TU Delft Delft University of Technology

Water, Weather and Climate Services for Africa: the case of Ghana and Kenya

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TWIGA

Introduction to the TWIGA project

The **objective** of the project is to provide currently **unavailable geo-information on weather, water and climate** for sub-Saharan Africa by enhancing **satellite-based geo-data** with innovative **in situ sensors** and developing related **information services** that answer needs of African stakeholders and the **GEOSS** community.

FarmerLine · FutureWater · GAIP

GReD · HCP International · HydroLogic

Imperial · KMD · KNUST

Makerere · MicroStep · PolMi

SAWS · Starlab · Strathmore

TAHMO · TU Delft · UFZ

18 Partners

10 - Europe
8 - Africa

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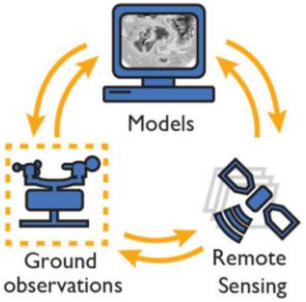
Sensors in TWIGA Countries

Ghana

Kumasi DTS, UAV, TAHMO, VegMon, Plastic CS

Tamale Disdro, Rainfall CS, DTS, TAHMO, VegMon

Navrongo VegMon, TAHMO



Uganda

Entebbe GNSS, TAHMO

Bugame GNSS, TAHMO

Kenya

Narok **Disdro, Soil** moisture, TAHMO, Evaporometers, VegMon

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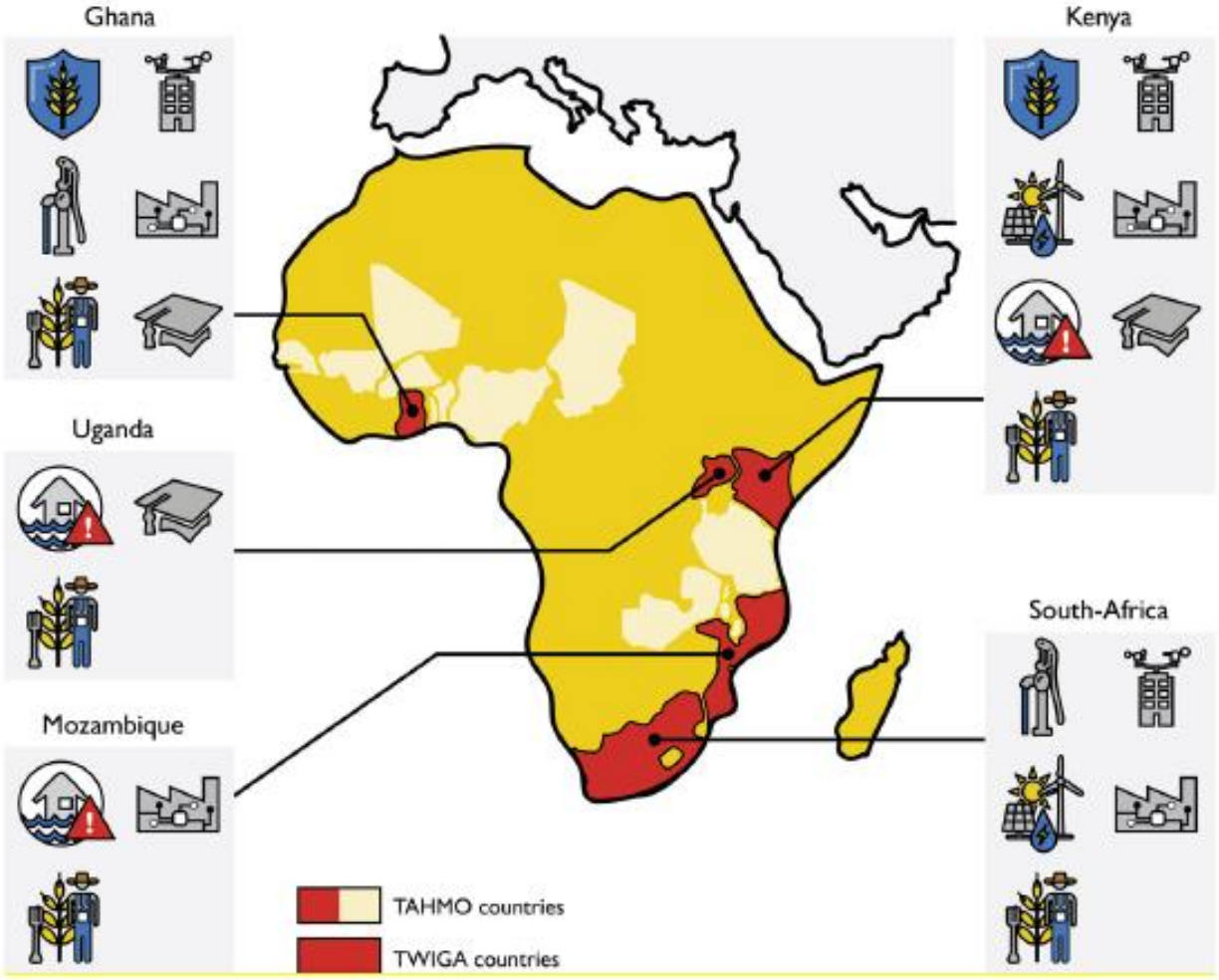
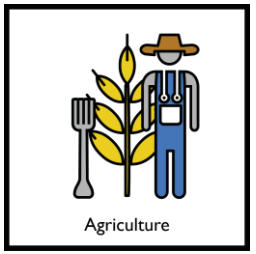
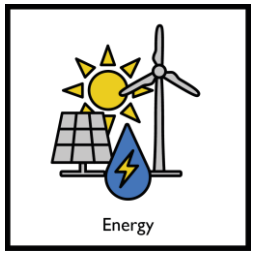
Mapped Services







