Seasonal forecasting for climate risk management

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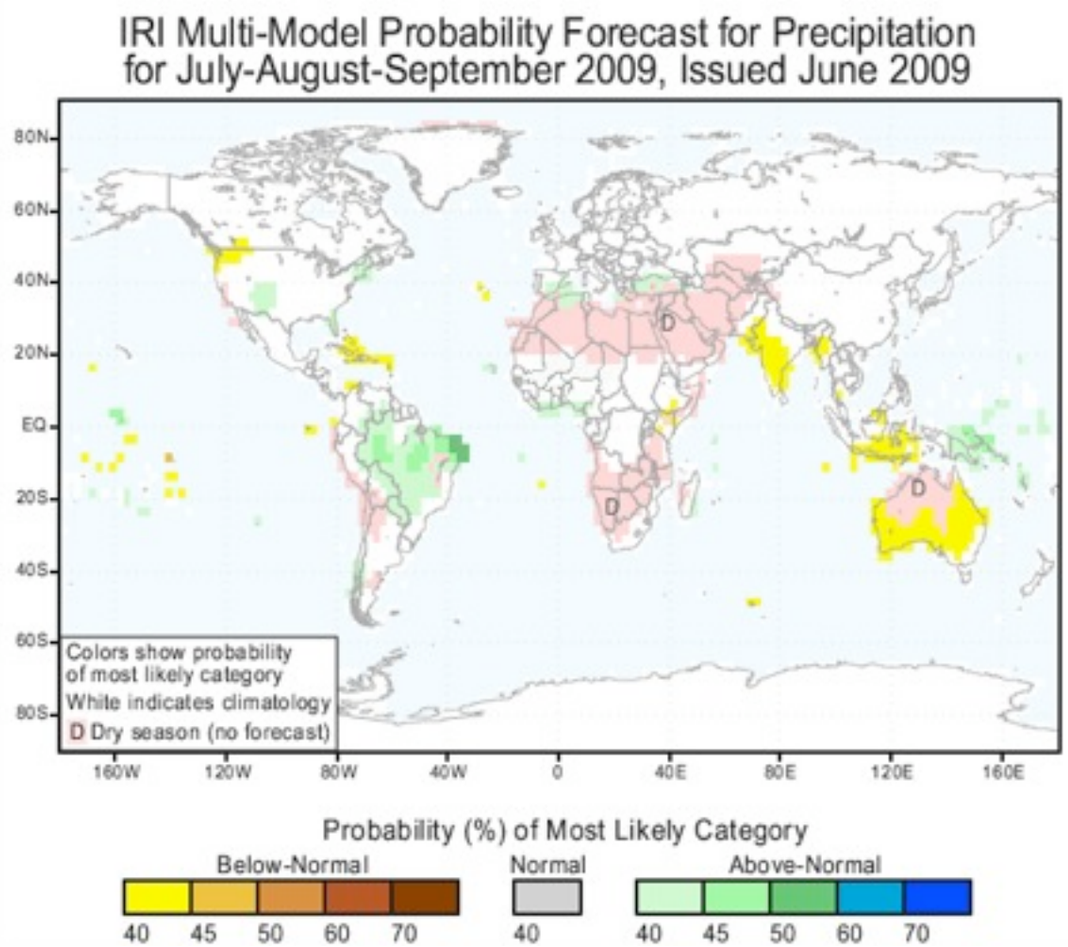
New York, USA

with contributions from Lisa Goddard, David DeWitt, Dong Eun Lee, Vincent Moron and many others

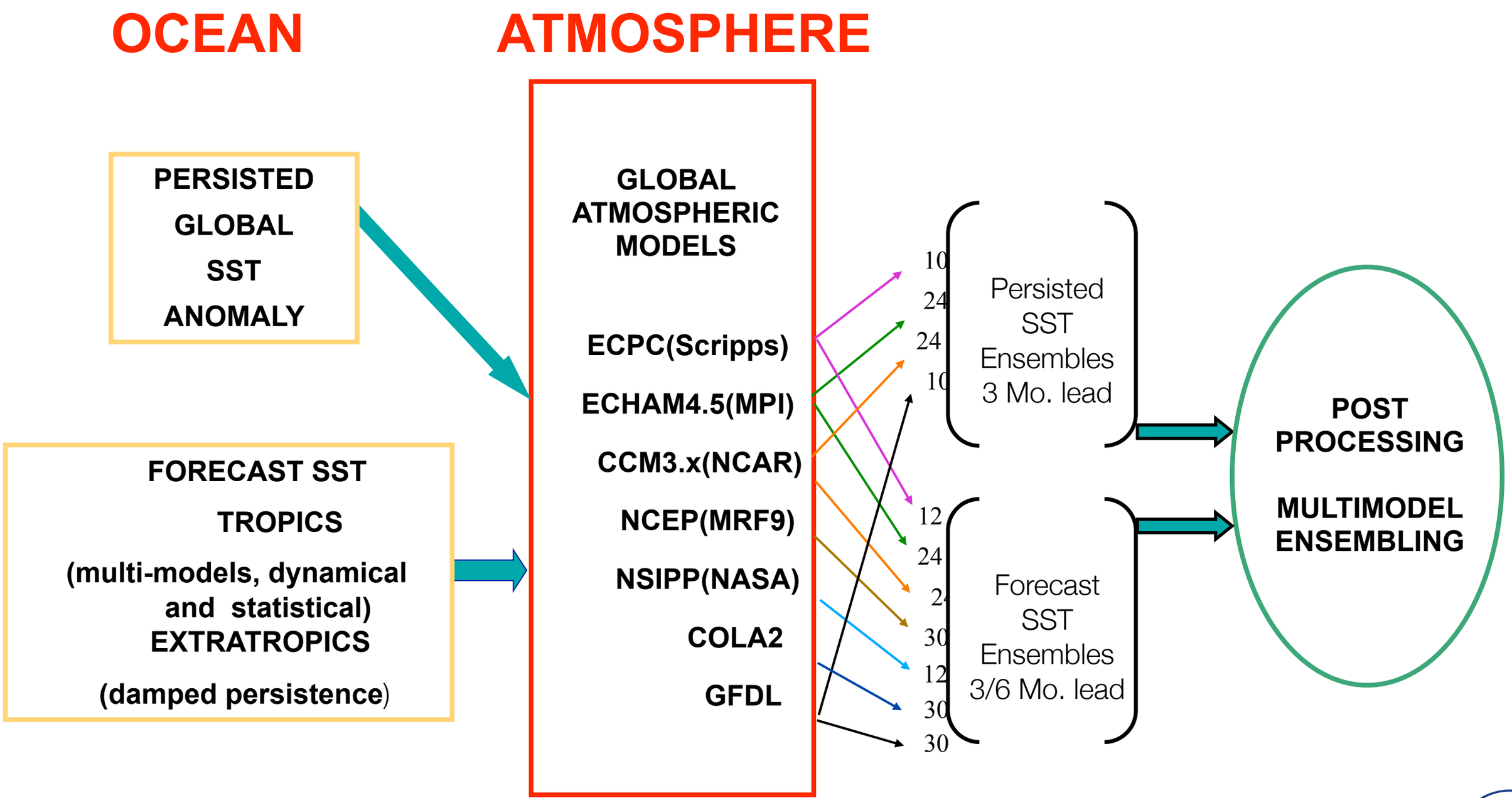
outline

- global ocean-atmosphere model and prediction system development at IRI for seasonal forecasts

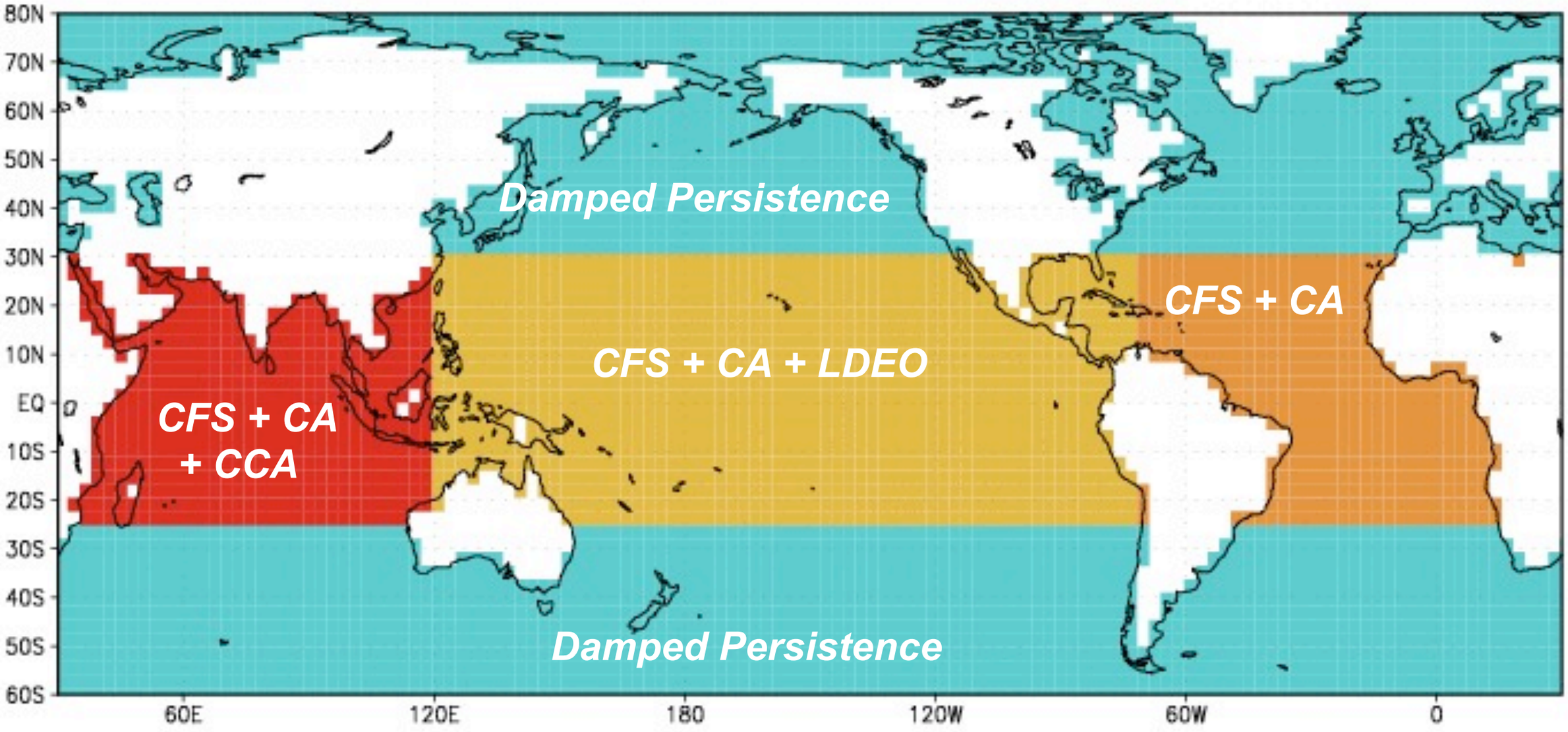
- downscaling and “tailoring” of forecasts and historical climate information



