Weather and climate

In the debate over climate change, there is an understandable tendency to use recent weather events to draw conclusions about global warming. However, weather and climate are not the same — climate is far more complex.

While we all know what weather is, most of us are less clear about climate. A region's climate is defined as the prevailing behavior of its weather, including variability. Several decades of weather must ordinarily be considered to establish the average conditions and variability of climate.

Thus, the recent record cold weather in the Northeast U.S. does not indicate a cooling climate, just as last year's record summer heat in Europe does not confirm a warming world.

Geological evidence indicates that Earth's climate has varied continuously, warming and cooling due to changes on and beyond Earth. Factors as diverse as variations in sunlight and Earth's magnetic field, asteroid impacts, Sun-Moon-Earth orbital interactions, cosmic ray fluxes, continental drift, fluctuations in sea level, volcanic eruptions, changes in the biosphere, and massive ebbs and flows of continental glaciers, have significantly influenced climate.

Changes in one feature can affect others. During recent ice ages, another factor, greenhouse gas concentrations, changed for reasons that remain unclear. Evidence suggests that shifts in the flow of dust and nutrients from lands to oceans may have significantly altered the exchange of carbon dioxide between the air and oceans.

Observations and theory both indicate that weather and important aspects of climate, for instance El Niño events, behave in a chaotic fashion that may never allow for definitive, long-term predictions. These and other fluctuations produce significant natural climate variability. For example, over the past thousand years historical accounts and scientific data show evidence of a Medieval Warm Period followed by a Little Ice Age.

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In the face of natural variability and complexity, the consequences of change in any single factor, for example greenhouse gases, cannot readily be isolated and prediction becomes difficult. Geological and historical records make clear the need to account for natural climate variability and the integrated response of the entire climate system.

Over the last few decades climate research has made great progress. In particular, research has highlighted the risks to society and ecosystems resulting from the buildup of greenhouse gases. At the same time, scientific uncertainties continue to limit our ability to make objective, quantitative determinations regarding the human role in recent climate change or the degree and consequences of future change.

This reinforces the view that, as countries and societies work to find acceptable approaches to address climate change while continuing to promote global prosperity, there is an ongoing need to support scientific research to inform decisions and guide policies.