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U.S. Water Conservation Laboratory, Phoenix, Arizona, U.S.A.

Greenhouse Warming or Little Ice Age Demise: A Critical Problem for Climatology

S. B. Idso

With 1 Figure

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Summary

A comparative analysis of long-term (several-hundred-year) temperature and carbon dioxide (CO_2) trends suggests that the global warming of the past century is not due to the widely accepted CO_2 greenhouse effect but rather to the natural recovery of the Earth from the global chill of the Little Ice Age, which was both initiated and ended by some unrelated phenomenon, the latter expression of which is the very warming generally attributed to the CO_2 increase of the past century.

1. Introduction

The greenhouse effect is now an established scientific fact. So begins a recent article (Pearce, 1986) in one of the world's leading science news magazines, which undoubtedly reflects the thinking of many climatologists and non-climatologists alike. It is very possible, however, that this concensus declaration may be somewhat premature, in light of several recent discoveries about both the carbon dioxide (CO_2) and temperature trends of Earth's past history.

Paradoxically, the primary reason for believing CO_2 and other trace "greenhouse gases" to be capable of significantly warming the planet as they increase in concentration derives from these very same considerations (U.S. National Research Council, 1979, 1982, 1983). The reasoning involved suggests that since all of the temperature reconstructions of Earth's recent history show a mean global warming over the past century or so (Hansen et al., 1981; Folland et al., 1984; Jones et al., 1986 a, b), and since this rise in temperature coincides with a similar rise in atmospheric CO_2 (Neftel et al., 1985; Raynaud and Barnola, 1985; Pearman et al., 1986), the latter phenomenon must be the cause of the former, particularly since there is a very straightforward theory which suggests that that is the way it should be, and since most climatologists appear to agree on that point, as is implied by the many articles on the subject which are based on the premise of Pearce's (1986) opening sentence.

This view, however, is rather myopic, as it does not encompass the broader environmental context within which both the CO_2 and temperature trends of the past century are embeded, and as it closes its eyes to the existence of equally simple theories which can just as easily cast CO_2 in the role of an *inverse* "greenhouse gas" (Idso, 1983 a, b, 1984). Hence, in this brief note I will assume a perspective which looks across the entire past millenium, with a view to determining whether there is any valid reason for believing that the atmospheric CO_2 increase of the past century has been responsible for the concurrent rise in air temperature or, indeed, whether such an exercise suggests the *invalidity* of that hypothesis.

2. The Perspective

The particulars of the millenial perspective I will employ are presented in Fig. 1, which is adapted primarily from Thompson et al.'s (1986) study of the stratigraphy of the tropical Quelccaya ice cap in southern Peru. Shown there are 1 000-year records of decadal conductivity and $\delta^{18}O$ values derived from their summit ice core, along with a 400-year record of decadal temperatures for the Northern Hemisphere derived by Groveman and Landsberg (1979) from long temperature series stretching back to 1658 and from proxy data including freeze records and tree rings before 1658. Also shown is a 750-year record of atmospheric CO_2 concentration derived by Friedli et al. (1984, 1986) from Antarctic ice cores.

