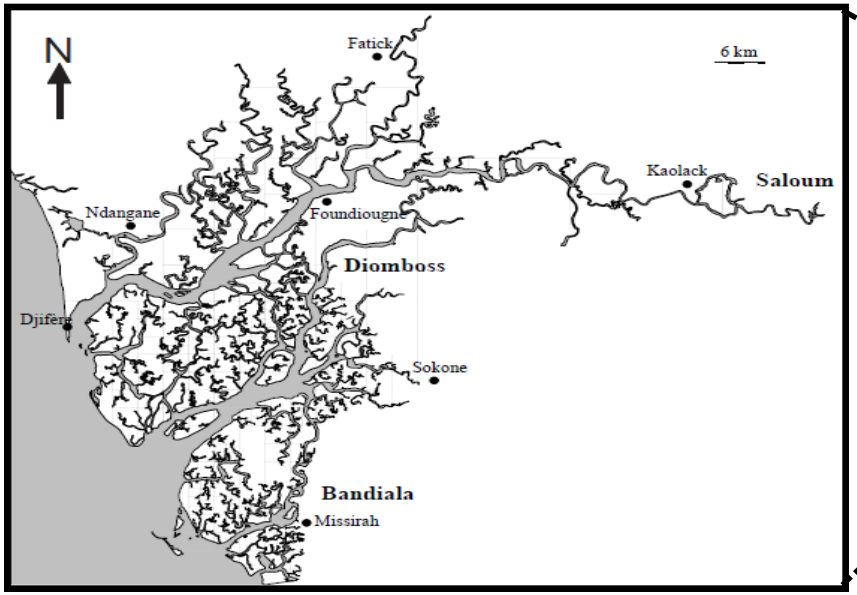
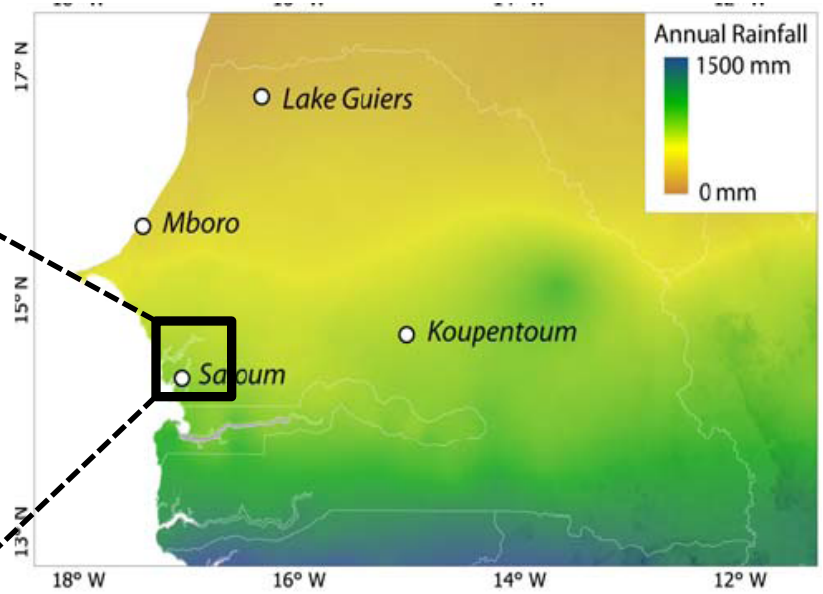
The West African monsoon duration and intensity from AD 450 - 1090 inferred from high resolution isotope sclerochronology of modern and fossil mollusk shells in the Saloum estuary (Senegal)

Azzoug, M., Carré, M., Schauer A.J., Lazareth, C.E., Mandeng-Yogo, M., Sultan, B.

Study site

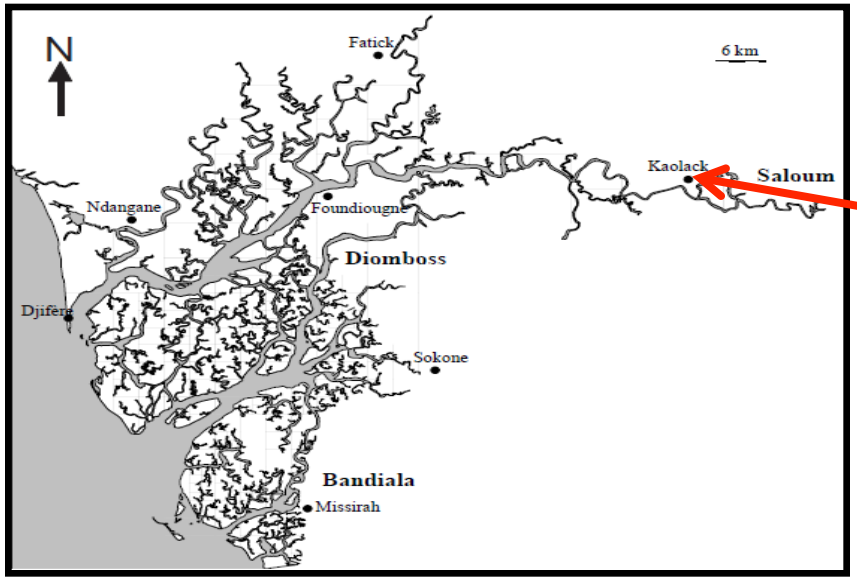
The Saloum Estuary

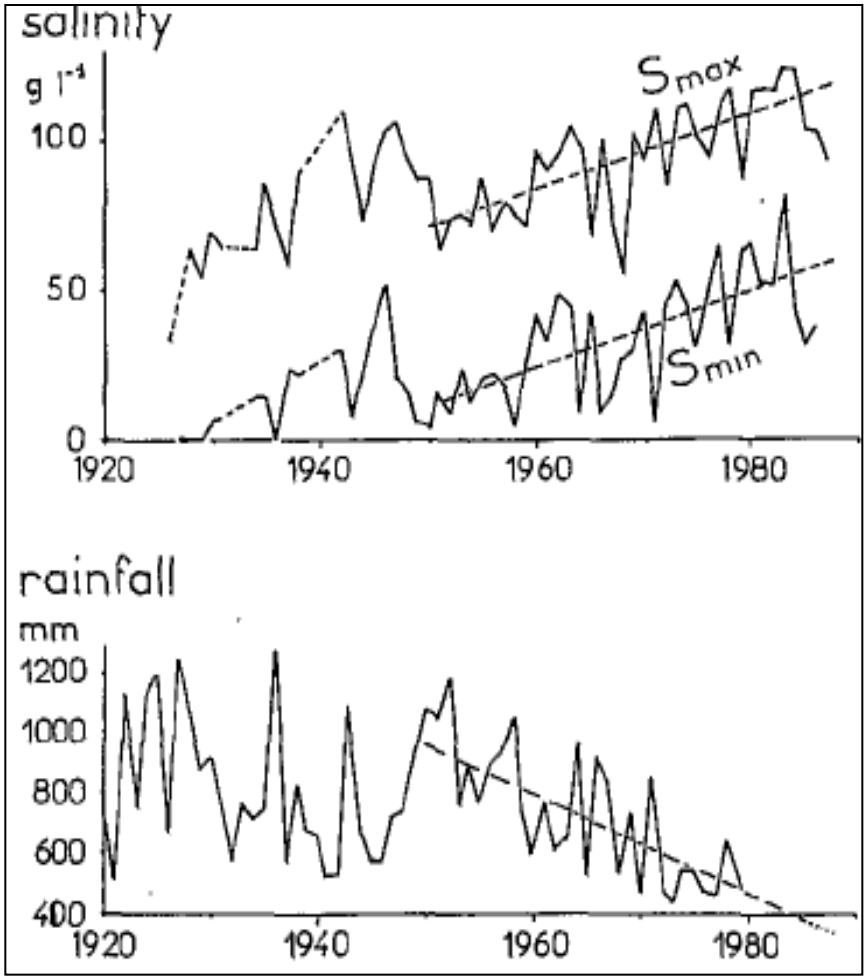




The Saloum Estuary

Hydrology

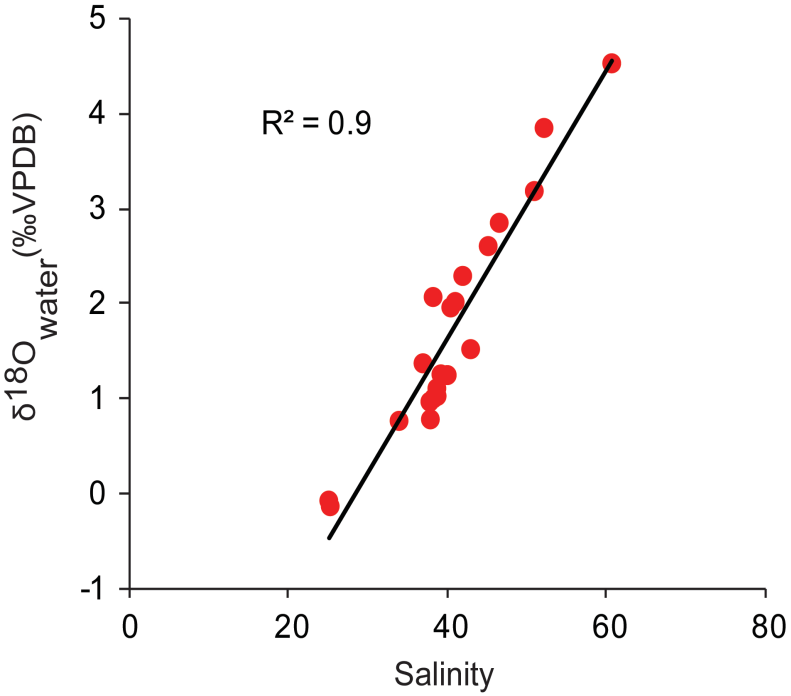




The Saloum hydrological conditions are highly sensitive to Precipitation-evaporation budget

