Building accurate and timely rainfall maps for Africa

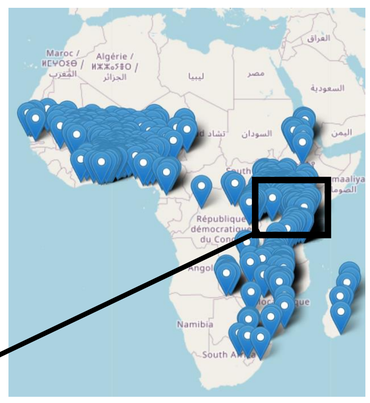
Enhancing Rainfall Estimates in Africa by Merging TAHMO ground data with Satellite Rainfall Datasets

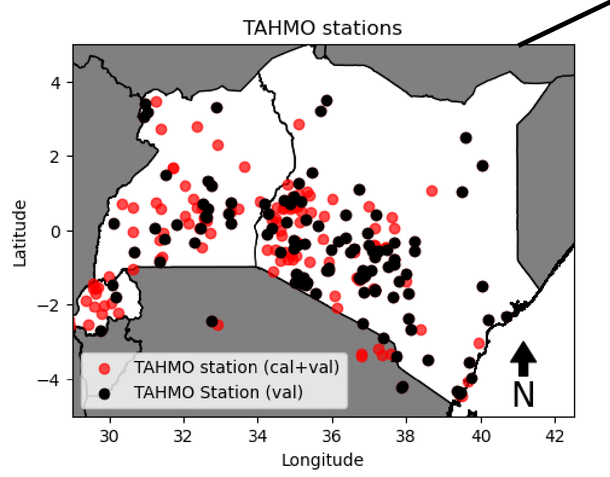
Vincent Hoogelander, Nick van de Giesen, Rolf Hut

Why?

- Rainfall variability plays a crucial role in Sub-Saharan Africa (SSA), and the impacts of climate change are expected to increase the frequency of severe droughts and floods.
- SSA is highly dependent on satellite rainfall measurements due to a lack of available ground data.
- While many satellite rainfall products are available, their performance in SSA is typically poor.
- The goal of this research is to enhance satellite rainfall measurements in SSA by merging satellite data with data from a relatively new network of ground stations

TAHMO weather stations

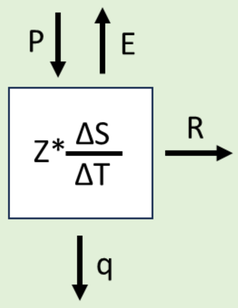


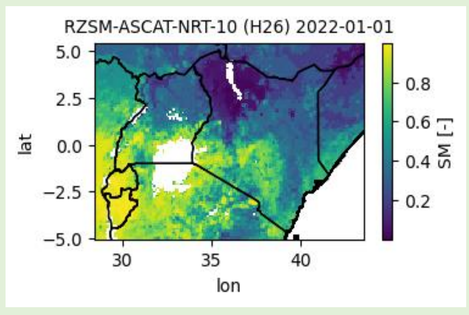


The Trans-African Hydro-Meteorological Observatory (TAHMO) aims to tackle the ground data gap by installing and operating a dense network of weather stations in Sub-Saharan Africa.

Using satellite-derived soil moisture data to measure rain (SM2Rain)

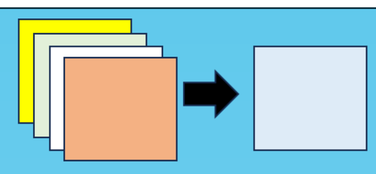
- Rainfall can be directly estimated based on the conversion of the soil moisture water balance (SM2Rain)
- SM2Rain utilizes satellite-derived soil moisture data
- SM2Rain parameters are calibrated with TAHMO data



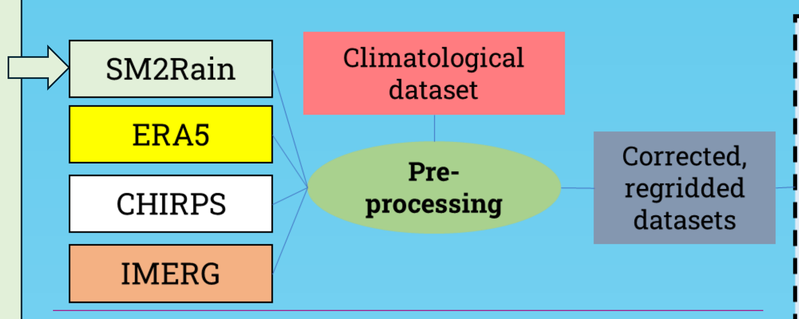


P = Precipitation (mm/d), E = Evapotranspiration, S = Soil moisture content (-), T=Time (day), Z = Storage capacity (mm), R = Overland flow (mm/day), q = Drainage (mm/day)

