

The 'Hockey Stick': A New Low in Climate Science

by
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Introduction

A blaze of publicity accompanied publication of the 1995 Intergovernmental Panel on Climate Change (IPCC) because it contained the infamous phrase concerning "a discernible human influence on global climate." [10] Although it attracted much less attention, the assessment also contained information on global climate over the last thousand years using a graph of temperature change since 900 A.D. (Figure 1),

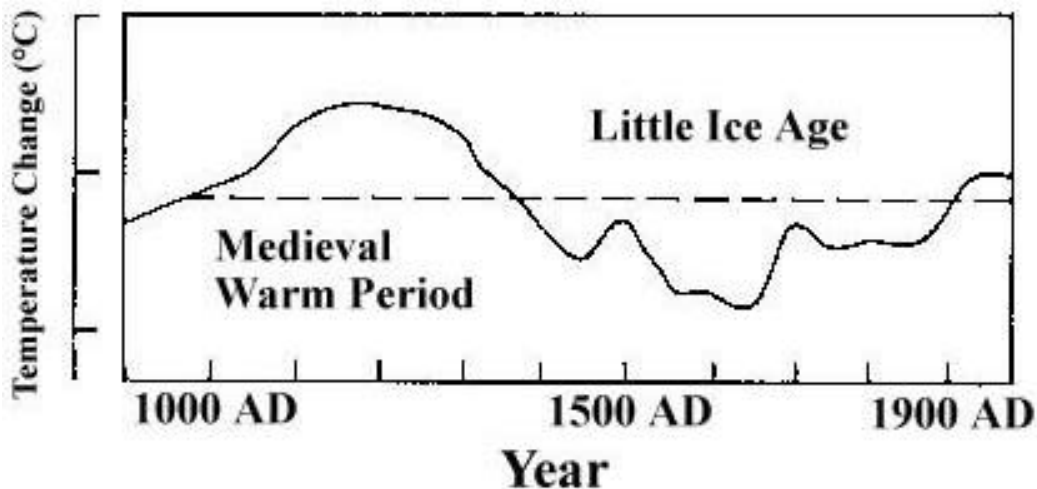


Figure 1: Global temperature since 900 AD.

This is a graphic illustration of how temperatures during the Medieval Warm Period were higher than temperature today. This fact also is hinted at in 1386 in the opening lines of Geoffrey Chaucer's *Canterbury Tales*:

Whan that Aprille with his shoures soote -
The droughte of March hath perced to the roote,
And bathed every veyne in swich licour
Of which vertu ungedred is the flour;"

It also graphically illustrates how much cooler it was during the Little Ice Age, which also has a literary reference in a sermon by the Elizabethan preacher John King in 1595:

Our years are turned upside down; our summers are no summers; our harvests are no harvests!

Historical records from all over Europe and from Greenland attest to the reality of both the medieval warming and the Elizabethan cooling. Both events profoundly impacted human society. Colonization of Greenland by the Vikings early in the millennium only was possible because of the medieval warmth. During the Little Ice Age, those Greenland Viking colonies collapsed and the River Thames often froze over, resulting in frequent 'frost fairs' on the river ice in London.

The dating of these two climatic events depends to some extent on what one regards as 'warm' and 'cold' in comparison with present temperature. So the following is an approximation.

1) "Medieval Warm Period"	700– 300 AD
2) "Spörer Minimum" cool period	1300–500 AD
3) Brief climatic warming	1500–1560 AD
4) "Little Ice Age" ("Maunder Minimum")	1560–1830 AD
5) Brief warmer period	1830–1870 AD
6) Brief cool period	1870–1910 AD
7) 20 th century warm period	1910–2000 AD

As to the cause of these two major climatic events, the most probable candidate is the variable sun, particularly with respect to the Little Ice Age. We have direct observations of sunspot counts going back to 1600 AD. These permit comparison of variations in the sun with variations in global climate. *Figure 2* shows how the sun has changed over time. Radiation is at its greatest during a sunspot maximum and least when there is minimal sunspot activity. This happens on an 11-year cycle.

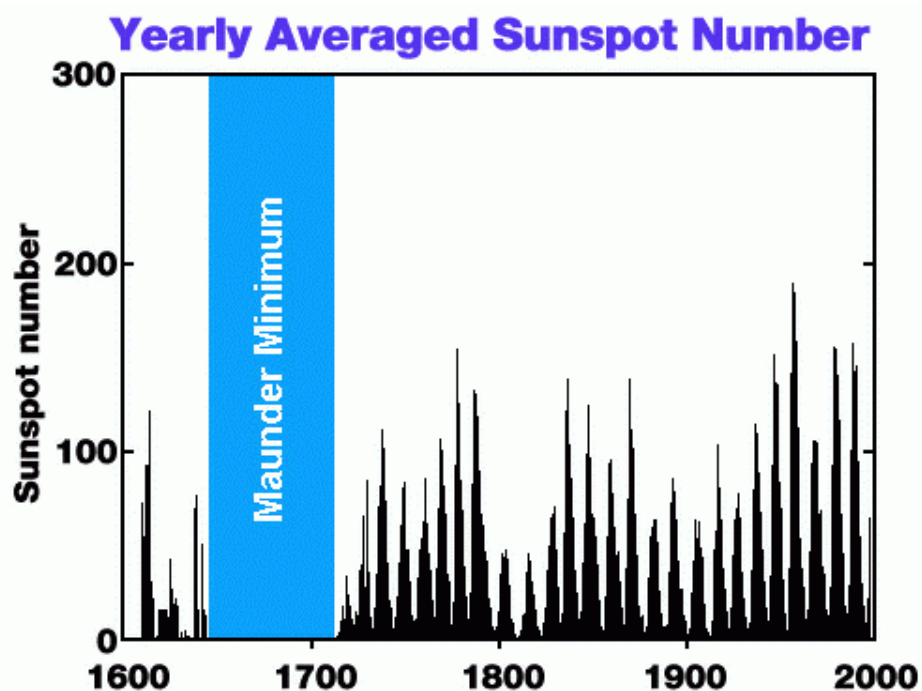


Figure 2: The Solar Cycle since 1600 AD

The most striking feature of this 400-year record of solar variability is the Maunder Minimum, a 70-year period during which there were practically no sunspots at all. It's as if the sun had 'stopped breathing'. But even before 1640 when the Maunder Minimum started, the cycle was clearly fragmented and irregular in contrast with the solid rhythmic cycles of subsequent years after 1710. When we compare this extraordinary solar event with the climate record from Fig.1, we can see the Maunder Minimum occurred at exactly the same time as the lowest point of the Little Ice Age.

The inference is clear. The variable sun caused the Little Ice Age and in all probability caused the Medieval Warm Period as well. Carbon 14 isotopes are used as a proxy for solar activity prior to 1600 AD. This indicates a high level of solar activity during the medieval period, resulting in climatic warmth. A reduced level of solar activity during a cold period called the 'Spörer Minimum' centers on 1350 AD.

This account of climatic history contains two serious difficulties for the present global warming theory.

- 1) If the Medieval Warm Period was warmer than today and there was no greenhouse gas contribution, why would modern-day warming be unusual?
- 2) If the variable sun caused both the Medieval Warm Period and the Little Ice Age, wouldn't stronger solar activity of the 20th century account for most, if not all, 20th century warming?

Both propositions pose a serious threat to continued public acceptance of the climate modeler's catastrophic view of future climate. This is because new findings in solar science suggested that the sun, not greenhouse gases, is the primary driver of 20th century climate trends.

