Seasonal-Scale Drought Forecasting in Africa and the Middle East

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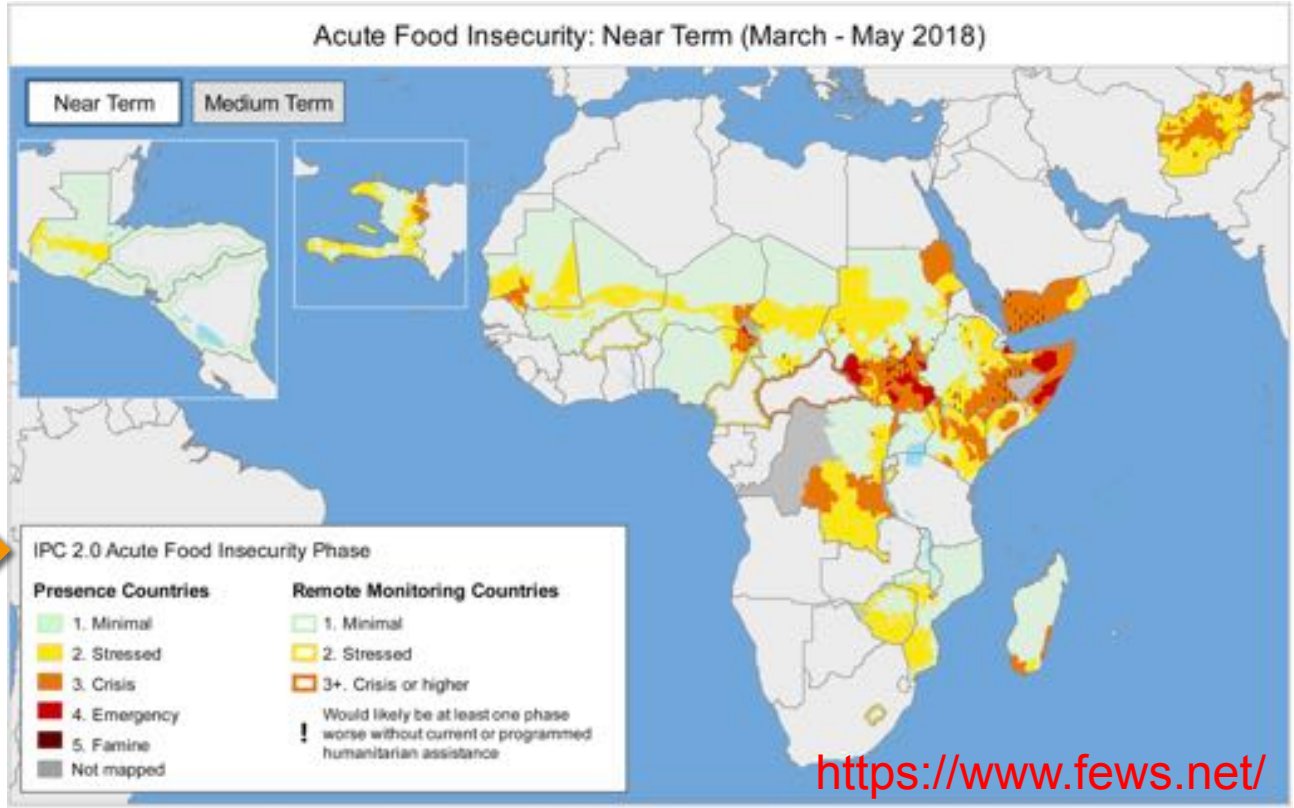
Goal: To develop a drought forecasting system to support FEWS NET's food insecurity early warning efforts.

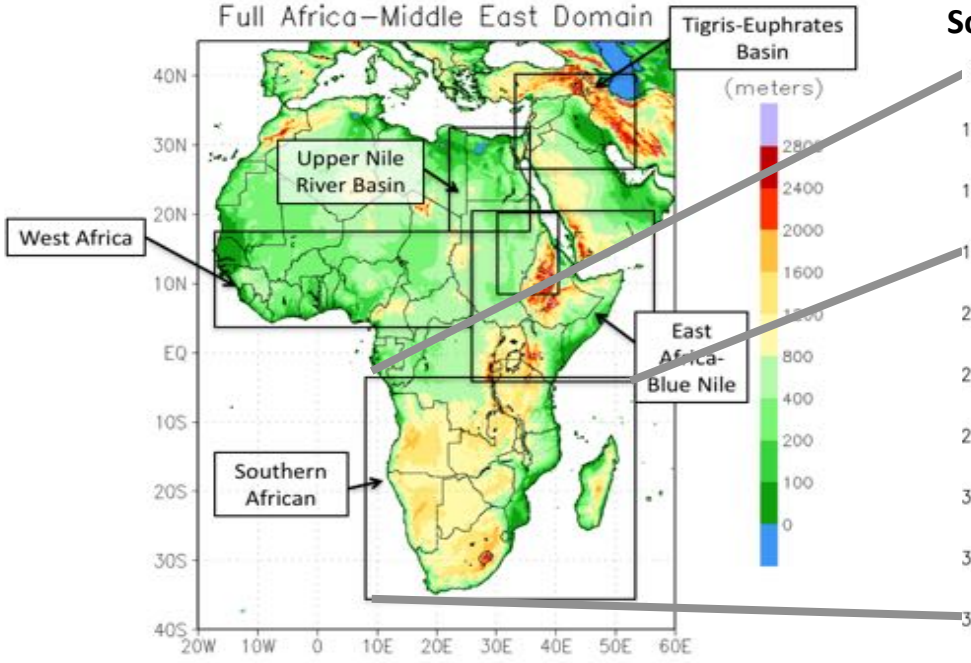


"Across 45 countries, some 76 million people will require emergency food assistance in 2018": USAID's Famine Early Warning System Network Team

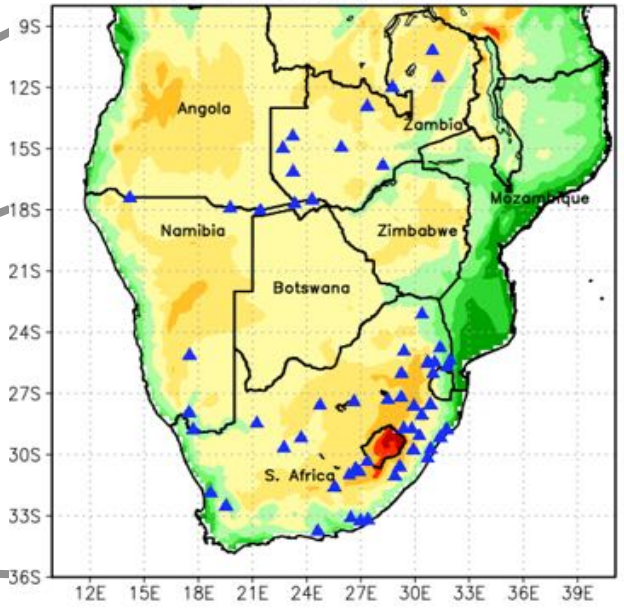
Outline

- Pilot domain and approach
- Evaluation
- Summary

Drought Forecasting Regions:
The Southern African Region Case



Southern Africa Region (& GRDC* Streamflow Sites)

