The Medieval Warm Period in Japan

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The Medieval Warm Period (MWP) was a global climatic anomaly that encompassed a few centuries on either side of AD 1000, when temperatures in many parts of the world were even warmer than they are currently. The degree of warmth and associated changes in precipitation, however, sometimes varied from region to region, with the result that the MWP was expressed somewhat differently now and then in different parts of the world. How it manifested itself in Japan is the subject of this Summary.

Kitagawa and Matsumoto (1995)[1] analyzed $\delta^{13}C$ variations of Japanese cedars growing on Yakushima Island, southern Japan (30°20'N, 130°30'E), in an effort to reconstruct a high-resolution proxy temperature record covering the past two thousand years, while they applied spectral analysis to the $\delta^{13}C$ time series in an effort to learn if any significant periodicities were present in the data. These efforts revealed that there was significant decadal to centennial-scale variability throughout the record, with temperatures fluctuating by about 5°C across the series. Most notable among the fluctuations were multi-century warm and cold epochs. Between AD 700 and 1200, for example, there was about a 1°C rise in average temperature, which in the words of the two researchers, "appears to be related to the 'Medieval Warm Period'."

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In contrast, temperatures were about 2°C *below* the long-term pre-1850 average during the multi-century Little Ice Age that occurred between AD 1580 and 1700. Kitagawa and Matsumoto also reported finding significant temperature periodicities of 187, 89, 70, 55 and 44 years; and noting that the 187-year cycle closely corresponds to the well-known Suess cycle of solar activity, and that the 89-year cycle compares well with the Gleissberg solar cycle, they concluded that their findings provided strong support for a sun-climate relationship. In addition, their results gave added strength to the growing body of evidence that indicates that the Medieval Warm Period and Little Ice Age were both *global* phenomena; and they thus concluded there was nothing unusual, unnatural or unprecedented about Current Warm Period temperatures in this region, which according to real-world data remain about one degree Celsius *lower* than the peak warmth of the Medieval Warm Period.

[1] http://www.co2science.org/articles/V9/N19/C2.php.

Six years later, and noting that instrumental climate records are insufficient to be used alone in understanding natural climate variability, Adhikari and Kumon (2001)[2] analyzed the total organic carbon, total nitrogen and sand content of sediment cores extracted from Lake Nakatsuna in central Japan (36°30'N, 137°51'E) to produce a proxy record of climate for this region that covered the past 1300 years. This project revealed both the well-known Medieval Warm Period (AD 900-1200), which the two researchers said was "warmer than any other period during the last 1300 years," and the Little Ice Age (AD 1200-1950), which was punctuated by three major cold phases (AD 1300-1470, 1700-1760 and 1850-1950), thereby providing more evidence for a *global* Medieval Warm Period and a *global* Little Ice Age, the case for which keeps getting stronger by the day, while also demonstrating that the Intergovernmental Panel on Climate Change (IPCC) should never have abandoned their *original* climate history of the world - which more accurately depicted these significant temperature excursions (Houghton *et al*., 1990) - in favor of the flawed "hockey stick" temperature history of Mann *et al*. (1998, 1999).

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In a paper published the following year, Daimaru *et al*. (2002)[3] wrote that "in snowpatch grasslands, plant distributions follow the contours of the snowmelt gradient around summer snowpatches," producing "similarly steep gradients in plant productivity and topsoil (e.g. Billings and Bliss, 1959; Helm, 1982; Kudo, 1991; Stanton *et al*., 1994.)" In fact, they say that "in the subalpine zone of northeastern Japan, sites where the snow cover disappears after July are usually occupied by 'snowpatch bare grounds' with extremely poor vegetation cover" that is "encircled by snowpatch grassland," citing Yamanaka (1979). And as a result, they say that "litter fall and the organic content in topsoil decrease toward the center of a snowpatch because the period for plant growth becomes shorter with delay in the time of snow disappearance," so that in *current* "snowpatch grasslands, peaty topsoil is restricted to sites where snowmelt comes early." And as a result of *this* fact, the unique situation provided by a snowpatch can provide a good

[2] http://www.co2science.org/articles/V9/N13/C3.php.
[3] http://www.co2science.org/articles/V13/N42/C2.php.

opportunity for paleoclimatic reconstructions based on vertical profiles of soil characteristics at various locations along transects moving outwards from summer snowpatches.

