



# Outputs from WISER: Strengthening Climate Information Partnerships - East Africa (SCIPEA)

Richard Graham, Andrew Colman, Tracy Small, Andy Robertson, Sylwia Trzaska, Joseph Mutemi, Maureen Anyango and other SCIPEA colleagues from IRI, ICPAC & Met Services of Kenya, Tanzania, Ethiopia, Uganda

Second WMO Workshop on Operational Climate Prediction, 30 May – 1 June 2018, Barcelona Supercomputing Centre, Barcelona, Spain

# WISER Background

<http://www.metoffice.gov.uk/about-us/what/international/projects/wiser/>

- **Weather and Climate Information SERVICES - Africa**
- **Funded by the UK Department for International Development (DFID)**
- **4 year programme, consisting of 2 parts:**
  - **A pan-African programme:** focus on **strengthened governance and enabling environment** for weather and climate services
  - **A regional programme:** focus on the Lake Victoria Basin and surrounding region - **strengthened quality and relevance of weather and climate information, uptake and use, global/regional/national links**
- **Phase 1:** 5 “quick start” projects – 1.5 year duration (now finished);
- **Phase 2:** just beginning: includes W2SIP (Strengthening ICPAC Project)



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# SCIPEA Structure

## 5 Consortia

GHA

Kenya

Uganda

Ethiopia

Tanzania

Met Office  
Project Lead

ICPAC (RCC-IGAD)  
Regional  
Inputs and  
Coordination

SCIPEA Steering  
Group  
Met Office, IRI,  
NMHSs leads

## Regional consortium

ICPAC

User 1

User 2

Uni/TC

IRI & Met Office  
Global Centre inputs

## 4 National consortia

NMHS

Kenya  
Uganda  
Ethiopia  
Tanzania

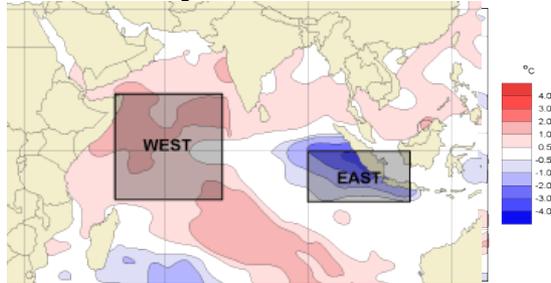
User 1

User 2

Uni/TC

# Key SCIPEA objective: strengthen use of GPCs – but how good are they over East Africa?

Indian Ocean Dipole (IOD) SST mode - partly driven by ENSO  
*Saji et al. 1999*



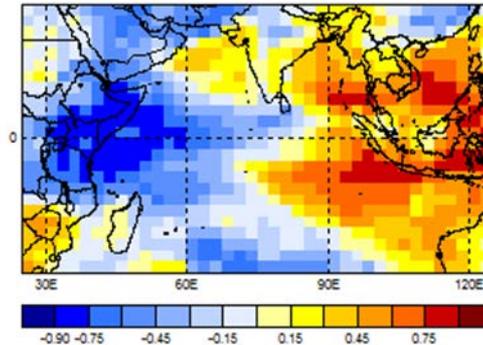
SST anomalies 1997

Most (all?) models have some degree of positional error and/or distorted response – due to teleconnection errors

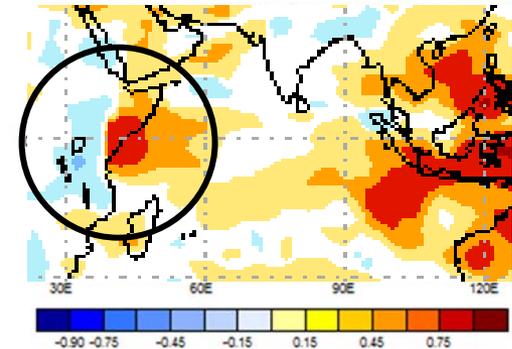
## First EOFs of OND rainfall variability

### Observed

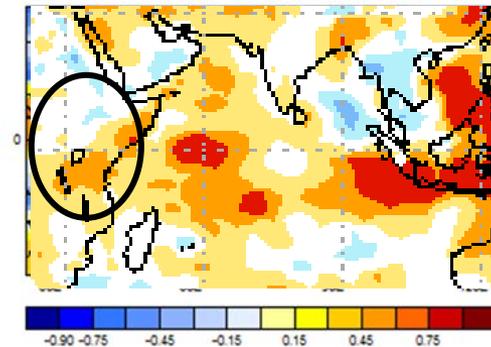
X Spatial Loadings (Mode1): GPCP 1983-2010