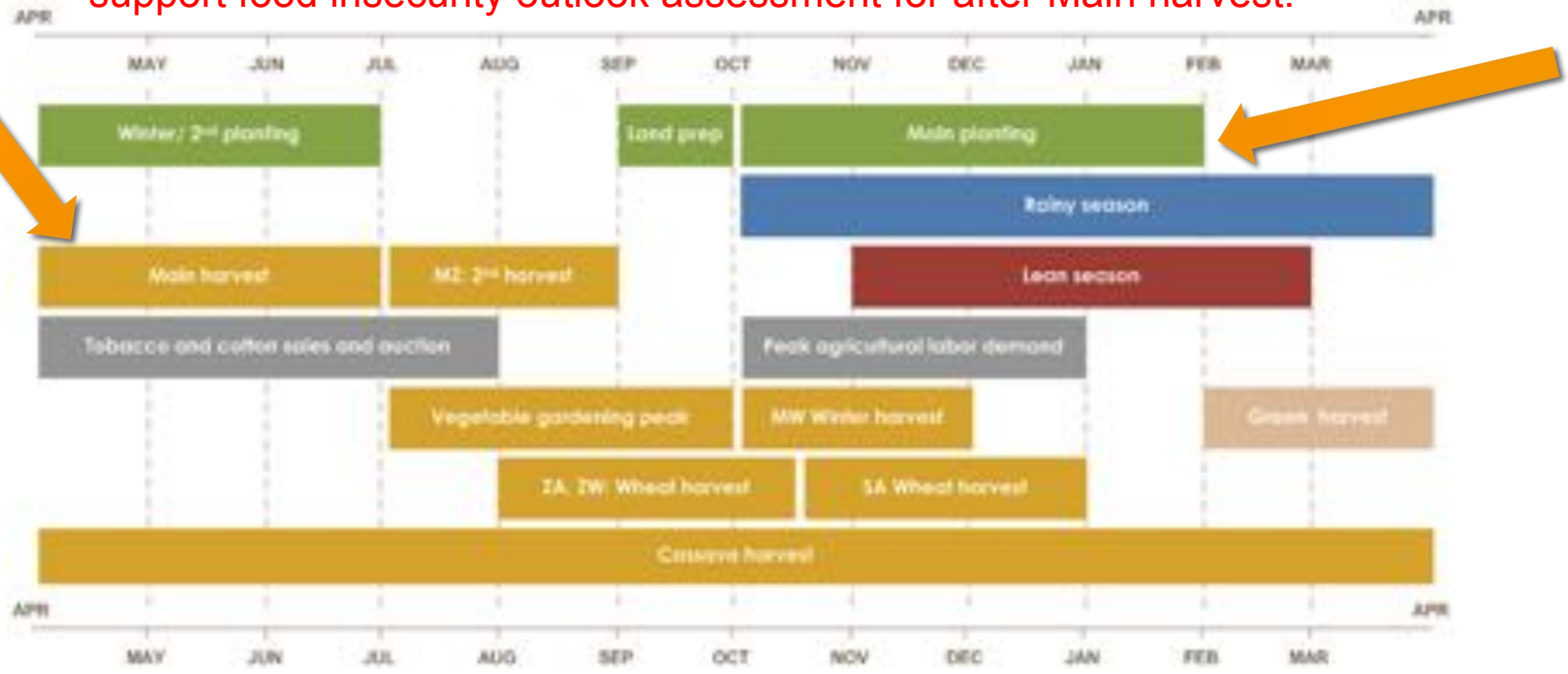


▲ 58 GRDC sites;
Span at least 25 years of data.

