

Environmental Education Conference

Climate Change

**Presenting to the Virginia Coastal Zone
Partners Workshop**

**Portsmouth, VA
December 6, 2007**

Ron Gird

**National Oceanic and Atmospheric Administration
National Weather Service
Outreach Program Manager**

Outline

- ✓ **Introduction**
- ✓ **Weather versus Climate**
- ✓ **Climate Change Signals**
- ✓ **What Causes Climate Change?**
- ✓ **The Role of Transportation/Agriculture**
- ✓ **Role of Humans**
- ✓ **Getting More Information**
- ✓ **Questions/Discussions**

NOAA's National Weather Service

✓ Provide climate, water and weather forecasts and warnings to protect **life** and **property** and enhance the economy

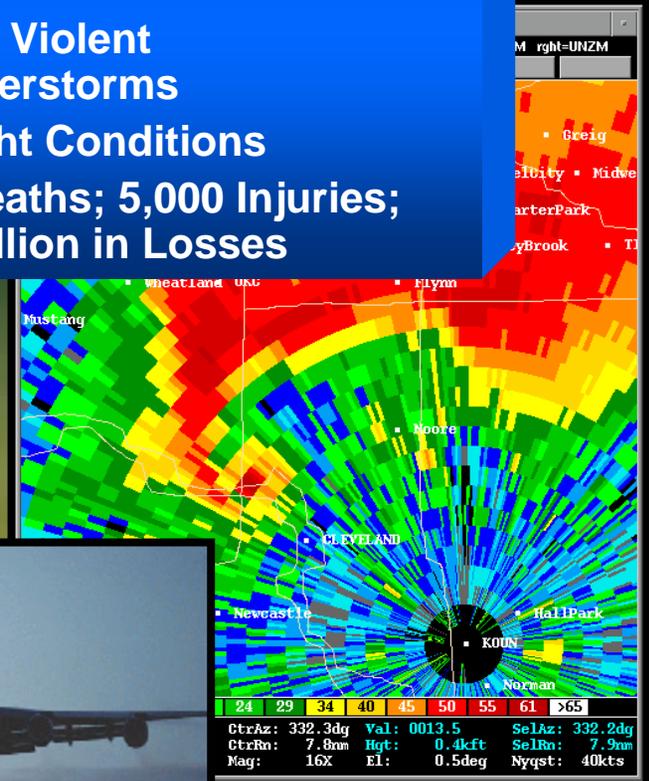
✓ 76 billion observations

✓ 1.5 million forecasts

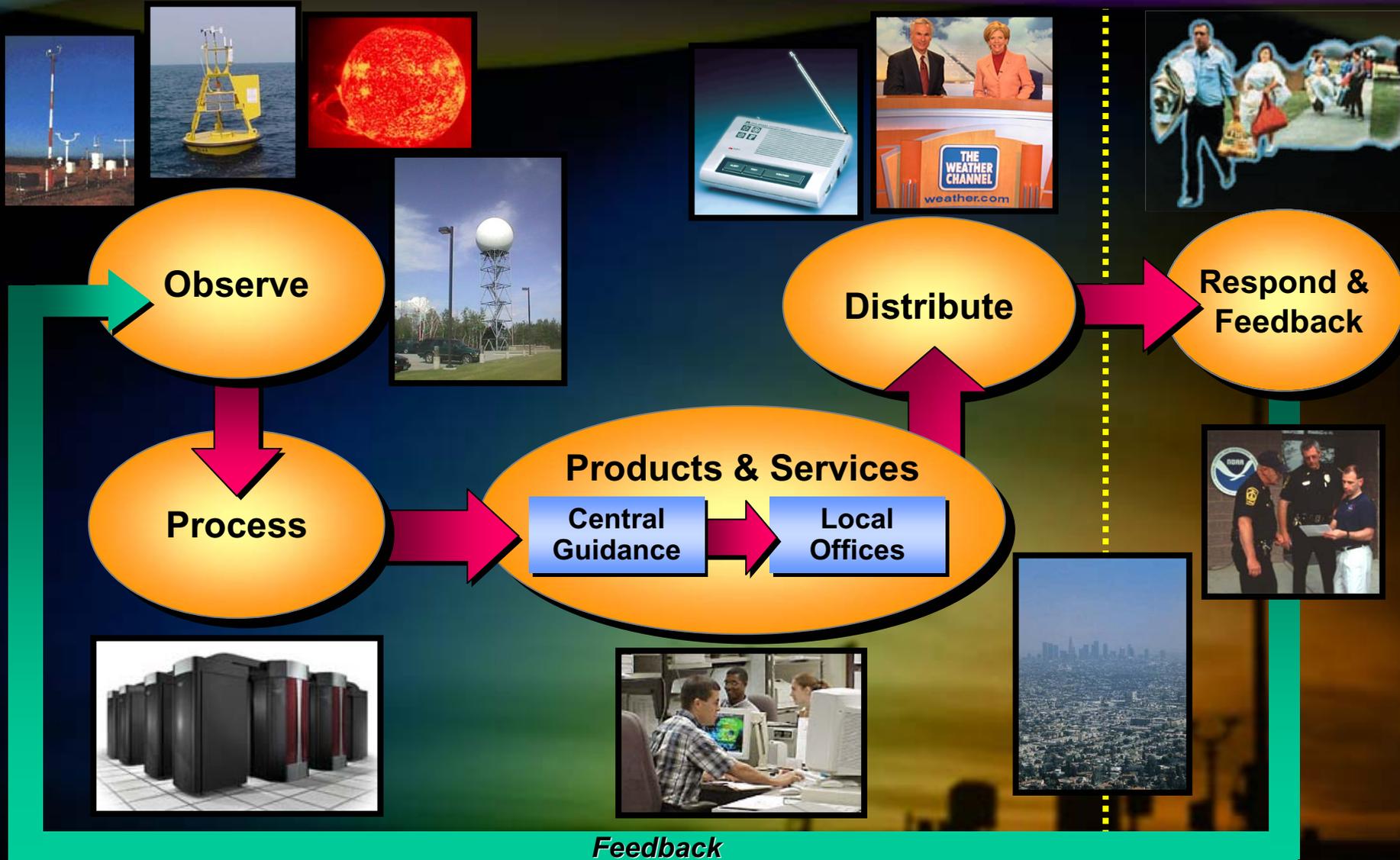
✓ 50,000 warnings

A Typical Year Brings:

- 7 Hurricanes
- 1,000 Tornadoes
- 5,000 Floods
- 10,000 Violent Thunderstorms
- Drought Conditions
- 500 Deaths; 5,000 Injuries; \$14 Billion in Losses

