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Seasonal and Subseasonal Forecast Applications on Climate and Malaria in West Africa

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This study is a contribution to the Climate and Health Project in development at the CPC/NOAA

Climate and Malaria Relationship

Essential parameters

Pathogen agent: plasmodium

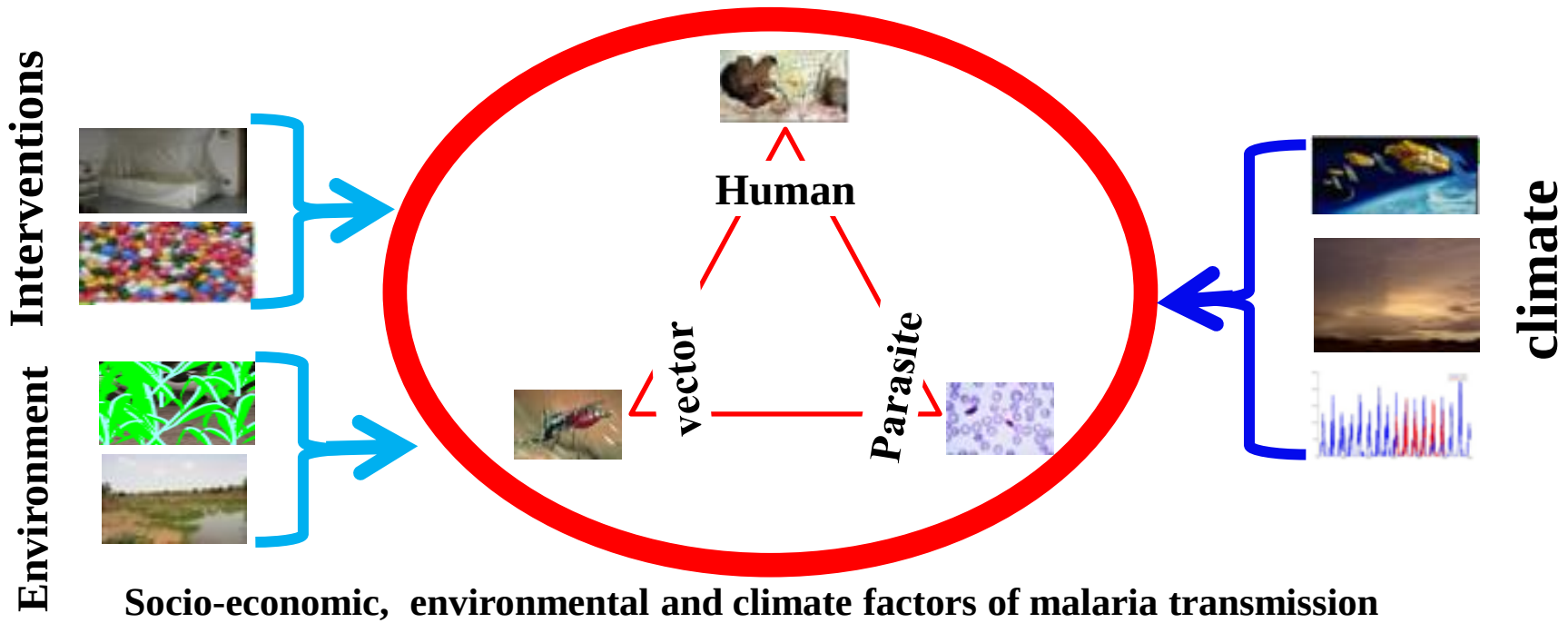
Vector of transmission : anopheles

Host: human

Climate drivers of malaria

Rainfall : provides breeding sites for mosqutoes.

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



Socio-economic, environmental and climate factors of malaria transmission

❑ Data:

➢Daily rainfall and daily temperature extracted from available datasets at CPC/NOAA

➢Simulated malaria parameters such as Incidence in %

➢Malaria data obtained from National Program for Malaria Control (like in Senegal)

❑ Tools:

➢Liverpool Malaria Model (LMM) (Hoshen etal, 2004)