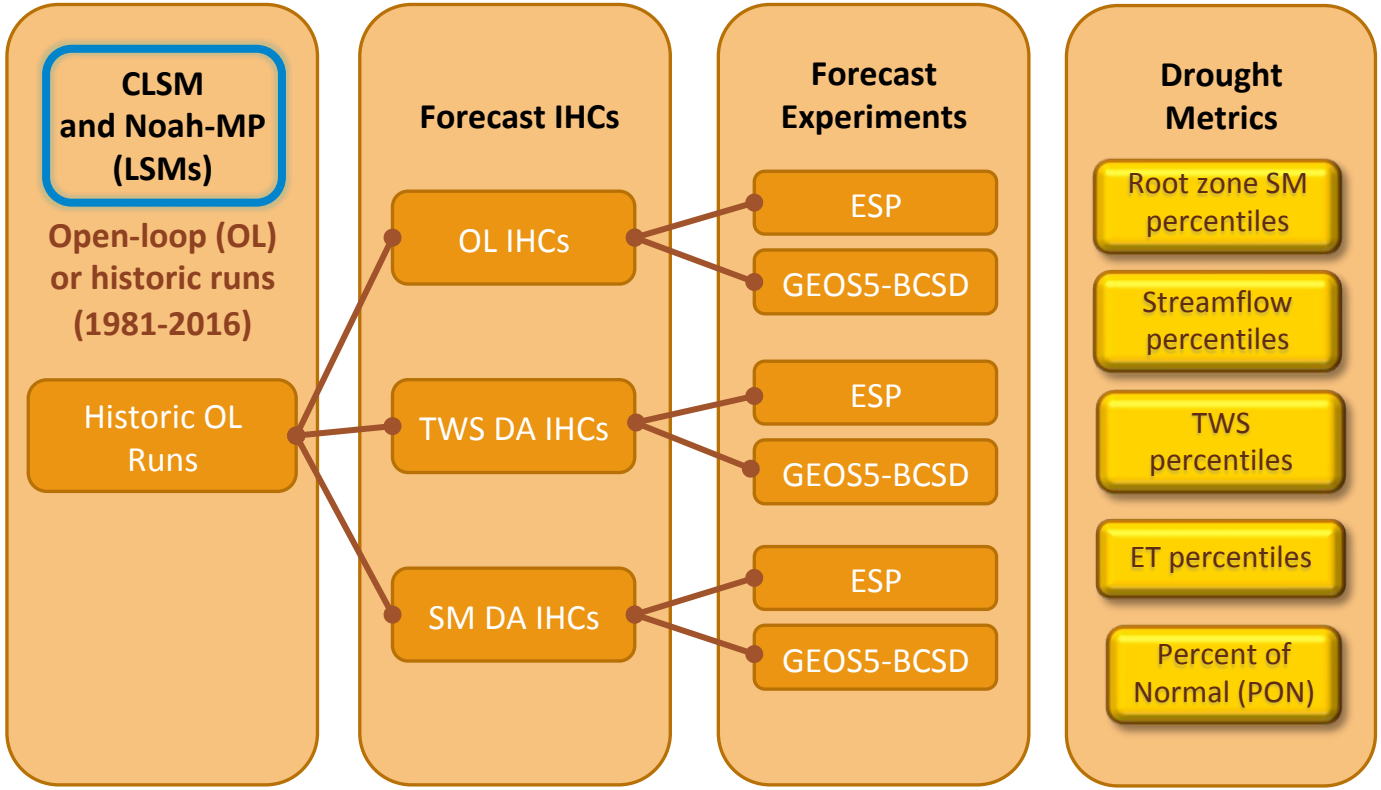
** GRDC – Global Runoff Data Center*

Typical seasonal calendar in Southern Africa

Drought forecasting before and during the main rainy season can help support food insecurity outlook assessment for after Main harvest.



Approach


CLSM and Noah-MP (LSMs)
Open-loop (OL) or historic runs (1981-2016)
Historic OL Runs
Forecast IHCs
OL IHCs
TWS DA IHCs
SM DA IHCs
Forecast Experiments
ESP
GEOS5-BCSD
ESP
GEOS5-BCSD
ESP
GEOS5-BCSD
Drought Metrics
Root zone SM percentiles
Streamflow percentiles
TWS percentiles
ET percentiles
Percent of Normal (PON)

Evaluation

- Can the models' simulated hydrologic variables recreate major historical drought events in Southern Africa?
- Do seasonal climate based drought forecasts perform better than the ESP forecast benchmark?
- Do improved initial hydrological conditions (IHCs) help our ability to better forecast drought events?

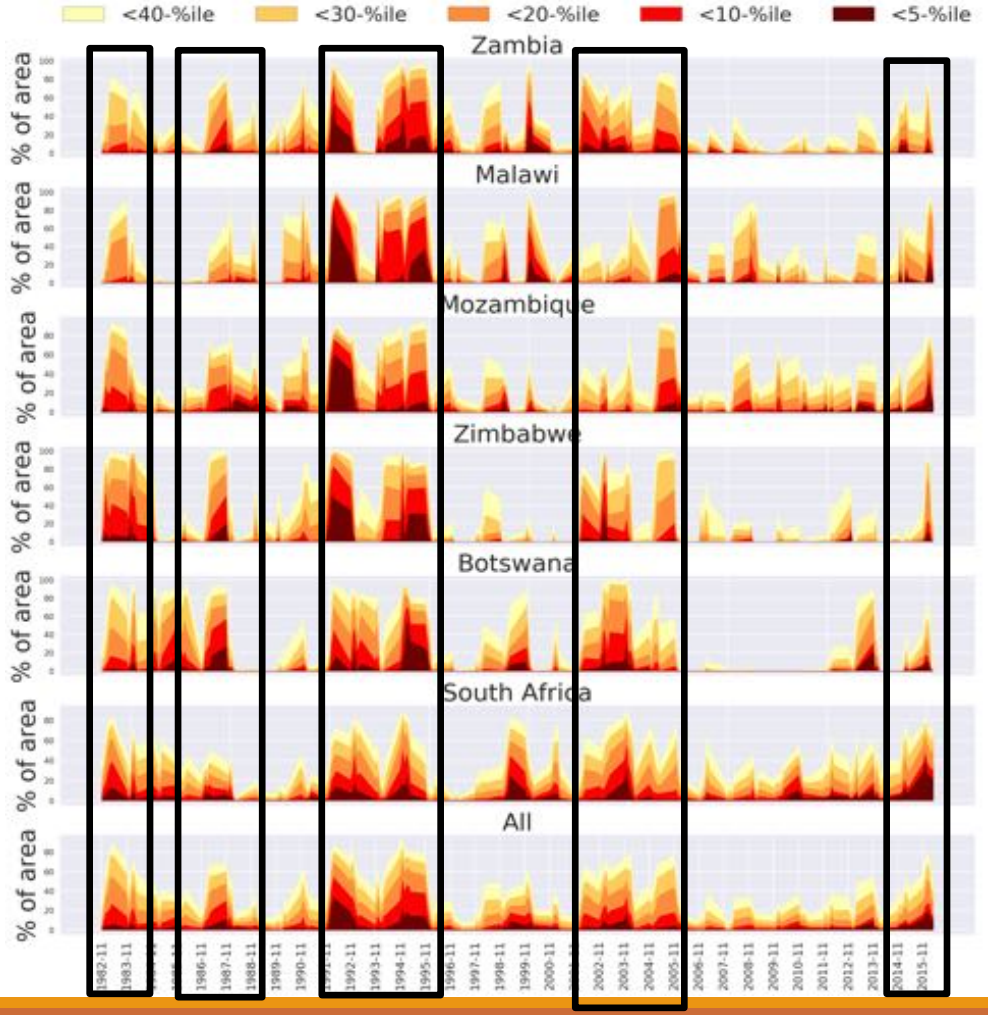
Multimodel simulated Total Water Storage (TWS) based historical reconstruction identifies major drought events!

Major historical drought events include:

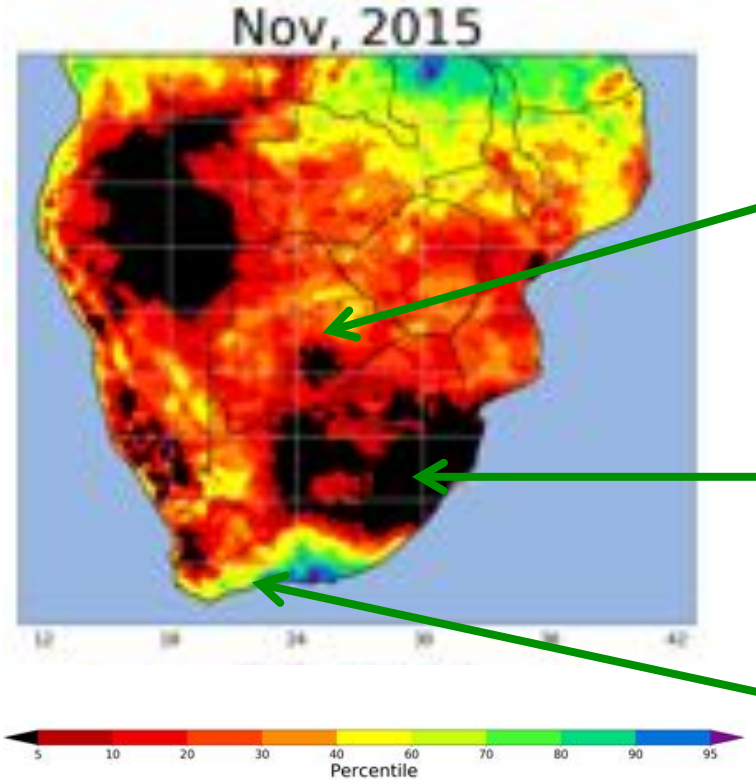
1982–1993, 1986-1987,

1991–1992, 1994–1995,

2001–2003, 2004-2005, 2015-2016



Multimodel Total SM percentile reconstruction



FEWS NET's Seasonal monitor report, November 2015

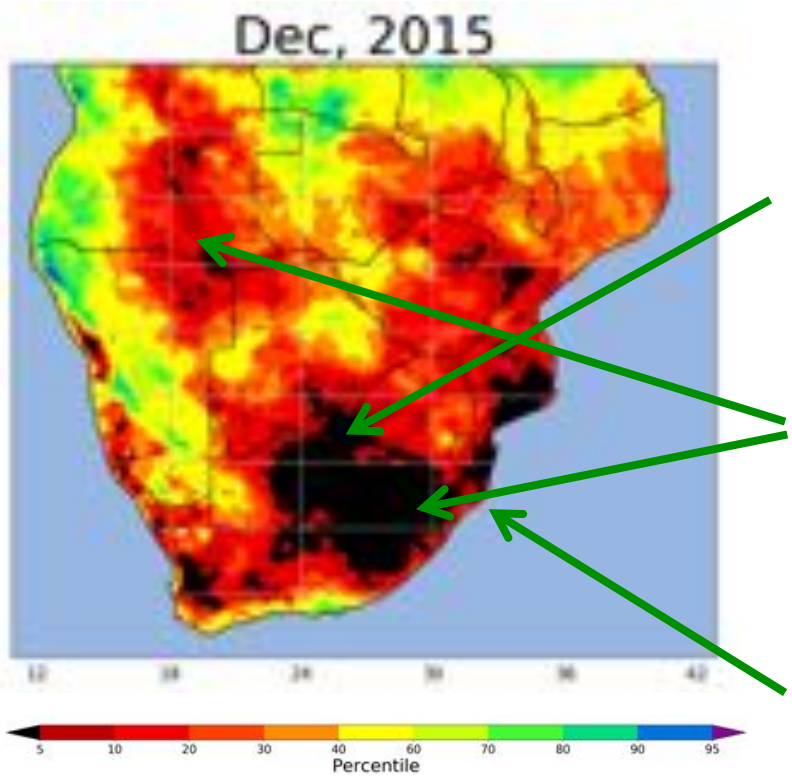
Key Messages

"Pre-agricultural season rains are absent in several parts of the region due to the ongoing El Niño."

"Slow and erratic onset of rains in eastern South Africa, Swaziland and Lesotho is increasing pressure on water resources, livestock, and agriculture."

"Heavy mid-November rains expected to reduce dryness in southeastern parts of the region".

Multimodel Total SM percentile reconstruction



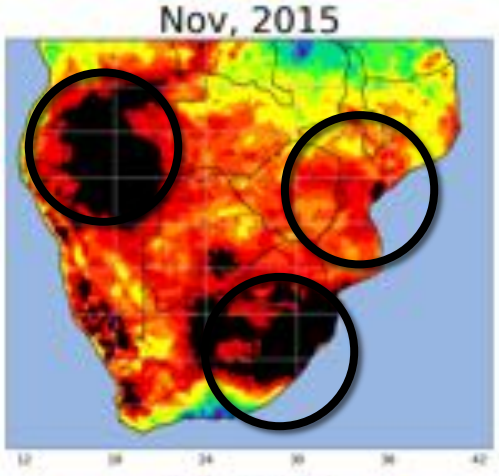
FEWS NET's Seasonal monitor report, March 2016

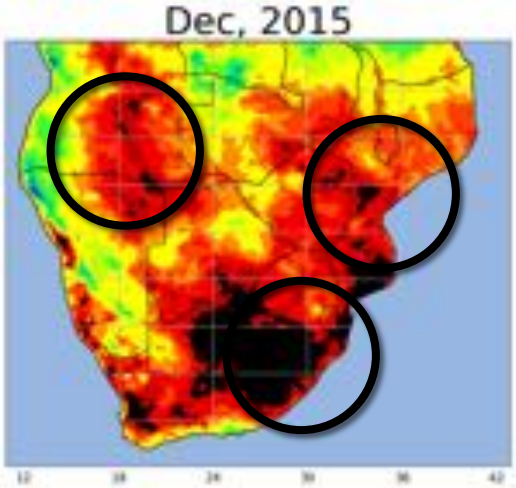
Key Messages

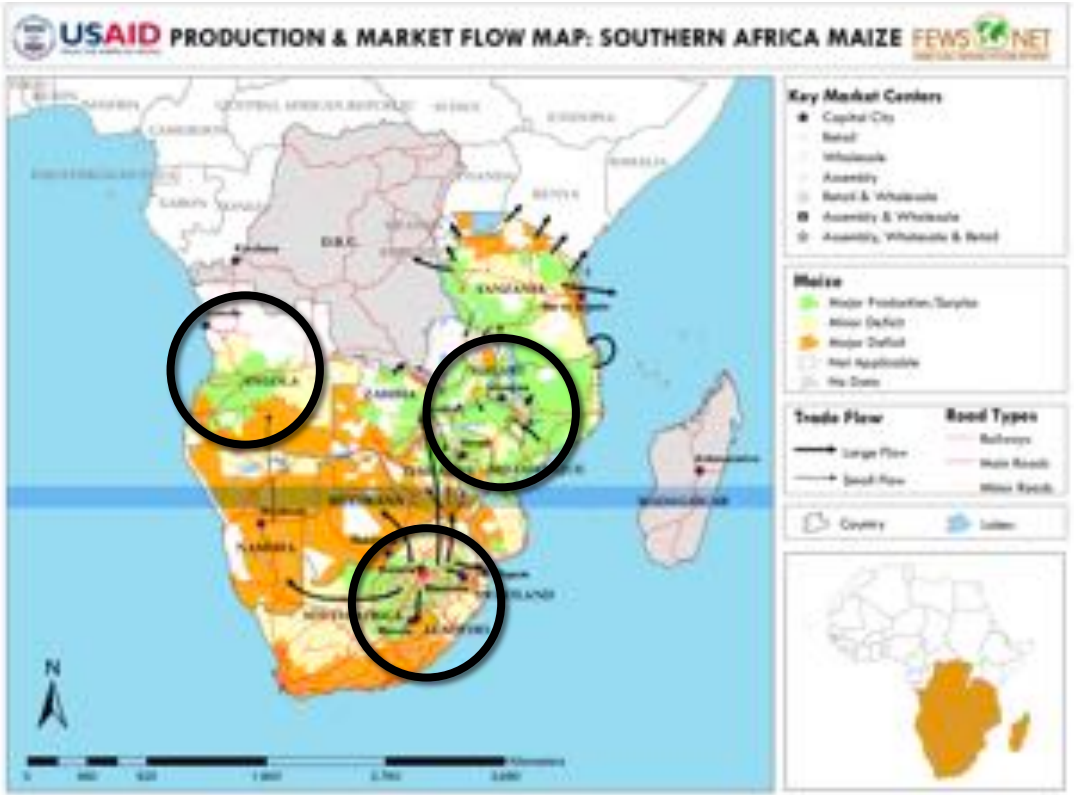
"Rains are still well below normal in the southern half of the region, with deficits strengthening in some areas in recent weeks."

