



# MERRA-2 Reanalysis in Products for the Famine Early Warning System

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# The Famine Early Warning Systems Network



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**UPDATE**

**FAMINE LIKELY OCCURRED IN NORTHEAST NIGERIA**



Acute Food Insecurity: Near Term (October 2016 - January 2017)

Near Term

Medium Term



The Famine Early Warning Systems Network (FEWS NET) is a leading provider of early warning and analysis on food insecurity. Created by USAID in 1985 to help decision-makers plan for humanitarian crises, FEWS NET provides evidence-based analysis on some 35 countries. Implementing team members include NASA, NOAA, USDA, and USGS, along with Chemonics International Inc. and Kimetrica.

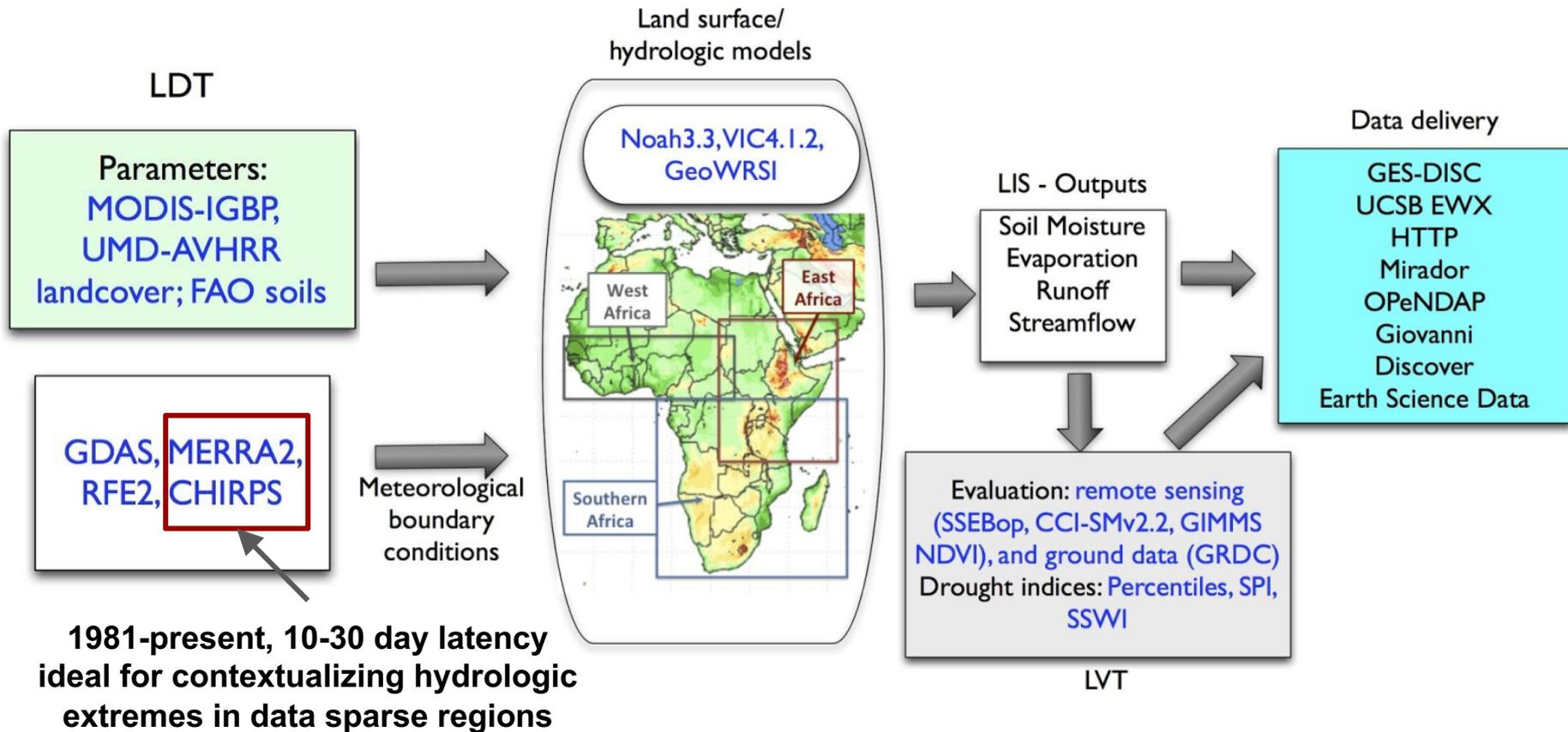
# Why We Use MERRA-2 Reanalysis



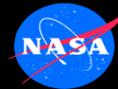
- Long record (1979-present): Contextualizing hydrologic extremes (e.g., percentiles, anomalies) is particularly important in data sparse regions.
- Moderate latency that meets the needs of drought monitoring (10-30 days).
- A publicly accessible archive that meets research and applications needs: FEWS NET simultaneously monitors drought conditions, while also conducting research for improving products and forecasts.
- Temporally and spatially consistent reanalysis (compared to e.g., GDAS) and continuity with GEOS-5 forecasts.
- MERRA-2 is demonstrating high quality/performance in on-going evaluations by its large user community.

