Climate Science and the President's Climate Action Plan: An Update

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Outline of the talk

CLIMATE SCIENCE

- Foundational understandings
- Recent observations and analyses
- Future change and the leverage of timely action

THE PRESIDENT'S CLIMATE ACTION PLAN

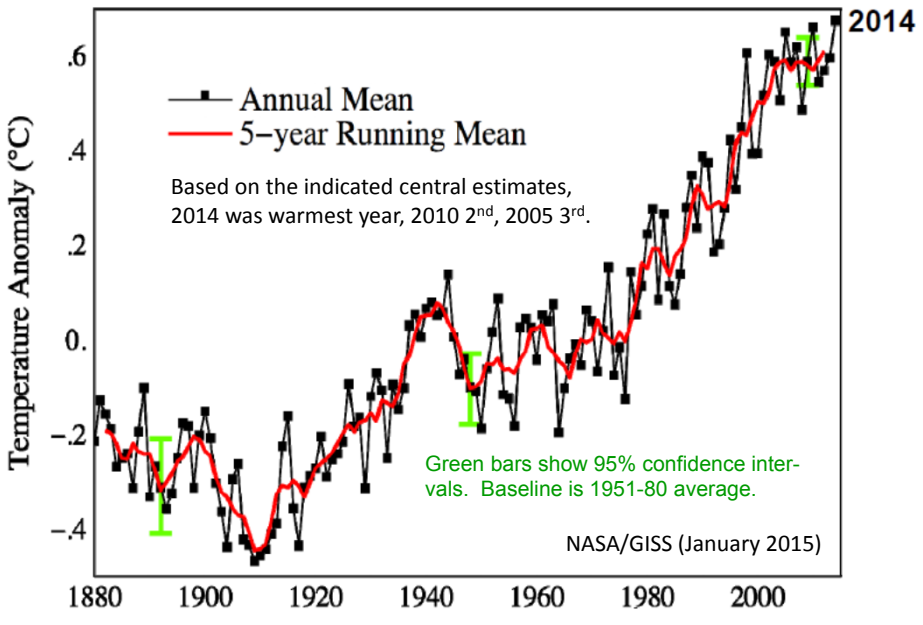
- Basis in science (including tech assessment & economics)
- Progress report
- The path forward

Climate science: the foundational understandings underpinning the President's Climate Action Plan

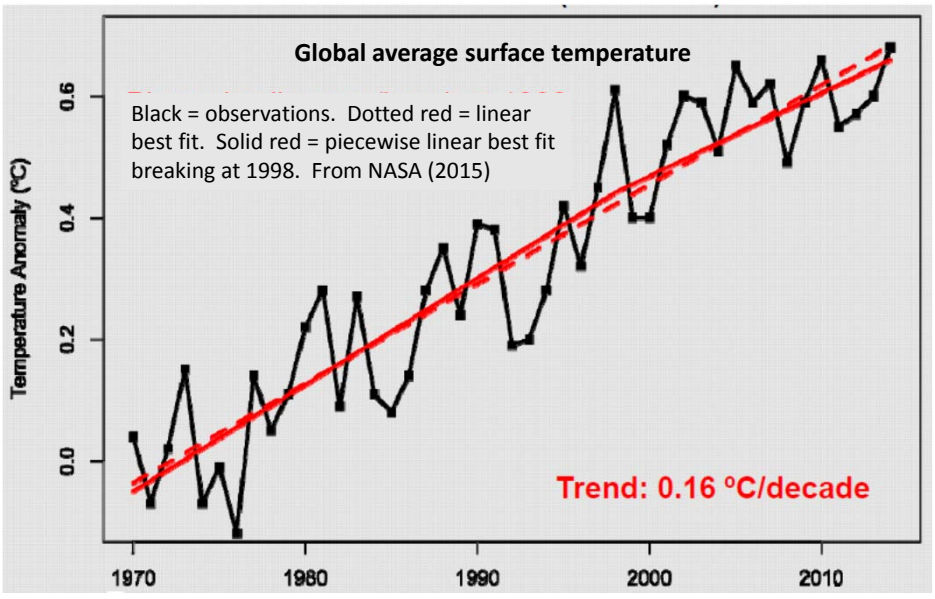
1. Earth's climate is changing at a pace and in a pattern not consistent with natural influences.
2. The dominant driver is the human-caused buildup of CO_2 and other heat-trapping substances in the atmosphere, mainly from fossil-fuel combustion and land-use change.
3. These changes in climate are already causing harm in many parts of the world and many parts of the United States.
4. The harm will continue to grow for decades to come, due to time lags in the climate system and the energy system.
5. There's an enormous difference between the additional harm expected in the absence of vigorous remedial action versus what's expected if such action is initiated promptly.

