Use of S2S forecasts in applications

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ECMWF Workshop on sub-seasonal predictability, Nov 2–4, 2015

Outline

- Types of user and application, and entry points for obtaining S2S forecasts - developed and developing country users
- Tailored forecast information and verification
- Question of most user-relevant formats for forecasts on different time scales (weather-S2S-seasonal)

Types of user and application

- Hazard early warning - enhancing preparedness to high-impact weather events
- Management decisions in weather-sensitive operations
- Large range of users from sophisticated to developing country

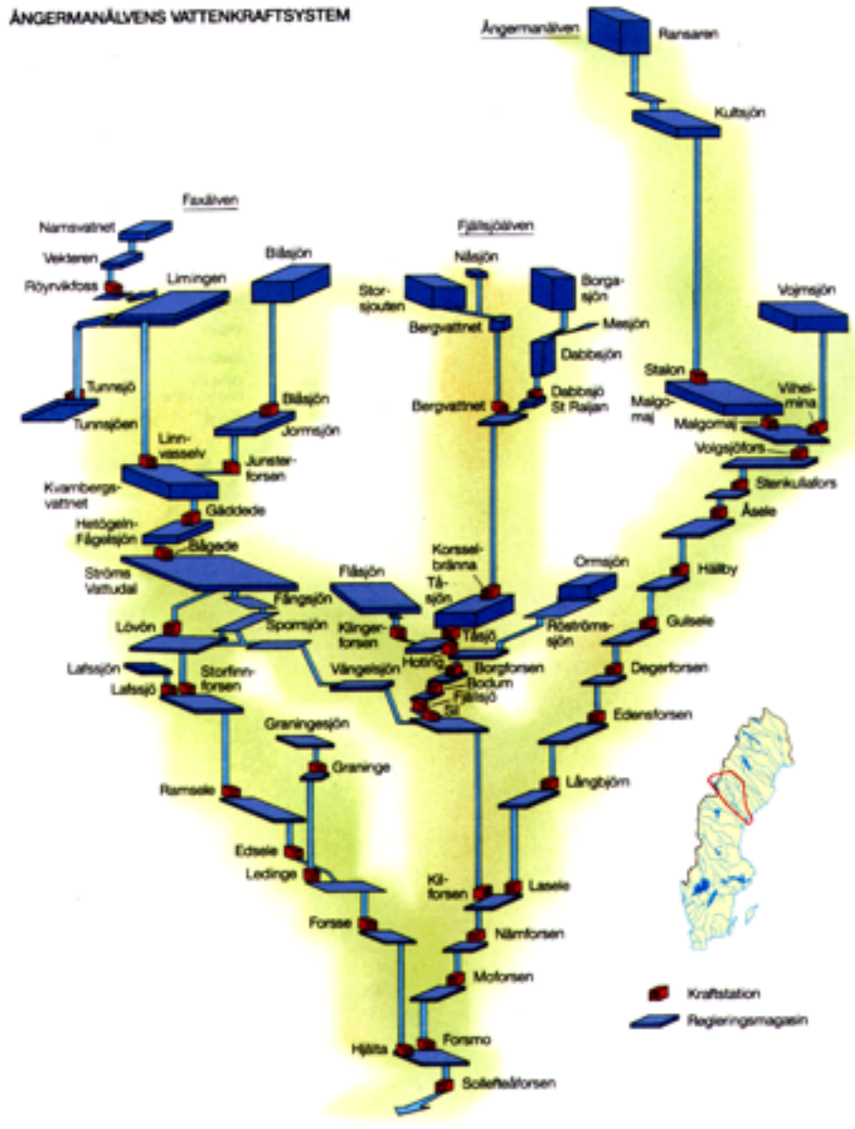
Hydrologic Forecasts of spring flood volumes for Hydropower

Short range forecasts, up to 10 days ahead

- Based on a meteorological forecast
- Most valuable at high flows (flood warnings), and for short term reservoir planning

Long range forecasts, 1 to 6 months ahead

- Climatological forecast based on historical precipitation and temperature records
- Most valuable for water resources planning and operation of reservoirs



Kean Foster

GFCS GLOBAL FRAMEWORK FOR CLIMATE SERVICES

Search this website...

WMO OMM

Priority areas

Agriculture and food security

Disaster risk reduction

Health

Water

GFCS in action

Latest Contributions

The International Climate Assessment and Dataset (ICA&D)
Submitted on: March 11, 2015

How farmers around the world are making decisions based on weather and climate information

As climate change threatens food production, climate information services are helping farmers in Africa and South Asia make better decisions in the short and long-term to adapt to changing growing conditions.

	Type of information	Vehicles for delivering information	Farmer decisions affected
WEATHER **Days to weeks**	• Observed rainfall and temperature • Daily forecasts up to one week ahead of time • Alerts on pests and diseases • Early warning of extreme weather events	• Mobile phones • Radio • Television	• Timing of planting and harvest • Timing of fertilizer, pesticide, and irrigation application • Protecting lives and property from extreme events
CLIMATE VARIABILITY **Months to Years**	• Probabilities for seasonal rainfall and temperature conditions • Seasonal climate variables targeted to particular agricultural risks (dry spells, rainy season start date, etc) • Historical variability of climate variables	• Workshops with experts • Conversations with agricultural extension agents (farm educators)	• Selecting crops and varieties • Livestock stocking rates and feeding strategies • Intensity of input use (fertilizer, pesticides) • Labor or marketing contracts • Intensifying and diversifying crops • Diversifying sources of income
CLIMATE CHANGE **Decades or longer**	• Projections of future rainfall and temperature • Historical trends in rainfall and temperature • Historical changes in extreme events	• Workshops with researchers, agricultural extension agents, and meteorological services.	• Major capital investments (buying or expanding landholding, irrigation systems, farm equipment etc) • Changing farming system or livelihood strategy • Deciding whether or not to farm

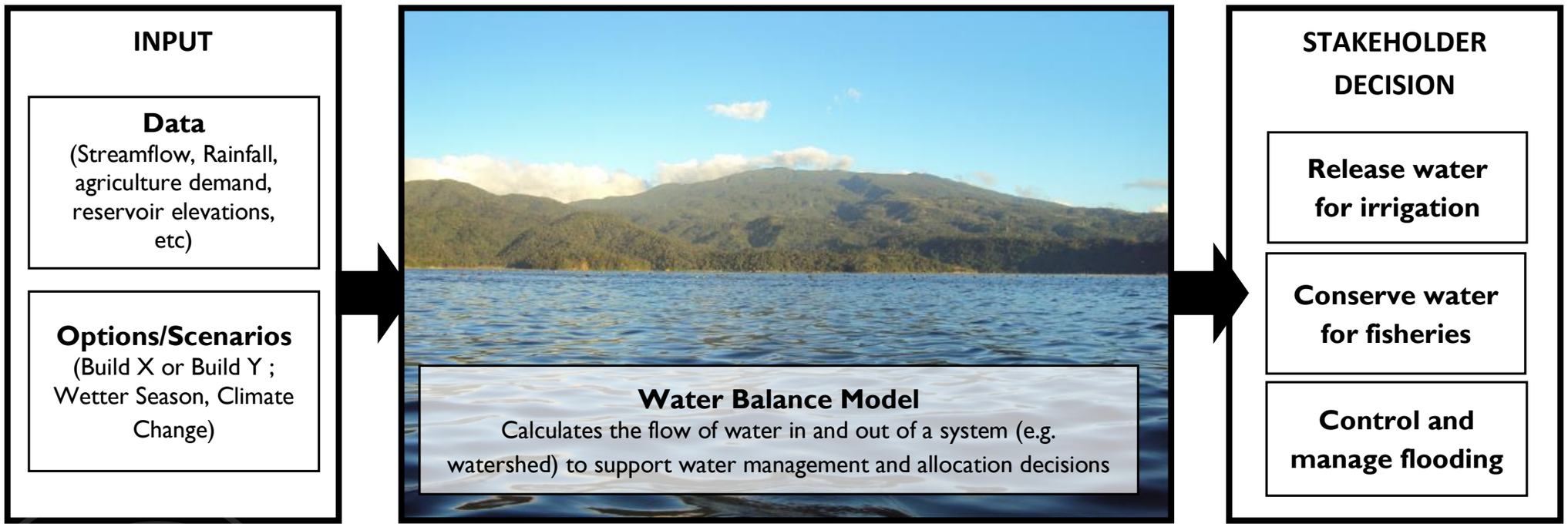
CGIAR RESEARCH PROGRAM ON Climate Change, Agriculture and Food Security CCAFS

