



4th AMMA International Conference

The improvement in seasonal forecasting systems for malaria prediction in Africa in the 10 years of AMMA

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Quantifying Weather and Climate
Impacts on Health in Developing
Countries (QWeCI)

**A Seventh Framework Programme
Collaborative Project (SICA)**

13 partners from 9 countries

www.liv.ac.uk/QWeCI

Grant agreement 243964



Themes

- Background and scene setting
- Some brief details on the Liverpool Malaria Model (LMM)
- Results from DEMETER, ENSEMBLES and ECMWF System 4 for precipitation and temperature; and malaria simulation
- Summary

Introduction

- Climate variability important component determining incidence number of diseases (vector-born especially) with significant human and animal health impacts.
- Seasonal forecasting can give information to give better early warning of events opposed to using weather observations or disease surveillance
- Worked with PROVOST, DEMETER, ENSEMBLES (and AMMA), now ECMWF System 4 in QWeCI also GloSea4 (not shown). DEMETER onwards fully coupled models, System 4 (and GloSea4) is operational.
- Have we seen improvements from the prediction systems in the Sahel?

Introduction to Model Systems



DEMETER 1980-2001, **May start** dates – month (**3-5**) forecasts - (7 model, 9 members each, 63 members); 2.5° x 2.5° resolution



ENSEMBLES 1960-2005 **May start** dates – month (**3-5**) forecasts - (5 models, 9 members each, 45 members); 2.5° x 2.5° resolution



System 4 1981-2010 **multiple start dates** from month 1-3 to 5-7; 15 members each start, 0.7° x 0.7° resolution

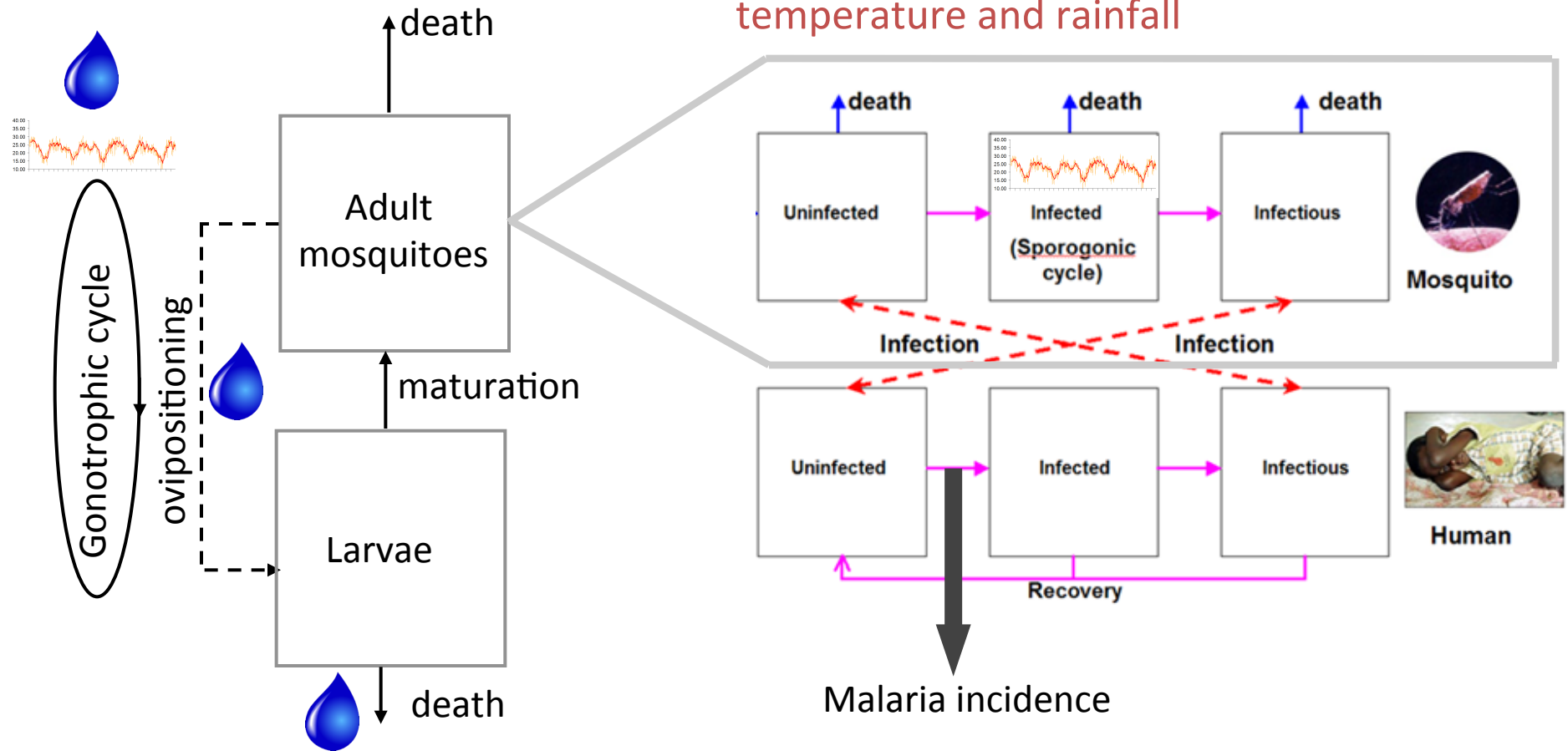
Target is **JAS**, validation is against NCEP for temperature and GPCP for precipitation. Data have interpolated to the lower resolution grid.



Liverpool Malaria Model

(Hoshen and Morse, 2004)

Dynamic, process-based model driven by daily temperature and rainfall



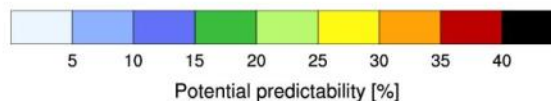
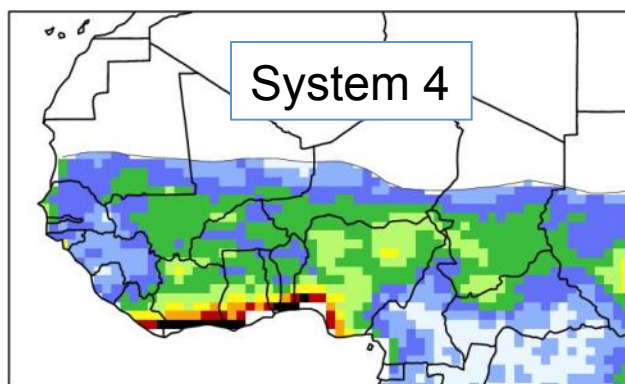
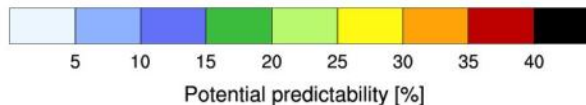
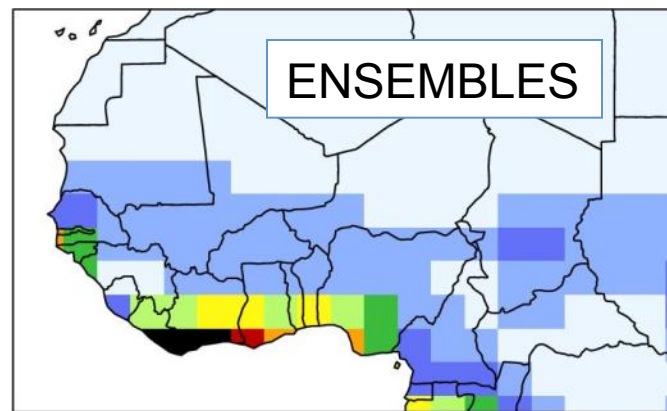
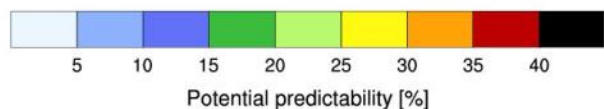
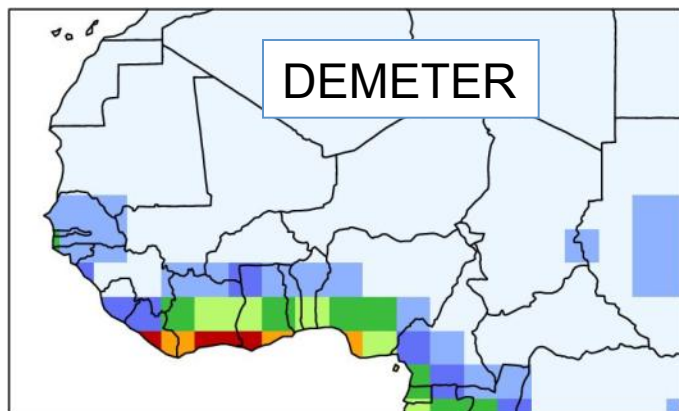
Dynamic mosquito population

