Climate Variability and Malaria over the Sahel Country of Senegal

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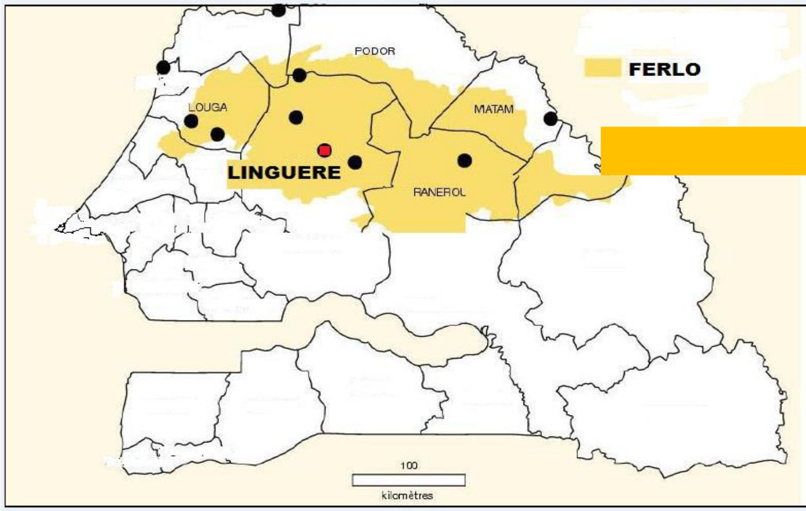
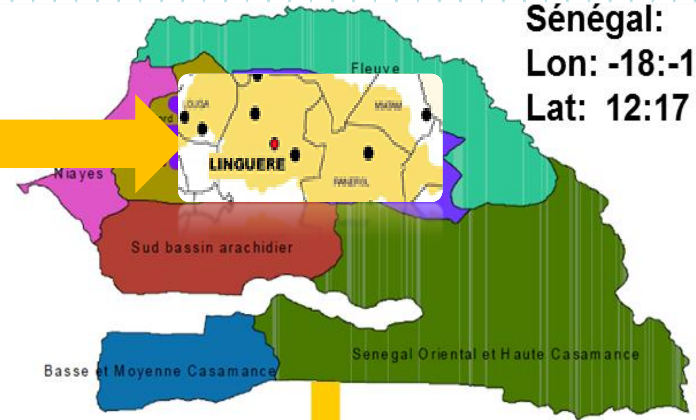
Area of study

INTRODUCTION





Sénégal:
Lon: -18:-11
Lat: 12:17

Barkedji, station référence au Ferlo:
Lon: 14° 53
Lat: 15° 57

The Ferlo is a sylvopastoral region, with a most sahelian climate conditions.

Sahel:
Lon: -18:15
Lat: 9:21

Map showing locations of the stations used in this study. The study is extend to the Sahel region for the seasonal malaria predictability using the S4CAST model

