

Achieving Climate Predictability using Paleoclimate Data: Euroconference on Abrupt Climate Change Dynamics

CASTELVECCHIO PASCOLI, ITALY, 10-15 NOVEMBER 2001

What have we learned about abrupt climate change in the past decade and is this knowledge applicable to the future? What drives abrupt change, and how do other parts of the earth system respond to it? These, and other important questions were the focus of a Euroconference on Abrupt Climate Change Dynamics held at Castelvechio Pascoli, Italy. The goals of the workshop were to summarize our current understanding of abrupt climate change dynamics in both glacial and interglacial intervals and to help guide future research efforts in the area.

A variety of presentations showed that local to regional ecosystem response to abrupt climate change is immediate and substantial. Of particular note were the presentations by Brigitta Ammann (Switzerland) and Brian Huntley (U.K.) showing rapid and large amplitude vegetation changes in central and southern Europe during the late Glacial in response to the large climatic changes of that period. These and other presentations clearly showed that vegetation is a dynamic component of the climate system in that it can respond on the same timescale as abrupt change and can also influence abrupt change.

Another important theme arising from the meeting was the nature of a muted Holocene millennial-scale climate oscillation. It is best developed in the North Atlantic as a record of enhanced southerly sea-ice drift as described by Bond et al. (1997). It appears that many records miss some or all of these oscillations due to their muted nature. Peter Fawcett (United States) presented a study detailing Holocene climatic oscillations from several different paleorecords from western North America that correlate strongly with each other, and with the North Atlantic record (Fig. 1). Mikhail Levitan (Russia) also presented a compelling record from

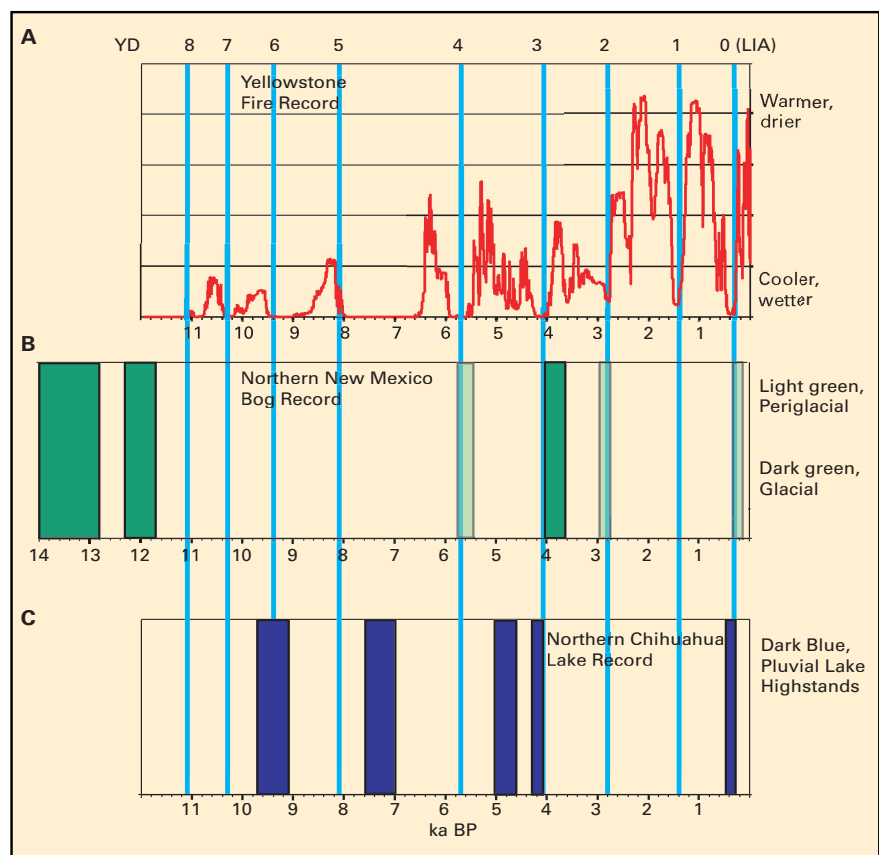


Fig. 1: Three Holocene paleoclimate records from western North America displaying colder and wetter events that are synchronous with cooler climate episodes in the North Atlantic (Bond et al. 1997). **A:** Fire and alluvial record from Yellowstone National Park, Wyoming, adapted from Meyer et al. (1995). **B:** Glacial and periglacial record from a high-elevation bog core in northern New Mexico, adapted from Armour et al. (2002). **C:** Pluvial lake highstand record from northern Chihuahua, Mexico, adapted from Castiglia and Fawcett (2001). Blue lines and numbering represent ice-rafting episodes in the North Atlantic, adapted from Bond et al. (1997).

the Laptev Sea for similar timing of Holocene cold events.