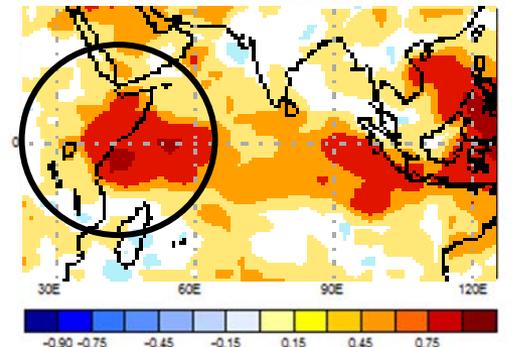
### GPC 1 hindcast



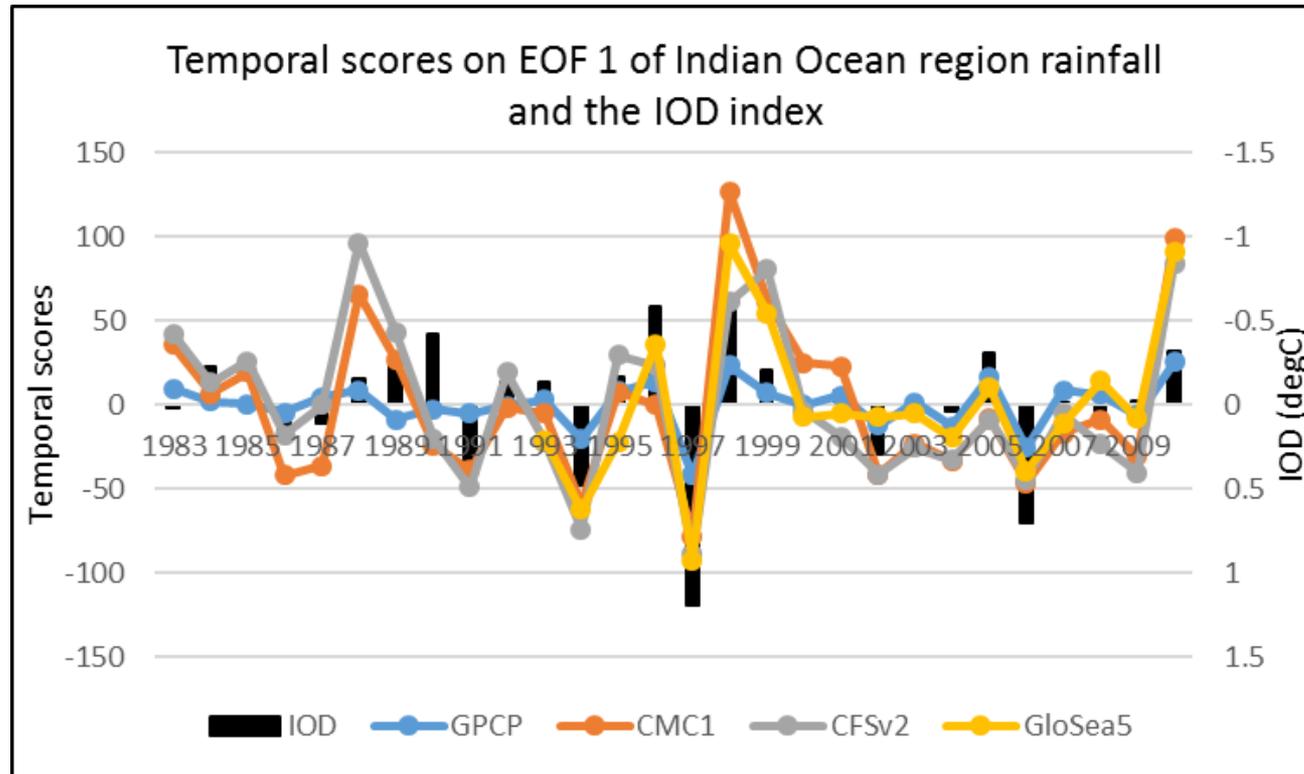
### GPC 2 hindcast



### GloSea5 hindcast



# Year-by-year projections of each models Indian Ocean area rainfall pattern onto its own EOF1



- All model predictions pick up on IOD variability – but predict their own characteristic rainfall response pattern (not necessarily the observed)
- Thus, we can use model forecast signals on the large (Indian Ocean ) scale to infer the forecast on smaller East Africa scale - CALIBRATION

# Canonical Correlation Analysis (CCA) calibration of GPC1 using CPT



IRI's Climate Predictability Tool (CPT) – widely used and in Climate Services Toolkit

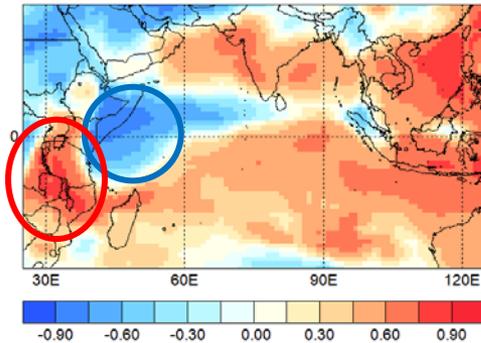
CCA is used here to find modes of co-variability between:

- Model hindcasts over predictor domain (here: Indian Ocean)
- Observations over target domain (CHIRPS)
- Period used for training is 1981-2010

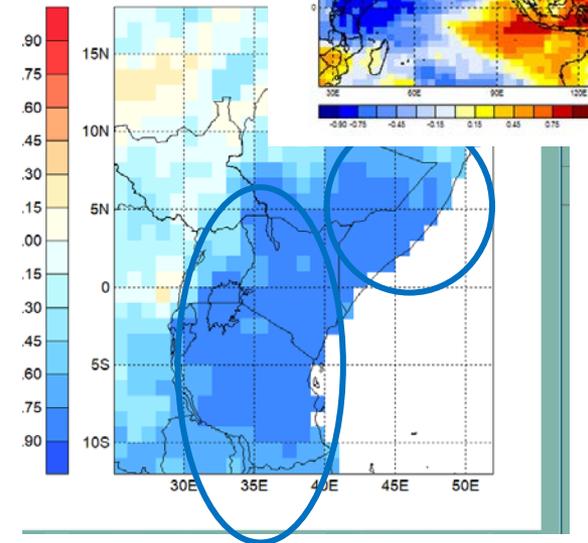
## Leading CCA paired mode of co-variability

Canonical Correlation: 0.8009

X Spatial Loadings (Mode1)



Y Spatial



When GPC1 predicts a large scale (IO) rainfall pattern line this...

