A Discussion on Climate Change Science
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Welcome!

• Two of the world’s leading independent scientific bodies are lending their voices to the public discussion about climate change at this critical time.
Introducing a new resource

• Booklet
  – in accessible language
  – defines current scientific understanding
  – identifies areas of wide consensus
  – makes clear where understanding is developing.

Find it at:
americasclimatechoices.org
royalsociety.org
Purpose of the document

• An up-to-date, authoritative reference for:
  – science editors, journalists,
  – educators,
  – non-governmental organizations,
  – policymakers,
  – and other individuals involved in conveying what is known today about climate change.
Based upon current knowledge

- Past work of the National Academy of Sciences and The Royal Society.
- IPCC assessments
- Research to date
  - Includes consideration of new research since IPCC AR5 cutoff (March 2013)
Written by leading climate scientists

- Eric Wolff FRS (UK lead), University of Cambridge
- Inez Fung (NAS, US lead), University of California, Berkeley
- Brian Hoskins FRS, Imperial College London and University of Reading
- John Mitchell FRS, UK Met Office
- Tim Palmer FRS, University of Oxford
- Benjamin Santer (NAS), Lawrence Livermore National Laboratory
- John Shepherd FRS, University of Southampton
- Keith Shine FRS, University of Reading
- Susan Solomon (NAS), Massachusetts Institute of Technology
- Kevin Trenberth, National Center for Atmospheric Research
- John Walsh, University of Alaska, Fairbanks
- Don Wuebbles, University of Illinois
A paleoscientist’s perspective

• Climate is always changing. Major changes have been disruptive.

• Speed of current climate change is more than 10 times higher than warming out of the last ice age.
We know why $\text{CO}_2$ causes warming
Clear evidence we’ve increased CO$_2$ levels

- By 40% in the last two centuries
- And continues to rise today
And that CO$_2$ levels are higher now...

- than in 800,000 years
Earth’s global mean temperature has risen

• 0.8°C (1.4°F) rise, documented by multiple groups
Other evidence indicates warming

- Ice and snow decreasing
Other evidence of warming

• Ocean heat and sea level increasing
Rigorous analysis shows human causation

- An increase in CO$_2$ 40% over pre-industrial levels
- Unique fingerprints of human climate change
- Models cannot simulate observed climate change without incorporating human influences
The warming is not due to the Sun

• Warming even as solar output has been low since 2003
• Warming of troposphere, cooling of stratosphere expected from greenhouse gases
The rate of warming varies

- Temperature variations from year to year, decade to decade, and place to place are expected, due mainly to natural causes.
- Earth is still receiving more heat than it's losing.
- Since the very warm 1998, a slowdown in the rate of warming has not invalidated our understanding of the warming due to increases in greenhouse gases.
- Despite a slowdown, the 2000s were warmer than the 1990s.
Why has winter been so cold in the central and eastern United States?

- Unusually cold days and nights and winters and summers will occur, even as the climate warms.

- January 2014: warm in the western US and Alaska; globally 4th warmest January since 1990
As CO$_2$ rises, more warming is expected

- If emissions continue on their present trajectory, further warming of 2.6 to 4.8°C (4.7 to 8.6°F) is expected by 2100.
CO₂ levels are changing the oceans

- As oceans have absorbed excess CO₂, ocean pH has dropped (acidification)
Sea level is rising faster

- Sea level has risen about 20 cm since 1901, and is now rising about 3.2 mm per year.
A few degrees is cause for concern

• Temperatures during last ice age only about 4 to 5°C (7 to 9°F) colder.
• Will cause widespread changes in regional and local temperature and precipitation
• These and other changes (such as sea-level rise) will impact human societies and the natural world.
Weather extremes are affected

• A warmer, moister atmosphere provides more energy for storms and certain severe weather events.
• As expected, heavy rainfall and snowfall events and heat waves are becoming more frequent.
• Understanding of effects on hurricanes, tornadoes, and droughts is still developing.
Tipping points not likely soon

• Models do not point to major tipping points in the near future, including:
  – shutdown of ocean circulation
  – large release of methane

• However, the possibility of abrupt change cannot be ruled out.
Actions today have long-term effects

- If greenhouse gas emissions were to suddenly stop, Earth would not cool to preindustrial levels for thousands of years.
Scientists work to improve understanding

- Science is a continual process of observation, understanding, modeling, testing, and prediction
- Areas of active research include:
  - Cloud dynamics
  - Climate variations on centennial and decadal timescales
  - Climate variations on regional-to-local scales
Joining by videoconference:
Sir Brian Hoskins, Imperial College, London and University of Reading
Dr. Benjamin Santer, Lawrence Livermore National Laboratory