Climate Science:
Recent Observations and Analyses

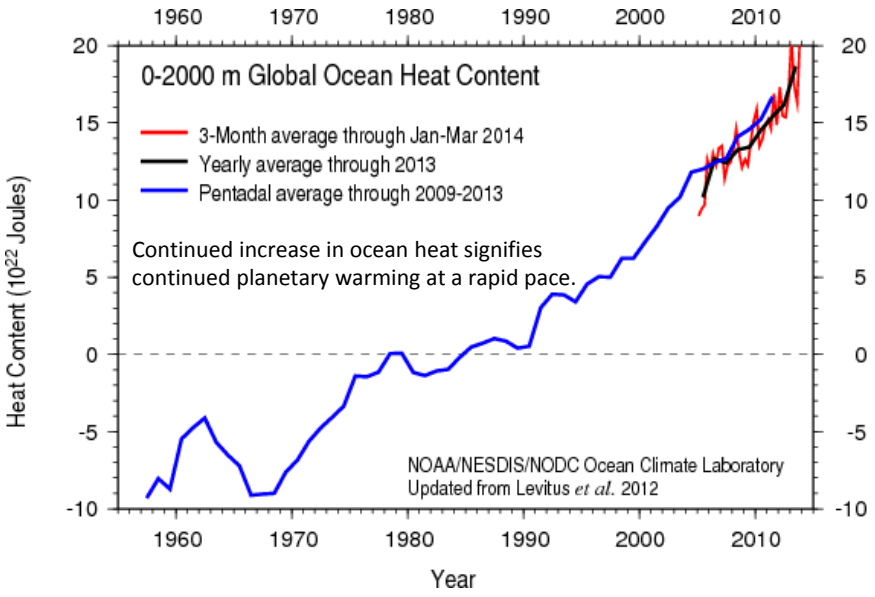
Global average surface temperature, 1880-2014



Hiatus since 1998? Linear fit for 1970-2014 & piece-wise linear fit breaking at 1998 don't differ much.



Over 90% of the excess heat trapped by GHG goes into the ocean, and its warming continues apace.

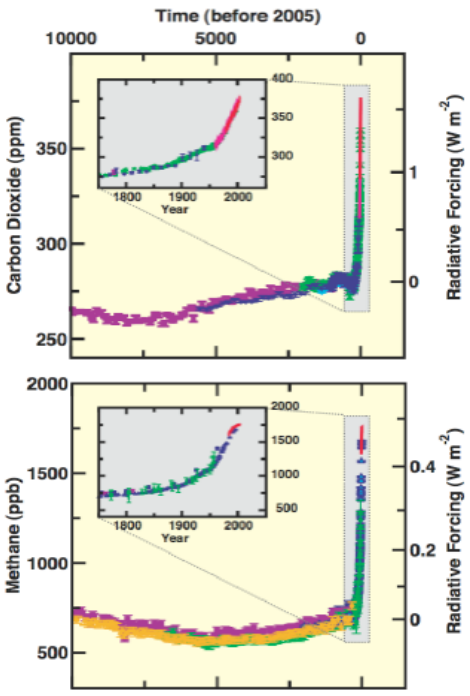


Evidence that human activities are responsible

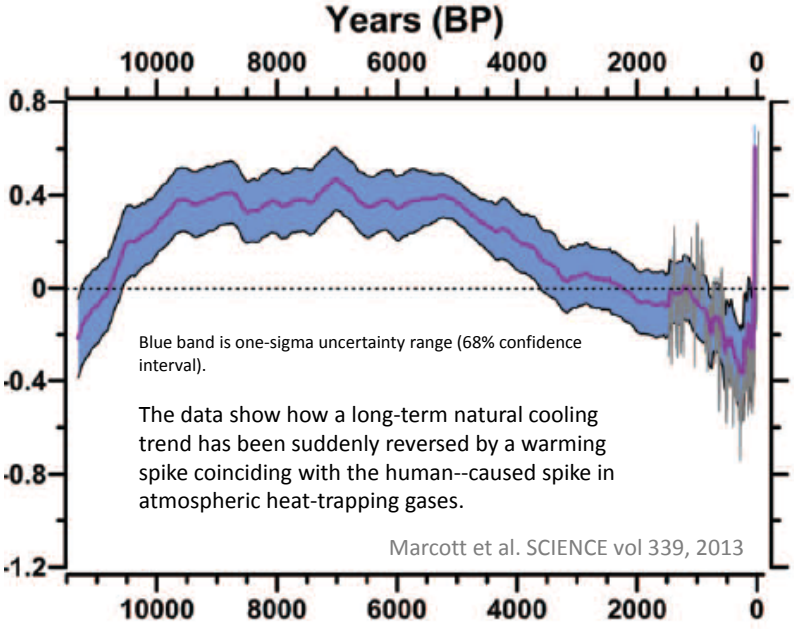
Compared to natural changes over the past 10,000 years, the spike in concentrations of CO_2 & CH_4 in the past 250 years is extraordinary. Both are potent heat-trapping gases with well documented sources in fossil-fuel combustion, land-use change, and animal husbandry.

Further evidence that fossil-fuel burning, specifically, is mainly responsible for the CO_2 spike: Fossil CO_2 lacks carbon-14, and the drop in the proportion of C-14 in atmospheric CO_2 as a result of the fossil-CO_2 additions is readily measurable.

