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The Journey to Sustainability Begins with Education

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WACKY WEATHER?
WHAT'S UP WITH THAT? . . .
Updates from Science of Climate Change

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UF/IFAS Extension Sarasota County

WACKY WEATHER
WHAT'S UP WITH THAT?
Climate Change Series

Today's Topic

Topics In This Series:

1) Updates from Science of Climate Change
2) Impacts and Responses: Social Systems Human Health and Resilient Communities
3) Impacts and Responses: Agriculture and Food Systems
4) Impacts and Responses: Biodiversity and Ecosystems

WACKY WEATHER?

What Do You Mean?

Wacky . . . as in eccentric, crazy, erratic

WACKY WEATHER?

WAIT A MINUTE! AREN'T WE SUPPOSE TO BE SERIOUS HERE?

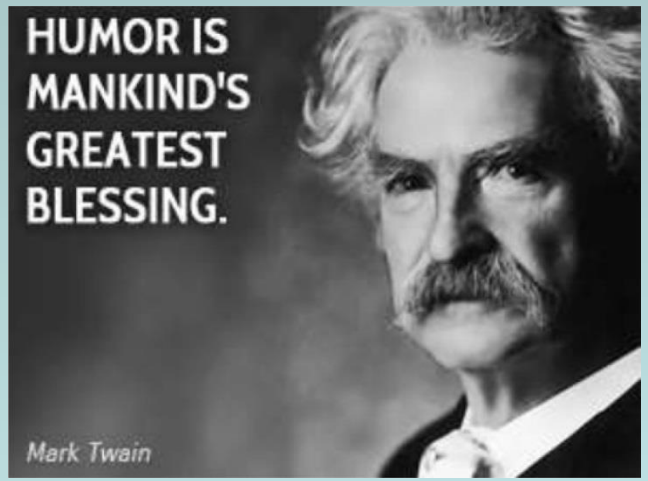
WELL YES! BUT WHO SAYS THAT WE CAN'T MAINTAIN A SENSE OF HUMOR ABOUT SERIOUS MATTERS?

If I had no sense of humor, I would long ago have committed suicide.

Mahatma Gandhi

A well-developed sense of humor is the pole that adds balance to your steps as you walk the tightrope of life.

William Arthur Ward



Extreme Weather Events Are Wacky Weather

- By definition, extreme weather events are rare and based on a long record of observations and data to establish definitive links between severe events and climate change.

First, Some Definitions . . .

- **Weather**

  - basically the way the atmosphere is behaving, mainly with respect to its effects upon life and human activities over a short period of time.

- **Climate**

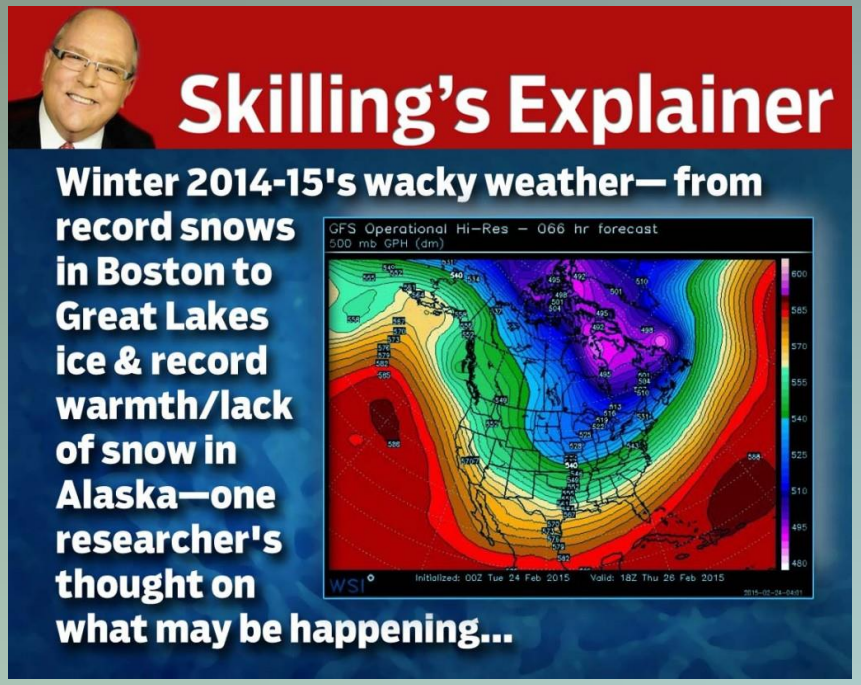
  - the average of weather over time and space over relatively long periods of time.

- **The difference between weather and climate is a measure of time.**

See the video 'Weather vs Climate Change' at https://www.youtube.com/watch?v=cBdxDFpDp_k

WACKY WEATHER?

Who Else Calls It ‘Wacky Weather’ ?



SCIENTISTS

EDUCATORS

MEDIA

The New York Times

“Making Sense of the Wacky Weather” By JUSTIN GILLIS MARCH 30, 2012 – see https://green.blogs.nytimes.com/2012/03/30/making-sense-of-the-wacky-weather/?_r=0

The Many Faces of Climate Change

The Many Faces of Climate Change…

… storms, floods, and forest fires have battered the U.S.

East Coast Flooding, 2013

Super Storm Sandy, 2012

The Many Faces of Climate Change…

… storms, floods, and forest fires have battered the U.S.

Arizona Extreme Wildfires, 2014

US Mega Wildfires, 2015

The Many Faces of Climate Change…

… including super tornados in the U.S.

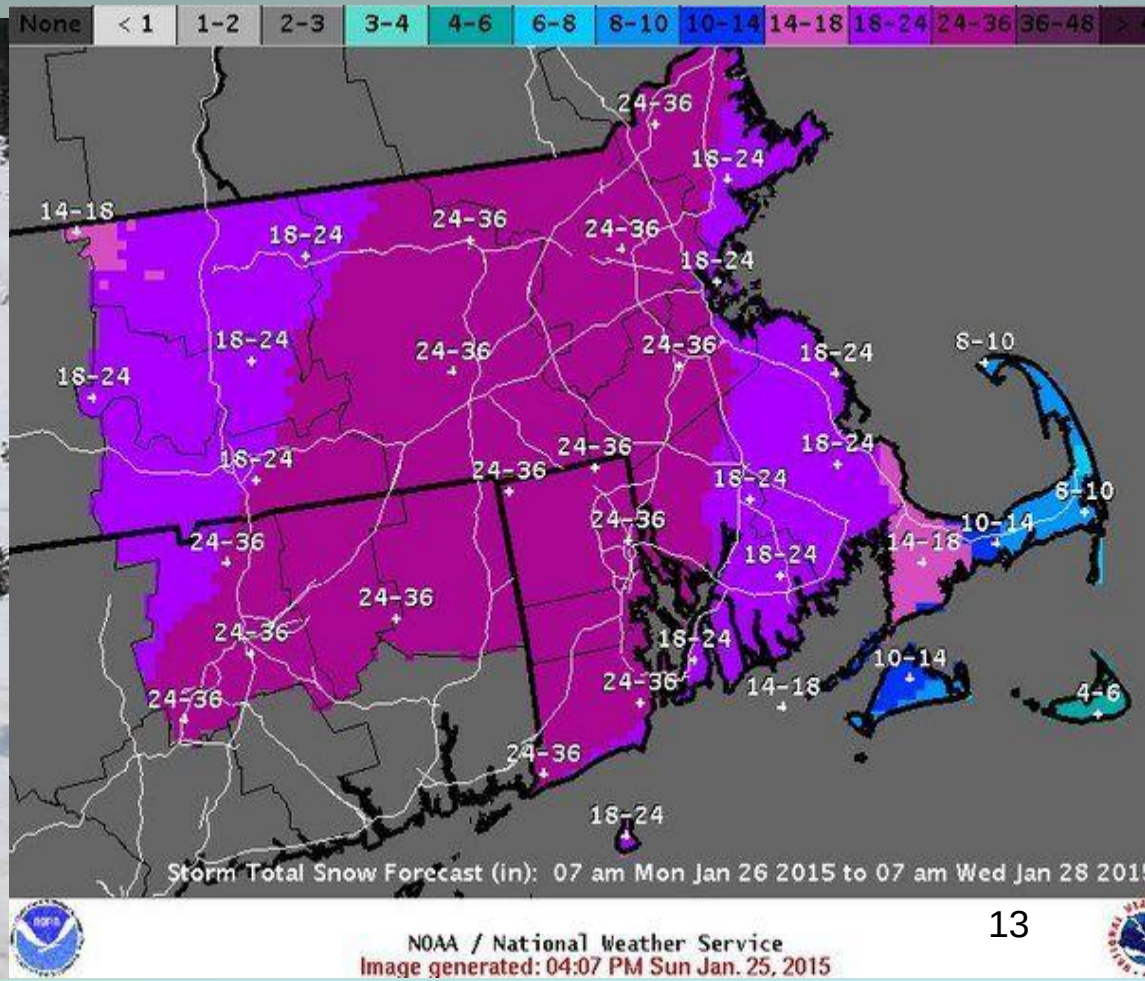
EF5 tornado, Oklahoma, May 2013

The Many Faces of Climate Change…

…and blizzards raged across US and Europe

2014 Europe Winter Storms

2015 New England Blizzard



The Many Faces of Climate Change…

…also floods have battered the world.

Flood Area

Europe Floods, 2013

http://en.wikipedia.org/wiki/2013_European_floods

The Many Faces of Climate Change…

…also floods have battered the world.

http://en.wikipedia.org/wiki/2013_European_floods

Europe Floods, 2013

The Many Faces of Climate Change…

…also floods have battered the world.

http://en.wikipedia.org/wiki/2013_European_floods

Europe Floods, 2013

The Many Faces of Climate Change…

…also droughts have ravaged the world.

CA Drought, 2015

The Many Faces of Climate Change…

…also, storms have battered the world.

Super Typhon Haiyan in Phillippines, Jan 2014

Arctic Polar Ice Cap Melting Over Time

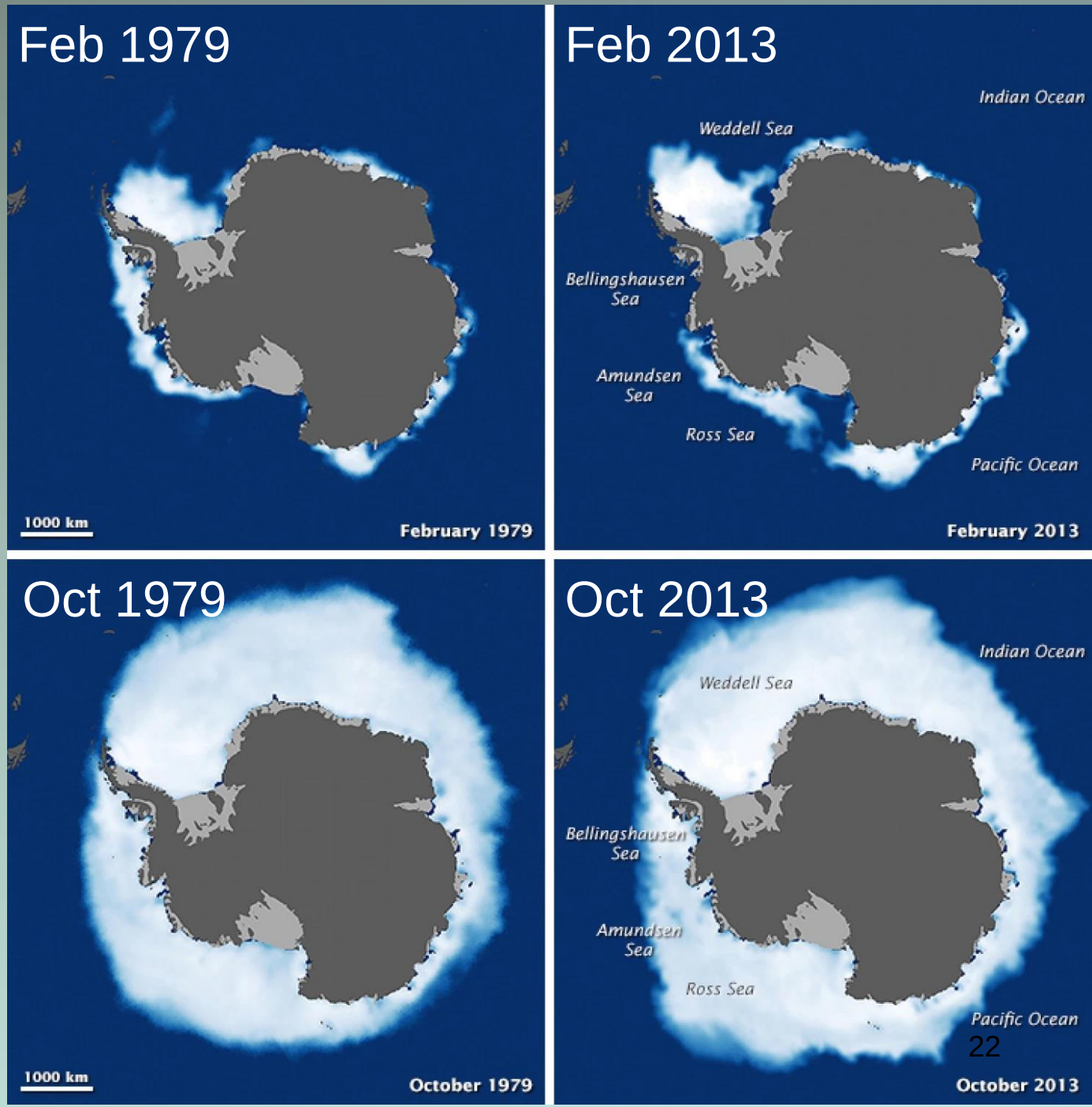
See the video “Arctic Ice: at https://www.youtube.com/watch?v=iS_XfvSylCs

