables

- Each team will communicate through wiki-based structure

- ➢ Each class describes and justifies its overall plan in a web site

- ➢ Each class explains the design in a two-hour presentation before a panel of experts and a general audience

Home

Geology

Hydrocarbon Formation
Geologic History
Hydrocarbon Reserves
Hydrocarbon Values
Expected Recovery

Environment

Physical Environment
Terrestrial Life
Aquatic Life
Avian Life
Plant Life
Decomposers

Drilling

Drilling Technology

Pipeline Technology

The proposed pipeline will be modeled after the Trans-Alaskan Pipeline System (TAPS) which features the following technologies:
- sideways maneuverability: horizontal shifting along pylons and zigzag formation; together, these will allow for thermal expansion from the transport of heated fluids and motion during seismic activity; these features help ensure the structural integrity of the pipeline
-internal heating and insulation: to keep the oil within the pipelines liquid in an arctic environment while minimizing thermal radiation to the environment at large
-leak control system: series of valves, automated control, for shutoff in case of detected leaks; these valves limit the maximum volume of oil that can be spilled; there are also manned routine maintenance trips along pipeline
-pigs: automated vehicals which travel up and down the inside of the pipe which are used to 1) clean the inside of the pipeline by scraping, 2) sense/detect pipeline cracks/ deformations; small enough to fit in pipe but big enough to maintain one-way orientation (i.e. won't turn around/rotate inside the pipe)
-vertical loops: used at the Alpine field, artificial high points in pipeline system which create a vacuum/siphon at top of a "loop" (really, just vertical zigzags) in case of

Mission 2008

Galapagos Islands

Las Tortugas

Front Page

Background

Biopreserve

Monitoring

- Marine
  - *Buoys*
  - *Fish and Fishing*
  - *Floating Island*
- Terrestrial
  - *Soil*
  - *Fauna*
  - *Flora*
  - *Seismic*
  - *Atmospheric*
  - *Dissolved Oxygen*
- Logistics
  - *Central Database*
  - *Public Survey*
  - *Scientist Committee*

Ecovillage

About the Site

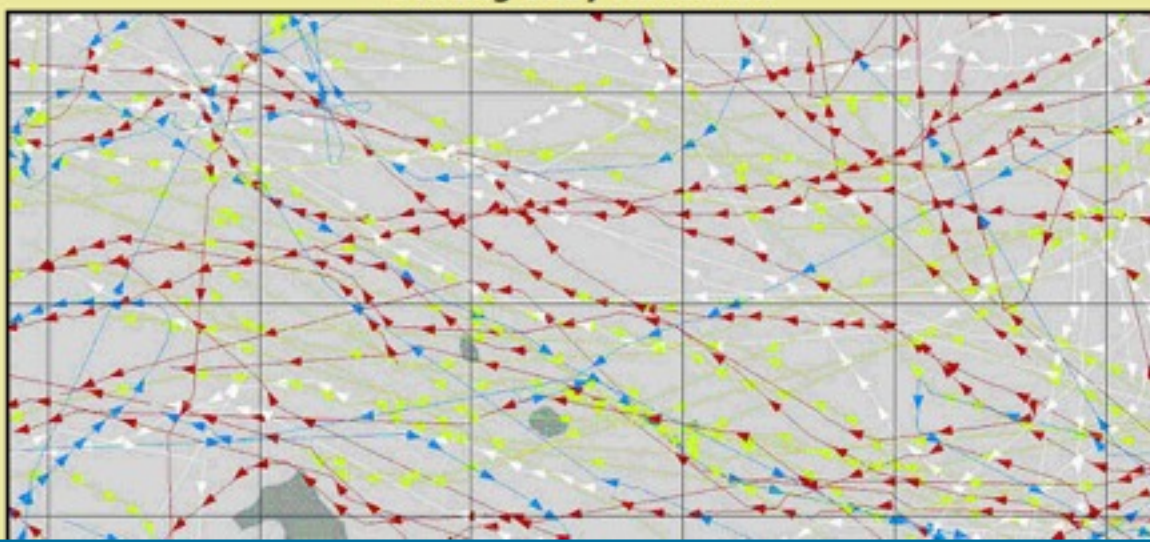
Buoys Introduction

Currently, there are no permanent buoys in many parts of the Galapagos waters. The implementation of such a system would render multiple benefits to ecosystem monitoring, such as in the response of oceanographic and atmospheric variables to the construction proposals available in the ecovillage section. Below is a map from 2000 of drifting buoys and their trajectories over the year. Note the coverage absence near the geographical center of the Galapagos.

