Evaluating soil hydraulic parameter datasets and their impact on soil moisture simulations

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1. Abstract

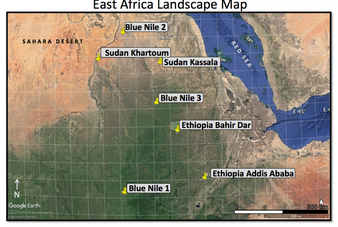
- Land surface and hydrology models use physical soil and meteorological variables to determine soil moisture
- Soil moisture data is used for agriculture growing seasons and weather predictions
- Abundant soil data are widely available for the U.S., but are inconsistent and sparse in regions such as East Africa
- Insufficient amounts of soil data in East Africa previously made soil moisture modeling difficult and may have resulted in inaccurate results

This study:
- We compare different land model experiment results between the original soil parameter standards (e.g., STATSGO/FAO) versus the latest high resolution soil parameter datasets (e.g., ISRIC)
- Information from this study may ultimately help those living in drought regions by producing more accurate and realistic modeled soil moisture conditions

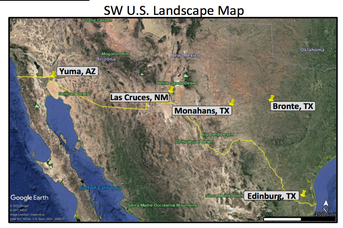
2. Background

Regions of Interest

East Africa Landscape Map

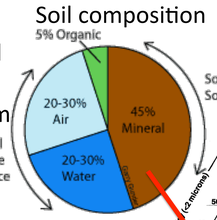


SW U.S. Landscape Map

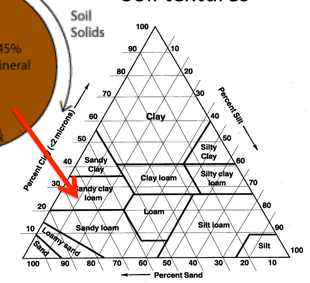


Soil moisture (SM) - Volume of water in soil pore spaces per total soil volume; varies from surface to root zone

Soil composition



Soil textures

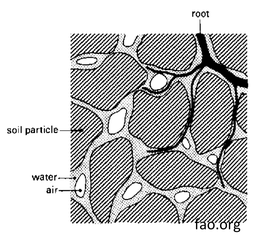


Soil parameters that affect soil moisture:
- Soil type
- Precipitation
- Soil porosity
- Soil wilting point

Soil porosity – percent of void space that can hold water or air
Wilting point – the soil moisture percent at which plants can not extract water from pores

3. Data &Methods

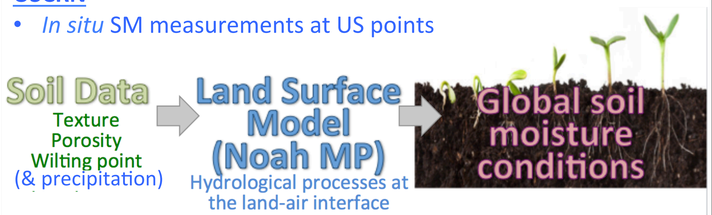
Soil Datasets



STATSGO/FAO
- Global coverage with 50 km spatial resolution
- US coverage with 1km resolution

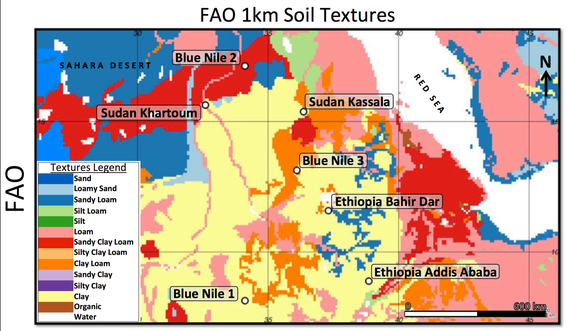
ISRIC (International Soil References and Information Centre)
- Global coverage with 250m spatial resolution
- Soil textures divided into clay, silt, and sand percentages