Global Polar Ice Cap Melting Trends

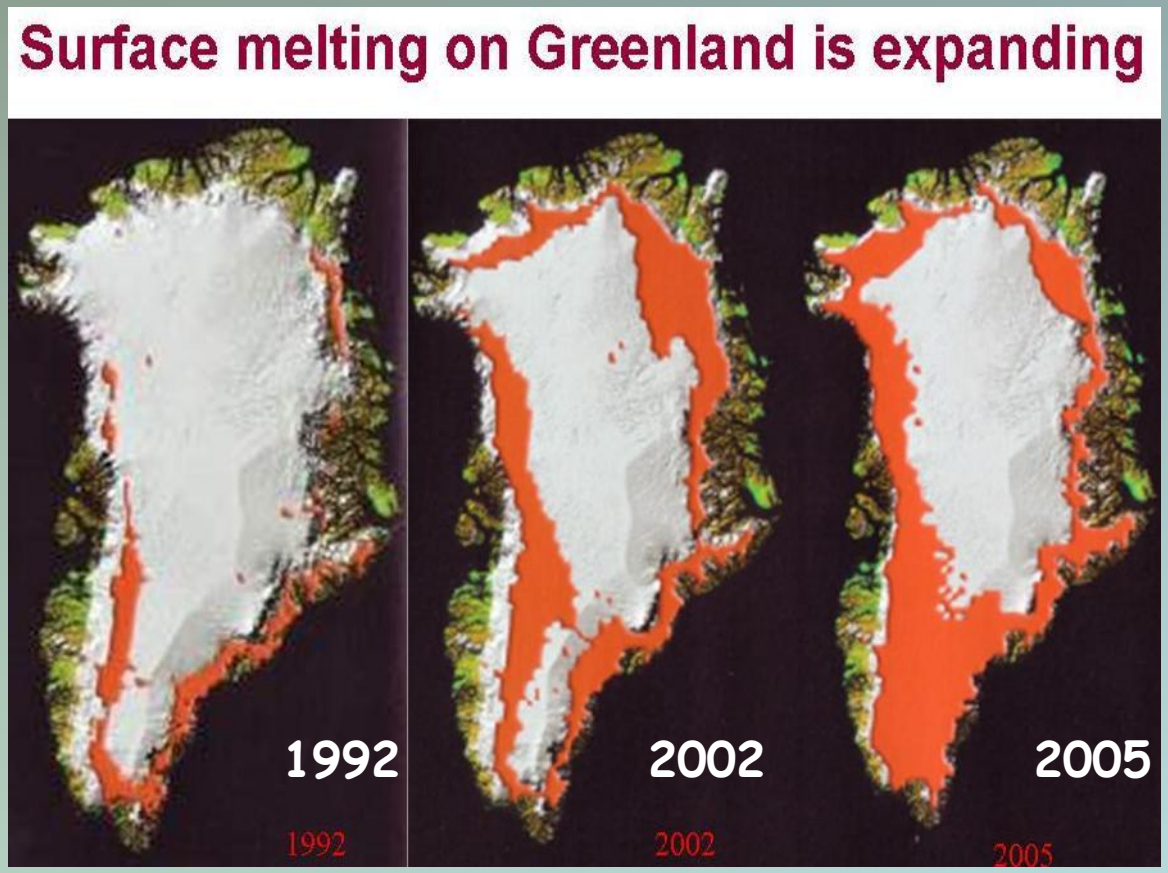
- NASA 2014 study reports the Earth, as a whole, has been losing sea ice at annual rate of 13,500 square miles per year, an area roughly the size of the state of Maryland.
- Global sea ice loss has actually accelerated in the last 17 years.
- Ice cap melting trends:
  - Arctic ice cap continues to show losses
  - Antarctic ice cap recently showed gains

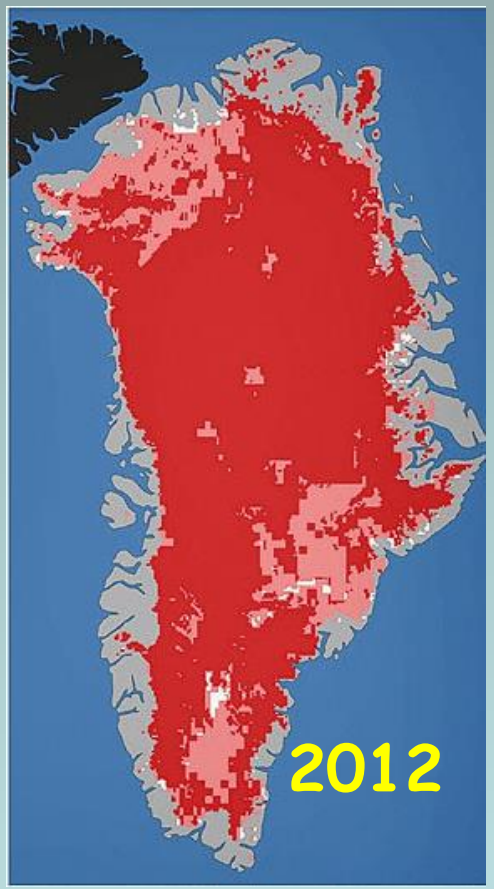
http://journals.ametsoc.org/doi/abs/10.1175/JCLI-D-14-00605.1

Antarctic Polar Ice Cap Changes Over Time



Greenland Ice Sheet Surface Melting Timeline

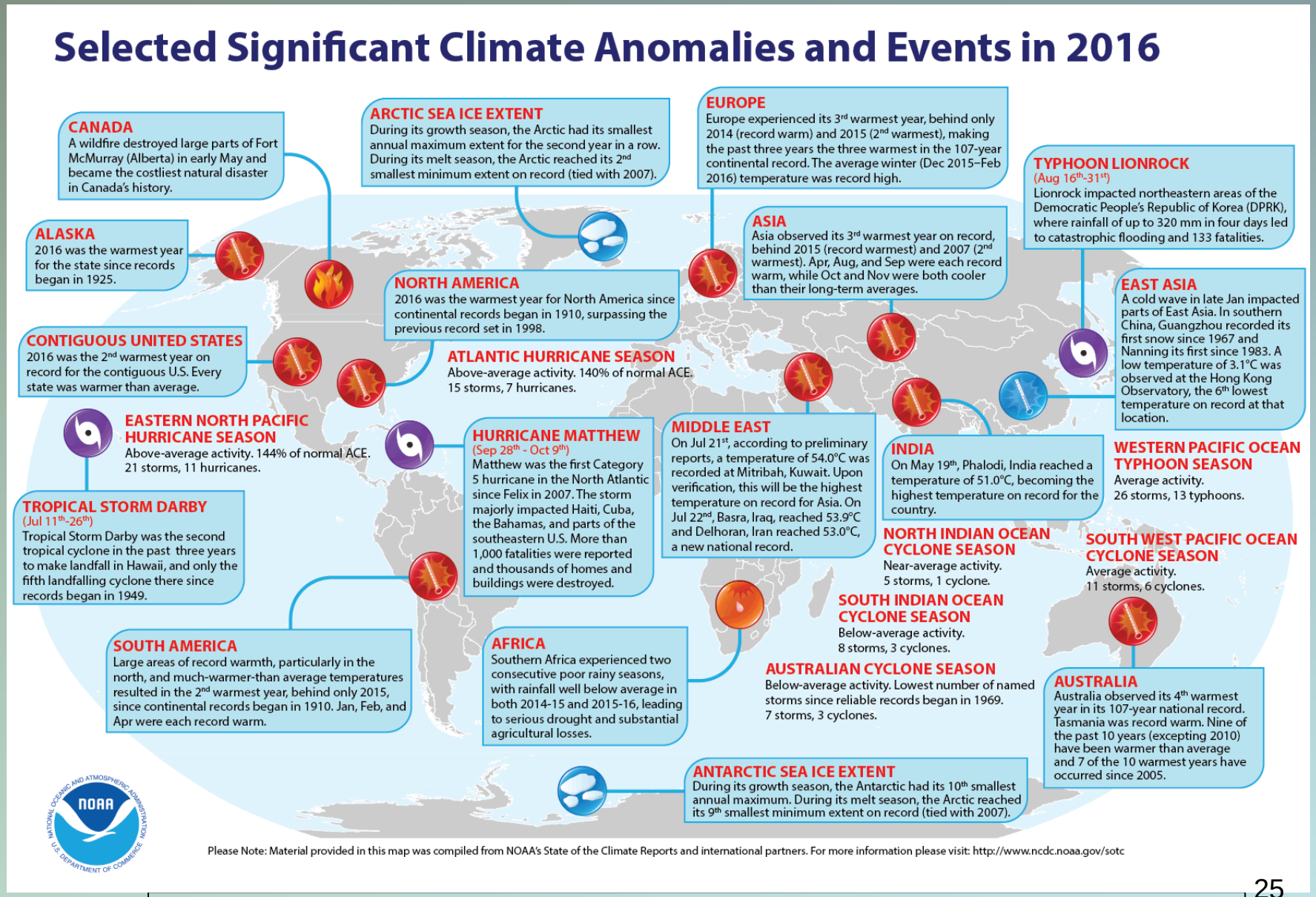




Images from NASA

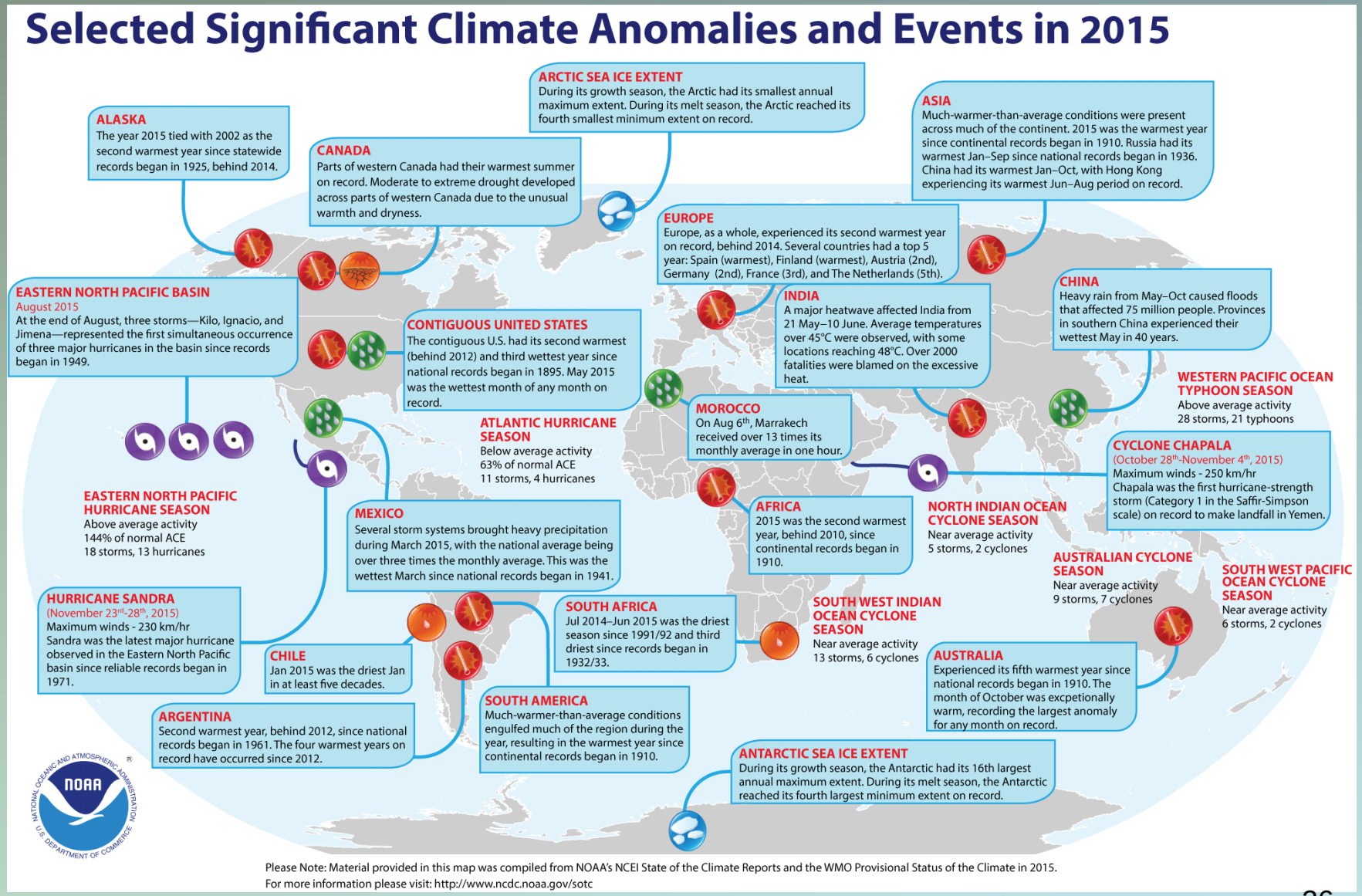
- 2012 – 97% of ice sheet surface has melted!