Decision Support Tools for Climate Resilient Agriculture in the Philippines

Flooded rice paddies in Nabua, Camarines Sur after a typhoon

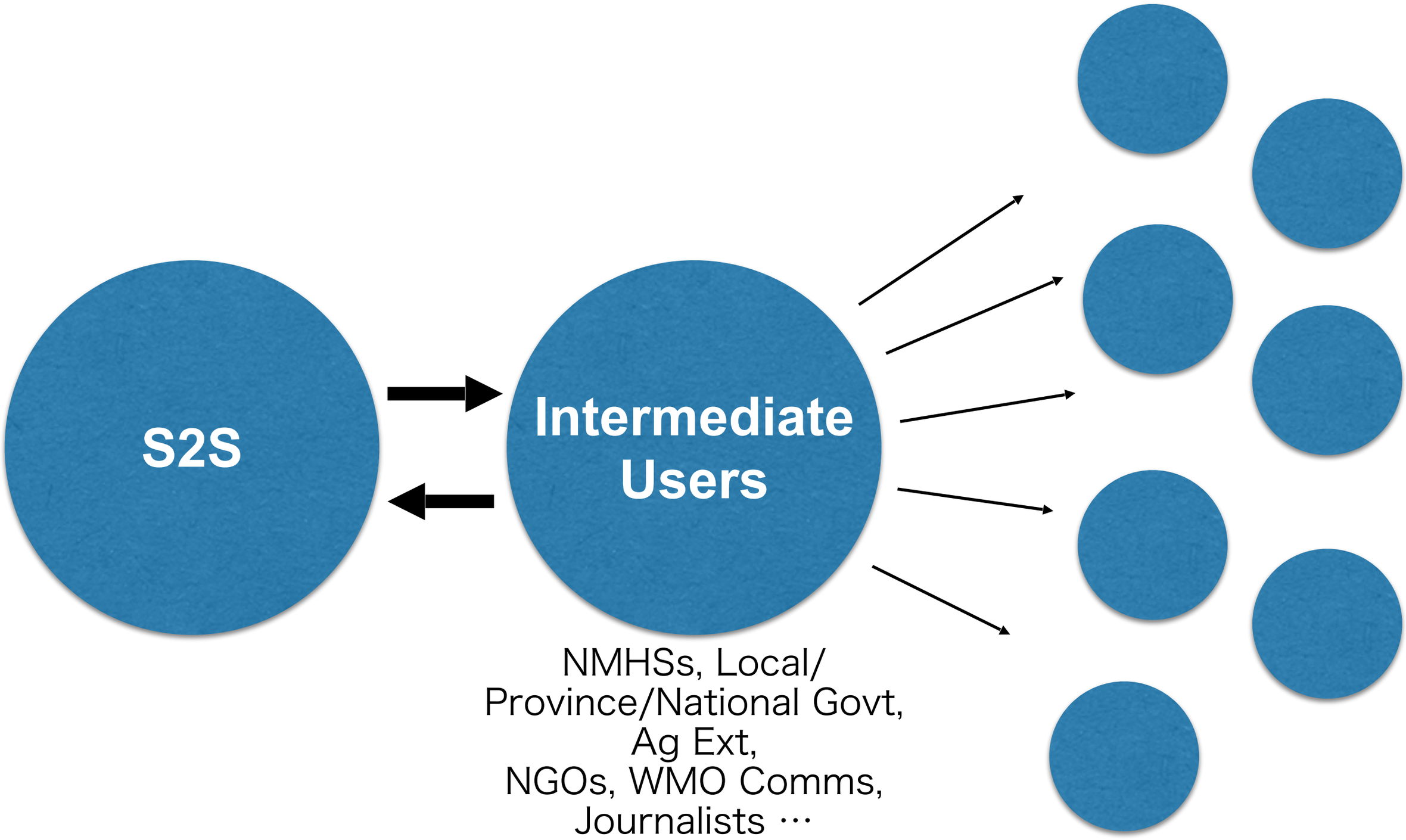
The Bicol Agri-Water Project - a USAID grant implemented by the **University of the Philippines Los Banos** Foundation, Inc. (UPLBFI), in partnership with the **IRI**, and the **Philippines Dept of Agriculture**, and Met Service (**PAGASA**) is working to develop, test, and apply **agro-climate tools to support decisions for managing climate risks at the farm level and water resources at the watershed level**.

Schematic diagram of WEAP Model



PI: A. Ines

Important Entry Points with Users



Indirect Link with End Users via Intermediaries

HIWeather

Scope defined by a set of hazards...

Urban Flood:
Reducing mortality, morbidity, damage and disruption from flood inundation by intense rain, out-of-bank river flow, coastal wave & surge overtopping and from consequent urban landslides.

Disruptive Winter Weather:
Reducing mortality, morbidity, damage and disruption from snow, ice and fog to transport, power & communications

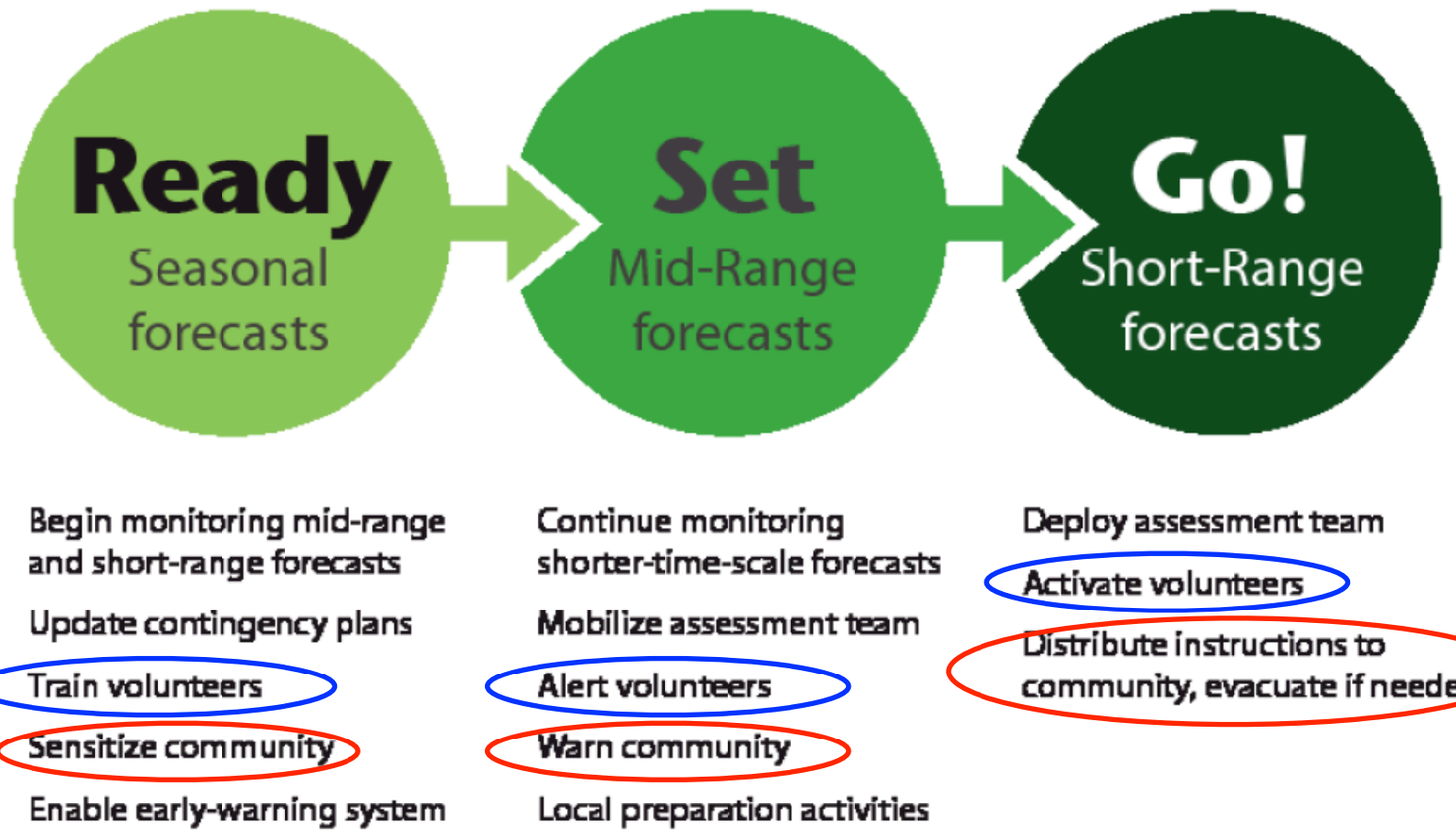
Wildfire:
Reducing mortality, morbidity, damage and disruption from wildfires &their smoke.

Heat & Air Pollution in Megacities:
Reducing mortality, morbidity and disruption from extreme heat & pollution in the megacities of the developing and newly developed world.

Extreme Local Wind:
Reducing mortality, morbidity, damage and disruption from wind & wind blown debris in tropical & extra-tropical cyclones, downslope windstorms & convective storms, including

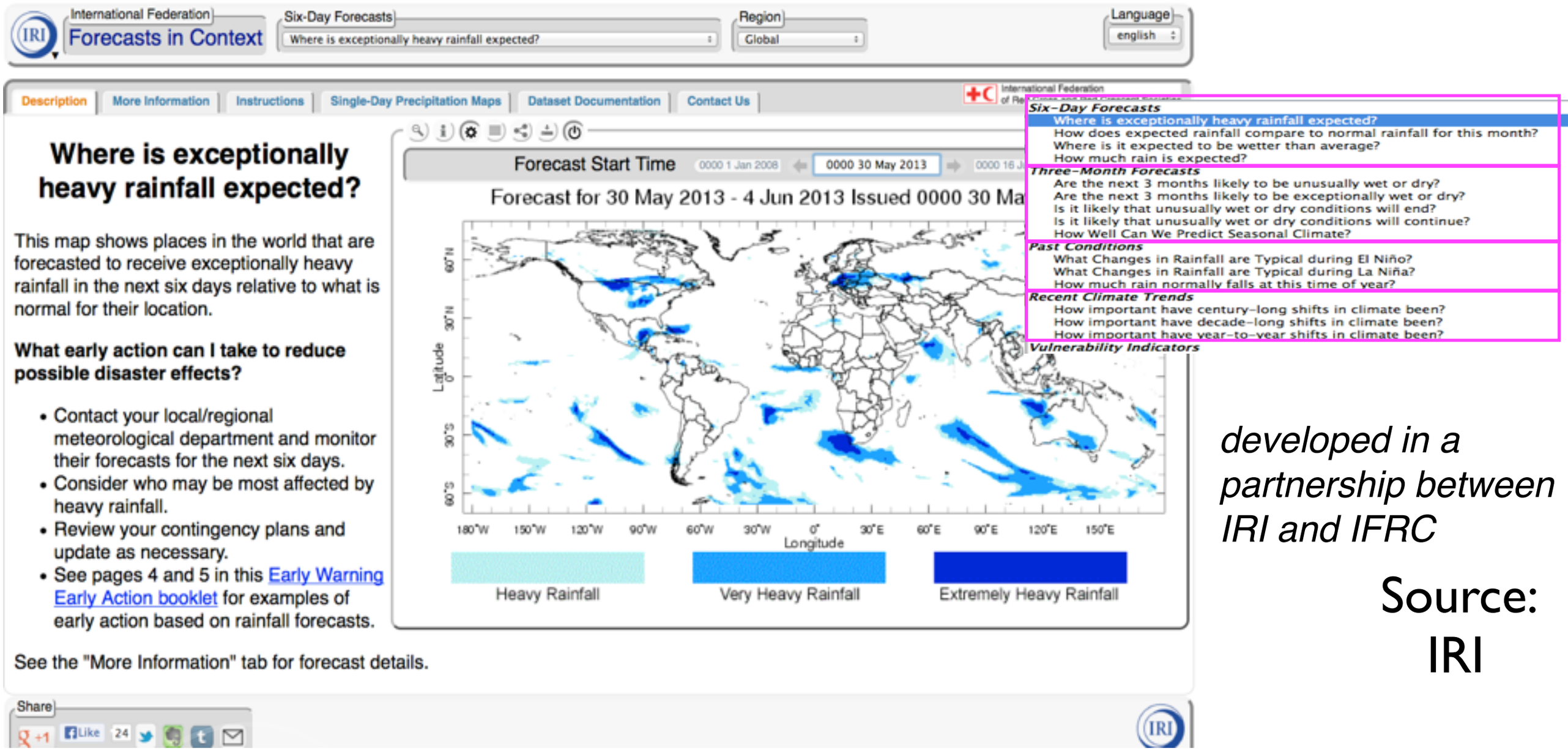
WMO
OMM

Red Cross/IRI Example of using forecasts for Humanitarian aid Early Action



Source: M. Daly

Maprooms for Humanitarian Aid



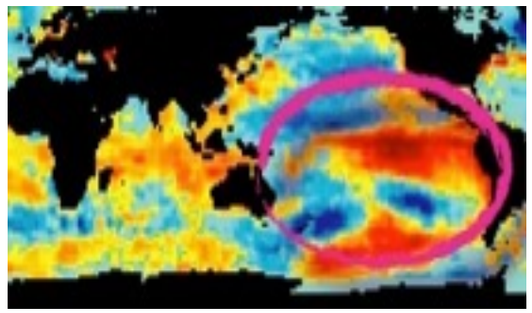
developed in a partnership between IRI and IFRC