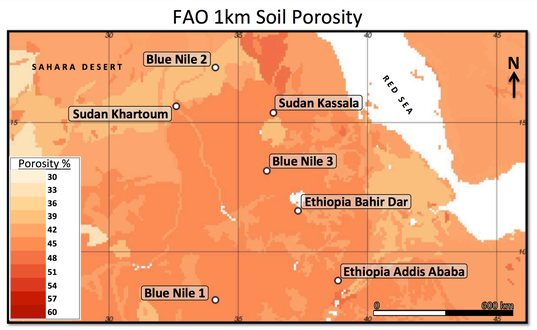
USCRN
- *In situ* SM measurements at US points

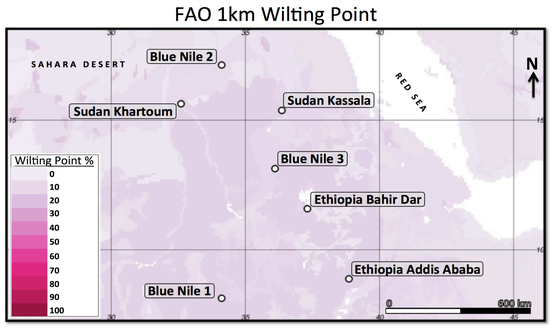


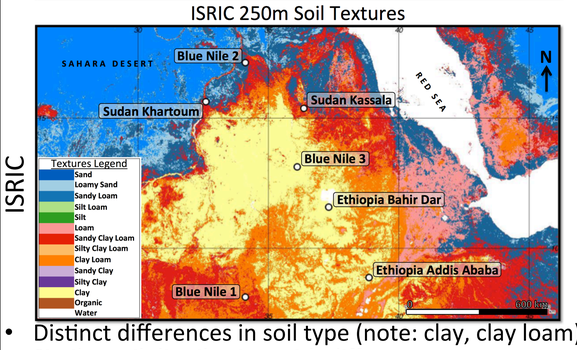
Computer software used: QGIS gnuplot GrADS

