Early warning of food insecurity in Sub-Saharan Africa: Exploring predictors beyond traditionally used seasonal rainfall forecasts

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Shraddhanand Shukla[1](sshukla@ucsb.edu), Gregory J Husak[1], Daniel McEvoy[2], Kristi R Arsenault[3], Will Turner[1], Laura Harrison[1], Frank Davenport[1], Martin Francis Landsfeld[1], Amy McNally[4,6], Christopher Funk[5,1] and Christa D Peters-Lidard[6]

(1) University of California Santa Barbara, Santa Barbara, CA, (2)WRCC, Desert Research Institute, Reno, NV, (3) SAIC, Greenbelt, MD, (4) University of Maryland, MD, (5) EROS, USGS, South Dakota, (6) NASA GSFC, Greenbelt, MD

Background

- Early warning of food insecurity is crucial for mitigating adverse impacts.
- Traditionally seasonal rainfall forecasts have been used as the main agroclimatic predictor of food insecurity.
- Here we highlight three novel avenues of providing early warning that are in different stages of application readiness level (ARL).

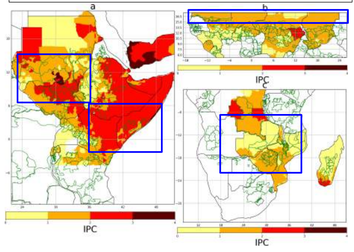
Goal: To provide skillful **EARLY** warning of food insecurity during the harvest season

1: Start of Season (SOS) forecasts

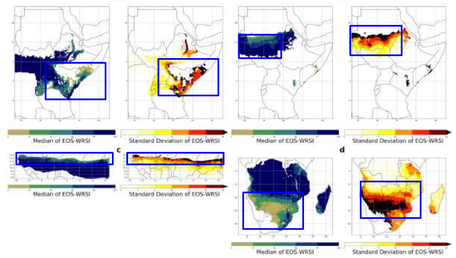
- Ongoing research indicates that there are several regions in Africa (encompassing ~50 million people) where forecasts of SOS can help support outlooks for the harvest season.
- ~ 2 week weather forecasts are being experimentally used to provide SOS forecasts.
- Target forecast timing: Within a few dekads of typical SOS.

Current Application readiness: *Operational production and dissemination to FEWS NET is ongoing. Research to examine the value of the product in supporting early warning of food insecurity is underway (journal article to be submitted)*

Mean Integrate Phase Class (indicative of food insecurity) between 2011 through 2016



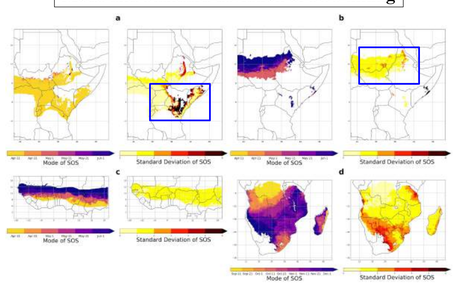
Median and standard deviation of EOS-WRSI (indicative of crop water stress)



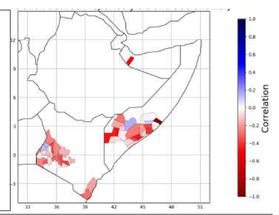
Sub-regions within East, West and Southern Africa that have experienced at least one food insecurity event since 2011, and where crop water stress is highly variable and its median is below average

Africa regions	Sub-regions with low median and high variability Crop WRSI, that typically experience at least some level (>0) of food insecurity
East Africa March-May (MAM)	Central Ethiopia, Northcentral Eritrea, Southern and Southeastern Kenya, Southern Somalia,
East Africa May-September (MJJAS)	Sudan
West Africa	Northern Senegal, Southern Mali, Northern Burkina Faso, Southern Niger and Central Chad
Southern Africa	Northeastern and Central Tanzania, Northeastern and Central Namibia, Botswana, Zimbabwe, Central and Southern Mozambique, Central and Northeastern South Africa, Southern Madagascar

Mode and Standard deviation of SOS timing

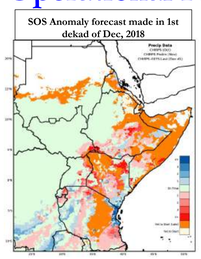


Spearman Rank Correlation between the reported crop yield and SOS anomaly for the period of 1983-2014 indicates that crop yield is generally lower in case of delay in SOS.