"The onset of rains is delayed by at least 30-40 days in parts of Angola and South Africa."

"Vegetation conditions in many areas are among the worst in 15 years. These conditions have some negative implications for pastures, livestock, and hydrology."







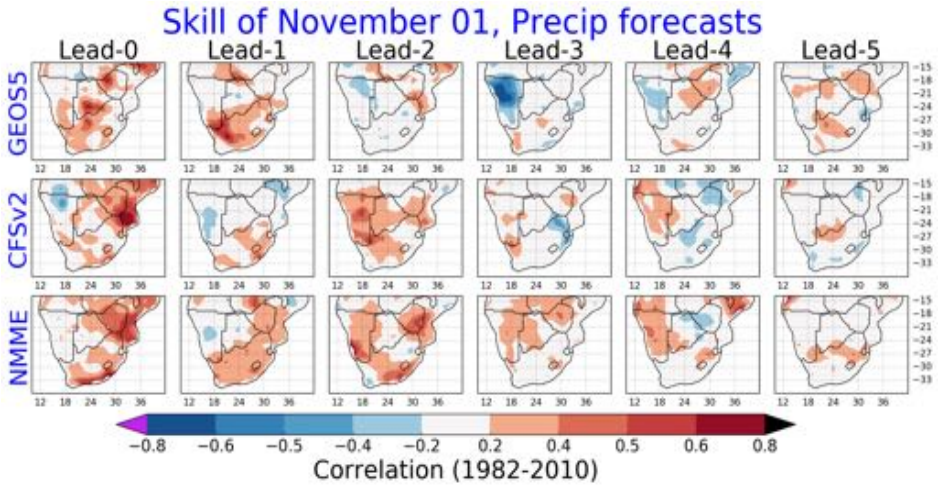
Agricultural (SM) drought in major production/surplus regions is of particular consequence for region's food insecurity. Modeled SM can be an useful tool for monitoring!

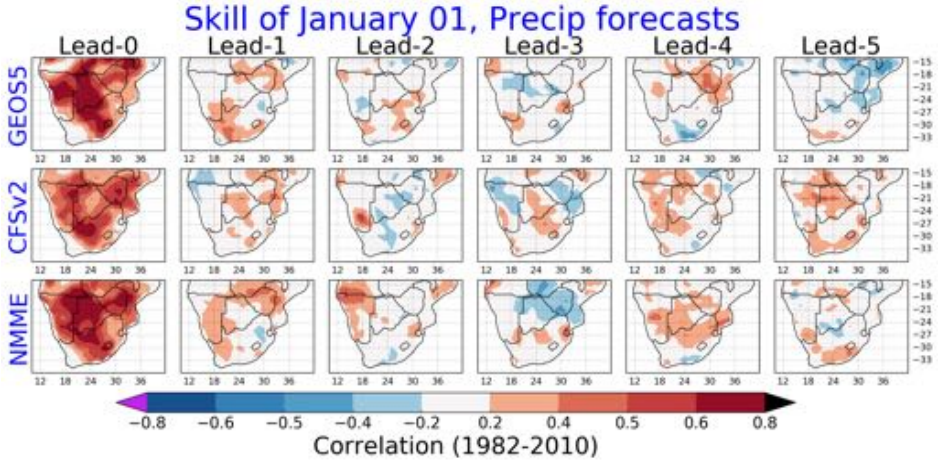
Evaluation

- **Do seasonal climate based drought forecasts perform better than the ESP forecast benchmark?**
  - **Skill in forecasting area in drought at the start of the season.**

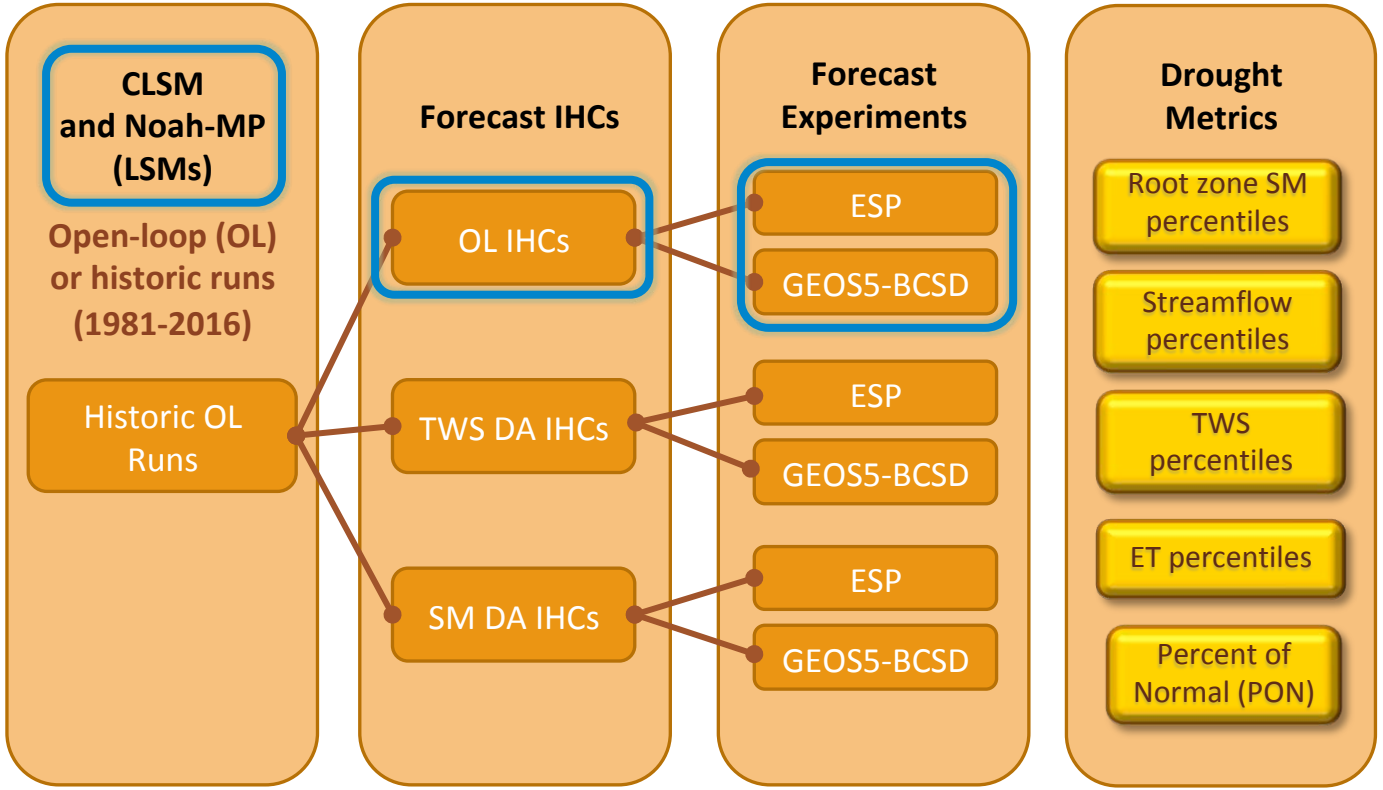
How skillful are GEOS5 seasonal forecasts in the region?

