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Operational crop monitoring in Africa using the **Food Security TEP**

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Vista GmbH

Bringing together Food Security and Big Data

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Start of the project: April 2017 / Platform Release 1.2: Sep. 2018

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- strong focus on users
- agile development
- learning from other TEPs

- other ESA TEPs started beginning 2015 -

https://foodsecurity-tep.net

urban tep | geohazards tep | forestry tep | coastal tep | hydrology tep | polar tep

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The European EO Ecosystem: Space 4.0 ("the agreed picture")

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Food and Agriculture Organization of the United Nations

WFP wfp.org

belgapom

BayWa

FarmDrive

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Supporting sustainable Food Production from Space

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Access to key satellite products and ancillary data, backed up by a **scalable** processing **infrastructure**

Universities

Interact with a range of users through a dedicated **forum**

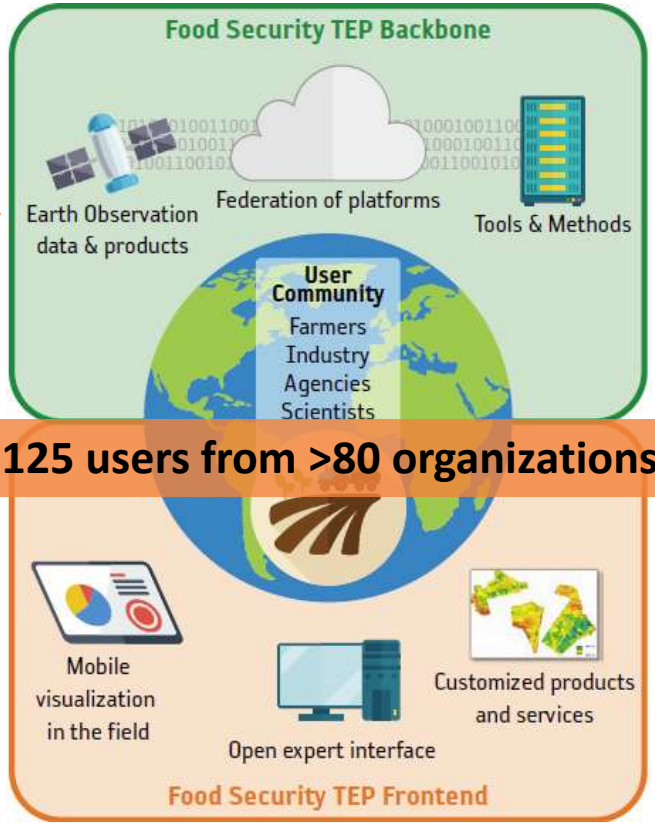
App developers

Ability to **easily develop new services**, with the ability to share processors and outputs only with selected user groups

Service Providers

New Business Model offer for private companies

Start-Ups



Access to **tools** to derive **agricultural** and **aquacultural** products

Researchers

Technical **support** for platform use

Public Entities

Provision on request of **high-accuracy, quality checked** vegetation parameters (LAI, fAPAR, etc), suitable for use in operational scenarios.

Int. Bodies

Finance Ind.

Access to **ready-to-use products** or customized services

Farmers

Ag & Aquac. Industry

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The Main User Interface

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- Visit the **ESA Data Access Booth** anytime and/or meet us at the booth on Thursday 11:00-13:00
- See our public **Food Security presentation** in the EO4Society Area, Thursday 17:30-18:00

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Tools on Food Security TEP

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SNAP

QGIS

RStudio

Run your scripts in parallel mode!

R UNDER CONSTRUCTION

jupyter

sentinel-2 → AGRICULTURE UNDER CONSTRUCTION

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Food Security Data and Service Portfolio

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Public processing services	Spatial res.
SNAP S-2 Band Ratio Processor	yes
SNAP S-2 Normalized Band Difference Processor	yes
SNAP S-2 Red Edge Position Index	yes
SNAP S-2 Modified Chlorophyll Absorption Ratio	yes
SNAP S-2 Brightness Index	yes
SNAP S-2 Generic Graph Processor	(beta)
Generic R Script Processor	(upcoming)
Sen2Cor	(beta)
(+ your contributions that you an share with others!)	

