HAIL STORM TRENDS

What do scientific papers say about the occurrence of hail storms?

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Insurance costs related to life and property damages caused by extreme weather events have been steadily rising in the United States and elsewhere; and it is not uncommon for many in the insurance industry and government to place the blame for this development on what they claim are significant increases in the frequencies and intensities of severe weather events, since climate models suggest that these phenomena should be increasing as a consequence of CO_2-induced global warming. But is this explanation correct? The following material reviews this question as it pertains to hail storms.

After describing and analyzing property losses due to a series of Midwestern U.S. hailstorms that occurred on 13-14 April 2006 and resulted in property losses totaling $1.822 billion, which he characterized as "an amount considerably more than the previous record high of $1.5 billion set by an April 2001 hail event," Changnon (2009)[1] described and analyzed the "top ten" hail-loss events that occurred in the U.S. over the period 1950-2006, finding "an increase over time in [hail event] frequency and losses with most major events occurring since 1990."

At first glance, these findings would appear to support the climate-alarmist contention that global warming is causing more hail events. However, the Illinois State Water Survey researcher opines that only "two factors could have affected this increase." One of them, in his words, could have been "more frequent occurrences of major cases of strong atmospheric instability, leading to the development of supercell thunderstorms capable of persisting for many hours, covering large areas, and producing large hailstones." However, he says that this scenario "has not been measured and cannot be verified." The second factor, as he describes it, "is the expansion of the nation's metropolitan areas, enhancing the target for hail damages to property," in support

Changnon and Changnon (2000) analyzed hail-day occurrences over the century-long period 1896-1995, obtained from records across the United States.

Hail-day occurrence, in fact, decreased to only 65% of what it had been at mid-century, dropping so low that there actually was a decline in national hail insurance losses over the final two decades of the study.

[1] http://www.co2science.org/articles/V12/N45/C1.php.

of which he notes that "urban population in the U.S. since 1960 increased by 56% and urban areas grew by 154%," as per data contained in the World Almanac (2008), all of which makes a pretty good case for the second of the two factors Changnon suggested.

This latter scenario was also favored by Changnon in an earlier study (Changnon, 2003[2]) in which he investigated trends in both severe weather events and changes in societal and economic factors over the last half of the 20th century. In doing so he found that trends in various weather extremes over this period were mixed, noting that "one trend is upwards (heavy rains-floods), others are *downward* [including "*hail*, hurricanes, tornadoes, and severe thunderstorms"], and others are unchanging flat trends (winter storms and wind storms)." As for why United States insurance losses due to *most* extreme weather events (remember, *hail* was the exception in this study) rose so rapidly over the past several decades, Changnon reports that "the primary reason for the large losses [was] a series of societal shifts (demographic movements, increasing wealth, poor construction practices, population growth, etc.) that collectively had increased society's vulnerability."

Further support for this thesis comes from the even earlier work of Kunkel *et al*. (1999)[3], who analyzed historical trends in several different types of extreme weather events, together with their societal impacts near the close of the last century. Their results indicated that most measures of the economic impacts of weather and climate extremes over the past several decades do indeed reveal increasing losses. However, they found that "trends in most related weather and climate extremes do not show comparable increases with time." This observation led them to conclude that the increasing economic losses "are primarily due to increasing vulnerability arising from a variety of societal changes," and in this regard they found that "increasing property losses due to thunderstorm-related phenomena (winds, *hail*, tornadoes) are explained *entirely* [italics added] by changes in societal factors." And when the temporal view of analysis is expanded even further, the claim that global warming is increasing hail events is *completely* debunked.

Focusing on the same hundred-year time period in Poland, Bielec (2001) analyzed thunderstorm data obtained at Cracow in Europe.

With respect to the annual number of thunderstorms with hail, Bielec reports there was also a decrease over the hundred-year period.

Changnon and Changnon (2000)[4], for example, analyzed hail-day and thunder-day occurrences over the century-long period 1896-1995 in terms of 20-year averages obtained from records of

[2] http://www.co2science.org/articles/V6/N32/C3.php.
[3] http://www.co2science.org/articles/V2/N22/EDIT.php.
[4] http://www.co2science.org/articles/V3/N5/C3.php.

66 first-order weather stations distributed across the United States. This effort revealed that thunder-day frequency peaked in the second of the five 20-year intervals, while hail-day frequency peaked in the third or middle interval. Thereafter, both parameters declined to their lowest values of the century in the final 20-year period. Hail-day occurrence, in fact, decreased to only 65% of what it had been at mid-century, dropping so low that there actually *was* a decline in national hail insurance losses over the final two decades of the study.

But what about locations *beyond* the United States? Do they yield similar results?

Focusing on the same hundred-year time period in Poland, Bielec (2001)[5] analyzed thunderstorm data obtained at Cracow, which is described as possessing "one of the few continuous records in Europe with an intact single place of observation and duration of over 100 years." Over the entire length of this record, there were 2470 days with thunderstorms, or an average of about 25 days per year. The highest annual number of thunderstorm days was 37, recorded in 1968 and again in 1975, while the lowest annual number was 9 in 1904. Close analysis of the data revealed a slight but non-significant linear increase of 1.6 storms per year from the beginning to the end of the record. From 1930 onward, however, the trend is *negative*, revealing a linear decrease of 1.1 storms per year. And with respect to the annual number of thunderstorms with *hail*, Bielec reports there was also a decrease over the hundred-year period.

