SENSITIVITY STUDY OF RAINFALL TO SST OVER WEST AFRICA WITH FOCUS ON COTE D'IVOIRE: OISST VS HADSST AND STATIC VS DYNAMIC MODE

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INTRODUCTION

- RCMs) are still being used to contribute in several objective and acceptable manners to represent, analyze and understand the West African Monsoon (WAM) (Druyan & al. 2007; 2008; 2010; Sylla & al. 2009; Moufouma-Okia & Rowell 2009; Konaré & al. 2008)
  - Druyan and al. (2010 in WAMME: Observed relative difference between universities of Cocody (Côte d'Ivoire) and Abdou Moumouni (Niger) simulation while executing an inter-comparison between five RCMs.
    - These biases ⟶ to different SST used
- Additionally, WAM is known for its strong dependence to precipitations regarding to regional and global SST variations.
- **The first objective : studying the sensitivity of the model concerning SST data: HadISSTT1 vs OISST.**
- **The second : assessing the real contribution of the dynamic mode in the representation of the WAM to judge its validity over West Africa.**

MODEL VALIDATION

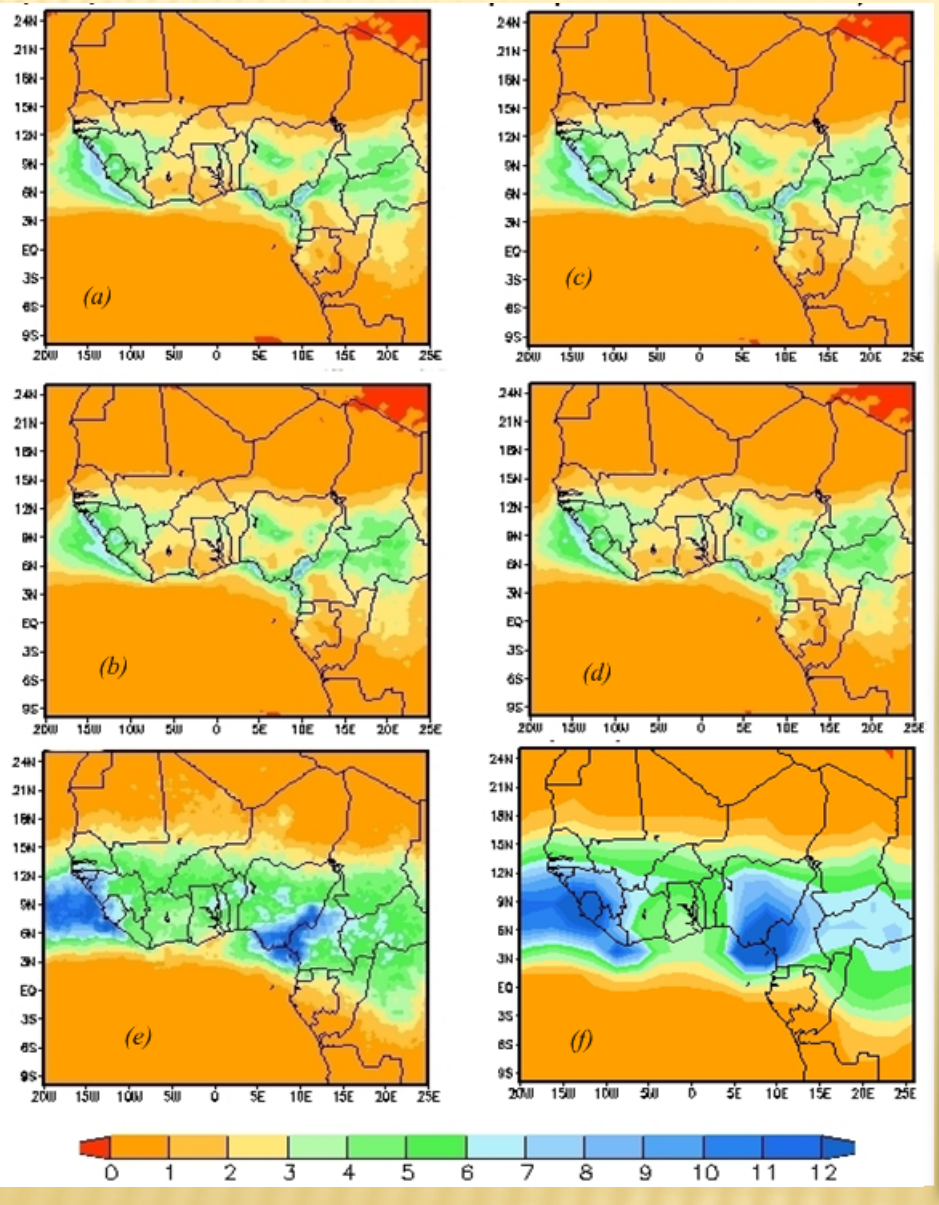


Figure 1: Mean precipitation during the monsoon season “June-July-August-September” (JJAS) over the years 2000 and 2004-2006. (a) RegcM (static OISST) (b) RegCM (static HadlSST1) (c) RegCM (dynamic OISST) (d) RegCM (dynamic HadlSST1),

