

Simulating and Understanding Abrupt Transition into the African Humid Period

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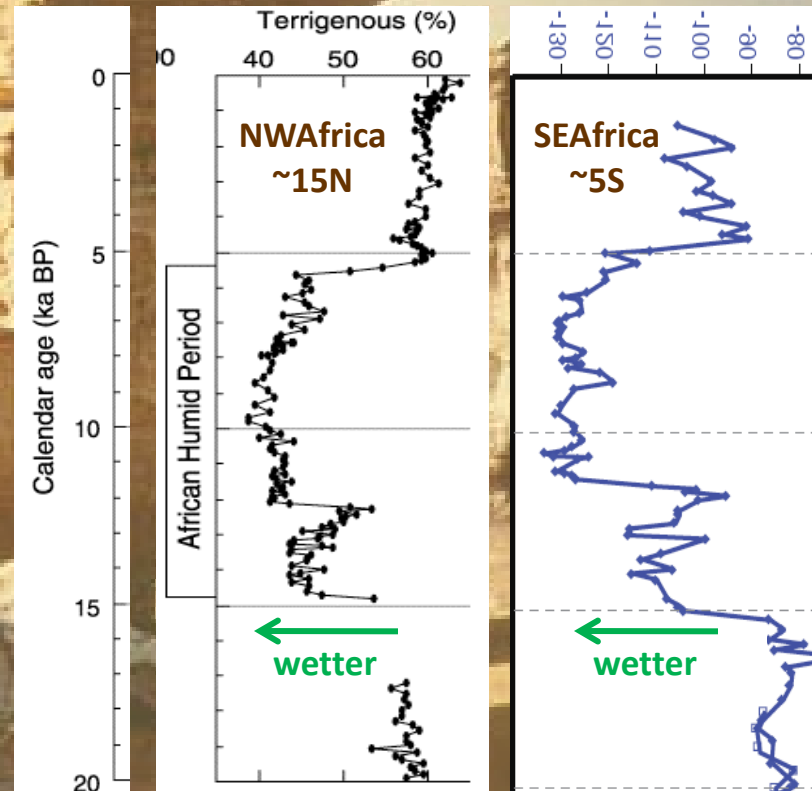
Z. Liu

Center for Climatic Research &
Dept. Atmospheric and Oceanic Sciences
