Benchmarking Improvements in Global Agricultural Drought Monitoring using Soil Moisture Modeling and Remote Sensing Tools

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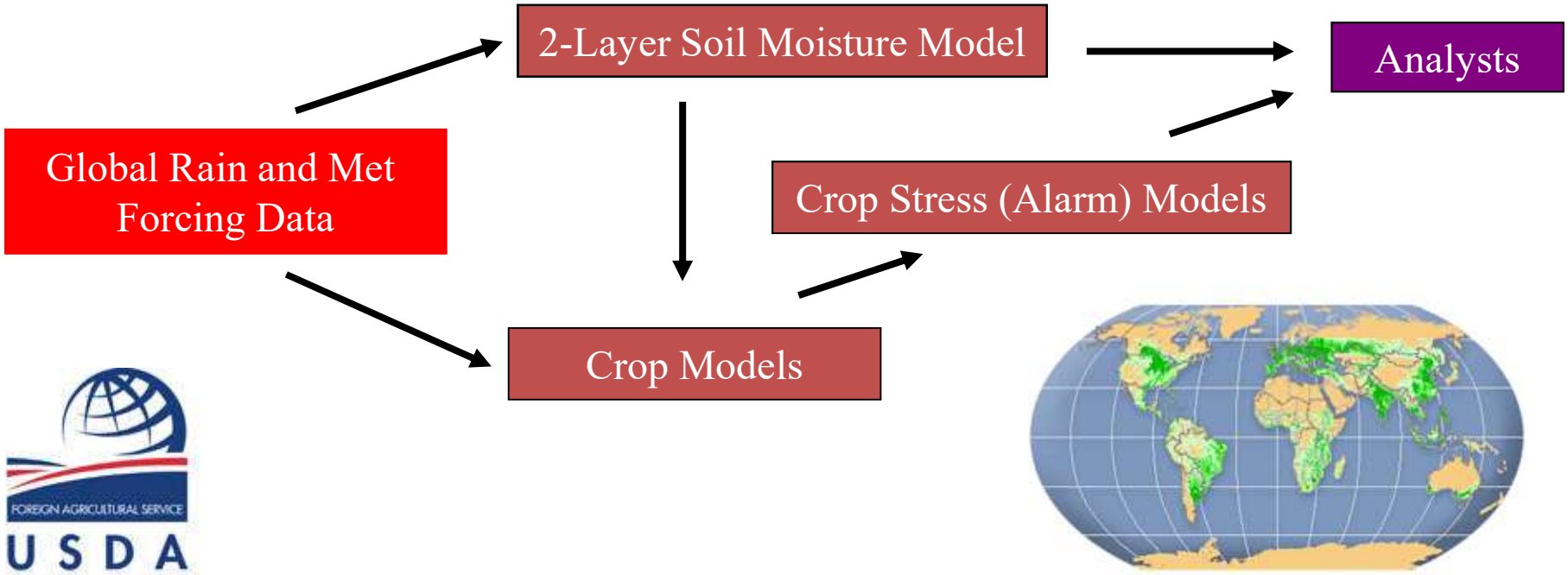
Baseline USDA FAS Treatment of Soil Moisture

Goal: Use global soil moisture products (among many other things) to forecast variations in international agricultural productivity and yield.

