Towards a History of Paleoclimatology: Changing roles and shifting scales in climate sciences

Interdisciplinary Workshop
Hamburg, 6-7 September 2017

Convenors:

Dania Achermann
Simone Rödder

Supported by:

Centre of Excellence ”Integrated Climate System Analysis and Prediction” (CliSAP), Hamburg
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Call for Papers

The climate of the past is a fundamental part of today's climate research. Paleoclimatological data from the archives of nature serve to calibrate climate models and inform current knowledge about future climate changes. Historian of science Matthias Dörries argues that paleoclimatology gained political relevance by writing a "history of the deep past" by which it also influences the interpretation of the present; it helped to fill the Earth's history with concrete climate events (Dörries 2015: 25). But how did the study of this "deep past" become such a crucial pillar of modern climate science? How has it impacted the very notion of 'climate', and what were the consequences for both, paleoclimatological and climate science practices? It is the goal of this workshop to tackle these and related questions in an interdisciplinary setting.

In the 1960s and 70s, results from the study of ice cores, sea sediments and tree rings provided evidence that climate is prone to change not only over thousands of years but also during period of times that are within the reach of human imagination, like years or decades. At the same time, these studies extended the temporal scale of climate change beyond any human imagination, to millions of years, and helped to expand the spatial scale from regional data gathering to a global concept of climate. As Dörries points out: "the Earth's past in the 1980s had become quite different from its past in the early 1960s" (27). The study of the climate's past shifted from being a marginalised subject of historical climatology to being a pool of data indispensable for climate modelling. Consequently, and with this increasing relevance, new research questions, approaches and technologies were developed and led to an enormous growth of the field.

Paleoclimatological disciplines such as ice core research, tree rings and pollen analysis, ocean and lake sediment studies have emerged from a range of scientific fields such as physics, glaciology, oceanography, botany, ecology, chemistry or archaeology with differing research questions, cultures and methods of data interpretation. The integrative presentation of paleoclimatological data as a fundament of global climate change knowledge, as for example in IPCC reports, tends to hide conflicts between the different paleoclimatological fields as well as between paleoclimatology and climate modelling regarding type and complexity of data or scales of their validity, as well as the frictions in the process of making paleoclimatological data fit for computer models.

This workshop aims at exploring the changing roles of paleoclimatology as a part of climate science and its contribution to the understanding of climate on different temporal and spatial scales throughout the 20th century.

Literature:

Dörries, Matthias 2015: "Politics, geological past, and the future of earth", Historical Social Research 40: 2. pp. 22-36.

Programme

Wednesday, 6 September 2017

Venue:
Max Planck Institute for Meteorology, Bundesstrasse 53, Room 22/23, 20146 Hamburg, Germany

12:00–13:00 Lunch and gathering

13:00–13:15 **Dania Achermann/Simone Rödder** Welcome and Introductory remarks

FIRST SESSION (Chair: Simone Rödder)

13:15–14:05 **Gerhard Schmiedl** (Institute of Geology, University of Hamburg)
Historical milestones in marine paleoclimate research: A micropaleontological perspective

14:05–14:55 **Meritxell Ramírez I-Ollé** (Sociological Review Fellow, Keele University)
A climate of scepticism about paleoclimatology

14:55–15:25 Coffee break

SECOND SESSION (Chair: Dania Achermann)

15:25–16:15 **Martin Claußen** (Max Planck Institute for Meteorology, Hamburg)
The past is the key to the future

16:15–17:05 **Christoph Rosol** (Max Planck Institute for the History of Science, Berlin)
Marrying the signals of deep time: When proxy data and model data meet

17:05–17:55 **Felix Riede** (Dept. of Archeology and Heritage Studies/Centre for Environmental Humanities, Aarhus University)
Tracing the rise and fall of vegetation history research in Denmark

17:55–18:15 Wrap-up

19:00 Dinner for all speakers at Restaurant ”Brodersen”, Rothenbaumchaussee 46

Programme

Thursday, 7 September 2017

THIRD SESSION (Chair: Simone Rödder)

9:00–9:50 **Eduardo Zorita** (Institute for Coastal Research, Helmholtz-Centre Geesthacht)
The climate of the past millennium: a conflict by proxy

9:50–10:40 **Hans von Storch** (Institute for Coastal Research, Helmholtz-Centre Geesthacht)
Paleodata inversion – from a statistical challenge to a political weapon

10:40–11:00 Coffee break

FOURTH SESSION (Chair: Dania Achermann)

11:00–11:50 **Heinrich Miller** (Alfred Wegener Institute, Bremerhaven)
How icecores shape our views of the climate system

