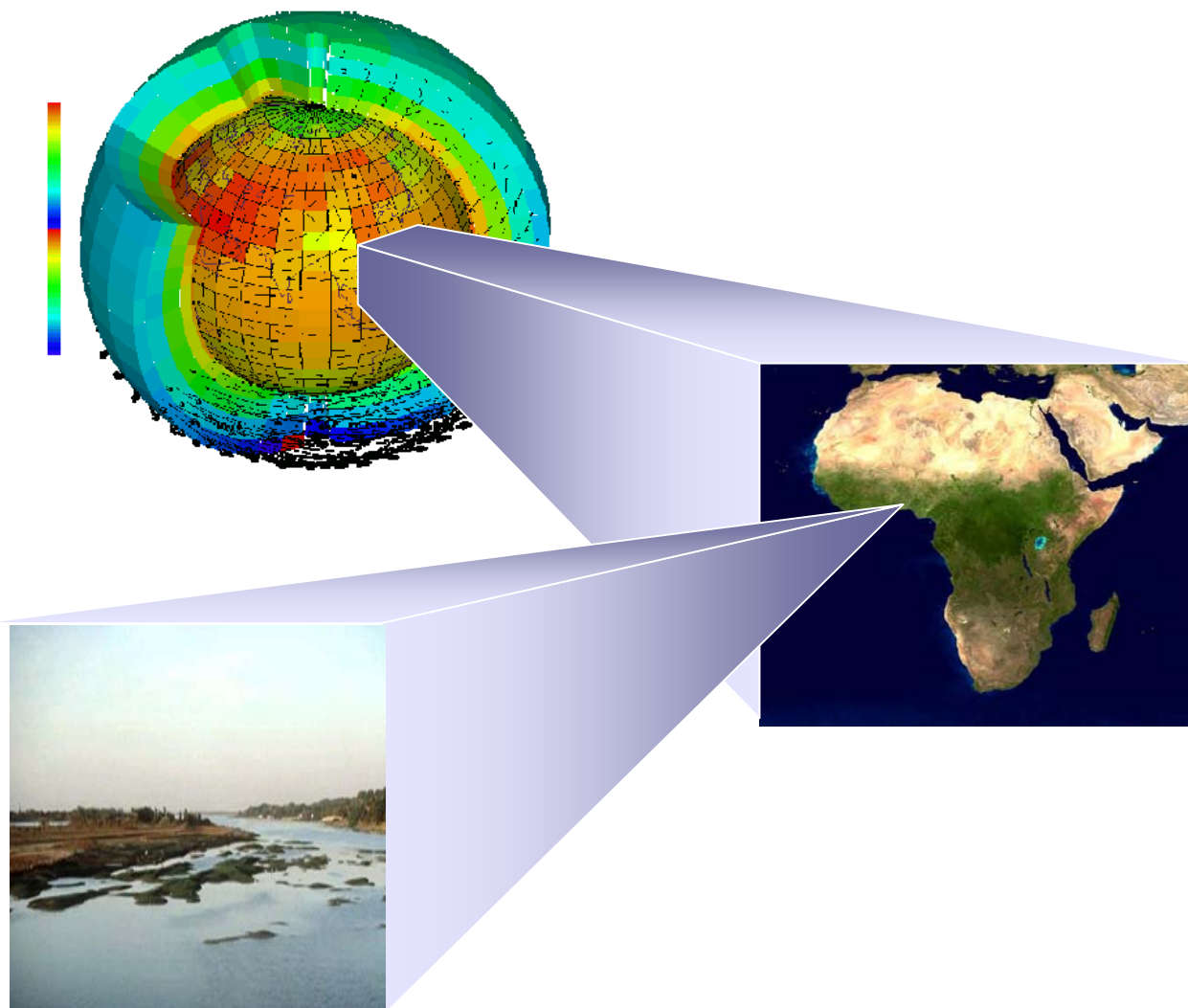




Impact of the Sahel drought on the Water Balance in LSMs

T. d'Orgeval, J. Polcher, P. de Rosnay, T. Ngo-Duc

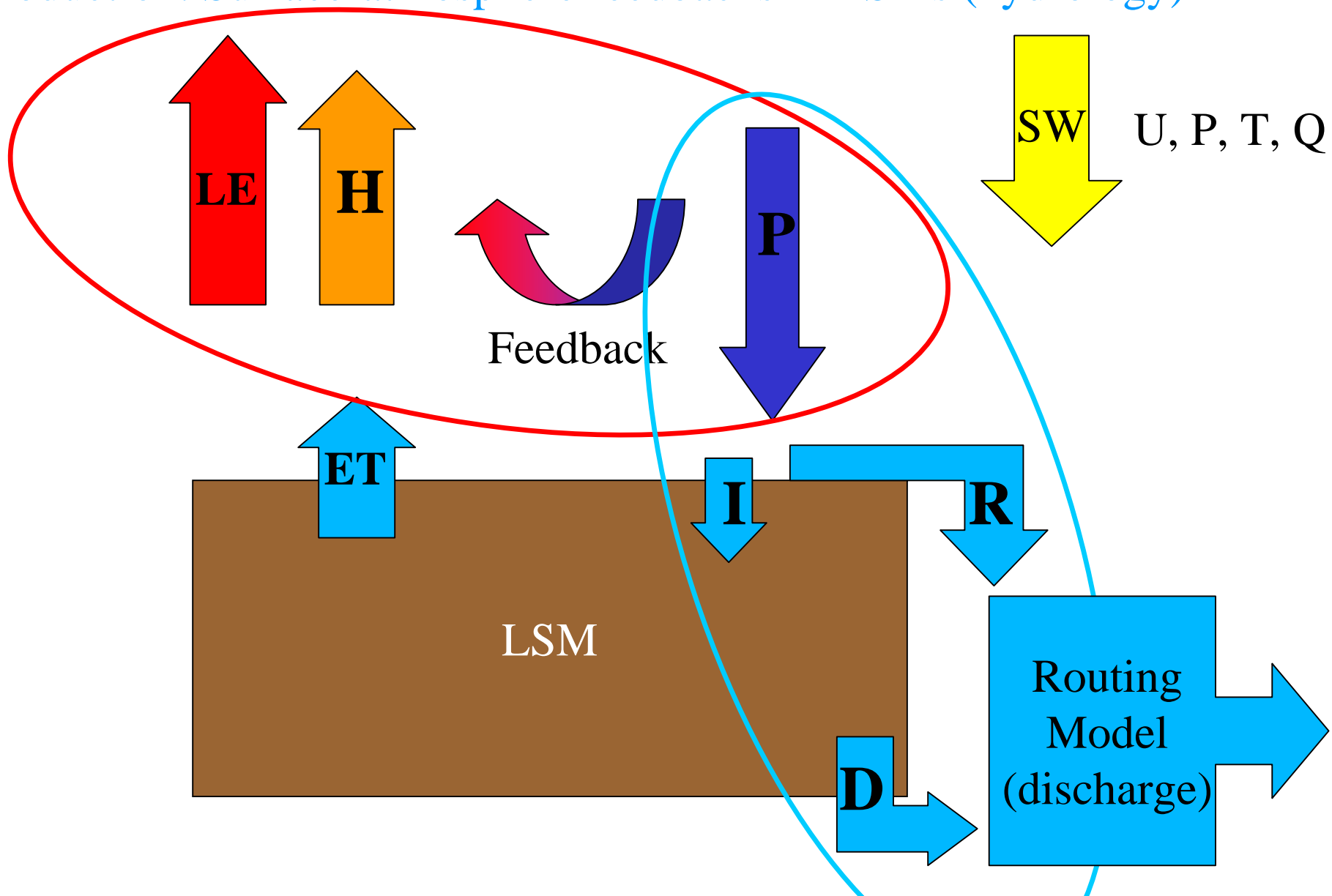




Impact of the Sahel drought on the Water Balance in LSMs



Introduction: Surface-atmosphere feedbacks in LSMs (hydrology)





Outline

Impact of the Sahel drought on the water balance in LSMs

Introduction

- I. Spread in the surface feedbacks between different LSMs
- II. Impact of the representation of rootzone soil-moisture in ORCHIDEE at the local scale
- III. Validation at the regional scale: influence on large river discharge simulation

