

**PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM
ON THE LITTLE ICE AGE CLIMATE**

Edited by

T. MIKAMI

**Editorial Committee of
LIAC Proceedings**

**Department of Geography
Tokyo Metropolitan University**

1992.

WHEN WAS THE "LITTLE ICE AGE" ?

Raymond S. Bradley¹ and Philip D. Jones²

¹ University of Massachusetts, Amherst, U.S.A.

² University of East Anglia, Norwich, England

ABSTRACT

The origin of the term "Little Ice Age" is reviewed and discussed in terms of problems which arise in using only glacial deposits as a means of characterising the climate of this period. It is argued that *continuous* proxy records of climate must be used to understand how climate varied over the last 1000 years, not simply the record of episodic glacial events. Dendroclimatic, glaciological and historical data reveal that cool periods have not been globally synchronous for extended periods. In general, the seventeenth and nineteenth centuries were cool in the northern hemisphere, but in the southern hemisphere the sixteenth and seventeenth centuries may have been the coolest prolonged period of the last millennium. When the "Little Ice Age" began remains controversial; depending on your perspective, it can be argued that it began in the late 13th century, or in the early 16th century. The term should thus not be used without clearly defining its usage.

1. INTRODUCTION

The term "Little Ice Age" originated with Matthes (1939) who stated,

"We are living in an epoch of renewed but moderate glaciation -- a 'little ice age' that already has lasted about 4,000 years."

Thus, in its original useage the term was informal (not capitalized) and referred to what is now called the period of neoglaciation (Moss, 1951; Porter and Denton, 1967). However, Matthes (1940) also noted that,

"...glacier oscillations of the last few centuries have been among the greatest that have occurred during the 4,000 year period...the greatest since the end of the Pleistocene ice age."

It is this latest and most dramatic episode of neoglaciation to which the term "Little Ice Age" is now generally applied, though there is considerable uncertainty about when this period began (and ended) and what its climatic characteristics were. For example, Porter (1986) indicates that the "Little Ice Age" began near the end of the Middle Ages at around A.D. 1250 and continued until about 1920, whereas Lamb (1977) confines the "Little Ice Age" to 1550-1850, with its main phase from 1550-1700. Grove (1988) in her comprehensive treatise on

the "Little Ice Age" seems to concur with Lamb but does not explicitly define the term. Clearly, if the term is to be useful, it must be universally understood. This is especially important in determining what caused the "Little Ice Age".

2. THE EVIDENCE OF GLACIAL DEPOSITS

Early evidence for the occurrence of the "Little Ice Age" came from Europe (Lamb, 1977). Glaciers tended to be more advanced than at present particularly during the 18th and 19th centuries. For example, a series of pictures from the Grindelwald glacier (Zumbühl, 1980; Messerli et al., 1978) illustrates quite dramatically the advance and retreat of the glacier over the last few hundred years. A variety of glacier evidence from other alpine regions of the world also indicates that many glaciers were extensive in the 19th century and have retreated dramatically over the last century (Grove, 1988; Wood, 1988). However, few regions have the detailed historical documentary records which are available for the European Alps to determine glacier positions over time, particularly before A.D. 1850.

In most regions, glacier fluctuations have been dated by ^{14}C and/or lichenometry (often calibrated by ^{14}C). ^{14}C dates in the range of 100 to 500 B.P. often provide non-unique calendar year ages (Stuiver and Pearson, 1986) which create considerable uncertainty in reconstructing glacier positions over this interval (Porter, 1981). Glacier advances are also episodic events which result from cumulative increases in mass balance and the interaction of these changes with each glacier's unique dynamic system. Hence, glacier position changes are not easily ascribed to specific changes in climate. Mass balance changes can be brought about by a variety of climatic perturbations (such as changes in snowfall and/or temperature and/or radiation, etc) (Oerlemans, 1988; 1989).

3. THE EVIDENCE OF CONTINUOUS PROXY RECORDS

A more useful approach towards understanding the nature of the "Little Ice Age" and its cause(s) is to examine *continuous* climatic and paleoclimatic records from around the world to determine what the principal climatic characteristics were during the last 500 years, and thereby to determine what was so different about climate in the recent past. Such records include historical, dendroclimatic and ice core data from as wide an area as possible. An examination of these records indicates marked regional differences, as well as seasonal differences within a given region. Although there is a lot of noise in these diverse sources of information, the following general conclusions can be made:

In Europe, the 19th century experienced the most widespread negative anomalies --- in the 1810s, and from the late 1830s to the 1910s. In many cases the 17th century was also cold. However, most records indicate relatively warm conditions in the 16th and 18th centuries.

In eastern Asia, the 17th century was the coldest period; the late 18th and early 19th century was also cold, but there is little evidence

for persistent low temperatures throughout the 19th century, as in Europe.

In North America, the 19th century was the coldest period. In northern regions, dendroclimatic evidence suggests that the 17th century was also cold, but in many parts of the western U.S. conditions at that time were warmer than in the 20th century.

Southern Hemisphere records show the main period of negative anomalies occurred earlier than in the Northern Hemisphere, with widespread cool conditions in the 16th and 17th centuries. In some records these anomalies continued into the mid-19th century.

These conclusions are obtained by making broad generalisations about diverse records which often represent different seasons and which may differ in record length. Furthermore, proxy evidence tends to highlight variations at higher frequencies. Variations at lower frequencies are much more likely to be obscured by the proxy source itself or by the methods used to produce the reconstruction. Nevertheless, as a first step towards a better understanding of the "Little Ice Age" generalisations such as those made here are necessary.

4. DISCUSSION

The last 1000 years was a period of complex climatic anomalies, the understanding of which is not well-served by the continued use of the term "Little Ice Age" which implies a globally synchronous event with clearly defineable starting and ending dates (cf. Landsberg, 1985). In fact, there is little agreement on when the "Little Ice Age" occurred, other than a general feeling that it took place within the last 500-700 years. A survey of participants at this conference revealed two groups: those who believe the term "Little Ice Age" applies to an event which began in the late 13th century (1275 ± 60 years) and those who favour an early 16th century onset (1510 ± 50 years). However, both groups were in agreement that the "Little Ice Age" came to an end in the 19th century (1850 ± 50 years). The difference of opinion regarding the onset date may, in part, reflect the division between those with long data sets, and those with a shorter perspective. If so, the last millennium may be best characterised as experiencing two or more widespread cool periods, the first beginning around 1275, the second around 1510. In the latter period, better geographical coverage, and more abundant records show that both warm and cold episodes were experienced, and these varied in importance geographically. There is no evidence for a world-wide, 300-400 year long, synchronous cold interval, affecting all seasons, to which we can ascribe the term "Little Ice Age". Persistent anomalies do not appear to have lasted for more than a few decades over geographically extensive areas. For example, only a few short cool episodes (lasting sometimes for up to 30 years) appear to have been synchronous on the hemispheric and global scale. These are the decades of the 1590s-1610s, the 1690s-1710s, the 1800s-1810s and the 1880s-1900s. Prolonged and synchronous warm periods are less evident, although the 1650s, 1730s, 1820s and the 1930s and 1940s appear to be the most important.

5. CONCLUDING REMARKS

As more research begins to fill in the gaps in our knowledge, a better understanding of the prevailing circulation patterns at these various times should emerge. In the meantime, we suggest that the term "Little Ice Age" be used cautiously, and if used, be accompanied by an explanation of what is meant by the term.

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