Pagès and Citeau, 1990

$$\delta^{18}O_{aragonite} = f(\delta^{18}O_{water}, T°C)$$



Low variability of sea water temperature in the Saloum estuary

Shell $\delta^{18}O$ record mainly water $\delta^{18}O$ variations

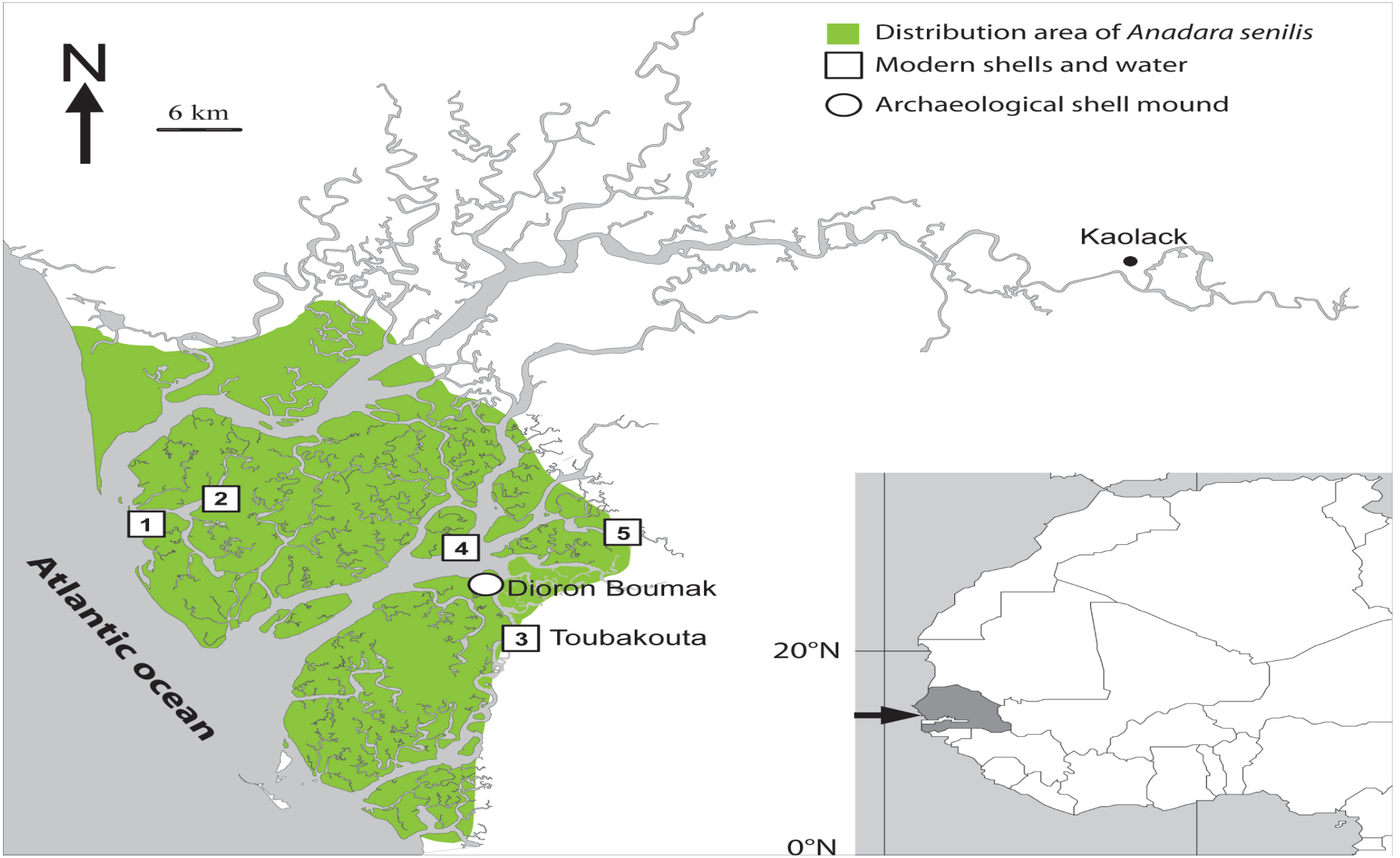
Why *Anadara senilis?*

- **Widely distributed along the West African coast.**
- **Large ecological tolerance.**
- **Abundant in fossil shell middens. (paleo-hydrological archive).**