**Examples:** FEWS NET Land Data Assimilation System (FLDAS), Reference ET products, seasonal hydrologic forecasting

# NASA Land Information System



# NASA Land Information System



## Which variables from MERRA-2 do we use?

Tair	(K)	Near Surface Air Temperature
Qair	(kg/kg)	Near Surface Specific Humidity
SWdown	(W/m <sup>2</sup> )	Incident Shortwave Radiation
LWdown	(W/m <sup>2</sup> )	Incident Longwave Radiation
Wind	(m/s)	Eastward & Northward Wind
Psurf	(Pa)	Surface Pressure

GDAS, MERRA2,  
RFE2, CHIRPS

## How do we get from MERRA-2's resolution to 10km? And from hourly to daily?

- We use a "bilinear" interpolation method to downscale to the FLDAS 10 km scale.
  - We use the hourly MERRA-2 files to drive our models but then temporally average the output fields to daily.
- \*□ For our Asia FEWS NET region, we also use MERRA-2's total precipitation to drive the models in LIS.
- \*□ We will also use MERRA-2's hourly rainfall to help temporally disaggregate daily rainfall using LIS's Land Data Toolkit (LDT).

# NOAA ESRL: Evaporative Demand for FEWS NET

## Evaporative demand ( $E_0$ ) for FEWS NET

$E_0$  from reference  $ET$  ( $ET_0$ ) Penman-Monteith reference  $ET$  (FAO-56)

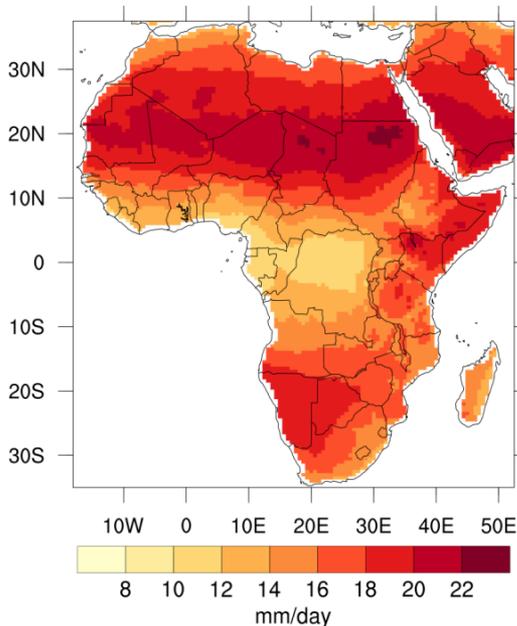
### MERRA-2 Fields Used:

- temperature at 2 m
- specific humidity at surface
- downward SW at surface
- wind speed at 10 m
- surface pressure

Data compare well with GSOD station estimates.

M. Hobbins (NOAA/ESRL)

Mean daily  $ET_0$  (mm), 1981-2010



### EO Product specifications:

- Daily, Jan 1 1980 – present
- Latency ~ 10 days
- Downscaled with IWMI monthly PET means to 0.14 deg. lat/lon grid.

### FEWS NET Applications:

- Evaporative Demand Drought Index (EDDI)
- Water requirement Satisfaction Index (WRSI)
- Standardized Precipitation and Evaporation Index (SPEI)
- Drought Attribution

# The Famine Early Warning Systems Network



1. Understanding the Context & Ongoing Monitoring
2. Analyzing and Forecasting Outcomes
3. Classifying Food Insecurity
4. Supporting Decision Makers