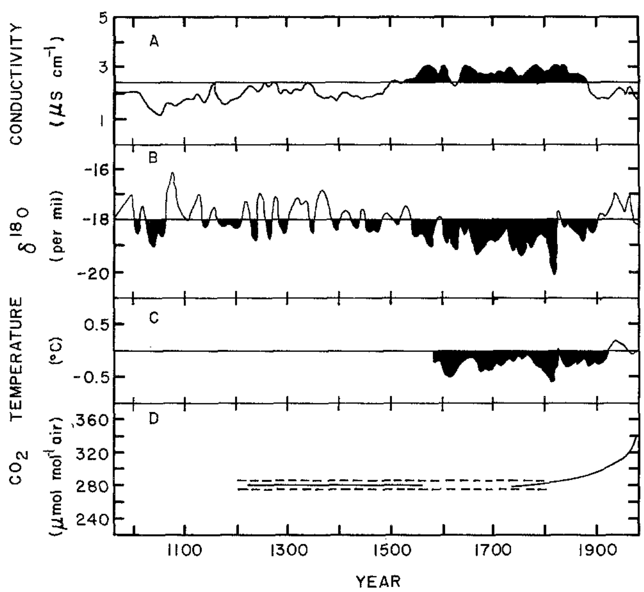

Fig. 1. Decadal variations in conductivity (A) and oxygen isotopic ratios (B) determined by Thompson et al. (1986) for an ice core taken from the summit of the Quelccaya ice cap in southern Peru; decadal variations in temperature (C) determined by Groveman and Landsberg (1979) for the Northern Hemisphere; and similar time scale variations in Antarctic atmospheric CO_2 content (D) determined by Friedli et al. (1984) from a South Pole ice core and by Friedli et al. (1986) from a Siple Station ice core. The solid horizontal lines of parts A and B represent averages over the entire 1 000-year records of those parameters; while the solid horizontal line of part C represents the 1880–1980 mean of the data there presented, and the solid horizontal line of part D represents the mean CO_2 content of air extracted from a South Pole ice core representative of the time period 1220–1560. The two dashed horizontal lines of part D are based upon the analyses of Friedli et al. (1986) which lead them to conclude that "we therefore have no reason to assume any secular fluctuation exceeding 10 ppm between the years 1200–1800".

3. Points to Be Made

The first points to be made from a perusal of the plots of Fig. 1 come directly from Thompson et al. (1986). First, "as the $\delta^{18}O$ profile is significantly correlated with Northern Hemisphere temperature, as long ago as the data reach, it is reasonable to associate the period of generally low $\delta^{18}O$ values between 1530 and 1900 with the Little Ice Age." Noting further that "the 'Little Ice Age' (1500–1900) stands out clearly in the $\delta^{18}O$ and conductivity records as a major climatic event in tropical South America", they thus conclude that the well-dated climatic record of the Quelccaya ice core provides strong support for "the growing body of evidence that the Little Ice Age was a global event".

This likely fact has important implications for the supposed CO_2-climate connection, because Earth's temperature history of the past century or so is the standard against which model predictions of the strength of the CO_2 greenhouse effect are characteristically compared. Indeed, the observed warming of the past 100-plus years—which is now also evident in Arctic permafrost data (Lachenbruch and Marshall, 1986)—is almost invariably cited by most climate modelers as evidence for the reality of their CO_2-based predictions (U.S. National Research Council, 1979, 1982, 1983). If, however, this warming is but the natural expression of Earth's recovery from the global chill of the Little Ice Age, it provides no evidence whatsoever for the validity of those prognostications or the conventional CO_2 greenhouse effect theory upon which they are based.

Perhaps it could be claimed, however, that the rising CO_2 content of Earth's atmosphere over the past century or so is the very phenomenon which has brought an end to the Little Ice Age. The problem with this proposal is that it is reasonable (but, obviously, not necessary) to expect that the reverse of whatever phenomenon brought us out of this four-century interval of relatively colder temperatures is probably what brought us into it, and there is no significant drop in atmospheric CO_2 content coincident with the commencement of the Little Ice Age. Indeed, Earth's atmopsheric CO_2 content appears to have been incredibly constant for a period of several centuries both before and after the initiation of this significant climatic excursion. Consequently, since something other than atmospheric CO_2 variability was thus clearly responsible for bringing the planet into the Little Ice Age, something other than atmospheric CO_2 variability may just as well have brought the planet out of it, in which case the concurrent rise in atmospheric CO_2 content is seen to be nothing more than a global geophysical coincidence.

4. Conclusions

On the basis of the data and reasoning presented above, I conclude that a millenial perspective of Earth's temperature and CO_2 histories argues against (but, obviously, does not yet totally disprove) the popular and widely held view that the conventional CO_2 greenhouse effect is as strong as it is generally portrayed to be. Although the significant warming of the globe over the past century or so may well be referred to as "established scientific fact", the attribution of that warming to the concomittant rise in atmospheric CO_2 content must be considered to be much more tentative. As a result, gaining a better understanding of the Little Ice Age looms as a critical problem in the climatology of the past with important implications for the climatology of the future.

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Authors' address: Dr. S. B. Idso, USDA-ARS, U.S. Water Conservation Laboratory, 4331 E. Broadway, Phoenix, AZ 85040, U.S.A.