- ✓ Maximum values around orographic zone of Guinea, mountainous zone of Cameroon and Joss plateaus
- ✓ Precipitations mostly located between 5° N - 17°N Coherent with the mean location of ITCZ (Sylla et al. 2009; Sultan & Janicot 2000).
- ✓ RegCM estimations show lower precipitations (less than 9 mm/day) compared to the observations of the TRMN and CMAP.
- ✓ Despite these relative weak values (with a bias of 1-2 mm/day), RegCM reproduced very well the zones of strong precipitation.
- ✓ realistic representation of monsoon precipitations with a maximum bias of 15 %.

REGIONAL LEVEL RAINFALL SENSITIVITY SST (OISST-HADSST)

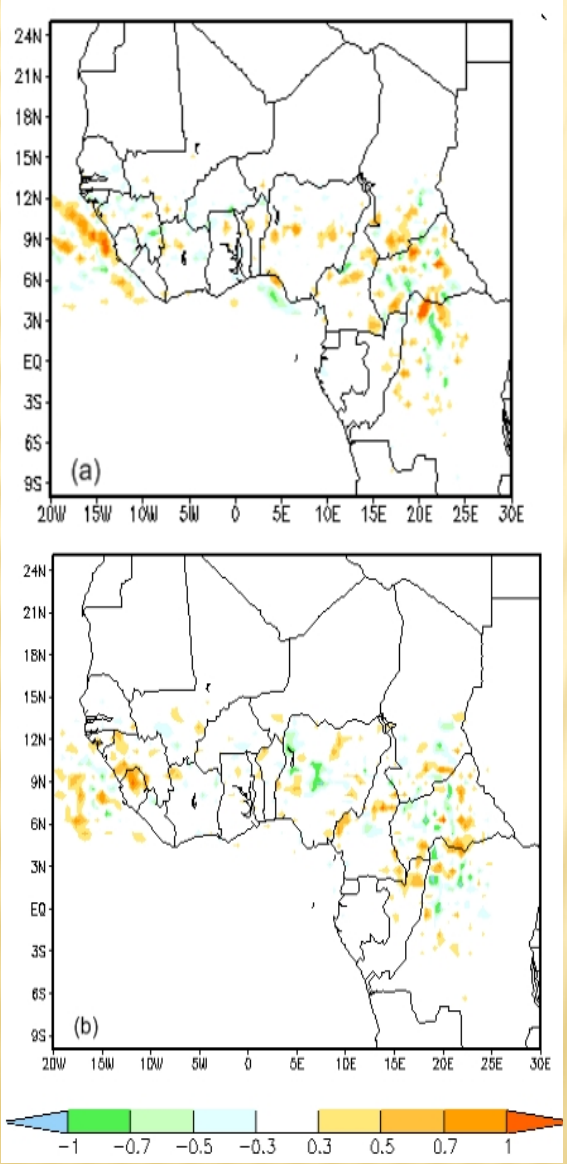


Figure 2: difference between the mean JJAS precipitation over the years 2000 and 2004-2006 model forced with two types of SST. (a) OISST-HadISST1 (static). (b) OISST-HadISST1 (dynamic).

- Same structure regarding results
- Quasi-absent baises over a large zone on the continent and generally lower than 0.4 mm/day.
  - ✓ very weak difference between the results obtained after using OISST and HadSST1 data
  - ✓ Biases observed between the universities of Cocody and Abou Moumouni can't be attributed to SST used.

