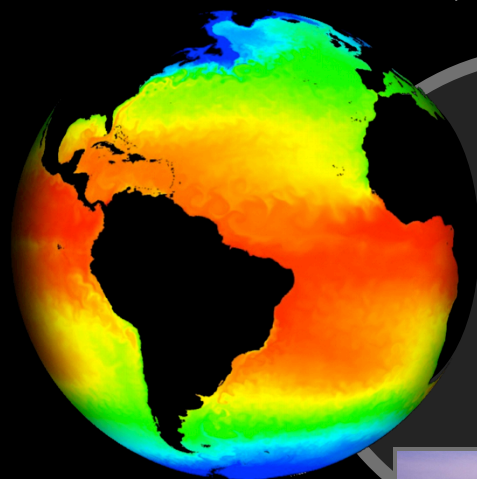




Low-frequency Sahel rainfall variability and Atlantic Sea Surface Temperatures during the last century

**DIEPPOIS B., DURAND A., FOURNIER M., DIEDHIOU A.,
FONTAINE B., MASSEI N., NOUACEUR Z., SEBAG D.**



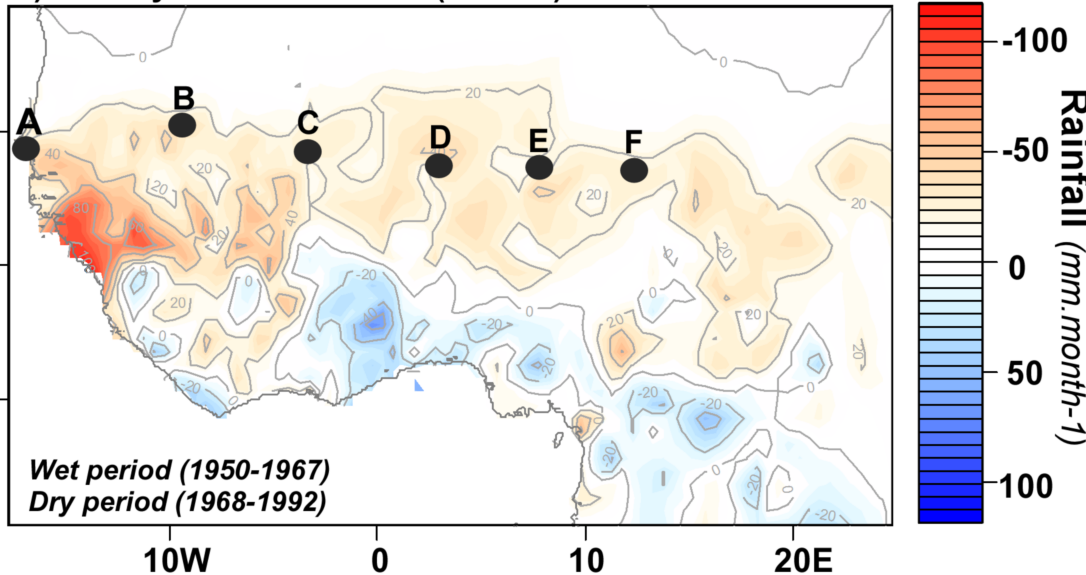
4th AMMA international conference, Toulouse 2012

Severe droughts since the late 1960's

Rainfall deficit

Reduction of
vegetation cover

a) wet-dry difference fields (MJJAS)



SST forcing dominant driver of
West-African rainfall variability

(Folland et al., 1986; Palmer, 1986; Rowell et al., 1992;
Giannini et al., 2003; Lu and Delworth, 2005)

