EXTREME TEMPERATURES ACROSS THE *REST* OF THE GLOBE

Have there been more frequent hot weather events during the past century?

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One of the projected negative consequences of global warming is a concomitant increase in climatic variability, including more frequent hot weather events. It is a relatively easy matter to either substantiate or refute such claims by examining trends in extreme temperatures over the past century or so; because if global warming has truly been occurring at an unprecedented rate over the past hundred years, as climate alarmists claim it has, temperature variability and extreme temperature events should be increasing, according to them. In prior summaries we have investigated this issue as it pertains to North America, Europe, and Asia. In the present review, we investigate how it pertains to other locations across the globe.

We begin with a long temporal view of the subject provided by Oppo *et al.* (1998)[1], who studied sediments from Ocean Drilling Project site 980 on the Feni Drift (55.5°N, 14.7°W) in the North Atlantic. Working with a core pertaining to the period from 500,000 to 340,000 years ago, they analyzed $\delta^{18}O$ and $\delta^{13}C$ obtained from benthic foraminifera and $\delta^{18}O$ obtained from planktonic foraminifera to develop histories of deep water circulation and sea surface temperature (SST), respectively. In doing so, they discovered a number of persistent climatic oscillations with periods of 6000, 2600, 1800 and 1400 years that traversed the entire length of the sediment core record, extending through glacial and interglacial epochs alike. These SST variations, which were found to be in phase with deep-ocean circulation changes, were on the order of 3°C during cold glacial maxima but only 0.5 to 1°C during warm interglacials.

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Similar results were obtained by McManus *et al.* (1999)[2], who also examined a half-million-year-old deep-sea sediment core from the eastern North Atlantic. Significant SST oscillations were again noted throughout the record, and they too were of much greater amplitude during glacial periods (4 to 6°C) than during interglacials (1 to 2°C). Likewise, in another study of a half-

[1] http://www.co2science.org/articles/V2/N1/C1.php.
[2] http://www.co2science.org/articles/V2/N6/C3.php.

million-year-long sediment core from the same region, Helmke *et al*. (2002)[3] found that the most stable of all climates held sway during what they called "peak interglaciations" or *periods of greatest warmth*. In this regard, it is worth noting that the temperatures of *all four* of the interglacials that preceded the one in which we currently live were *warmer* than the present one, and by an average temperature *in excess of 2°C*, as determined by Petit *et al*. (1999)[4]. Thus, even if the Earth were to continue its recent (and possibly ongoing) recovery from the global chill of the Little Ice Age, that warming would likely not only *not* lead to greater temperature variability, as suggested by climate alarmists, but rather to a state of *reduced* temperature variability, as evidenced by real-world data pertaining to the past half million years.

New Zealand climate was much less variable over the last century than it was over the prior 700 years.

Coral records from the Indian and Pacific Oceans uncovered decadal variance was much greater between 1850 and 1920 than it was between 1920 and 1990.

Shifting the temporal focus to the past millennium, Cook *et al*. (2002)[5] report the results of a tree-ring study of long-lived silver pines on the West Coast of New Zealand's South Island. The chronology they derived provided a reliable history of Austral summer temperatures from AD 1200 to 1957, after which measured temperatures were used to extend the history to 1999. In discussing their findings, Cook *et al*. say their reconstruction indicates "there have been several periods of above and below average temperature that have not been experienced in the 20th century," indicating that New Zealand climate was much *less* variable over the last century than it was over the prior 700 years.

Focusing yet on still a finer temporal resolution, Ault *et al*. (2009)[6] employed 23 coral $\delta^{18}O$ records from the Indian and Pacific Oceans to extend the observational record of decadal climate variability in this region back in time to cover the period from AD 1850-1990, noting that "coral records closely track tropical Indo-Pacific variability on interannual to decadal timescales (Urban *et al*., 2000; Cobb *et al*., 2001; Linsley *et al*., 2008)." In doing so, the seven scientists identified "a strong decadal component of climate variability" that "closely matches instrumental results from the 20th century." In addition, they report that the decadal variance they uncovered was much greater between 1850 and 1920 than it was between 1920 and 1990. And as a result of these findings the researchers "infer that this decadal signal represents a fundamental timescale of ENSO variability," whose enhanced variance in the early half of the record "remains to be explained."