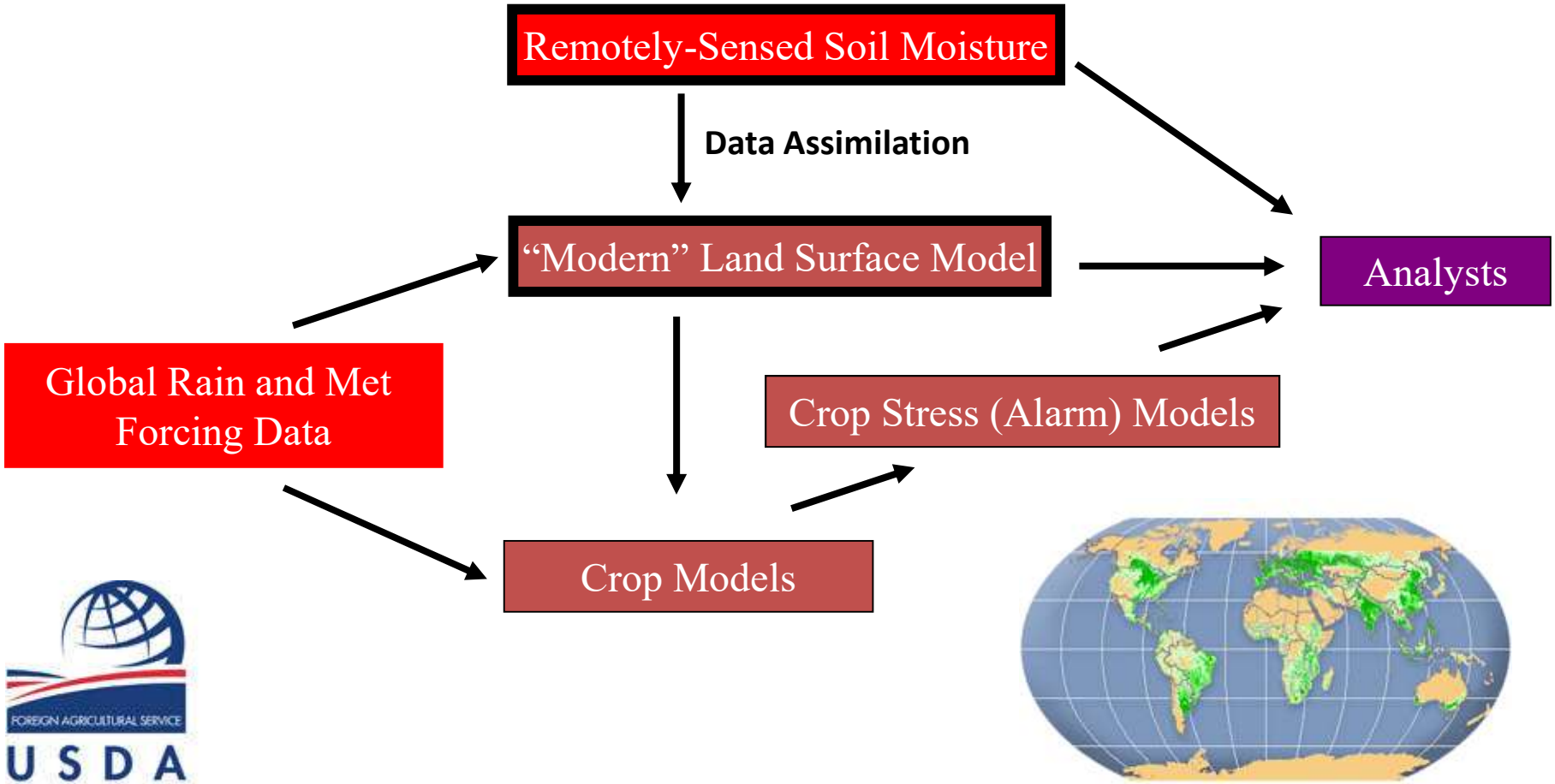
Baseline Approach: Global application of a (simple) soil water balance model.



Modifications Made by Project

What is the added value of integrating remotely-sensed soil moisture information?

What is the added value of integrated more complex soil moisture models?

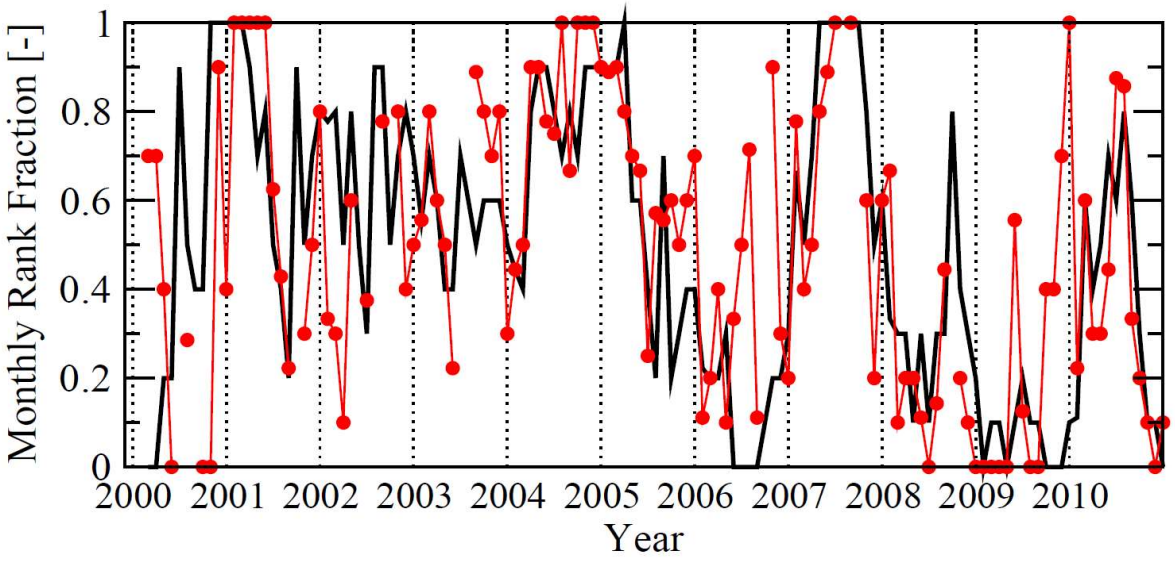


How do We Evaluate These Modifications?

