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Winter reflections on more signs of climate change

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As a climate scientist, I like to look back in winter on the year that has passed and ask what we have learnt. The year 2010 tied with 2005 as the warmest year on record, and brought much extreme weather around the globe. Temperatures in Moscow reached 100 degrees for the first time, contributing to fierce forest and peat fires. Pakistan set a new temperature record of 129 degrees, followed by catastrophic floods that submerged a fifth of the country. In northwest Amazonia, the Rio Negro fell to its lowest recorded level since records began in 1902. By the end of the year, a strong La Nina brought massive floods to Queensland in Australia, which continued into January.

The Earth's climate system has always been rather unstable, and now it is being driven by the increase in greenhouse gases and the warming of the Arctic into new patterns, which are giving us new extremes of weather. The Arctic warming may be accelerating. In 2010 Canada set a new temperature record of 5.4 degrees above normal – almost a degree above the previous record set in 1998. Most of Nunavut and northern Quebec was at least 7.4 degrees above normal. The Arctic sea-ice continues to melt away in summer and refreeze more slowly in winter. This winter has set new record lows for sea-ice cover in December and January. Hudson's Bay did not freeze over until mid-January, far later than "normal." Of course what was considered normal in the last decades of the twentieth century is now history.

Why is the frozen north warming so much faster than the Earth as a whole? There are two amplifying climate factors. As snow and ice cover are reduced, less sunlight is reflected — and so the north warms faster. If the Arctic waters and bays are unfrozen, then more water evaporates into the dry Arctic air. Water vapor is a powerful greenhouse gas, which stops the Earth's heat from radiating away into space, so again the north warms faster. Over the past four decades, Vermont has also been warming twice as fast in winter as in summer. These climate processes are familiar to us because they also work in the opposite sense. The heavy snowfalls in December gave us a chilly January by reflecting sunlight and reducing evaporation and water vapor in the air. Our nighttime January temperatures plunged as a result.

Now a new third factor has entered the picture. Last winter and this past December, a remarkable climate shift took place. The polar vortex, which used to trap the very cold air around the pole, got much weaker. This allowed frigid air to spill out into the central and south-eastern U.S. (as well as Europe). Exceptional snowfalls occurred up the east coast, while relatively warm air flowed up into Canada and the Arctic.

Weather and climate are fascinating, and every year we make new breakthroughs in understanding. Scientists love all this detail and complexity. Still, when rapid change comes like this year, it takes us a few years to fully analyze what has happened. Meanwhile the public and politicians just wish the problem of climate change would go away, so we can get back to the good old days! Perhaps those days are also now part of our history.

This is the snowiest winter in years. Last Saturday evening, I found myself plowing snow at night amid falling rain and vivid lightning and thunder. It was beautiful, but a little uncanny in early February.

National Climatic Data Center http://www.ncdc.noaa.gov/sotc/
Environment Canada http://ec.gc.ca/adsc-cmda/