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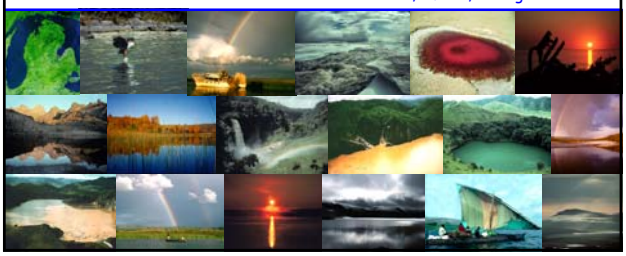
Teaching:
Global Change (Bio 110)
Ecosystem Ecology (EEB 476)
Limnology (study of lakes; EEB 483)

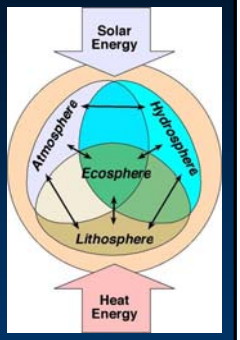
Research:
Aquatic Ecosystems
Impacts of Climate Change
Biogeochemistry
- Arctic, Africa, Michigan



Ecosystem Roadmap

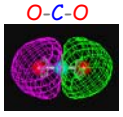
We wish to know:

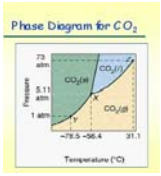
- **Where we are going?**
  - Tie together 3 previous sections of the class
  - Climate warming, acid rain, lost tropical rainforests
- **Why we should care?**
  - See Dave Allan's Roadmap lecture, ***plus…***
- **How do we get there?**
  - Facts and concepts (and, dispelling "truth")



1. FACTS

O-C-O



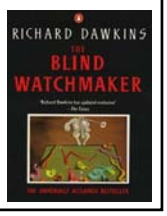


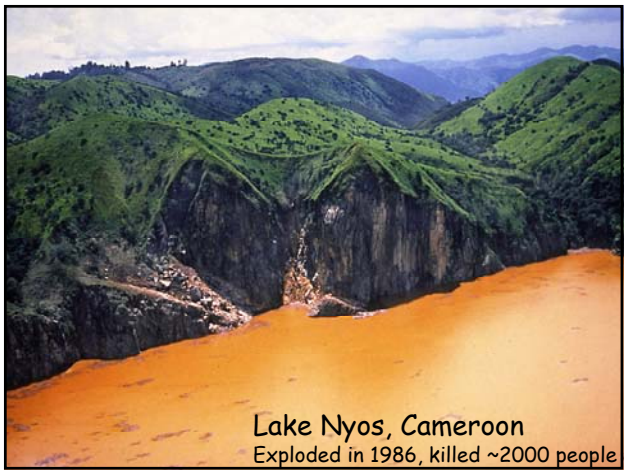
Physical constants of CO_2:

Mol. Weight	Density	mag. sus.	ref. index	Cp	delta H
44.01	1.799	-21.0	1.663	29.14	-110.5

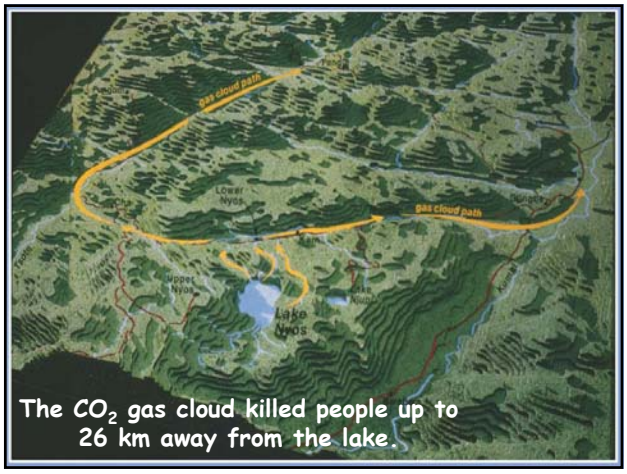
2. CONCEPTS

"Life is like a blind watchmaker"





Lake Nyos, Cameroon
Exploded in 1986, killed ~2000 people



The CO_2 gas cloud killed people up to 26 km away from the lake.