Parallel Processing Services	Public?
VISTA (Green) Leaf Area	(upcoming)
VISTA Reflectance at Bottom of Atmosphere	(upcoming)
VITO Fraction of APAR	(upcoming)
VITO Fraction of Vegetation Cover	(upcoming)
VITO Normalized Difference Vegetation Index	(upcoming)
VITO Leaf Area Index	(upcoming)
Higher level services (VITO, VISTA, Hatfield)	(upcoming)
(+ your services if you like to deploy your algorithm on the Food Security TEP and become an EO service provider on the platform!)	

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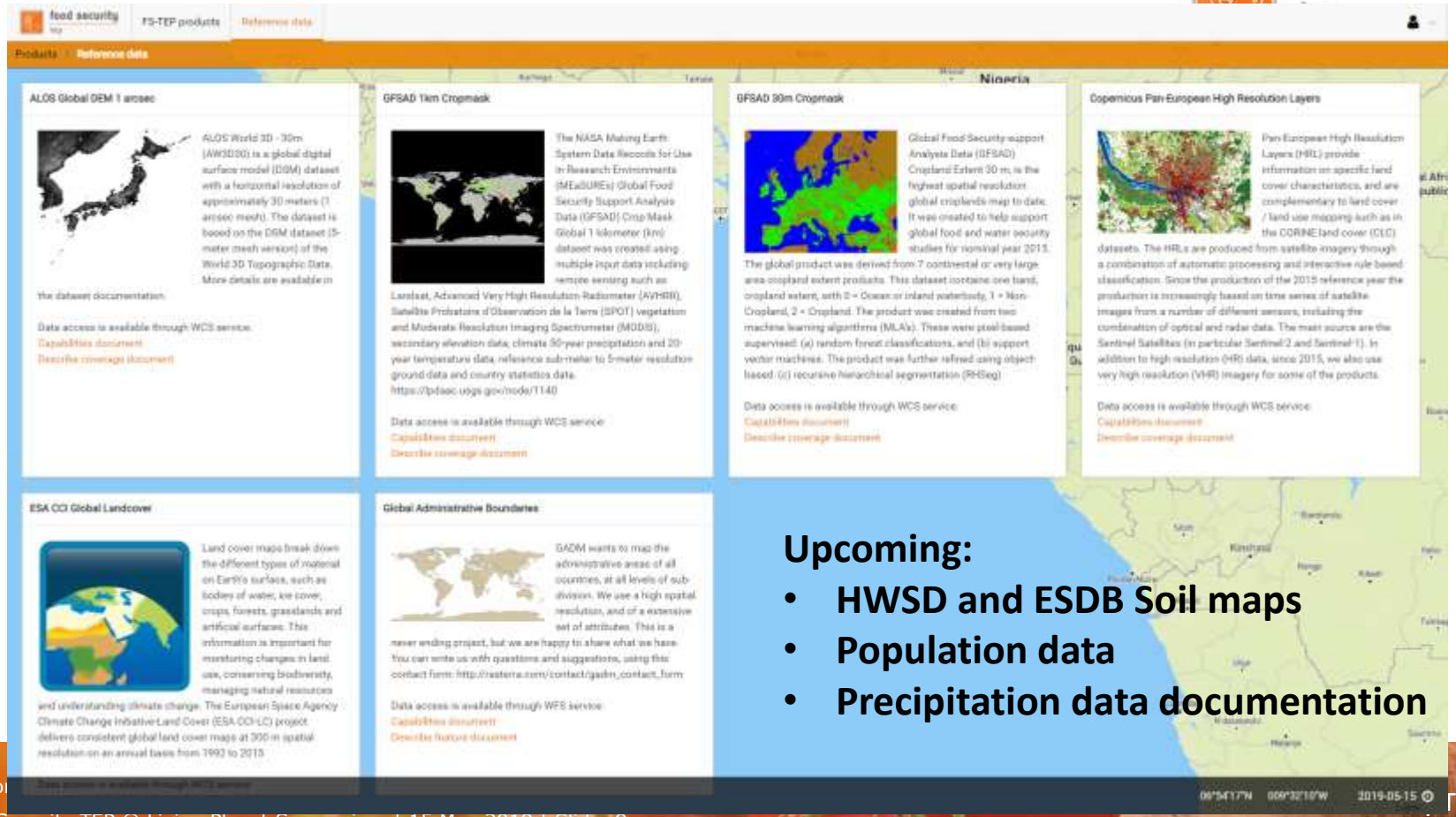
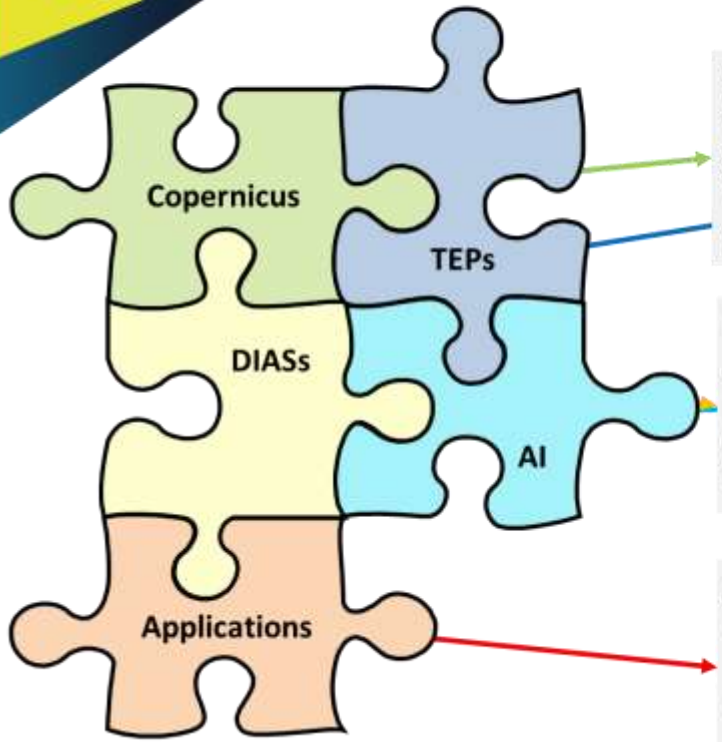
Complementary data for analysis