Temperature and rainfall-driven

Dynamic malaria transmission

Temperature-driven

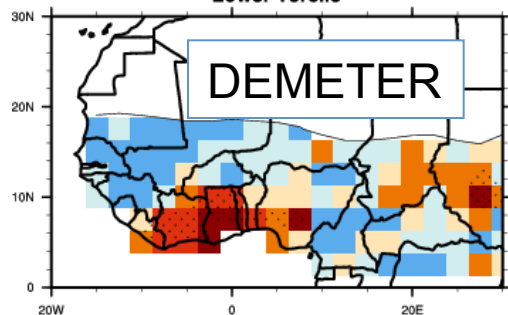
Potential Predictability Precipitation – May for JAS (3-5)



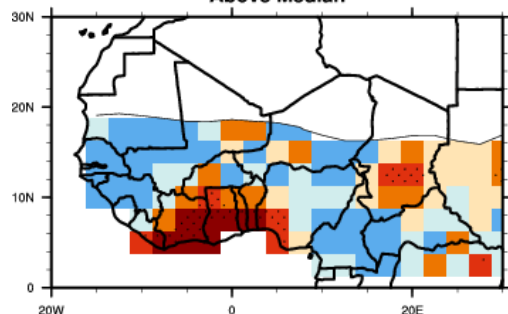
Precipitation ROC May (3-5)

DEMETER s_ensemble prlr ROC area
JAS target, initialised May

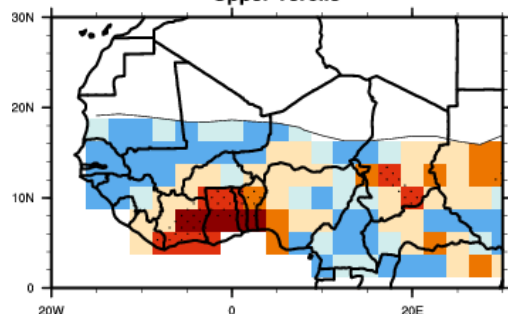
Lower Tercile



Above Median

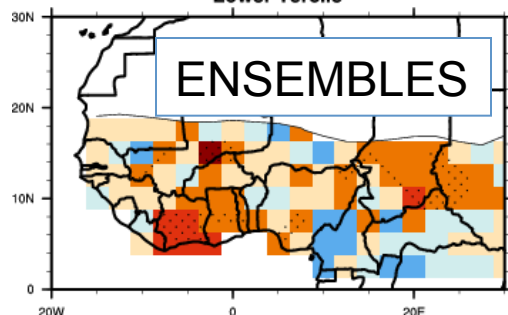


Upper Tercile

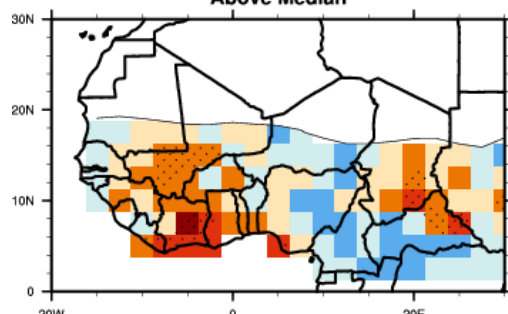


ENSEMBLES-s_ensemble prlr ROC area
JAS target, initialised May

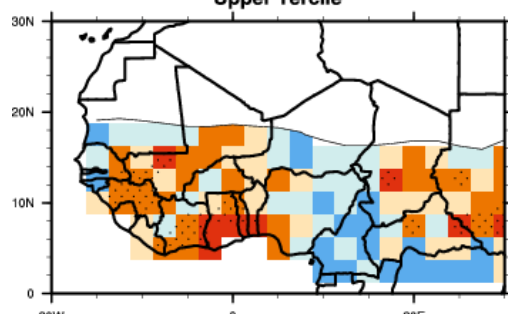
Lower Tercile



Above Median

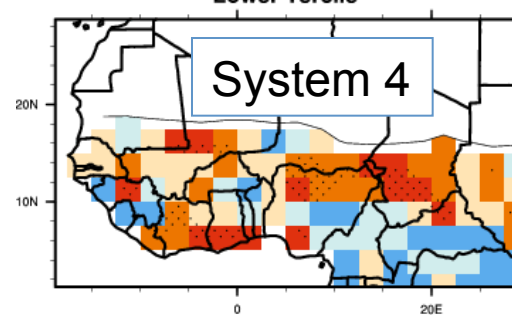


Upper Tercile

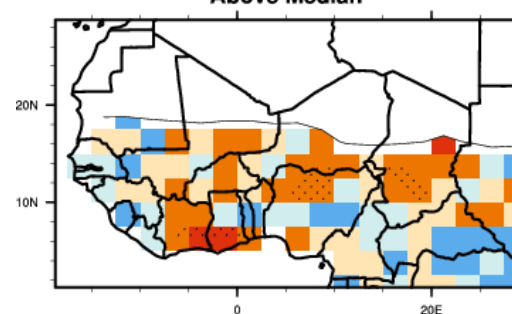


System 4 precipitation ROC area
JAS target, initialised May

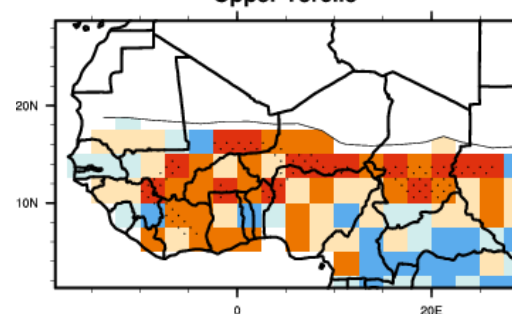
Lower Tercile



Above Median



Upper Tercile



LT

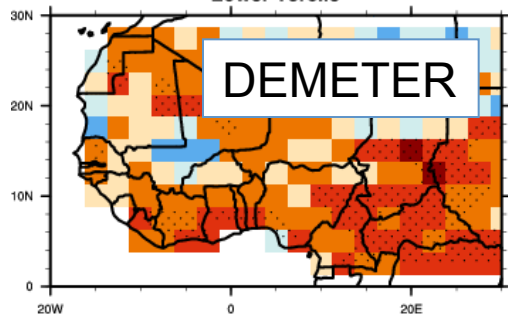
AM

UT

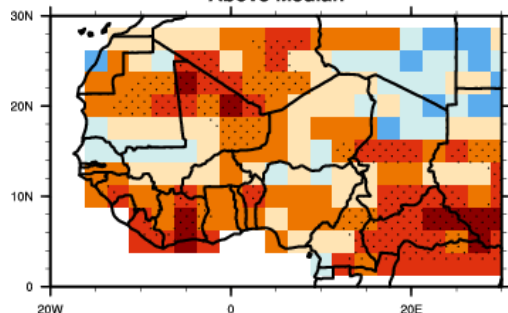
Temperature ROC May (3-5)