University of Wisconsin-Madison

and M. Wehrenberg, Feng He, and many others



NCAR is sponsored by the NSF



deMenocal et al., 2000 Tierney et al., 2008

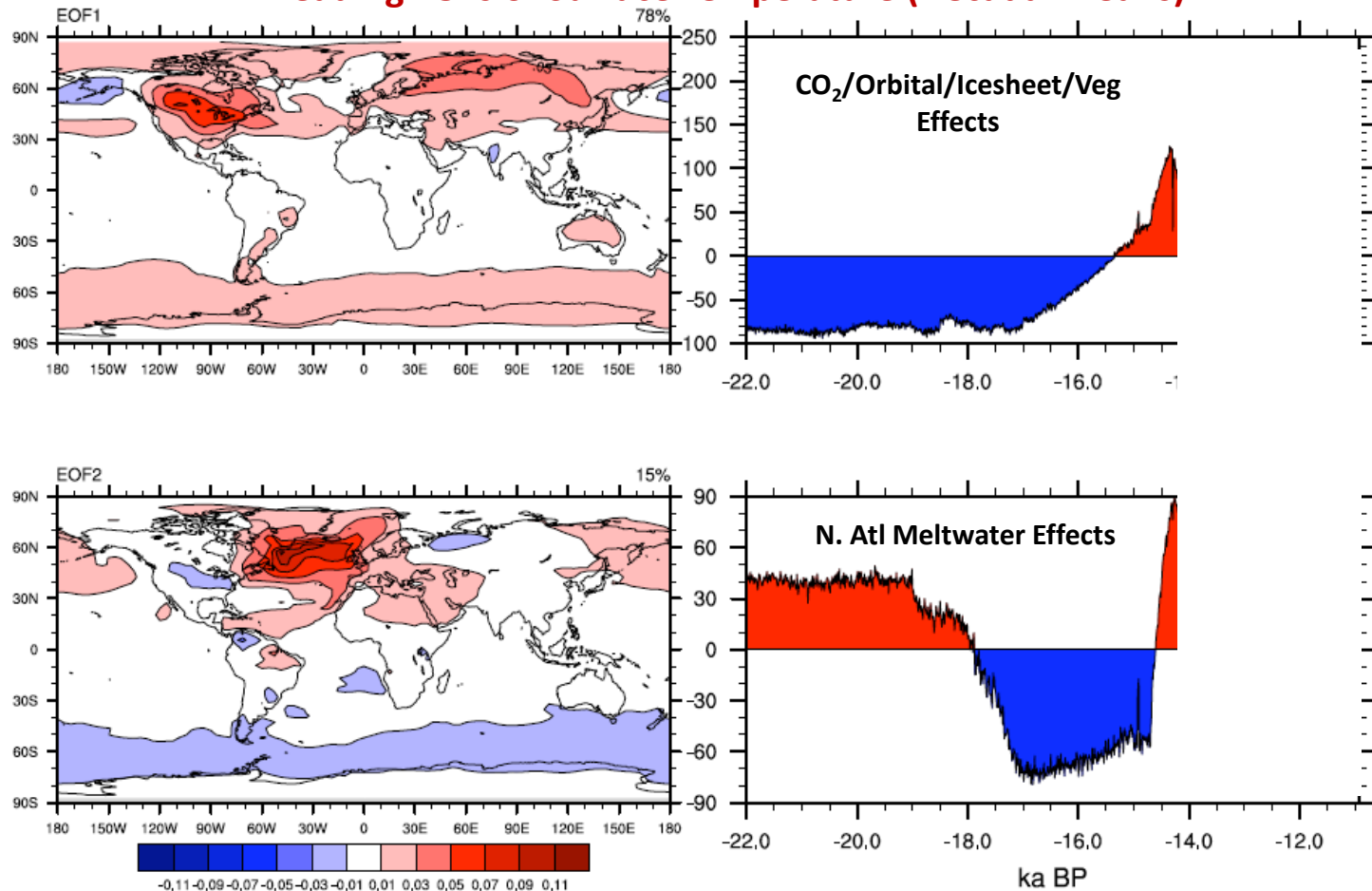
Transient Simulation of Climate Evolution of the Last 21,000 years