1977 Manga december



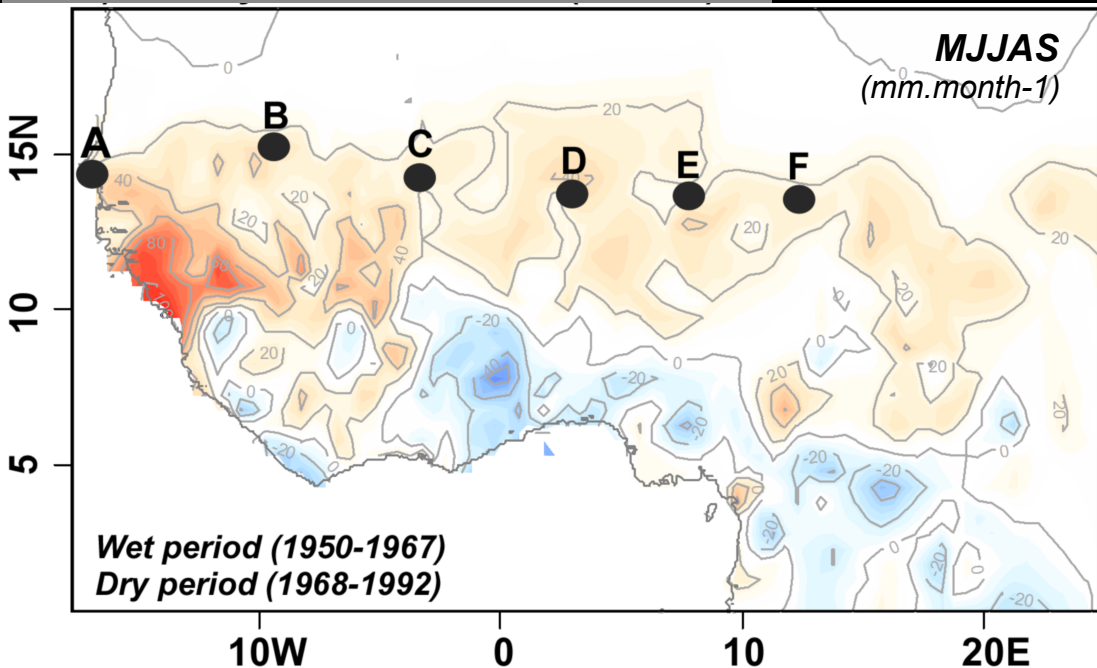
2002 Manga december



Time/space variabilities of Sahel rainfall

Specific scales of variability??

A: Dakar; B: Nioro du Sahel; C: Mopti;
D: Niamey; E: Maradi; F: Maine-Soroa



(1) Sahel rainfall variability

(2) Atlantic-SST teleconnections

Local

Six rainfall stations

GHCN-2

Regional

West-African rainfall fields

CRU TS-3.1

Global

Atlantic SST GRID

Selected area

60°S-70°N ; 65°W-30°E

ERSST-V3b

key Atlantic-SST
indices

AMO

25-60°N ; 7-70°W

TSA

0°-20°S ; 10°E-30°W

Rainfall analysis

Continuous Wavelet transform

Rainfall variability modes

Time/frequency variations

Power Hovmöller & Mapping

Spatial distribution

**Variability modes
= climate typical states**

Teleconnection stability (*Time/
frequency*)

Coherence & phase Hovmöller

Common oscillation & time-lag

Pre-processing

Fast Fourier Filter

- multi-decadal (>20ans)
- quasi-decadal (10-20yr)

