

A new, long-term root zone soil moisture (RZSM) dataset for operational agricultural drought monitoring over Africa

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With thanks to: Ewan Pinnington, Amsalework Ejigu,
Dhirendra Kumar and Simon Thomas



**University of
Reading**



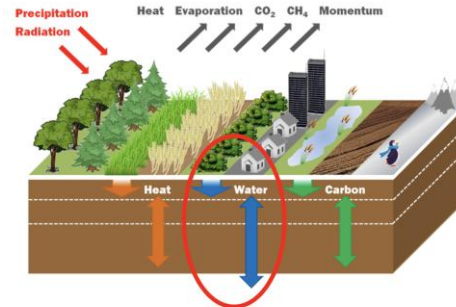
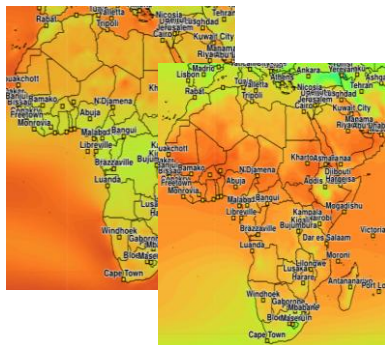
**National Centre for
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TAMSAT RZSM dataset: Estimation methodology

Driving data

TAMSAT satellite
rainfall estimates

Temperature,
radiation, wind
speed, humidity, etc



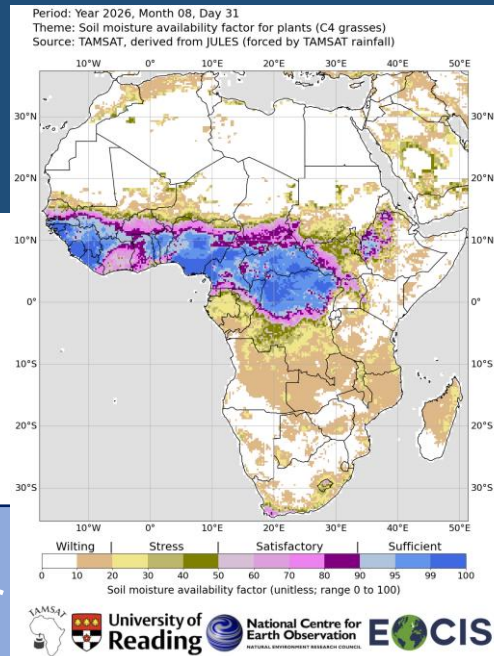
JULES model schematic

JULES

Land surface model

SMAP satellite soil moisture
observations
(for tuning JULES
soil hydraulic properties)

RZSM and other
water balance
variables
Daily, $0.25^\circ \times 0.25^\circ$
1983-present



Dataset paper:

Maidment et al., (2026)