DEMETER-s_ensemble tas ROC area
JAS target, initialised May

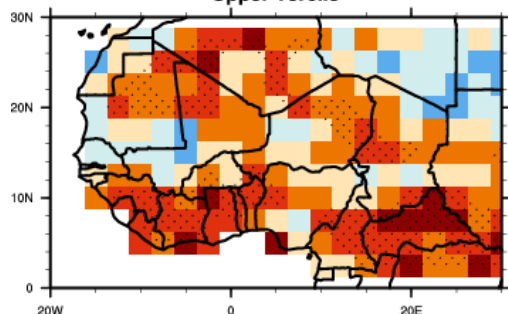
Lower Tercile



Above Median

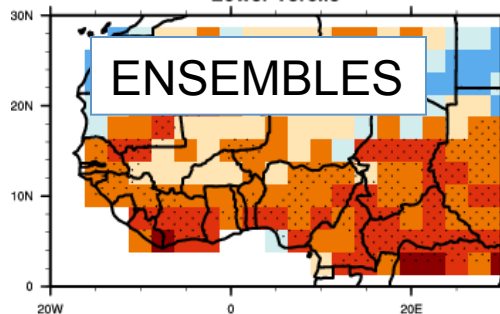


Upper Tercile

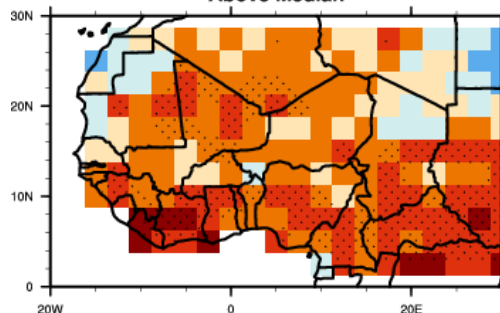


ENSEMBLES-s_ensemble tas ROC area
JAS target, initialised May

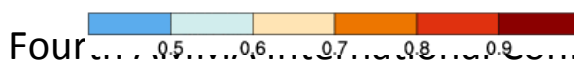
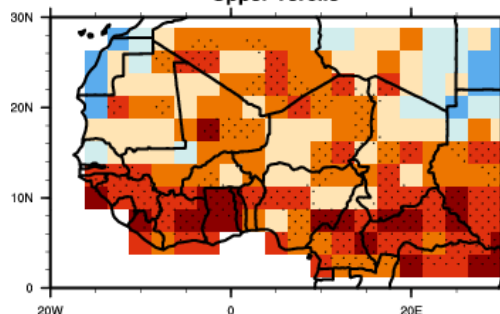
Lower Tercile



Above Median

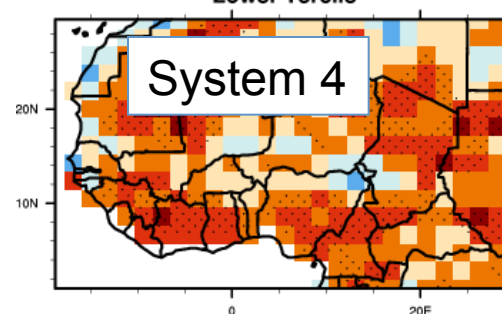


Upper Tercile

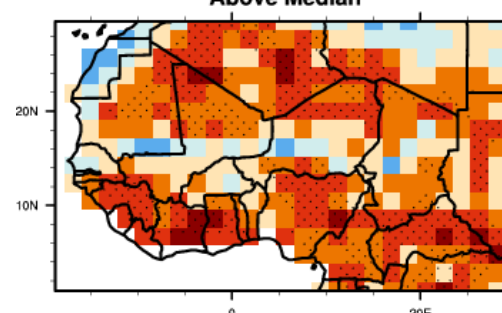


System 4 surface temperature ROC area
JAS target, initialised May

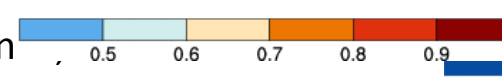
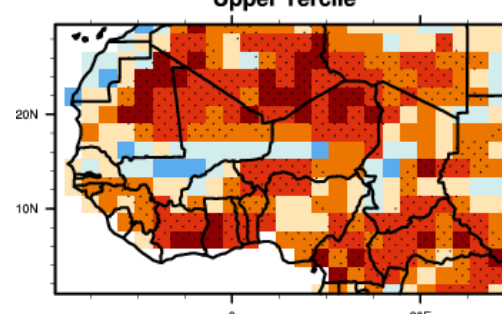
Lower Tercile



