Station Géophysique de Lamto

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Sensitivity of a RCM to prescribed SST.

Fidèle YOROBA

2 juillet 2012

Introduction

- The West Africa climate is marked by changes in SST (Cook, 2000 ; Janicot and Fontaine, 1997) over a wide range of time scales (intraseasonal to decadal).
- So, the West Africa appears as a geographic area suitable for assessing the effects of SST on both the seasonal pattern of precipitation and atmospheric dynamics associated with it.
- Assumed the climatic role of SST in this region, is to condition the Sahelian rainfall and those of the Gulf of Guinea (Nicholson, 2001).
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- The contribution of a regional climate model that has a physical suited to West Africa as a way to identify their impacts on regional climate.
- The RCM MAR is forced by two types of prescribed SST (ERA40 reanalysis SST and Reynolds SST) over the 1983-2000 periods.
- Main objective : To evaluate the sensitivity of the MAR model to the prescription of these types of SST.
- Special case of climate variability at the local scale on the humid savanna region of Lamto (6.13°N,5.02°W in Côte d'Ivoire) is also studied..

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Data

- ERA40 SST : The meteorological model calculates the SST with a reminder to the Reynolds SST. The data are interpolated in time and space on a horizontal resolution of 100 km of the Gaussian grid of ERA.
- Reynolds's SST (Reynolds and Smith,1994) : This climatology derived from monthly Optimum Interpolation SST analyses.The optimum interpolation SST analysis is produced weekly on a 1° grid.
- Lamto dataset (Observations data) : This climatological data derived from 1962-2011 period. It includes daily data of Rain,Temperature, Relative humidity.

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- The model MAR (Gallée et Schayes,1994) is a hydrostatic primitive equation model in which the vertical coordinate is normalized pressure.
- The hydrological cycle of MAR is described in Gallée (1995).
- MAR is adapted to tropical regions by including the convective adjustment scheme of Bechtold et al. (2001).
- The horizontal grid spacing is 40 km. The vertical grid is represented by 40 vertical levels irregularly spaced.

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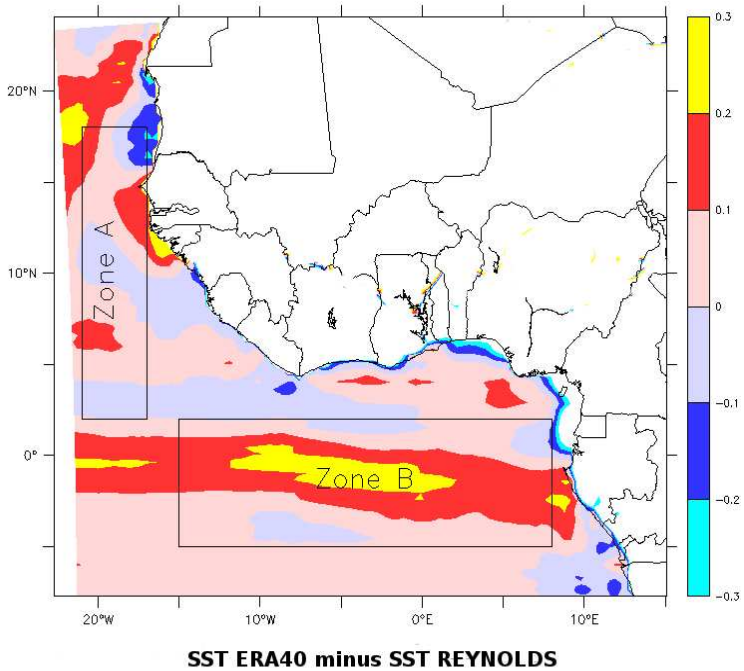
Experimental Protocol