REGIONAL LEVEL SENSITIVITY STUDIES

SENSITIVITY TO STATIC AND DYNAMIC CONFIGURATIONS

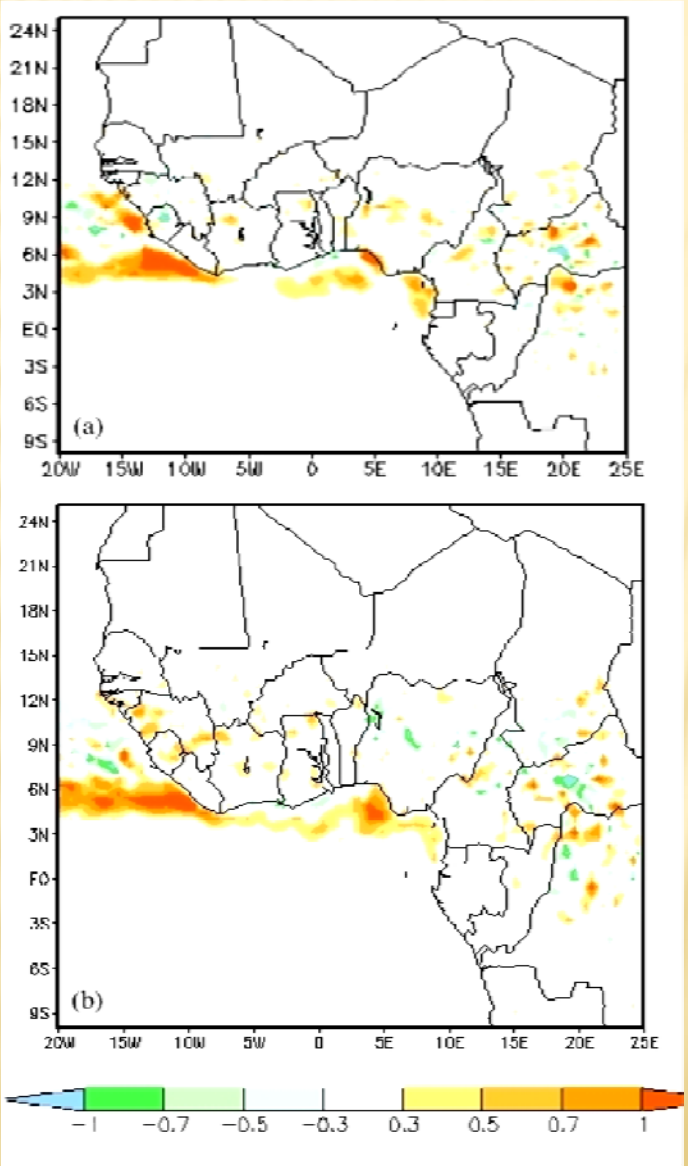


Figure 3: Difference between the mean precipitations during the JJAS period over the years 2000 and 2004-2006 resulting from simulations (using the model) in static and dynamic modes: (a) static OISST-dynamic OISST; (b) static HadISST1-dynamic HadISST1.

- The mostly biases observed over ocean but the values were relatively lower than 0.6 mm/day.
- over the continent, biases lower than 0.4 mm/day
- Dynamic mode simulation of the WAM did not fundamentally improve at the seasonal scale
- This result not deny the impact of oceanic conditions of the Atlantic on WAM variability : shows the necessity of a real coupling between ocean and atmosphere.