IRI current operational two-tier seasonal forecast system

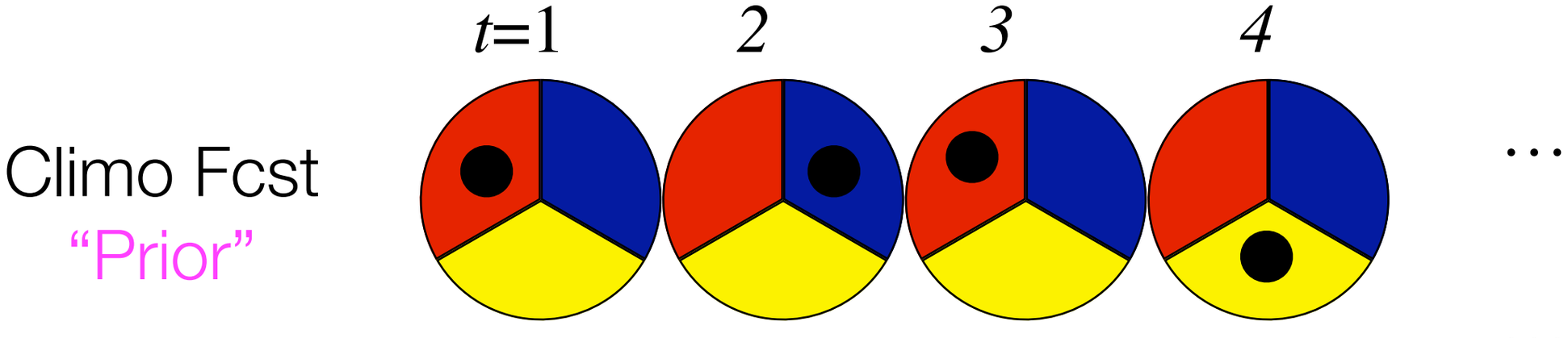


SST prediction



Moving towards global SST prediction products ONLY: ***CFS, ECMWF-Sys3, CA***

Bayesian Model Combination



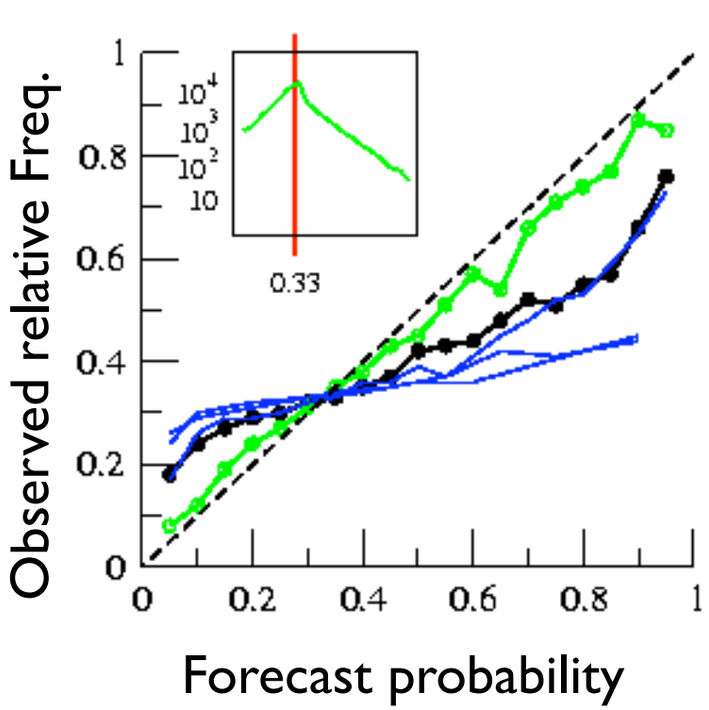
Combine "prior" and "evidence" to produce weighted "posterior" forecast probabilities, by maximizing the likelihood.

(Rajagopalan et al. 2001, MWR; Robertson et al., 2004, MWR)

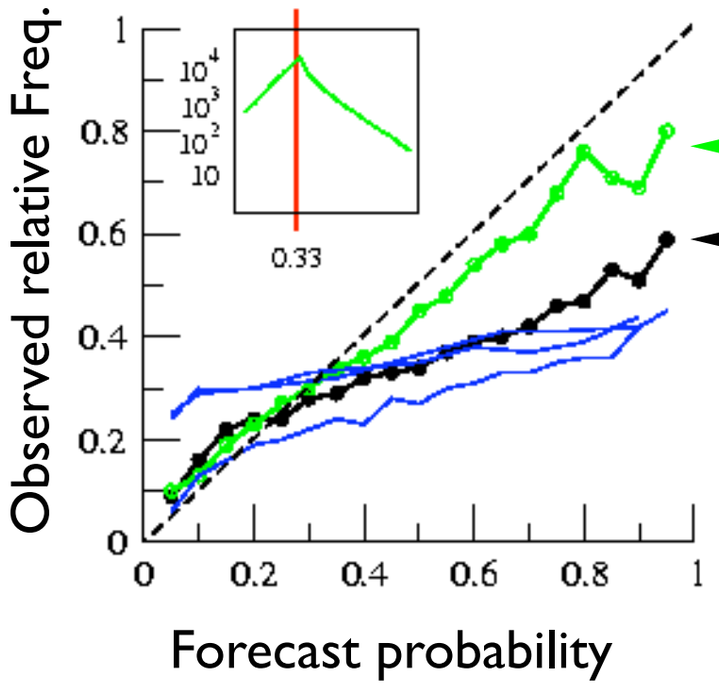
Reliability

JAS Precip., 30S-30N

Above-Normal



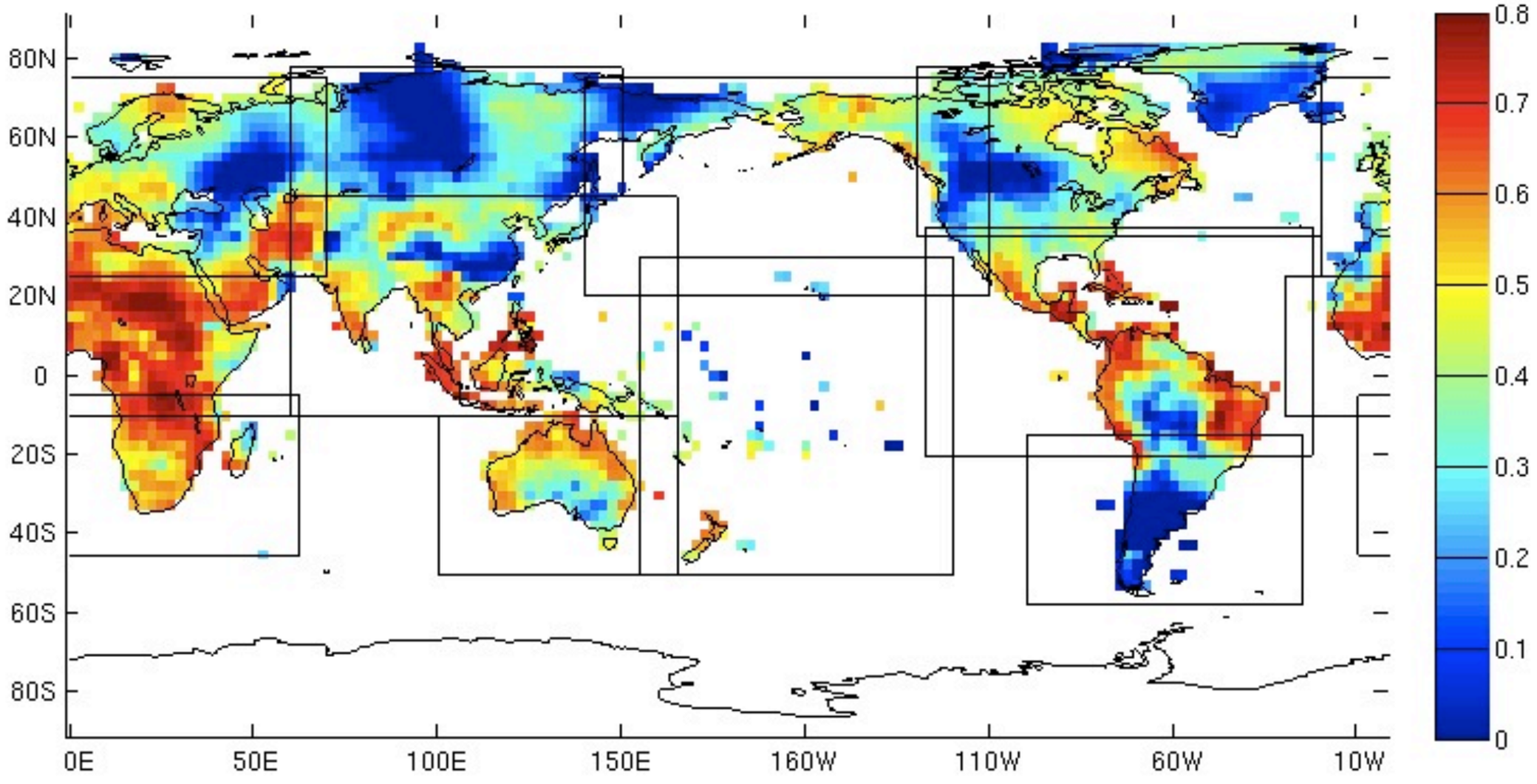
Below-Normal



(3-model)

Spatial Bias Correction: CCA performed regionally. Results are smoothed along overlapping areas.

