

Managing Forests in an Uncertain Climate

Presented at First Friday All Climate Change Talk

June, 2011

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EFETAC

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All across the world, in every kind of environment and region known to man, increasingly dangerous weather patterns and devastating storms are abruptly putting an end to the long-running debate over whether or not climate change is real. Not only is it real, it's here, and its effects are giving rise to a frighteningly new global phenomenon: the man-made natural disaster.



Barack Obama

A More Appropriate Quote....

I wanted a perfect ending. Now I've learned, the hard way, that some poems don't rhyme, and some stories don't have a clear beginning, middle, and end. Life is about not knowing, having to change, taking the moment and making the best of it, without knowing what's going to happen next.



-- Gilda Radner
(Saturday Night Live Actress for those under 40)

SEISMOLOGY

Scientists on trial over L'Aquila deaths

Seismologists charged for giving apparent reassurances on Italian earthquake risks.

BY NICOLA NOSENGO IN ROME

The perils of communicating scientific uncertainty when under the media spotlight are set to be probed in an Italian court later this year. The case, which was given the go-ahead by a judge last week, involves six Italian seismologists and one government official. They will be tried this autumn for the manslaughter of some of the 309 people who died in the earthquake that struck the city of L'Aquila on 6 April 2009. If convicted, they could face jail sentences of up to 12 years.

The seven were on a committee tasked with assessing the risks of increased seismic activity in the area. At a press conference following a committee meeting a week before the earthquake, some members assured the public that they were in no danger. After the quake, many of the victims' relatives said that because of these reassurances they did not take precautionary

measures, such as leaving their homes.

L'Aquila's public prosecutor, Fabio Picuti, argued last week that although the committee members could not have predicted the earthquake, they had translated their scientific uncertainty into an overly optimistic message. The prosecution has focused on a statement made at the press conference by accused committee member Bernardo De Bernardinis, who was then deputy technical head of Italy's Civil Protection Agency. "The scientific community tells me there is no danger," he said at the time, "because there is an ongoing discharge of energy. The situation looks favourable."

Many seismologists — including one of the accused, Enzo Boschi, president of the National Institute of Geophysics and Vulcanology in Rome — have since criticized the statement as scientifically unfounded. The statement does not appear in the minutes of the committee meeting itself, and the accused seismologists

say they cannot be blamed for it. De Bernardinis's advocate insists that his client merely summarized what the scientists had told him. The prosecutor claims that because none of the other committee members immediately corrected De Bernardinis, they are all equally culpable.

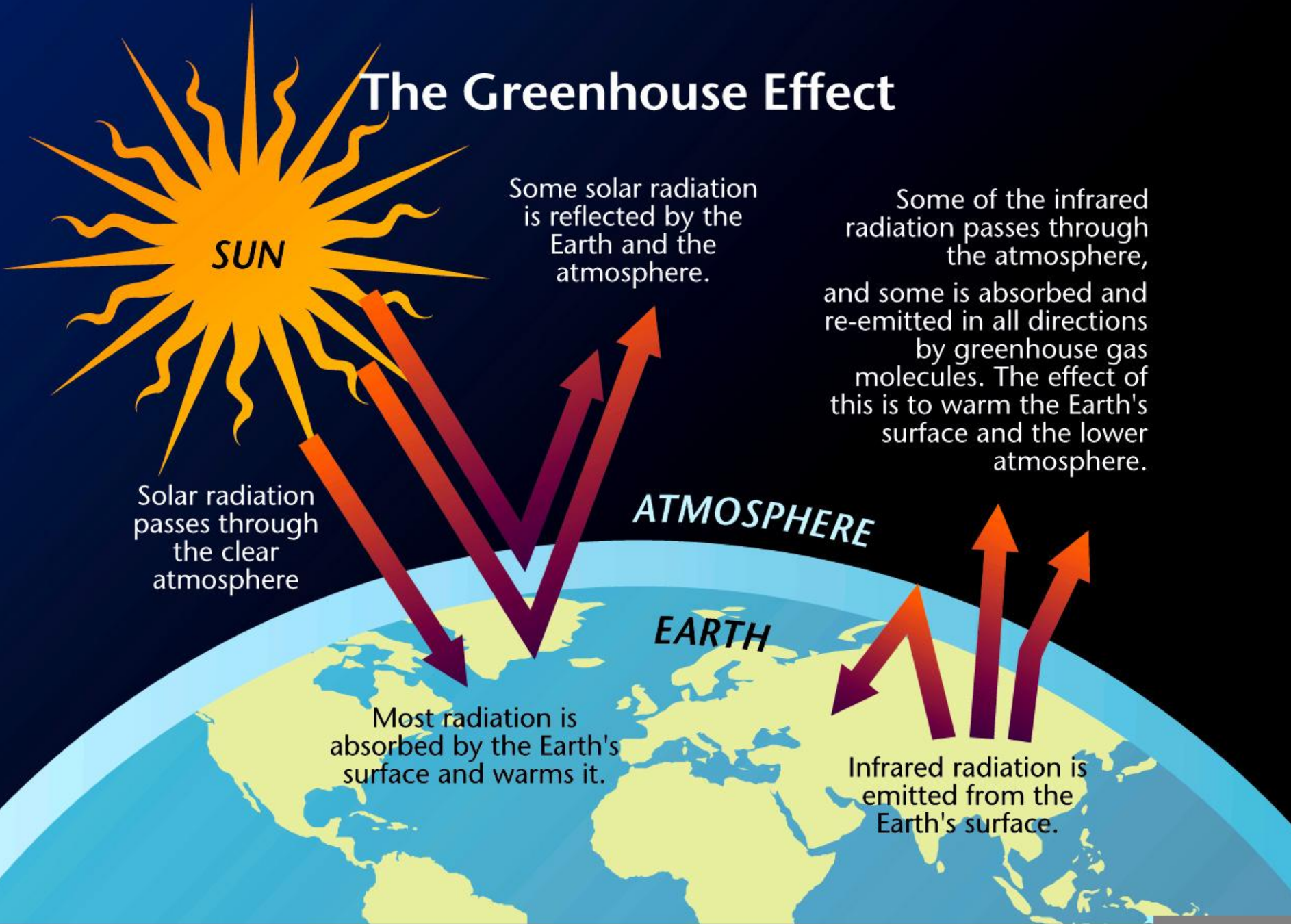
Boschi says that he is "devastated" by the ruling. He notes that there are hundreds of seismic shocks every year in Italy: "If we were to alert the population every time, we would probably be indicted for unjustified alarm," he said, adding that poor building standards were the main cause of the tragedy.

Vincenzo Vittorini, a physician in L'Aquila whose wife and daughter were killed in the earthquake and who is president of the local victims' association, hopes the trial will lead to a thorough investigation into what went wrong. "Nobody here wants to put science in the dock," he says. "All we wanted was clearer information on risks in order to make our choices?" ■

