# Initiative on sub-seasonal to seasonal (S2S) forecast in the agricultural sector

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# Context

- In Central Africa agriculture is essentially rain-fed, and employs more than half of the population
- Large contribution of the sector to the economy
- Agricultural production is tightly linked to weather and rainfall fluctuations.

# Context

In Cameroon

- more than 70% of labour force is employed by the agricultural sector
- about 30% of the GDP come from this sector

Similar condition for DRC

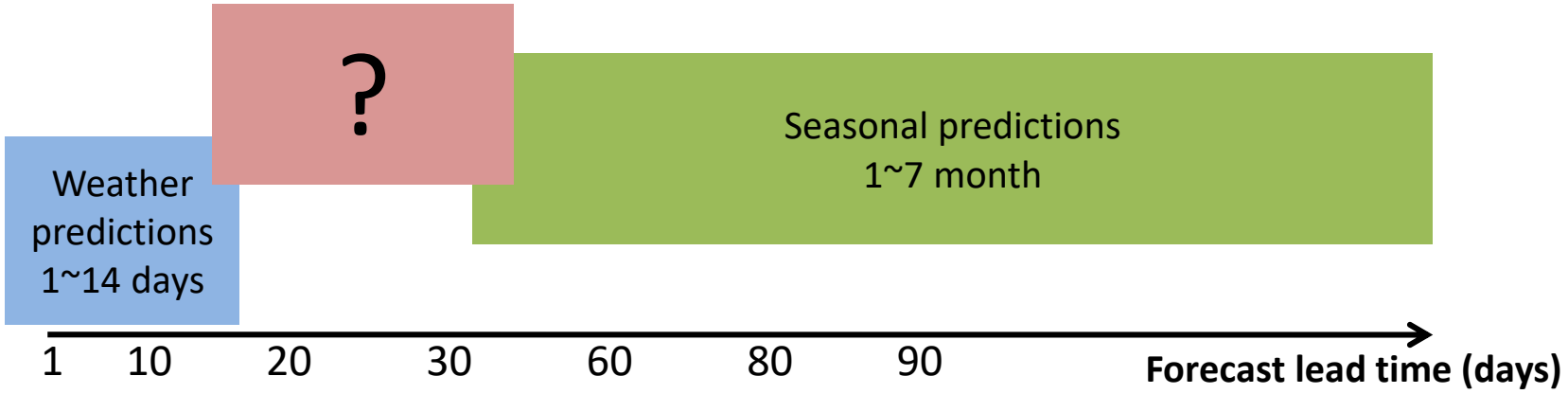
Observed changes are obvious in temperature and precipitation in Central African countries (Aguilar *et al*., 2009).

Some **farmer needs** for efficient **planning**

- When to plant?
- When the next rainy season will start?
- ???

What climate information is available?

# Available climate information



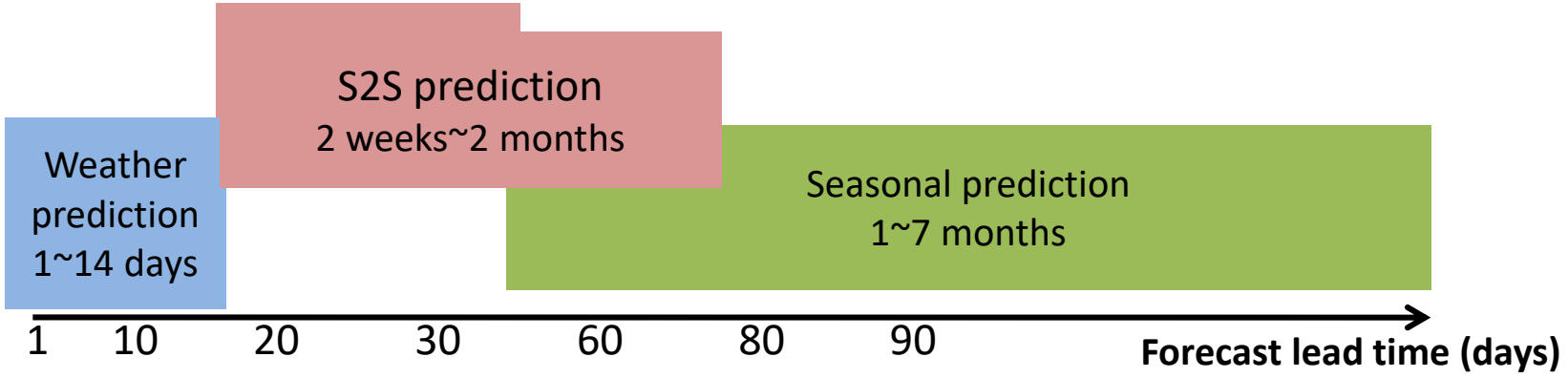

**Weather predictions**: provide **details** weather information, but **time** scale **too short** for agricultural **planning**

**Seasonal predictions**: indication of seasonal average conditions of weather parameters (normal, wet,dry)

Good time scale, but **information not detailed enough** for local agriculture Planning *(e.g. onset of growing season, dry episodes)*

Need to address **both time scale** and **detailed** information

# Initiative on S2S prediction




**S2S predictions** contribute to fill the gap between weather and seasonal time scales

# Initiative on S2S prediction Over Central Africa

- **Pilot project** on S2S prediction
- **Aim**: assess the skill of available S2S predictions to capture seasonal characteristic useful for agriculture over Central Africa *(e.g. onset of growing season, occurrence of dry spells during the growing season)*
- **4 months**: June-October 2016)
- Within the framework of **CR4D**
- **Two Countries** :Cameroon and Dem. Rep. of Congo (DRC)