RPSS Relative to Original Model Ensemble
2mT JJA 1957-2001



“Primary” Coupled Model at IRI

AGCM: MPI ECHAM4.5 (MPI parallelism)

- T42L19 (~2.8125° Gaussian grid)
- Global Spectral model

OGCM: GFDL MOM3 (MPI parallelism)

- Domain: 75°S - 65°N
- Resolution: 1.5° zonally, 0.5°–1.5° meridionally
- Ocean initial conditions from GFDL temperature-only ODA

Coupling: Anomaly coupling

Hybrid coupled system

Atmosphere

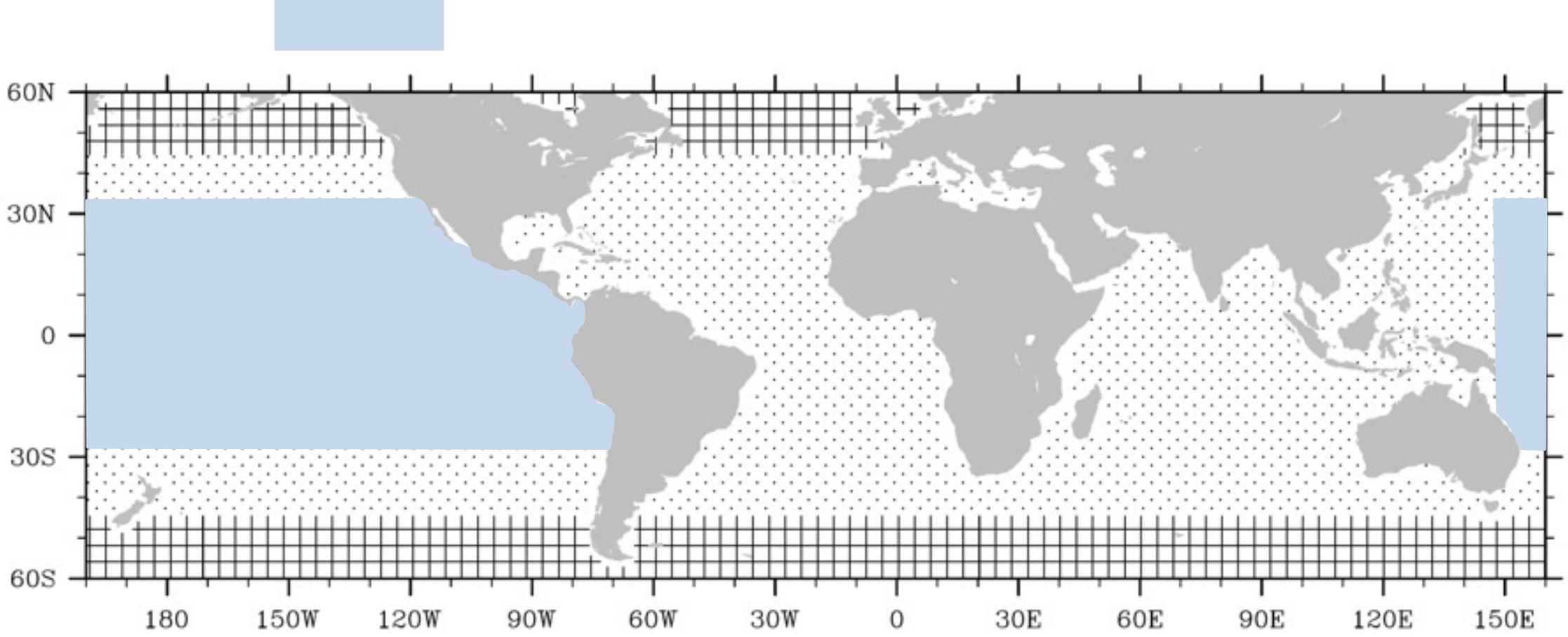
ECHAM v4.5 AGCM

Ocean

Mixed Layer Ocean

Climatology

Prescribed with SST forecasts from CFS



downscaling and “tailoring” of forecasts and historical climate information

... from static to dynamic risk estimates, expressed in terms of the variable of interest

IRI
Data Library
Maproom
ENSO
Fire
Food Security
Global
Health
International Federation
Local
Regional
International Federation
Forecasts
Forecasts
day1fcstapcp
day2fcstapcp
day3fcstapcp
day4fcstapcp
day5fcstapcp
day6fcstapcp
instructions
help
Printable Page

International Federation of Red Cross and Red Crescent Societies

Precipitation Forecast in Context Map Tool

The International for Climate and

Instructions for Use of this Tool

What Would You Like to Know?

Forecasts for the Next 6 Days

- How much rain is expected cumulatively?
- Where is it expected to be wetter than average?
- Where is unusually heavy rainfall expected?
- How heavy is the rainfall expected to be?

Forecasts for the Next 3 Months

- Are the next 3 months likely to be unusually wet or dry?
- Is it likely that unusually wet or dry conditions will continue?
- Is it likely that unusually wet or dry conditions will end?

Historical Conditions

- How much rain normally falls at this time of year?

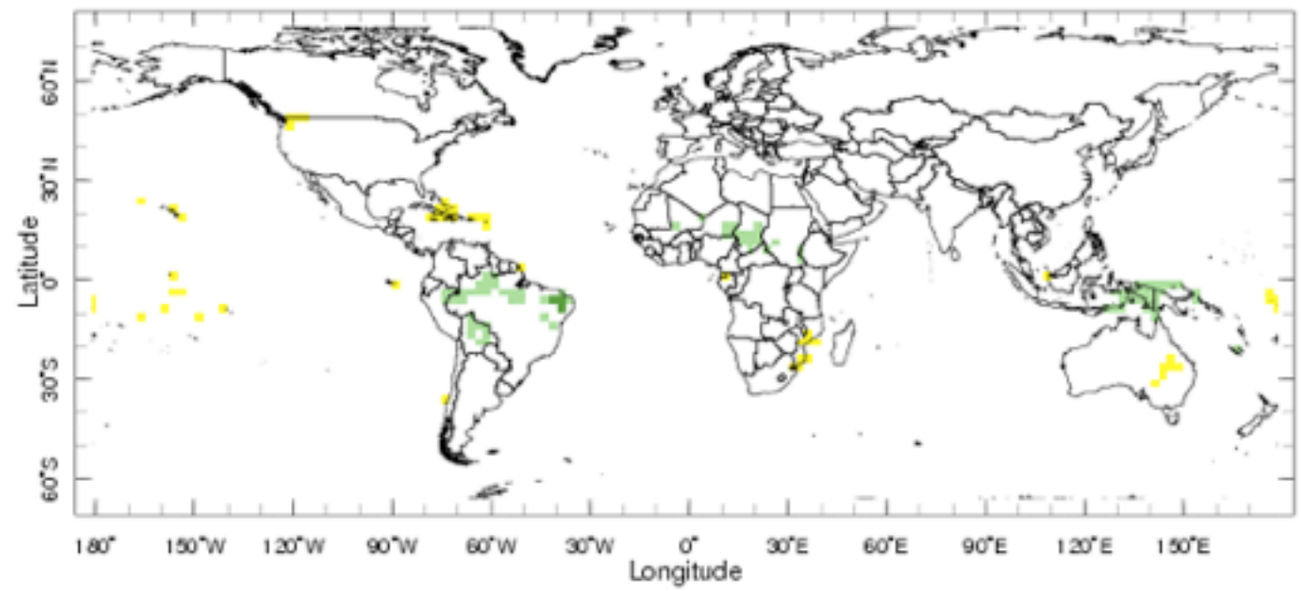
Vulnerability Indicators

- Are the areas at risk of heavy rainfall densely populated?
- Are the areas at risk of heavy rainfall inhabited by vulnerable populations?