Conclusion

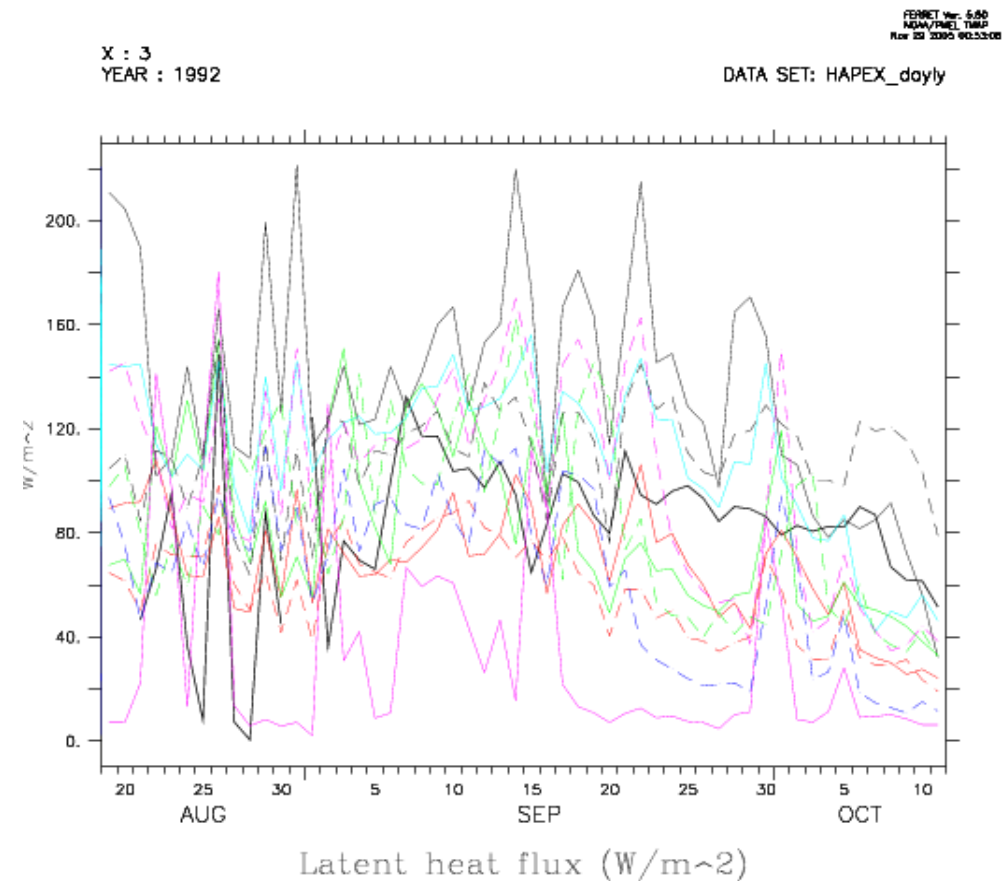
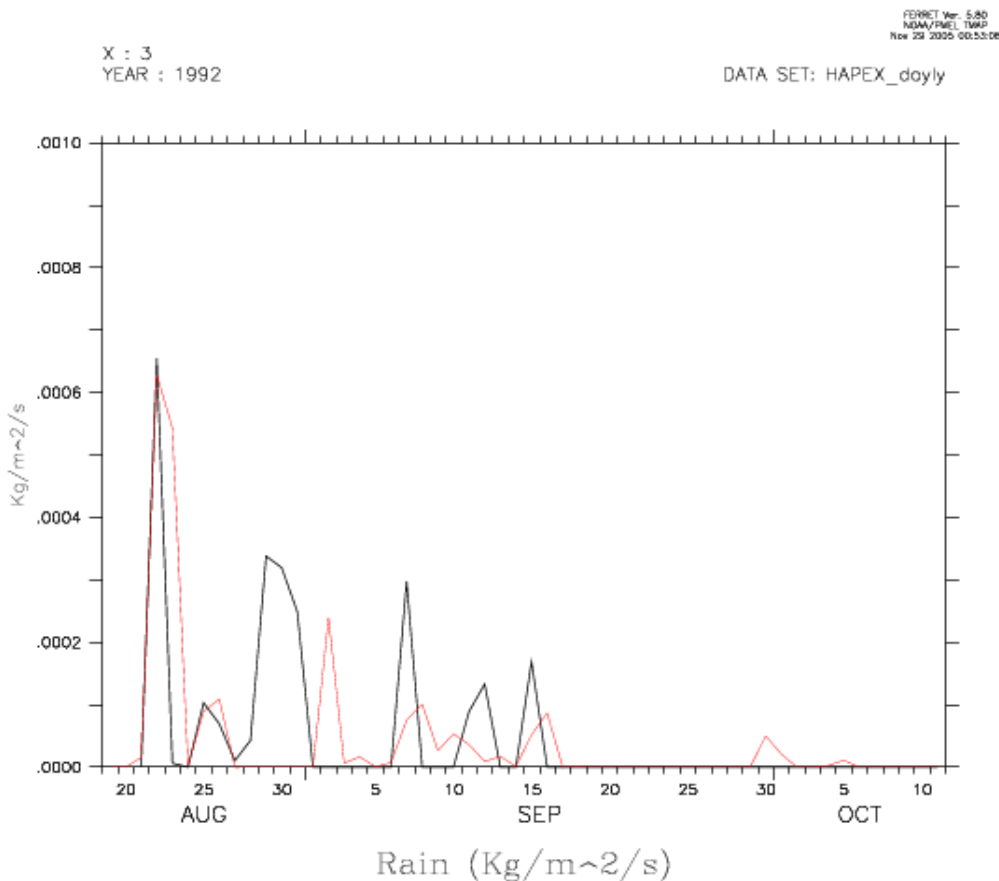


Outline

Impact of the Sahel drought on the water balance in LSMs

Introduction

I. Spread in the surface feedbacks between different LSMs



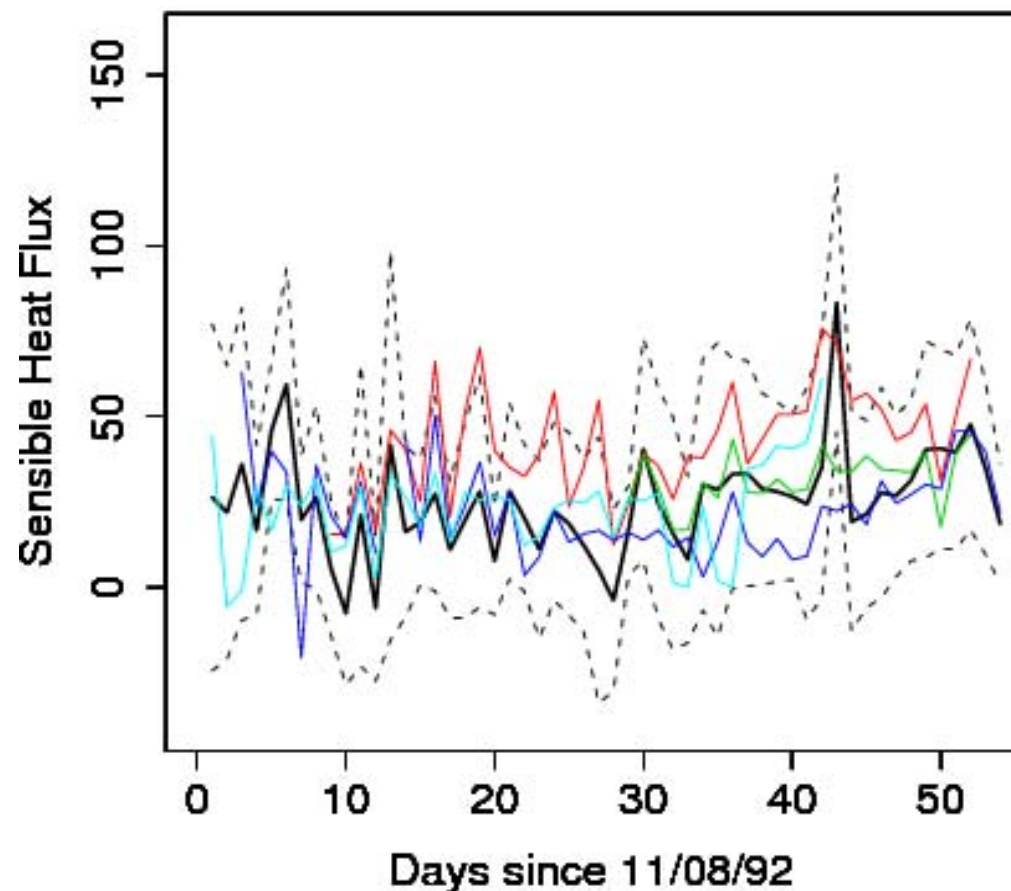
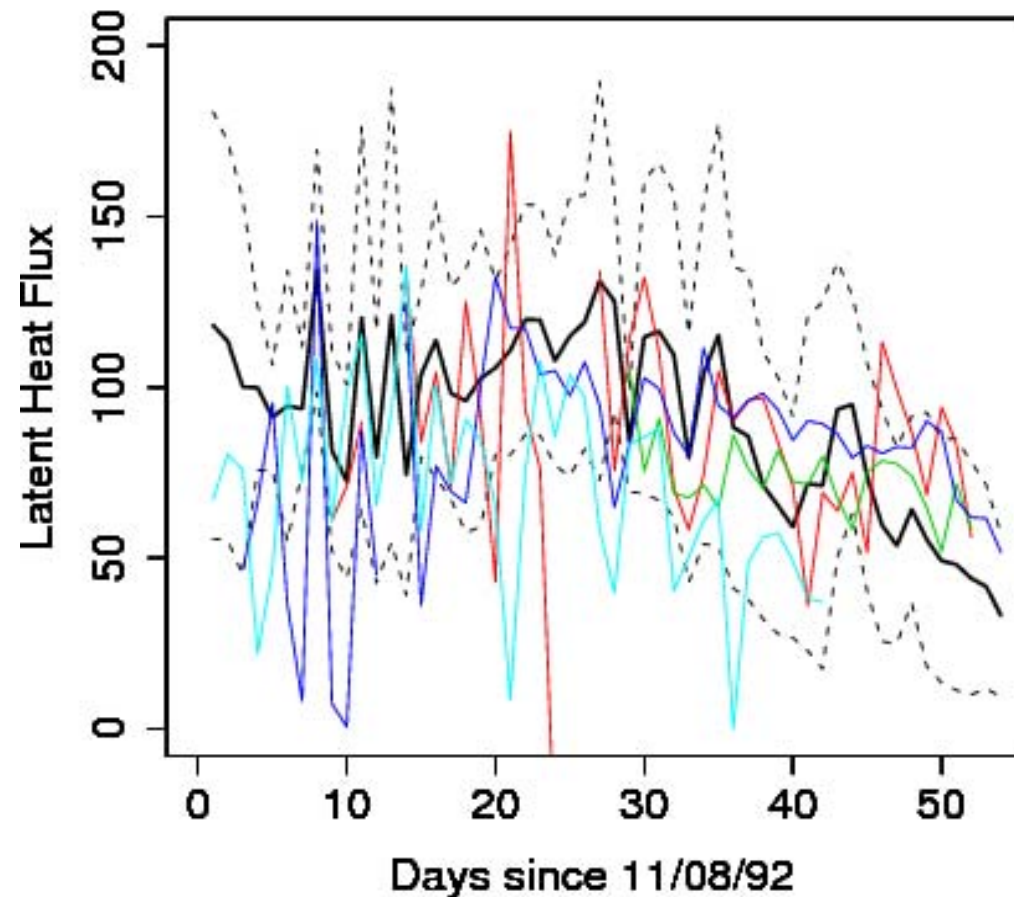
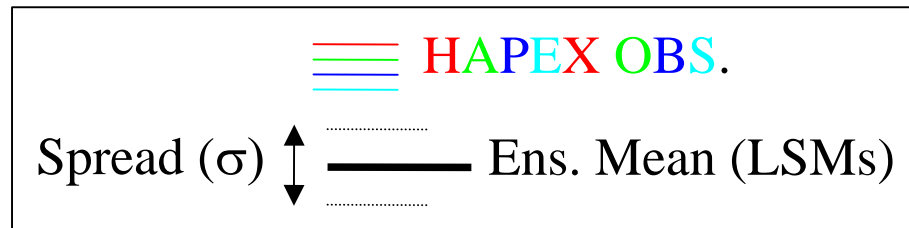
GSWP2: 12 models forced by ISLSCP2 (1986-1995)