# Project activities

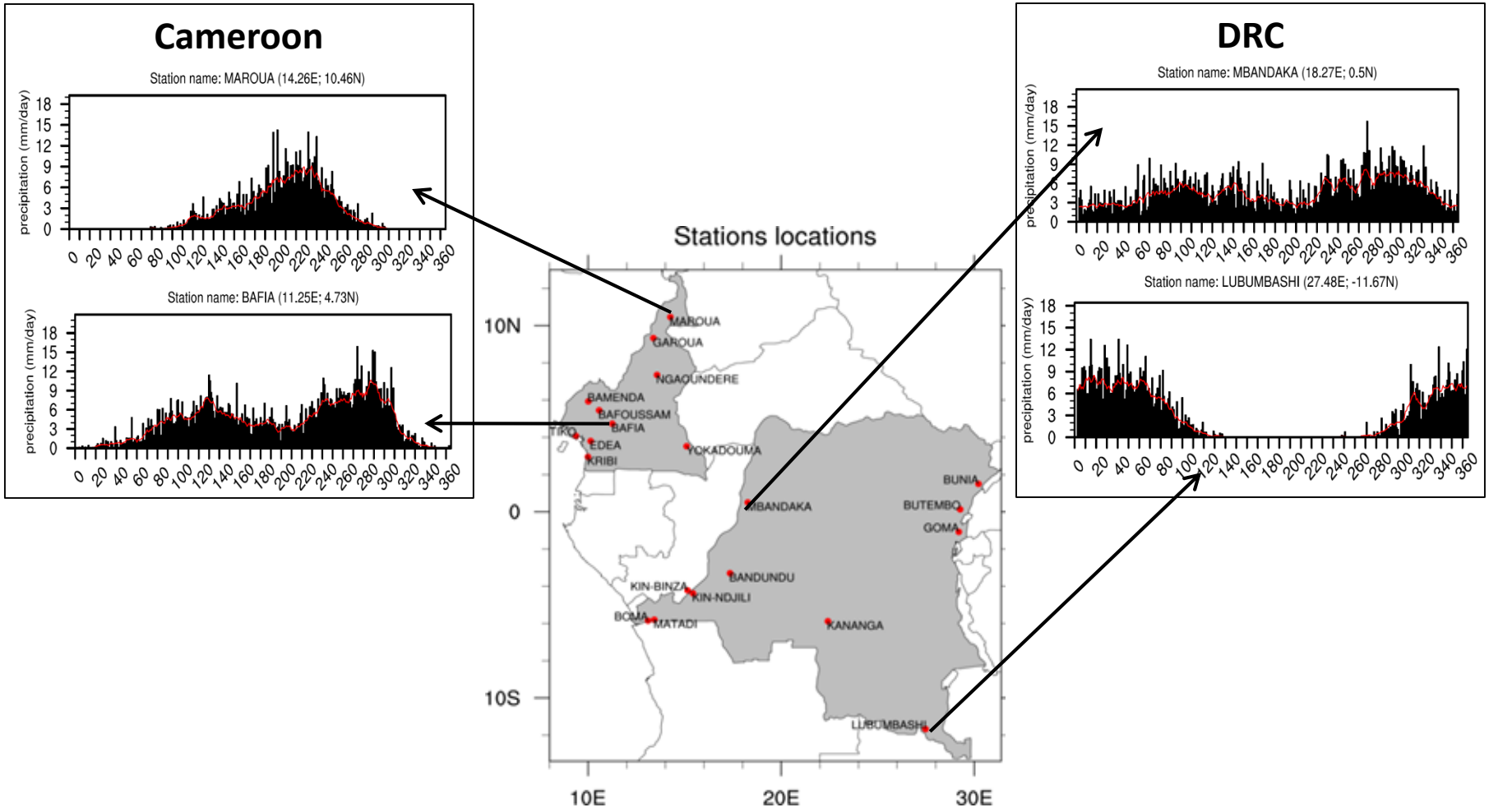
- Present the current state of climate service for agriculture over CA
- Highlight climate information needed by farmers
- Define meaningful climate index related to information need by farmers
- Assess the skill of climate model predictions at S2S timescales over Central Africa

# Project activities

Define meaningful climate index related to information need by farmers

| Event/shock identified by farmers | Climate information related to event/shock | Climate information needed by farmers |
|---|---|---|
| prolonged episode of drought during the rainy season | Length of dry spells during the rainy season | -onset of growing season<br>-dry spells distribution during the growing season<br>-dry spells duration |

# Annual cycle of rainfall




Strong spatial variability of rainfall regime leads to different criterias for agro-meteorological metrics

# Agro-ecological metrics

## Observations

### Onset date of growing season

- **Cameroon**

- 20 mm of precipitation is recorded
- no more than 5 consecutive dry days within the next 30 days.