TraCE-21000

Model: CCSM3 T31x3 with dynamic vegetation
Transient forcings of solar insolation (orbital), Greenhouse gases,
Ice sheet heights and extent, Meltwater to ocean

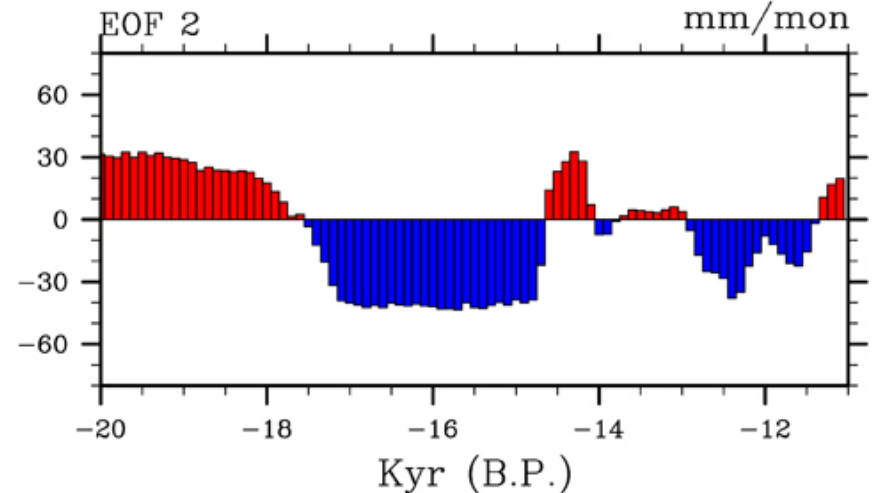
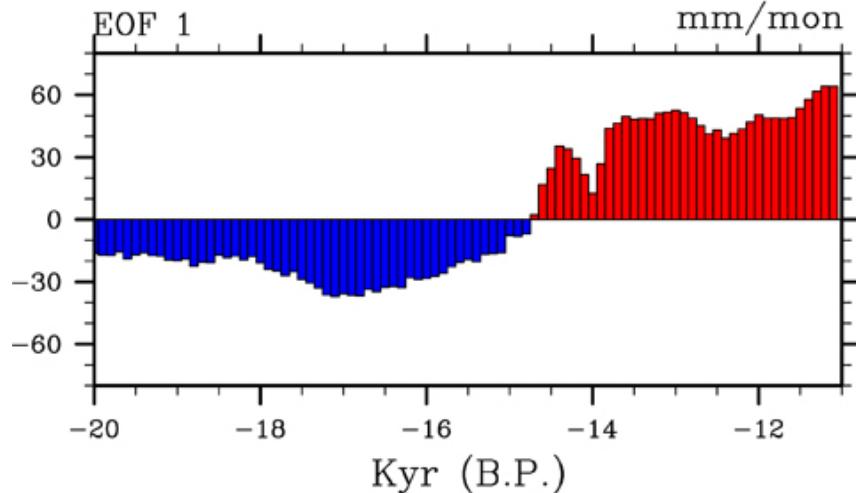
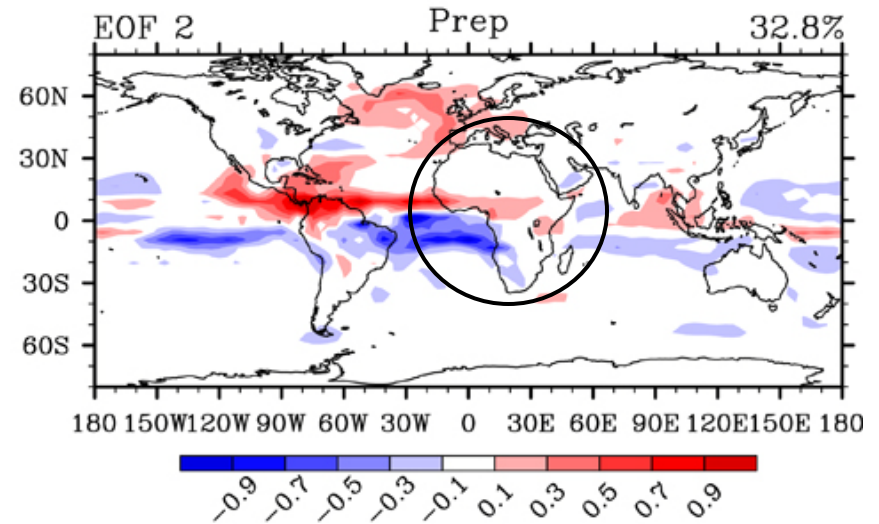
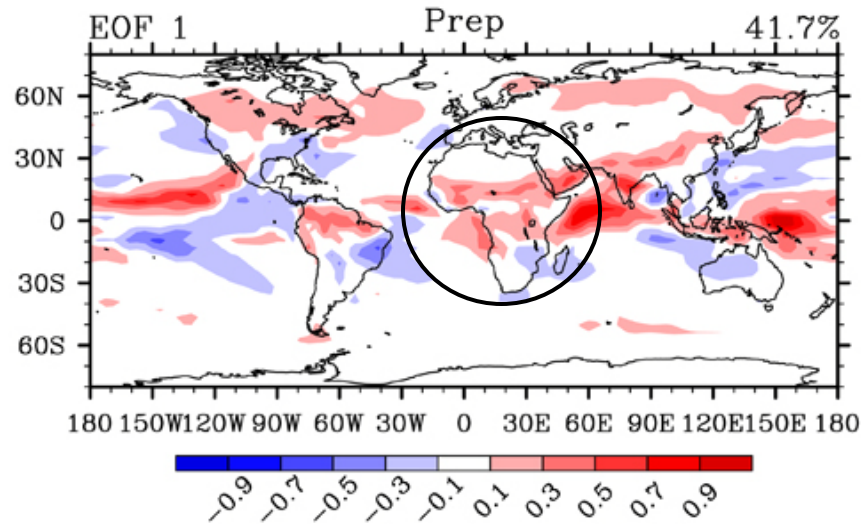
Part 1: Analysis of
AMOC and Polar
Temperature
Responses:
LGM to abrupt BA
warming

Leading EOFs of Surface Temperature (Decadal means)



Part 2: Analysis of Precipitation Response LGM to early Holocene

Leading EOFs of Precipitation (Decadal means)