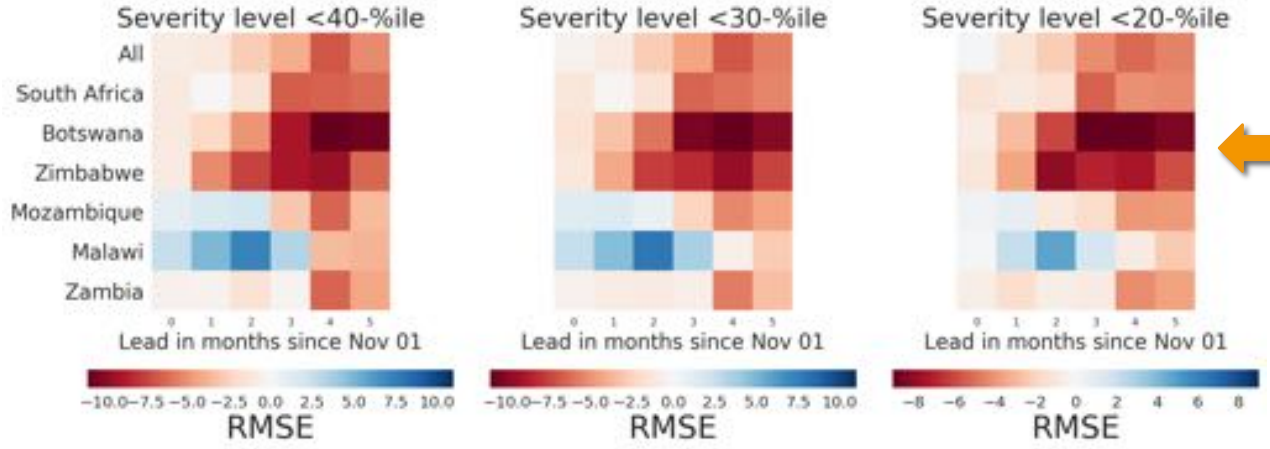
- Limited precipitation forecast skill.
- Skill decreases past lead-0. However present in parts of Botswana, Zimbabwe and South Africa at higher lead-time
- Including additional models can help increase the skill.





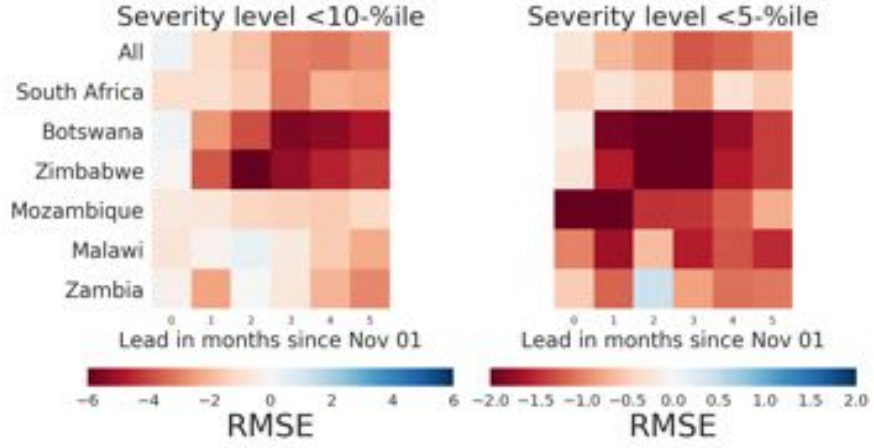
Do seasonal climate based drought forecasts perform better than the ESP forecast benchmark?