Upcoming:

- **HWSD and ESDB Soil maps**
- **Population data**
- **Precipitation data documentation**

AI on Food Security TEP (2019-2021)



Copernicus
the most important digital big data resource:
Volume – Velocity – Variety – Veracity - Value

ESA thematic exploitation platforms:
virtual environments for user relevant EO data and applications
advantage of available computing resources

Data and Information Access Service (**DIAS**) platforms
computing power close to the data

AI & Deep Learning
deep neural network architectures
architectures for satellite images
large benchmark datasets
cloud and GPU technologies

Applications / Use Cases:

- Food Security - high resolution water availability maps for agricultural areas for irrigation support, for farmers.
- Polar - high resolution ice maps for maritime safety for increasing traffic in critical polar environments

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Pre-processed products

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Product collections of commercial and public service providers provide analysis ready data sets

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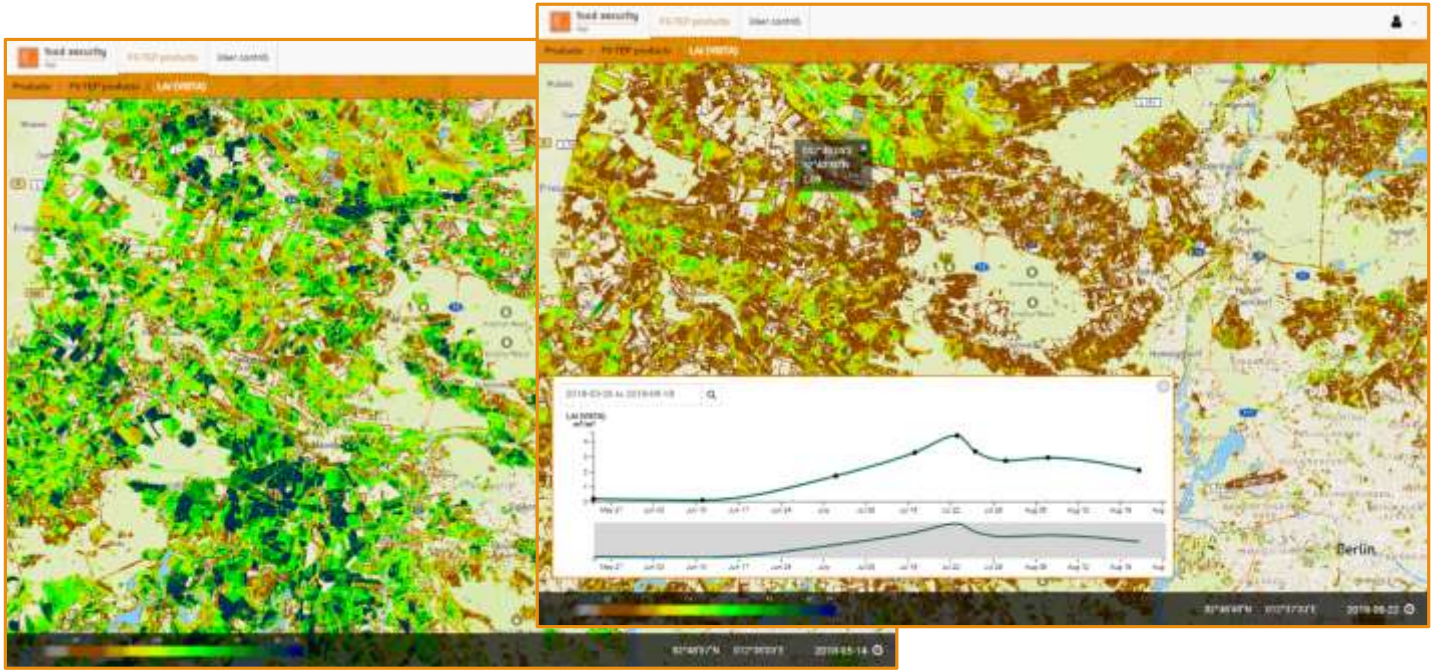
Food Security TEP Analyst View: Browser based visualization



Green leaf area of agricultural areas near Berlin, Germany showing the decrease of plant health during the summer drought 2018

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Food Security TEP Service Pilots

Food Security TEP Customized is **demonstrated** in three **service pilots.**

Pilot 1 'Agriculture' (**VISTA** – VITO)

Central Europe & Southern Africa

BayWa

belgapom

Pilot 2 'Agriculture' (**VITO** – VISTA)

Kenya

WFP wfp.org

FarmDrive

Pilot 3 'Aquaculture' (**Hatfield**)

Tanzania

Food and Agriculture Organization of the United Nations

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Service Pilot 2: Micro-credits

- Agriculture employs 2/3 of Africa's population and contributes 1/3 of its GDP. Yet only **1% of commercial loans** go to the agricultural sector, and very little of that reaches SHFs (**Small Holder Farmers**).
- SHFs are often denied loans because they **lack credit profiles** and lenders have no efficient methods to assess the risks lending to SHFs.
- Additionally, lenders **lack visibility** (i.e. data) into SHFs' agri-businesses and use inflexible lending systems not applicable to the needs of SHFs.
- Lenders therefore either refrain from lending to SHFs or have a high effort which results in exorbitantly **high interest rates**.
- This results in a **agricultural funding gap** ($450 billion globally) leaving farmers underserved and creating a hole in lenders' client base