Simulation of Present-day African Climate

Northern Hemisphere Summer
June-July-August

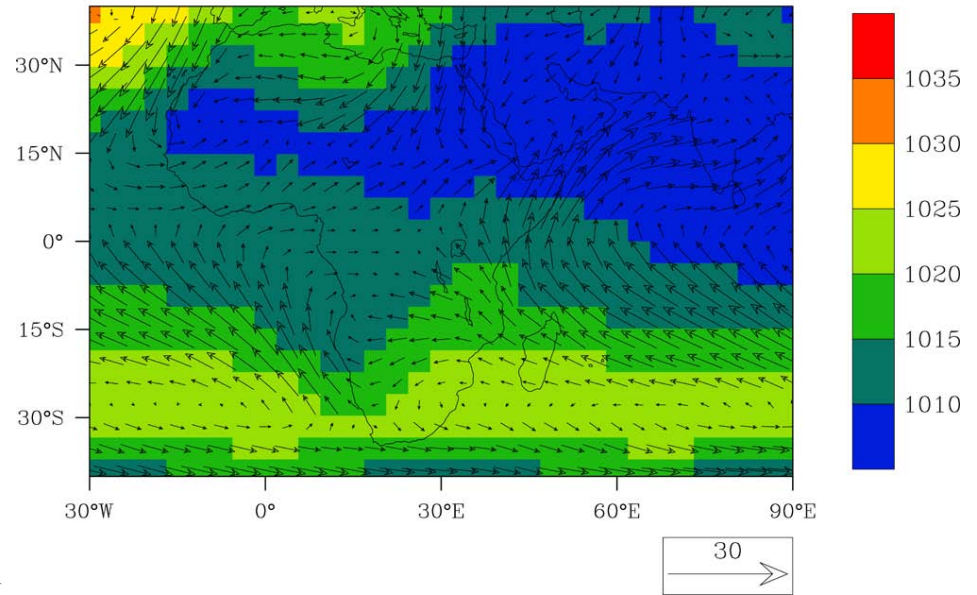
Sea level pressure
& surface winds



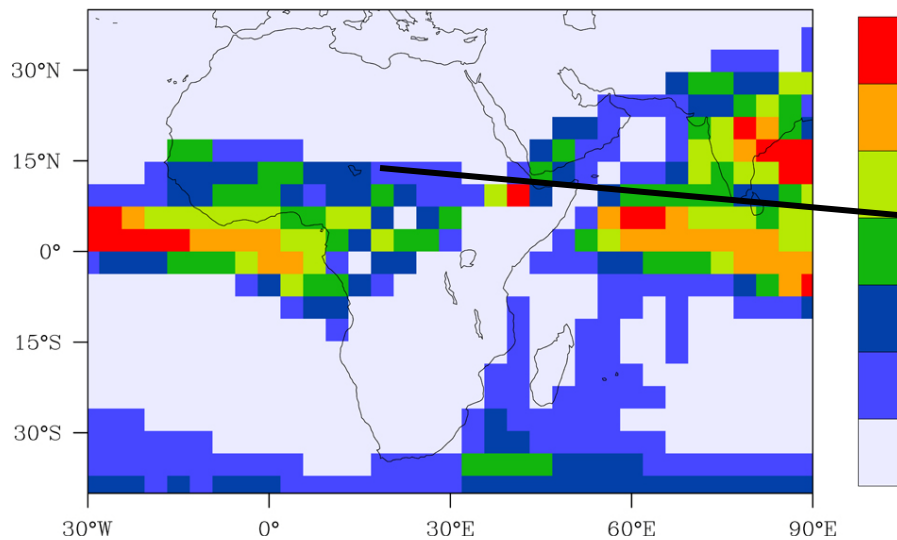
Precipitation



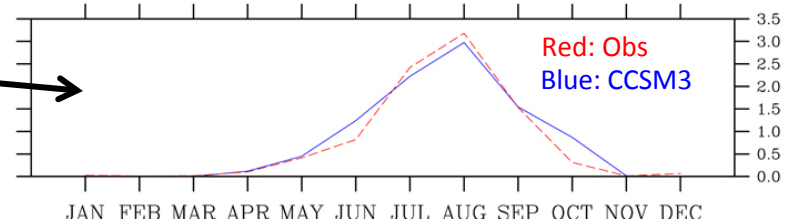
Sea-Level Pressure & Wind, JJA, Modern (T31 ctrl) hPa



Prec JJA, Modern (T31 ctrl) mm/month



Central Sahel (12.9-17°N, 15°E)