The power of the sun to modulate our climate is reinforced by recent research that shows it is not only the cyclic warming and cooling of the sun (manifested by the 11-year sunspot cycle) that causes climate to change, but also changes in the solar spectrum toward greater ultra-violet radiation compared with visible or infra-red light (see *Figure 3*). [14] [8]

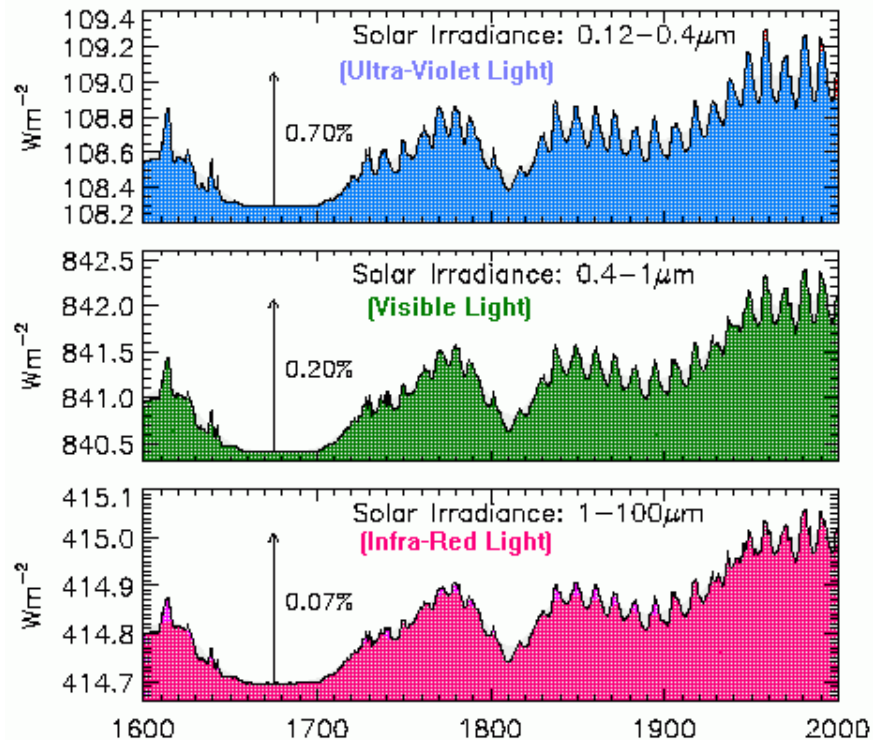


Figure 3: The sun since 1600 AD.

The disproportionate enhancement of the ultra-violet part of the solar spectrum affects the ozone layer and other atmospheric chemistry, which may amplify any warming. In addition, recent changes in magnetic activity on the sun influence cosmic radiation reaching Earth, which in turn modulates low-level cloudiness and therefore temperature. [24] In other words, solar scientists have identified three separate mechanisms by which the sun can warm or cool the earth. They are now believed to have been responsible for the Medieval Warm Period, the Little Ice Age, and the 20th century climatic trends.

These new solar findings either have been ignored by greenhouse theorists or treated with hostility.

In 1999, a paper published in *Geophysical Research Letters* (GRL) [15] altered the landscape concerning interpretation of climate history. It contrasts with the challenge posed by the solar scientists. In it, the infamous 'Hockey Stick' was first unveiled.

The 'Hockey Stick'

Dr Michael Mann of the Department of Geosciences at the University of Massachusetts is primary author of the GRL paper. [16] Using tree rings as a basis for assessing temperature change back to 1000 AD (and supplementing with other proxies from more recent centuries), the paper completely redraws climate history. It renders the Medieval Warm Period and Little Ice Age as non-events, consigning them to an Orwellian 'memory hole'. *Figure 4* depicts Mann's revisionism.

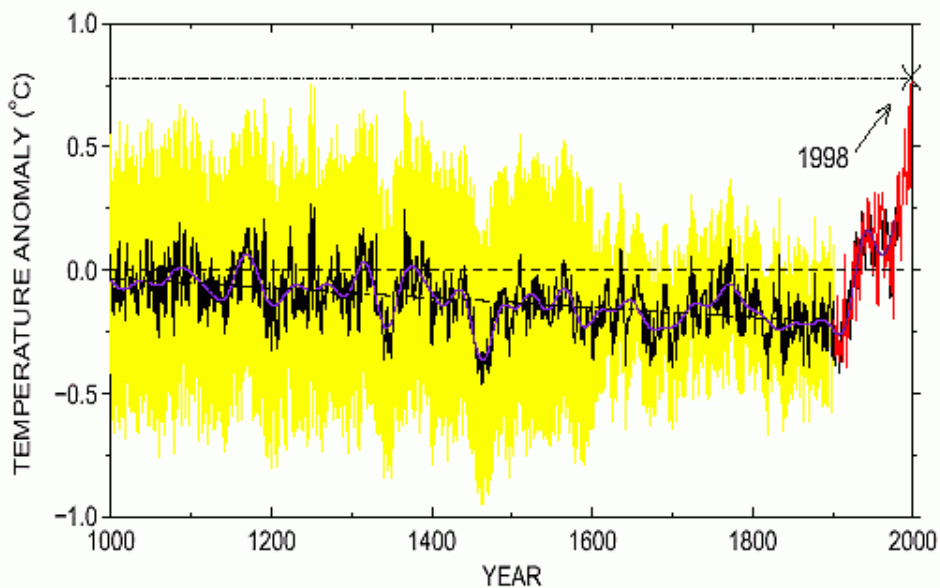


Figure 4 : The 'Hockey Stick'

Compare *Figure 1* and *Figure 4*. The Medieval Warm Period and Little Ice Age have been replaced by a largely benign and slightly cooling linear trend in climate – until 1900 – at which point Mann et al. complete their coup by crudely grafting the surface temperature record of the 20th century (shown in red and itself largely the product of urban heat islands) onto the pre-1900 tree ring record.

The effect is visually dramatic. Twentieth century climate appears to be rocketing out of control. The red line extends all the way to 1998 (Mann's 'warmest year of the millennium'), a year warmed by the big El Niño.

This surface temperature record is completely at variance with the satellite temperature record. [20] Had the satellite record been used to represent the

last 20 years, the effect would have been to make the 20th century much less significant when compared with earlier centuries.

As a piece of science and statistics, this graph has serious flaws. Two data series representing radically different variables (temperature and tree rings) cannot be grafted together credibly to create a single series. When such a drastic revision of previously accepted knowledge is promulgated in any branch of science, it can be expected that there will be considerable debate and scepticism. Such a radical departure from conventional wisdom will face a gauntlet of criticism and intense peer review. It is only when the new idea survives that process that it becomes broadly accepted within the scientific peer group and by the public at large. Or so it was until Mann's Hockey Stick. In this instance the scientific coup was total, bloodless, and swift. A chorus of accolades greeted Mann's paper. It has taken less than a year to become the new orthodoxy.

Its consummation as "the new theory" comes with the release of the Intergovernmental Panel on Climate Change (IPCC) draft of the Third Assessment Report (TAR-2000). [11] Overturning the state of the science as presented in the 1995 report, the IPCC presents the Hockey Stick without apology or explanation despite the abrupt U-turn.

The long-awaited draft U.S. National Assessment of the Potential Impact of Climate Change "Overview" features the Hockey Stick as the first among many climatic graphs and charts, affirming its crucial importance as a core foundation upon which a new publicity offensive on global warming is being mounted.

Two issues are raised by the Hockey Stick: (1) Why does the climatological community uncritically embrace it, and (2) Is it true? Its adoption disposes of the inconvenient Medieval Warm Period and Little Ice Age, and avoids the problem of the sun's role in climate history. In that way, it seems way too pat.