...the observed East Africa rainfall pattern tends to be is like this

Calibration improves forecast skill for EA (Colman et al. in prep.)

# SCIPEA Data Portal to the IRI Data Library

Much increased access to GPC seasonal forecast data (including CPT format) through dedicated portal to the IRI Data Library **hosted in region at ICPAC**: one-stop-shop for seasonal forecasting data needs (models, calibration/verification data). Also **widespread use – e.g. for ASPIRE in W. Africa**. [Complementary to LC-LRFMME](#)

**SCIPEA-tailored portal to the IRI data library** <http://scipea.icpac.net/>



## SCIPEA Climate Data Portal – to be hosted at ICPAC

Climate affects sectors in society in a number of ways. These effects may be direct, as with heat stress, or indirect, as with infectious diseases such as malaria and meningitis.

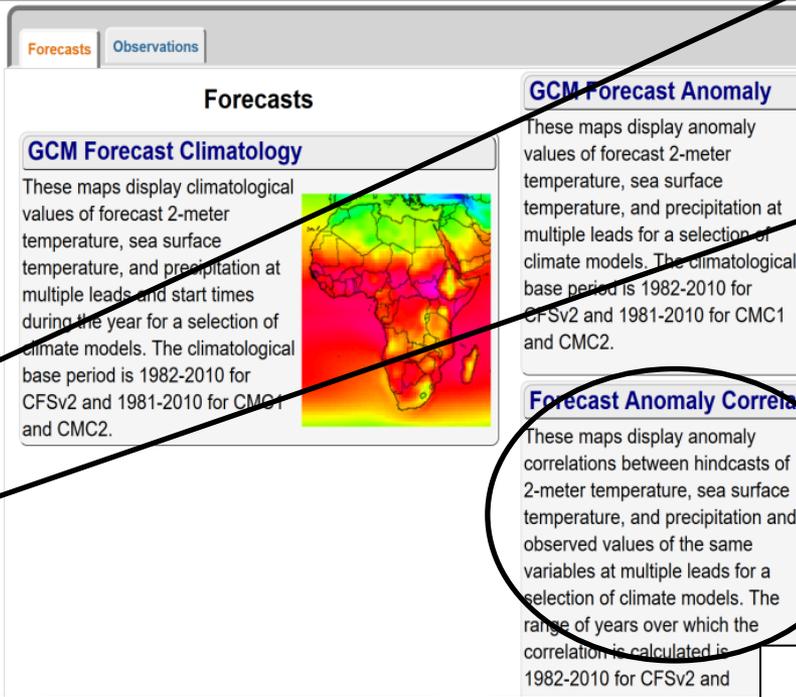
This facility aims to explore and inform users about the climate-society relationship with an emphasis on the seasonal nature of that relationship, where appropriate.

### Model Datasets

- [GPC Montreal](#)
- [GPC Washington](#)
- [GPC Exeter](#)
- [NASA](#)
- [GFDL](#)
- [CSIRO](#)

### Observation Datasets

- [CAMS OPI Precipitation](#)
- [GHCN CAMS Temperature](#)
- [FRSST Sea Surface Temperature](#)



**Forecasts**

**GCM Forecast Climatology**  
These maps display climatological values of forecast 2-meter temperature, sea surface temperature, and precipitation at multiple leads and start times during the year for a selection of climate models. The climatological base period is 1982-2010 for CFSv2 and 1981-2010 for CMC1 and CMC2.

**GCM Forecast Anomaly**  
These maps display anomaly values of forecast 2-meter temperature, sea surface temperature, and precipitation at multiple leads for a selection of climate models. The climatological base period is 1982-2010 for CFSv2 and 1981-2010 for CMC1 and CMC2.

**Forecast Anomaly Correlation**  
These maps display anomaly correlations between hindcasts of 2-meter temperature, sea surface temperature, and precipitation and observed values of the same variables at multiple leads for a selection of climate models. The range of years over which the correlation is calculated is 1982-2010 for CFSv2 and

Download latest model forecast/hindcast data for regional/national analysis

Download observations for forecast calibration and verification

“Quick look” maprooms giving model forecasts and first order skill



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# SCIPEA Data portal

## Data can be downloaded in a wide range of formats

### Download Data To Specific Software

<a href="#">ingrid</a>	The Postscript-based software on which the Data Library is built.
<a href="#">CPT</a>	Climate Predictability Tool <a href="#">More information</a>
<a href="#">ferret</a>	Interactive computer visualization and analysis software. <a href="#">More information</a>
<a href="#">GrADS</a>	Grid Analysis and Display System <a href="#">More information</a>
<a href="#">matlab</a>	Data analysis and visualization software. <a href="#">More information</a>
<a href="#">NCL</a>	NCAR Command Language <a href="#">More information</a>
<a href="#">WinDisp</a>	A public domain software package for the display and analysis of satellite images, maps and associated databases, with an emphasis on early warning for food security. <a href="#">More information</a>