Distribution area of *Anadara senilis*

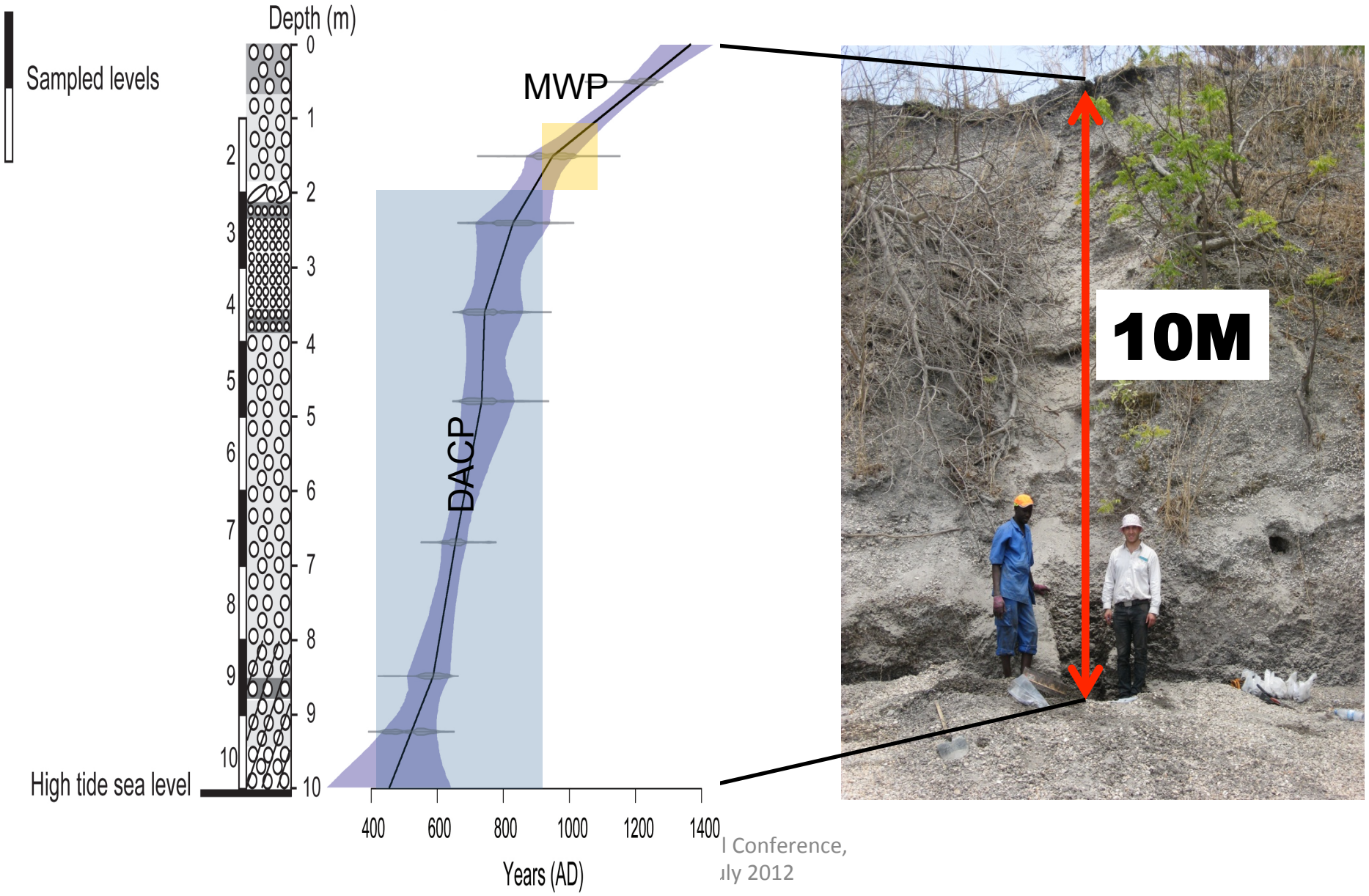
Methodology

Sampling sites

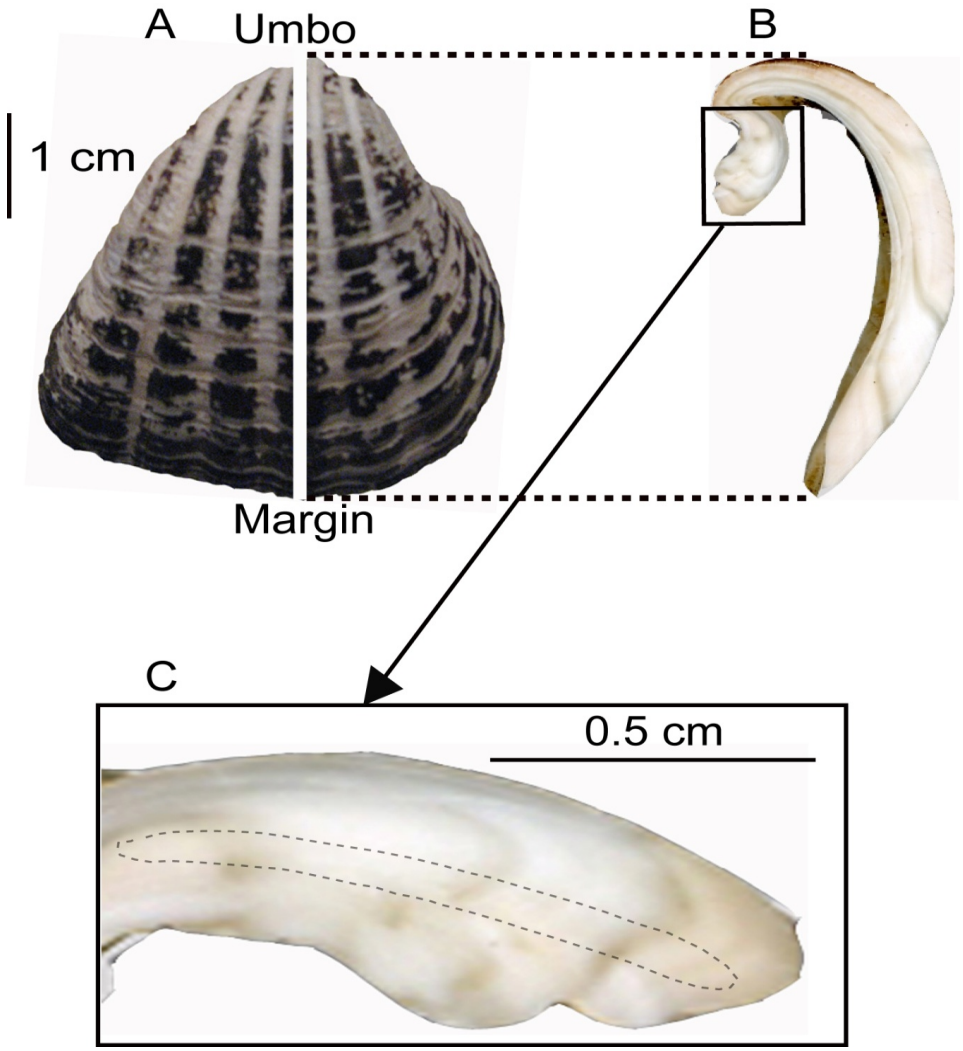


Methodology

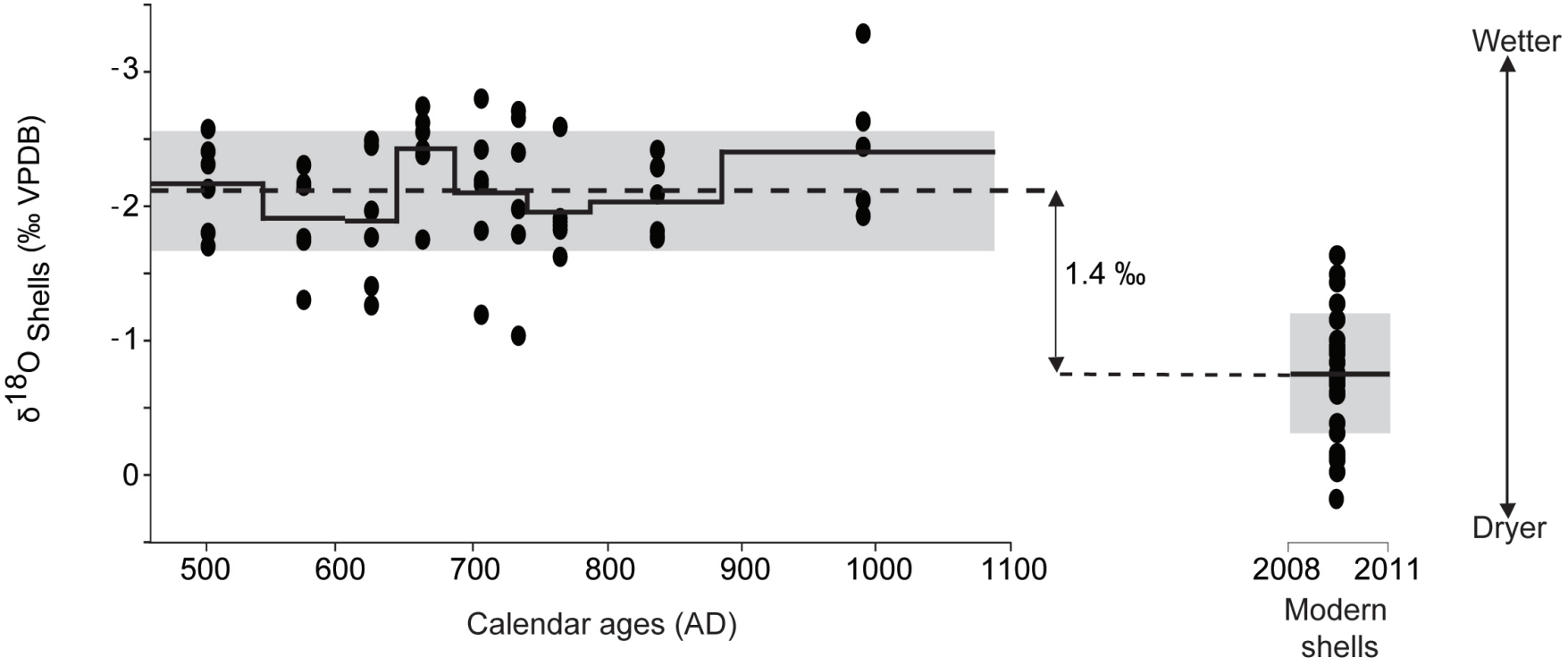
fossil samples



Shell sampling



Mean hydrological conditions

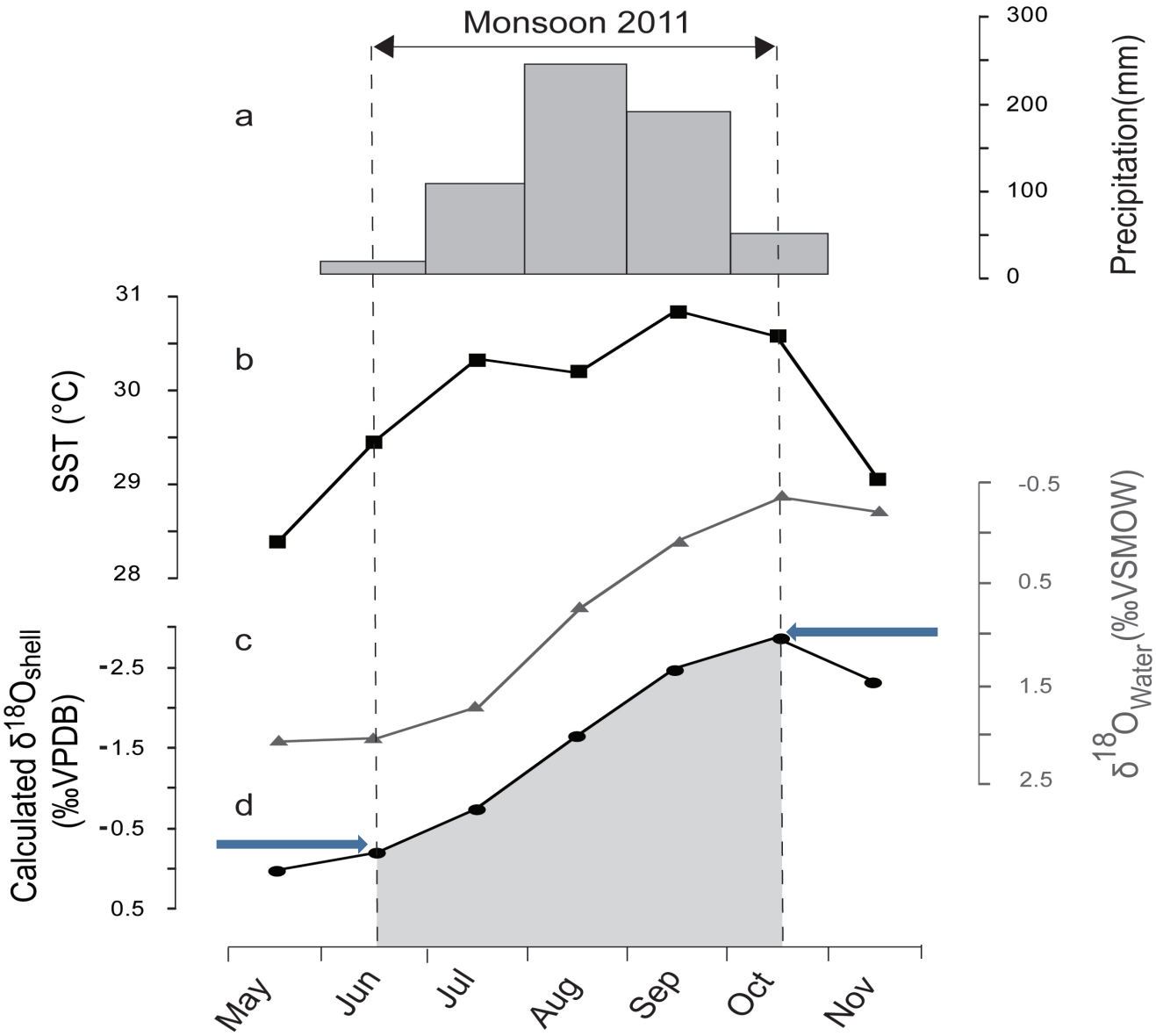


Hydrological conditions in the Saloum Estuary from AD 460 to 1090 were fresher than today

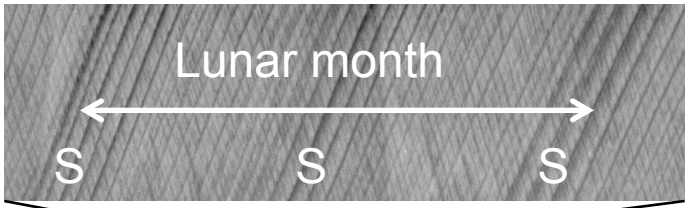
Stronger rainfall amounts?

Less evaporation?