Nature Scientific Data

<https://doi.org/10.1038/s41597-026-06585-w>

-026-06585-w

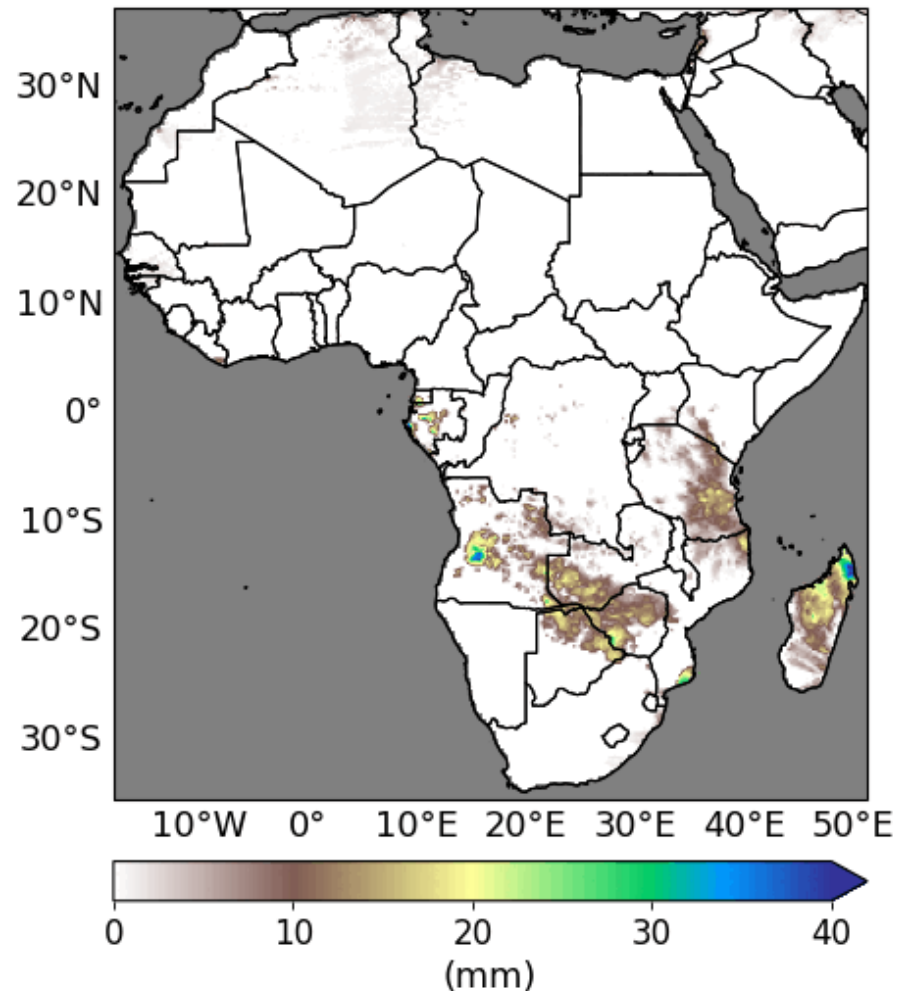
Key dataset characteristics

1. Provides **full column soil moisture**:
 - *beta* (soil moisture availability factor for C4 grasses) over top 1m of soil - important for staple crops such as maize whose roots can reach similar depths (*satellite-only soil moisture measurements can only “see” the top 5-10 cm of soil*)
 - moisture content for each soil layer (0–0.1 m, 0.1–0.35 m, 0.35–1.0 m, 1.0–3.0 m)
2. Provides other **water balance variables**: *precipitation, fqw_gb, fao_et0, runoff*
3. Long-term record (1983-present) – important for assessing **drought risk**
4. High temporal (daily) and spatial (0.25° x 0.25°) resolution
5. Operational (since Jan 2024) with ~7-day latency – important for **near-real time applications**
6. Consistent with:
 - **TAMSAT satellite rainfall estimates** (already widely used across Africa)
 - **TAMSAT-ALERT soil moisture forecasts**

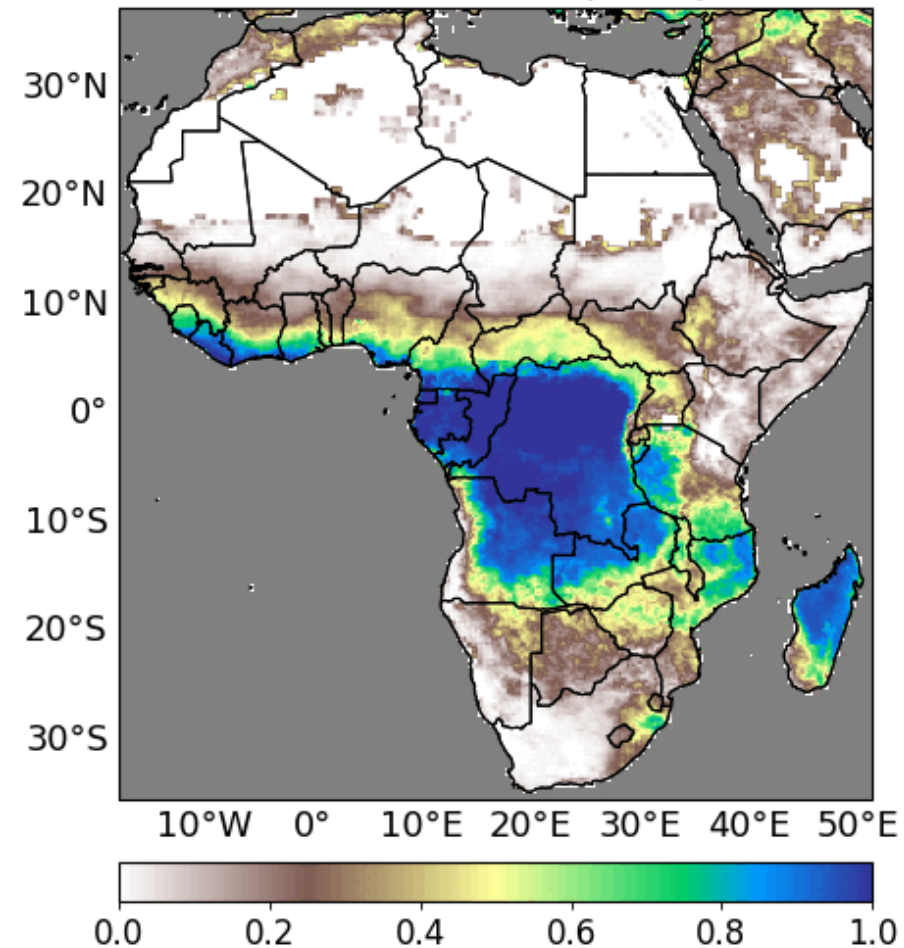
Soil moisture has consistent mass balance with TAMSAT rainfall