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TWIGA Services in Ghana & Kenya

Implemented

SN	Service	Description of Service	TWIGA Innovations/Data requirement
1	How humid is my environment	Provide estimates of how wet the soil is in five classes: very dry, dry, moist, very moist, and saturated. "Very dry" corresponds with wilting point and "very moist" with field capacity.	Thermal imagery from UAVs, Sentinel-1 , DTS, Evaporometers, Low-cost soil moisture sensors and TAHMO stations
2	Crop insurance based on soil index	The crop insurance product uses soil moisture conditions for pay-outs instead of only rainfall (this include yield and germination insurance). The soil moisture is determined using satellites and soil moisture probes and DTS in 2 pilot locations (Districts) - one each in Northern and Southern Ghana.	Farmerline's Mergdata Platform, Sentinel-1 derived soil moisture products, Disdrometers, TAHMO Stations, HydroNet Platform, Soil moisture sensors including Teros-12
3	Short-term prediction for solar energy	By extrapolating cloud movements and daily cloud formation patterns, it is possible to develop a short-term prediction for the amount of solar radiation reaching the surface. This information will be useful for energy managers that include large solar farms. TAHMO data is used to train the model and assess the results.	TAHMO stations, Satellite Data and Models
4	EWS for clogging of drains	Urban drainage networks in Africa tend to clog at bottlenecks with discarded plastic. A camera is used to take regular pictures and transform the image into a simple measure of accumulation. This information will be sent to the web. Warnings can be issued to municipalities and/or plastic collectors.	GNSS network for early warning system, Disdrometers (intervalometers), Flood Mapping App, TAHMO stations
5	EWS for heavy rains	Mapping open water floods and vegetated flooded areas, combining satellite remote sensing with UAV. Products: River cross-sections and DEM + flood map + training	Sentinel-1 data, UAVs, Soil Moisture Sensors, Flood Mapping App, DEM, HydroNet platform
6	Crop detection and condition monitoring (crop doctor)	Crop detection, crop stress monitoring	UAVs (NIR, NDVI), VegMon App

