Ten Key Facts: Climate Change

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The facts about climate change are clear: the earth is warming, man-made emissions are causing the warming, and the effects will get worse over time.

For the 5th time since it was chartered by the UN in 1988 to review and assess the science of climate change, the Intergovernmental Panel on Climate Change (IPCC) has released a series of reports in 2013-2014 detailing the state of knowledge on climate change, including its impacts and efforts to both mitigate and adapt to it.

The basics of climate change, therefore, are solidly established. The political discourse on the issue is very different than the scientific arguments.

In order to clearly show the basics that policymakers need to know, this paper lays out 10 essential facts about climate change.

These are facts and are not in dispute:

- The Earth is Warming
- The Climate has always Changed - but never this rapidly in human history
- Today’s Warming is Due to Emissions from Fossil Fuels
- Sea Levels Are Rising
- The Arctic is Melting
- The Oceans are Becoming More Acidic
- Weather Events are Becoming more Intense
- Seemingly Small Changes in Temperature have Immense Consequences
- Climate Change Presents National Security Threats
- The Effects of Climate Change Will Make Life Difficult for People
The Evidence of Climate Change

1) The Earth is Warming

- Average surface air temperatures have warmed 1.4°F since the beginning of the 20th century, with most of that warming since the 1970s.

![Changes in global surface temperatures since 1880](image1.png)

- The warmest decade on record was the 2000's, with each of the three decades before that warmer than the one before.

![Average temperature by decade since the 1880s](image2.png)
• However, measures of the increases in air temperature understate the amount of excess heat absorbed by the earth because they leave out water temperatures. The oceans, since the mid-1970s, have absorbed much of the heat (chart 3).

![Accumulation of Global Excess Heat Since 1960]

2) The Climate has always Changed - but never this rapidly in human history

• The Earth’s climate has always changed; that is not in dispute. Carbon dioxide concentration, global temperatures, and sea level have naturally varied, in close correlation with each other, over the last 400,000 years.

![Carbon Dioxide Concentration, Temperature Change, and Sea Level for 450,000 years]
• The last 10,000 years, however, have demonstrated remarkable stability, with a slight downward trend.

Global Temperature Changes Since 10,000 BC

• The past century has seen an abrupt shift. Temperatures are no longer stable and have increased suddenly.

Global Temperature Changes the last 2000 years
3) Today’s Warming is Due to Emissions from Fossil Fuels

- Greenhouse gases (including carbon dioxide) are necessary to life as we know it; without them, the earth would lose all the sun’s heat into space.

- With an increase, more of the sun’s heat is retained. As concentrations of heat-trapping gases increase, the natural greenhouse effect is enhanced, causing average global temperatures to increase.

- The atmospheric concentrations of greenhouse gases have increased over the past two centuries as a result of human activities, particularly the burning of fossil fuels, but also through land-use changes (clearing forests for farming) and livestock breeding.

- These rising levels of greenhouse gases are directly linked to man-made emissions – and those emissions are largely responsible for the changes in climate.

![Global Average Temperatures vs. Atmospheric CO2](image)
4) Sea Levels Are Rising

- The global average sea level has increased 8-10 inches since 1870. This trend is projected to increase. By the end of the century (2100), sea levels worldwide could rise 2-3 feet or more, depending on the melting of ice sheets in Greenland and Antarctica.

- Rising sea levels will have effects on societies around the world.

- Almost 50% of the U.S. population lives within 50 miles of the coastline and 39% of the total population lives in counties directly on the shoreline, while an estimated 16% of total U.S. property value is located in coastal counties. This places much of the populace at greater risk of storm surges and prolonged flooding.

- These effects are dwarfed by small island countries like Nauru and archipelagoes like Indonesia and others throughout the Pacific and Oceania, threatened with the complete submersion of their country.

- Freshwater aquifers and groundwater supplies on coasts around the world are at risk of becoming salted, creating further restraints on freshwater consumption.
5) The Arctic is Melting

- Arctic Ice Coverage (surface area) and Arctic Sea Ice Volume have shrunk precipitously in the past decades. While ice coverage has always varied, it has dramatically decreased in a short period.

![Sea Ice Annual Minimum Extent Since 1979](chart1)

- Notably, this means that there is little of the thick, multi-year ice remaining every year. So, even though the Arctic refreezes every winter, there is less thick ice remaining in the summer. This has contributed to a “death spiral” of Arctic Sea ice.

![Decline in multi-year sea ice, 1988-2013](chart2)

- For all of human history, the Arctic Ocean has been inhospitable and unnavigable, until now. The Northwest Passage, sought by explorers for centuries is now opening as ice in the northern region of Canada has melted enough to allow commercial shipping and military vessels through. The Northern Sea Route through Russia’s territory is even more navigable.
6) The Oceans are Becoming More Acidic

- The ocean absorbs an estimated 25-50% of manmade carbon emissions. The chemical interactions between CO$_2$ and seawater create bicarbonate molecules, an acid which lowers pH, making seawater more acidic.