Simulation of Present-day African Climate

Southern Hemisphere Summer December-January-February

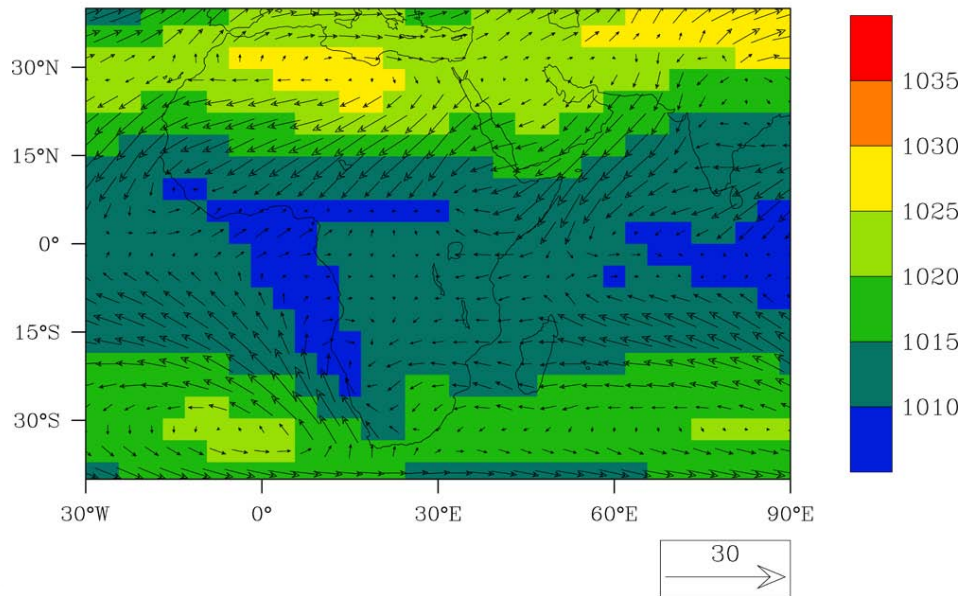
Sea level pressure
& surface winds



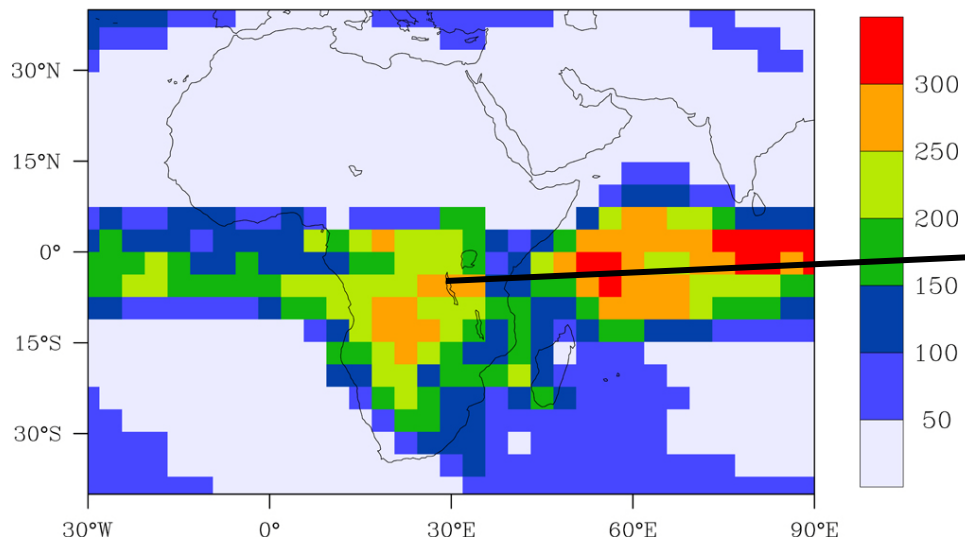
Precipitation



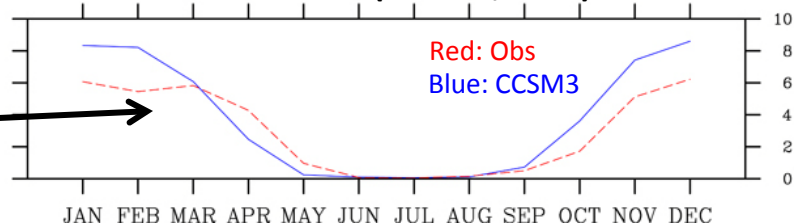
Sea-Level Pressure & Wind, DJF, Modern (T31 ctrl) hPa