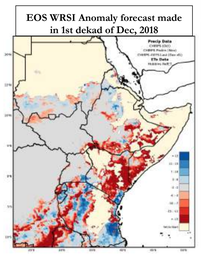


Operational Product

SOS Anomaly forecast made in 1st dekad of Dec, 2018



EOS WRSI Anomaly forecast made in 1st dekad of Dec, 2018



References:

Shukla et al.,: Where in food-insecure regions of Africa does a delayed start of season anticipate crop water deficits? (**To be submitted**)

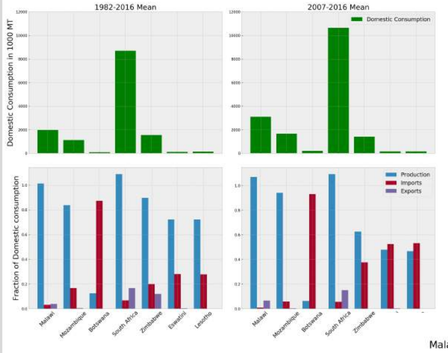
Landsfeld et al., 2018: **GC51L-0940** The CHIRPS-GEFS Precipitation Dataset for Improved Food Security Forecasts and Analysis in Africa. (Friday, 14 December 2018 08:00 - 12:20)

2: Seasonal Soil Moisture (SM) monitoring and forecasts

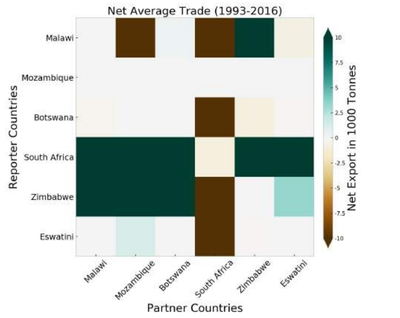
- Ongoing research has established that simulated SM and their forecasts can support early warning of food insecurity in Southern Africa, as (i) they can explain the variability of crop yield in Southern Africa better than ENSO, and (ii) dynamical seasonal SM forecasts are more skillful than rainfall forecasts.
- Target forecast timing: Near the SOS through MOS.

Current Application Readiness: *Operational production and dissemination to FEWS NET ongoing. Value of the product in supporting early warning of food insecurity has been demonstrated (journal article to be submitted).*

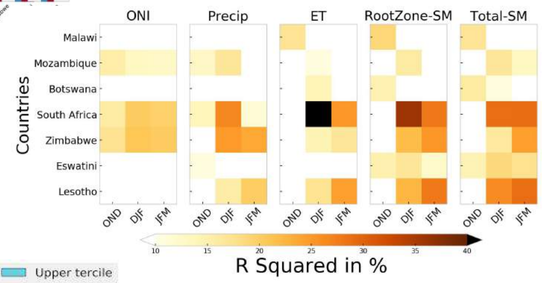
South Africa is the main producer country in Southern Africa.
South Africa, Malawi, and Zimbabwe (historically) are most "self-sufficient" countries in Southern Africa.

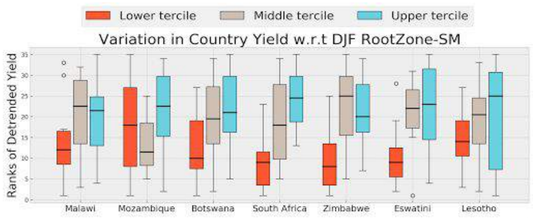


South Africa is the main exporter country to the rest of the Southern Africa countries.



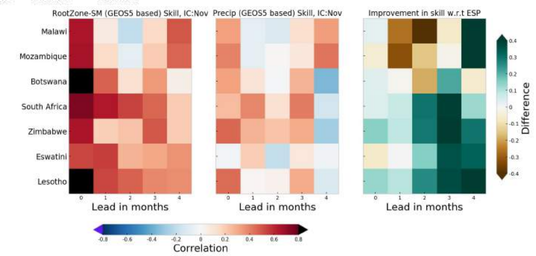
Seasonal SM, in general, explains more variability of crop yield of Southern African countries (South Africa being the most important) better than ENSO.