Pipeline

1. Route planning for agribusiness
2. Meteorological information for livestock – EWS
3. Meteorological information for plagues prediction
4. Vulnerability Indexes for Insurance
5. Wind forecast for wind energy
6. Water quality monitoring tool
7. Water availability
8. Post-disaster vector-borne diseases forecast
9. Downscaling seasonal forecast
10. Heatwave forecast/heat index
11. Fire danger index
12. Seasonal forecast (onset of rain, temp)
13. Forecast for fisheries (heavy rains over lakes/coastal areas)
14. Fog prediction
15. Thresholds for specific extremes
16. Map4ER: Mapping for Emergency Response
17. Flood Impact: Early warning flood forecasting
18. Erosion and landslide Risk
19. Basin Water Control Room
20. Energy flux maps
21. Drought monitoring forecasting
22. Drought/Flood vulnerability maps
23. Yield prediction
24. Pre-harvest crop status
25. Post-harvest crop status

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Acceleration of TWIGA Innovations

Innovation	*TRL before the Project*	*Status of Innovation*	*Current TRL*
100 Euro neutron counter	1	Experimental stage at the Lab at the TU Delft and Oregon State University	3
Laser micro scintillometer	2	No TRL acceleration yet	2
Doppler radar rain sensor	3	No TRL acceleration yet	3
Evaporometer	4	Installed in an operational environment in Kenya (Narok test bed)	7
Accelerometer tree weighing	4	No TRL acceleration yet	4
Intervalometer rain gauge	5	System complete and qualified and in continuous monitoring mode at selected sites in Kenya (Narok), and Ghana (Tamale)	8
Lightning tracking	6	These are operational in TAHMO stations (commercially available)	9
GNSS water vapour	6	System complete and qualified and in continuous monitoring mode at selected sites in Uganda	8
Flood mapper	7	Mobile phone app to map extent of flooding - System complete and qualified and in continuous monitoring mode at Aboabo, Kumasi in Ghana	8
Humidity Tracker	1	Operational within Farmerline Mergdata App - System complete and qualified and in continuous monitoring mode in Ghana	8
VegMon	1	Mobile phone app to monitor vegetation parameters - System complete and qualified and in continuous monitoring mode in Ghana (Tamale, Navrongo and Kumasi) and in Kenya (Narok)	8
Crop doctor	7	It is operation in Mozambique and Kenya	8

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In situ sensors - Atmospheric moisture Precipitable Water Vapor

remote sensing

MDPI

Article

Potential of Cost-Efficient Single Frequency GNSS Receivers for Water Vapor Monitoring

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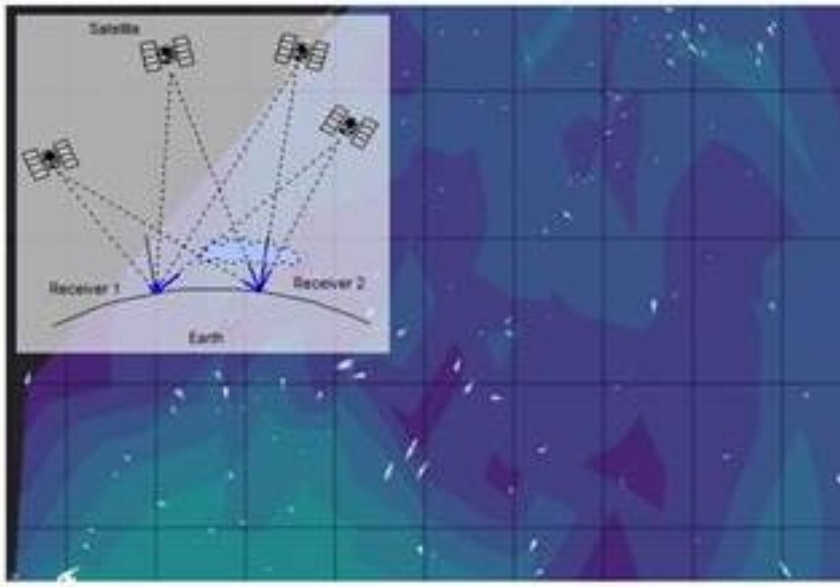