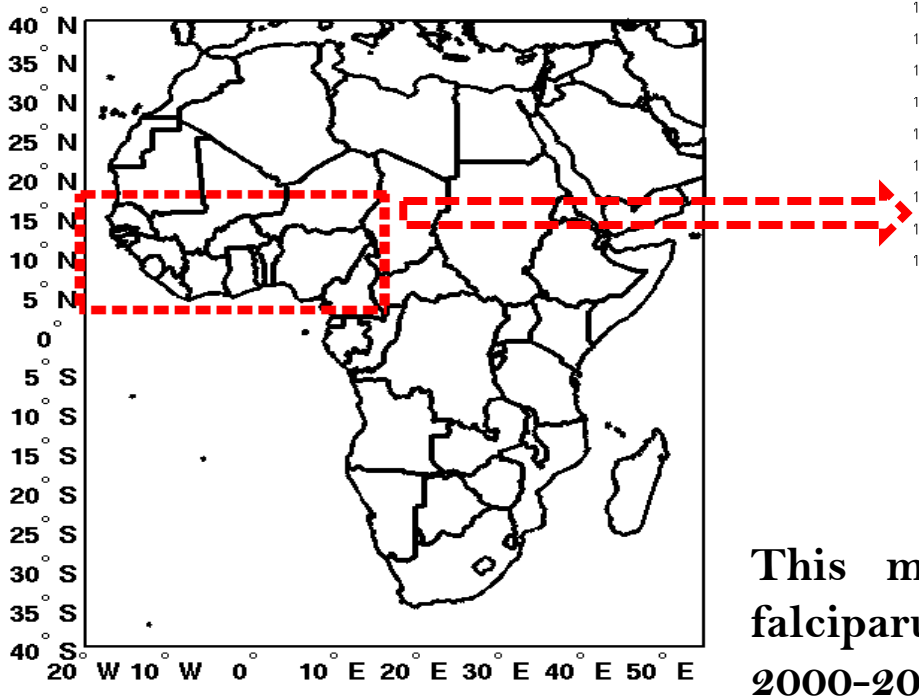
➢VECTRI model (VECtor borne disease community model of ICTP, TRIeste) (Tompkins AM, & Ermert V, 2013)

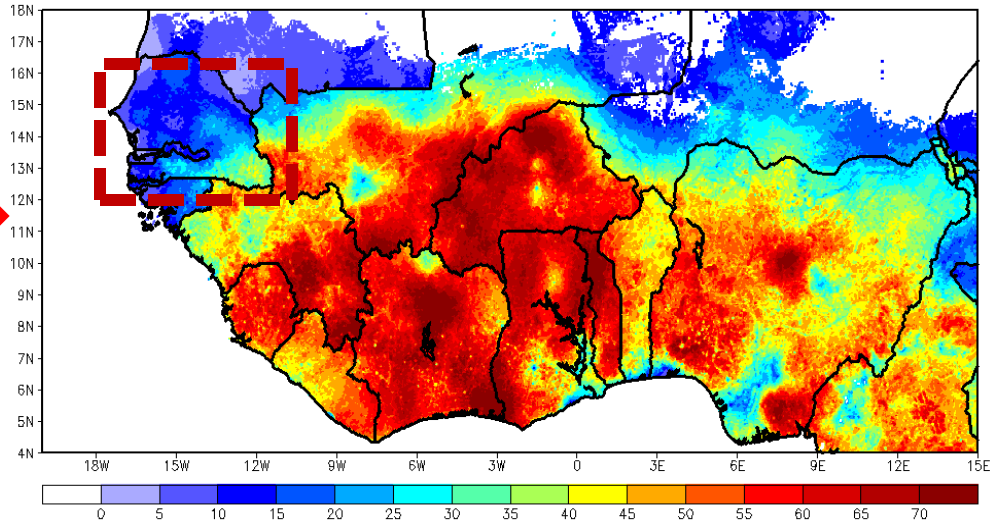
➢ Canonical Correlation Analysis (CCA) (Thompson B., 2005)

➢ Sea Surface based Statistical Seasonal Forecast (S4CAST) (Suárez-Moreno and Rodríguez-Fonseca, 2015, 2018)

