Selected IRI Activities in Africa

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Talk Outline

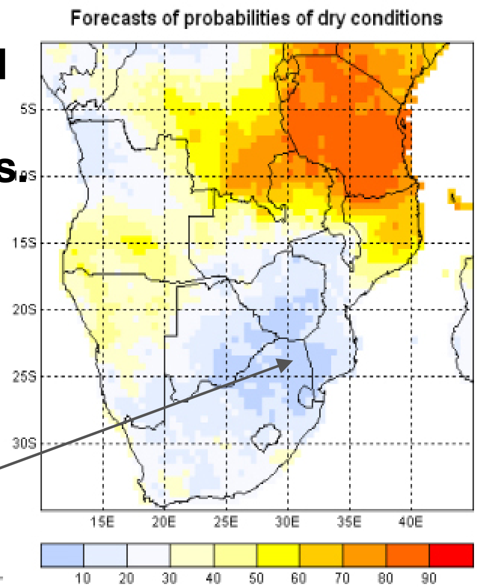
1. IRI Mission and background
2. IRI Africa Regional Program
3. Improving availability of climate information in Ethiopia
4. Index Insurance
5. Characterizing decadal variability in southern Africa
6. Crop modeling in Kenya
7. High-resolution dust modeling in the Meningitis Belt
8. IFRC Flood Preparation and Precipitation Map Room
9. Climate Information for Public Health
10. Reservoir Management in Ethiopia
11. Climate Predictability Tool (CPT): Used at RCOFs (in Africa)
12. Statistically corrected dynamical forecast for Sahel
13. IRI Net-Assessment Seasonal Forecasts
14. Trend Analysis in East Africa

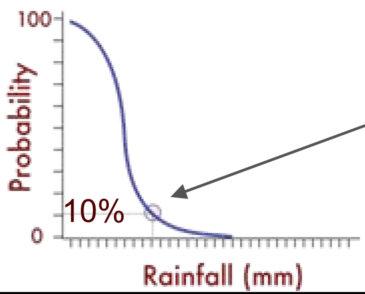
IRI Mission

We use a science-based approach to enhance a society’s capability to understand, anticipate and manage the impacts of climate in order to improve human welfare and the environment, especially in developing countries.

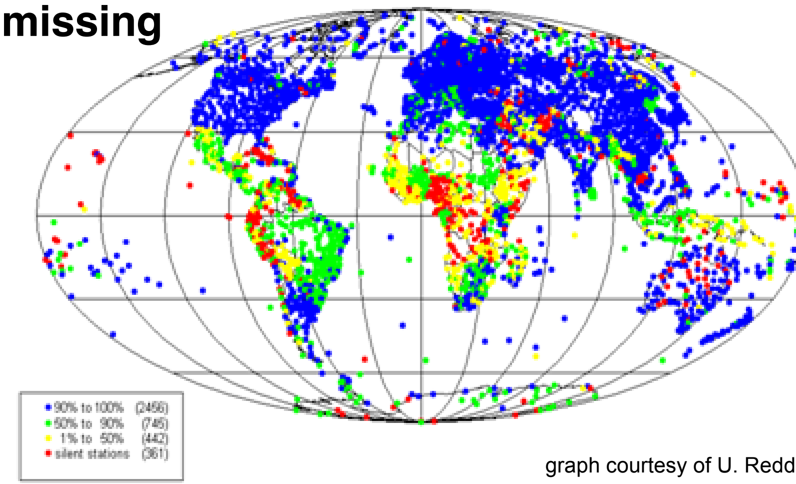
International Research Institute for Climate and Society
Research in support of climate risk management

Leaders in the development and assessment of forecast products.



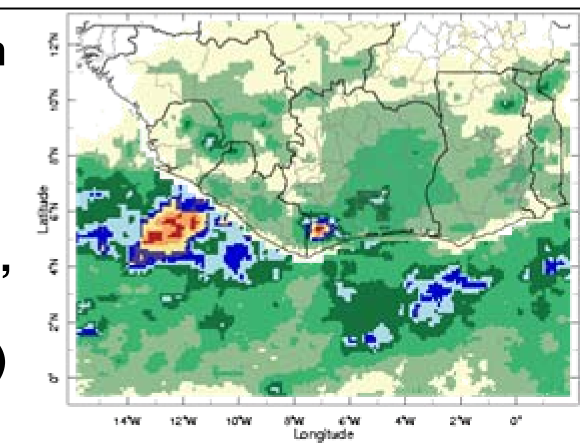


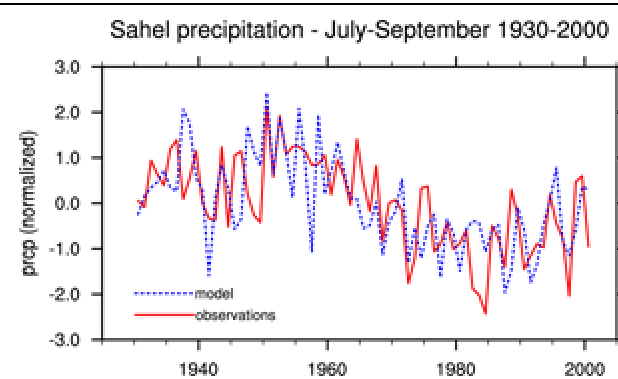
Experts in the use of remotely sensed data to establish regional climate patterns where direct observations are missing



graph courtesy of U. Redding

Innovators in the sectoral analysis of climate impacts (e.g., malaria early warning tool)





Basic research to unravel and understand climate mechanisms

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IRI Africa Regional Program

IRI works in over 30 countries internationally with concentrated activities within Africa in **Ethiopia** and **the Sahel**.

Additionally, IRI continues to support cross-regional work, as well as some efforts in Southern Africa (incl. Botswana, Madagascar and South Africa) and in the Greater Horn.

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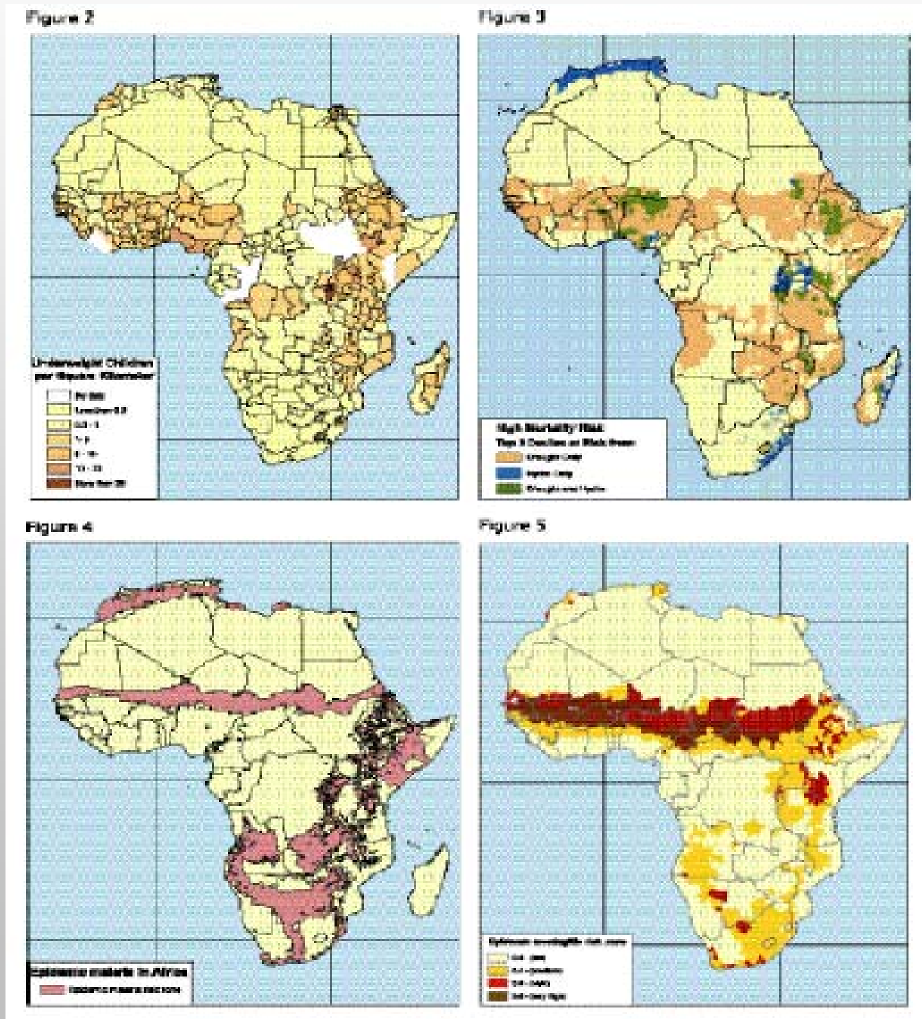
Targeting…



Semi-arid areas:

The inhabitants prone to hunger, droughts, epidemic malaria epidemic and meningitis.

Working across sectors:

- Agriculture
- Health
- Water
- Economics & Livelihoods

…Also Disaster Risk Management

Improving Availability, Access and Use of Climate Information Ethiopia

Tufa Dinku
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International Research Institute for Climate and Society
The Earth Institute at Columbia University

The Problem

- Number of weather stations not adequate, and deteriorating
- Most stations located in the cities along main roads
  - ➔ Limited data over most of rural Africa
- Serious gaps in observations (missing data)
- Quality of available data not very good
- Limited access and use of the available data

Proposed Solution

Improving availability:

Quality control and combine local observations with global products such as satellite proxies and model reanalysis data

➔ Global products help in filling spatial and temporal gaps

Improving access:

- Provide online-access to data, analysis tools, and products

Improving use:

- Develop products for specific applications
- Train users to understand, demand, and use climate data
- Facilitate the formation of community of practice

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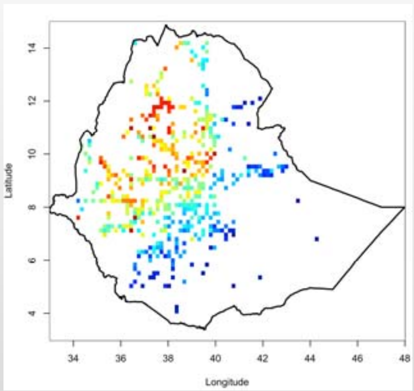
Current projects

Ethiopian Climatology Work:
Improving Data Availability through Use of Station Observations & Satellite Estimates



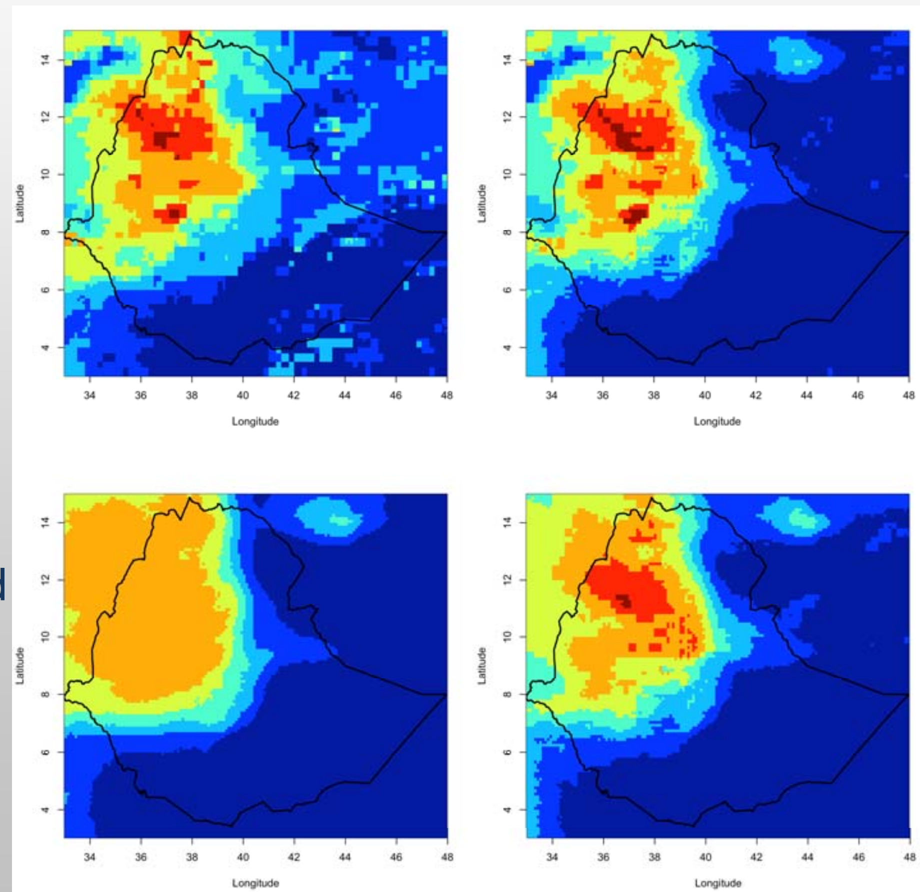
(A) Raingauge data

(B) Interpolated gauge

(C) As in (B) but bias-adjusted satellite data used as background

(D) Satellite rainfall estimate

(E) Bias-adjusted (using raingauge) satellite rainfall estimate



With direct funding from Google.org and CCAFS

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Current projects

Ethiopian HARITA project: Connecting Satellites, Climatologies and Farmers for Adaptation