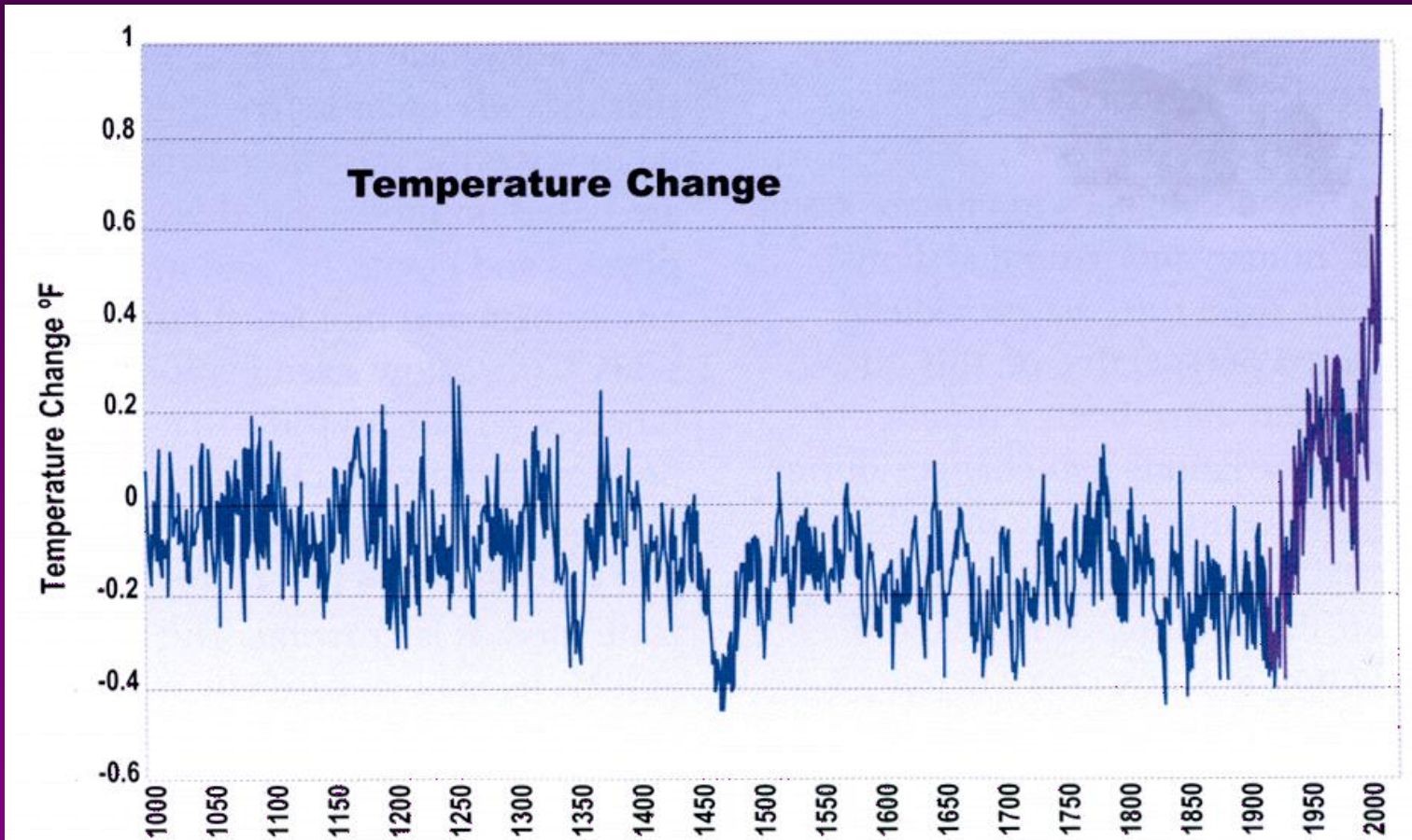
We will only BRIEFLY cover

1. What the climate will be like in 50 -100 years
2. What impacts that these changes will have on ecosystems

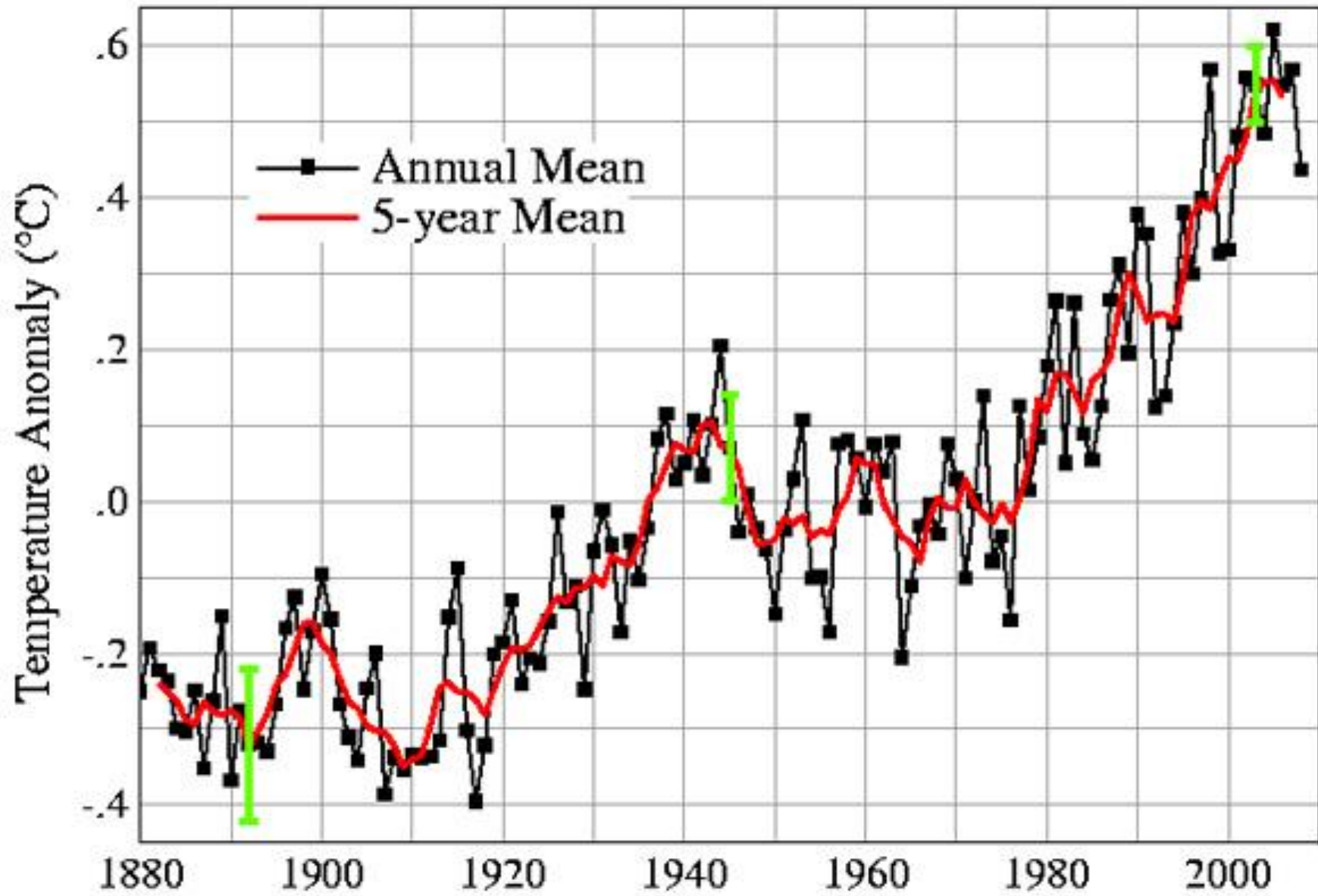
The Greenhouse Effect

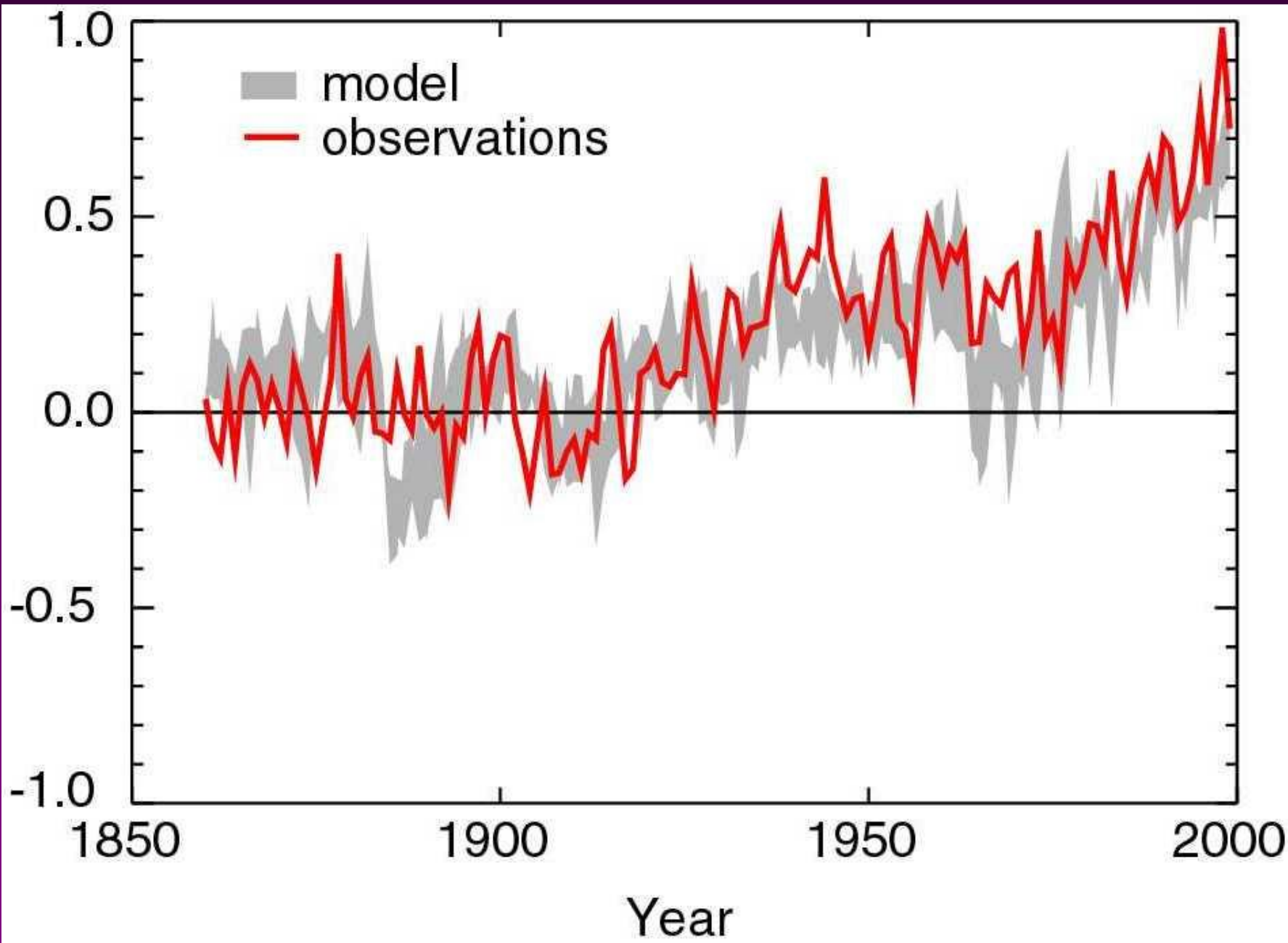


Northern Hemisphere Surface Temperature



Global Land-Ocean Temperature Index





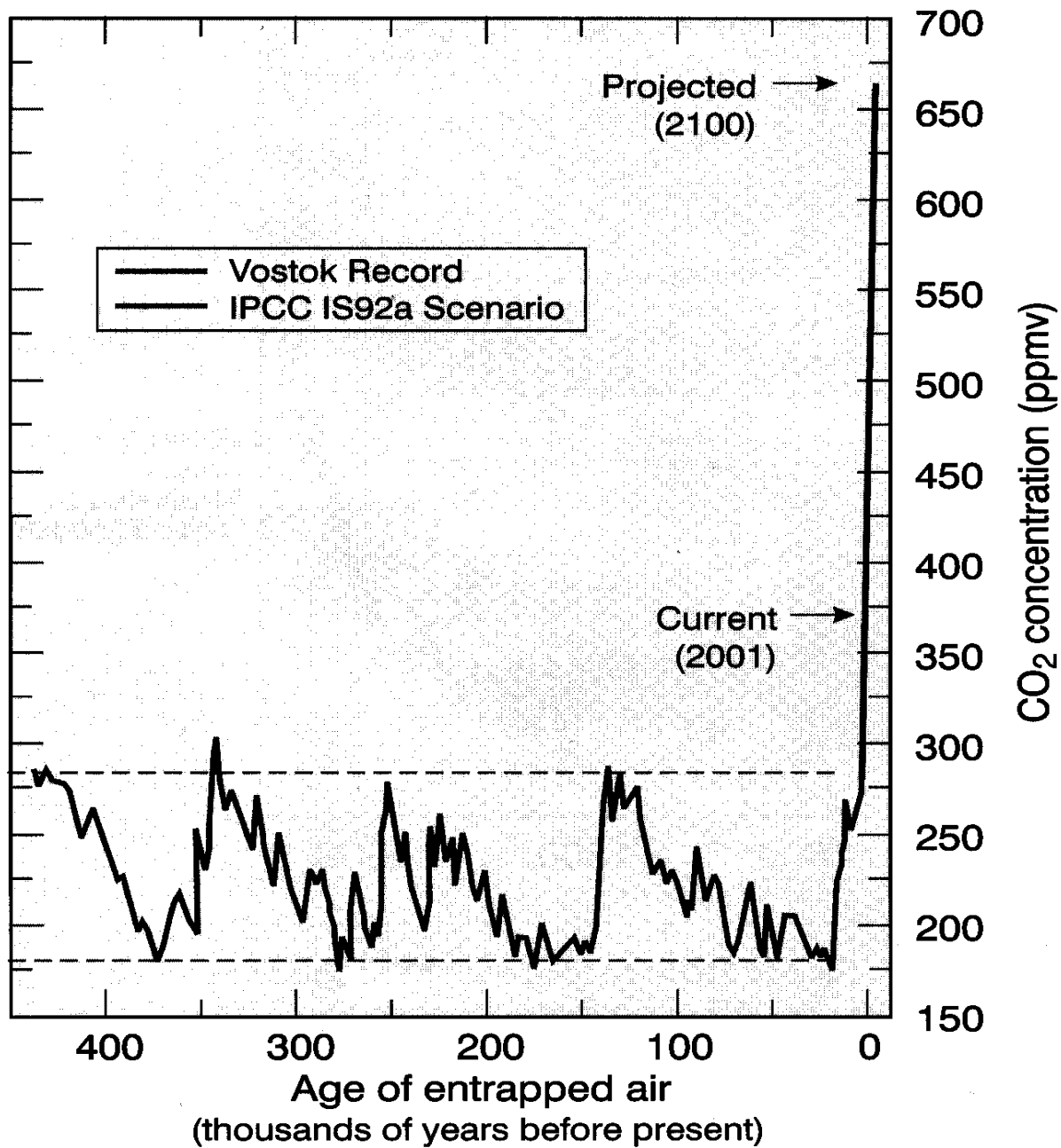
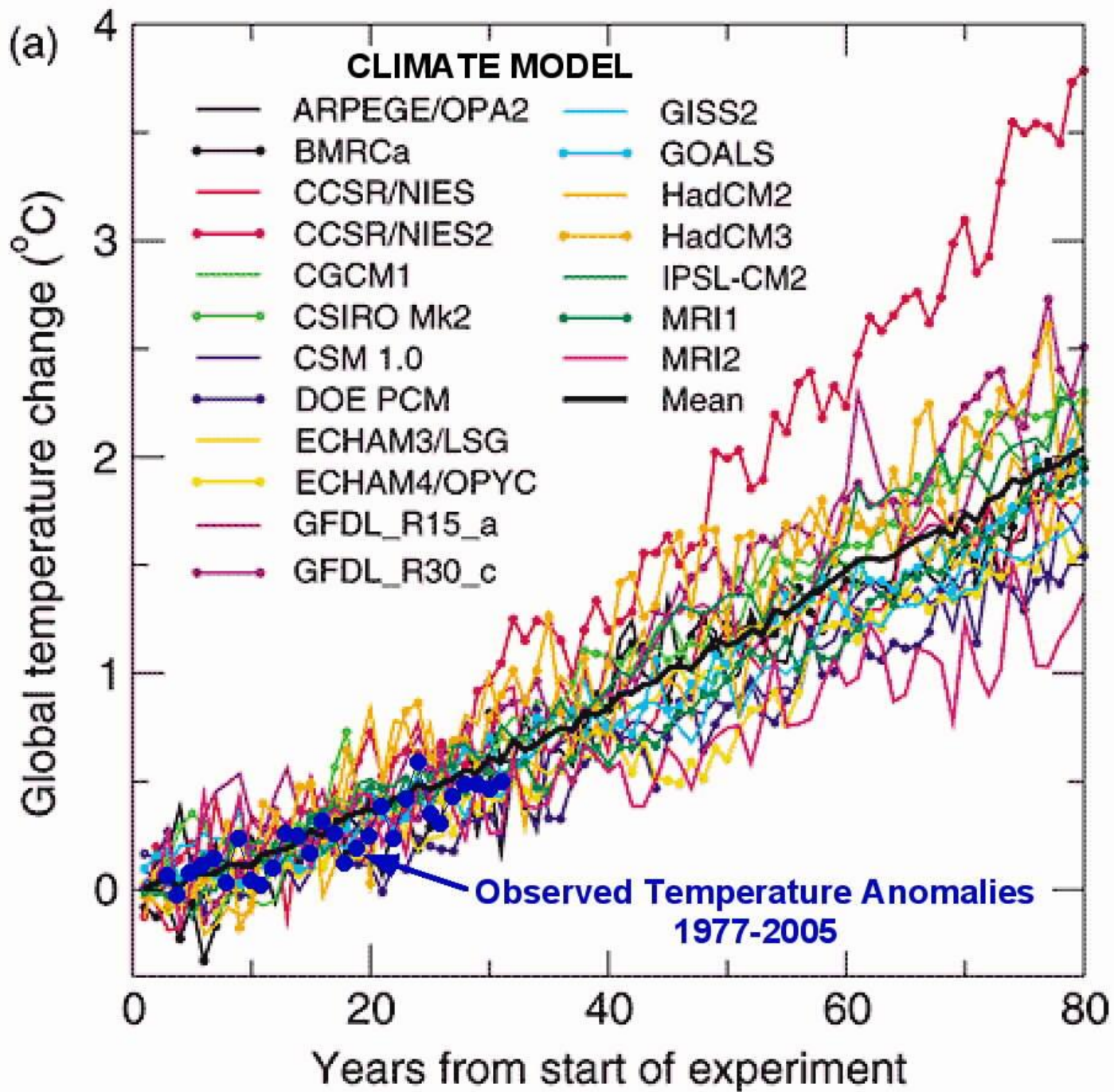
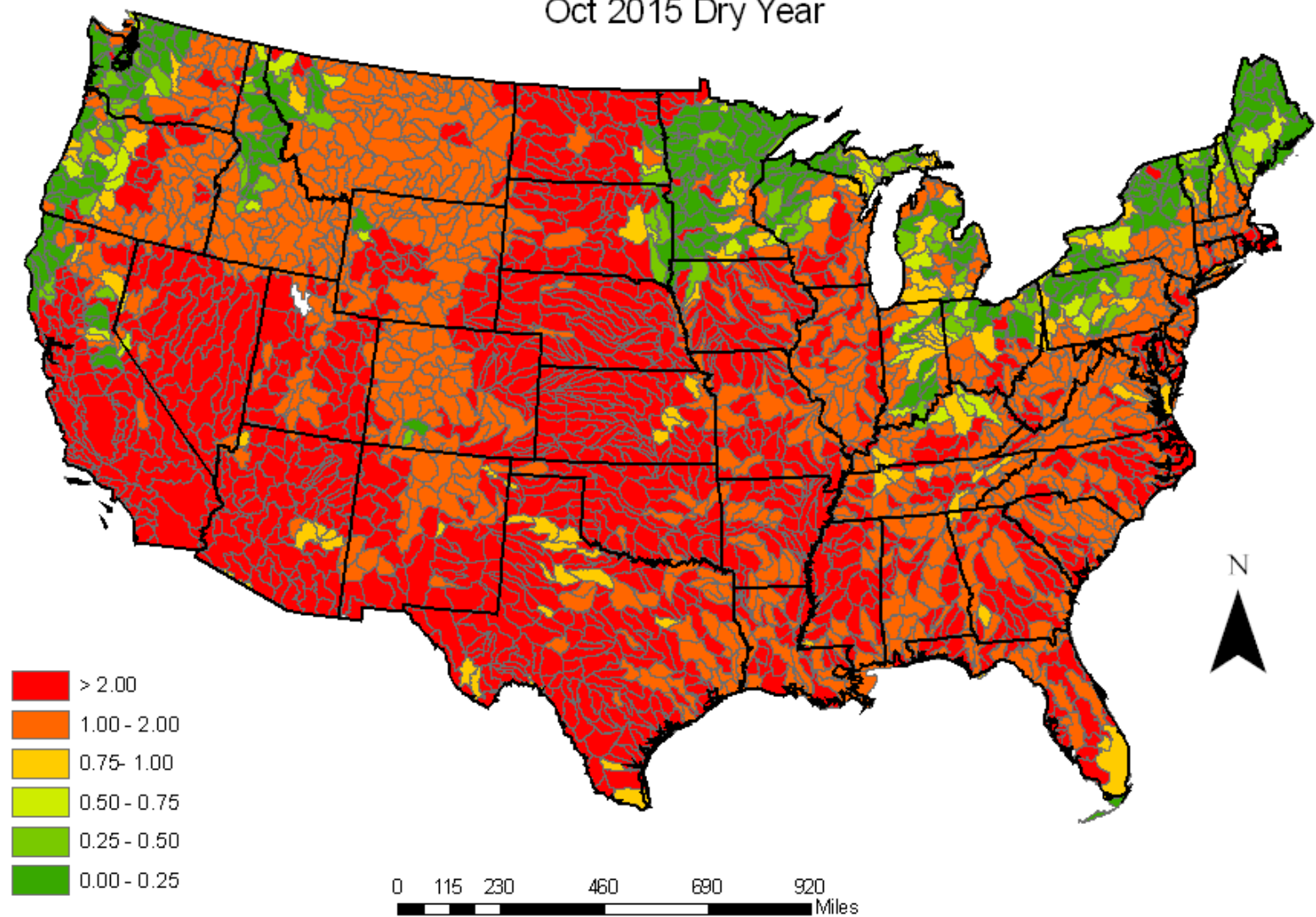


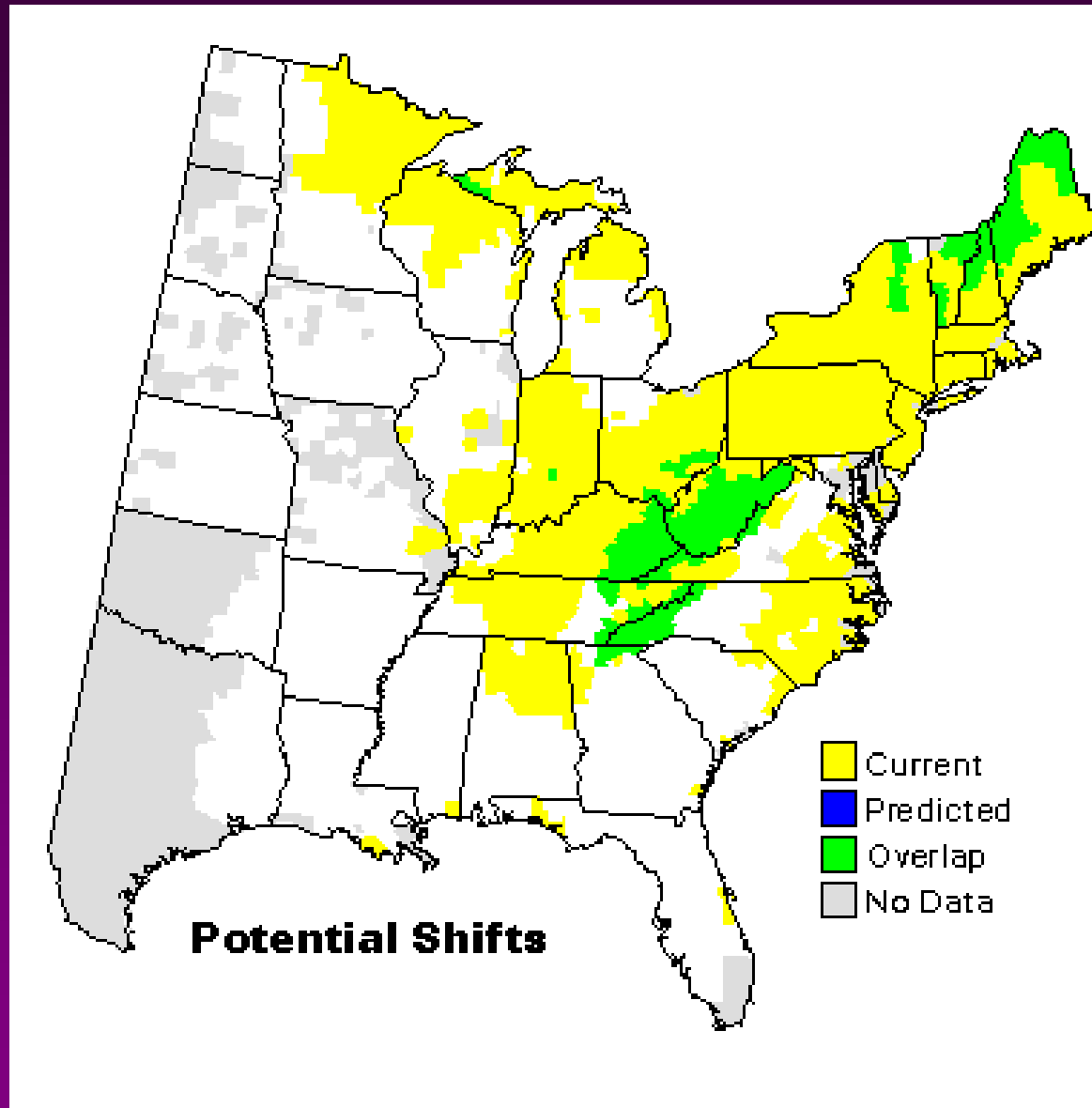
Figure 1. The Vostok ice-core record for atmospheric CO₂ concentration from Petit et al. (1999) and the “business as usual” prediction used in the IPCC Third Assessment (Prentice et al. 2001). The current concentration of atmospheric CO₂ is also indicated.