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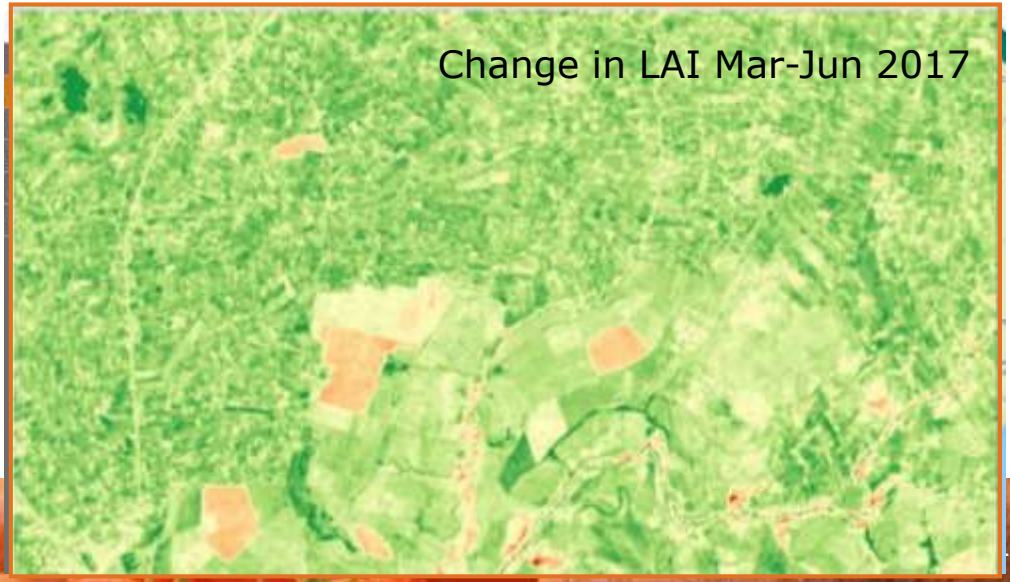
FarmDrive's VP

FarmDrive provides tailored mobile loans to SHFs by using innovative credit assessment, data analytics and operational efficiencies. FarmDrive's goal is to efficiently drive capital to smallholder farmers.

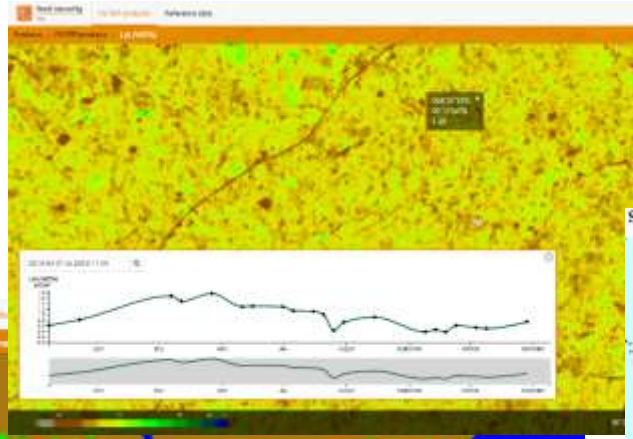
Service Pilot 2: Micro-credits

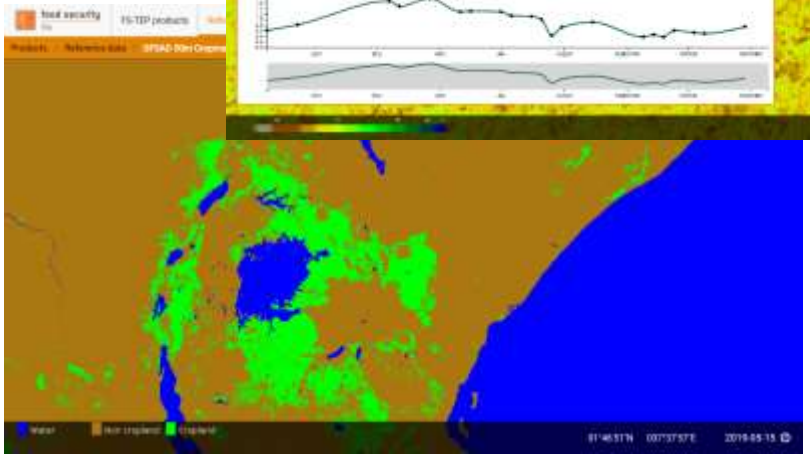
Trial service to support improved access to credits for smallholder farms (ongoing):