Climate adaptation at local scale

- Improve productivity, reduce vulnerability through
  - Community risk reduction activities
  - Community savings
  - Loans and Drought Insurance
- Scaling from 5 villages to dozens this year

Index insurance against drought

- Insurance payouts triggered by NOAA CPC ARC realtime remote sensing product
- Designed, validated with satellites, gauges, and farmers
  - NOAA CPC ARC satellite climatology
  - Ethiopian NMA/Reading/IRI satellite, gauge climatology
  - Ethiopian NMA gauge network
  - Remote sensing of vegetation
  - Farmer experience, data

Satellite & village info map used by Ethiopian experts to coordinate farmer validation & design process

Farmer remote sensing validation training

In each Village, farmers:

- Design
  - Adaptation package
  - Drought index insurance product
- Validate
  - Remote sensing climatology

With direct funding from Oxfam America-
More partners and technical details at:
http://iri.columbia.edu/publications/id=1002

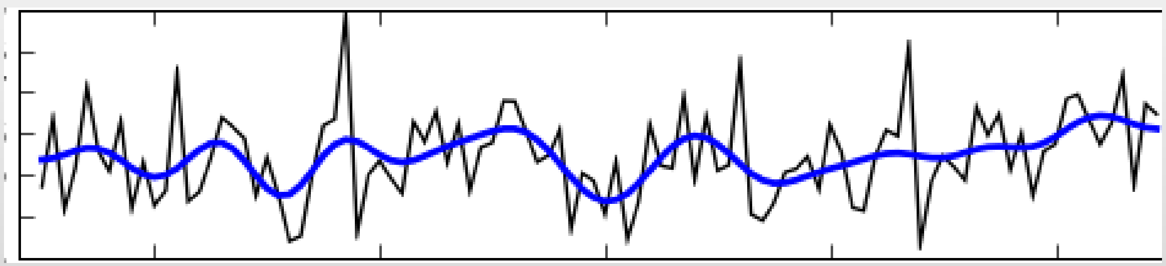
IRI The International Research Institute for Climate and Society

Current projects

South African Multi-Decadal Work:
Managing Climate Risk for Agriculture and Water Resources Development

• Looking at the implications of Near-Term Climate Change on runoff

• Assessing benefits and costs of different adaptation strategies



Rainfall in the western cape:

• What are the implications on water resource management?

May point to reprioritization, reordering, or delay of implementation of options.

• Partners: Universities of Cape Town, Free State, Kwa Zulu Natal, Columbia (IRI), UNEP-Risoe

• Context of Cape Water Mgmt Area: Irrigated activities, wine/table grapes and deciduous fruit exports ~ 86% of GDP ~3.5 million people

• Consumptive Water Use
  Urban: 54%
  Ag. : 42%

With direct funding from Climate Change and Adaptation in Africa (CCAA) – IDRC/DFID

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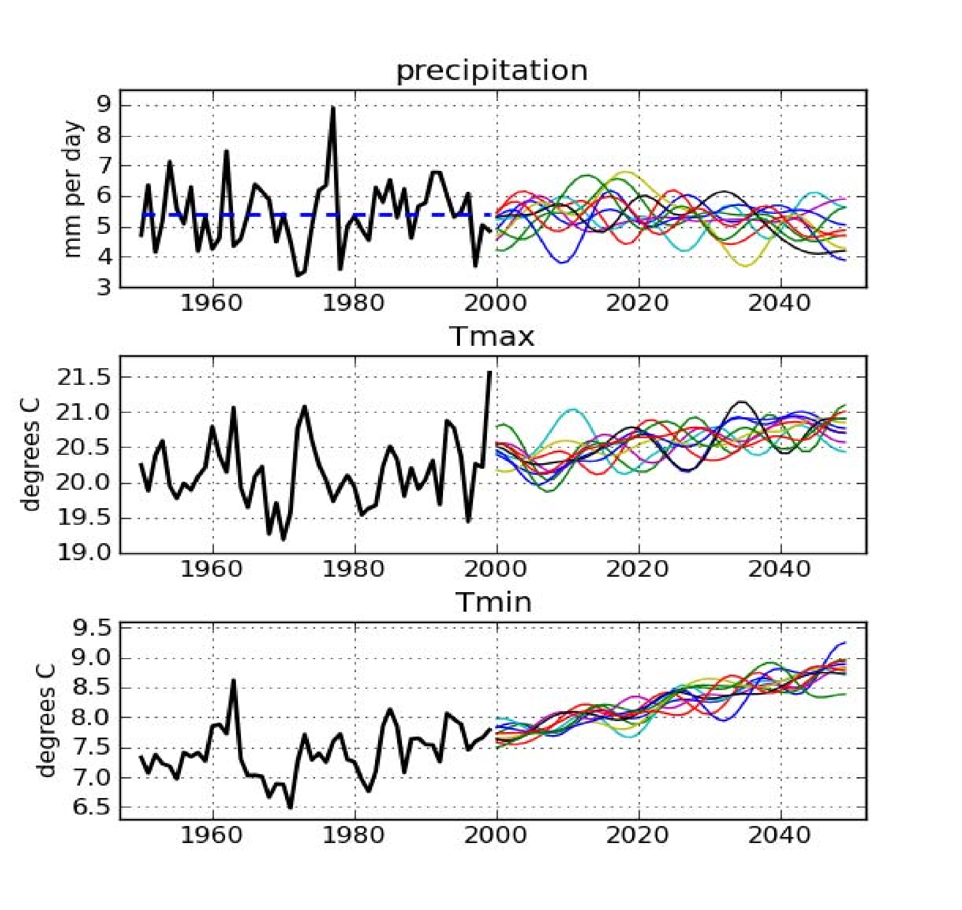
Current projects

South African Multi-Decadal Work Continued: Managing Climate Risk for Agriculture and Water Resources Development

Stochastic decadal simulations for the Berg River catchment, Western Cape province

Shown is an ensemble of ten stochastic simulations (colors) for one station along the Berg, designed for driving a hydrology model. Rainfall, maximum and minimum temperatures are correlated and must be simulated jointly. The sequences are smoothed; daily values are ultimately generated.

The dashed blue line shows the 1950-1999 precipitation mean. Post-2000 there is a declining trend, consistent with IPCC projections and amounting to a reduction of nearly 10 percent by 2050. Tmax and Tmin show increasing but differing trends. Interannual-to-decadal variations are superimposed on the long-term tendencies, providing a rich set of synthetic data for testing the resilience of proposed adaptations to decadal climate variations, in the context of a shifting background state.



With direct funding from Climate Change and Adaptation in Africa (CCAA) – IDRC/DFID

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Current projects

Raised Temperatures over the Highlands of East Africa: Revisiting the Facts in the East African Highlands Malaria Debate

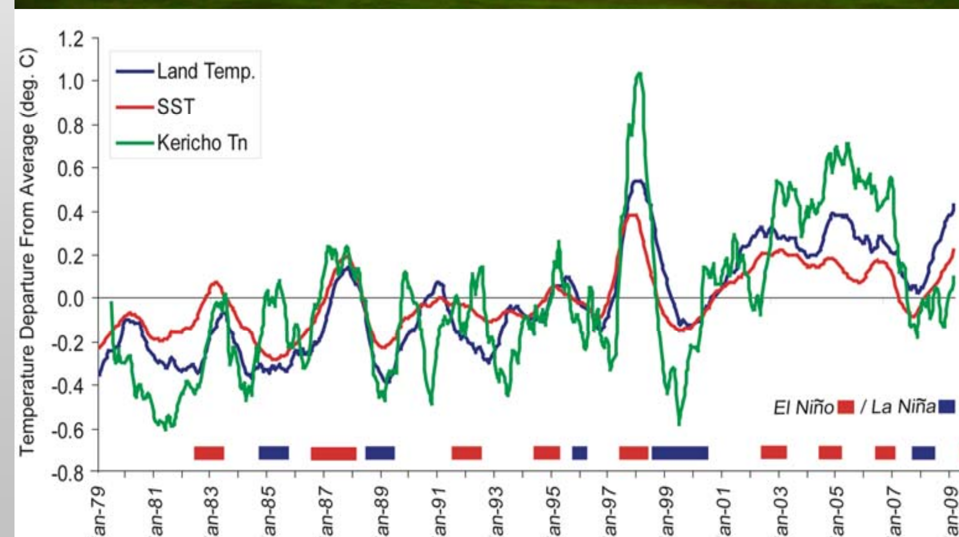
IRI's strategy for the health sector involves building partnerships between national climate services and global health policy in support of data-driven decision making for climate sensitive disease control.

Temperature is a key determinant of malaria transmission.

Using national climate data, we have shown that temperatures in the tea estates of Kericho have been rising by ≈0.2^{O}C per decade since 1979.

This has important implications for the emergence of malaria in highland regions.

Global climate processes, *eg*. Tropical SSTs are also shown to have varied around the same warming trend as minimum temperatures around Kericho.



Land temp., SST and temp. in the tea estates of Kericho, Kenya

In collaboration with the US President's Malaria Initiative (PMI)

Extracting Useful Information from Daily GCM Rainfall for Cropping System Modeling

