

Climate Update 2005 #2

- Climate is the most important issue of the 21st Century
 - Because what we do will determine the environment in the 21st century and beyond
- Overview
 - Current Knowledge
 - Avg. temperatures up 0.3 C
 - Lots of new information
 - Current Conclusions
 - There is human caused warming
 - We cannot extrapolate reliably

What Do We Know?

- Global Warming is Real
 - But we can't reliably forecast what will happen
 - Simulations are incomplete and limited accuracy
 - Our knowledge of some factors is very limited
 - There may be discoveries of new factors
- We have a little time to prepare
 - Time for better simulations
 - Time to educate everyone, especially politicians
 - Time to get new energy sources ready
 - Time to raise the efficiency of all energy use

Climate Simulation Challenges

- Many Variables
- Unknown Interactions
 - What happens if ocean floor or arctic methane clathrate escapes?
- Long Time Constants
 - Ocean temp responds in 30 year timeframe
- Problems with data accuracy
 - Long term baseline data is derived indirectly from historic sources
- NP Complete Problem
 - Doubling accuracy increases cpu time by a factor of eight

Simulation Inputs #1

- Solar Input
 - Orbital change
 - Sun Variance
 - Maunder Minimum
 - Sunspots
- Atmosphere
 - Clouds & Particles
 - Absorbing Gasses (CO₂, Methane)
- Ocean
 - Circulation (Gulf Stream)
 - Heat Sink
 - Carbon Sink

Simulation Inputs #2

- Snow and Ice
 - Reflects solar input
 - Water Storage
 - Affects ocean circulation
- Land
 - Absorbs solar input
 - Plants capture carbon
 - Animals release methane
 - Decomposing plants release methane

Simulation Inputs #3

- Industry
 - CO2 Generation
 - Deforestation
 - Monoculture replanting
- Population
 - Plant reduction
 - Water pollution
 - Energy demand
 - Food demand

Current Simulations

- National Center for Atmospheric Research (NCAR)
 - Prehistoric extinctions possible from extreme global warming
 - Basic climate and model information
- England's MET Office
 - ClimatePrediction.net (BOINC)
 - 45 year run takes about 3 weeks
 - 32837 machines currently
 - New version adds sulphur cycle
 - To investigate 'global dimming' effect
 - Internal use of two vector machines
 - Good source of climate education

What Do We Need?

- More Climate Funding
 - Research for better data
 - Research for more understanding
 - Better software simulations
 - Faster supercomputers for more accurate simulations
- More support from the politicians
 - Take actions that we understand now
 - Higher CAFE standards, more hybrids
 - Emphasis on mass transit, not highways
 - Encourage car pooling
 - Benefits in reduced oil imports and pollution
 - Improves US economy by reduced transport costs

What Should We Do?

- Contribute cycles to climateprediction.net
- Learn more and educate others
- What can each of us do?
 - Buy a hybrid car (or car pool)
 - Look for energy efficiencies
 - This will save you money in the future
 - Push for mass transit (and use it!)
 - Educate politicians
 - They are the current roadblock to progress
 - Push for cheaper space access
 - Support Burt Rutan's project
 - Get NASA out of the launch business

Why Should We Do This?

- Because of our inability to simulate exactly, why make changes?
- There are enough probable downside events to justify taking action
 - CO2 levels will not level off for a long time
 - Rising sea levels **will** flood low countries
 - Warmer ocean may have lower productivity
- The biggest near term threat is much more unseasonable weather and bigger storms
- These threaten cities, life and food sources
- Recent events: Drought in Washington; Mudslides in California; Katrina in Alabama

Critical Environments

- Gulf Stream moves as much heat north as does the whole atmosphere
- The Jet Stream controls the tracks of high and low pressure areas (Storms)
 - It is influenced by changes in heat and circulation
- US weather has displayed a number of anomalies this year
- The American breadbasket, food we sell to the world, is currently in a serious drought

Why is the Gulf Stream Important?

- Gulf Stream carries one third of the solar heat energy in the tropics towards the poles
- It is a **major** moderating climate influence to the East coast, Newfoundland, England and the European continent
- In 2002, the jet stream moved north and floods inundated Britain and Europe
 - Maybe a random event, maybe connected
- It directly and indirectly contributes to edible fish populations

What Could Happen?

- Increased melting ice on Greenland threatens the Gulf Stream's thermohaline circulation by cooling the northern water
- Reduced circulation means hotter water in the tropics
- Katrina was powerful because the whole Gulf was at 30 degrees C (80 F), much warmer than usual
- Hurricanes, now maxed at Category 5 (175 MPH winds), may need Category 6 (200 MPH) in the near future

Other Possibilities

- Increased temperature could trigger an Ice Age
 - Warmer weather causes increased moisture in the atmosphere
 - Moisture causes more clouds
 - Clouds reflect more radiation
 - Temperature drops causing condensation
 - Cold air causes snow to fall
 - Snow reflects radiation
- And now we have positive feedback, forcing a colder environment that may persist for 50,000 years

What is the Near Term Outlook?

- Larger and more numerous big storms
 - Not just hurricanes; tornados and thunderstorms
 - Difficult growing conditions push food prices up
 - Disaster relief will become routine
 - No part of the US, or of the planet, is immune
- Climate change will get big financial support
 - Money for climate data research and simulations
 - Real changes to limit human caused warming
 - Higher fuel economy standards, more hybrids
 - We will begin to 'Lock Up' carbon
 - Tree planting, Carbon recapture at power plants
 - Research on long term Carbon sequestration
 - Insertion into Pacific plate subduction zone

Current Policy Outlook

- Energy Policy
 - Addiction to oil & coal
 - CO2 generation + pollution
 - Little progress towards alternatives
 - Little emphasis on efficiency
- Transportation Policy
 - Primarily road building
 - No effective mass transit
 - Inefficient automobiles
- These policies are the result of short term planning horizons
- In a few years, they will all begin to change

Long Term Energy Outlook

- Energy Sources
 - Oil supply **is limited**
 - Coal has serious problems
 - Mining deaths, CO2 generation, Toxic ashes
 - Nuclear
 - Opposed by political groups
 - Building process too expensive
 - Needs standardized designs
 - Solar and Wind
 - Expensive and inefficient
 - Useful in limited areas
 - Solar power satellites are possible
 - But requires a change of public opinion
 - Or a serious lack of alternatives
 - And much cheaper space access

Is There Any Good News?

- The serious nature of the climate problem is generally appreciated worldwide
- The US Senate recently reversed its position to support the reality of climate change
- Economic pain will force changes
- We can tolerate a short delay before major changes must happen
- Supercomputers will reach teraflop capability soon (IBM Blue Gene), more in 2010
- Personal computers can make a very powerful net
- Simulations are improving rapidly

What Can We Do?

- Lobby your Senators and Representatives
 - They will listen, and enough input will change what they support
 - Fund or work for election of supporters in 2006
 - Don't be put off by politics reputation
 - It's a tough job, sissies need not apply
- Support Climateprediction.net
- Change your own lifestyle
- Let your neighbors know
- Try out the local mass transit
 - You may be pleasantly surprised

Where to Follow Up

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