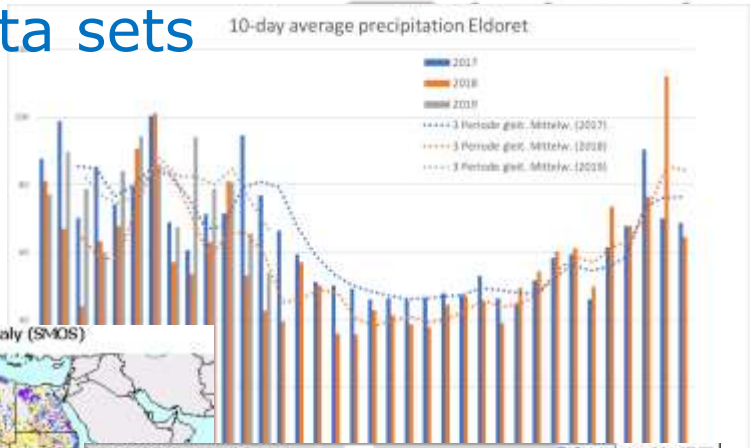
- **continuous monitoring** of agricultural crops and soils with high resolution data at the regional scale **adding weather and yield estimation data**
- Supporting the local **Kenyan SME FarmDrive** by providing additional information for their portfolio management
- Focus on north-western **Kenya**, where most of FarmDrive's customers are located

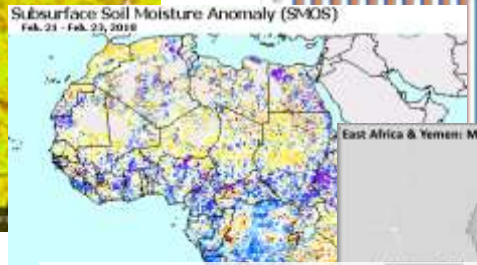


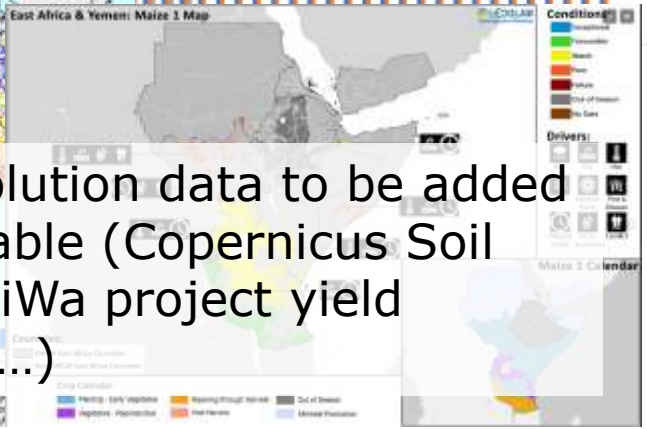
Monitoring using multiple data sets











Higher resolution data to be added when available (Copernicus Soil Moisture, ViWa project yield estimates, …)