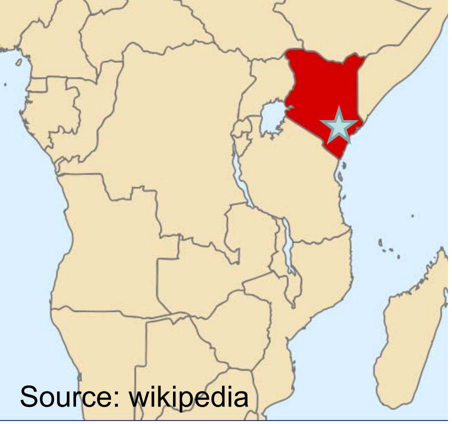
Amor VM Ines and James W Hansen

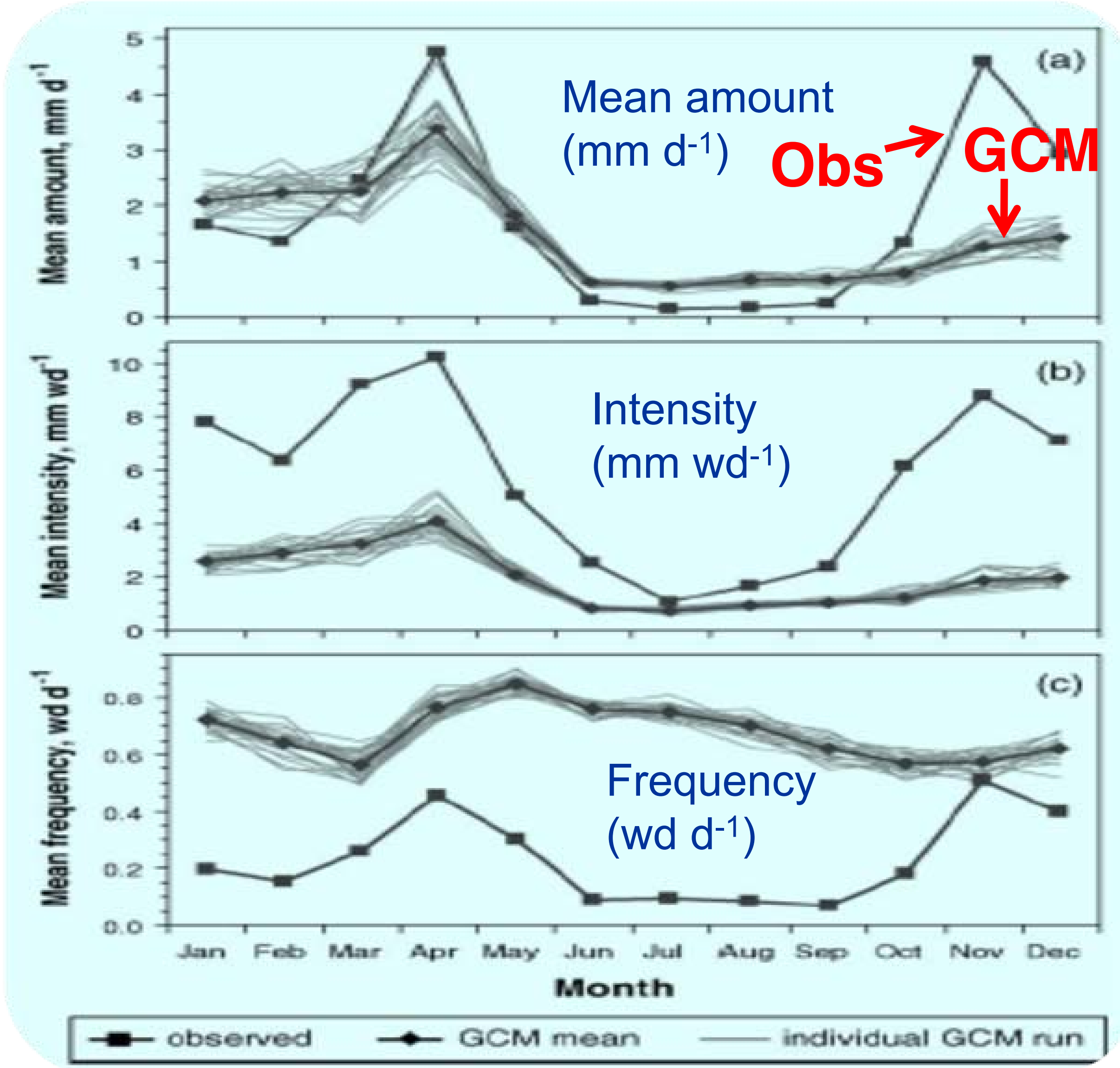
International Research Institute for Climate and Society (IRI)

The Earth Institute at **Columbia University**, New York

USA

GCM Rainfall vs. Observed Rainfall


Source: wikipedia



Ines and Hansen (2006). Agric. For. Meteorol.

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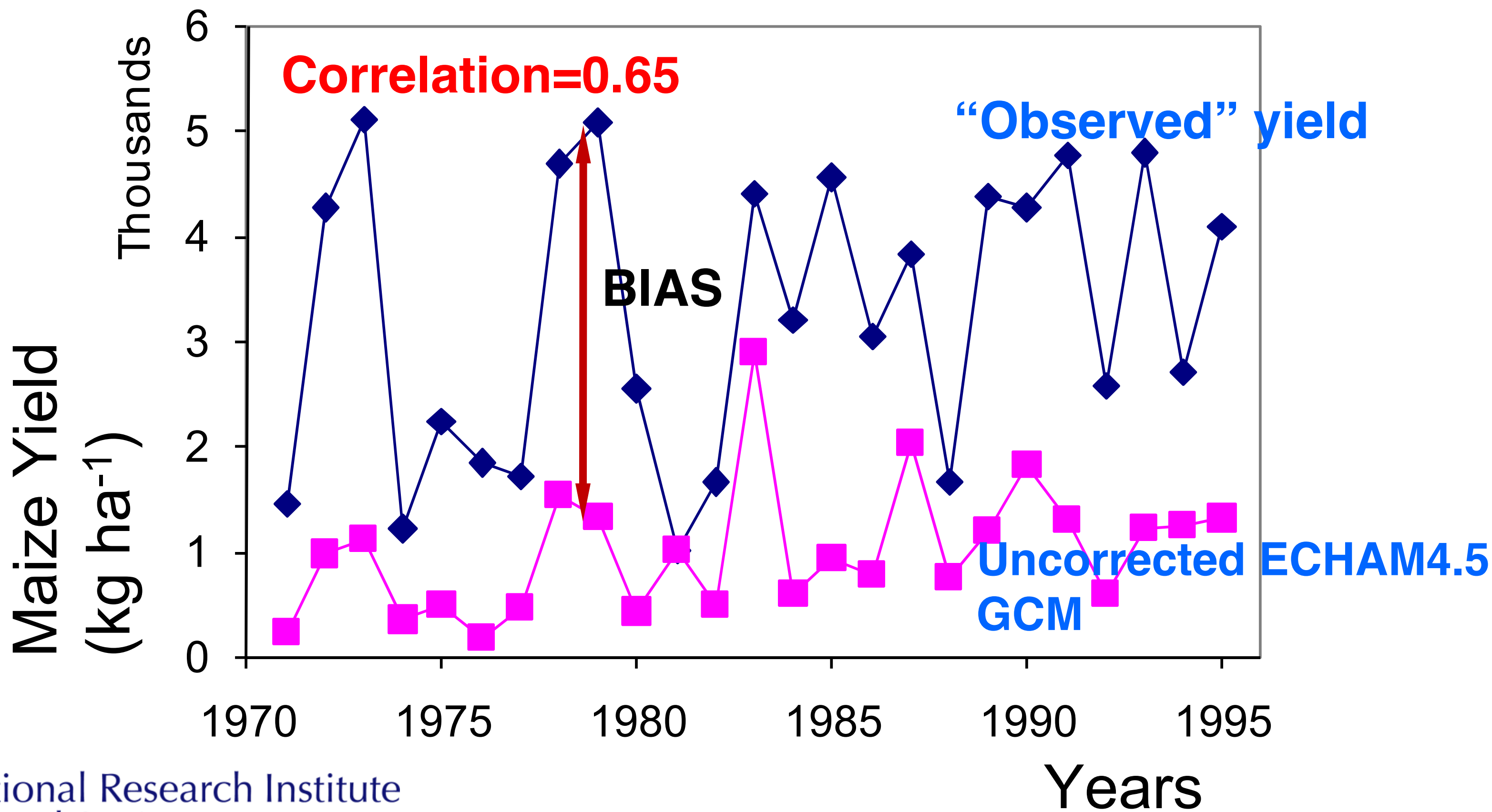
Weather within Climate Hypothesis

Machakos Southern Province, Katumani, Kenya

Cropping season: Oct-Feb (Maize crop)



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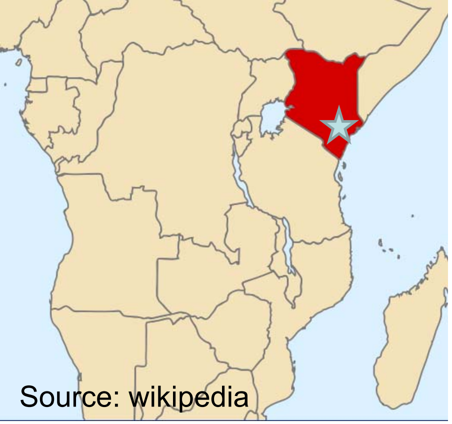
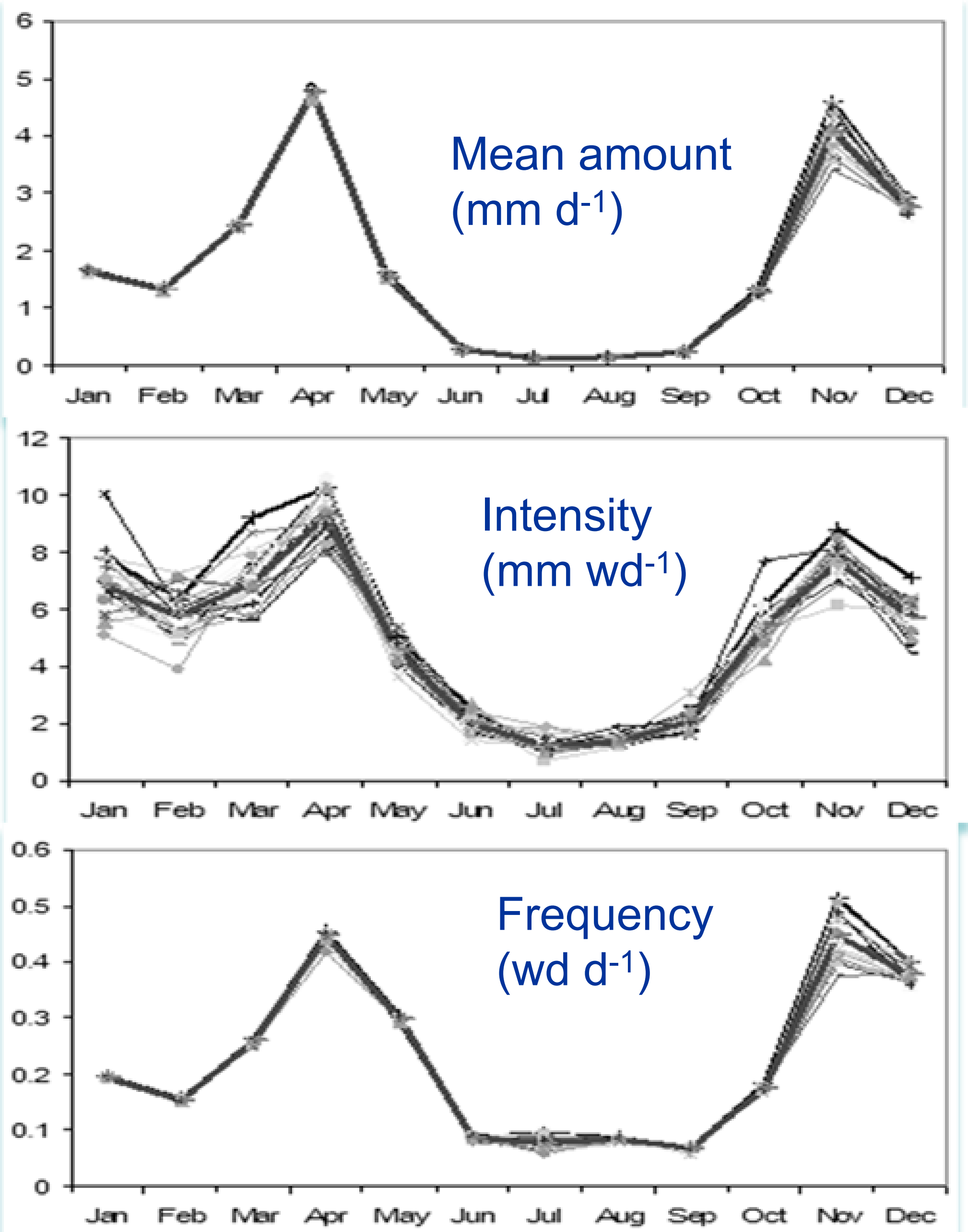


BC-GCM Rainfall vs. Observed Rainfall



Ines and Hansen (2006). Agric. For. Meteorol.