Atlantic-SST Teleconnections

Composite analysis

Typical states of Atlantic-SST

**Sahel rainfall/Atlantic SST
teleconnections vary in time**

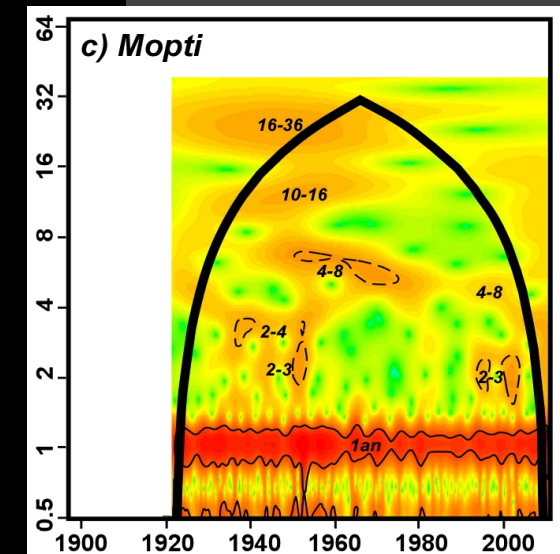
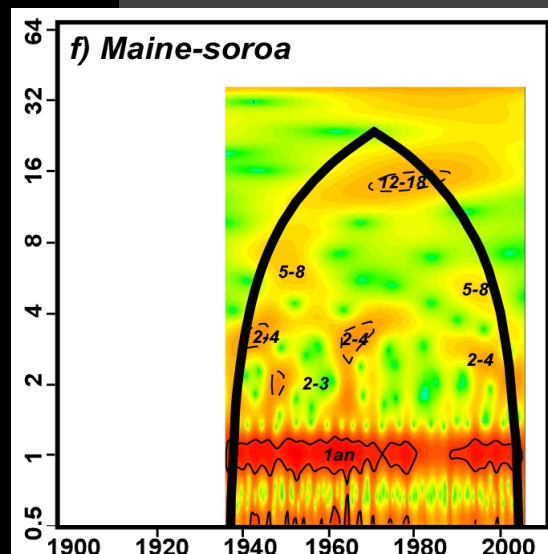
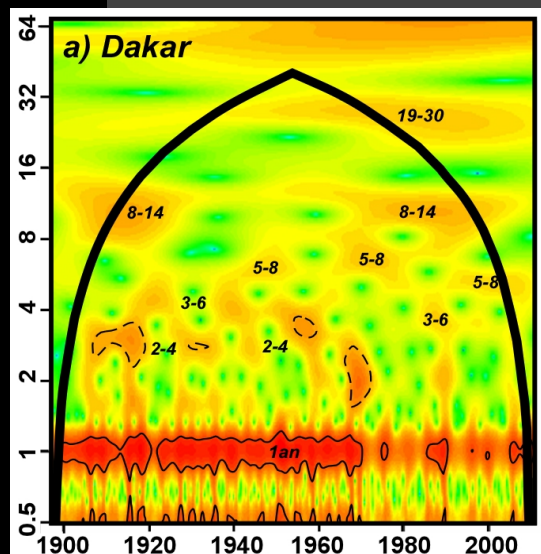
(1) Multi- and quasi-decadal
during dry years

(2) Overall low-frequency
variability during wet years

(A)
Atlantic Coast
(Dakar)

(B)
Eastern Sahel
(Niamey-Maradi-Maïné)

(C)
Central Sahel
(Nioro-Mopti)



Three coherent regions of Sahel rainfall variability

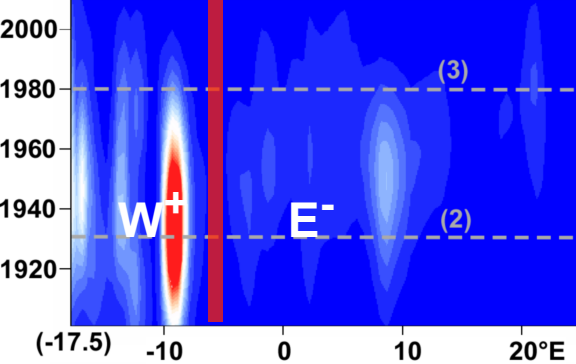
Rainfall analysis

Relationship with Atlantic-SST

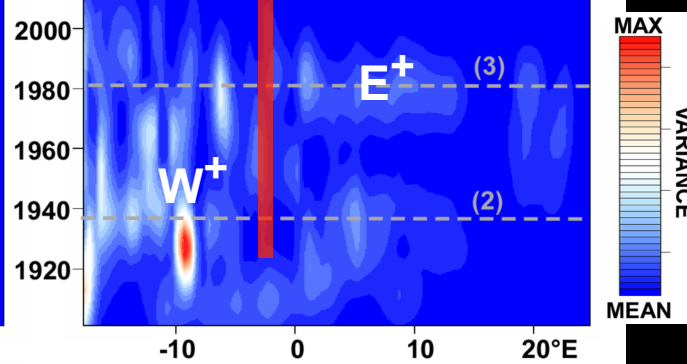
Teleconnection stability

Conclusion/Perspective

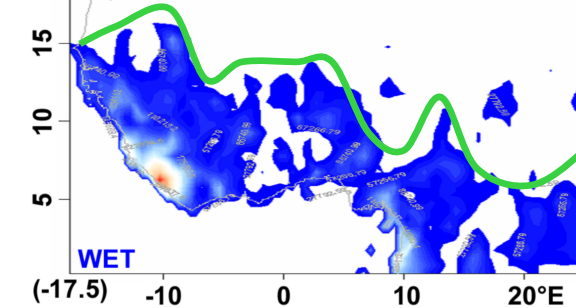
a.1) Multi-decadal power Hovmöller (14-15°N)