### Other Available File Formats

Full Information Formats	
These files contain all of the available metadata.	
<a href="#">OPeNDAP</a>	A system which downloads data directly to software, such as matlab, Ferret, GrADS, etc. Specific instructions are available in the table above. Note: OPeNDAP was formerly known as DODS (Distributed Oceanographic Data System). <a href="#">More Information</a>
<a href="#">netCDF</a> (network Common Data Form)	A commonly supported self-describing data format. <a href="#">More Information</a>



# Links with ENACTS-Ethiopia project with IRI

<https://iri.columbia.edu/resources/enacts/>



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- ENACTS: blending national observational station data (rainfall and temperature) with satellite rainfall estimates and re-analysis temperature (more obs available than on GTS)
- Result: spatially and temporally complete, high resolution, high quality, gridded observation datasets
- Some countries now use ENACTS for GPC model calibration – with evidence that forecasts are improved

## MAM skill: December initialisations

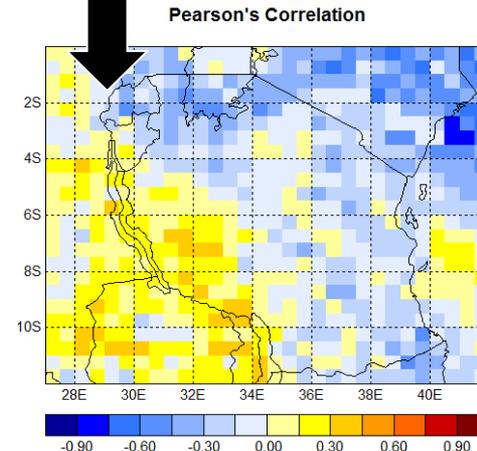
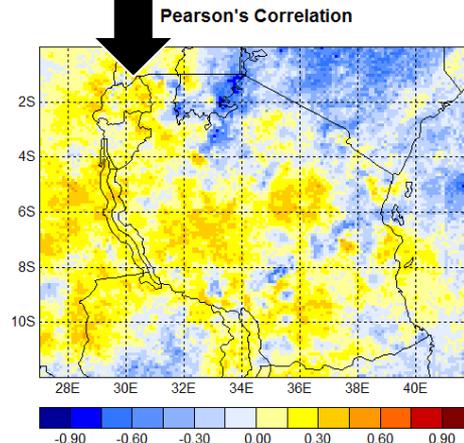
Correlation skill for CFSv2 calibrated

using ENACTS (left),

using FEWS-ARC2 (right)



Areas of better skill using ENACTS suggests benefit from use of more national observations



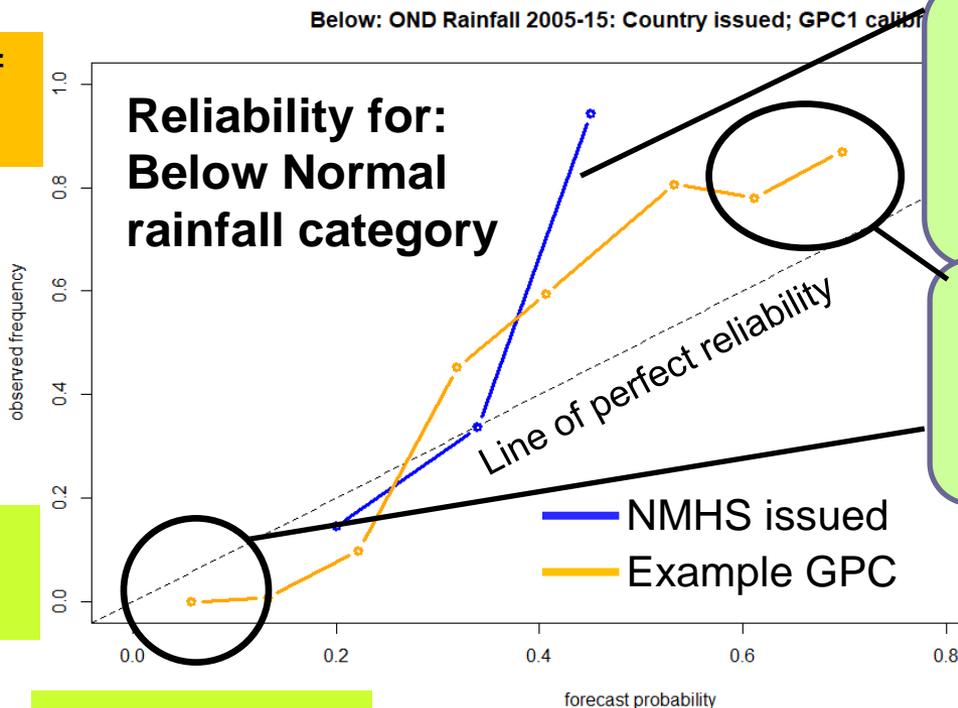
Courtesy Hellen Msemo, TMA

# Benefits to reliable probabilities From use of calibrated GPCs

Statistical reliability (key to FbA/FbF) of historical forecasts assessed – highlighting strengths, challenges and where use of GPCs can bring improvements.