2018-01-01

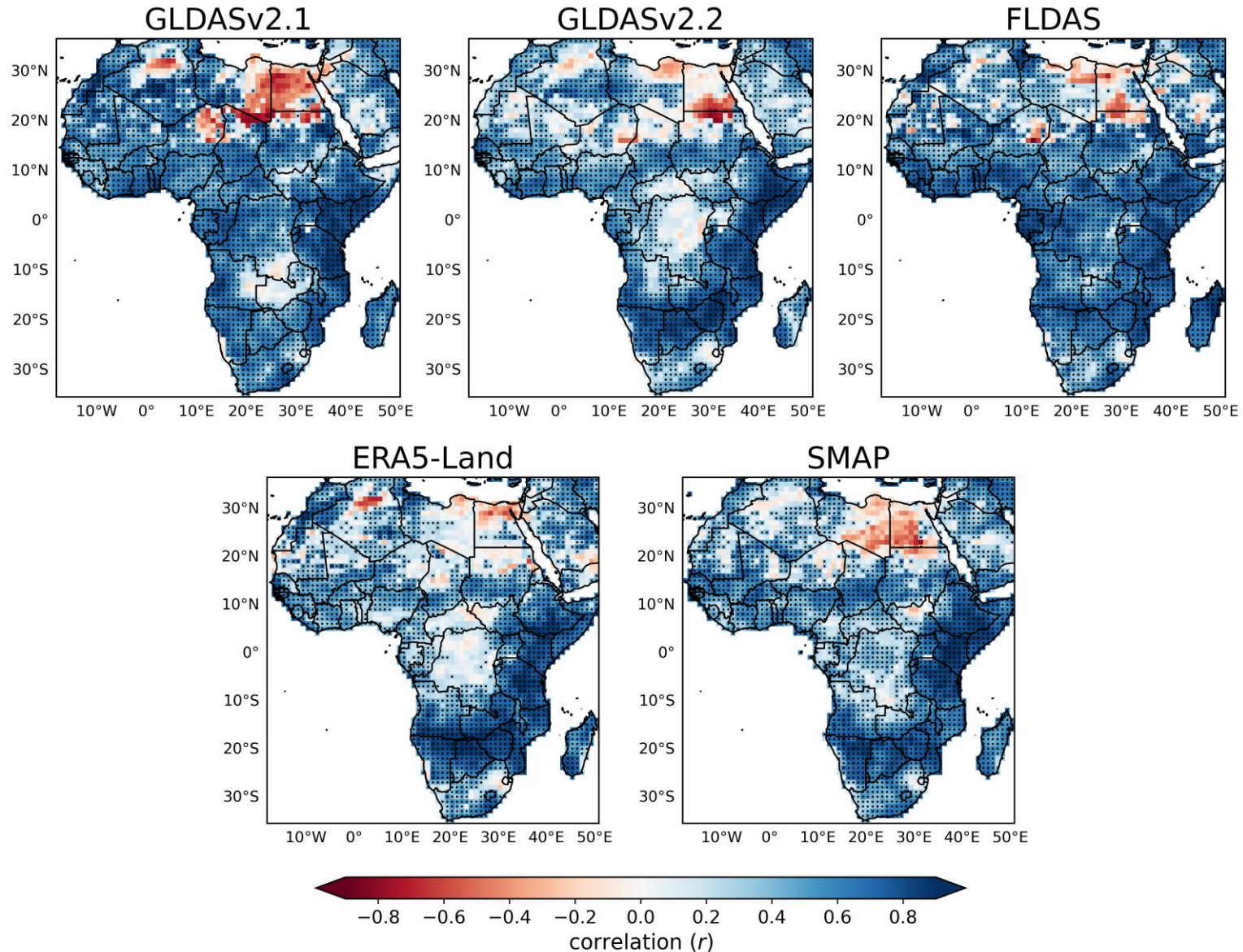
TAMSAT rainfall



TAMSAT soil moisture (beta)