CLIMATE AND MALARIA RELATIONSHIP

INTRODUCTION

Essential parameters

Pathogen agent: plasmodium

Vector of transmission : anopheles

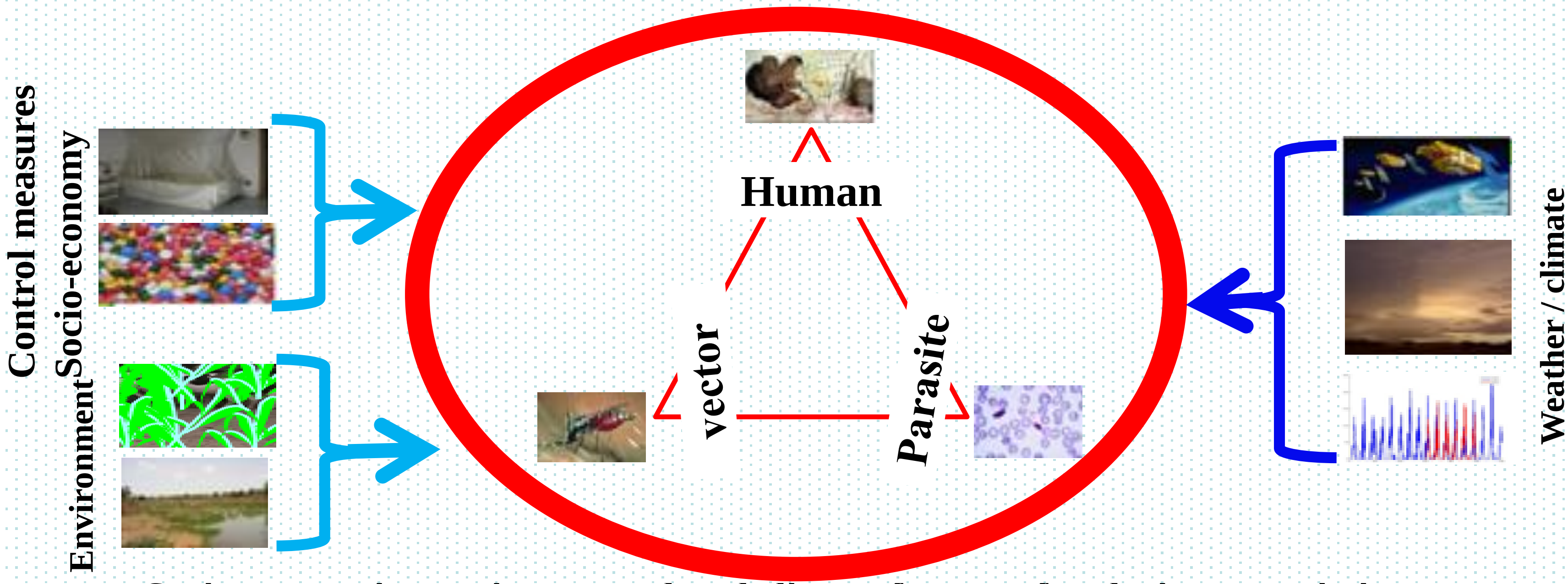
Host: human

Climate drivers of malaria

Rainfall : provides breeding sites for mosqutoes.

Temperature: larvae growth, vector survival, egg development in vector, parasite development in vector.

Climate parameters can influence malaria transmission by tree (3) ways : 1) distribution and abondance anopheles vectors, 2) possibility and success of the sporogonic cycle of the parasite inside the vertor, 3) and then the modulation of human-vector (Lindsay et al, 1996)