Presentations by Jean-Claude Duplessy (France), Claude Hillaire-Marcel (Canada) and Jürgen Willbrand (Germany) highlighted the critical role of the oceans in abrupt climate change, especially in sensitive regions like the Labrador Sea and the North Atlantic. The ocean-climate link was also explored in detail through a variety of climate system model presentations (e.g. Thomas Stocker, Switzerland). Other presentations addressed issues of climate model variability and its relationship to natural variability (e.g. Andrey Ganopolski, Germany). All of these talks addressed in different ways the critical role of models in understanding the dynamics of abrupt climate change and the is-

sue of future predictability. Sigfus Johnson (Denmark) discussed results from the new Greenland ice core, NGRIP, a highlight was the recognition of a large cooling event at 9.2 ka (calendar). Dominique Raynaud (France) discussed phasing of abrupt change at both poles during the late glacial and the Holocene and the role of methane and carbon dioxide in the system.

After discussion of the abrupt climate change events of the late Glacial and the Holocene, the focus switched to the last millennium. Heinz Wanner (Switzerland) discussed two changes: one that occurred during the middle part of the 19th century, and a significant change in variability in ENSO and the NAO that occurred during the mid 1970s.

The meeting was co-chaired by Jean-Claude Duplessy (France), Thomas Stocker (Switzerland) and Keith Alverson (Switzerland). The conference was held under the auspices of the CLIVAR and PAGES programs with funding provided by EURESCO and PAGES, which is gratefully acknowledged.

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Tree-rings and People - A "Pointer Year" for the Tree-ring Community?

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"Pointer year" means a very unusual year when most trees within a large area form a particular ring, creating a distinct mark for crossdating and reconstructions. The year 2002 probably represents a "pointer year" for the international dendrochronological community. Indeed, in September 22-26, 2001, the members of this community met in Davos, Switzerland.

The general discussion was focused on the past achievements and future challenges for tree-ring research.

The main take-home messages from the talks given during the different sessions are the following: a) We need to better understand the physiology of wood formation, and to communicate these research results to forestry planners to increase the quality of forest products b) The enormous climatological potential contained in tree rings in archaeological remains is still underestimated, and c) better cooperation between archaeologists and climatologists is highly desirable.

More than twenty new reconstructions based on ring width, wood density and isotopic ratios were presented during this session. Other posters displayed studies of solar variability and of the influence of environmental factors such as elevation and continentality on tree growth.

New approaches revealed the potential of parts of trees usually neglected in climate reconstruction, such as roots and needles. Shrubs and even mosses were

found to be potentially useful to dendrochronology.

A flowering application of dendrochronology is the use of tree-ring studies in forest ecology. Here, tree rings are used to detect the effect on the tree growth of aging, genetics, gender, as well as external non-climatic disturbances. Natural and anthropogenic disturbances like fire or hurricane frequency can also be studied.

Tree-ring studies may be used to reconstruct the past severity of pollution events in heavily-polluted areas. For example, heavy-metal air pollution in the Urals has an influence on rates of trunk decay. Proton Induced X-ray Emission was used in the Mexican basin to trace element content in tree-rings and soil samples. The historical trend in metal and monomeric lignin constituents from 1940s was studied in Aosta Valley, Italy. In contrast to the acidification processes ongoing in Central Europe, alcalisation is the most important problem in the industrial areas of Estonia, where reduced radial increment and high concentration of lignin is found in conifers growing in polluted areas.

37 violins made by Antonio Stradivari were dated using an Alpine spruce chronology. He discovered that on many occasions Stradivari used wood 4-5 years after felling. Martinelli reported an early medieval chronology from Venice, which reveals a maximum building activity in Venice during the second half of the 7 century AD. According to tree-ring data the Ljubljana Moor in Slovenia was in-

habited in the 4th and the 3rd millennium BC.

Tree rings enable the past history of debris flows, landslides, thermokarst, ground instability, glaciers, rock glaciers, floods, river flows, coastal erosion, lake level, and even extra-terrestrial disturbance to be reconstructed. The availability of supra-long multi-millennia chronologies will hopefully enable soon a considerable extension of time frames covered by dendrogeomorphological records in many regions.

At the same time that traditional branches of tree-ring analysis are developing and numerous "side" branches are expanding, the use of tree-ring techniques, namely crossdating to develop charcoal or mollusk chronologies shows that the use of multiple proxies is both possible and fruitful. When will the link within different disciplines using different proxies and methods to study the Holocene become a reality? If it happens, the resolution of these new multi-proxy reconstructions based on carefully crossdated time series, and thereby our knowledge about past climatic conditions will be increased dramatically.

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