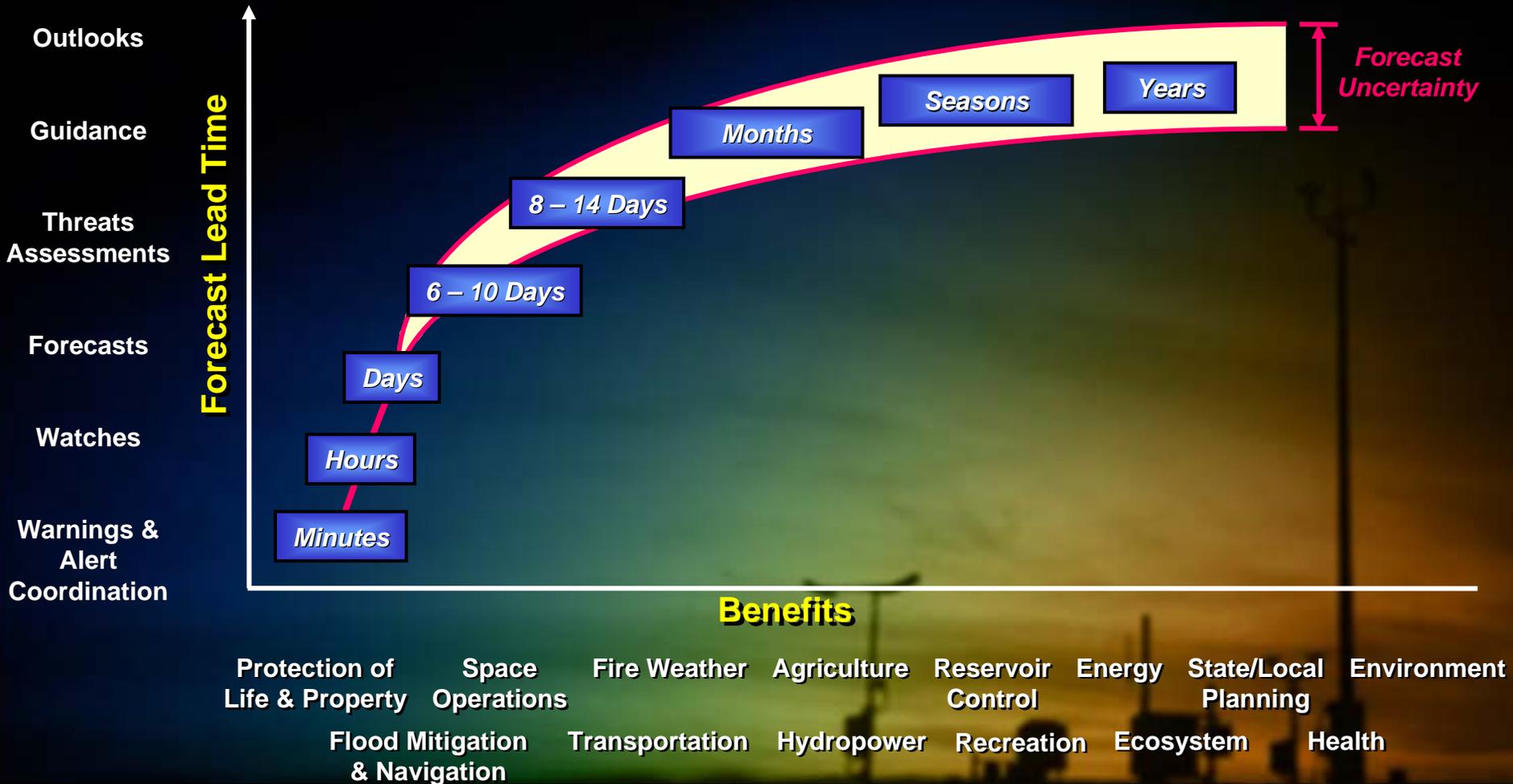


NOAA's NWS Overview



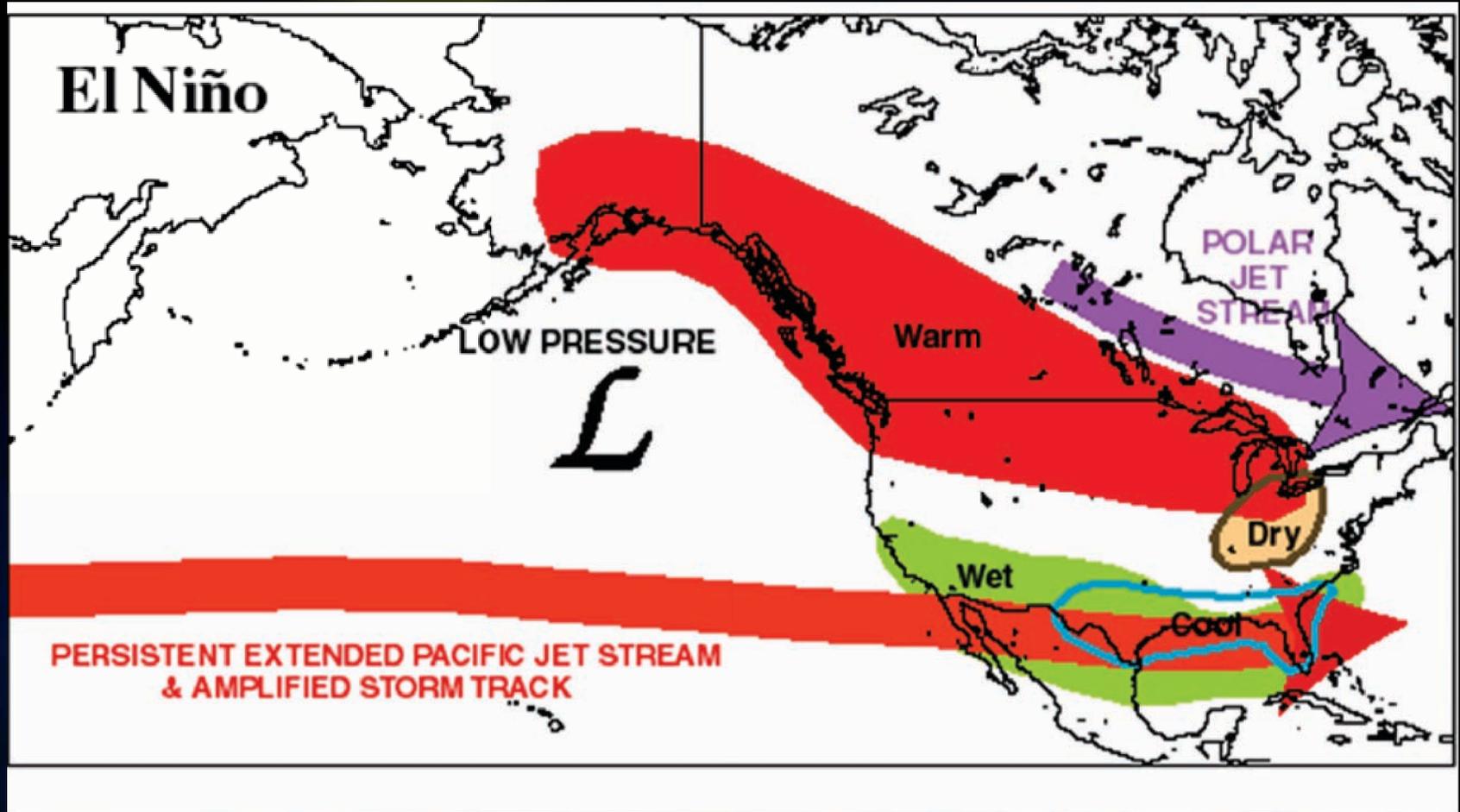
NOAA's NWS Overview

Seamless Suite of Products



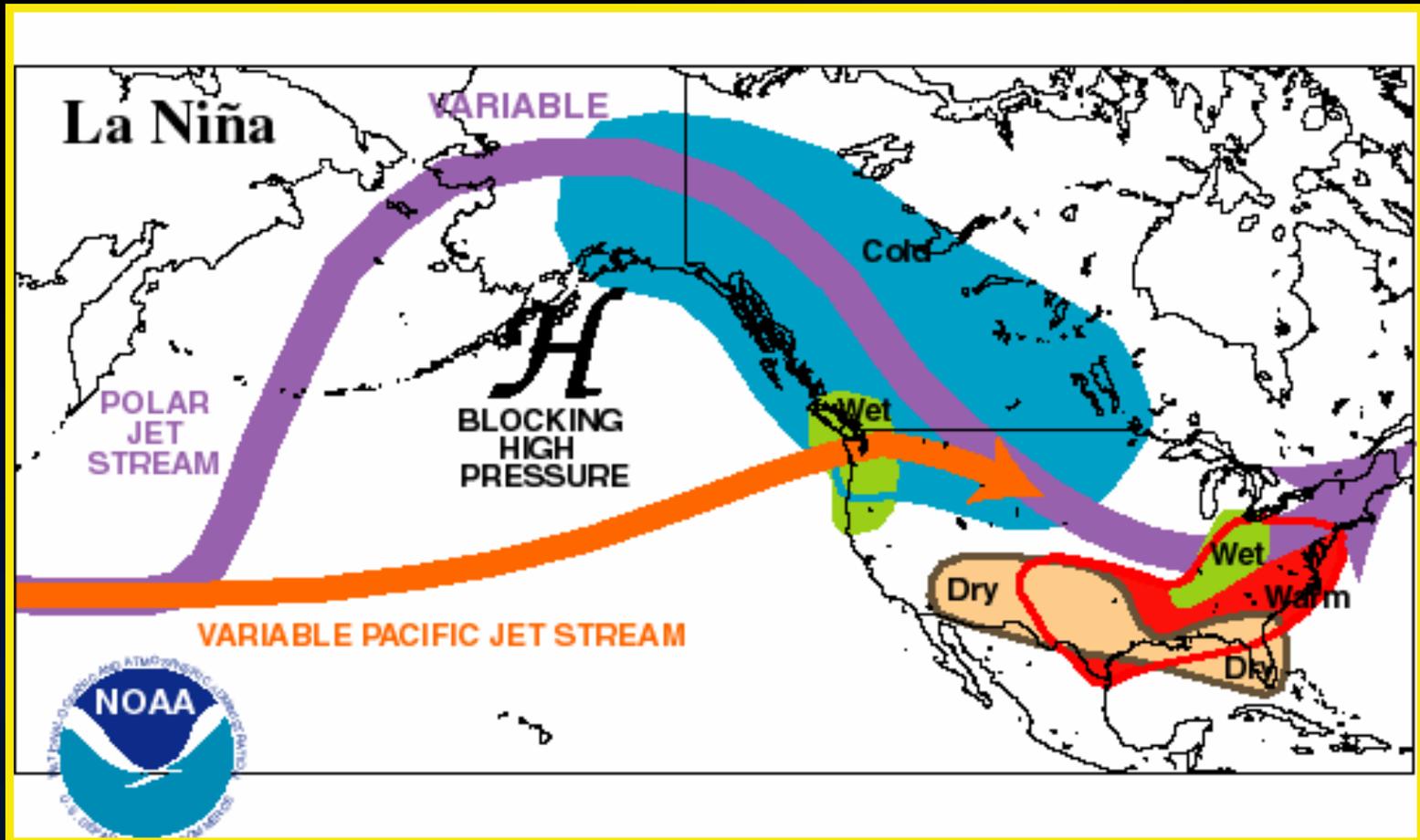
NWS Climate Services

Seamless Suite of Products (El Niño Outlook)



NWS Climate Services

Seamless Suite of Products (La Niña Outlook)



Weather Versus Climate

✓ **Weather is what you get Now:**

- Temperature
- Moisture
- Air Pressure
- Wind Speed/Direction

✓ **Climate is what you expect in the Future:**

- Based upon recent past
- Defined by the World Meteorological Organization (WMO)
- 30 year average of daily weather

Weather Versus Climate

Climate Change: What is it?

From a human perspective, **climate change** is the departure from the expected average weather or climate normals (temperature and precipitation) for a given place and time of year.

Climate change reflects significant shifts in the mean state of the atmosphere-ocean-land system. These shifts impact regional weather.

Weather Versus Climate

Global Warming: What is it?

The term **Global Warming** refers to the observation that the atmosphere near the Earth's surface is warming, without any implications for that cause or magnitude.