The Many Faces of Climate Change…



https://www.ncdc.noaa.gov/sotc/service/global/extremes/201613.gif

The Many Faces of Climate Change…



https://www.ncdc.noaa.gov/sotc/service/global/extremes/201513.gif

UPDATE: 2016 is Earth's New Warmest Year by Widest Margin on Record !

RANK 1 = WARMEST PERIOD OF RECORD: 1880–2016	YEAR	ANOMALY °C	ANOMALY °F
1	2016	0.94	1.69
2	2015	0.90	1.62
3	2014	0.74	1.33
4	2010	0.70	1.26
5	2013	0.67	1.21
6	2005	0.66	1.19
7	2009	0.64	1.15
8	1998	0.63	1.13
9	2012	0.62	1.12
10 (tie)	2003	0.61	1.10
10 (tie)	2006	0.61	1.10
10 (tie)	2007	0.61	1.10

https://www.ncdc.noaa.gov/sotc/global/201613

Who Says So ?

- Intergovernmental Panel on Climate Change (IPCC)
- Scientific body under auspices of the U.N.
- Currently 195 countries have scientist panel members
- Reports endorsed by Science Academy & government of all panel member countries
- Fifth Assessment Report (AR5) released in 2014

http://www.ipcc.ch/

What Does the IPCC Really Say?

Watch the video ‘Climate Change: The State of the Science’ at https://www.youtube.com/watch?v=_EWOrZQ3L-c

What Does the AR5 Say?

- The AR5 provides a clear and up to date view of the current state of scientific knowledge relevant to climate change.
- It consists of three Working Group (WG) reports:
  - Mitigation of Climate Change – options & their underlying technological, economic and institutional requirements
  - Impacts, adaptations & vulnerability – exposure and future risks of human and natural systems, and the potential for and limits to adaptation
  - Physical Science Basis - a comprehensive assessment including a detailed climate change observations throughout the climate system
- And a Synthesis Report (SYR) which integrates and synthesizes material in the WG reports for policymakers

http://www.ipcc.ch/

What Does the AR5 Say ?

Partial Summary of Impacts

- Total anthropogenic GHG emissions have continued to increase from 1070 to 2010 with largest increases at end of this period
- CO_2 emissions from fossil fuel combustion & industrial processes contributed about 78% of these increases
- Without additional efforts to reduce GHC emissions beyond those in place today, emissions growth is expected to increase driven by population growth and economic activities

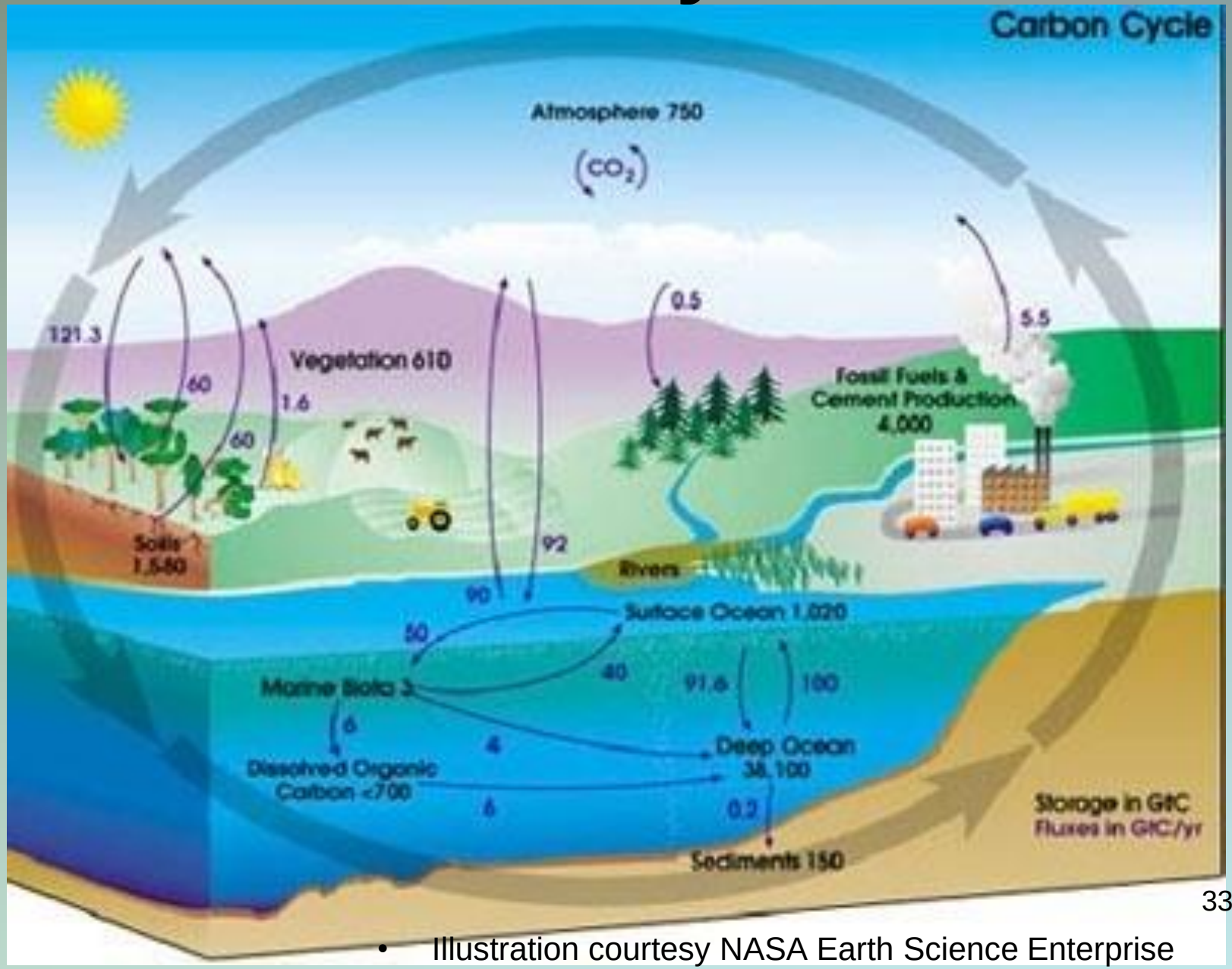
http://www.ipcc.ch/

What Does the AR5 Say ?

Partial Summary of Impacts (Cont.)

- Such a scenario will result in CO_2 equivalent concentrations in 2030 of > 450 ppm and in 2100 of 750-1300 ppm compared to 430 ppm in 2011.
- Such a scenario will result in global mean surface temperature increases in 2100 of 3.7^o to 4.8^o C (6.7^o to 8.6^o F) compared to pre-industrial levels (i.e., before 1750)

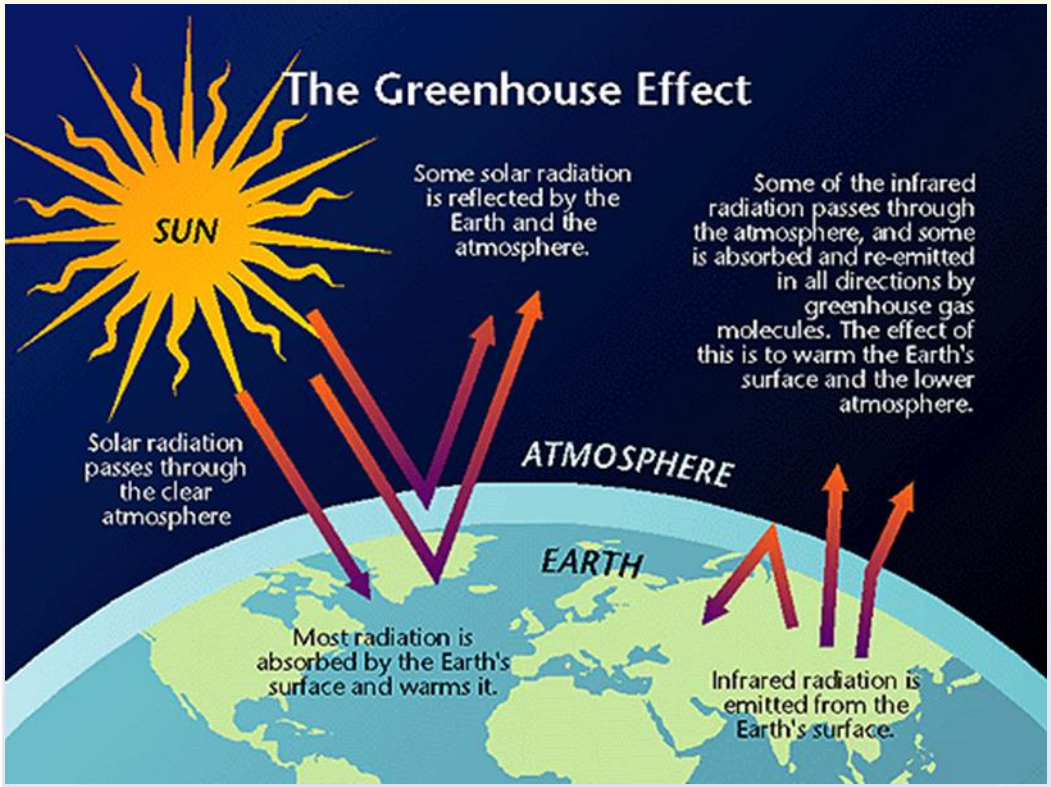
Global Carbon Cycle Science



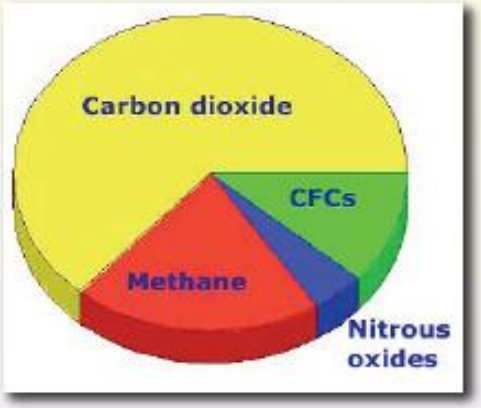
- Illustration courtesy NASA Earth Science Enterprise

Global Warming Science

The problem: greenhouse gases absorb and radiate heat to the lower atmosphere.



Relative importance



Greenhouse gases are higher now than in over 650,000 years

See the video 'Explanation of Climate Change' at https://www.youtube.com/watch?v=6VUPIX7yEOM

Remember These Definitions . . .

- **Global Warming**

  - an increase in average global temperature as influenced by increased greenhouse gas concentrations without regard to other factors that may cause climate change

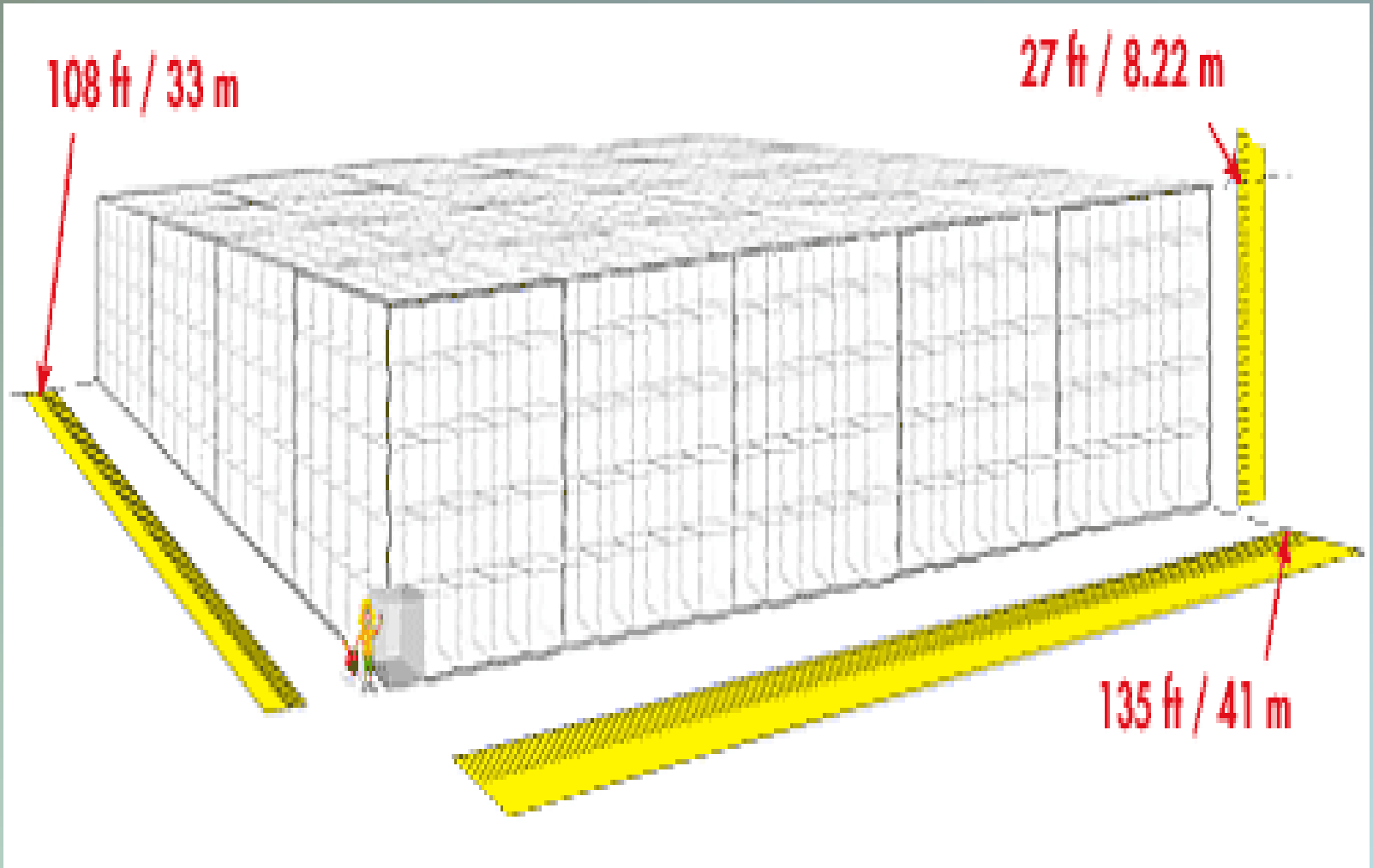
- **Climate Change**

  - changes in the atmosphere over time scales ranging from weeks to decades to millions of years.