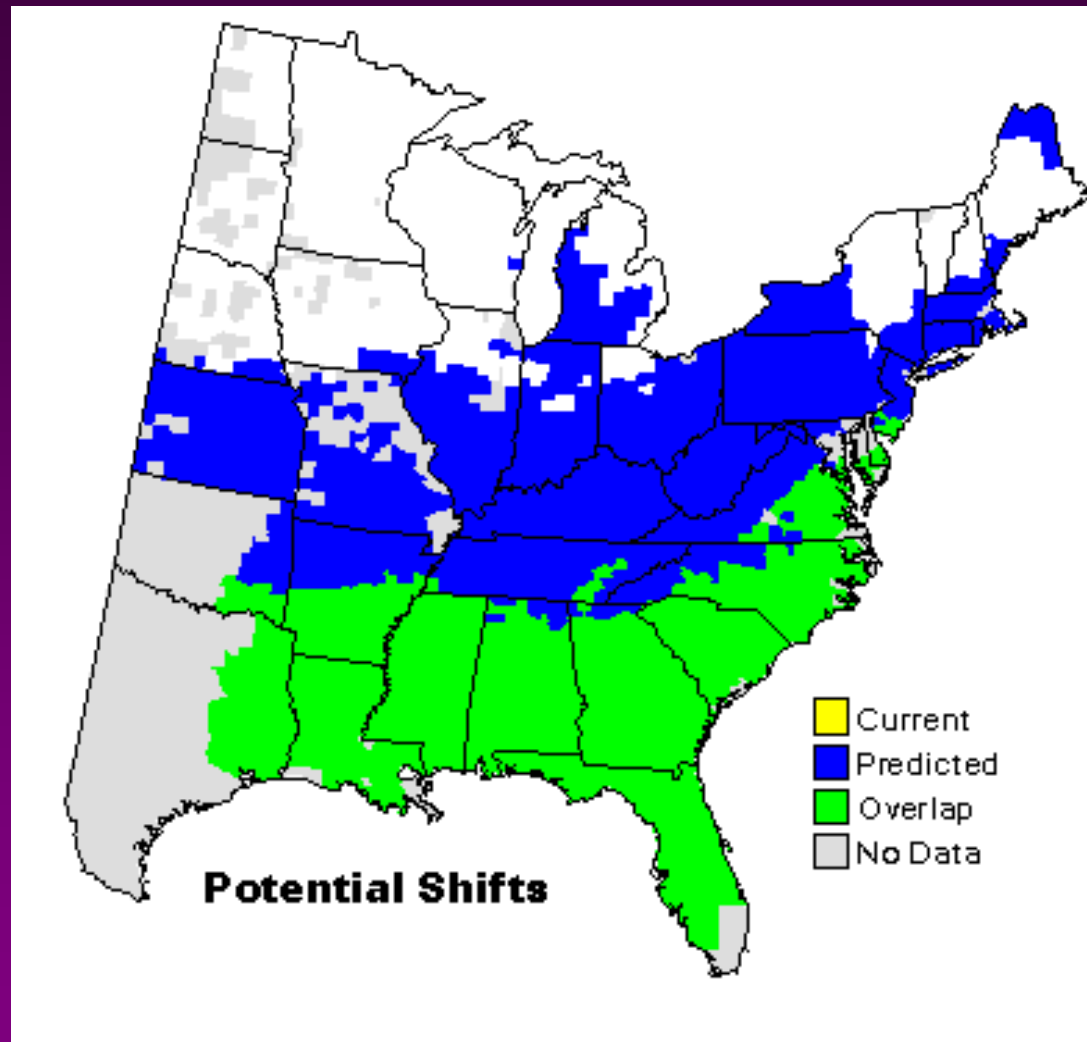
Water Supply Stress Index
No Groundwater
Oct 2015 Dry Year



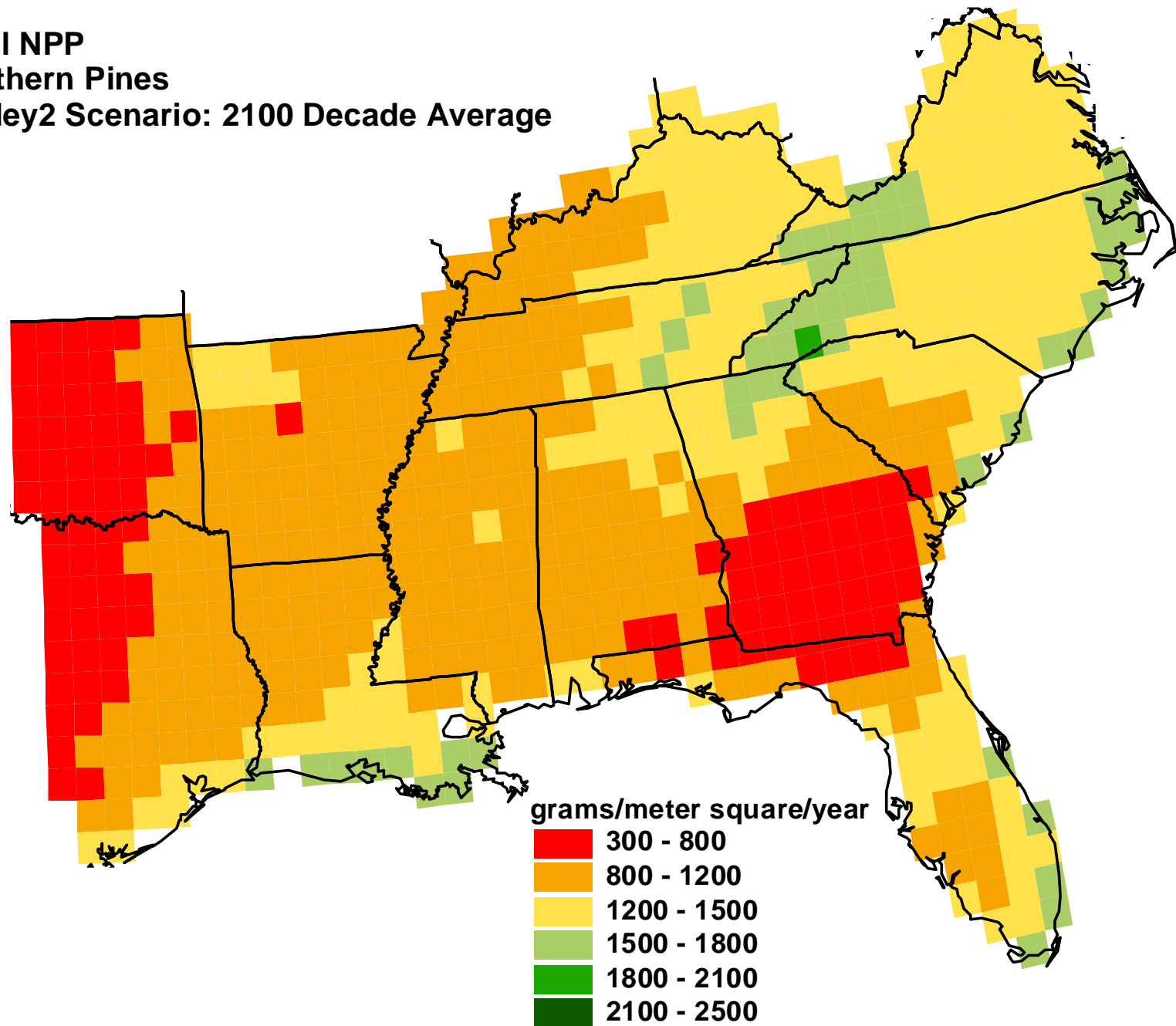
American beech



Loblolly pine



**Total NPP
Southern Pines
Hadley2 Scenario: 2100 Decade Average**



Why we WILL focus on current weather,
uncertainty and variability

.... and why UNCERTAINTY is
less important than VARIABILITY

Weather in Our Nations Capital City



Source:
ABC News

Climate Change in Our Nations Capital City



Tea Party (in infancy)

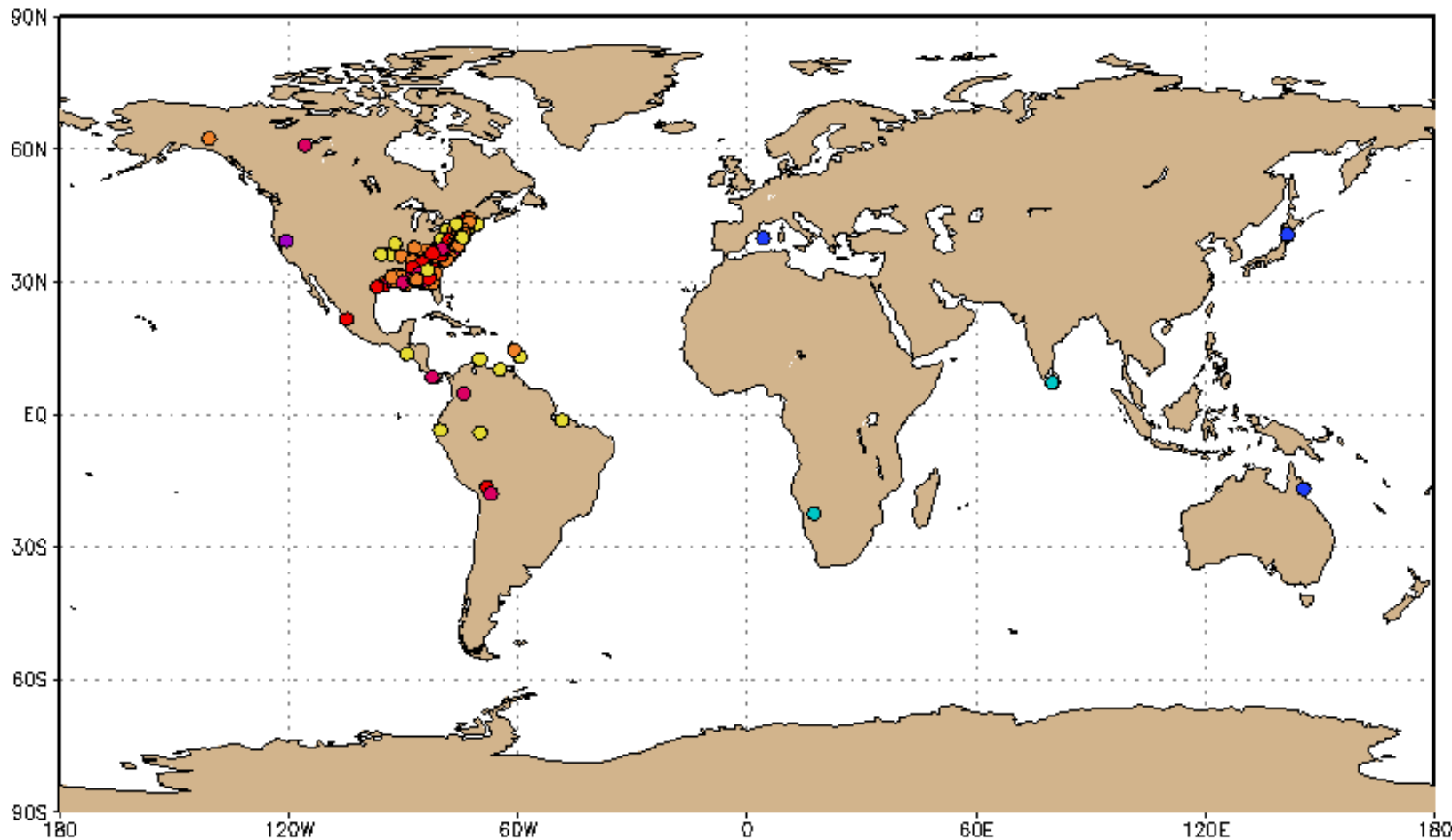
Ice age Republican

Ice age Democrat

Note: Computer Simulated Ice Age

How Weather Change Becomes Climate Change

Locations approaching or surpassing unofficial
daily (01 Jun) temperature records based on temperature
at 1900 UTC 01 Jun



Within 3F of daily record high
Within 2F of daily record high
Within 0.5F of daily record high
Has broken daily record high

coolwx.com/record

Within 3F of daily record low
Within 2F of daily record low
Within 0.5F of daily record low
Has broken daily record low

1 record low, 60 record highs

June 2 – 9, Long term average temperature 82°



U.S. Drought Monitor

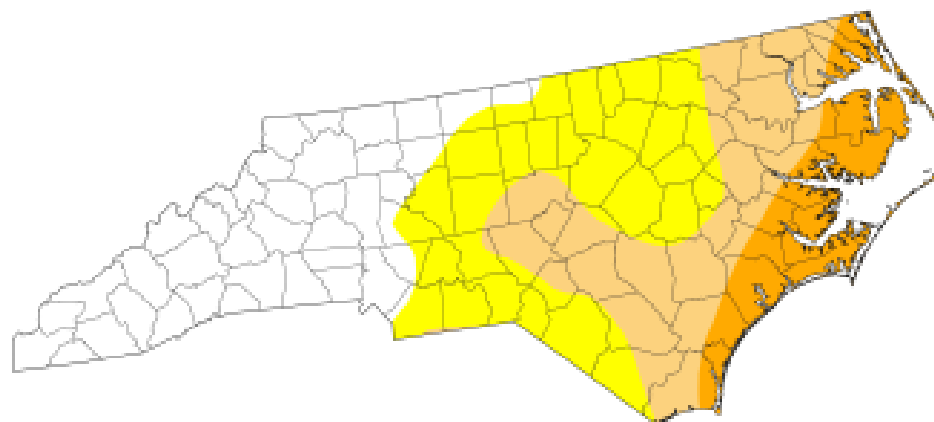
May 31, 2011

Valid 7 a.m. EST

North Carolina

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	32.20	67.80	36.70	11.76	0.00	0.00
Last Week (05/24/2011 map)	35.09	64.91	37.16	0.00	0.00	0.00
3 Months Ago (03/01/2011 map)	21.10	78.90	52.41	23.96	0.00	0.00
Start of Calendar Year (12/28/2010 map)	42.54	57.46	14.89	0.00	0.00	0.00
Start of Water Year (09/28/2010 map)	7.08	92.92	28.93	0.00	0.00	0.00
One Year Ago (05/25/2010 map)	93.62	6.38	0.00	0.00	0.00	0.00



Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

<http://drought.unl.edu/dm>



Released Thursday, June 2, 2011
Anthony Artusa, NOAA/NWS/NCEP/CPC

U.S. Drought Monitor

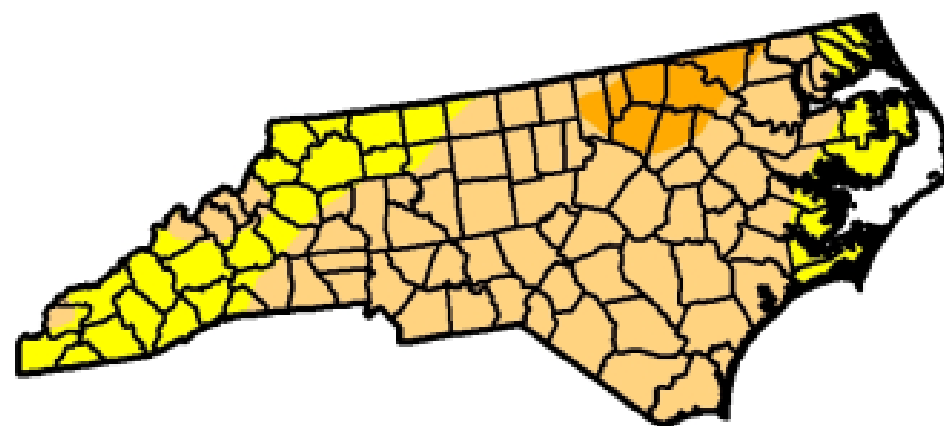
North Carolina

September 21, 2010

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.1	99.9	72.6	6.3	0.0	0.0
Last Week (09/14/2010 map)	8.1	91.9	28.7	2.8	0.0	0.0
3 Months Ago (06/29/2010 map)	56.0	44.0	0.0	0.0	0.0	0.0
Start of Calendar Year (01/05/2010 map)	100.0	0.0	0.0	0.0	0.0	0.0
Start of Water Year (10/06/2009 map)	51.4	48.6	13.9	0.0	0.0	0.0
One Year Ago (09/22/2009 map)	35.8	64.2	26.9	0.0	0.0	0.0



Intensity:

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- D3 Drought - Extreme
- D4 Drought - Exceptional