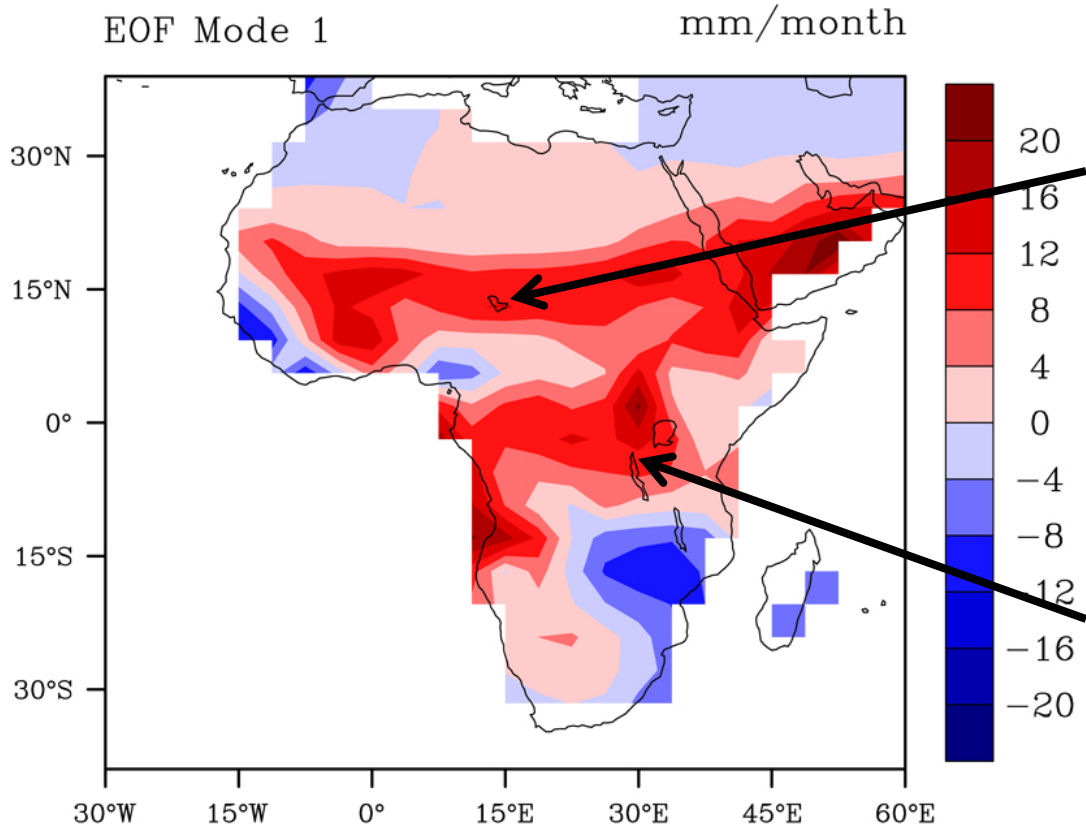
Prec DJF, Modern (T31 ctrl) mm/month



Great Lakes (5.5-9°S, 30°E)



CCSM3 Model Results



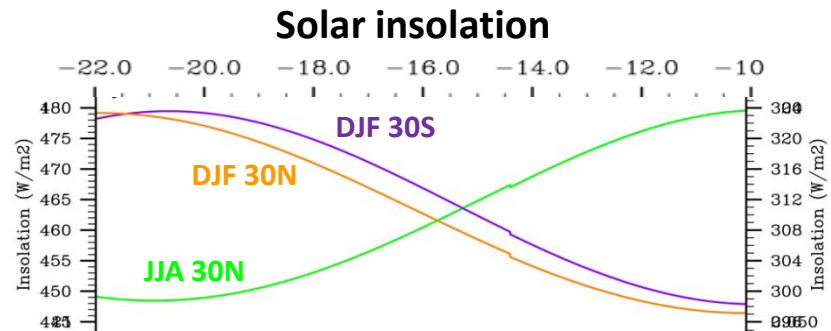
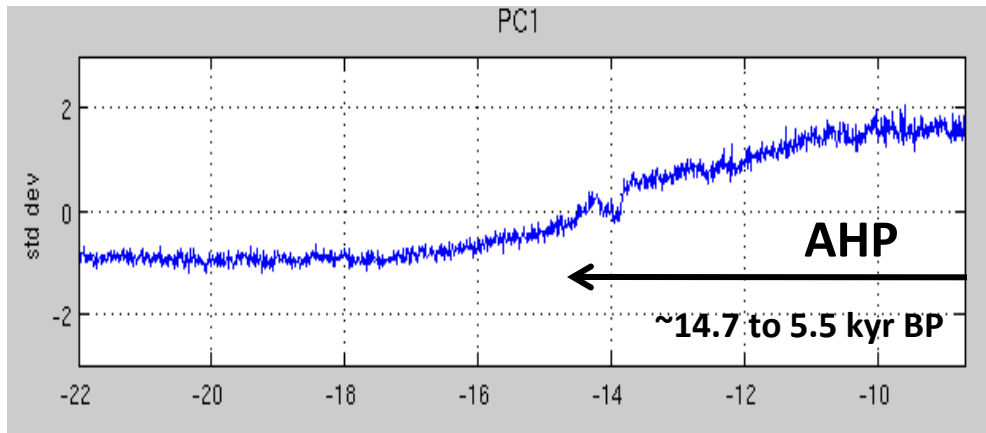
Data Interpretation

Sahel-Sahara region:

AHP starting at ~14.7 kyr BP, with **increased summer (JAS) monsoon precipitation** associated with orbitally-induced increases in **local summer insolation**

SE Africa “Great Lakes” region:

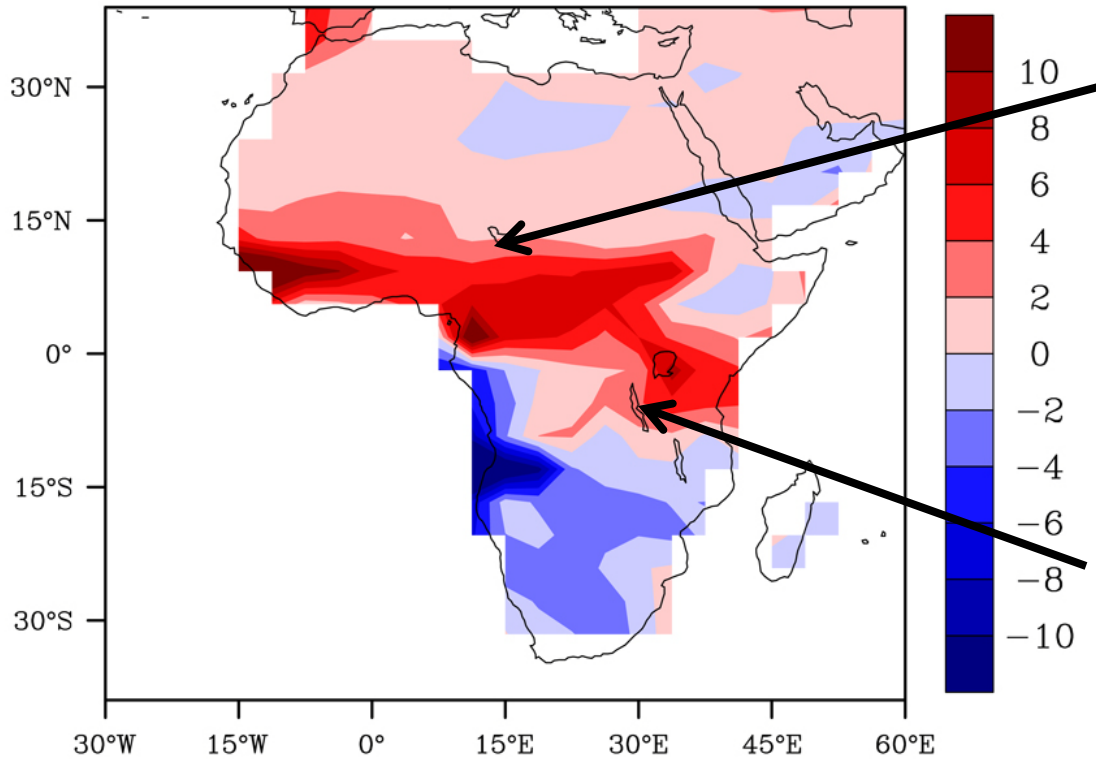
AHP starting at ~14.7 kyr BP, with **increased summer (DJF) monsoon precipitation** associated with orbitally-induced decreases in **remote (NH) winter insolation.**



CCSM3 Model Results

Data Interpretation

EOF Mode 2 mm/month

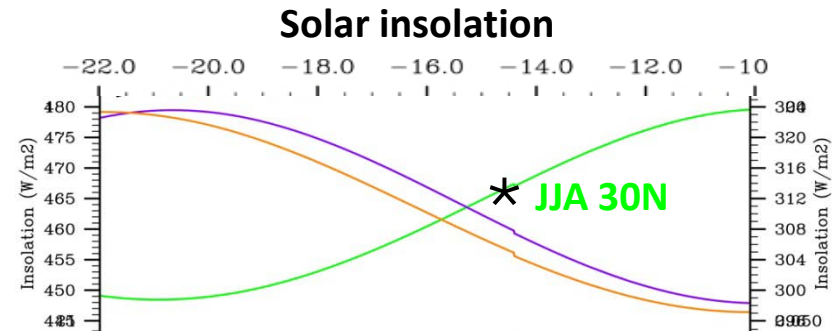
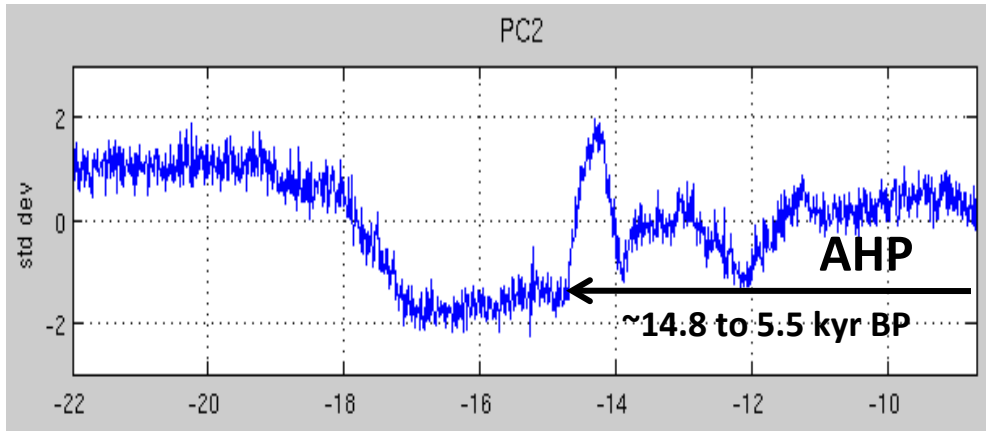