1. Fact/Concept ratio Low = ?

Philosophy

2. Fact/Concept ratio High = ?

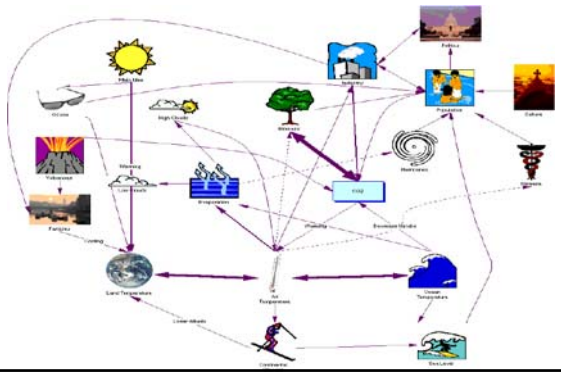
Engineering, Medicine

Scientific Concepts:

1. Standing Stock
2. Mass Balance
3. Material Flux Rate
4. Residence Time = Stock/Flux Rate
5. Negative/Positive Feedback

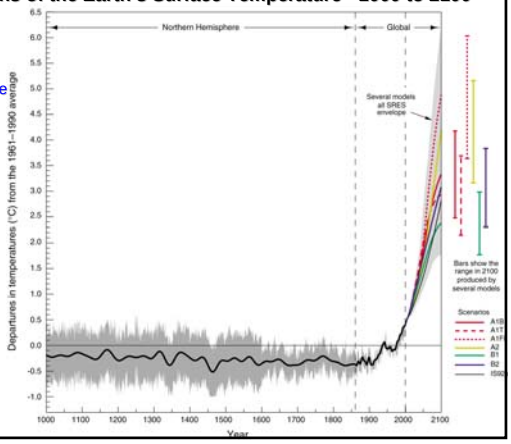
Understanding Complex Systems --

Use conceptual tools (and some facts…)



Variations of the Earth's Surface Temperature - 1000 to 2100

- 1000 to 1861, N. Hemisphere — proxy data
- 1861 to 2000, Global — instrumental
- 2000 to 2100 Global — model projections



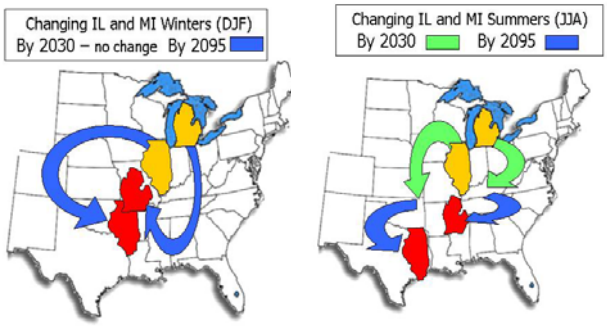
• "There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities"

• "…most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations".

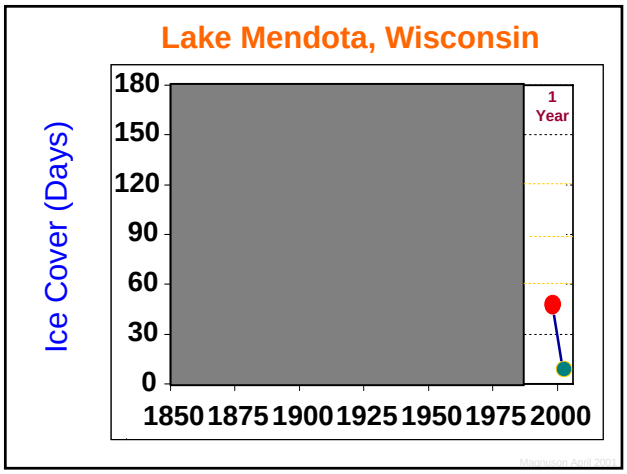
IPCC 2001

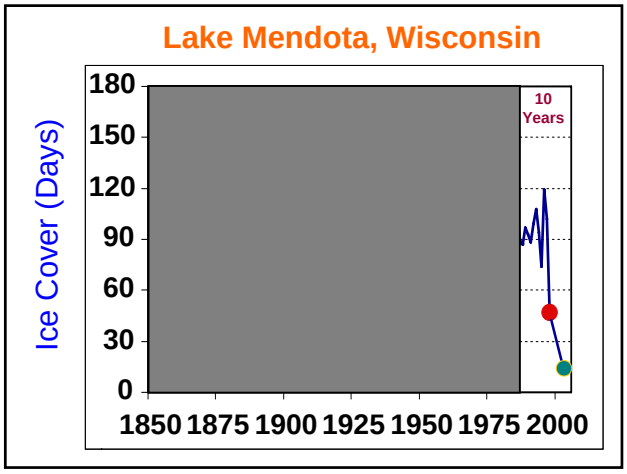
This has never happened before!