FOCUS ON COTE D'IVOIRE: SENSITIVITY TO SST

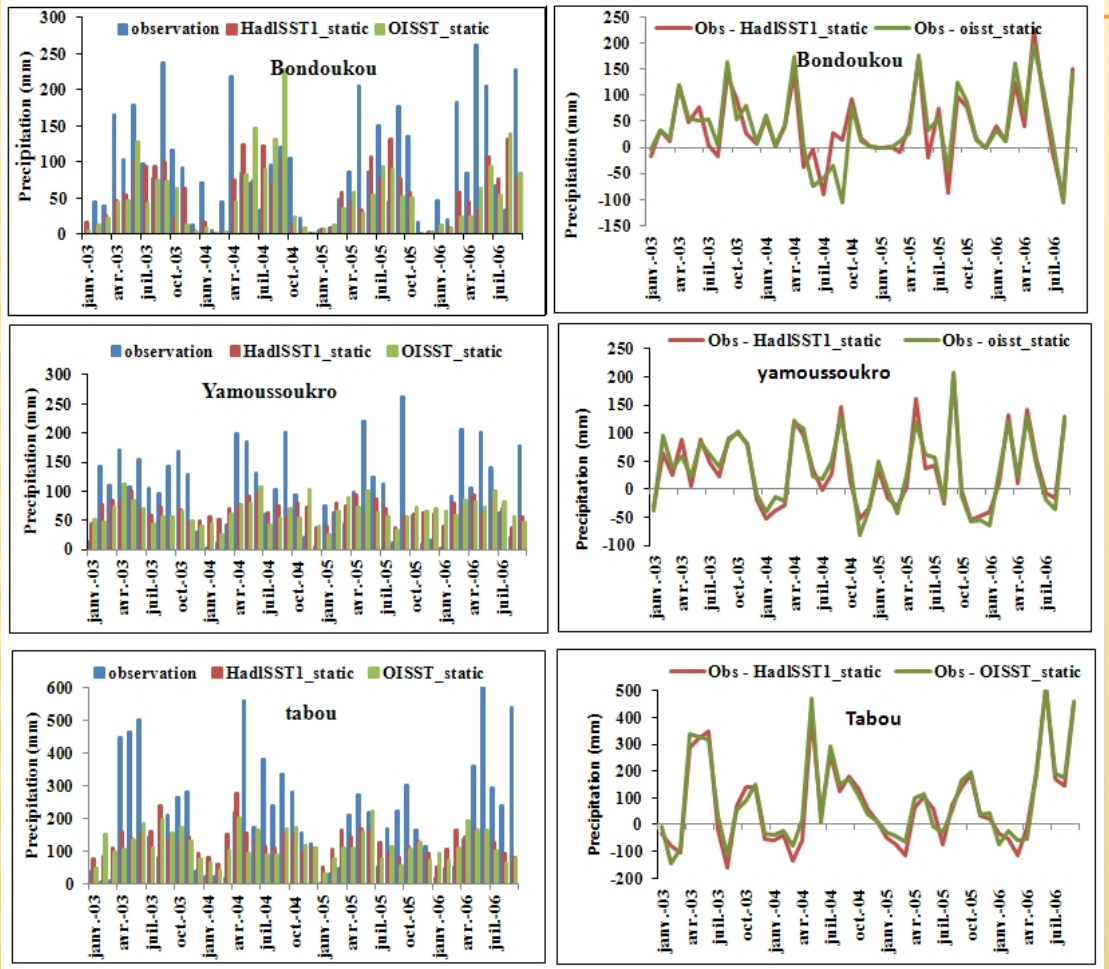


Figure 5: Evolution and differences related to observations of precipitations at three stations in Côte d'Ivoire (Bondoukou, Yamoussoukro and Tabou). Left: cumulated means; right: differences in relation to observations. Simulations were made using the model in static mode.

- Generally, RegCM underested precipitations at each meteorological stations - agrees with spatial studies made on the West African domain.

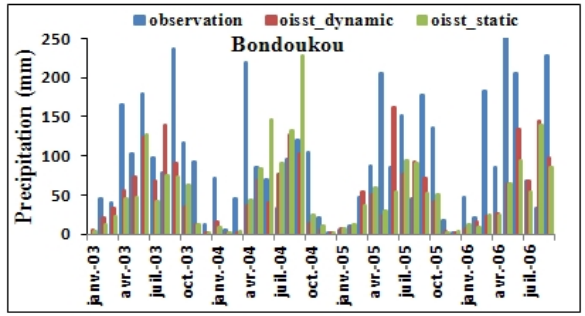
- At Bondoukou station (8'03°N and 2'59°W):
  - ✓ the most realistic RegCM simulations were provided during the monsoon (June-September) which seemed to moderately overestimate.

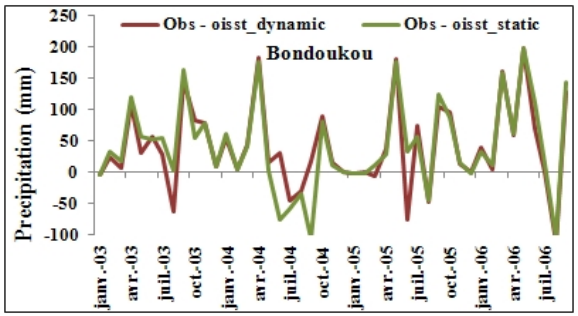
  - ✓ The most elevated biases (to 200 mm/month) found both before and after monsoon rains i.e. during dry season