- **DRC**

- 20 mm of precipitation is recorded followed by
- an accumulation of at least 10 mm the next 20 days

### Maximum dry spell length (both countries)

- Maximum consecutive days with rain amount less than **0.1 mm**, from the 25$^{th}$ to 90$^{th}$ day after the start of the growing season

## Models

2-, 3- and 4-weeks lead times before

- onset date
- first day of the observed dry spell period

# GCM forecasts

S2S database archives include near real-time ensemble forecasts and hindcast (reforecasts) up to 60 days from 11 centers (Vitart et al., 2016).

| Model | Timerange (days) | Hindcast (Reforecast) | Forecast |
|---|---|---|---|
| | | ***Period*** | ***Start date*** |
| **BoM** | 0-62 | 1981-2013 (**1981-2000)** | January 2015 |
| **CMA** | 0-60 | 1994-2014 (**1994-2000**) | January 2015 |
| ECCC | 0-32 | 1995-2012 | January 2016 |
| **ECMWF** | 0-46 | past 20years (**1995-2000**) | January 2015 |
| **HMCR** | 0-61 | 1985-2010 (**1985-2000**) | January 2015 |
| ISAC-CNR | 0-31 | 1981-2010 | November 2015 |
| JMA | 0-33 | 1981-2010 | January 2015 |
| KMA | 0-60 | 1996-2009 | Not available |
| Météo-France | 0-61 | 1993-2014 | May 2015 |
| **NCEP** | 0-44 | 1999-2010 (**1999-2000)** | January 2015 |
| UKMO | 0-60 | 1996-2009 | December 2015 |

In bold : models used in this study

Two type of analysis

Hindcast

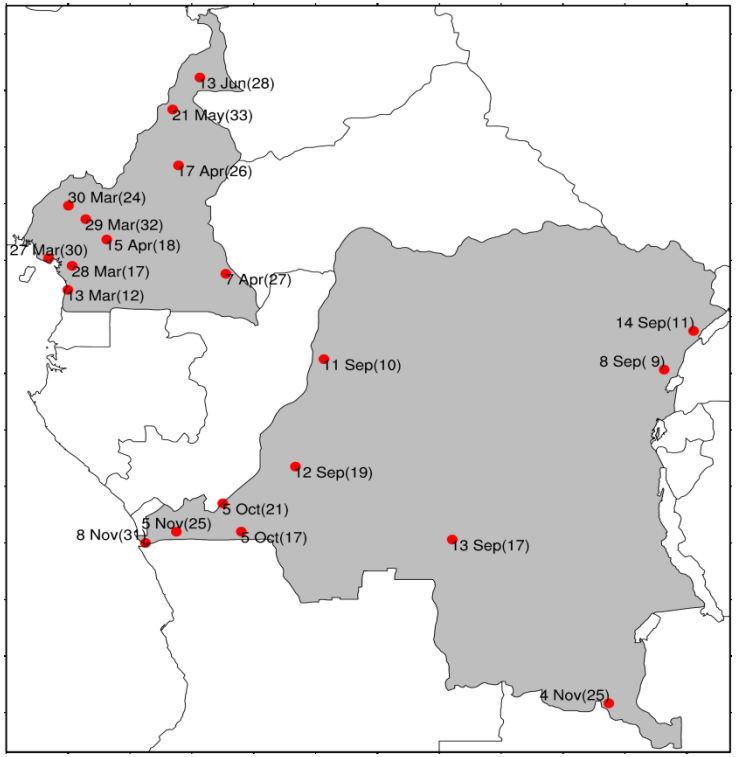
Period varies with model (bold in table)

Forecast

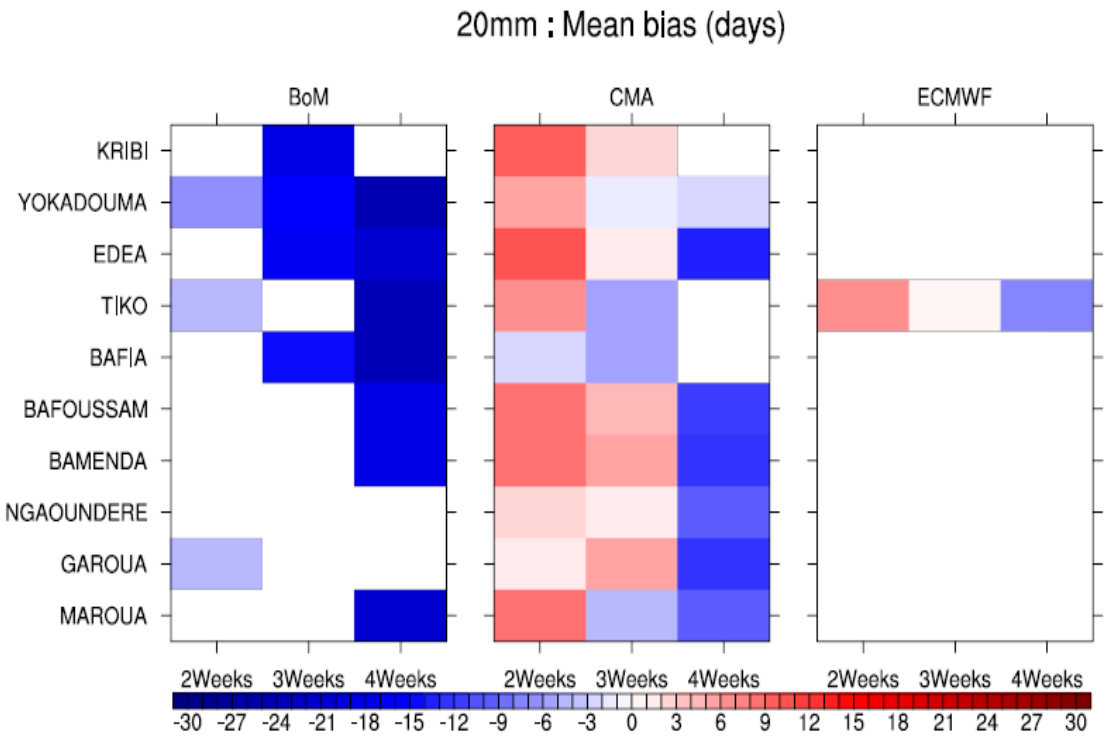
Jan – Dec 2015

# GCM forecasts evaluation
# Onset dates

Observed mean onset dates (standard deviation)