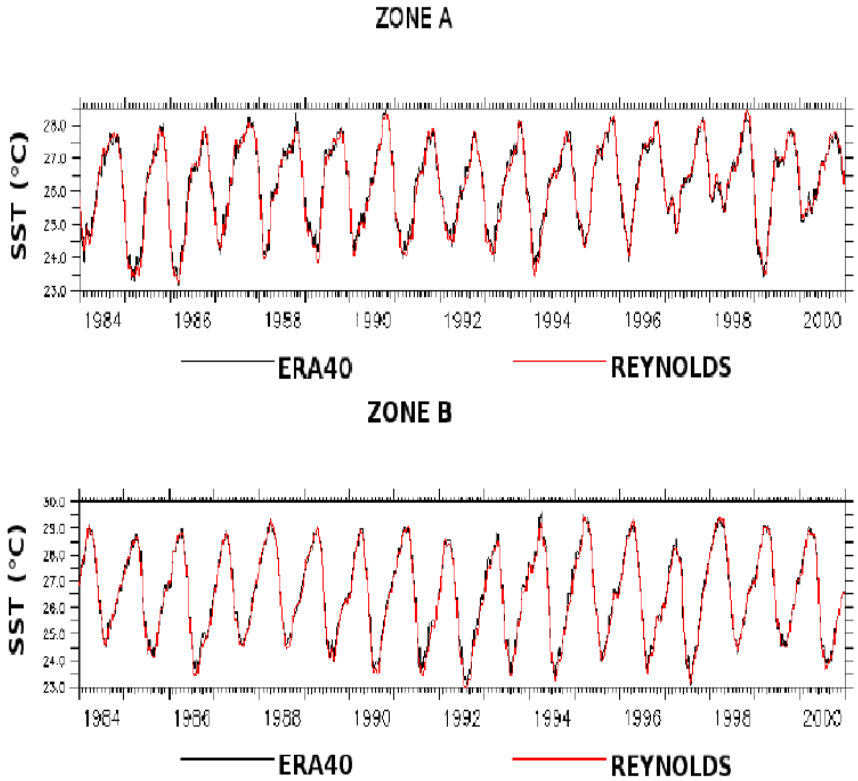
TABLE 1: Experience names and SST characteristics of the two simulations

Name of experiment	Period simulated	SST used in the RCM
WAFSSTERA	1983-2000	ERA40
WAFSSTREY	1983-2000	REYNOLDS

Spatial Mean SST difference



(a) Mean regional SST differences between ERA40 and Reynolds from 1984 to 2000. Zone A and Zone B represent the areas of the two SST dataset comparisons. (Color interval is 0.1°C).



(b) Time evolutions of spatial mean SST of ERA40 reanalysis (black line) and Reynolds (red line) in °C over the zone A (top) and over the zone B (bottom) from 1984 to 2000.

Statistical Study

TABLE 2: Correlation Coefficients (*100) between the 1984-2000 time-series of the two SST datasets (i.e ERA40 SST and Reynolds SST)

Period	Variable	Domain	Correlation Coefficient
1984-2000	SST	ZONE A	99.21
		ZONE B	99.62