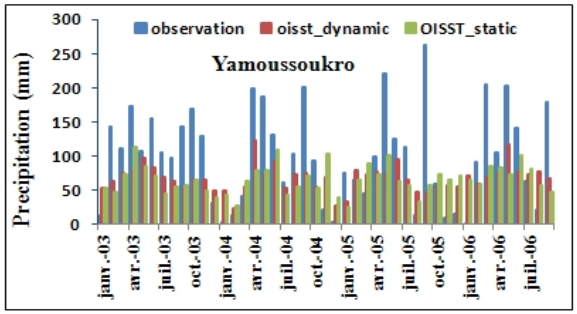
- At Yamoussoukro station (6'28°N and 3'30°W:
  - ✓ Results close to Bondoukou station

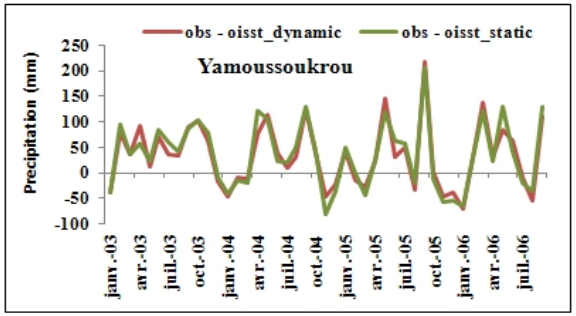
- Tabou station (4'25°N; 7'22°W); coastal zone:
  - ✓ Most biases (to 300mm/month) during period of intensive precipitations (May-June)
  - ✓ which might be an obstacle while representing the near-coastal monsoon band

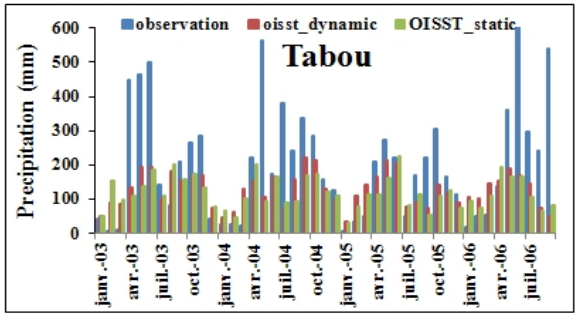
FOCUS ON COTE D'IVOIRE SENSITIVITY TO STATIC AND DYNAMIC CONFIGURATIONS











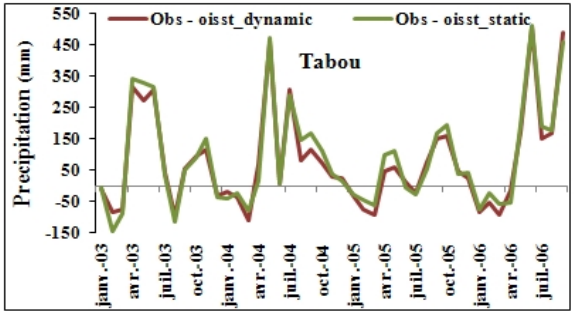


Figure 6: Evolution and differences related to observations of precipitations at three stations in Côte d'Ivoire (Bondoukou, Yamoussoukro and Tabou). Left: cumulated means; right: differences in relation to observations. Results obtained in dynamic and static modes have been superimposed.

- Bondoukou station:
  - ✓ most sensitive biases found at rainy season (but too weak to be interpreted).
- Yamoussoukro and Tabou stations:
  - ✓ any significant difference in the respective progressions of the two simulations modes.
  - ✓ However, the static mode seemed to provide weaker values compared to those of the dynamic mode at Yamoussoukro.
- Identical representation of dry and humid periods, which confirmed the result found at the spatial study.