The Origins of the Hockey Stick

Tree rings are the primary proxy used to fabricate the Hockey Stick, particularly in the earlier part of the millennium. Tree rings are created during the growing season, not over an entire year. They tell scientists little or nothing about annual climate. Think of it this way: This year (2000) there was a warm winter and early spring in the northeastern U.S., followed by an unusually cool summer and fall. These events largely are self-cancelling. As a consequence, 2000 will be fairly average. But the tree rings only will record the cool summer and thus give a completely false impression of the full year's temperature. Tree rings do not record nighttime or winter temperature when photosynthesis is not underway. Yet winter and nighttime temperatures are essential components of what we understand annual mean temperature to be.

What a tree ring does record is whether or not combined micro-environmental conditions during the growing season were favourable for tree growth. Tree

rings are influenced by numerous factors. Rainfall, sunlight, cloudiness, pests, competition, forest fires, soil nutrients, frosts, and snow duration all play important roles. As a consequence, tree-rings aren't particularly good proxies for daytime temperature during the few months of the growing season. Other proxies such as isotopes in coral, ice, minerals, and sediments are far superior.

To state the obvious, trees grow on land. Because oceans, seas, and lakes inundate 71 percent of the earth, tree rings tell us nothing about maritime climate. This is no small point. Oceans are the primary determinant of climate conditions throughout the world.

Historical climate simply cannot be described without taking into account the winter and adjacent months' temperatures, nighttime temperatures, and ocean sea surface temperatures. Tree rings, no matter how carefully they are measured and examined, cannot provide information on any of these key parameters and are even a doubtful proxy for daytime temperatures on land in summer.

A final weakness arises in calibration of tree rings against temperature. When measuring the width or density of a tree ring, exactly what temperature does the measurement represent? This only can be determined if one is able to calibrate recently laid rings against known temperatures. This process is fraught with its own problems. Under certain circumstances it is possible for "known temperature" to incorporate contamination of the temperature record by heat island or other local errors. An error in calibrating known temperature compromises the entire tree ring temperature reconstruction, all the way into the distant past. These difficulties are so great that there is a sub-specialty within the greenhouse sciences devoted to it. Dendrochronology (the study of tree rings) has prospered and been highly successful in projecting itself within the climatological community despite its weakness as a proxy.

The simple fact is this: Climatology can say very little about climate trends looking at a temperature record extends back several generations to the dawn of scientific observation.

The IPCC and U.S. National Assessment did not dare challenge the existence of the Medieval Warm Period and Little Ice Age with respect to Europe and Greenland. The events are too well "recorded" by other proxy indicators and within human-recorded history. Rather, the events are dismissed as local, and confined to Europe and Greenland. They are perceived to be the experience of old, dead white men – experiences absent elsewhere in the annals of world climate. The historical evidence is dismissed as anecdotal and professional historians not to be trusted as to objective. But objectivity is determined by the manner in which evidence is treated, not the nature of the evidence itself.

Historians regard their work to be scientific. As a prominent Finnish scientist remarked about a historical military event in his country's distant history, "If 'anecdotal' ice is thick enough to carry a whole army, we can infer the ice was

both thick and durable as an objective conclusion based on a documented historical fact."

Similar inferences can be made elsewhere in the world. For example, if whole populations suffer from drought-induced famine, we can infer reduced rainfall. Proxies are not needed to conclude that this was so. When a society is ravaged by great flood, increased precipitation can be inferred. When Polynesians are able to populate the Pacific Islands using outriggers, climate inferences can be made. Reluctance to declare the Medieval Warm Period and Little Ice Age as "non-events" in Europe suggests that historical evidence is overwhelming and selected proxies "proving" otherwise not credible.

If the IPCC genuinely desires full information about millennial climate, it will involve historians in its process. Research into past climates as observed, experienced, and recorded by human societies around the world would be funded. After all, in Mann's original formulation, the Hockey Stick applies only to the Northern Hemisphere. However, the U.S. National Assessment by giving it a new title treats it as if it is a global history rather than merely hemispheric. [19]

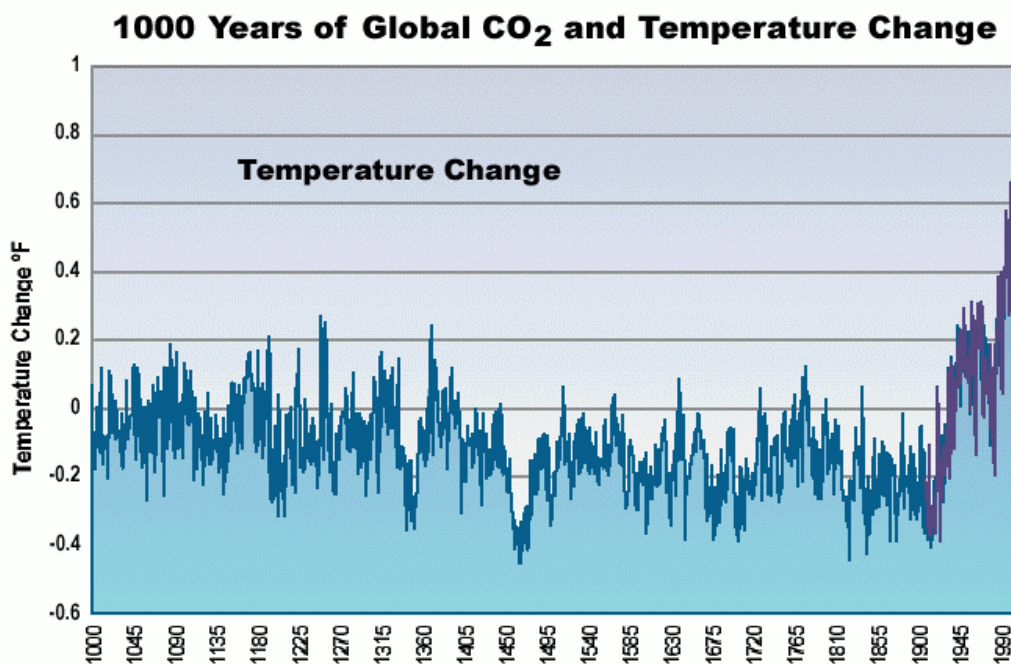


Figure 5: The Hockey Stick as it appears in the U.S. National Assessment. Compare with *Figure 4*.

The globalisation that results from the graph's title, also omits the wide error margins integral to Mann's original graphic. The yellow "margins of error" in *Figure 4* are a graphic admission of how wrong Mann's formulation might be. Mann et al. concede that the pre-1400 AD data is uncertain. The notion that global temperature a thousand years ago can be calculated with an accuracy of 0.1°F based on a limited number of tree rings is not credible.

The authors of the U.S. National Assessment of the Potential of Climate Change throw scientific caution to the wind and starkly assert:

New studies indicate that temperatures in recent decades are higher than at any time in at least the past 1,000 years.
(Overview p.11)

The origin of this statement is Mann's similar, but comparably more careful, conclusion:

Our results suggest that the latter 20th century is anomalous in the context of at least the past millennium. The 1990's was the warmest decade, and 1998 the warmest year, at moderately high levels of confidence.

Yet even Mann's conclusion seems dramatic and uncompromising. It lacks more than a hint of the uncertainties admitted to be inherent in the research.

The Hockey Stick – True or False?

What is required to disprove the Hockey Stick is to demonstrate conclusively the existence of the Medieval Warm Period and/or the Little Ice Age as recorded in proxy and/or historical evidence from around the world. The "falsifiability principle" is this: substantial evidence that contradicts a theory is sufficient to falsify the theory.

Here goes.

Exhibit 1 - The Sargasso Sea

Radiocarbon dating of marine organisms in Sargasso Sea (Bermuda Triangle) sediments by L. Keigwin [12] demonstrates that sea surface temperatures there were around 2°F cooler around 400 years ago (during the Little Ice Age) than they are today. They were some 2°F warmer than today one thousand years ago (during the Medieval Warm Period). The data also demonstrate that the period before 500 BC (the so-called Holocene Climatic Optimum) experienced temperatures up to 4°F warmer. That would have transpired without a greenhouse gas component as a cause.