Surface feedbacks in different LSMs

Comparison between simulated (mean \pm std. dev.) and observed (4 st.) fluxes

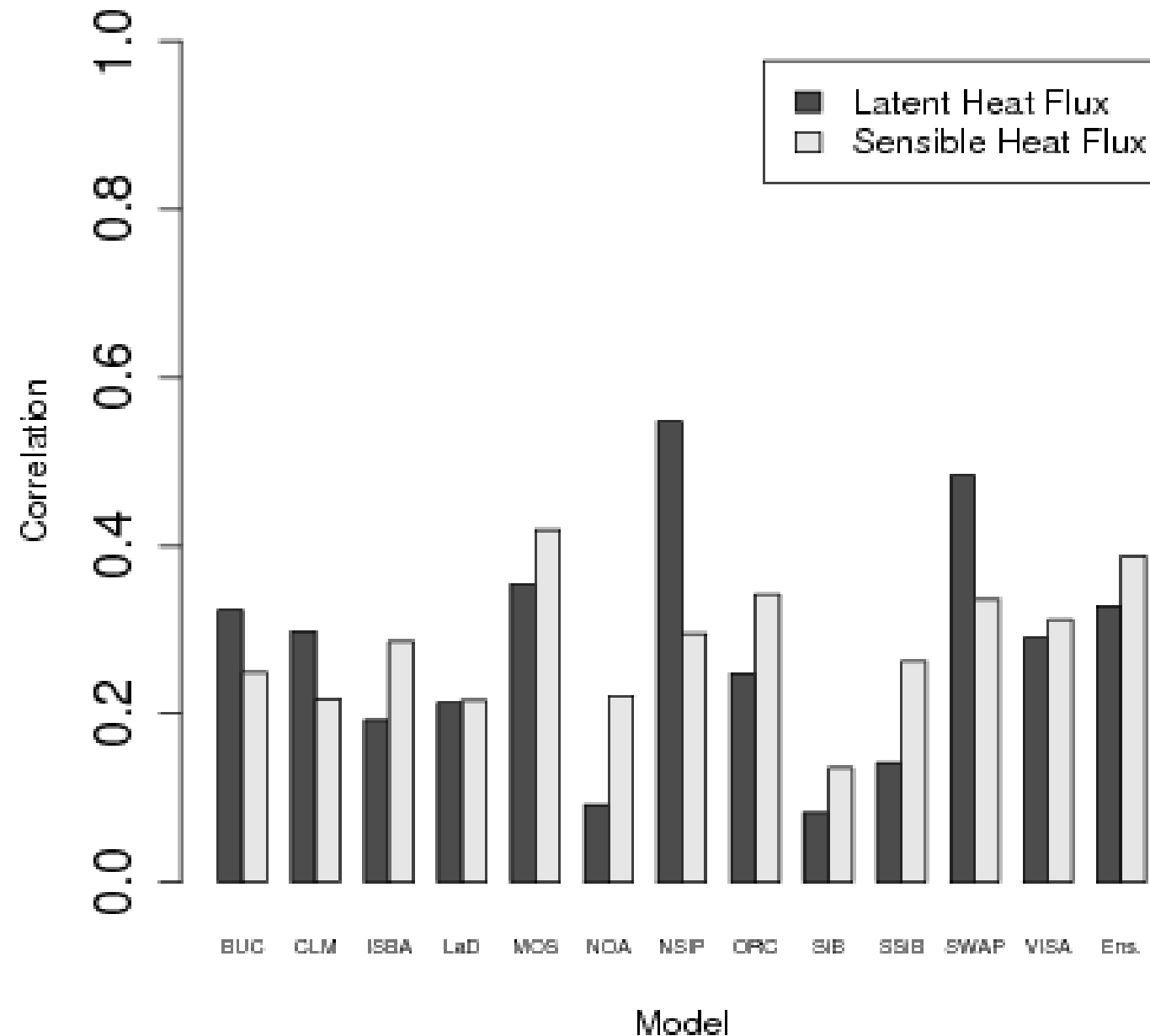
HAPEX-SAHEL fluxes simulations





Surface feedbacks in different LSMs

Correlation between simulated (each model) and observed fluxes (station 3)



- large spread between models
- ensemble mean is not the best guess
- MOSES2 is better overall
- which is the uncertainty from the forcing?