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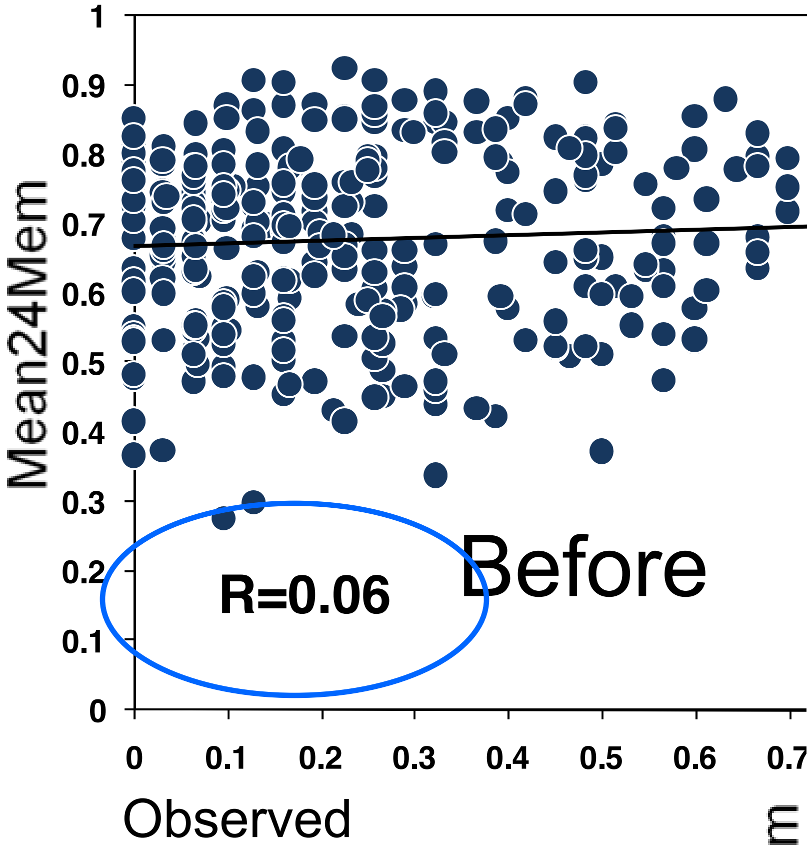
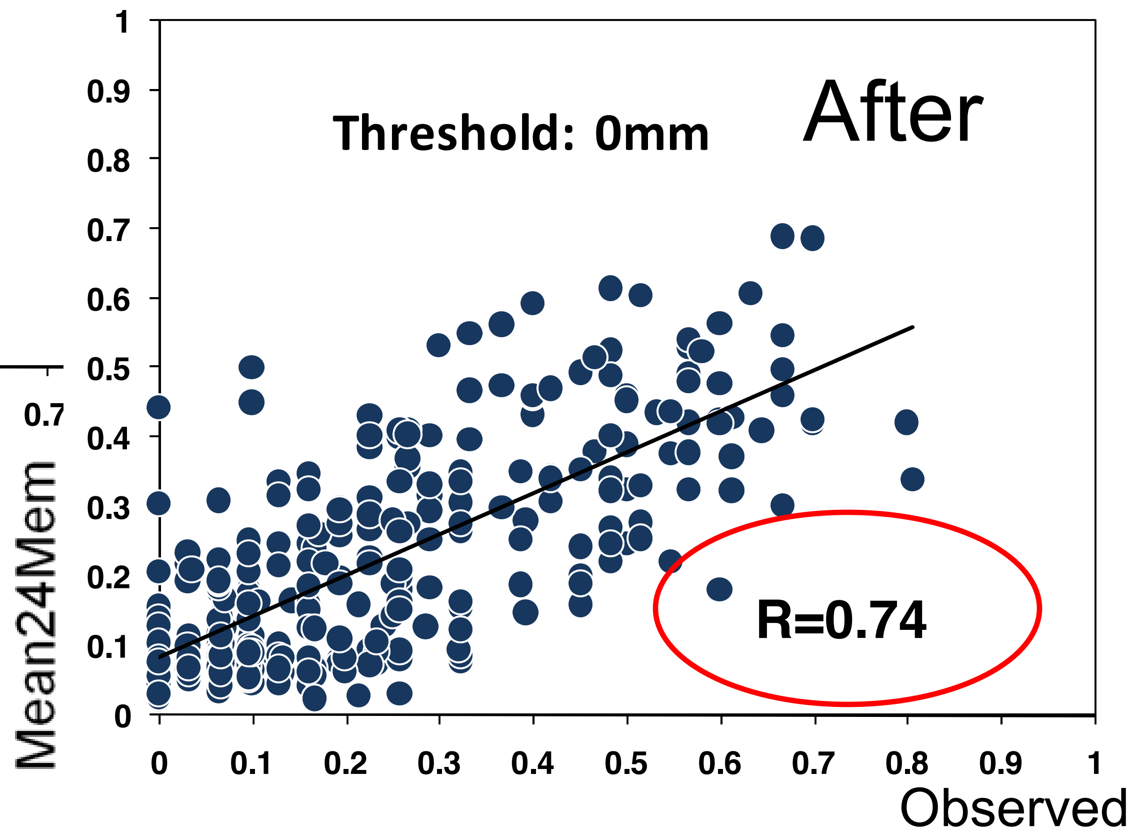
Corrected Monthly Rainfall Frequency after BC





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THE EARTH INSTITUTE
COLUMBIA UNIVERSITY

A 30-year High-Resolution Model Reanalysis of Dust and Climate for the Meningitis Belt

Carlos Pérez García-Pando

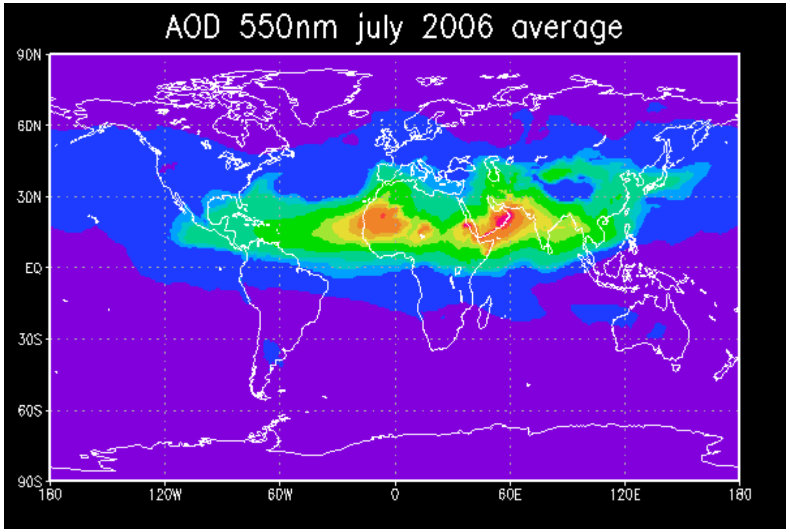
Earth Institute - NASA GISS - IRI

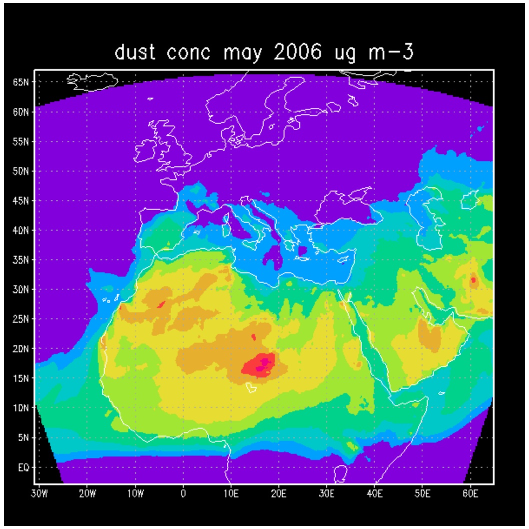
Collaborators:
S. Trzaska, M. Thomson, P. Ceccato (IRI), M. Stanton, P. Diggle (CHICAS, U. of Lancaster), R.L. Miller, J. Perlwitz (GISS), S. Adamo, G. Yetman (CIESIN), K. Haustein, J.M. Baldasano (BSC-Spain), E. Cuevas, C. Camino (AEMET-Spain)

IRI Seminar
September 2, 2011

NCEP Nonhydrostatic *Multiscale* Model on B grid (NMM-b) (Zavisa Janjic)

- Further evolution of WRF NMM (Nonhydrostatic Mesoscale Model)
- Intended for wide range of spatial and temporal scales, from meso to global, and from weather to climate
- The nonhydrostatic option as an add–on nonhydrostatic module
- Global lat-lon, regular grid ; Regional rotated lat-lon
- Arakawa B grid (in contrast to the WRF-NMM E grid) and Pressure-sigma hybrid





NMMb/BSC-Dust (Pérez et al.,2011)

GOALS

✓Common 'on-line' dust module for regional and global domains

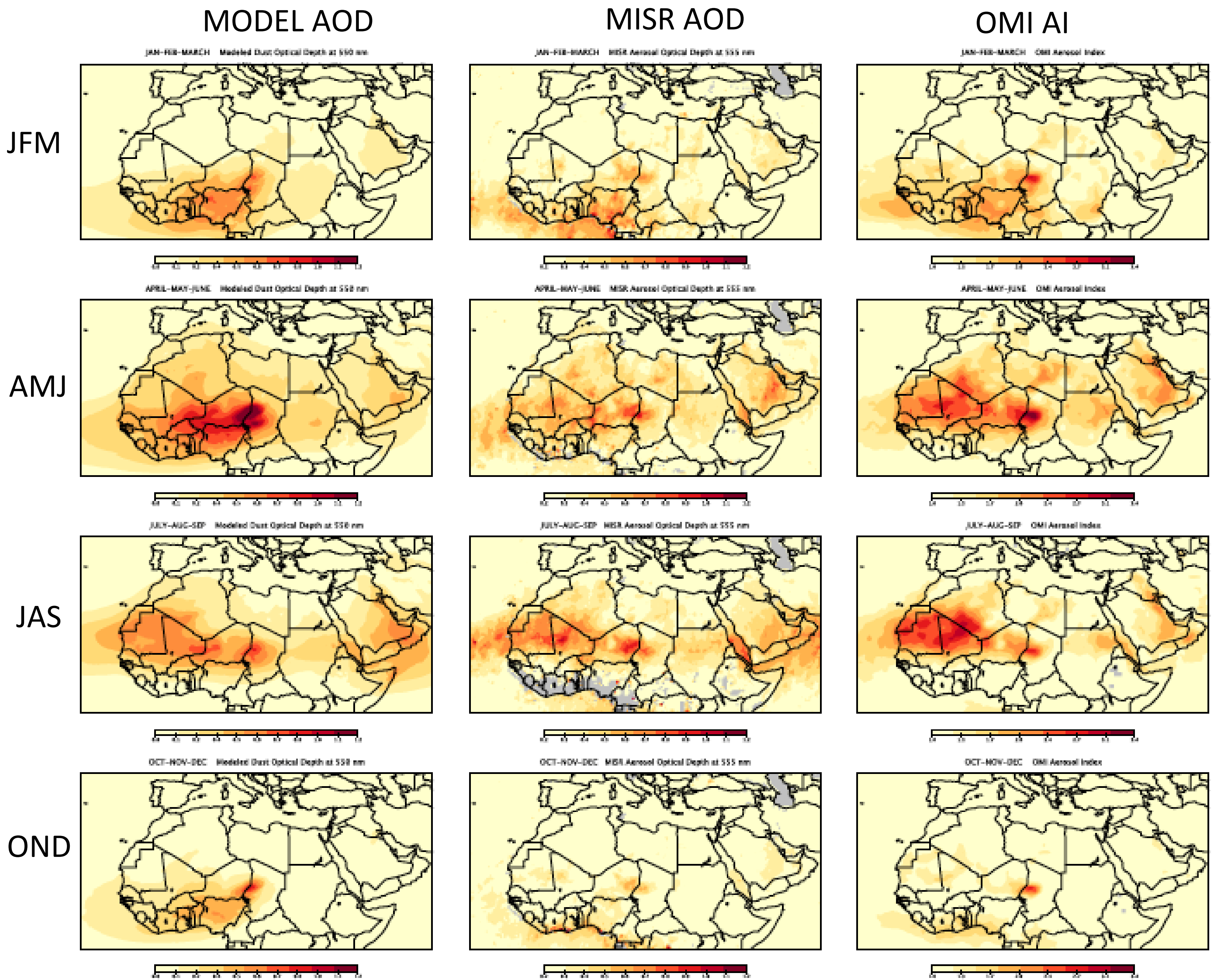
✓ Global dust forecasts up to 7-8 days at sub-synoptic resolutions and nested regional domains at high resolution (5-10 km).

✓ Intermediate complexity dust emission scheme

✓ Include new high resolution databases for soil textures and vegetation fraction.

