

Assessing the North American Multi-Model Ensemble (NMME) forecasts for seasonal forecasting and decision making over Africa

Eric F. Wood
Princeton University



APEC Climate Symposium 2015

From Science to Action: The use of weather and climate information
for efficient disaster risk management

Manila, Philippines

2 – 4 November 2015

Outline of the talk

1. A framework for providing climate information for society
2. Princeton's African and Latin American flood and drought monitoring and forecasting systems
3. Recent skill assessment using seasonal forecasts from the North American Multi-Model Ensemble (NMME) system
4. WMO's Global Framework for Climate Services (GFCS): a feasible or infeasible system?



CHRIS SISAIRICH / WORLD VISION

GFCS provides a worldwide mechanism for coordinated actions to enhance the quality, quantity and application of climate services.

[Previous](#) [Pause](#) [Next](#)

Priority areas



Agriculture and food security



Disaster risk reduction



Energy



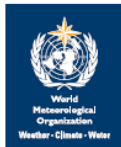
Health



Water

CLIMATE KNOWLEDGE FOR ACTION:

A GLOBAL FRAMEWORK
FOR CLIMATE SERVICES—
EMPOWERING
THE MOST VULNERABLE



THE REPORT OF THE HIGH-LEVEL TASKFORCE
FOR THE GLOBAL FRAMEWORK
FOR CLIMATE SERVICES



WMO-No. 1065

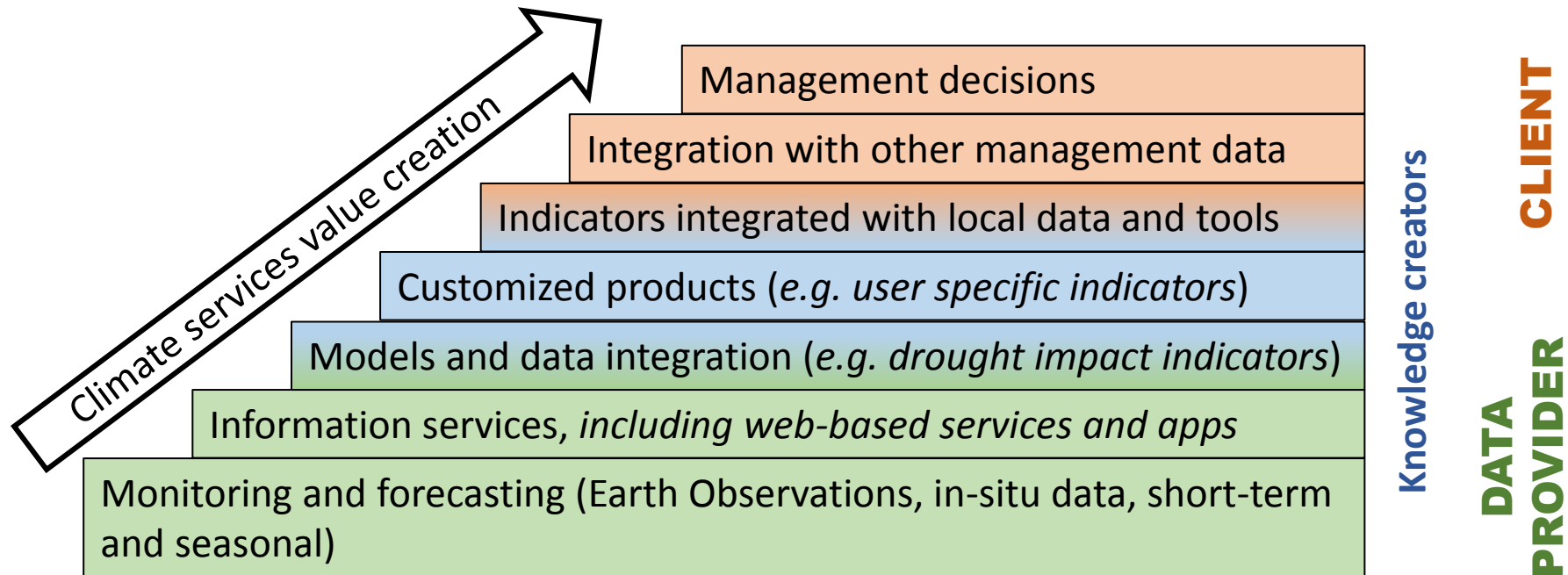
Climate product:

The end result of a process of synthesising climate science and data.

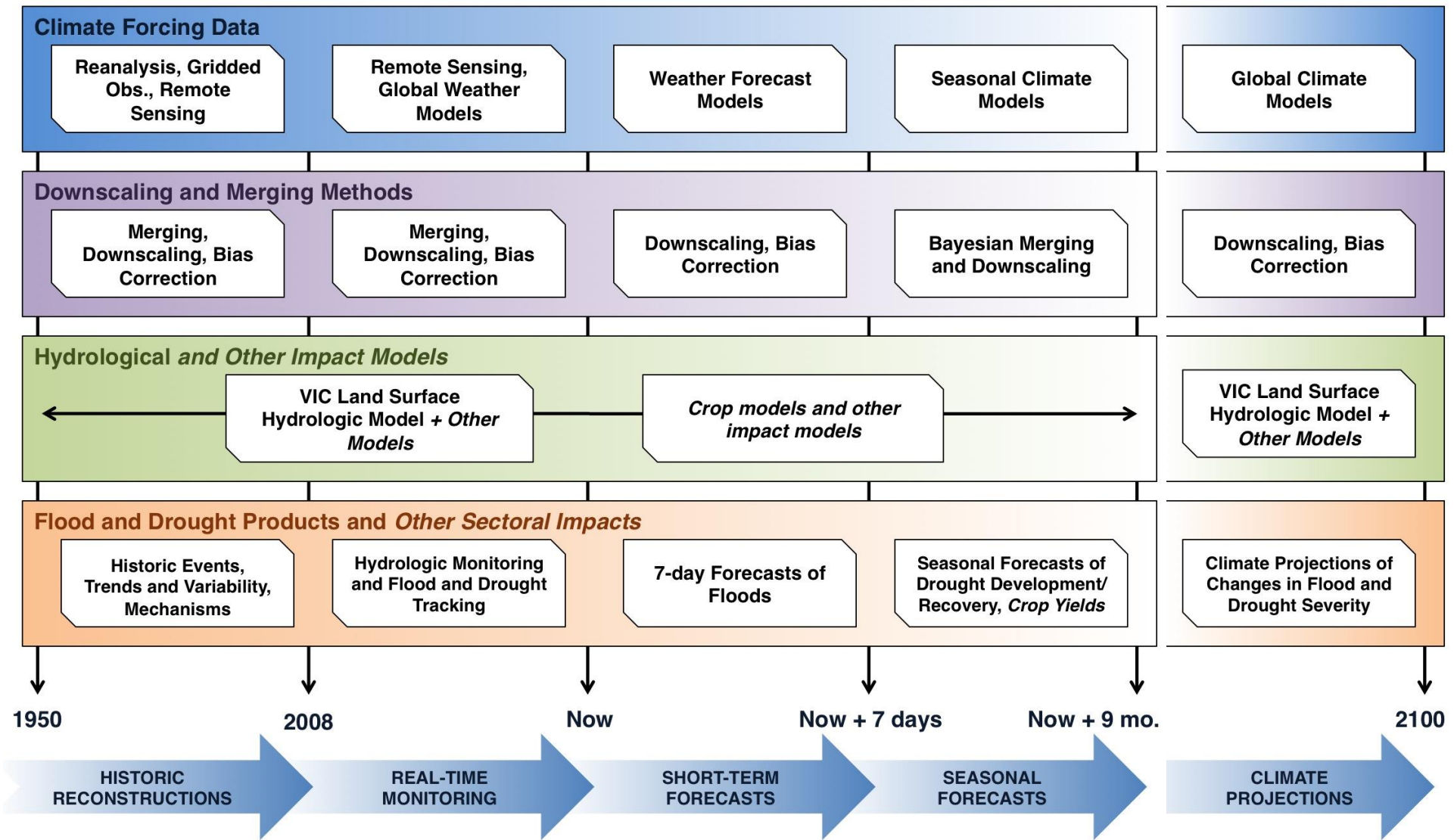
Climate service:

Climate information prepared and delivered to meet a user's needs.

Climate service staircase: From data to knowledge for decision making



Monitoring and forecasting (Earth Observations, in-situ data, short-term and seasonal)



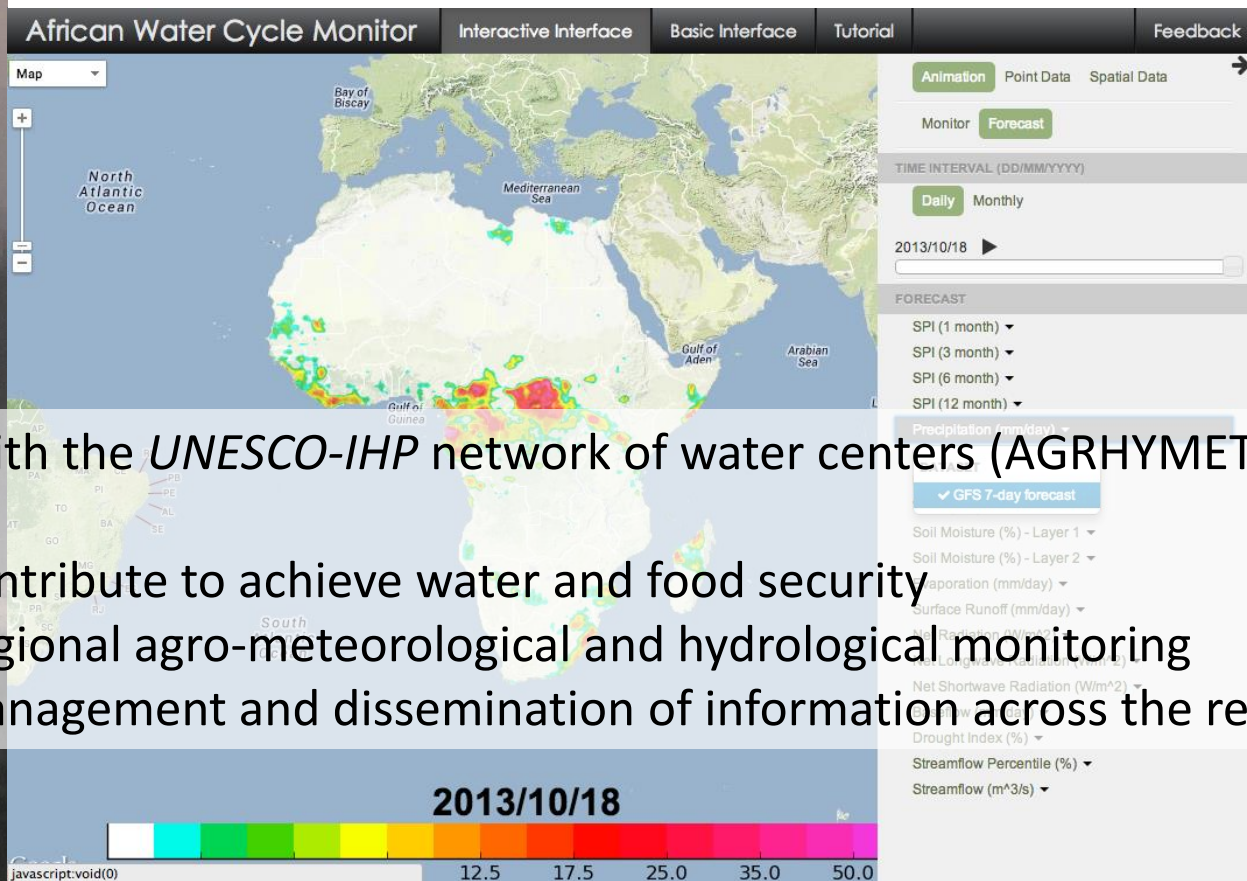
Sheffield, J., et al., 2014; A drought monitoring and forecasting system for sub-Saharan African water resources and food security. *Bull. Am. Met. Soc.*, in