Navigation

- Introduction
- Sea Surface Temperature
- Nitrates
- Disolved Oxygen
- Atmospheric
- Sources

Drifting Buoy Movement



Mission 2009

the tsunami threat in the Pacific

saving the world, one mission at a time.

The Mission 2009 Project

This site is the product of a 3-month intensive research and design effort to solve the complex problem posed by Mission 2009. Mission 2009, or Solving Complex Problems (12.000), is a course taught at the Massachusetts Institute of Technology (MIT) that allows students to work as part of a team to develop a solution to a complex problem. In light of the December 26th, 2004 tsunami, this year's mission is to develop strategies for developing countries in the Pacific basin to cope with tsunami hazards and disasters. Due to the unique needs of each country, we specifically focused on developing plans for Peru and Micronesia.

In our approach to solving this complex problem, our class was divided into ten groups, guided by trusty mentors. Each group was dedicated to finding a solution for a specific aspect of the problem. Later in the term, we united as one team and solidified a solution for this tsunami problem.

Our mentors greatly facilitated this project. They were there every step of the way to make sure we stayed on track. In addition to our mentors, we could not have completed this project without various other resources.

The reader can begin browsing our site by clicking on any of the categories in the menu to the left. We have organized the issues, as best we could, chronologically, starting from before the tsunami strike, moving into the strike itself and the direct aftermath, and then into long-term consequences and recovery.

Before the Tsunami

The Before Section of this website will focus on issues that reflect what happens before a tsunami hits. To better help you navigate this website the information in the Before link is broken down into these other seven links that are summarized below:

- Risk Assessment - Risk Assessment deals with evaluating the danger in areas of Peru and Micronesia. Under this link you will find information concerning tsunamis and how they interact with the environment as well as the danger they can cause when they hit the shorelines. Other helpful information include an algorithm for the risk assessment and also information on the sensors for the tsunami such as how they function and where they will be placed.

- Chain of Command - The Chain of Command deals with the people involved in the whole process in the case of a tsunami happening. It is broken down into 5 other components with directors of people that will decide the danger of a tsunami, and communicating this information to the governments. The Directors will be responsible for maintaining the detection instruments and for coordinating the whole situation.