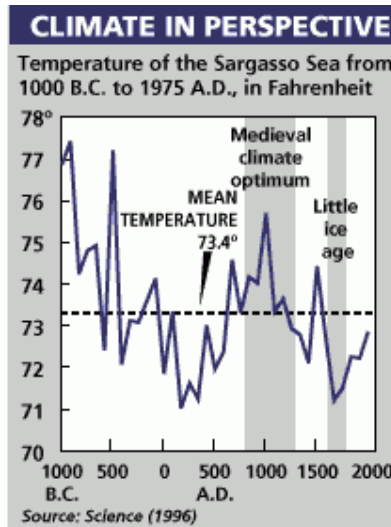


Figure 6 . 3,000 years of climate in the Sargasso Sea [12].

Exhibit 2 - Caribbean Sea

Measurements by Winter *et al*/of oxygen isotopes in coral skeletons from Puerto Rico [32] compared modern isotope ratios with those of the distant past. Sea surface temperature records from 1983-89 around Puerto Rico were used to calibrate the coral isotopes. This calibration provided the baseline the researchers used to test the coral for temperatures during known cold phases of the Little Ice Age, 1700-1710, 1780-1785, and 1810-1815. They found that during the Little Ice Age, sea surface temperature in the Caribbean was 2 - 3°C cooler than it is today. This is a truly massive reduction in temperature and could by no stretch of the imagination be local.

Exhibit 3 - West Africa

In an ocean drilling study off Cap Blanc, Mauritania in West Africa, de Menocal *et al* [6] recovered ocean bed sediments in order to examine various mineral and biological proxies. According to their paper -

A faunal record of sea-surface temperature (SST) variations off West Africa documents a series of abrupt, millennial-scale cooling events, which punctuated the Holocene warm period. These events evidently resulted from increased southward advection of cooler temperate or subpolar waters to this subtropical location or from enhanced regional up-welling. The most recent of these events was the Little Ice Age, which occurred between 1300 to 1850 A.D., when subtropical SSTs were reduced by 3° to 4°C.

The result is a profile of ocean temperature going back 2,500 years. It is very similar to that acquired from the Sargasso Sea. Both the Medieval Warm Period and Little Ice Age are strongly evident (see *Figure 7*). In fact,

deMenocal *et al* identify two periods of colder climate coinciding with two similar cold periods revealed in the Sargasso Sea.

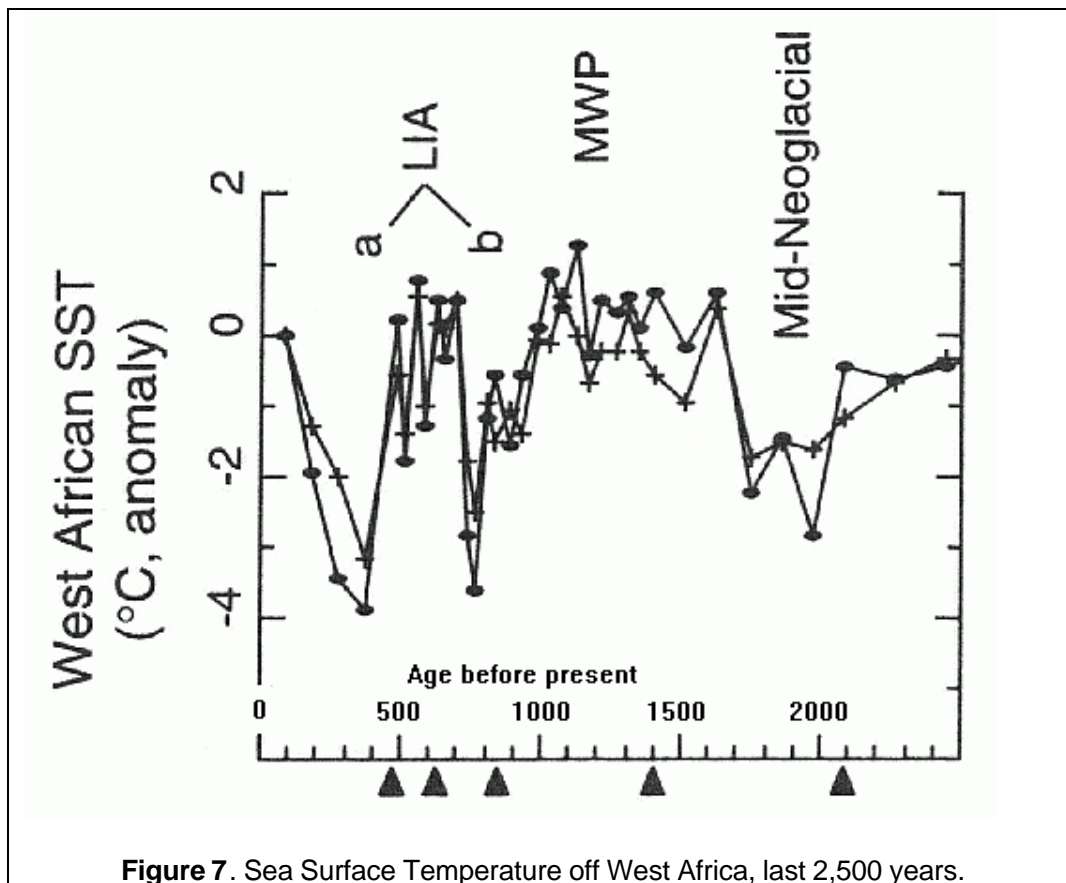


Figure 7. Sea Surface Temperature off West Africa, last 2,500 years.

In other words, existence of the Medieval Warm Period and Little Ice Age can be found throughout the North Atlantic Basin, from the tropics to the Americas, from Europe to the far North Atlantic and Greenland. Geographically, this is a huge slice of the Northern Hemisphere. It is virtually impossible that climate elsewhere in that hemisphere could negate the effect of these events in compiling a hemispheric average.

Exhibit 4 - Kenya, East Africa

In Kenya, Verschuren *et al* [29] extracted lakebed sediments from Lake Naivasha. According to their paper:

Our data indicate that, over the past millennium, equatorial east Africa has alternated between contrasting climate conditions, with significantly drier climate than today during the 'Medieval Warm Period' (~AD 1000-1270) and a relatively wet climate

during the 'Little Ice Age' (~ AD 1270-1850) which was interrupted by three prolonged dry episodes.

The researcher determined historical lake level and salinity measurements from proxy indicators in the lake bed sediments.

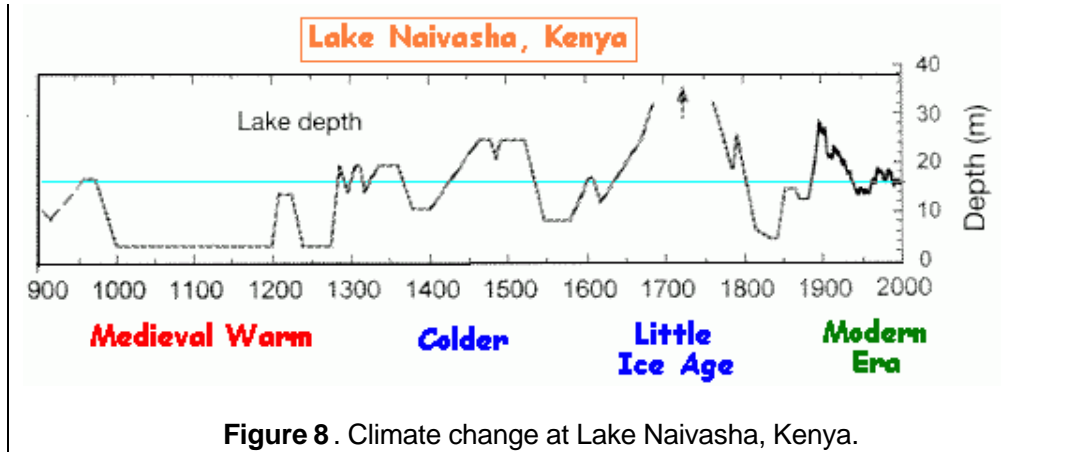


Figure 8. Climate change at Lake Naivasha, Kenya.

