



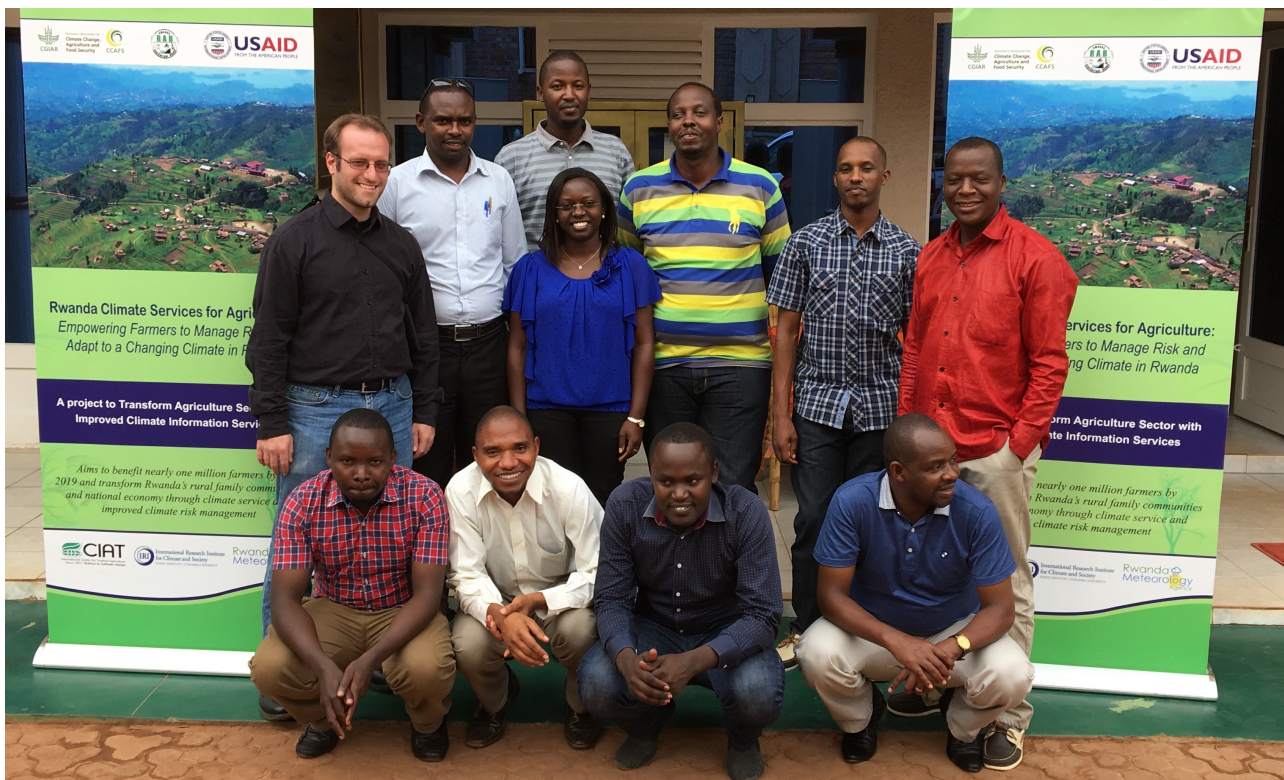
RESEARCH PROGRAM ON  
**Climate Change,  
Agriculture and  
Food Security**