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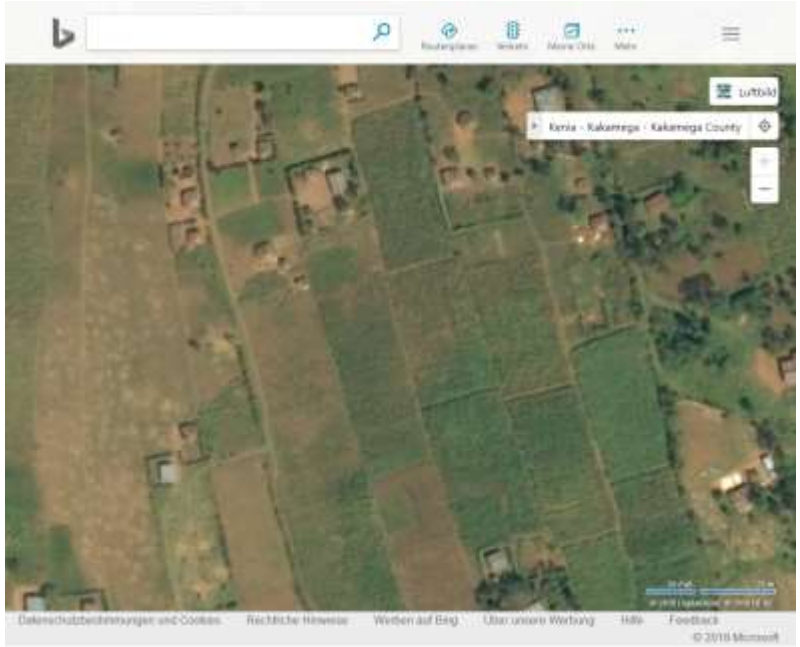
Challenges of the approach

- The **dominant crops** of the Northern Rift region around Eldoret are maize, wheat, beans and potatoes
- There is a **variety of maize grown** by SHFs, most of them take up to 9 months to harvest, the main cropping period is from February to November
- Typically, **mixed cropping** on small fields (~0.1 ha) does not allow field-scale monitoring with Sentinel-2 data



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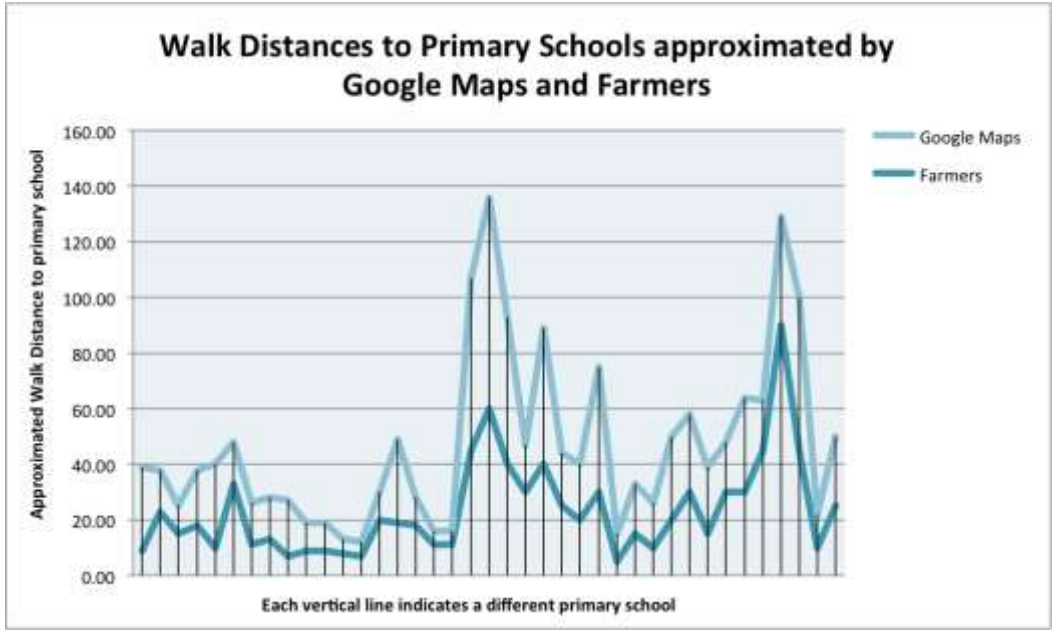
Geolocation algorithm