In a separate study, designed to investigate the IPCC contention "that in the future the frequency of extreme temperature events and their magnitude will increase," Rusticucci and

[3] http://www.co2science.org/articles/V5/N5/EDIT.php.
[4] http://www.co2science.org/articles/V2/N12/C1.php.
[5] http://www.co2science.org/articles/V5/N38/C1.php.
[6] http://www.co2science.org/articles/V12/N31/C3.php.

Barrucand (2004)[7] investigated how such a claim might possibly apply to Argentina, deriving trends of the mean, the standard deviation, and the extreme maximum and minimum daily temperatures over the period 1959-98 based on "a deeply quality-controlled stations database." According to the two Argentine scientists who conducted the study, "the variable that presents the largest number of stations with observed significant trends is the minimum temperature in summer, where positive trend values were found at many stations over 4°C (100 yr)$^{-1}$." They also report that "the maximum temperature in summer presented strong negative values of the same magnitude in stations located in central Argentina." And as a result of these findings, the researchers concluded that "a large fraction of the area that yields most of the agricultural production of Argentina should result in reduced air temperature variability in the case of a warming climate, as is also shown by Robeson (2002) for the United States."

Eight years later, Rusticucci (2012)[8] branched out on her own to further examine the claim that one of the negative consequences of global warming is a concomitant increase in *climatic variability*, including more extreme values of meteorological variables, such as air temperature, as it pertains to South America. Specifically, Rusticucci reviewed many studies that have explored this subject - throughout the length and breadth of South America - particularly as it applies to daily maximum and minimum air temperatures, the former of which is hypothesized to become more extreme in both degree and frequency in a warming world, while the latter of which is hypothesized to become less extreme.

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When all was said and done, the Buenos Aires researcher found the most significant trends to exist in the evolution of the daily *minimum* air temperature, with "positive trends in almost all studies on the occurrence of warm nights (or hot extremes of minimum temperature)," as well as negative trends in the cold extremes of the minimum temperature, which is indeed what one would expect to find with rising mean air temperatures. And she says that this was the case "in almost all studies." On the other hand, she writes that "on the maximum temperature behavior there is little agreement, but generally the maximum temperature in South America has decreased," which is just the *opposite* of what is projected by the models in a warming world. In general, therefore, over most of South America there has been a *decrease* in the *extremeness* of both daily maximum and minimum air temperatures, with the maximums declining and the minimums rising. These findings are very encouraging for that continent's inhabitants, as Rusticucci notes that cold waves and frost are especially harmful to agriculture, which she says is one of the main economic activities in South America. And cold waves and

[7] http://www.co2science.org/articles/V8/N12/C1.php.
[8] http://www.co2science.org/articles/V15/N29/C1.php.

frost days have been on the decline nearly everywhere throughout the continent during the period of 20th-century global warming.

Over most of South America there has been a decrease in the extremeness of both daily maximum and minimum air temperatures, with the maximums declining and the minimums rising.

Real-world data from various locations around the world, as described above, demonstrate that global warming is often accompanied by a decrease in temperature extremes, which for agriculture is generally a positive development.

Expanding still more on the spatial scale was Alexander *et al.* (2006)[9], who developed what they call "the most up-to-date and comprehensive global picture of trends in extreme temperature," using results from a number of workshops held in data-sparse regions and high-quality station data supplied by numerous scientists from around the world, after which several seasonal and annual temperature indices for the period 1951-2003 were calculated and gridded, and trends in the gridded fields were computed and tested for statistical significance.

In presenting their findings, Alexander *et al*. report that "over 70% of the land area sampled showed a significant increase in the annual occurrence of warm nights while the occurrence of cold nights showed a similar proportion of significant decrease," with some regions experiencing "a more than doubling of these indices." At the other end of the temperature scale, however, they found that only 20% of the land area sampled exhibited statistically significant changes, specifically noting that "maximum temperature extremes have also increased but to a lesser degree." These findings, in the words of the researchers, "agree with earlier global studies (e.g., Jones *et al*., 1999) and regional studies (e.g., Klein Tank and Konnen, 2003; Manton *et al*., 2001; Vincent and Mekis, 2006; Yan *et al*., 2002), which imply that rather than viewing the world as getting hotter it might be more accurate to view it as getting less cold."

Contrary to the contention of the IPCC, therefore, real-world data from various locations around the world, as described above, demonstrate that global warming is often accompanied by a *decrease* in temperature extremes, which for agriculture is generally a positive development.

[9] http://www.co2science.org/articles/V9/N24/C2.php.

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