Remotely sensed, agriculturally relevant, surface temperature validation in sub-Saharan Africa: preliminary results

Rationale

Satellite remote sensing is used an ever-widening range of agricultral applications.

But, how relevant is a satellite measurement of surface temperature for conditions in a field?

This is important given that it is the field conditions that matter for pest and disease development.

Furthermore; there are known issues with satellite land surface temperature (LST) product accuracy over areas that experince a wet-dry season cycle.

Eyes on the PRISE

A Pest RIsk Information SErvice for the 21st century.

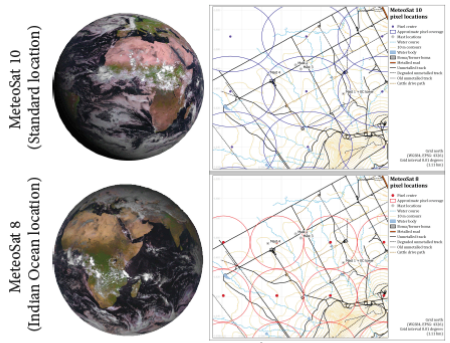
Combines:
> Temperature and rainfall remote observations
> Plant health modelling
> Real-time field observations
> Models of pest and disease development

For pest and disease alerts delivered by SMS and app to farmers, industry and government departments.



Thomas Dowling[1], Mary Langsdale[1], Lutz Merbold[2] & Martin Wooster[1]
[1]Department of Geography, King's College London, Bush House (NE) 4.01, 40 Aldwych, WC2B 4BG, London, United Kingdom
[2] Mazingira Centre, International Livestock Research Centre (ILRI), PO Box 30709, 00100 Nairobi, Kenya
Contact: thomas.dowling@kcl.ac.uk

Satellite data



Meteosat SEVIRI full disk views, and positioning of the pixel fields of view centers and extents across the validation site. The recent re-positioning of MeteoSat 8 affords a near-nadir view of East Africa.

The temperature monitoring segment of the PRISE system is currently driven by the ERA5 weather and climate model.

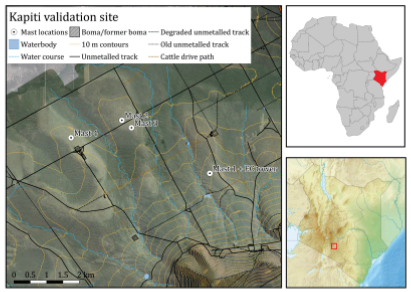
In the future it will be driven by the geostationary satellite LST product from EUMETSAT-LSA SAF.

However, this LST data needs to be validated in the agricultral setting before inclusion.

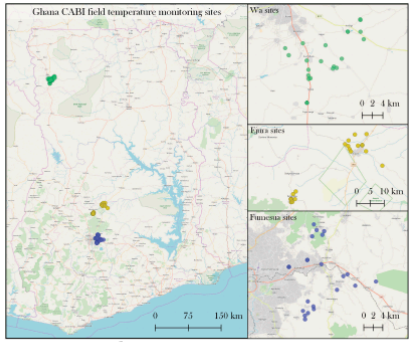
Validation site - Kapiti, Kenya - ILRI

Each mast mounts a JPL-NASA radiometer, vegetation monitoring cameras and a Heitronic radiometer. Two masts also mount downwelling radiation monitors.

Mast 1 mounts a $CO_2/H_2O/CH_4$ eddy-covariance (EC) system in addition to the radiometers and cameras.



Agricultral sensor network - CABI

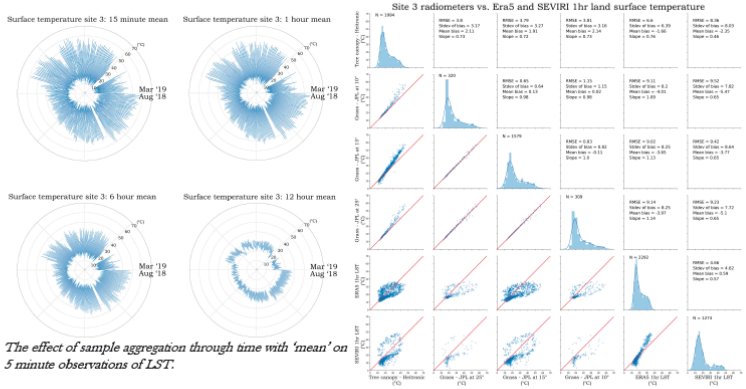


Basemap courtesy of OpenStreetMap2018

The inital analysis uses a network of 84 low-cost air temperature monitors spread over three localities in Ghana; in maize and tomatoe fields. Future work will include networks in Kenya and Zambia.

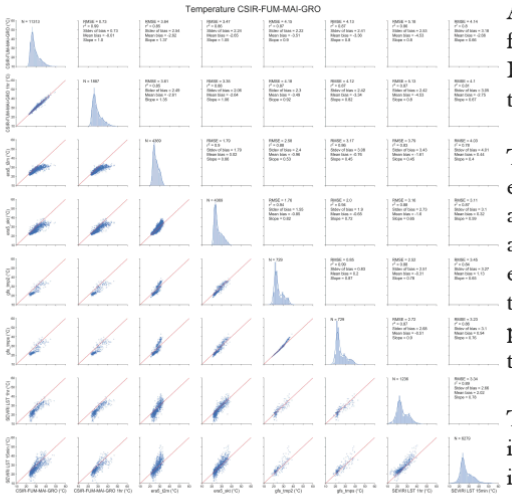
The air temperature monitors will be validated and expanded upon by a thermal camera mast experiment soon to be installed in Zambia.

Initial data: validation site



The effect of sample aggregation through time with 'mean' on 5 minute observations of LST.

Initial results: agricultral field temperature



Sample cross-correlation plot: compares the field temperature logger against a range of EO and model temperature outputs. From left to right: the raw logger data, the logger data mean for 1hr, ERA5 2m air temperature, ERA5 skin temperature, GFS 2m air temperature, GFS skin temperature, SEVIRI LST 1hr product and the SEVIRI LST 15 min.

Analysis of all CABI field loggers finds that ERA5 best represents the temperatures in field.

This is not a suprise given that ERA5 is evaluating air temperature, as are the loggers. However, the actual temperature experienced by the pests is that of, on or -in the plant.

Therefore, further work is needed to better calibrate SEVIRI LST against crop surface temperatures.

Scientific partners
LSA SAF
Mazingira Centro
ILRI
NASA JPL
CABI
ASSIMILA

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UK SPACE AGENCY
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