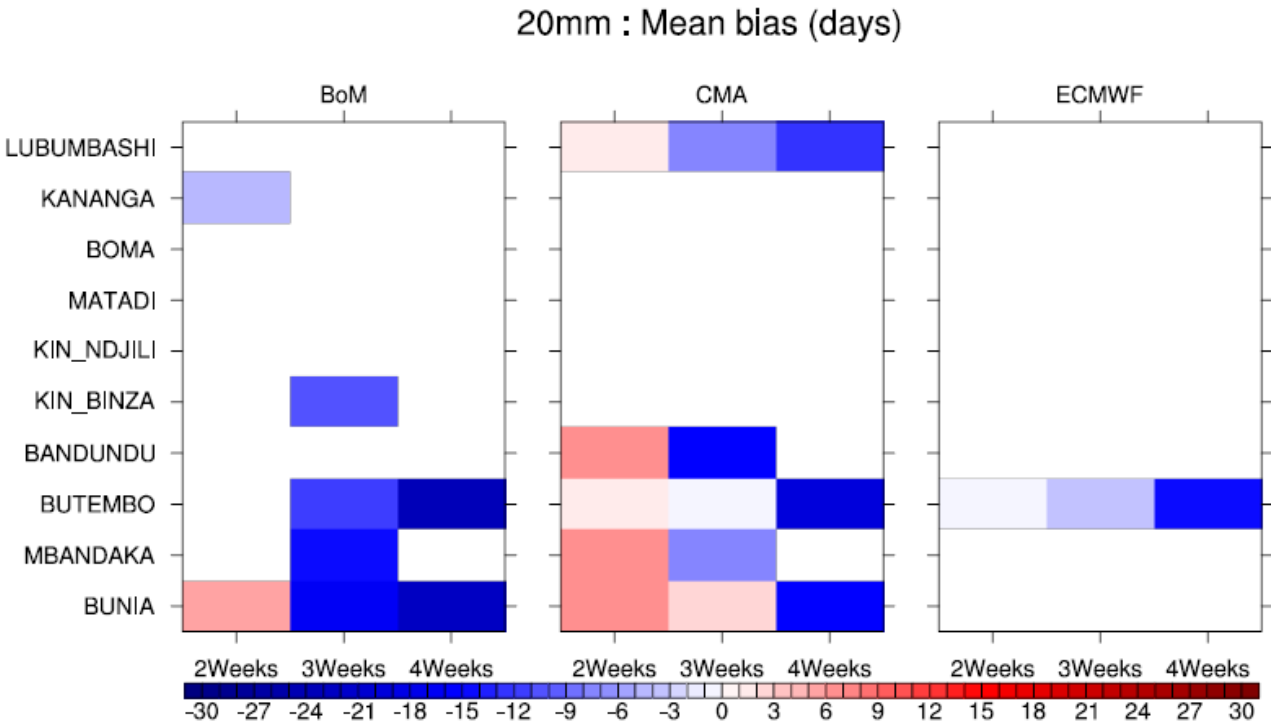

## Cameroon




- BoM : earlier onset going from moderate to too early onset dates as the lead time increases
- CMA : bias values range from later to early as lead time increases
- ECMWF clearly shows bad skill

# GCM forecasts evaluation
# Onset dates

## DRC




Blank areas : no skill

- BoM : onset dates with approximately one week in advance DRC except for Bunia
- CMA : bias values range from later to early as lead time increases
- ECMWF clearly shows bad skill

# GCM forecasts evaluation

## Onset dates

- Weak skills suggested that GCMs forecast may underestimate heavy rain events.

-a well known issue of coarse resolution model (Kendon et al., 2012)

-Assess to reduced threshold with forecasts in order to explore potential bias correction