# Workshop report: Training and Development of Downscaled Seasonal Forecasts for Pilot Districts, Kigali, Rwanda

**August 2016**

**Asher Siebert, Desire Kagabo, Floribert Vuguziga**



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Workshop Report

CGIAR Research Program on Climate Change, Agriculture  
and Food Security

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## **Abstract**

This report summarizes the discussions, analysis and interactions during IRI postdoctoral research scientist Asher Siebert's one-week stay in Rwanda in late August 2016 as part of the CCAFS-Rwanda project. The overall aim of this project is help farmers in Rwanda to be better adapted to climate variability and any climate change they may face, and, in doing so, to help improve food security and agricultural outcomes. Seasonal forecasting and downscaling methods were discussed, and a particular national forecast made with the Climate Predictability Tool (CPT) and was shared, along with downscaled results in probability of exceedance format. In country meteorology participants were trained in CPT. Further discussions addressed longer-term collaborative work on both climatology and further seasonal prediction work, particularly with regard to El Nino/Southern Oscillation (ENSO) and the Indian Ocean Dipole (IOD). Discussions with experts at CIAT and the Rwanda Agriculture Board also addressed the prospect of using the Water Requirement Satisfaction Index (WRSI) as a monitoring and climate/agriculture risk management tool in the future.

### **Keywords**

Climate variability; seasonal forecasting; downscaling; capacity building; ENACTS

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Institutional and technical support for this work was provided by IRI. Air travel support was provided by the WISER initiative. The Rwanda Meteorology Agency provided an invitation letter. For most of the week of August 22 to August 26, 2016, the host institution was CIAT Rwanda. Desire Kagabo/CIAT Rwanda kindly coordinated logistics and arranged local transportation between Asher's hotel, CIAT and other appointments. This report is an output of USAID's Rwanda Climate Services for Agriculture Project, and was made possible through support provided by the Rwanda Mission, US Agency for International Development. The opinions expressed herein are those of the authors, and do not necessarily reflect the view of the US Agency for International Development.

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## Acronyms

CCA	Canonical Correlation Analysis
CIAT	International Center for Tropical Agriculture
CPT	Climate Predictability Tool
ENACTS	Enhancing National Climate Services
ENSO	El Nino/Southern Oscillation
GHACOF	Greater Horn of Africa Climate Outlook Forum
IOD	Indian Ocean Dipole
PCR	Principal Component Regression
PICSA	Participatory Integrated Climate Services for Agriculture
RAB	Rwanda Agriculture Board
WRSI	Water Requirement Satisfaction Index



## Introduction

This report summarizes the discussions, analysis and interactions important to the Rwanda CCAFS initiative during IRI postdoctoral research scientist Asher Siebert's one-week stay in Rwanda in late August 2016. During this visit, discussions between Asher (as a representative of IRI) and personnel from CCAFS Rwanda, the Rwanda Meteorology Agency and the Rwanda Agriculture Board took place. The Rwanda CCAFS initiative is a USAID supported project to help citizens of the nation of Rwanda better manage climate related agricultural risks and to hopefully enjoy better long-term food security.

Project planning began in 2015 and the project began in 2016. There are four critical outcome areas of this project and the project is envisioned to last until 2019. The four main outcome areas are: (1) Climate services for farmers, (2) Climate services for government and institutions, (3) Climate information provision, and (4) Climate services governance.

This visit was most aligned with the objectives of outcome area 1, although some aspects of the analysis may be insightful for some of the other outcome areas, particularly, outcome area 2.

During this visit, a seasonal forecast for the September-December (SOND) 2016 rainy season was made and downscaled information from that forecast for four target Districts was provided. The scope of further collaboration on both meteorological/climatological topics and on agricultural topics was discussed.

## Overview of Daily Program

This report summarizes the discussions, analysis and interactions during postdoctoral research scientist Asher Siebert's one-week stay in Rwanda in late August 2016 as part of the Rwanda-CCAFS initiative. Seasonal forecasting and downscaling methods were discussed, and a particular forecast made with the Climate Predictability Tool (CPT) was shared. In country meteorology participants were trained in CPT. Further discussions addressed longer-term collaborative work on both climatology and further seasonal prediction work. Discussions with experts at CIAT and the Rwanda Agriculture Board also addressed the prospect of using

the Water Requirement Satisfaction Index (WRSI) as a monitoring and climate/agriculture risk management tool in the future.