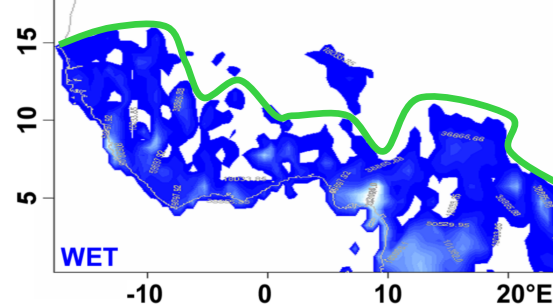
b.1) Quasi-decadal power Hovmöller (14-15°N)



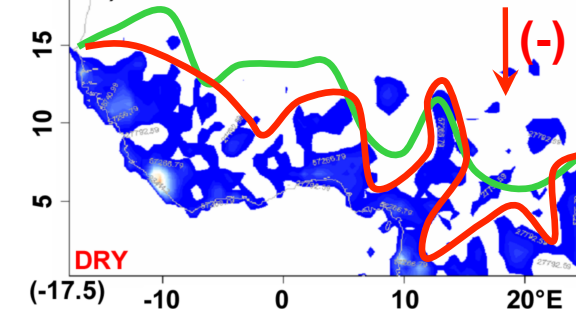
a.2) Multi-decadal variance in 1931



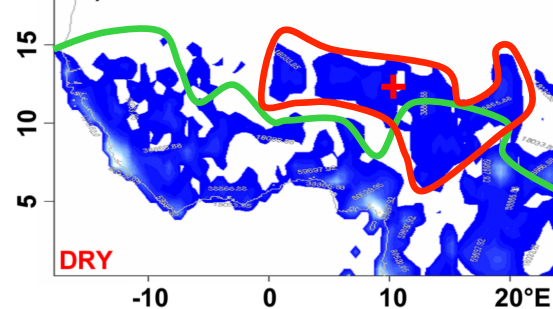
b.2) Quasi-decadal variance in 1938



a.3) Multi-decadal variance in 1980



b.3) Quasi-decadal variance in 1980



Atlantic coast rainfall area is not evident

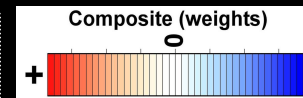
Power Hovmöller (14-15°N)



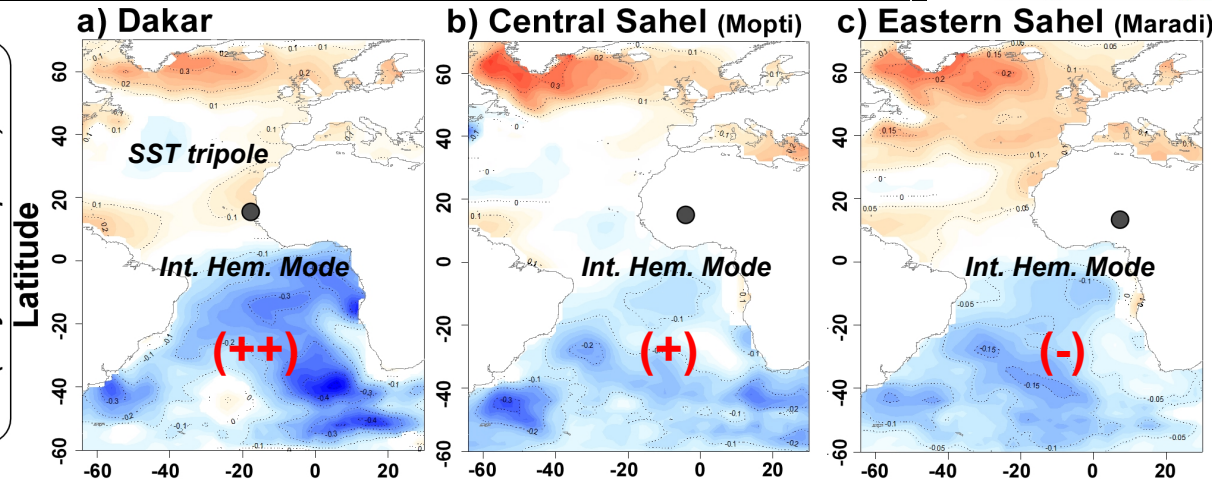
Limits between central (western) and eastern sahel are not constant in space, time and frequency

