



# Climate Change Activities that clarify the 2007 IPCC Report

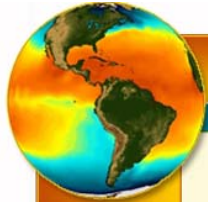
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Space Science and Engineering Center  
UW-Madison

*ESIP Summer meeting July 2009 UCSB*



# On-Line Climate Change Curriculum



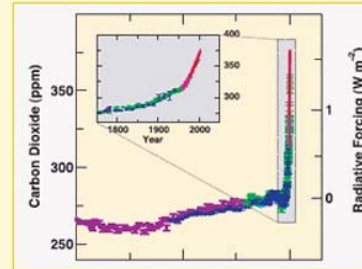
## Global and Regional Climate Change

[Home](#) | [Course Outline](#) | [Resources](#) | [Glossary](#) | [About](#)

Clarifying concepts, processes and graphs presented in the summary of the Physical Science Basis of the 2007 IPCC report on Climate Change.

### Course Units

- OUR GLOBAL CLIMATE SYSTEM
- OBSERVATIONS OF CLIMATE CHANGE
- GLOBAL CLIMATE CHANGE
- CLIMATE MODELING
- REGIONAL CLIMATE CHANGE



Course content is consistent with the Climate Literacy Framework set out by the National Oceanic and Atmospheric Administration and the National Science Foundation and is intended to clarify concepts in the Intergovernmental Panel on Climate Change (IPCC) *Summary for Policy Makers*, a report compiled to provide decision-makers with an objective source of information about climate change.

This professional development course for G6-12 science teachers is offered through the University of Wisconsin-Madison. To earn credit and receive feedback, educators must first register and enroll.



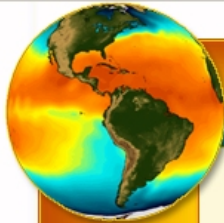
- Funded by UW-Madison
- Based on feedback from 2007 teacher summit
- Developed collaboratively by four departments (CIMSS, AOS, Geology, CCR)
- Consistent with Climate Literacy Framework
- Clarifies IPCC report
- Beta version debuted summer 2008
- 15 teachers took course and provided detailed feedback on each module
- Follow-up interviews with independent evaluator

<http://cimss.ssec.wisc.edu/climatechange/>



# Climate Change Course Outline

## 15 lessons (8 weeks)



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#### Course Outline

This course is divided into five units and fifteen lessons. When taking the course for professional development credit, participants are expected to work through two lessons per week.

#### Our Global Climate System

- 1) Life and Climate
- 2) Energy and Climate
- 3) Radiative Forcing

#### Observations of Climate Change

- 4) Direct Observations of Recent Climate Change
- 5) Paleoclimatic Perspectives on Climate (Indirect Observations)
- 6) Past Climates – Natural Drivers

#### Global Climate Change

- 7) Human Influences on Climate
- 8) Panels, Protocols and a Common Misconception about Ozone
- 9) Probabilities, Uncertainties and Units used to quantify Climate Change

#### Climate Modeling and Future Scenarios

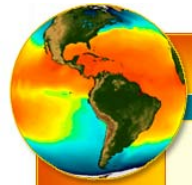
- 10) Models as Tools
- 11) Feedback Loops
- 12) Emission Scenarios
- 13) Projections of Future Changes in Climate

#### Regional Climate Change

- 14) Global Projections for Regional Climate Change
- 15) Climate Change in the Great Lakes Region

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# Climate Literacy Essential Principles



## Global and Regional Climate Change

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### Life and Climate » Concepts

Regional and local weather are manifestations of the climate system. Earth's climate is dynamic and is constantly changing. Climate molds the landscape and the landscape molds human kind - at least early in our development. Our ancestors adapted their clothing, housing and lifestyle to the natural environment. Examples of the adaptation of various life forms to climate is all around us.

#### Climate Connections to Life on Earth

##### 1) Trees

The mass of any single tree consists primarily of carbon and water combined by solar energy through photosynthesis over time.

Plant decomposition and geological forces over millions of years have generated carbon-based fossil fuels. When we burn these resources, carbon that was stored for thousands of years enters the atmosphere in a matter of minutes or hours. Every climate zone and time period has characteristic vegetation. Trees can tell us about current and past climate.



[Slide 1 of 5]



[Continue](#)

CIMSS was developing the outline for the course at the same time NOAA & NSF were developing **The Climate Literacy Framework** so we simply wove the two together as individual lessons advanced.

First 6 Climate Literacy Principles are addressed in detail

- Interdependency of Life & Climate
  - Observation & Modeling
  - Sun's Energy
  - Complex Earth System Interactions
  - Climate changes over time and space
  - Certainty of human influence on climate
- The 7th principle, economic costs & social values, is included but not explored.