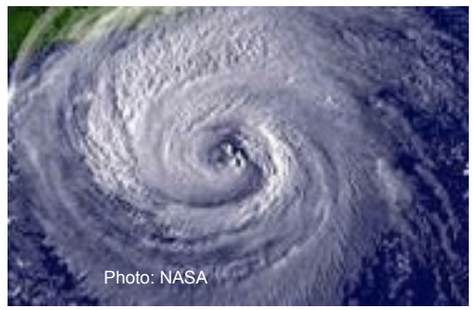
Source: IRI

Using information across time-scales

Long Lead

more specific information





Short Lead

more time to reduce risk

Climate change
rising risks, trends, more surprises

Decades, end of century

Seasonal forecasts
level of risk in coming months

next 3-6 months

Weather forecasts
impending hazard

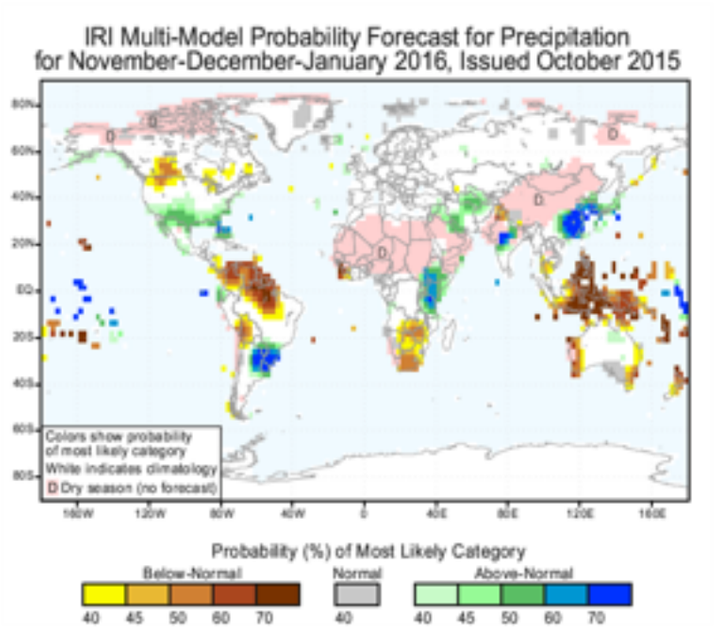
10 days or less

Source: Erin Coughlan

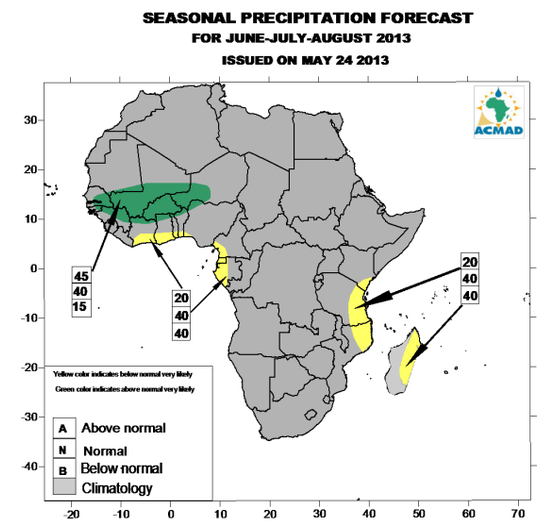
Forecast access

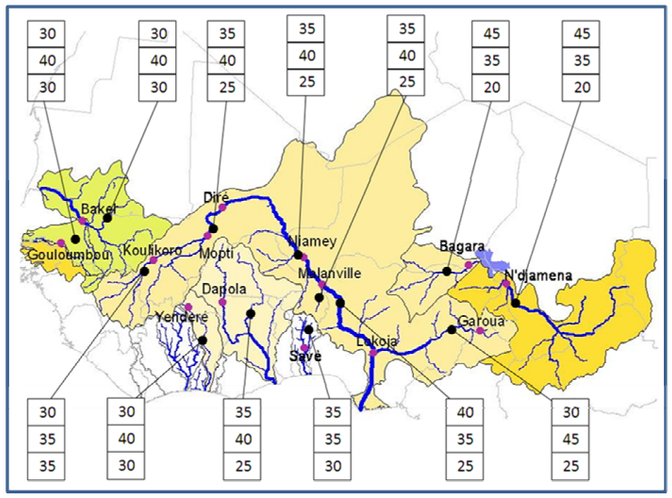
Press, TV, Radio

Online



Regional Climate Outlook Fora





Graphics vs data
to run sectoral models

Enhancing National Climate Services (ENACTS) in Africa

Improve Availability

- Build capacity of NMHS
- Quality Control station data
- Combine station data with proxies
- Improve seasonal forecast

Enhance Access

- Install IRI Data Library
- Develop online tools for data analysis and visualization
- Create mechanisms for data sharing

Promote Use

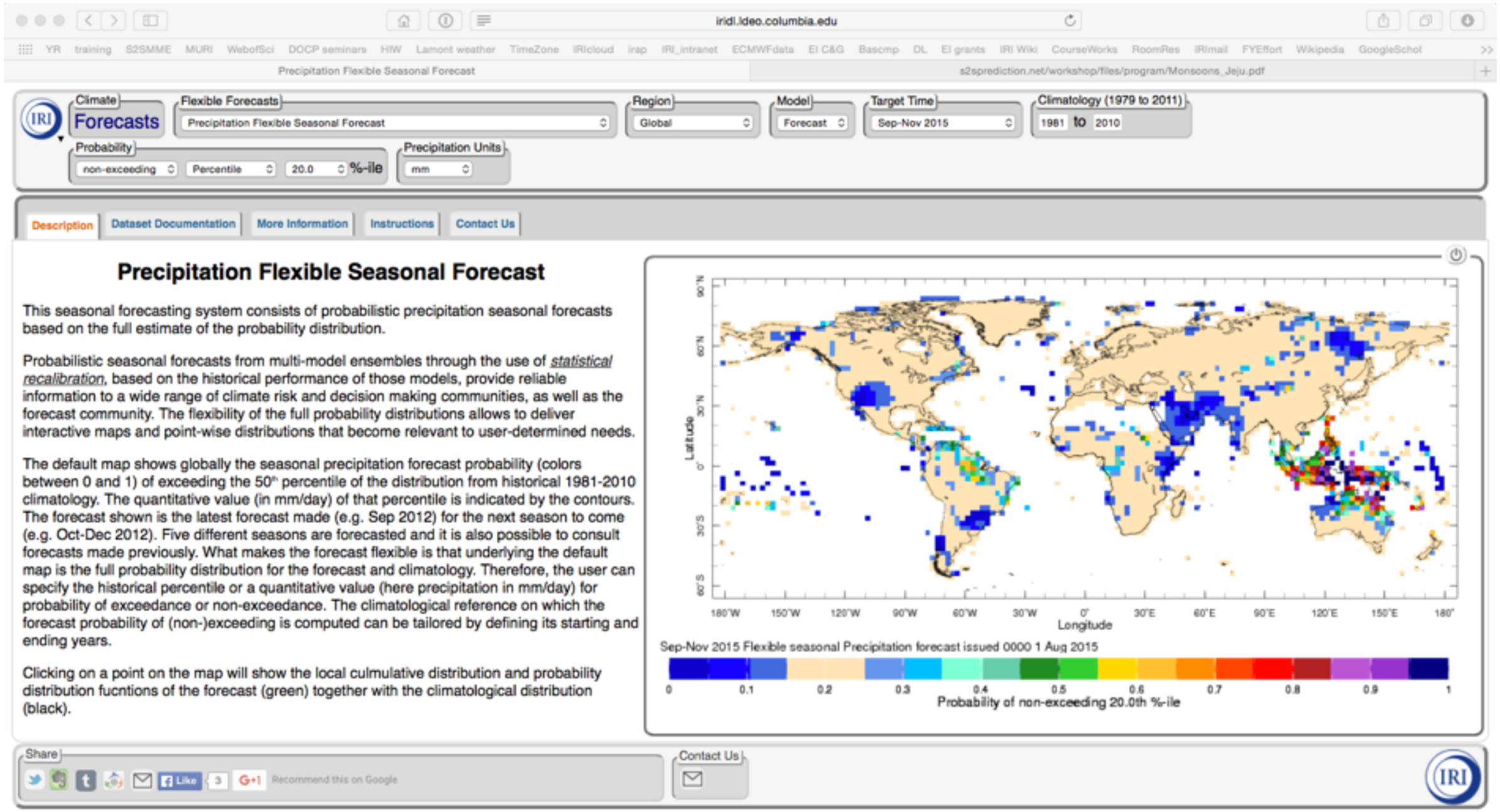
Engage users:

- ***Raise*** **awareness**
- **Build capacity of users to understand and use climate info**
- **Involve users in product development**