  - vary by natural processes internal to the Earth (e.g., continental drift), external forces (e.g., solar energy), and human activities which affect global wind patterns, rainfall, and temperatures.

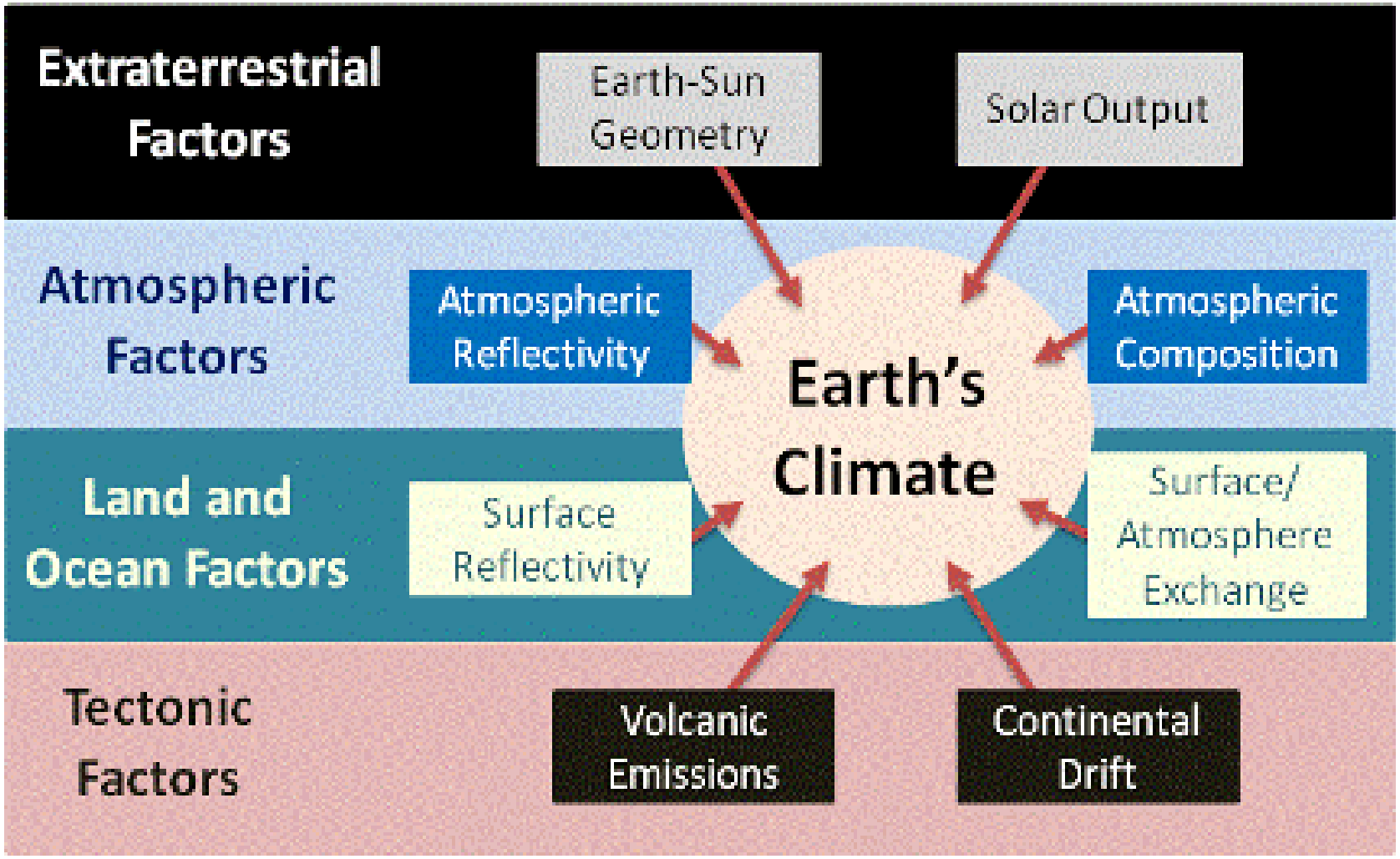
See the short video "Climate Change" at
https://www.youtube.com/watch?v=TQlHaGhYoF0

Making Visible Our Carbon Footprint



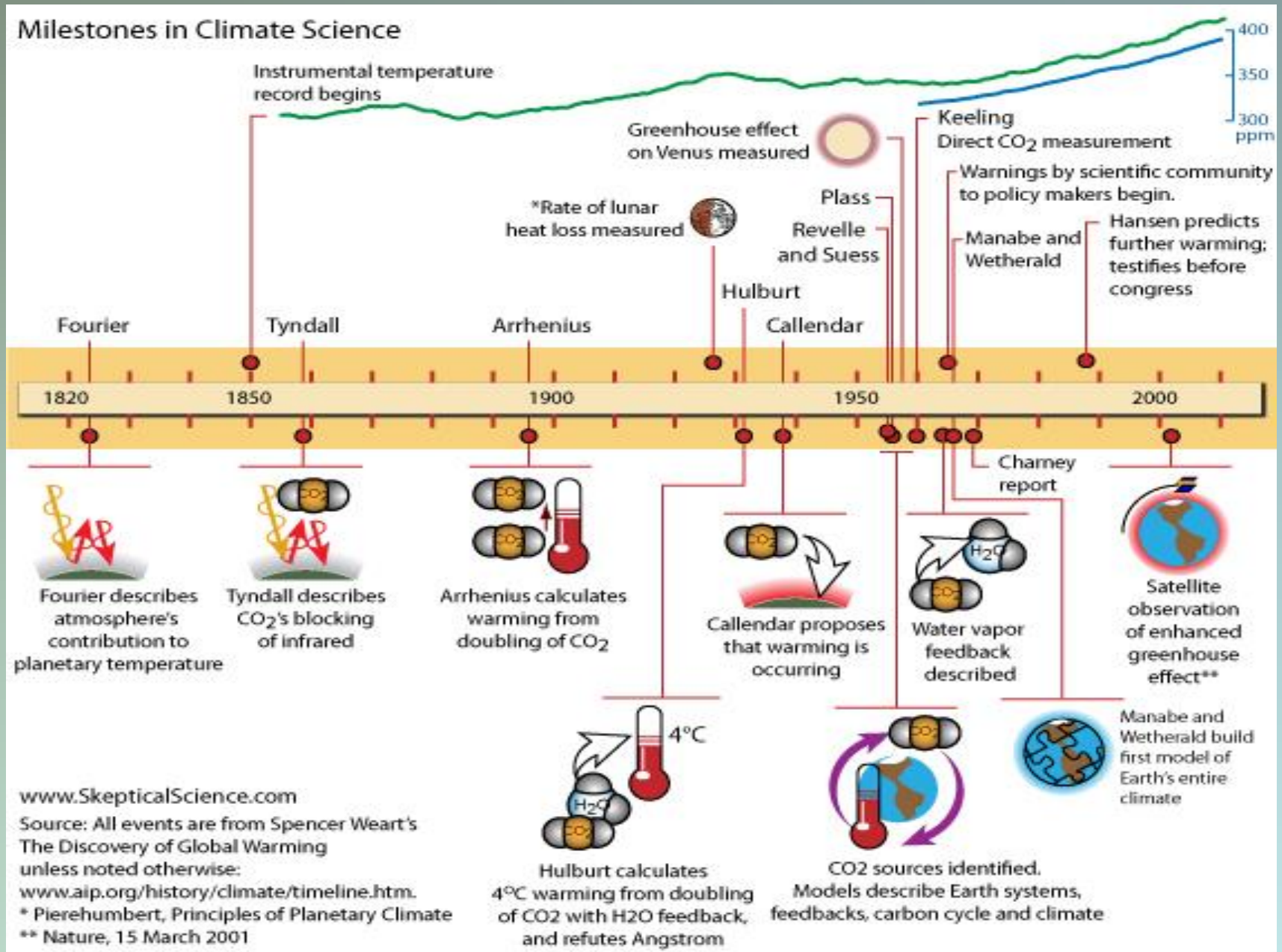
To sustain one person, the US produces 22 tons of CO_2 per year.

Climate Change Science



http://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/Browse_by_Topic/ClimateChange

History of Science of Climate Change

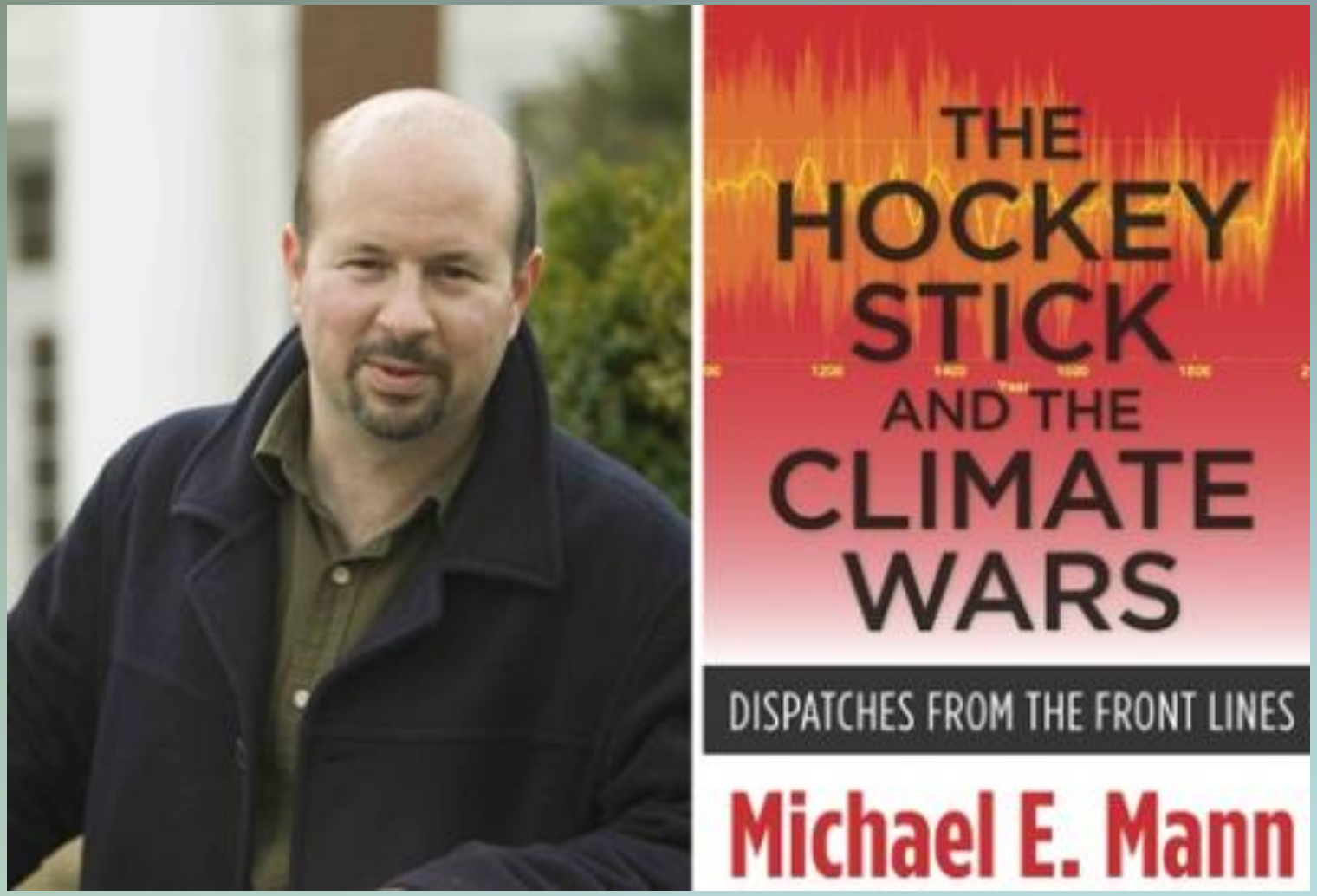


http://www.skepticalscience.com/introducing-history-of-climate-science.html

History of Science of Climate Change

Watch the video ‘CO_2 at the Top of the World’’ at
http://yearsoflivingdangerously.com/video/co2-top-world/