Taking advantage of this situation, while working in a snowpatch grassland within a shallow depression of landslide origin on the southeastern slope of Japan's Mt. Zarumori (~39.8°N, 140.8°E), Daimaru *et al*. dug 27 soil pits at various locations in and around the central location of the snowpatch, carefully examining what they found and determining its age based on ^{14}C dating and tephrochronology. And they say that in doing so, "peaty topsoils were recognized at seven soil pits in the dense grassland, whereas sparse grassland lacked peaty topsoil." They also found that "most of the buried peat layers contained a white pumice layer named 'To-a' that fell in AD 915." And they say that this observation, plus their ^{14}C dating, led them to conclude that the buried peat layers *in the poor vegetation area* indicate "warming in the melt season," as well as "a possible weakened winter monsoon in the Medieval Warm Period," which their data suggest prevailed at the site they studied throughout the tenth century, i.e., AD 900-1000. And the fact that they stated that "many studies have reported climatic signals that are correlated with the Medieval Warm Period from the 9th to 15th centuries in Japan," suggests that the possibly weakened winter monsoon of AD 900-1000 may also have been a consequence of the warmer temperatures of that period. And so the evidence continues to mount for a *global* Medieval Warm Period that was *warmer* than the Current Warm Period has been to date. And since the atmosphere's CO_2 concentration was so much *lower* a millennium ago than it is today, there is no compelling reason to attribute the *lesser* warmth of the present to the air's *higher* CO_2 content.

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Two years later, based on pollen analyses of a sediment core retrieved from Karikomi Lake in the border area between the Hida and Echizen regions of Japan in the Hakusan mountains, as well as the contents of numerous local histories, Kitagawa *et al*. (2004)[4] first learned about (and then described) the historical development of a practice called *hansaibai*, whereby local inhabitants encouraged the growth of horse-chestnut (*Aesculus turbinata*) trees as a food source during cold-induced famines of the Little Ice Age. Prior to that time, however, when the Medieval Warm Period prevailed, they learned that the mix of tree species comprising the local forest was that of "a warm temperate forest." At about AD 1360, however, they say the warm-climate species "decreased, suggesting cooler climatic conditions," which point in time is noted by them as corresponding to "the beginning of the Little Ice Age as generally recognized in Japan (Sakaguchi, 1995)."

[4] http://www.co2science.org/articles/V7/N46/C2.php.

During this multi-century cold spell, Kitagawa *et al*. reported that "serious famines frequently occurred because of adverse climatic conditions," three of which were especially serious; for quoting them again, "both the Kyoho famine in 1732 and the Tenmei famine (1782-1787) resulted in population decreases of about one million, and during the Tenpo famine (1823-1839) the population declined by ca. 290,000 (Nakajima, 1976)."

These diverse observations clearly reveal the existence of both the Medieval Warm Period and Little Ice Age in Japan, thereby strengthening the proposition that these distinctive climatic intervals were in fact *global* as opposed to merely *regional* phenomena that were restricted to countries bordering the North Atlantic Ocean (as climate alarmists still are inclined to claim). They also reveal the *harshness* of the Little Ice Age, which the five Japanese scientists say "caused serious famines in Europe, Argentina, and Mexico (Appleby, 1980; Cioccale, 1999; Post, 1984; Swan, 1981)," the latter two of which locations are also far removed from the North Atlantic Ocean.