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<http://drought.unl.edu/dm>



Released Thursday, September 23, 2010

Author: Richard Heim, NCDC/NOAA

U.S. Drought Monitor

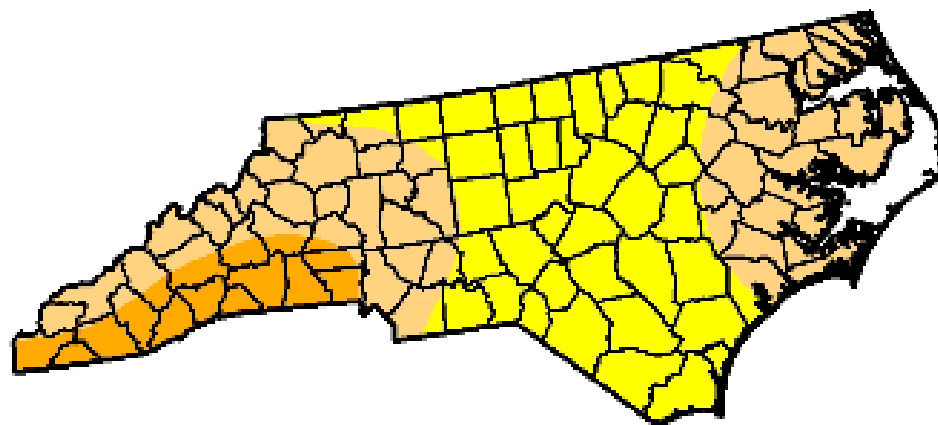
North Carolina

February 24, 2009

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.0	100.0	52.8	10.6	0.1	0.0
Last Week (02/17/2009 map)	0.0	100.0	52.8	10.6	0.1	0.0
3 Months Ago (12/02/2008 map)	42.4	57.6	31.2	16.8	11.1	8.3
Start of Calendar Year (01/06/2009 map)	76.7	23.3	18.4	7.2	0.0	0.0
Start of Water Year (10/07/2008 map)	40.2	59.8	46.1	20.5	10.9	0.0
One Year Ago (02/26/2008 map)	0.0	100.0	98.8	87.7	61.3	26.3



Intensity:

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- D3 Drought - Extreme
- D4 Drought - Exceptional

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements

<http://drought.unl.edu/dm>



Released Thursday, February 26, 2009

Author: Rich Tinker, CPC/NOAA

U.S. Drought Monitor

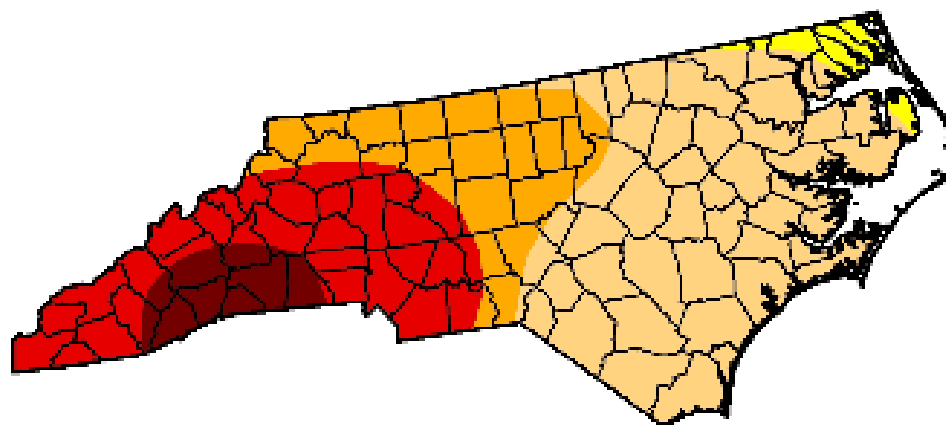
North Carolina

June 24, 2008

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.0	100.0	96.9	48.6	30.1	6.4
Last Week (06/17/2008 map)	0.0	100.0	96.9	48.6	28.7	2.6
3 Months Ago (04/01/2008 map)	0.0	100.0	89.8	68.6	30.9	0.0
Start of Calendar Year (01/01/2008 map)	0.0	100.0	100.0	100.0	83.7	51.3
Start of Water Year (10/02/2007 map)	0.0	100.0	100.0	92.8	79.4	37.7
One Year Ago (06/26/2007 map)	0.0	100.0	63.4	14.7	3.9	0.0



Intensity:

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- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements

<http://drought.unl.edu/dm>



Released Thursday, June 26, 2008

Author: M. Brewer/L. Love-Brotak, NOAA/NESDIS/NCDC

U.S. Drought Monitor

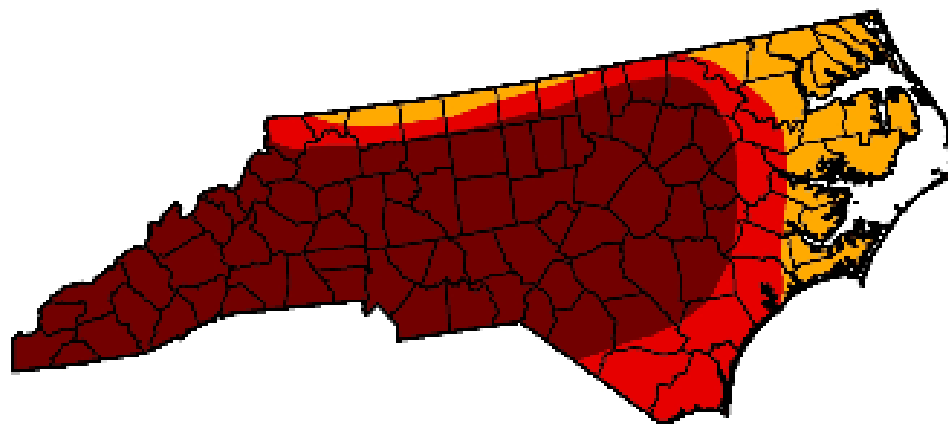
North Carolina

December 18, 2007

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.0	100.0	100.0	100.0	84.0	66.2
Last Week (12/11/2007 map)	0.0	100.0	100.0	100.0	84.0	66.2
3 Months Ago (09/25/2007 map)	0.0	100.0	100.0	92.8	75.1	4.0
Start of Calendar Year (01/02/2007 map)	98.5	1.5	0.0	0.0	0.0	0.0
Start of Water Year (10/02/2007 map)	0.0	100.0	100.0	92.8	79.4	37.7
One Year Ago (12/19/2006 map)	98.5	1.5	0.0	0.0	0.0	0.0



Intensity:

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- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements

<http://drought.unl.edu/dm>

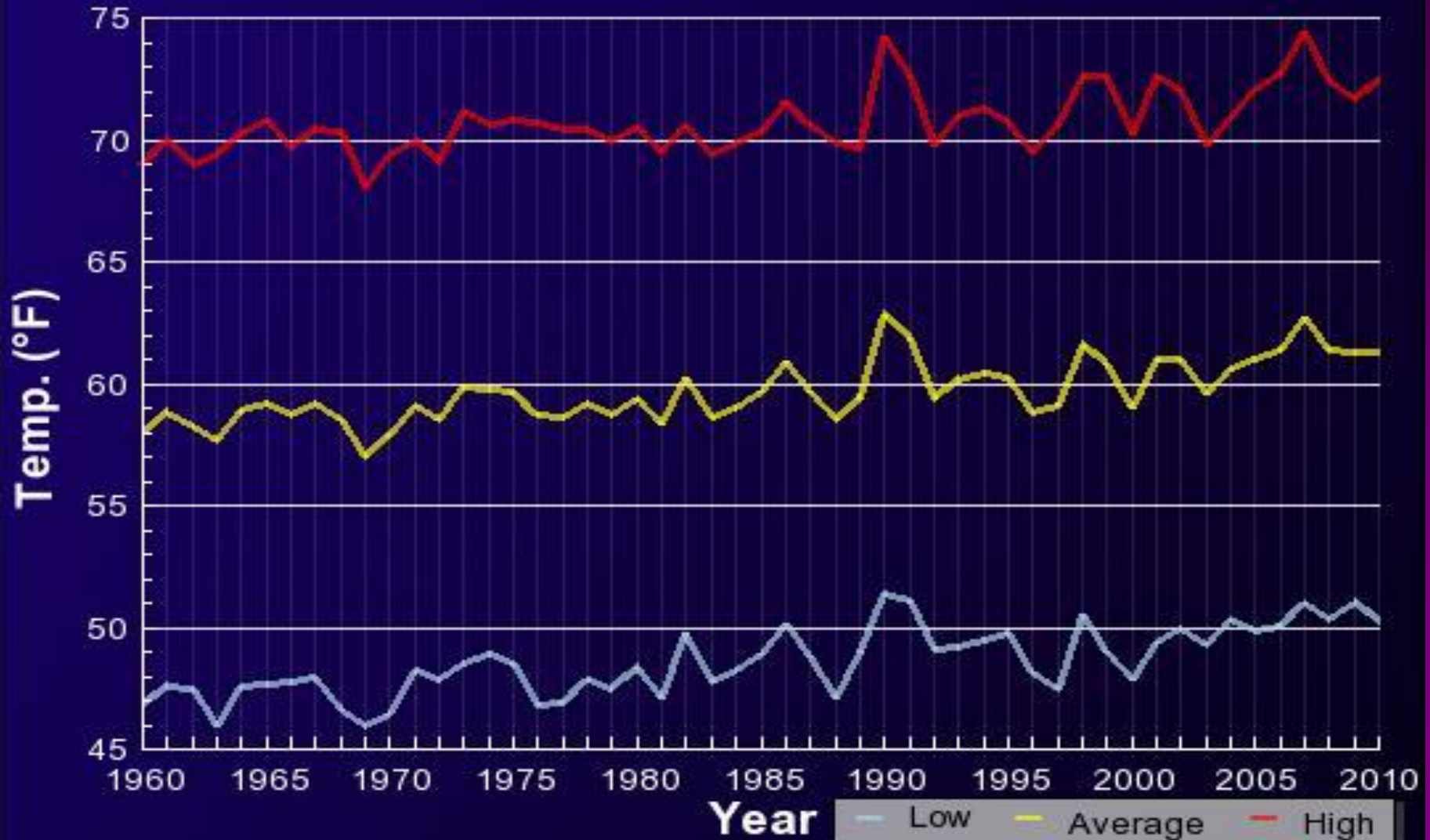


Released Thursday, December 20, 2007

Author: Brian Fuchs, National Drought Mitigation Center

Change in Raleigh Temperature

Average Yearly Temperature (1960 - 2010)



THE 90°F+ POLL

How many days this year will hit the 90°F mark? (as measured by NWS for Raleigh Nc)

Tiebreaker: What is the maximum temperature Raleigh Nc will experience this year?

<u>NAME</u>	<u>NUMBER OF DAYS</u>	<u>TIEBREAKER</u>
Jen	94	103
Emrys	93	107
Lisa	89	105
Steve	84	102
Pete	91	99
Johnny	89	102
MICHAEL	92	103
Anna	105	110
Kelly	90	104
Travis	95	105

HINT: There were 90 days in 2010 at/above 90°F, which broke the previous record; on average Raleigh has 43 days/year at/above 90°F

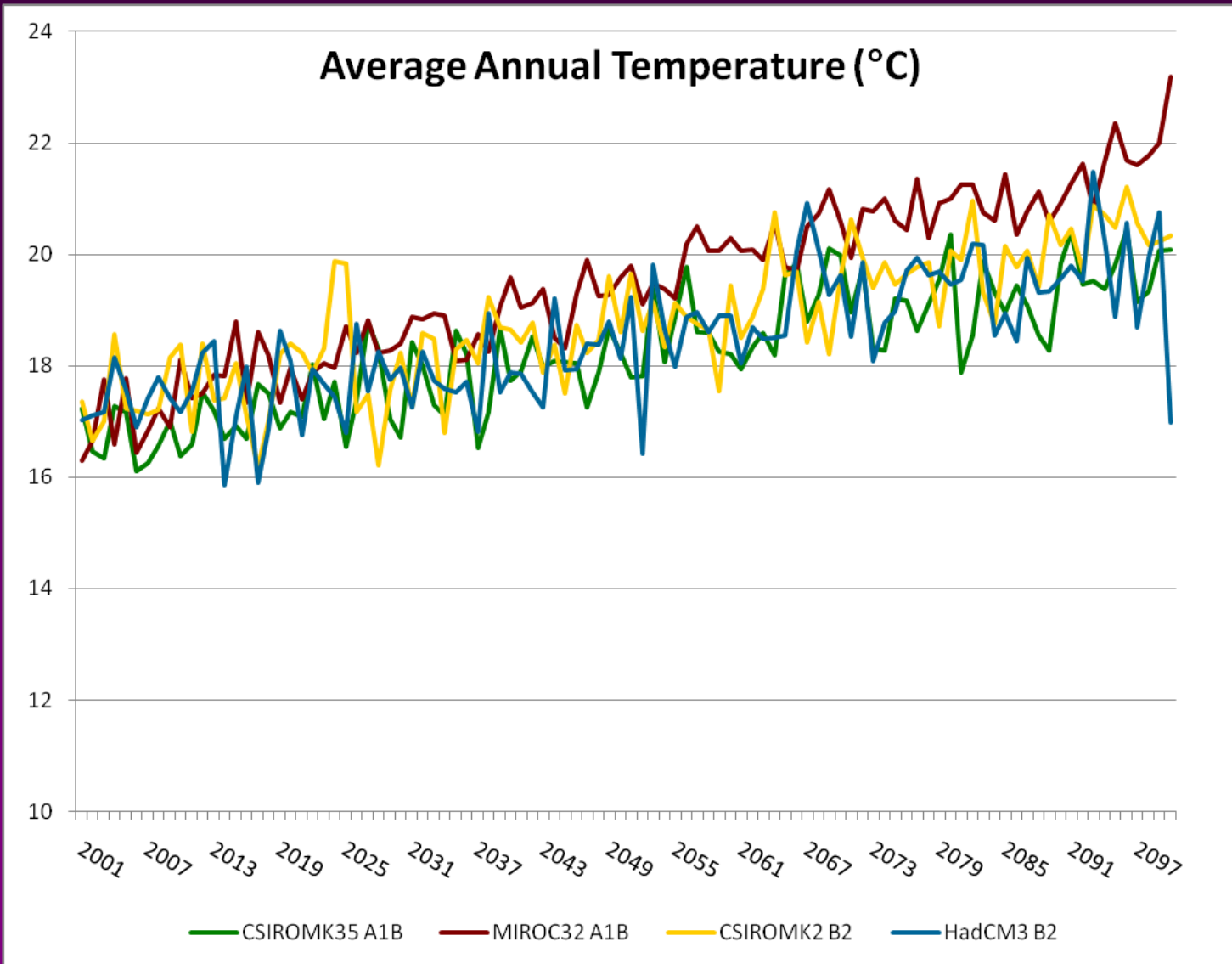
BONUS HINT: The highest temp ever recorded in Raleigh (RDU) is 109°F

What Global Warming???

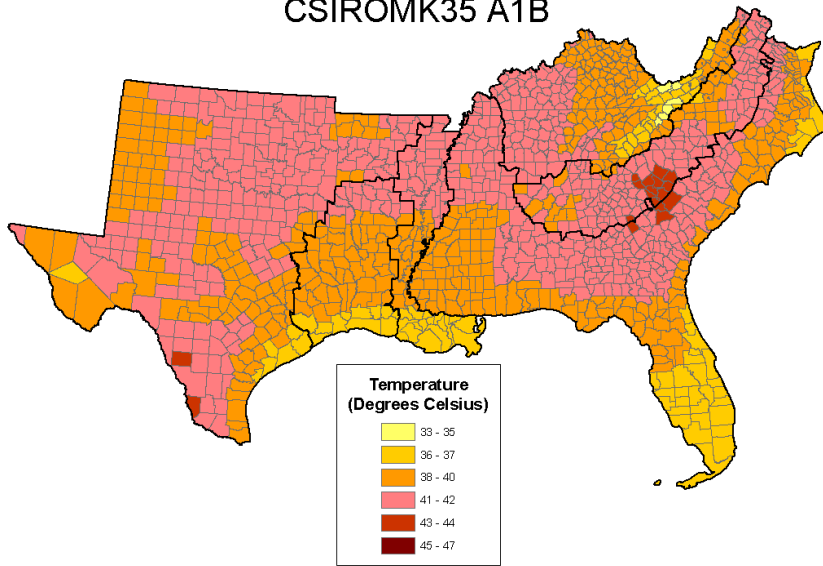


Why variability is more important than change
(at least in the near term...)