### **Monday 22 August**

The day was spent at CIAT. Asher worked with Desire Kagabo (CIAT-Rwanda), Glorioso Nsengiyumva (CIAT-Rwanda), Floribert Vuguziga (Rwanda Meteorology Agency), Prosper Ayabagabo (Rwanda Meteorology Agency) and Jonah Kazora (Rwanda Meteorology Agency). Seasonal forecasting, canonical correlation analysis (CCA) using the Climate Predictability Tool (CPT) and probability of exceedance methods were discussed at length. Asher demonstrated how to derive probability of exceedance from empirical ENACTS data for four sector locations (one in each province) provided by IRI Senior Scientist Tufa Dinku.

Rwanda's rainfall variability has some relationship with El Nino-Southern Oscillation (ENSO) with El Ninos tending to correlate with wet years and La Ninas tending to correlate with dry years (although anecdotally, the relationship is not as strong as is the case for other regions in East Africa (Kenya and Tanzania for example)). Rwanda's rainfall is also influenced by the Indian Ocean Dipole (IOD) and is partly modulated by the dynamics of the Congo basin.

### **Tuesday 23 August**

Asher spent the day at CIAT and worked with the same group as on Monday. The work on seasonal forecasting and probability of exceedance format continued with an emphasis on the four sector locations. Information was shared regarding the ICPAC SCIPEA portal. Asher explained/demonstrated the difference between CCA and principal component regression (PCR) analyses in CPT. A reasonably skilful forecast for the SOND rainfall season for Rwanda was chosen and downscaled information for the probability of exceedance format was extracted. Prosper Ayabagabo was able to replicate the forecast results.

The following four figures are the downscaled probability of exceedance graphs for the SOND rainfall season for the empirical and four District locations chosen as a focal point in this first year.

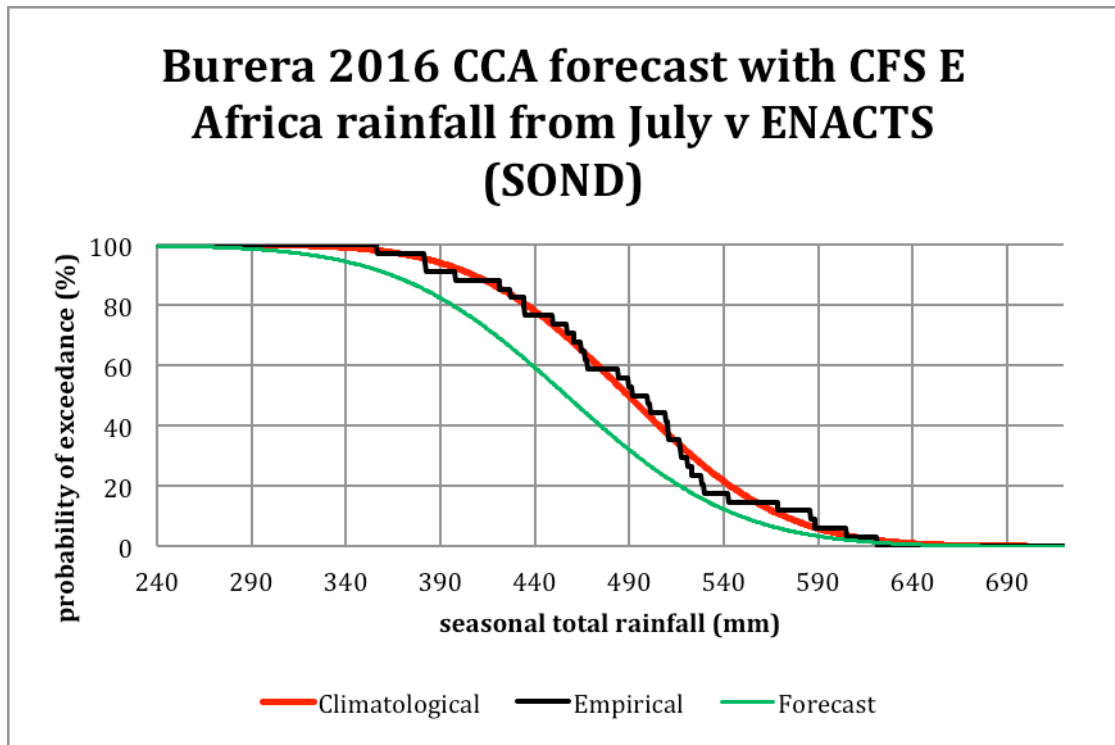


Figure 1: SOND rainfall probability of exceedance for Burera (Northern Province, 29.75E, 1.45S)