(1) Several states of Atlantic-SST associated to various scales of variability

Composite maps rainfalls/ Atlantic-SST
(significant level – 95%)



(1) Multidecadal
(20yrs low pass)

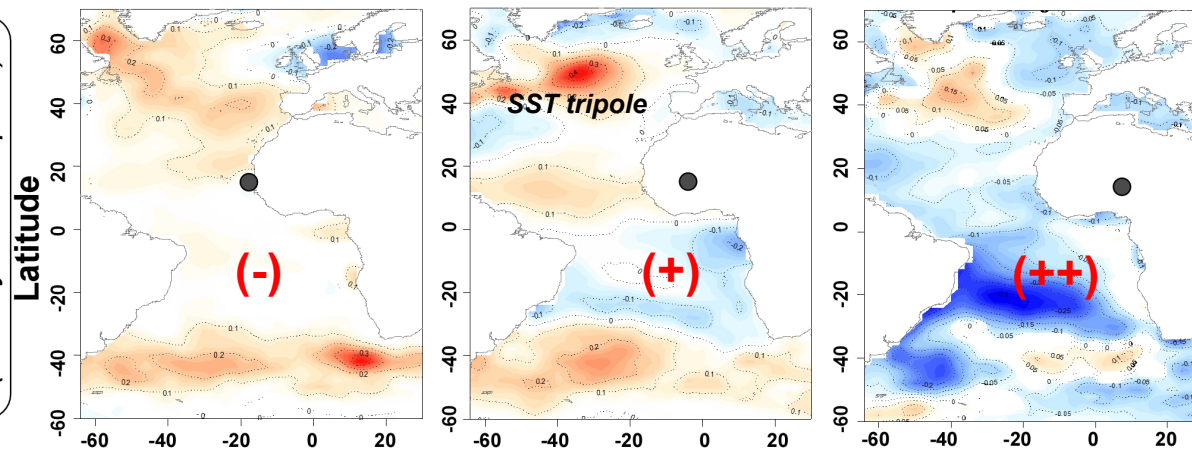


(2)