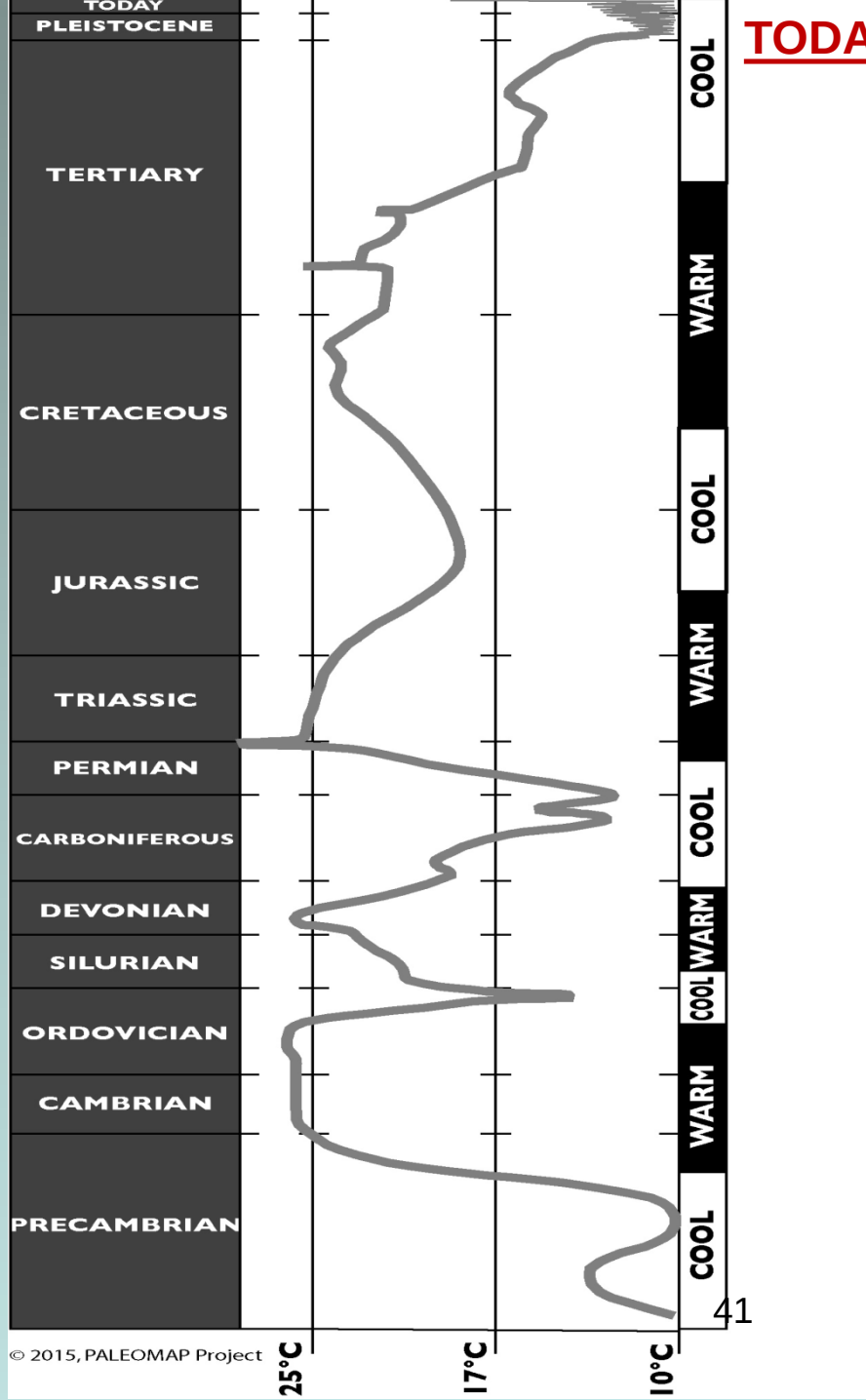
History of Science of Climate Change



Watch the video 'The Hockey Stick at 16' at
http://yearsoflivingdangerously.com/video/hockey-stick-16/

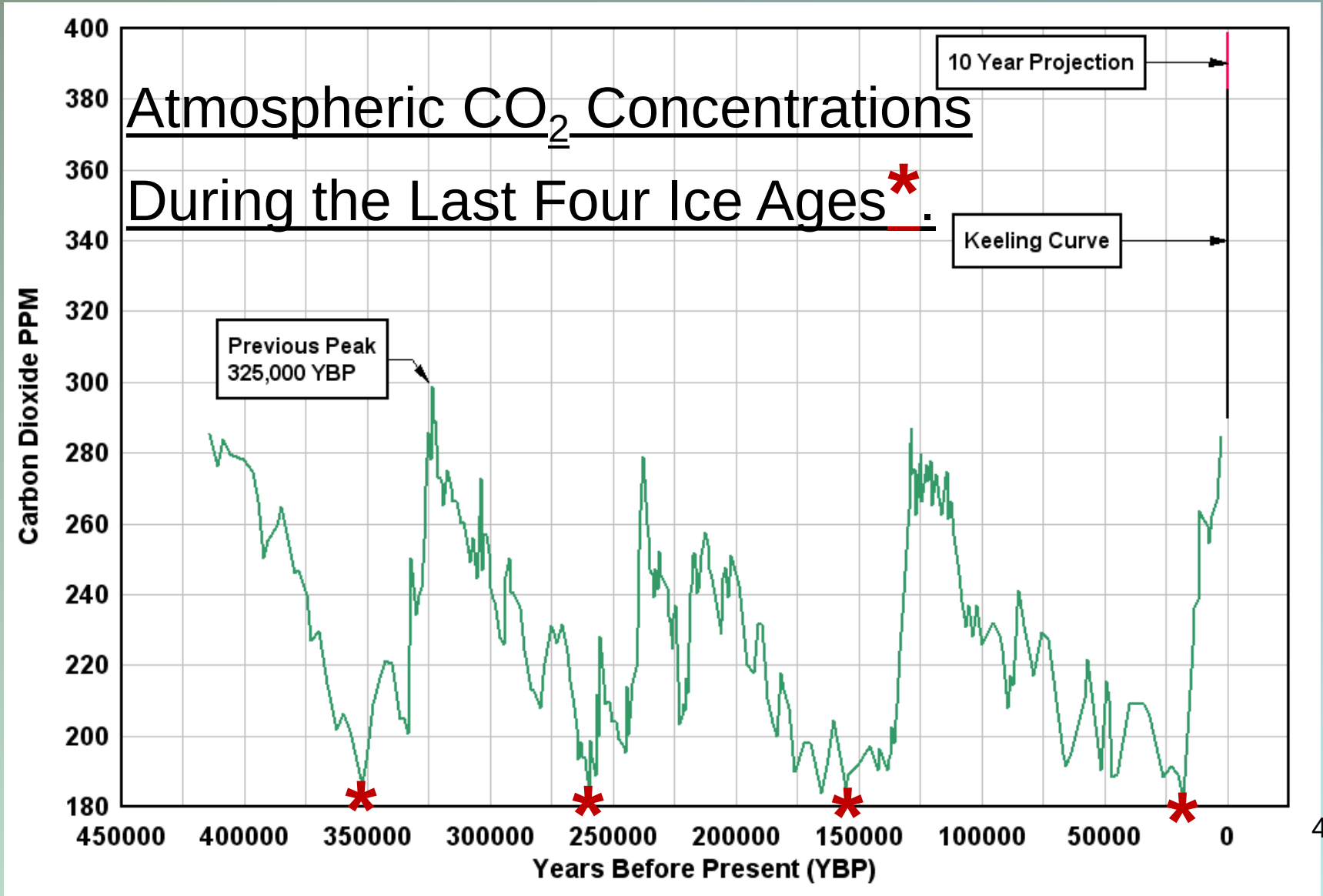
Geological History of Atmospheric CO_2 Concentrations

- During the last 2 billion years the Earth's climate has alternated between a frigid "Ice House“ and a steaming "Hot House“.



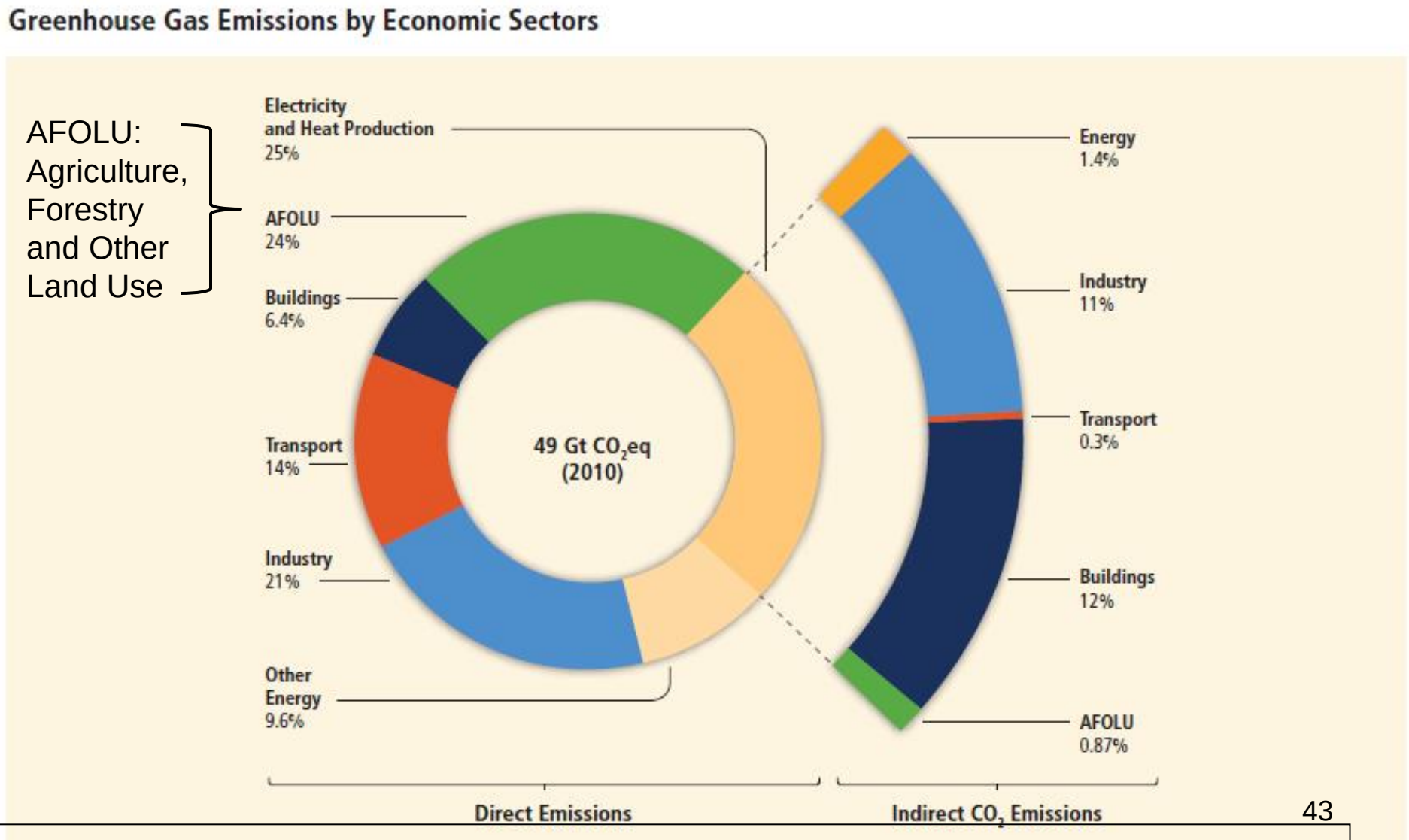
http://www.scotese.com/climate.htm

History of Atmospheric CO_2 Conc. And Occurrence of Ice Ages



http://www.planetforlife.com/co2history/

Science of GHG Emissions From Human Activities



http://report.mitigation2014.org/spm/ipcc_wg3_ar5_summary-for-policymakers_approved.pdf

Science of Climate Change

Climate scientists can use weather data averaged over time plus **proxy data** to help them identify previous trends to improve their predictions of future trends.

What Are Proxy Data?

Proxy data include biological, cryological (which refers to frozen water), geological, and historical records that scientists use to deduce Earth's atmospheric conditions in the distant past. By examining evidence such as the tree rings of old-growth trees and ice core samples taken from glaciers, scientists can figure out what Earth's temperature, greenhouse gas composition, and precipitation levels were like over the course of its geologic history.

See the videos 'Mountain Expedition' and 'Ice Core Climate Record' of 'Years of Living Dangerously' series at Access Video of Sarasota County Library at http://sarac.co.sarasota.fl.us/

Science of Climate Change

Once More, Weather Vs Climate Forecasting

- Meteorologists predict local or regional atmospheric conditions for the hours, days, or weeks ahead. Prediction tends focus primarily on real-time (current) data.
- Climate scientists, on the other hand, look at atmospheric conditions in terms of averages and trends (patterns) that have occurred over many decades, centuries, and millennia.

See the video 'Tree Rings' at http://www.sho.com/sho/video/titles/29655/tree-rings

Tools Used to Forecast Climate & Weather

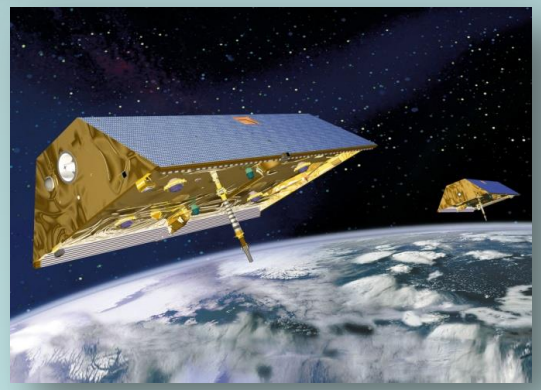
➢Weather balloons, satellites, specially designed airplanes, and radar and other ground-based data collection instruments are used to measure

- wind speed
- Precipitation
- air temperature
- humidity levels, etc.