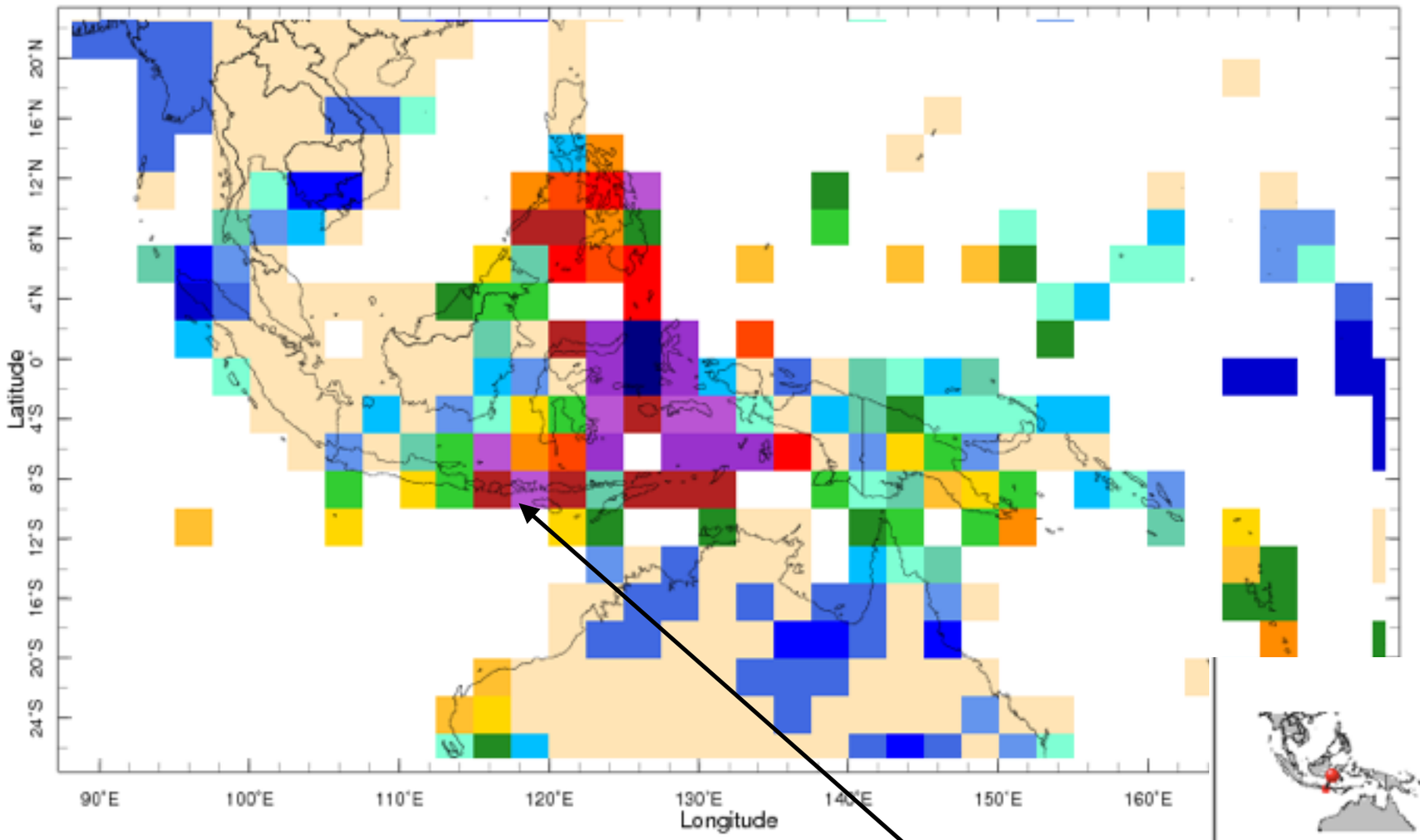
Tufa Dinku, IRI

Tailored forecast information and verification

Flexible Format Probabilistic Forecasts



Non-exceedance probability of 20%-ile NDJ 2016 from Oct



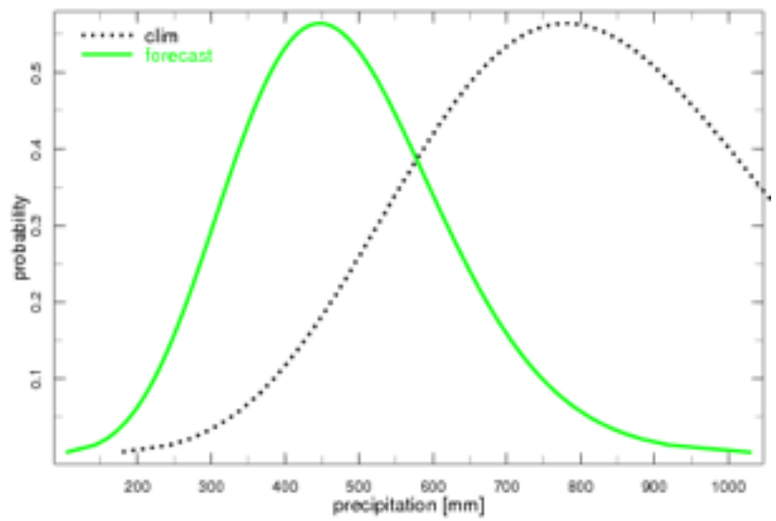
Nov 2015 - Jan 2016 Flexible seasonal Precipitation forecast issued 0000 1 Oct 2015

User Query of Forecast PDF

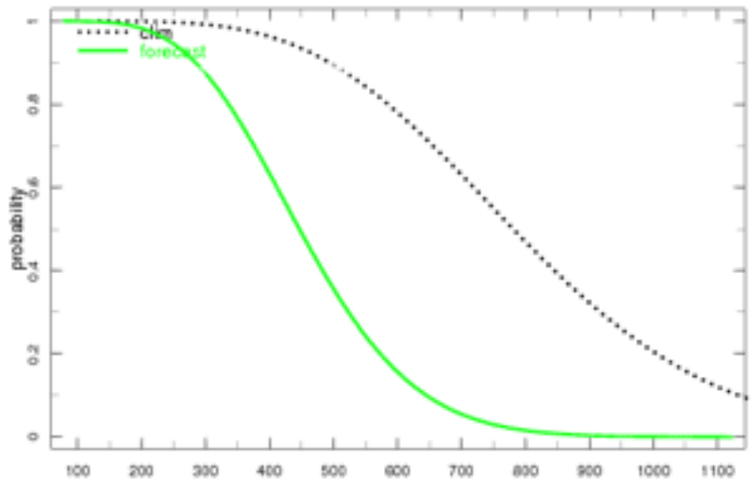
- deciles
- seas rainfall (mm)

Target Date	Issue Date	Lead Time
Nov 2015 - Jan 2016	**0000 1 Oct 2015**	**2.5**

Forecast made for **[115E-117.5E, 10S-7.5S]**
located in , **Jawa Timur , Indonesia**



lead 2.5 months S 0000 1 Oct 2015



Nov 2015 - Jan 2016 issued 0000 1 Oct 2015 at (116.25E,8.75S)

Seasonal Climate Verifications

Download: Descriptions of the IRI Climate Forecast Verification Scores

Verification of IRI's Seasonal Climate Forecast

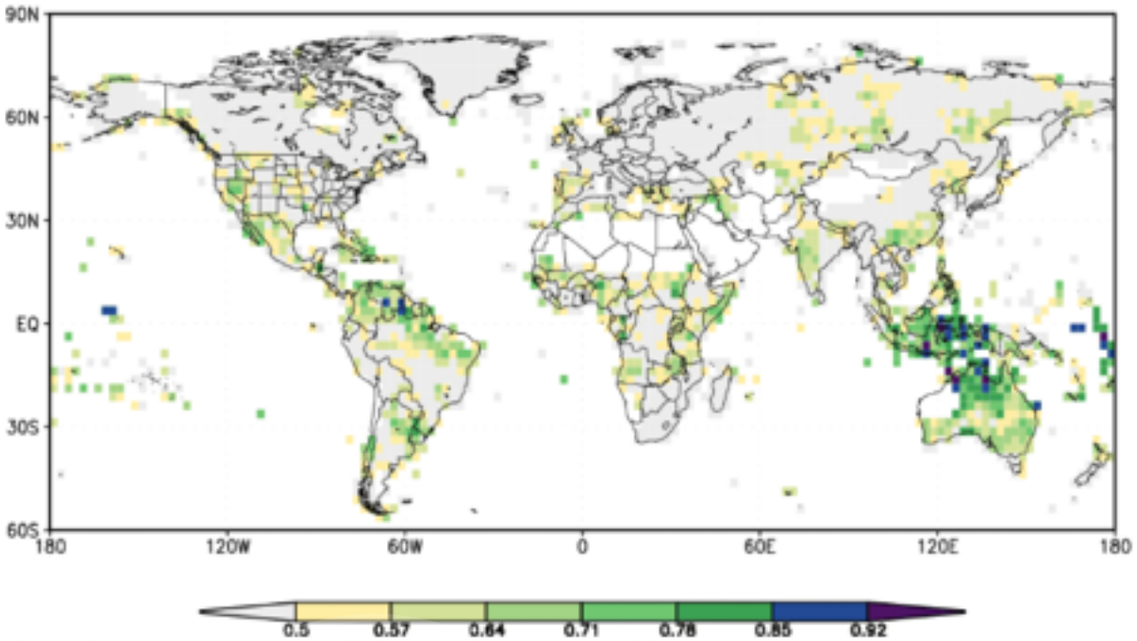
Skill Category: Measures of Discrimination
Score: GROC
Variable: Precipitation
Season: Sep-Oct-Nov
Lead: 0.5 month Leac

- ✓ Measures of Discrimination
- Measures of Resolution and Reliability
- Measures of Unconditional Bias
- Measures of Number of Hits
- Measures of Value

Description of Score

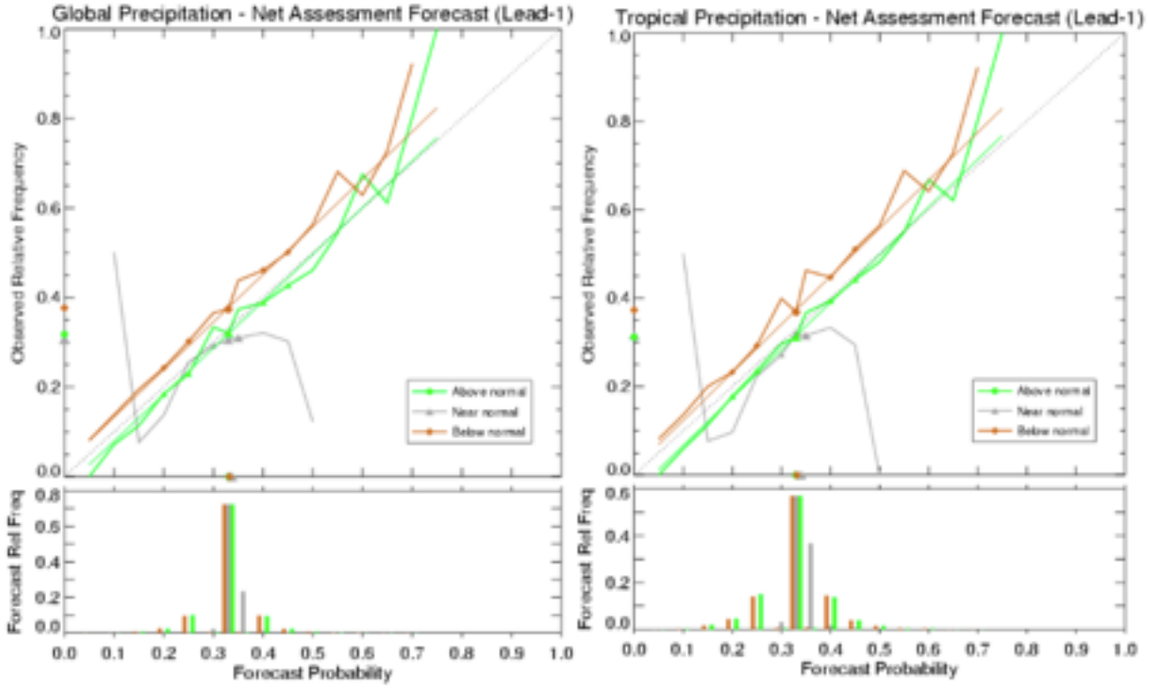
The generalized ROC score (GROC), like the ROC, shows the degree of correct probabilistic forecast discrimination, even if the forecasts have biases or calibration problems. However, unlike ROC, GROC is generalized to encompass all forecast categories (below, near, and above collectively, rather than being specific to a single category.