This warming is one of many kinds of climate change that the Earth has gone through in the past and will continue to go through in the future. It implies warming across the entire globe.



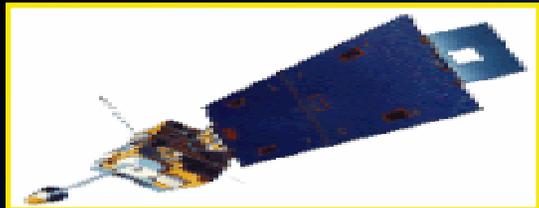
Weather Versus Climate

NOAA's Observing Systems

How Do We Detect These Signals?

U.S Climate Reference Network (**USCRN**):

Surface Temperature & Precipitation Observations



Geostationary Operational Environmental Satellite

(**GOES**):

Track & Monitor Severe Weather

Carbon Cycle Greenhouse Gases (**CCGG**):

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Land, Sea & Aircraft



Global Sea Level Network (**GSLN**):

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Weather Versus Climate

Virginia Climate Observations and Forecasts

- ✓ Give Virginians information during natural disasters on flooding, road loss, and extent of property damage
- ✓ Help track plant diseases and invasive species (tobacco blue mold)
- ✓ Integrate satellite images and water quality models to pinpoint beach areas impacted by environmental pollutants such as aquatic blooms and oil spills
- ✓ Track water temperatures, harmful algal blooms, invasive species, and other environmental factors affecting the estuaries and shoreline communities

Weather Versus Climate

Virginia Climate Observations and Forecasts (cont.)

- ✓ Monitor soil moisture through satellite technology to evaluate drought stress in crops for agriculture and forestry
- ✓ Track water temperatures, harmful algal blooms, invasive species affecting the estuaries and other shoreline communities.
 - Outbreaks in Chesapeake Bay (1997) cost the Maryland seafood and recreational fishing industries almost \$50 million in just a few months.

Weather Versus Climate

NWS Cooperative Observing Program

USA TODAY weather focus

Volunteers are the backbone of the nation's weather network

Swedish chaplain John Campanius Holm was the first person known to have kept systematic weather observations in the American colonies. He did that, without instruments, in 1644 and 1645 in Wilmington, Del. Today: 11,700 National Weather Service Cooperative Observers across the nation donate more than 1 million hours each year to collect weather data.

They record:

Rainfall and frozen rain or snow amounts



Snowfall and snow depth



River levels



Air temperature



Soil temperature



Evaporation



They report daily; when heavy precipitation or flooding occurs, they report up to four times a day.

Top ways the data is used:

- ▶ To predict climate trends
- ▶ To monitor local weather
- ▶ For further research by the National Weather Service and universities

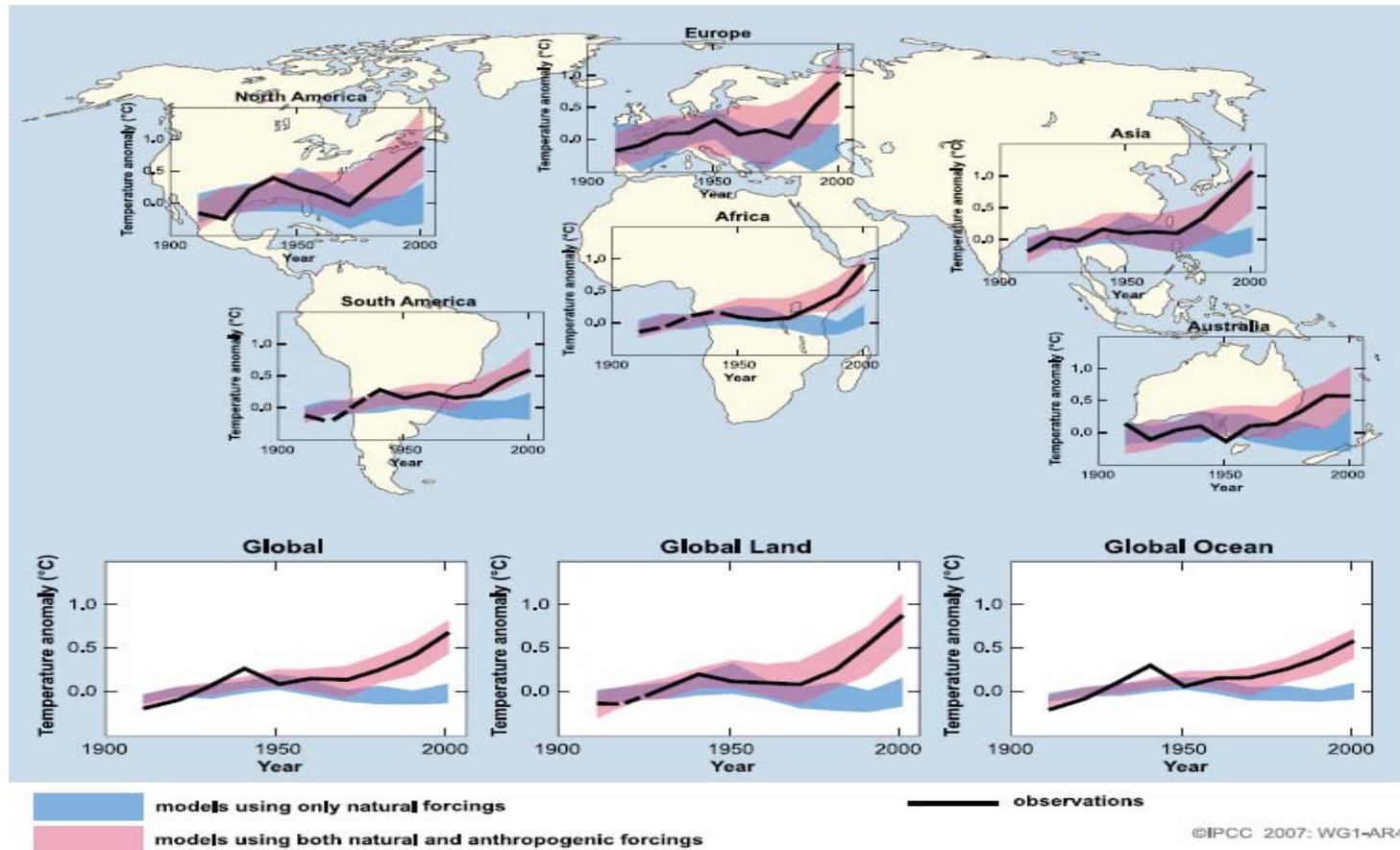
Climate Change Signals

- ✓ **Global View**
- ✓ **Animal Behaviors**
- ✓ **Snow and Ice Examples**
- ✓ **Environmental Examples**



Climate Change Signals

Global View



FAQ 9.2, Figure 1. Temperature changes relative to the corresponding average for 1901-1950 (°C) from decade to decade from 1906 to 2005 over the Earth's continents, as well as the entire globe, global land area and the global ocean (lower graphs). The black line indicates observed temperature change, while the coloured bands show the combined range covered by 90% of recent model simulations. Red indicates simulations that include natural and human factors, while blue indicates simulations that include only natural factors. Dashed black lines indicate decades and continental regions for which there are substantially fewer observations. Detailed descriptions of this figure and the methodology used in its production are given in the Supplementary Material, Appendix 9.C.

Climate Change Signals

Animal Behavior



Shifting Migration Patterns

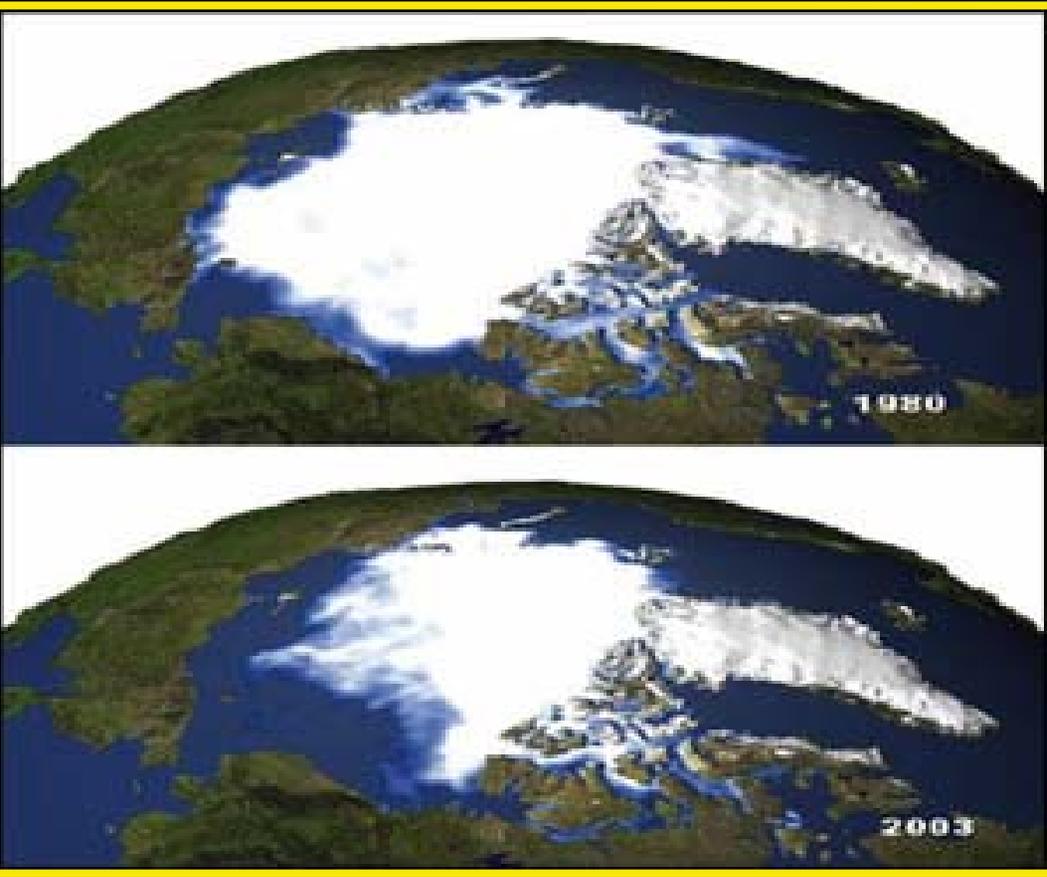
Birds changing habits & routes accordingly to warmer winters, disappearing feeding grounds, & shrinking wetlands. Some southern migration has ceased altogether.