RMSE of
GEOS5 – ESP

Red: Improvement
Blue: Degradation



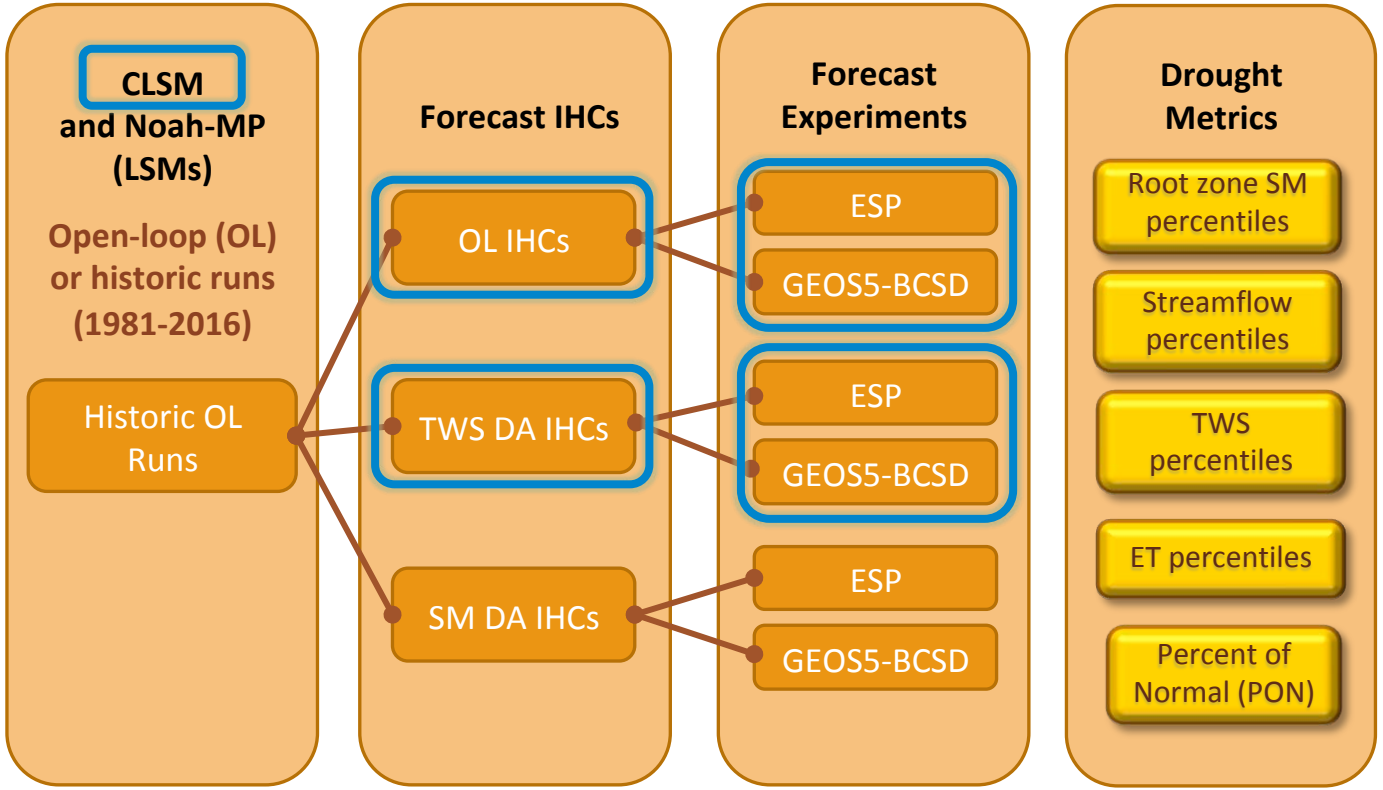
GEOS5 improves the skill of forecasting % area in drought relative to ESP!

The skill is the highest in Botswana, Zimbabwe and South Africa at higher lead times.

Evaluation

- **Do improved initial hydrological conditions (IHCs) help our ability to better categorize and forecast drought events?**

Do improved initial hydrological conditions (IHCs) help our ability to better forecast drought events?

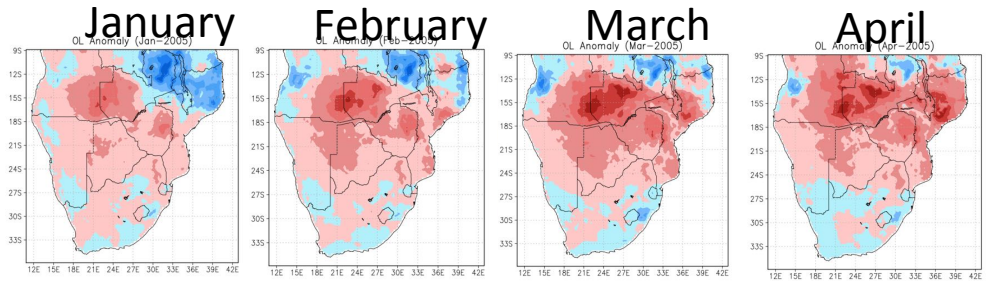


2005 Drought

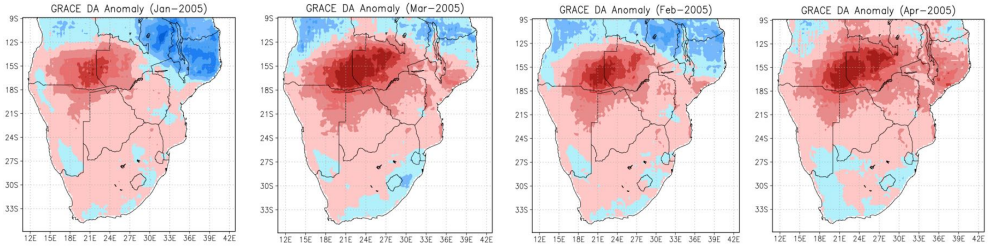
Comparing TWS reconstruction with and without assimilating GRACE

- The GRACE DA based TWS indicated greater drought severity than OL runs (without any DA).