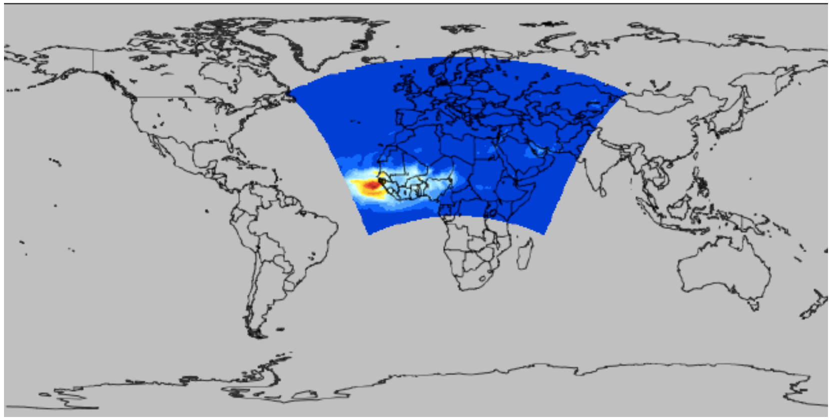
✓ Update deposition schemes

✓Radiative feedbacks between dust and meteorology


MODEL AOD
MISR AOD
OMI AI
JFM
AMJ
JAS
OND
JAN-FEB-MARCH Modeled Dust Optical Depth at 550 nm
JAN-FEB-MARCH MISR Aerosol Optical Depth at 555 nm
JAN-FEB-MARCH OMI Aerosol Index
APRIL-MAY-JUNE Modeled Dust Optical Depth at 550 nm
APRIL-MAY-JUNE MISR Aerosol Optical Depth at 555 nm
APRIL-MAY-JUNE OMI Aerosol Index
JULY-AUG-SEP Modeled Dust Optical Depth at 550 nm
JULY-AUG-SEP MISR Aerosol Optical Depth at 555 nm
JULY-AUG-SEP OMI Aerosol Index
OCT-NOV-DEC Modeled Dust Optical Depth at 550 nm
OCT-NOV-DEC MISR Aerosol Optical Depth at 555 nm
OCT-NOV-DEC OMI Aerosol Index

Long-term integrations

- 2 regional simulations (NA-ME-EU domain):
  - 1979-2008 at 0.5x0.5 deg: boundaries and daily initial conditions with NCEP Reanalysis-2 data for atmosphere and GLDAS-1 for soil conditions (problems in GLDAS period 1995-1997)
  - 1985-2006 at 1x1 deg: boundaries and daily initial conditions with NCEP Reanalysis-1 data for atmosphere and GLDAS-2 for soil conditions



3 hourly output of climate (humidity, temperature, winds, precipitation and other) and dust respirable concentrations

Summary and preliminary) conclusions

- High resolution reanalysis of dust and climate available for meningitis studies and other applications
- The model developed reproduces satisfactorily the dust variability
- Differences in the seasonal cycle and interannual winter variability of dust concentration and dust optical in Niger -> implications for the use of satellite estimates
- Early season climate (temperature) and early cases explain up to 50% of the year-to-year variability of the seasonal national incidence
- Best district Poisson model achieves a pseudo-R2 of 0.6 including population density, early cases (national and district), and early season climate (national and district)

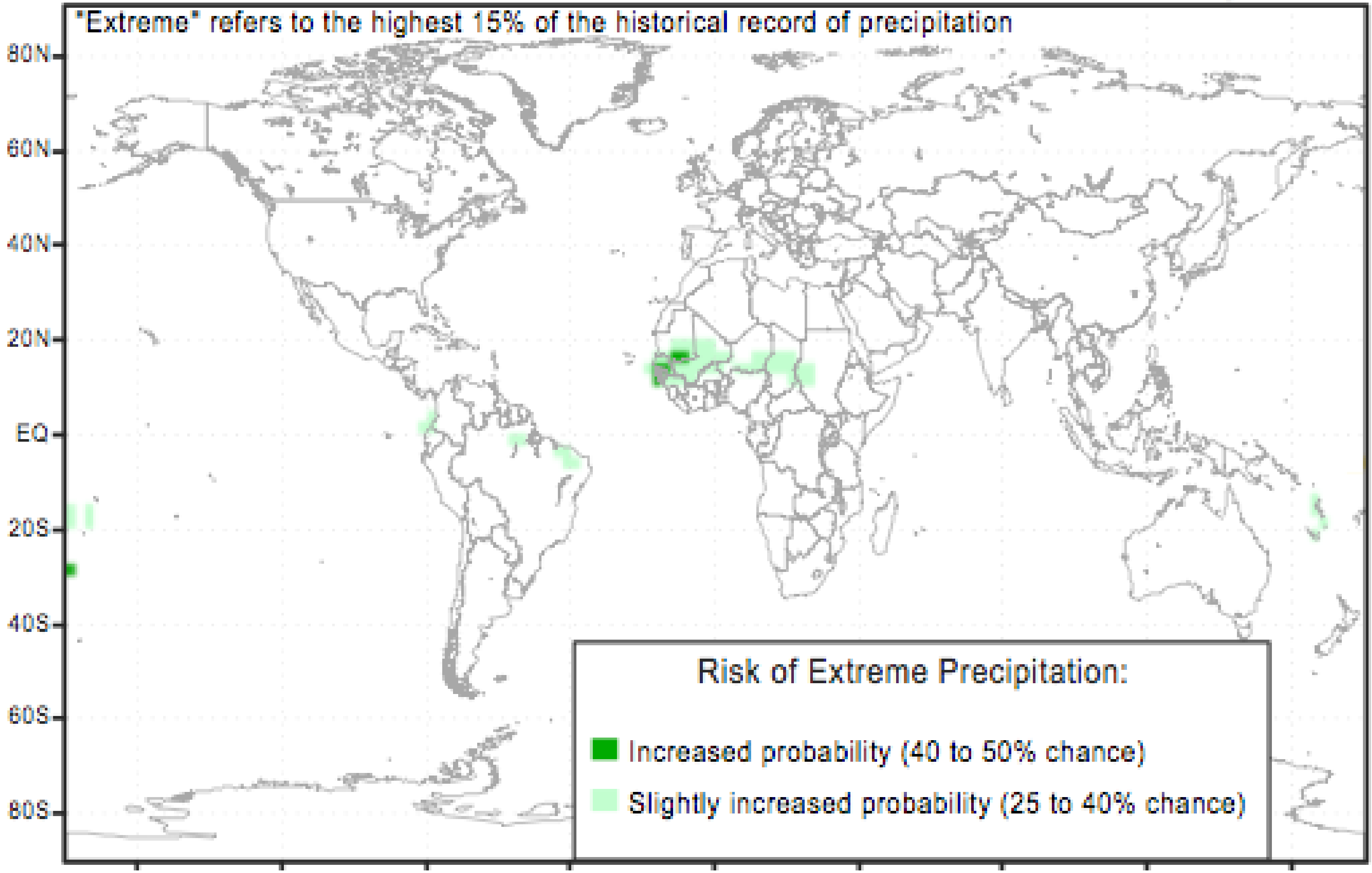
Currently: testing other climate parameters at a district level and other model types (e.g. negative binomial model)

SESSION 4: Case study
IFRC flood preparedness in West Africa, 2008

OUTLINE

1. Background: the 2007 flood season
   - Overview of predictable losses
   - Capacity building at IFRC-Dakar
2. The seasonal forecast
   - “Probability of extreme rains is enhanced from 15% to between 40 and 50%”
3. Forecast-based disaster preparedness
   - Emergency appeal
   - Donor response
   - Regional, national and local decisions
4. Results
   - Avoided losses

Seasonal Forecast of Extreme Precipitation for June-August 2008



Given what we know as of May 15 2008, we can say that, in the areas of West Africa highlighted in the map, there is an enhanced probability of extreme precipitation for the period June-August 2008. In other words, the probability of seeing precipitation that would rank in the top 15% of the historical record is now enhance d to between 40% and 50%Ó.

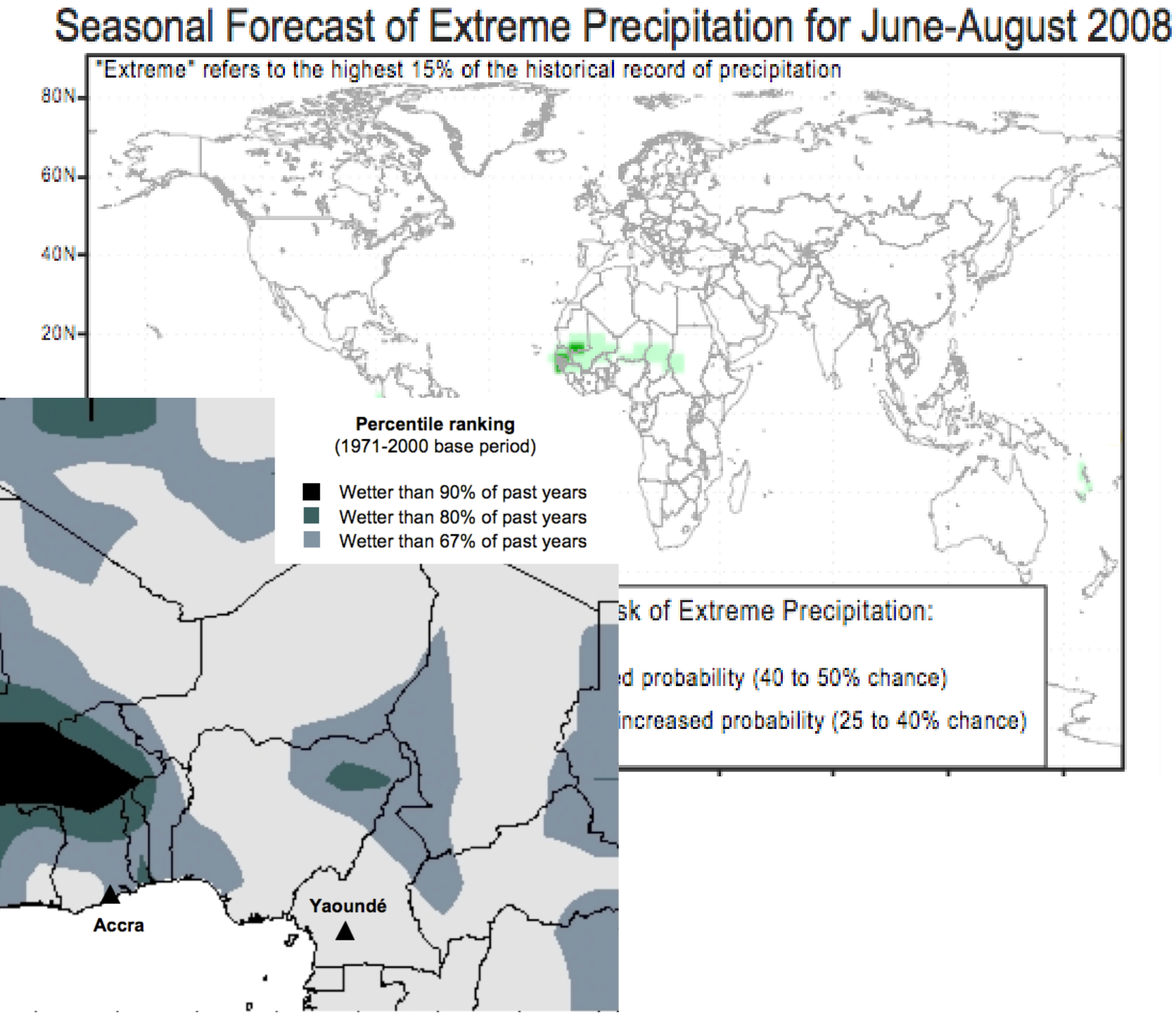
Floods downstream of the Bagre dam (Burkina Faso)

2007
- Inadequate warnings
- 200,000 affected
- 30+ deaths

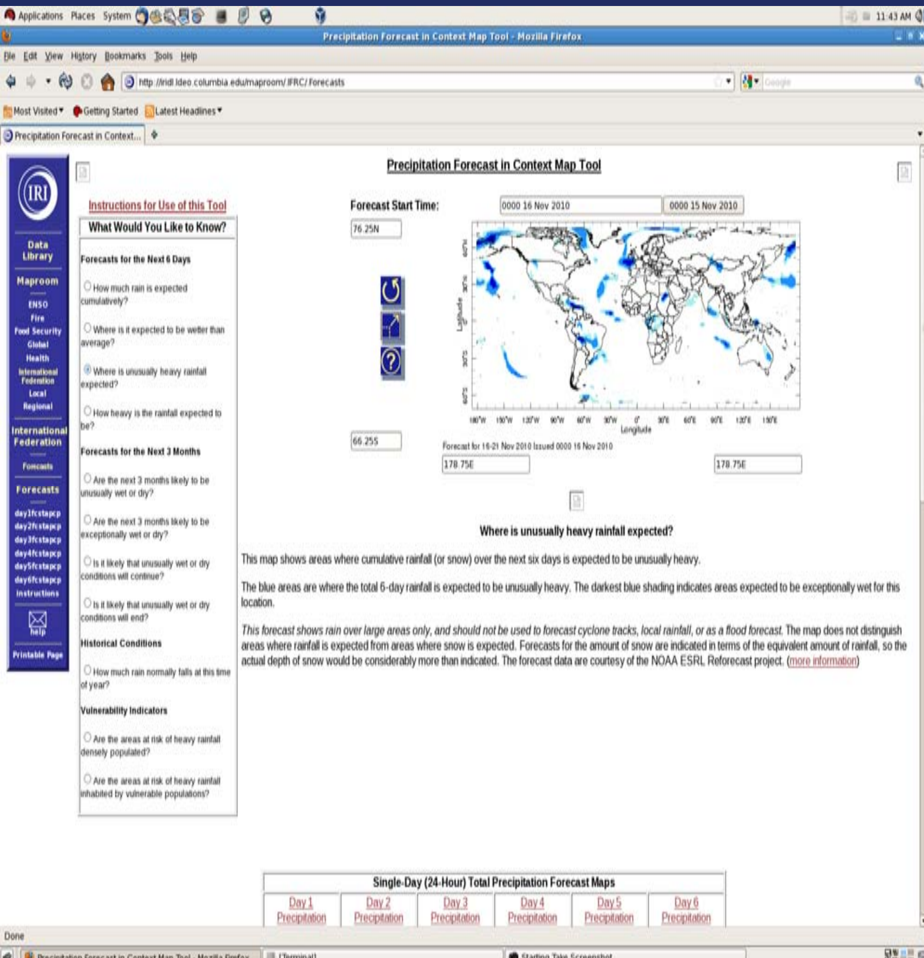
Recovery
- Integrate resilience
- Model flood-resistant homes
- Dialogue with Met Agencies