❖Provide Access to Real-Time Climate Information for Malaria

Study Area: West Africa, 18W-15E; 4N-18N



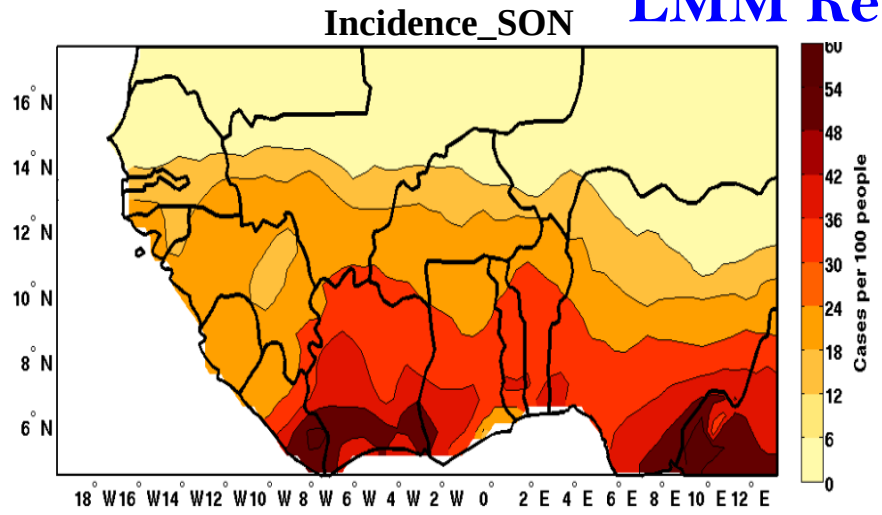


This map represents the prevalence rate of P. falciparum malaria in 2-10 year olds in WA, (average 2000-2015).

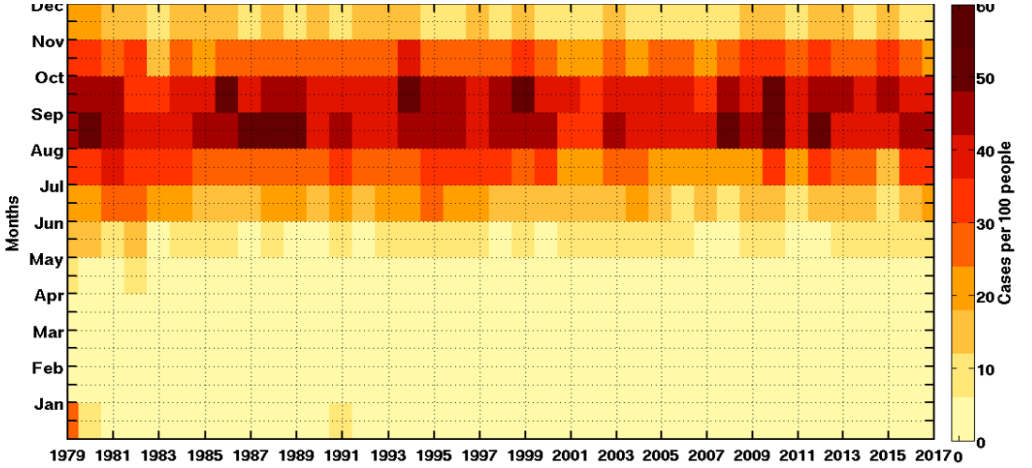
Location of the study area: West Africa delimited in red color, - 4 °N to 18 °N and 20 °W to 15 °E.

- These data are collected from different malaria locations across African countries via the Malaria Atlas Project (MAP), they could serve to partially validate the model outputs.
- **Malaria prevalence is low in Senegal, this is related to malaria control parameters such as interventions with insecticide-treated bed nets, but also the Artemisinin-based combination therapy (ACT) for treatment.**
- The wetter area (south of West Africa) experiences endemic malaria prevalence.