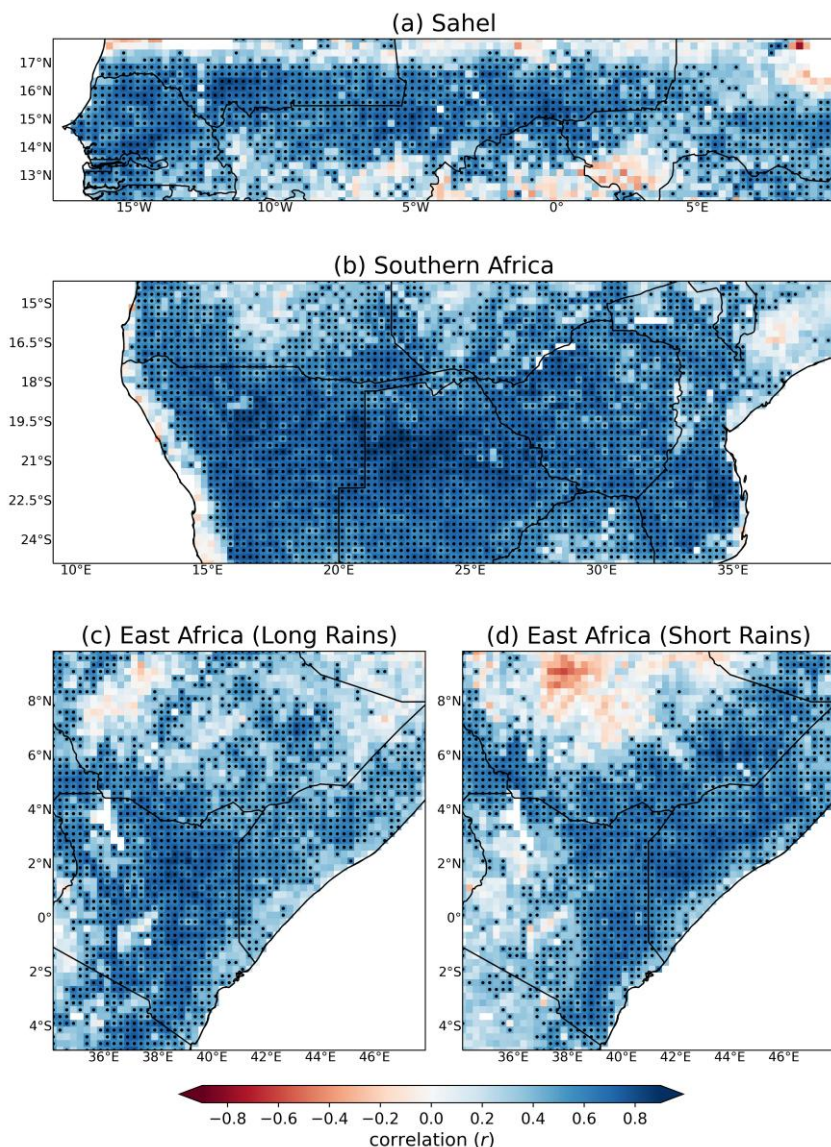
Skill: TAMSAT is consistent with other RZSM datasets



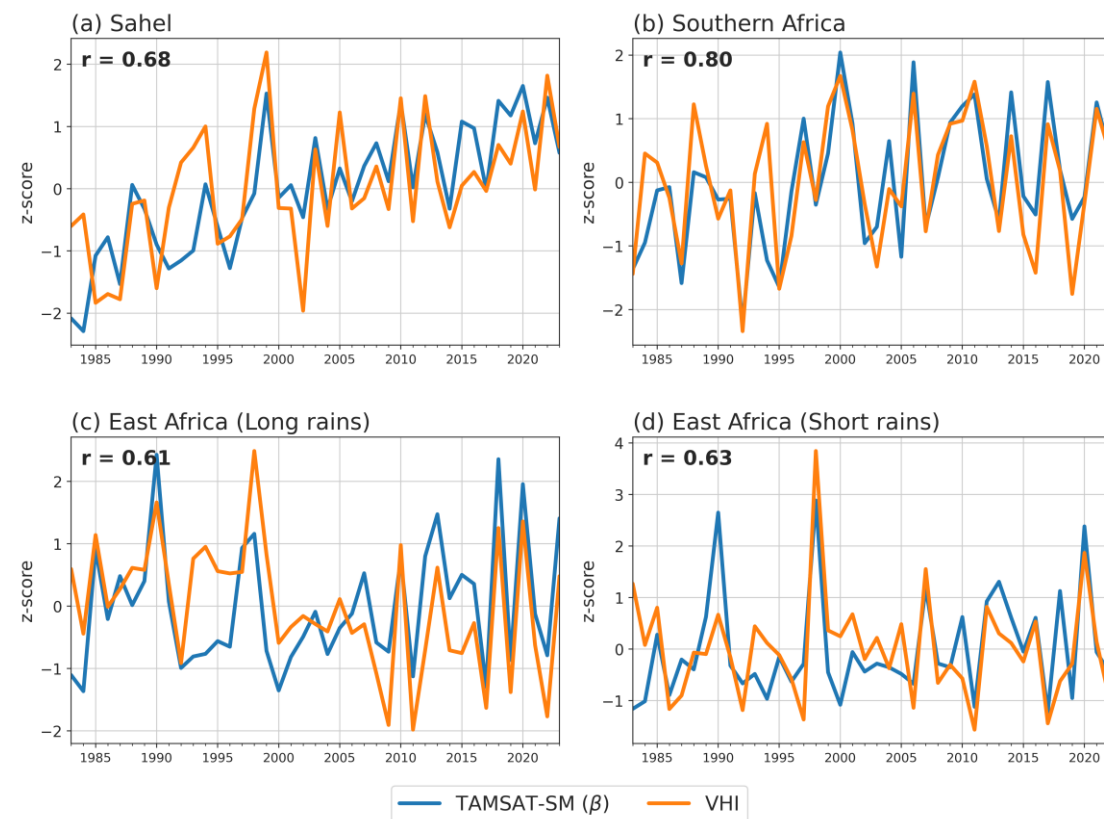
Correlation in monthly RZSM anomalies between TAMSAT and other commonly used soil moisture datasets (2016-2023).