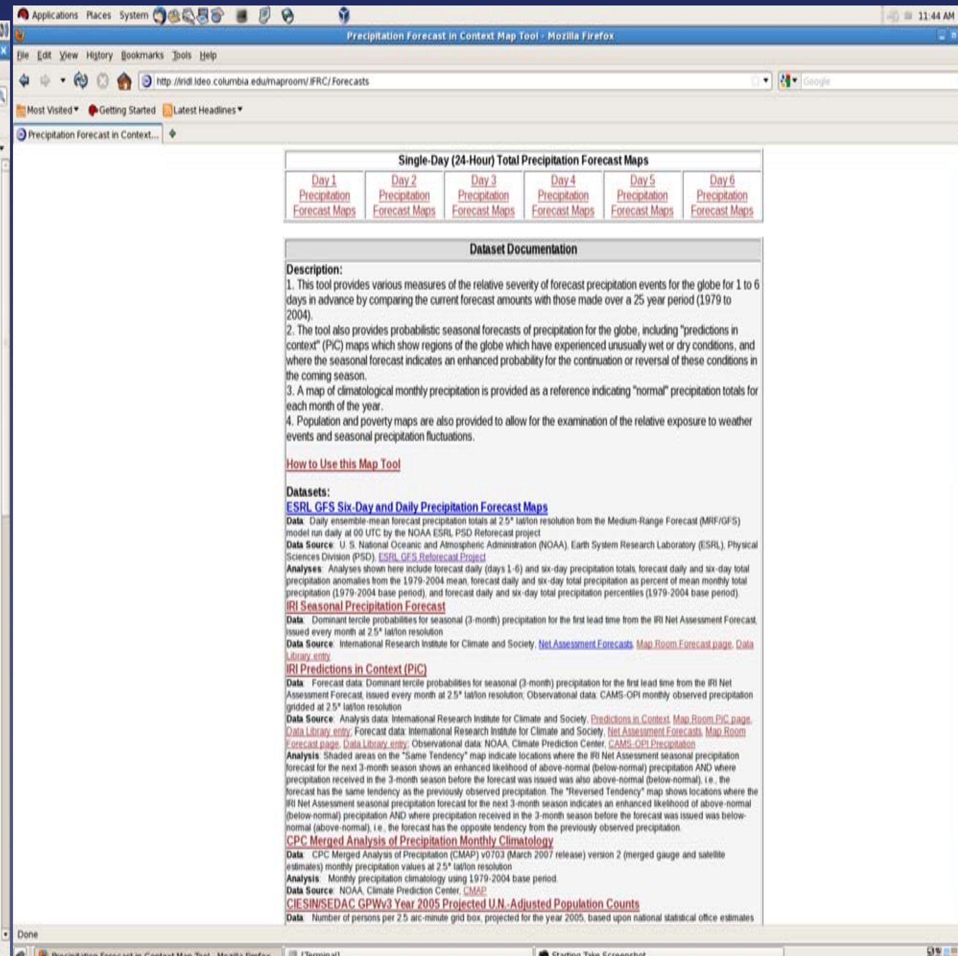
2008
- Bi-country mgment of dam
- RC community warnings
- Only 2 deaths

Key elements of West Africa success story



IFRC-IRI Precipitation Map Room





Climate information for Public Health

Madeleine Thomson, Stephen Connor

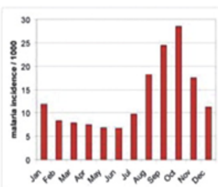
- Understanding of disease transmission mechanisms
- Estimating current populations at risk
  – in geographic space
  – by season
- Predicting changes in risk from season to season (including epidemics
- Monitoring and predicting long term trends
- Improving the measurement of climate sensitive MDG interventions

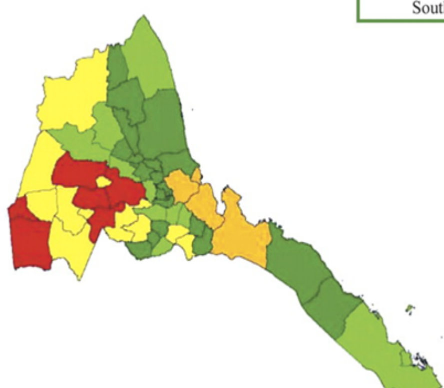
Estimating current populations at risk – in geographic space & by season

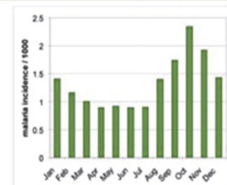
Climate – rainfall and temperature is a major determinant of spatial - seasonal risk of malaria

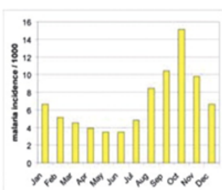
4. High incidence (Oct peak)
- Average 6.8 to 28.5 cases/1000/month
- Clear seasonal peak in October
- Includes most subzobas of Gash Barka.

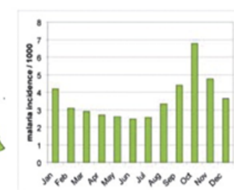
1. Very low incidence year around (Oct peak)
- Average 0.9 to 2.3 cases/1000/month
- Peak incidence in October with second smaller peak in January
- Includes central Northern Red Sea subzobas, most Debub higher altitude subzobas, Asmara city and central subzobas of Southern Red Sea.

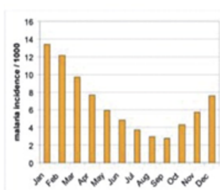










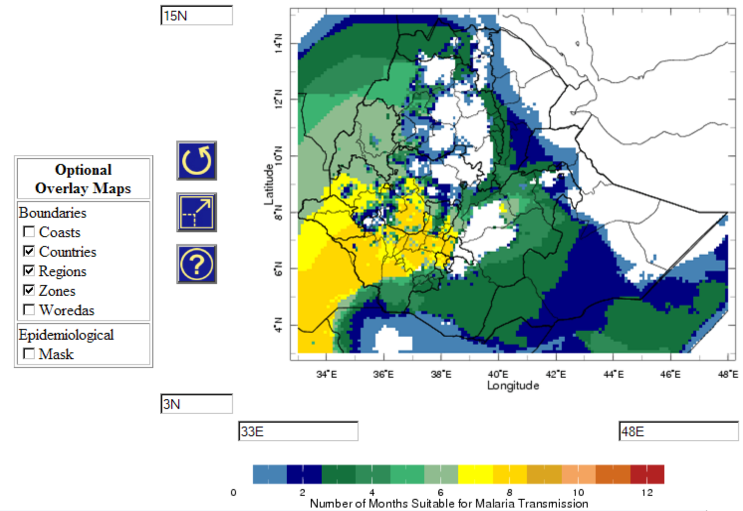


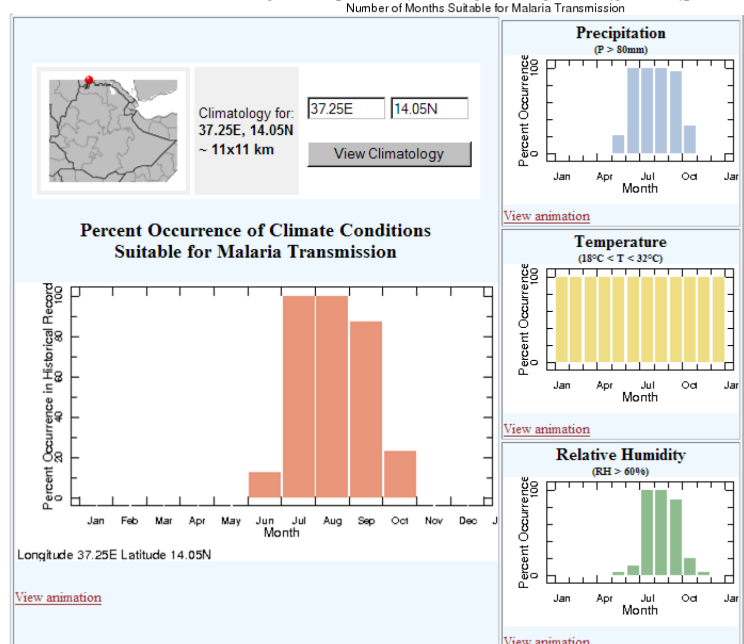
3. Moderate incidence West (Oct peak)
- Average 3.5 to 15.1 cases/1000/month
- Clear seasonal peak in October
- Includes some subzobas in Gash Barka and subzobas on the western escarpment in Anseba and Debub.

2. Low incidence year around (Oct peak)
- Average 2.5 to 6.8 cases/1000/month
- Peak incidence in October with second smaller peak in January
- Includes some western escarpment subzobas of Anseba and Debub as well as extreme northen and southern coastal subzobas.

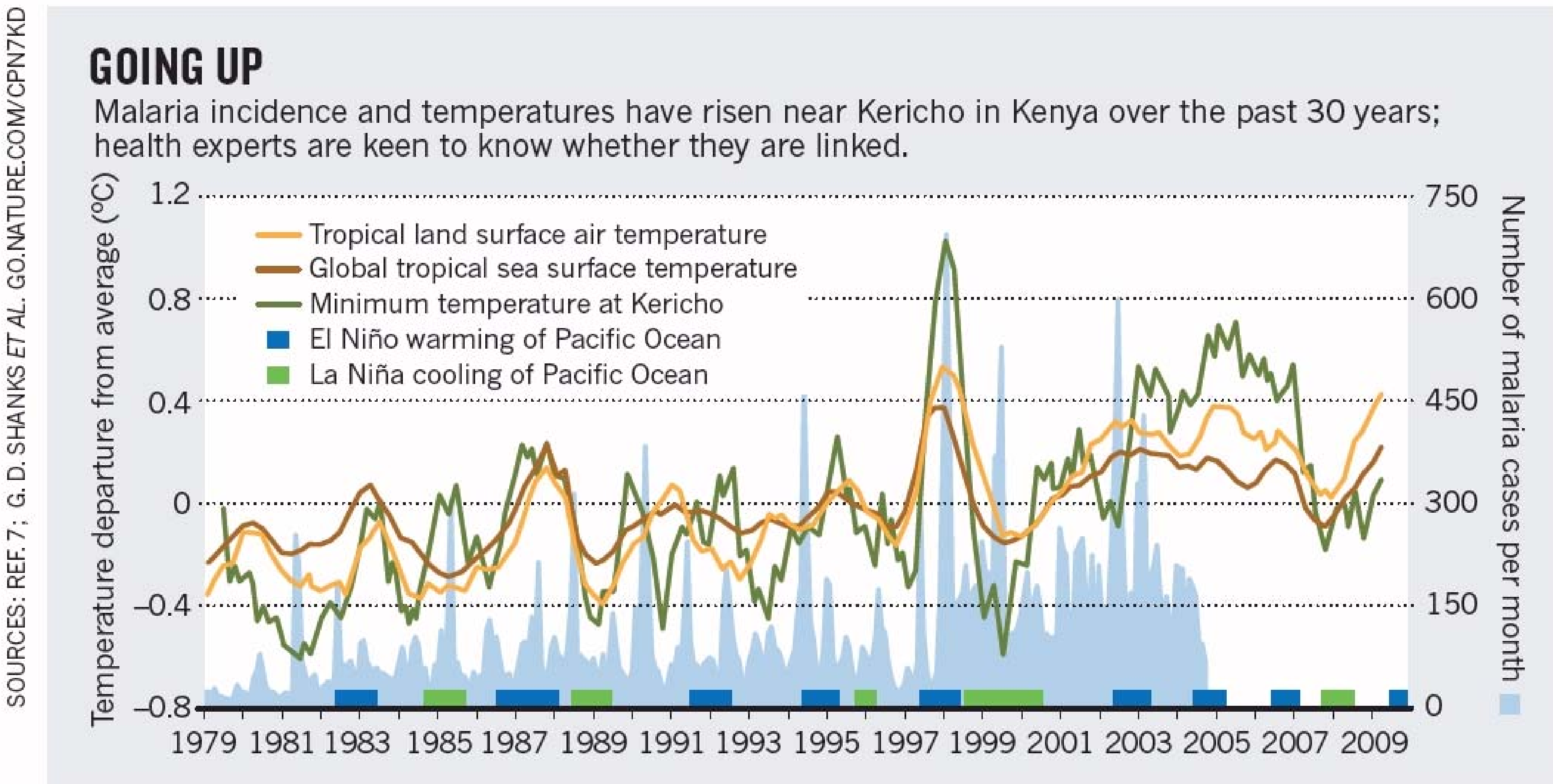
5. Moderate incidence East (Jan peak)
- Average 2.7 to 13.4 cases/1000/month
- One clear peak in January
- Four subzobas in south Northern Red Sea only.