11:50–12:40 Lunch

12:40–13:30 **Sarah Dry** (History Department, University of Oxford)
'Only the northern tip of Greenland': How ice cores became global indicators

13:30–14:30 Commentary by **Hartmut Heinrich** (German Federal Maritime and Hydrographic Agency, BSH) and **Final discussion**

Abstracts

Martin Claußen (Max Planck Institute for Meteorology, Hamburg)

The past is the key to the future

The past is the key to the future – this statement can often be read in papers and brochures related to palaeo climate, biology, and geology. It appears to be the invers of the concept of Scottish geologists and the Scottish enlightenment at the end of the 18th and beginning of the 19th century. According to James Hutton and Charles Lyell, two prominent representatives of that era, natural processes being at work today should have been the same in the past. Hence, the understanding of present processes would help the understanding of what has happened in the past. The Scottish philosopher David Hume has extended this concept to conclude that "all inference from experience suppose … that the future will resemble the past". This has paved the way to the modern phrase and to palaeo analogues which are frequently used today. In my talk, I will critically re-assess palaeo analogues. Such analogues can be useful for conceptual visualization, if they are not taken as predictions. However, palaeo analogues often fail, i.e., lead to misinterpretation or flawed prediction, because in most cases, external climate forcing differs between past, present and future. Is then the "understanding the Earth's past environment" a prerequisite "in order to make predictions for the future" as suggested in the science plan of the PAGES (Past Global Changes, a Future Earth project)? Progress in palaeo climate simulations apparently corroborates this preposition. But have we really understood the Earth's past environment, or have we just properly tuned or parameterized our models to fit the past? It seems that, for fast climate processes, a better understanding of the present could lead to making better predictions of the past – which takes us back to the original concept of the early Scottish geologists. If, on the other hand, slow climate processes, e.g. ice sheet dynamics, carbon cycling and vegetation migration are concerned, there is no alternative for testing our models and ideas by studying the past.

Sarah Dry (History Department, University of Oxford)

'Only the northern tip of Greenland': How ice cores became global indicators

In 1975 Wally Broecker published a now-famous commentary in *Science* proclaiming the risk of a 'pronounced global warming.' Evidence from the O^{18} record in ice cores from Greenland was central to his argument that mean global temperatures were likely to rise in the next 25 years. While Broecker's prediction of increased warming came true, the inference on which it was based turned out to be groundless. Broecker later admitted as much. 'My prediction was based on the false premise that Dansgaard's record typified the globe. In reality, it typified only the northern tip of Greenland.' Subsequent ice cores from different locations didn't reveal additional 120 year cycles of the type upon which Broecker had based his prediction. In a sense, it didn't matter that Broecker's assumption about the global nature of the changes represented by the Greenland cores was incorrect. The abrupt climate changes – including changes on the order of just 80 to 120 years – indicated by the ice cores spurred him to consider possible mechanisms for global climate change and inspired his theory of a so-called global conveyor belt in the ocean.

In this paper, I consider Broecker's consequential interpretation along with other instances when scientists in a range of disciplines utilized of ice core records to make increasingly confident predictions about global (as opposed to regional) climate change. Janet Martin-Nielsen has argued

during the early decades of the Cold War, ice cores in Greenland changed from being tools for basic military research into ice and snow to being tools for understanding past and future climate. Extending her argument, I'd like to consider how ice core records came to be accepted as proxies for global climate change, despite uncertainties about their global representativeness. Factors to be considered include the increasing interdisciplinarity of climate science in this period, a growing sense of urgency felt by some scientists, and increasing awareness of the global effects of nuclear fallout and pollution.

Hartmut Heinrich (Bundesamt für Seeschifffahrt und Hydrographie)

Concluding remarks

Heinrich Miller (Alfred Wegener Institute, Bremen)

How icecores shape our views of the climate system

Ice cores at a fist glance are almost ideal paleoclimate archives. They not only record temperatures of the past in a relatively direct way, they also keep the atmospheric composition intact. In the end it is only a question how smart we are in using appropriate analytic techniques to unravel the complete atmospheric record – greenhouse gases, aerosols and dust. Another advantage of ice cores is that we can count on very high resolution in time and although we have no direct dating method we can fairly confidently ascribe an absolute time to samples retrieved from a certain depth.

From the first ice cores drilled in the sixties until today results from ice cores have helped us to better understand the climate system in particular its inherent global teleconnections. Ice cores are also our climate conscience – they show us without doubt how humankind is altering climate boundary conditions i.e. the greenhouse gas concentrations at an unprecedented rate.

In my presentation I will briefly touch on techniques from drilling to analytics and show some of the most important results.