Monitoring and forecasting (Earth Observations, in-situ data, short-term and seasonal)



Princeton's African drought and flood monitoring and forecasting system

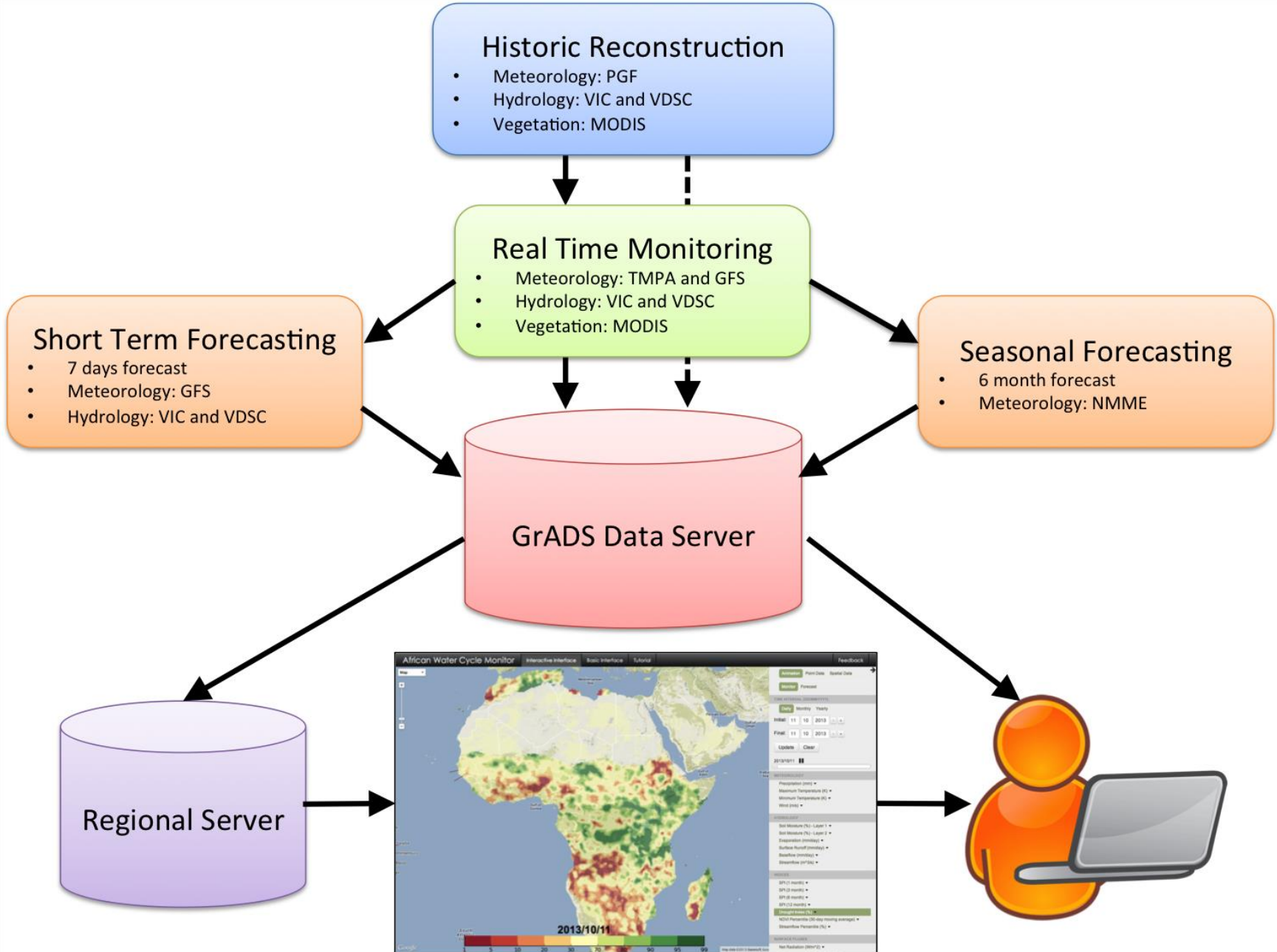
<http://hydrology.princeton.edu/monitor>



Partner with the *UNESCO-IHP* network of water centers (AGRHYMET, ICPAC, SADC, ...)

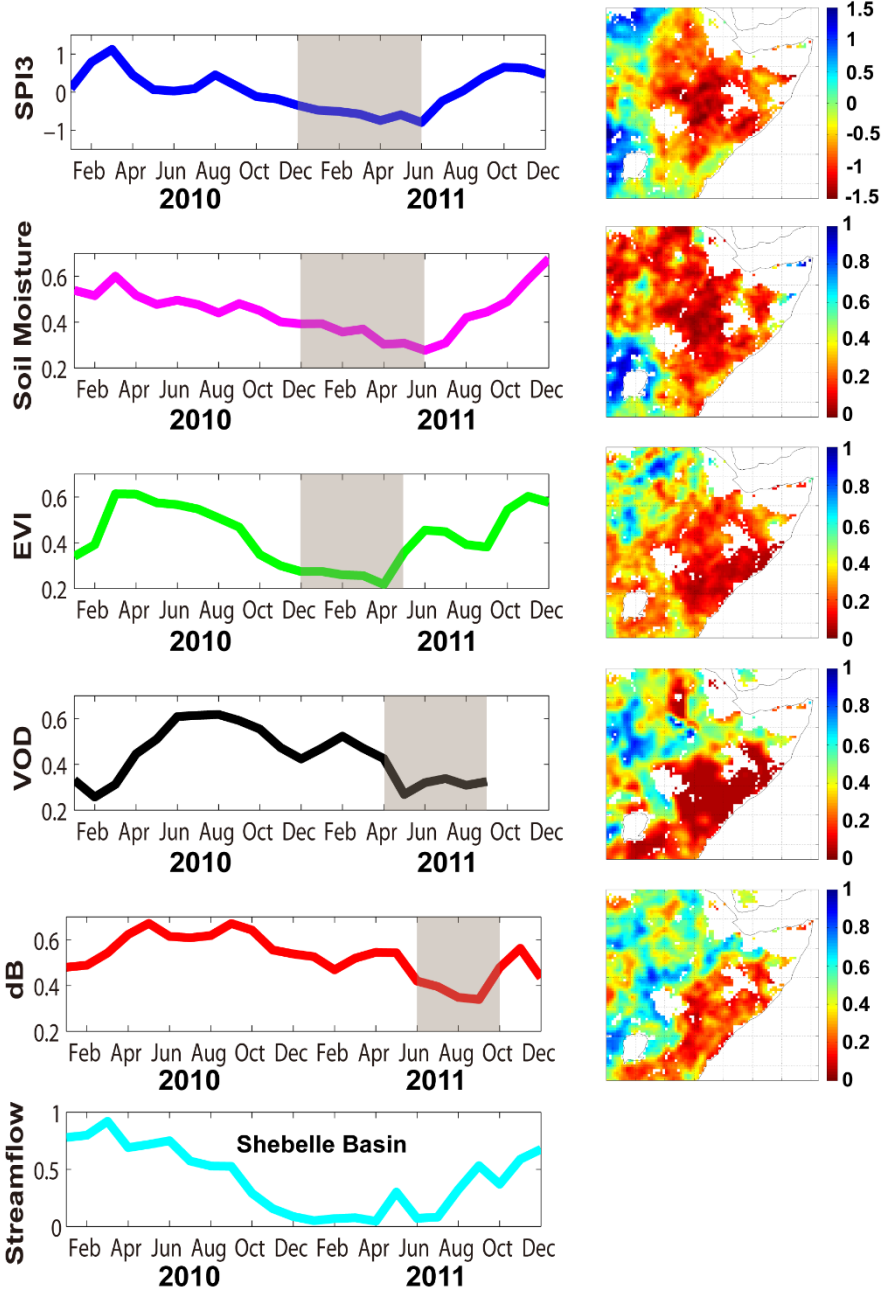
- Contribute to achieve water and food security
- Regional agro-meteorological and hydrological monitoring
- Management and dissemination of information across the region.

Information services, including web-based services and apps



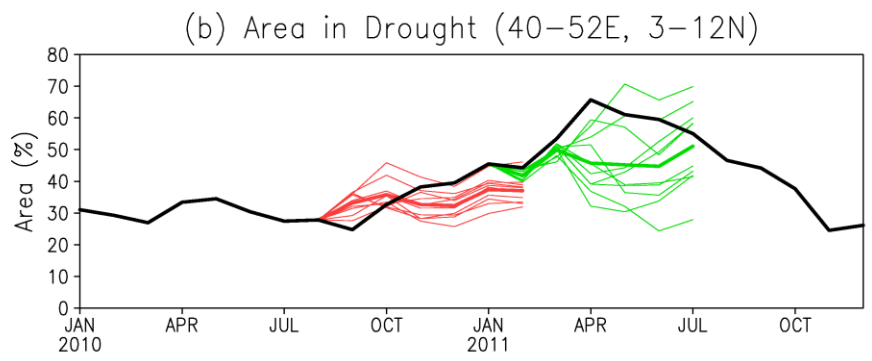
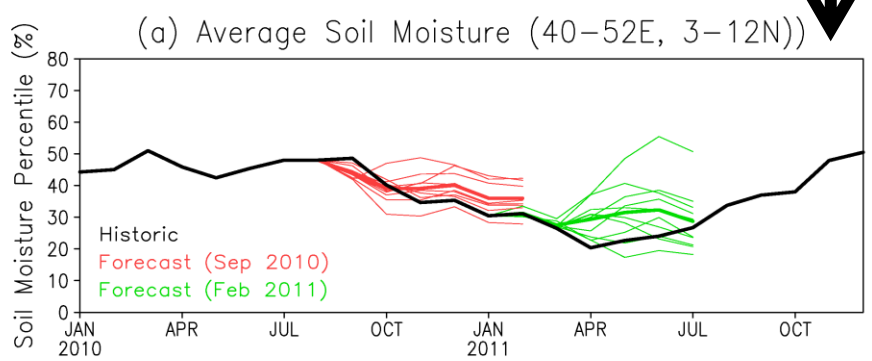
Customized products (e.g. user specific indicators)