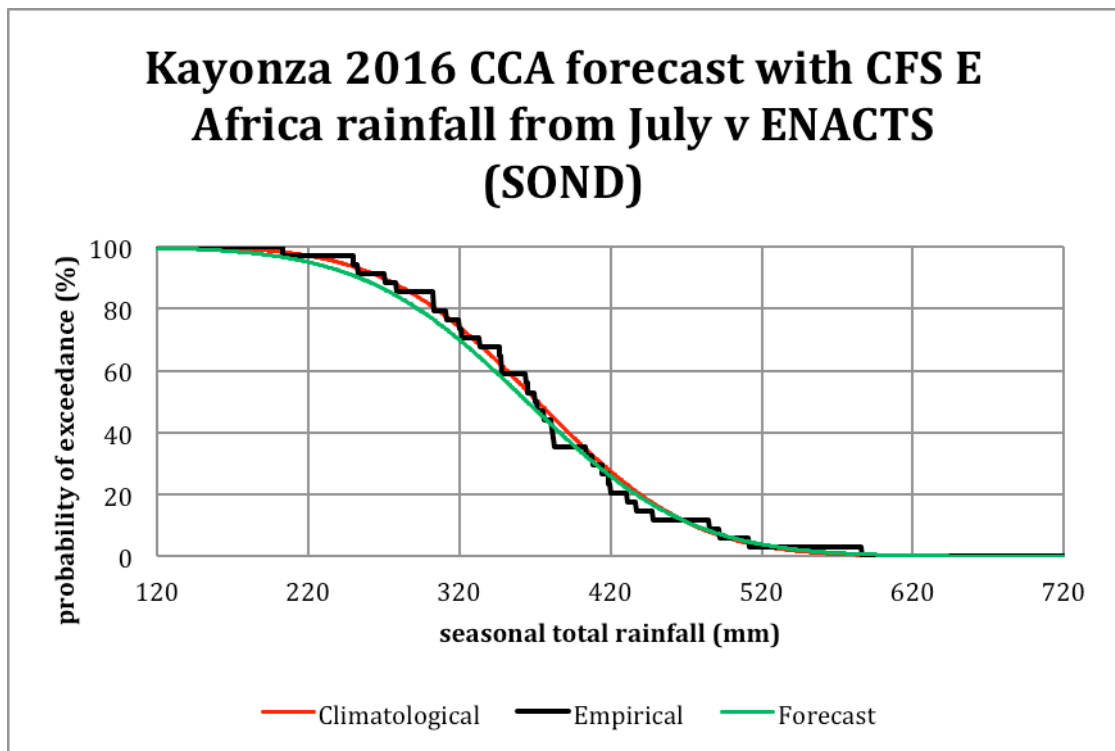


Figure 2: SOND rainfall probability of exceedance for Kayonza (Eastern Province, 30.55E, 1.85S)