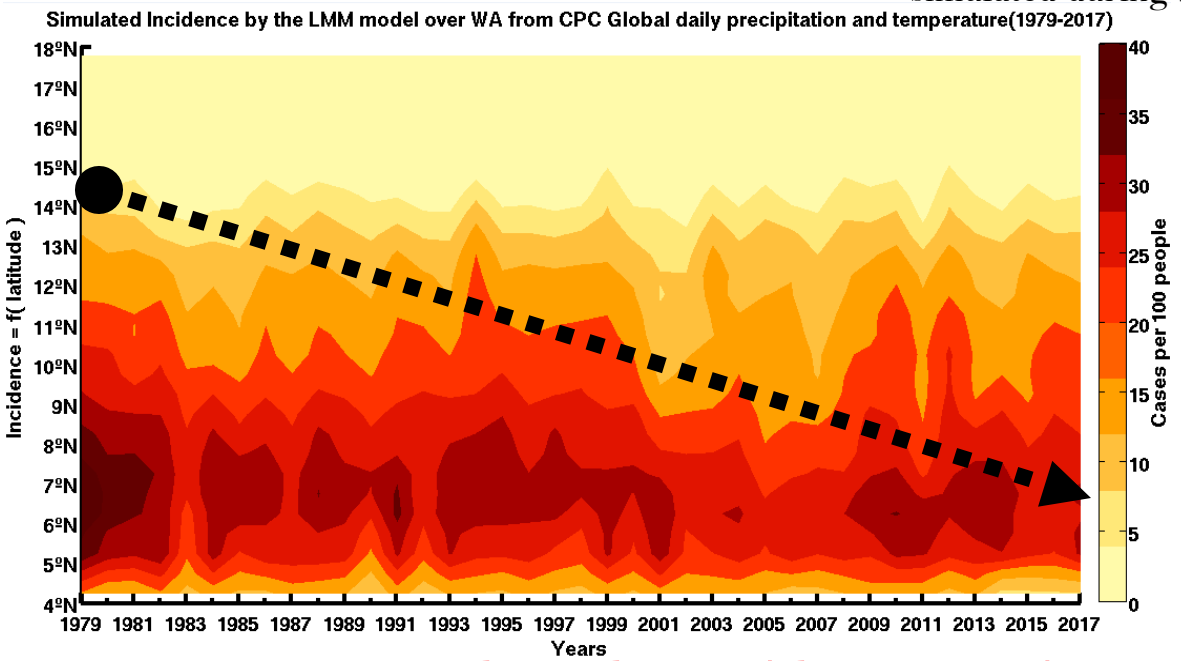
LMM Results in West Africa



Spatial distribution of malaria incidence in WA from CPC Global daily rainfall and temperature (1979-2017). Maximum occurrence area is found in the South and South-eastern of West Africa.