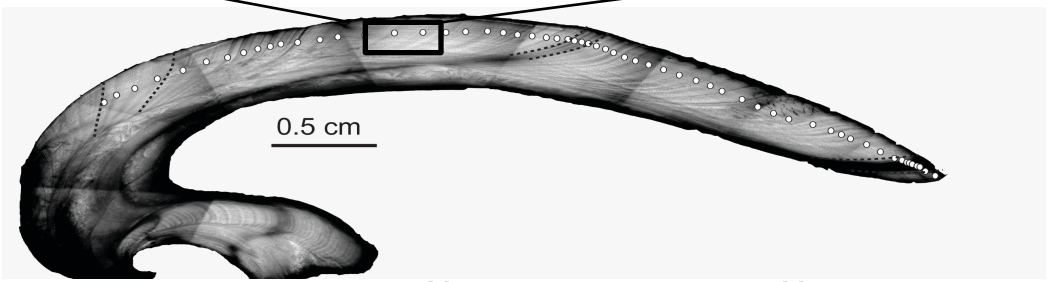
Methodological approach

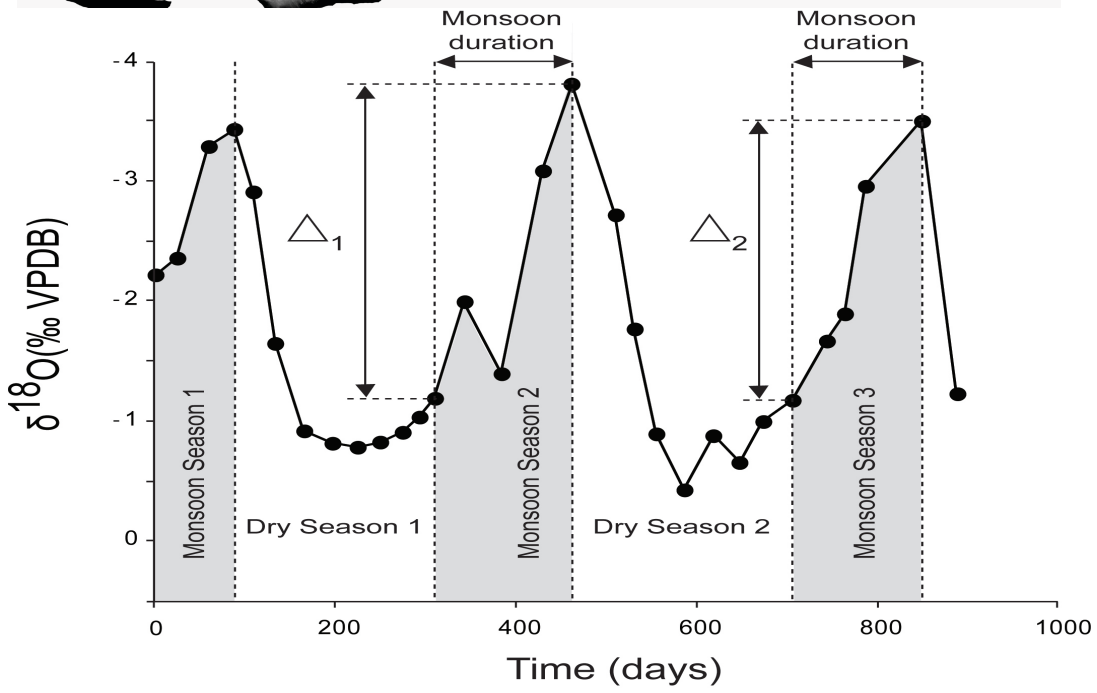


Methodological approach



Internal chronology to align isotopic Record into a time axis.

