NORTHERN AFRICA -
PAST, PRESENT, AND FUTURE CLIMATE CHANGES

Workshop of the Excellence Cluster CliSAP
and the Max Planck Institute for Meteorology
at KlimaCampus Hamburg

on 7 - 9 February 2011
A workshop of the Excellence Cluster CliSAP
(Integrated Climate System Analysis and Prediction, DFG EXC 177)
and the Max Planck Institute for Meteorology at KlimaCampus
Hamburg on 7 - 9 February 2011

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Klimaneutraler Druck: flyeralarm GmbH, Würzburg

Workshop Dinner
The workshop dinner is scheduled for Tuesday 8 February 2011
at 19:00 h at the Germania Rowing Club, Alsterufer 21 (phone:
+49-40-418035). The Germania Rowing Club is nicely located with
a view over the lake Außenalster. Walking distance from the Geo-

matikum is about 20 minutes. When you reach the square across
the street from Dammtor railway station (Theodor Heuss Platz),
head East crossing the street Moorweide and then using the small
street Alsterterrassen until you reach the Alster lake. Then turn
left and after 200 m you will reach the Germania Rowing Club.

The closest stations for public transport are Dammtor and
Stephansplatz. From Geomatikum you can take bus no. 4 to
Dammtor (direction Hauptbahnhof/ZOB or Marco-Polo-Terrassen
or Rathausmarkt), leaving every 10 minutes just from the subway
station Schlump, Gustav-Falke-Straße.

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WLAN access
WLAN is available in the ZMAW building. You have to connect to
the wireless network of the University of Hamburg with the SSID
„GUEST“. Please find more information in the User Manual for Uni-
versity of Hamburg Wireless Network „GUEST“ in your workshop
folder.
NORTHERN AFRICA — PAST, PRESENT, AND FUTURE CLIMATE CHANGES

“Will greenhouse green the Sahara?” This question posed by Nicole Petit-Maire some 20 years ago (Petit-Maire, Episodes, 1990) refers to the apparent correlation between global temperature and Northern African vegetation change. During the early and mid-Holocene, Northern Africa was, at least regionally, warmer and more humid than today, and during glacial periods, deserts covered a larger area.

Thus it seems plausible to assume that Northern Africa could become greener again if anthropogenic greenhouse gas-induced warming continues to increase. Although it has been disputed whether the so-called mid-Holocene climate optimum is a direct analogue for future greenhouse gas-induced climate change in Northern Africa, current recovery of vegetation in the Sahel is sometimes, at least in some media, interpreted as “greenhouse gas greening”.

Science, as summarized in the latest IPCC report, reveals an ambiguous picture with the exception for the Mediterranean region, where all models indicate dryer climate. Hence, today the classical question is still open. The current workshop attends to critically revisit the scientific challenge by reviewing and discussing the following questions:

1. How green was Northern Africa in the early and mid-Holocene?

The extent of vegetation coverage of Northern Africa during the mid-Holocene wet phase is still not fully known. Areal reconstructions differ, so do model simulations. Was the Sahara more or less uniformly covered by diffuse vegetation with trees along lakes and rivers?

Or did contracted vegetation prevail in large oases being surrounded by desert? Is the vegetation-atmosphere interaction the dominant, positive feedback as previously assumed?

2. How fast did Northern Africa change?

Model studies indicate the possibility of multiple states of the atmosphere-vegetation system in Northern Africa and the possibility of an, in comparison with orbital forcing, abrupt retreat in the early Holocene, or even in the Bølling/Allerød, and abrupt expansion of the Sahara. However, different types of transition are realized in the models ranging from single abrupt transition, apparently smooth transition and a flickering in a bi-stable or mono-stable regime. Dynamics in the Western and the Eastern part of the Sahara seem to differ.

Evidence to falsify models is sparse. A number of marine records indicate a fast change in humidity proxies and dust trans-
port. Terrestrial records point at a sequence of dry and wet spells around the mid-Holocene. What do we know about the onset of the wet phase in Northern Africa?

3. How could Northern Africa change in the future?

According to the latest IPCC report, estimates on possible precipitation changes in Northern Africa vary. The standard deviation among various model estimates is larger than the ensemble climate change signal—except for the region around the Mediterranean (see Fig. 10.9 in IPCC AR4, 2007). Therefore, it is not at all obvious whether greenhouse gas-induced climate warming will lead to more or less rainfall.