Mission 2010

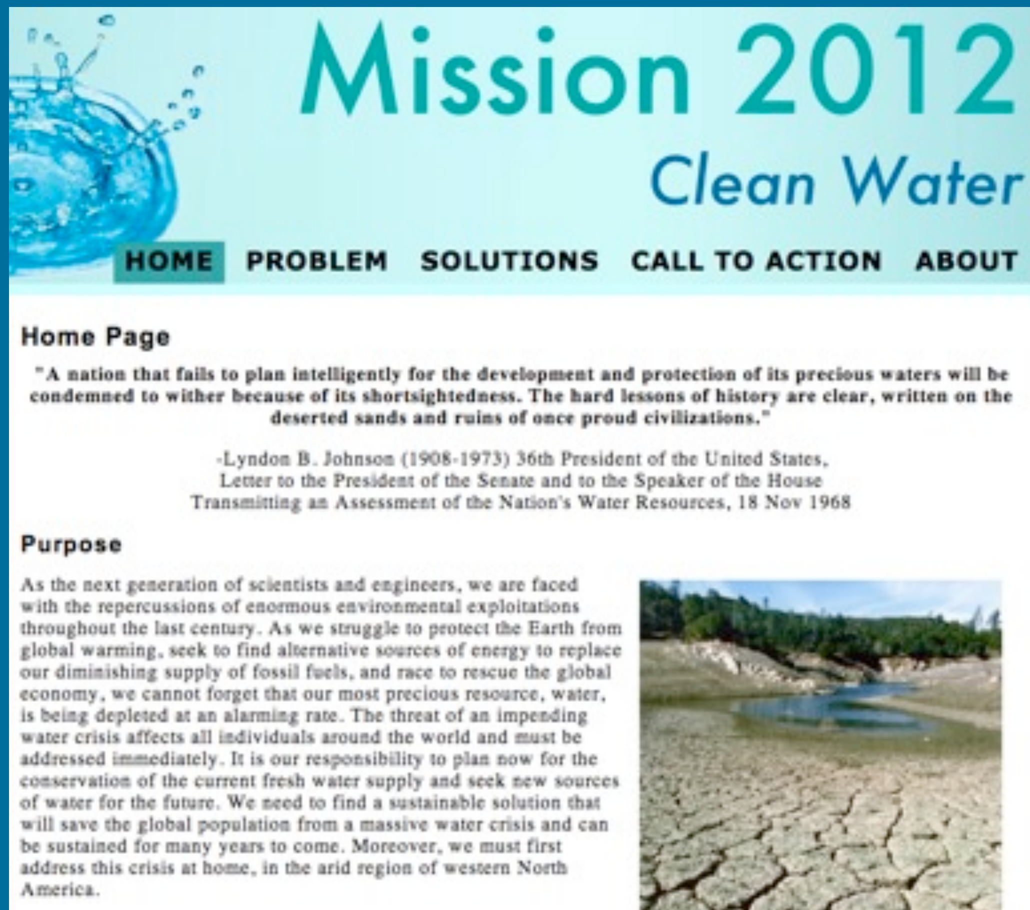
New Orleans

Long Term Solutions

- **Downsizing of Districts** - Plans for which neighborhoods of New Orleans to rebuild, and to what extent
- **Wetlands** - Prevent additional land loss and battle changing global environment
- **Mississippi River** - Plans for river control as relevent to bed level rise and sediment delivery to wetlands *(Note: this page was edited on Sunday, December 3rd at 5:50 pm)*
- **Changing Port Functions** - Altering ports of New Orleans and South Louisiana
- **Following the Jobs** - Population will shift with the job market
- **Relocation Aid and Compensation** - Helping residents relocate
- **Evacuation Capacity** - Future evacuation plans
- **Culture** - Preserving the rich culture of the area

Mission 2011

Mission 2012



Mission 2012
Clean Water

HOME PROBLEM SOLUTIONS CALL TO ACTION ABOUT

Home Page

"A nation that fails to plan intelligently for the development and protection of its precious waters will be condemned to wither because of its shortsightedness. The hard lessons of history are clear, written on the deserted sands and ruins of once proud civilizations."

-Lyndon B. Johnson (1908-1973) 36th President of the United States,
Letter to the President of the Senate and to the Speaker of the House
Transmitting an Assessment of the Nation's Water Resources, 18 Nov 1968

Purpose

As the next generation of scientists and engineers, we are faced with the repercussions of enormous environmental exploitations throughout the last century. As we struggle to protect the Earth from global warming, seek to find alternative sources of energy to replace our diminishing supply of fossil fuels, and race to rescue the global economy, we cannot forget that our most precious resource, water, is being depleted at an alarming rate. The threat of an impending water crisis affects all individuals around the world and must be addressed immediately. It is our responsibility to plan now for the conservation of the current fresh water supply and seek new sources of water for the future. We need to find a sustainable solution that will save the global population from a massive water crisis and can be sustained for many years to come. Moreover, we must first address this crisis at home, in the arid region of western North America.

“What I have learned is that passion, along with curiosity, drives science. Passion is the mysterious force behind nearly every scientific breakthrough. Perhaps it’s because without it you might never be able to tolerate the huge amount of hard work and frustration that scientific discovery entails….”

“For the next four years you will get to poke around the corridors of your college, listen to any lecture you choose, work in a lab. The field of science you fall in love with may be so new it doesn’t even have a name yet. You may be the person who constructs a new biological species, or figures out how to stop global warming, or aging. Maybe you’ll discover life on another planet. My advice to you is this: Don’t settle for anything less.”