High freq. of occurrence

Low freq. of occurrence



Past NMHS forecasts: good information, but narrow range of probability and not “bold” enough when high chance of dry

Calibrated GPC forecasts: work still needed - but can bring new “boldness” to probabilities – helpful to FbA

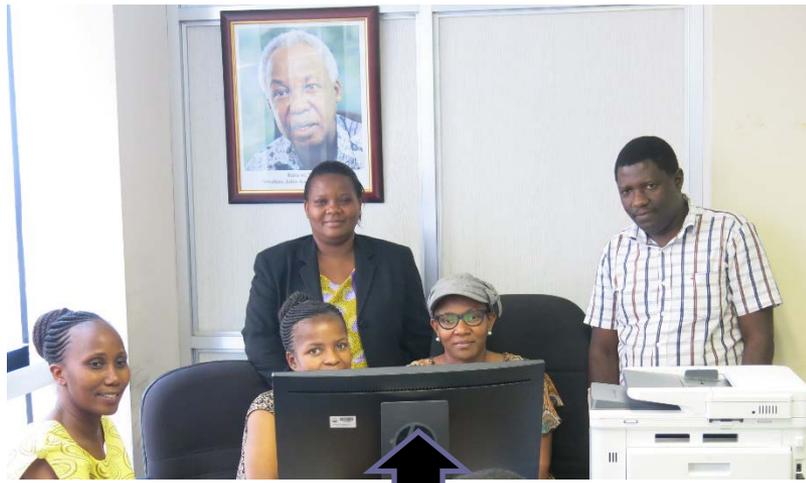
Gearing with West Africa (ASPIRE) and East Africa (SHEAR-ForPac)

Low forecast probability

High forecast probability

# Changing forecast operations

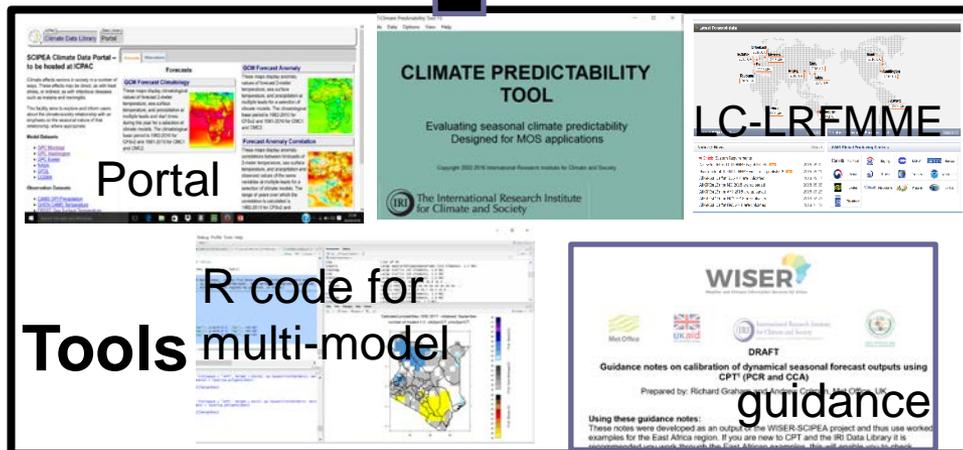
Strong evidence that methods are now in use



Example:  
Tanzania Meteorological Agency (TMA) established a National Centre for Interpretation of GPC products

Dedicated “desk”:

- WMO infrastructure
- portal access & data store
- processing tools e.g. CPT
- R software (for multi-model analysis)
- Technical guides
- Staff training resource



**Portal**

**CLIMATE PREDICTABILITY TOOL**  
Evaluating seasonal climate predictability  
Designed for MOS applications

**LC-LRFMME**

**R code for multi-model**

**guidance**

**WISER**  
Met Office | IRI | DRAFT  
Guidance notes on calibration of dynamical seasonal forecast outputs using CPT (PCR and CQA)  
Prepared by: Richard Graham, Met Office

# Summary

- Although most GPC models predict ENSO well (IOD less well) – getting associated rainfall teleconnections right is tough – particularly at regional/national scale – why should RCCs use the “raw” precip. outputs?
- For optimum use at regional/national scale all models need calibration (to greater or lesser degree)
- To promote use of GPCs – calibration tools must be supported
- Infact: best skill comes from a mix of calibrated and uncalibrated outputs (Colman et al. in prep) – another story for later

## SCIPEA outputs:

- Ready access to data and CPT format for some GPCs (NMME + Exeter) through new data portal **hosted at ICPAC (RCC-IGAD)** - strengthened GPC/RCC/NMHS links
- Sustained training in GPC calibration (including with view to onward sustainability) – increased use of GPC outputs (changed practices)
- User engagement – prototype service documents trialled over OND 2017
- Next steps: WISER Phase 2: continued strengthened use of GCM-based forecasts; implementation of climate services, user engagement and co-production. Also S2S training.



**Met Office**  
Hadley Centre



Thank you! Any questions?

# Prototype Climate Service documents: trialled over Short-Rains (OND) 2017 season

- Includes
  - Objective (from multi-model of 4 calibrated GPCs) 3-month tercile-category rainfall outlook
  - Drought Index – 10-month observed/predicted SPI (March-December)
  - Probability of exceeding thresholds 150mm, 250mm, 350mm
  - Predicted reservoir inflow for Masinga dam
  - Season onset timing
  - Rainday frequency
- First issue facilitated (with Users) at GHACOF (Zanzibar)
- Second (update) issue done by ICPAC/KMD without Met Office/IRI facilitation



# Socio-economic impact of new services

The trial seasonal climate services developed must be integrated into NMHS and Regional Centre operational outputs to consolidate potential for impact. This is planned for Phase 2 of WISER.