Models which include atmosphere-vegetation interaction indicate that this interaction might amplify any signal, i.e., by producing a stronger greening or a stronger desert expansion. What are the newest estimates? Would falsification of models by use of palaeoclimatic reconstruction help improve estimates of potential future changes? Can current greening as observed from satellites already be interpreted as response to greenhouse gas increase? Or does decadal variability in Sahelian rainfall conceal any detection of a signal?

Scope of the workshop

This is the first of (at least) two workshops on Northern African climate change. In the first workshop, we would like to focus on the dynamics of the natural climate system and on lessons learnt from palaeoclimate modelling and palaeoclimatology. A second workshop will focus on humans and human interaction with Northern African climate.

A desirable outcome of the workshop would be a comprehensive discussion being presented in a review paper or a series of papers, perhaps even a special issue in some of the open-access journals. The paper(s) should summarize the spectrum of data and of our conceptual and model-based interpretation of data. Where do we agree, and where do we disagree?
Fig. 1: Transient development of vegetation fraction and climate in the Sahara. (a) Simulated changes in vegetation fraction on average over the entire Sahara by Claussen and Gayler (1997). (b) Simulated changes in vegetation fraction in the Western Sahara/Sahel region (14°W to 3°E, 17°N to 28°N) by Renssen et al. (2003). (c) Simulated changes in grass cover in the Eastern Sahara (11°E to 34°E, 18°N to 23°N) by Liu et al. (2007). (d) Reconstructed dust concentration in North Atlantic marine sediment (at approximately 20.8°N, 18.5°W) by deMenocal et al. (2000). (e) Number of 14C dates in the Sahara east of 11°E by Pachur (1999). (f) Reconstructed change in tropical plant taxa from Lake Yoa (at approximately 19°N, 20.3°E) by Kröpelin et al. (2008). This figure is taken from Claussen (2009).


Workshop Agenda

Presentation format:
15 min presentation and 5 min brief questions

Monday 7 February 2011

13:00 – 13:15 Welcome and Introduction to the Workshop

Question 1: How green was Northern Africa in the mid-Holocene?

Sahara and Sahel vulnerability, lessons from the past: Holocene pollen and hydrological data

13:40 – 14:00 Stefan Kröpelin (U Köln)
Discrepancies between marine and terrestrial data on Holocene climate change in the Sahara and the so-called „African Humid Period”

14:00 – 14:20 Philipp Hoelzmann (FU Berlin)
Ideality and reality: The dilemma of palaeohydrological and palaeoenvironmental data bases for the Sahara

14:20 – 14:40 Hans-Joachim Pachur (FU Berlin)
Palaeohydrology of the Eastern Sahara - a CO₂-sink at 6 ka

14:40 – 15:00 Brief Discussion

15:00 – 15:30 Coffee Break

15:30 – 15:50 Stefan Mulitza (MARUM, Bremen)
Mid- to late Holocene history of West African precipitation, vegetation and dust production

15:50 – 16:10 Matthias Prange (MARUM, Bremen)
African Humid Period: Mid-Holocene versus earlier interglacials

16:10 – 16:30 Anne Dallmeyer, Freja Vamborg (MPI-M, Hamburg)
Green Sahara as simulated in the ECHAM-N models

16:30 – 16:50 Jim Russell (Brown, Rhode Island)
Synchronous and asynchronous monsoon variations in Northern and Equatorial Africa

16:50 – 17:10 Brief Discussion

17:15 Ice Breaker
Tuesday 8 February 2011

Question 1: How green was Northern Africa in the mid-Holocene? (Cont.)

09:00 – 09:20 Lydie Dupont (MARUM, Bremen)
Green, greener, greenest? The Sahara in Middle Pleistocene and Late Pliocene

09:20 – 09:40 Uli Salzmann (Northumbria, Newcastle)
Shifting savannas and collapsing forests: A Holocene and Pliocene view from the South

09:40 – 10:00 Jörg Völkel (TU München)
Megafloods and landscape change during OIS 3 in the Sinai Mts., Egypt

10:00 – 10:30 Coffee Break

10:30 – 12:00 Discussion (chair: Martin Claussen)

12:00 – 13:30 Lunch

Question 2: How fast did Northern Africa Change?