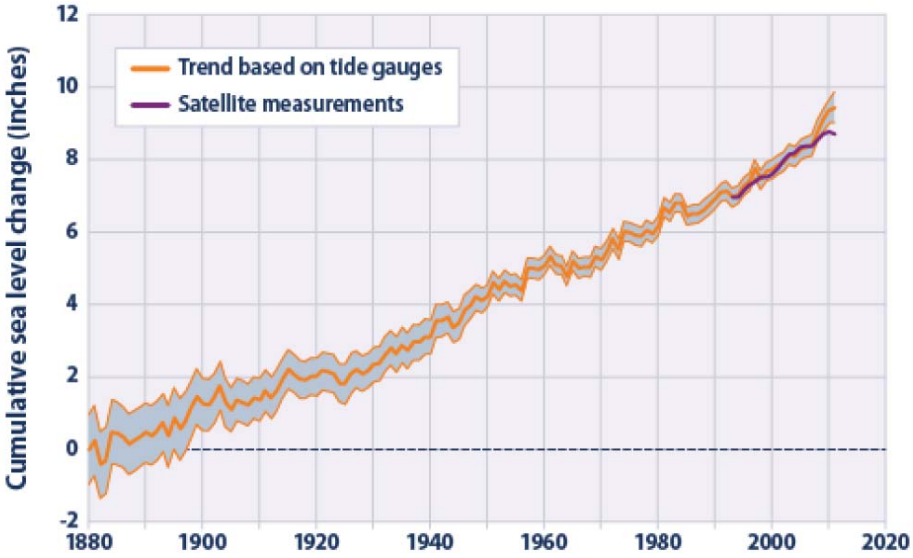
IPCC AR4, WG1 SPM, 2007



Evidence of human responsibility (continued)



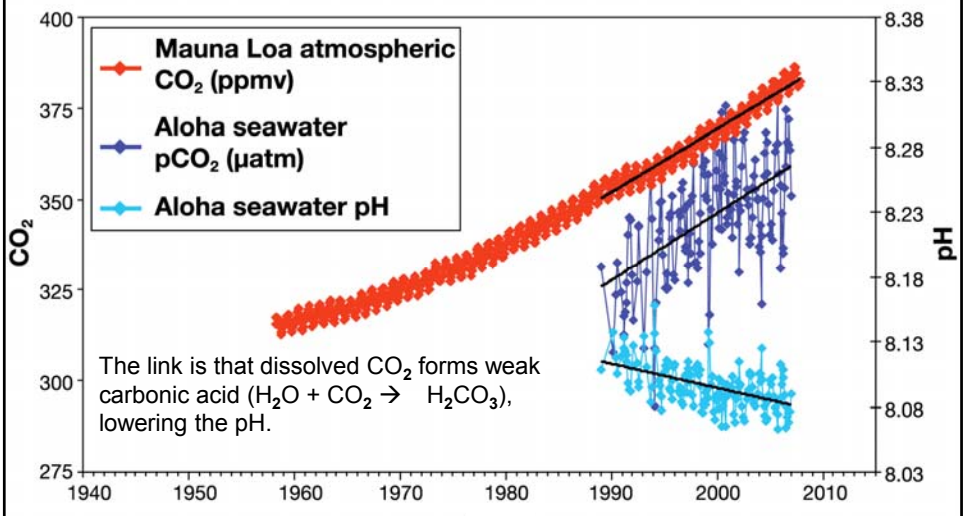
Global average sea-level rise from 1880 to 2012



Source: EPA Climate Change Indicators

Atmospheric CO_2 and ocean pH

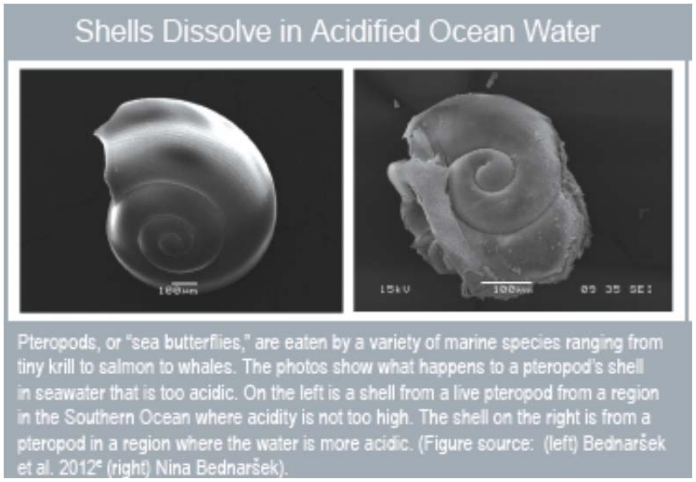
About 1/3 of CO_2 added to atmosphere is quickly taken up by the surface layer of the oceans (top 80 meters).



World Bank / Potsdam Institute Nov 2012

Why ocean acidification matters

Increased H+ concentration imperils marine organisms that make shells or skeletons from calcium carbonate ($CaCO_3$): e.g., corals, shrimp, clams, oysters, pteropods…



Pteropods, or "sea butterflies," are eaten by a variety of marine species ranging from tiny krill to salmon to whales. The photos show what happens to a pteropod's shell in seawater that is too acidic. On the left is a shell from a live pteropod from a region in the Southern Ocean where acidity is not too high. The shell on the right is from a pteropod in a region where the water is more acidic. (Figure source: (left) Bednaršek et al. 2012[4] (right) Nina Bednaršek).