➢Reliable records have been kept since 1800s and provide accurate weather forecasts (weekly and daily).

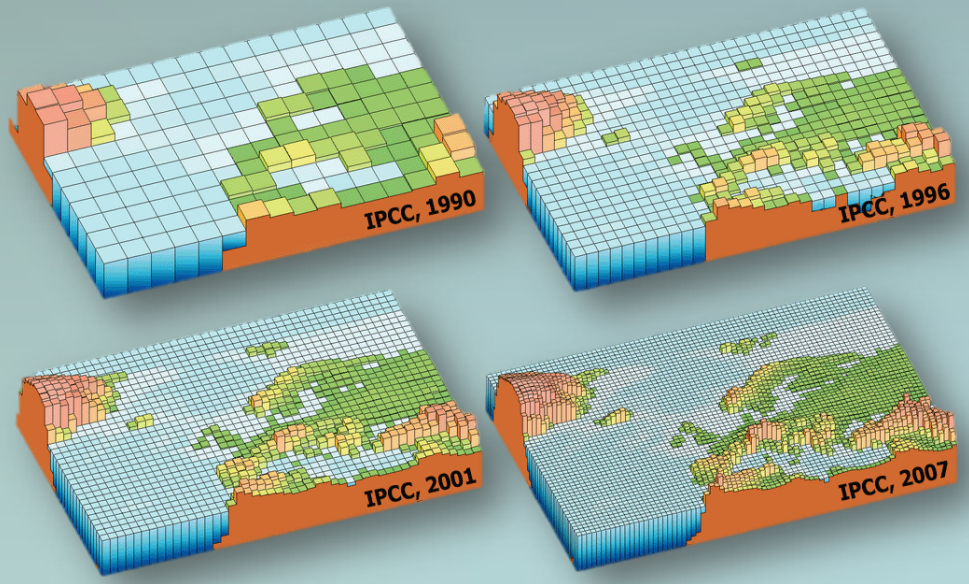
➢Sophisticated Earth-observing satellites equipped with remote-sensing equipment circle the globe to

- record sea surface and other temperatures,
- measure atmospheric gases and rainfall amounts,
- take visible and infrared photos of Earth's surface, and
- calculate Earth's outgoing infrared and reflected solar radiation.



Global Climate Models

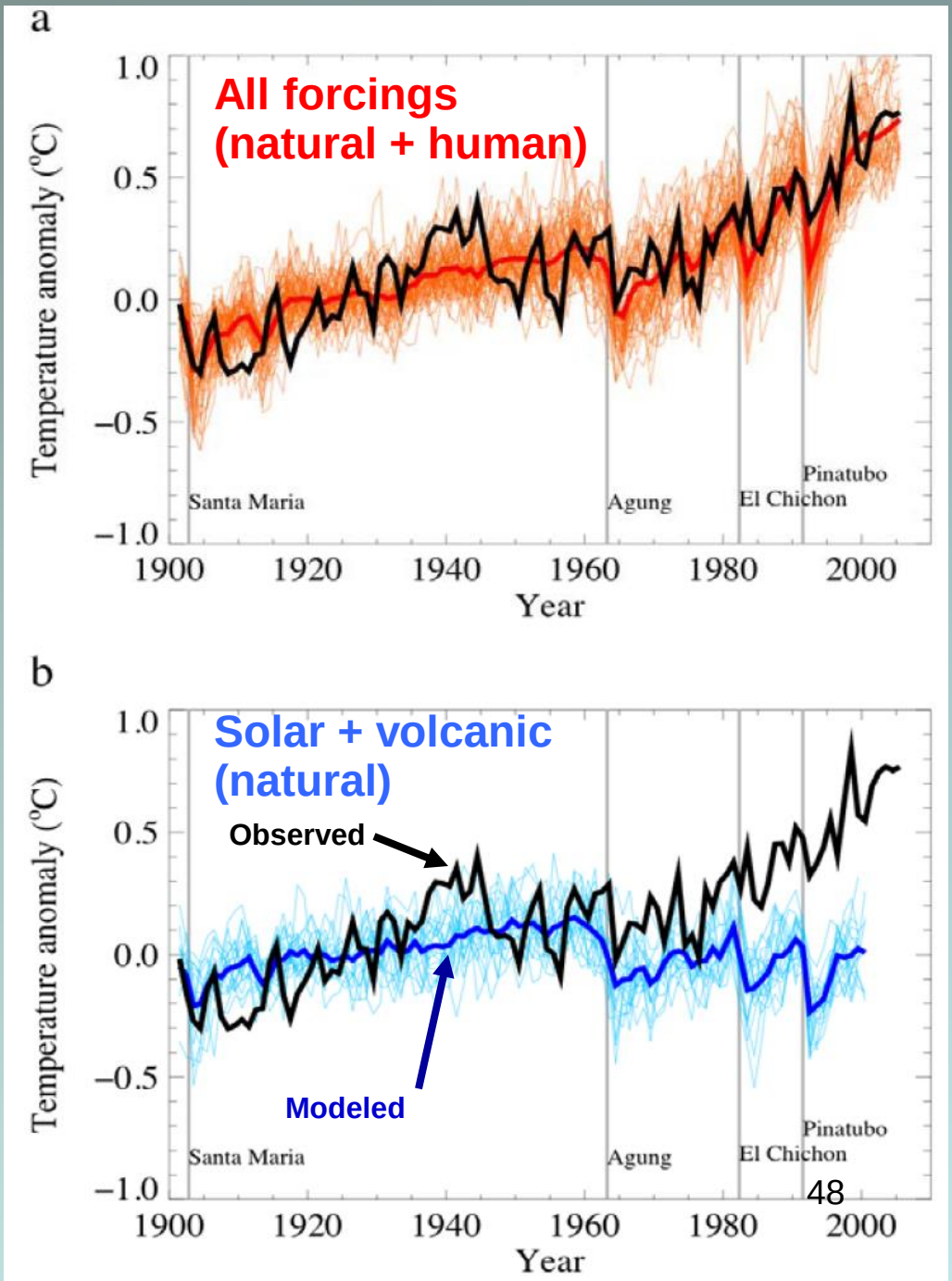
Climate scientists also use increasingly higher resolution computer models, known as **global climate models**, to simulate the physical processes of the atmosphere and oceans and make predictions about future climate scenarios.



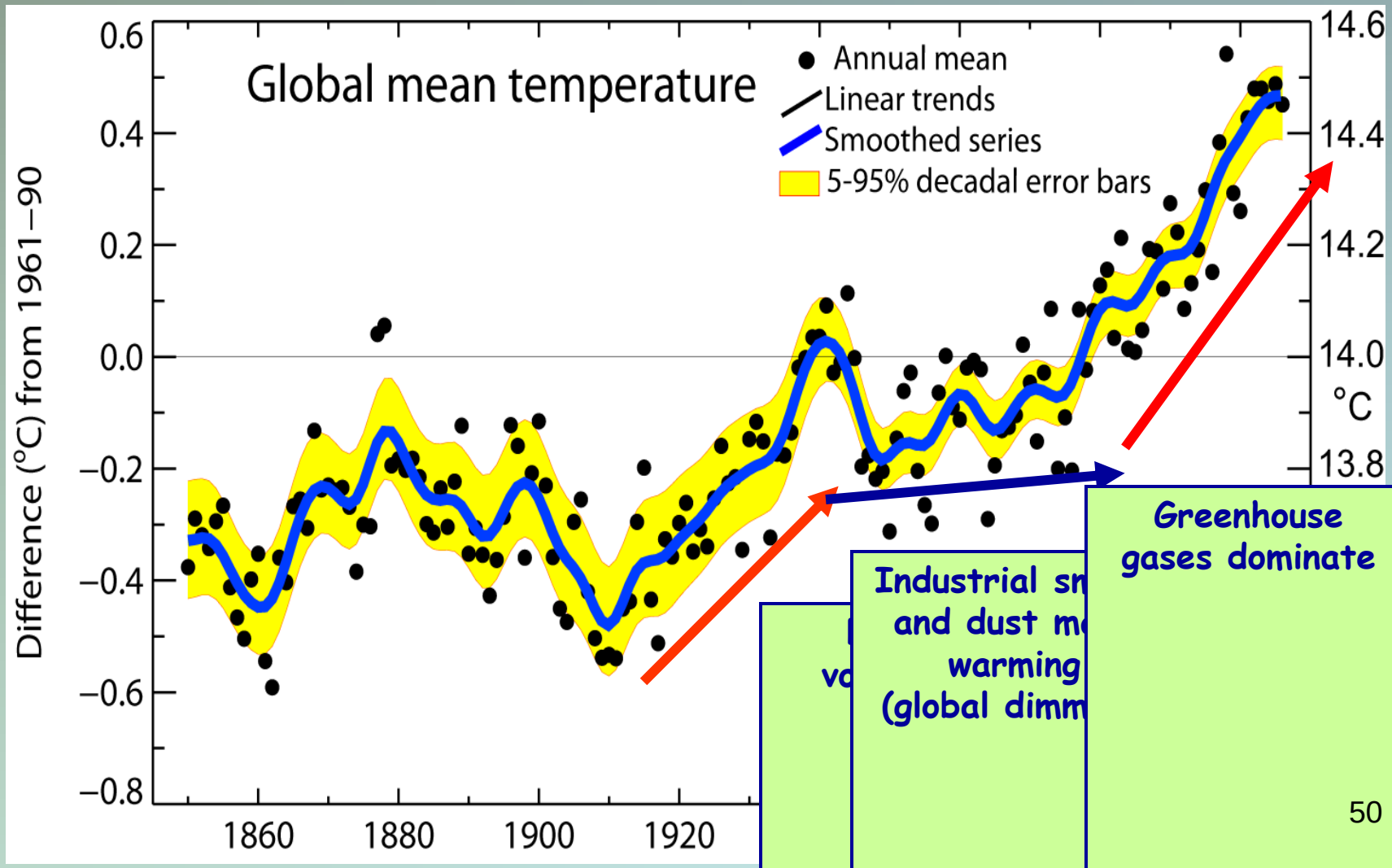
Watch the short video 'Modeling Our Climate' at https://www.youtube.com/watch?v=SuZHnqxltKo

Global Climate Models

Global climate computer programs ("models") simulate and analyze the complex physics of the atmosphere, ocean, snow, ice, and land and all the forces acting on them.



Global Mean Temperatures Track Both Natural & Human-Induced Effects



Are Extreme Weather Events Increasing?

➢IPCC's 2012 special report, '*Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation' (SREX)*

- indicates that scientists have enough confidence in the data collected since 1950 to definitively link extreme events to global climate change.

Watch the video 'Overview of the IPCC Report on Extreme Events' at https://www.youtube.com/watch?v=VIGeHzuwFSQ

What Does *this* Change in Climate Mean?

“Many of the world's climate zones may disappear by 2100, leaving new ones in their place unlike any that exist today”

“..we are going to be seeing climates that certainly are completely outside the range of modern human experience.."