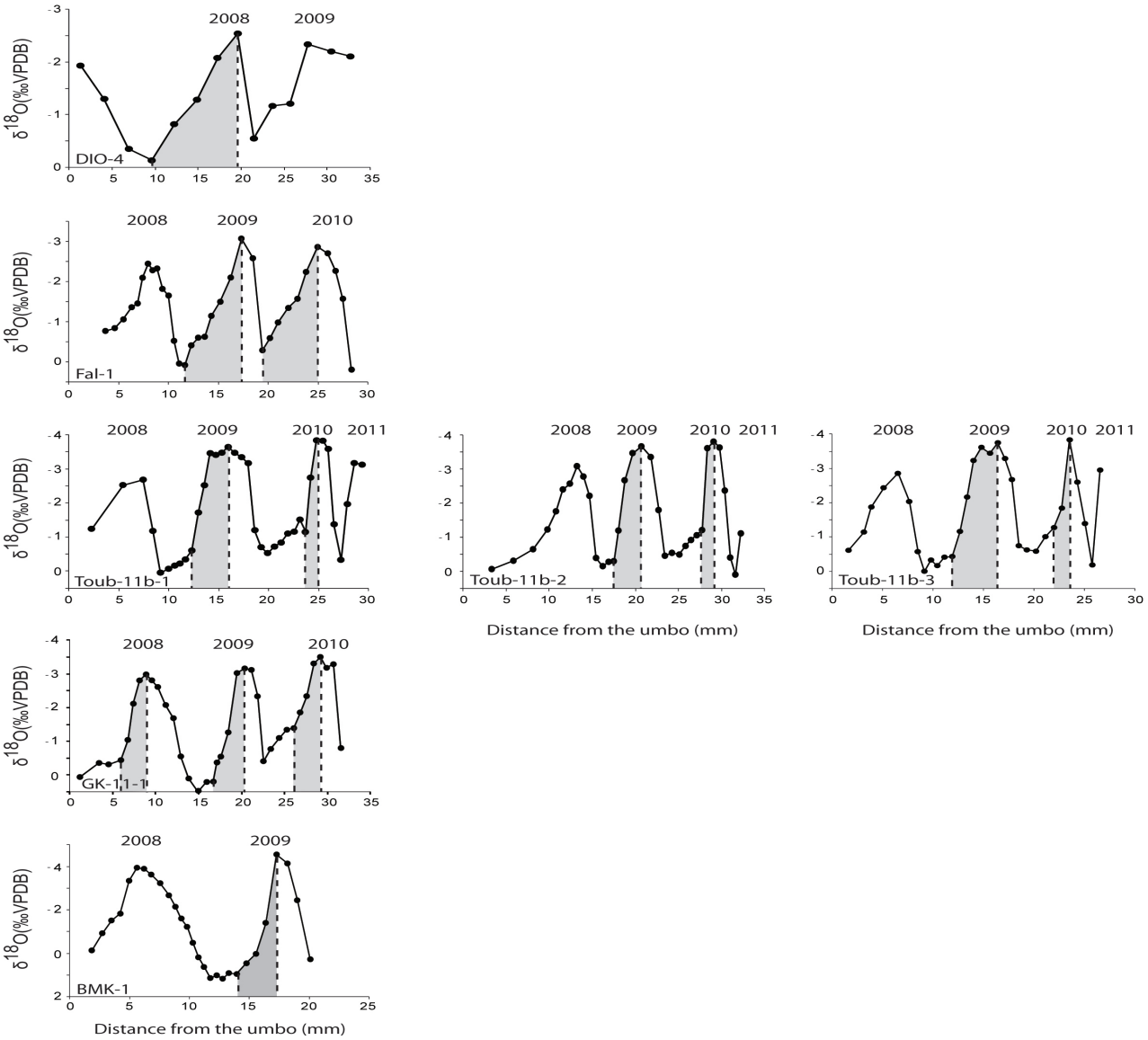




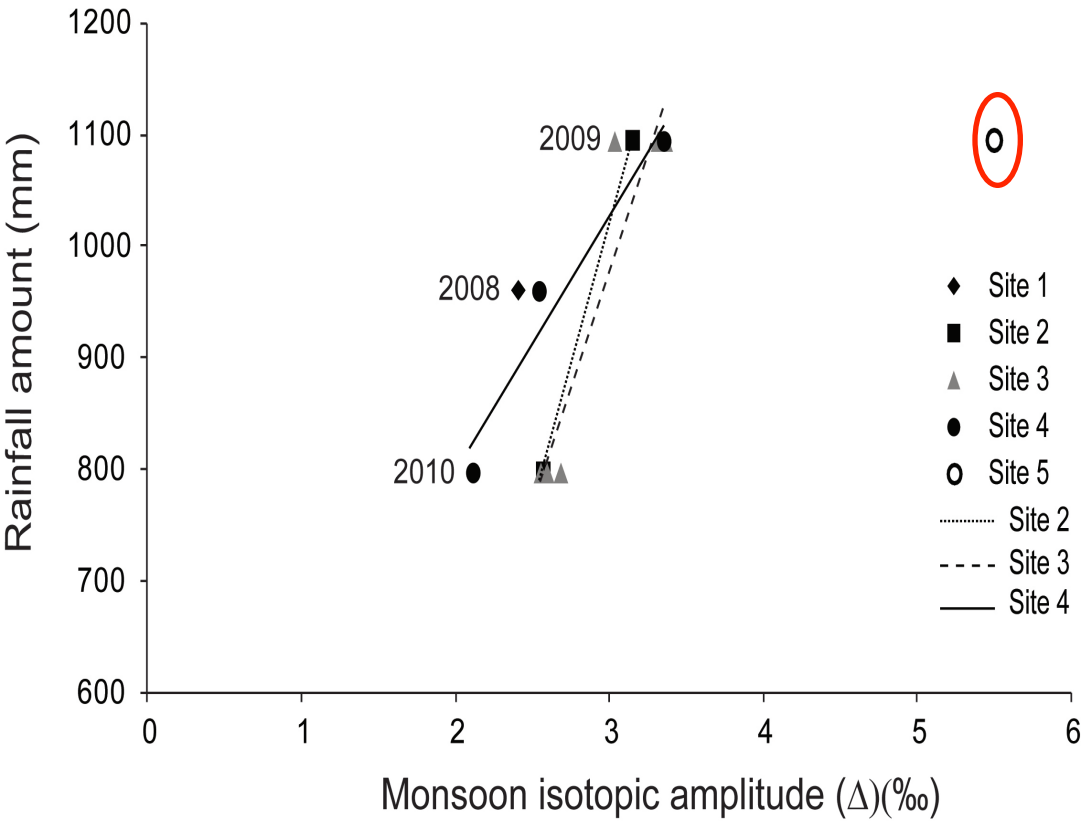
Parameter 1: Monsoon duration

Parameter 2: monsoon isotopic amplitude (**Δ1, Δ2)**

Modern shells



Modern shells



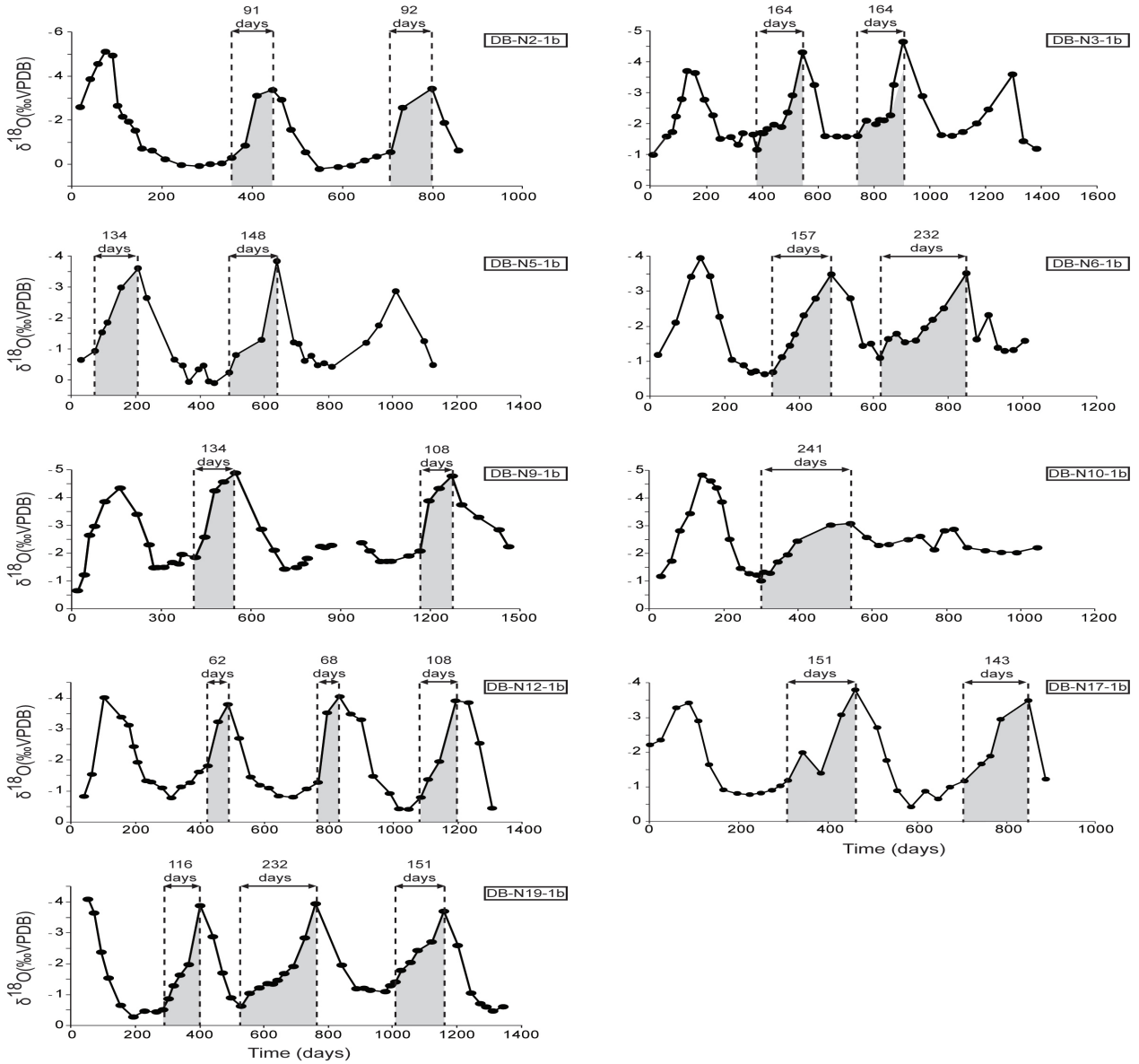
Monsoon isotopic amplitudes (Δ) seem to be related to rainfall amounts

New insights for rainfall amounts reconstructions

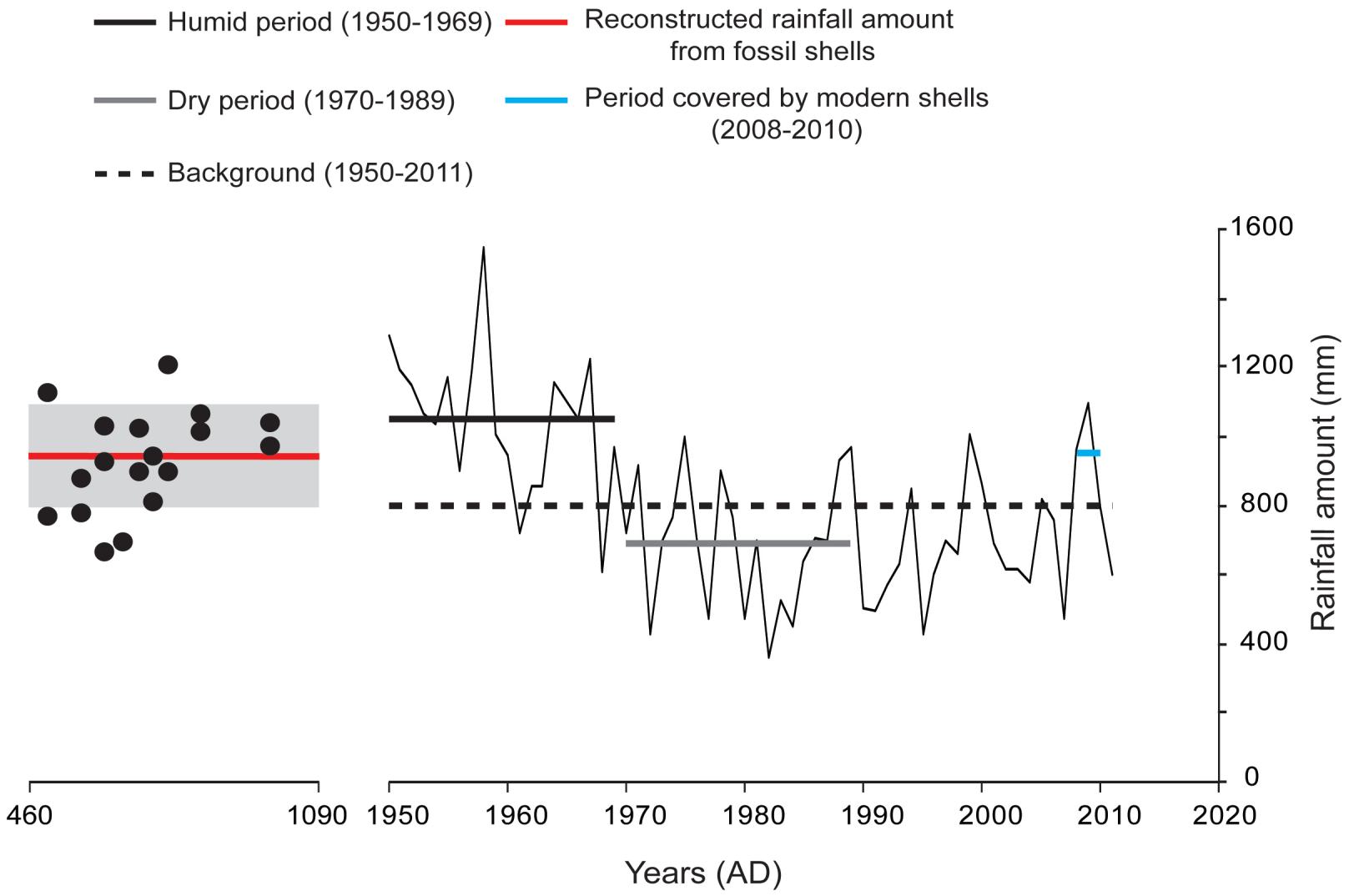
Stronger Δ upstream, probably due to decrease in marine influence