GNSS Early results

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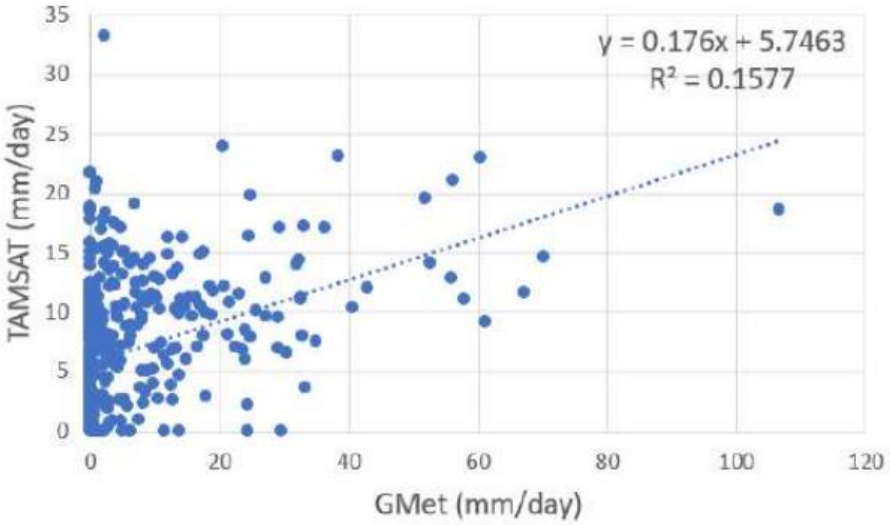
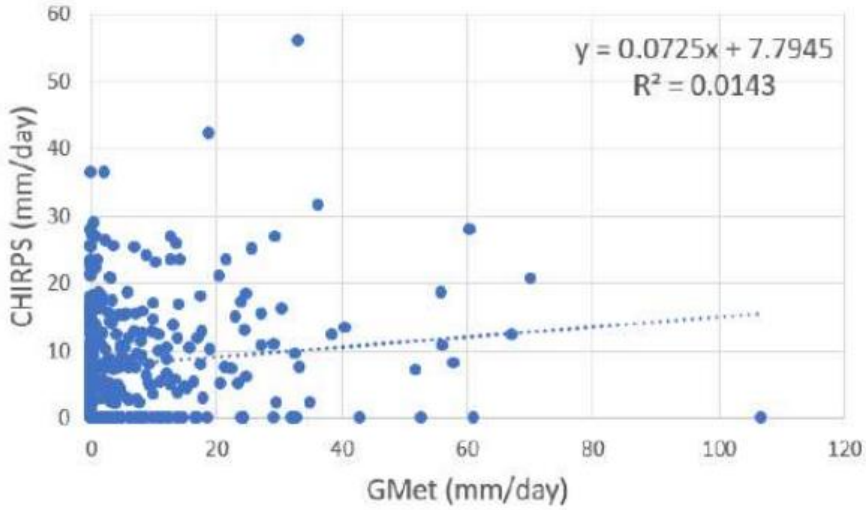
Getting Rainfall Right
Services: Agriculture, insurance, flood