Regional Example:
Horn of Africa Drought
2010-2011



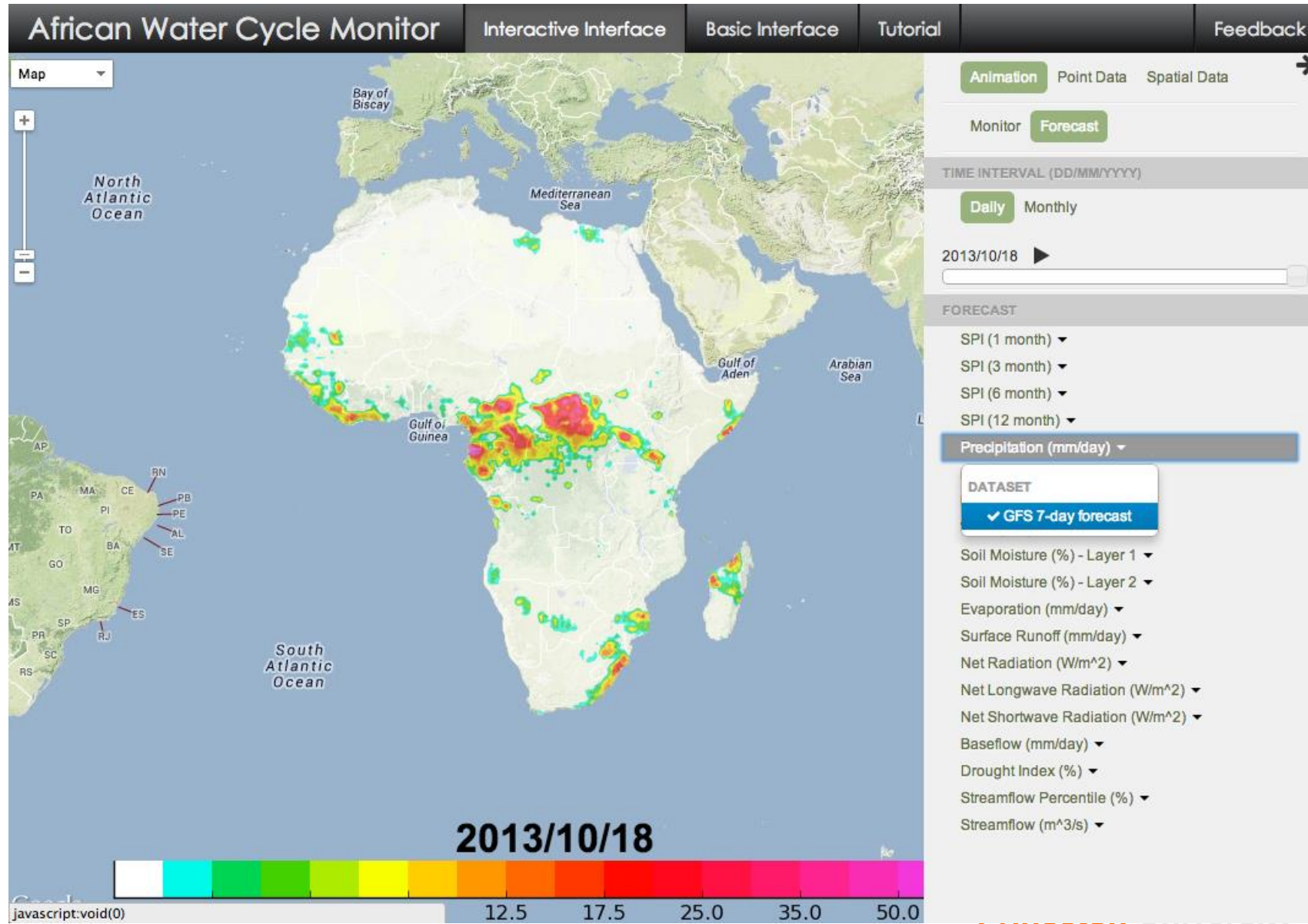
← Monitoring the propagation of the drought

Seasonal drought forecasts (based on CFS model only)



Information services, including web-based services and apps

7-day forecasting based on NCEP's GFS



Forecasts from the North American Multi-Model Ensemble (NMME)

Seasonal (monthly forecasts out 12 months)

- Monthly total precipitation and mean Tair (1982-2015)
- Number of ensembles varies by model
- CanCM3, CanCM4, CFSv2, GEOS-5 (NASA), CCSM4, CM2p1 (GFDL)

Sub-seasonal forecasts (Daily resolution out 12 months)

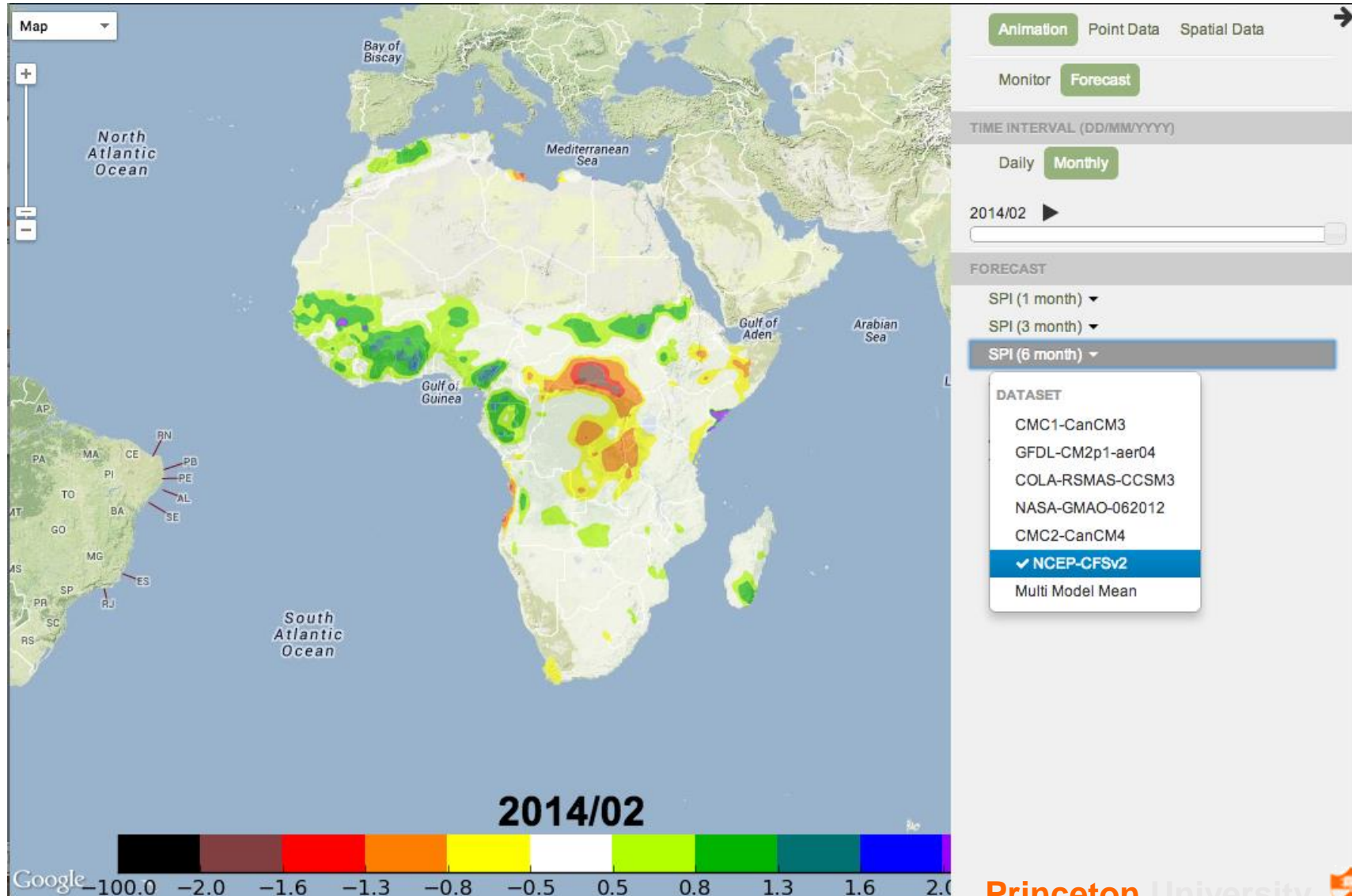
- Many meteorological and hydro. variables (surface and atmospheric)
- CCSM4, **CFSV2**, CanCM3, CanCM4, FLORB-01, **GEOS-5**

	CanCM3	CanCM4	FLOR-B01	CCSM4
Institute	Environment Canada	Environment Canada	GFDL	NCAR/University of Miami
Temperature data availability	100%	100%	100%	71.4%
Precipitation data availability	100%	100%	100%	76.5%

Models and data integration (e.g. drought impact indicators)

Information services, including web-based services and apps

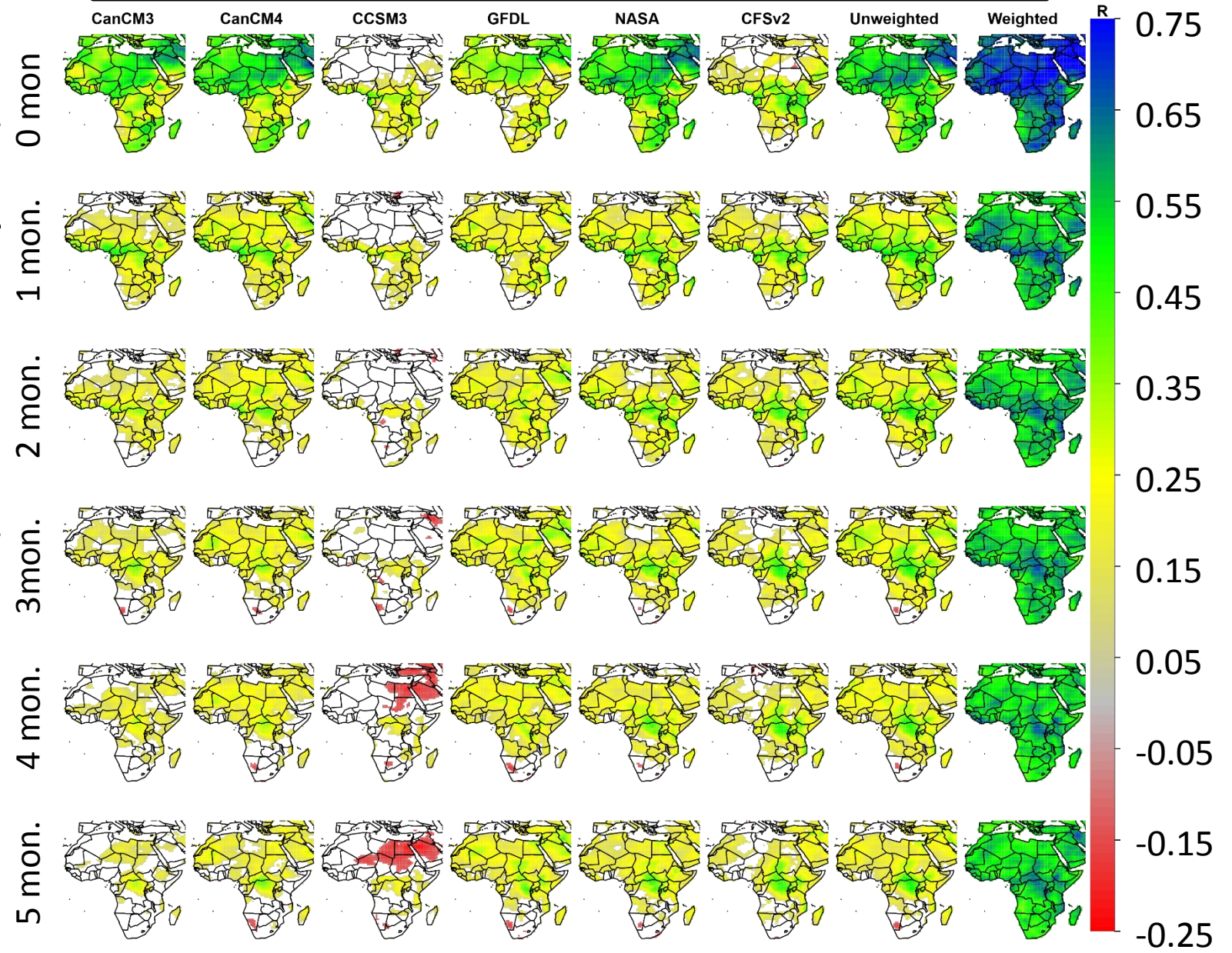
Seasonal SPI-6 (6-month) forecast (e.g. for 2/14 from 9/13)