Socio-economic, environmental and climate factors of malaria transmission

DATA AND METHODS

DATA AND METHODS

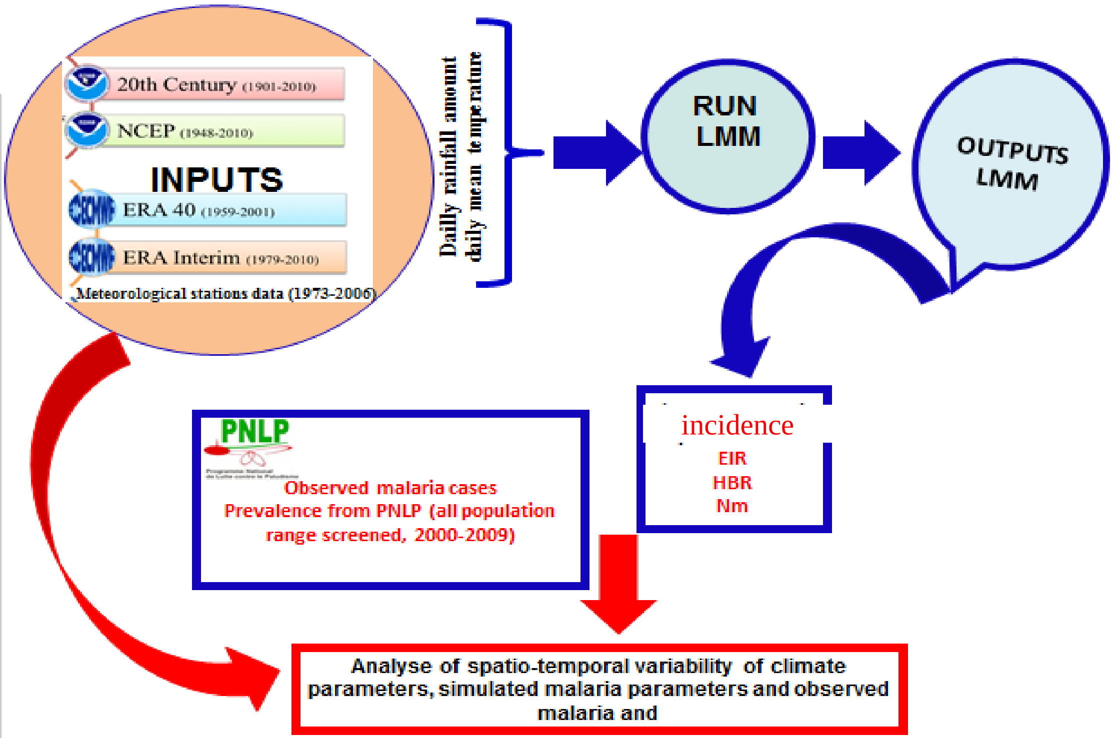
Observations		
Datasets	**Period**	**Stations**
Malaria cases	2001–2016	Dakar 14.73° N, 17.5° W; Diourbel 14.4° N, 16.6° W; Fatick 14.21° N, 16.35° W; Kaolack 14.13° N, 16.07° W; Kolda 14.88° N, 14.08° W; Louga 15.37° N, 16.13° W; Matam 15.65° N, 13.25° W; Saint-Louis 16.05° N, 16.45° W; Tambacounda 13.77° N, 13.68° W; Thies 14.8° N, 17° W; Ziguinchor 12.55° N, 16.27° W
Meteorological and CHIRPS rainfall	1981–2010	