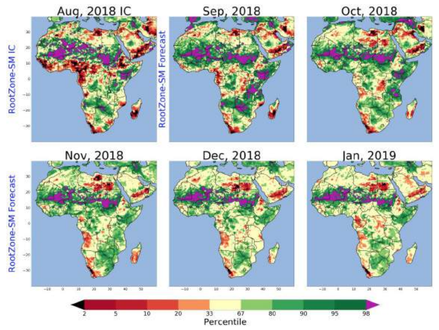
Seasonal SM can also better identify the years within the bottom tercile crop yield than ENSO forecasts.

- SM forecast skill (initialized in Nov.) is generally greater than the skill of rainfall.
- SM forecasts generated using dynamical climate forecasts have higher skill than the ones generated using simply climatology.



Operational Product

https://lis.gsfc.nasa.gov/projects/fame



References:

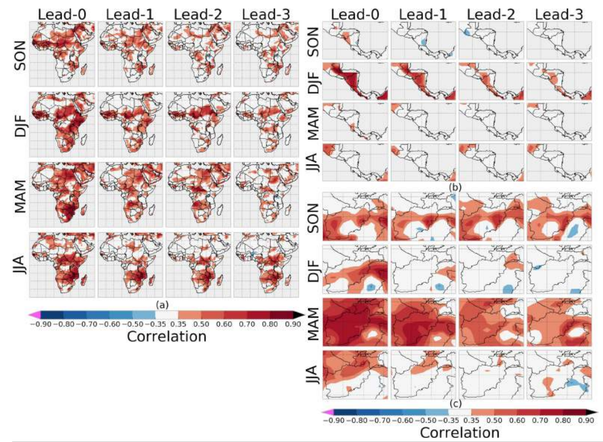
McNally et al., 2017: A land data assimilation system for sub-Saharan Africa food and water security applications. Scientific Data volume 4, Article number: 170012 (2017).

Shukla et al.,: Dynamical hydrologic forecasts can support early warning of food insecurity in Southern Africa. (**To be submitted**)

3: Seasonal Evaporative Demand (ETo) forecasts

- Past research has identified the seasons and regions where ETo forecasts are skillful and demonstrated the potential for application for early warning of food insecurity.
- Target forecast timing: SOS through MOS during rainy season and after rainy season for pastoral applications.

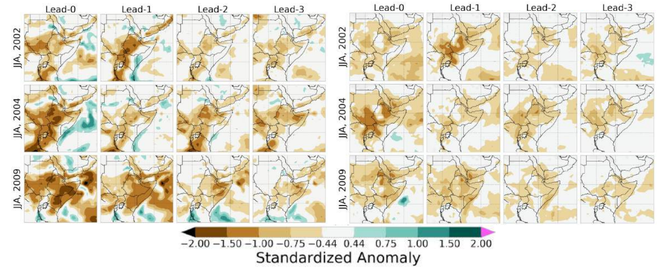
Current Application Readiness: *Operational production is underway, further research to be done to examine the value in supporting early warning of food insecurity.*



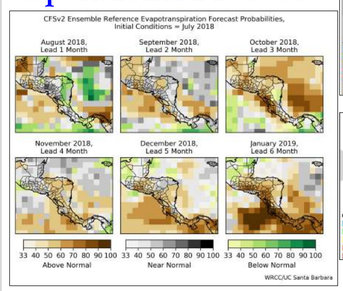
List of the FEWS NET regions and seasons with ETo forecast skill persisting up to lead-3 months.

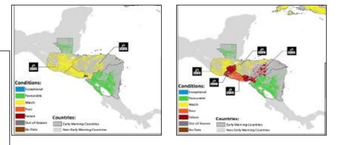
Region	Season	Type of season
Northern sub-Saharan Africa	DJF	Dry season
Central America	DJF	Dry season
East Africa (mainly Ethiopia, Sudan, Uganda)	JJA	Wet season
Southern Africa	JJA	Dry season
Central Asia	MAM	Wet season

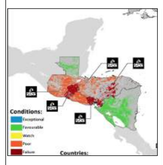
Some of the most severe drought events since the early 2000s (specifically, 2002, 2004, 2009) had a common climatic feature: the region experienced both below-normal precipitation and above-normal ETo, with the latter likely exacerbating the impacts of the former. With new ETo forecasts, such events can be identified in a timely manner.



Operational Product







Reference: Shukla et al., 2017, Examining the Value of Global Seasonal Reference Evapotranspiration Forecasts. J. Appl. Meteor. Climatol., 56, 2941–2949