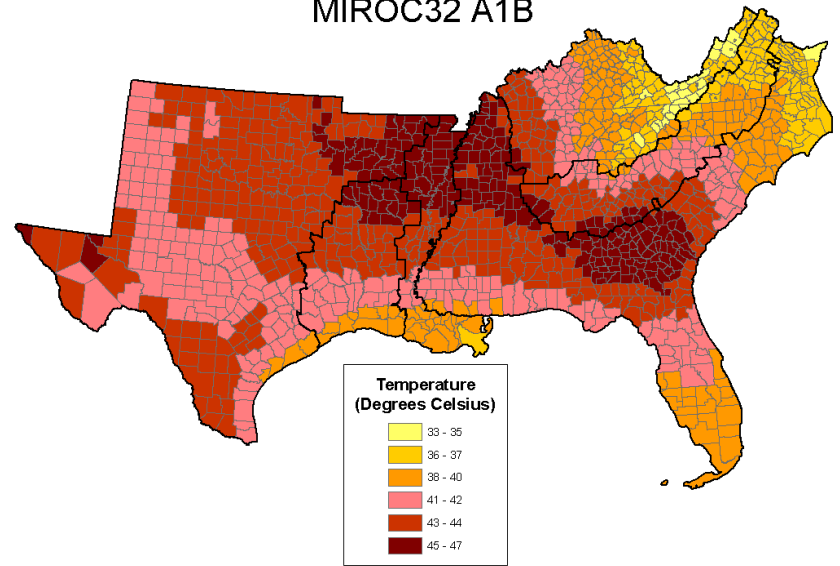
Southern US Air Temperature Change During 21st Century



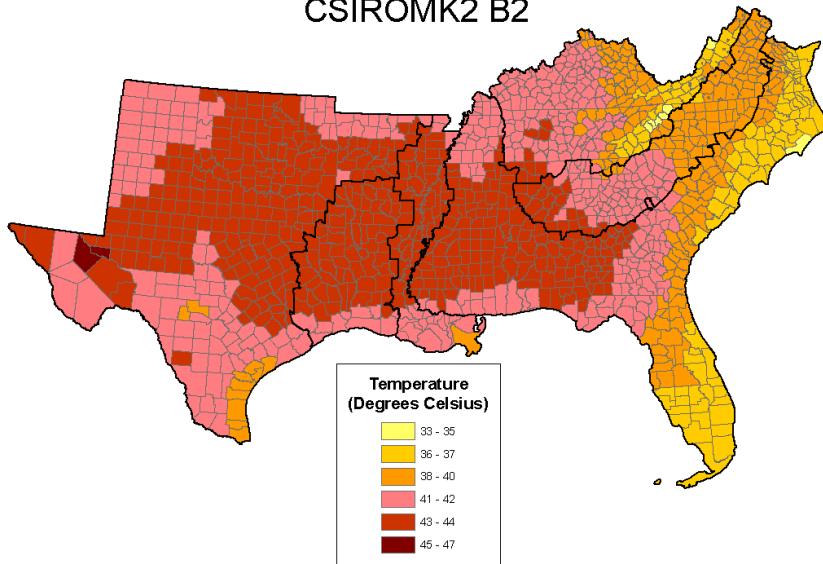
Maximum Temperature 2010-2060
CSIROMK35 A1B



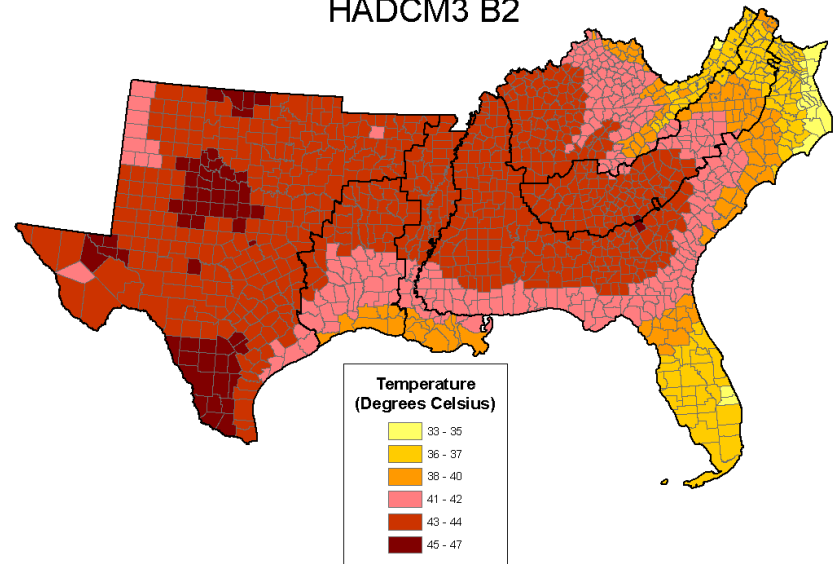
Maximum Temperature 2010-2060
MIROC32 A1B



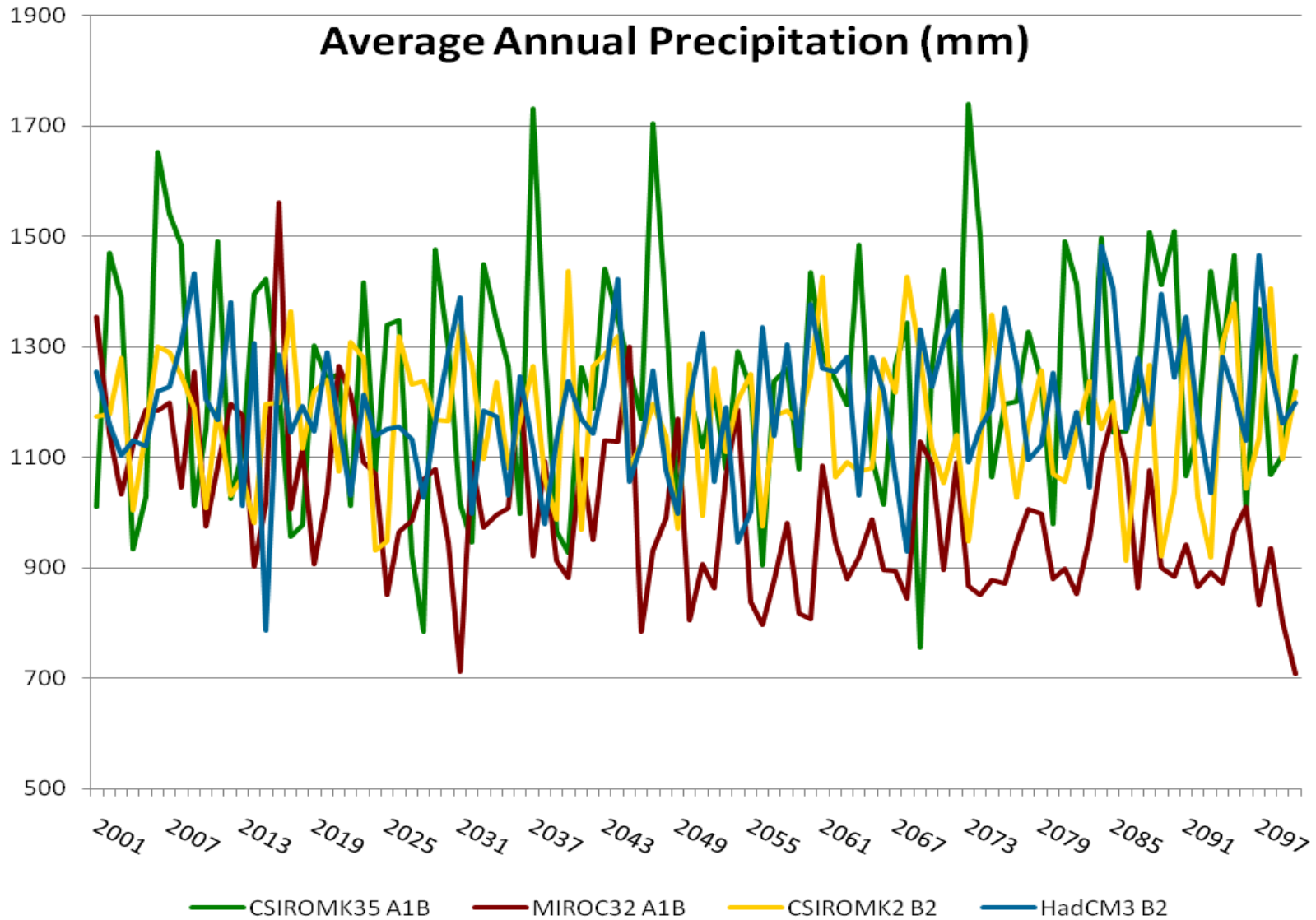
Maximum Temperature 2010-2060
CSIROMK2 B2



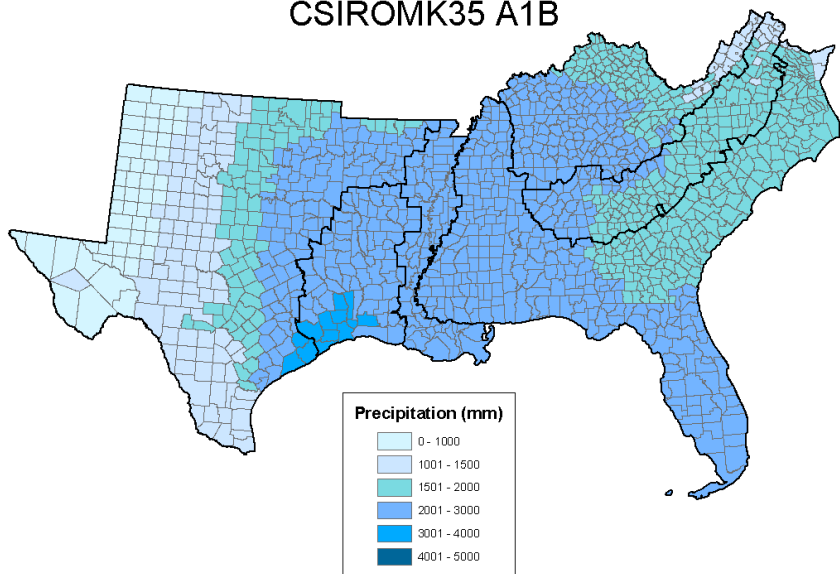
Maximum Temperature 2010-2060
HADCM3 B2



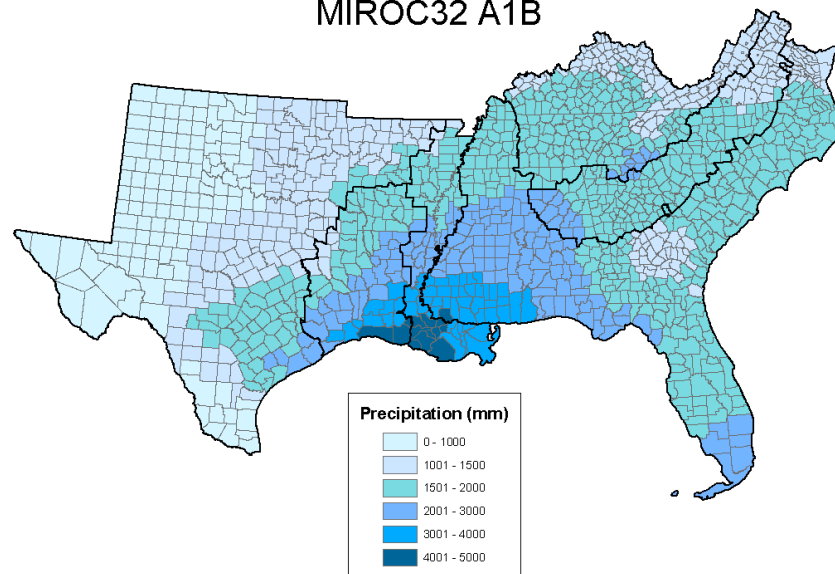
Southern US Precipitation Change During 21st Century



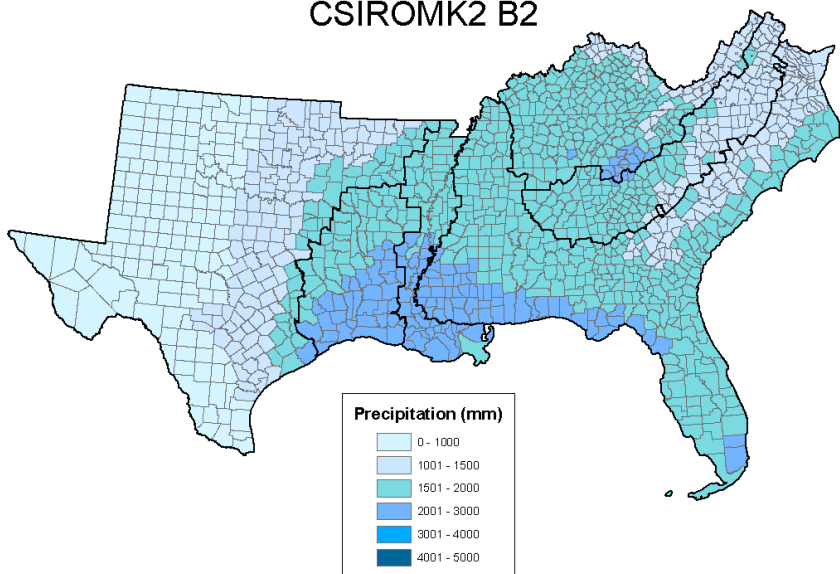
Maximum Precipitation 2010-2060
CSIROMK35 A1B



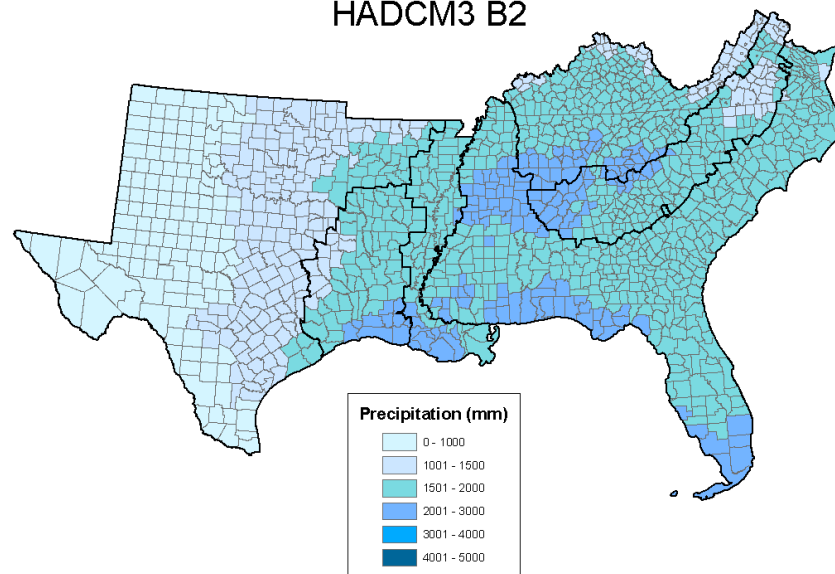
Maximum Precipitation 2010-2060
MIROC32 A1B



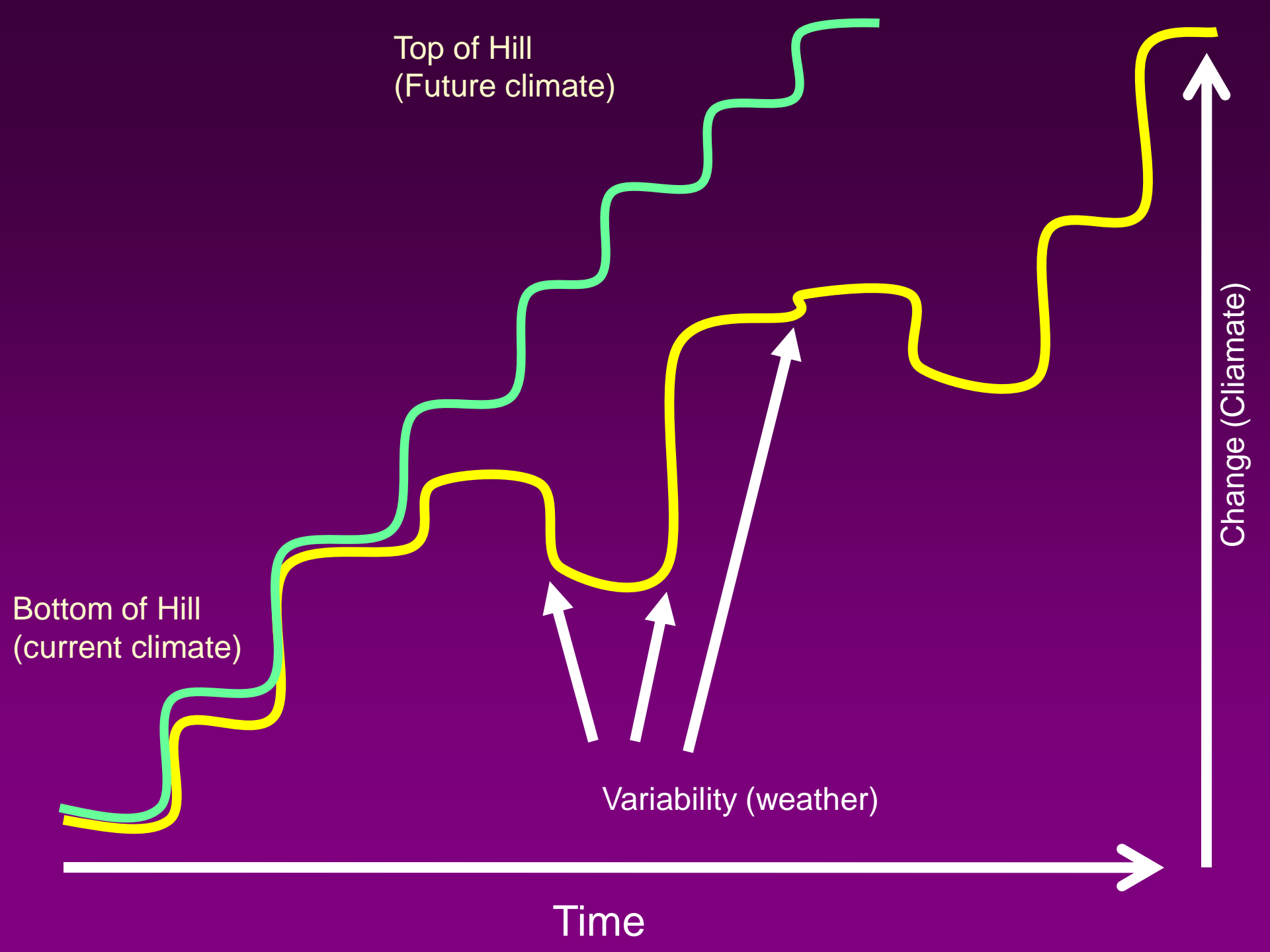
Maximum Precipitation 2010-2060
CSIROMK2 B2