Ceccato et al., (2006) Am. Soc Trop Med & Hyg





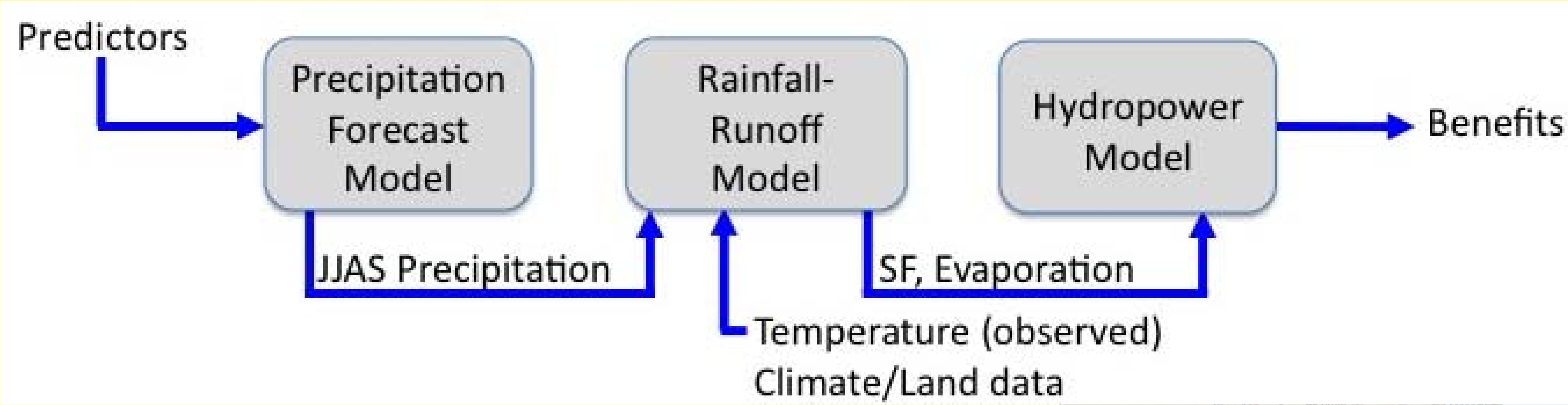
Monitoring and predicting long term trends



Thomson et al., 2011 Nature

Blue Nile Basin, Ethiopia

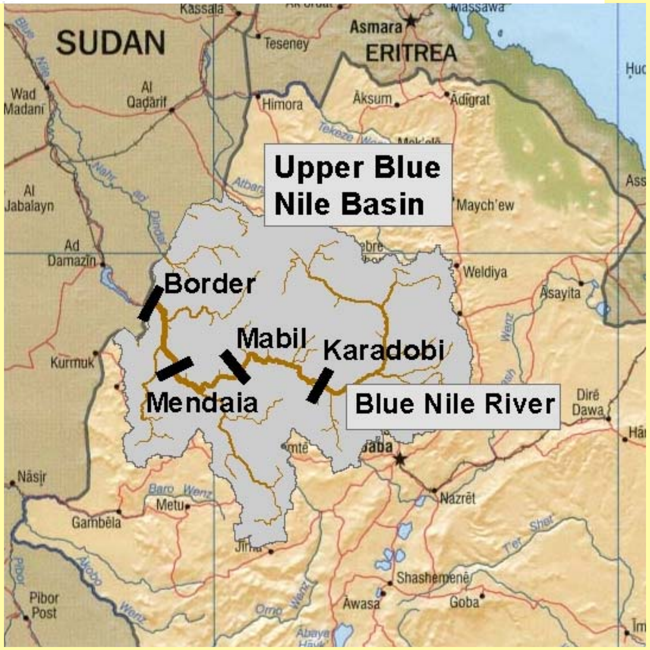
Multi-model streamflow forecasting for hydropower management



Precipitation forecast model = Statistical + CFS

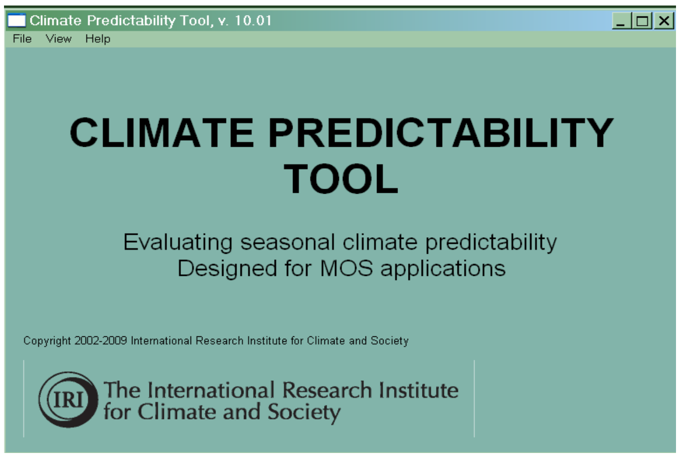
Select precipitation probability of exceedance levels to address manager's risk

Assess hydropower benefits and reliability, compared with no forecast

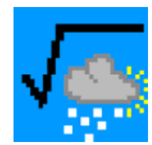


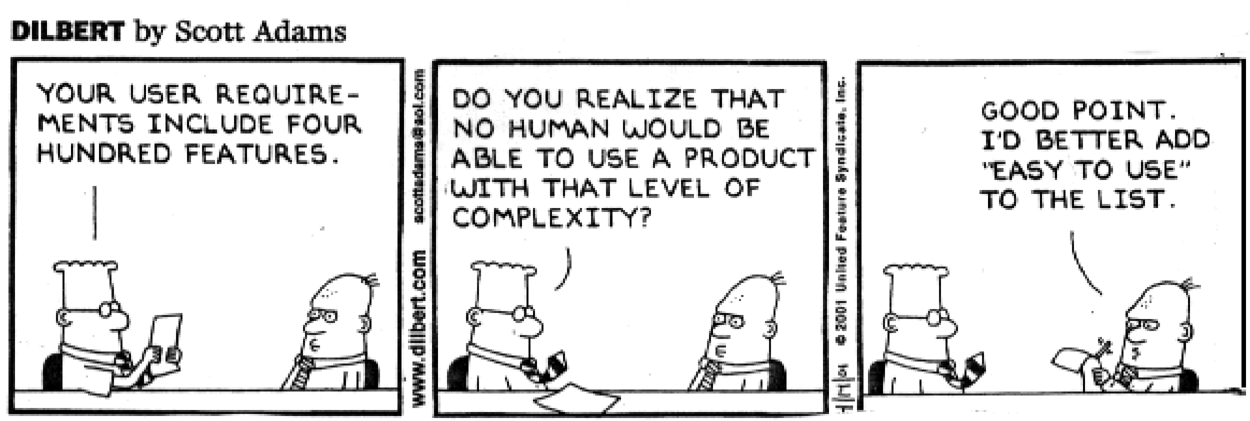
What is CPT?

Climate Predictability Tool (CPT) is an easy-to-use software package for making tailored seasonal climate forecasts.



Versions:

- Windows 95+ 
- Batch
- Generic GUI version (under development)



Why CPT?

CPT was developed to address some problems in producing seasonal climate forecasts at a number of the RCOFs:

Slow production time - expensive pre-forum workshops expensive, and limited availability of monthly updates;

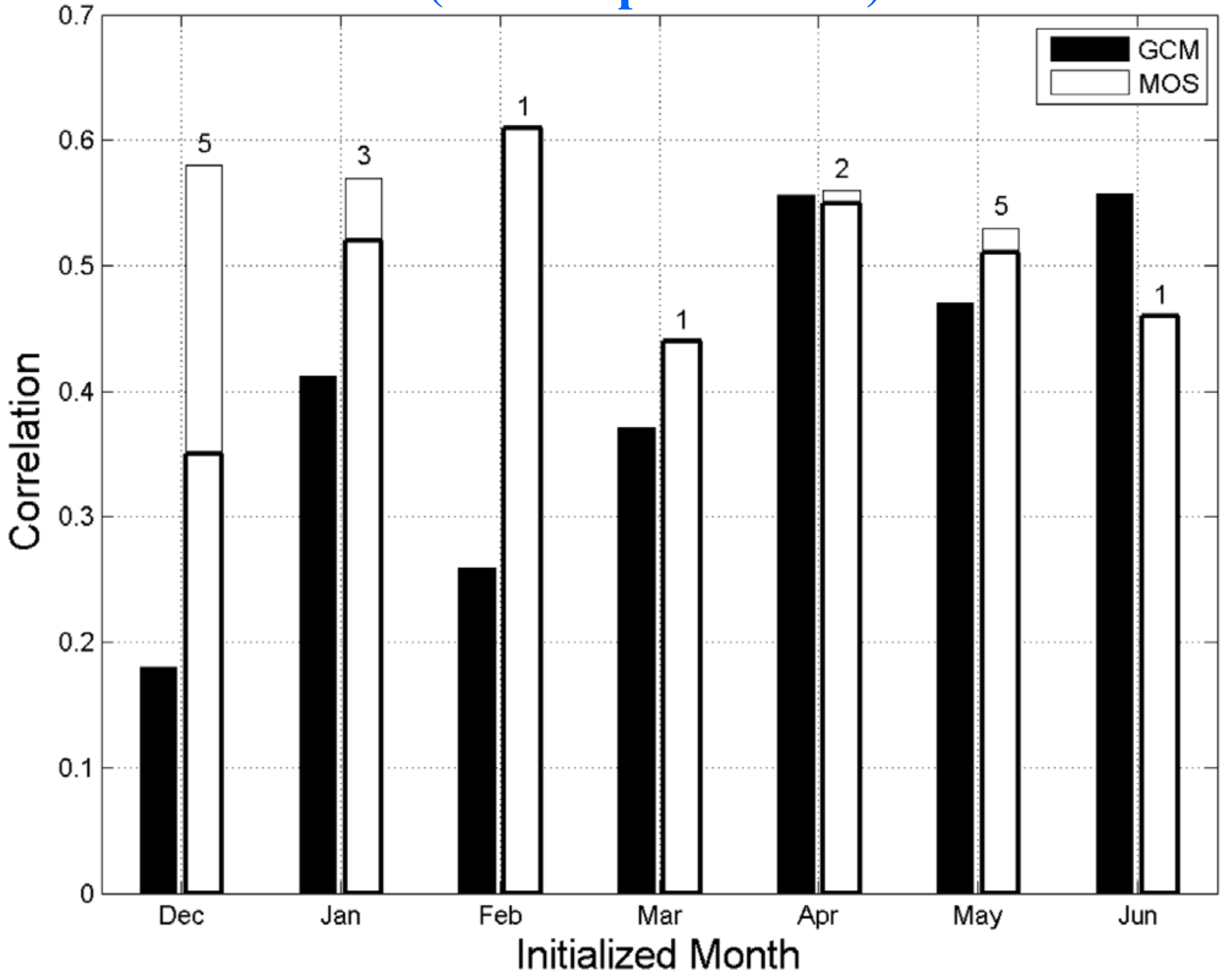
Artificial skill, and lack of vigorous performance evaluation;

Minimal consideration of global products.