1) Obtain a multi-year, monthly, 0.25° root-zone soil moisture (SM) product.
2) Obtain a multi-year, monthly, 0.25° vegetation indices (VI) product (e.g., NDVI or EVI)
3) Sort both by month-of-year and rank across all years of the multi-year data set.

(e.g., count all June's in 2000-2010 that are wetter than June 2005).

4) Calculate the cross-correlation of SM/VI ranks.



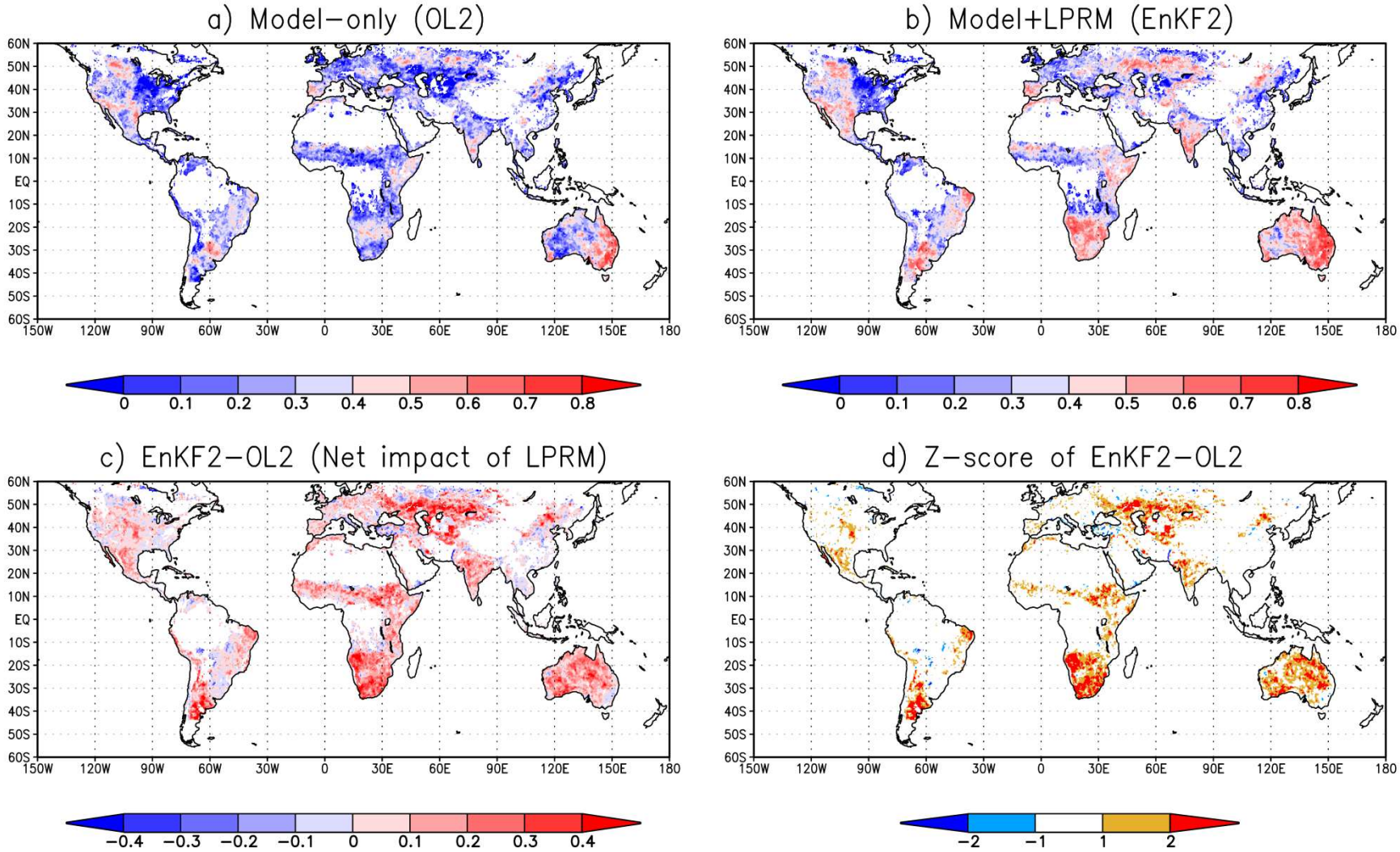
For a 0.25° OK box:
Soil Moisture is black
NDVI is red.