Zonal Mean Winds simulated by the MAR model

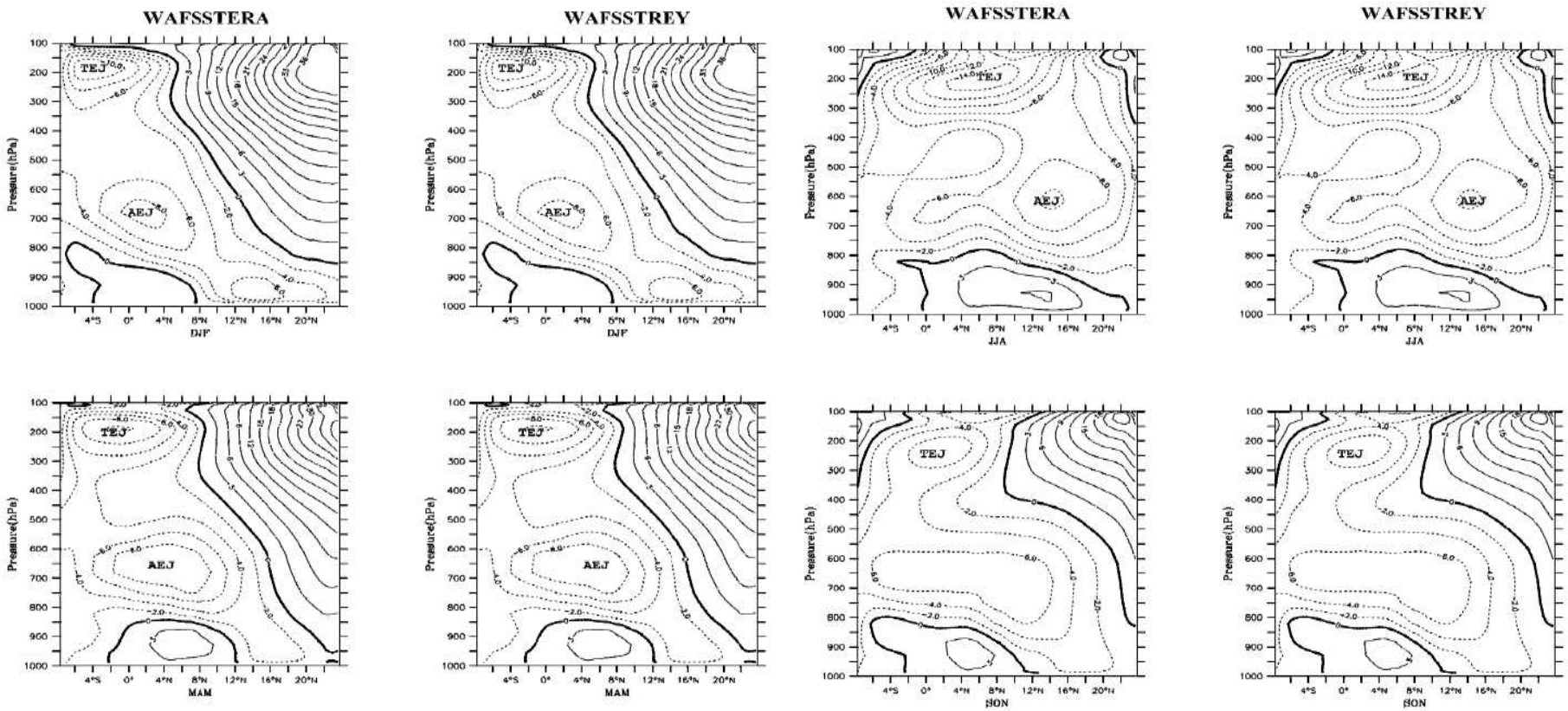
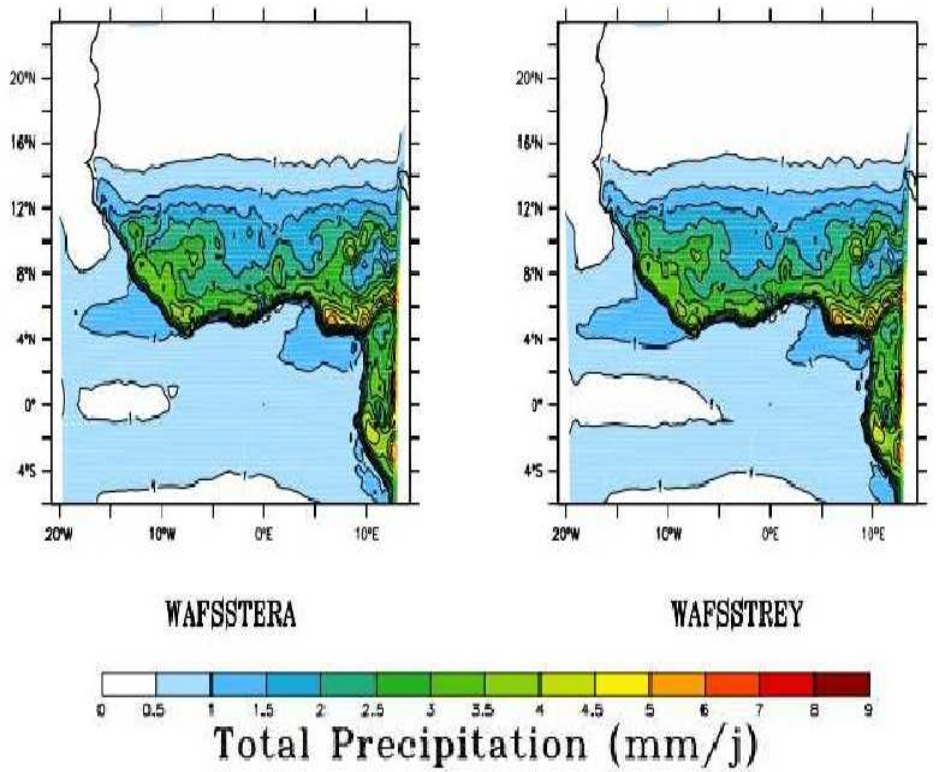
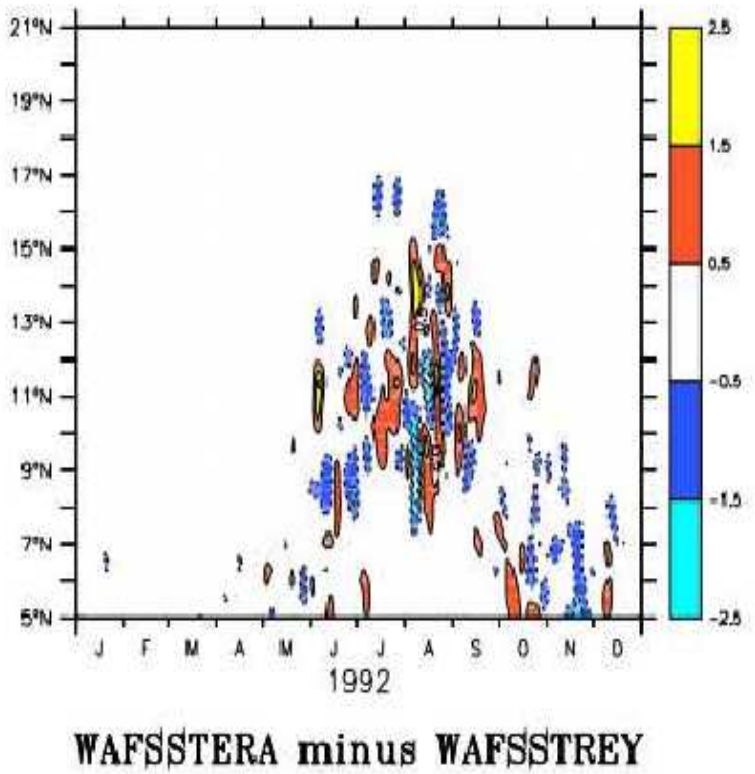