“Species that adapt to change over millennia are now being asked to make those adaptations extremely quickly because of swift rise in temperatures.”

The Examiner 5/14/07

Climate Change Signals

Snow and Ice Examples

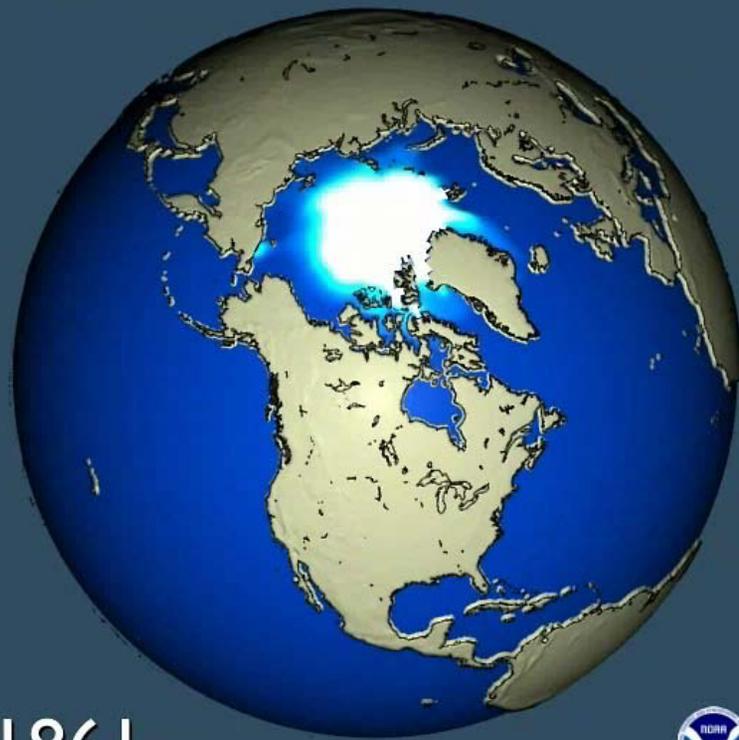


These images from NASA's ICESat satellite show the different in ice cover in the Arctic between 1980 (top) and 2003 (bottom).

Climate Change Signals

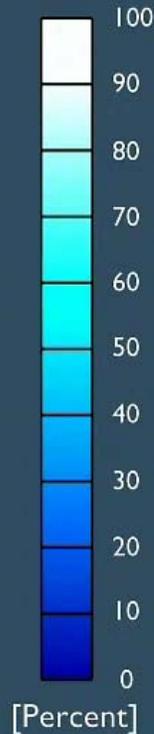
Snow and Ice Examples

NOAA GFDL CM2.1 Model Simulation: SRES A1B Scenario

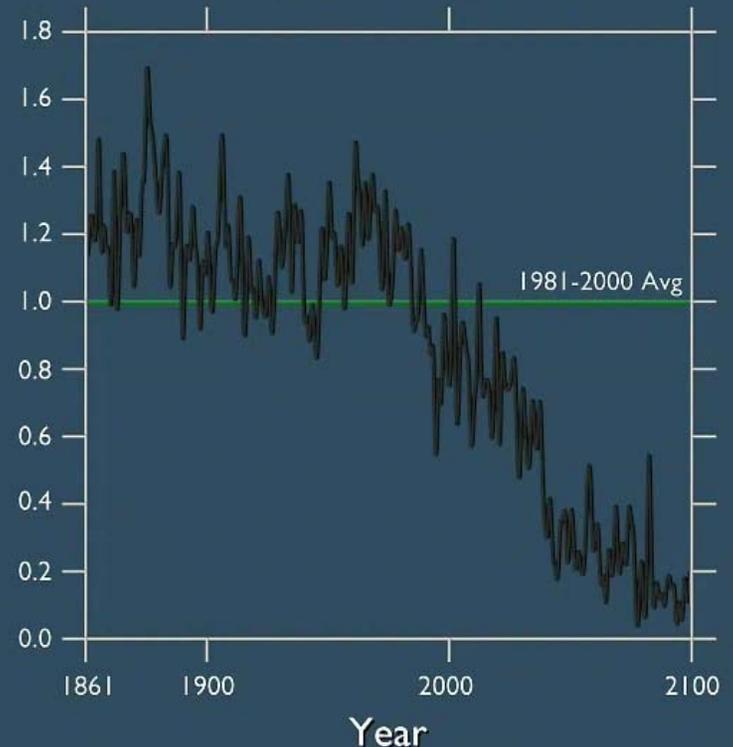


1861

Aug Sept Oct Avg Sea Ice Concentration



Fractional Arctic Wide
Sea Ice Concentration



Climate Change signals

Snow and Ice Examples

Pasterze Glacier, Austria 1875



Portage Glacier, Alaska 1914



Pasterze Glacier, Austria 2004



Portage Glacier, Alaska 2004



Climate Change Signals

Snow and Ice Examples

✓ **Glacial Changes**

- **European Alps**

- Lost half their volume
- 33% of their 1850 extent

- **Antarctic**

- 85% of glaciers are retreating
- They are also thickening

- **USA Colorado Arapaho glacier**

- Since 1960 thinned by 40 meters

Climate Change Signals

Snow and Ice Examples

Gangotri Glacier

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water

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drinking and farming



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“If humans don’t change their interference, our very religion, our livelihoods are under threat.”

Climate Change Signals

Snow and Ice Examples



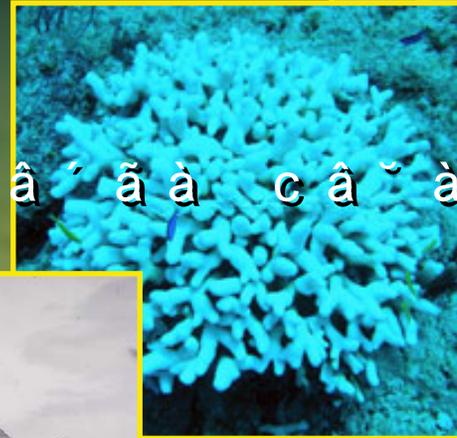
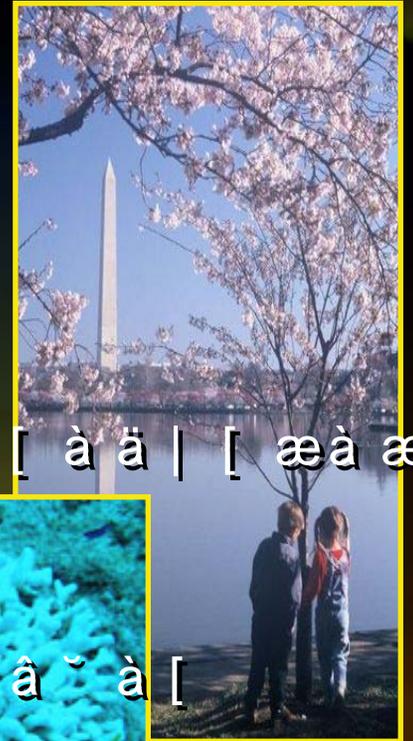
Climate Change Signals

Environmental Examples

Signs of Change

- DC trees flower 4.5 days sooner
- Australia Coral Reefs
 -
- Snowmelt in the west begins 2 weeks sooner

— to cities

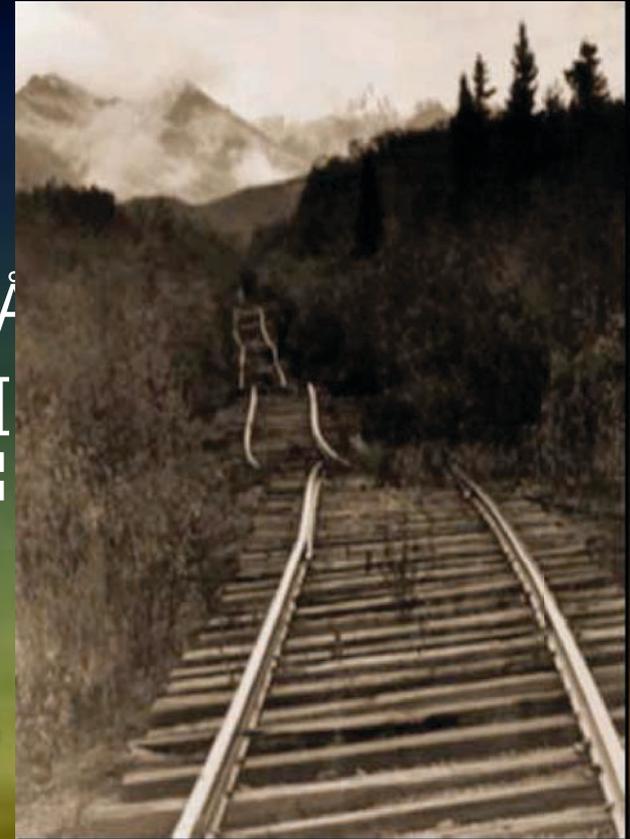


Climate Change Signals

Environmental Examples

Polar Changes

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“Roller Coaster Railroad” AK

Climate Change Signals

Environmental Examples

- ✓ Higher temperatures could threaten quality of wines.
- ✓ Cultivation of olive trees, which grow in mild climates, has almost reached the Alps.