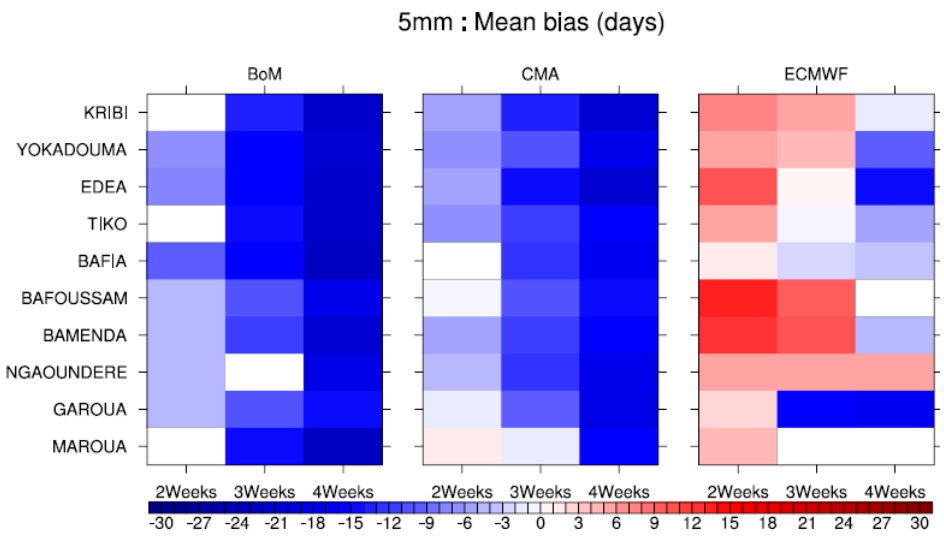
# GCM forecasts evaluation

## Onset dates

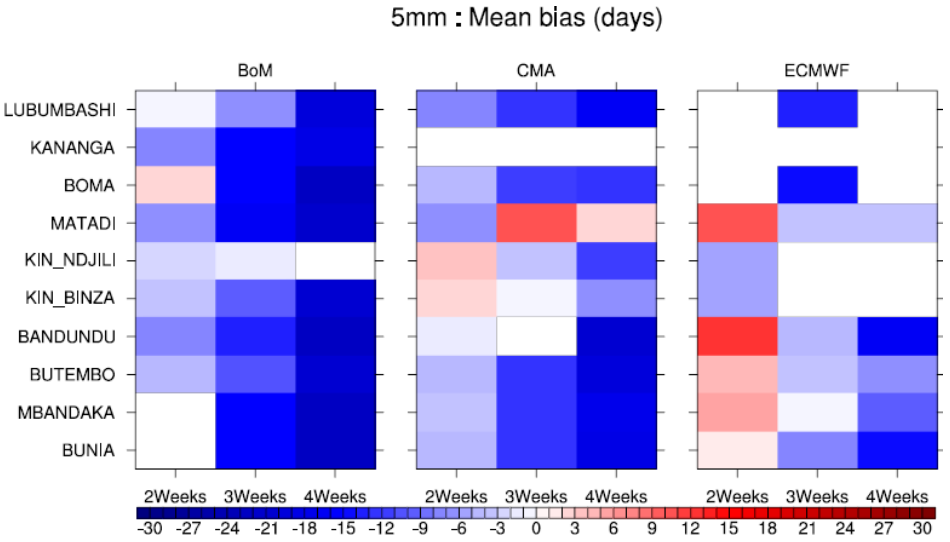
Other forecasted precipitations threshold

5 mm

### Cameroon




### DRC



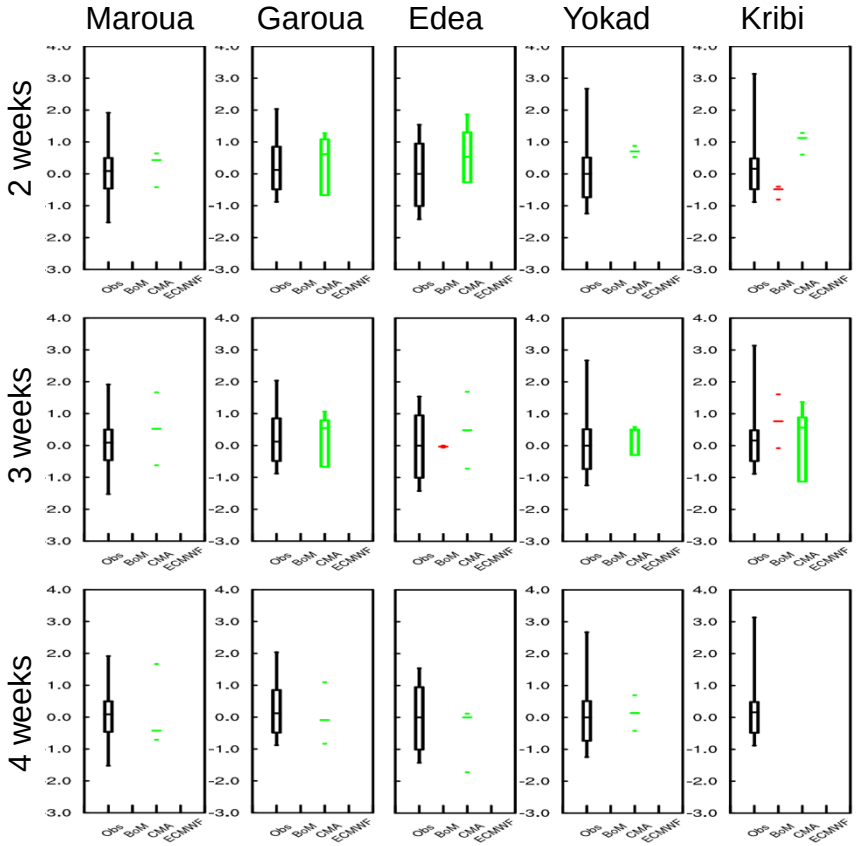

- Model skills increase
- Predominance of moderate earlier to too earlier forecasted onset date in BoM and CMA
- Caution : different trends across lead times with thresholds