USGCRP, National Climate Assessment (2014)

Impacts of climate change on weather extremes

nature climate change

PERSPECTIVE

PUBLISHED ONLINE: 25 MARCH 2012 | DOI: 10.1038/NCLIMATE1452

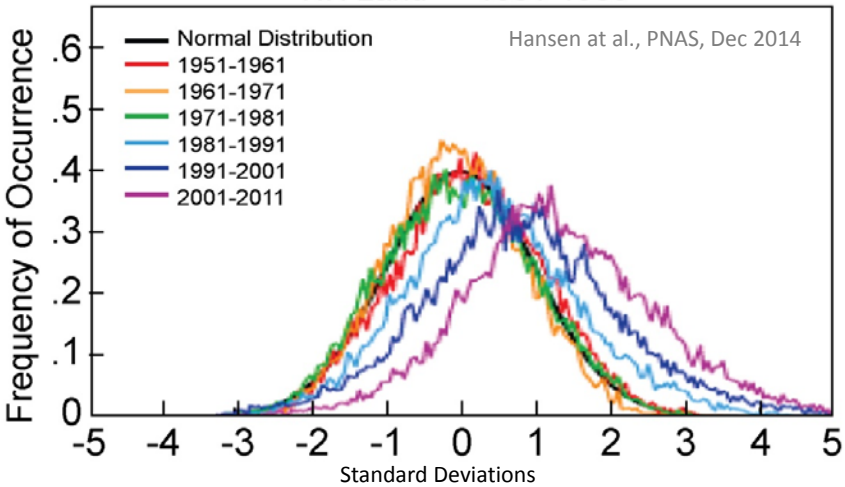
A decade of weather extremes

Dim Coumou and Stefan Rahmstorf*

In 1988, Jim Hansen famously stated in a congressional hearing that "it is time to stop waffling so much and say that the evidence is pretty strong that the greenhouse effect is here"[82]. We conclude that now, more than 20 years later, the evidence is strong that anthropogenic, unprecedented heat and rainfall extremes are here — and are causing intense human suffering.

Very hot summers: big increase in probability

Probability distribution for Jun-Jul-Aug temperature anomaly on land in the Northern Hemisphere. Baseline normal distribution is for 1951-80.

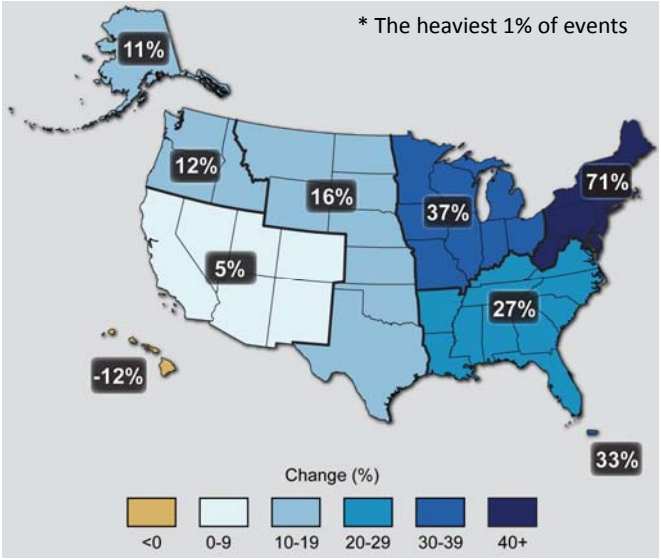


Portion of NH land experiencing > 3σ summer heat in a given year increased from 0.1-0.2% in 1951-80 to 10% in 2001-2011.

14

Changes in very heavy precipitation

Increases 1958-2012 in precipitation occurring in extreme downpours.*

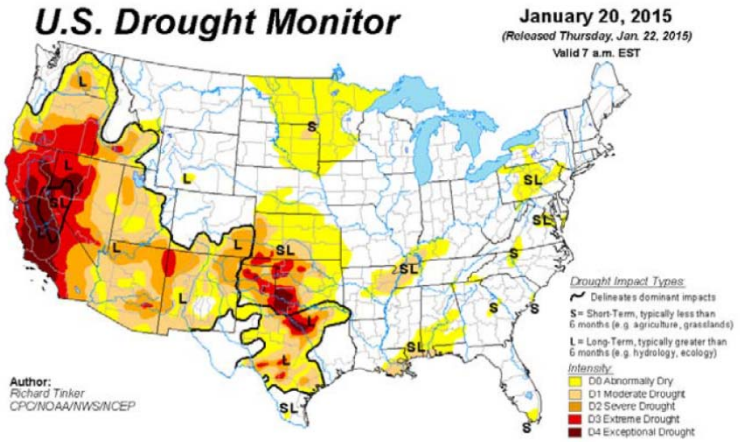


U.S. National Climate Assessment (2014)

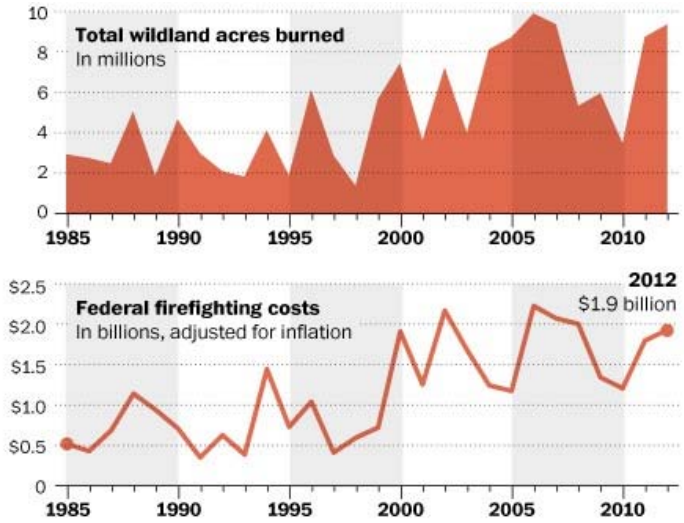
This is happening in many regions.