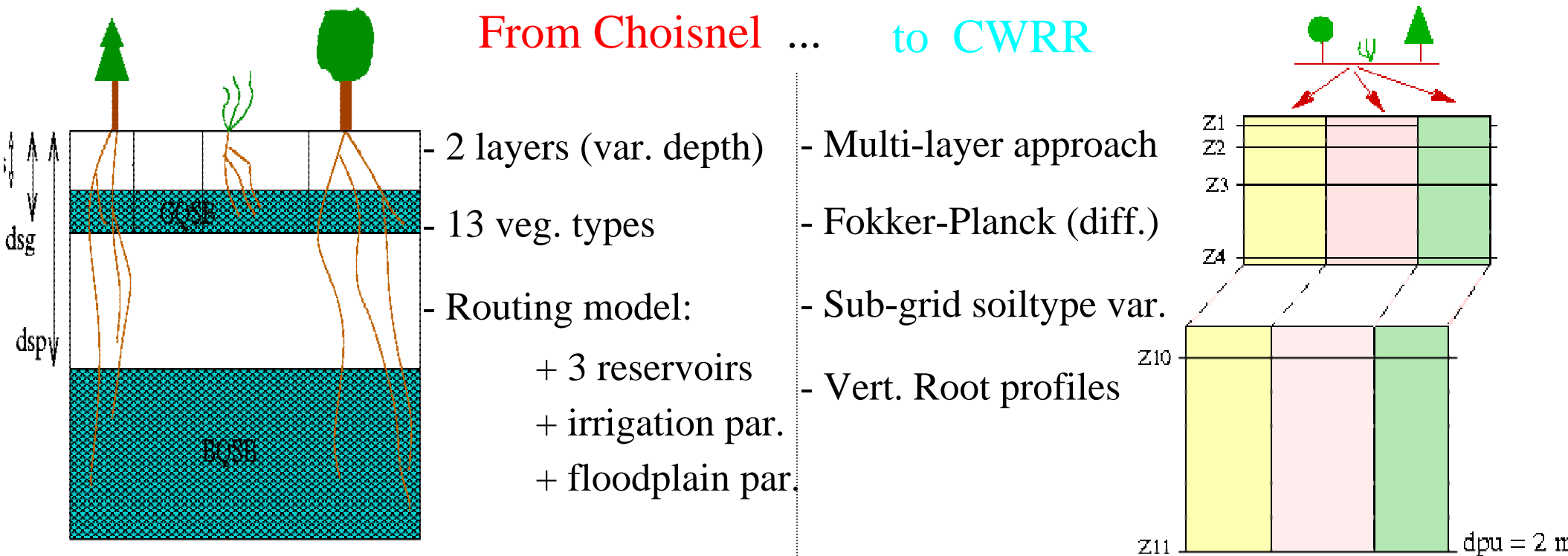


Outline

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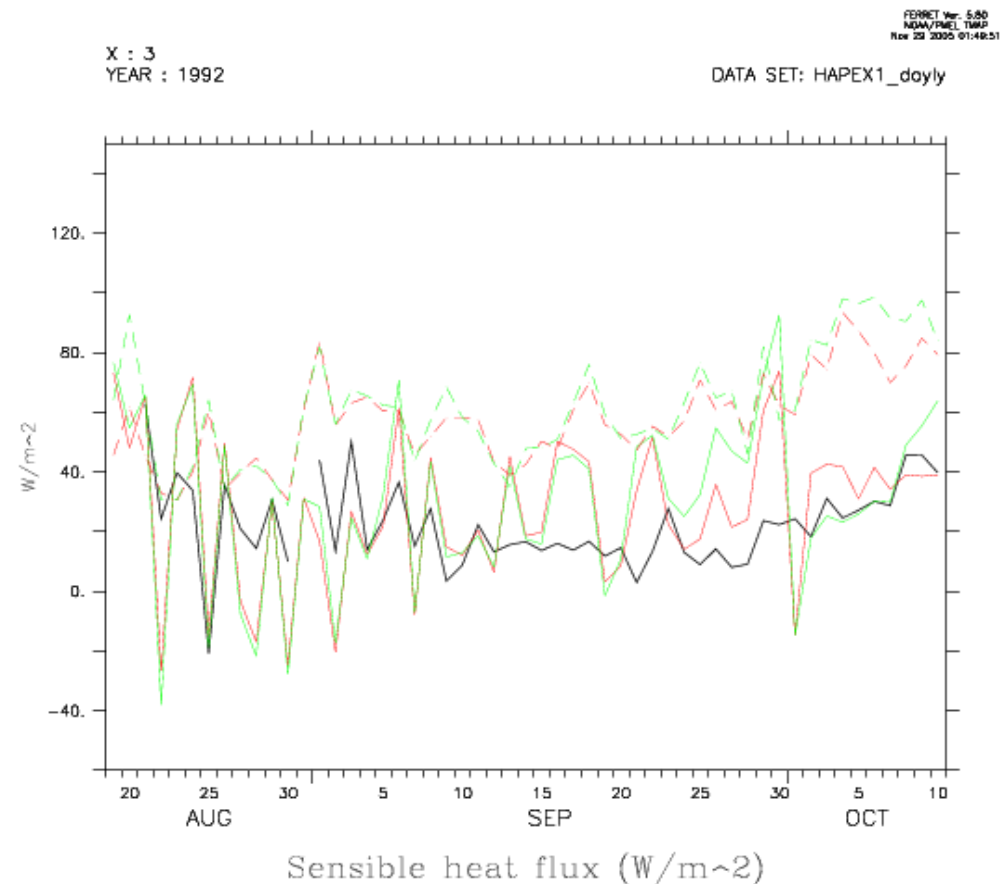
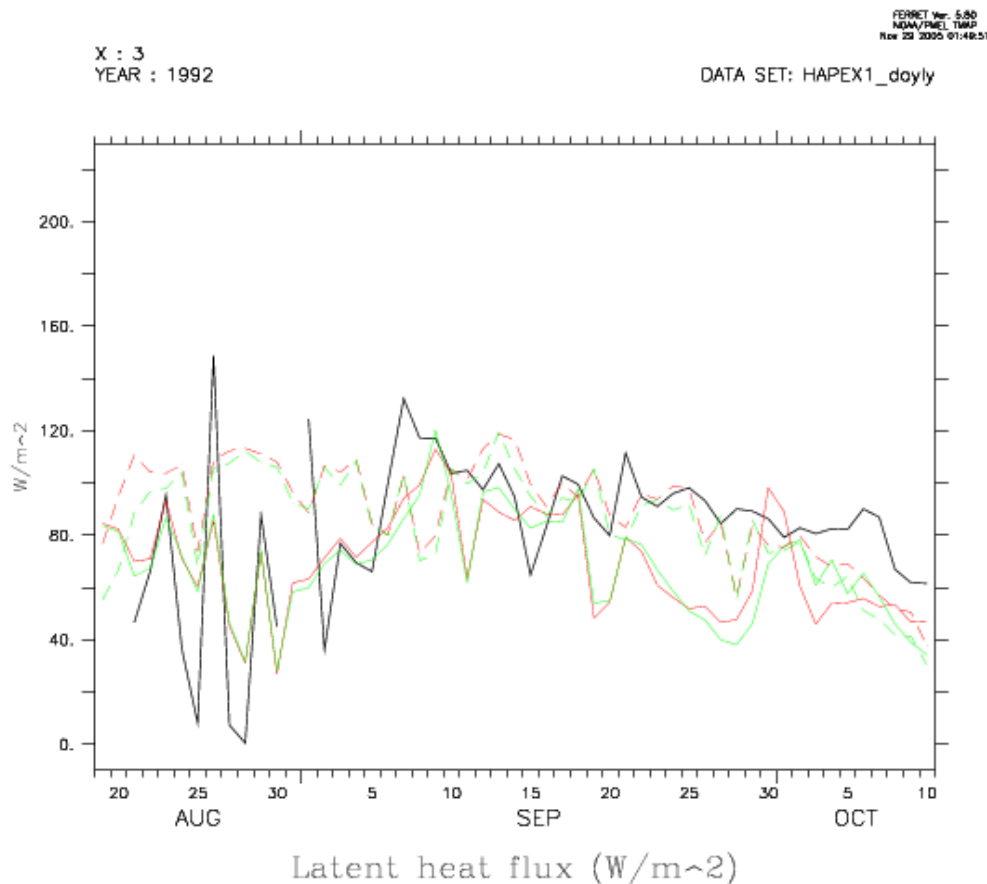


Impact of rootzone moisture representation

Relative impacts of:

- soil moisture representation (Choisnel or CWRR)
- forcing data (ISLSCP2 or NCC)

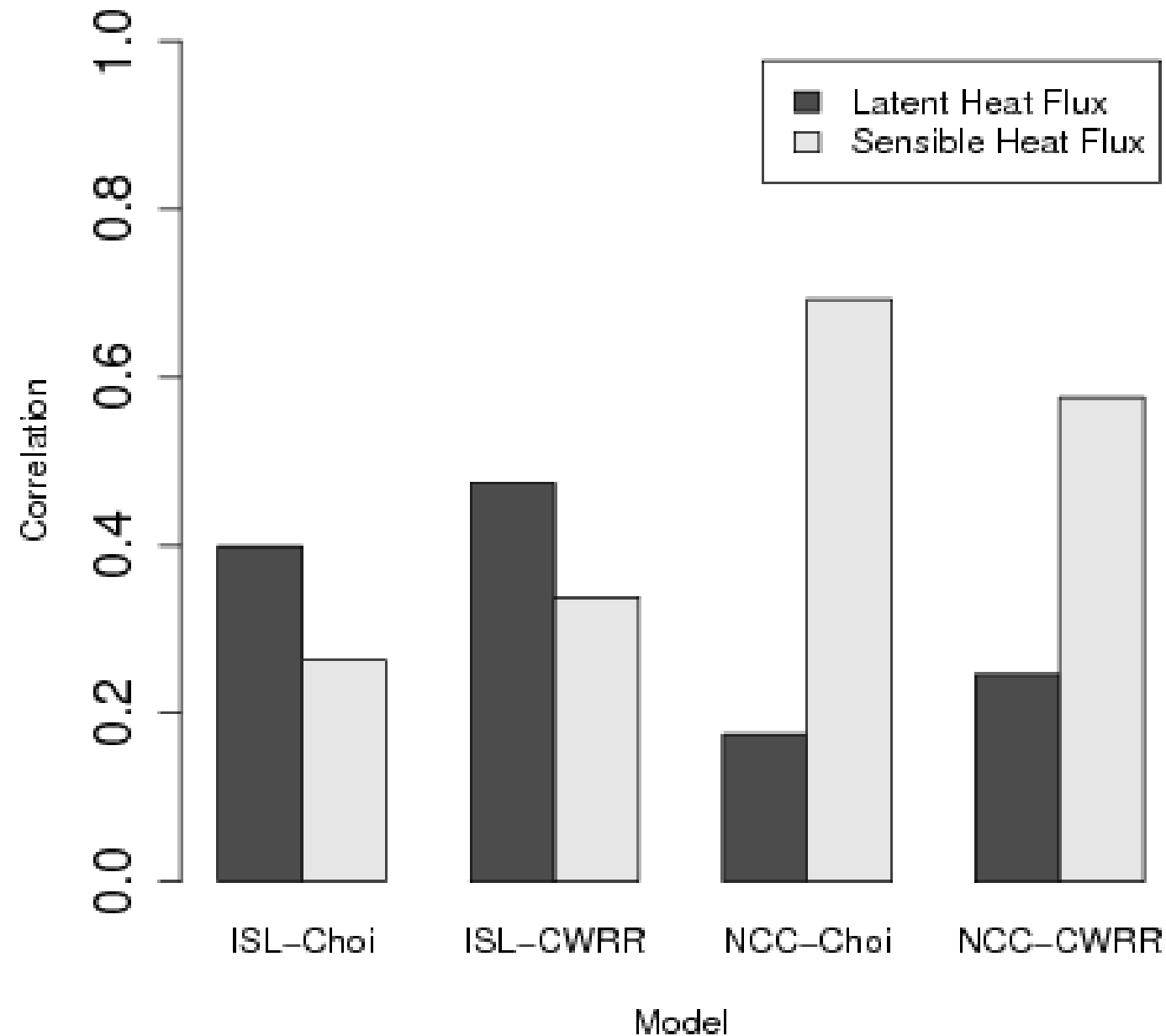
Larger difference between different forcings than different parametrisations





Impact of rootzone moisture representation

Correlation between simulated (each model) and observed fluxes (station 3)



- ISLSCP2 rainfall is closer to obs.
- Better LE with ISLSCP2
- Better H with NCC
- CWRR improves LE (diff.)

- forcing is more influent than moisture param.