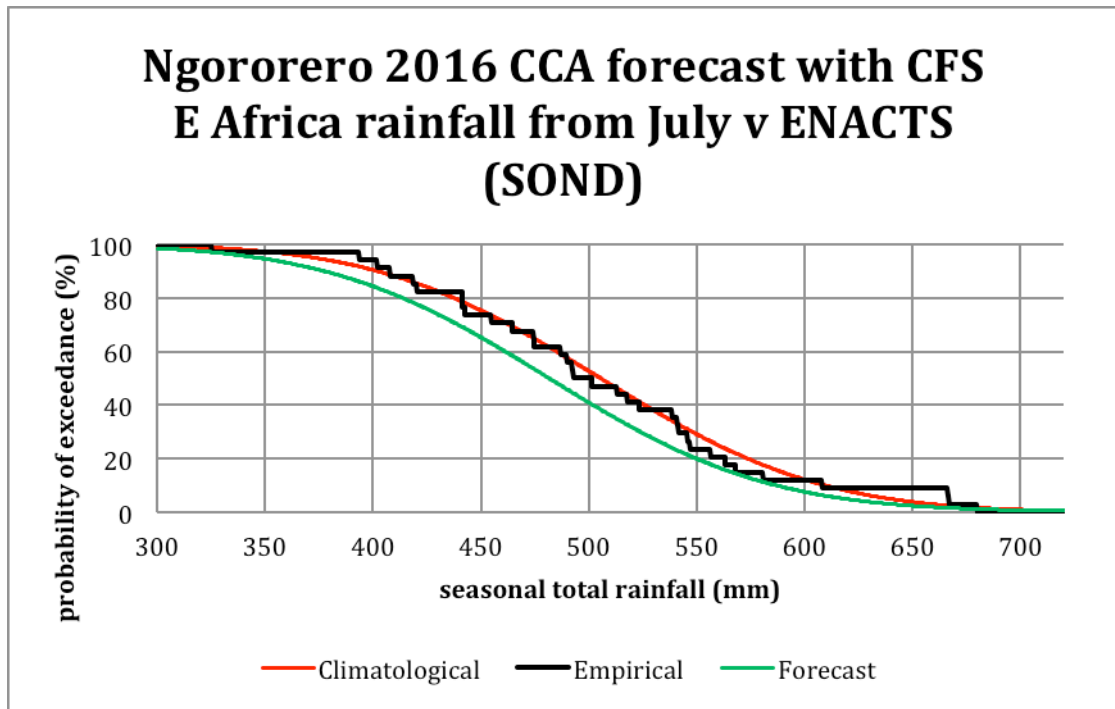


Figure 3: SOND rainfall probability of exceedance for Ngororero (Western Province, 29.55E, 1.75S)