Degree of cross-correlation depends on:

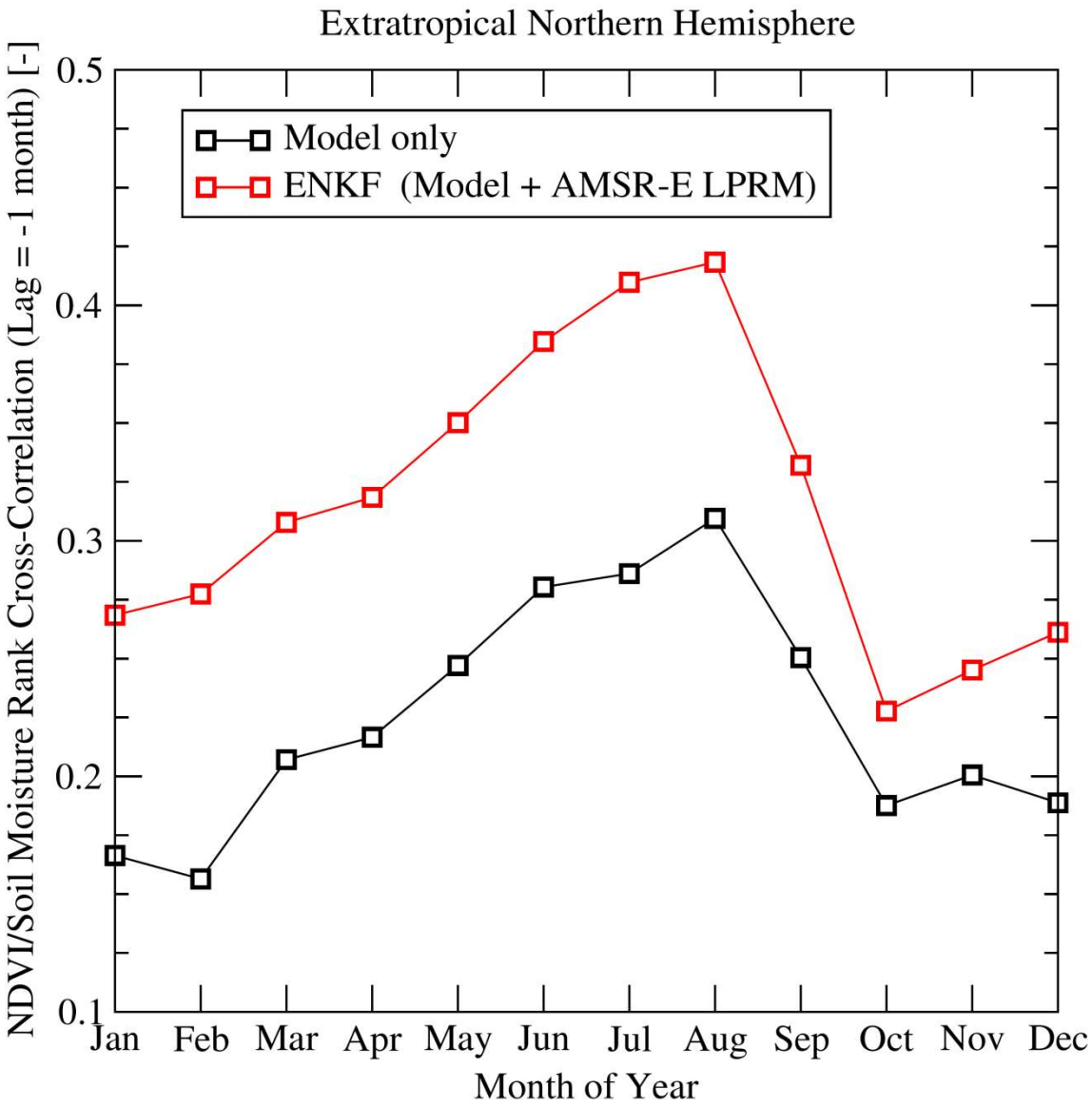
1) Climate (water versus energy limited growth conditions).
2) Accuracy of the VI product.
3) Accuracy of the SM product [*Peled et al.,* 2010].