Outline

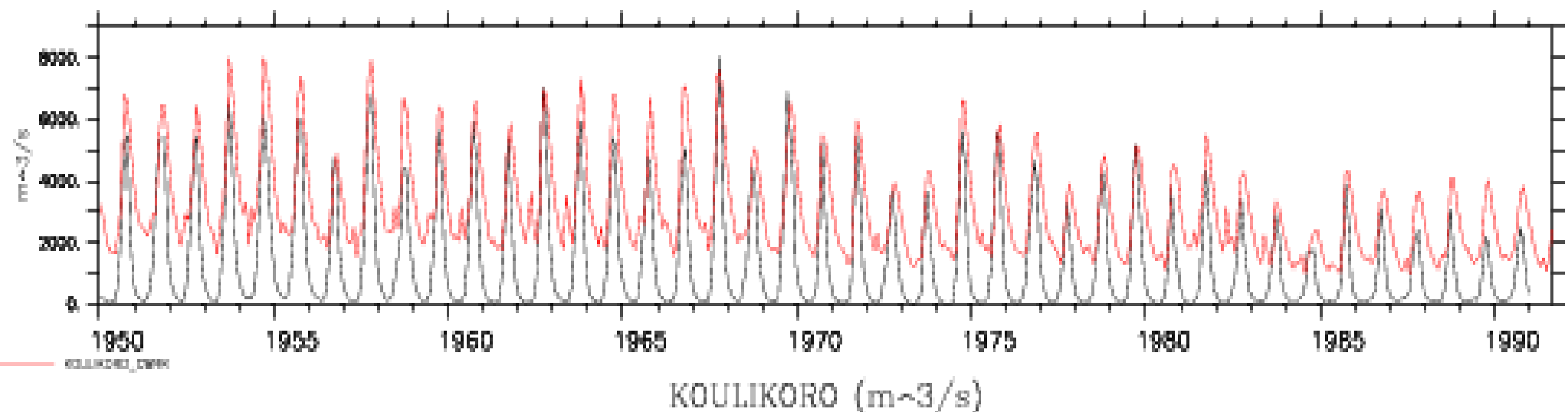
Impact of the Sahel drought on the water balance in LSMs

Introduction

- I. Spread in the surface feedback between different LSMs
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- III. Validation at the regional scale: influence on large river discharge simulation

1950-1990
1950-1990
1950-1990

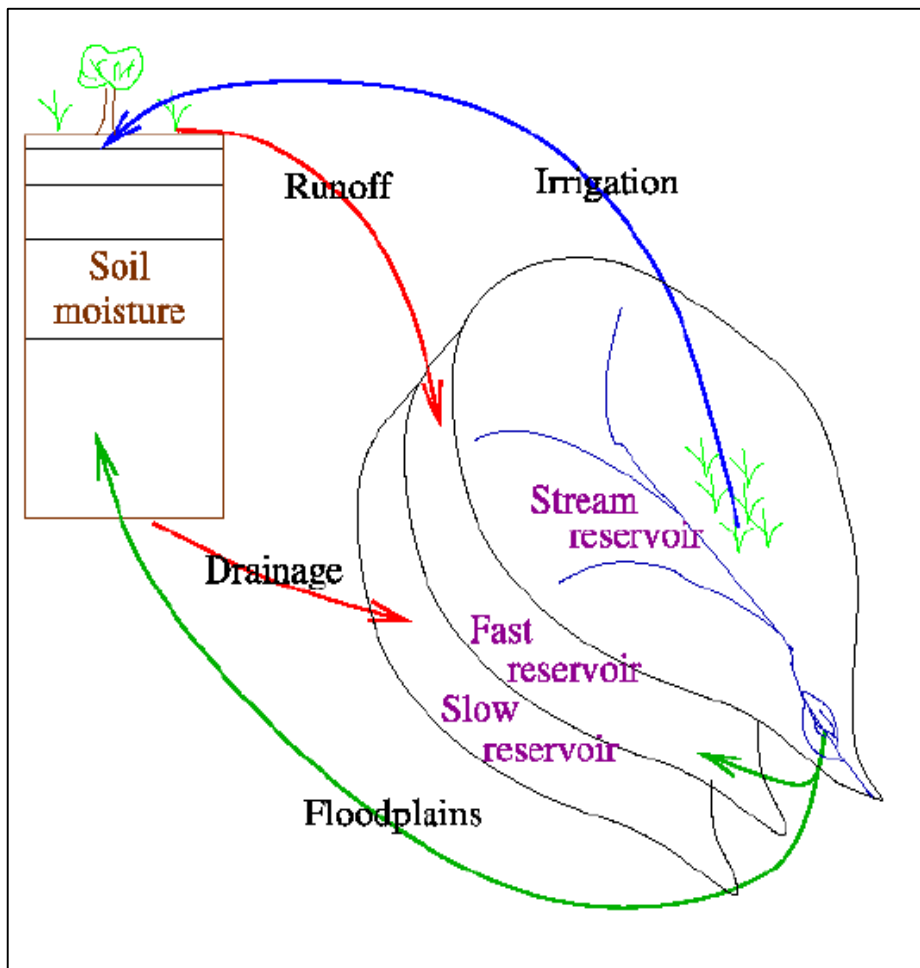
DATA SET: stations_format



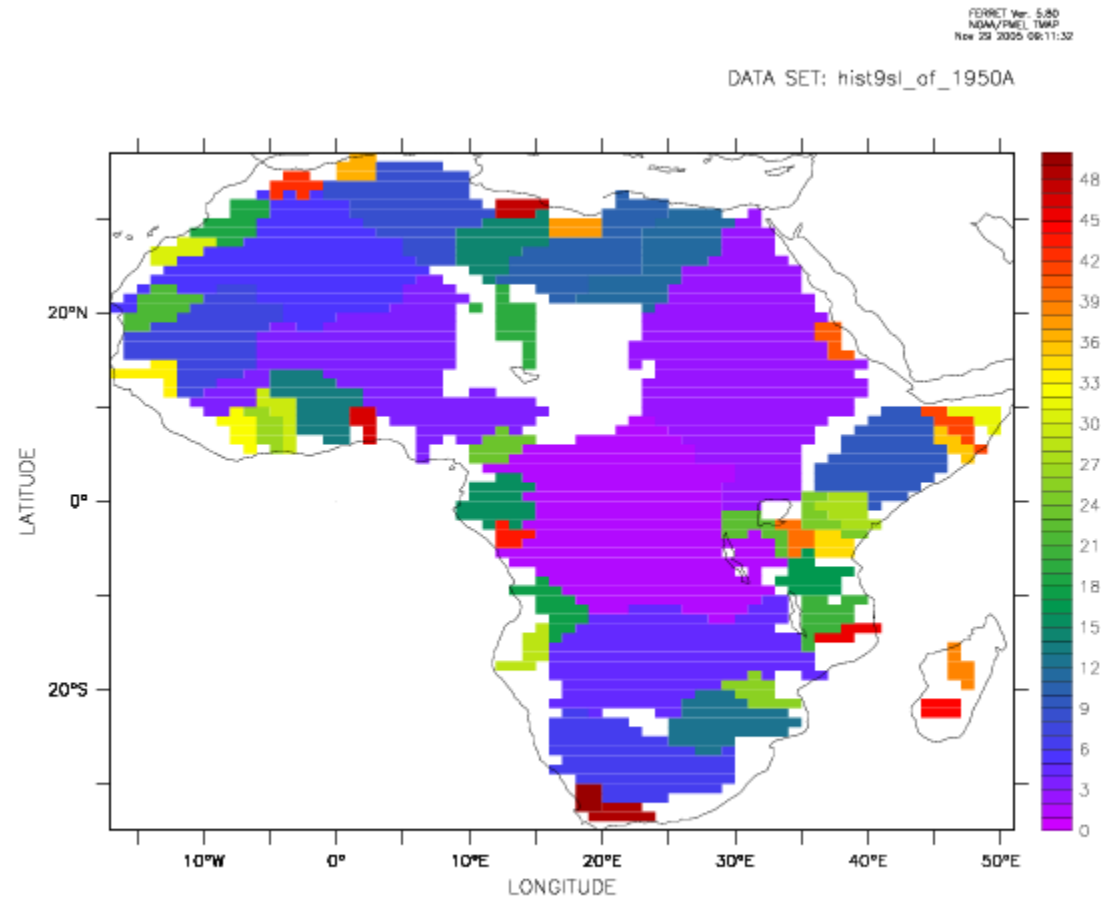


Large river discharge simulation

Validation of ORCHIDEE with river discharge observations
The routing model scheme principle