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Jumping ahead a full six years, one finds Yamada *et al*. (2010)[5] working with sediment cores they obtained in July of 2007 from Lakes Ni-no-Megata (39°57'N, 139°43'E) and San-no-Megata (39°56'N, 139°42'E) on the Oga Peninsula of northeastern Japan, where they measured a number of sediment properties, among which were *sulfur content* and *coarse mineral grains*, the former of which served as a proxy for paleo-Asian *summer* monsoon activity, and the latter of which served as a proxy for paleo-Asian *winter* monsoon activity over the last two millennia. These data revealed the presence of a cold/dry interval stretching from AD 1 to 750, a warm/humid interval stretching from AD 750 to 1200, and another cold/dry interval stretching from AD 1200 to the present; and they say that these intervals could represent, respectively, "the Dark Ages Cold Period (DACP), the Medieval Warm Period (MWP) and the Little Ice Age (LIA)."

In further discussing their findings, they note that they complement the findings of Kitagawa and Matsumoto (1995), whose study of tree-ring records in southern Japan "suggested the existence of one warm interval at AD 750-1300 and two cold intervals at AD 200-750 and AD

[5] http://www.co2science.org/articles/V13/N47/C3.php.

1600-1800," as well as the findings of Sakaguchi (1983), whose study of the pollen record of peaty sediments in central Japan revealed "an unusual warm interval (AD 700-1300) and a cool interval (ca. AD 250-700)." In addition, they write that the "strong summer monsoon and weak winter monsoon at Lakes Ni-no-Megata and San-no-Megata from AD 750-1200 correlates with the lower ð^{18}O values from Wangxiang Cave (Zhang *et al.*, 2008) and lower values of minerogenic clastic content (Chu *et al.*, 2009)." Once again, therefore, evidence continues to accumulate for the *global scope* of the millennial-scale oscillation of climate that reverberates throughout glacial and interglacial periods alike.

Closing out this summary of studies of the Medieval Warm Period in Japan, Aono and Saito (2010)[6], as they describe it, "investigated documents and diaries from the ninth to the fourteenth centuries to supplement the phenological data series of the flowering of Japanese cherry (*Prunus jamasakura*) in Kyoto, Japan, to improve and fill gaps in temperature estimates based on previously reported phenological data," after which they "reconstructed a nearly continuous series of March mean temperatures based on 224 years of cherry flowering data, including 51 years of previously unused data, to clarify springtime climate changes." In addition, they estimated still other cherry full-flowering dates "from phenological records of other deciduous species, adding further data for six years in the tenth and eleventh centuries by using the flowering phenology of Japanese wisteria (*Wisteria floribunda*)."

As a result of their many and detailed efforts, the two researchers report that their temperature reconstruction "showed two warm temperature peaks of 7.6°C and 7.1°C, in the middle of the tenth century and at the beginning of the fourteenth century, respectively," and they state that "the reconstructed tenth century temperatures [AD 900-1000] are somewhat higher than present temperatures after subtracting urban warming effects." Last of all, they add that "the general pattern of change in the reconstructed temperature series in this study is similar to results reported by previous studies, suggesting a warm period in Asia corresponding to the Medieval Warm Period in Europe."

All these things come together to further strengthen the likelihood that the Medieval Warm Period was truly a global phenomenon, and that its peak warmth was greater than what has been experienced to date in our day.

This insightful new study is truly a stellar example of both ingenuity and tedious bibliographic sleuthing that testifies of the significant warmth of the Medieval Warm Period at *a specific location*, but which is said to be typical of what has been learned about *the Asian continent in general* by the studies of others. In addition, it suggests the importance of considering the

[6] http://www.co2science.org/articles/V13/N40/C2.php.

presence or absence of urban heat island effects when comparing current and past reconstructed temperatures. And when considered in their totality, all of these things come together to further strengthen the *likelihood* that the Medieval Warm Period was truly a *global* phenomenon, and that its peak warmth was *greater* than what has been experienced to date in our day.

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