# GCM forecasts evaluation

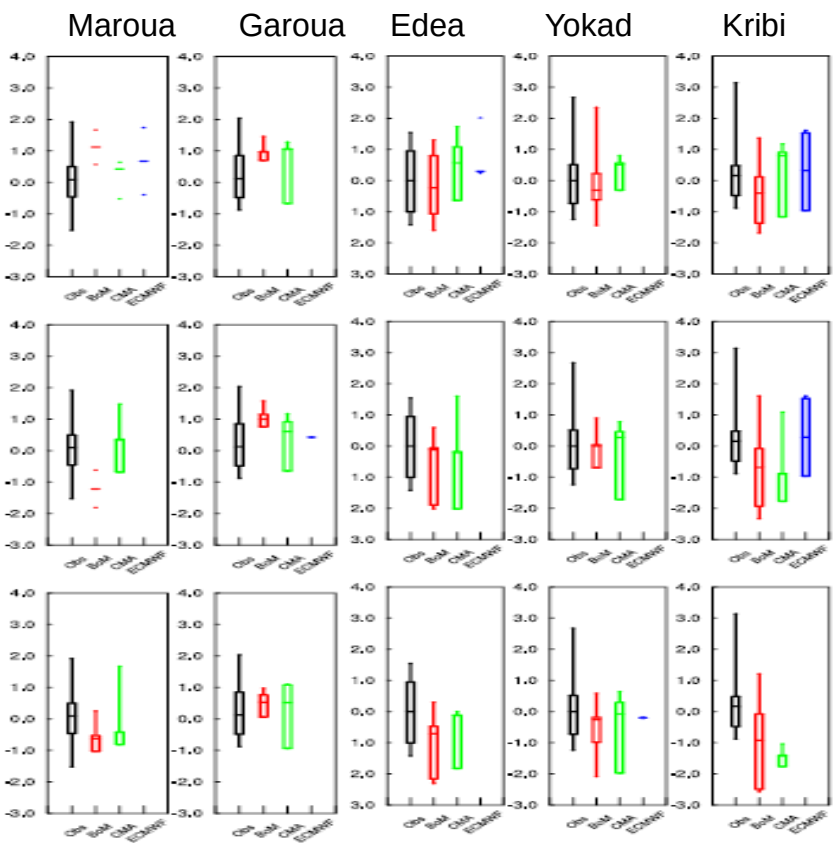
## Onset dates : SAI analysis

## Cameroon

20 mm




5 mm




Box plots of standardized anomaly index (SAI) for observations (black) and models (BoM: red, CMA: green, ECMWF: blue)

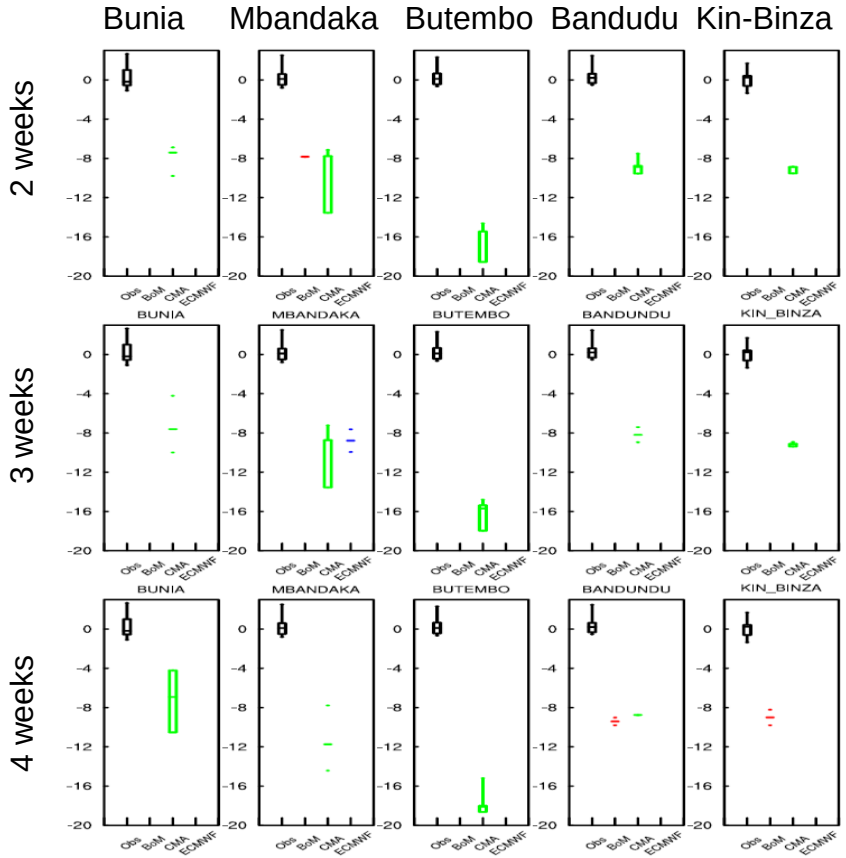
- increased skills with reduced threshold
- Trend from moderate earlier to too earlier forecasted onset date
- Reasons of trend varies with models