Yet some drought-prone regions are getting drier.

- More of the rain falling in extreme events = more loss to flood runoff, less moisture soaking into soil.
- Higher temperatures = bigger losses to evaporation.
- Mountains get more rain, less snow, yielding more runoff in winter and leaving less for summer.
- Earlier spring snowmelt also leaves less runoff for summer.
- Altered atmospheric circulation patterns can also play a role.



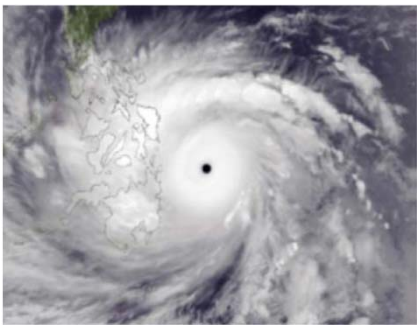
Wildfires have been increasing apace.

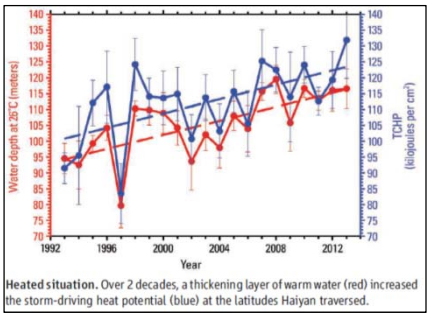


Data source: National Interagency Fire Center

The most powerful storms are getting more so.

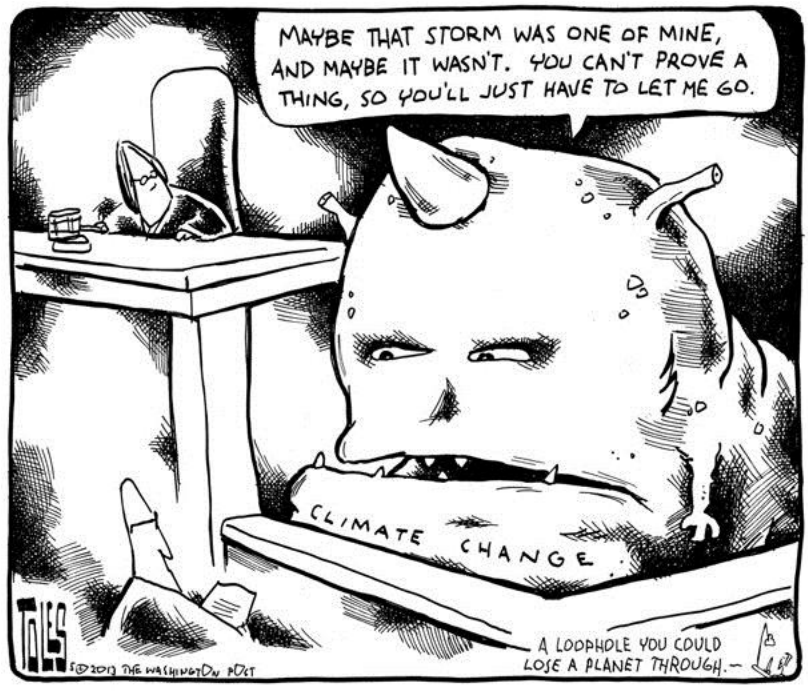
Tropical cyclones get their energy from the warm surface layer of the ocean (which is getting warmer and deeper under climate change) and from water vapor in the atmosphere (also going up). In the region that spawned Haiyan—probably the most powerful typhoon to make landfall in modern times—the "Tropical Cyclone Heat Potential" has gone up more than 20% since 1990.





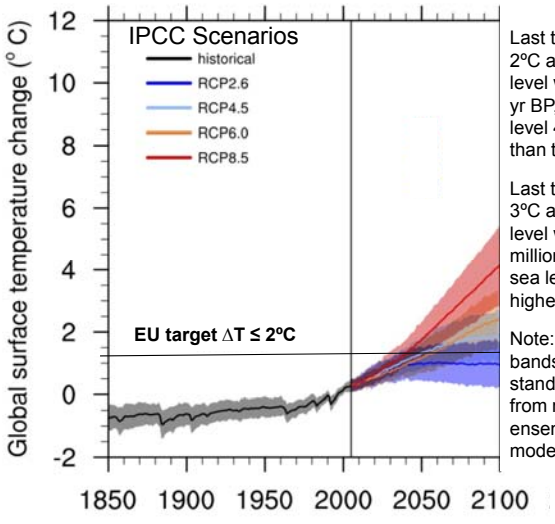
Heated situation. Over 2 decades, a thickening layer of warm water (red) increased the storm-driving heat potential (blue) at the latitudes Haiyan traversed.