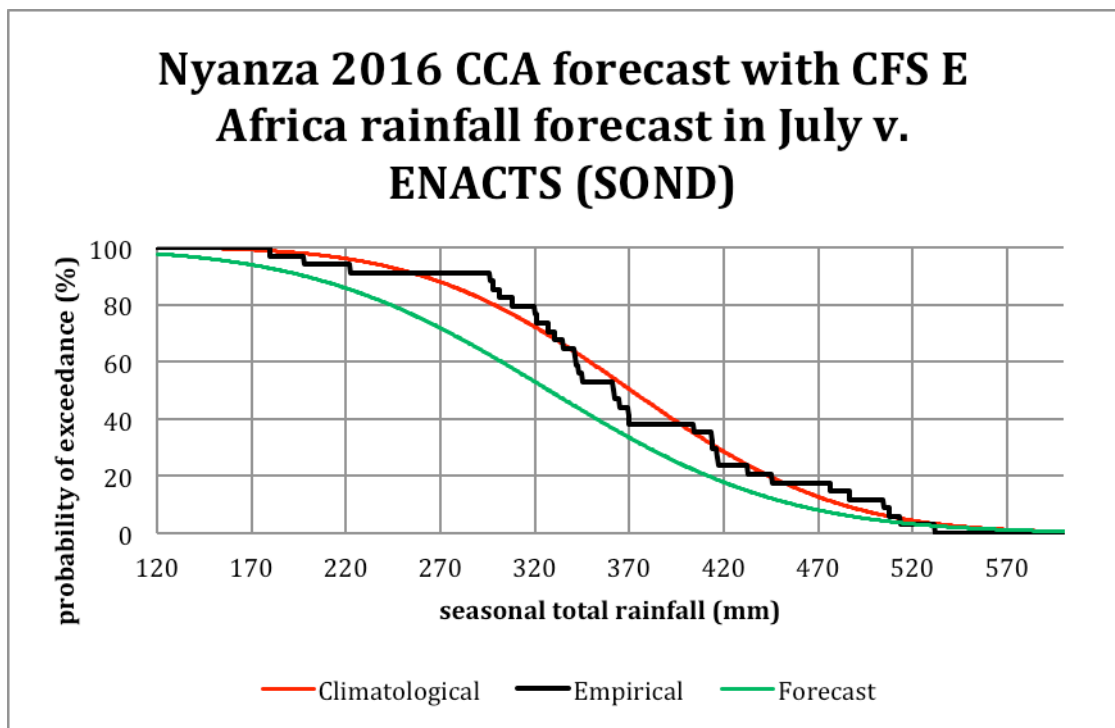


Figure 4: SOND rainfall probability of exceedance for Nyanza (Southern Province, 29.85E, 2.35S)

The following figures show the skill of the forecast over Rwanda and over the predictor region, along with the leading mode time series.

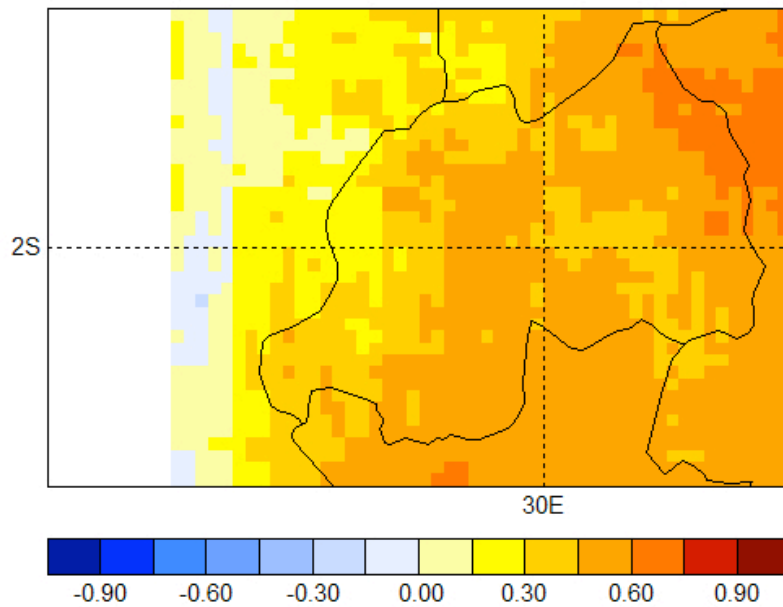


Figure 5: Pearson's correlation over Rwanda for abovementioned forecast (a canonical correlation analysis of the CFS SOND rainfall predictor in July as predictor and the ENACTS SOND rainfall as predictand).