2002 – 2010 Global Rank Correlations for Model and Data Assimilation

Rank correlation between moisture for month i versus NDVI for month i+1

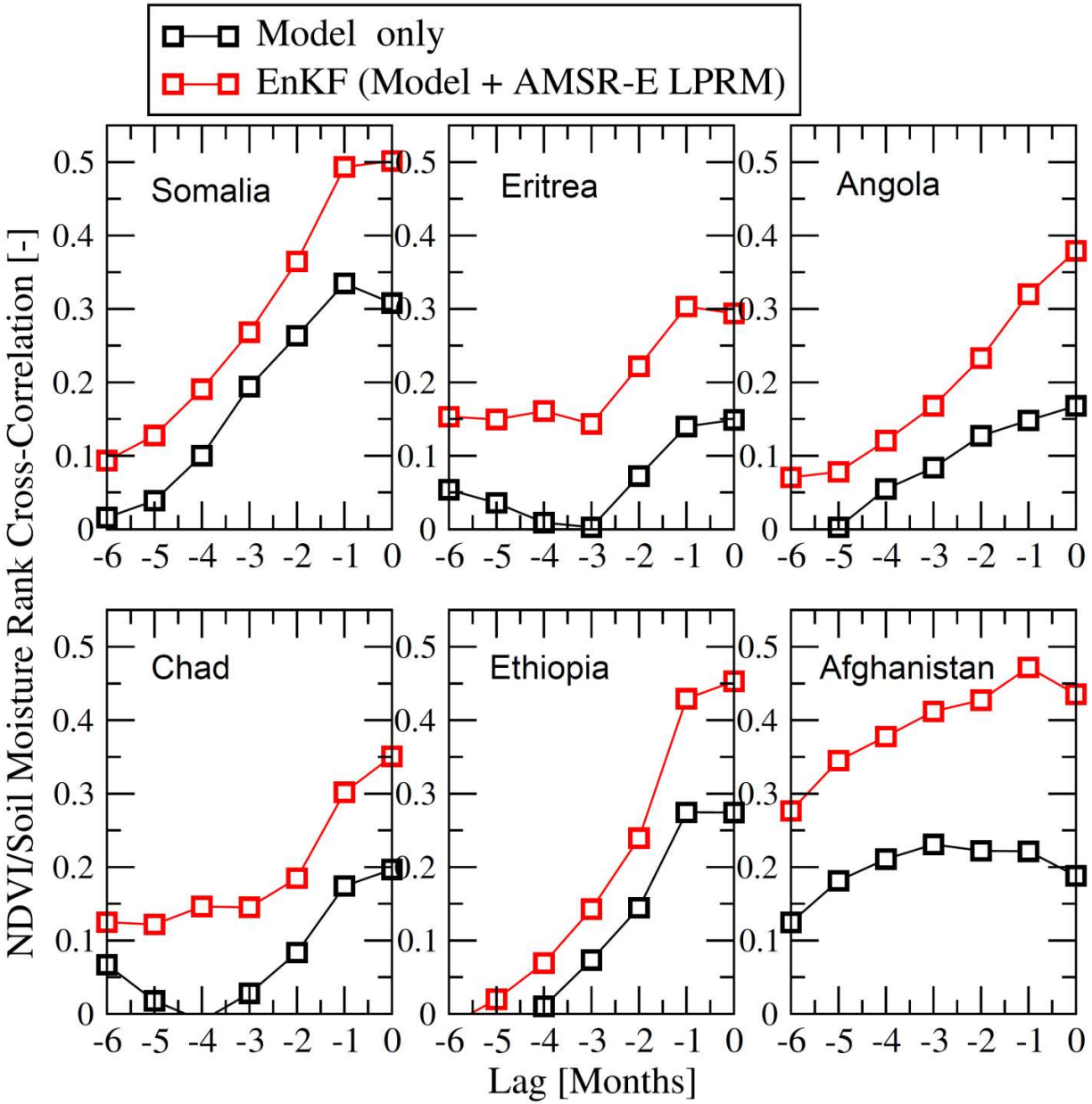


2002 to 2010 Seasonality Impacts



Rank correlation between moisture for month i versus NDVI for month i+1

2002-2010 Performance in Data-Poor Regions



6 of the 10 most "food insecure" countries in 2011.

Since the October 2011 failure of AMSR-E, the system has been run on SMOS soil moisture retrievals.

Bolten, J.D. and W.T. Crow, "Improved prediction of quasi-global vegetation conditions using remotely-sensed surface soil moisture," *Geophysical Research Letters*, 39, L19406, doi:10.1029/2012GL053470, 2012.

USDA FAS early adopter goals/activities:

1) Examine the impact of L-band SMOS soil moisture retrievals (relative to AMSR-E results presented here).

2) Understand the relationship between the existing system and the SMAP L4 RZSM product.

3) Prepare USDA FAS modeling system for the ingestion of SMAP L2/3 and/or L4 products.

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