Get handle on variability

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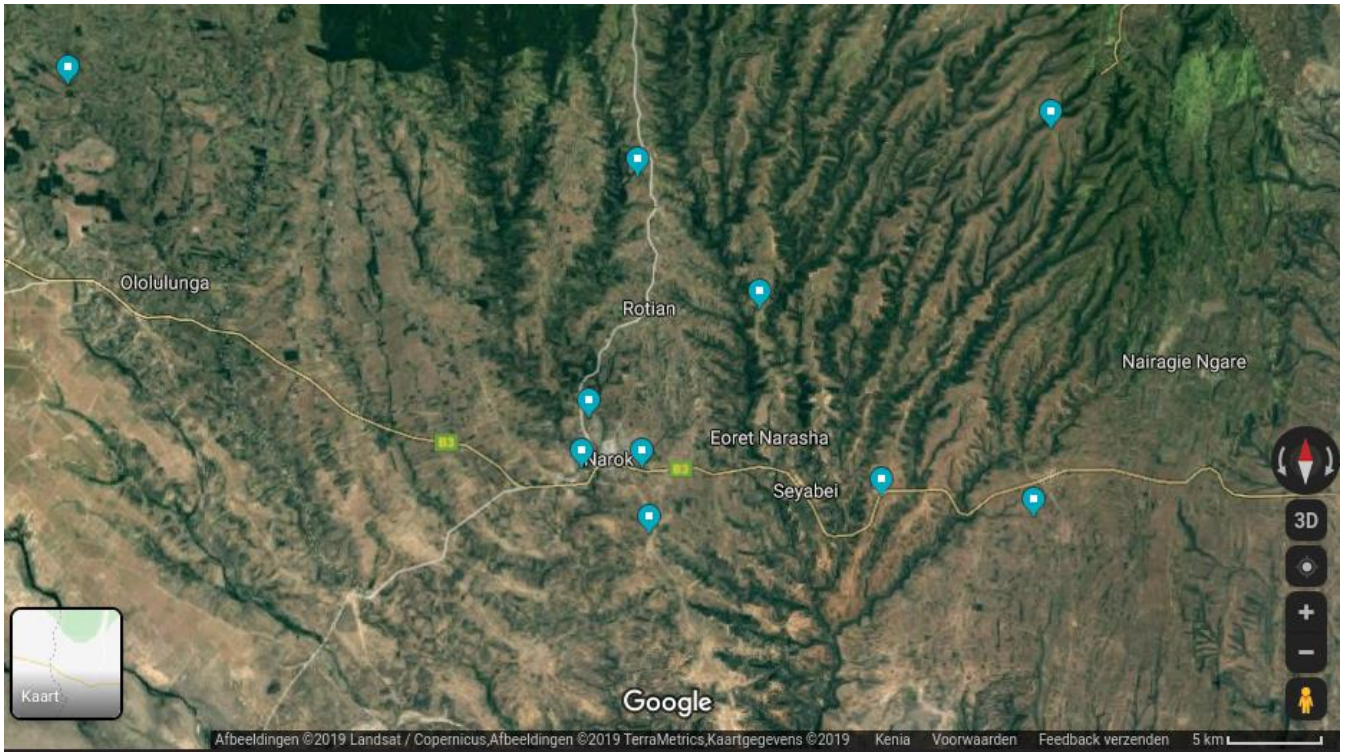
In situ Sensors - Rainfall variability



Narok - Kenya: Disdros and Intervalometers

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In situ Sensors - Rainfall variability

Nyankpala - Ghana: Disdros and Citizens

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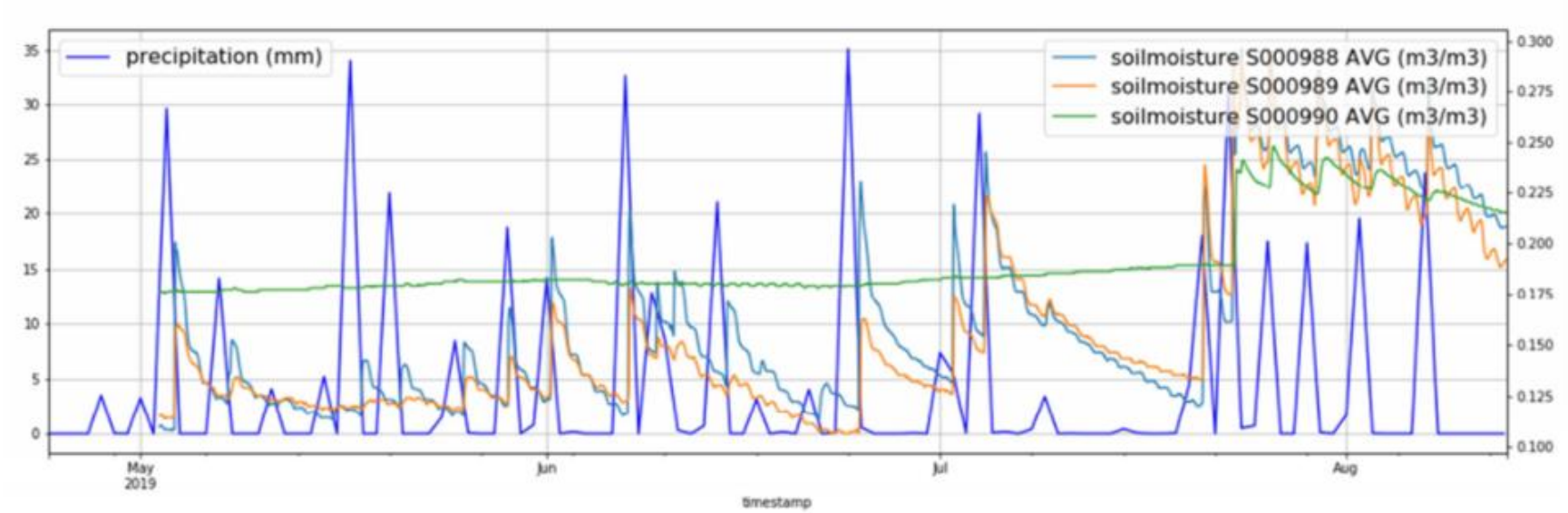
In situ Sensors - Soil moisture