Very good agreement across semi-arid regions – places where RZSM information is needed the most.

Skill: TAMSAT is consistent with satellite vegetation indices



TAMSAT soil moisture (beta) shows very good agreement with the satellite-derived vegetation health index (VHI) across semi-arid regions.



TAMSAT Data Access: www.tamsat.org.uk


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TAMSAT

Tropical Applications of Meteorology using Satellite and ground-based data

What is TAMSAT?

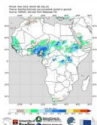
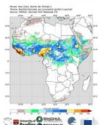
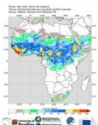
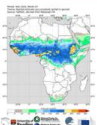
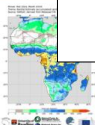
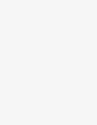
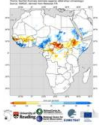
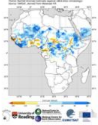
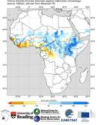
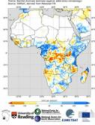
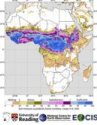
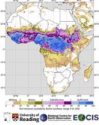
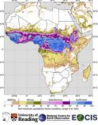
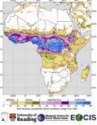
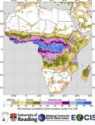
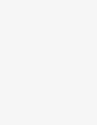
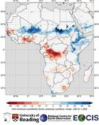
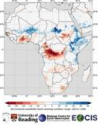
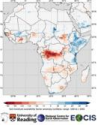
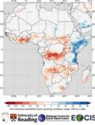
TAMSAT* enhances the capacity of African meteorological agencies and other organisations by providing and supporting the use of satellite-based rainfall estimates, soil moisture and rainfall anomaly maps.

TAMSAT products are available as well as soil moisture maps at 0.25° x 0.25° resolution. These products are used for delayed precipitation, risk assessment, insurance and disaster relief.

TAMSAT rainfall data is used by the 26th of the month for commercial use.

Latest Maps

Latest rainfall and soil moisture maps for all Africa.

Product	Daily	Pentad	Dekadal	Monthly	Seasonal
Rainfall					
Rainfall anomaly					
Soil moisture availability factor for plants					
Soil moisture availability factor for plants anomaly					

Data Access

There are several options to download TAMSAT rainfall and soil moisture estimates:

Time and area subsetting tool
(rainfall and soil moisture)

Extract a time-series for a given location or an area-average from January 1983 to present. This tool is recommended for users conducting time-series analysis.

Individual file quicklook and download (rainfall)

Download individual rainfall files (netCDF format at 0.0375° resolution) and accompanying quicklook files (png format). This is useful if you want to look at rainfall estimates for a single event or over a short time-period.

Individual file quicklook and download
(soil moisture)

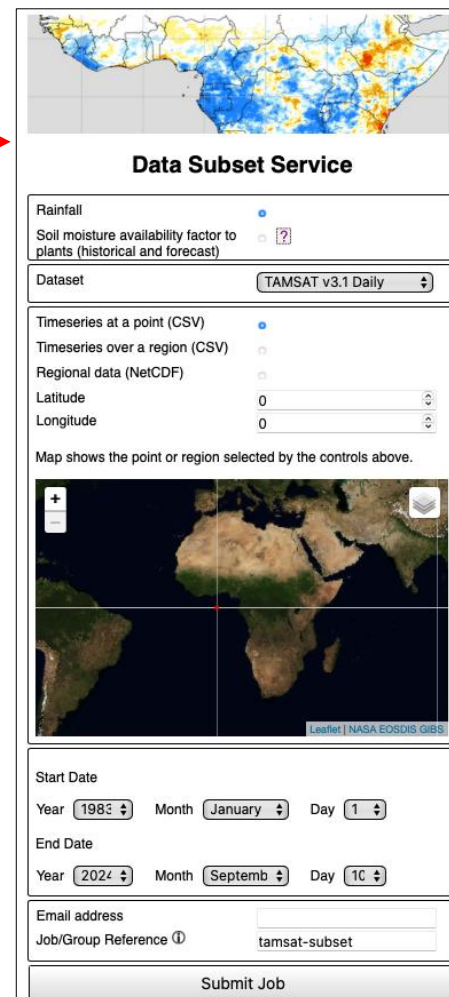
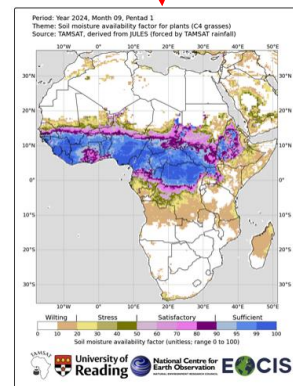
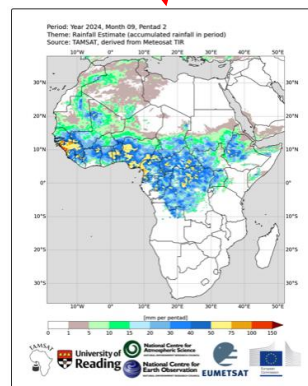
Download individual soil moisture files (netCDF format at 0.25° resolution) and accompanying quicklook files (png format). This is useful if you want to look at agricultural drought conditions at given point in time.