Climate Change Signals

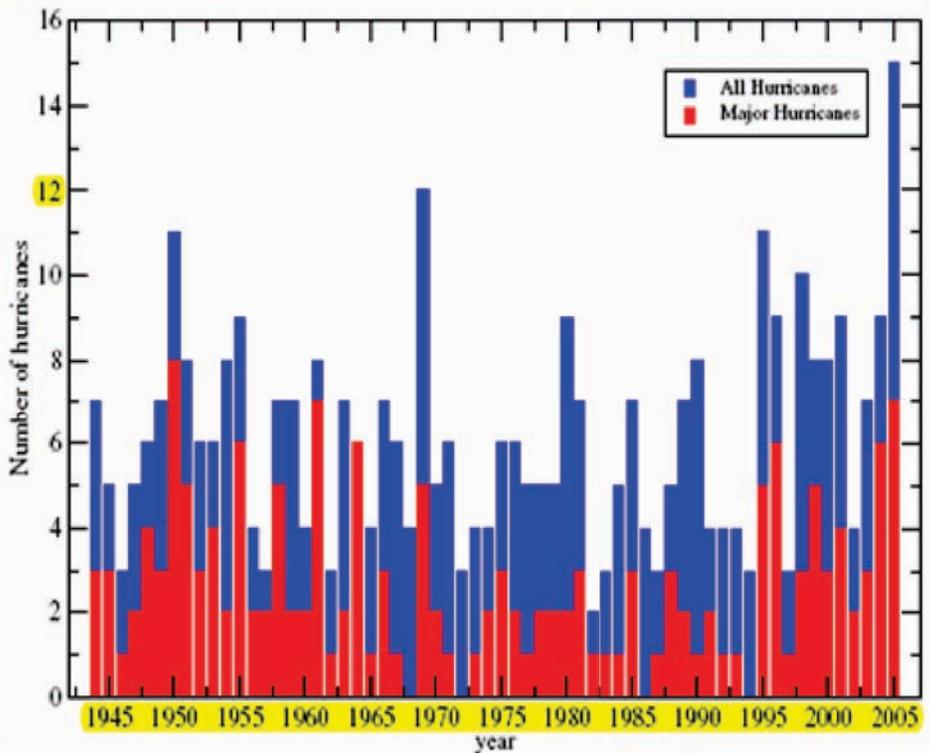
Environmental Examples

Number of hurricanes seasons have increased since the 1970s and are more active.

Hurricanes are more intense than the previous two decades.

Number of hurricanes in the most recent decade.

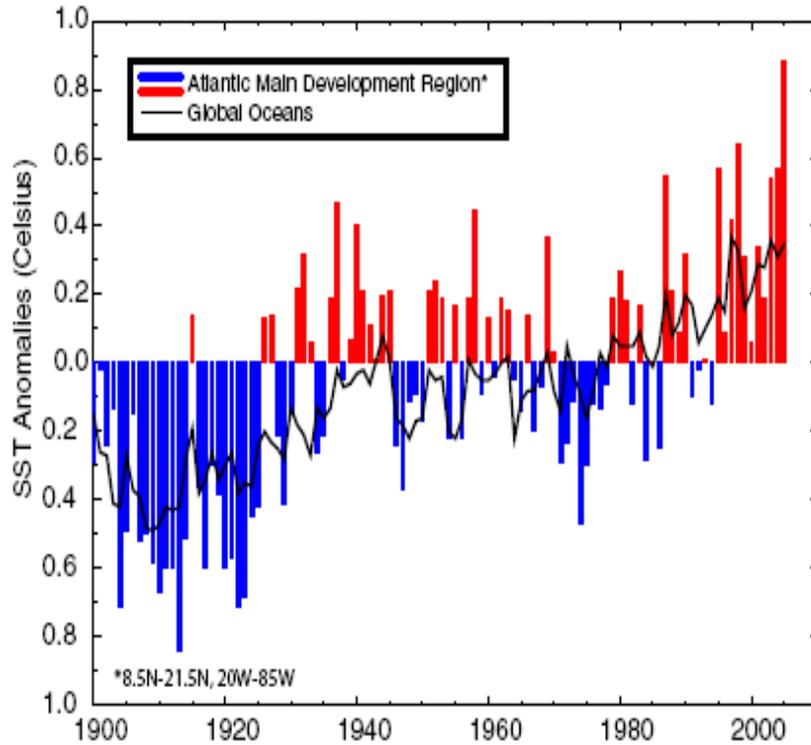
Figure 1: Number of Hurricanes and Major Hurricanes (cat. 3-5); Atlantic Basin (1945-2005)



Climate Change Signals

Environmental Examples

Figure 3: June - November Average Sea Surface Temperature Anomalies



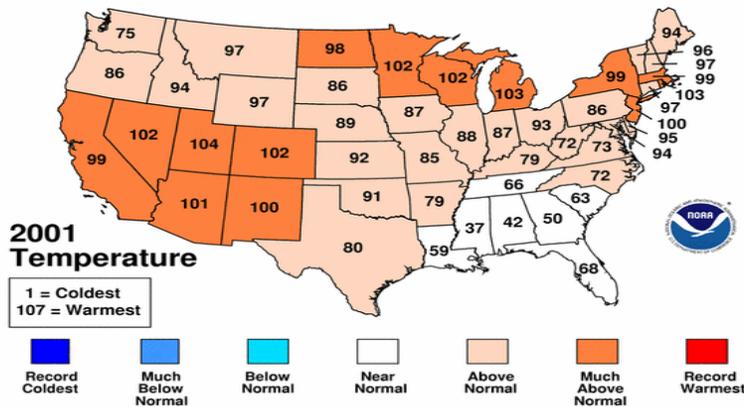
During the 20th century, ocean & sea surface temperatures where hurricanes develop, have warmed at similar rates.

Climate Change Signals

Environmental Examples

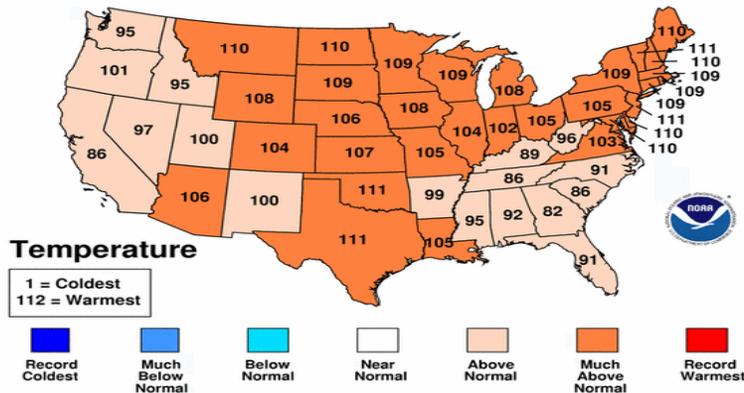
January-December Statewide Ranks

National Climatic Data Center/NESDIS/NOAA



Statewide Ranks Jan-Dec 2006

National Climatic Data Center/NESDIS/NOAA



✓ 2001-2005 30% of U.S. cites experienced daily minimum temperatures “much above normal”
This means summer nights are hottest on record.

✓ Urban centers are usually 10 degrees hotter than rural areas.

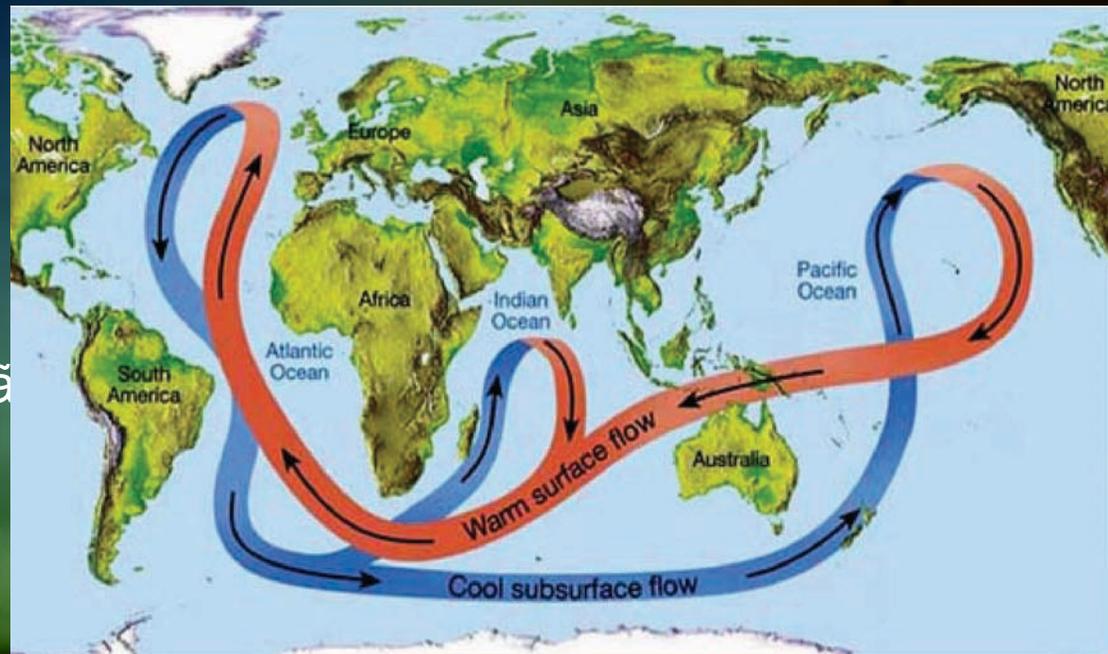
What Causes Climate Change?