Maximum Precipitation 2010-2060
HADCM3 B2

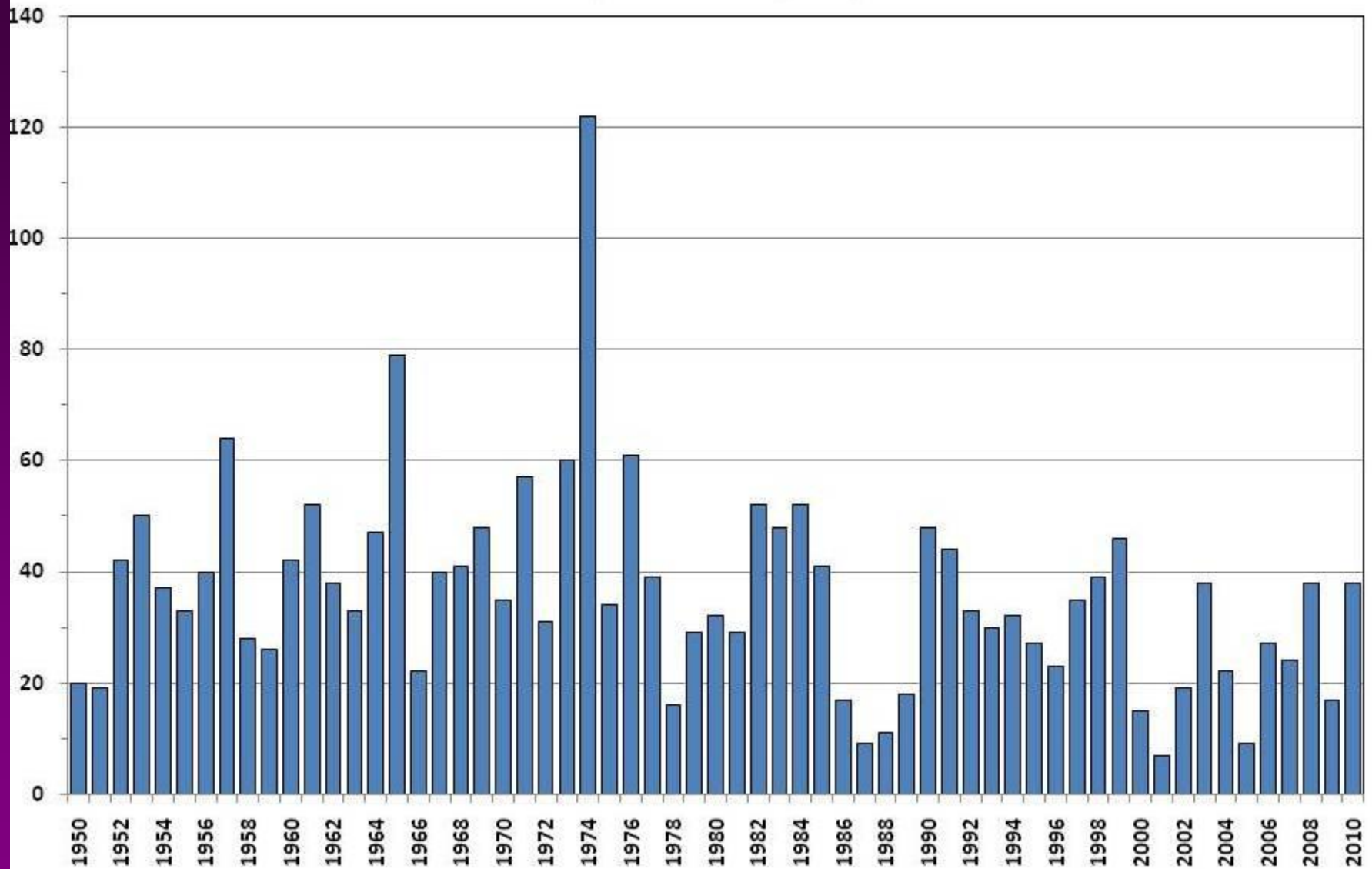


The Problem with High Variability is in
Planning for the Future





Number of Strong to Violent (EF3-EF5*) Tornadoes U.S. (March-August)



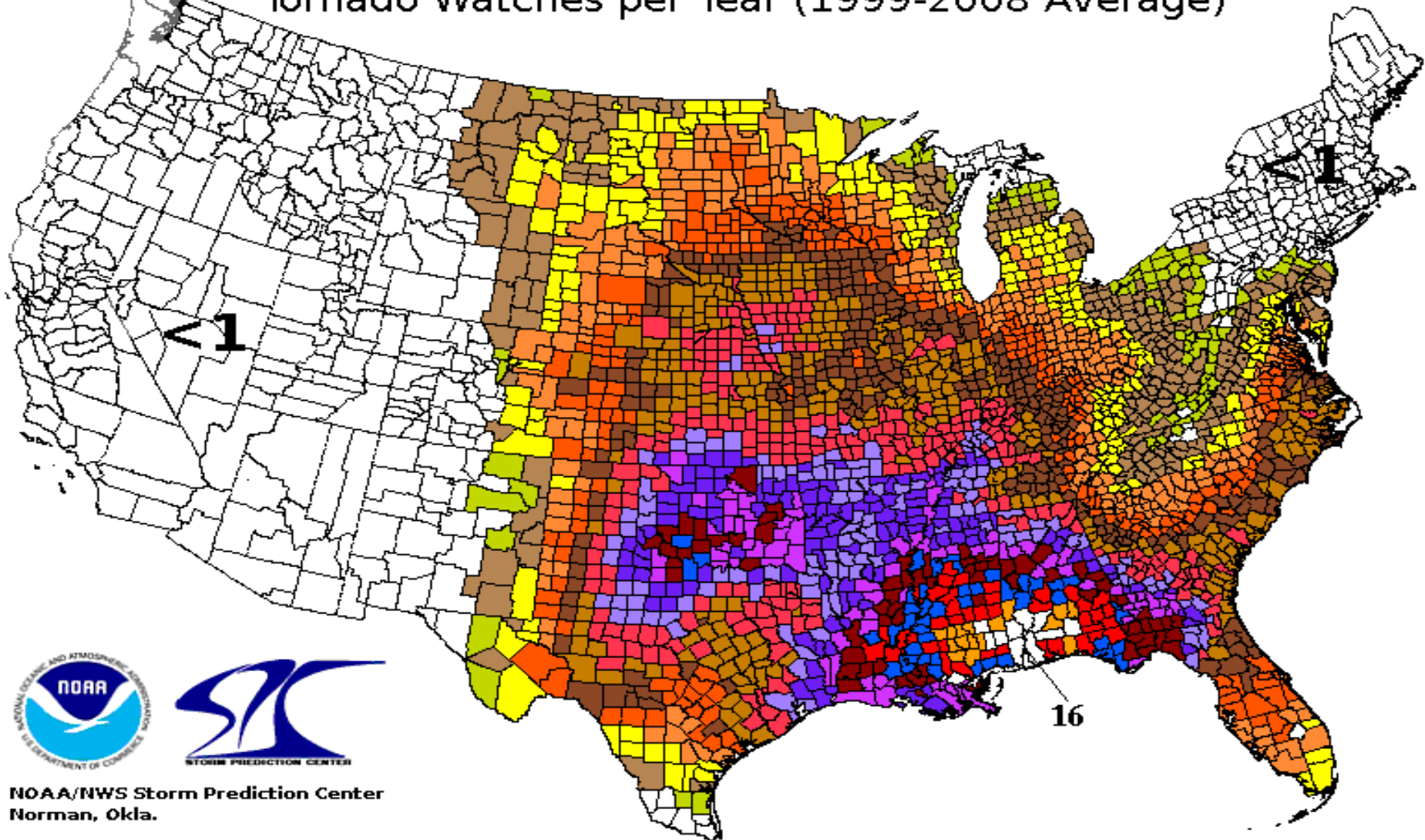
*Beginning in 2007, NOAA switched from the Fujita scale to the Enhance Fujita scale for rating tornado strength.



Record number of Tornado's, April 2011

Where?

Tornado Watches per Year (1999-2008 Average)



NOAA/NWS Storm Prediction Center
Norman, Okla.

Tornado Watches per Year



When?



Subscription information box

Price information box

DEATH TOLL IN SWEEP OF TORNADO IS 82 AND DAMAGE IS ESTIMATED AT 50 MILLION

Leominster Residents Tell Of Scenes In Tornado Area

Several Leominster residents tell of scenes and incidents witnessed where devastating tornado struck.



Report 2500 Homeless In Area Which Is Hit In The Path Of Tornado

Approximately 2500 people are reported to be homeless in the area which was hit in the path of the tornado.

Leominster Man Tells of Death and Destruction Wrought By Tornado and Holden Areas

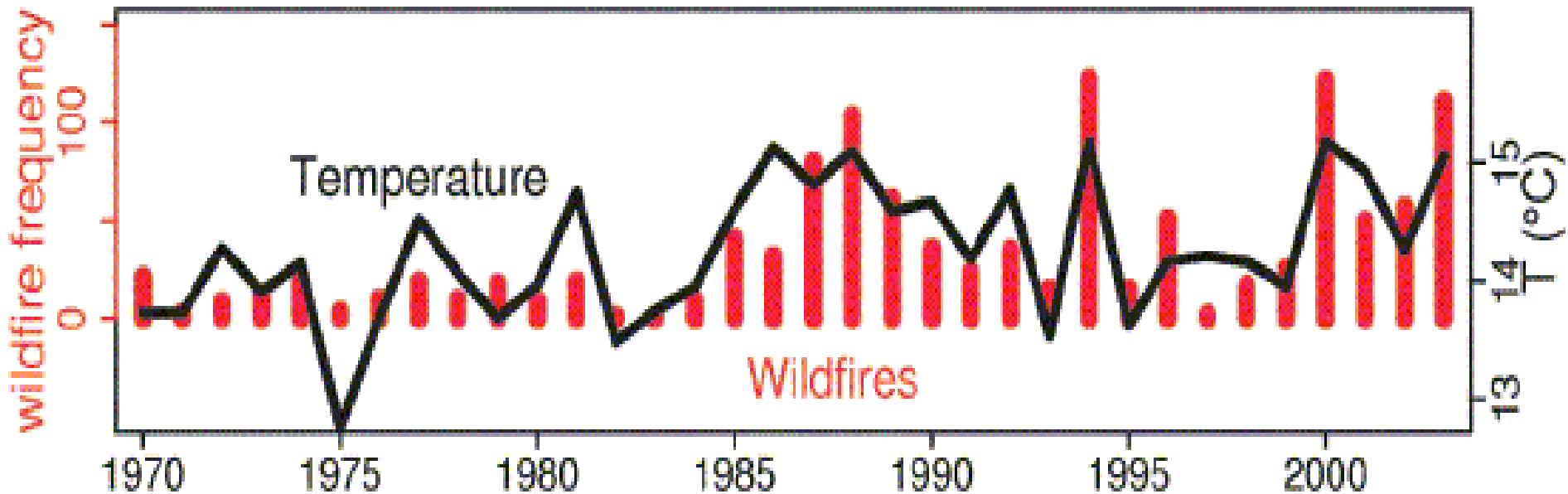
Leominster man tells of death and destruction wrought by tornado and Holden areas.

Rev. Fr. Brassard Is Injured V... Strikes Assumption C...

Rev. Fr. Brassard is injured in a strike that hit Assumption Church.

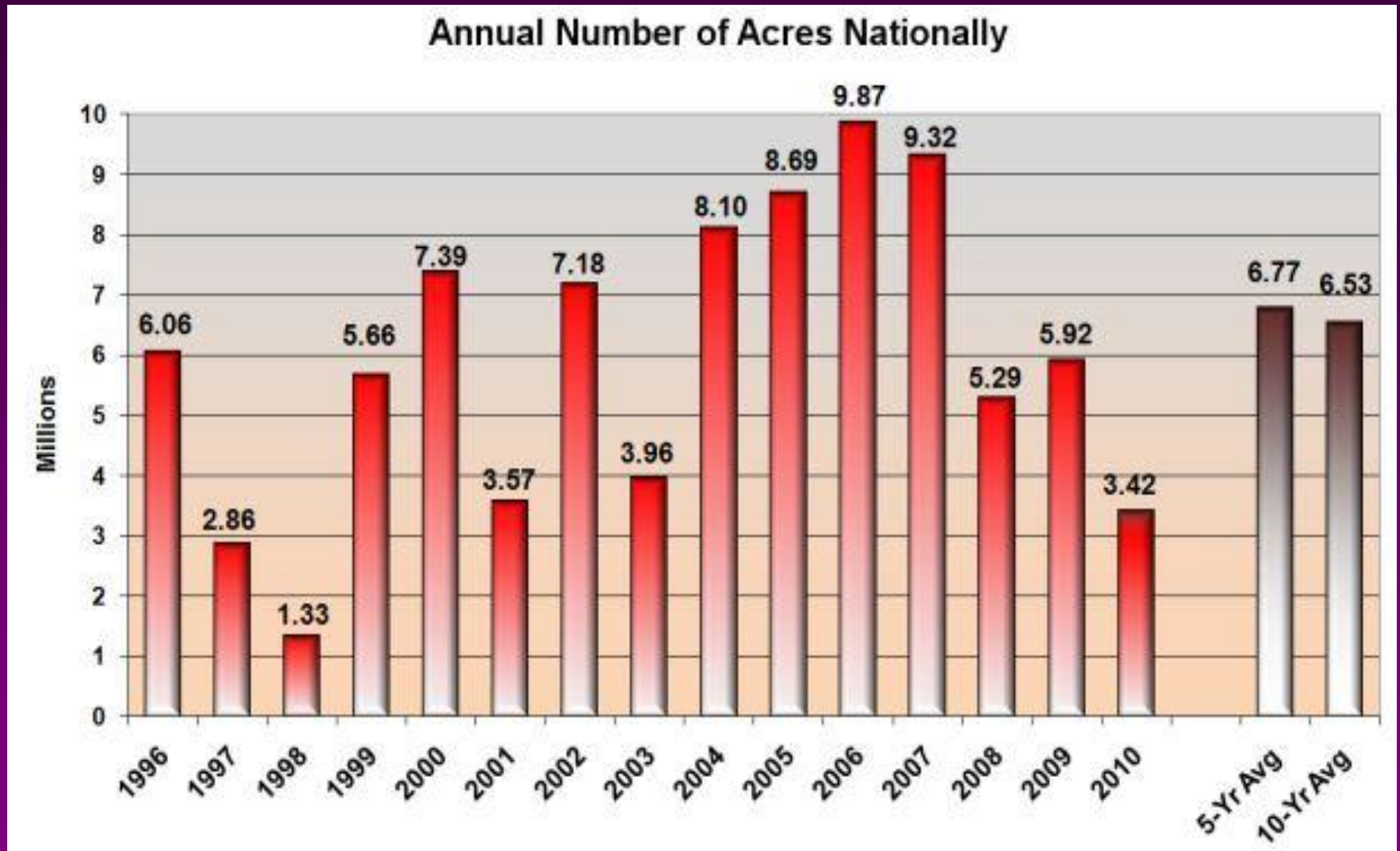
Large scale (> 400 ac) Wildfires and Air Temperature

Western US Forest Wildfires and Spring–Summer Temperature



From Westerling et al. 2005

Up? Down? Through the roof? What to do?!?!?