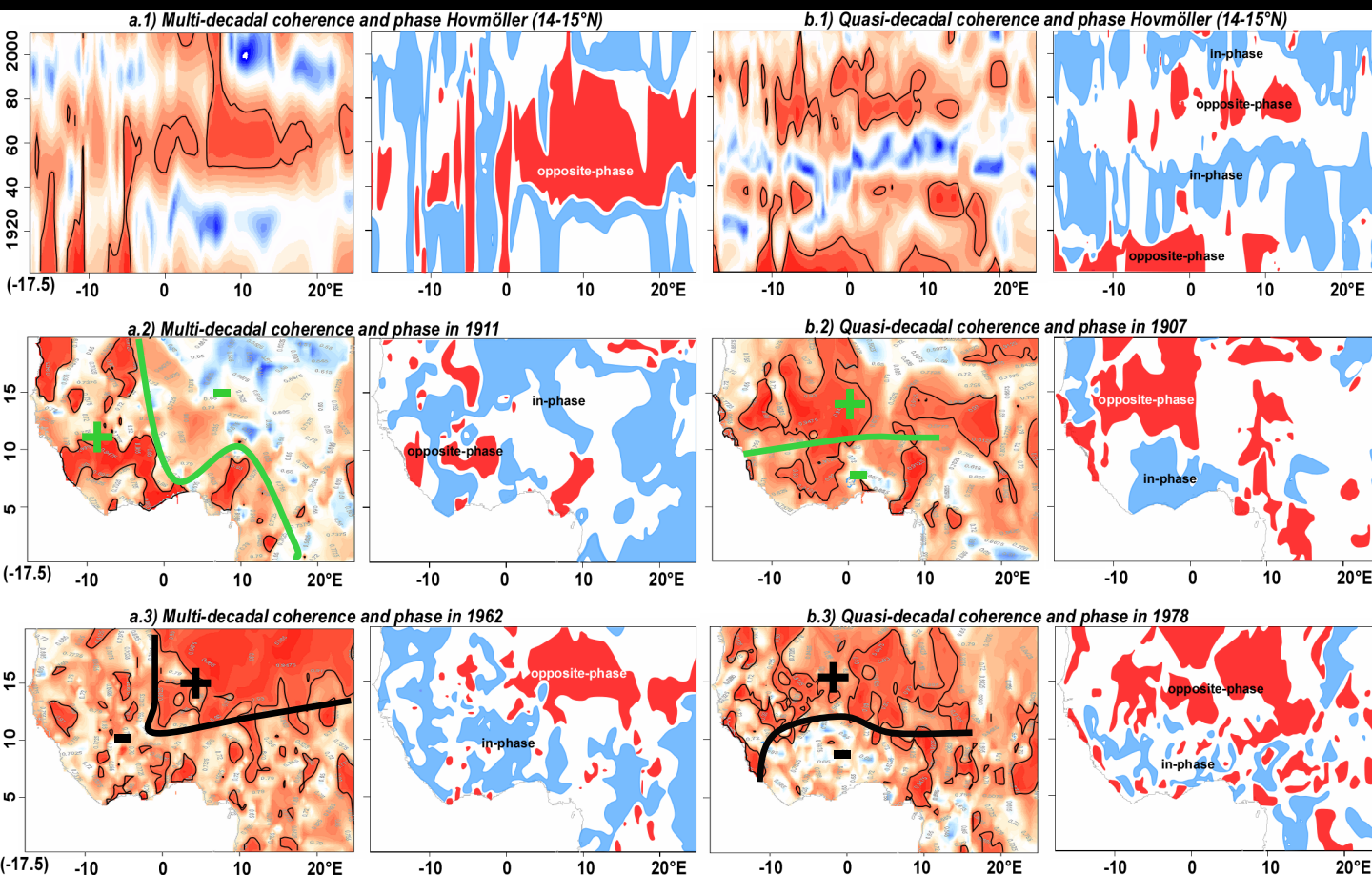
Zonal contrast

Respective weight of
N. and S. Atlantic-SST

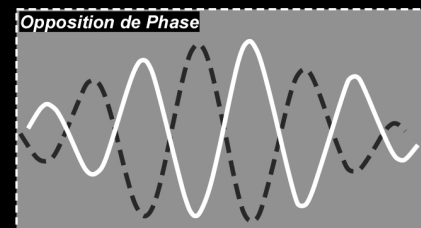
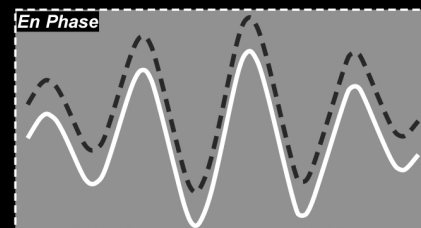
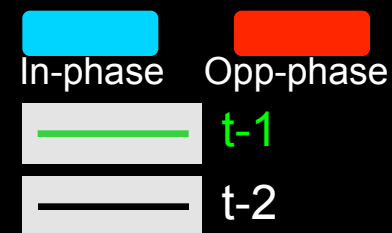
(2) Quasi-decadal
(10-20yrs band-pass)



Rainfall-TSA teleconnection is varied in time/space



Coherence & Phase Hovmöller (14-15°N)



Before 50's

Opp-phase

W

Multi- & quasi-decadal
(up to 0/3°E)