The Greenhouse Effect

- More greenhouse gases, the warmer the Earth's surface and lower atmosphere
 - Trapping more heat

The Climate System

- Global Ocean
- conveyor belt
 - Warm surface current
 - Cold deep current



THERMOHALINE CIRCULATION - GREAT OCEAN CURRENT

What Causes Climate Change?

✓ Interpreting Past Climates

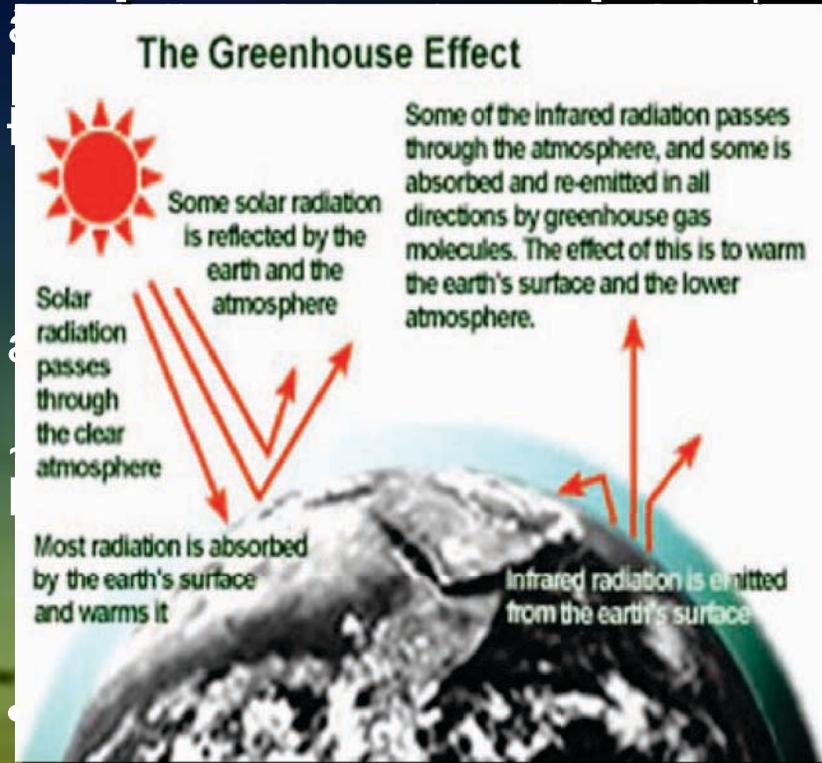
- Earth is warmer than anytime in the past 1000 years
- Earth has been warmer
- CO₂ higher than almost any other time
 - Rate of increase is unprecedented
 - Humans exacerbate the problem (IPCC)

What Causes Climate Change?

Greenhouse Effect

greenhouse, trapping heat and making the earth warmer.

So, the concern is not with the fact that we have a greenhouse effect, but to an *enhancement* of the greenhouse effect.



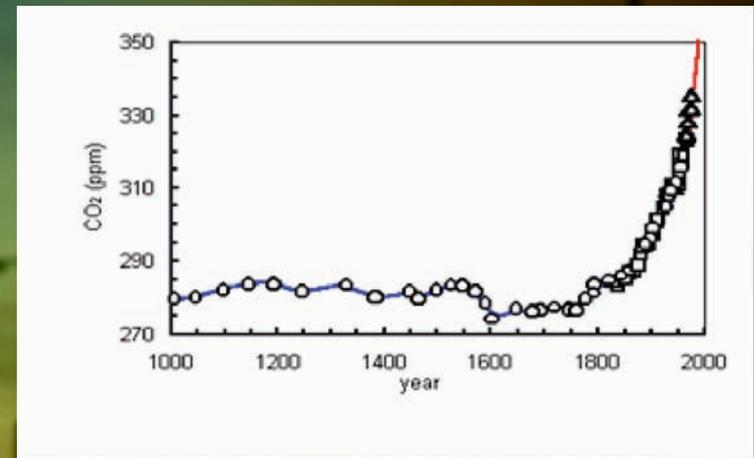
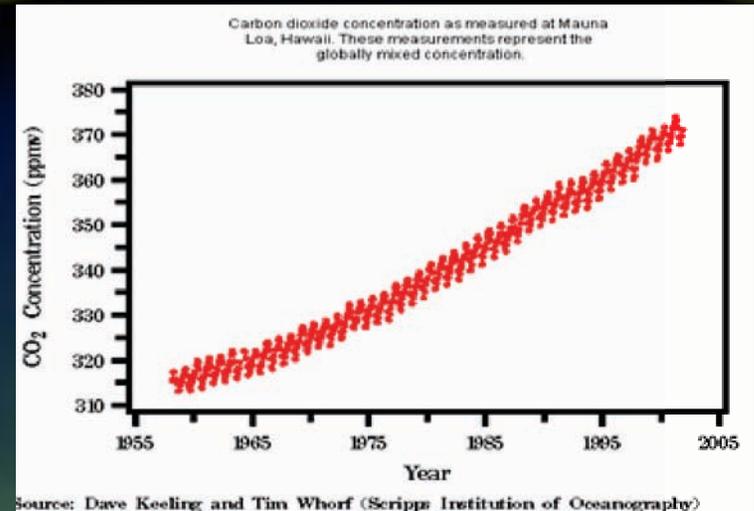
What Causes Climate Change?

The Role of CO₂

Human activity is adding more CO₂ to the atmosphere. The current level is the highest in the past 400,000 years.

The burning of fossil fuels, like oil, coal, and natural gases are sources of energy that release CO₂ into the atmosphere.

Adding more CO₂ to the atmosphere could possibly enhance the greenhouse effect and potentially result in climate change.



What Causes Climate Change?

Are Greenhouse Gases Increasing?

This graph shows the increase in the atmospheric concentration of Carbon dioxide (CO₂), methane (CH₄) and Antarctic temperature from 420,000 years ago until prior to the industrial revolution.

As can be seen, pre-industrial levels (~280 ppmv) were similar to previous interglacial periods (times which were not considered an 'ice-age').

The present, post-industrial atmospheric level of CO₂ concentration is around 370 ppmv, which on this graph would be off the scale.

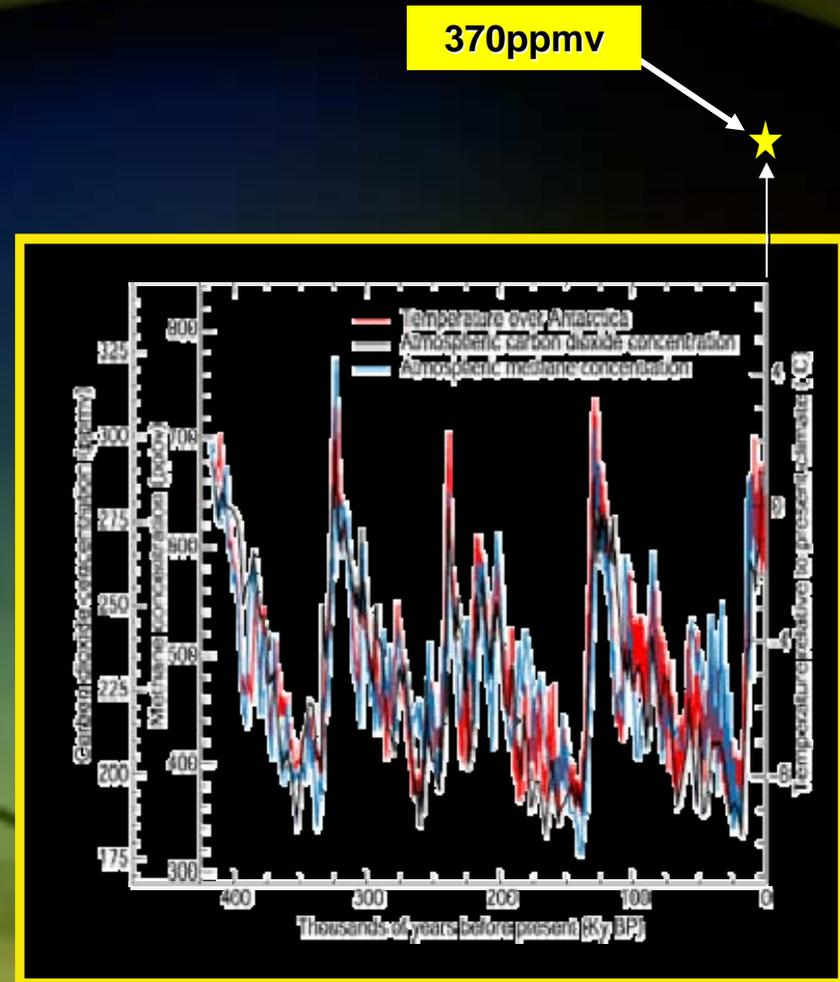


Figure from IPCC 2001

The Role of Transportation

Emissions

- Road transport is the largest source of greenhouse gas emissions from the transport sector, accounting for approximately 75% of total emissions. This is primarily due to the high volume of passenger and freight vehicles, particularly in developed countries.