Above Median



Upper Tercile



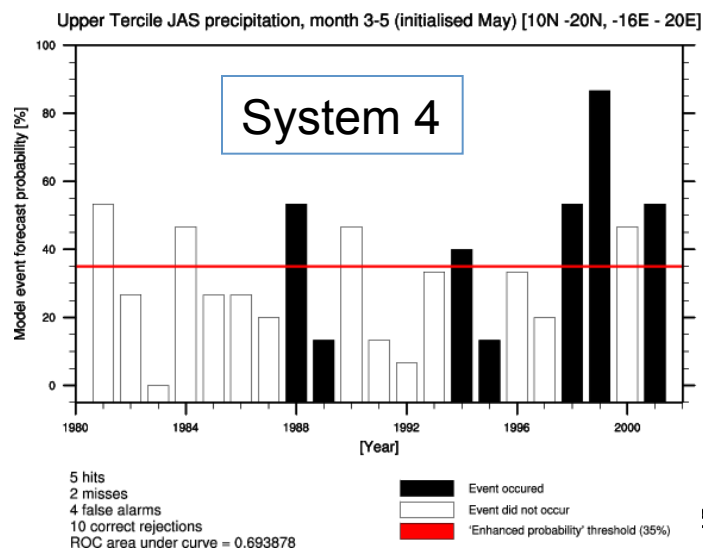
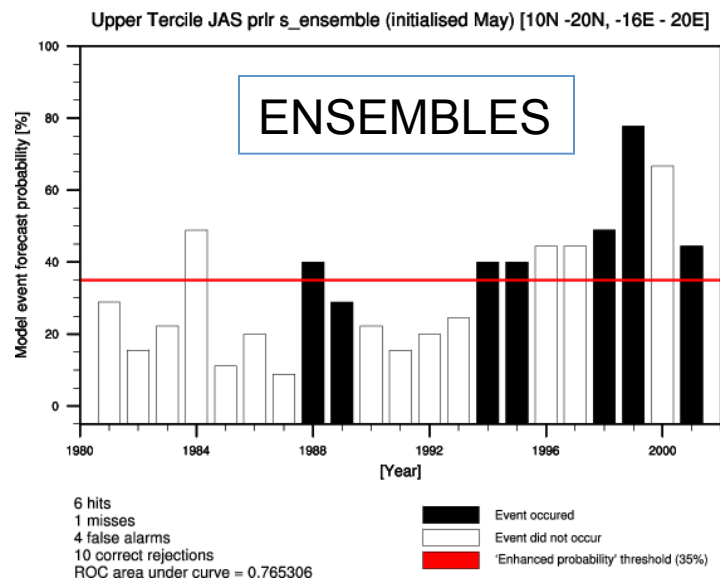
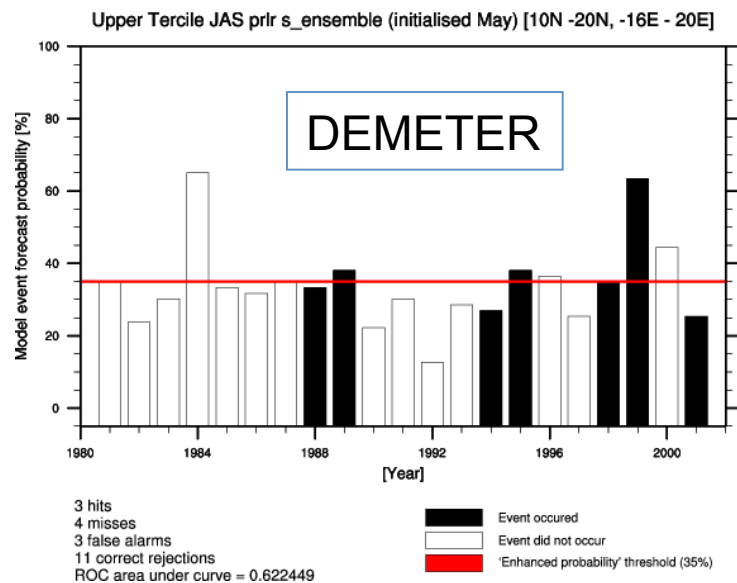
LT

AM

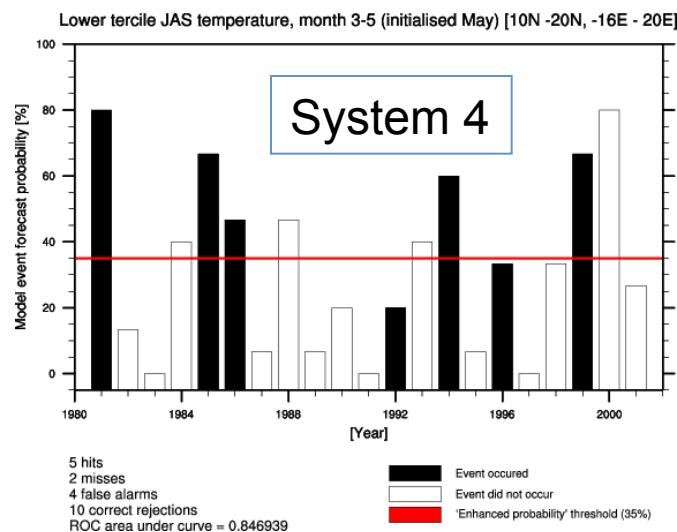
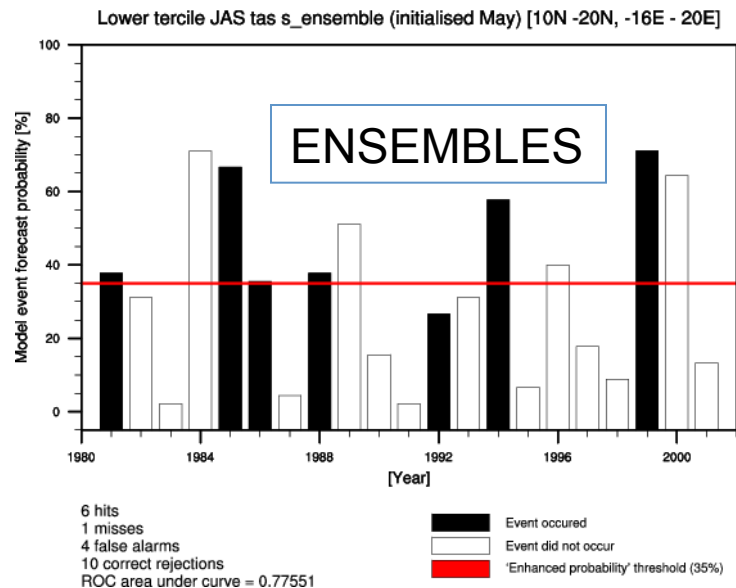
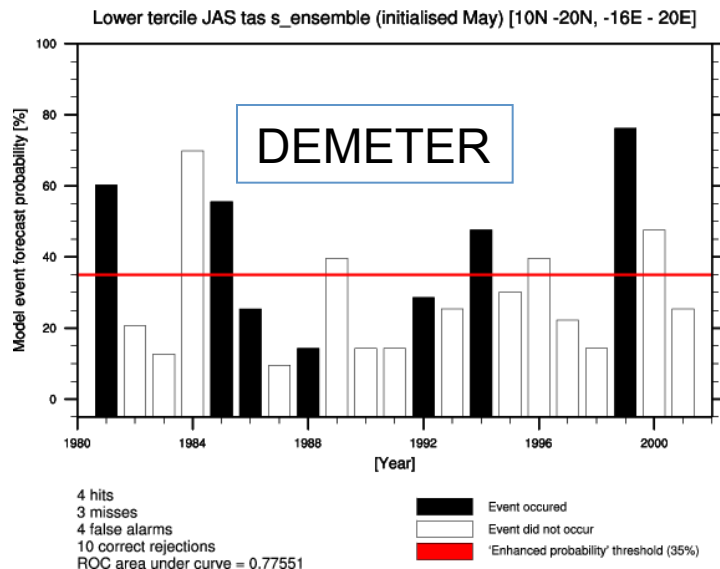
UT



Precipitation bar charts 'ROClke' upper tercile May (3-5)

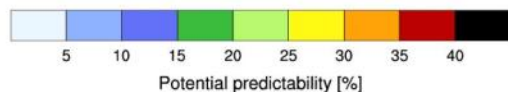
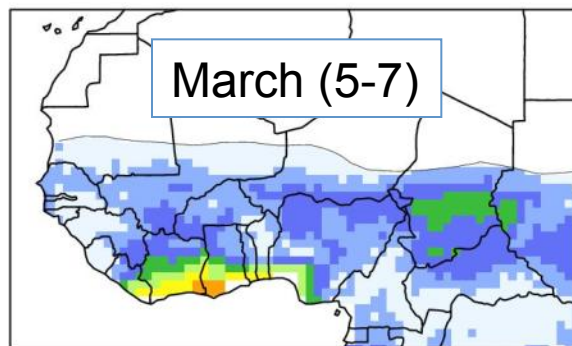


Tempertaure bar charts 'ROClke' lower tercile May (3-5)