After 50's

Opp-phase

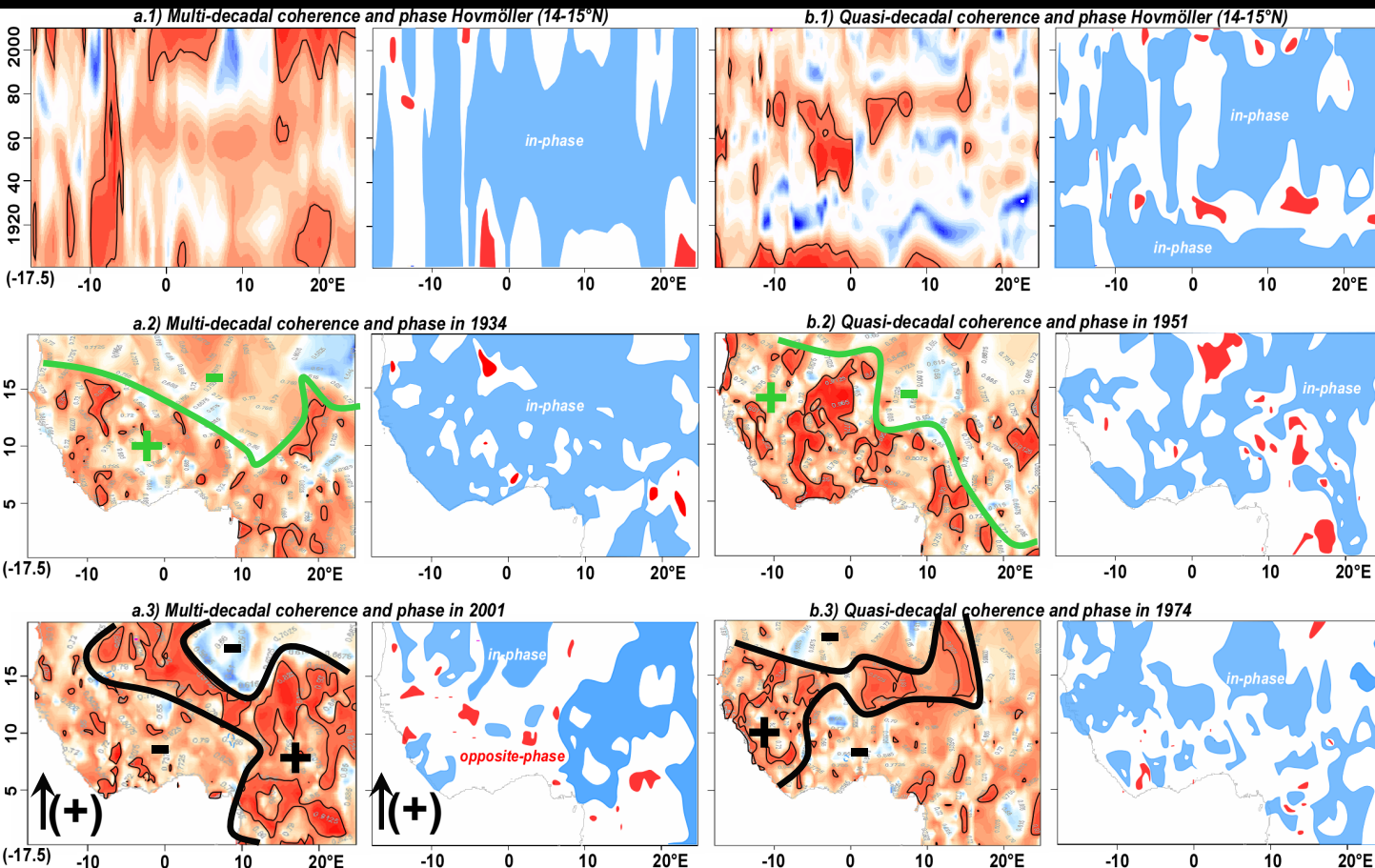
Multi- & quasi-decadal

E

(+)

N. Opp-phase
S. In-phase

Rainfall-AMO teleconnection across multi- & quasi-decadal scales



In-phase
(lag~0)

Coherence & Phase
Hovmöller (14-15°N)



AMO contributed to the W.Sahel rainfall
variability (up to long. 6°W/2°E)

(1) LF variability of Sahel Rainfall

Three coherent regional variabilities of Sahel rainfall
Atlantic Coast – Central (Western) Sahel – Eastern Sahel

Limits between Western and Eastern Sahel are not constant in space, time and frequency