Merging algorithm



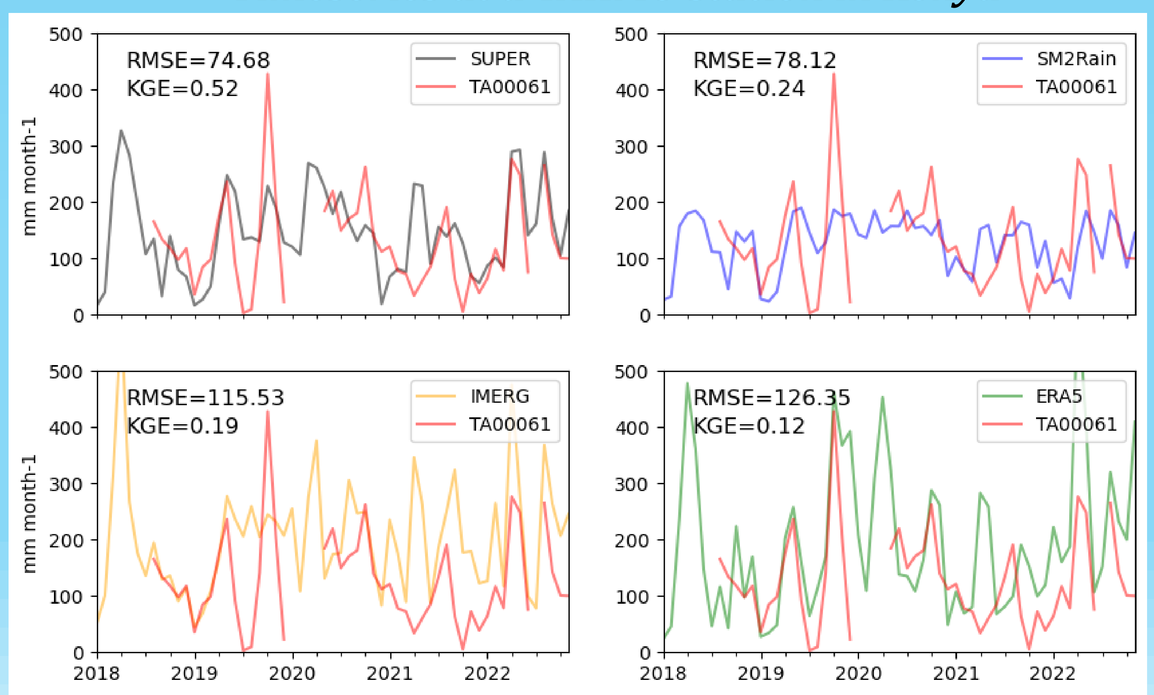
(Pixel-to-pixel)



	Spatial Resolution	Temporal resolution	Latency
SM2Rain	0.1°	1-day	12 h
ERA5	0.1°	1-hour	5 d
CHIRPS	0.05°	1-day	3 w
IMERG (L)	0.1°	30-min	10 h

SM2Rain is merged with other existing satellite rainfall products (ERA5, IMERG, and CHIRPS) using a Statistical Uncertainty analysis-based Precipitation mERging framework (SUPER).

Timeseries at a TAHMO station in Kenya



Key Findings so far

- Ground stations can be easily integrated through the SM2Rain algorithm.
- SUPER generally outperforms individual rainfall products, potentially making it a more reliable reference product for operational purposes.
- Validating satellite rainfall products (areal) against ground measurements (point) can be tricky, especially given the variability in rainfall as observed by the TAHMO stations.

What's next?

West-Africa
Apply the methods in West-Africa to extend the analysis (in progress)

Nyankpala rainfall observatory
Compare the satellite-based rainfall estimates with a dense network of rain gauges in Northern Ghana to better understand errors in satellite-derived rainfall estimates in Africa (planned)

Near-real-time satellite rainfall product
Develop a new rainfall product based on MeteoSat Third Generation data (planned)

***TEMBO Africa**: The work leading to these results has received funding from the European Horizon Europe Programme (2021-2027) under grant agreement n° 101086209. The opinions expressed in the document are of the authors only and no way reflect the European Commission's opinions. The European Union is not liable for any use that may be made of the information*

Contact: Vincent Hoogelander MSc

V.Hoogelander@tudelft.nl

Building 23 (CITG), room 4.96