Reanalysis Inputs		
Datasets	**Period**	**Grid**
20th Century Reanalysis Project daily averages	1910–2009	2.5° × 2.5°
NCEP	1960–2013	2.5° × 2.5°
ERA40 [58]	1958–2001	2.5° × 2.5°
ERA Interim	1979–2015	1.5° × 1.5°

CHIRPS: Climate Hazards Group InfraRed Precipitation with Stations; NCEP: National Centers for Environmental Prediction; ERA: European Center for Medium Range Weather Forecast reanalysis.

Different reanalysis datasets used to perform the malaria incidence with their full periods, grid and references.

DATA AND METHODS



This study consists of observations and simulations of malaria parameters using the Liverpool Malaria Model (LMM).

The LMM is a dynamical malaria model driven by daily time series of rainfall and temperature.

(Hoshen et al., 2004)

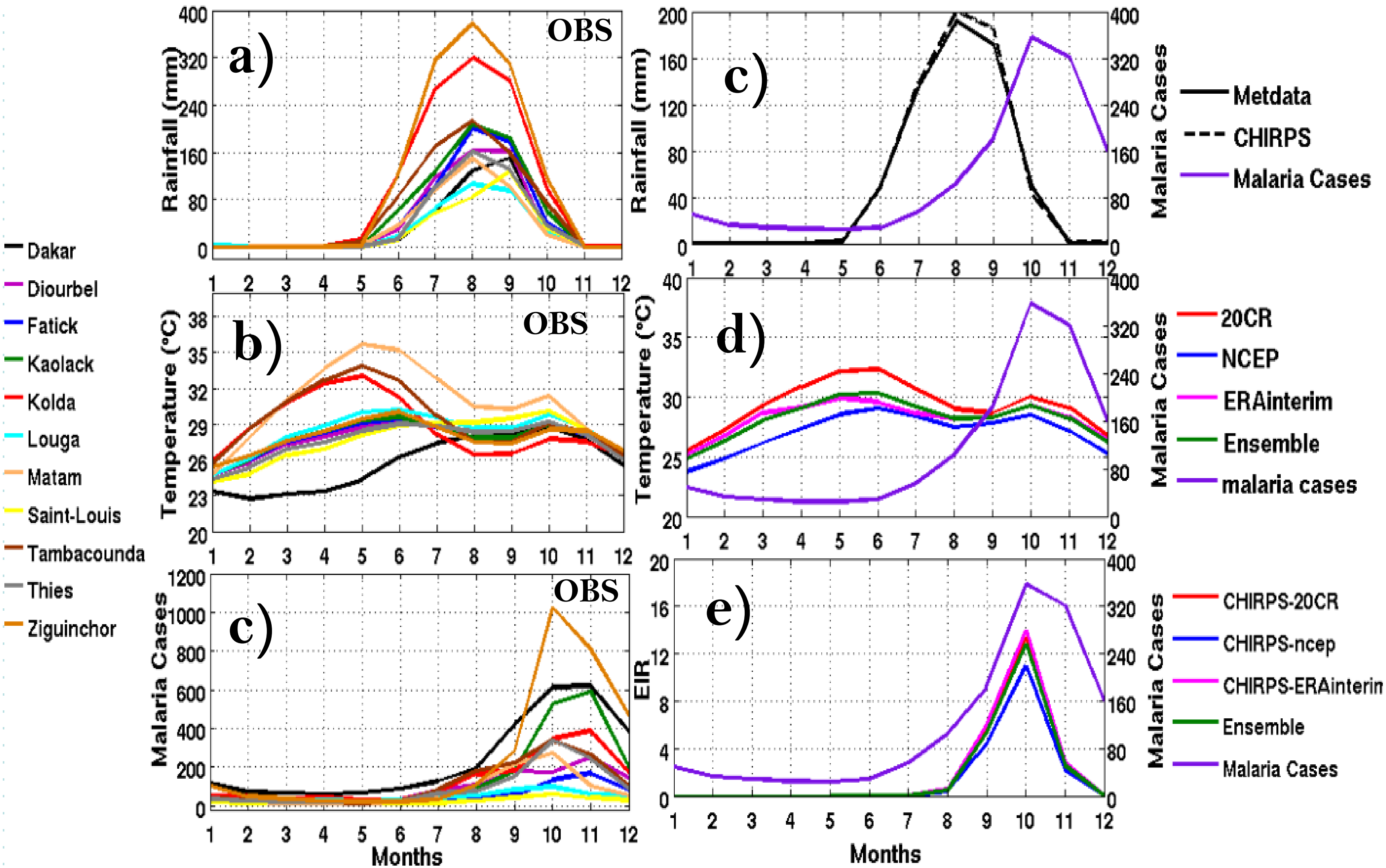
DATA AND METHODS

In addition, we employ the S4CAST model (Sea Surface temperature based Statistical Seasonal Forecast model) to explore the malaria outbreaks predictability over Sahel.

We use observed SST as predictor field due to its influence on rainfall and temperature, and then on malaria incidence. We examine the leading MCA covariability mode to evaluate and quantify the predictability of malaria in relationship with SST. (Suárez-Moreno et Rodríguez-Fonseca, 2015)