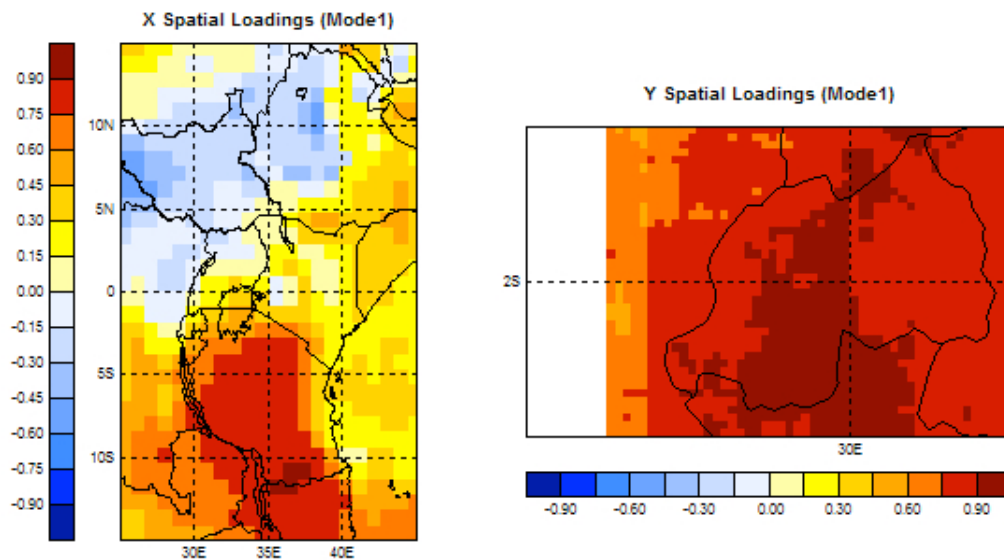


Figure 6: X and Y spatial loadings for leading Canonical Correlation Mode of the abovementioned seasonal forecast.

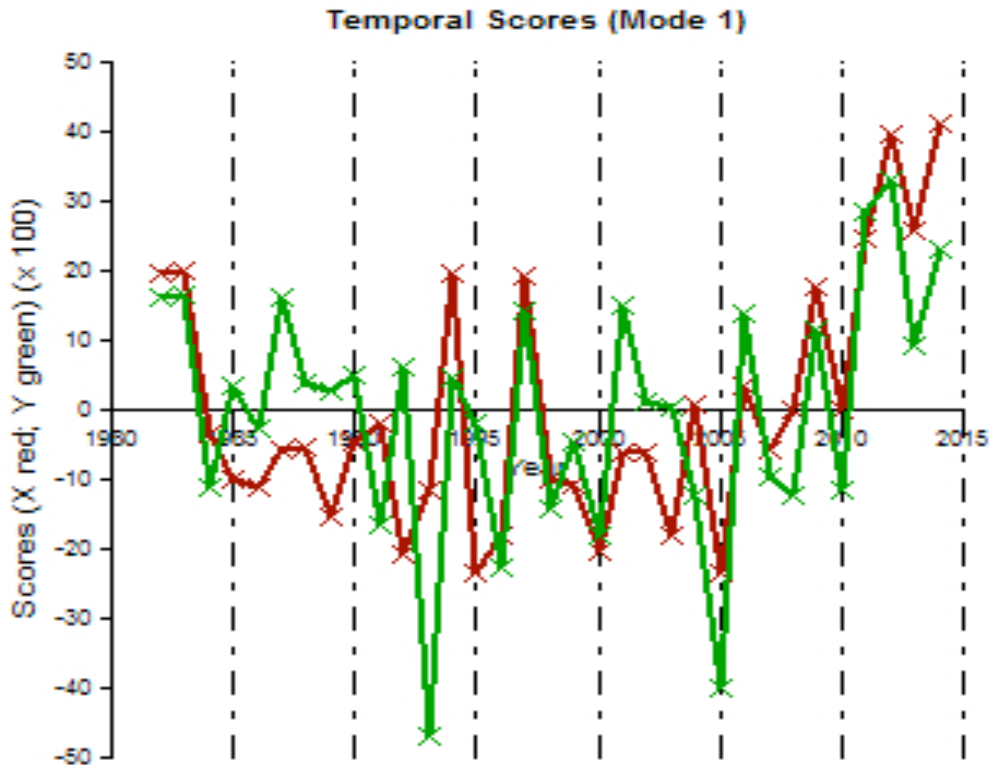


Figure 7: The Mode 1 observed (red) and hindcast (green) values for Rwanda rainfall based on the abovementioned forecast.

Wednesday 24 August

Asher spent the morning at CIAT meeting mainly with Floribert, Prosper and Jonah (the three meteorologists). There was some brief discussion of the forecast information that emerged from the CPT analysis. Floribert, Prosper and Jonah shared the official Meteo-Rwanda release information for the GHACOF with Asher.