Generalized ROC (GROC): Lead 0.5 months, Precipitation Forecast Skill: SON



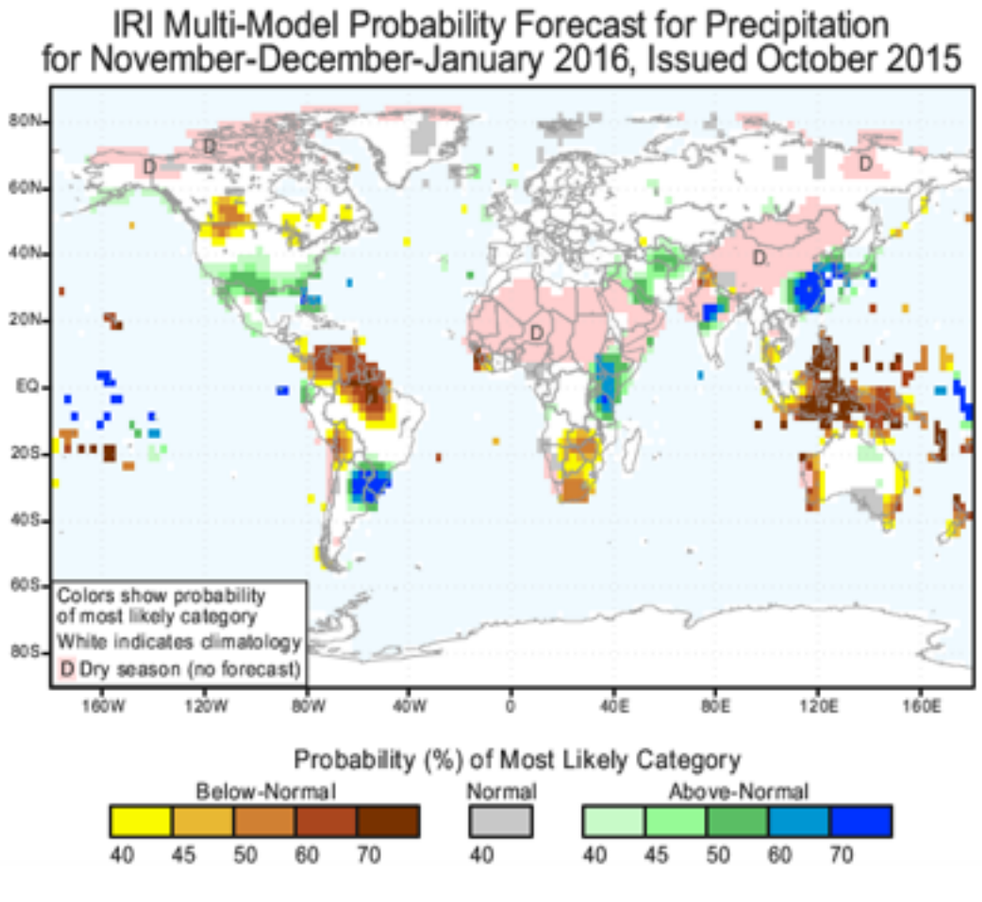
Gray indicates no (or negative) skill, Purple indicates highest skill.

Reliability Plots: Lead 0.5 months, Precipitation Forecast Skill: All Seasons



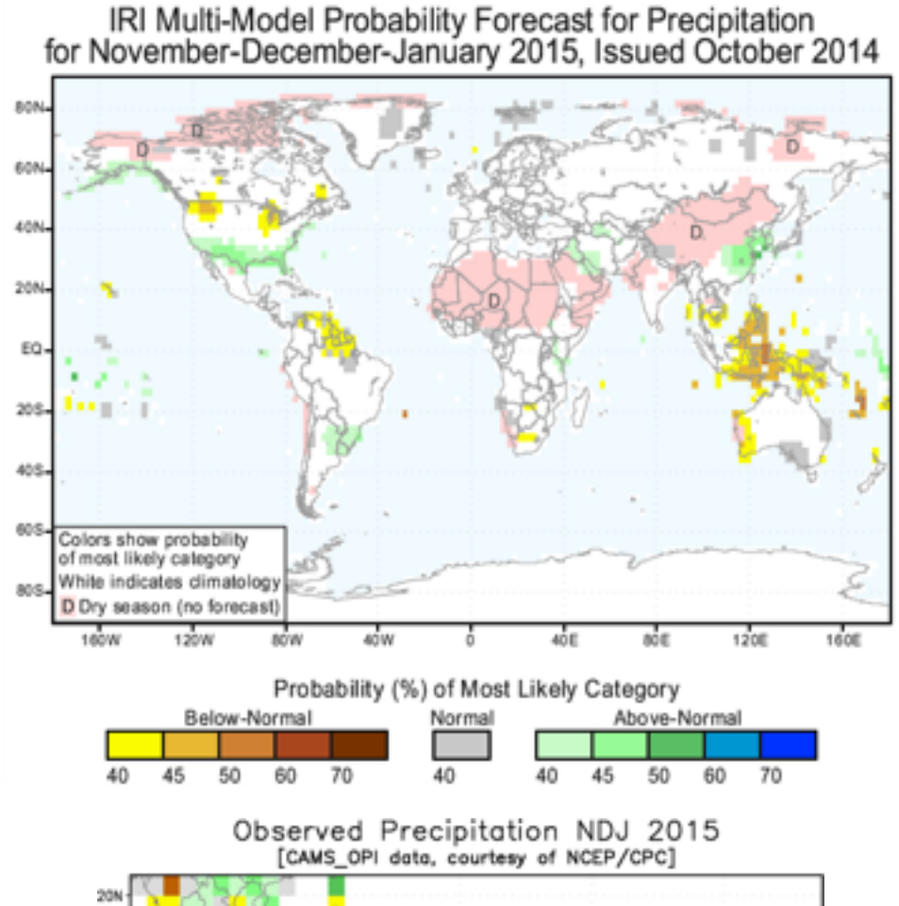
Individual Forecast Score

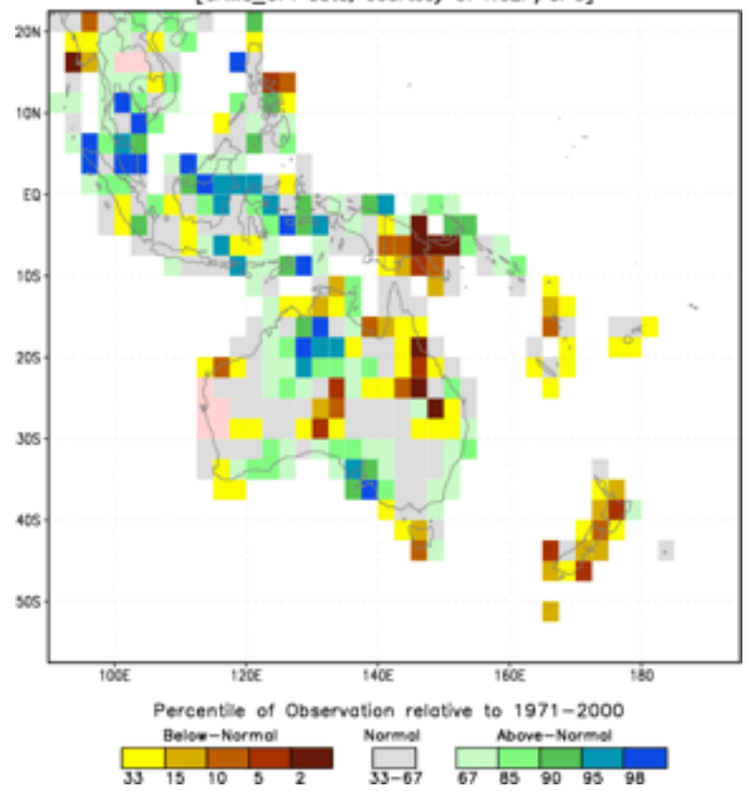
NDJ 2016 Forecast



Forecast calibration… only when there is signal and skill should the forecast deviate from the climatological distribution