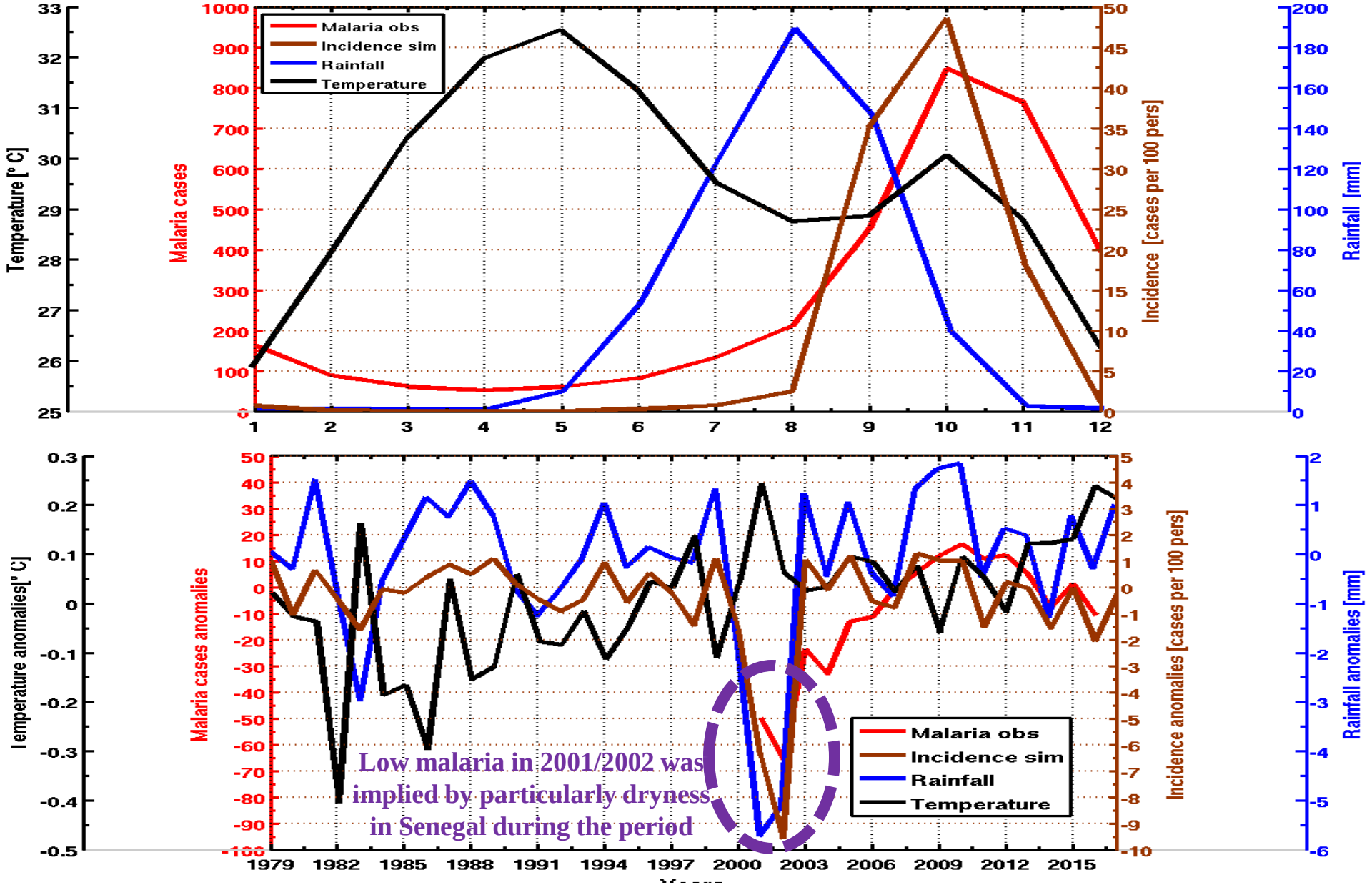


Simulated intra/inter-annual variability of malaria incidence in WA from CPC Global daily rainfall and temperature (1979-2017). Maximum occurrence area is found in the South and South-eastern of West Africa. Maximum malaria incidence is simulated during Sept-Oct-Nov.



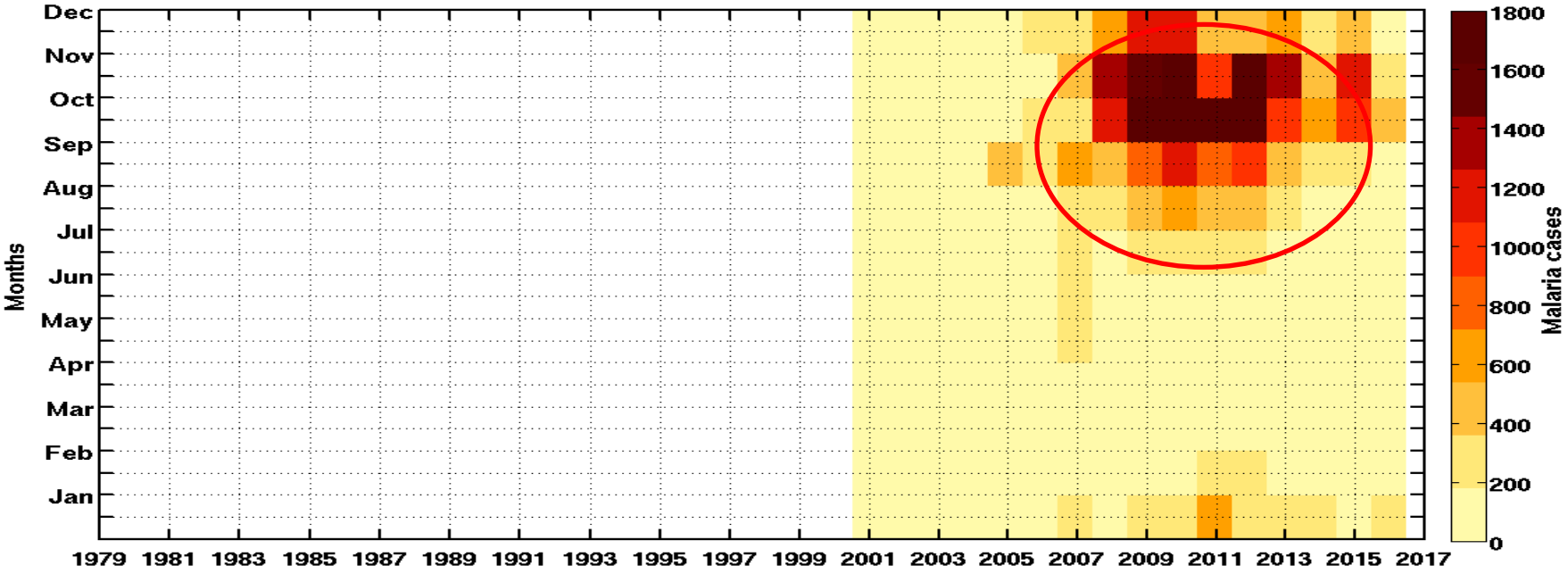
Decrease in inter-annual variability and strong malaria incidence signal over the Southern latitudes