13:30 – 14:00 Peter deMenocal (LDEO, Columbia)
Marine sediment records of the African Humid Period: Timing and Rates of Climate Transitions

14:00 – 14:20 Dirk Verschuren (U Gent)
Abrupt or gradual: the archive and proxy do matter

14:20 – 14:40 Zhengyu Liu (U Wisconsin)
Abrupt change and vegetation feedback in N Africa climate-ecosystem: A combined paleo- and present perspective

14:40 – 15:00 Hans Renssen (VU Amsterdam)
Simulation of the Holocene climate evolution: The termination of the African Humid Period

15:00 – 15:30 Coffee Break

15:30 – 15:50 Sebastian Bathiany (SICSS, Hamburg)
Implications of climate variability for a vegetation collapse at the end of the African Humid Period

15:50 – 16:10 Bette Otto-Bliesner (NCAR)
Onset of the wet phase in North Africa: orbital, carbon dioxide and meltwater effects

16:10 – 16:30 Sharon Nicholson (Florida State U)
Non-linearities in the environmental system over West Africa and implications for abrupt change

16:30 – 18:00 Discussion (chair: Zhengyu Liu)

19:00 Dinner “Der Hamburger und Germania Ruder Club”
Follow the directions on page 2 „Workshop Dinner“
Wednesday 9 February 2011

Question 3: How could Northern Africa change in the future?

09:00 – 09:20 Martin Claussen (UHH/MPI-M, Hamburg)
The future of North Africa as simulated in the CLIMBER Model

09:20 – 09:40 John Hughes (UK MetOffice, Reading)
The future of North Africa as simulated in the Hadley Center Model

09:40 – 10:00 Sam Levis (NCAR)
21st century climate and vegetation simulated for N. Africa by the CCSM4/CESM1

10:00 – 10:30 Coffee Break

10:30 – 10:50 Victor Brovkin (MPI-M, Hamburg)
The future of North Africa as simulated in the MPI-ESM

10:50 – 11:10 Kerry Cook (U Texas)
Future Climate of Northern Africa: Regional Prediction and the Evaluation of Confidence

11:10 – 11:30 Heiko Paeth (U Würzburg)
Man-made land-cover changes as a driver for future climate change in Africa

11:30 – 11:40 Jonathan Seaquist (Lund)
Sahel greening patterns derived from Earth observation data

11:30 – 12:40 Discussion (chair: Victor Brovkin)

12:40 – 13:00 Final Remarks
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Public Transport

Hamburg buses and undergrounds are operated by HVV. All tickets you buy are valid for buses and undergrounds. An underground map to direct you to MPI-M can be found at the next two pages.

From Hamburg Airport

Please take the S-Bahn S1 (signed Ohlsdorf) to Ohlsdorf station where you get off to enter the blue underground line no. U1, signed Ohlstedt/Großhansdorf. Please exit at Kellinghusenstrasse, change to the yellow line no. U3 on the same platform, signed Wandsbek-Gartenstadt, and get off at Schlump underground station.

Travel time for the alternative route is about 5 minutes more, but only requires one change of trains: Take the S-Bahn S1 signed Ohlsdorf as far as Barmbek station (please note: at Ohlsdorf two coaches will be coupled, but you can remain seated). At Barmbek please change to the yellow underground line U3 signed Wandsbek-Gartenstadt via Kellinghusenstrasse and exit at Schlump underground station.

Taxi from the Airport

Cost is approx. 17-23 EUR. Transfer time: 30-50 minutes, depending on traffic density.

By Train

Public Transport

Arriving by train at the central railway station (Hauptbahnhof Hbf), take the HVV underground U2, red line, (tickets from machines in the station entrance hall). Enter trains signed Niendorf-Nord/Niendorf-Markt. Get off at Schlump underground station.

Alternatively, check if your train continues to Dammtor (Bahnhof) Station. If so, this station is the better choice for reaching MPI-M: Take bus No. 4 in front of Dammtor station, signed Wildacker, and exit at bus station Bundesstrasse. From there, turn towards the high-rise building, Geomatikum, on the left-hand side of which MPI-M is located.

Taxi from the Central Railway Station

Cost is approx. 10 EUR. Transfer time: 15-25 minutes, depending on traffic density.