NDJ 2015 Forecast

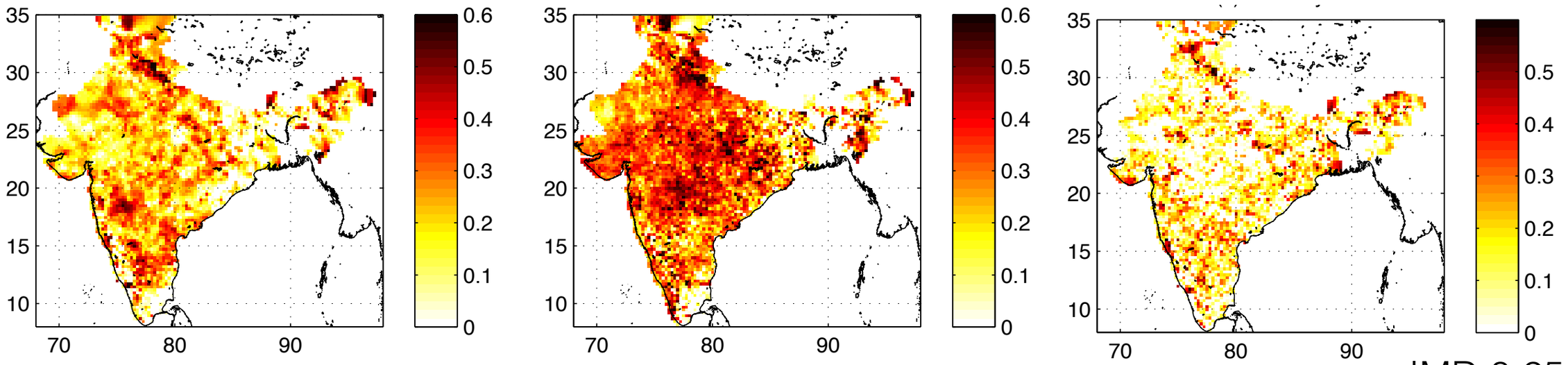




Verification of individual forecasts

Certain User-relevant quantities may be *more* predictable

Seasonal Total = Rain Day Frequency x Mean Intensity



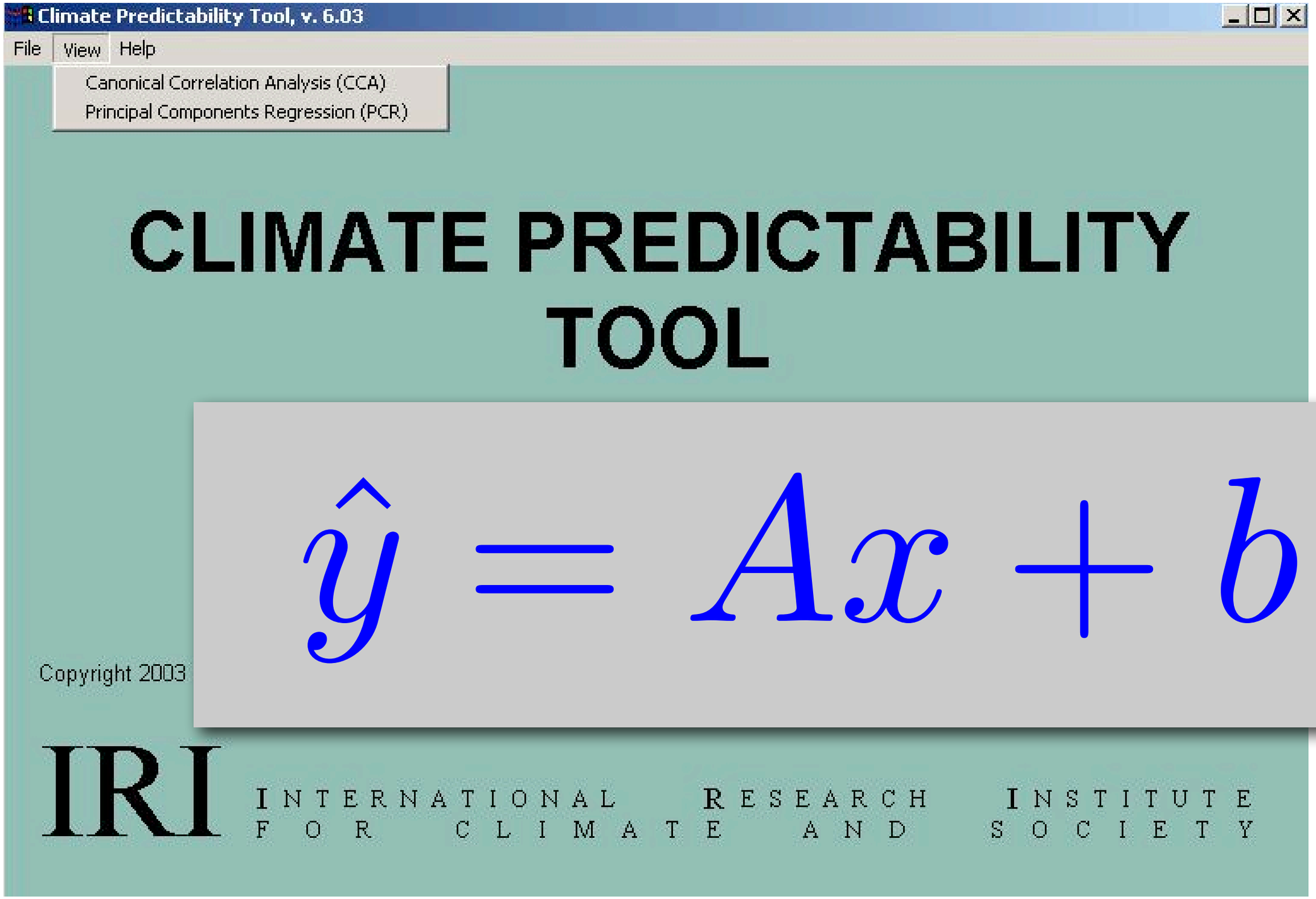
IMD 0.25-degree daily rainfall data

Anomaly Correlation "Skill"

Cross-validated regression with observed tropical Indo-Pacific SST

Jun–Sep 1901–2004

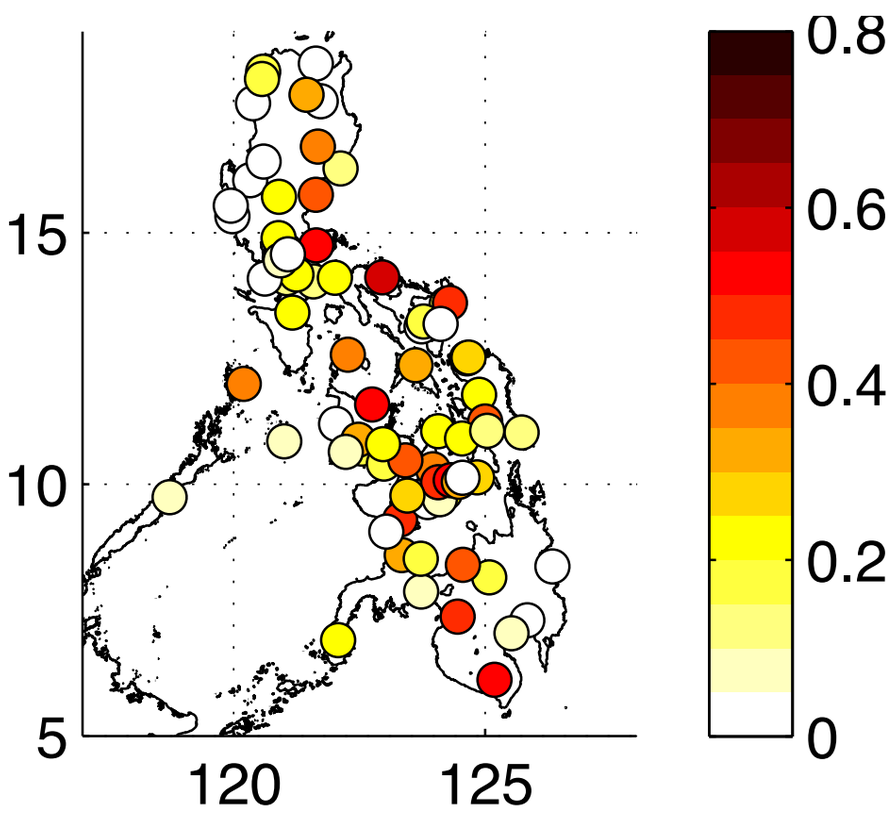
Downscaling and tailoring



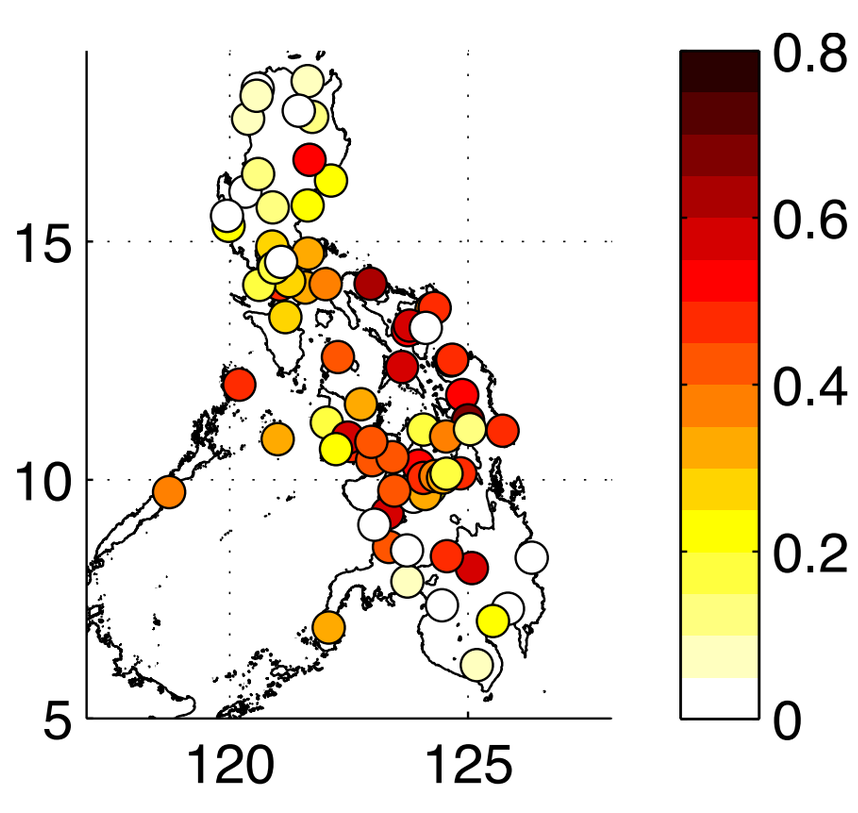
Dynamical vs Statistical Downscaling of Seasonal Rainfall