Time series of soil moisture and precipitation at station TA00616 (Tamale). Soil moisture profiles show response rainfall: steep rise followed by a gradual decrease in soil moisture content over a period of up to ~25 days.

Teros-12 Nyankpala (Ghana)

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In situ Sensors - Soil moisture

Distributed Temperature Sensing

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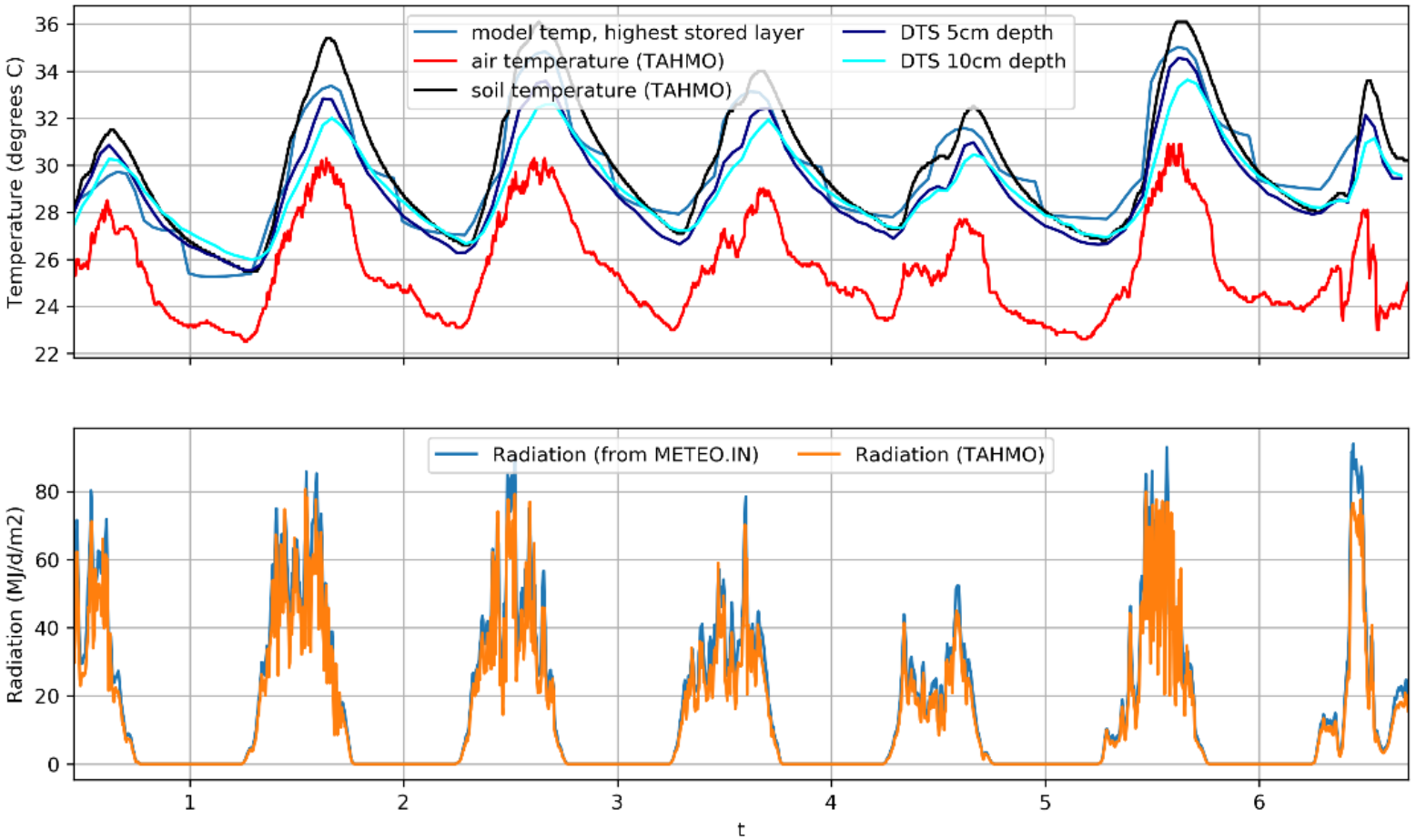
In situ Sensors - Soil moisture