Many factors affect the formation and tracks of these storms, but, all else equal, a given cyclone will be more powerful in the presence of a warmer ocean and higher atmospheric water content than it would be otherwise. And the higher local sea level is, the worse the storm surge from any given cyclone will be. Haiyan killed 6,000 people, injured 27,000, and destroyed or damaged 1.2 million homes.



Climate Science:
Future Change and the Leverage of Timely Action

T and impacts grow for decades under all scenarios.



Last time T was 2ºC above 1900 level was 130,000 yr BP, with sea level 4-6 m higher than today.

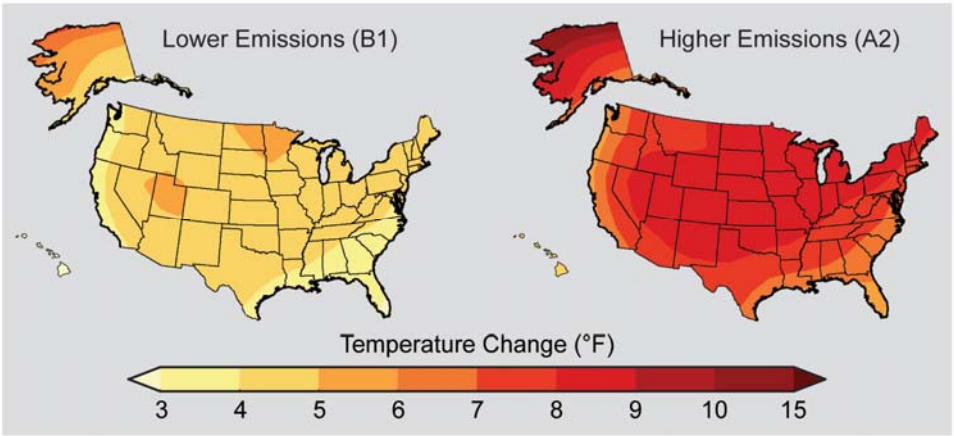
Last time T was 3ºC above 1900 level was ~30 million yr BP, with sea level 20-30 m higher than today.

Note: Shaded bands denote 1 standard deviation from mean in ensembles of model runs

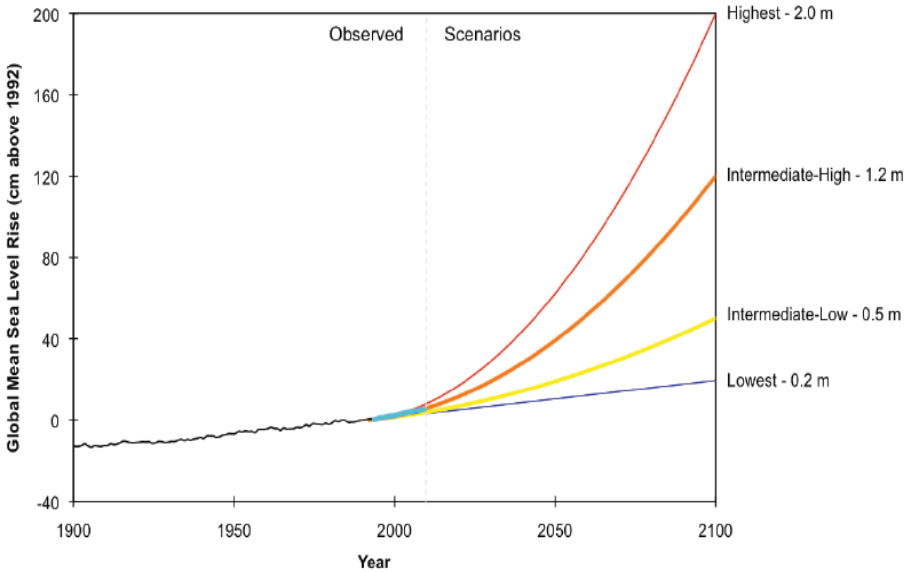
IPCC 2013

But the difference between low & high emissions is huge.

Change in average surface air temperature between 1970-1999 and 2070-2099

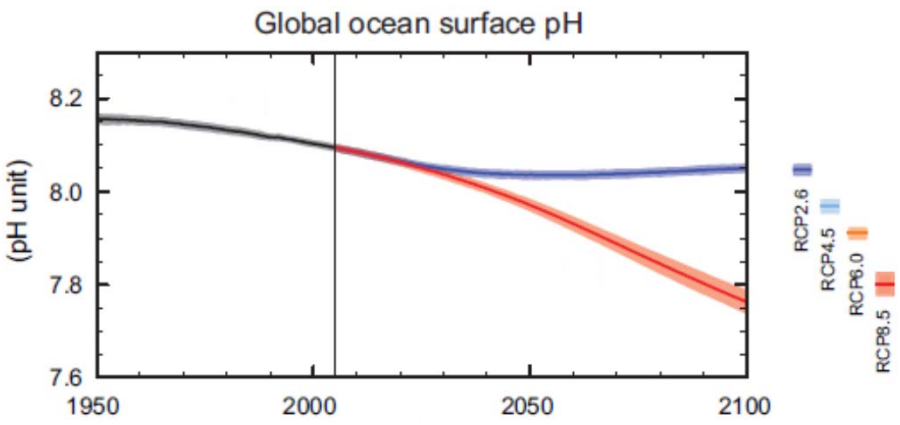


Sea level will rise for centuries, but how fast and to what ultimate level depend on what we do