Only Δ for Site 3 and 4 will be taken into account when compared to fossil Δ

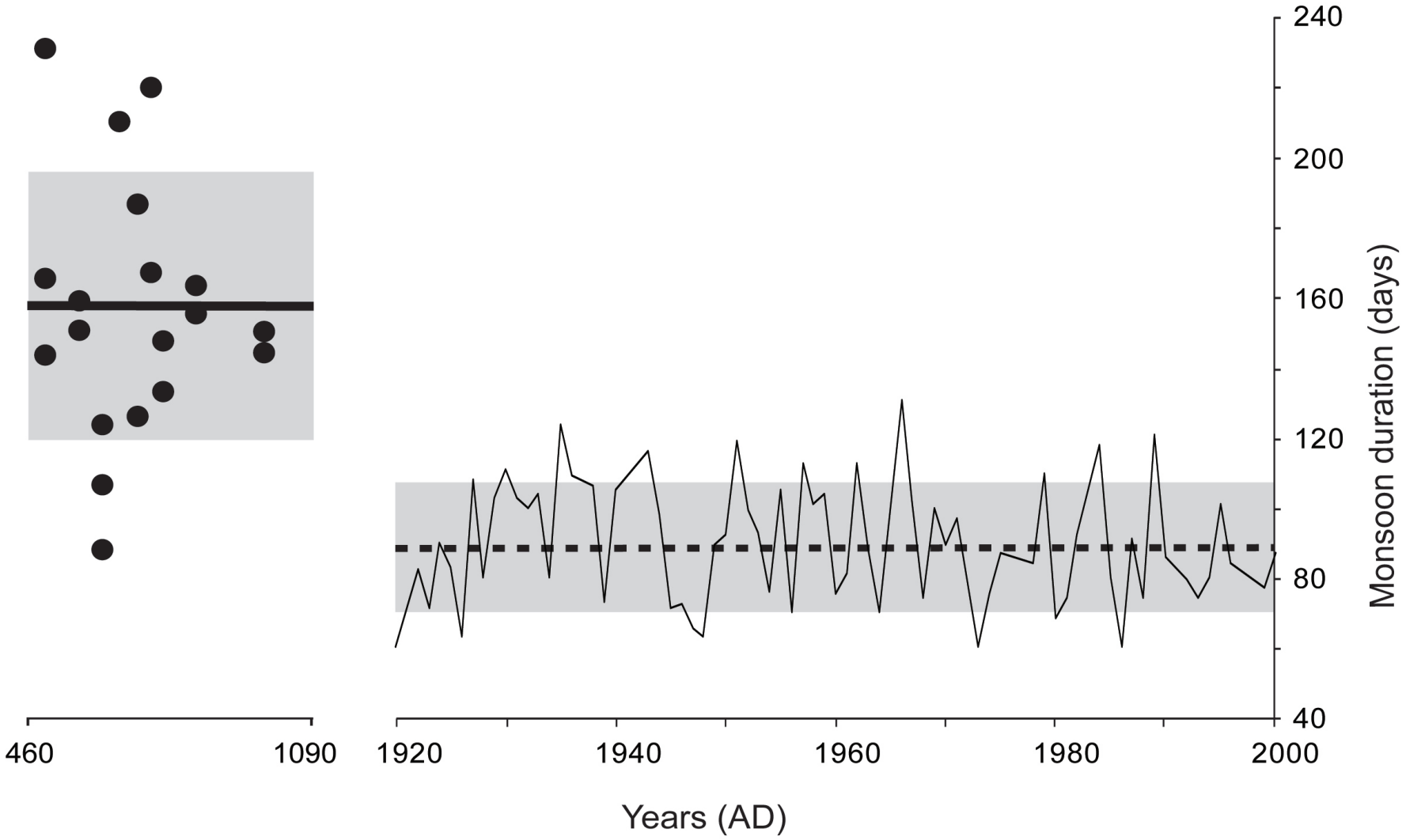
Fossil shells



Rainfall amounts



Monsoon duration



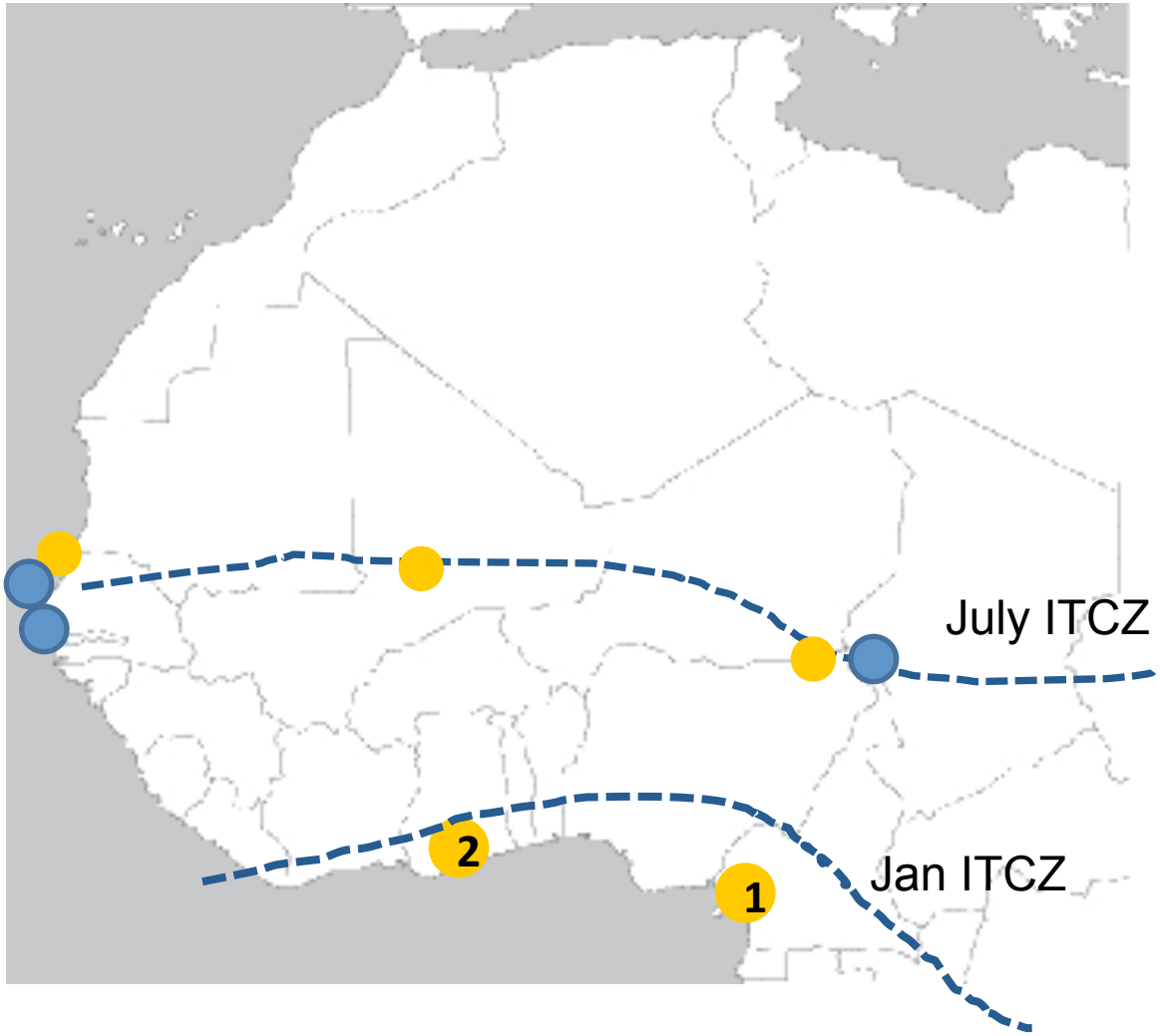
Regional pattern of the WAM From AD460 to 1090

Dryness Wetness

The DACP

1. Lake Ossa, Cameroon (*Nguetsop et al., 2004).*
2. Bosumtwi lake, Ghana (*Shanahan et al., 2009).*
3. Lake Tchad, Tchad (Maley and Vernet, 2012).
4. Kajemarum Oasis, Nigeria (Holmes et al.,1998).
5. Dune field, Mali (Stokes et al., 2004).
6. Senegal river, Senegal (Bouimetarhan et al., 2009)
7. Senegal river, Senegal (Nizou et al., 2011).
8. This study.

Discrepancies between proxy records: very complex WAM patterns.



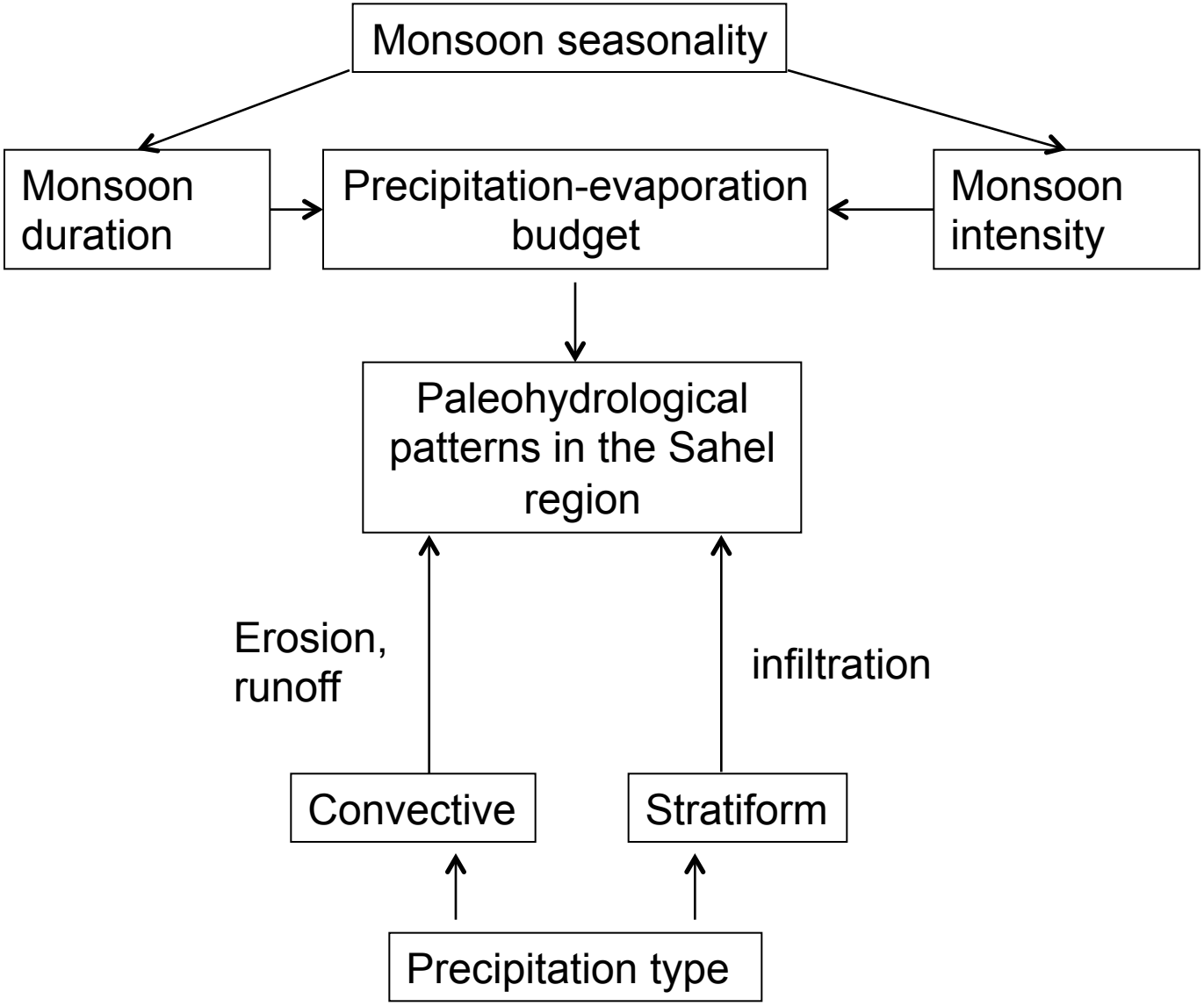
Acknowledgments

We wish to acknowledge the support that was provided to the Saloum Project:

- Conseil scientifique de l'université Montpellier 2
- INSU, programme LEFE-EVE

Thanks

Complex interpretation of paleohydrological patterns

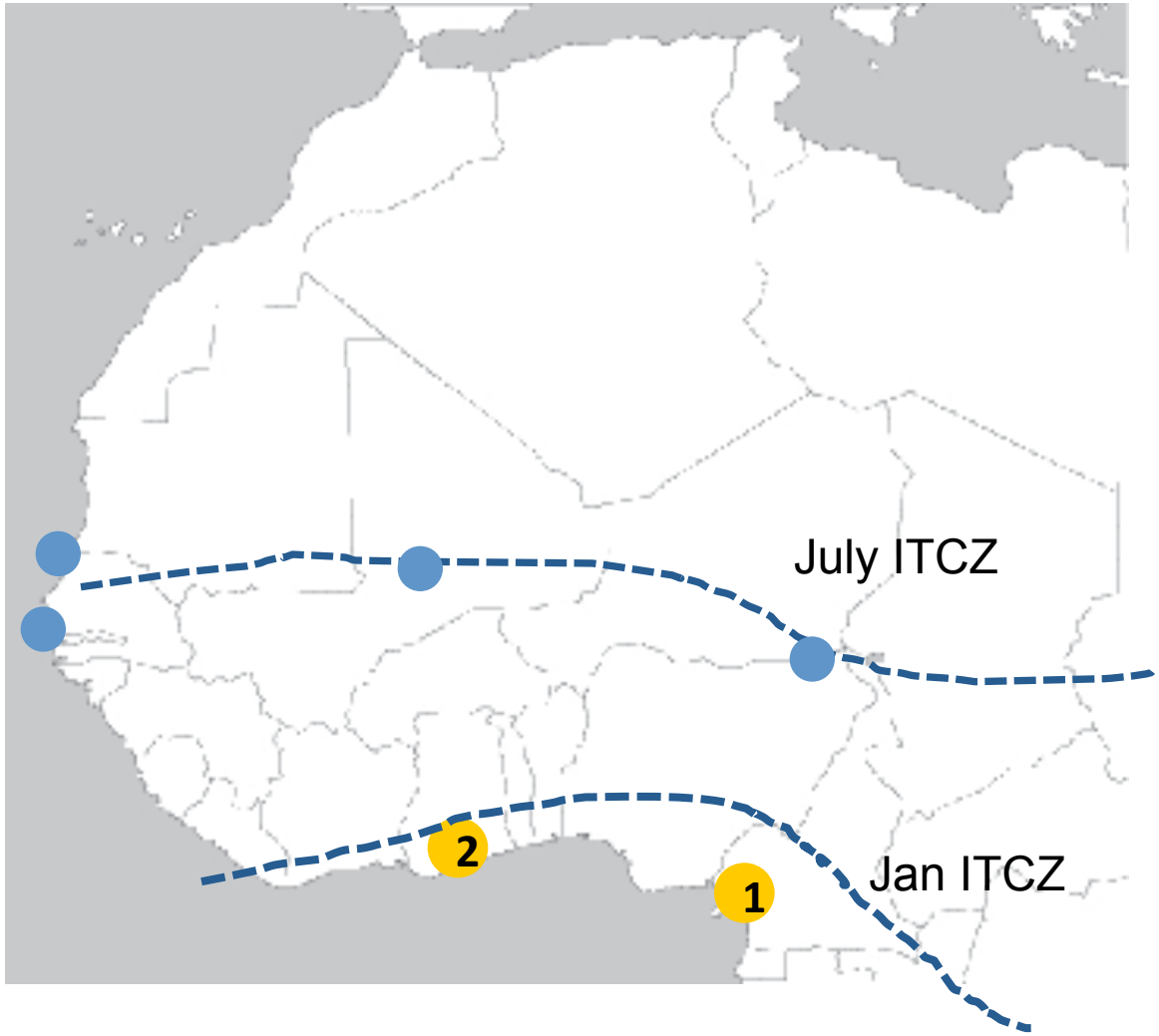


Regional pattern of the WAM From AD460 to 1090

Dryness Wetness

The MWP

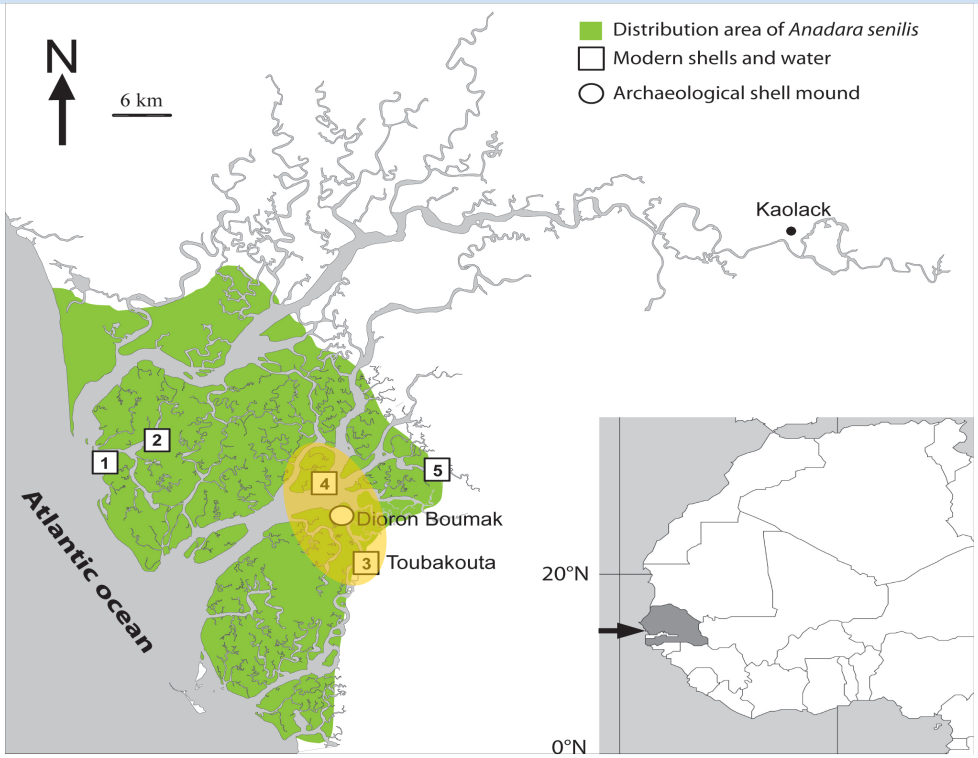
1. Lake Ossa, Cameroon (*Nguetsop et al., 2004).*
2. Bosumtwi lake, Ghana (*Shanahan et al., 2009).*
3. Bal lake, Nigeria (Holmes et al., 1999).
4. Dune field, Mali (Stokes et al., 2004).
5. Senegal river, senegal (Nizou et al., 2011).
6. This study.

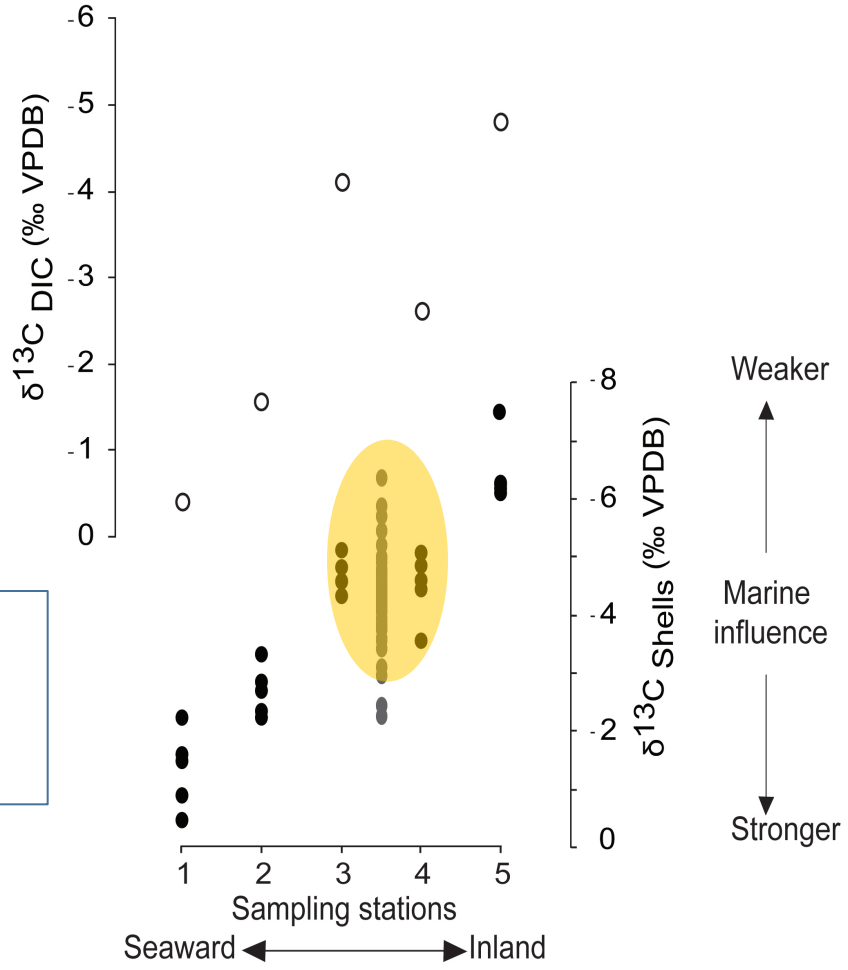


Wettening period during the MWP in the Sahel: might have been caused by northward shift of the ITCZ.