From an historical hail dataset of 753 stations compiled by the National Meteorological Information Center of China, which "includes hail data for all weather stations in the surface meteorological observational network over the whole of China from 1951 to 2005," Xie *et al.* (2008)[6] "chose 523 stations with complete observations from 1960 to 2005" to use in their study of "annual variations and trend[s] of hail frequency across mainland China during 1960-2005."

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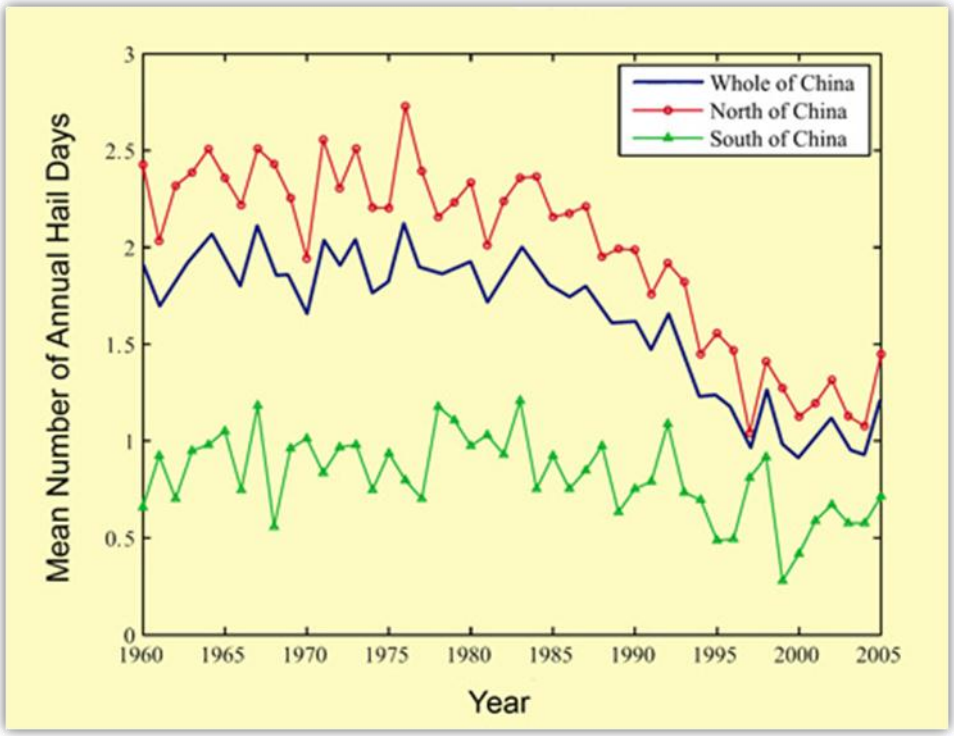
As is clearly evident in the figure below, Xie *et al*. report that the results of their study "show no trend in the mean Annual Hail Days (AHD) from 1960 to [the] early 1980s but a significant decreasing trend afterwards," which latter downturn, it should be noted, was concomitant with a warming of the globe that the world's climate alarmists claim was *unprecedented* over the past one to two *millennia*, leading the three authors to conclude that global warming may actually imply "a possible reduction of hail occurrence."

[5] http://www.co2science.org/articles/V4/N18/C2.php.
[6] http://www.co2science.org/articles/V11/N35/C2.php.



Mean Annual Hail Day variations and trends in northern China, southern China and the whole of China. Adapted from Xie et al. (2008).

Recognizing that Xie *et al*. (2008) found there was a "significant decreasing trend of hail frequency in most of China from the early 1980s based on 46 years of data during 1960-2005," Xie and Zhang (2010)[7] set out to learn if there had also been any change in another type of extremeness (hailstone size), noting that "changes in hail size are also an important aspect of hail climatology." Specifically, they examined the long-term trend of hail size in four regions of China over the period 1980-2005, using *maximum hail diameter* data obtained from the Meteorological Administrations of Xinjiang Uygur Autonomous Region (XUAR), Inner Mongolia Autonomous Region (IMAR), Guizhou Province and Hebei Province.

The results of this study indicated an uptrend in maximum hail diameter in Hebei, a flat trend in XUAR, and a slight downtrend in both Guizhou and IMAR; but they add that "none of the trends is statistically significant." And in light of these several findings, it is clear that the highly-hyped global warming of the past few decades has led to no increase in the extremeness of Chinese hail storms. In fact, the data suggest there was a slight *decline* in the frequency of such storms, along with a hint of a possible decrease in maximum hail diameter, which latter non-significant observation doesn't mean very much, except that it strongly suggests there was at least no *increase* in maximum hail diameter.

[7] http://www.co2science.org/articles/V13/N51/C3.php.

These results, combined with the other findings presented above, demonstrate that global warming -- CO_2-induced or otherwise -- has had nothing to do with the increasing damages caused by extreme weather events in general; and it has had absolutely *no* tendency to increase the occurrence of *hail* storms, at least in the United States, China, and portions of Poland for which pertinent data have been properly analyzed.

It is clear that the highly-hyped global warming of the past few decades has led to no increase in the extremeness of Chinese hail storms. In fact, the data suggest there was a slight decline in the frequency of such storms, along with a hint of a possible decrease in maximum hail diameter.

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Cover photo of a hailstorm in Wyoming, USA
provided by Jenn Stewart.