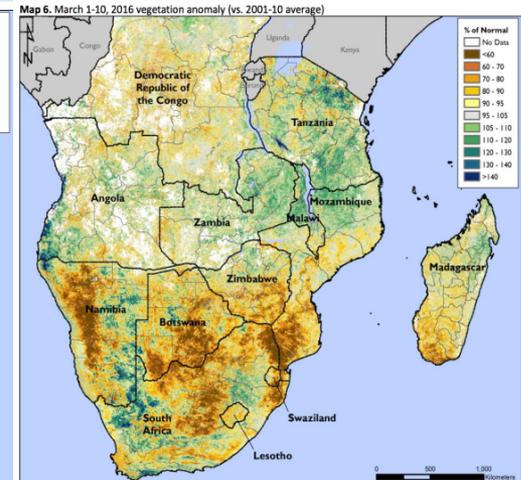
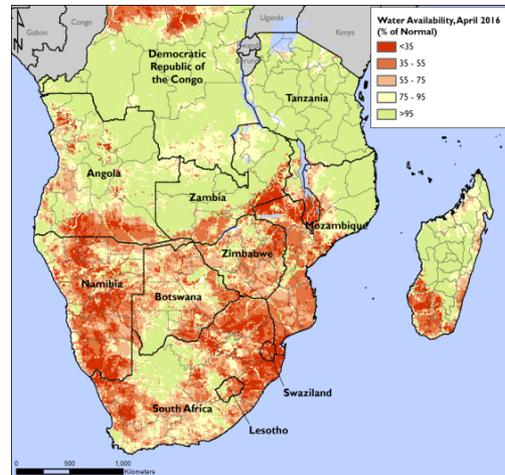


**SOUTHERN AFRICA** Special Report

March 18, 2016

*Illustrating the extent and severity of the 2015-16 drought*

*A severe drought, related to El Niño, is ongoing across the Southern Africa region. This drought has limited crop production and exacerbated the current lean season. While April/May harvests will provide some temporary relief, [food insecurity during the 2016/17 consumption year is expected to be severe](#). This report presents a series of maps which illustrate the extent and the severity of the drought as well as its impacts on water availability, crop and rangeland conditions, food prices, and food security. For a more detailed narrative and analysis of the drought's current and expected impacts on food security, please visit [www.fews.net/south](http://www.fews.net/south).*



Source: FEWS NET/USGS

# Forecasting for Middle East & Africa (FAME)



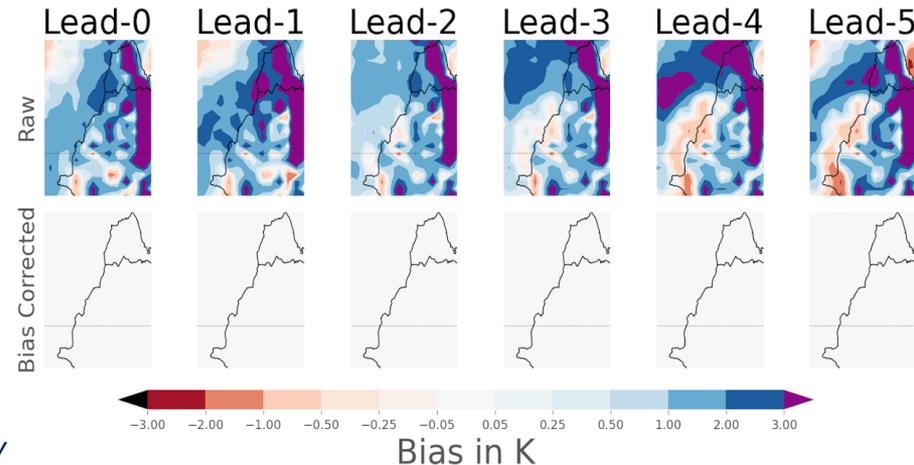
- **PI:** Dr. Christa Peters-Lidard; **Project Co-Lead:** Dr. Kristi Arsenault
- Companion project to FLDAS, where we are expanding FLDAS' capabilities to include seasonal climate forecasts and improve model initial conditions with assimilating satellite observations.
- We use MERRA-2's reference height forcing fields (e.g., 2-meter air temperature, "T2M") to drive our historic deterministic model runs, and also to bias-correct the GEOS-5 seasonal forecast fields (except for precipitation, in which case we use CHIRPS).

## Comparison of bias of Raw and Bias corrected forecasts of T2M

Initialized on May, 1 Period:1982-2010

Using bias-correction methods, we are able to remove much of the bias in the GEOS-5 seasonal forecasts using MERRA-2 fields, while preserving the skill and temporal variability of the GEOS5 forecast fields.

We use both the hourly and monthly MERRA-2 meteorological fields, and downscale to both  $0.25^\circ$  and  $0.1^\circ$  spatial resolutions using scripts and LIS.



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