As in the Sargasso and Cape Blanc data, the major portion of the Little Ice Age (late 1600s and 1700s) is confirmed. During the Medieval Warm Period, the Lake Naivasha clearly endures a period of extended drought from 1000 to 1200 AD. Today's lake level is half-way between the two extremes. This, in turn, suggests that our present climate is mid-way between the extremes.

Exhibit 5 - Quelccaya Glacier, Peru

Quelccaya Glacier is in the Peruvian Andes. Ice coring yielded oxygen 18 isotopes, a proxy for temperature at the time the ice was laid down [23]. The Little Ice Age clearly stands out. The Medieval Warm Period is less pronounced than it is at other sites. The 20th century appears to be no warmer than existed before the Little Ice Age. Some medieval temperature spikes are warmer than those, today.

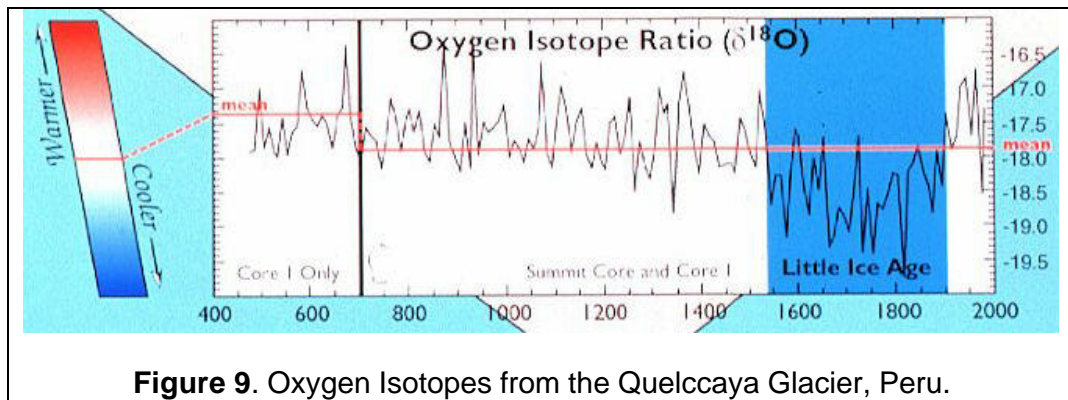


Figure 9. Oxygen Isotopes from the Quelccaya Glacier, Peru.

Such evidence from the Southern Hemisphere demonstrates that both historical events extended beyond the Northern Hemisphere.

Exhibit 6 - Taiwan and China

Kuo-Yen Wei *et al* performed lake sediment studies in Taiwan similar to those of Verschuren *et al* in Kenya. Again, they reveal the imprint of the Medieval Warm Period and Little Ice Age [13].

The interlaminated dark and light colored lake sediments obtained from several mountain lakes appear to reflect large-scale wet and dry cycles over the past 2400 years (Chen *et al.*, 1993; Lou *et al*, in press). The detected 450-years periodicity is similar to that of the solar oscillation. The Medieval Warm Period (1000-1300 AD) and the Little Ice Age (1300-1850 AD) were recognized (Lou *et al.*, in press). These two epochs were also identified from palynological records from the Central Range (Liew *et al.*, 1995).

The researchers make this reference to studies of annual to seasonal records from tree-rings.

Studies of tree rings of Taiwan fir allowed to reconstruct past summer and winter temperatures of the alpine mountain area during the past 300 years (Fig. 1). It is demonstrated that cold climate prevailed during the Little Ice Age (Tsou and Liu, 1995).

Finally, there is this in a synopsis of the various proxies studied in and around Taiwan.

During the past 2000 years, the climate has become warmer and wetter, intervened with the conspicuous Medieval Warm Period (1000-1300 AD) and the Little Ice Age (1300-1850 AD). Tree-ring data confirmed also the effect of the Little Ice Age in alpine Taiwan mountains. Fluctuation of humidity over the past 2,400 years as derived from lake sediments suggests that the recognized dry/cold periods coincide with major historical commotion events in Chinese history.

The verdict from Taiwan is conclusive. What are supposed to be European and North Atlantic climate anomalies are found even on the western rim of the Pacific Ocean.

The Taiwanese researchers even link major “commotion events” in mainland China with these climatic events. According to Hong *et al* [9] and their study of oxygen isotopes in a peat bog in northeastern China close to its border with North Korea, a 6000-year temperature history compared with carbon 14 solar proxies matches the temperature history to solar change.

They estimate the temperature between 1100 and 1200 AD to have been some 2°F warmer than it is today. This matches the Medieval Warm Period and is confirmed by plant remains from species that normally found in southern China. They ascertain very cold temperatures between 1550 and 1750, matching the Little Ice Age. They also see a solar connection in these climate changes. A carbon 14 solar proxy correlates with the oxygen 18 temperature proxy. In other words, sun caused Chinese climate changes.

Exhibit 7 - Japan

With the Medieval Warm Period and Little Ice Age clearly evident in Taiwan and China, the appearance of the events in Japanese climate records would provide useful validation. Call it *kharma*, scientific serendipity or ironic, but most of the proxy and historical evidence from Japan is from Kyoto. According to a study by Tagami [26]:

On the Medieval Warm Period.

It is not [doubted] that there was a warm climate age in historical times of Japan. Many former studies, e.g. the study on the changes of cherry-blossom-viewing date in Kyoto, show the warm climate around the early this millennium. But they are not clear when the warm climate began and when it ended. And also they are not clear how it relate to the climate situation in other areas. In this study, climate in the Medieval Warm Period of Japan is reconstructed and also its condition is compared to that of other areas.

Processing databases and the analysis

Mainly the historical documents are used in this study. The data which are chosen from them are classified into two types. One is a seasonal climate type from the 7th century and the other is a daily weather type from the 10th century. The former type data are climatic hazards, unusual weathers, cherry-blossom-viewing dates, lake freezing dates and so on. The climatic hazards were drought, long rain, heavy snow, mild winter and so on. The latter type data are described in private diaries of nobles who lived in Kyoto. The databases have been prepared for the both type of them. And using the databases, climate around the Medieval Warm Period is reconstructed. It is as following way: first, seasonal climate charts are drawn, then climate condition of each season is examined. ...

Some remarks on the climate of the Medieval Warm Period

As the results, some characteristics of climate are recognized around the Medieval Warm Period. However it is relatively hot conditions continued until the 8th century, cool condition

appeared for short period in the late 9th century. Then warm conditions continued from the 10th century to the former half of the 15th century. After the latter half of 15th century, cool conditions appeared and then considerable cold conditions started from the 17th century. So, between the former and the latter cold ages, the warm condition is clear from the 10th century to the 14th century.

A Euro-centric view of science should not blind scientists to valuable work from Japan and elsewhere. There *was* a Medieval Warm Period *and* a Little Ice Age. They took place within the same timeframe elsewhere in the world.