Fossil Fuels

- Road transport is the largest consumer of fossil fuels in the transport sector, accounting for approximately 75% of total fuel consumption. This is primarily due to the high volume of passenger and freight vehicles, particularly in developed countries.

Transportation

- Road transport is the main source of emissions from the transport sector, accounting for approximately 75% of total emissions.



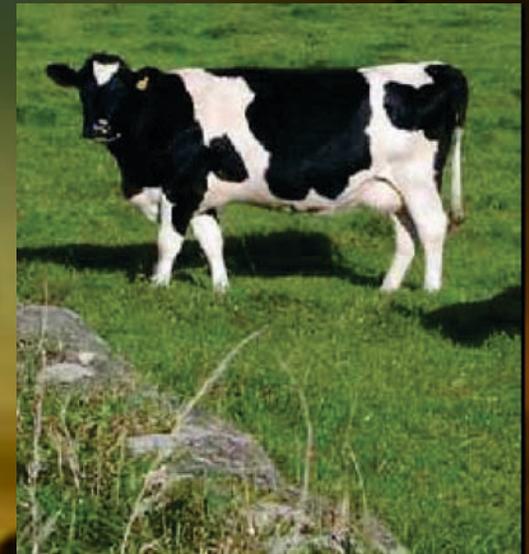
Agriculture

Methane, Water Vapor and other Gases

- Contribute to an unknown extent

Food Cycle

- Main economic activity of rural population
- Basic needs versus luxury of choice



Role of Humans

What We Know

- ✓ **Human activities contribute to the atmospheric buildup of greenhouse gases.**
- ✓ **Gases trap heat in the atmosphere, and by increasing the levels of these gases, human activities are strengthening the natural greenhouse effect.**
- ✓ **A warming trend of about 1°F has been recorded since the beginning of the 19th century.**
- ✓ **As said by the *IPCC*: “Complex systems, such as the climate system, can respond in non-linear ways and produce surprises.”**

Role of Humans

The Big Unknowns

- ✓ **Projecting what exact impacts will occur remains very difficult.**
- ✓ **Projecting exactly how much and how fast the warming will occur remains unclear.**
- ✓ **There are large uncertainties in forecasting effects at specific locations, although scientists are more confident about their projections for large-scale areas.**

Role of Humans

Impacts

- ✓ **Uncertain but IPCC highlights possible areas:**
 - **Threatened Water Supplies**
 - **Food Security**
 - **Threats to Health**
 - **Rising Sea Levels**
 - **Cities at Risk**
 - **Disrupted Ecosystems**

- ✓ **Impacts could be exacerbated in lesser developed countries**

Role of Humans

What Can You Do?

- ✓ **Adapting to Change**
- ✓ **Use Renewable Energy**
- ✓ **Local Commitment**
- ✓ **Carbon Dioxide and Economic Growth**

Role of Humans

What Can You Do? Baby Steps

- ✓ Wash clothes in cold water and line dry when weather allows
- ✓ Combine errands and use public transportation
- ✓ Winter:
 - Turn down thermostat
 - Open blinds to let light AND heat in
- ✓ Summer:
 - Turn up thermostat
 - Close blinds to keep heat out

Role of Humans

What Can You Do? Getting Serious

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Role of Humans

What Can You Do? Extremely Committed

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Getting More Information

Getting the Word Out



Getting More Information

NOAAWatch: The All Hazards Monitor

- NOAAWatch **Main Page** provides access to a wide range of hazards & events.

- **Theme Pages** provide specialized information on various hazards and events.



www.noaawatch.gov/

“Want people to visit frequently, but stay briefly”

Getting More Information

Obtaining Information

GET THE INFORMATION YOU NEED...24 HOURS A DAY...GET A **NOAA WEATHER RADIO!**



Mark Trail image courtesy of North American Inc., World Rights Reserved

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NWS Climate Services

Internet Products

Access your Local Climate page from the NWS National Climate web page, by selecting your location on the national map.

National Oceanic and Atmospheric Administration's
National Weather Service

Site Map News Organization Search NWS All NOAA

Local forecast by "City, St"
City, St Go

XML RSS Feeds
Warnings
Current
By State/County...
UV Alerts

Observations
Radar
Satellite
Snow Cover
Surface Weather...

Forecasts
Local
Graphical
Aviation
Marine
Hurricanes
Severe Weather
Fire Weather

Text Messages
By State
By Message Type
National

Forecast Models
Numerical Models
Statistical Models...

Climate
Past Weather
Predictions

Weather Safety
Weather Radio
Hazard Assmt...

Click on map below to obtain local climate information.

As part of its ongoing efforts to improve service to the public, The National Weather Service has released an experimental local 3-month temperature outlook. Access the product through the "Select Climate Outlook" drop down menu above the national map.

Warnings & Forecasts Graphical Forecasts National Maps Radar Rivers Air Quality Satellite Climate

Max/Min Temperatures Go Apr-May-Jun 2007 Go

Highest and Lowest Temperature for the 24 Hours ending at 7 AM EST Sun Nov 26 2006

Prepared by NOAA National Centers for Environmental Prediction, Hydrometeorological Prediction Center
American Samoa · Guam · Puerto Rico

<http://www.weather.gov/climate>



National Weather Service Climate Prediction Center



Home Site Map News Organization Search Go

HOME > Expert Assessments > Drought Assessment

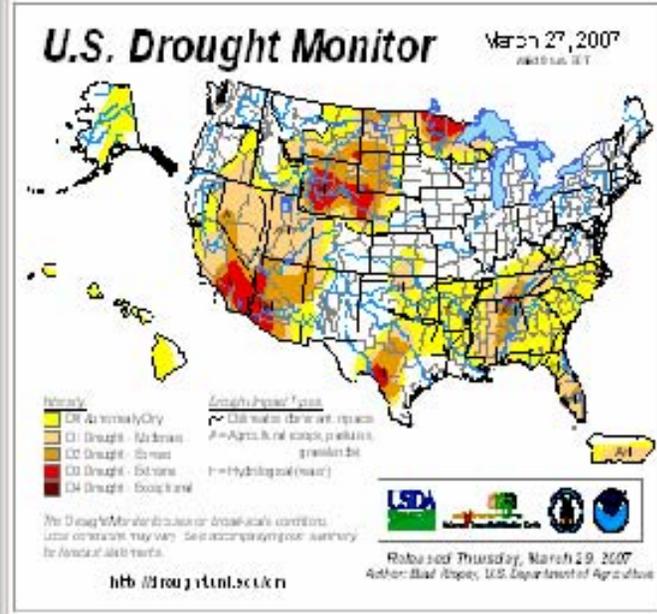
Search the CPC
 Go

About Us
Our Mission
Who We Are

Contact Us
CPC Information
CPC Web Team



U.S. Drought Assessment



[The Latest Weekly Assessment From the United States Drought Monitor](#)

[The Latest Seasonal Outlook](#)

Wakefield, VA

Home > Climate > NWS Wakefield > Climate Prediction > Local Temperature Outlook

Three-Month Temperature Outlook (Issued: November 2007)

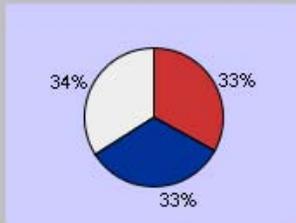
- National Outlook
- Local Outlook
- Background Information
- Questions and Feedback

ELIZABETH CITY, NC
 PASQUOTANK County, Coop ID: 312719
 Elevation: 8 ft.
 Latitude: 36° 18' N Longitude: 76° 12' W

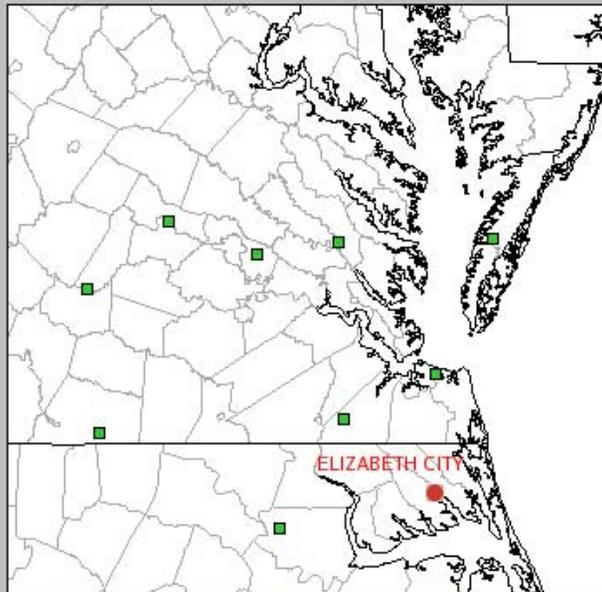
[NOAA Online Weather Data](#)



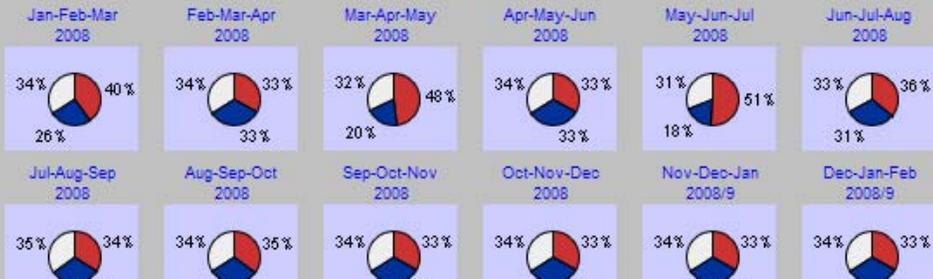
Three Category Temperature Outlook Dec-Jan-Feb 2007/8



- Above Normal
- Near Normal
- Below Normal



Click site to change location or use Select Location tool below.