INTRA-SEASONAL VARIABILITY

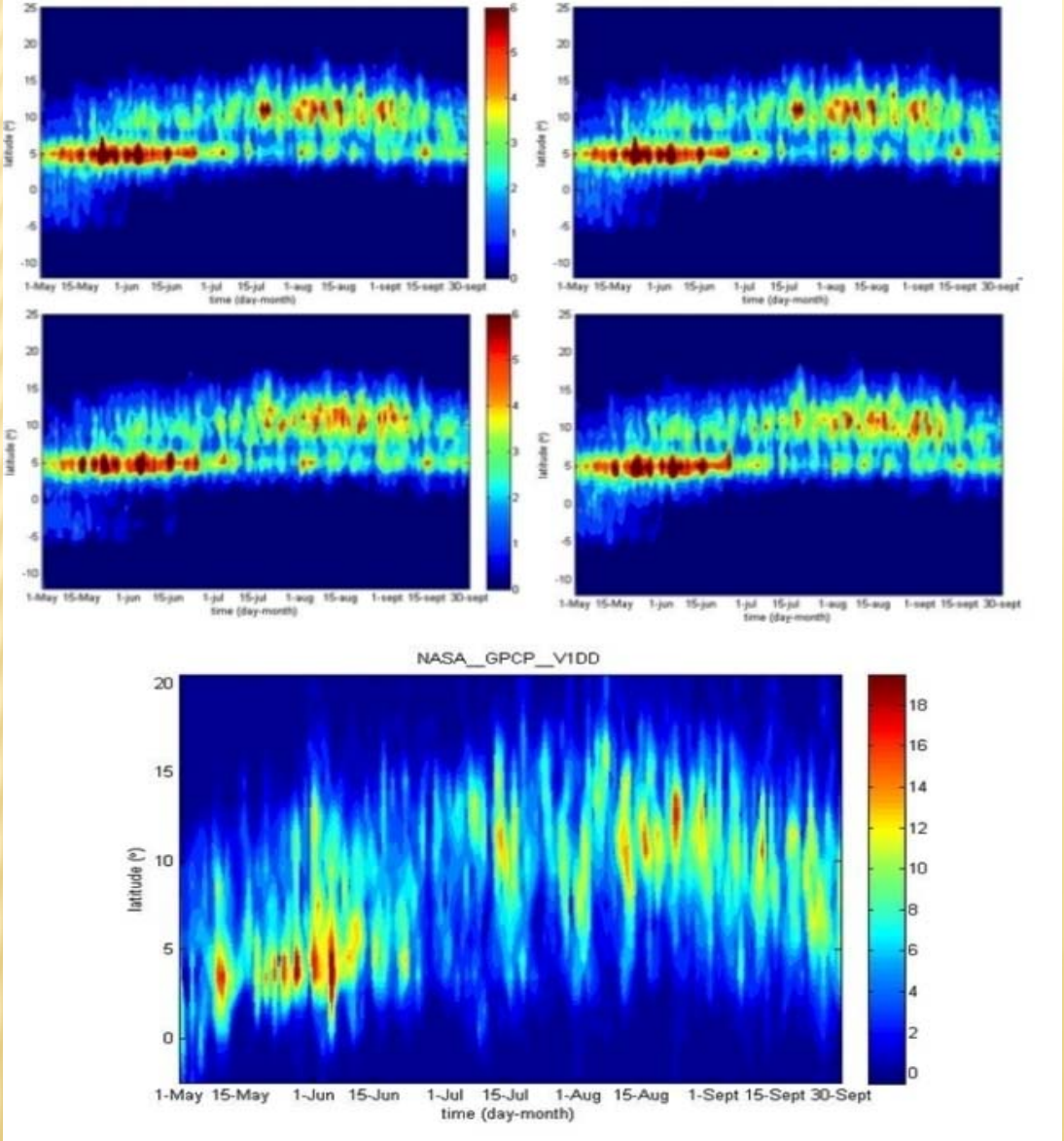


Figure 4: Seasonal progression of daily mean precipitation (time-latitude) recorded between 10°W and 10°E over the years 2000; 2004-2006. (a) simulation forced with OISST in static mode; (b) simulation forced with OISST in dynamic mode; (c) simulation forced with OISST in static mode; (d) simulation forced with HadISST1 in dynamic mode

- not significant differences through the monsoon jump representation.
- same dates of jump and retreat were found
- dynamic simulation seems to reduce precipitations.
- better catch of monsoon jump and retreat

SUMMARY

- It appeared a better RegCM simulation of zones of strong pluviometry. Precipitation distribution in agreement with the mean position of ITCZ whatever the SST used to force the model and the mode chosen.
- In general, realistic representation of monsoon precipitations found with a maximum bias of 15 %.
- the chosen version of SST (OISST or HadlSST1) did not really influence precipitation simulations during the WAM whatever the mode used.
- Monsoon simulation in dynamic mode did not provide fundamental improvement
- this result demonstrates the need to take into account effectively the ocean-atmosphere feedback in the simulation of the West African monsoon through a real coupling between ocean and atmosphere.
- better catch of monsoon jump was done in this study, which remained an important criterion for model ability in reproducing and predicting basic characteristics of the WAM.
- Focus on Côte d'Ivoire through the stations of Bondoukou, Yamoussoukro and Tabou, confirmed spatial study i.e. very low differences between precipitations resulting from OISST and HadlSST1 both in static and dynamic mode.

- THANK YOU FOR YOUR ATTENTION