A paper by J. Magnuson *et al* on freeze/melt dates for lakes and rivers around the world [15] provides further evidence of the Little Ice Age in Japan. Data for freeze dates on Lake Suwa, in which earlier freezes indicate cold climate and later freezes warmer climate show the impact of the Little Ice Age. Lake Suwa has the longest record of freeze dates in the study. Lake Suwa data extend back to 1443 AD, almost three times further than any other water mass in the study. According to Magnuson *et al*

Lake Suwa was ice covered for 240 out of 243 winters (99%) from 1443 to 1700, but only for 261 out of 291 winters (90%) from 1700 to 1985.

The earlier “99% period” is within the Little Ice Age.

Exhibit 8 - Tasmania, Australia

Tasmania is an island state of Australia. It's about the size of Maine and is deep within southern latitudes. It provides insight to the origin of flaws inherent in the Hockey Stick.

Ed Cook is a prominent tree ring researcher and, over the last decade, a frequent visitor to Tasmania. He takes tree ring samples from a unique species of long-lived softwood known as Huon Pine (*Lagarostrobos Franklinii*). Some of the trees are more than a thousand years old. Because Tasmania is so remote south Australia's mainland, Cook's papers do not receive the critical examination they warrant. They contain flaws not only in his conclusions, but in his handling of local data as well.

To calibrate tree rings against temperature, Cook and his team use urban surface temperature records from the island's dry eastern half and compare them with tree rings taken from the wet west despite the fact there are rural surface records in the west from which a more valid comparison could be made. In earlier studies, no allowance is given to carbon dioxide's “fertilizer effect.”

Back in 1992 – seven years before Mann's paper –Cook was co-author of a paper in *Holocene* [3] presenting a time series of Huon Pine tree rings going

back to 900 AD. This is the graph he presented. It was scanned, with color and the “CO₂ Fertilization” label added for emphasis and clarity.

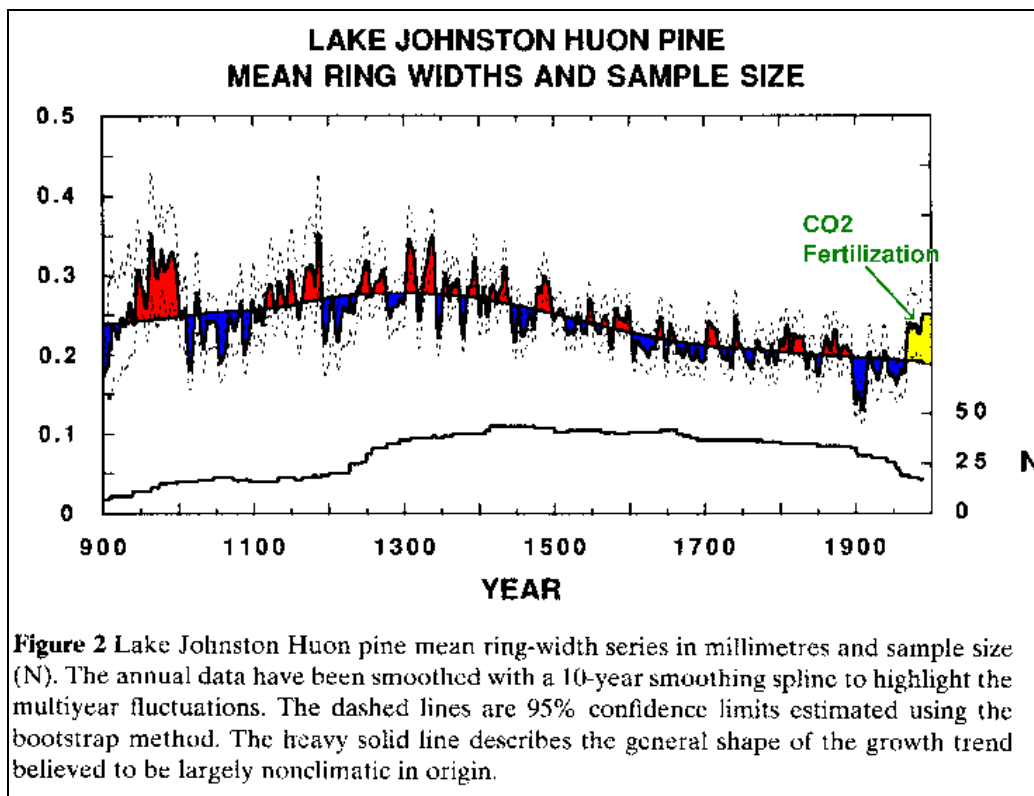


Figure10. Huon Pine tree ring widths from Lake Johnston in western Tasmania.

From this record, it is clear Huon Pine experienced strong growth surges from 940–1000 AD and from 1100–1200 AD. That’s the Medieval Warm Period, as Cook acknowledges in his paper. The Little Ice Age appears only weakly in the proxy record. Cook attributes it to moderating influences of the Southern Ocean on the small island.

The Huon Pines’ growth spurt in the late 20th century cannot be attributed to climate alone. The CO₂ Fertilizer Effect (a phenomenon not allowed for by Cook) has been found to be accelerating plant growth all over the world, as predicted by plant biologists. When late 20th century growth is discounted by incorporating this undeniable factor, it is clear that climate was warmer during medieval times than it is today in Tasmania.

Cook's drawing of a heavy curved line to act as his “zero line” (which was distorted as a consequence of scanning the figure) represents what he believes is a largely non-climatic origin. In this he clearly imposes subjectivity. If, on the other hand, the “general shape of the growth trend” (as he puts it) were *climatic* in origin, then the whole record would indicate an even stronger imprint of the Medieval Warm Period.

Cook uses his subjective zero line as a basis to reconstruct growing season temperatures in Tasmania. He and his co-researchers produce a 25-year “low-pass filter” smoothed graph that bears striking similarity Mann’s Hockey Stick. The result appears as *Figure 11*.

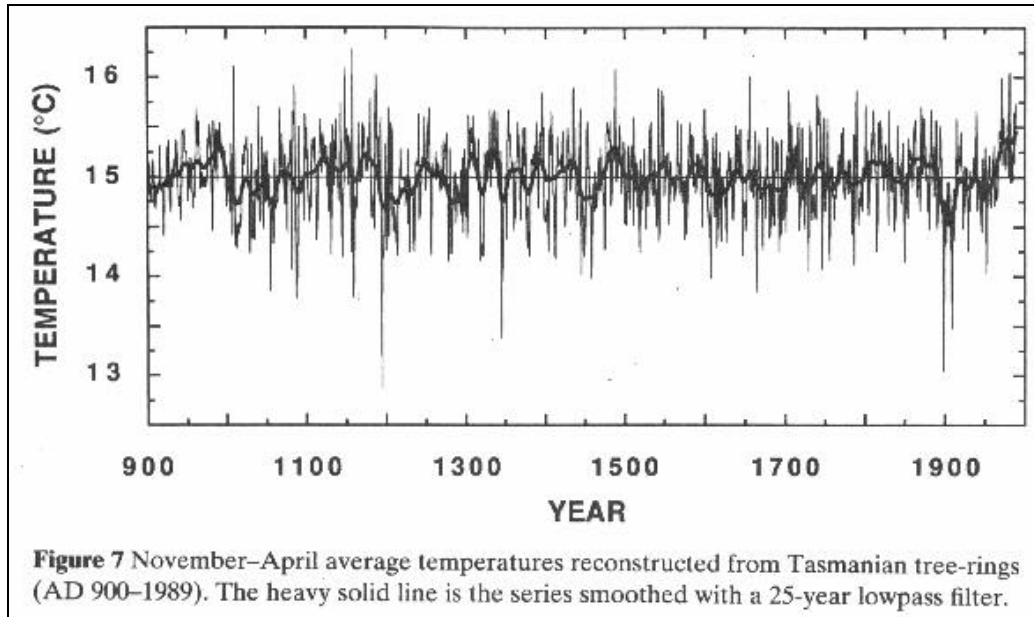


Figure 11. Temperature reconstruction from tree rings, Cook [3].