- Local forecast by "City, St"
- Current Hazards
 - Virginia
 - North Carolina
 - Maryland
- National Warnings
 - Day 1 TSTM Outlook
 - Hazardous Weather
 - Day 2 TSTM Outlook
 - Send a Storm Report
- Current Conditions
 - Observations
 - Satellite Images
 - Rivers
 - Rivers & Lakes
 - AHPS
- Radar Imagery
 - Wakefield VA Radar
 - Nationwide
- Forecasts
 - Tabular Forecasts
 - Public Forecasts
 - Graphic Forecasts
 - PDA Users
 - XML/RSS Data Feed
 - Tropical Weather
 - Winter Weather
 - Severe Weather
 - Aviation
 - Marine & Tides
 - Rip Current
 - Fire Weather
- Climate
 - Local
 - Records
 - Prediction
 - More...
- Hydrology
 - River Data
 - River Forecast
 - VA Streamflow
 - NC Streamflow
 - Rivers & Lakes

NWS Climate Services

Local 3-month Temperature Outlook

A User Guide for the L3MTO product is available for downloading at:

[**http://www.weather.gov/climate/L3MTO_User_Guide.pdf**](http://www.weather.gov/climate/L3MTO_User_Guide.pdf)

NWS Climate Services

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Getting More Information

Nauticus, The National Maritime Center



**NOAA@Nauticus
Partnership**

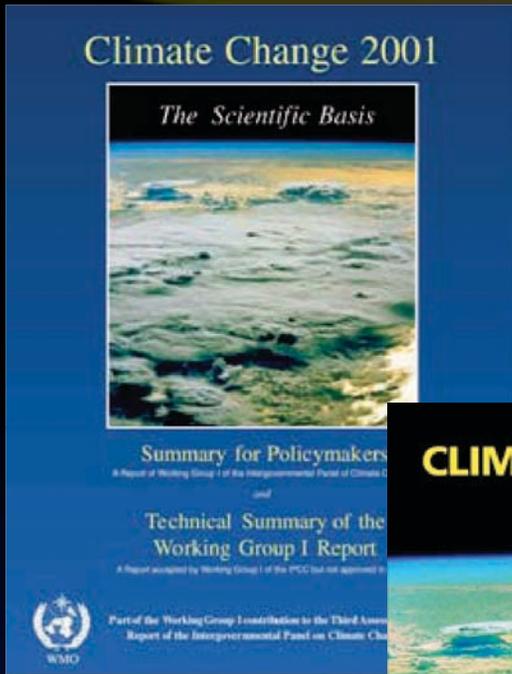


Science on a Sphere



Getting More Information

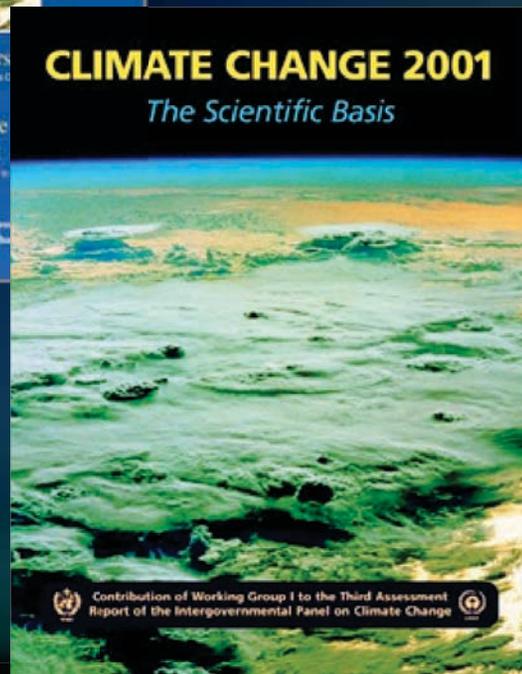
Intergovernmental Panel on Climate Change (IPCC) Resources



Summary for Policymakers (SPM)

Drafted by a team of 59 members

Approved 'sentence by sentence'
by WGI plenary (99 Governments and
45 scientists)



14 chapters

881 pages

120 Lead Authors

515 Contributing Authors

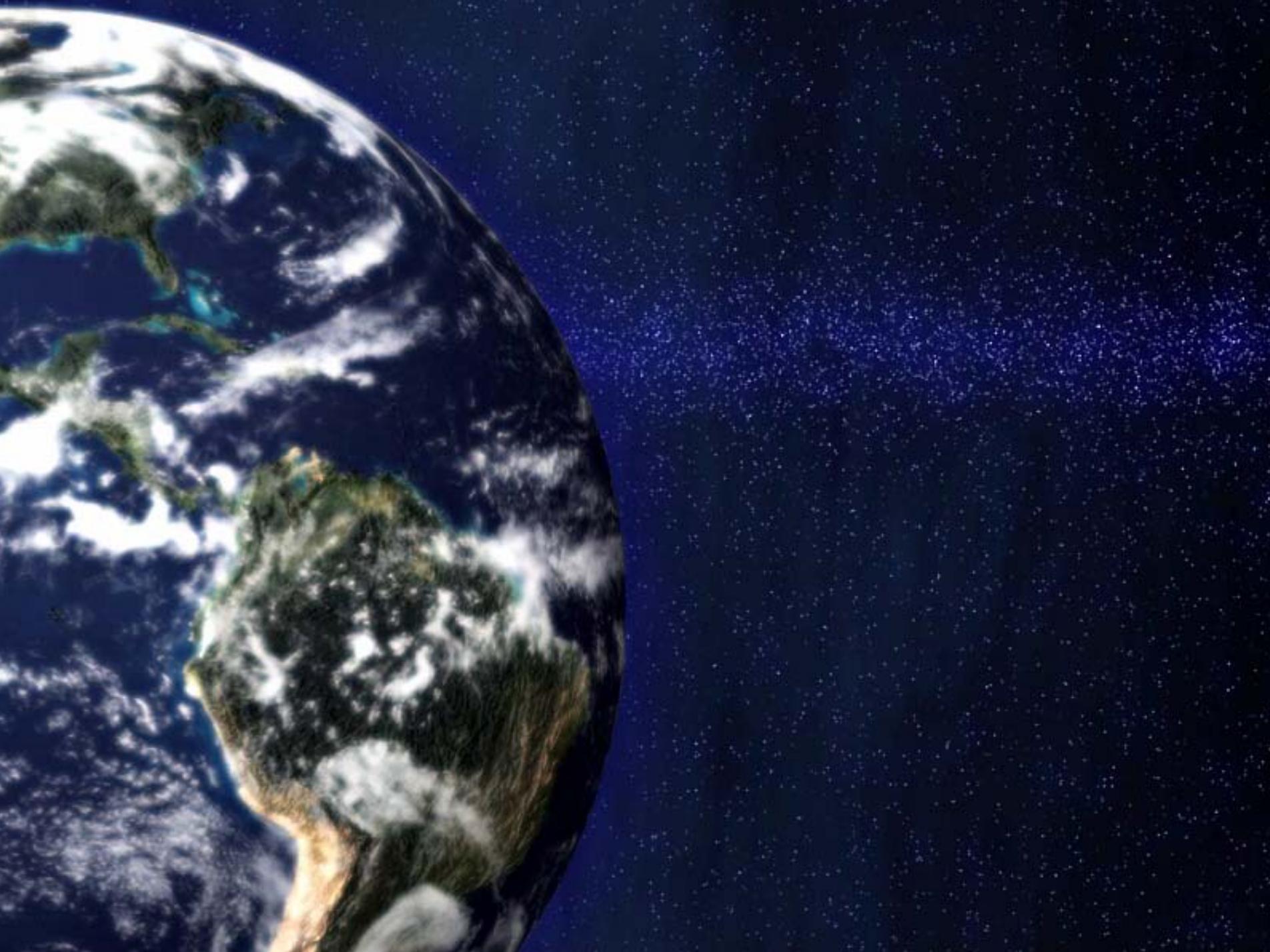
4621 References quoted

Additional Information

✓ Global Warming video

- Bob Ryan, NBC4-TV Meteorologist
- Dr. Ralph Cicerone, President, National Academy of Sciences
- For teachers and students
- 15 minute video and transcript

<http://video.nbc4.com/player/?id=59901>



References

**“The Atlas of Climate Change: Mapping
the World’s Greatest Challenge”**

Kirstin Dow and Thomas E. Downing
University of California Press
2006

**Intergovernmental Panel
on Climate Change:
The Scientific Basis**

2007

National Weather Service Publications



QUESTIONS?

LETS TALK

Thank you



Ron Gird

Outreach Program

NWS/NOAA

Ron.Gird@noaa.gov

301-713-0090 x154