Month Forecast Issued: May 2009 | Apr 2009

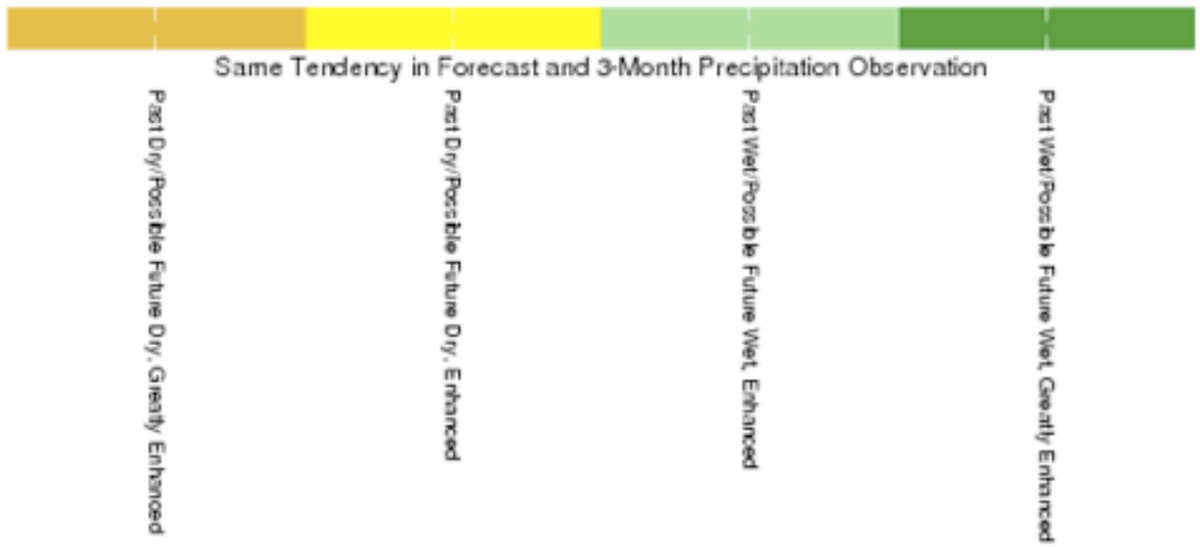
76.25N

66.25S



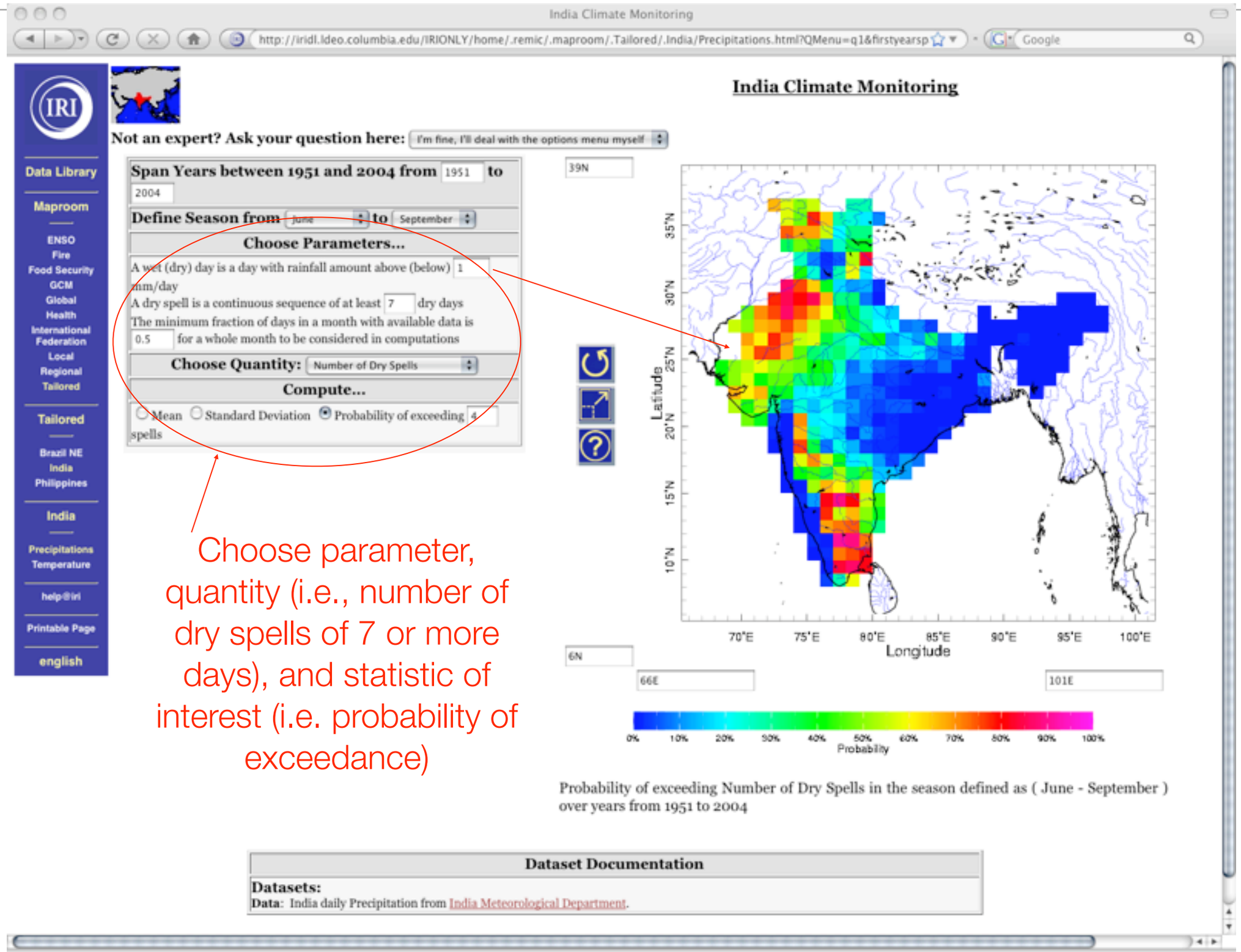
Jun-Aug 2009 Forecast Precipitation Tendency same as Observed Feb-Apr 2009, issued May 2009

178.75E 178.75E



Is it likely that unusually wet or dry conditions will continue?

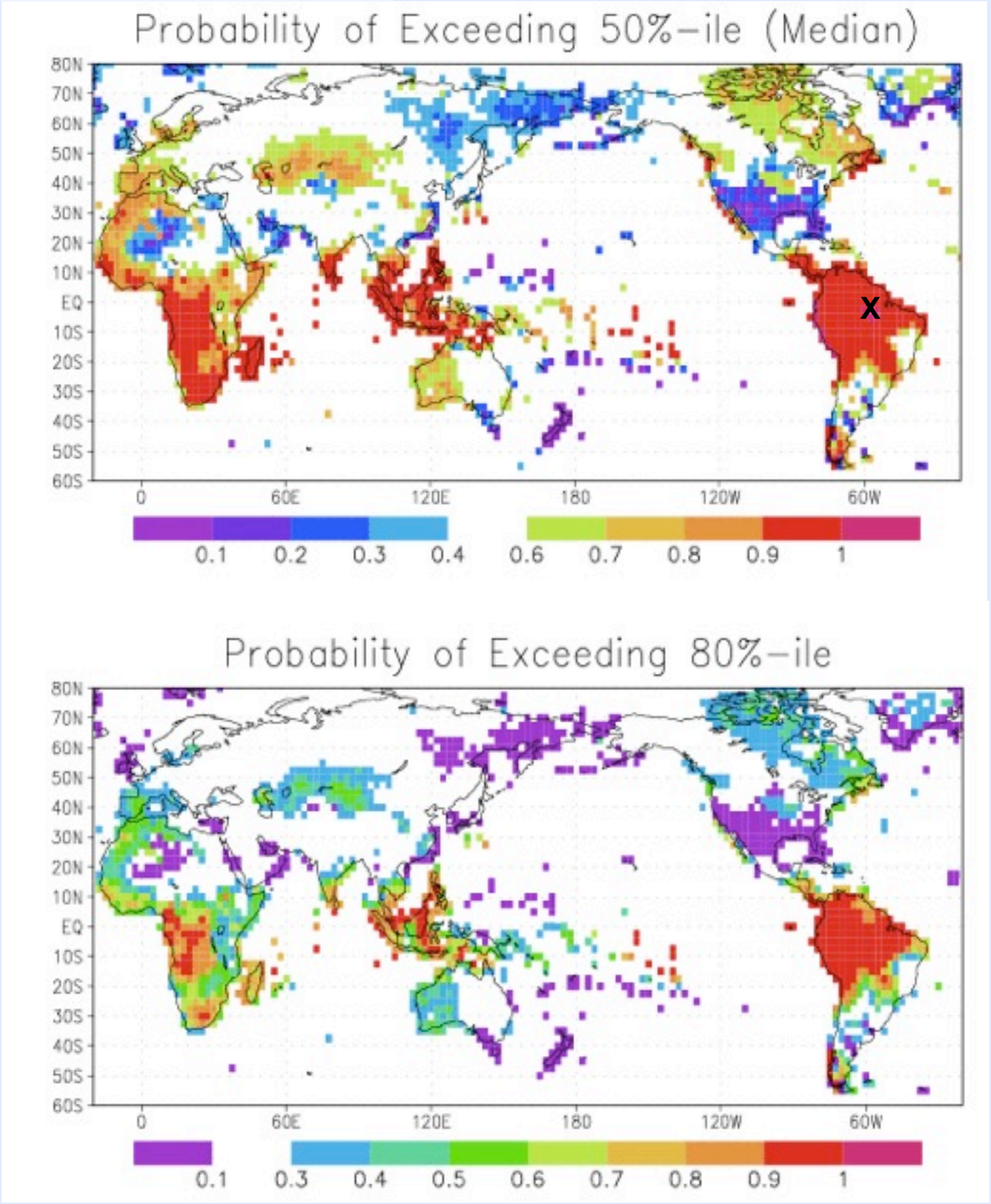
tailored historical information maproom



Choose parameter, quantity (i.e., number of dry spells of 7 or more days), and statistic of interest (i.e. probability of exceedance)

Flexible format global forecasts

ECHAM4.5 2m Temperature: JFM 1983 – El Nino

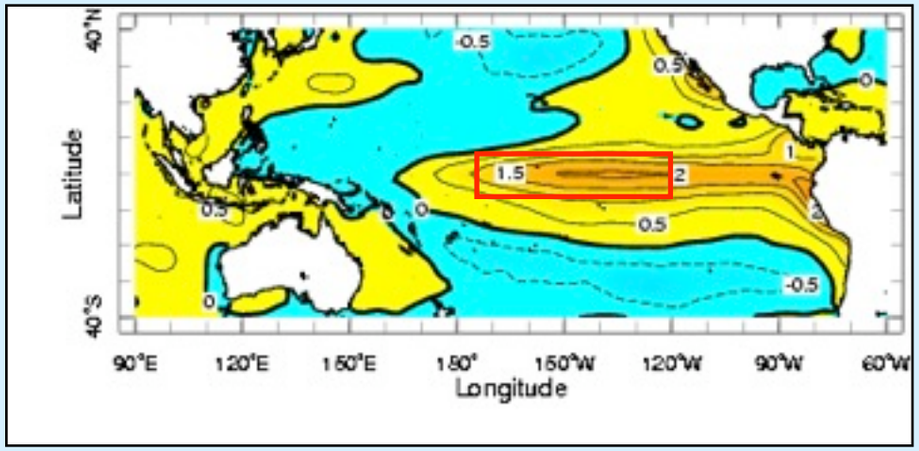


Forecasts for the full PDF allows users to produce probabilistic forecasts for any category or threshold of interest.