Evidently, (perhaps in large part due to the strong El Nino), the 2015 SOND season was above normal rainfall for most of the country, although the eastern province experienced below normal rainfall in SOND 2015. The 2016 MAM season also had above normal rainfall throughout most of Rwanda. The colleagues from Meteo-Rwanda shared that historically, there has been a stronger ENSO related rainfall anomaly in the decaying phase of an El Nino event than during the onset phase. The country specific reporting at the GHACOF 44 the following week shared the same conclusions about the MAM 2016 season and shared that there some unusually dry conditions in parts of the country during JJA.

Some broader discussion followed on the abstract that Asher had submitted to the American Meteorological Society. The scope for future collaboration was also discussed. Asher spent the afternoon at Meteo-Rwanda and met briefly with the division leader Anthony Twahirwa and the director general Jonathan Ntaganda Semafara.

#### Thursday 25 August

Asher spent the morning at CIAT and met with four specialists from the Rwanda Agriculture Board (in addition to the meteorologists and Desire) to discuss the Water Requirement Satisfaction Index and requirements for future collaboration (regarding soil information, water holding capacity and crop information).

Discussions focused not only on data requirements, but on the practical utility of WRSI and ways in which it can be coupled with other modelling approaches to help with intra-seasonal crop forecasting. While WRSI is used primarily as a monitoring tool, there may be some scope for integrating WRSI values mid-season with other forecast information to provide intra-seasonal climate risks.

#### Friday 26 August

Asher spent the morning and afternoon at CIAT continuing discussion from previous day. One additional person, Aimable Gahigi from the Rwandan Agriculture Board joined the discussion. Discussion continued in the same vein. There is scope for collaboration between CIAT, Rwanda Agriculture board and IRI, although the timeline is not very clear. Developing all the information necessary for WRSI to be operational across the country may take several months if not more than a year.

## Conclusion

The main conclusion is that this is work in process and that further collaboration between all parties is necessary to ensure improved climate information dissemination and improved food security outcomes for Rwanda. Asher and the Rwanda meteorologists should be in regular

contact regarding the AMS climatology project<sup>1</sup> and other areas of research collaboration. The IRI team, Rwanda Meteorology Agency and CCAFS Rwanda should discuss the evolution of the SOND 2016 rainy season and should evaluate how skilful the forecasts were after the fact.

Many of these discussions will take place when Desire and Floribert visit IRI in October and November 2016. Depending on user needs and/or preferences, more work at IRI should/could be done (primarily by Asher) on creating forecasts for other derived seasonal predictands (including onset timing, number of rainy days, rainfall intensity, dry spell length, etc.).

Further collaboration between IRI, CCAFS and the Rwanda Agriculture Board may help Rwanda to operationalize a WRSI monitoring and risk management tool; although this may be a longer-term project.

<sup>1</sup> Asher has recently received word from the American Meteorological Society that the abstract was accepted as a poster presentation for the annual meeting in Seattle, WA, USA in January 2017.



## Appendix: Participant List

Name	Institutional Affiliation and nation	Gender
Dr. Asher Siebert	IRI postdoctoral research scientist, USA	Male
Dr. Desire Kagabo	CIAT CCAFS project coordinator, Rwanda	Male
Ms. Gloriose Nsengiyumva	CIAT CCAFS Outcome 1 project coordinator, Rwanda	Female
Mr. Floribert Vuguziga	Rwanda Meteorology Agency climatologist, Rwanda	Male
Mr. Prosper Ayabagabo	Rwanda Meteorology Agency forecast officer, Rwanda	Male
Mr. Jonah Kazora	Rwanda Meteorology Agency forecast officer, Rwanda	Male
Mr. Michel Kabirigi	Rwanda Agriculture Board research scientist, Rwanda	Male
Mr. Bernard Musana	Rwanda Agriculture Board senior research scientist, Rwanda	Male
Mr. Celestin Ndayisaba	Rwanda Agriculture Board research scientist, Rwanda	Male
Mr. Claude Muhutu	Rwanda Agriculture Board research scientist, Rwanda	Male
Mr. Aimable Gahigi	Rwanda Agriculture Board research scientist, Rwanda	Male