HTTP file listing
(rainfall)

Download individual rainfall files (1983-present) using HTTP file listing. This can be used with tools such as `wget` to download multiple files.

HTTP file listing
(soil moisture)

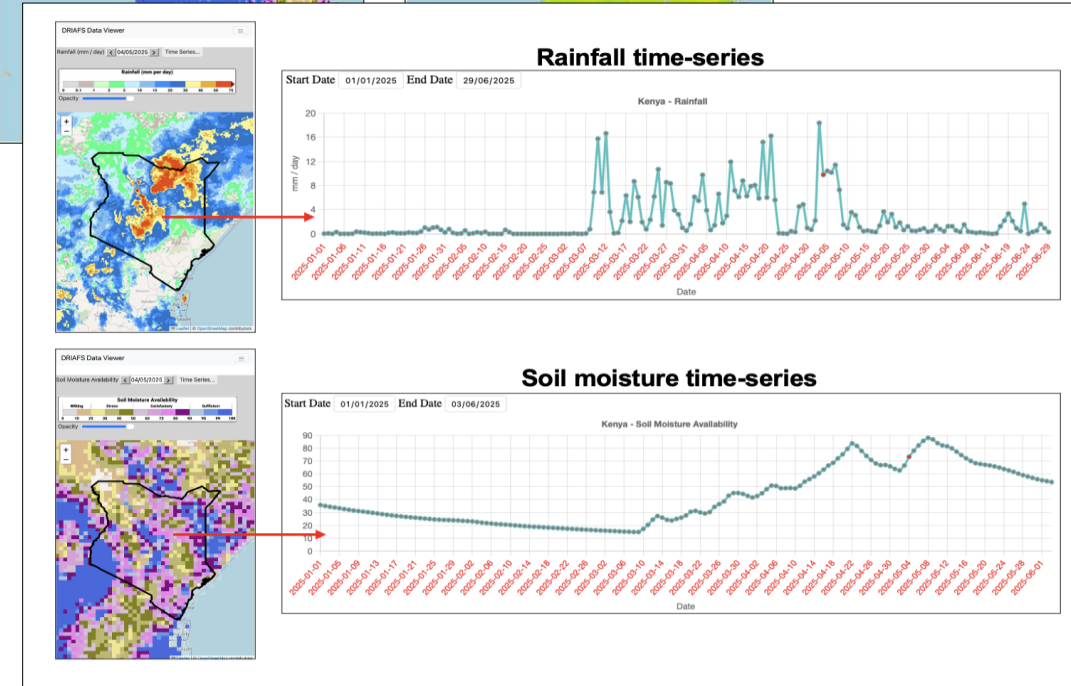
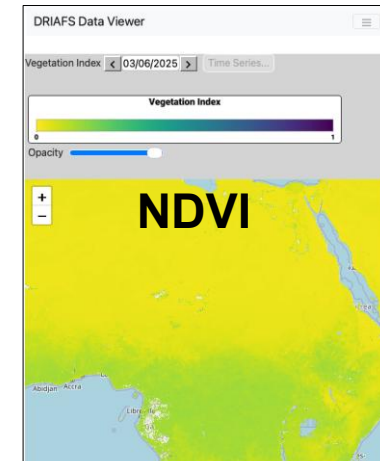
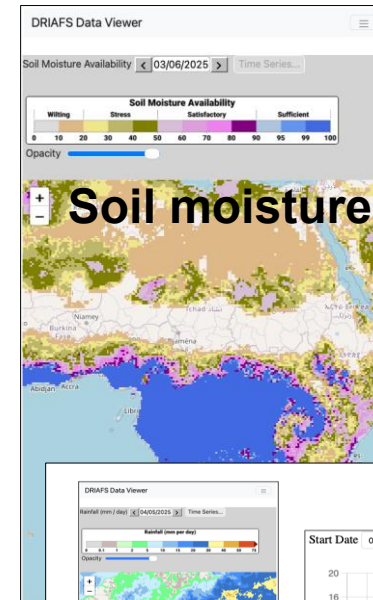
Download individual soil moisture files (1983-present) using HTTP file listing. This can be used with tools such as [wget](#) to download multiple files.