FIGURE 1: Altitude-latitude diagrams of the 17-years (1984-2000) seasonal zonal wind (m/s) of the WAFSSTERA simulation (left) and WAFSSTREY simulation (right) averaged over 10°W-10°E along 7.2°S-24°N.

Mean daily Rain



(a) Mean Rainfall (in mm/day) from 1984 to 2000 of the MAR simulations for WAFSSTERA (right) and WAFSSTREY (left).



(b) Time-latitude diagram of rainfall difference (mm/day) between WAFSSTERA and WAFSSTREY simulations for 1992. Rainfalls have been averaged from 10°W to 10°E.

Region of LAMTO (6.13°N,5.02°W)

- Lamto is located in the Guinean region (particularly in Côte d'Ivoire) and covers an area of about 2,700 Ha.
- Its climate is of equatorial transition type (Bonvallot, 1968 ; Arbeille, 1986) and has a large interannual scale variability.
- Lamto is under the influence of the dynamics of African monsoon and also regional SST.
- And, in a local climate, these influences can have as much or more impact than in a regional framework.Therefore we evaluate the sensitivity of climate of Lamto to the SST.

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Temperature and Specific humidity at Lamto

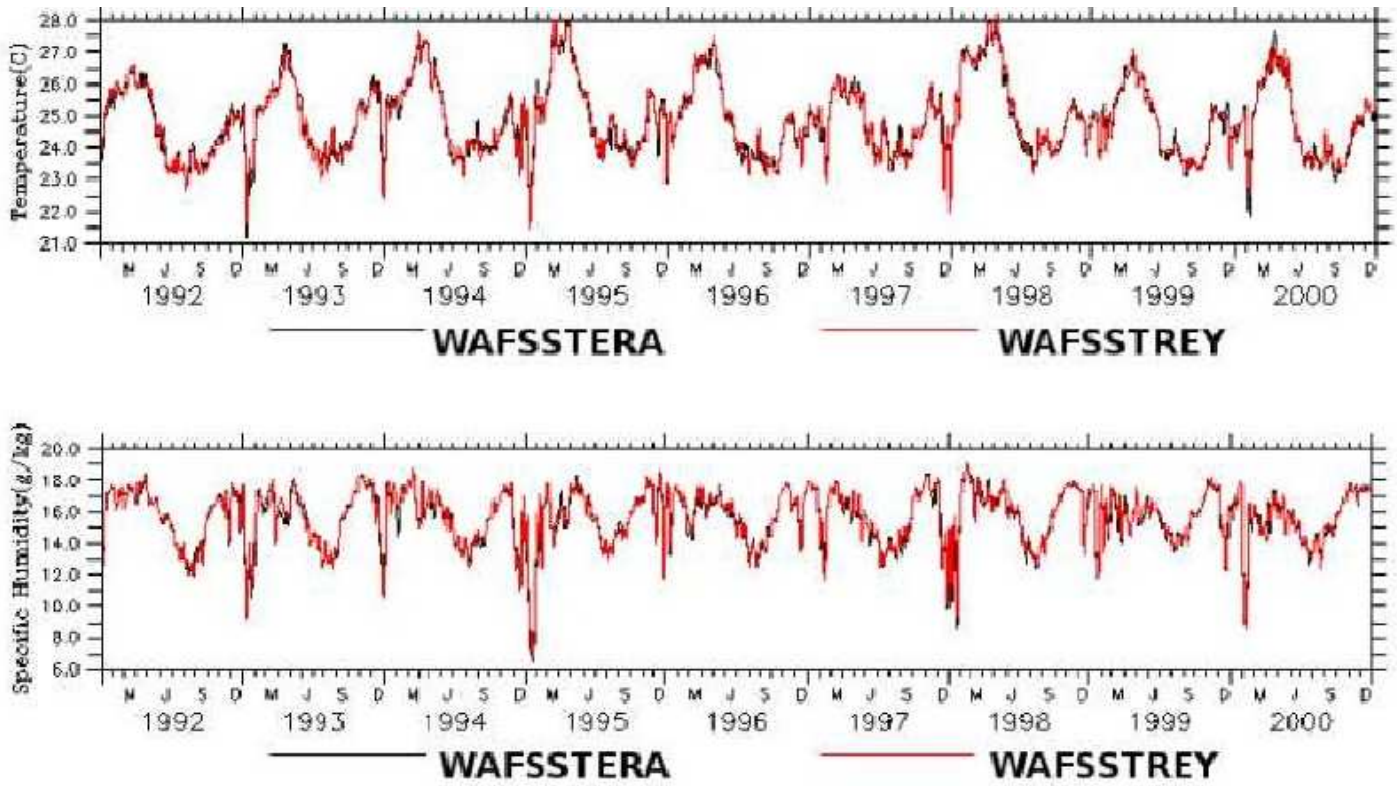
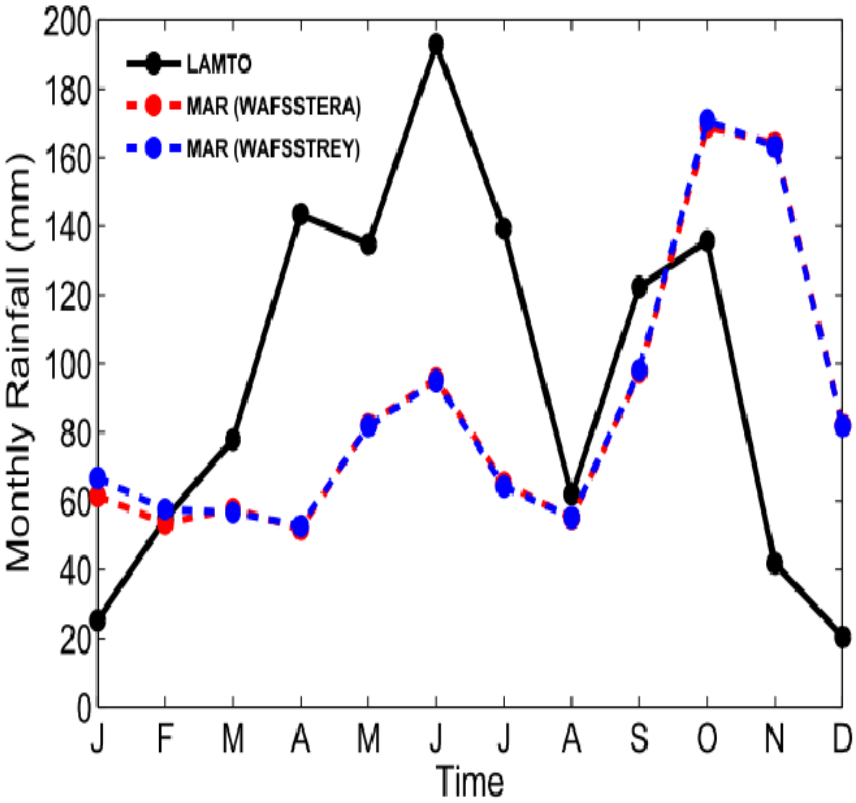
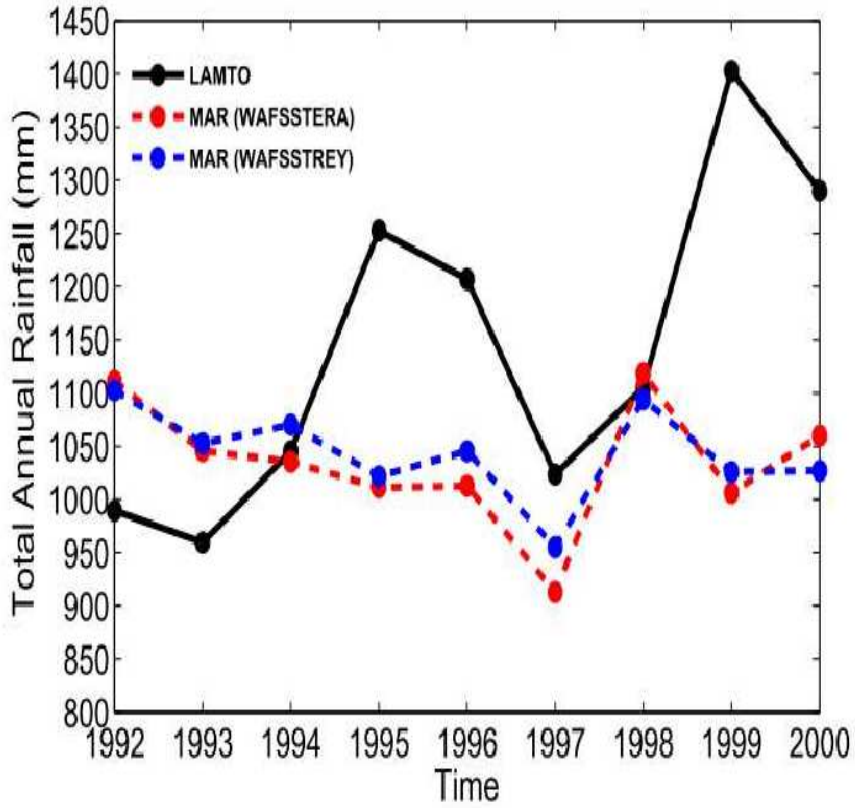