FINDINGS ON MALARIA IN SENEGAL

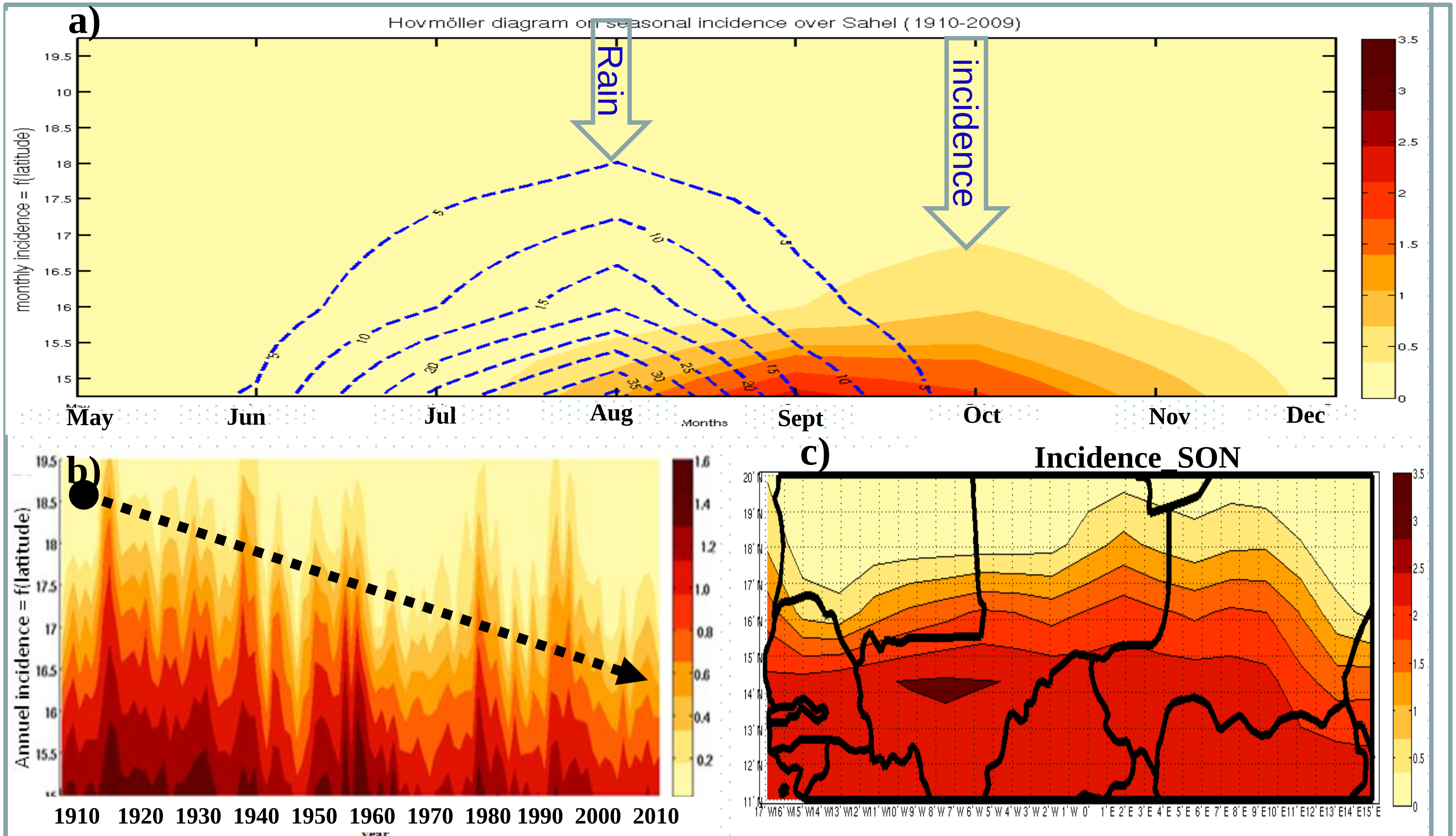
RESULTS



Diouf etal., 2017 in International Journal of Environmental Research and Public Health (IJERPH)