# Interactive On-line Lessons explaining IPCC Findings

## Global and Regional Climate Change

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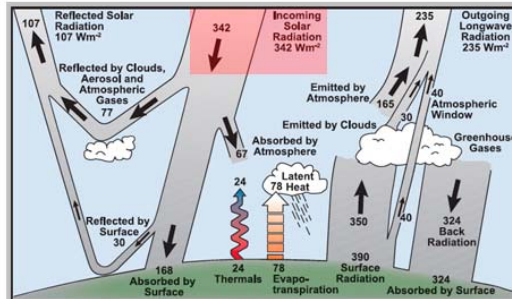
### Energy and Climate » Concepts

Solar energy drives Earth's climate system. As solar energy interacts with the atmosphere and land surfaces, it takes different forms and moves in different directions. These interactions are understood and referred to in part as the global energy budget. Move through the slides below to examine the different aspects of the global energy budget.

#### The Global Energy Budget

##### 2) Incoming Solar Radiation

Globally averaged, over all latitudes and including both day and night sides of the globe, the earth intercepts  $342 \text{ Wm}^{-2}$ .



← [Slide 2 of 11] →



Continue

The science behind every graph and every table from the IPCC ***Summary for Policy Makers*** is explained along with several images and graphs from the IPCC ***Frequently asked Questions***

In order to engage on-line participants and enhance learning, concepts are delivered via a “slide show RCO” which requires the user to advance slides within each lesson with an option for audio which complements (but not duplicate) the on-line text .

# On-Line Activities to enhance concepts in each lesson



## Global and Regional Climate Change

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### Past Climates - Natural Drivers » Activities

**1.** When large meteors, or asteroids, collide with planets, they eject dust and debris that can cause extended darkness, global fires, acid rain, ozone loss and even tsunamis. The result of these extraterrestrial catastrophes can be a cooling of global climate and widespread extinctions. Click on the image to learn more about the end of the age of the dinosaurs due to an ancient asteroid impact.



**2.** Milankovitch's theories were verified by trace gas concentrations in the Vostok ice core. Click on the image to compare a graph of this data with past Earth Orbits.



**3.** Try to identify the Milankovitch cycles on this graph of temperature over the past 400,000 years derived from the **Vostok Ice Core**



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Along with audio and interactive lesson content, each lesson features one or more activities to reinforce concepts, many from NASA & NOAA but most are unique to CIMSS

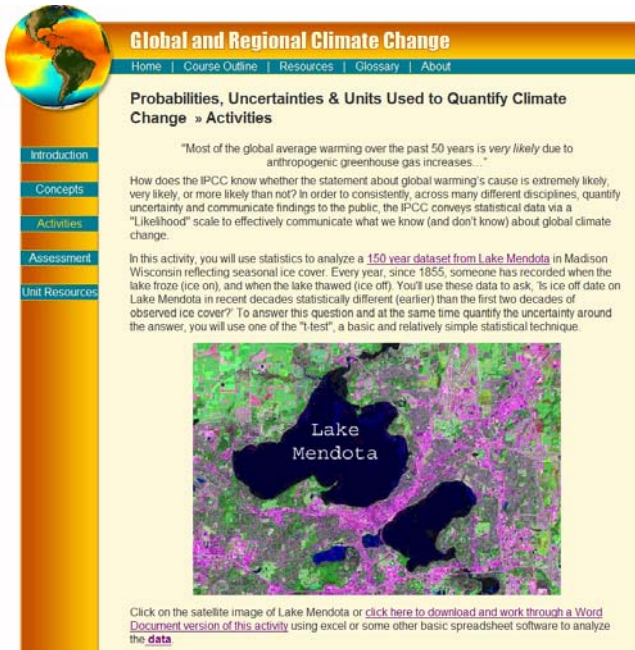
# IPCC Probability Exercise

*Using Ice-on/Ice-off data from actual report*

What does it mean when the IPCC uses the term *likely* or *very likely*?

First, a summary of IPCC Sequence of Key Findings.....

- 1990 Broad overview of climate change science, evidence for warming and discussion on uncertainties.
- 1995 "The balance of evidence suggests a **discernible human influence** on global climate."
- 2001 "Most of the warming of the past 50 years is **likely (>66%)** to be attributable to human activities."
- 2007 "**Warming is unequivocal**, and most of the warming of the past 50 years is **very likely (90%)** due to increases in greenhouse gases."