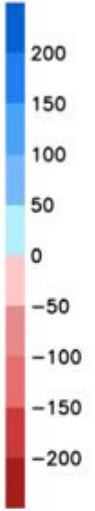
OL TWS Anomaly



GRACE DA TWS Anomaly

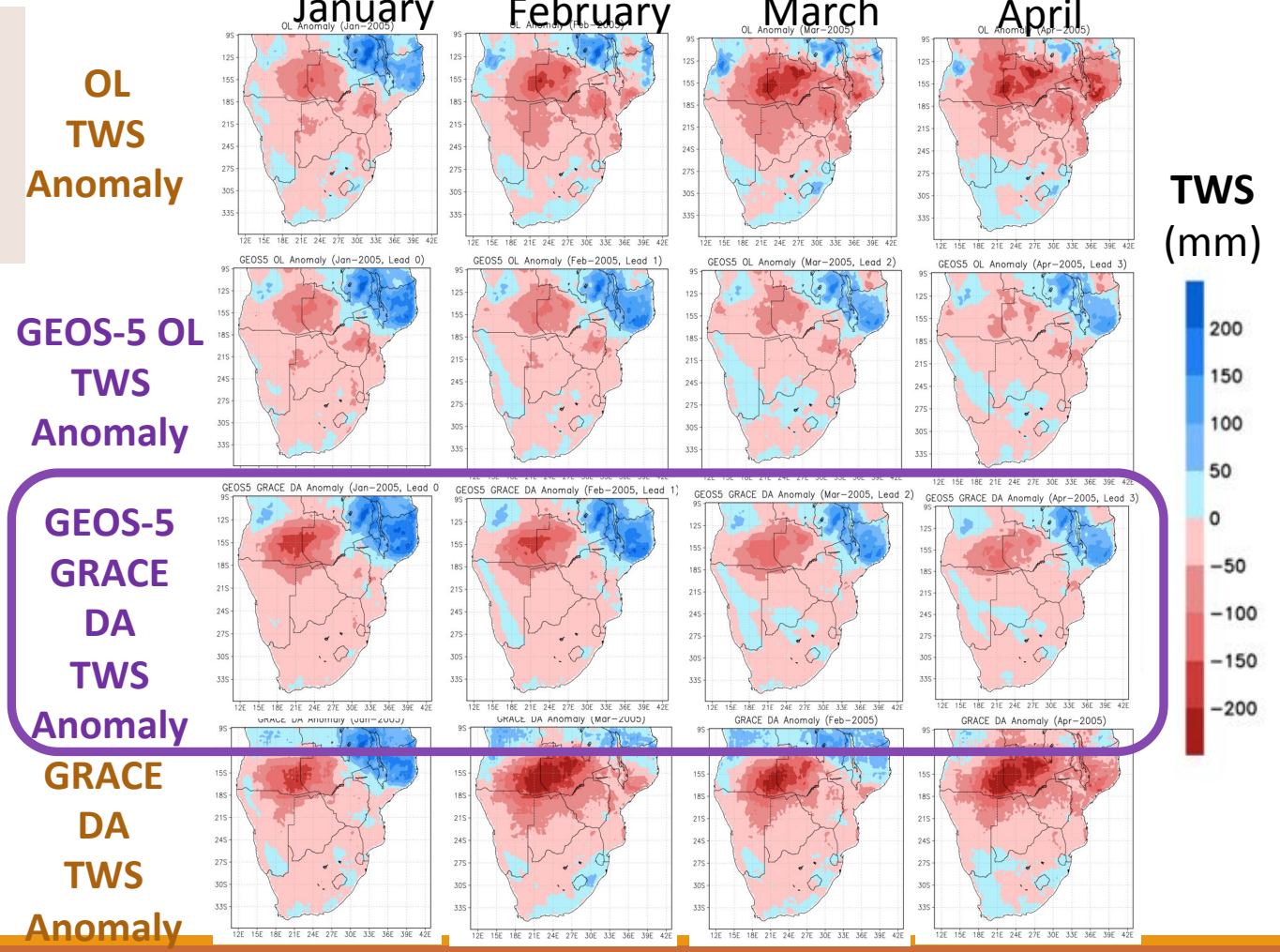


TWS (mm)



Comparing TWS forecasts with and without assimilating GRACE

- Forecasts initialized with GRACE DA based IHC was able to better simulate the severity of the drought than the IHC without GRACE DA.



Summary

- Modeled simulated TWS is able to reconstruct major drought events in Southern Africa.
- Modeled simulated SM can be useful for operational agricultural drought monitoring.
- Despite limited precipitation forecast skill GEOS5 adds to skill of drought forecasting beyond ESP. More climate models can add to skill.
- Drought severity detection can be improved by assimilating GRACE (potentially more useful for real-time forecasts)

FAME monitoring and forecasting products are promising tools for supporting FEWS NET's food insecurity outlook assessments!

Co-Authors and Acknowledgements

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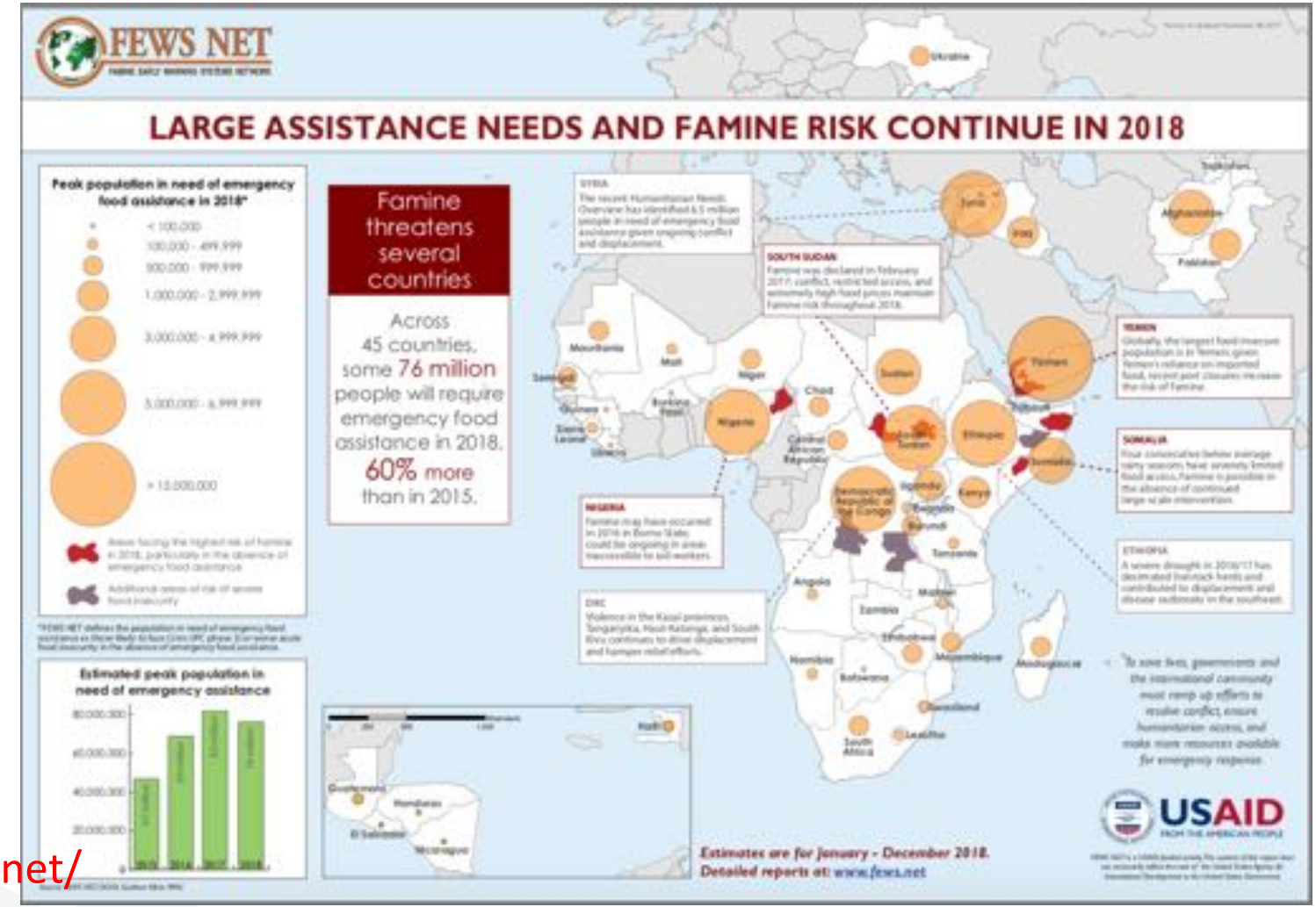
Thank you!

Drought contributes to food insecurity!



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