Information services, including web-based services and apps

Data integration and applications depend on skillful forecasts

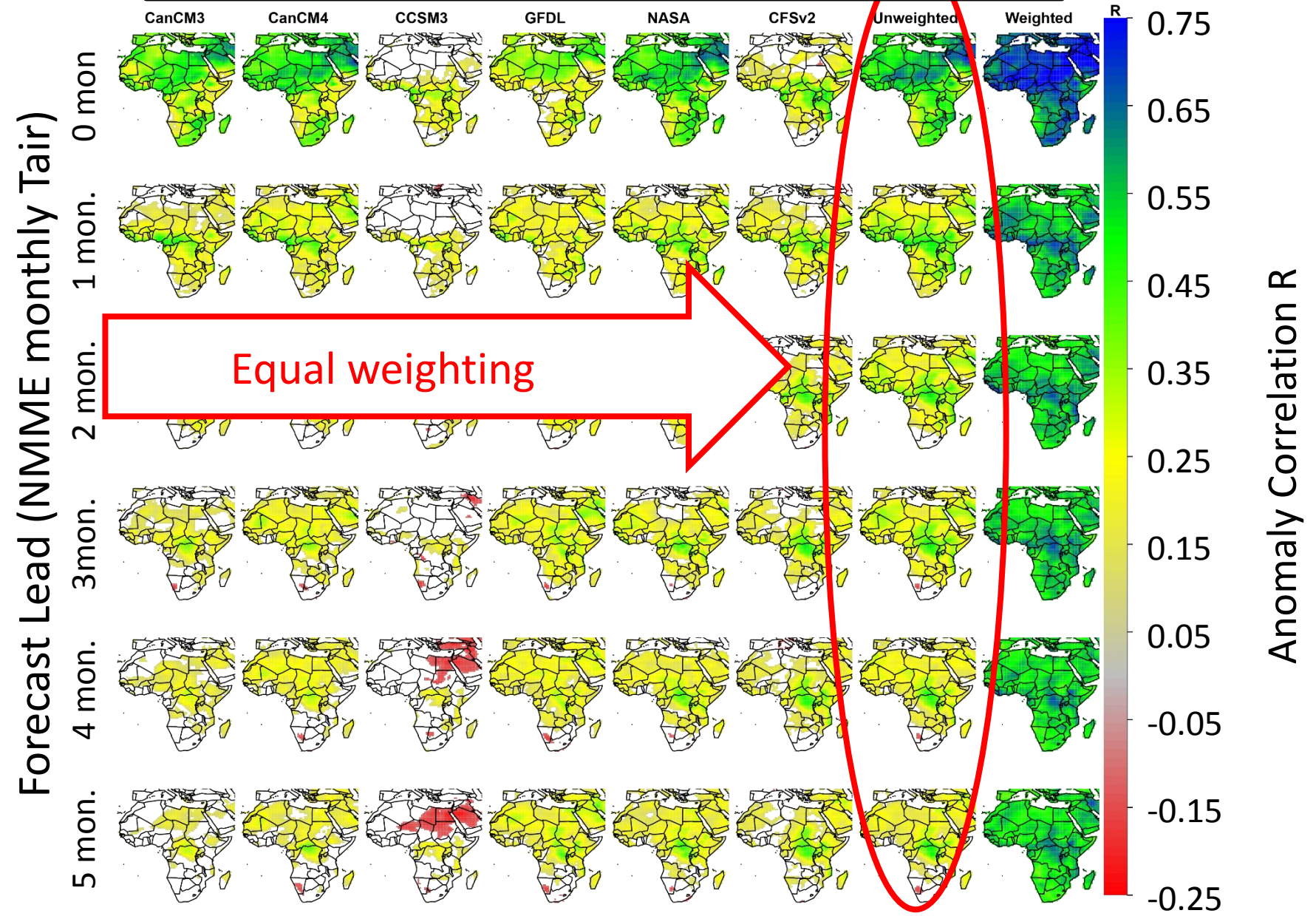
Forecast Lead (NMME monthly Tair)



Anomaly Correlation R

Information services, including web-based services and apps

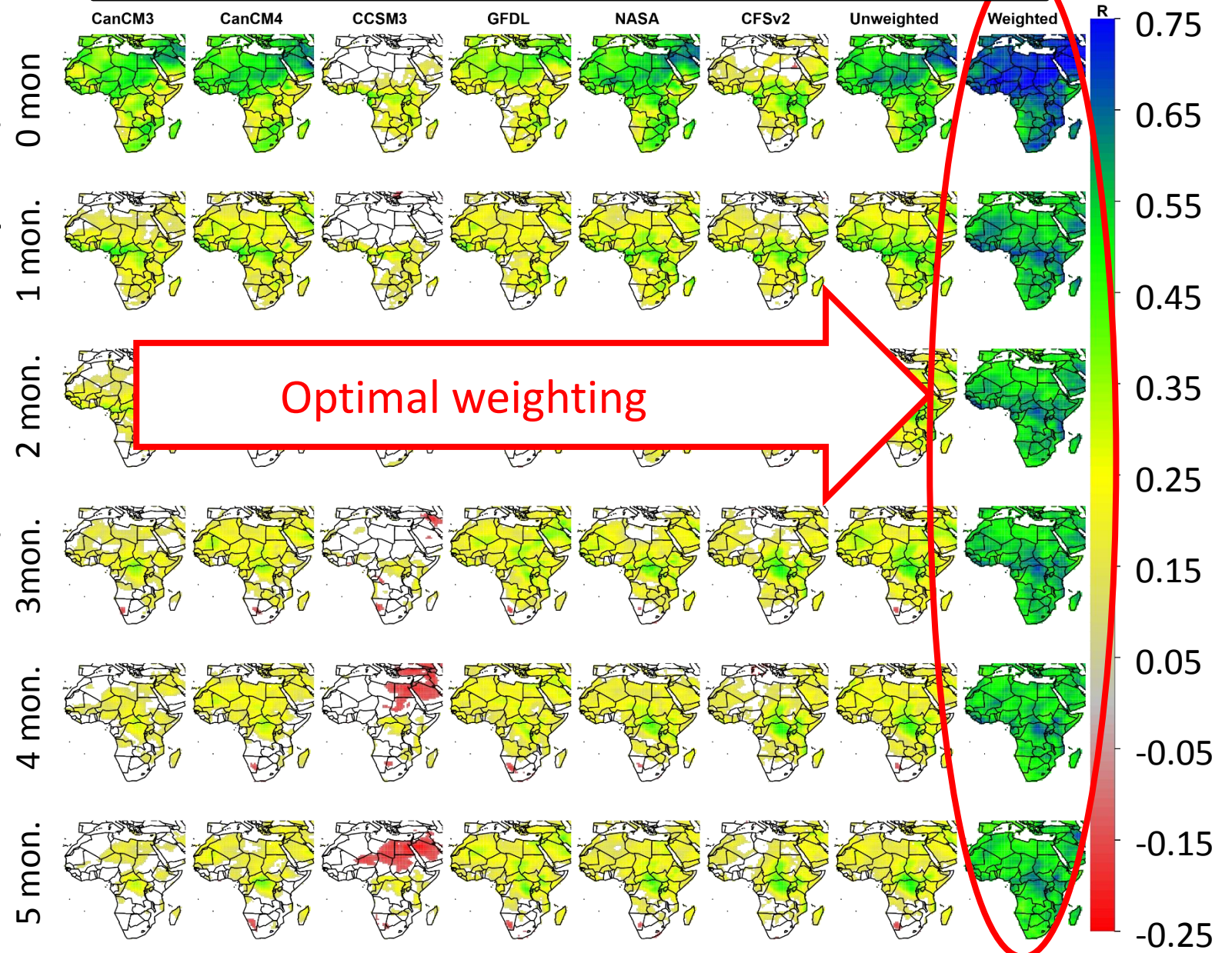
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Information services, including web-based services and apps

Data integration and applications depend on skillful forecasts

Forecast Lead (NMME monthly Tair)