The screenshot shows the 'Global and Regional Climate Change' website. It features a navigation menu on the left with links to Home, Course Outline, Resources, Glossary, and About. The main content area is titled 'Probabilities, Uncertainties & Units Used to Quantify Climate Change » Activities'. It includes an introduction to the IPCC's likelihood scale and a satellite image of Lake Mendota. The text explains that the IPCC uses a 'Likelihood' scale to communicate findings, and the activity involves analyzing a 150-year dataset from Lake Mendota to determine if ice-on and ice-off dates have changed statistically.

**Probability** refers to the likelihood of occurrence of an event.

The IPCC uses the following likelihood scale:

Virtually Certain > 99% probability of occurrence

Extremely likely > 95% probability of occurrence

Very likely > 90% probability of occurrence

Likely > 66% probability of occurrence

More likely than not > 50% probability of occurrence

Unlikely < 33% probability of occurrence

Extremely unlikely < 5% probability of occurrence

<http://cimss.ssec.wisc.edu/climatechange/globalCC/lesson9/activity.html>

# IPCC Probability Exercise

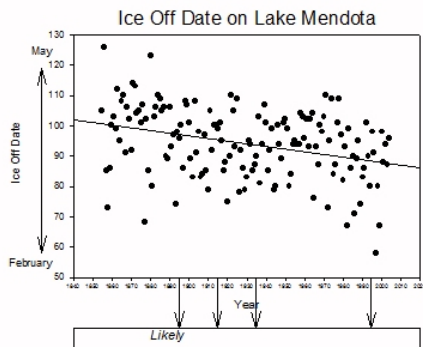
<http://cimss.ssec.wisc.edu/climatechange/globalCC/lesson9/activity.html>

NAME \_\_\_\_\_

1) Enter your results from the Lake Mendota ice off comparison in this table:

Which comparison?	T Stat	Probability of Occurrence	IPCC Likelihood Scale
1 vs. 2	0.958	< 85%	Likely
1 vs. 3			
1 vs. 4			
1 vs. 7			

2) Report the Likelihood Scale results on the graph below:



3) Did the certainty level for 1994 match the certainty level you reported for the *qualitative* analysis? Why or why not?

4) Did the level of certainty change over time as you hypothesized it would?

5) Briefly comment on the significance between the 2001 IPCC report that stated "most of the global average warming over the past 50 years was *likely* due to anthropogenic greenhouse gas increases..." to the 2007 IPCC report when they changed the wording in the same phrases to "*very likely*".

