Comparison of the Tercile and Probability Distribution Formats of Seasonal Forecast Information for Climate Services Applications
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Introduction

Historically, seasonal regional Climate Outlook Forums around the world (eg. Greater Horn of Africa, West Africa, Southern Africa, South Asia, Southeast Asia, Caribbean and Latin America) have had a tendency to present their central findings in the format of consensus based maps of tercile probabilities of rainfall and temperature for the coming season. Tools developed at Columbia University's International Research Institute for Climate and Society (IRI) can enable a more refined understanding of the full forecast probability distribution function. This study heuristically explores the advantages and disadvantages of these two approaches from technical and user perspectives, drawing on several examples at the regional level and from Rwanda. More complex probabilistic information has been developed by IRI staff in interactive online maproom formats.

While the tercile approach may convey less information than the full PDF and while it may be easier to arrive at a consensus on tercile forecasts than a full PDF, the tercile approach may over-emphasize the near normal category, may fail to convey some important information about uncertainty and may not have as direct a translation to actionable decisions on the part of the user community as may be the case if the full forecast PDF is disclosed. This being said, there may be additional technical, cost and capacity building challenges to developing robust information on the full forecast probability distribution function and translating those outputs into products that can effectively inform user decisions.

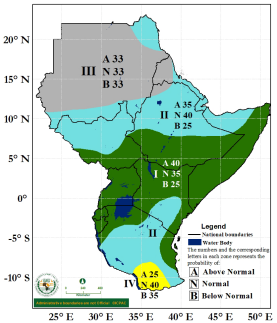
Tercile Format

The tercile format shows forecasts of geophysical variables (most typically rainfall and temperature) in terms of weighted probability of being below normal (0-33rd percentile), near normal (33-67th percentile) or above normal (67-100th percentile). However, further interpretation of these forecasts requires a knowledge of the climatology and variability of each subregion.

In the figure shown here, region I has forecast odds shifted towards wetter than normal conditions, region II has forecast odds shifted very slightly towards wetter than normal conditions, region III has forecast odds in line with climatology and region IV has forecast odds shifted slightly towards drier than normal conditions.

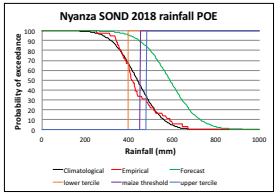
This format has been used for many years and is a format with which many meteorological services are familiar, but it can cause some confusion in the interpretation.

In practice, forecast categorical probabilities using this consensus based tercile approach rarely exceed 50%, or are less than 20%, not just in the GHA but other regions as well[1,2]



Consensus Rainfall Forecast figure produced by ICPAC (IGAD Climate Prediction and Applications Center) for GHACOF 50
Kigali, Rwanda, August 2018

Challenges for User Uptake



- Maize typically requires at least 450 mm rainfall/season
- A typical SOND in Nyanza, Rwanda has only a 45% POE for the maize threshold
- For 2018, the forecast POE is 90% for the maize threshold
- Using the full objective POE may be more insightful than the consensus based tercile forecast

- Different user groups have different needs
- Users from different groups need to have a voice in demanding and structuring the format of forecast information from regional centers and the NMHS
- More dissemination of forecast information does not necessarily translate to better use or improved outcomes
- All user groups need transparency and actionable information
- Most user groups want location-tailored information (although skill at high resolution may be uncertain and that uncertainty needs to be conveyed adequately)
- Historical forecast conservatism and avoidance of 30/40/30 forecasts motivated by NMHS desire to avoid being categorically wrong
- Incentives need to be created for making bolder forecasts, breaking with tradition and encouraging user uptake even in the face of uncertainty and imperfection
- Communication and cultural challenges exist between the NMHS community and the user community[3,4]
- Shift towards demanding full probability distribution in the GFCS[5,6]

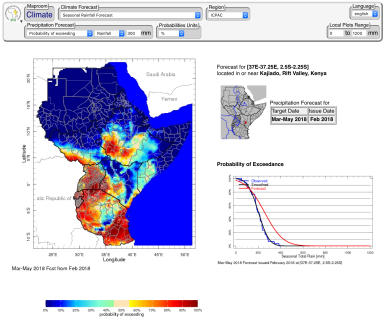
Probability of Exceedance Format(s)

There are several formats for conveying probability of exceedance (POE) information and the forecasts themselves can be based on a number of different statistical methodologies: canonical correlation analysis, principal component analysis, multiple linear regression, etc..

Through IRI's digital maprooms, POE information can be conveyed on a regional map for the probability of exceeding a specified threshold or percentile, or POE graphics for an individual location or region can be plotted with a range of values on the x axis and the probability on the y axis.

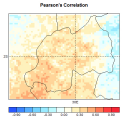
POE forecasts may not lend themselves to the same kind of multi-forecast consensus process that takes place before the regional climate outlook forums, but POE forecasts may ultimately be more useful to user community, because the interpretation may be more straightforward.

POE information may enable targeted adaptations like planting drought resistant varieties, targeted health interventions and index insurance.

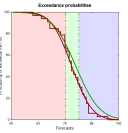


Maps extracted from the ICPAC seasonal forecast page for MAM 2018 (issued February 2018): http://digilib.icpac.net/maproom/
Probability of exceeding 300 mm of rainfall in MAM
Forecast odds towards higher variability and higher mean rainfall
Ethiopia: http://129.236.111.111/maproom/index.html
Rwanda: http://maproom.meteorwanda.gov.rw/maproom/

	Pros	Cons
Tercile Forecasts	• Can be presented in a single regional map • Legacy – this format has now been used for 20 years • Lends itself to consensus process	• Doesn't give information tailored to user needs • Historical tendency to make conservative forecasts • Conservative forecasts may underestimate the probability of the extreme tails[1,7] • Requires additional knowledge by the users to translate format into action
Probability of Exceedance	• Offers more detailed information for more targeted application • Doesn't require as much additional interpretation on the part of the users • Would not necessarily create a conservative bias	• Format is less familiar to NMHS • Would be more difficult to achieve consensus



Skill Map for Rwanda RDF forecast SOND 2018



Burera SOND 2018 RDF POE forecast

A Path Forward

- GFCS/WMO support for increased interaction between NMHS/regional centers/user community to better define most appropriate user tailored format
- Regional centers/NMHS should define best practices for extracting objective forecasts and translate objective forecasts into POE format
- Resources should be allocated for the development and maintenance of online digital maprooms (and the training of the user community)
- Both formats can still be conveyed, but with an emphasis on POE for user specific application and tercile forecasts for an overview
- Proper incentives need to be created (with user community engagement) for moving away from such conservative forecasts
- More transparency about matters of skill and uncertainty
- More emphasis on forecasts for daily derived fields that may be more relevant for agriculture (eg. rainy day frequency, dry spell frequency, onset date, water balance)

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