SHFs can only be located by cell phone towers, so **no clear georeferencing** can be made. Thus, FarmDrive is working on their own geolocation algorithm based on school distances

Both Google Maps and farmer approximations follow a similar trend across 39 different primary schools, but farmers appear to walk faster than google Earth estimations

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Monitoring the Water-Food-Energy Nexus

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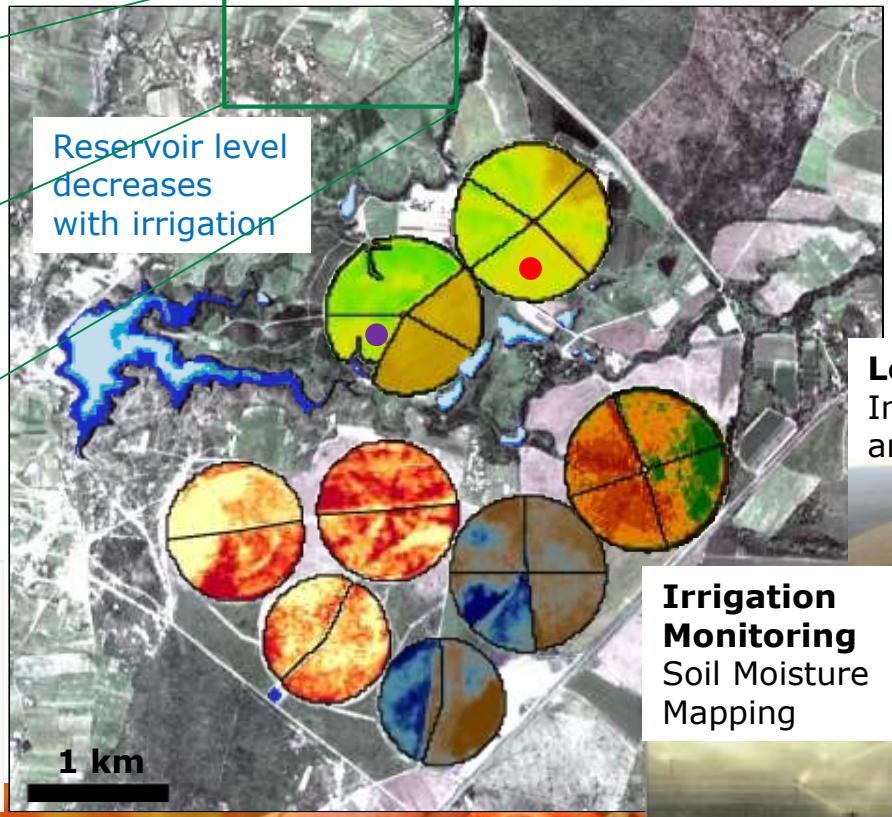
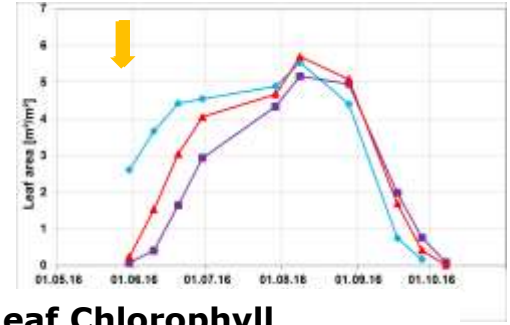
Spatial resolution of S-2 now also allows monitoring of small holder farms.



Crop Growth Monitoring



Leaf Chlorophyll
Indicating nitrogen stress and yield losses

Irrigation Monitoring
Soil Moisture Mapping

Soil Quality / Degradation
Mapping of organic content based on spectral features

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More on Food Security TEP during LPS19:

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- See our public **Food Security presentation** [EO4Society Area, Thursday 17:30-18:00]
- "**Extreme Earth**– Extreme Data Analytics to Manage an Extremely Dynamic Planet" [*AI and Data Analytics: Technologies and Applications*, Thursday 14:45, Amber 7+8]

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