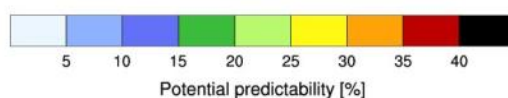
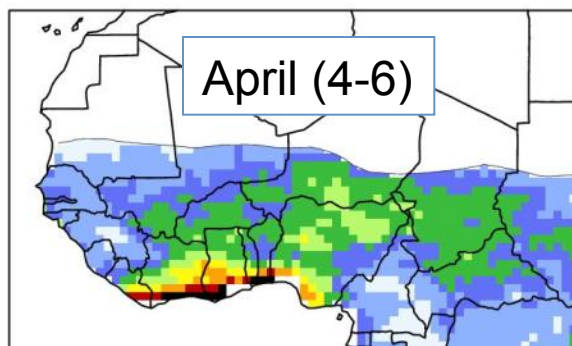


System 4 - Potential Predictability Precipitation - JAS target

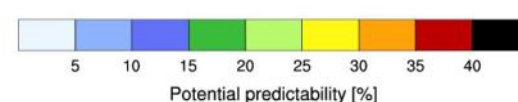
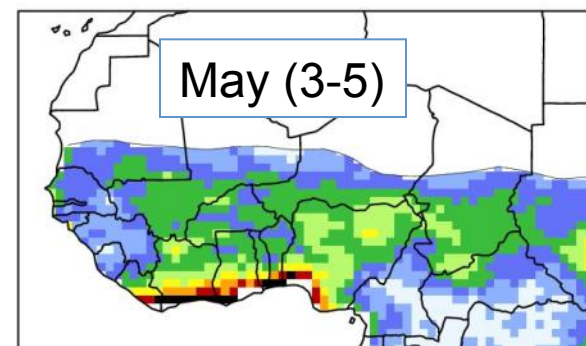
Potential predictability; System 4 precipitation
JAS target, initialised March



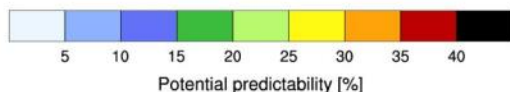
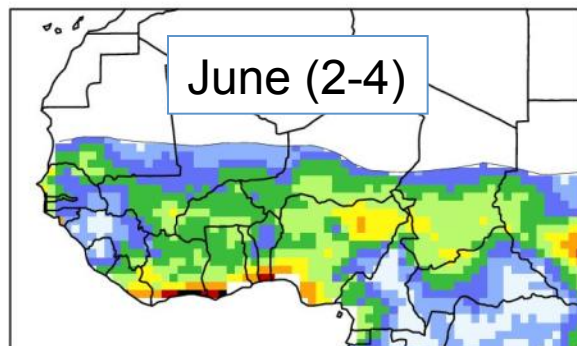
Potential predictability; System 4 precipitation
JAS target, initialised April



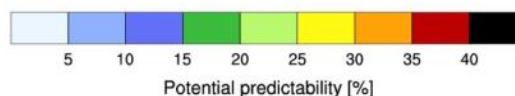
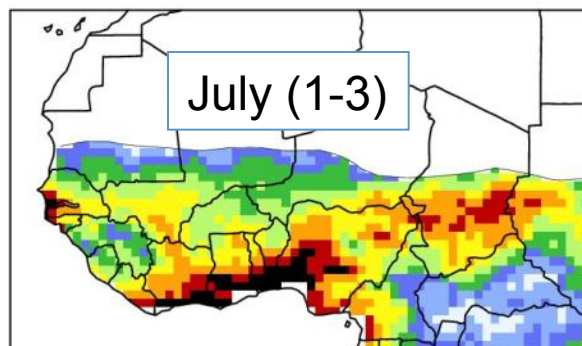
Potential predictability; System 4 precipitation
JAS target, initialised May



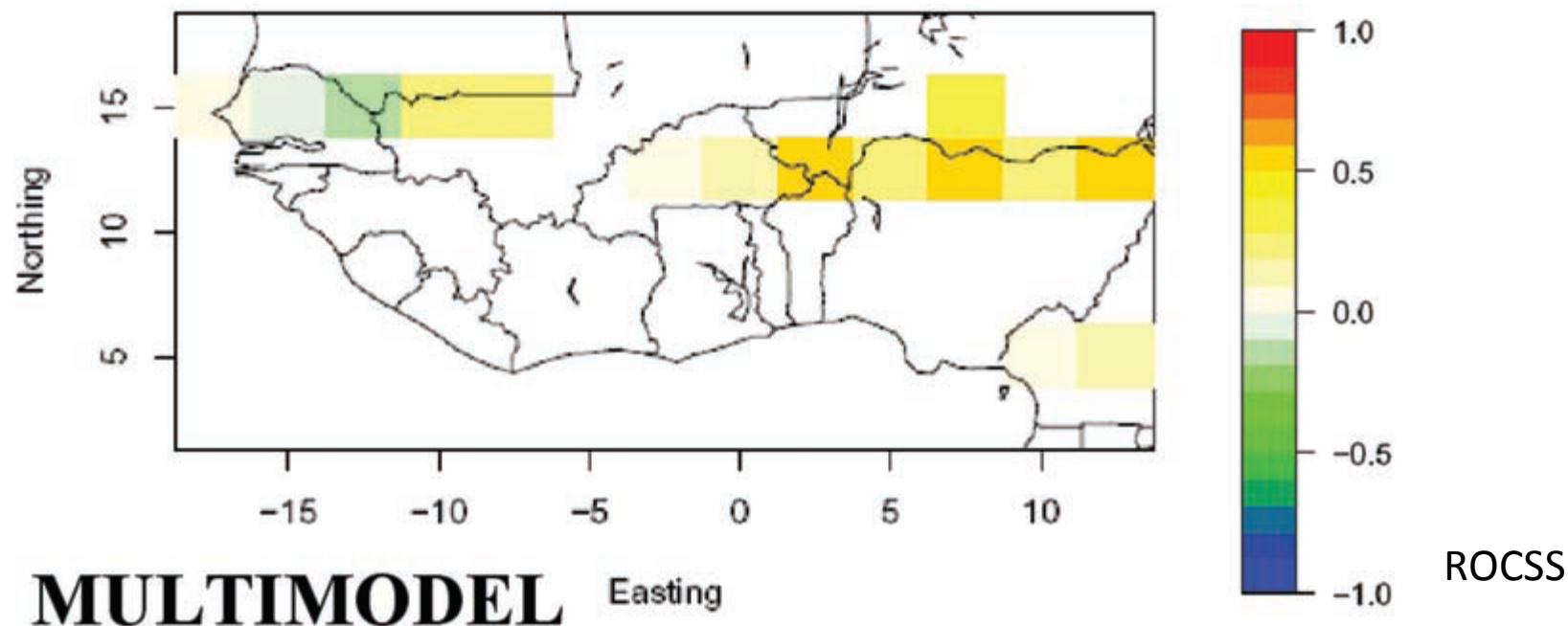
Potential predictability; System 4 precipitation
JAS target, initialised June