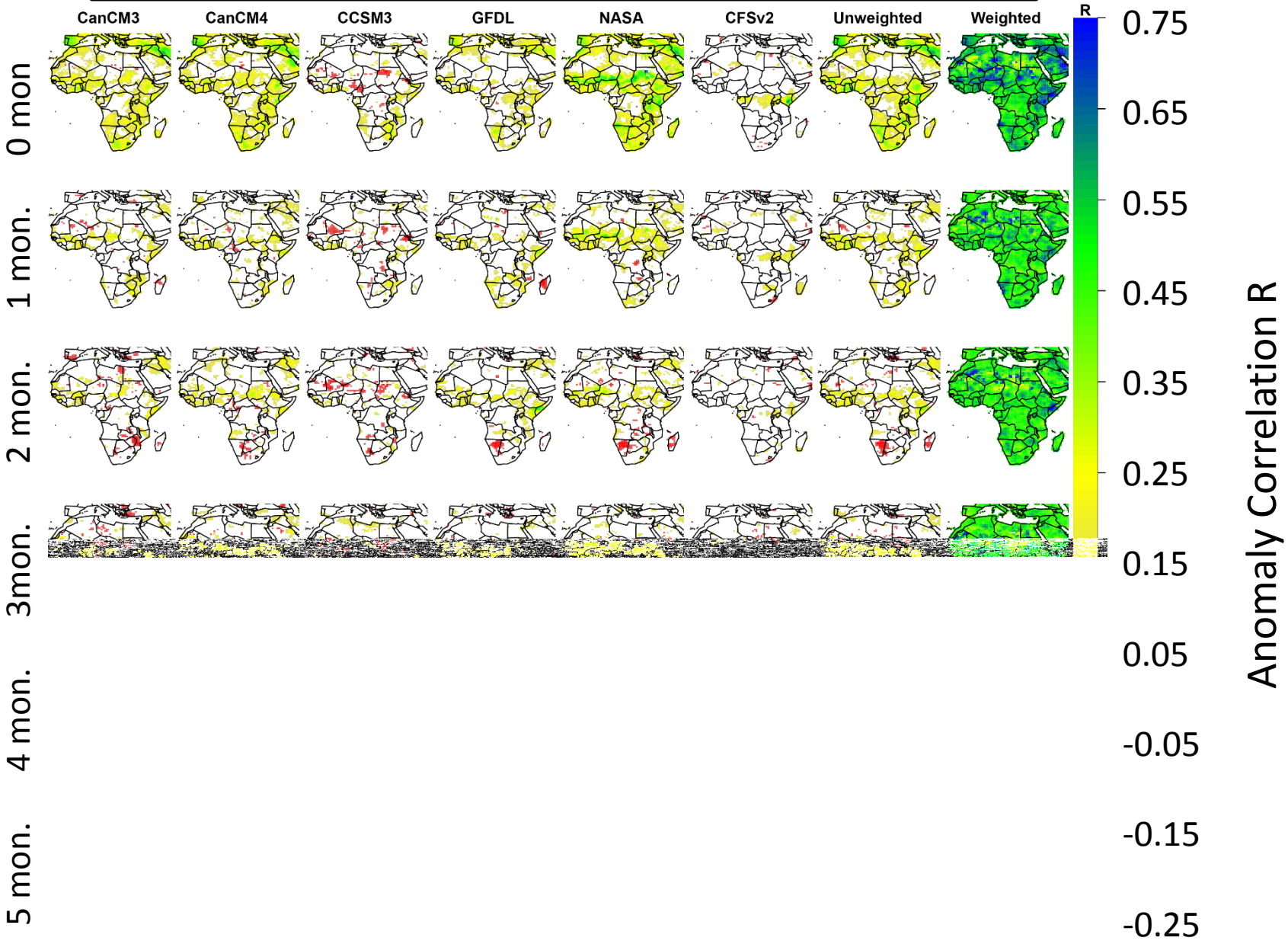
Optimal weighting

Anomaly Correlation R

Information services, including web-based services and apps

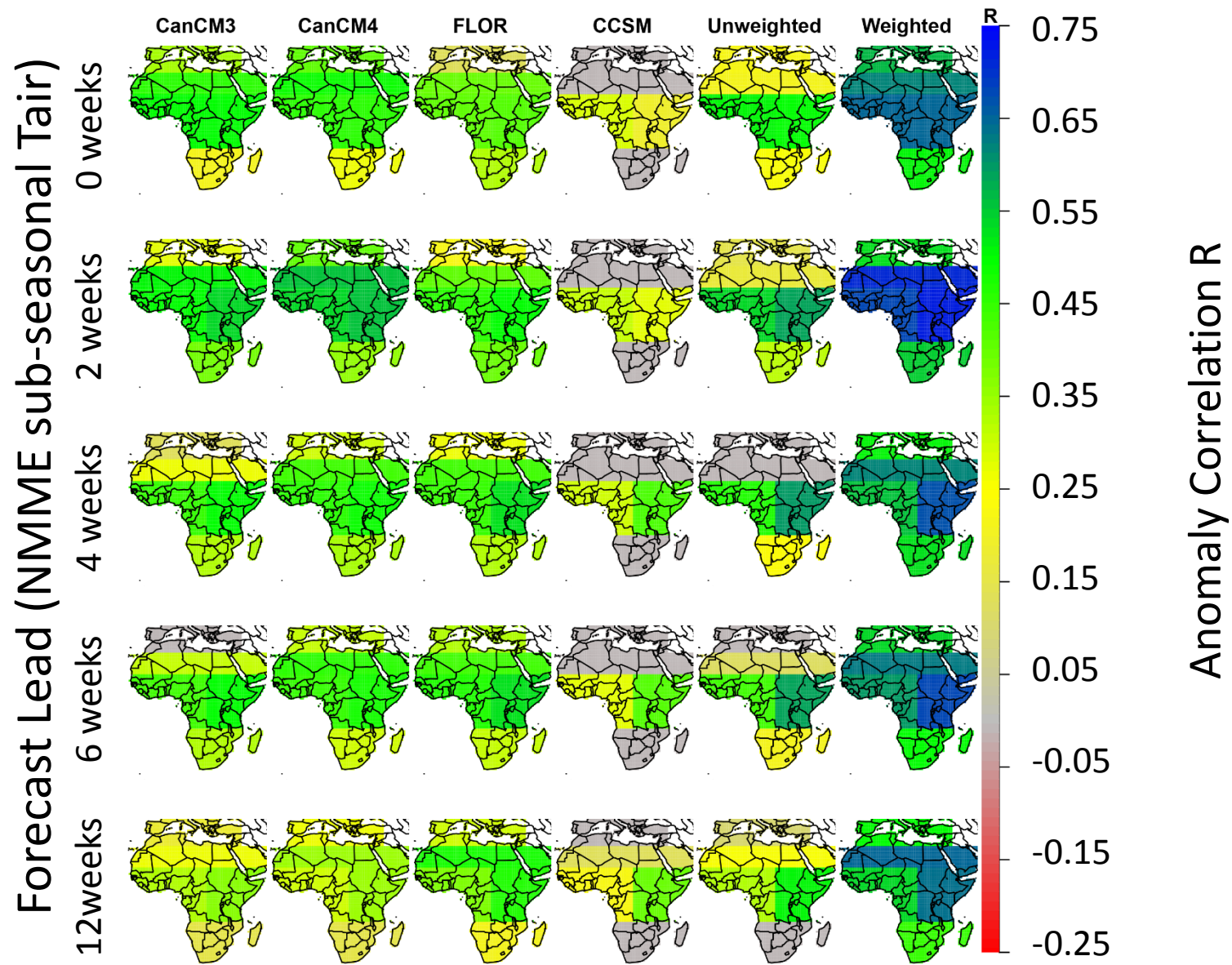
Data integration and applications depend on skillful forecasts

Forecast Lead (NMME monthly ppt.)



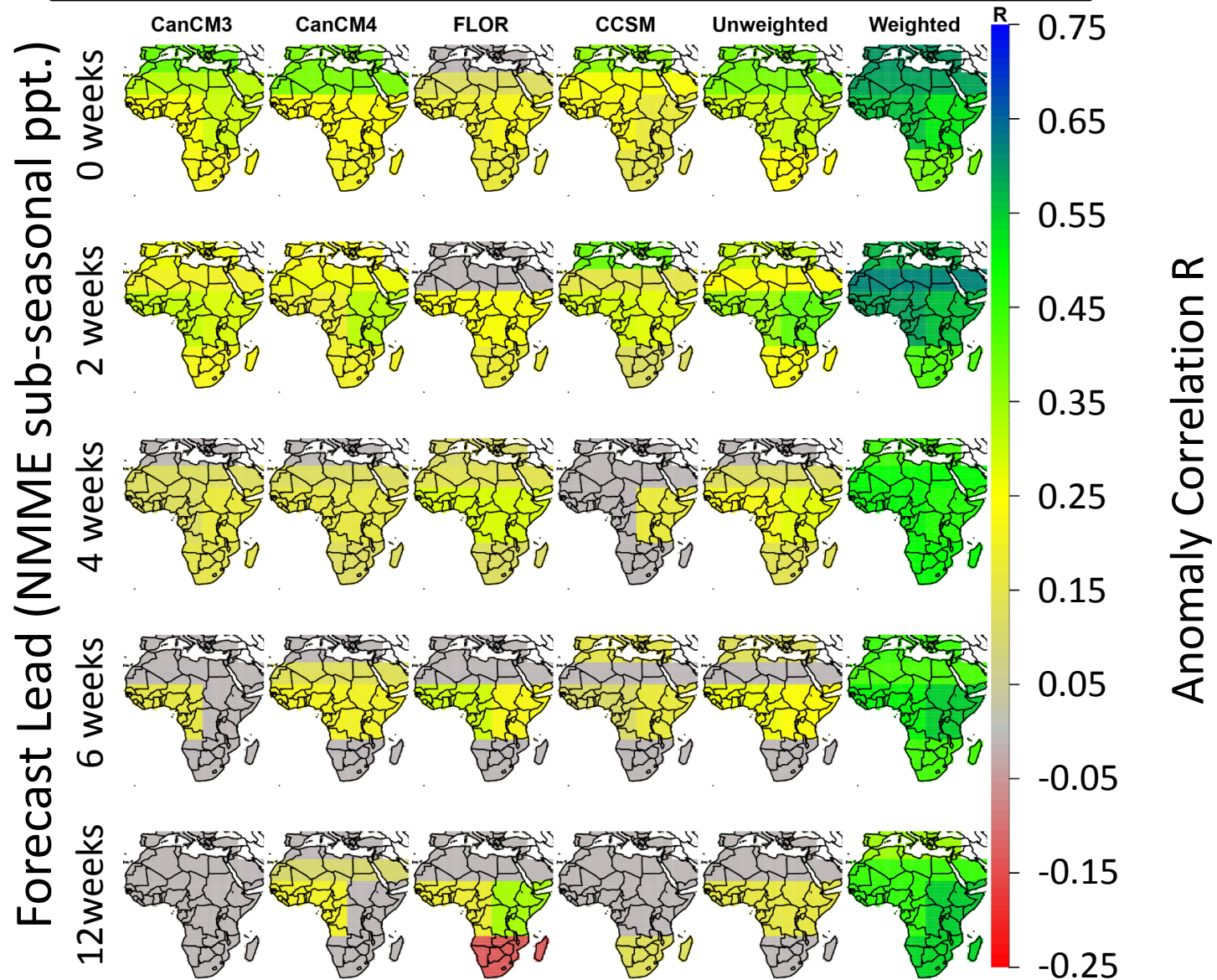
Information services, including web-based services and apps