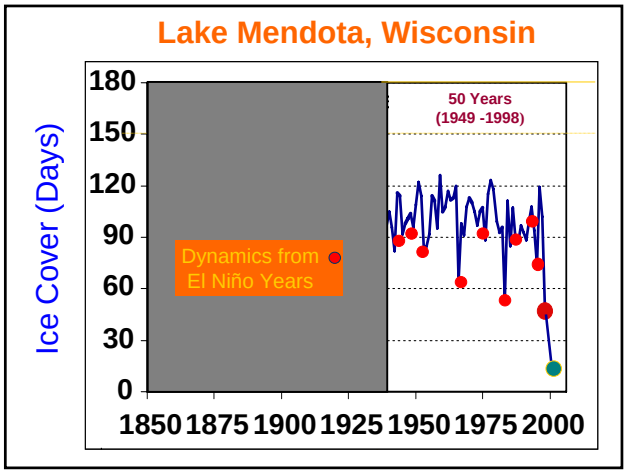
Climate Warming will Impact the Future Weather we "Feel" in Michigan and Illinois



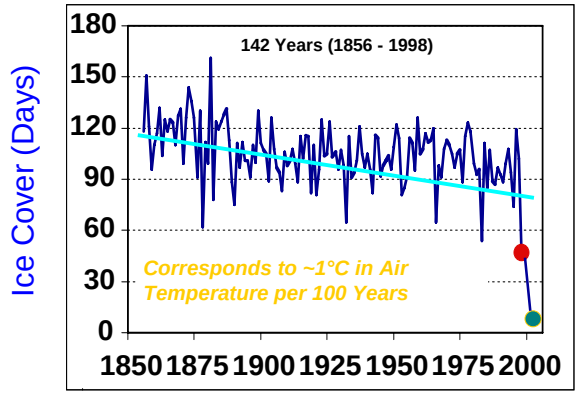
Unusual Events on Lake Mendota


Lake Mendota, Wisconsin
Ice Cover (Days)
180
150
120
90
60
30
0
1850 1875 1900 1925 1950 1975 2000
1 Year
Magnuson April 2001


Lake Mendota, Wisconsin
Ice Cover (Days)
180
150
120
90
60
30
0
1850 1875 1900 1925 1950 1975 2000
10 Years


Lake Mendota, Wisconsin
Ice Cover (Days)
180
150
120
90
60
30
0
1850 1875 1900 1925 1950 1975 2000
50 Years
(1949 -1998)
Dynamics from
El Niño Years

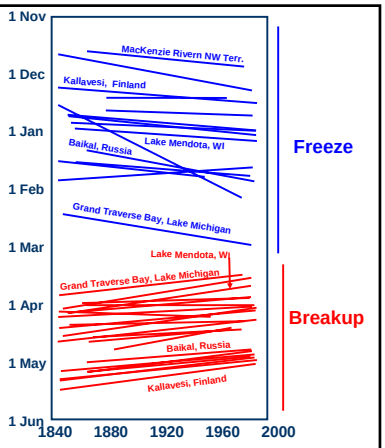
Trend caused by Global Change



Historical Trends in Lake and River Freeze and Breakup Dates in the Northern Hemisphere.

(37 of the 39 time series are in the direction of warming)

Modified from Magnuson et al. 2000 for IPCC 3rd Assessment 2001



Climate Change

1. How do we know it's happening?
   -- Easy, just look around
2. What do the skeptics say?

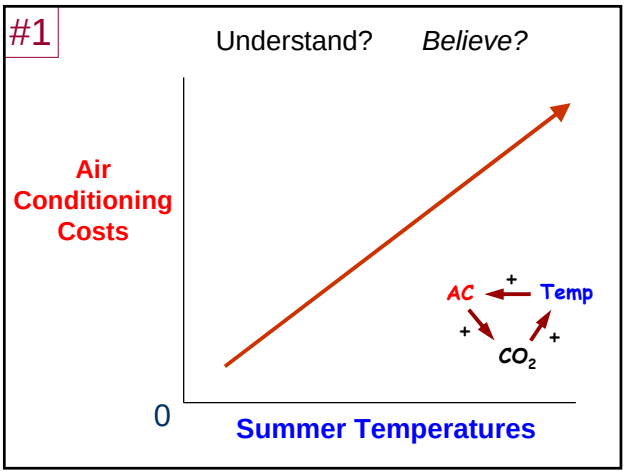
Lay-person's view -- *doubt and uncertainty*

Professional approach
-- *uncertainty and deception*

We don't care who made the watch, we just want to know how it works !