According Cook, he converted the tree ring widths graphed in *Figure 9* onto *Figure 10*'s temperature reconstruction. This makes the Medieval Warm Period all but disappear in the process. He then calibrates the growth rings against surface temperatures recorded at three weather stations in Tasmania. Those three include the island's capital city, Hobart (pop. 130,000), Launceston (pop. 70,000), and Low Head Lighthouse on the north coast.

Hobart is a documented heat island [21]. Launceston is similarly affected. Low Head reflects a local anomaly [4] that caused its daytime temperature to rise in recent decades as a consequence of vegetation growth close to the instruments used to record temperature. They sit in a mini sun-trap. It is upon these flawed records that Cook et al. develop the temperature reconstruction.

A further flaw of the study is a result of the island's geography. Tasmania has two distinct climate regimes: a cool, wet climate in the western half of the island and a dry, warmer climate in the eastern half. The sharp contrast between the two is obvious even to visitors who drive across the island.

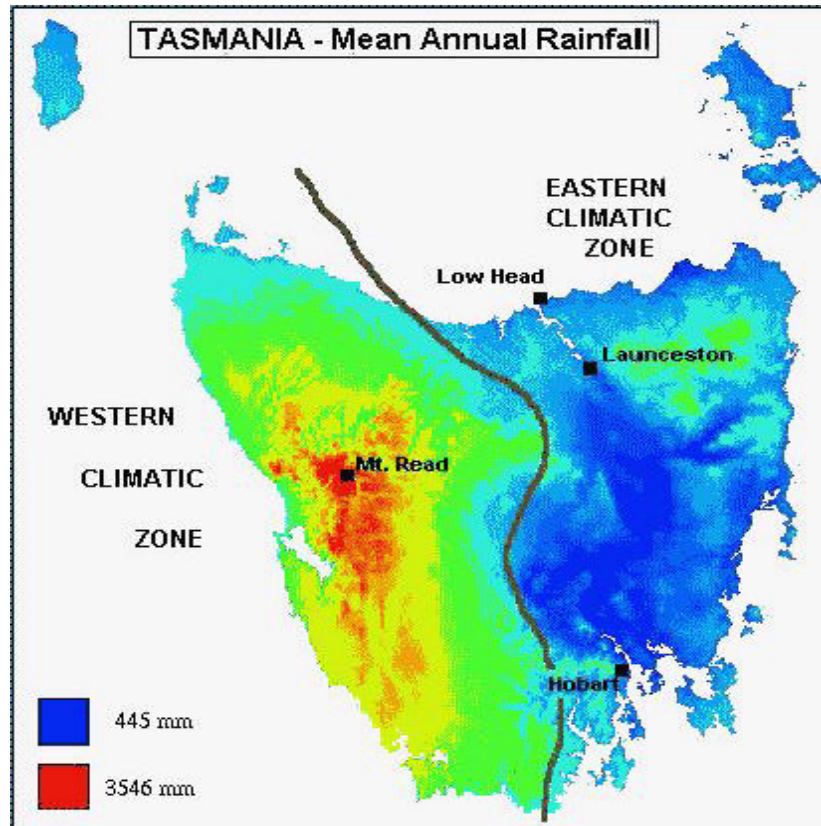


Figure12. Tasmanian climatic zones and locations.

The Huon Pines are in the west, close to Mt. Read. This is a region of high rainfall. Cook's three calibrating temperature records come from the warmer and drier east. While his statistical treatments are at once elegant and esoteric, the faulty surface records invalidate the entire exercise.

Exhibit 9 - South Africa

In a recent paper in the *South African Journal of Science*, Tyson *et al* [27] develop a climate history using oxygen 18 isotopes as a temperature proxy, carbon 14 isotopes as a proxy for solar activity, and colour density data from a well-dated stalagmite in a cave in the Makapansgat Valley. According to the authors:

The climate of the interior of South Africa was around 1°C cooler in the Little Ice Age and may have been over 3°C higher than at present during the extremes of the Medieval Warm Period. It was variable throughout the millennium, but considerably more so during the warming of the eleventh to thirteenth centuries. Extreme events in the record show distinct teleconnections with similar events in other parts of the world, in both the northern and southern hemispheres.

They date the Medieval Warm Period at pre-1000 to 1300 AD, with mean temperatures 6° to 7°F warmer than today. They date the Little Ice Age from 1300 to 1800 with mean temperatures up to 2°F cooler than today. The authors then proceeded to attribute a cause to these two events.

The lowest temperature events recorded during the Little Ice Age in South Africa are shown to be coeval with the Maunder and Sporer Minima in solar irradiance. The medieval warming is shown to have been coincided with the cosmogenic ¹⁰Be and ¹⁴C isotopic maxima recorded in tree rings elsewhere in the world during the Medieval Maximum in solar radiation.

The variability of the sun as a cause of impacts on earth's climate is reaffirmed by this study. All the climate changes they note are correlated with known changes on the sun.

Exhibit 9 - East-central Idaho

A tree ring study by F. Biondi et al, [1] uses an 858-year proxy record of summer temperature for east-central Idaho. Although, tree rings are not a reliable measure of annual temperature, it is notable that this particular set was not included in Mann's study. Biondi found periods of "extreme cooling" around AD 1300, 1340, 1460 and after 1600. This confirms findings of other studies where there appear to have been two little ice ages. One was minor and during the sun's Sporer Minimum. The second, during the main Little Ice Age, coincides with the sun's Maunder Minimum during the 1600s.

The authors state, "Neither instrumental nor proxy data in Idaho northeast valleys show unusual warming during the twentieth century." This challenges the toe of Mann's Hockey Stick that results in the appearance of 20th century unprecedented and rapid warming. The authors' statement is borne out by a long-term rural temperature record from Ashton, which is in eastern Idaho.

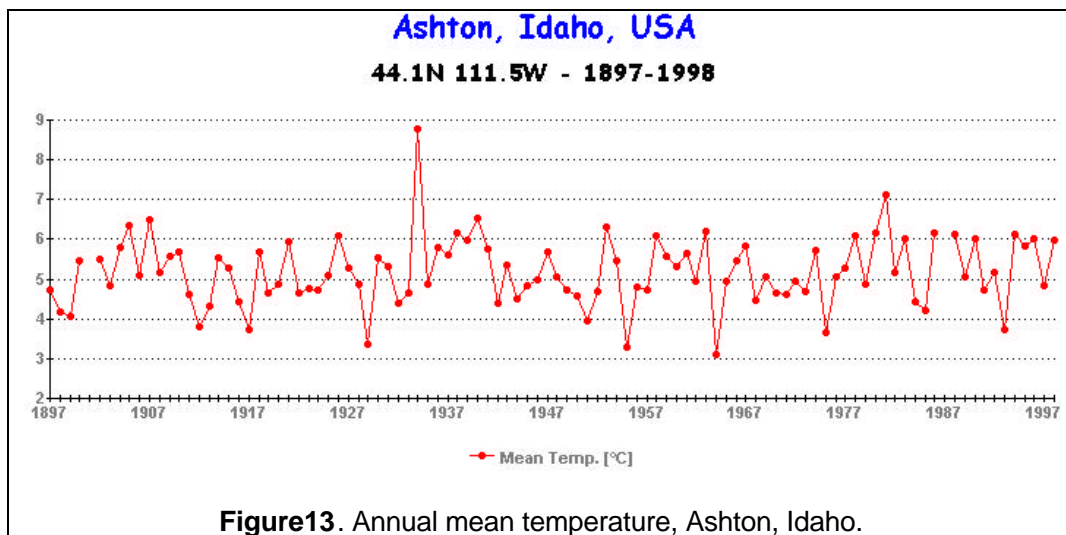


Exhibit 10 - Argentina

Multi-proxy studies published by Villalba (1994) [30] and Cioccale (1999) [2] detect the existence of the Medieval Warm Period and Little Ice Age in Argentina.