Meritxell Ramírez I-Ollé (Sociological Review Fellow, Keele University)

A climate of scepticism about paleoclimatology

This talk will contextualise the recent development of paleoclimatology in relation to wider historical trends of social change within climate sciences and Western societies. At least since the inclusion of the 'hockey stick' graph in the 2001 IPCC Third Assessment Report, paleoclimatologists and their work have been the focus on intense public scrutiny and suspicion. Michael Mann's memoir "The Hockey Stick and the Climate Wars: Dispatches from the Front Lines" is a good testament of such climate of scepticism. My recent ethnography of a group of dendroclimatologists, which I conducted between 2012-2015, also reflects this broader context. In this talk, I will suggest that if we want to understand why some members of the public are more sceptical of paleoclimatologists than they used to be, we should look at the changes occurring at both the recipients and emitters of that scepticism. On the one hand, we should consider the historical changes within paleoclimatology, and the progressive integration, over the last century, of climate research into government agendas and industries. On the other hand, we should consider the profound social changes within society - such as the expansion of formal education and the emergence of new communication technologies - which explain the emergence of a better-informed and more self-confident citizenry that is rightly suspicious of the alleged political autonomy of paleoclimatology.

Felix Riede (Dept. of Archeology and Heritage Studies, Centre for Environmental Humanities, Aarhus University)

Tracing the rise and fall of vegetation history research in Denmark

The study of vegetation history – and especially of palynology – once had pride of place among natural scientific disciplines in Denmark. Some of its founding fathers such as Johannes Iversen had a strong interest in human-environment relations and, hence, much early palynological work was driven by the desire to better understand the influence of environmental changes on human society and history. Over time, however, palynology and related disciplines were increasingly marginalised from discussion of past – and by recent extension future – climate change. Pollen analysis has been usurped in Denmark by ice-core and environmental ancient DNA research in particular and although recent efforts to further quantify palynology and to so make it more readily compatible with other scientific disciplines, the discipline is now largely confined to developer-led commercial archaeology. In this presentation, I attempt to trace the rise and fall of this discipline in articulation with observations of research priorities and publication strategies. With the imminent retirement of the only professor of palynology in Denmark, this research field stands at a crossroads: I suggest that making the 'disciplinary splits' between heavily quantified model-based landscape studies on the one hand and the renewed interest in the environment in the humanities on the other (Richer and Gearey 2017) may yet save the discipline.

(Richer, S., & Gearey, B. (2017). From Rackham to REVEALS: Reflections on Palaeoecological Approaches to Woodland and Trees. Environmental Archaeology, 1-12, doi:10.1080/14614103.2017.1283765.)

Christoph Rosol (Max Planck Institute for the History of Science, Berlin)

Marrying the signals of deep time: When proxy data and model data meet

The unorthodox way by which data-based reconstruction and model-based simulation of deep-time paleoclimatic events are cast today into a common heuristical framework may seem puzzling to epistemologists. However, they present only a very radical articulation of the semi-empirical, semi-experimental and highly pragmatic nature of how the current Earth sciences operate. This talk gives a cursory outline of the converging histories and historical interdependencies of proxy data generation and model development in the scientific practice of paleoclimatology. Such a historical account may help to identify the complementary and interchanging roles of what can be termed „observational" and what „explanatory".

Gerhard Schmiedl (Institute for Geology, Universität Hamburg)

Historical milestones in marine paleoclimate research: A micropaleontological perspective

Gerhard Schmiedl (University of Hamburg, Center for Earth System Research and Sustainability, Institute of Geology, Bundesstrasse 55, 20146 Hamburg, e-mail: gerhard.schmiedl@uni-hamburg.de)

Our present understanding of past changes in climate and ocean circulation is to a large extent based on information from marine sediments. Deep-sea sediments contain a variety of microfossils, which record (paleo)-environmental information through their floral and faunal assemblages and geochemical composition. Sampling campaigns in the late 19th and early 20th century were dedicated to the inventory of sediment types and microfossil taxa. The documented results of campaigns such as the expedition of the H.M.S. Challenger in the years 1872 to 1876 still provide the systematic basis for many modern micropaleontological studies. With the initiation of the Deep-Sea Drilling Project in

the late 1960s and subsequent international programs, sediment cores were systematically drilled from all ocean basins and shaped our present knowledge on the ocean history. Highlights include the discovery of the Messinian Salinity Crisis, the recovery of the Cretaceous-Paleogene mass extinction interval from sites proximal to the meteorite impact site, and drilling of sediments from the Paleocene-Eocene Thermal Maximum, which represents a phase of unusually rapid climate warming. The stable oxygen isotope composition of foraminiferal tests from the recovered sediment cores delivered a continuous record of the Cenozoic glaciation history. This record impressively proved the effects of changes in the Earth's orbit on climate on ten to hundred thousands of years, which are described as Milankovitch cycles. The marine paleoclimate research was challenged by the suborbital climate information retrieved from Greenland and Antarctic ice cores, which stimulated the search and exploitation of high-resolution sediment archives. Modern marine paleoclimate research is commonly conducted in interdisciplinary teams and delivers quantitative information on physical and biogeochemical properties of the oceans. A new tradition of communication skills is required for the realization of joint trans-disciplinary projects between proxy- and model-based research and social sciences.