FIGURE 2: Time evolutions of means Temperature (top) in °C, Specific humidity (bottom) in g/kg from 1992 to 2000 at Lamto for MAR simulations. WAFSSTERA (black line) and WAFSSTREY (red line).

Precipitation at Lamto



(a) Annual variability



(b) Interannual variability

FIGURE 3: Means annual (left) and interannual (right) variabilities of rainfall simulated by MAR model and observations at Lamto (6.13°N, 5.02°W) from 1992 to 2000.

Statistical Study

TABLE 3: Correlation Coefficients (*100) between the 1992-2000 time-series of the two MAR simulations (i.e WAFSSTERA and WAFSSTERY).

Period	Variable	Domain	Correlation Coefficient
1992-2000	Temperature	LAMTO	98.3
	Specific Humidity		97.95
	Daily Rainfall		99.99
	Monthly Rainfall		99.87
	Annual Rainfall		92.54

Conclusion and Perspective

- A similarity between WAFSSTERA and WAFSSTREY simulations, particularity to the means structures of AEJ and TEJ (intensities and location).
- Large differences in total rainfall around the 12°N latitude on an annual scale.
- Strong similarities to the temperature and to the Specific humidity.

Conclusion and Perspective

- However, the correlation coefficients (calculated on the time series from 1992 to 2000) for precipitation show that differences between WAFSSTERA and WAFSSTREY become important for large scales.
- This study could also be conducted at the decadal scale. The advantage of such investigation may be of great significance in the sense that it will bring additional answers to the sensitivity of RCMs to prescribed SST, including those of ERA40 reanalyses and Reynolds climatology.

THANK YOU