In Argentina's central regions there was a warm climate from 600 AD through 1320. It allowed humans to settle and cultivate crops at higher altitudes. This matches the Medieval Warm Period. After 1320, two cold pulses were noted. During the second pulse (the main phase of the Little Ice Age), glaciers in the southern Andes began to advance. Settlements in the higher altitudes were abandoned. According to Cioccale, "Both cold pulses can be related to the Sporer and Maunder Minimums respectively". Again the sun is held responsible.

We've now completed a full-circle of the deep southern hemisphere, from Argentina east to South Africa and on to Tasmania. The two climate events dismissed as Northern Hemispheric and European are anything but.

Exhibit 11 - California

In a 1993 study [25], tree-ring data from subalpine conifers in the southern Sierra Nevada Mountains were used to reconstruct temperature and precipitation back to AD 800. The summer temperature reconstruction shows a period with temperatures exceeding late 20th-century values between AD 1100 and 1375. This corresponds with the Medieval Warm Period. There also was a period of cold temperature from AD 1450 to 1850 – the time of the Little Ice Age.

Exhibit 12 - Western Indian Ocean Islands

Dullo et al [7] studied long coral cores from reefs in La Réunion, Mayotte and Madagascar. Oxygen isotope data were calibrated with local instrumental data to derive a proxy for historical sea surface temperature. The longest record from Madagascar dates back to AD 1640 and clearly records the impact of the Little Ice Age. The data also reveal the imprint of the El Niño Southern Oscillation with a 3 to 5 year cycle, similar to that of today.

Exhibit 13 - Sea Levels

The current prediction about rising sea levels is predicated on the assumption that the 20th century has seen a warming of +0.7°C. Further warming can be expected as a result of computer modelling. On that basis the IPCC estimates sea level already has risen 10 to 25 cm over the last 100 years. This estimate largely is based on modelling and because the 20th century warming is much less than claimed (due to errors in station data, e.g. urbanization), 20th century

sea level really has risen little. [5] However, it is a reasonably sound notion that sea levels should rise as a consequence of significant warming, or fall when cooling occurs, due to thermal expansion and contraction of the ocean mass. This is accompanied by reservations concerning changing ice accumulation at the poles that might also affect sea levels.

That said, sea level should provide a proxy to use in ascertaining the existence of the Medieval Warm Period. Global warming of such magnitude should have caused some measure of sea level rise. Similarly, the Little Ice Age should have triggered contraction.

A study by van de Plassche and van der Borg of Free University Amsterdam, and Utrecht University, Netherlands [28] of sea level over the last 1400 years determined a mean high water curve for Hammock River marsh near Clinton, Connecticut. The marsh water elevation was calculated from foraminiferal analysis of a six-foot long peat core. Changes in sea level were validated against similar trends in sea level during the past 1400 years from salt marshes ten miles further west. On the basis of the Clinton mean-high water data, the researchers concluded that real sea level oscillated by centimeters to decimeters on a century-long time scale. The idea that sea level did not change prior to the 20th century is false.

On the basis of the Clinton mean-high water curve, we conclude that real sea level oscillated centimeters to decimeters on a century time scale over the past 1400 yr, was 25 ± 25 cm higher ca A.D. 1050 (Medieval Warm Period) than ca A.D. 1650 (Little Ice Age).

A 10-inch difference in sea level between the Medieval Warm Period and Little Ice Age would confirm the existence of both events, solely on that basis.

In another sea level study [31], Wang Wen and Xie Zhiren of Nanjing University, China, analyze more than 2000 records concerning Chinese tidal disasters during the last 2000 years. The T'ang Dynasty (AD 618 - 900) and Sung Dynasty (AD 960 - 1279) experienced the peak periods of tidal disaster. Subsequent centuries experienced fewer. The Chinese response was to build sea walls to hold back the sea. Construction only could begin after the experience of the disasters, leading the researchers to conclude:

Further analysis shows that the temperature peaks of climatic fluctuations which took place in the Medieval Warm Period and the following Little Ice Age are coincident with the peaks of the tidal disaster intensity, while the peaks of seawall construction lag behind. The research reveals the relationship among the climate, sea level, tidal disaster and seawall construction, namely, warm periods coincide with relatively high sea level, the peak periods of tidal disaster, and the following peak periods of seawall construction.

The Science that Lost its Way

The climate history of the northern hemisphere and the globe as a whole bears no similarity whatever to that portrayed by Mann's Hockey Stick. It is inconceivable that two major climatic events of the last millennium – the Medieval Warm Period and Little Ice Age – could be observed around the world in varied locations at the same points in time using an array of proxies and yet be missed by Mann's study. A possible explanation is that tree rings are inappropriate as temperature proxies, as much as dendrochronologists would be reluctant to admit it.

Why do people who claim scientific credentials in this field tenaciously cling to a characterization of past climate that patently is false? Why has there been so little peer challenge of Mann's theory? What explains collective denial of the sun's role when published and peer-reviewed evidence from solar scientists demonstrates a clear relationship between solar change and climate change?

A booklet published by the National Academy of Science in 1995 and entitled *On Being a Scientist: Responsible Conduct in Research*^[18] provides a set of criteria to guide the conduct of scientists as they ethically navigate difficult choices.

The fallibility of methods is a valuable reminder of the importance of skepticism in science. Scientific knowledge and scientific methods, whether old or new, must be continually scrutinized for possible errors. Such skepticism can conflict with other important features of science, such as the need for creativity and for conviction in arguing a given position. But organized and searching skepticism as well as an openness to new ideas are essential to guard against the intrusion of dogma or collective bias into scientific results.

Skepticism is a virtue. But this contrasts with the hostile treatment afforded skeptics in the climate sciences. The Academy presents a cogent warning against dogma and collective bias intruding upon science. It risks inevitable contamination of the peer review process – the very basis of scientific publication.

Scientists who engage in research that may impact the public understandably resist public input concerning conduct of their work. The peer review process provides an effective barrier to public scrutiny, as does a tendency to regard people as needing to be educated rather than heeded. The result is a form of intellectual arrogance has a corrosive effect. It transforms scientists into a sort of medieval priesthood. They become keepers of secret, exclusive, and elusive knowledge. They reveal Truth to common folk. But people pay for research out of public funds.

In fulfilling these responsibilities scientists must take the time to relate scientific knowledge to society in such a way that

members of the public can make an informed decision about the relevance of research. Sometimes researchers reserve this right to themselves, considering non-experts unqualified to make such judgments. But science offers only one window on human experience. While upholding the honor of their profession, scientists must seek to avoid putting scientific knowledge on a pedestal above knowledge obtained through other means.

This is a criticism of scientism – a belief that knowledge not acquired by professional scientists is worthless. Scientism is an affront to free people, everywhere. It denies a public right to informed judgment, the fruit of taxpayer investment in research. Scientism postures scientists as above criticism and accountable to no one but their peers. It is an anti-democratic. It clearly is opposed by the National Academy. Yet in the climate sciences, there are numerous examples of public criticism and concern dismissed with gratuitous statistics and spurious appeals to academic authority.

Proponents of the Hockey Stick need recall George Orwell's *Nineteen Eighty-Four* wherein a fictional totalitarian regime uses “memory holes” to forget and subsequently re-invent past history. [22] In an age of instant communication, there is no memory hole sufficiently large to hide the historical truth of the Medieval Warm Period and Little Ice Age.

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