Potential predictability; System 4 precipitation
JAS target, initialised July



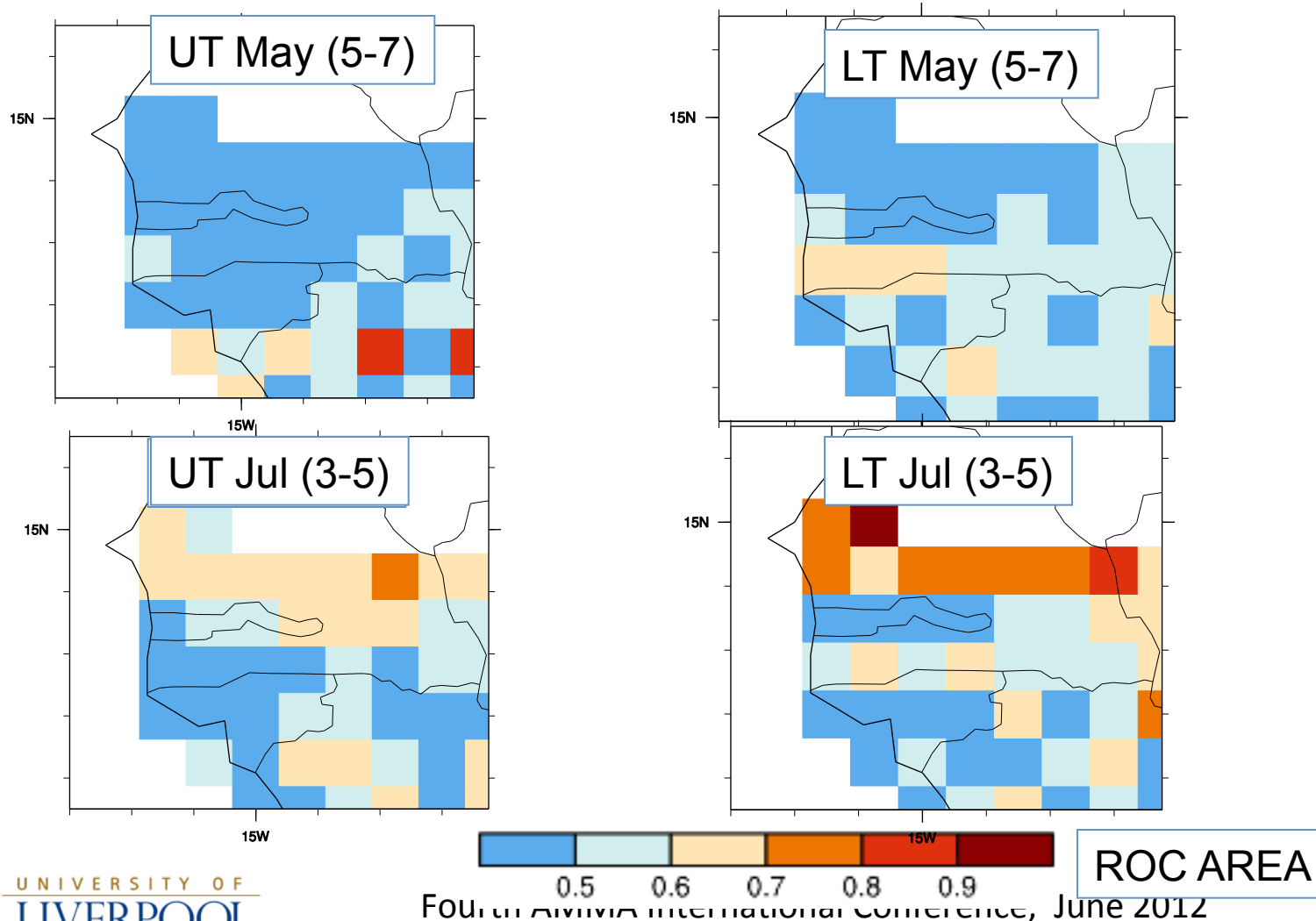
Potential Seasonal Skill in Epidemic Zones for Malaria



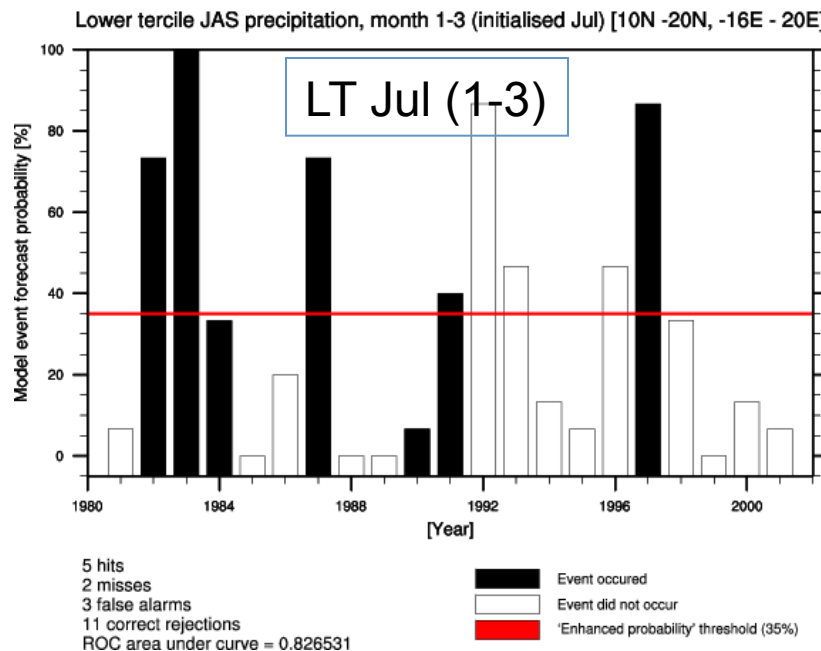
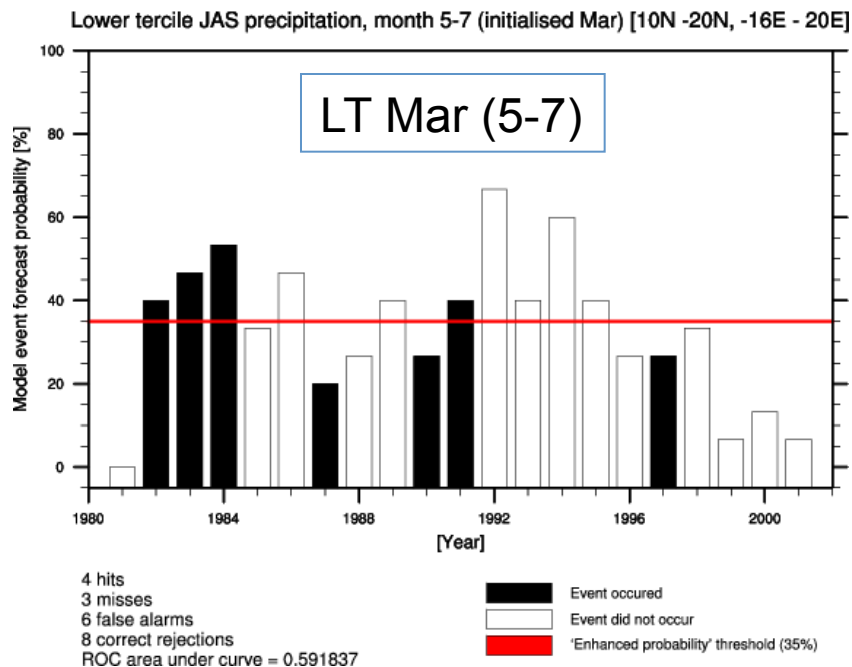
Based on the Liverpool Malaria Model simulations driven by seasonal ensemble multi-model outputs (Rainfall and Temperature)

ENSEMBLES Seasonal EPS May 4-6 (ASO) upper tercile
epidemic transmission zone ROCSS
Jones and Morse (2012) in revision
NOT TO BE DISTRIBUTED

System 4: Liverpool Malaria simulated incidence Model ROC area **SON** target



System 4 Precipitation bar charts 'ROCLike' – JAS target



Summary

- Show improvement through last 10 years in season forecasts
- Forecasts skill still low at long lead times
- Skill sharpens near target and improvement is seen in malaria simulations
- Work on seasonal and sub-seasonal forecasts (seamless system)
- Can we make sufficiently skilful seasonal scale predictions of malaria for the region? Working within Climate Services Framework.
- Need more spatially consistent skill in seasonal forecasts and at longer lead times
- Issues of forecast biases, target data biases, interpolation
- Short hindcast sets in operational systems

A group of men, likely of African descent, are gathered outdoors under the shade of a large, leafy tree. They are dressed in traditional clothing, including various styles of caps (kufi) and patterned shirts. The men are looking towards the camera with neutral expressions. A semi-transparent blue box is overlaid on the center of the image, containing the text "Thank you. Any questions?".