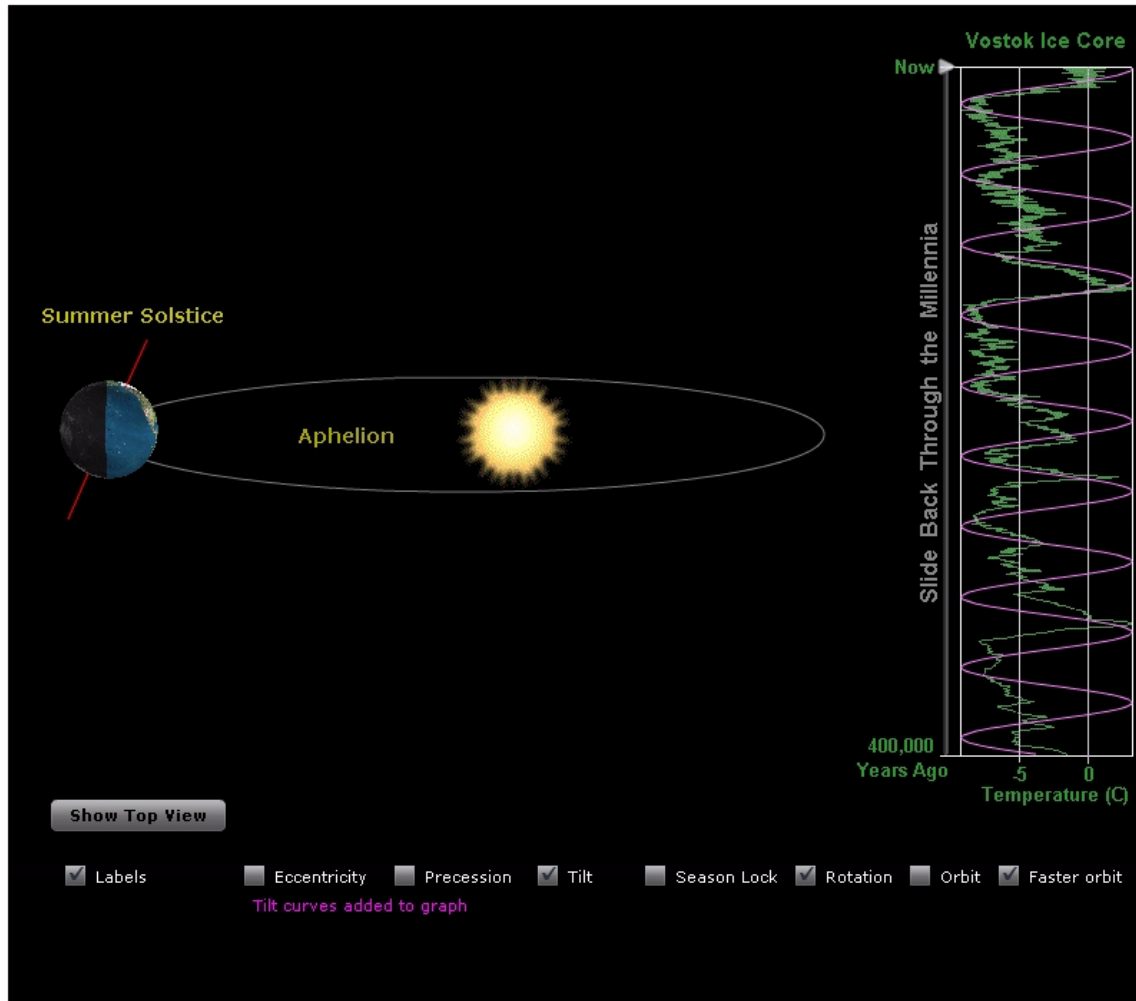
## Work through activity by

- 1) Downloading detailed Instructions (5 pages)
- 2) Downloading Lake Mendota Ice-on/Ice-off data
- 3) Using Excel to compare a *qualitative* interpretation with a *quantitative* analysis and gain insight into how the IPCC conveys statistical data via a "Likelihood" scale to quantify uncertainty and effectively communicate climate change data and findings to the public.



# Activity to explore Past Climates





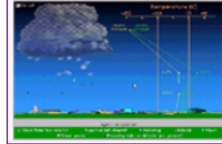
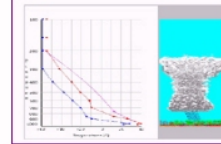
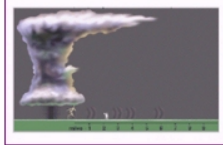

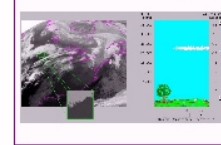
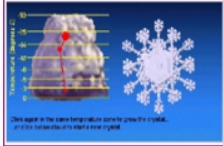
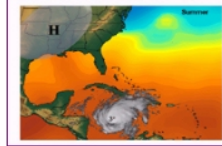
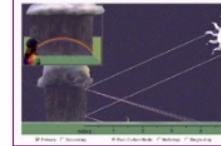
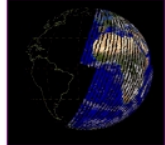

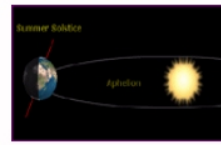
## The Vostok Core and Milankovic Cycles Climate Applet



- 1) Graph on the right shows 400,000 years of temperature anomalies derived from the Vostok Ice Core sample. As the three main elements of Earth orbit changes are enabled (checkboxes) a magenta-colored line plot is made which combines the sine ways of each element according to their periodicity.
- 2) The Earth-Sun system depicts the Earth in orbit around the Sun, as controlled by the various checkboxes.
- 3) The controls:
  - Toggle between orbital plane
  - Label checkbox
  - Eccentricity
  - Precession
  - Tilt
  - Season Lock
  - Rotation
  - Orbit
  - Faster Orbit

# CIMSS Weather & Climate Applets

**Weather and Climate Activities to *Explore the Atmosphere***

  	<b>Friction and Fly Balls</b> 	<b>Precipitation Type</b> 	<b>Make a Thunderstorm</b> 
	<b>Lightning and Thunder</b> 	<b>Tornadoes!</b> 	<b>Satellite Images</b> 
	<b>Grow Snow Crystals</b> 	<b>Hurricanes</b> 	<b>Exploring Rainbows</b> 
	<b>Satellite Orbits</b> 	<b>Relative Humidity</b> 	<b>Past Climates</b> 
	<p>Check out all our educational applets at  <a href="http://profhorm.meteor.wisc.edu/wxwise/">http://profhorm.meteor.wisc.edu/wxwise/</a></p> <p><b>Other Cool Internet Activities:</b>            Acquire satellite data <i>anywhere on the globe</i>            Measure <i>cloud top temperatures</i> from IR images</p>		

**<http://cimss.ssec.wisc.edu/wxfest/>**