LMM Results vs observed malaria in Senegal

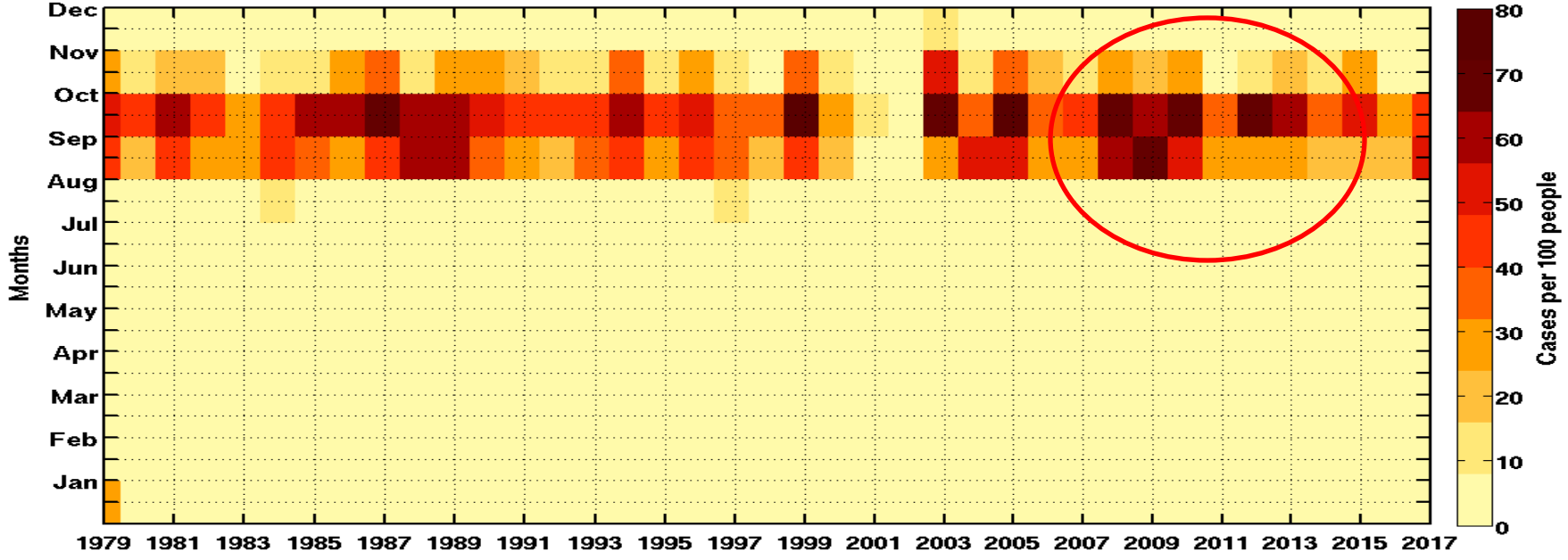


LMM Results vs observed malaria in Senegal

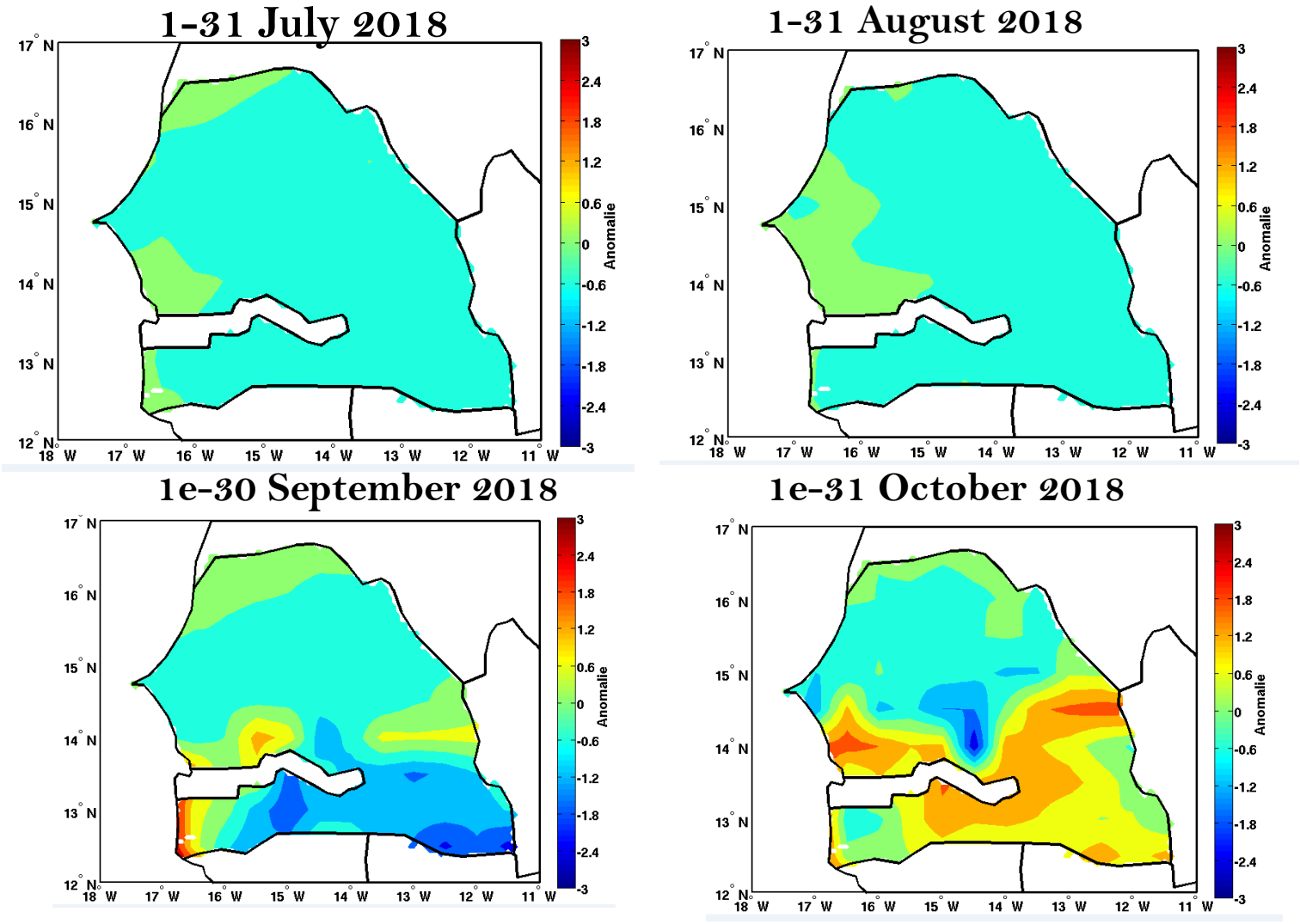
Observed malaria cases malaria



Simulated malaria incidence



LMM Results vs observed malaria in Senegal



In yellow to dark red color, we note an increase in the incidence for the month of October especially in the south-eastern area of Senegal; a drop in blue in the south in September. The situation is almost normal in July and August.