Nancy Hopkins, a professor of biology at M.I.T., has been teaching since 1973.

Extracted from OP-ED contribution in New York Times, September 5 2009

Subject Grading

Individual performance (35%)

Team performance (35%)

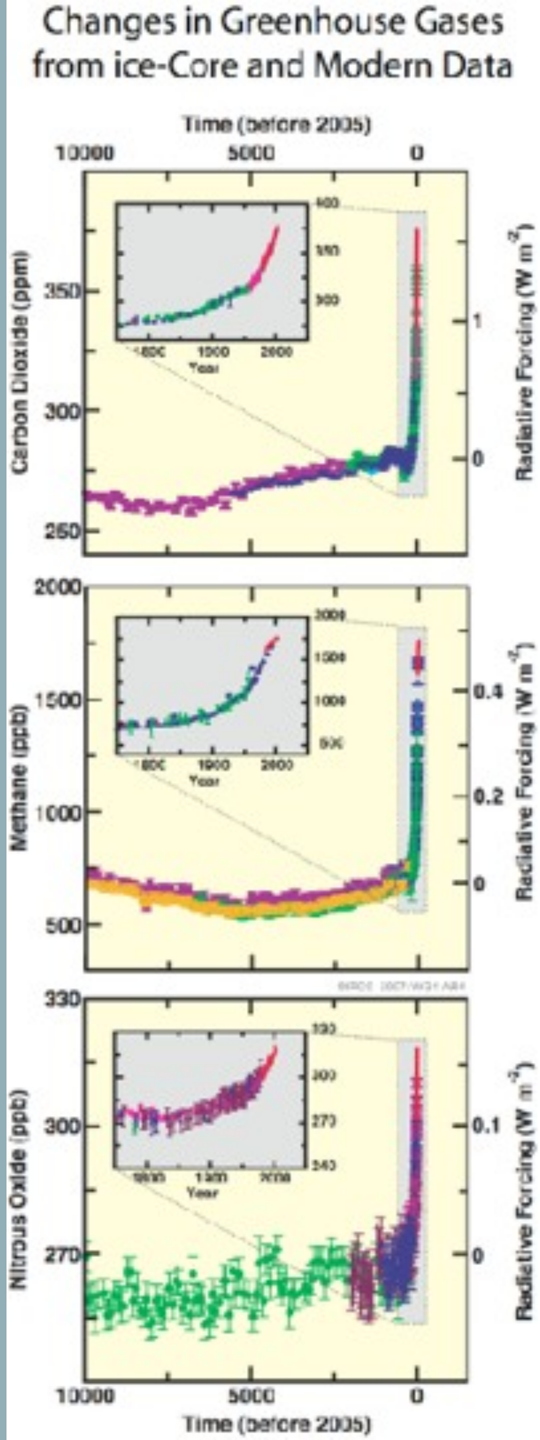
Class accomplishment (30%)