Data integration and applications depend on skillful forecasts

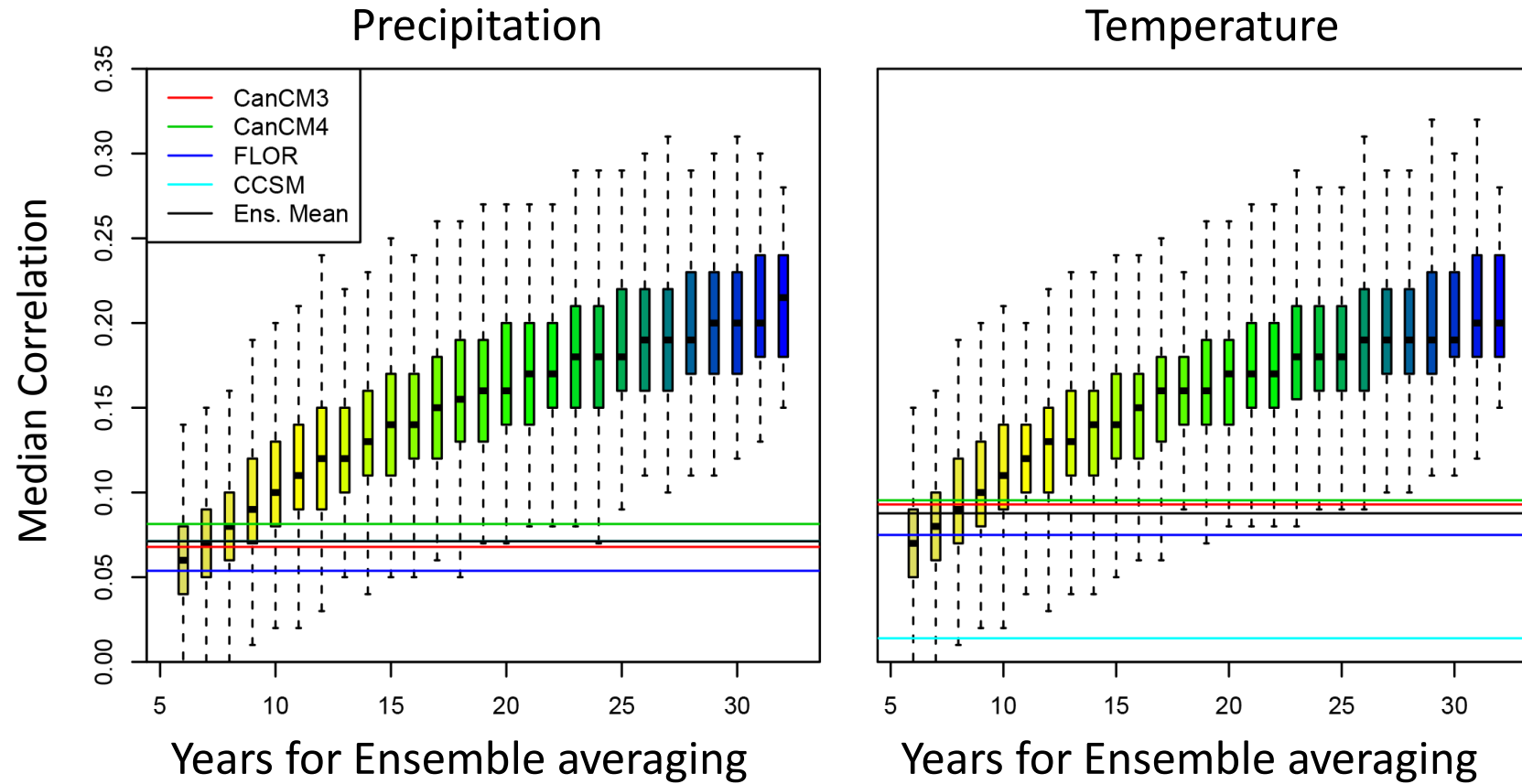


Information services, including web-based services and apps

Data integration and applications depend on skillful forecasts

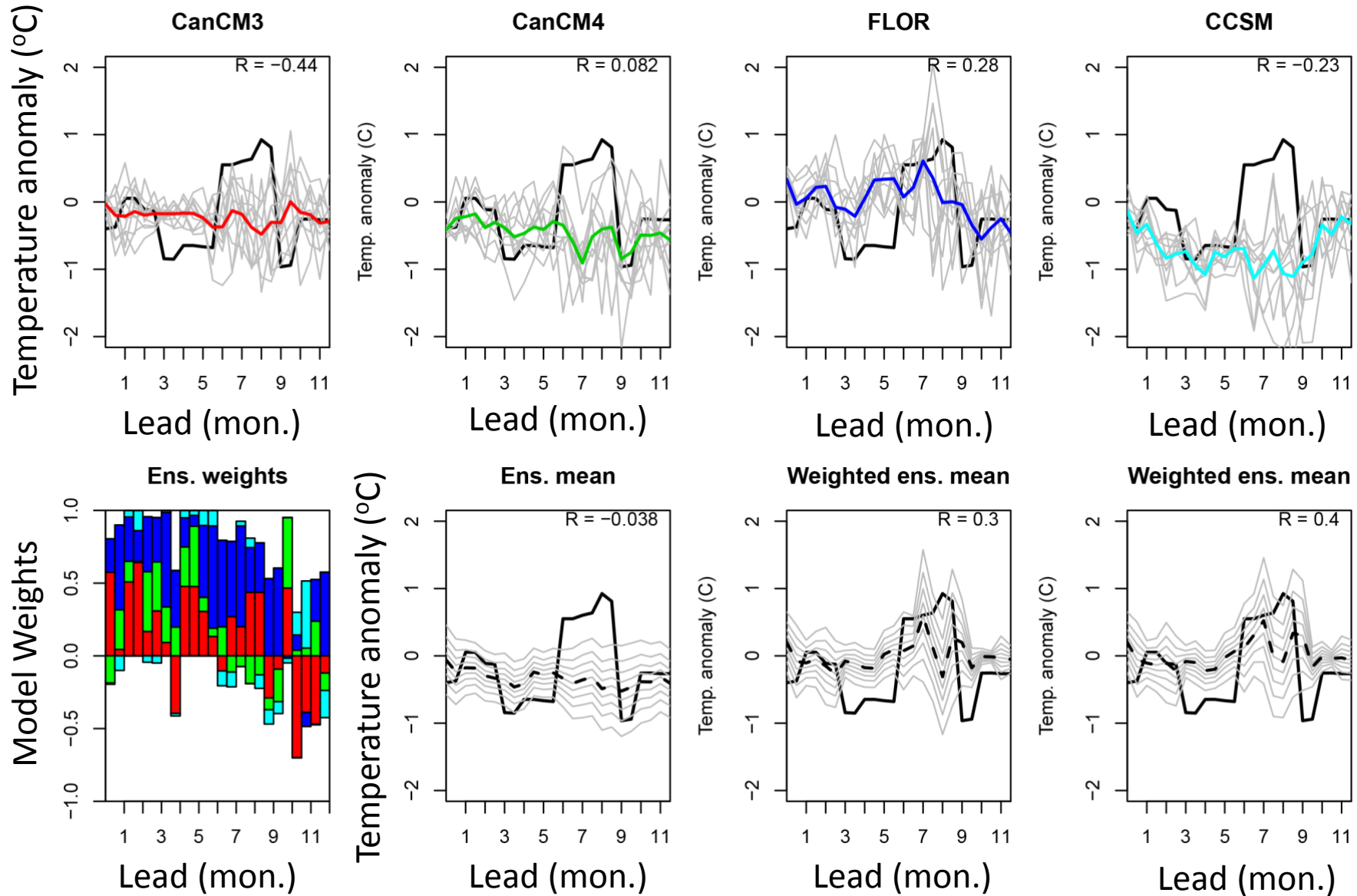


Verification of optimal weighting (using bootstrap sampling)

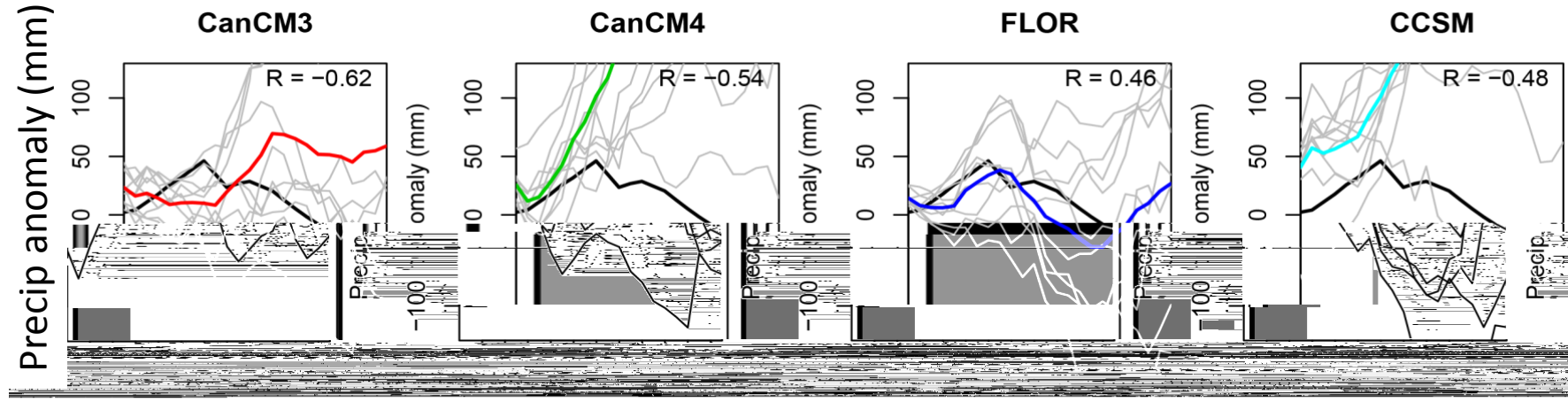


Performance of weighted ensemble mean
superior with 10 years of data

West Africa drought 2000



2010 East - Africa drought



Lead (mon.)

Lead (mon.)

Lead (mon.)

Lead (mon.)

Model Weights

Precip anomaly (mm)

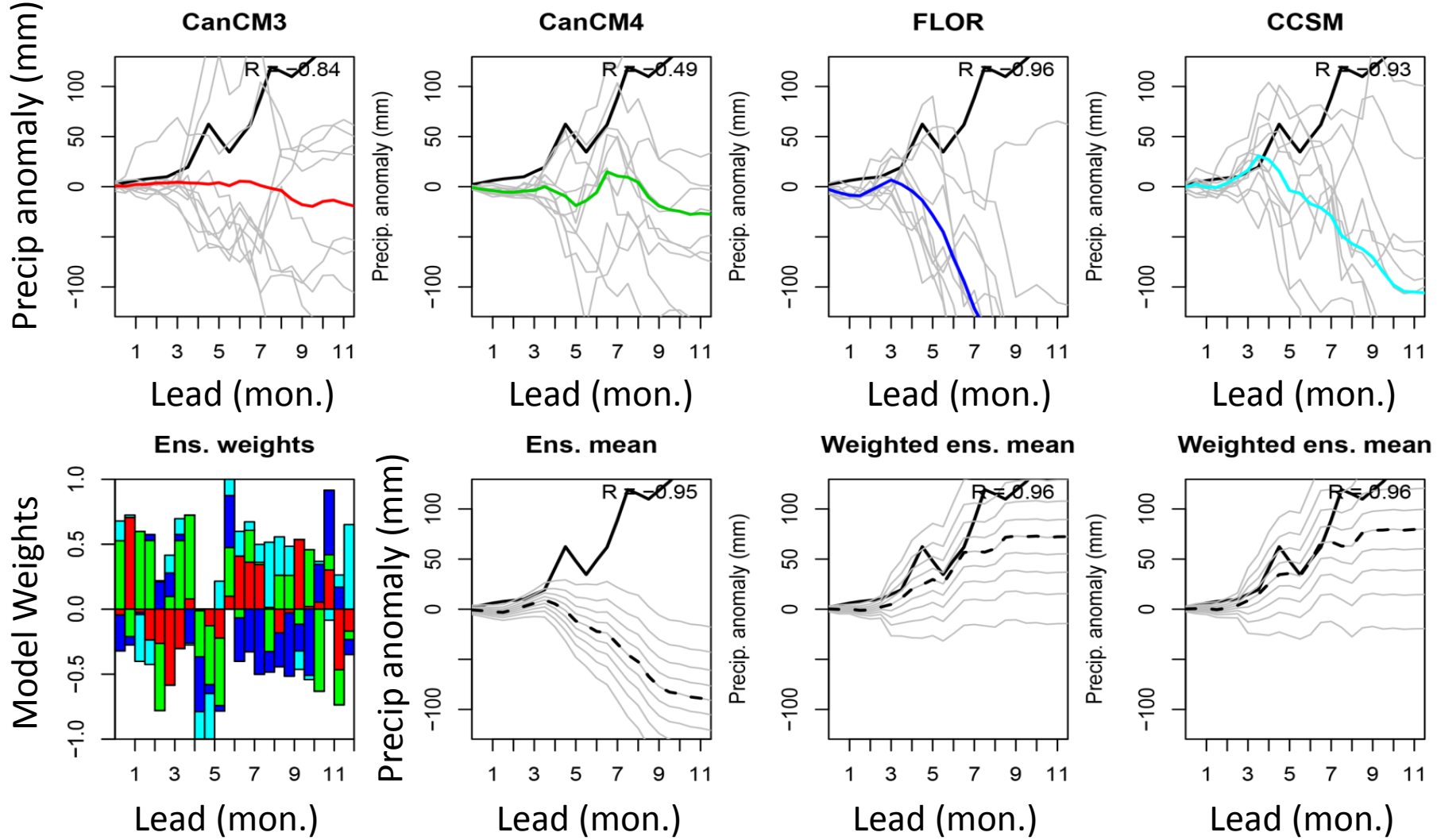
Lead (mon.)

Lead (mon.)

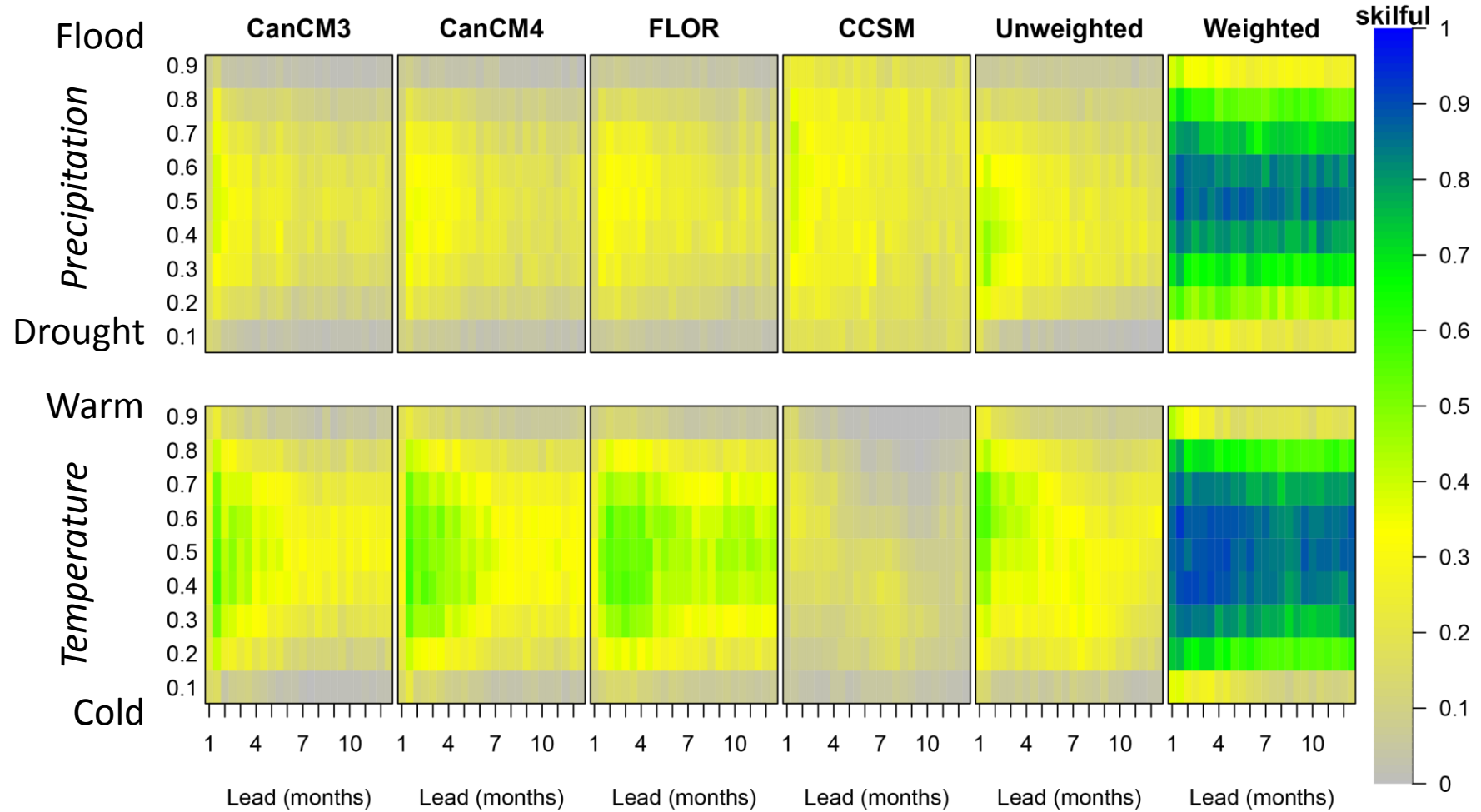
Lead (mon.)

Lead (mon.)