Nyankpala – Tamale, Ghana

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Distributed Temperature Sensing

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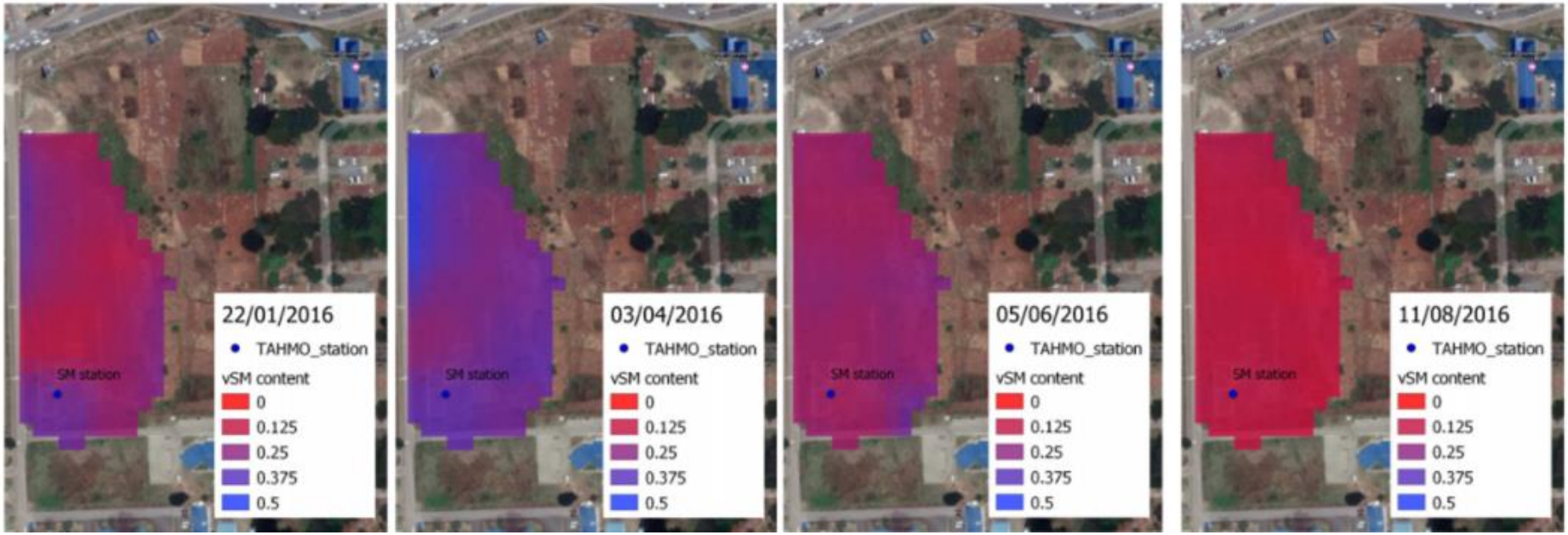
TWIGA Sensors: Soil moisture



SAR
Soil Moisture (Sentinel-1)

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TWIGA Sensors: Flood

Kumasi (Ghana) water level

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TWIGA Sensors: Flood

Kumasi (Ghana) - Does it drain?