ORCHIDEE routing scheme



Approximate map of the river basins

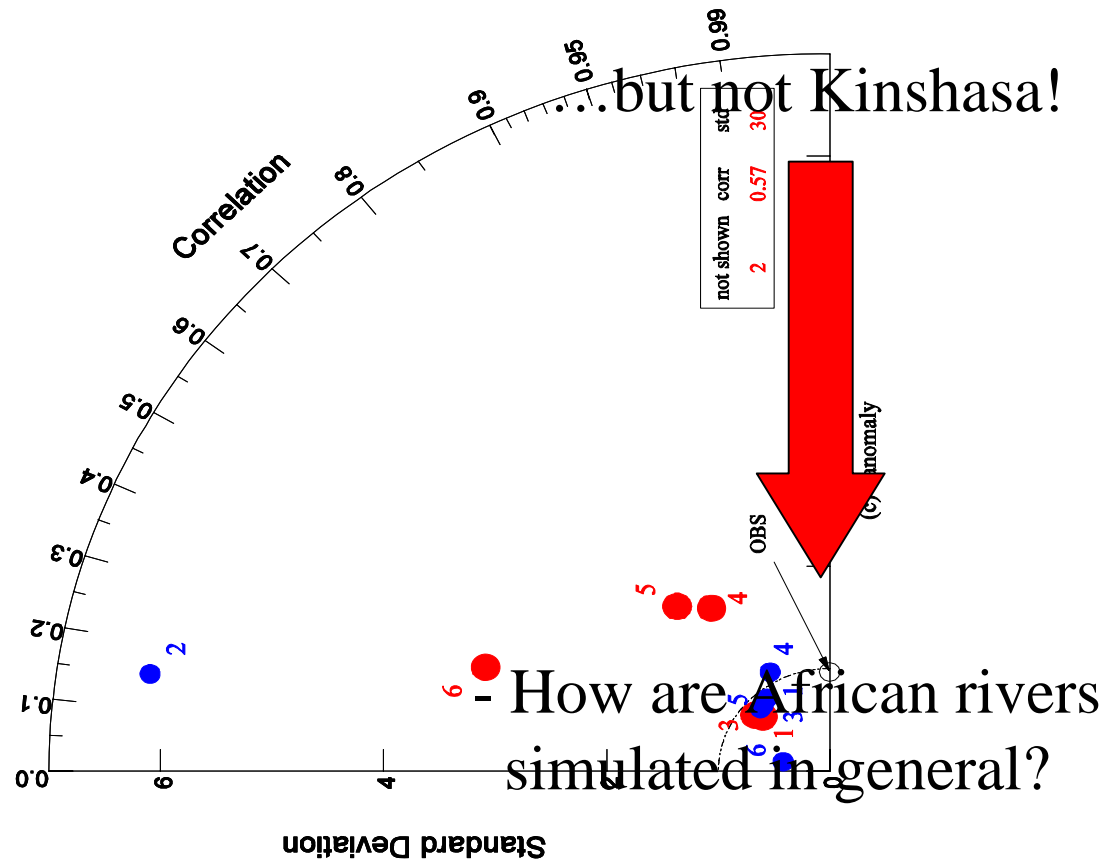
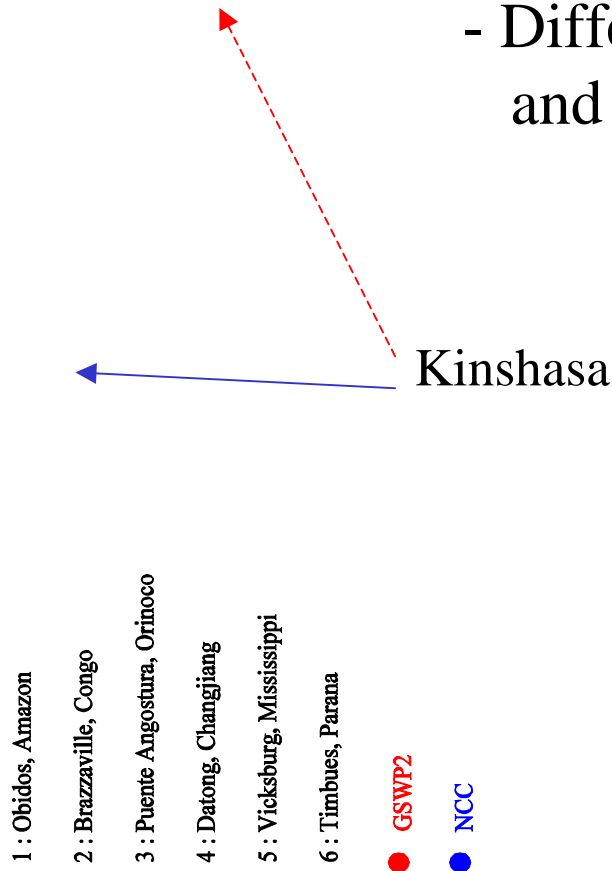


Large river discharge simulation

Taylor diagram of observed (UCAR dataset) vs. simulated (ORCHIDEE) river discharges:
 - Influence of forcing (NCC or ISLSCP2) on the world largest river discharge

- Differences between NCC and ISLSCP2 simulations

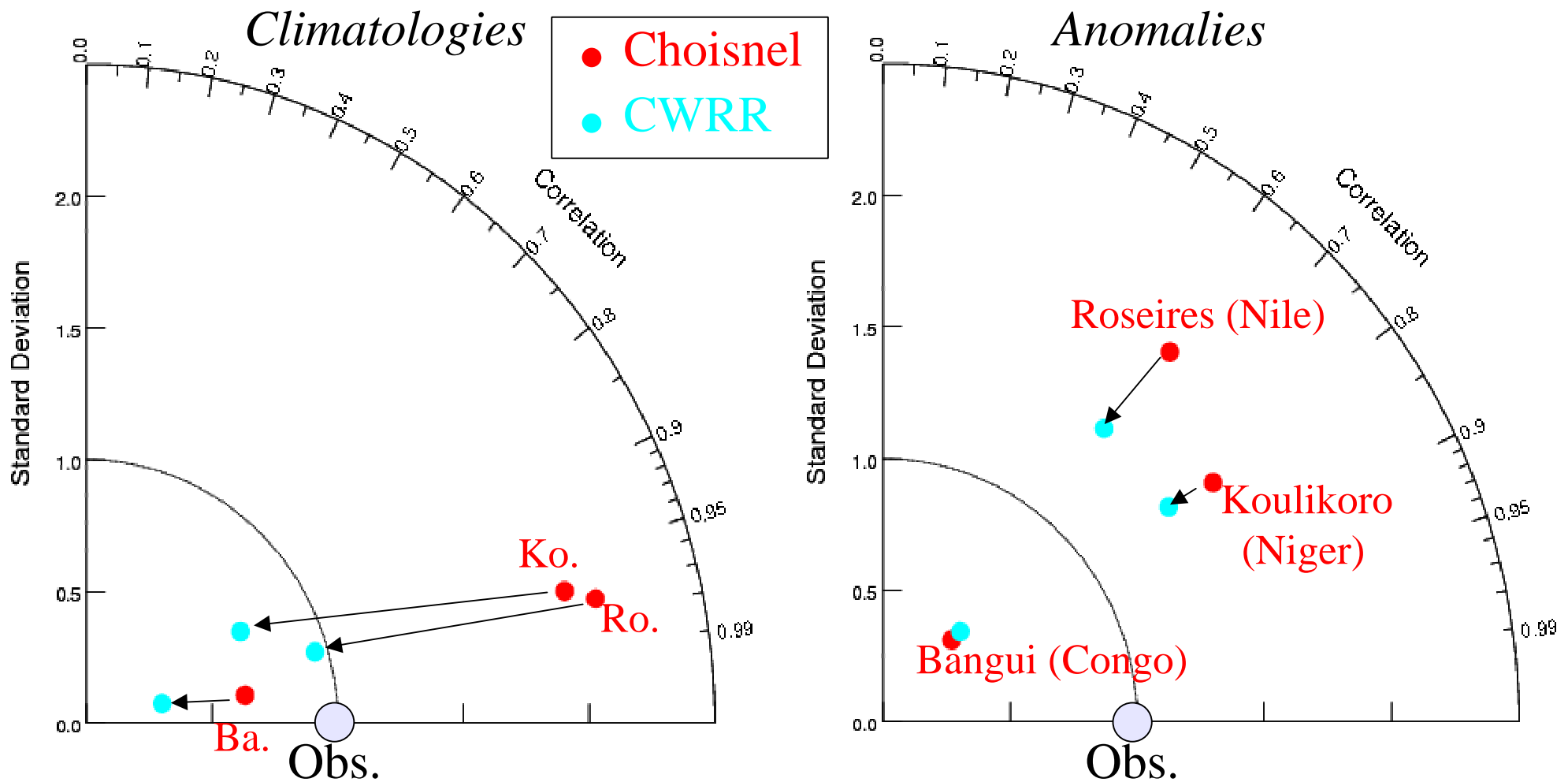
- Large rivers are well represented by ORCHIDEE...