Hans von Storch (Institute for Coastal Research, Helmholtz-Centre Geesthacht)

Paleodata inversion – from a statistical challenge to a political weapon

1. Reconstructions of past temperature variability is interesting by itself but also of practical importance for assessing ongoing recent temperature change.
2. In the First Assessment Report of IPCC, crude estimates of past variability were shown, indicating a Medieval Warm Period, which was warmer than the state at the end of the 20th century.
3. A similar conclusion was drawn by Soon and Baliunas in their literature review in 2003.
4. At about the same time, advanced methods were developed to "invert" proxy data; some of these methods used "indirect" data (e.g., tree rings characteristics), other "direct" data (borehole temperatures). These went along with a loss of variance (not all variability can be regained). The proxy reconstructions contradicted the Soon and Baliunas result.
5. Another estimate of past variations was obtained by simulations with climate models, which were forced by estimated past drivers (volcanism, solar output, greenhouse gas emissions). Also such estimates contradicted the Soon and Baliunas claim.
6. The most prominent example of a proxy reconstructions was the "hockeystick" by Mann et al. (1999), which indicated a lengthy decrease of temperatures since about 1000 until 1850, or so, and a steep increase since then. This results featured prominently in the Third assessment Report (AR3) of the IPCC, published in 2001.
7. The Hockeystick was presented on the front page of New York Times, when the AR3 report was presented.
8. Results inconsistent with the hockeystick (but consistent with the concept of a general and clear warming) had difficulties to pass the review process (e.g., borehole temperature studies) because of gatekeeping.
9. The top of the hype came with Al Gore's "Inconvenient truth". The hockeystick became the ultimate argument for the reality of severity of man-made climate change – a "political weapon".

10. Our paper studying the methodological credentials of the method behind the hockeystick, published in 2004 (in science) and Moberg's alternative reconstruction from 2005 (in nature), changed the game somewhat. After the 2006-report of US-National Research Council it became clear that the issue of the temperature history in the past 1000-2000 years would not yet be settled.
11. The view that a range of propositions for the millennial temperature variability would be valid given the evidence, was adopted by the IPCC in the Fourth and Fifth Assessment reports (AR4, AR5). Since then the intellectual interest in the issue has not ceased, whereas in the public domain the Hockeystick no longer plays a prominent role.

Eduardo Zorita (Institute for Coastal Research, Helmholtz-Centre Geesthacht)

The climate of the past millennium: a conflict by proxy

Following the Third Assessment Report of the IPCC, the climate of the past millennium attracted widespread and intense attention from the scientific community and the blogosphere. One reason was probably the simple and yet powerful scientific messages conveyed - for instance, temperatures in year xxx are 'unprecedented' in the context of the last centuries - that could be

easily understood by lay persons outside the narrow climate science community. Also, main stream paleoclimate research suggested that the analysis of the climate of the past millennium could help understand and quantify future climate changes. This interest gave rise to a surprisingly large number of internet discussions focused on the hockey-stick and other climate reconstructions, and also prompted some lay persons to engage in actual scientific activity, re-checking calculations and evaluating the quality of the formal scientific research. Some even referred to the dawn of a new scientific era, in which the public as a whole could engage in sort of crowd-science.

My presentation will try to evaluate in retrospect the degree to which those expectations have been fulfilled. In general, the public discussions on the internet, sometimes with a rather acid tone, focused on a few salient points that were actually not that relevant in the broader view of the science. Although there were definitely some benefits from the public evaluation of paleoclimate research, and specially affecting the policy of data sharing, it did not lead to any noticeable breakthrough. The number of scientific papers published in main stream scientific journals that resulted from the crowd-science activity was very low. On the other hand, the expectations raised by paleoclimate science on the relevance of paleoclimate research for future climate projections seem to be overblown. Although some results have contributed to frame the uncertainties in future projections, less than expected has so far trickled from paleoclimate research to future climate scenarios.

(Wally Broecker, 'Are we on the brink of a pronounced global warming?' Science, Aug 8, 1975, 460-463; Wally Broecker, 'The Carbon Cycle and Climate Change: memoirs of my 60 years in science,' Geochemical Perspectives, 1 (2012) 221-337, pp 276-277.)