However, the increased user-engagement required for the trials has in itself had encouraging benefits.



The FSNWG/ICPAC SD team

Jasper Mwesigwa (former FSNWG co-chair): “FSNWG’s Oct/Nov 2016 drought alert used information from working sessions with SC�PEA. It helped make our messaging more credible and contributed to governments, humanitarian and other partners responding in a timely manner and preventing the worsening food security conditions from reaching famine levels as during the 2010/11 drought in this region.”



The KenGen/KMD SD team

Willis Ochieng (Chief Energy Planner, KenGen): “A particular benefit of enhanced engagement with KMD during the recent drought was reduced shut-down time of the Masinga dam - for only three weeks while in the past such droughts could result in shutdown of reservoirs of up to 6 months or more.” (*load shedding has large economic impact - industry/business/jobs*)

# Applications for the Food Security and Nutrition Working Group – SPI facility in CPT

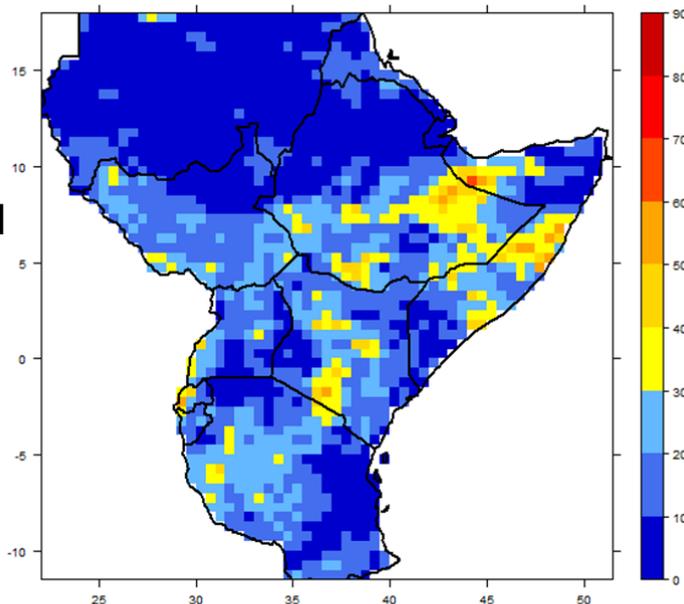
- Projected 10-month Standardised Precipitation Index (SPI) to end December



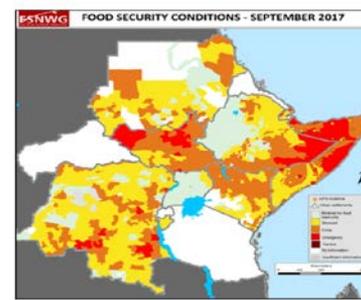
↑ Issue forecast early Oct

From trial ICPAC climate services for FSNWG; 3-model calibrated multi-model

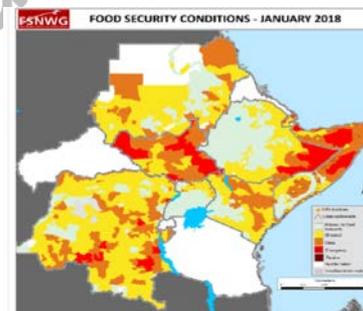
Predicted SPI-10  
Mar-Dec 2017  
Issued early Oct 17



Prob. SPI below 10th percentile



FS  
Status  
Sept 17



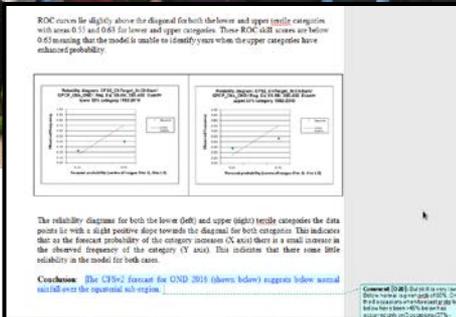
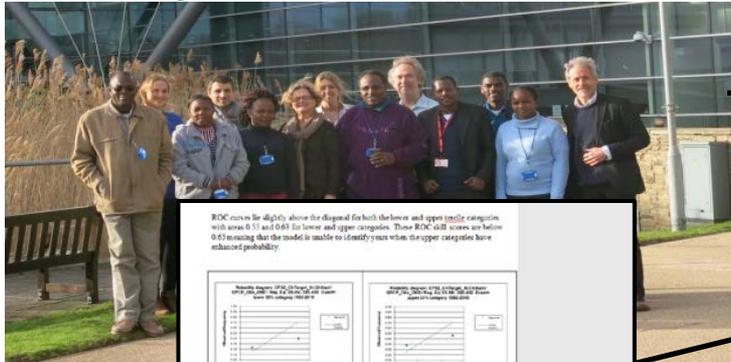
FS  
Status  
Jan 18

**Figure 3:** Probability that March-December 2017 rainfall deficits will be more severe than experienced on average once in 10 years. The baseline chance is 10%.