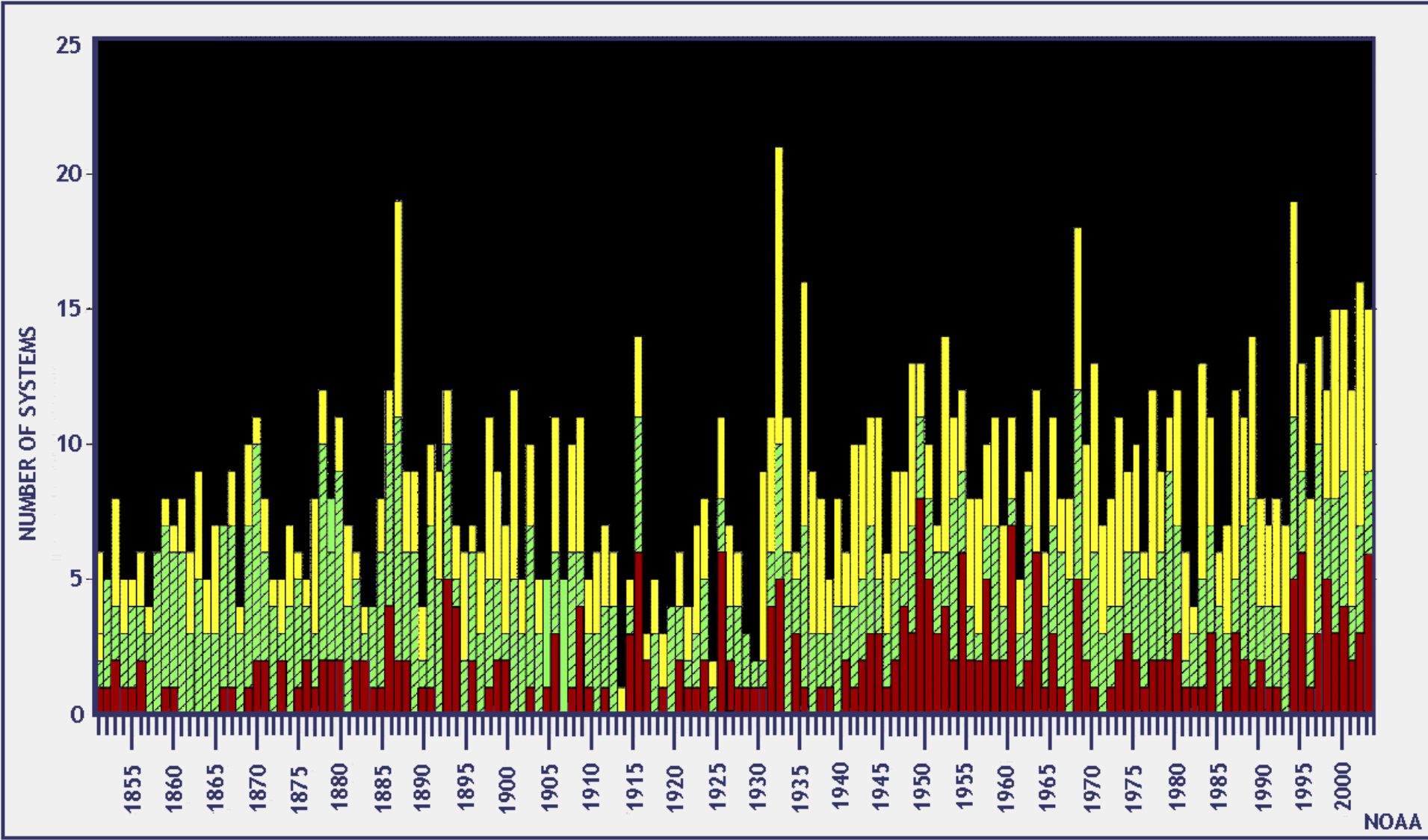


YTD 2006 1,136,987 ac

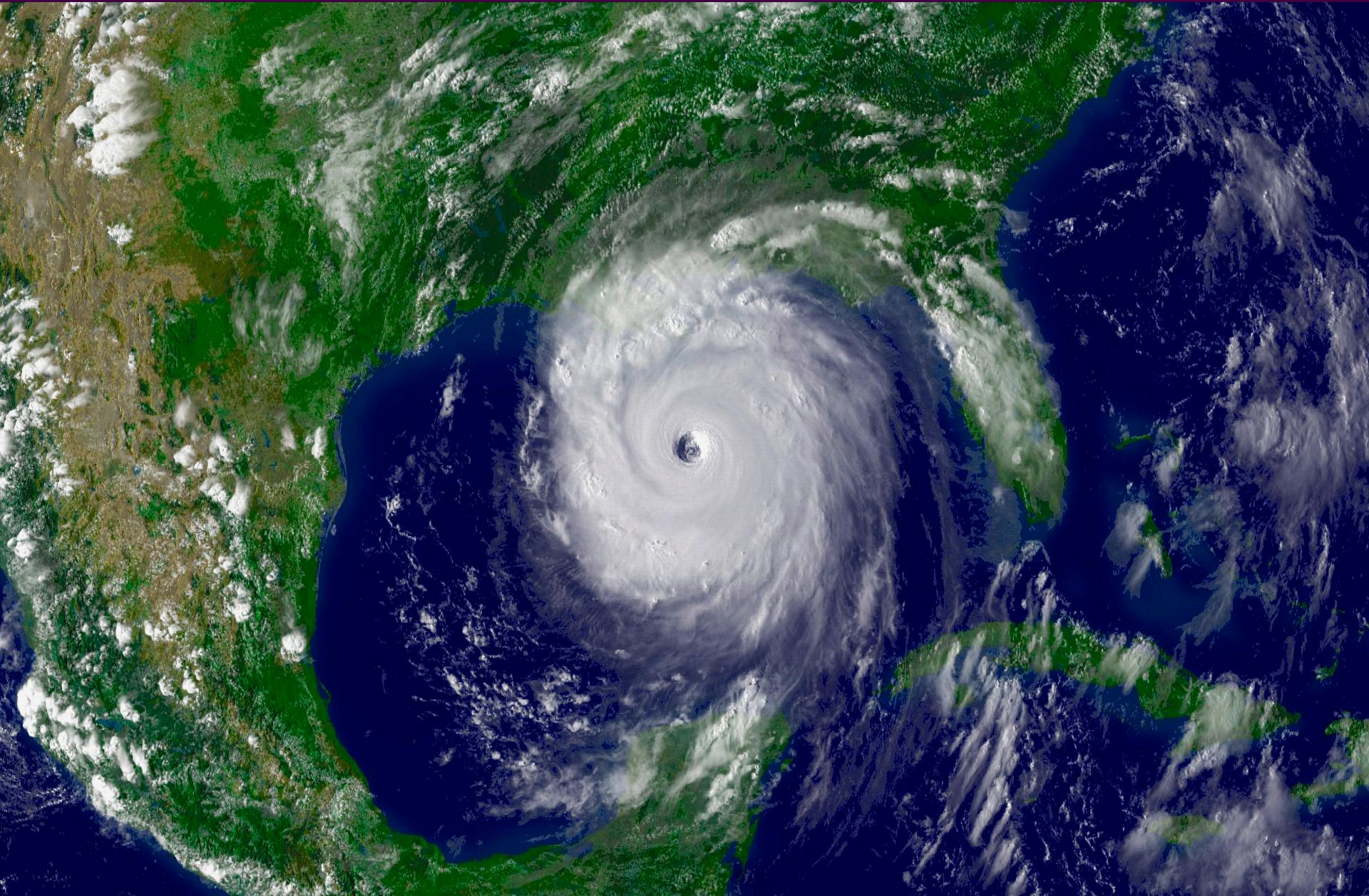
YTD 2011 3,166,885 ac

Source NIFC

Hurricanes per Year

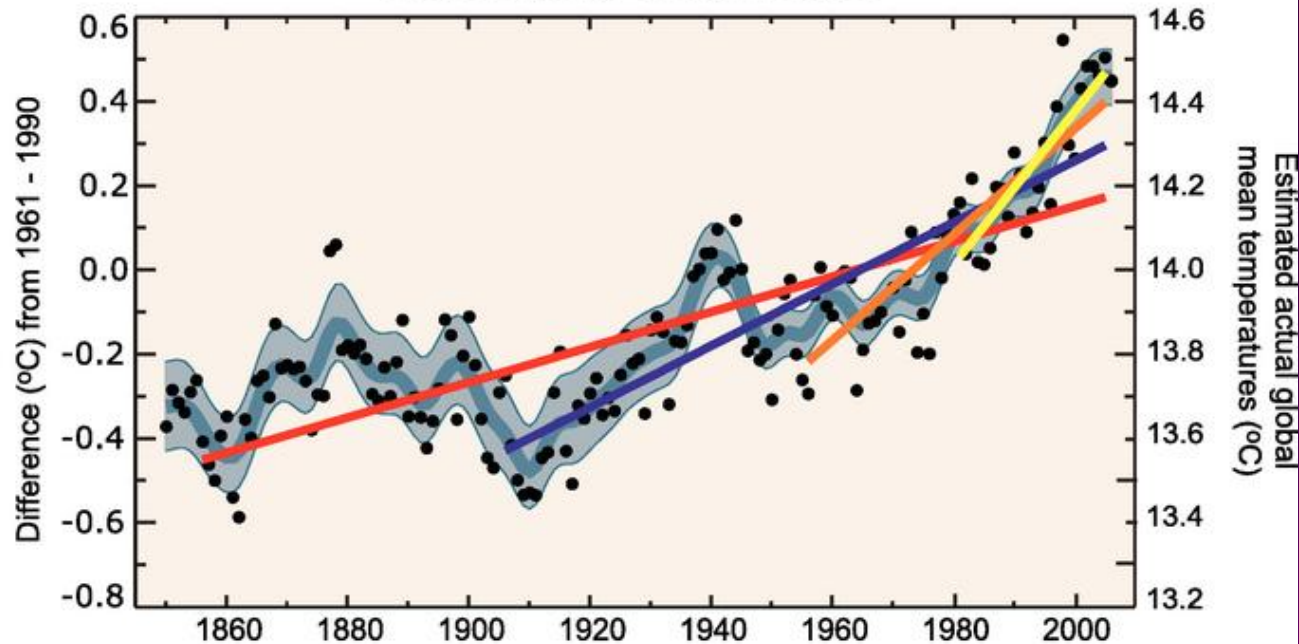


When is the next Katrina?

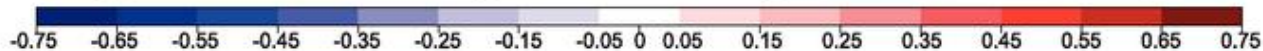
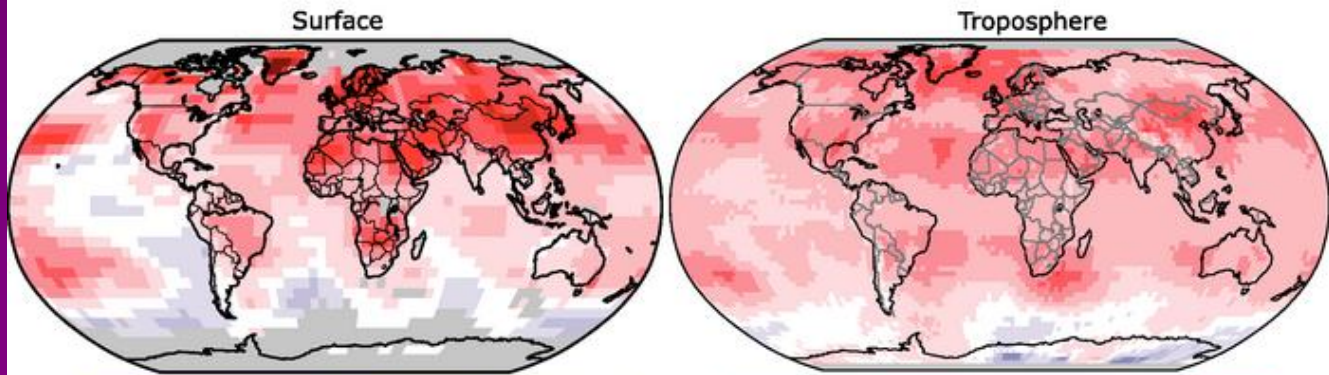


Current Impacts with high confidence
Of low medium term (decadal) variability

Global Mean Temperature

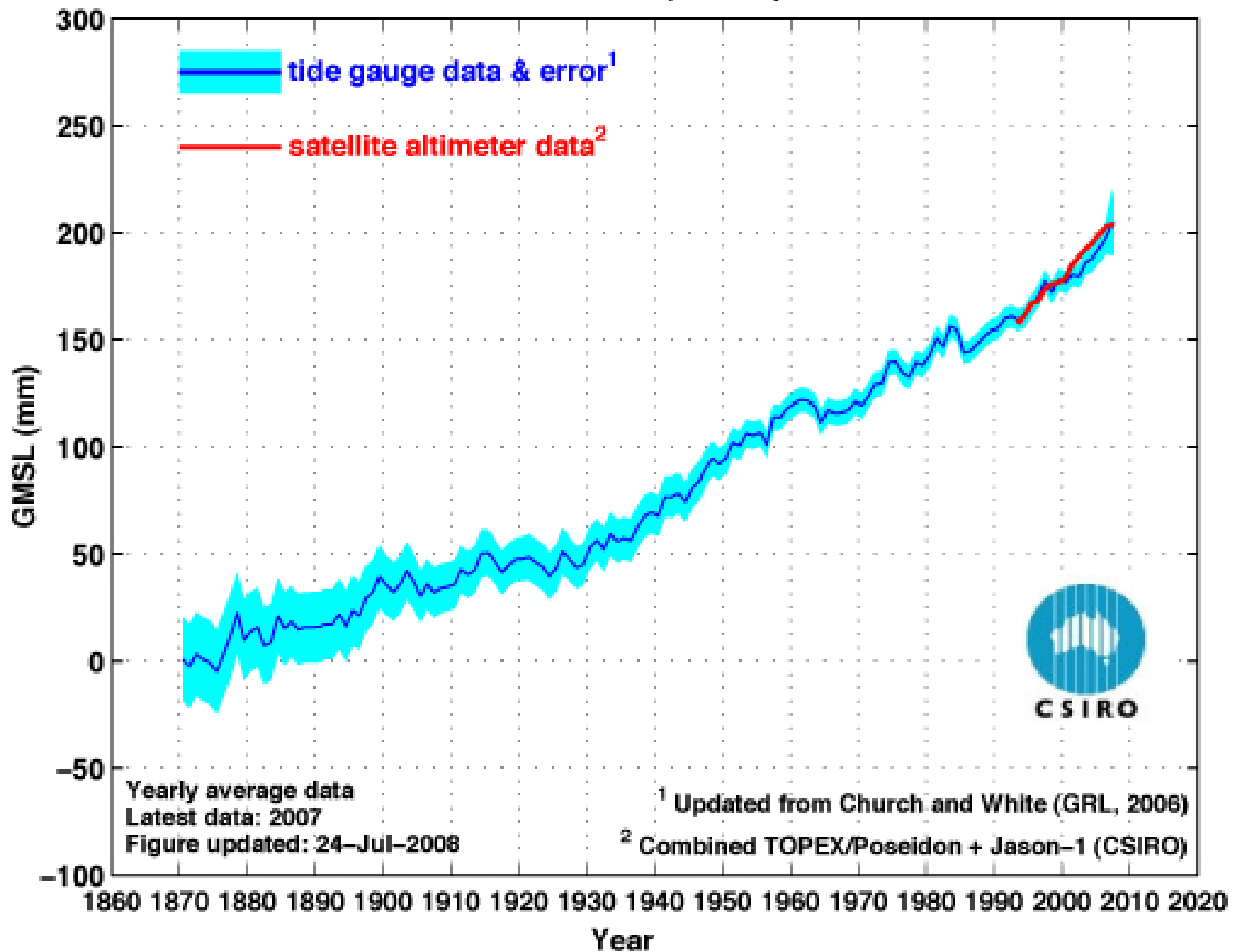


Period (Years)	Rate (°C per decade)
25	0.177 ± 0.052
50	0.128 ± 0.026
100	0.074 ± 0.018
150	0.045 ± 0.012



°C per decade

Global Mean Sea Level (GMSL) – 1870 to 2007



Sea Level Rise Pop Quiz!!

