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NOAA's Climate Prediction Center (CPC) International outreach: From the African Desk to the International Desks, Twenty Years of Developing the Capacity of National Meteorological Service

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1. Introduction

CPC's African Desk was established in 1994 as part of the NCEP International Desks. The historical context in which the African Desk was established is reported in Thiaw and Kumar (2015), and is summarized here. The persistent drought in the Sahel in the 1970s led to the establishment in the mid-1980s of the Permanent Interstate Committee for Drought Control in the Sahel (CILSS) and its technical body the Agriculture Hydrology and Meteorology (AgrHyMet) Center. The U.S. Agency for International Development (USAID) established the Famine Early Warning System (FEWS) to assist Sahel countries mitigate the impacts of the drought. USAID/FEWS quickly recognized the importance of weather and climate information to monitor drought and to plan for humanitarian action. CPC began to provide FEWS with gauge-based 10-day weather summaries to enable real-time monitoring of crop conditions in the Sahel. In the early 1990s, CPC began to provide FEWS with access to satellite rainfall estimates, which also helped refine the 10-day weather summary. The presentation discusses the evolution of CPC's international outreach from the African Desk to the International Desks, with a focus on real-time products at all time scales from weather to sub-seasonal and seasonal forecasts, and the monitoring of recent evolution of climate conditions. These products are made available to the international community through in support of decision making in various socio-economic sectors. The presentation will also discuss capacity development with ongoing professional development training for professionals at National Meteorological and Hydrological Services (NMHSs).

2. The CPC International Desks website

The African Desk was initially established to provide NMHSs with access to real time weather and climate information to serve as guidance for national forecasts. However, with increasing demand for climate services around the world, and to better serve the mission of USAID, the African Desk website evolved into the CPC International Desks website (Figure 1), featuring regionalized weather and climate forecasts and climate monitoring tools. The public can access forecasts derived from the NCEP global forecast system (GFS), the global ensemble forecast system (GEFS), the Climate Forecast System (CFS) version 2, the U.S. National Multimodel Ensemble Forecast (NMME), the Global Data Assimilation System (GDAS), and many other satellite derived products such as rainfall estimates, normalized difference vegetation index (NDVI), etc. The website also features expert assessment products, including forecast bulletins, regional hazards outlooks, and monsoon briefs. In addition, NCEP products on Africa are also being broadcast to Africa through a EUMETCast platform such that all NMHSs in Africa can receive the information directly through a reception station.

3. Expert assessment products

The operational products prepared in the CPC International Desks include daily weather forecasts and week-1 and week-2 outlooks for Africa. The weather forecasts are prepared in support of the WMO Severe Weather Forecast Demonstration Project (SWFDP). Sub-Seasonal forecasts are issued weekly for Week-1

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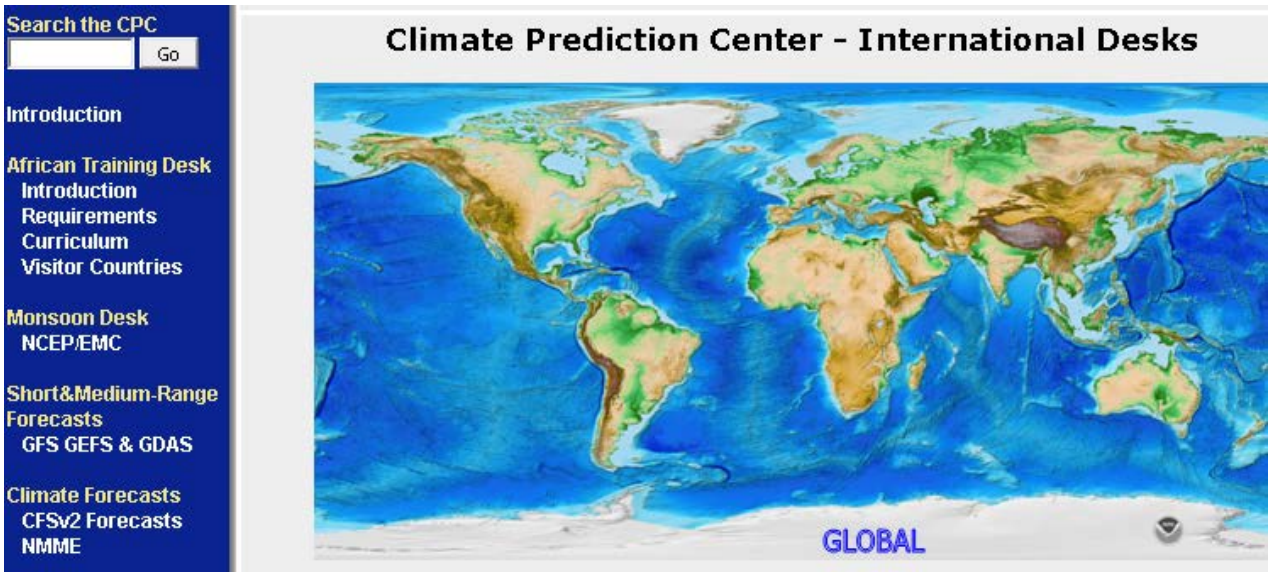