Modern hydrology

Spatial gradients



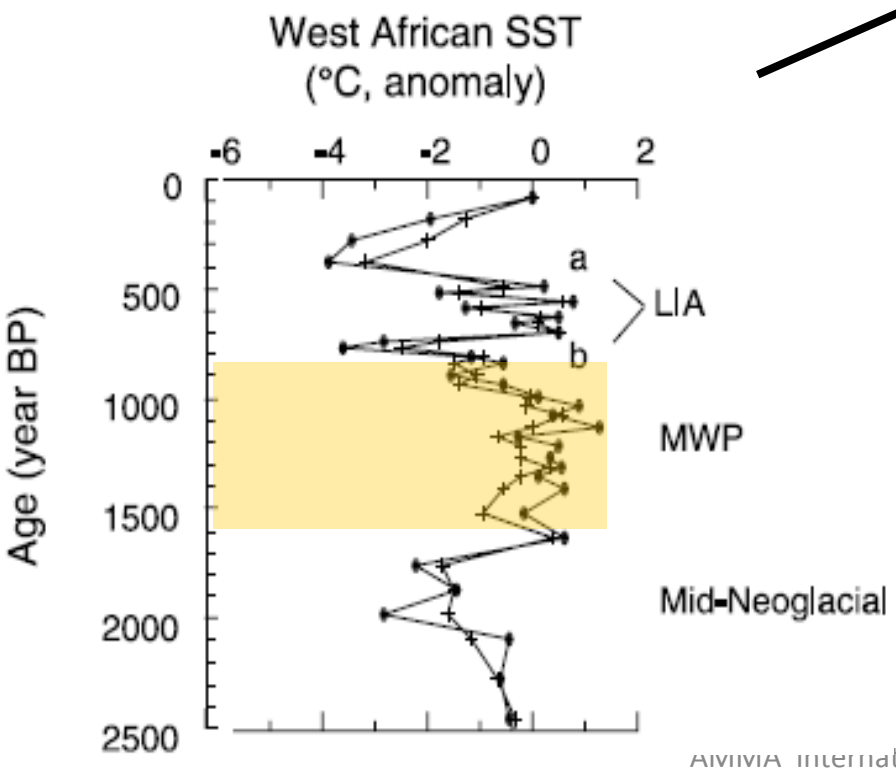


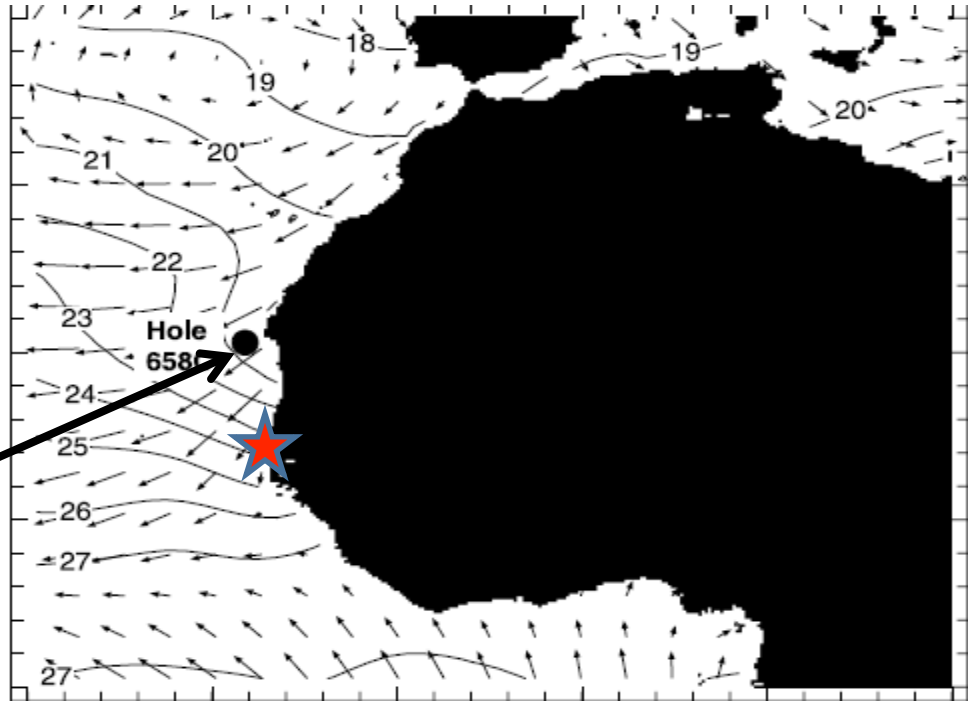
Fossil shells were collected in the immediate vicinity of the shell mound

Paleo-temperatures in the West African Coast

The temperature can not explain the depletion in ^{18}O observed in fossil $\delta^{18}O_{shells}$

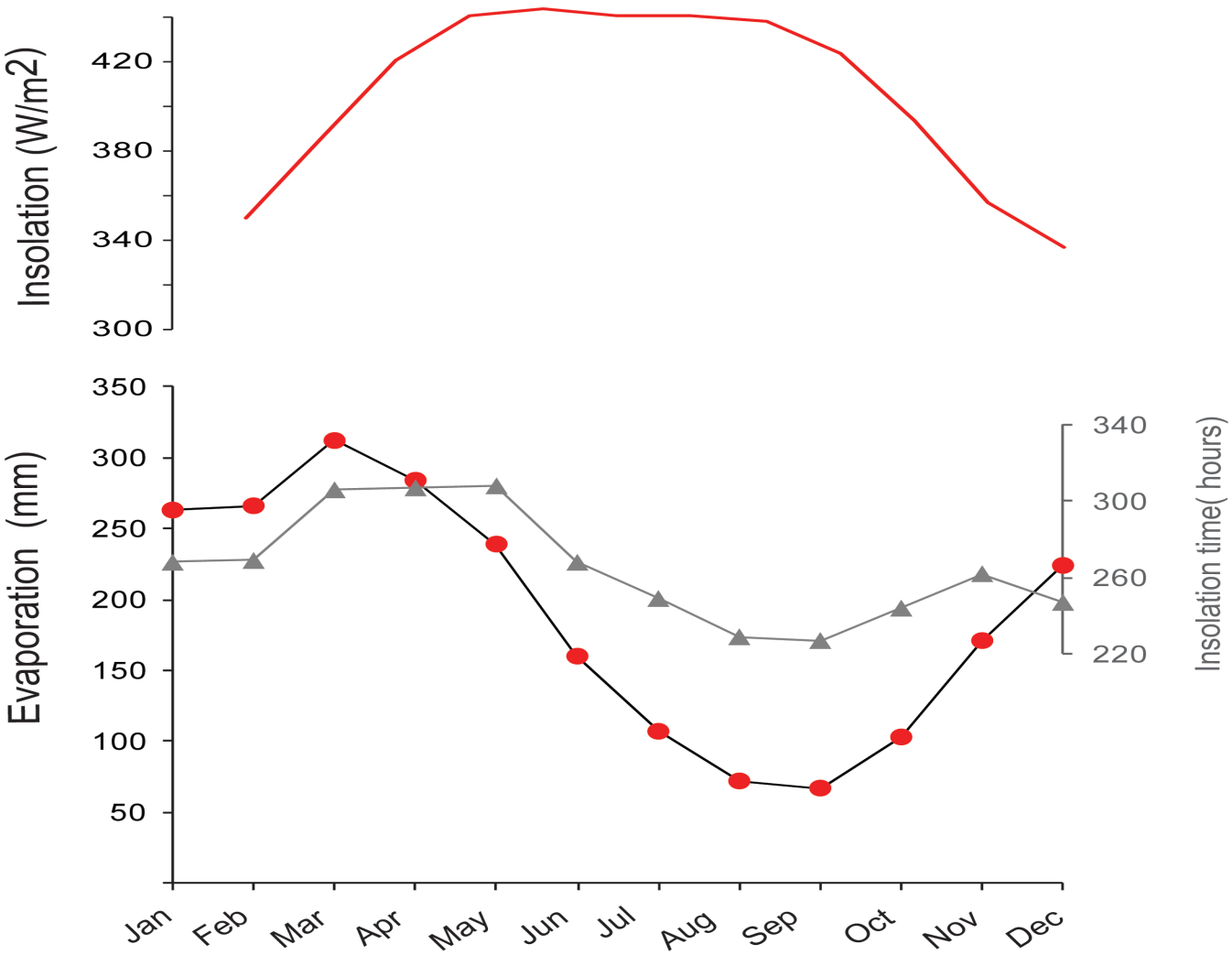
T°C anomaly < 1°C





deMenocal et al., 2000

The Salum Estuary location


Insolation (W/m2)
420
380
340
300
Evaporation (mm)
350
300
250
200
150
100
50
340
300
260
220
Insolation time(hours)
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Nizou et al., 2010