# Building sustained partnerships

Met Office

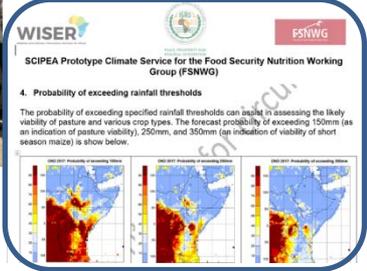
- Cohort of 11 East African climate scientists trained in dynamical seasonal forecasting, with step-change access to data and tools
- Strengthened partnerships with users – new trial co-developed services



4 model interpretation workshops; 1-month science visits to IRI & Met Office

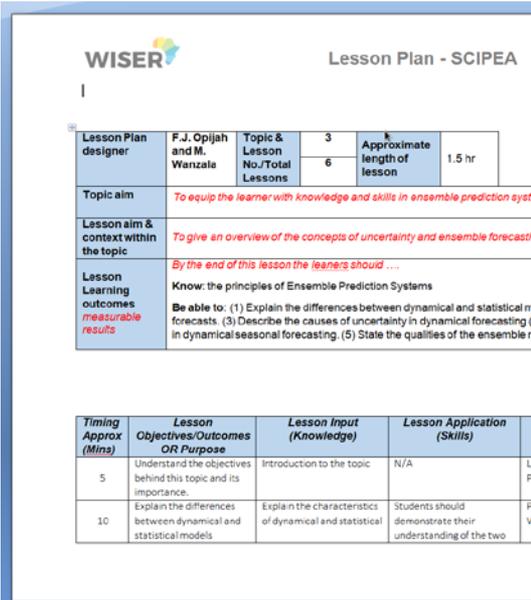
Continuous learning: monthly analysis & review of latest real-time forecasts

4 User/Provider Forums, plus national/regional Service Development Teams leading to trial services for OND 2017 – prepared with new skills and tools



# Sustaining in-region expertise

Framework developed for “in-region” and “by region” training on use of dynamical seasonal predictions – core lesson planning and materials ready for trial



**Lesson plans**

**Materials and exercises**

**SC�PEA workshop materials in use in new MSc at Adama Science and Technology University**

Understanding Dynamical Prediction for Seasonal forecasts

Overview of Uncertainty and Ensemble Prediction in Dynamical Seasonal Forecast Systems







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Weather and Climate Information Services for Africa



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# SCIPEA Project Partners

- **Global:** Met Office and IRI
- **Region:** ICPAC, Regional Food Security and Nutrition Working Group (FSNWG), Network of Climate Journalists of the Greater Horn of Africa (NECJOGHA), University of Nairobi
- **Kenya:** KMD, Red Cross Kenya, KenGen, Institute for Meteorological Training and Research
- **Tanzania:** TMA, Ministry of Energy and Minerals, Ministry Agriculture, Livestock and Fisheries, Dar Es Salaam Institute of Technology
- **Uganda:** UNMA, MAAIF Early Warning Unit, Water Resource Management, National Meteorological Training School
- **Ethiopia:** NMA, National Disaster Risk Management Commission, Ministry of Agriculture and Natural Resources, Adama Science and Technology University

Consortia led by the climate providers (ICPAC/NMHSs), coordination by ICPAC



Met Office

# Talk Content

- The Met Office GloSea5 seasonal forecast system
- WMO infrastructure for seasonal forecasting – the Global Producing Centres (GPCs) – within the GFCS
- Broad view of GPC performance over East Africa – the need for forecast calibration
- The DFID WISER programme
- The SCIPEA project: operational access to GPC data, calibration tools (e.g. CPT software package) and results
- Use of forecasts in Seasonal Climate Services – for Food Security
- Looking further ahead (convection permitting models) – the IMPALA project

# SCIPEA: Climate Partnerships on three levels

Contributes mainly to WISER Component: Supporting organisations ... to **develop global-regional-national links to strengthen production, uptake and use** of climate information.