TAMSAT Data Access: TAMSAT Drought Watch tool

- New **TAMSAT Drought Watch** tool currently in development will **facilitate easy access to drought information**
- Mobile phone friendly
- Maps and time-series at sub-national levels
- Provides three key drought indicators:
 - **Rainfall, soil moisture** (source: TAMSAT)
 - **Vegetation health (NDVI and VHI)** (source: NOAA-VHP)
- Absolute values and anomalies (1983-present)
- Developed through DRIAfS* NERC KE Fellowship

*Drought Risk Information for the African Finance Sector



Application: Drought index insurance for farmers

- Index insurance uses a **proxy** (e.g. rainfall) to determine payouts.
- **Soil moisture has advantages over rainfall-based drought index insurance schemes**, yet soil moisture is rarely used by the insurance sector.
- In recent years, we have carried out **capacity building** workshops with the African insurance sector and ran a series of **pilots** to demonstrate the value of satellite-derived soil moisture.



Zambia
Mar 2023



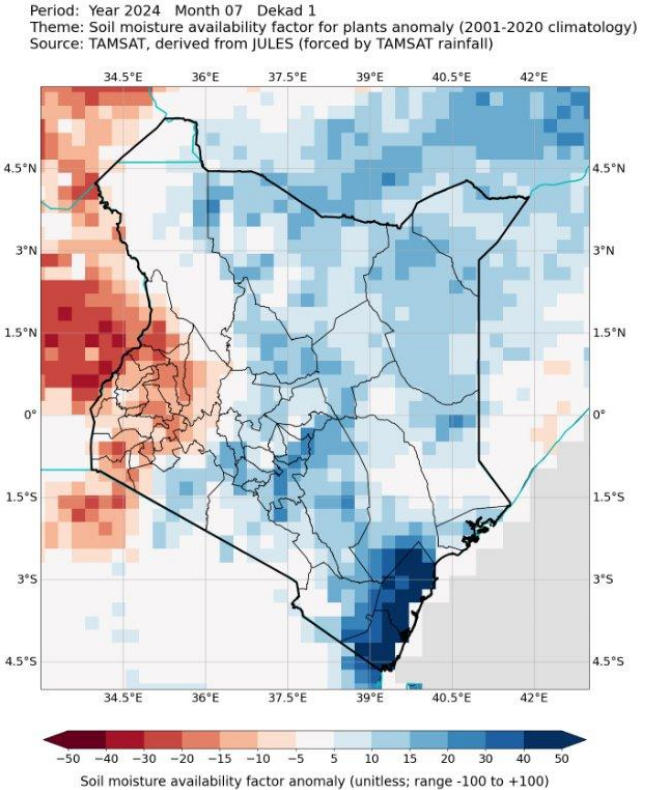
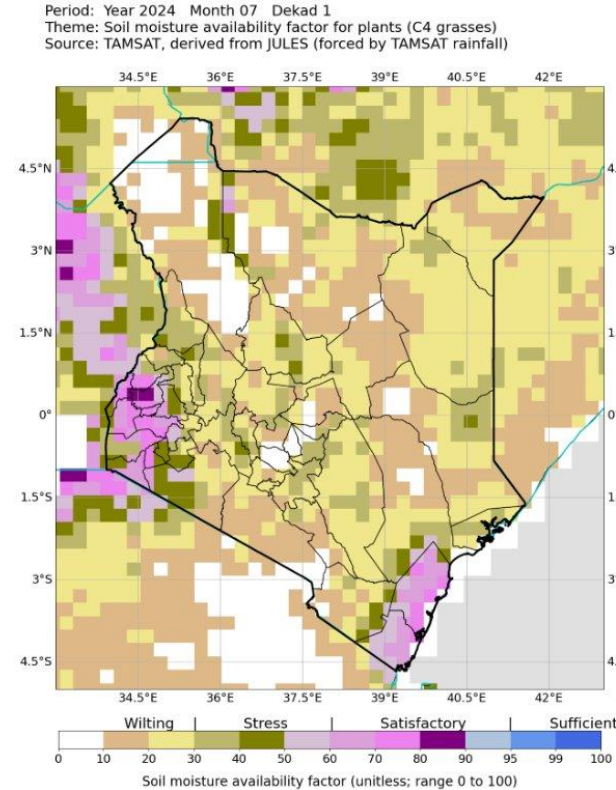
Kenya
Feb 2024



Zambia
May 2025

Application: Agricultural drought monitoring with African NMHS

- We have worked with the Kenya Meteorological Department to **develop a system for monitoring and forecasting agricultural drought**.
- System **complements in-situ monitoring** and provides **metrics tuned to Kenya's crop growing seasons** which are supported by soil moisture forecasts from TAMSAT-ALERT.