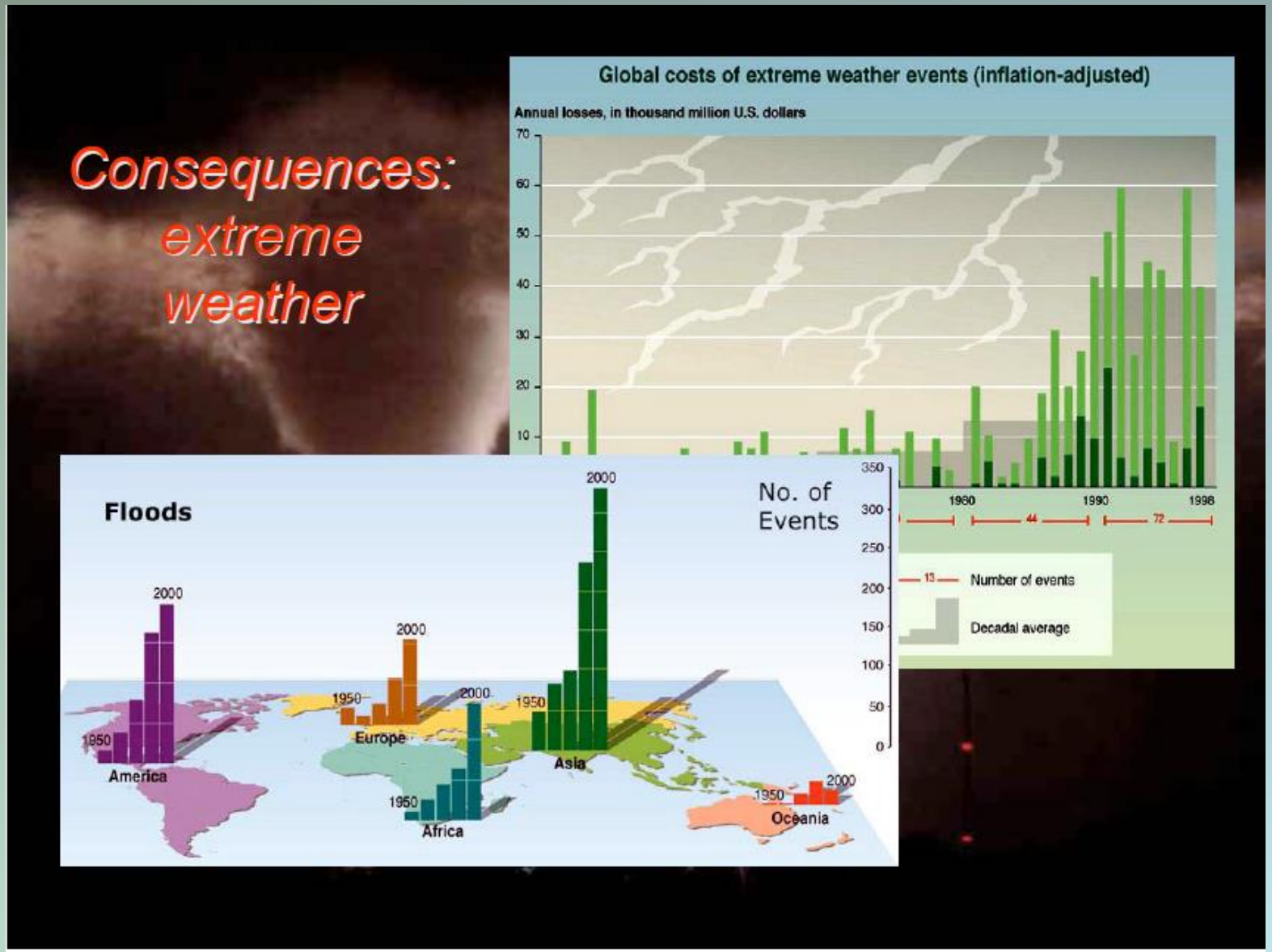
Source 2007 Articles: 26 March *Scientific American*; 27 March *Guardian*; 27 March IOL Reuters

Sea Level Rise & Extreme Flooding Events

- **Climate change computer models predict a range of sea level rises for different locations due to the global warming and melting of glaciers worldwide**

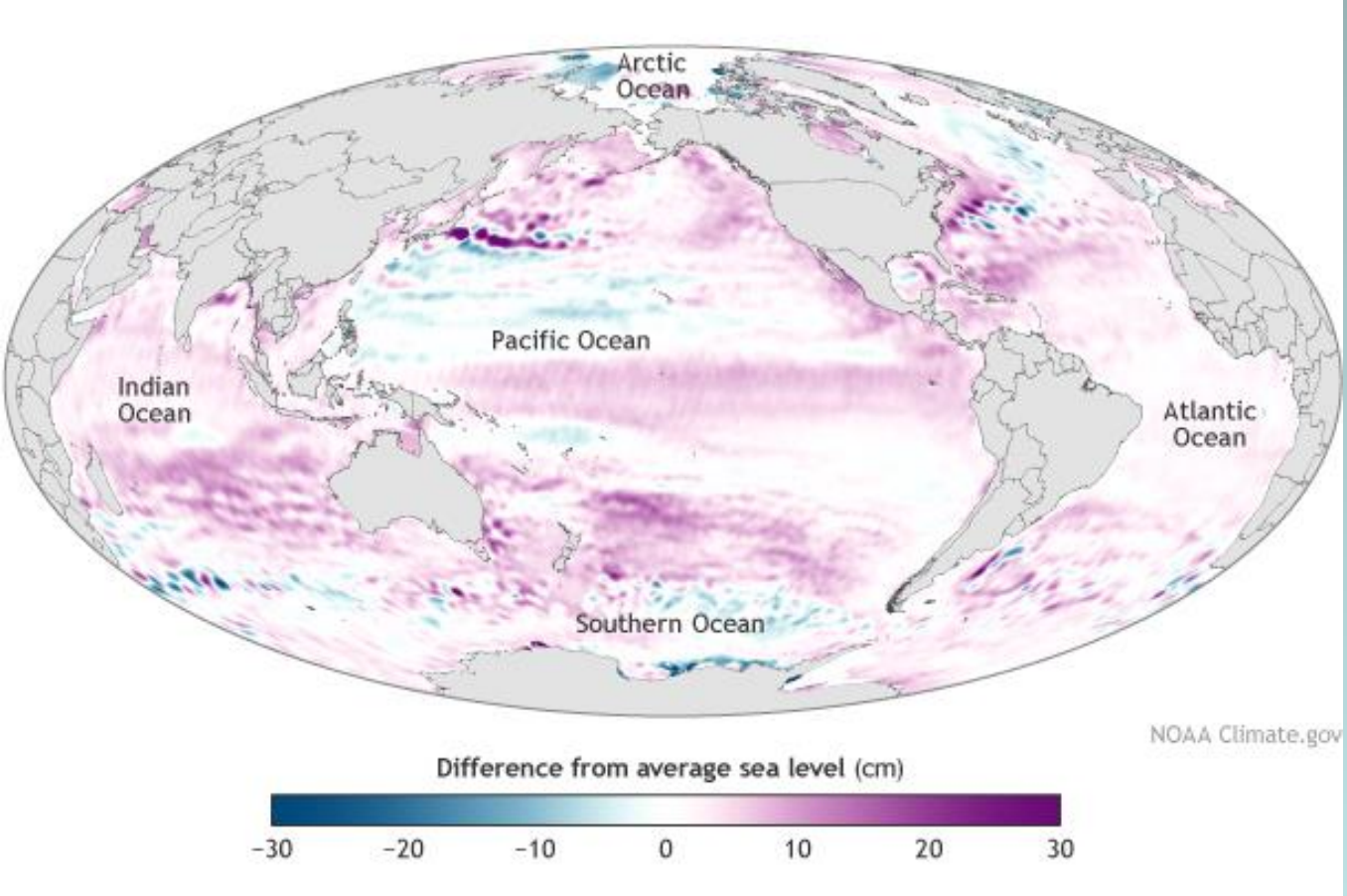
- **These models also predict more frequent extreme weather conditions that will produce heavy rains and flooding to many parts of the country**

Worldwide Documentation of Increasing Extreme Flooding Events and Impacts



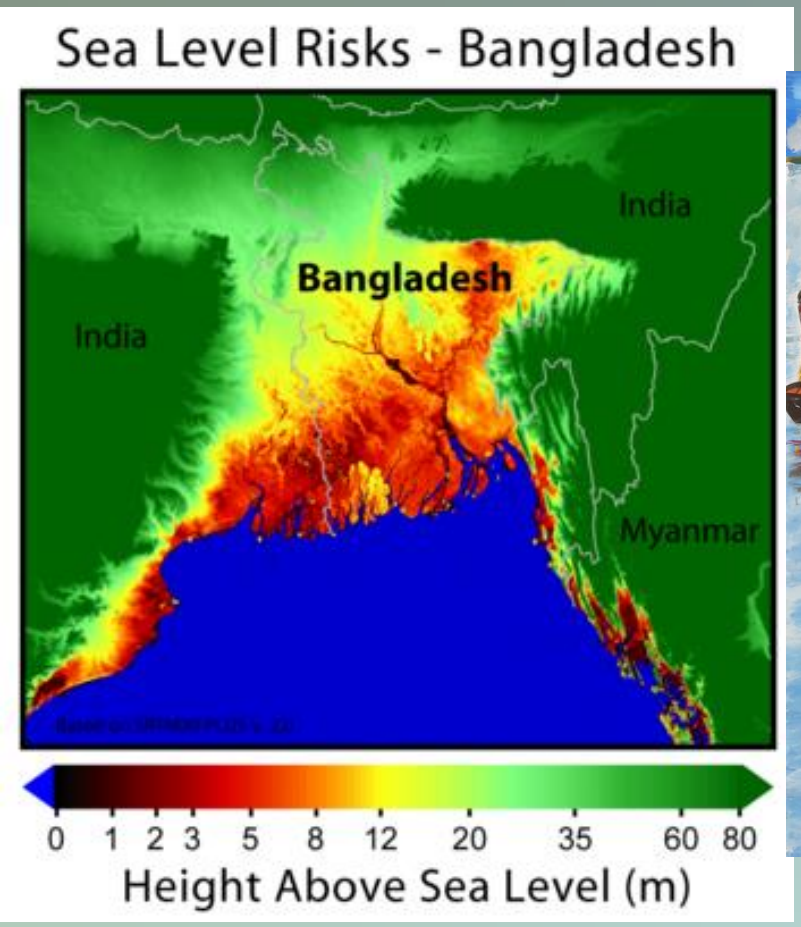
Worldwide Documentation of Increasing Sea Level Rises

Sea level in 2014 compared to the global average at the mid-point of the 1993-2013 time series.



https://www.climate.gov/news-features/understanding-climate/2014-state-climate-sea-level

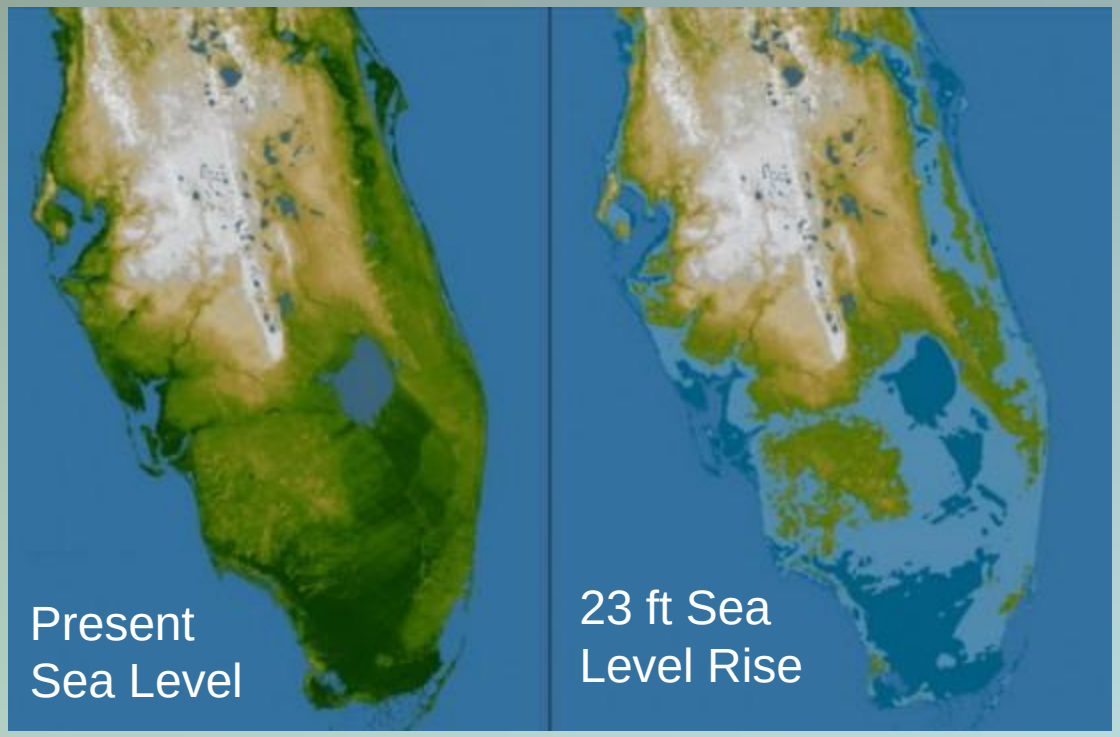
Global Sea Level Rise Impacts Example



See the videos ‘Geography of Bangladesh’ and ‘Climate Change’ of ‘Years of Living Dangerously’ series via Access Video of Sarasota County Library System at http://sarac.co.sarasota.fl.us/

Viewing FL Sea Level Rise Impacts

- **Online Flood Model Maps can be used to simulate rising sea levels anywhere in the world, including counties in Florida**

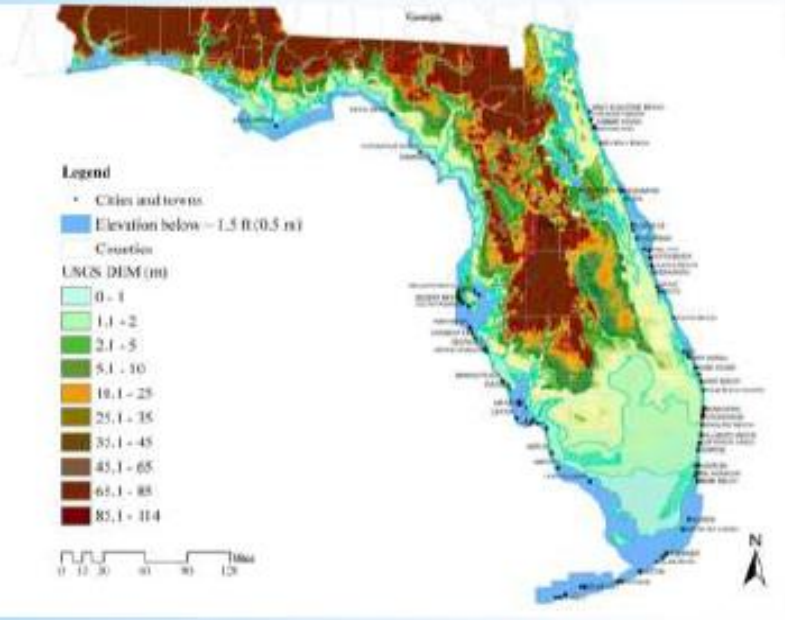


http://geology.com/sea-level-rise/florida.shtml

- Potential land mass impacts in FL w/ 23 ft sea level rise shown.
- Model predictions range from 2 feet up to 7 ft for 2100.
- Enough ice sheet mass exists for a 213 ft sea level rise.