2011 Brazil floods



Natural hazards



Models and data integration (e.g. drought impact indicators)

Information services, including web-based services and apps

- Animation of hydrologic variables
- Catchment data
 - Over 800+ basins from the GRDC network and FAO Reservoir database.
- User control is enhanced.
- Overlay basin maps
- Zoom in to regions of interest
- Access data record from 1950 – present.

User interface

Initial Time: 8 1 2012 (-) (+)
Final Time: 8 1 2012 (-) (+)
Frames per second: 1
Update time interval Clear all overlays
Image opacity: (-) (+)

Meteorology (?)

- Precipitation (mm/day)
- Maximum Temperature (C)
- Minimum Temperature (C)
- Wind (m/s)

Hydrologic Variables (?)

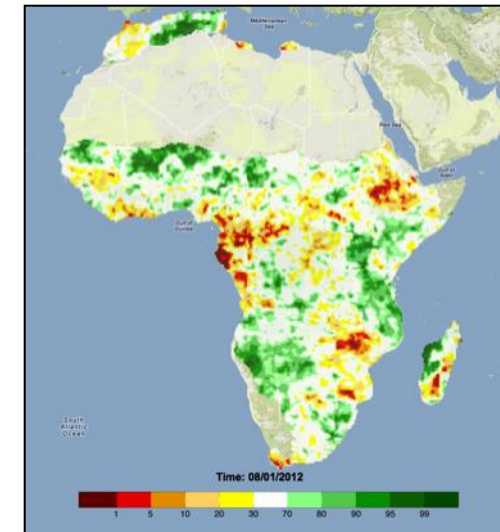
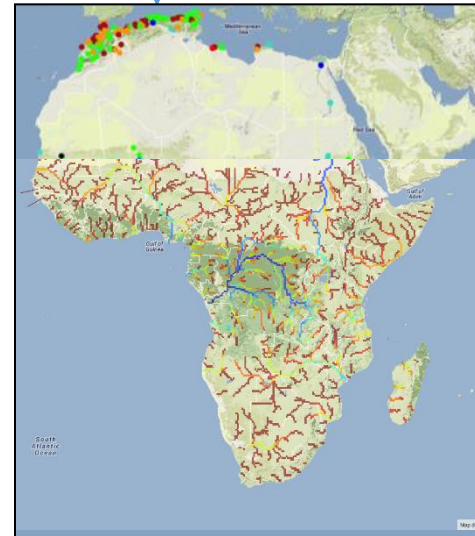
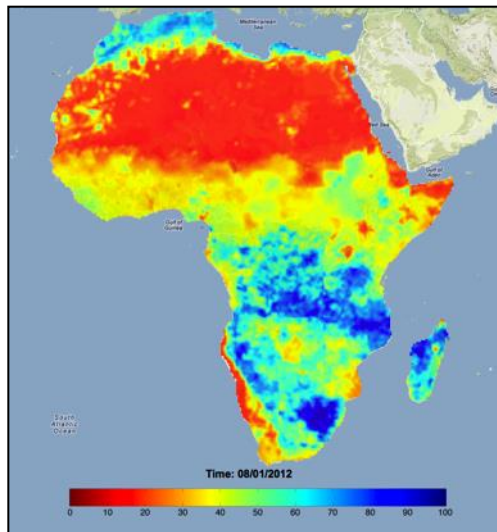
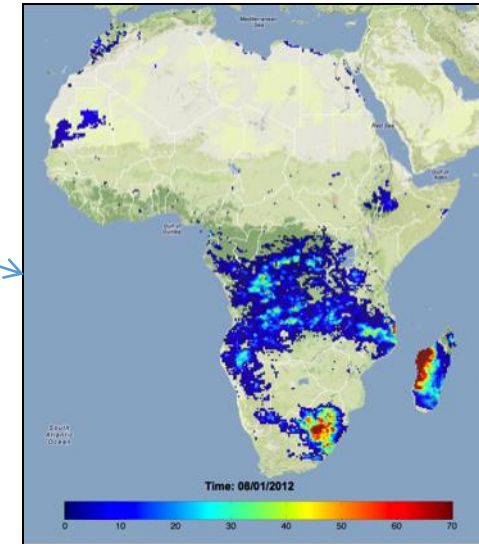
- Evaporation (mm/day)
- Soil Moisture(%) - Layer 1
- Soil Moisture(%) - Layer 2
- Surface Runoff (mm/day)

Drought Products (?)

- Drought Index

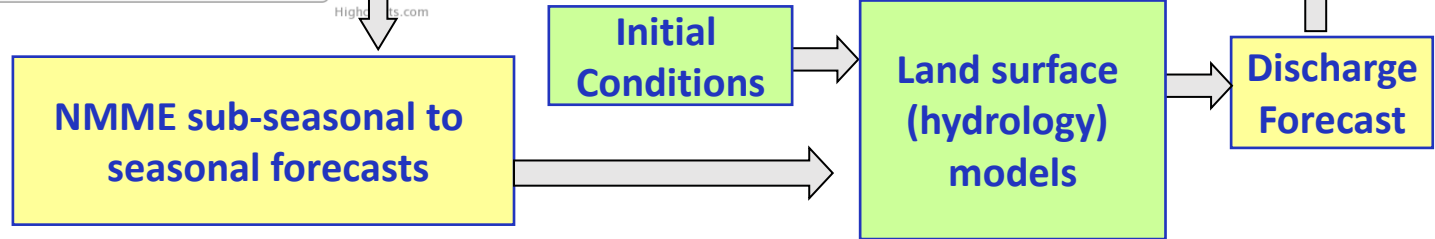
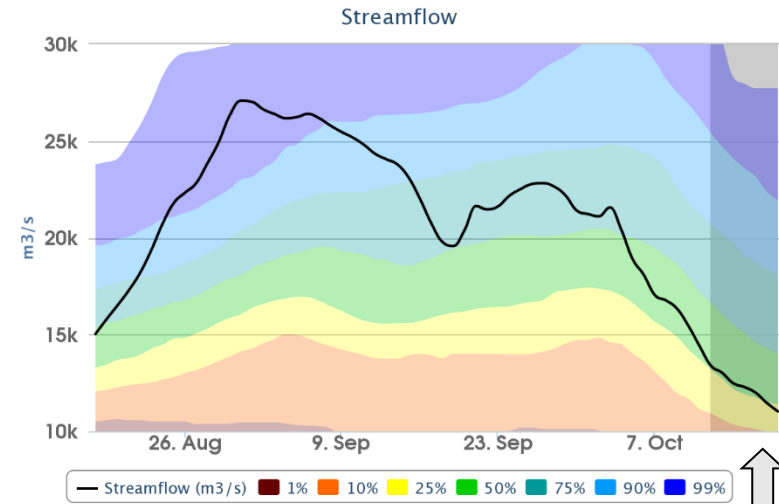
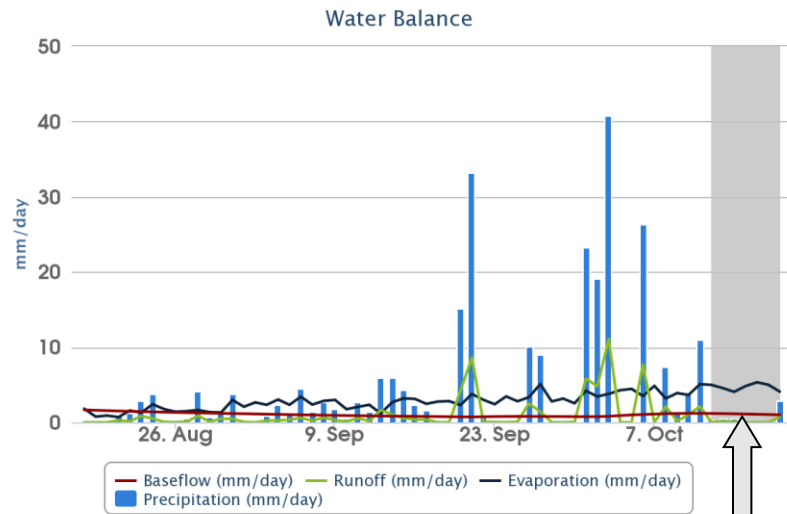
Catchment Data (?)

- Stream Gauges (8/1/2012)



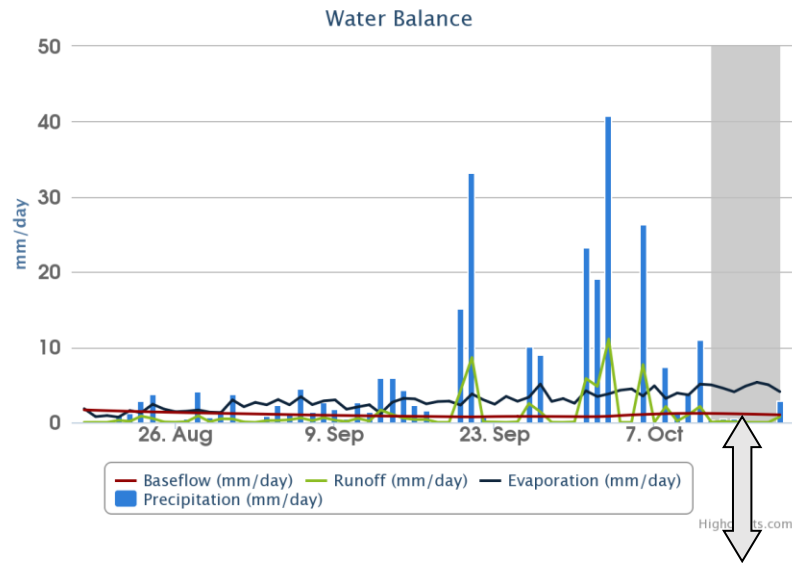
Indicators integrated with local data and tools

Models and data integration (e.g. drought impact indicators)



Indicators integrated with local data and tools

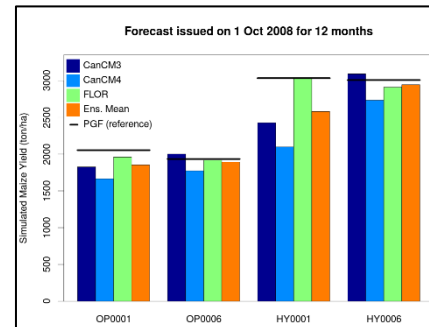
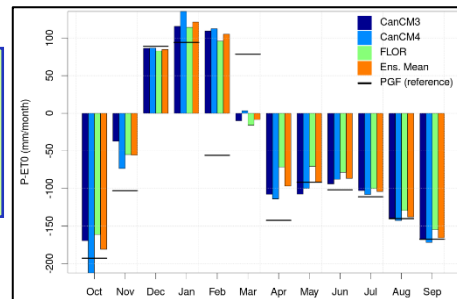
Models and data integration (e.g. drought impact indicators)