Thank you.
Any questions?

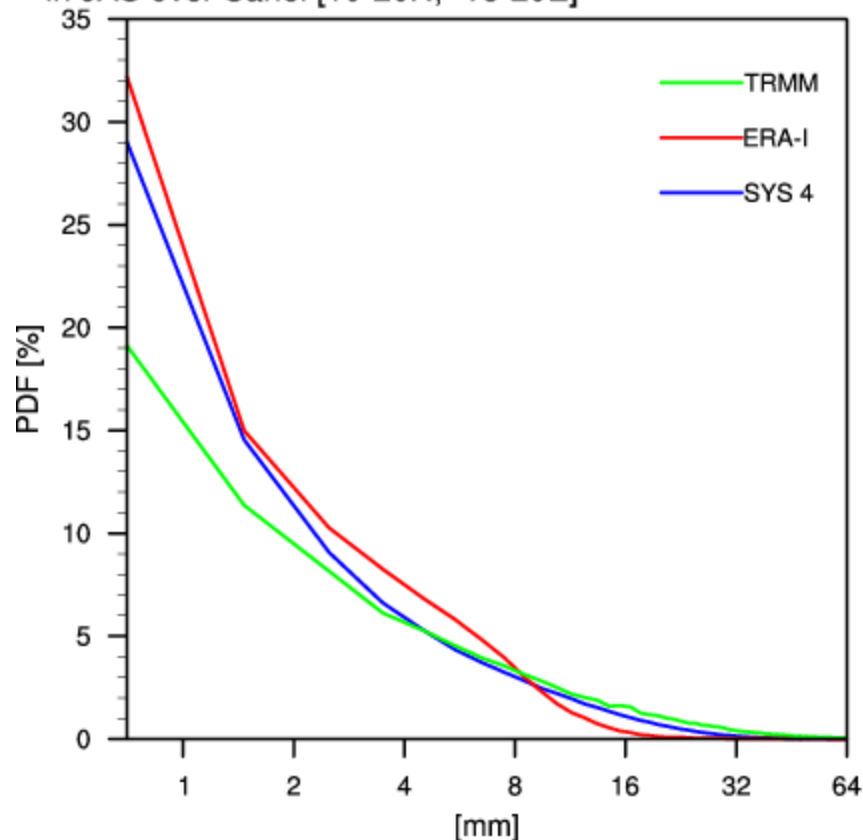
Sahel Area



Target region, 'Sahel': 10N - 20N, -16E - 20E

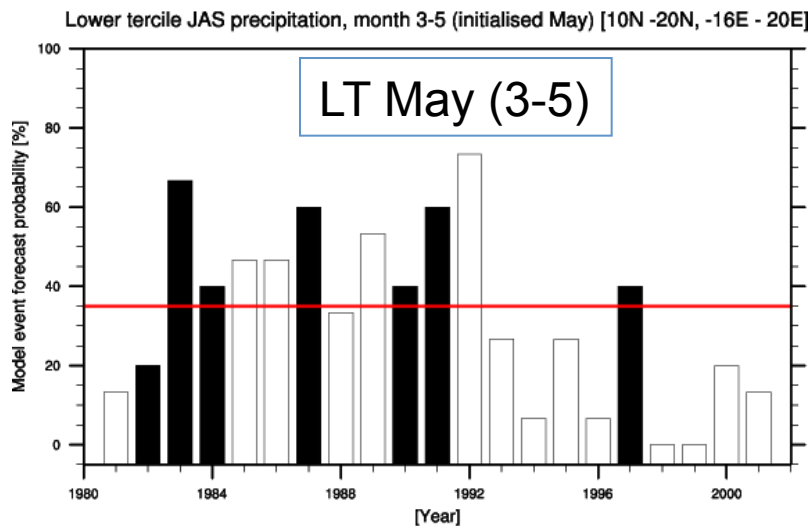
Sahel Area

Distribution of rainy days (greater than 0.1 mm accumulated)
in JAS over Sahel [10-20N, -16-20E]



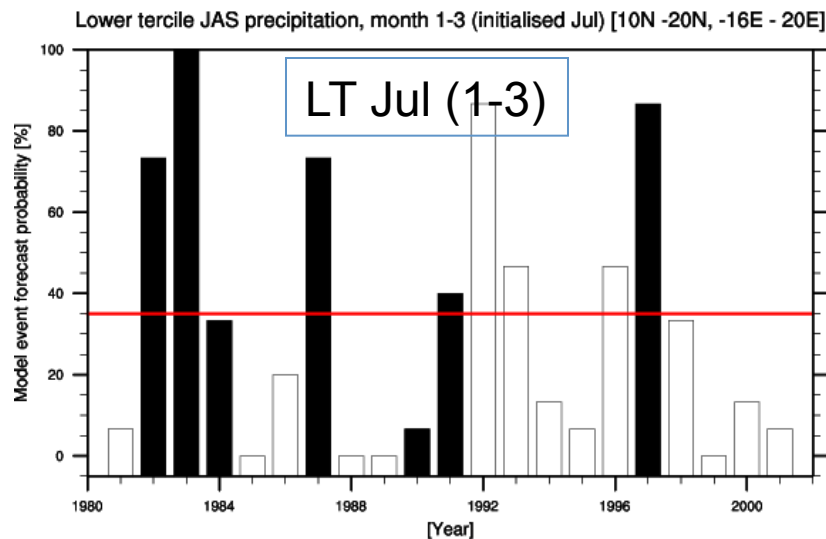
Distribution of rainy days in JAS over Sahel, vs TRMM and ERA-Interim
(note the logarithmic axis)

System 4 Precipitation bar charts 'ROClke' – JAS target



6 hits
1 misses
4 false alarms
10 correct rejections
ROC area under curve = 0.77551

■ Event occurred
□ Event did not occur
■ 'Enhanced probability' threshold (35%)



5 hits
2 misses
3 false alarms
11 correct rejections
ROC area under curve = 0.826531