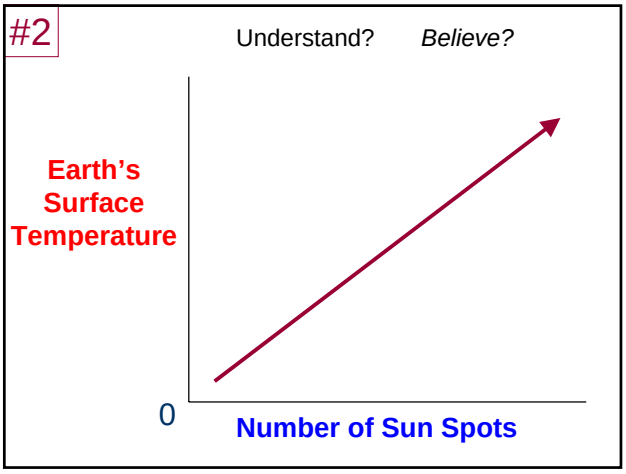
#1

Understand? *Believe?*



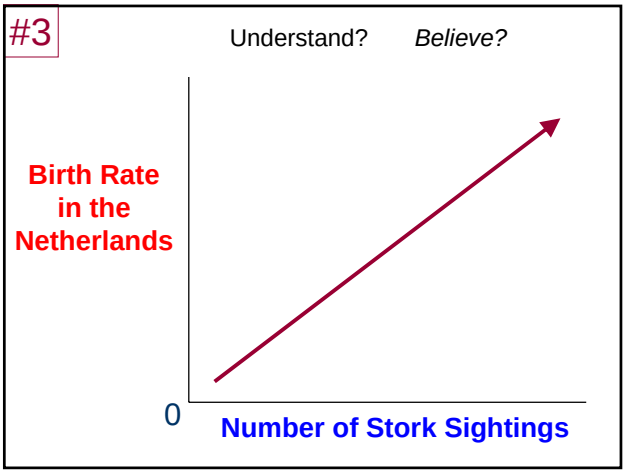
#2

Understand? *Believe?*



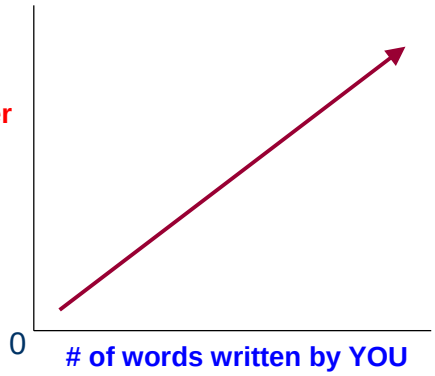
#3

Understand? *Believe?*



#4

Understand? *Believe?*



How does it work?

1. Mechanism OK
   Size/Impact OK
   (temperature & air conditioning costs)

2. Mechanism OK
   Size/Impact too Small
   (temperature & sun spots, # words written by YOU)

3. Mechanism Bad
   (birth rate & stork sightings)
   Hey, it's all BS! (Babies and Storks…)

The Political Uses of Uncertainty:

- All parties use uncertainty as rhetoric
  - Conservative: support for "high-proof" positions
    - *Uncertainty as a reason to wait*
  - Science: support for further research and political importance
    - *Uncertainty as a reason to continue*
  - Liberal: support for "frontier" positions
    - *Uncertainty as a reason to act*

We **must** learn how to apply Science (and its uncertainties) to Real Problems

My Themes

- Global change on our planet can only be understood by combining "abiotic" and "biotic" components – must look at the whole Ecosystem
- A combination of facts and scientific concepts can help us understand even the most complicated problems
- Science is NOT hard (it might sound scary), and everyone can learn enough to make rational decisions about our world's future

Possible Projects

- The "missing sink" - Where did all the CO_2 go?
- Microbes rule, Humans drool
- Does the rainforest *really* matter?
- The day the Earth turned brown and blue – The limits to food production
- Who's doing who? Climate skeptics and the use and misuse of Science
- Who needs more ice? Melting the Earth's glaciers *(a.k.a. "Water World 2050", starring B. van der Pluijm as K. Costner…)*
- WWF Climate slug-fest, 2006 – People vs. Nature
- The politics of uncertainty and the Scientific Platform
- Whatcha gonna do when the rain don't come – Shifts in the Global water cycle