Introduction on Malaria Predictability, Senegal, West Africa

Target Season: September-October-November **(SON)**
Used lead Time: March initial conditions

❑ Predictors are SST indices (°C):

➢ SST (ERSSTv4) in March over the following ocean basins :

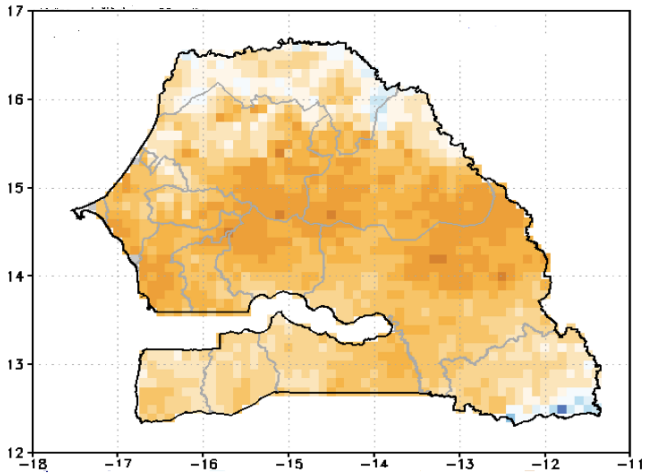
- ✓ **Tropical Pacific (TROP-PAC): 15N-15S & 70W-120E**
- ✓ **Gulf of Guinea (GG): 5N-5S & 10E-10W**
- ✓ **Global Tropics (GBL_TROP): 30N-30S & 0E-360W**