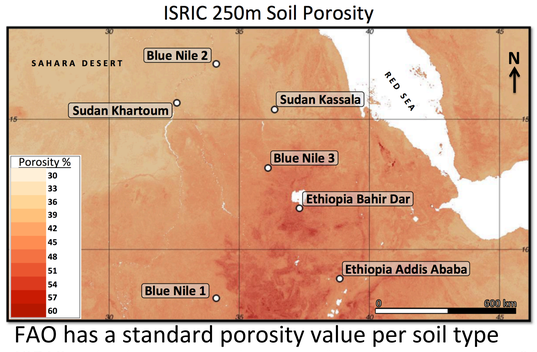
4. East Africa Results

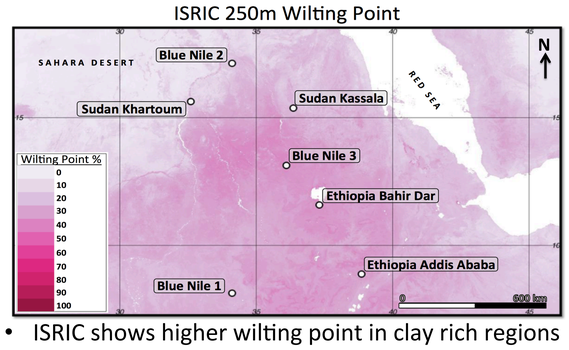








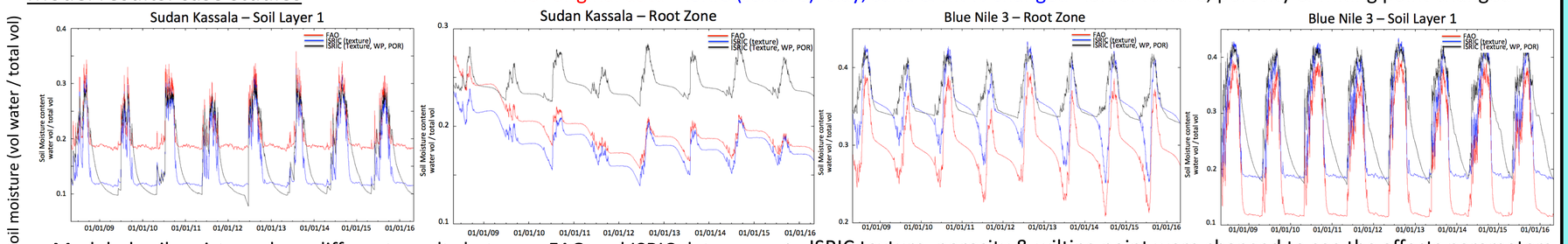




- Distinct differences in soil type (note: clay, clay loam)
- Similar soil distribution with difference textures
- FAO has a standard porosity value per soil type
- ISRIC calculates porosity based on clay, silt, sand %
- ISRIC shows higher wilting point in clay rich regions

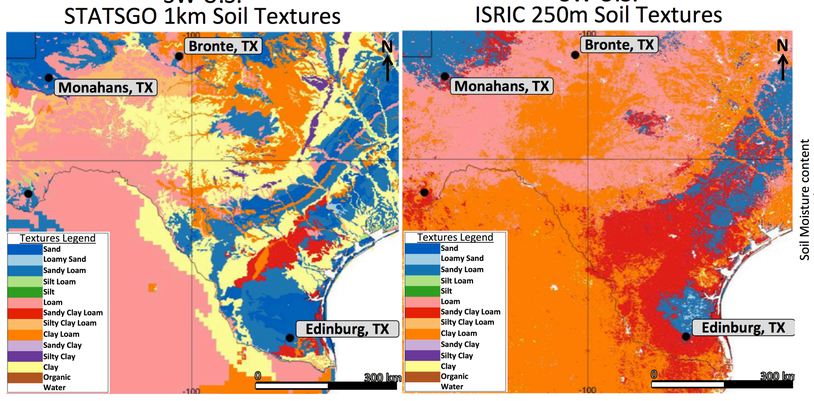
Model results: case studies

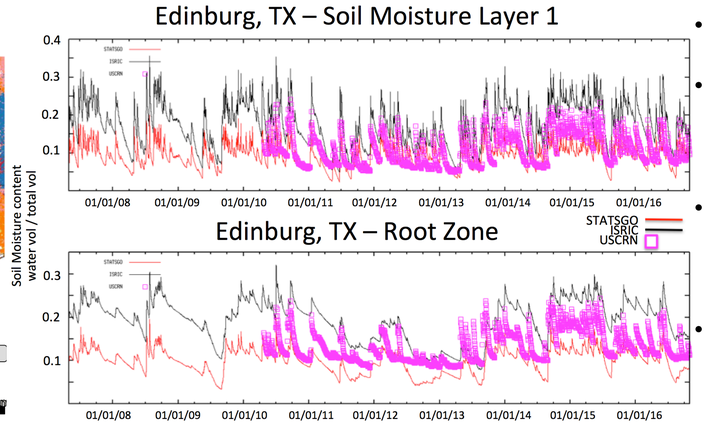
FAO: original data ISRIC (texture): clay, sand & silt % changed ISRIC: texture, porosity & wilting point changed



- Modeled soil moisture show different results between FAO and ISRIC data
- Top soil layer (5 cm) fluctuates more than root zone moisture (~1 m)
- ISRIC texture, porosity & wilting point were changed to see the affects parameters have on the model

5. Southwest U.S. Results





- USCRN sites are *in situ* soil moisture samples
- USCRN sites with low vol. SM values (< 10%) tend to be much lower than modeled SM
- SM values (> 10%) tend to correlate well within STATSGO and ISRIC-based model experiments
- STATSGO maps more clay than ISRIC soil type

6. Discussion & Conclusions

- Overall modeled SM for ISRIC and FAO data have similar shaped curves, however differences in SM can vary up to 10% (vol SM)
- US points with *in situ* SM data often fall in between the modeled STATSGO and ISRIC datasets; except when observed SM is below 10%

Differences in soil textures between FAO and ISRIC data is due to: FAO is a harmonized global soil map made of many difference soil surveys. ISRIC uses *in situ* measurements and extrapolated soil data through systematic "machine learning"

Final thoughts: There are large differences between the two model outputs. ISRIC appears to follow physical observations more closely than STATSGO/FAO

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