- Changes in ocean chemistry are apparent with changes in Aragonite concentration – a compound used to build seashells.

Without greater acidity, certain sea life will be unable to build the shells needed to grow, potentially changing the entire ocean ecosystem.

Changes to ocean chemistry are irreversible for thousands of years.

Changes in acidity disrupt the life cycle and resource gathering of many marine species at the bottom of the food chain, like plankton, sea snails, and coral separate from the effects of warming. As the basis for food for many larger marine animals, their decreased numbers could harm populations of species further up on the food chain that humans use as a source of food.
7) Weather Events are Becoming more Intense

- It is difficult to link individual weather events with climate change, but changes in climate do mean that overall weather events are expected, overall, to be more intense and volatile than historically.

- As temperatures rise, more water evaporates, and warmer air is capable of carrying more precipitation, increasing the potential for intense storms.

The Distribution of Weather Events Become More Extreme

- The effects of climate change are not uniform across the globe.

  - Some regions will become more prone to drought, such as the American West Coast and the Middle East. Droughts will be more frequent and longer in duration, putting areas already prone to wildfires even more at risk.
8) Seemingly Small Changes in Temperature have Immense Consequences

- Depending on the level of future greenhouse gas emissions, climate change models predict global warming to increase average global temperatures by 2°F to 11.5°F by the year 2100, depending on greenhouse gas emissions and the atmosphere sensitivity.¹⁵

- These changes will have consequences:

  1) An increase of 3.8°F would cause a catastrophic decrease in plant and animal life in the Arctic region.

  2) An increase of 5.4°F would decrease yields for all major cereal crops in all major regions of production. At low latitudes, some crops could see a yield decrease of over 20%.¹⁶

  3) An increase of 7.2°F would double the frequency of drought events across southern Africa, South East Asia, and the Mediterranean basin.¹⁷

  4) Increases of 7.2°F would cause sea levels to rise as much as 31 inches by the end of the century.¹⁸

9) The Effects of Climate Change Will Make Life Difficult for People

- Climate change is not an intangible abstraction that only polar bears have to worry about. It already threatens existing livelihoods and lifestyles around the world:

  1) Mass displacement of populations, especially of inhabitants of coastal cities and famine stricken regions.

  2) An estimated 150 million more people per year would experience flooding in 2075 if sea level are to rise an average 21 inches.¹⁹

  3) Disruption of transportation and energy infrastructure from extreme weather.

  4) Food insecurity from increased warming and more varied and extreme precipitation like droughts and flooding.

  5) Less access to drinking and irrigation water.
10) **Climate Change Presents National Security Threats**

- Global warming brings unique and previously unaccounted for national security problems. Climate change is an “accelerant of stability” and a “threat multiplier.” By itself, climate change is not likely to cause war, but it contributes to the conditions that do lead to conflict.

- Possible vectors through which climate change will impact national security include:
  - Declining food productivity
  - Decreased fresh water availability
  - Greater mass migrations and refugees
  - Changing political boarders
  - Dangers to human livelihoods from extreme weather

- These changes need not cause societies to fall into conflict.

- With reasonable foresight, countries can adapt to the effects of climate change and militaries can intervene before a problem becomes a war. On the other hand, in a world that already has many threats to security and stability, climate change will make the threats that much more dangerous and unpredictable.

- The threats to global security from these effects of climate change have raised the alarm among militaries and governments around the world.

- At least 110 nations have identified climate change as a threat to national security.\(^{20}\)
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Further Reading:

www.NationalSecurityandClimateChange.org

Climate Security Report

Protecting the Homeland – The Rising Costs of Inaction on Climate Change

Critical Security Challenges in the Arctic

The Global Security Defense Index on Climate Change

Pay Now, Pay Later, ASP’s Report on the 50-state impact of Climate Change
Endnotes


10. Sea Ice Index, National Snow & Ice Data Center. Available at: [http://nsidc.org/data/g02135](http://nsidc.org/data/g02135) (accessed April 11, 2014).


17. Ibid.

18. Ibid.

19. Ibid.

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The American Security Project (ASP) is a nonpartisan organization created to educate the American public and the world about the changing nature of national security in the 21st Century.

Gone are the days when a nation’s security could be measured by bombers and battleships. Security in this new era requires harnessing all of America’s strengths: the force of our diplomacy; the might of our military; the vigor and competitiveness of our economy; and the power of our ideals.

We believe that America must lead in the pursuit of our common goals and shared security. We must confront international challenges with our partners and with all the tools at our disposal and address emerging problems before they become security crises. And to do this we must forge a bipartisan consensus here at home.

ASP brings together prominent American business leaders, former members of Congress, retired military flag officers, and prominent former government officials. ASP conducts research on a broad range of issues and engages and empowers the American public by taking its findings directly to them via events, traditional & new media, meetings, and publications.

We live in a time when the threats to our security are as complex and diverse as terrorism, nuclear proliferation, climate change, energy challenges, and our economic wellbeing. Partisan bickering and age old solutions simply won’t solve our problems. America – and the world - needs an honest dialogue about security that is as robust as it is realistic.

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