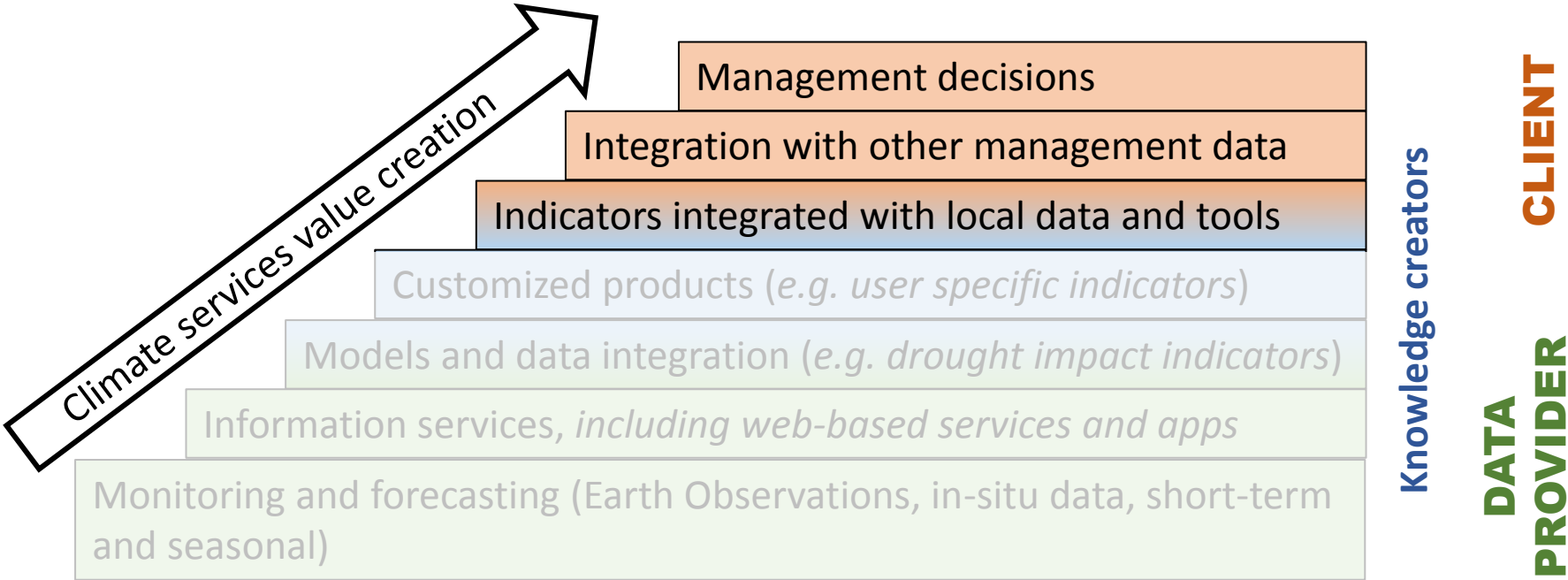
NMME sub-seasonal to seasonal forecasts

Irrigation Demand (P-Eto)

Crop forecasts



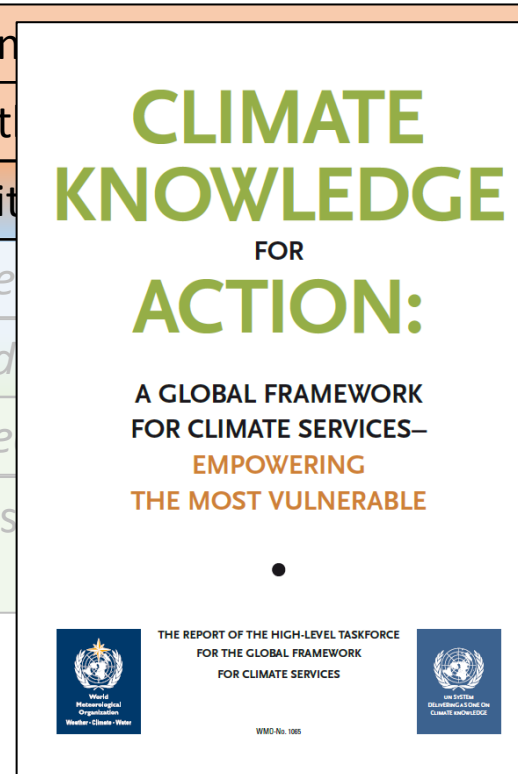
The big challenge: Can we create climate information useful for client decision making



The big challenge: Can we create climate information useful for client decision making



The screenshot shows the homepage of the Global Framework for Climate Services (GFCS). At the top left is the GFCS logo, and to its right is the text "GLOBAL FRAMEWORK FOR CLIMATE SERVICES". A search bar is located to the right of the logo. Below the search bar is a navigation menu with items: Home, About GFCS, Priority Areas, Governance, Partnership, Projects, Events, Documents, and News & Info. The main content area features a large image of a woman and a child in a dry, arid landscape. To the right of the image is the text: "GFCS provides a worldwide mechanism for coordinated actions to enhance the quality, quantity and application of climate services." Below this text are navigation controls: "Previous", "Pause", and "Next". At the bottom of the page is a section titled "Priority areas" with five circular icons representing: Agriculture and food security, Disaster risk reduction, Energy, Health, and Water.



The image shows the cover of the report titled "CLIMATE KNOWLEDGE FOR ACTION: A GLOBAL FRAMEWORK FOR CLIMATE SERVICES—EMPOWERING THE MOST VULNERABLE". The title is in large green letters. Below the title, it says "A GLOBAL FRAMEWORK FOR CLIMATE SERVICES—EMPOWERING THE MOST VULNERABLE" in smaller green and orange letters. At the bottom, it says "THE REPORT OF THE HIGH-LEVEL TASKFORCE FOR THE GLOBAL FRAMEWORK FOR CLIMATE SERVICES" in blue. There are two logos at the bottom: the World Meteorological Organization logo on the left and the United Nations logo on the right. The report number "WMO No. 1085" is at the bottom center.

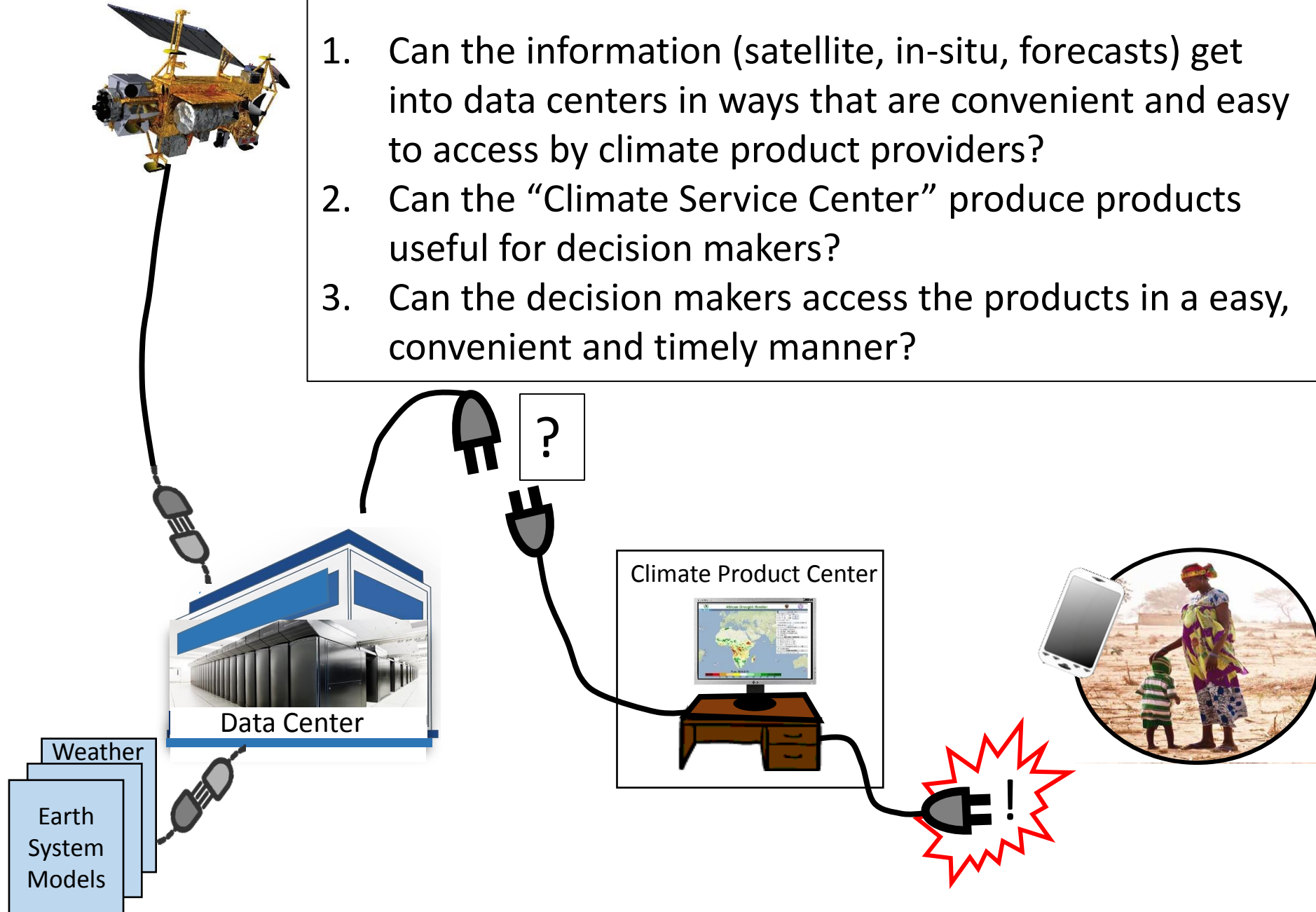
Knowledge creators

DATA PROVIDER

CLIENT

The challenges of a Global Climate Service System

1. Can the information (satellite, in-situ, forecasts) get into data centers in ways that are convenient and easy to access by climate product providers?
2. Can the “Climate Service Center” produce products useful for decision makers?
3. Can the decision makers access the products in a easy, convenient and timely manner?



SEARCH

Soil Moisture x [?]

Related Topics [?]

+ Themes [?]

+ Country/Geography [?]

+ Data Access Conditions [?]

+ Earth Observation Catalogs [?]

Start Date [?] End Date [?]

CLEAR

SEARCH




Legend

Total Results: 1727


1 2 3 4 NEXT LAST

Search Granule

- 




GOO DATA CORE SITE AVERAGED GRAVIMETRIC SOIL MOISTURE: 1987-1989 (BETTS)

The Site Averaged Gravimetric Soil Moisture Data: 1987 - 1989 (Betts) Data Set contains the site averaged product data collected during the 19

[Click to read more...](#)
- 




GOO DATA CORE AMSR-E/Aqua L2B Surface Soil Moisture, Ancillary Params, & QC EASE-Grids

The Advanced Microwave Scanning Radiometer - Earth Observing System (AMSR-E) instrument on the NASA EOS Aqua satellite provides global passive

[Click to read more...](#)
- 



GOO DATA CORE AMSR-E/Aqua level 3 global monthly Surface Soil Moisture Standard Deviation V005 (AMSRE_STDMO) at GES DISC

Global monthly AMSR-E-derived Soil Moisture The dataset contains global monthly-mean soil moisture statistics (standard deviation)

[Click to read more...](#)
- 


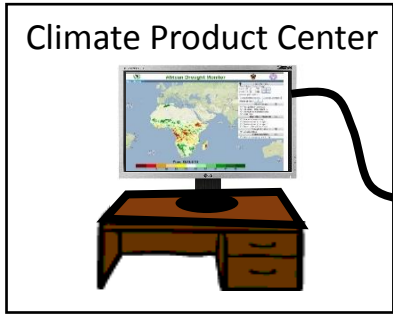
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The Site Averaged Gravimetric Soil Moisture Data: 1987 - 1989 (Betts) Data Set contains the site averaged product data collected during the 19

[Click to read more...](#)
- 


GOO DATA CORE LPRM/AMSR-E/Aqua Daily L3 Ascending Surface Soil Moisture, Ancillary Params, and QC

This Level 3 (gridded) data set?s land surface parameters, surface soil moisture, land surface (skin) temperature, and vegetation water conten



Transfer ADFM to AGRHYMET (1/2012; 10/2013),
ICPAC (6/2012), and
LAFM to CAZALAC (Santiago Chile, 11/2014)



Goals:

- Adapt the monitoring system to the region.
- Improve data dissemination, knowledge exchange
- Provide training and allow for feedback at workshops (participatory exercises)
- Followed by validation plans, operational evaluations, exchange visits, ...

**IN SUB-SAHARAN AFRICA, LIMITED CAPACITY AND LITTLE PROGRESS;
IN LATIN AMERICA, BETTER CAPACITY AND GOOD PROGRESS.**

Summary and conclusions

1. We are at the threshold of the development of climate services (e.g. IBM buying the Weather Corp. data for US\$2B, EU Copernicus' climate service program);
2. We (our community) are the “data providers” and “knowledge creators”, but to fulfill this role we need to continue our research to make the climate information skillful;
3. We (our community) don't understand well what climate products decision makers need (what and how good;)
4. The “data centers” have failed to provide easy access by decision makers to climate information.

Summary and conclusions

My personal assessment:

The GFCS and GEO/GEOSS are on pathways that will assure failure; but the problem is important enough that it needs to be correctly.