CPT Use

CPT downloads (circles) and known CPT courses (triangles) from 2003 to 2009

CFS JAS Precipitation Correlation Sahel 1981-2008 from raw forecast and MOS correction (Local Optimization)

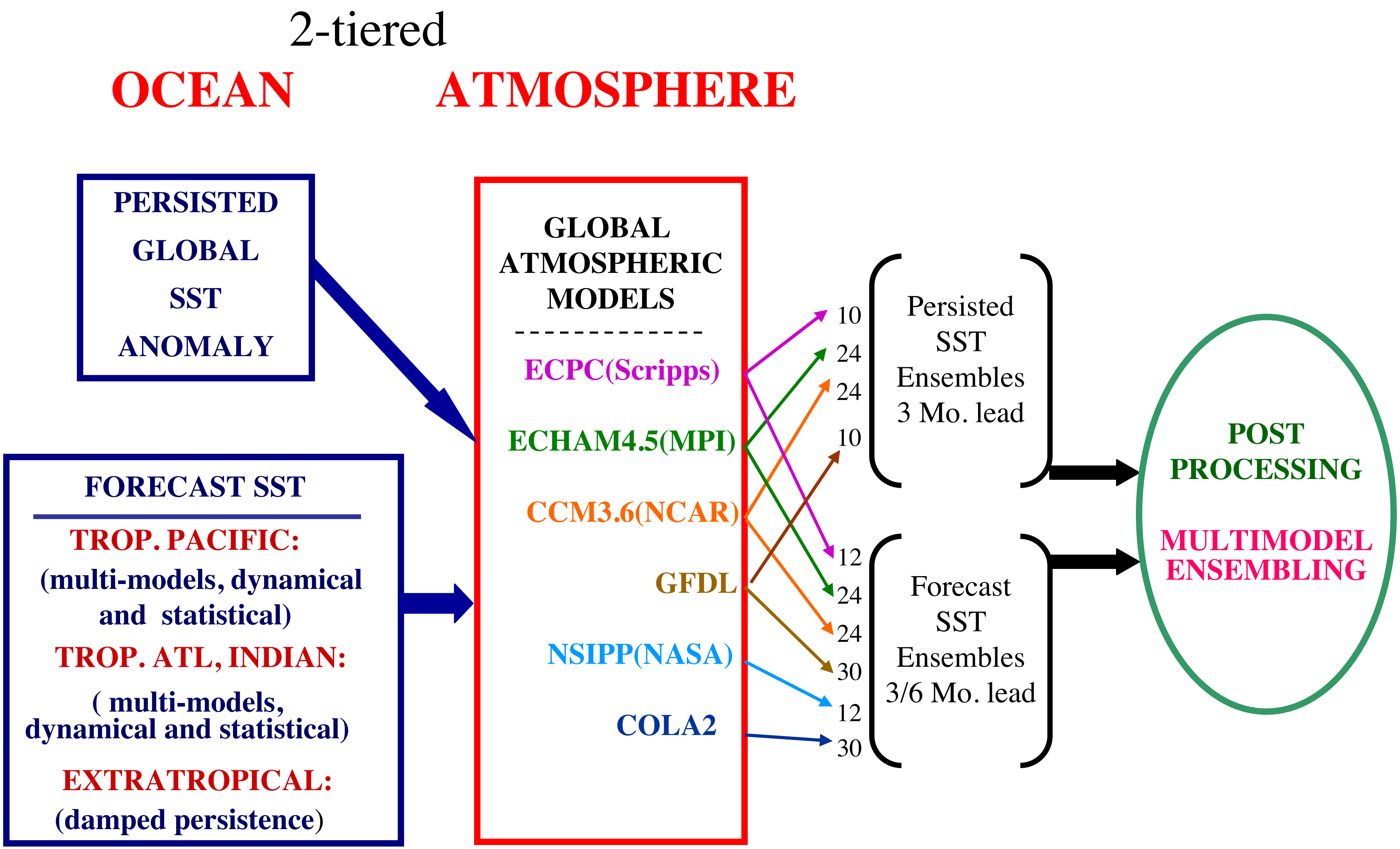


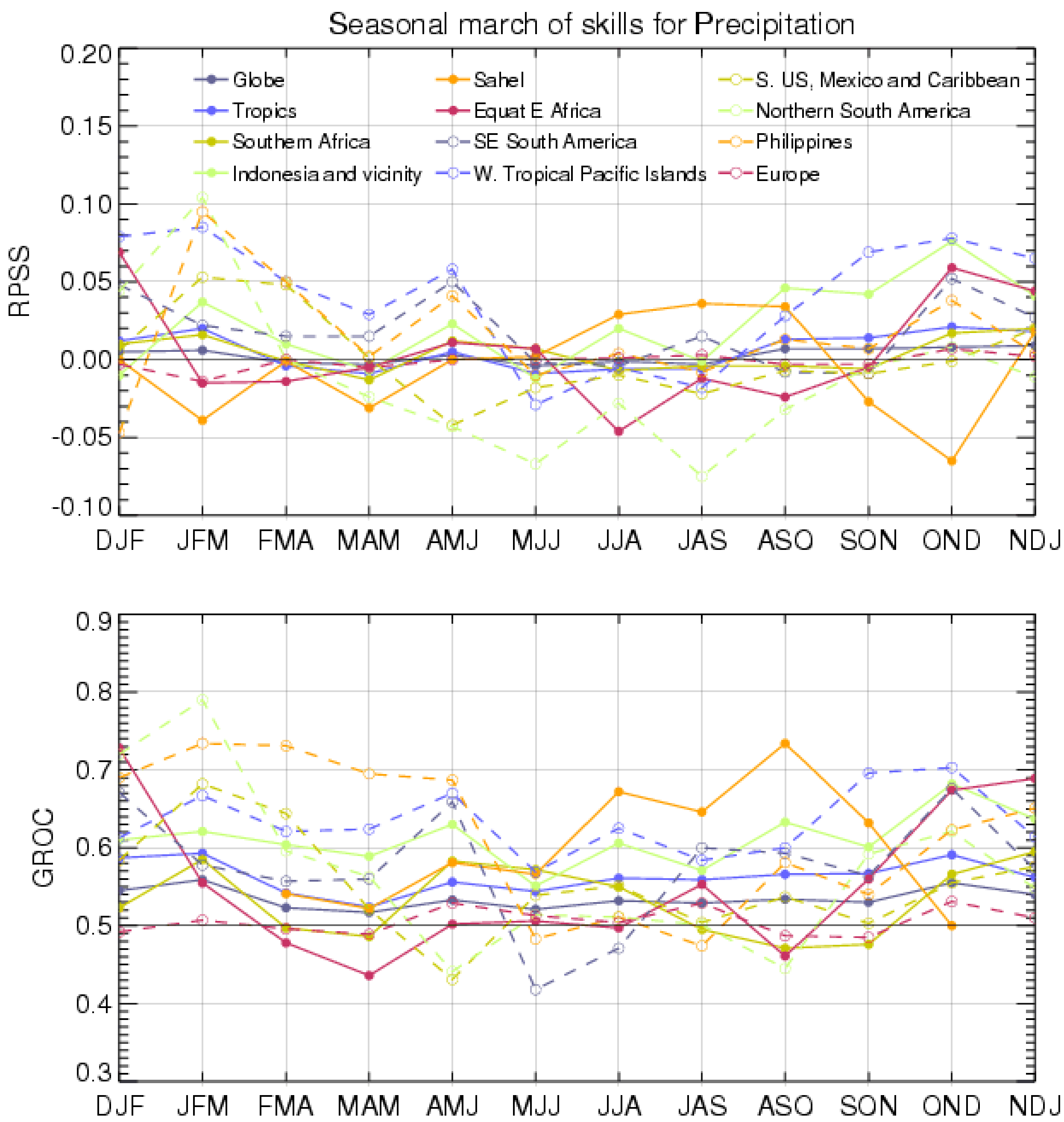
Raw CFS skill (shaded bar) MOS skill with one EOF (open)

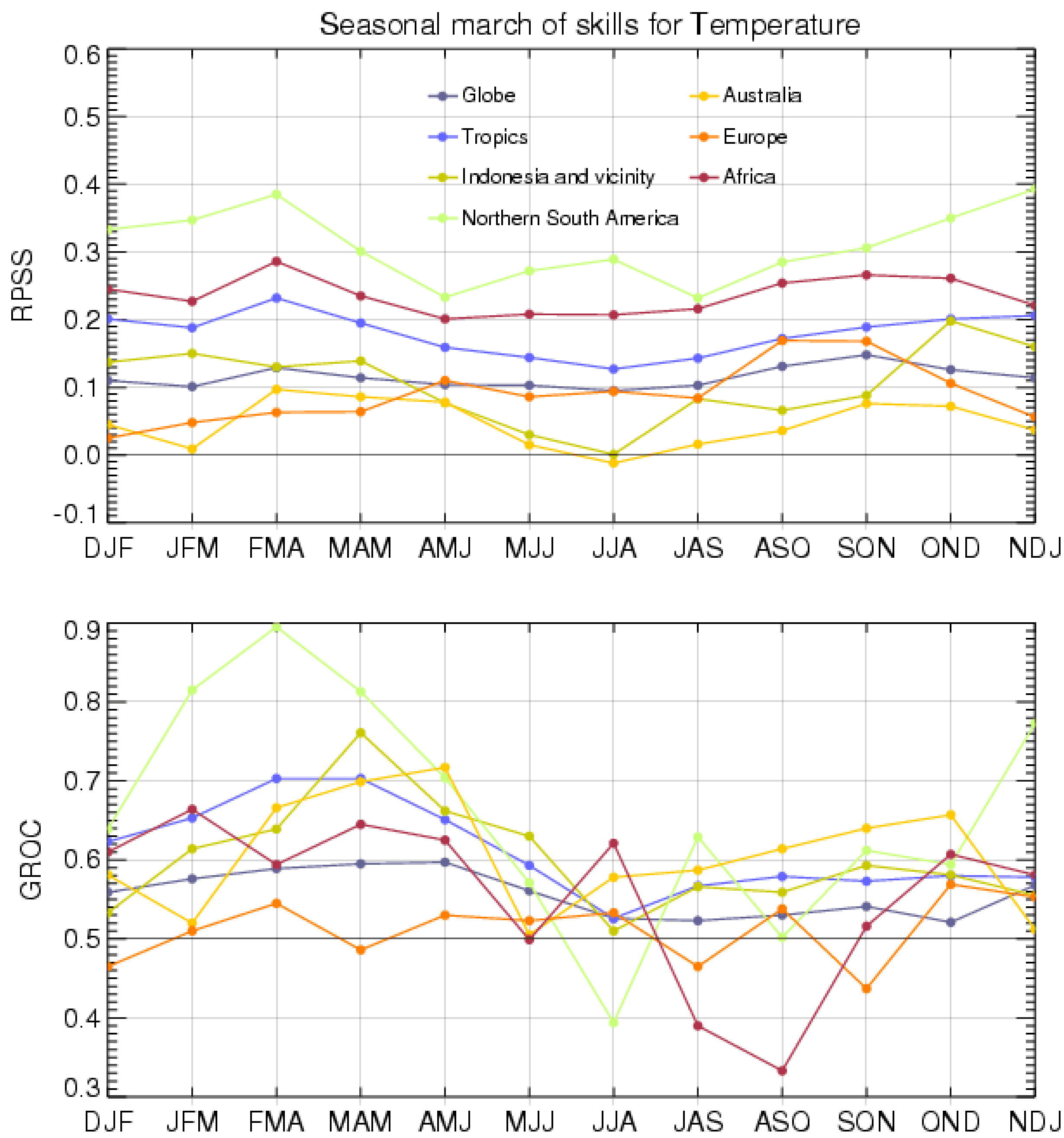
Materials accepted in Journal of Climate, Ndiaye et al.

IRI’s 2-Tiered Climate Forecasting System in 2010

IRI DYNAMICAL CLIMATE FORECAST SYSTEM




Seasonal march of skills for Precipitation
Globe
Tropics
Southern Africa
Indonesia and vicinity
Sahel
Equat E Africa
SE South America
W. Tropical Pacific Islands
S. US, Mexico and Caribbean
Northern South America
Philippines
Europe
RPSS
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
DJF JFM FMA MAM AMJ MJJ JJA JAS ASO SON OND NDJ
GROC
0.9
0.8
0.7
0.6
0.5
0.4
0.3
DJF JFM FMA MAM AMJ MJJ JJA JAS ASO SON OND NDJ



Seasonal march of skills for Temperature
Globe
Tropics
Indonesia and vicinity
Northern South America
Australia
Europe
Africa
RPSS
GROC
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
DJF
JFM
FMA
MAM
AMJ
MJJ
JJA
JAS
ASO
SON
OND
NDJ

Brad Lyon: Obs. Trend Analyses

Has there been an upward trend in Temperature in the Highlands of Kenya?