Anomaly Correlation Skill

25-km Nested Model



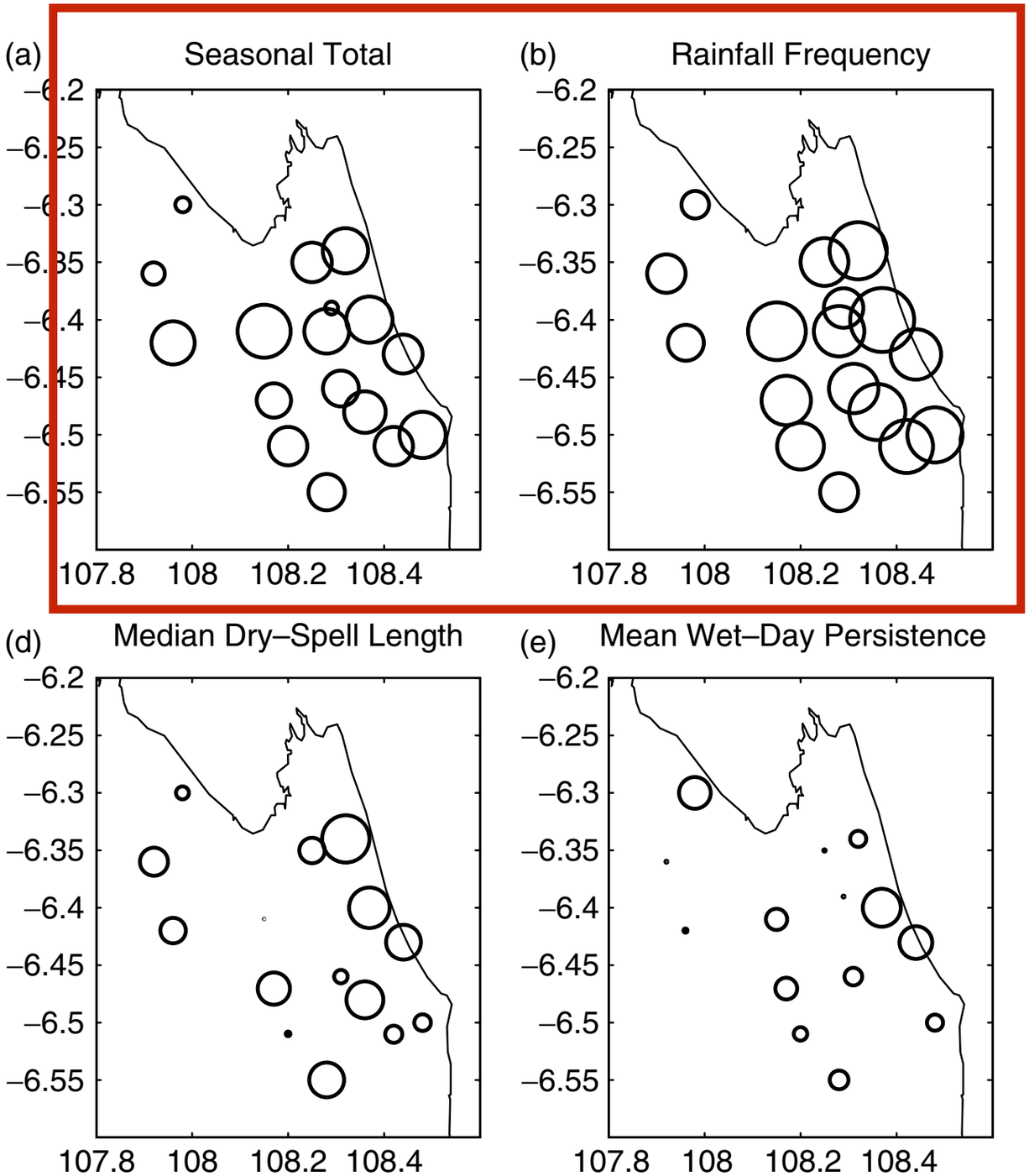
T42 GCM with PC Regression



April–June, 1977–2004

Robertson et al. (2012, MWR)

Skill of Downscaled Forecasts
Indramayu, Java



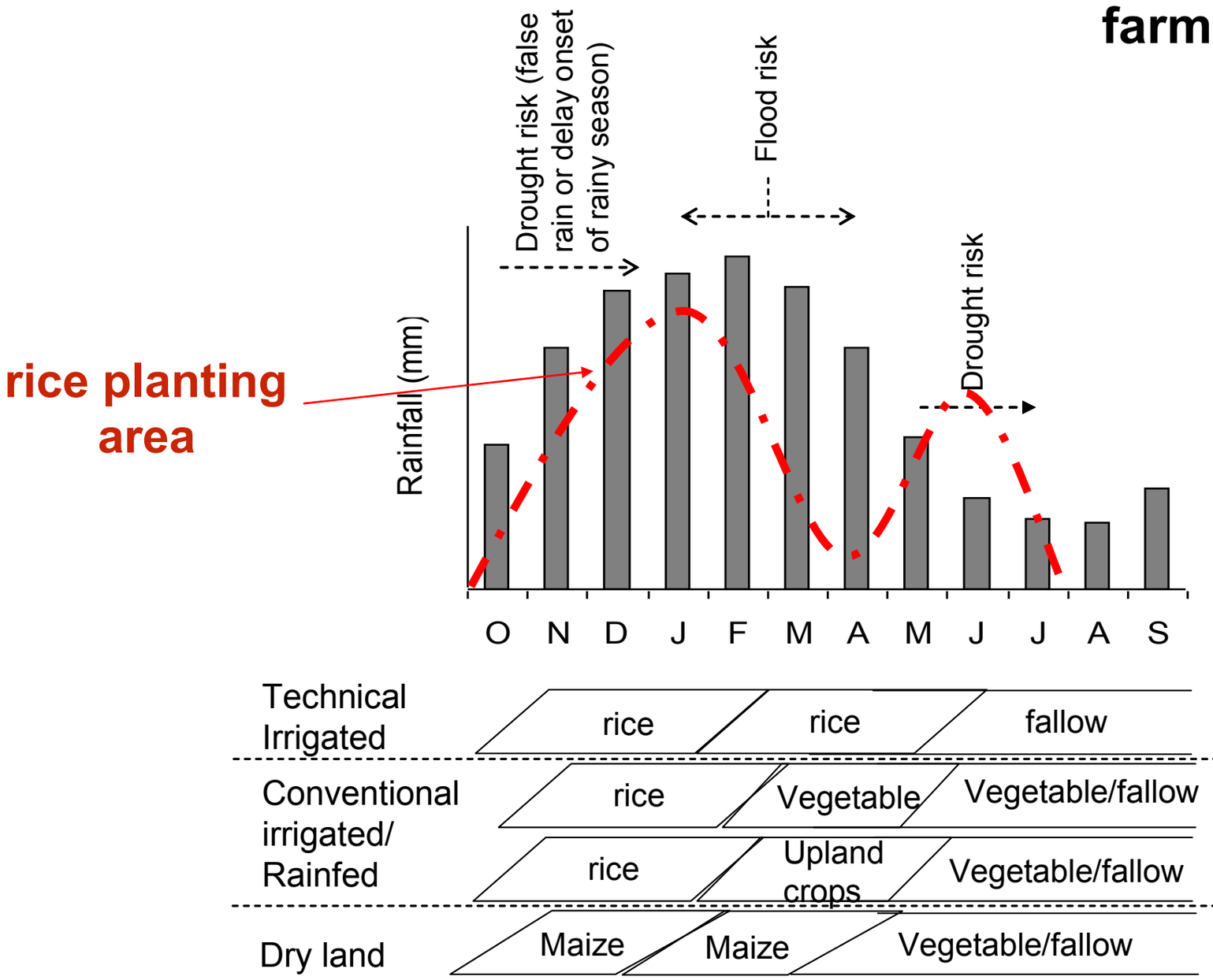
Station Rainfall Indramayu District, Indonesia

Forecasts for Sept–Dec from August 1

Skill = Circle size

Robertson et al. (2009)

Typical climate risks for farming in Java



Climate impact on farming system

Types of climate risks on lowland rice

- 1st Rice: flood risk in the period of between Jan and Feb
- 2nd Rice: drought risk due to early onset of dry season (rainy season ends earlier than normal)
- Maize: risk to be exposed to long dry spell at the start of rainy season (*false rain*)

Type of climate risks on dry-land farming

1. Maize/nuts: risk to be expose to drought risk (long dry spell or season break or rainy season ends earlier than normal)
2. Maize expose to high wind speed (Jan-Feb)

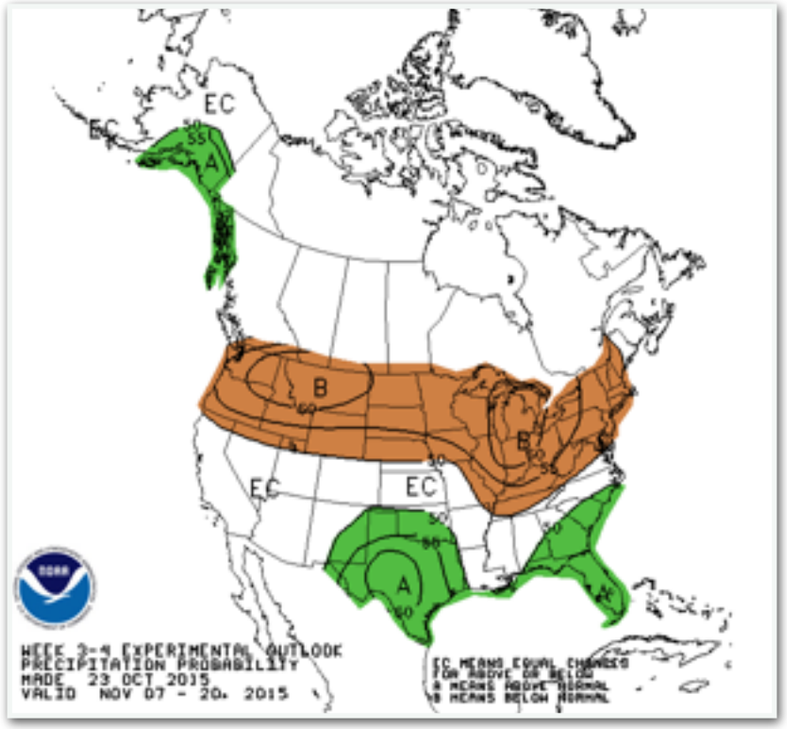
Source: Boer, 2005

User-relevant formats for forecasts on different time scales (weather-S2S-seasonal)