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TWIGA Sensors: Flood

Kumasi (Ghana) Hackathon
Plastic Spectrometer

Plastic Mapping App

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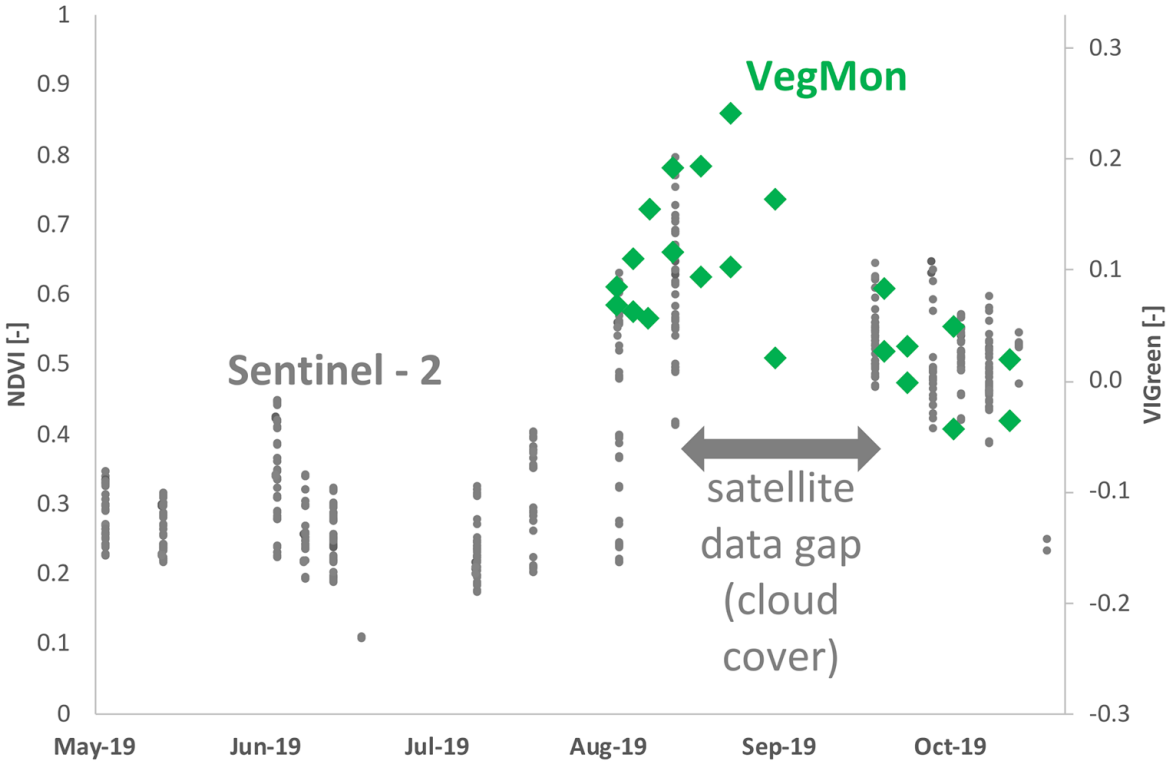
TWIGA Sensors: Crop monitoring



VegMon ODK App – Jan Friesen

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TWIGA Platform

TWIGA Portal

Web-portal and applications

Mobile apps

TWIGA Portal Training – Nairobi 2019

Platform

Application services

Backend services

AgriCloud services

Information services

Models

Open protocols

SOS2 API

Other platforms

GEOSS
Copernicus

Data services

Live connection
FTP
Excel importer

Distributed data sources

Time series (TAHMO, SAWS)
Events (lightning, pictures)
Grids (satellite, radar)
Model grids (weather forecast)

HydroLogic RESEARCH DELFT

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GReD

HCP International

HydroLogic

Imperial

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Makerere

MicroStep

PolMi

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