Fig. 1 CPC International Desks website. NCEP global forecast system (GFS) and ensemble (GEFS), global data assimilation system (GDAS), Climate Forecast System (CFS) and National Multi-model Ensemble Forecasts (NMME), satellite rainfall estimates, and sea surface temperature (SST) are made available over each geographical region through the clickable maps or through the menu on the left of the page. Expert assessment products are also available for Africa and other regions of special interest.

and Week-2 time scales. The main tools are the Madden Julian Oscillation, SST, NCEP GFS and CFS model guidance. The forecaster examines a number of products including the probability of exceedance, wind, divergence fields, etc., to reinforce the forecasts. For the seasonal forecasts, outputs from NCEP CFSv2 and the U.S. NMME are regionalized and calibrated with CPC gridded rainfall data, and forecasts expressed in probabilistic form. These are compared with CCA forecasts to issue consensus seasonal outlooks that feed into the Regional Climate Outlook Forums (RCOFs). Of the various products, the regional hazards outlooks for food security provide the most tangible applications to humanitarian relief planning and therefore are discussed in detail in the following.

3.1 Regional hazards outlooks

The hazards outlooks bulletin for food security are prepared weekly in collaboration with FEWSNET partners, including the U.S. Geological Survey (USGS), NASA, USAID, and Chemonix (Thiaw and Kumar, 2015). The bulletin features both the evolution of the most recent climate conditions throughout the season and outlooks into the near future about one week to a season. The objective is to provide targeted forecasts for areas that are vulnerable to droughts or flooding that might result in adverse impact on crops or pastures. Hence the hazards outlooks are based on a wide range of products, including rain gauge data and satellite rainfall estimates, rainfall and surface temperature forecasts up to 16 days, sub-seasonal and seasonal climate forecasts. Other inputs to the hazards outlooks include USGS' river flow forecasts and water requirement satisfaction index (WRSI) for crops and rangelands, NASA' s normalized difference vegetation index (NDVI), NOAA's vegetation health index (VHI), and field observations. The hazards outlooks process is designed as a loop that begins with the identification of areas that exhibit consistent rainfall deficits or frequent flooding through routine in-depth monitoring of the climate system. These areas are often faced with a high risk of food insecurity. Then model guidance tools are used to examine both short range and extended range forecasts. The reliability of these forecasts is qualitatively assessed by looking at consistency both within each model and between different models. Then based on current conditions and forecasts, a Geographical Information System (GIS) software is employed to draw polygons on a map to highlight areas at risk for food security. The preliminary hazards outlook bulletin is distributed to partners within FEWSNET including the field representatives who have expert knowledge of conditions on the ground. Then a teleconference takes place for a live discussion of current weather and climate conditions and the preliminary hazards outlooks. The

feedback received allows for the finalization of the hazards outlooks. A compilation of hazards outlooks issued between September and December 2015 is displayed in Figure 2. The color shades of the polygons determine the nature and severity of the hazards. In the example shown in the figure, consecutive weeks of above average rains caused flooding to persist during the West Africa summer monsoon rains and in East Africa during the fall rains. Disease outbreaks and human fatalities were reported in some of these areas. In contrast major rainfall deficits during the Belg (Feb-May) and Kiremt (Jul-Sep) rainfall seasons resulted in drought and failed crops in Ethiopia. Millions of people are believed to be in need of food assistance according to the United Nations. Similarly, in southern Africa, the ongoing drought due to the 2015-16 El Nino associated with extreme heat has caused many governments to declare some provinces in state of emergency. Human and livestock mortalities have already been reported. The hazards outlooks are disseminated through the website and an email distribution list. FEWSNET uses the information together with current climate forecasts and trends and other food security indicators to issue monthly food security outlooks. Finally, this information is provided to USAID for informed decision in humanitarian response planning based on the level of food insecurity.