# GCM forecasts evaluation

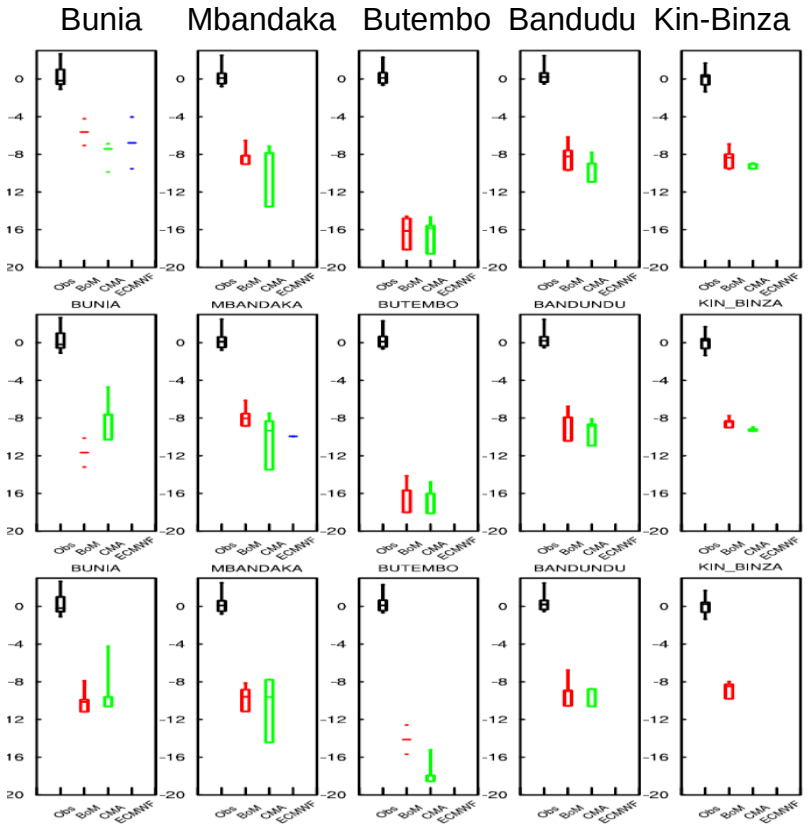
## Onset dates : SAI analysis

## DRC

### 20 mm




### 5 mm




Box plots of standardized anomaly index (SAI) for observations (black) and models (BoM: red, CMA: green, ECMWF: blue)

- increased skills with reduced threshold
- Weak improvement compare to Cameroon stations