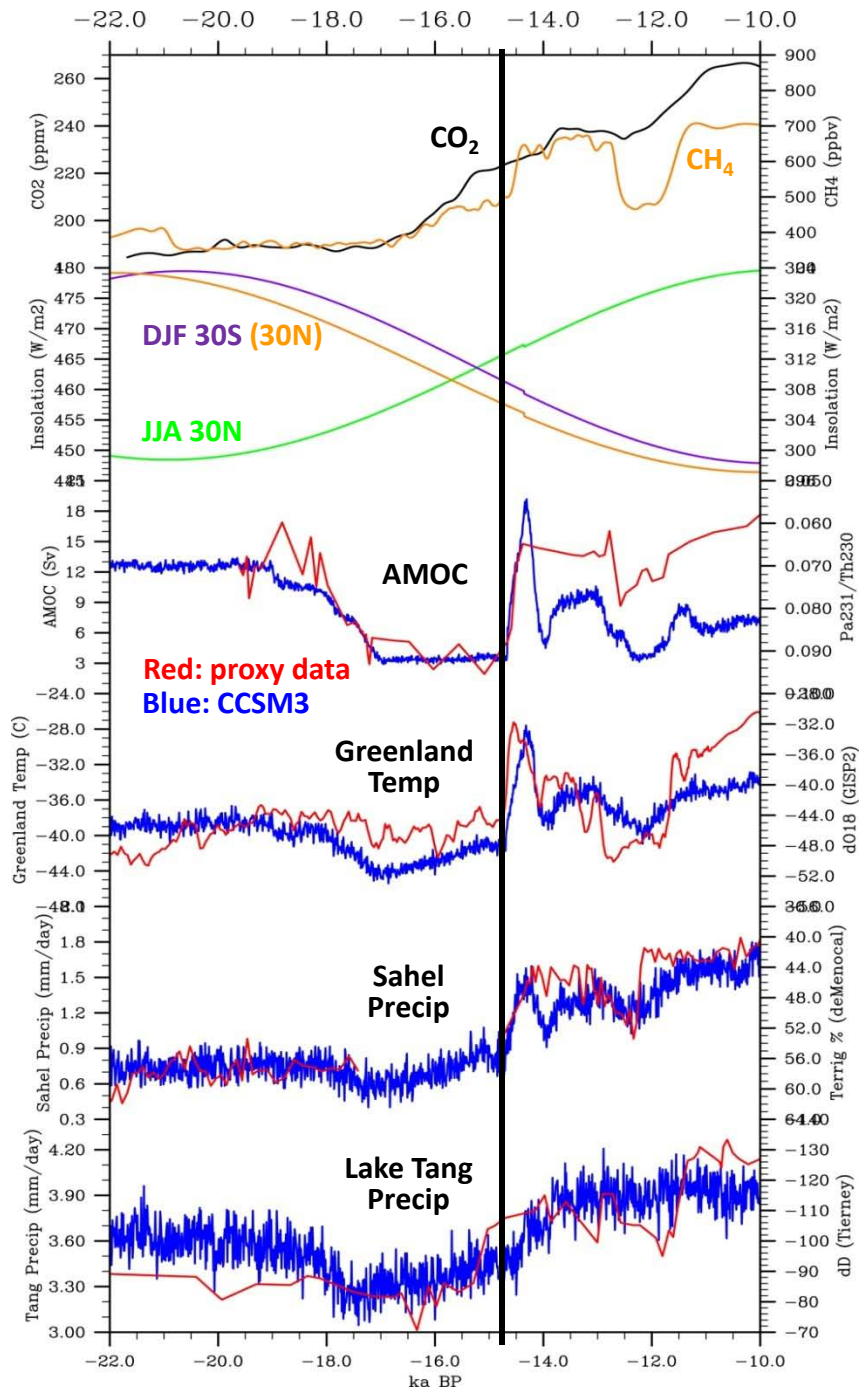
Sahel-Sahara region:

Abrupt start and end of AHP associated with **threshold insolation**

SE Africa "Great Lakes" region:

Abrupt start of AHP associated with AMOC






Interpretation from CCSM3 Transient Simulation

Abrupt start of AHP at ~14.7 kyr BP: coincides approx. with resumption of AMOC and warming of Greenland in both northern and southern subtropical Africa in CCSM3 (suggesting the AMOC as the possible dominant mechanism rather than a threshold response associated with solar insolation)

Enhanced precipitation in Sahel and Lake T after this abrupt start of AHP: Note local or remote insolation changes and GHGs could both have been the forcing

To separate out these forcings, we will analyze two additional sensitivity runs

A topographic map of the African continent with paleogeographic features highlighted in blue. The features include 'The Chotts Megalake' in the north, 'Lake Megafezzan' in the northeast, and 'Lake Megachad' in the central region. The map uses a color gradient from green (low elevation) to brown (high elevation).

The Chotts
Megalake

Lake
Megafezzan

Lake
Megachad

*Thank you for
your attention*