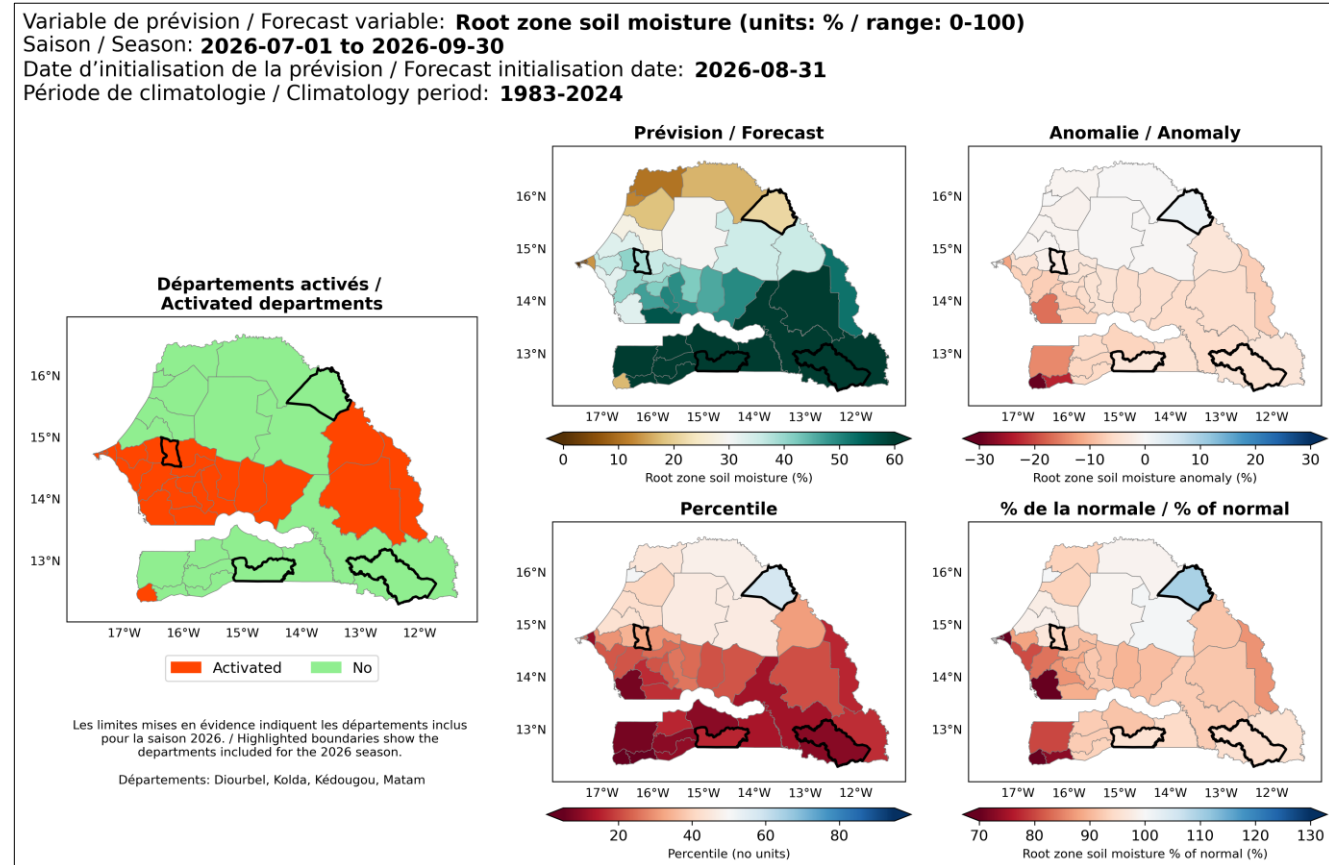
Application: Disaster Risk Finance (DRF) for agricultural drought

- We are working with **humanitarian sector** partners to realise the benefits of soil moisture for DRF for agricultural drought - for example:

**START
NETWORK**

Using TAMSAT RZSM to support drought risk financing in Senegal, with a new forecasting DRF system launched in 2026 (*example platform output shown left*).

Using TAMSAT RZSM to evaluate drought DRF products and assess its advantages over other drought indices.



Summary

- TAMSAT has developed a new JULES-based RZSM dataset providing Africa-wide soil moisture and water balance variables from 1983-present.
- Designed to **support agricultural drought monitoring and forecasting** across multiple sectors.
- We are using this dataset alongside our rainfall estimates to enhance existing and develop new **TAMSAT climate services**.

What next?

- Build capacity and uptake through further index insurance pilots and training under DRIAFS (*Drought Risk Information for the African Finance Sector; NERC KE fellowship; 2024-2027*).
- Expand collaborations within the humanitarian sector.
- Release a new dataset version in 2027, using ERA5 driving data and the latest JULES version.