Interpreting the major climate reports of 2018

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Princeton University
6 February 2019
League of Women Voters of Massachusetts
Two Reports (+ Severe Climate Events) Appear to be changing attitudes

Intergovernmental Panel on Climate Change (IPCC) Special Report on 1.5 degrees (Celsius) Warming

• Report attempts to answer the question “how warm is too warm?”
  i.e. When does climate change become “dangerous”? Earlier answer from science/governments: 1.5 or 2°

• Report requested by governments in 2015 Paris Agreement

• Addresses benefit, feasibility of 1.5 or 2°

Fourth US National Climate Assessment

• Comprehensive examination of current and future climate change impacts on the US

• Adaptation and emissions mitigation measures to address the problem
Taken Together, The Bottom Line

Danger already here by some measures for some people

- Extreme heat / humidity already up – heat-related deaths, wildfires
- Hurricanes shifting to Cat 4-5 (Maria, Michael)

Possible nearby tipping point: Danger of global average 6ft sea level rise by 2100 (and 30-50 ft. over centuries) for modest warming

- Exact warming that triggers this uncertain
- Time ice sheets need to “cook” uncertain

Some ecosystems may be “on the way out”: coral reefs

Things only get worse from here unless transformative action taken immediately
And...

- **1.5 beneficial vs. 2°:**
  - More coastal flooding
  - More coral reefs survive, 70-90% vs. 99% loss
  - Lower chance of exceeding threshold for big sea level rise

- **However, meeting either 1.5 or 2° target very difficult (unlikely):**
  - 1.5°: 45% CO2 global emissions cut by 2030
  - 2°: 20% CO2 global emissions cut by 2030
  - **Probably requires removal of CO2 already emitted**

- Doesn’t mean we shouldn’t try: every bit of reduction keeps us away from 2.5°, 3°, 4°: a 4° world would be ecologically disastrous and socially unmanageable.

- “We’re done for if we miss 1.5° or 2°”, is not an accurate or helpful message
Some Basics

Carbon dioxide measurements – highest levels in a million years at least

Atmospheric CO₂ at Mauna Loa Observatory

Scripps Institution of Oceanography
NOAA Earth System Research Laboratory
Recent Warming – mostly results from greenhouse gas buildup

Global Mean Estimates based on Land and Ocean Data

Deviation from long term average

-0.6 -0.4 -0.2 0.0 0.2 0.4 0.6 0.8 1.0

1880 1900 1920 1940 1960 1980 2000 2020

NASA GISS
Sea Level is Rising due to...

- Warming oceans
- Melting mountain glaciers
- Disintegrating polar ice sheets
Past Sea Level Rise

IPCC WGI AR5

(1901-1990: 1.2 ± 0.2 mm/yr)
(1993-2010: 3.0 ± 0.7 mm/yr)

~6" in 20th century
No Return: Irreversible CO2 Levels

Emissions

Amount in air
In addition to temperature and sea level change, a small sample of the many recent changes detected:

• More Extremely Hot Days
• More Deluges
• Destruction of Arctic, Coral Reefs systems
• More Acidic Ocean
• Many more…

-------------------------------------------------------------------------

• More Category 4,5 hurricanes
• End of Rapid Crop Yield Growth
• Many more…

*First five attributable to greenhouse gases
Too early to say for sure on rest.*
July 3 2014 - Central Arctic
The Future: Projected Warming and Sea Level Rise

IPCC WGI AR5
Since 2014, High Emission Sea Level Rise Projections Have Been Rising!
Projection of Warming

Low Emissions

High Emissions

(a) Change in average surface temperature (1986–2005 to 2081–2100)

(b) Change in average precipitation (1986–2005 to 2081–2100)

IPCC WGI AR5
What are now rare, killer heat waves become the norm

Extreme Summer 2003:
About 35,000 people in Europe succumb to extreme heat...

Observed Summers Now

2003

Predicted Summers, 2071-2100
Crop Yields: Declines Outpace Increases

Risk: increasing malnutrition, starvation in poorer regions

IPCC WGI AR5
Projected Impacts, 2080-99, Empirical Model

High Emissions

Mortality

Labor Supply

Hsiang et al Science 2017
Deadly Combination:

Hurricane + Sea Level Rise
How many times per century the current “100-year flood” will occur in 2050, 2100 ("AF")

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Rasmussen et al. 2018
Tipping Point Behavior?
Potential contribution of ice sheets to sea level rise, in meters

Last time (125,000 years ago) Earth was as warm as projected for mid-21st century, sea level was 6-9 meters higher due to melting/disintegration of polar ice sheets.
6-meter sea level rise
Over centuries or millennia?
Sources of emissions

Energy production remains the primary driver of GHG emissions

- 35% Energy Sector
- 24% Agriculture, forests and other land uses
- 21% Industry
- 14% Transport
- 6.4% Building Sector

2010 GHG emissions
Getting close to 1.5/2⁰ objectives ultimately about system transformation

• Compact settlement, efficient transportation and electric power production

• More efficient consumption (e.g., the food system)

• Such changes require improvement of governance and evolving social norms more than novel technologies
Short Term Goals

1. The End of Coal – de-carbonization of electricity production (price on carbon: federal role)

2. Modernize the Grid, develop storage to fully enable renewable energy (state coordination, federal R&D)

3. Electrify transportation (price on carbon: federal)

4. Push efficiency even higher (demand management, e.g.: state policy)

5. Reverse deforestation (global cooperation & finance)

6. Enhance adaptation! (local action, federal $$$)
Five Mega-Goals – start now

• Figure out, implement better communication about climate change

• Elect better leaders

• Capture generational energy at all levels of society – organize, organize, organize

• Work at ALL levels of governance – Community, local, state, federal, international

• Combat anti-science attitudes
The More We Delay, the Tougher the Choices

• Carbon Capture, Air Capture of carbon dioxide

• Biomass as fuel vs. food production and biodiversity

• Nuclearization of electricity supply?

• Geo-engineering sunlight?

• Test the limits of adaptation – the worst choice

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Questions?

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