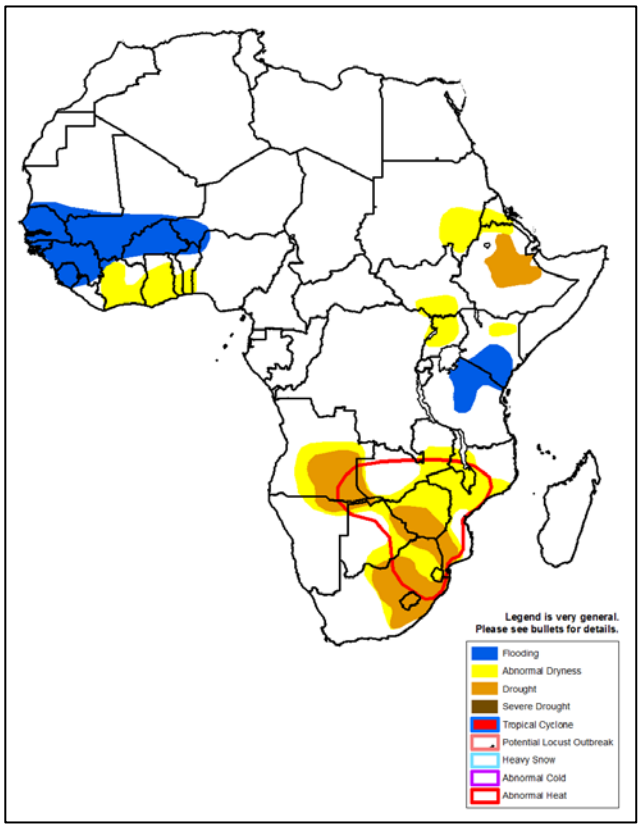

Fig. 2 Regional hazards outlooks for food security issued between September and December 2015. Included in the hazards outlooks are the long terms conditions in the field and the current meteorological and climate forecasts.

4. Professional development training program

4.1 The Residency Training Program

The African Desk became operational one year after it was established and hosted its first trainee in March 1995. The four-month residency training program is a U.S. contribution to the WMO Voluntary Cooperation Programme (VCP) managed by NWS. Each trainee receives a WMO fellowship. They arrive in staggered intervals of two months for a maximum capacity of 12 trainees per year. This approach allows the visitors who have been in training the longest to contribute to the training of the new trainees. The objective of the training program is to work with NMSs in Africa to enhance their capacity to deliver improved weather and climate forecasts. Each trainee returns to his or her home institution, equipped with a new set of tools that could be applied to improve forecasts. To date the African Desk has trained 170 professional meteorologists and scientists from approximately 40 countries in Africa. The programs take into account the diversity of the climate system in Africa. Hence fellows are selected from each region of Africa on a rotating basis and invited to participate in the training program during the active rainfall seasons of the respective regions. The Climate Desk and the Weather Desk have separate daily schedules. However, the desks share some common activities. Upon arrival at the desk, the trainees are introduced to the CPC online tutorial on major modes of variability including ENSO and the Madden Julian Oscillation (MJO). Then, they spend time learning the use of basic UNIX commands, shell programming, and the use of graphical packages such as the Grid Analysis Display System (GrADS), and applications of the GIS. These basic tools enable the trainees to access and process NCEP data for future use in climate diagnostics studies or in model forecasts verifications. A typical work environment for the trainees is displayed in figure 3. The trainees also spend time practicing the use of GIS to prepare forecast graphics.

4.2 The NOAA-USAID climate training workshop series

The residency training program is complemented by a NOAA-USAID climate training workshop series (Thiaw *et al.*, 2014) initiated in 2009 that have enabled the training in climate of far more professionals from different regions of the world than NCEP could host in the residency program. The training workshops have been organized for all the ocean basins of the world. A total over 300 meteorologists and scientists from countries in Africa, Asia, Caribbean, Central America, South America, and Southeast Europe have participated in either or both the NCEP residency training program or the NOAA-USAID series. In these series emphasis is on practical exercises combined with lectures on recent advances in climate variability and change. The trainees then learn how to set up seasonal climate prediction experiments using CCA and how to downscale model outputs to improve forecast skills. They also learn how to verify the forecasts. The trainees return to their home institutions with an improved understanding of the global climate system and how modes of variability can influence the climate in their respective regions. They also take home tools to improve forecast operations. The long term goal is for the trainees to become resource persons in their countries and regions to train other professionals.

Fig. 3 Four trainees in the African Desk in 2009 as part of the NCEP residency training program, featuring clockwise from top left, Fatou Sima (The Gambia), Aissatou Diallo (Guinea), Chali Gurji (Ethiopia) and Mamadou Savadogo (Burkina Faso).

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