NOAA OAR CPO-1, December 2012

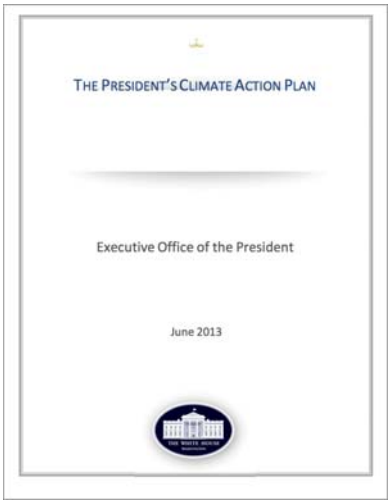
The same applies to ocean acidity: What we do to limit emissions matters enormously



IPCC 2013

The President's Climate Action Plan

Georgetown U, June 25, 2013



- Cutting carbon pollution in America
- Preparing the United States for the impacts of climate change
- Leading international efforts to address climate change

http://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf

The science basis of the Climate Action Plan

Understanding of the science summarized above provides:

- the motivation for seeking to develop a cost-effective plan to reduce those impacts;
- the sense of urgency for doing so at once rather than waiting;
- the awareness that such a plan must include both mitigation and adaptation, i.e., not only measures to reduce the emissions that are driving global climate change but also measures to increase preparedness for and resilience against the changes in climate that can no longer be avoided;
- the detailed knowledge of the sources of the offending emissions and the character of society's vulnerabilities that allows appropriate specificity in designing a plan; and
- the recognition that any U.S. plan must include a component designed to bring other countries along.

The science basis (continued)

Understanding of the technological possibilities for both mitigation and preparedness & resilience…

- reveals that there is a wide range of options for cutting the carbon pollution that is driving climate change and for better preparing society to deal with the changes that materialize
- has enabled the CAP to focus specifically on promoting progress on the development and implementation of the most promising options.

Understanding of the results of economic assessments of the costs of taking such actions versus the costs of inaction…

- provides the confidence that moving ahead now is the right thing to do;
- has provided the basis for the CAP's focus on those options that are most clearly cost-effective and that bring significant co-benefits.

Progress: Cutting Carbon Pollution in America

- Reducing carbon pollution from power plants
  - standards for cutting CO_2 from new power plants (Sept 2013)
  - and from existing power plants (June 2014)
- Reducing other greenhouse gases
  - interagency strategy to reduce methane emissions (March 2014)
  - EPA proposal on hydrofluorocarbons (July 2014)
  - 2025 target to reduce methane emissions form the oil and gas sector by 40-45% from 2012 levels along with various actions to reduce methane emissions going forward, including EPA regulation (January 2015)

Progress: Cutting Carbon Pollution in America

- Accelerating U.S. clean-energy leadership
  - increased electricity from wind (3X) and solar (>10X) since 2008
  - 50+ new utility-scale renewable projects on public lands since 2009
  - Federal gov't to buy ≥20 percent of its electricity from renewables by 2020
- Cutting energy waste
  - fuel-economy standards for med/heavy-duty vehicles (final 3-16)
  - 17 final or proposed appliance & equipment energy-efficiency stds
  - commitments to cut energy waste via the Better Buildings Challenge
- Building a 21st century clean-energy infrastructure
  - 1st installment Quadrennial Energy Review, focused on energy infrastructure, due in early 2015
  - improving Federal permitting for siting of infrastructure generally.

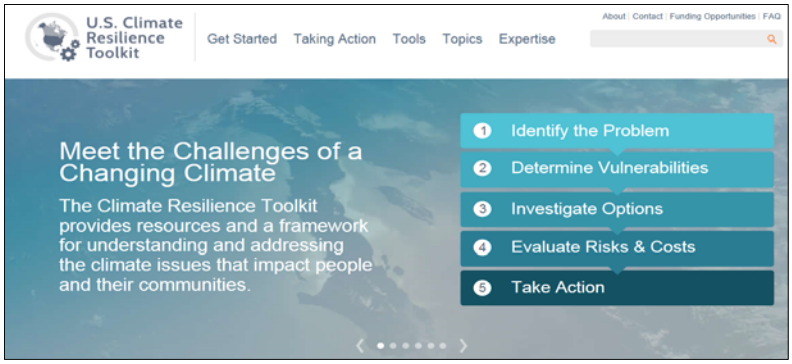
Progress: Preparing for the Impacts of Climate Change

- Directing agencies to support climate preparedness/resilience
  - All agencies required (by EO 13514, 13653) to develop & implement plans for integrating climate preparedness/resilience into their missions, policies, programs, investments, and grants.
- Establishing internal & external task forces on resilience
  - Interagency Council on Climate-Change Preparedness & Resilience (co-chaired by OSTP, CEQ, NSC, and OMB)
  - State, Local, & Tribal Leaders Task Force on Climate-Change Preparedness & Resilience, comprising 26 elected officials from across the country (delivered recommendations November 2014)
- Managing flood, drought, & wildfire risks
  - National Drought Resilience Partnership (11-13)
  - 7 USDA Regional Agricultural Hubs for Climate-Change Mitigation & Adaptation (02-14)
  - USDA/ DOI National Cohesive Wildland Fire Management Strategy (04-14)
  - $1B Nat'l Disaster Resilience Competition (HUD, 06-14).