Downscaling for Philippines Reservoir Inflow

B. Lyon (IRI)
A. Lucero (PAGASA)

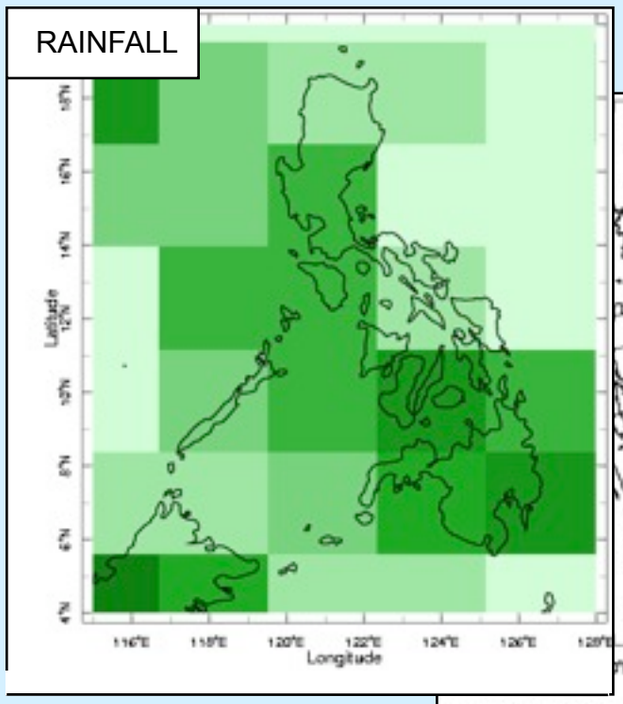
Sea Surface Temperatures



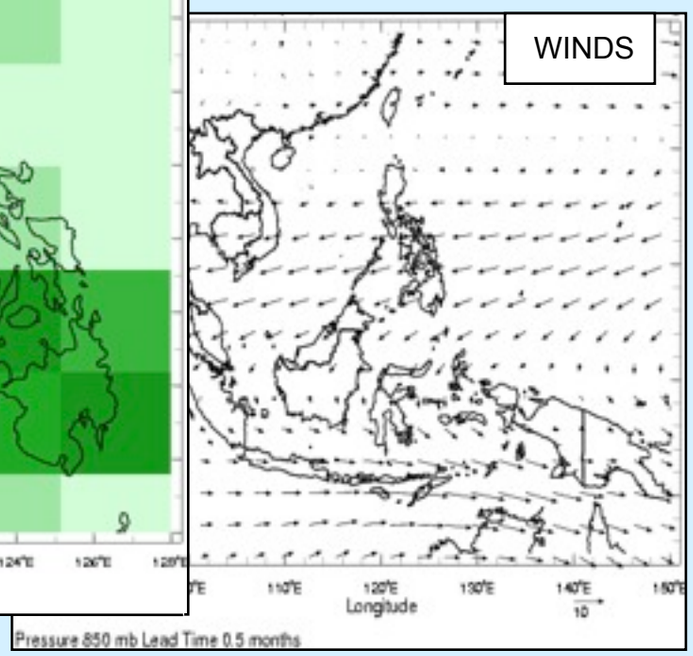
Historical Angat Inflow Observations

Global Climate Model

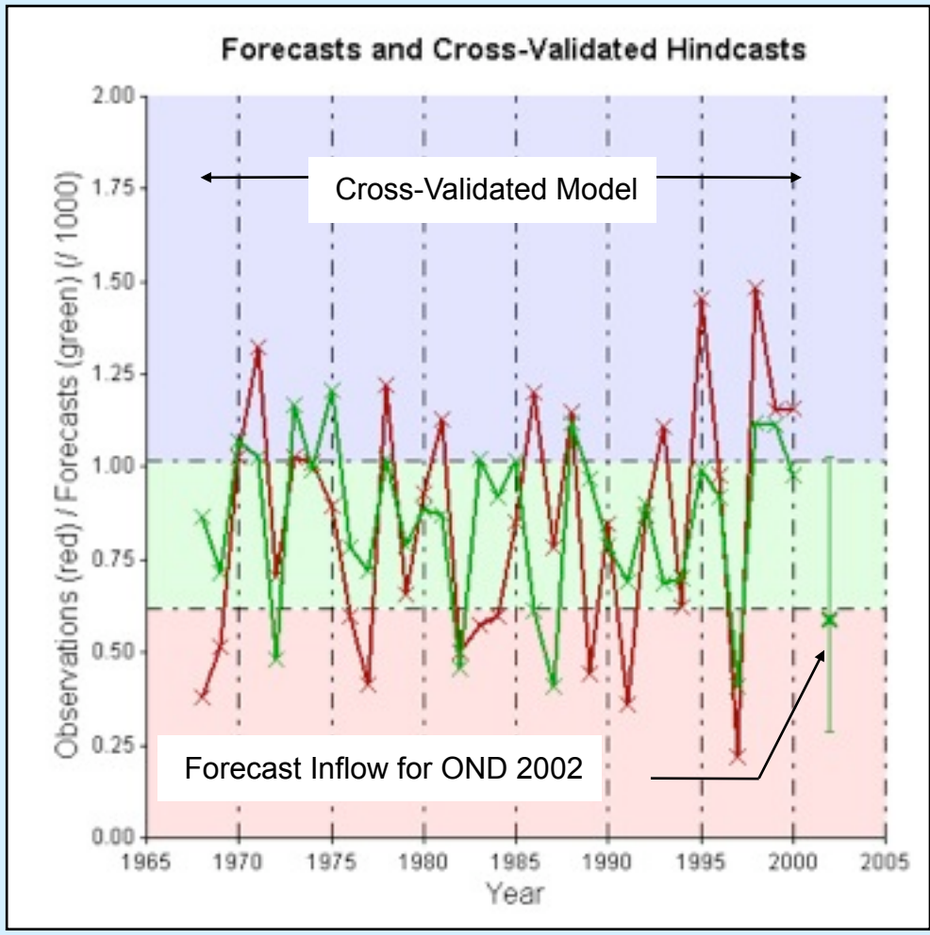
RAINFALL



WINDS

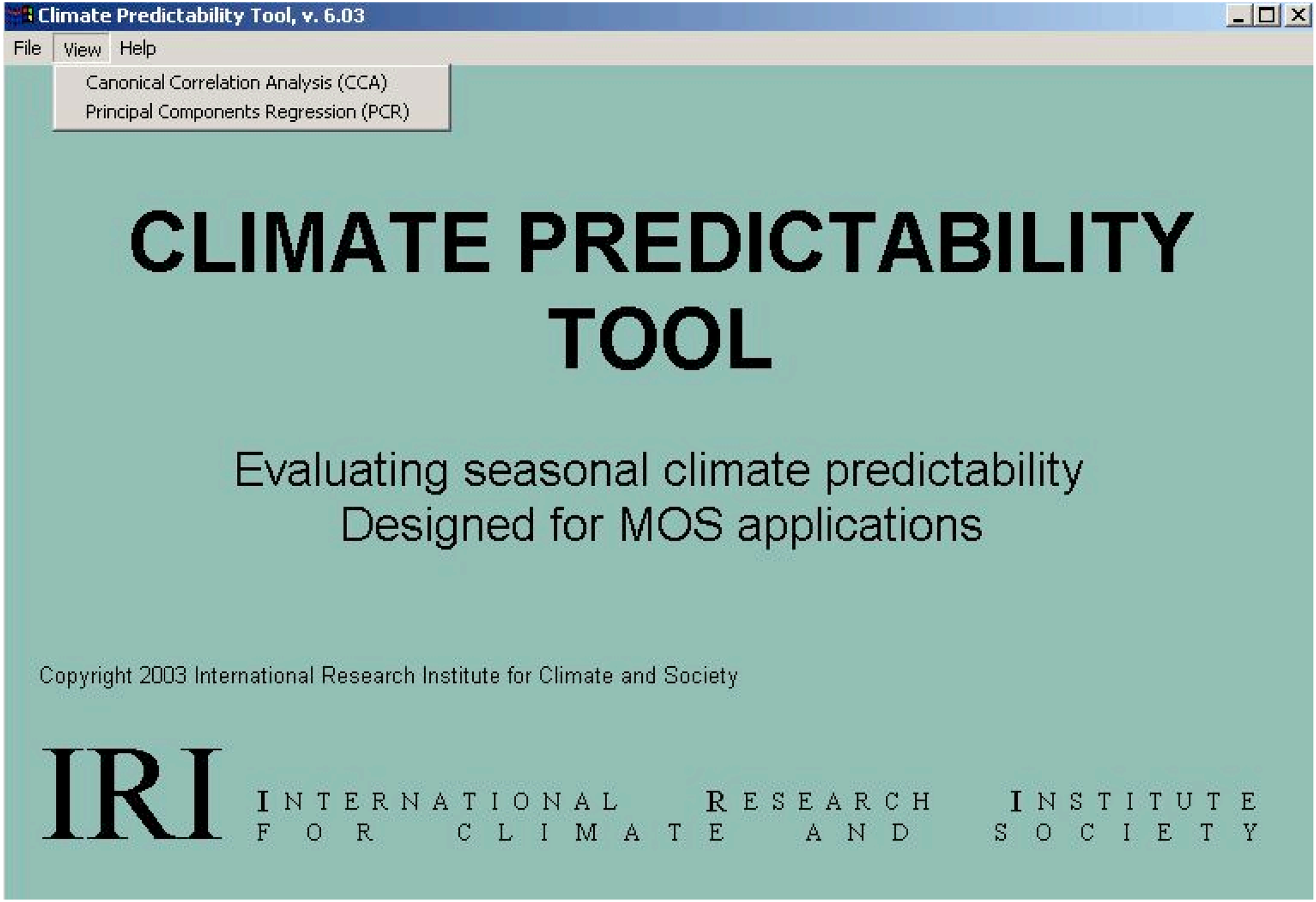


Statistical Model



motivated by experience at Climate Outlook Fora (COFs) in Africa

Tool for tailoring seasonal forecasts



Principal Components Regression

PROJECT:

Explanatory (X) variables:

Training data file:

X input file: HULM-OUG_OND5002prc| browse

Number
First yea
First yea

Minimun
Maximu

Response (Y) variables:

Training data file:

Y input file: SST_OND1950-08.tsv browse

Climate Predictability Tool, v. 9.10 - Results Window

File Tools Customise Help

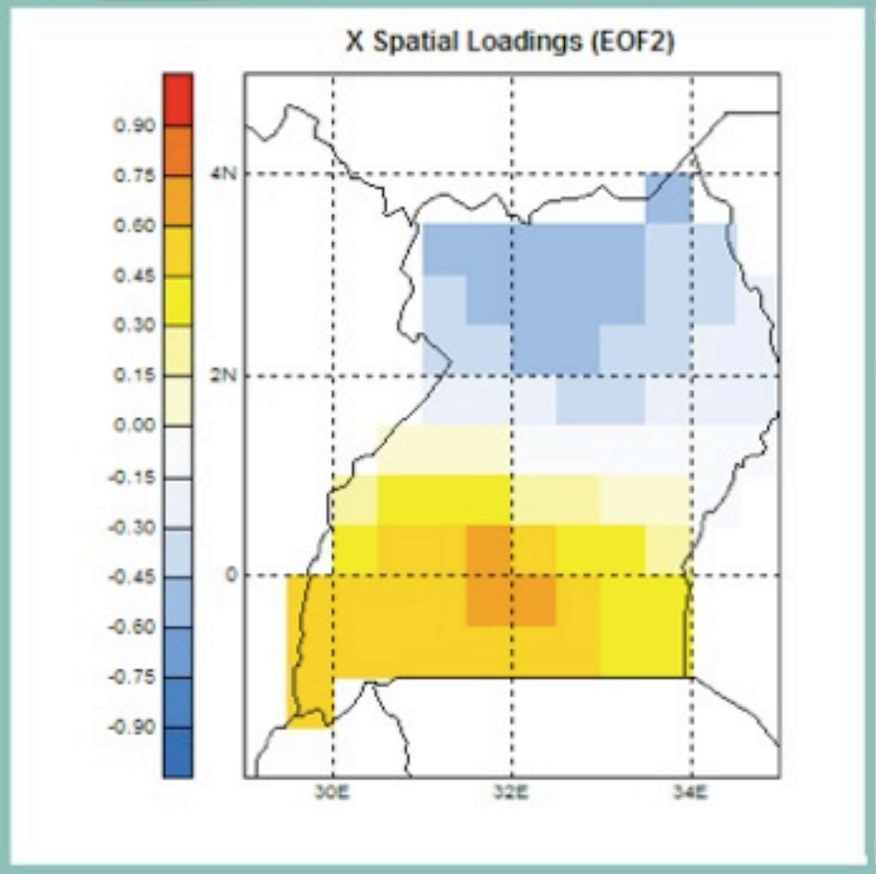
Project:
Progress: 100%
Actions:

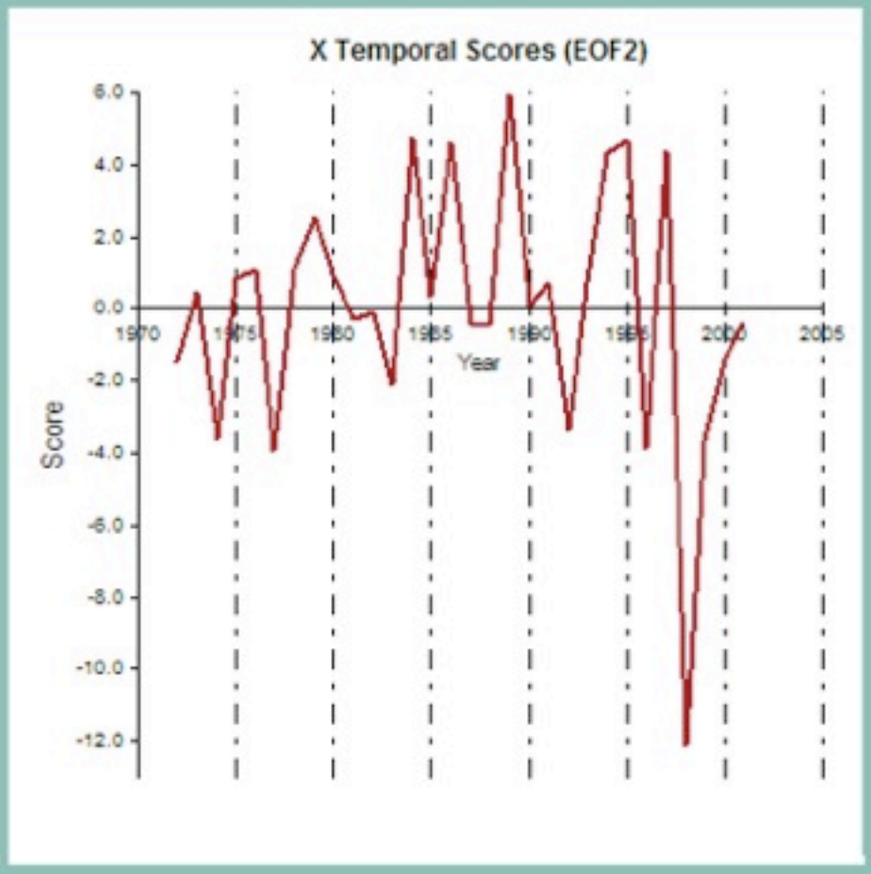
```
Checking for missing values ...
Data read successfully

Beginning analysis ...
Calculating climatologies and thresholds
Optimizing cross-v
Training period: 1

                CUR

      Number of Mo

              1
              2
              3
              4
Constructing model
Identifying catego
Done!
```

Scree plots

X EOFs

EOF: 29





Integration of Climate Forecasts into Reservoir Management Tool

File Edit View Insert Format Tools Data Window Help

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FORECAST

Inflow Forecast (3 Month)

Home

Climatology for OND

Mean 3 Month Sum = 844 MCM
Std Dev = 319 MCM

5% Exceedance = 320 MCM

Seasonal inflow forecast

Step 2(a). Set Forecast

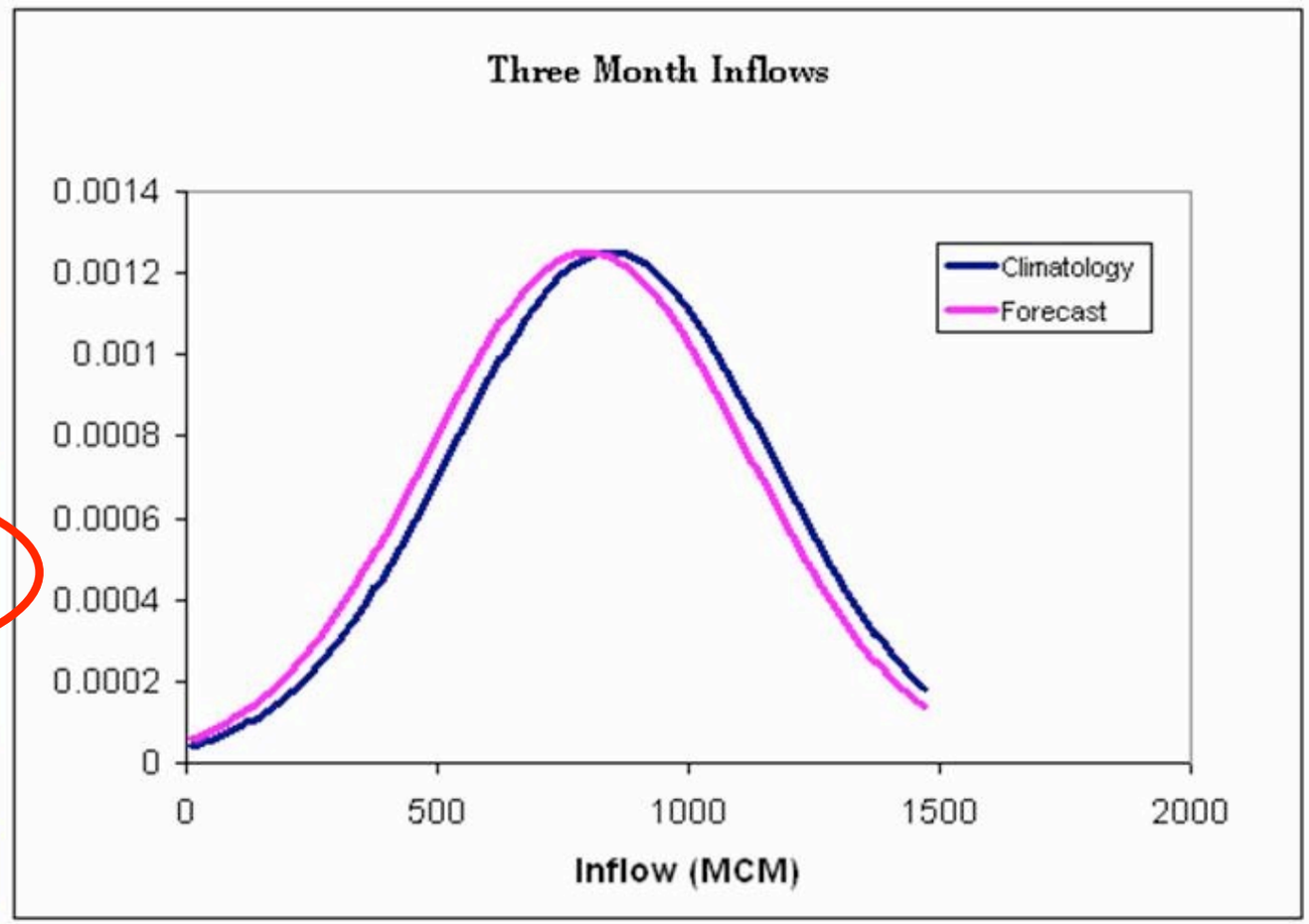
Forecast for OND

3 Month Sum = 800 MCM
Std Dev = 319 MCM

5% Exceedance = 276 MCM

Step 3. Scenario Analysis

Analysis



Tool: shows probability associated with particular allocations and forecasts

STEP 3(d)

Forecast

Probabilistic

Deterministic Scenario

80 % of Mean

STEP 3(e)

