Where we are and
Where we are going
The four stages of climate change denial
• It’s not happening
• It’s not happening

• YES IT IS !
• It’s not happening

• YES IT IS!

• It’s not us
• It’s not happening
• YES IT IS !
• It’s not us
• YES IT IS !
• It’s not happening
• YES IT IS !
• It’s not us
• YES IT IS !
• It’ll be good for us
• It’s not happening
• YES IT IS!
• It’s not us
• YES IT IS!
• It’ll be good for us
• NO IT WON’T!
• It’s not happening
• YES IT IS!
• It’s not us
• YES IT IS!
• It’ll be good for us
• NO IT WON’T!
• There isn’t anything we can do about it
• It’s not happening
• **YES IT IS !**
• It’s not us
• **YES IT IS !**
• It’ll be good for us
• **NO IT WON’T !**
• There isn’t anything we can do about it
• **YES THERE IS ! (Feb 23\textsuperscript{rd})**
• It’s not happening
• YES IT IS!
• It’s not us
• YES IT IS!
• It’ll be good for us
• NO IT WON’T!
• There isn’t anything we can do about it
• YES THERE IS! (Feb 23rd)
• ... BUT IT WON’T BE EASY...
Climate Science
February 16

• Review of Last Week’s Material
• Physical Signs of a Warming World
• Ocean Acidification: The other evil twin to global warming
• Human and Ecological Impacts
• Societal, Economic Impacts; interactions with other global issues (or Feb. 23rd)
• Charlee Smith graph discussion
• “Quiz” Answers and Review
• Responses to “top 8 myths” (or Feb. 23rd)
• Balog “trailer” (or Feb. 23rd)
Summary of Feb. 9 Material

- **Weather**: short term, semi-chaotic;
- **El Nino-La Nina**: longer term “weather”
- **Climate**: Averages over time and regions
- **Computer Simulations**: do well at global temperature projections; so-so at precipitation and regional climate
- **The Earth**: is out of energy balance & most of the accumulated heat is going to the oceans
Feb. 9th summary: continued

• The carbon-cycle is also out of balance; fossil fuel burning dumps twice as much CO$_2$ into the atmosphere as oceans and biosphere absorb.

• Hemisphere & globally averaged temperatures are higher than any over at least the last 1000 years.

• Ice ages are triggered by wobbles in the Earth’s motion and amplified by feedbacks
Feb. 9 summary: continued

• On all time scales, CO₂ and global temperatures are tightly coupled.
• The CO₂ level caused by the last decades of fossil fuel use is already higher than at any time in 800,000 years.
• By the end of this century, on any “business as usual” trajectory, CO₂ will be higher than at any time in at least 20 million years.
• The CO₂ imbalance persists for centuries; we are locked into some further warming.
Segment 8: Signs of A Warming World
Plants & little critters know it.
SUMMER ARCTIC SEA ICE BOUNDARY IN 1979
AVERAGE SEPTEMBER EXTENT

Data source: Satellite observations.
Credit: NSIDC
Arctic Sea Ice Volume Anomaly and Trend from PIOMAS

Anomaly Trend: -3.4 [1000 km$^3$/Decade]
Last Day: 2010-05-30
Arctic Ocean

September Sea Ice Extent: Observations (red) versus Models and Model Mean (averaged model data and s.d. in black)
Arctic sea ice extent over the last 1,450 years

- Reconstructed sea ice extent
- Modern observations

Kinnard et al 2011
GRACE satellites
SEGMENT 9
Ocean Acidification: Global Warming’s Other Evil Twin
see this website:
http://www.skepticalscience.com/Mackie_OA_not_OK_post_0.html
Placeholder for shell animation
The current rate of decrease in pH is thought to be ten to a hundred times faster than anytime in the past 50 million years, and many important species like corals, oysters, mussels, clams, crabs and plankton may be adversely impacted and may not have sufficient time to evolve mechanisms to cope with this changing chemistry....it is clear that the rise in CO2 is decreasing the corals’ ability to build their skeletons.
• “It is sobering to think we have used the lower range of IPCC scenarios yet still envisage serious if not devastating ramifications for coral reefs. …pathways [lead to 600 to 1000 ppm] and global temperatures of 3° to 6°C defy consideration as credible alternatives… policies that result in [CO2]atm above 500 ppm appears extremely risky for coral reefs and the tens of millions of people who depend on them directly
Healthy Coral
Dead Coral
Segment 10: Impacts on US and the rest of the Ecosystem
These impacts must be viewed in the context of others, including:

- World population headed toward 10 billion
- Environmental Degradation, Pollution
- Destruction of wildlife habitats
- Competition for increasingly scarce resources (especially water)
- Poverty and Social & Ethnic tensions
- Nuclear Proliferation threat
Extreme Weather Events: Posing the issue correctly

- Heat waves
- Droughts
- Floods & Intense storms
- Wildfires
- Hurricanes
- Tornedos
Metaphor Time!

bonds1
Increasing Probability of Heat Waves