(2) Atlantic SST-Sahel rainfall Teleconnections

Inter-hemispheric mode is rarely observed

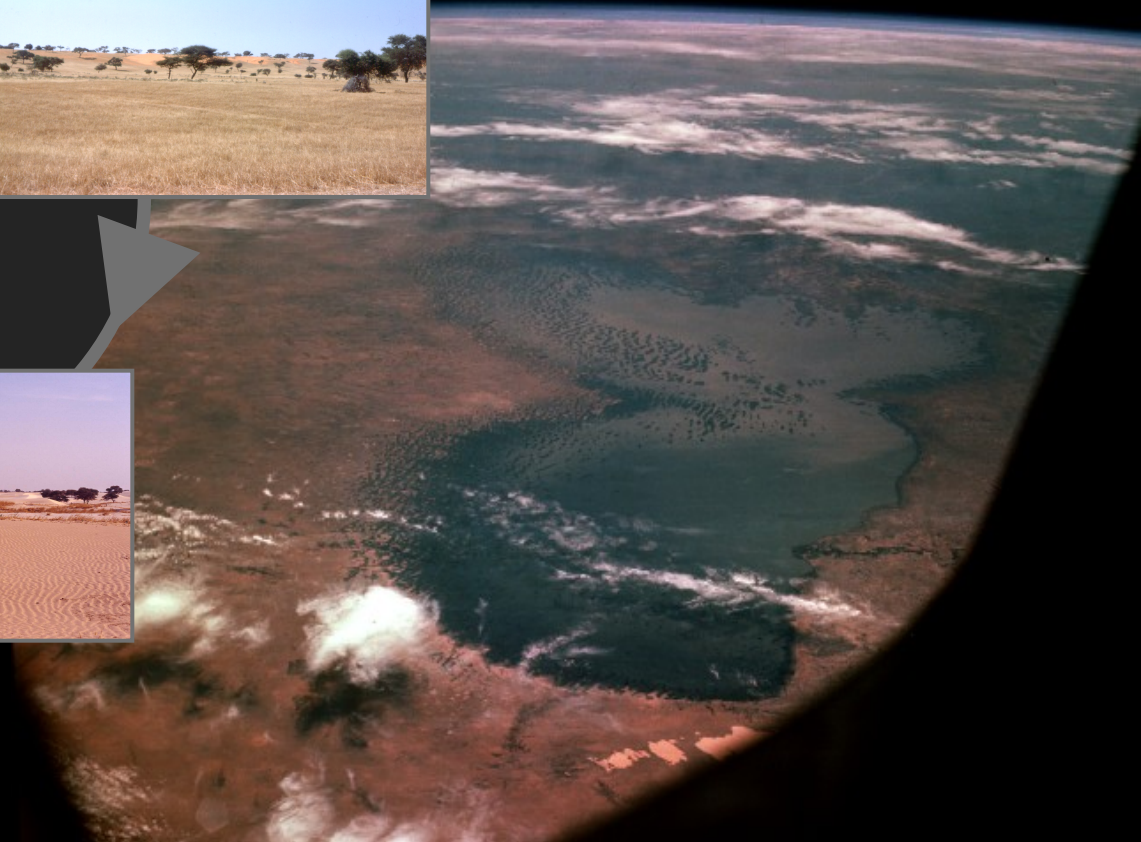
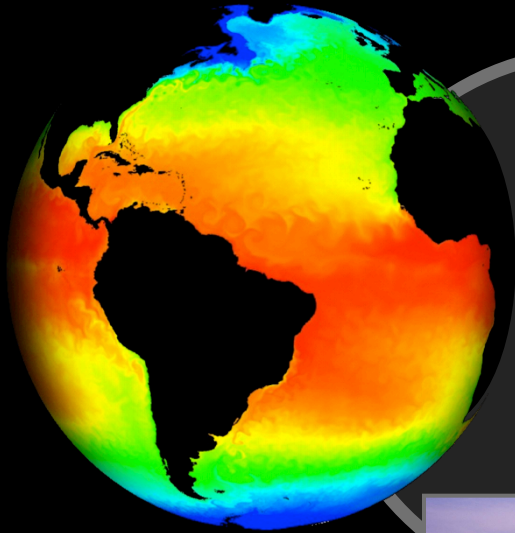
Warmer North Atlantic
+ W. Sahel rainfall

Multi- and quasi-decadal

Cooler Tropical South Atlantic
+ W. or E. Sahel rainfall

All scale of variability

Thank you for your attention



Contact :
bastien DIEPPOIS
University of Rouen
UMR CNRS 6143, M2C Laboratory,
Place E.Blondel, 76821 Mont-Saint-Aignan
phone. : 0033-(0)2.35.14.69.48
0033-(0)6.85.69.63.85
Mail : bastien.dieppois@univ-rouen.fr

4th AMMA international conférence
“Monsoon System : Climate II”



Toulouse, 02/07/2012