Reliability

Based on whether above

Lower Rule Curve

190.4

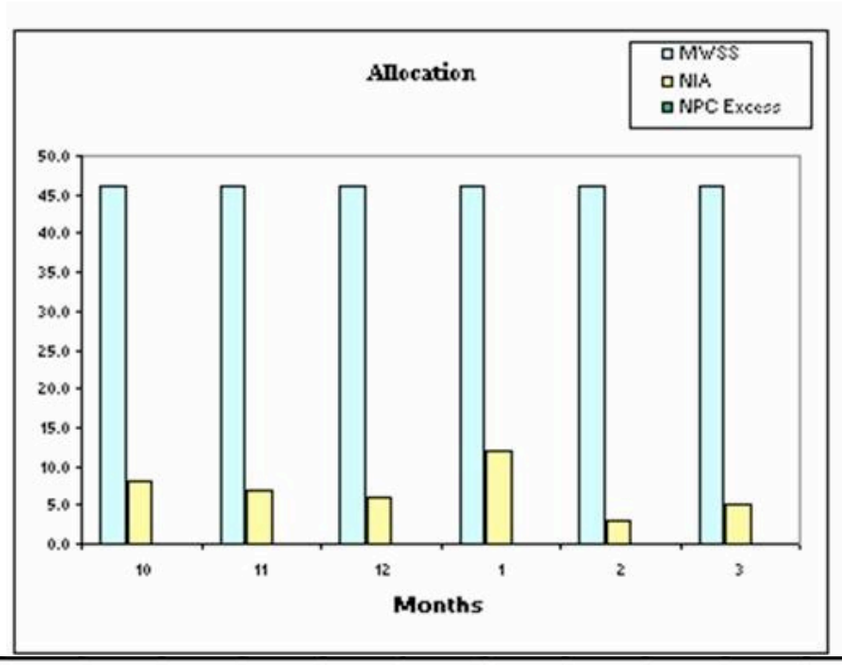
at the end of

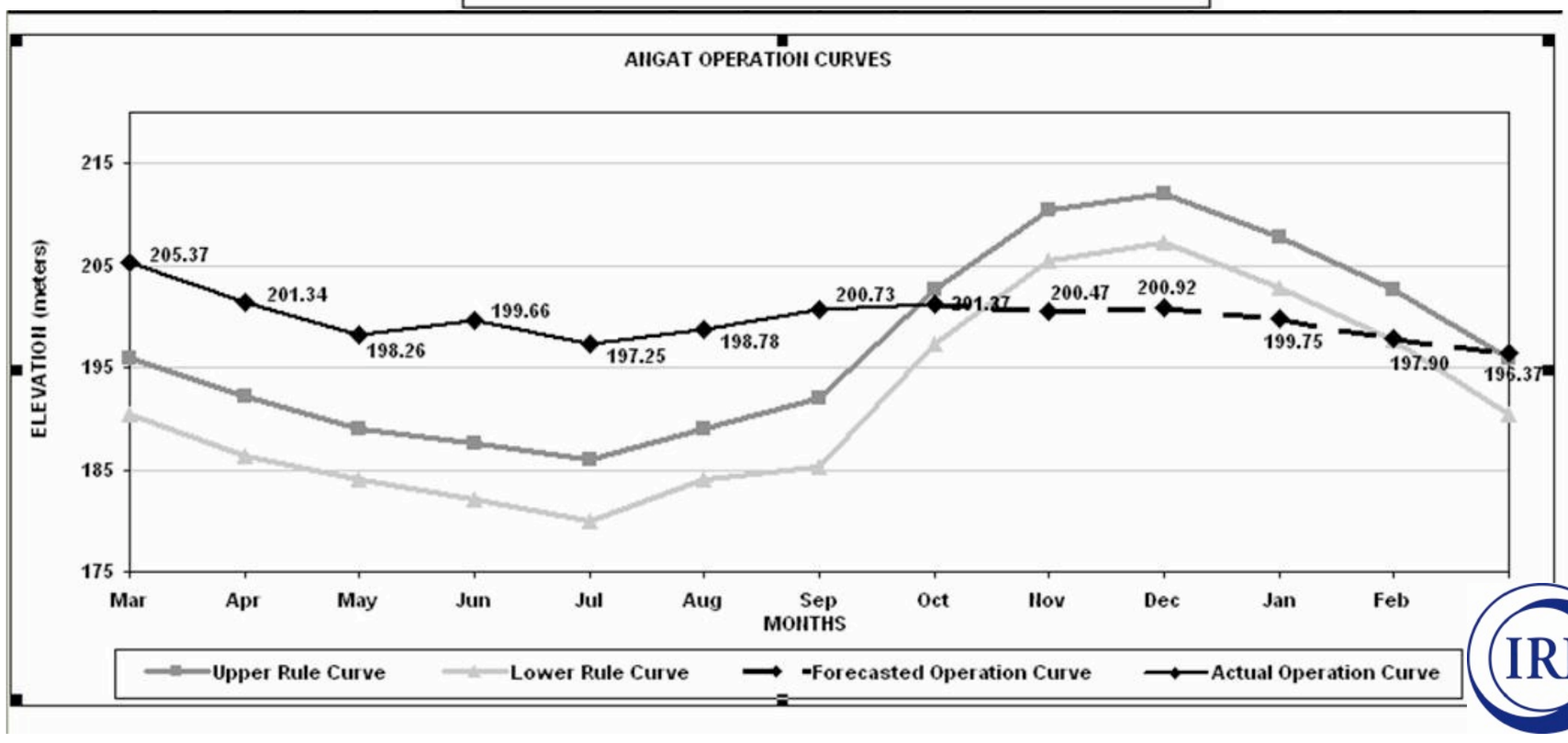
Mar

97%

Probability of Failure

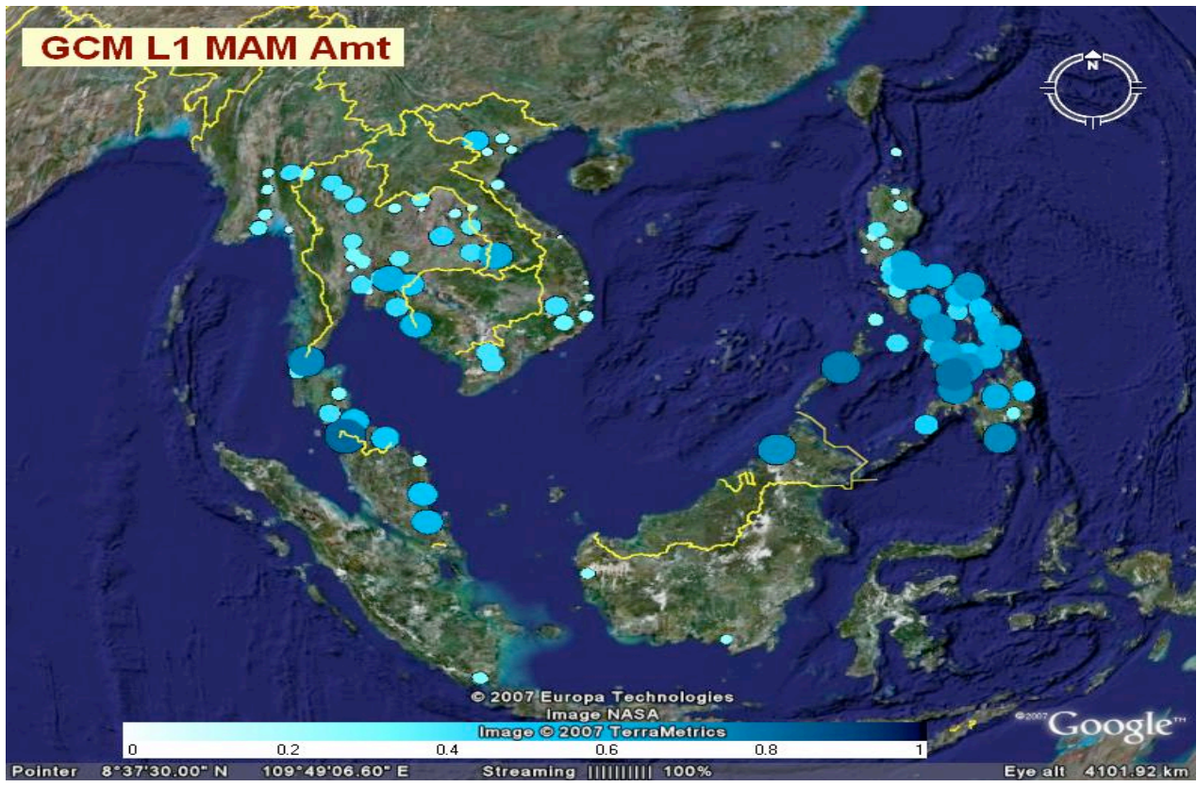
3%



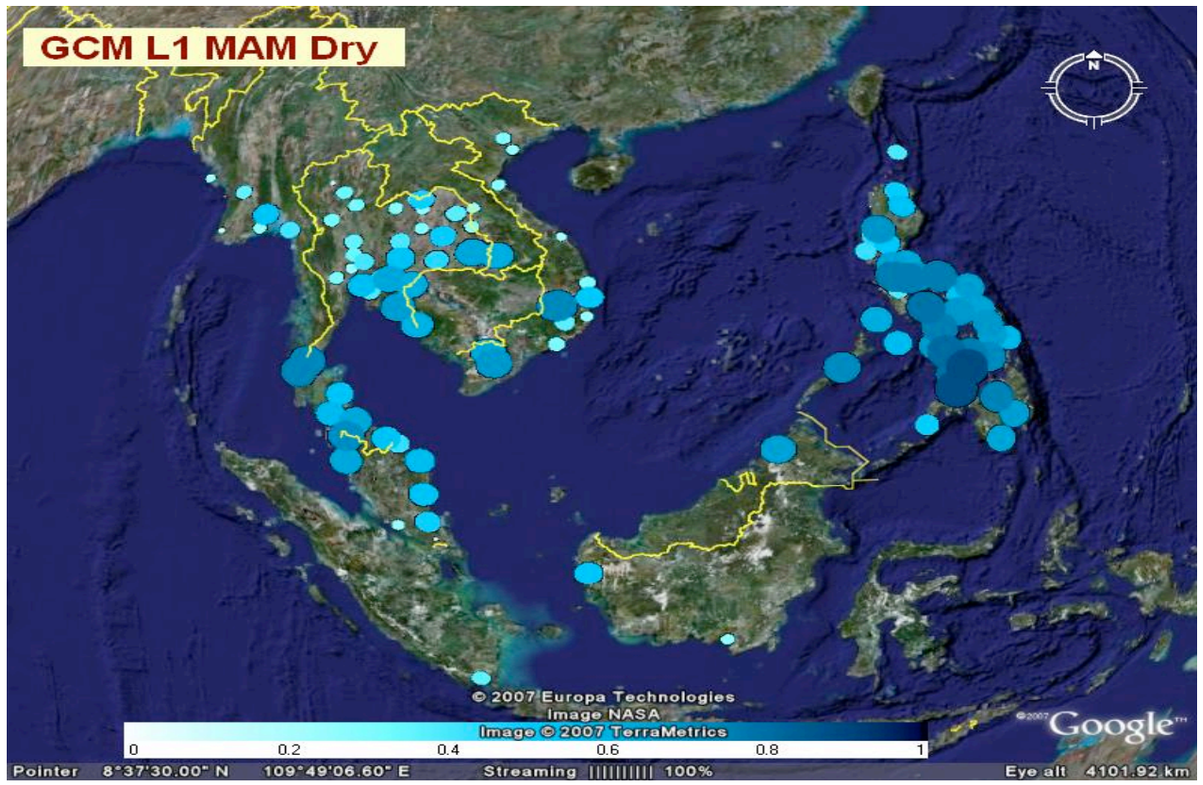


Anomaly correlation skill for MAM rainfall
2007 ASEAN-IRI training workshop

seasonal rainfall total

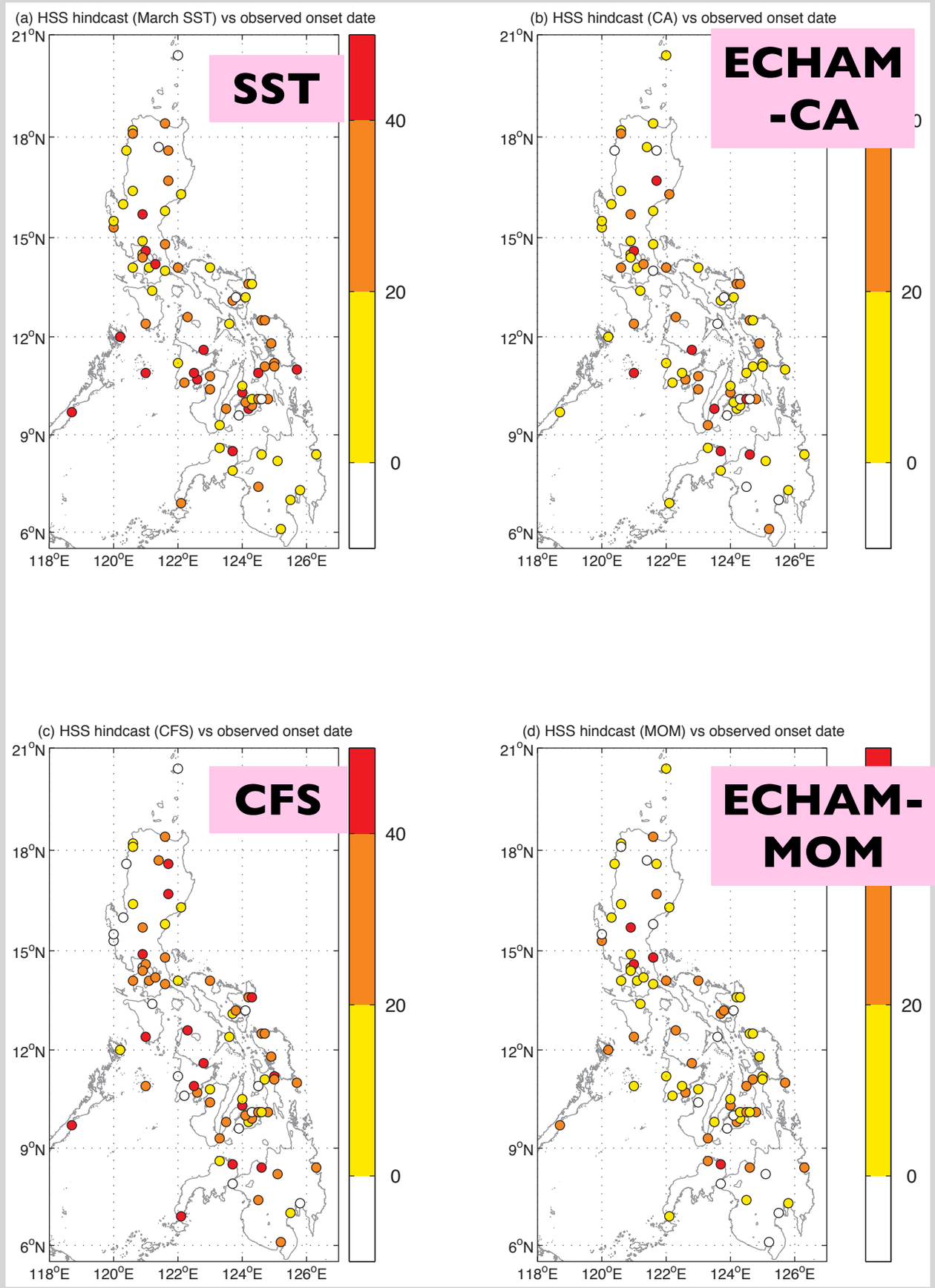


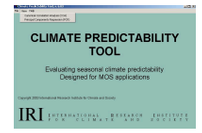
number of dry days per season



ECHAM-CA March 1st hindcasts

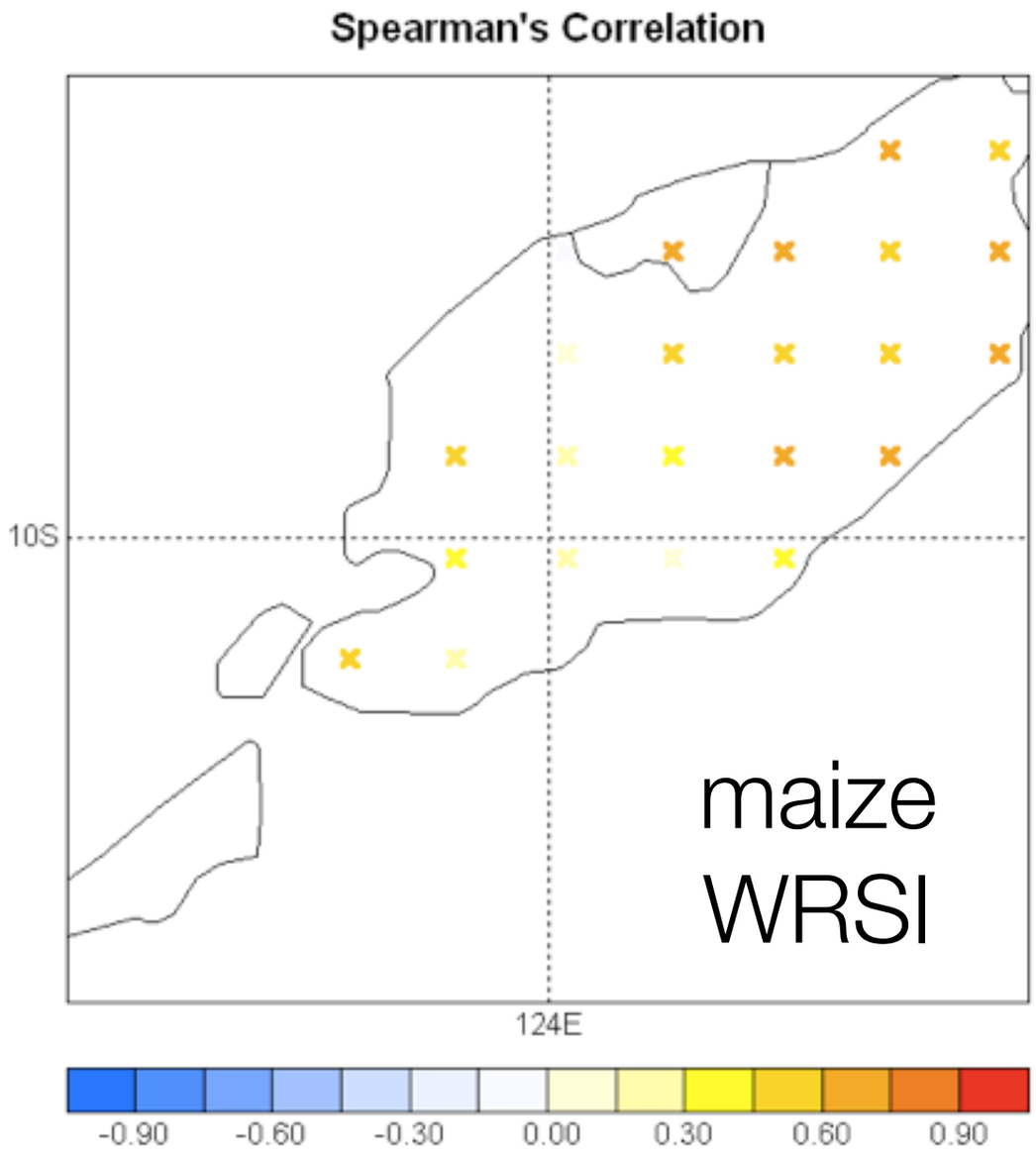
prediction skill of SW monsoon onset over Philippines