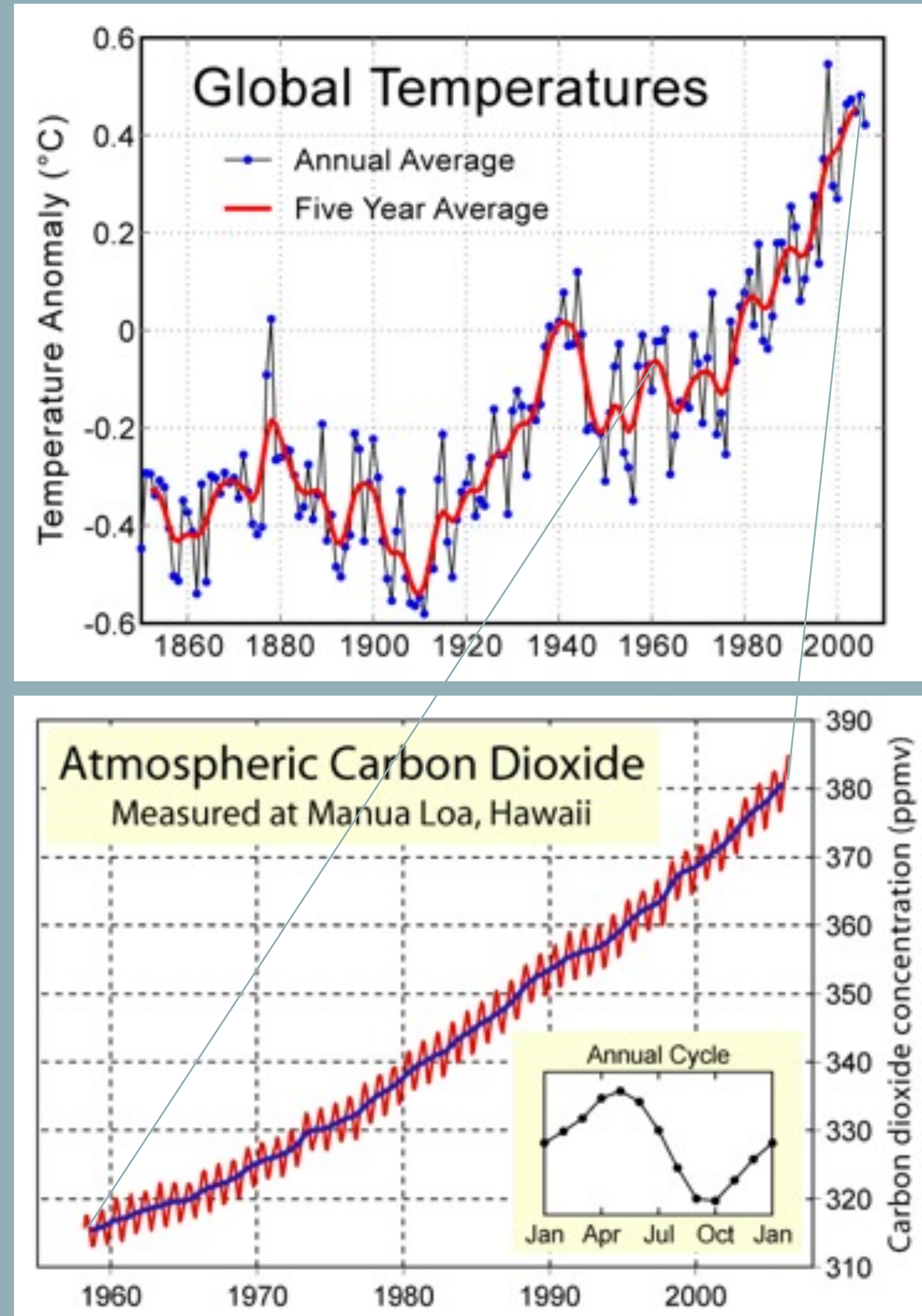
Wikis

- Share files in teams, class
  - All files online
    - Set permissions - who can read, edit
    - Know about others' work
      - Avoid doubling up, missing topics
    - Get good quality writing early
      - You'll be happy later, we promise