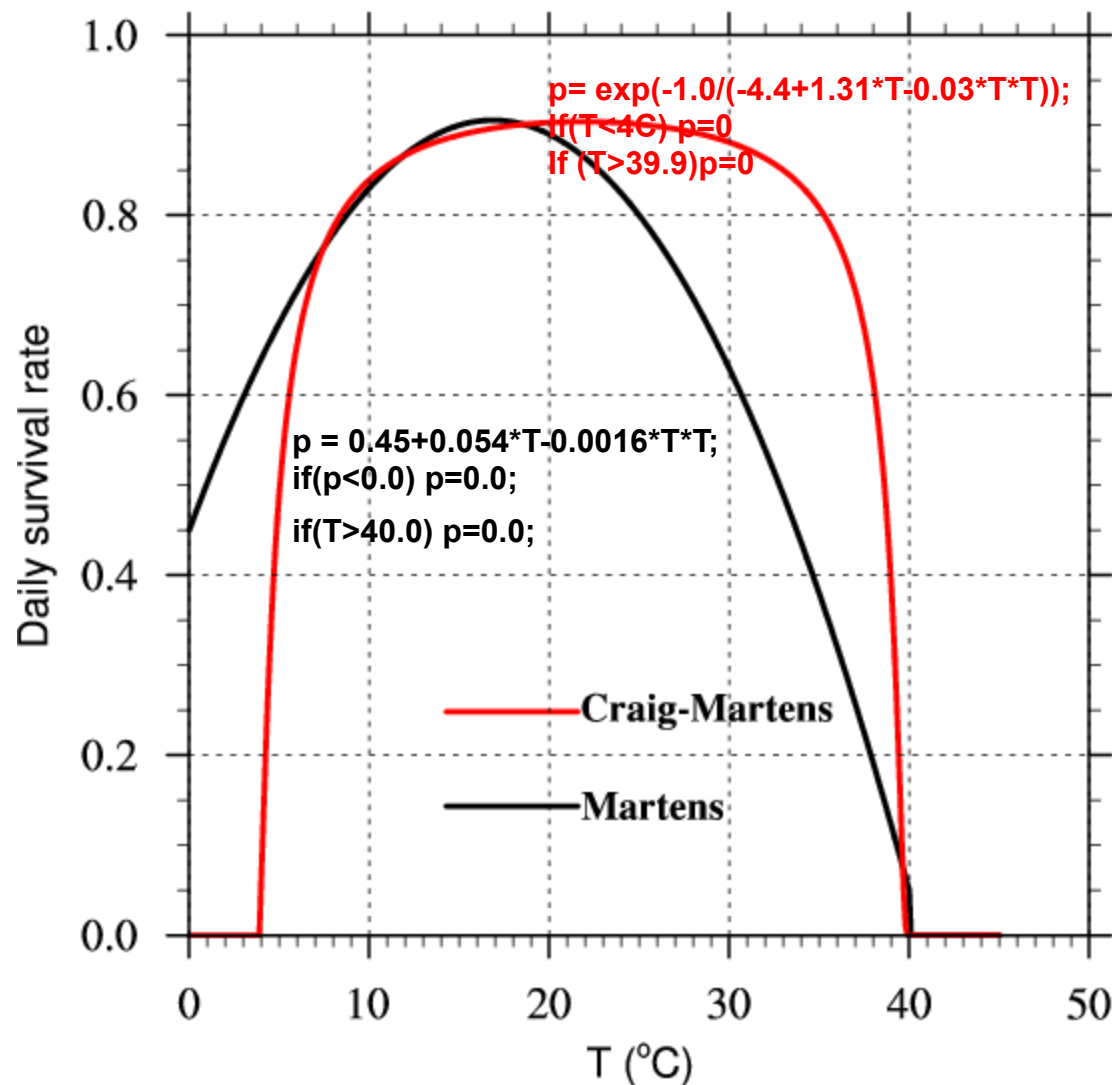
■ Event occurred
□ Event did not occur
■ 'Enhanced probability' threshold (35%)

Comparison
Between
Martens and
Craig-Martens

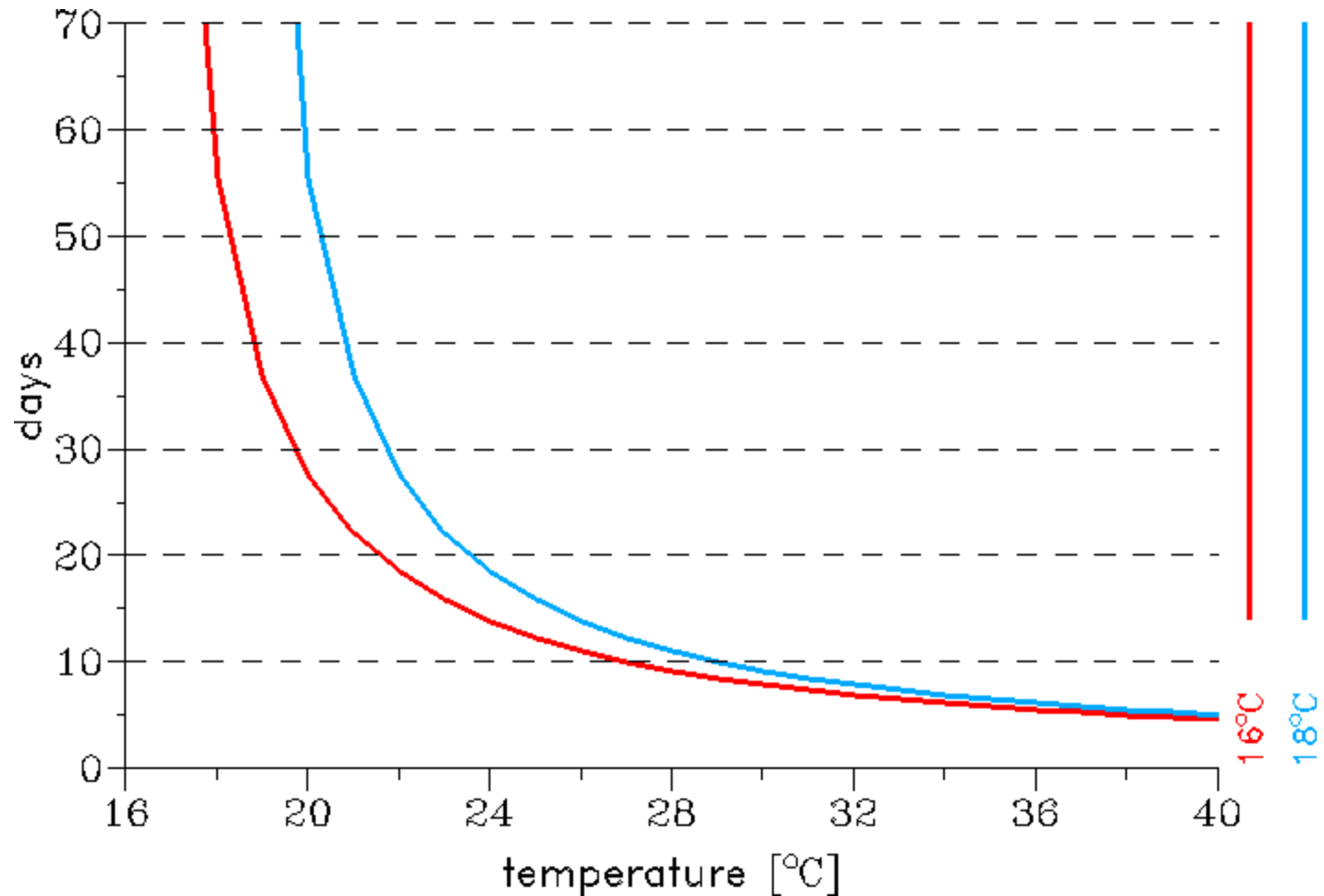
Adult mosquito
Survival schemes

Craig: More survivors
at high temperatures

Mosquito survival schemes



Sporogonic cycle



Survival probability scheme