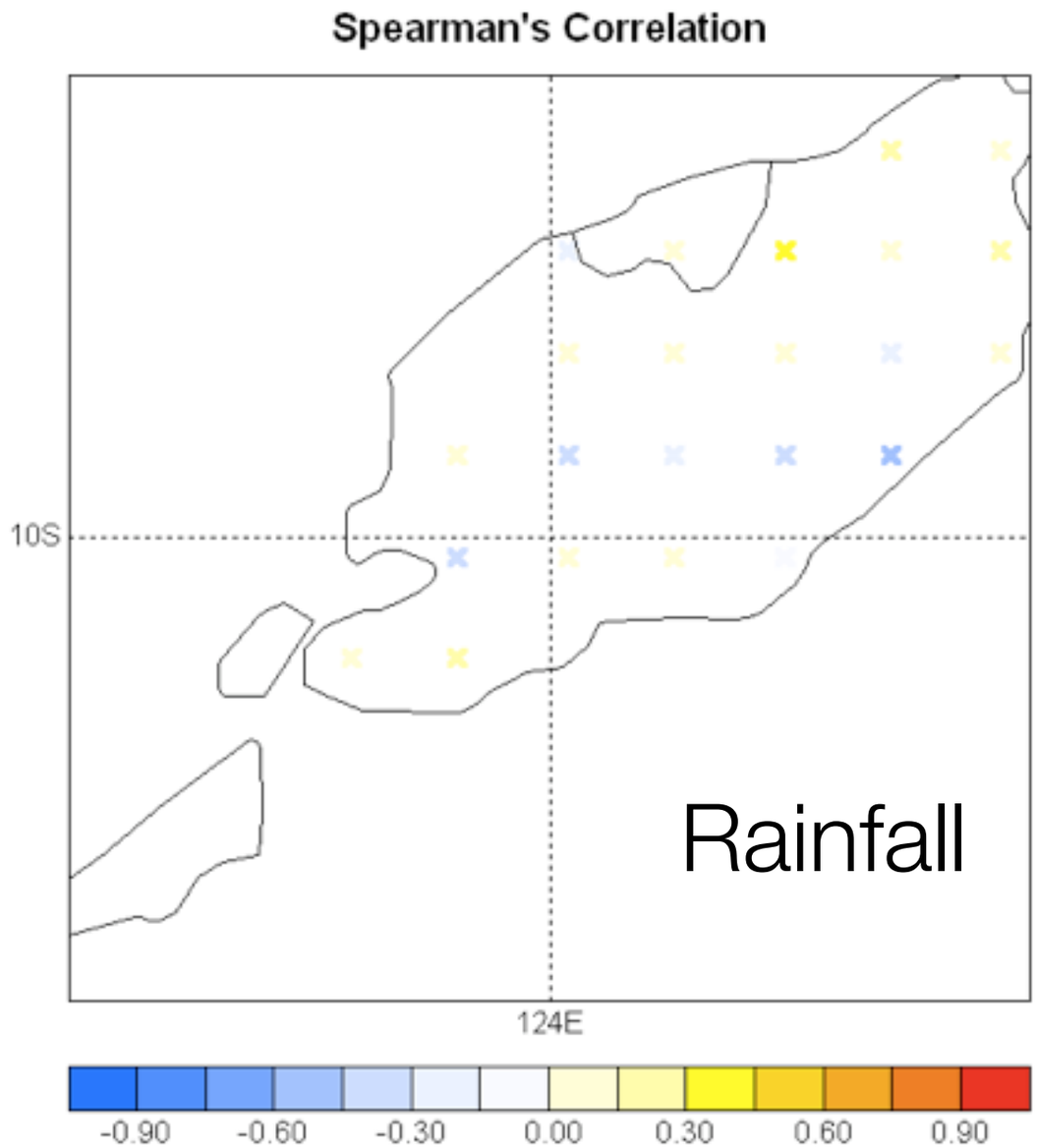




skill of statistical downscaling over Indonesia:

water requirement satisfaction index for Maize vs seasonal rainfall total





Nov–Feb season hindcasts made from Sept 1 (ECHAM-CA; 1974–02; NNRP-RegCM 25km rainfall)

summary

- reliable, probabilistic, MME global-model forecasts
- spatial “downscaling” of seasonal averages
  - local stations
  - administrative units, e.g. districts, to match user needs & ag. data
- user-relevant meteorological “events” (eg dry-spell probability)
- coupling to a sectoral (e.g. crop) model using “temporal downscaling”
- probability format: want a “CDF” conditioned reliably on fcst