Large river discharge simulation

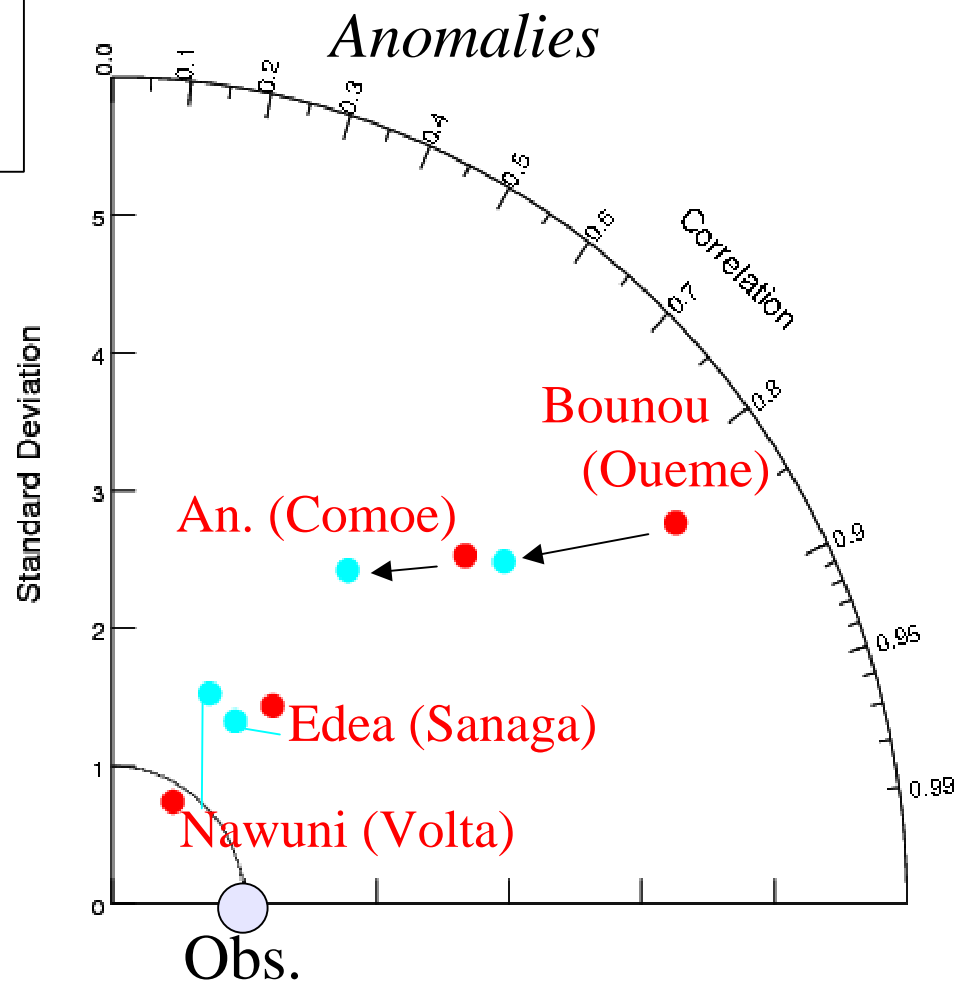
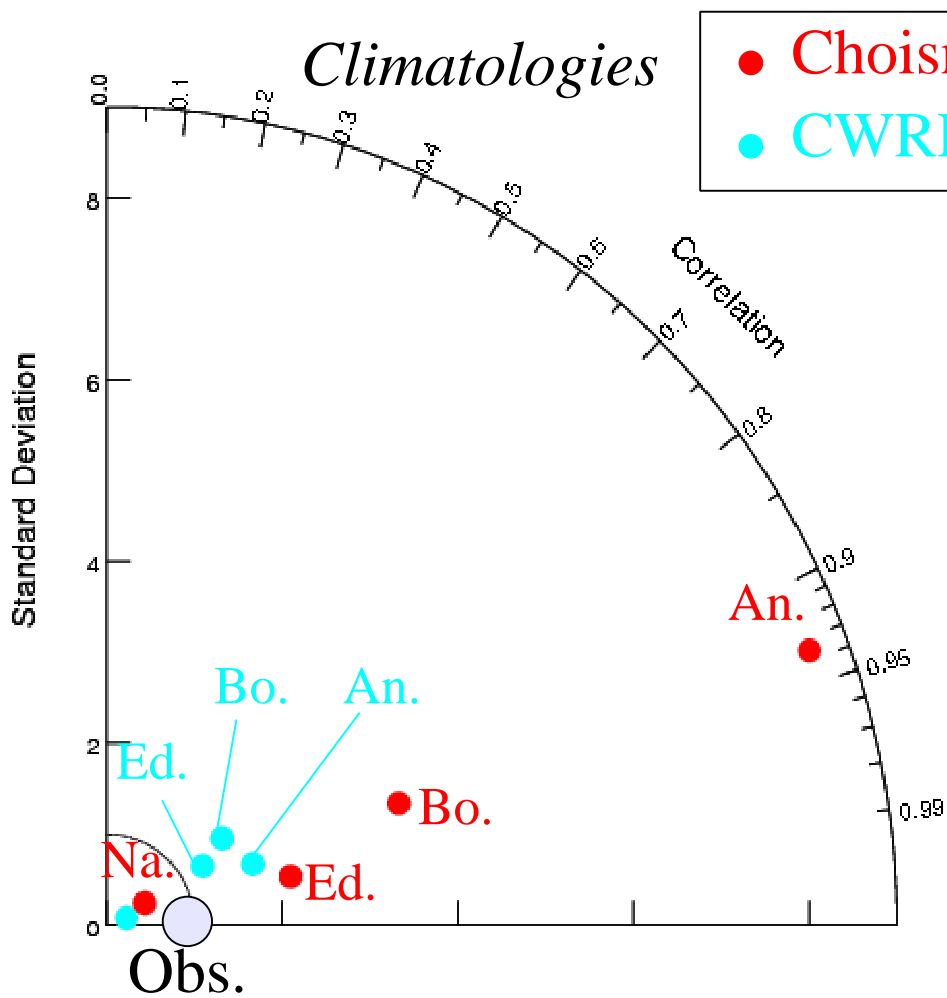
Taylor diagram of observed (UCAR dataset) vs. simulated (ORCHIDEE) river discharges:
- Influence of ORCHIDEE parametrisation on large African basins





Large river discharge simulation

Taylor diagram of observed (UCAR dataset) vs. simulated (ORCHIDEE) river discharges:
- Influence of ORCHIDEE parametrisation on smaller “guinean” basins





Large river discharge simulation

But is CWRR really a “more physical” parametrisation of soil infiltration and moisture?
Influence of the time step when working with 11 layers (top = 2mm)

In our tests:

- 9 layers
- 1cm-deep top layer

What happens with:

- A **thinner** top layer?
- A **different** time step?

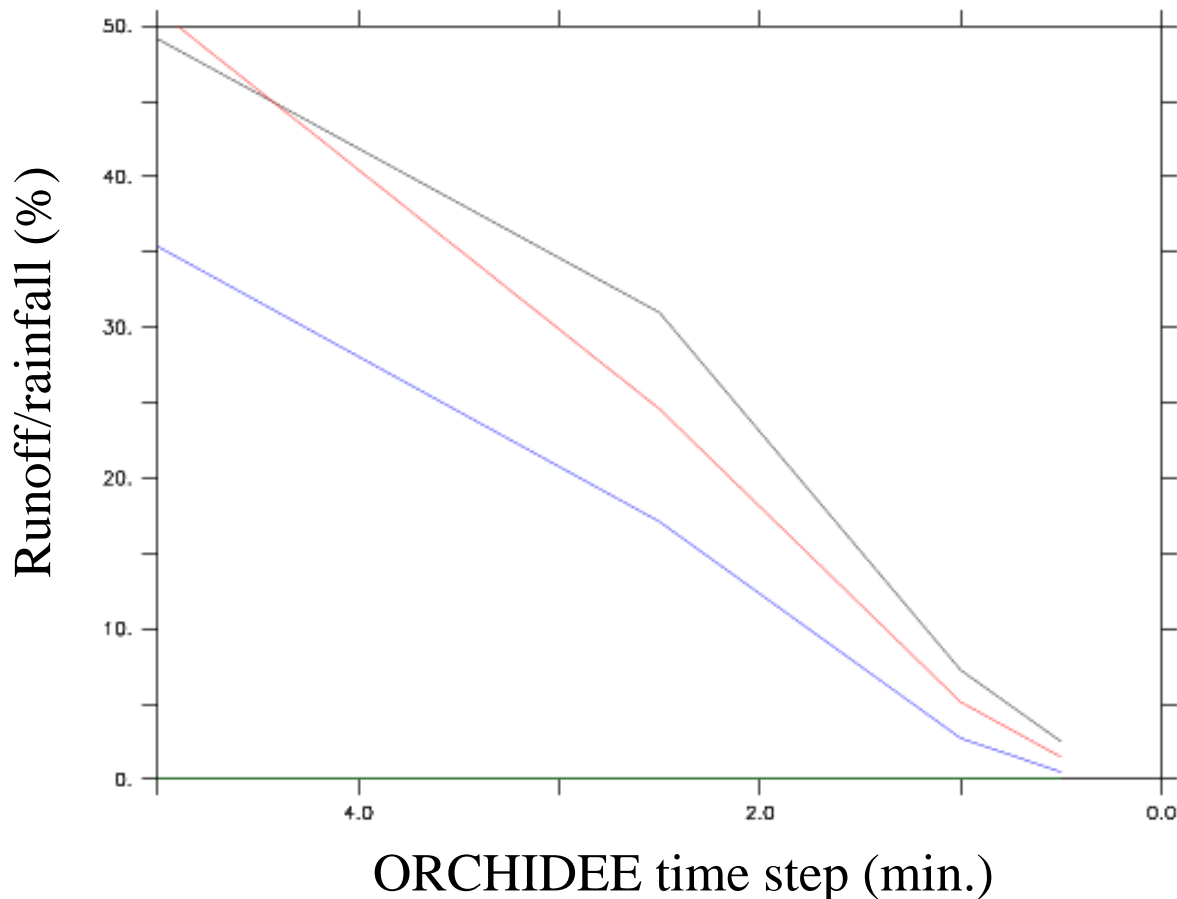
For sand, $K_s = 1.23 \cdot 10^{-5} \text{ m.s}^{-1}$

Physically,  no runoff

purely numerical

discrimination runoff/infiltration

Runoff over rainfall for the 4 strongest events (3h)
in 1992 at Niamey grid point (ISLSCP2)





Conclusion

Impact of the Sahel drought on the water balance in LSMs

- The ensemble mean of 12 LSMs from GSWP2) simulates **reasonable fluxes** in Niamey during HAPEX (small bias and good correlation)
- **However**, large uncertainties remain between the different LSMs, especially when looking at the Bowen ratio
- The uncertainties due to the forcings and to the LSM are of the same order for HAPEX. ISLSCP2 have more realistic precip for this period.
- The new representation of rootzone moisture improves the simulation of by ORCHIDEE of:
 - + Hapex fluxes
 - + Different River discharges