Progress: Preparing for the Impacts of Climate Change

Mobilizing science and data for climate resilience

Climate Data Initiative (03-14); 3rd U.S. National Climate Assessment (05-14); U.S. Climate Resilience Toolkit (11-14); Climate Education and Literacy Initiative (12-14).



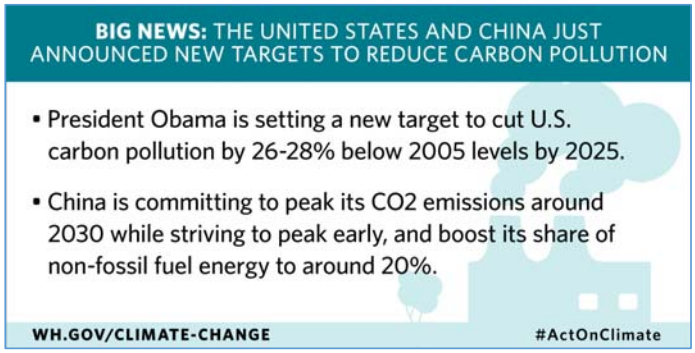
toolkit.climate.gov

Progress: International efforts

ENHANCING BILATERAL ENGAGEMENT

- **US-China**

  Joint Announcement (JA) in Nov. 2014:



  Also in announcement: 1st major carbon storage demonstration project, new Enhanced Water Recovery CCS project, new Clean Energy Research Center track on energy-water nexus, and new initiative on cities. Through July 2014 Innovation Dialogue, committed to work on RD&D for smart infrastructure / smart cities.

Progress: International Efforts

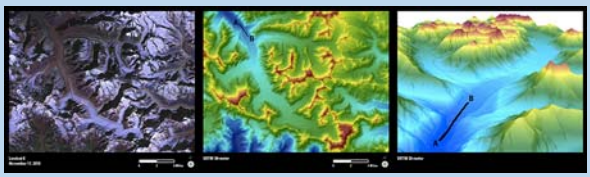
ENHANCING BILATERAL ENGAGEMENT

- **US-India**

  Agreement in Jan. 2015:

Initiating Climate Resilience Tool Development

- The U.S. and India will jointly undertake a partnership on climate resilience that will work to develop higher resolution climate models, assess climate risks, build local capacity, and engage decision makers to address climate resilient sustainable development, including for India's State Action Plans.
- The USG released higher-resolution elevation data for India (30m v. 90m) to help planners better assess and monitor the impacts of sea level rise, conduct environmental monitoring, and support resilience-relevant decision making.



(Shuttle Radar Topography Mission (SRTM) elevation data for Gangotri Glacier, India, image by NASA/USGS)

Also in agreement: Signed five-year MOU on Energy Security, Clean Energy, and Climate Change, renewed commitment to the U.S.-India Joint Clean Energy Research and Development Center (PACE-R), Department of Commerce commitment to launch a trade mission on clean energy.

Progress: International efforts (continued)

- Enhancing multilateral engagement

  G-20: Agreement to phase out fossil fuel subsidies and to develop a methodology for a voluntary peer-review process (09-13).

  UN: Extensive engagement w UNFCCC process toward a new global agreement in Paris in December 2015; President Obama speech at UN Climate Summit launched major new U.S. commitments on international assistance for preparedness/resilience (09-14).

- Mobilizing clean-energy and preparedness finance

  USA: $3 billion pledge to the Green Climate Fund at G20 in November 2014.

  USA/UK/Germany: Global Innovation Lab for Climate Finance - public-private platform to advance next generation of climate finance instruments (06-14).

The Path Forward Under the President's Climate Action Plan

Some focuses for the next year

- Defend the requests for clean-energy RD³ and for Earth observation in the President's FY16 Budget
- Complete the first phase of the Quadrennial Energy Review (QER)—focused on reliable, low-emission, renewable-friendly, climate-resilient infrastructure for energy transmission, storage, & distribution—and launch its implementation
- Finalize EPA's Power Plant Rules for both new and existing plants
- Increase preparedness by improving the coverage, usability, and user base of the Climate Data Initiative and Climate Resilience Toolkit

Some focuses for the next year (continued)

- Increase bilateral engagement on clean energy and climate change with major developing-country economies beyond India & China (e.g., Brazil, Indonesia, Mexico, South Africa)
- Build the public-private-global partnership for boosting resilience in developing countries that the President announced at the 09-14 UN Climate Summit
- Continue the all-fronts push toward a comprehensive, equitable, forward-leaning, and binding climate agreement in Paris in December
- Implement the President's Climate Education and Literacy Initiative to ensure continuing public support for all of the above

Some key references

- U.S. Global Change Research Program, Third U.S. National Climate Assessment, *Climate Change Impacts in the United States*, May 2014, http://nca2014.globalchange.gov
- Intergovernmental Panel on Climate Change, *Climate Change 2014: Mitigation: Summary for Policy Makers*, April 2014, http://www.ipcc.ch/
- Intergovernmental Panel on Climate Change, *Climate Change 2014: Impacts, Adaptation, and Vulnerability: Summary for Policy Makers*, March 2014, http://www.ipcc.ch/
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http://www.ostp.gov