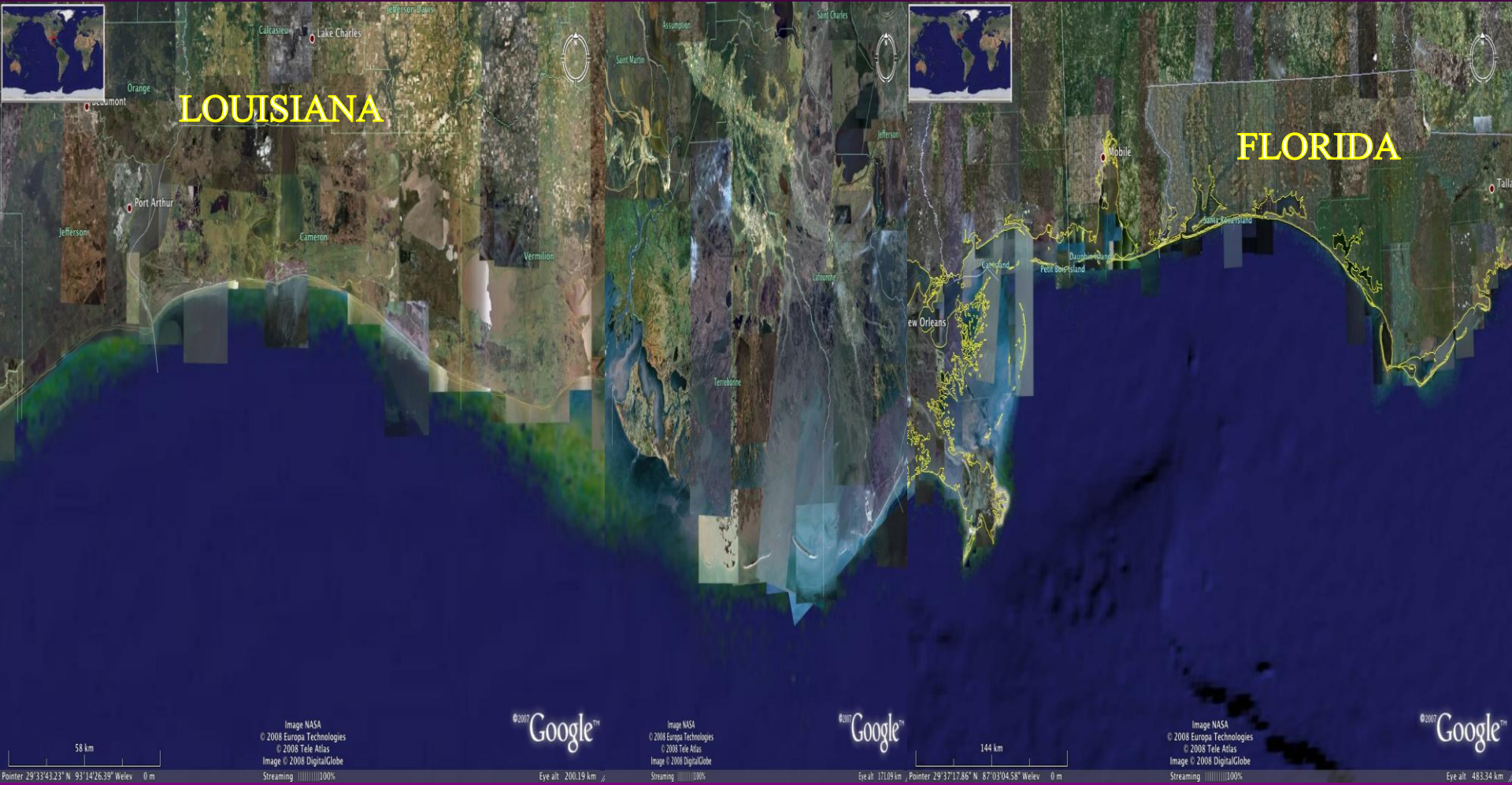


Thermo-expansion

Glacial Melting

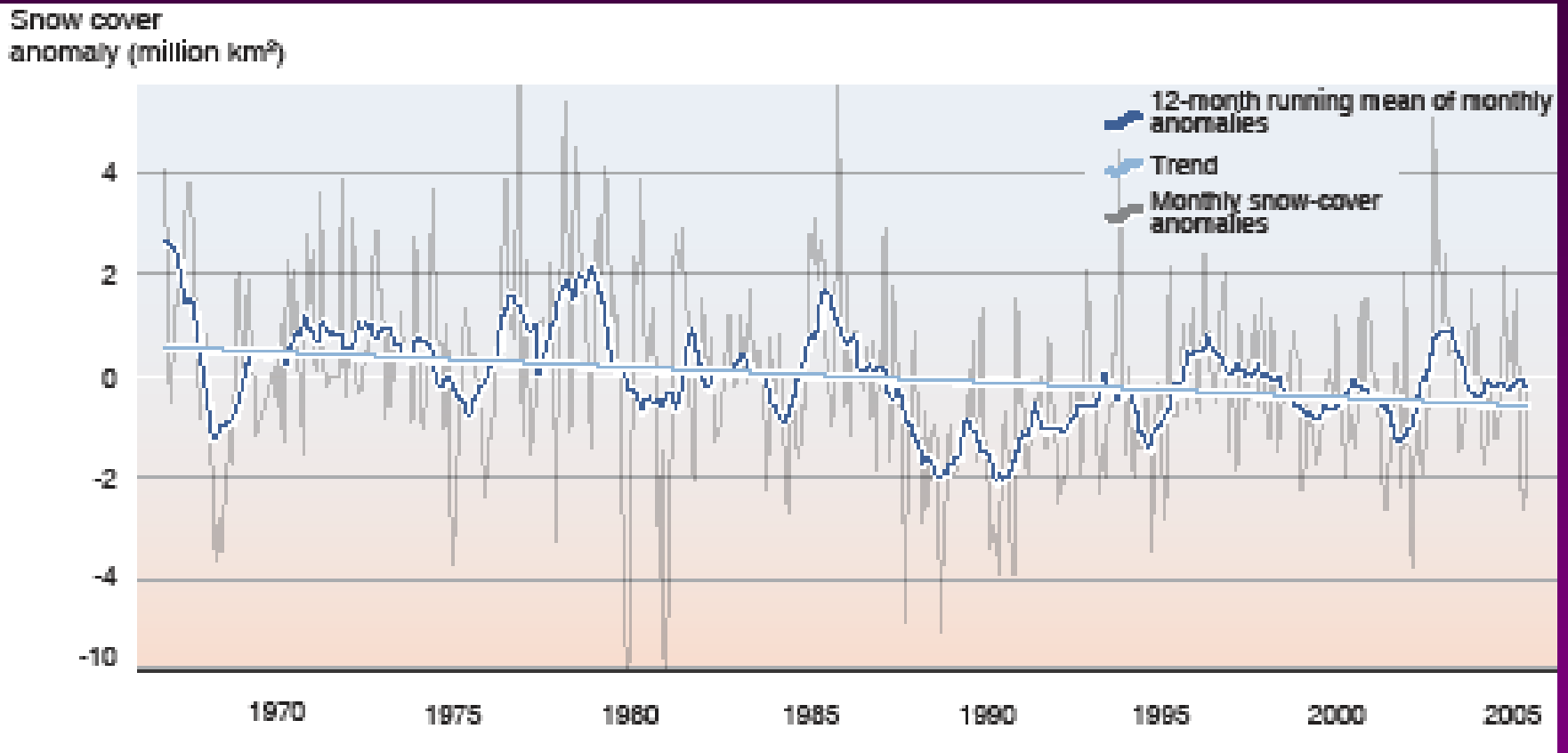
Melting Icebergs

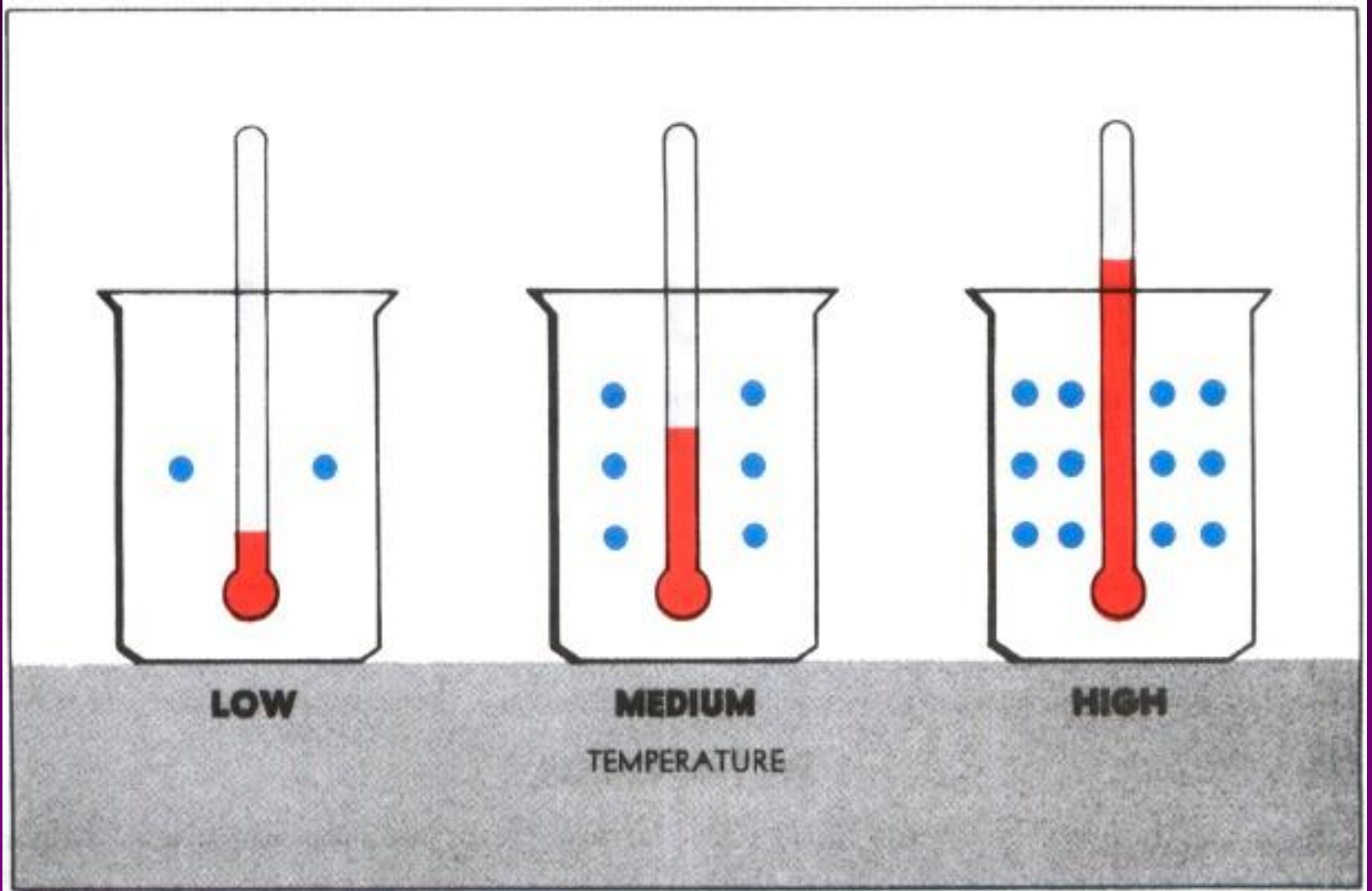
Results of Sea Level Rise



Gulf Coast Region

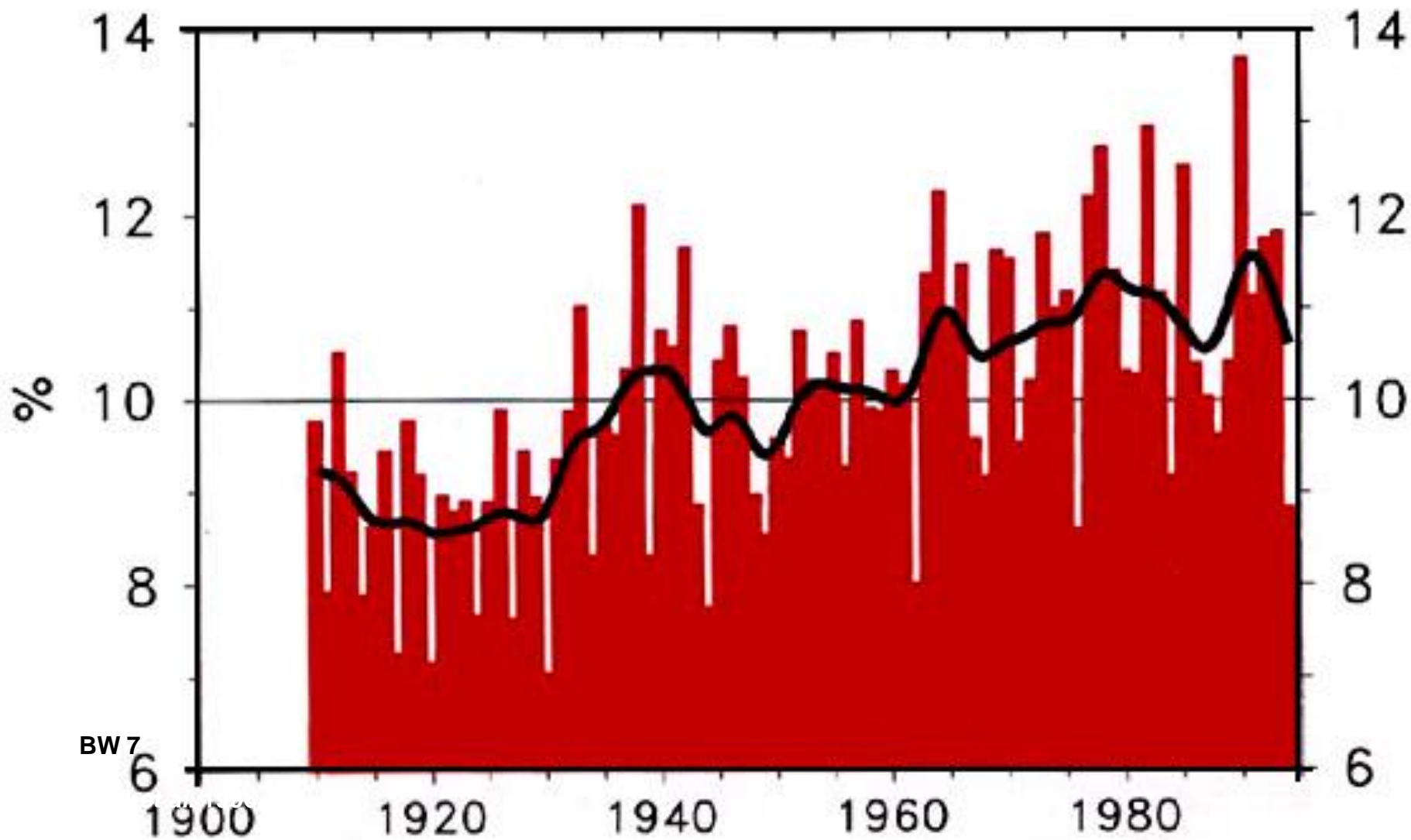
Northern Hemisphere Average Snow Cover





Source Aviation Weather

Percent of the continental USA with a much above normal proportion of total annual precipitation from 1-day extreme events (more than 2 inches or 50.8mm)



BW 7



With all the variability, and uncertainty
Who you gonna call?!



Resource Information

People

Tools

Websites

People

- Research Station Assistant Directors
- Region National Forest System Climate Change Coordinator
- Chiefs Advisors Office Staff (Cleaves et al).
- Senior Research Station climate scientists (e.g. Birdsey, Joyce, McNulty, Millar, Peterson)
- Linkages with other agency staff (through personnel listed above)

Tools

Models

- Carbon Models
 - Eg. COLE, FORCARB
- Water Models
 - E.g., WaSSI-CB, SWAT
- Species Change Models
 - E.g. Distrib-Shift

Literature

- FUTURES (southern US)
- IPCC TAR 4 (global)
- USGCRP SAP's (US)

Websites

Forest Service Climate Change Resource Center

<http://www.fs.fed.us/ccrc/>

EPA Climate Change

<http://www.epa.gov/climatechange/index.html>

USGS Climate Change

http://www.usgs.gov/global_change/

Fish and Wildlife Service Climate Change

<http://www.fws.gov/home/climatechange/>

State climate change offices

http://www.nc-climate.ncsu.edu/climate/climate_change

TACCIMO

<http://www.sgcp.ncsu.edu:8090/>

Take Home Points

- **There is a difference between uncertainty and variability**
E.g. wildfire risk and storm severity are high variable but we are very certain that this stresses will increase because the factors driving this factors are increasing over the long-term
- **Some ecosystem components are less variable than others**
E.g. 1990-1999 was the warmest decade until 2000-2009, etc..
- **Land managers now have many tools to assess and address impacts**
Much has been learned over the past 20 years, and the Forest Service is now much better equipped to address whatever challenges climate change might bring

Finally, a caution about limitations on knowledge

“As we know, There are known knowns. There are things we know we know. We also know. There are known unknowns. That is to say we know there are some things We do not know. But there are also unknown unknowns, the ones we don't know we don't know.”



Donald Rumsfeld Feb. 12, 2002
Department of Defense news briefing