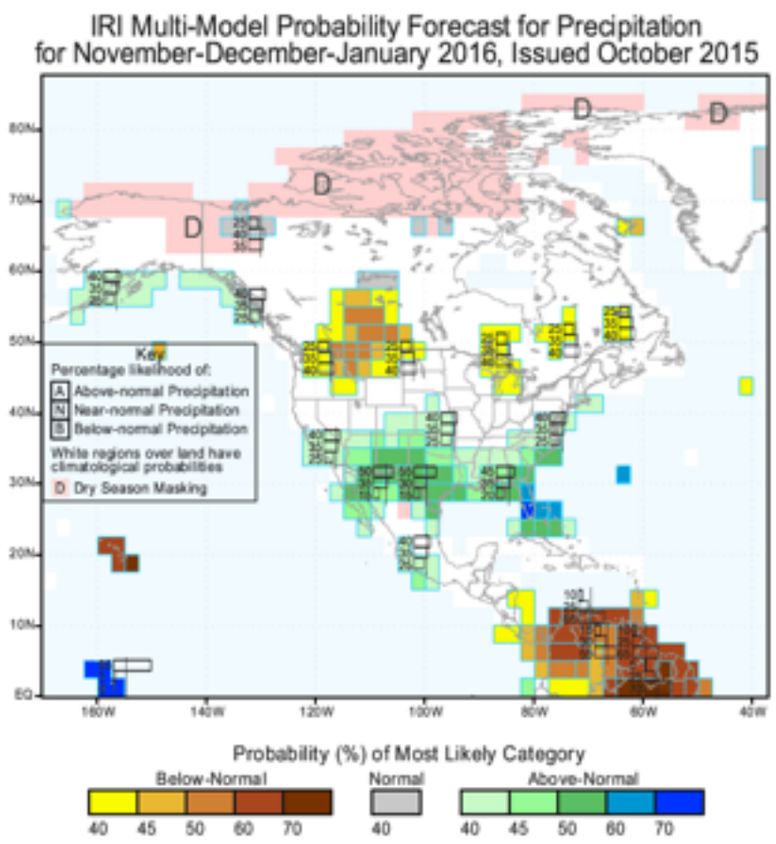
Forecast Formats

Daily weather Fcst

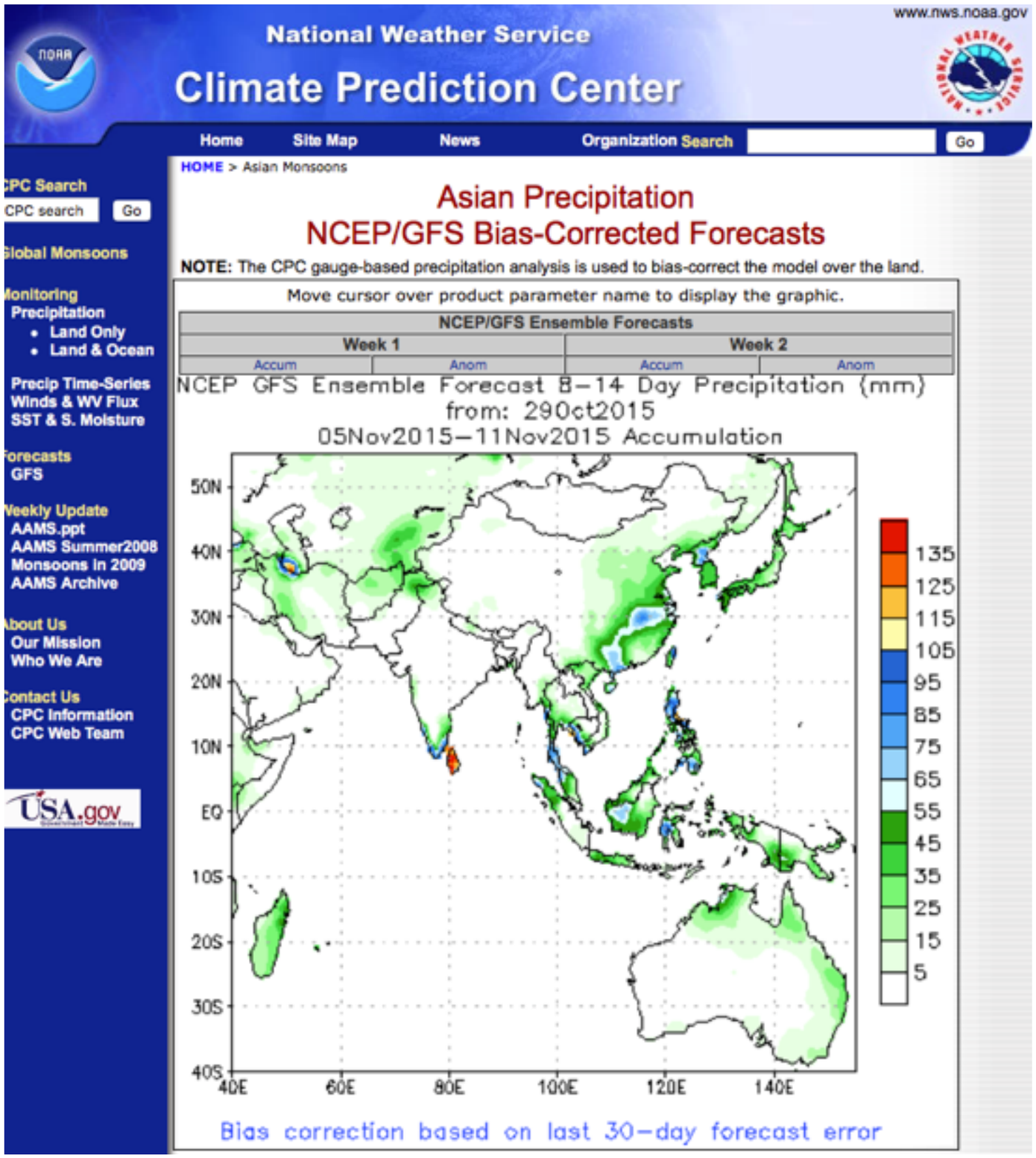
Week 3-4 Outlook



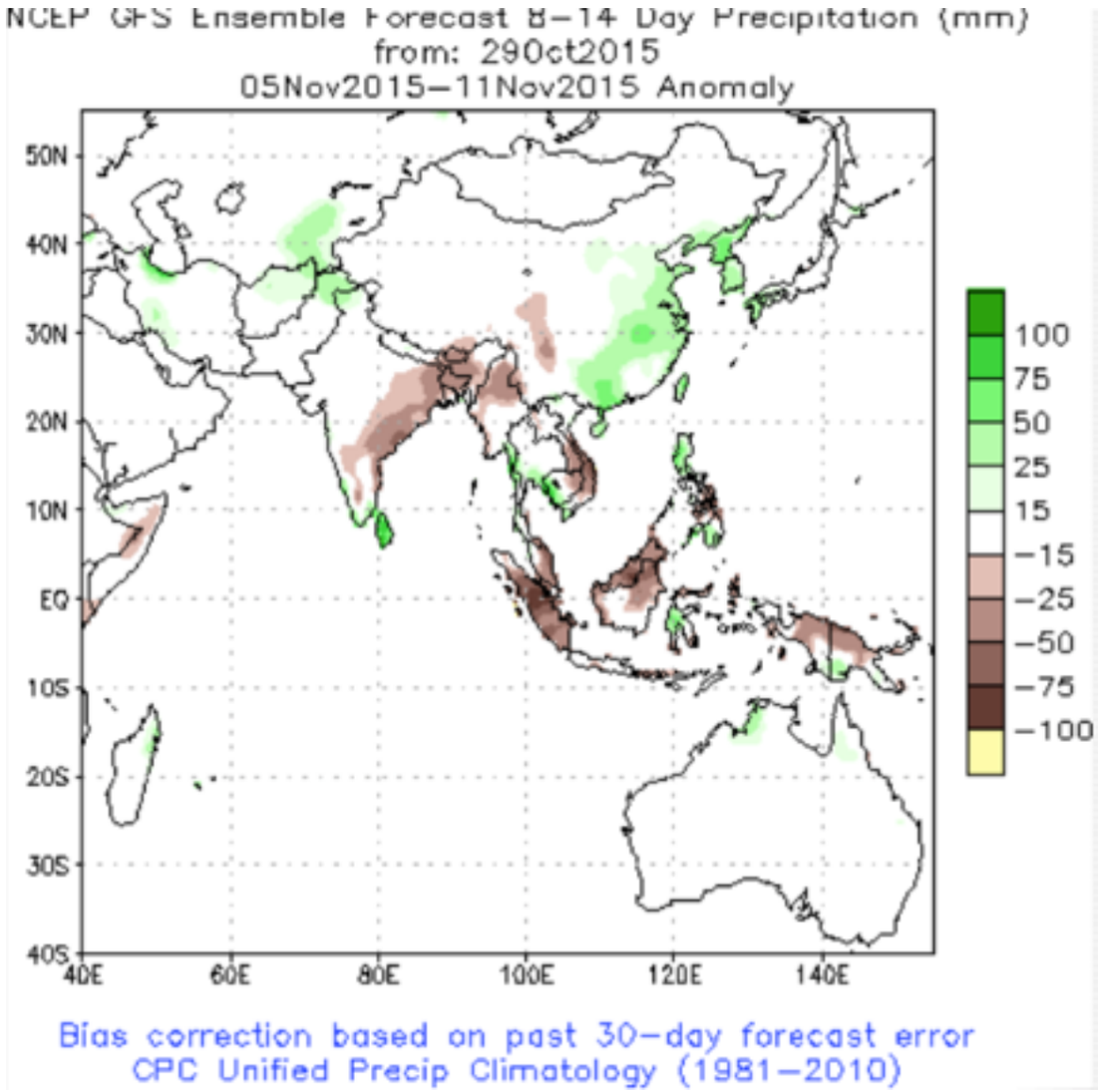
Seasonal Fcst



Weekly Averages: Full Fields vs Anomalies



Anomaly



Conclusions

- Need to consider S2S forecasts from perspective of user communities
  - Hazard early warning - enhancing preparedness to high-impact weather events
  - Management decisions in weather-sensitive operations [Crop management (e.g. fertilizer application, Reservoir system management, Climate sensitive diseases (e.g. malaria, flu), Energy generation/distribution (supply and demand mgmt), Transportation]
    - Large range of users from sophisticated to developing country
- Key attributes of Salience, Understandability, Legitimacy
  - Tailored products
  - Access by and from NMHSs
  - Proper verification

Key user needs

- Access to forecast products by and from legitimate sources

- Ability to develop tailored products that are salient and understandable
  - Full forecast PDF
  - Long reforecast sets
  - Participatory research
  - Training

Key Questions for S2S Applications

- **What are the key societal decisions** (low-hanging fruit) in agriculture food security, water management, public health, and DRR (i.e. the GFCS Priority areas) in monsoonal climates where sub-seasonal forecasts may have the most value?

- **What are the user requirements** for S2S monsoon forecasts to be useful to different these application communities? Are there specific needs for applications in terms of reforecasts, downscaling, and forecast verification?

- **How convenient is the S2S data portal** for applications community use? Which derived products would be most useful for applications?

- **What are important entry points** for connecting S2S forecast producers with users (e.g. governmental and non-governmental organizations that serve as intermediaries)?