# GCM forecasts evaluation

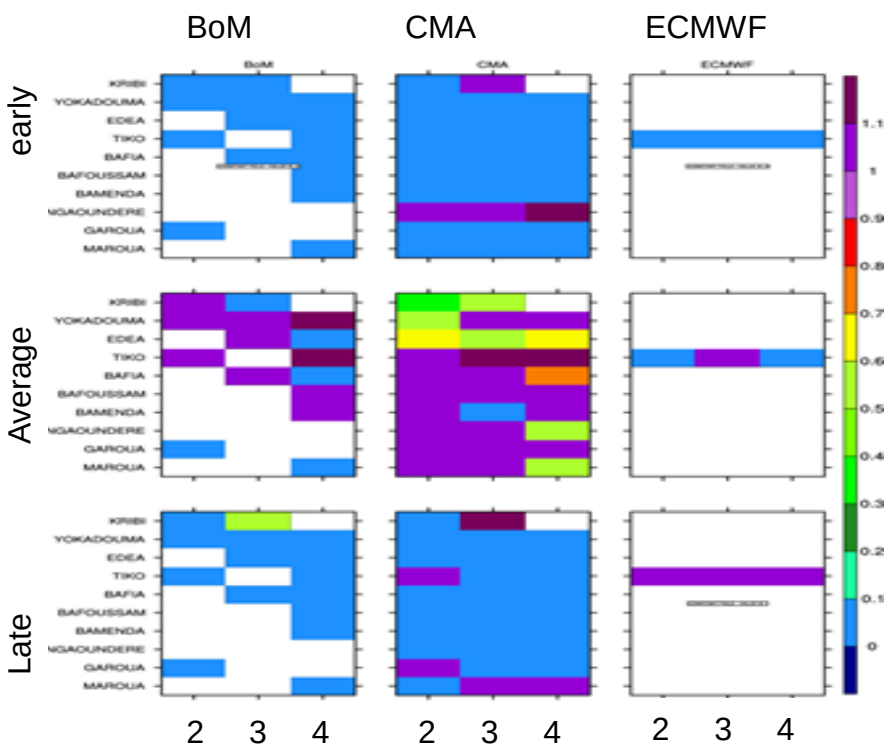
## Onset dates : Frequency bias

observed onset dates distribution suggests 3 categories of onset date

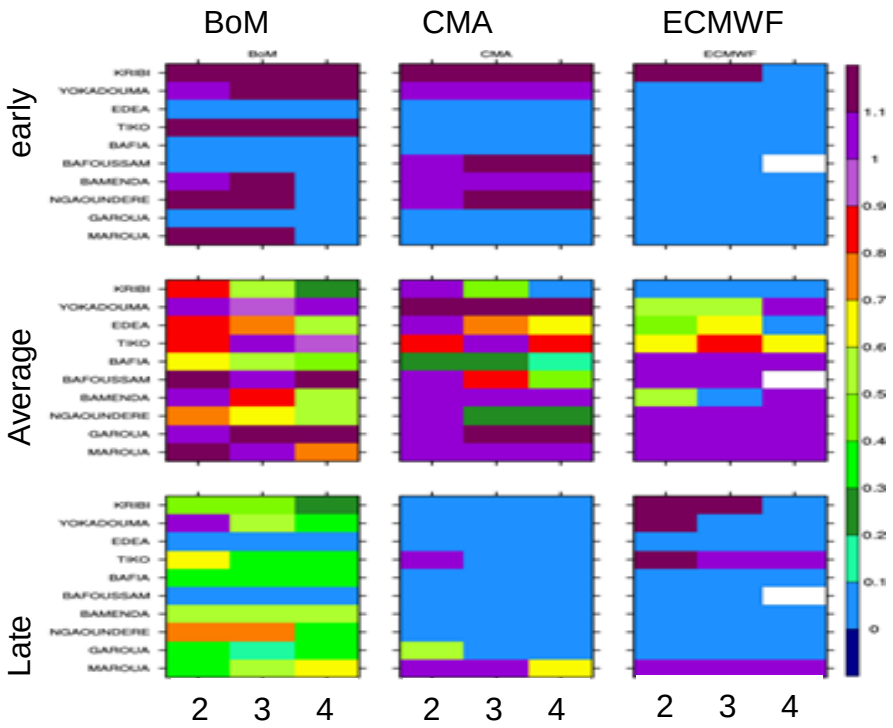
- Early - normal -late

Cameroon

20 mm




5 mm




-consitency between thresholds

-Main deficiency of models for early and late cathegories

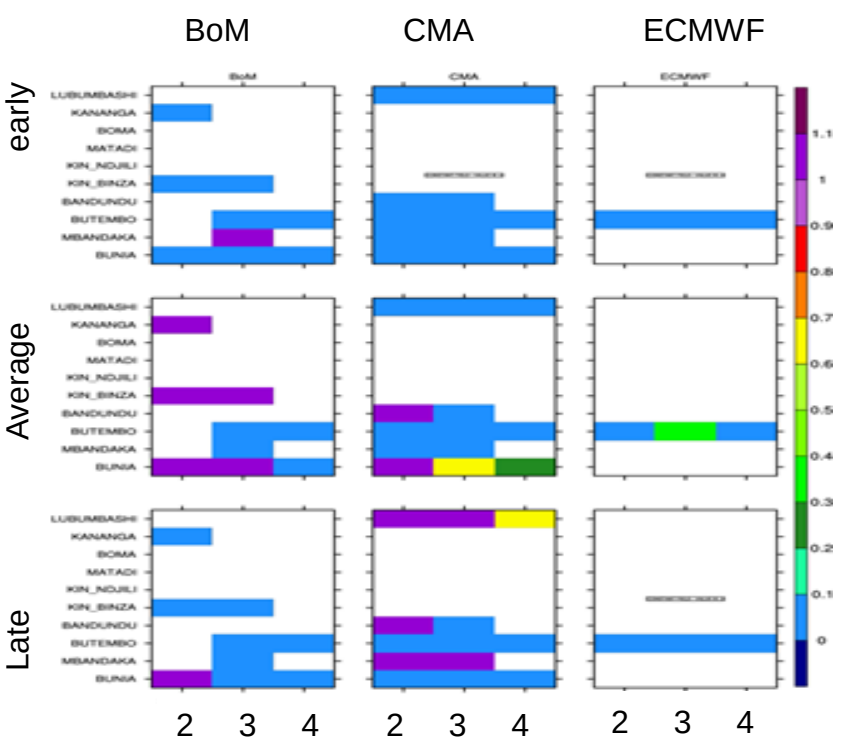
-BoM perform better

# GCM forecasts evaluation

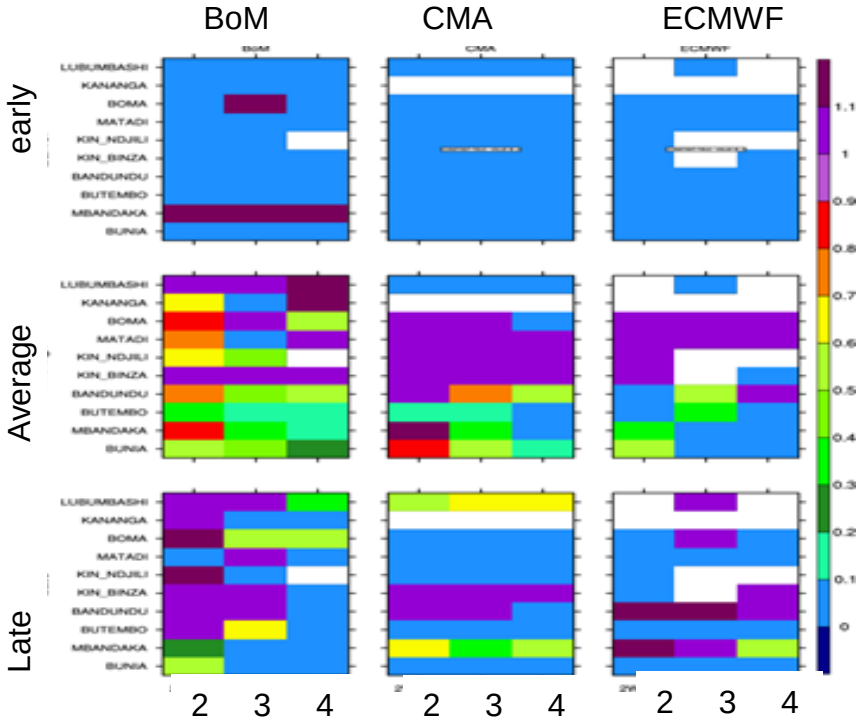
## Onset dates : Frequency bias

## DRC

20 mm




5 mm




-consistency between thresholds

-Main deficiency of models for early and late categories

-BoM perform better

# Other output : Capacity building

## Workshop on Sub-seasonal to Seasonal Prediction - Central Africa

CIFOR-Central Africa, Yaounde, Cameroon, July 25-29, 2016

**Objective** : strengthen links between climate science research and climate information needs in support development planning in Africa

**Partner** : Andrew Robertson,
- head of Climate Group at the IRI, Columbia University, USA
- Co-chair of the steering group of S2S prediction project .

http://wiki.iri.columbia.edu/index.php?n=Climate.S2S-CentralAfrica

# Conclusions

- S2S predictions is still a **research** project
- Research and operational : Strengthen link between Met services and Universities
- Defined new metrics (agriculture)
- Extend to other sectors and countries (Agroforestry, water, health)
- Develop network between initiatives on S2S over different regions : allowing regions to learn from others (know-how transfer).

# Thank you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