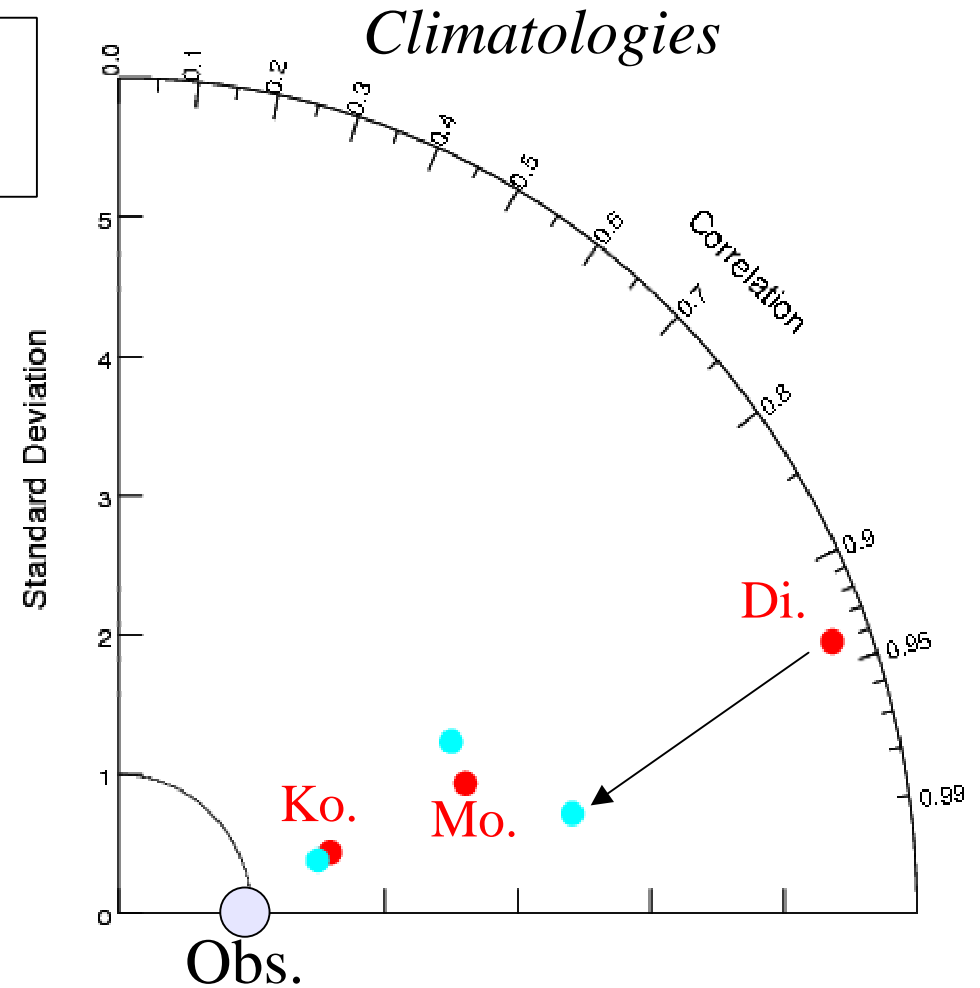
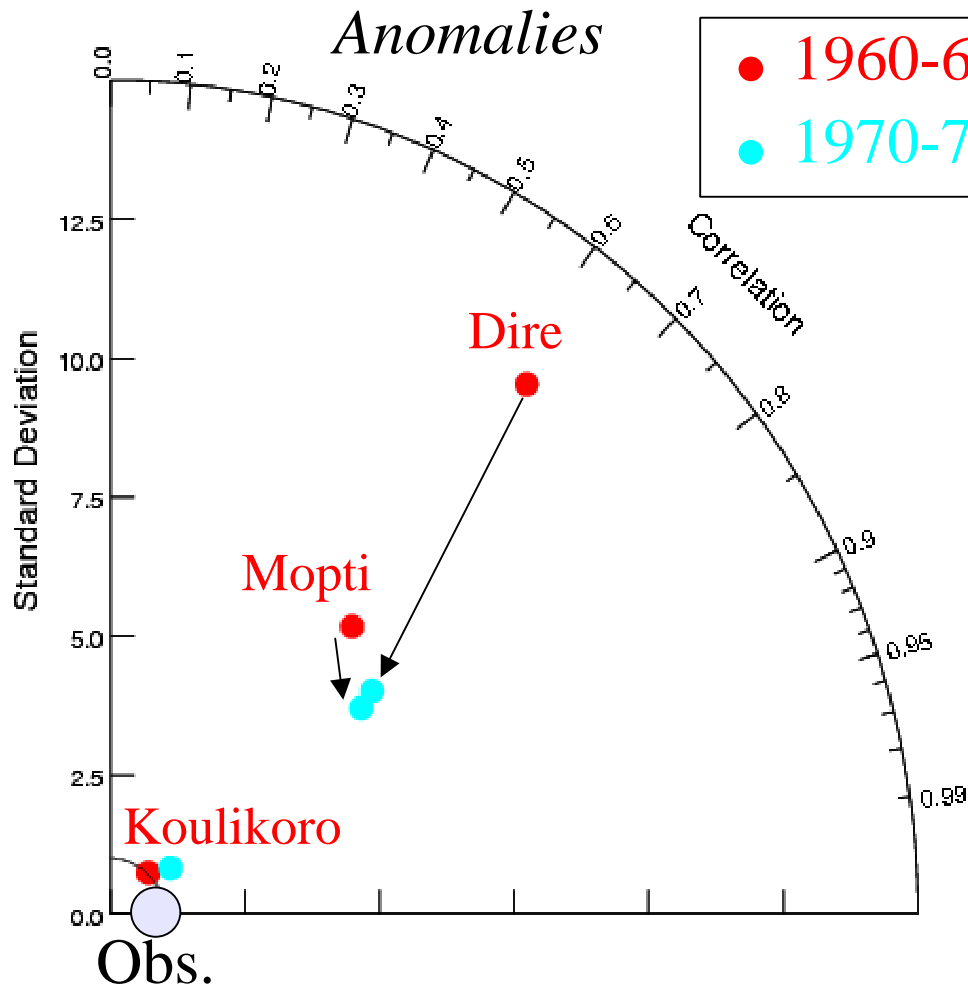
But runoff/infiltration discrimination is still purely “numerical”

HOW TO BUILD A USEFUL CONCEPTUAL PARAMETRISATION?



Large river discharge simulation

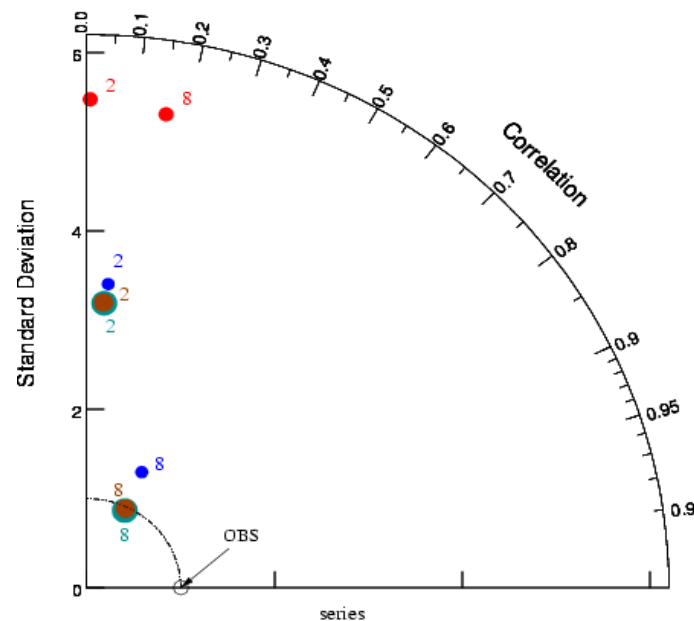
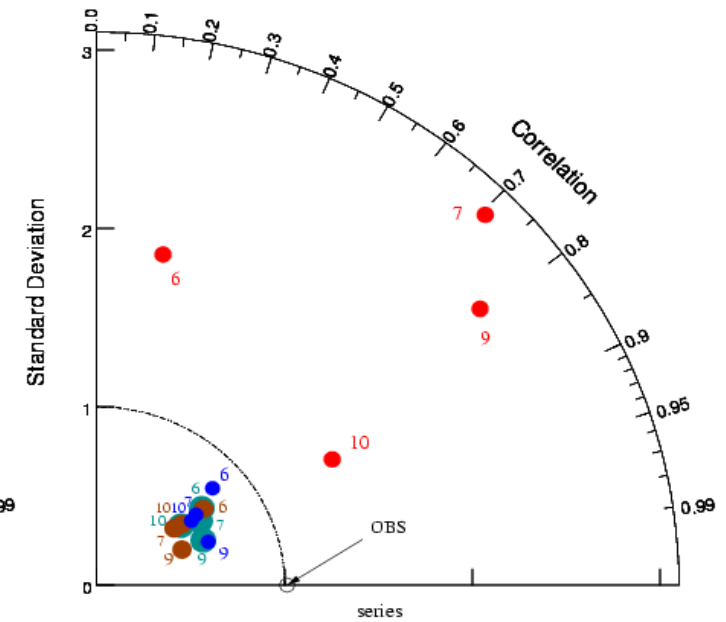
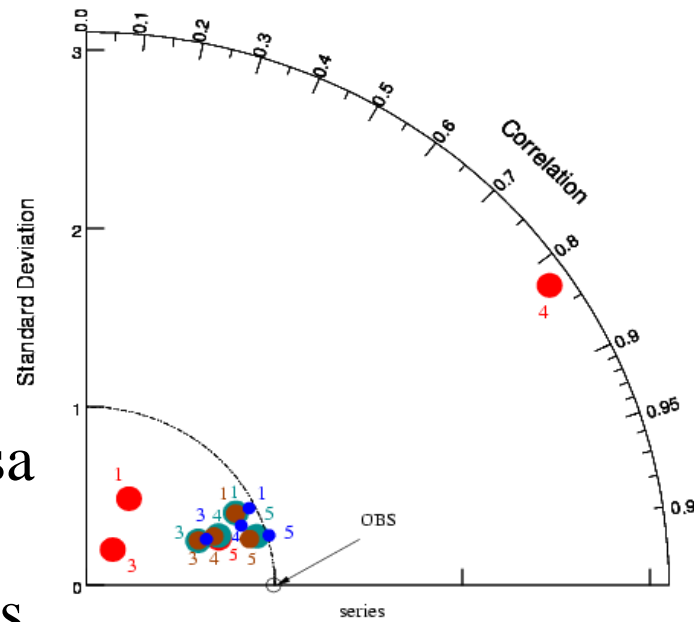
Taylor diagram of observed (UCAR dataset) vs. simulated (ORCHIDEE) river discharges:
- Influence of floodplains and inter-decadal variability in the Niger basin.





Large river discharge simulation

- Large rivers are very well represented by ORCHIDEE
- Apart from Parana and Congo at Kinshasa
- How are African rivers simulated in general?



- 1 : Obidos, Amazon
- 2 : Kinsasha, Congo
- 3 : Puente Angostura, Otinoco
- 4 : Datong, Changjiang
- 5 : Bahadurabad, Brahmaputta
- 6 : Vicksburg, Mississippi
- 7 : Igarka, Yenisey
- 8 : Timbues, Parana
- 9 : Kusur, Lena
- 10 : Pakse, Mekong

- NCEP
- NPRE
- NCRU
- NCC



African stations

Position