❑ Predictand: Malaria incidence (%) over Senegal :

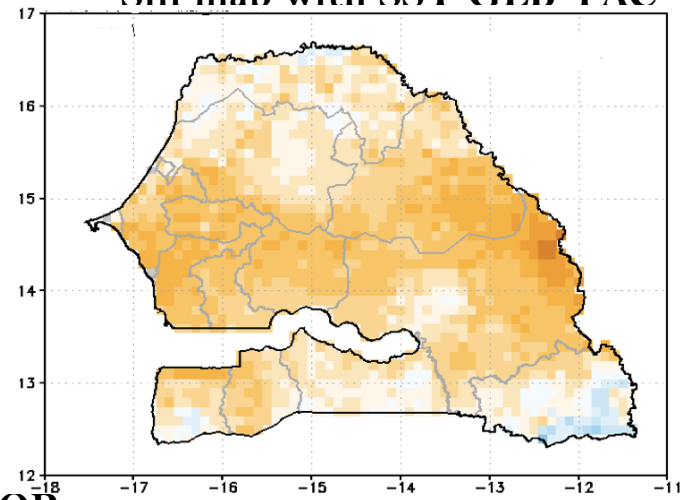
- ✓ **Simulated malaria incidence (LMM) over Senegal based on CPC Global daily precipitation and temperature**

Different ocean basins ERSSTV4 correlation skill Maps (IC: March)

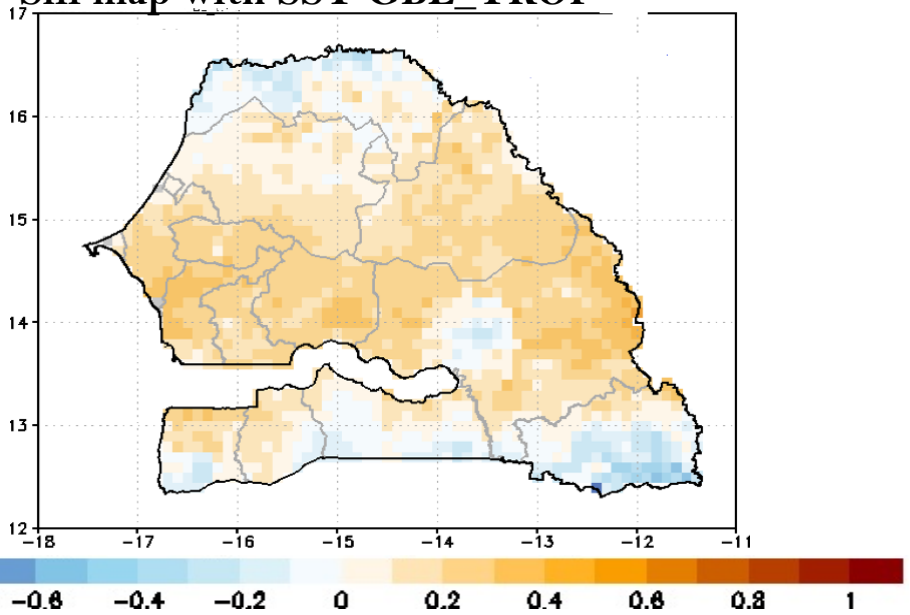
Sill map with SST GG



Sill map with SST GLB_PAC



Sill map with SST GBL_TROP



Good skills are shown for the Gulf of Guinea, the Tropical Pacific and the Global Tropics to a lesser extent.

Conclusions and Perspectives

- ❑ **High malaria transmission in September-October-November corresponding to two months after the peak of rainfall 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 evident ;**
- ❑ **Good skills with Gulf of Guinea, the Tropical Pacific and the Global Tropics encouraging malaria prediction investigation.**
- ➢ **We plan to extend our diagnostic study using NMME predicted SST**
- ➢ **Plan to work on Week 3/4 malaria outlooks, using LMM and VECTRI models and NCEP CFSv2 Model data**

THANK YOU FOR YOUR ATTENTION