FINDINGS ON MALARIA IN SAHEL

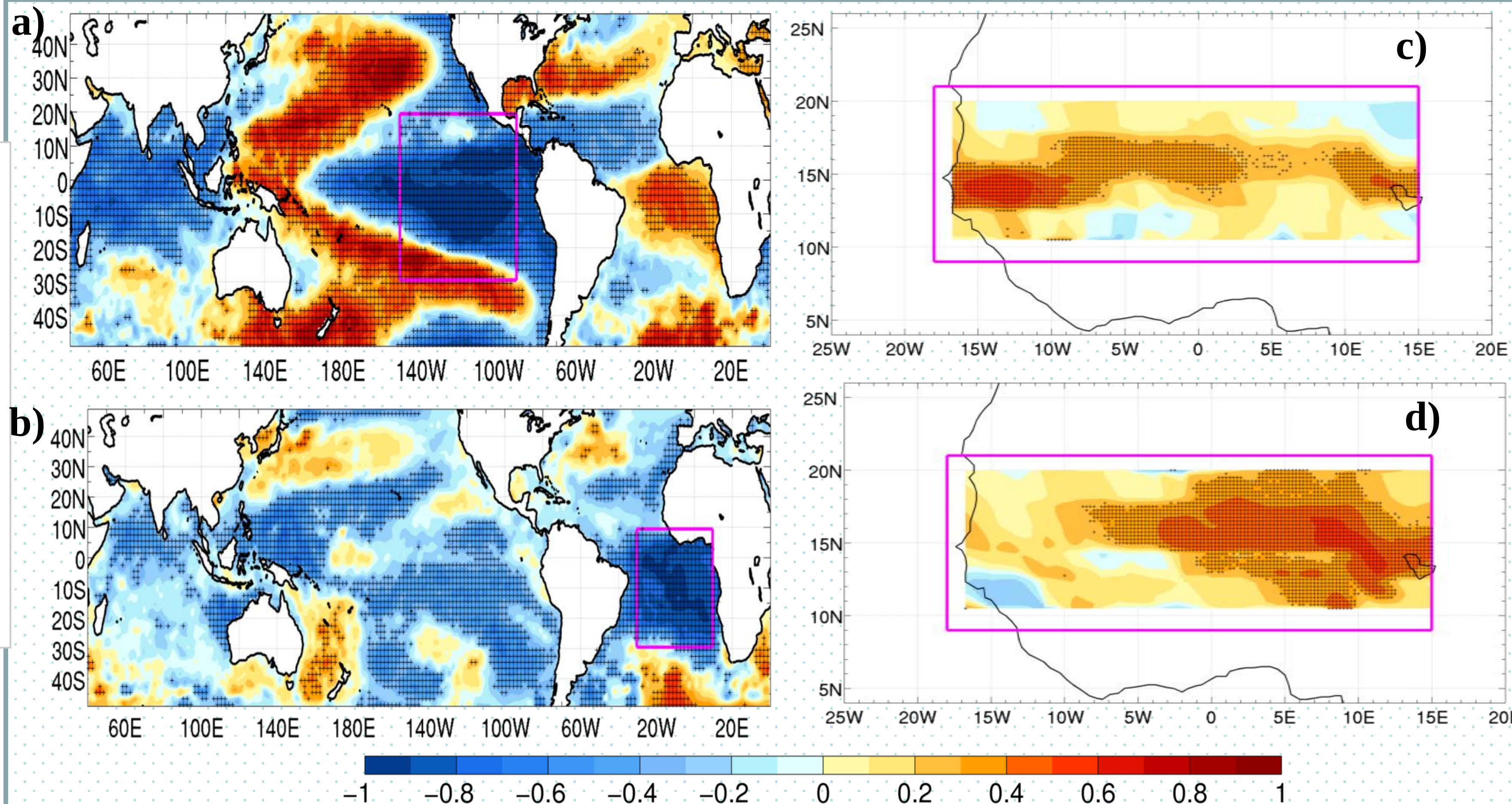
RESULTS



Hovmöller diagram on the annual cycle of the incidence superimposed on the annual precipitation cycle in the Sahel (a), Hovmöller diagram on the interannual variability of the incidence (b), spatial distribution of the malaria parameters in the Sahel in September-October-November (SON) (c) of malaria incidence averaged over the Sahel from 1910 to 2009 with 20thCR reanalysis

RELATIONSHIPS SST AND SEASONAL IMPACT ON MALARIA IN THE SAHEL

RESULTS



Column 1: Correlation map (a, Pacific, b, Atlantic) for the first mode of co-variability for the non-stationarity period and lag5 (Apr-May-Jun). Column 2: Correlation map (c and d, Sahel incidence on Sept-Oct-Nov) for the first mode of co-variability for the non-stationarity period and lag5 (Apr-May-Jun). The rectangles show the regions selected for the predictor and predictor fields and considered in the MCA analysis. The values are plotted for regions where the level of statistical significance under a MonteCarlo test is greater than 90%.

Conclusion

CONCLUSION

- High malaria transmission in September-October-November corresponding to two months after the peak of rains in August;
- North-South latitudinal gradient of malaria transmission according to the spatial variability of rainfall;
- The relationship between observed and simulated malaria parameters is presented, but there are some discrepancies between reanalysis.
- A negative anomalous SST signal in the Atlantic (cooling) is associated with a positive anomalous malaria incidence signal (high malaria transmission) on the Sahel, this result is coherent with the findings in relation to Atlantic SSTs and precipitations in the Sahel.
- A negative anomalous SST signal in the Pacific (cooling) is associated with a positive and strong anomalous malaria incidence signal (high malaria transmission) on the Sahel.
- In the framework of applying forecast on health issue, these results are expected to be useful for decision makers who plan public health measures in affected countries in Sahel and elsewhere

Perspectives in Climate and Health Project for Africa at CPC/NOAA

PERSPECTIVES

❖ Diagnostics: Malaria Predictability

Data:

- Malaria data obtained from the PNLP (National Program for Malaria Control in Senegal)
- Daily Rainfall and temperature extracted from meteorological stations, satellite, and reanalysis

Tools:

Liverpool Malaria Model (LMM) and VECTRI model (VECtor borne disease community model of ICTP, TRIeste)

- Canonical Correlation Analysis (CCA)
- Sea Surface based Statistical Seasonal Forecast (S4CAST)

❖ Operational Real-Time Climate Information for Malaria

- Provide access to real time climate information of potential benefit to the health sector
- Work with the health and meteorological communities in Africa to generate periodic experimental risk maps for malaria for Senegal and West Africa

THANK YOU