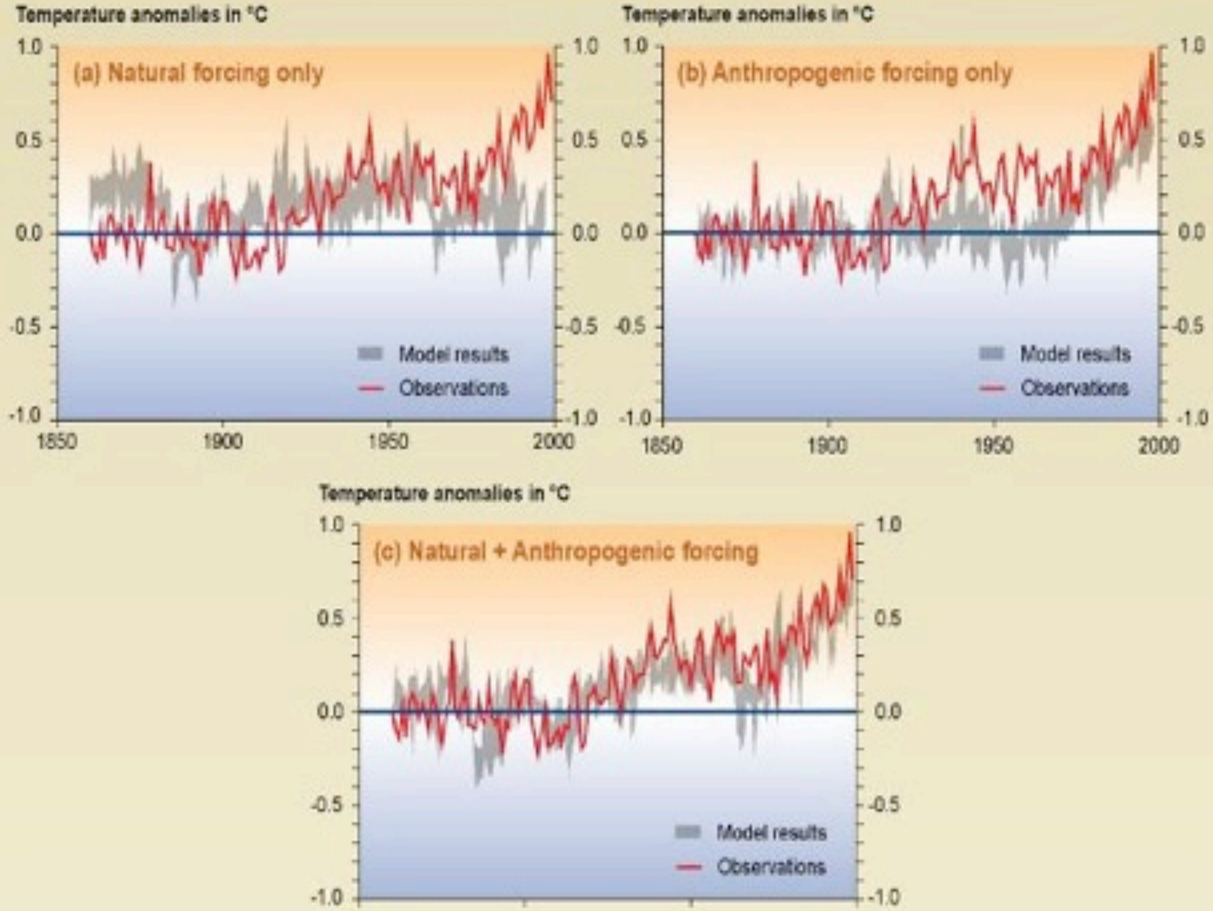
Wikis - structure

- One wiki
- One section per team
  - All read, team read/write

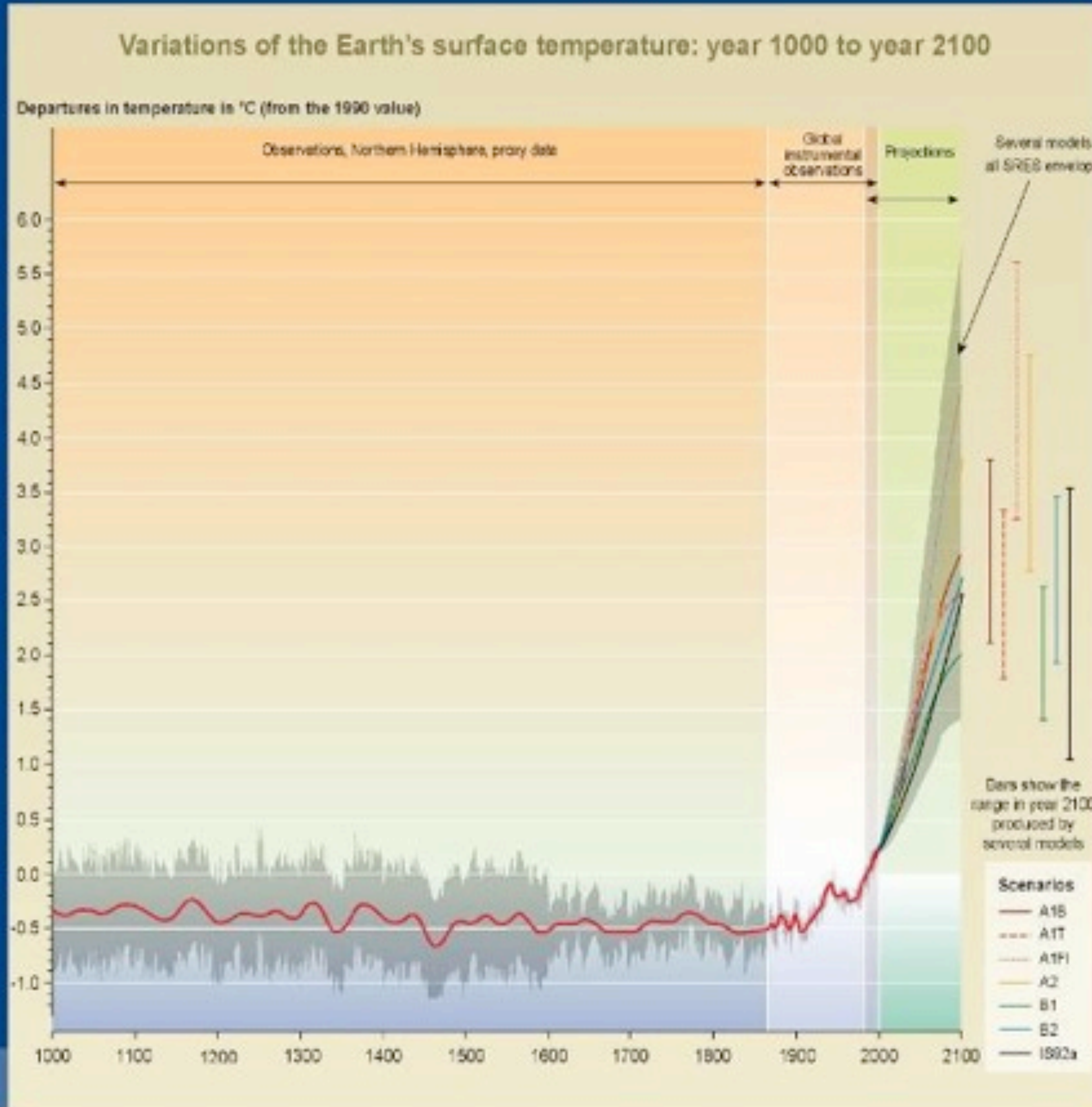

Changes in Greenhouse Gases
from ice-Core and Modern Data
Time (before 2005)
10000
5000
0
Carbon Dioxide (ppm)
Radiative Forcing (W m-2)
Methane (ppb)
Nitrous Oxide (ppb)
Year
Time (before 2005)


Global Temperatures
Annual Average
Five Year Average
Temperature Anomaly (°C)
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
1860
1880
1900
1920
1940
1960
1980
2000
Atmospheric Carbon Dioxide
Measured at Manua Loa, Hawaii
Annual Cycle
Jan
Apr
Jul
Oct
Jan
Carbon dioxide concentration (ppmv)
390
380
370
360
350
340
330
320
310
1960
1970
1980
1990
2000

Comparison between modeled and observations of temperature rise since the year 1860



SYR - FIGURE 2-4



SYR - FIGURE 9-1b

WMO UNEP

IPCC

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

Important Questions to Address

- **What are the consequences of doing nothing?**
- **Is access to food and clean water a basic human right?**

Class Structure

We will present possible team topics and allow you to “self-organize”

- Each of you will be assigned to a team, and each team will be assigned at least one upperclass teaching fellow (UTF), a library liaison, and multiple alumni mentors

- Each team will be responsible for proposing to the class one or more options for its assigned part of the solution

- Teams may work independently and will be responsible for their own solutions, although mentors and volunteer faculty resources may be called upon as “sounding boards”.

Important Contacts

Sam Bowring	sbowring@mit.edu
Seth Burgess	sburgess@mit.edu

Meeting Places

- **Class will meet in three different places, so consult the "Syllabus" page before each class meeting to see where you will go**
- **THIS FRIDAY WE MEET in 3-270**
- http://web.mit.edu/12.000/www/m2015/