Climate Change—The Basics

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As a public issue, climate change boils down to four overarching findings: 1) climate is changing, 2) people are causing climate to change, 3) human caused climate change poses serious risks to society, and 4) we have numerous options for managing climate change risks.

Is climate changing? Yes. Climate is changing. The science is conclusive because there are many separate lines of evidence that all agree and that are verified by many different experts. Think of it this way, if you feel heat, smell smoke, hear a fire alarm, and see flames then you have independent confirmation from four senses that there's a fire. Each line of evidence reduces doubt. The same is true for climate change. The evidence that climate is changing comes from more than a dozen independent sources including: 1) temperature increases in the air measured over land and the oceans using thermometers, 2) temperature increases in the air measured by satelites, 3) warmer ocean water temperatures (greater heat content), 4) melting glaciers throughout the world (the vast majority), 5) plant and animal species moving where they live and shifting the timing of key life events (e.g., migration, reproduction, and periods of activity).

Are people causing climate to change? Yes. People are causing climate to change. Multiple independent lines of scientific evidence demonstrate this. First, the warming effect of greenhouse gases is clear based on laboratory experiements, evidence from past changes in climate and greenhouse gases, and the role of greenhouse gases on other planets. A second line of evidence relates to the patterns of climate change underway. These patterns match the characterisitcs expected from greenhouse gases well and do not match the characteristics we would expect from the other factors such as the sun, volcanoes, aerosols, changes in land-use, or natural variability. Think of it like a who-done-it where the list of suspects is the potential causes of climate change. Each suspect has its own fingerprint. Scientsts have worked hard to identify the potential causes of climate change and the patterns of change they would cause. The changes in climate that we've witnessed over the last several decades match the fingerprint of greenhouse gases and not any of the other suspects. These separate lines of evidence, taken together, demonstrate conclusively that people are causing most of the recent climate change.

How serious are the risks of climate change to society? Climate change poses serious risks to society because the physical characteristics of the planet, the biological resources on which we depend, and the social systems that we have developed are all heavily adapted to existing climate conditions. The consequences of climate change to society will depend on how climate changes and the effect that those changes have on human society (how well we absorb climate change impacts). Neither of these is well known so predicting specific societal consequences is difficult and will surely remain so for the foreseeable future. However, relatively small changes in climate have, at times, had large consequences on societies locally or regionally, illustrating the potential for serious cosequences of climate change. The changes in climate expected over the next several decades are faster than anything the world has experienced since the start of human civilization and will take us to climate conditions that are entirely unprecedented for society. It is unclear whether humanity's scientific and technological capabilities are sufficient to cope with these changes. We simply do not know how much carbon we can safely emit.

December, 2016

What are the options for managing climate change risks?
In a very general sense, climate policies fall into four broad categories: 1) reducing greenhouse gas emissions— mitigation, 2) efforts to increase society's capacity to cope with climate impacts—adaptation, 3) attempts to counteract some climate change impacts through additional, deliberate manipulation of the earth system—geoengineering or climate engineering, and 4) expansion of the knowledge base—efforts to better understand climate change, its implications, and society's options. These approaches party overlap, can be used in combination, and may create additional risks or benefits unrelated to climate change risk management (co-benefits).

Reducing emissions is a little like disease prevention (e.g., exercise, eat well, don't smoke). Adaptation is like managing illness (e.g., take medicine to cope with symptoms and problems). Geoengineering is a little like organ transplant but keep in mind that the Earth is patient #1.

How strong is the agreement within the scientific community on the basics? Agreement is extremely strong on the basics of climate change. Independent assessments suggest that the vast majority of scientists with relevant expertise in climate science agree that climate is changing, that people are the primary cause, and that human-caused climate change poses significant risks. Numerous national and international scientific organizations have reaffirmed these basics. These institutions include: the U.S. National Academy of Sciences, the National Academies of more than 30 other countries, the American Association for the advancement of science (AAAS), the American Meteorological Society (AMS), The American Institute of Physics (AIP), The Geological Society of America (GSA), The American Physical Society (APS), the American Geophysical Union (AGU) and numerous others. I am not familiar with a single scientific organization that has relevant expertise in climate science that disagrees with these basics.

Furthermore, each of the institutions mentioned above has broad expertise in many scientific disciplines. Being inaccurate in their assessments about any subject (including climate change) would damage their credibility and effectiveness on all other scientific topics. This creates a strong incentive to be accurate and increases the credibility of these institutions' climate change statements. Therefore, the scientific evidence is extremely strong that: 1) climate is changing, 2) people are causing climate to change, 3) human caused climate change poses considerable risk to society, and 4) broadly beneficial risk management options are available.

This AMS Policy Program memo is adapted from:

Higgins, P.A.T., 2014. *Climate Change Risk Management*. An AMS Policy Program Study. The American Meteorological Society, Washington, DC.

The offical AMS position is provided in the "AMS Statement on Climate Change" (a full listing of AMS statemens is available here

December, 2016