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## 5 Consortia

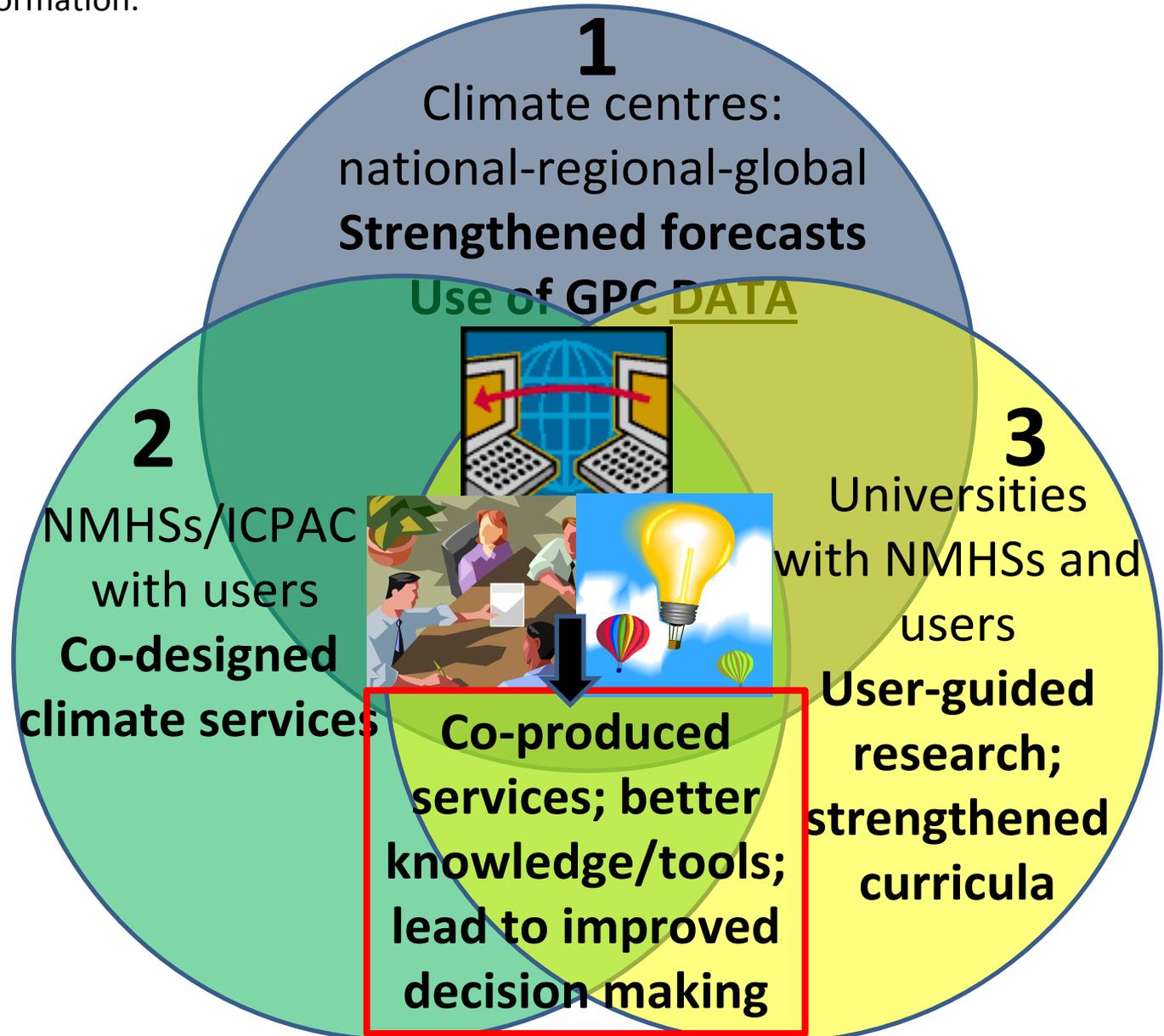
GHA

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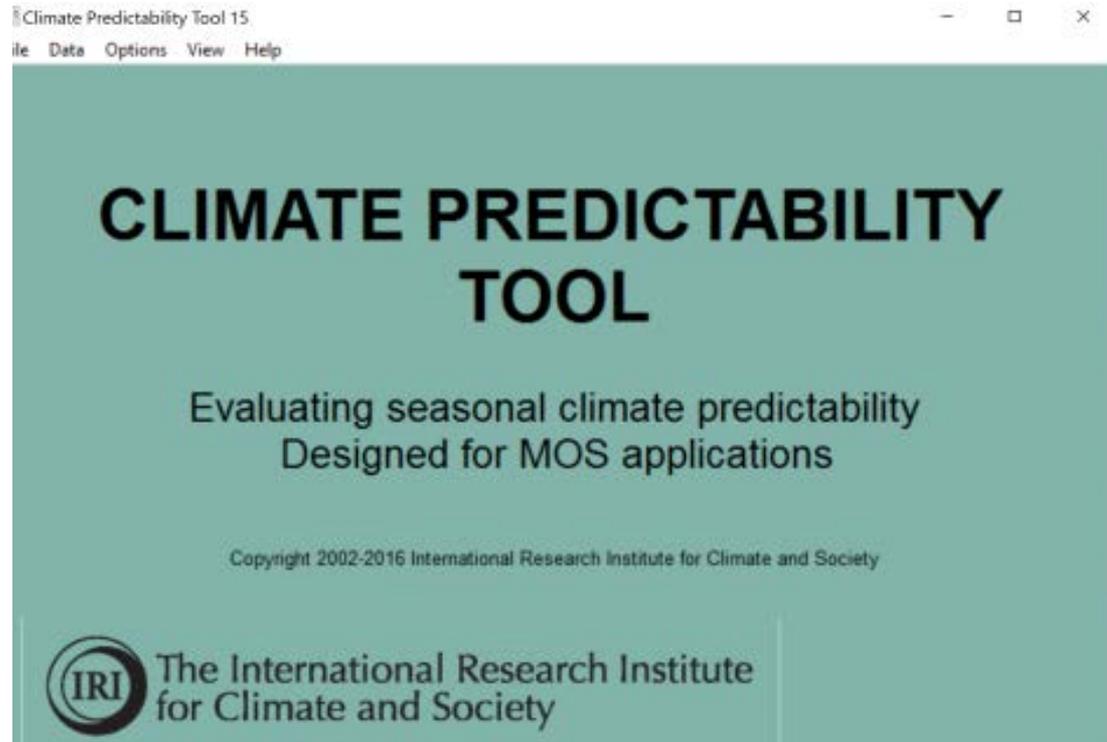




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IRI  
CPT



- developed by IRI (partners in SC�PEA)
- designed for Model Output Statistics (MOS) applications
- statistical correction of e.g. teleconnection errors
- part of the GFCS Climate Services Toolkit