Why is Florida so Vulnerable?

Flat Topography



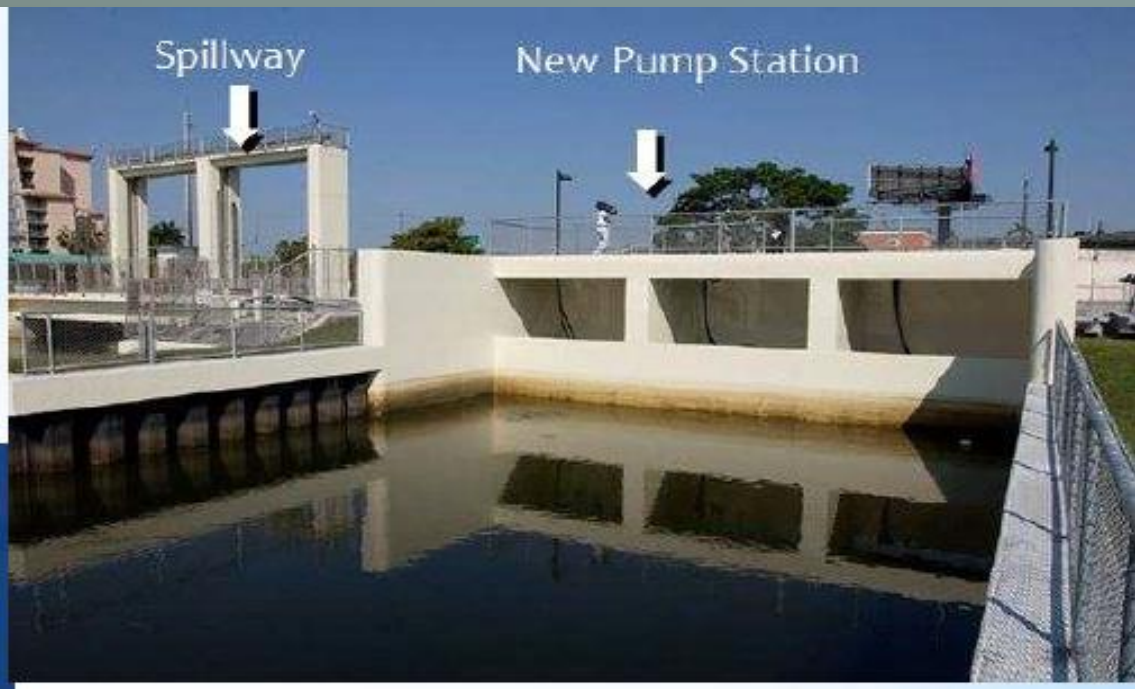
Limestone Geology

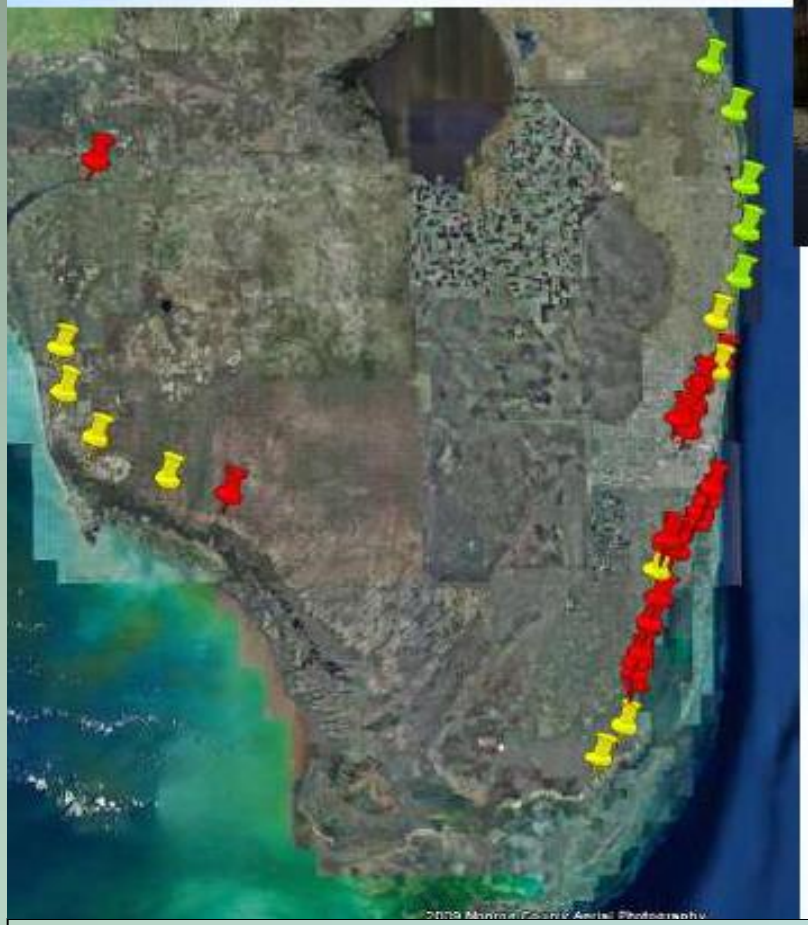
Hurricane and Storm Surge Impacts

Triple Whammy

See 12/16/13 presentation at https://floridaclimateinstitute.org/resources/presentations

Failing Drainage





Malfunctioning Canals

See 12/16/13 presentation at https://floridaclimateinstitute.org/resources/presentations

Sea Level Rise Impacts in FL

Miami Beach, South Florida

Watch the video ‘South FL and Sea Level Rise at https://www.youtube.com/watch?v=X1hJYLw7OlM

Viewing Sea Level Rise Impacts in Sarasota County

Island Park, Downtown City of Sarasota

Present

6 Ft Sea Level Rise

See Interactive Map to Visualize Sea Level Rise and Coastal Flooding Impacts at http://coast.noaa.gov/slr/

Climate Change Responses in FL

- *Formation of FL Climate Change Task Force*
  - includes all State University System in order to bring together the collective expertise and research in FL
  - cooperates with State and Federal agencies to bring science into climate change-related decision making
  - analyzing the significant economic and environmental risks to Florida
  - developing a climate change information system and portal that will connect State University System (SUS) assets with these agencies, private industries, and other groups to facilitate communication

https://floridaclimate.org/

Climate Change Responses in FL

Florida Climate Institute

- *Formation of FL Climate Institute*
  - created by Florida's universities with a goal of providing Florida and its businesses and communities the much needed scientific knowledge, support, and education to respond to a changing climate
  - includes a multi-disciplinary network of national and international research and public organizations, scientists, and individuals concerned with achieving a better understanding of climate variability and change.

https://floridaclimateinstitute.org/

What Can I Do?

- *Support and/or participate in the Resilience AmeriCorp program:*
  - recruits, trains, and embeds AmeriCorps VISTA members in ten communities across the country to increase civic engagement and community resilience in low-income areas
  - helps those communities develop plans for becoming more resilient to any number of shocks and stresses, including better preparations for extreme weather events

http://www.nationalservice.gov/programs/americorps/resilience-americorps

What Can I Do in Sarasota County?

- *Let your voice be heard on climate change planning and action via implementation of the*

a) *SW FL Regional Planning Council Assessments – see http://www.swfrpc.org/climate_change.html*
b) *Sarasota County Comprehensive Plan– see https://www.scgov.net/compplan/Pages/default.aspx*

- *Learn about local action steps to take from the Office of Sustainability of Sarasota County – see http://sarasota.ifas.ufl.edu/Sustain/climate.shtml*

What Can I Do in General?

1) *Green your commute*
2) *Be energy efficient*
3) *Choose renewable power*
4) *Eat wisely*
5) *Trim your waste*
6) *Let polluters pay*
7) *Fly less*
8) *Get informed*
9) *Get involved*
10) *Support and donate*

http://www.davidsuzuki.org/what-you-can-do/top-10-ways-you-can-stop-climate-change/

What Can I Do in General?

- *Engage your family, friends, neighbors and colleagues about the science of Climate Change using the insights from the Climate lab of the University of CA – see https://www.universityofcalifornia.edu/climate-lab*

Why Humans Are So Bad at Thinking About Climate Change

What Can I Do in General?

- *Remember to keep your sense of humor by enjoying a combination of comedy and science of Climate Change, for example the following video:*

- "Climate Change Debate: Last Week Tonight with John Oliver (HBO)" at https://www.youtube.com/watch?v=cjuGCJJUGsg&list=PLr_-568g8wbR6rqN_Zf6Qg2XRPCGfmJBJ&index=4

In Summary: Climate Change Science

Watch the video 'Climate Change 101 with Bill Nye the Science Guy' – see http://www.smithsonianmag.com/videos/category/3play_1/climate-change-101-with-bill-nye-the-science/?no-ist

CLIMATE
SUMMIT
WHAT IF IT'S A BIG HOAX AND WE CREATE A BETTER WORLD FOR NOTHING?
• ENERGY INDEPENDENCE
• PRESERVE RAINFORESTS
• SUSTAINABILITY
• GREEN JOBS
• LIVABLE CITIES
• RENEWABLES
• CLEAN WATER, AIR
• HEALTHY CHILDREN
• ETC. ETC.
12/7/19 USATODAY
JOEL PITT

THANK-YOU !!

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FL Center for Environmental Studies
FL Atlantic University
'Weather and Climate'
*www.ces.fau.edu/nasa/content/teacher-materials/wc-**ppt**.**ppt**x*

Online Resources

- Annenberg Foundation. The Habitable Planet Unit 12: Earth's Changing Climate – see http://www.learner.org/courses/envsci/unit/text.php?unit=12&secNum=1
- Climate Science Awareness and Solutions Program. Earth Institute. Columbial University – see http://csas.ei.columbia.edu/
- FL Center for Environmental Studies, FL Atlantic University, see http://www.ces.fau.edu/
- Florida Climate Change Task Force, Nov 2011 Workshop Proceedings, see https://floridaclimate.org/
- Florida Climate Institute – see https://floridaclimateinstitute.org/
- National Geographic, If All The Ice Melted: An Interactive Map, see http://ngm.nationalgeographic.com/2013/09/rising-seas/if-ice-melted-map
- NRDC. Feeling the Heat in Florida – see http://www.nrdc.org/globalwarming/florida/flainx.asp

Online Resources

- UF/IFAS, EDIS: Climate Change, see http://edis.ifas.ufl.edu/topic_climate_change
- UF/IFAS Extension Sarasota County, Climate Change, see http://sarasota.ifas.ufl.edu/Sustain/climate.shtml
- US EPA, Climate Change, see http://www.epa.gov/climatechange/
- US NASA, Global Climate Change, see http://climate.nasa.gov/

Sarasota County Library Resources

- Cosmos: a Space Time Odyssey. Episode 12: The World Set Free. 2014. DVD Collection.
- Environmental Library, Selby Library: Climate Change titles and documents
- Henson, R. 2014. The Thinking Person's Guide to Climate Change.
- Moyers & Company: Climate Change-Faith and Fact. 2014. Access Video Collection
- Squarzoni, P. 2014. Climate Changed: A Personal Journey Through The Science.
- US Global Change Research Program. 2014. Overview, climate change impacts in the United States : U.S. national climate assessment
- Years of Living Dangerously. 2014. Nine (9) Episodes. Access Video Collection

Online Video Resources

- FL Climate Institute. Presentations – see https://floridaclimateinstitute.org/resources/presentations

- Gore, A. Averting the Climate Crisis. Ted Talk – see https://www.youtube.com/watch?v=r593zLtZxAU

- National Academies of Sciences, Engineering and Medicine. Climate Change: Lines of Evidence Videos – see http://nas-sites.org/americasclimatechoices/videos-multimedia/climate-change-lines-of-evidence-videos/

- RSA. Seven Serious Jokes About Climate Change. – see https://www.youtube.com/watch?v=IHZ3oLdNKzw

- Ted Talks
  - Hansen, J. Why I Must Speak Out About Climate Change – see https://www.ted.com/talks/james_hansen_why_i_must_speak_out_about_climate_change?language=en
  - Poyser, J. Confessions of a Climate Change Humorist. Tedx Talk – see https://www.youtube.com/watch?v=hQFYA945WPc

Online Video Resources

- Ted Talks (continued)
  - Schmidt G. The Emergent Pattersn of Climate Change – see https://www.ted.com/talks/gavin_schmidt_the_emergent_patterns_of_climate_change?language=en
- Youtube Videos: Humor and Climate Change
  - "Climate Change Denial Disorder" at https://www.youtube.com/watch?v=fZTTI_0mHN0&list=PLr_-568g8wbR6rqN_Zf6Qg2XRPCGfmJBJ&index=3
  - *"Sex, Spock, and Climate Change" at https://www.youtube.com/watch?v=_hUtI2EMXGk&list=PLr_-568g8wbR6rqN_Zf6Qg2XRPCGfmJBJ*
  - "Sting Operation Outs Climate Change Denier Scientists [Humor News]" at https://www.youtube.com/watch?v=UeVy3zPDrt0&index=5&list=PLr_-568g8wbR6rqN_Zf6Qg2XRPCGfmJBJ