



science  
& technology

Department:  
Science and Technology  
REPUBLIC OF SOUTH AFRICA

# Piloting Crop Watch for South Africa - CW4SA

Clement Adjorlolo

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21<sup>st</sup> April 2016

# Outline

- ❖ Background on Crop Watch for South Africa
- ❖ The CW4SA System Concept
  - System Functionalities and End-to-End workflows
- ❖ Visualizing Biophysical Parameters
- ❖ Theme Applications:
  - Crop Condition Assessment
  - Crop Monitoring
  - Damage Assessment

# Background on Crop Watch for South Africa

- **This Project is being funded via the UK's International Space Partnership Program (IPSP)**

*The programme aims to show, through developing international partnerships, the additionality that UK satellite and space technology can provide over terrestrial solutions in terms of societal or economic benefits. Project funded under both calls will be used to provide sufficient evidence (in terms of benefits and output) to build a case for a longer term programme in this area. Bearing this in mind, all proposal have to be able to clearly show what output they provide on project completion and what this means in terms of societal or financial benefit*

- **Memorandum of Understanding between the UK Space Agency and SANSA. 16<sup>th</sup> July 2015**

*Purpose: (a) to provide a framework for collaborate activities and for reviewing areas of common interest in the civil aspects of space*

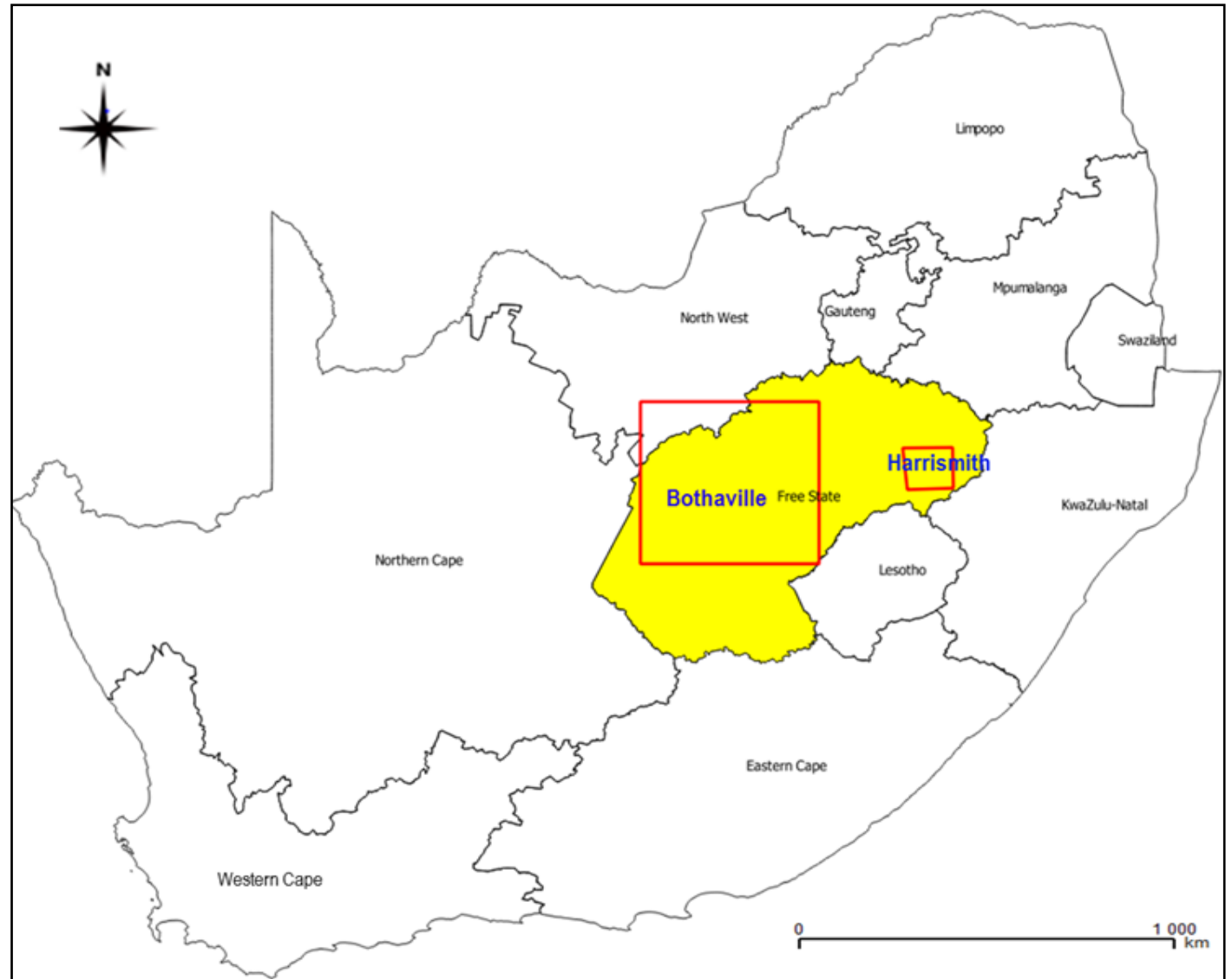
*Fields of Cooperation: (h) SANSA and UK Space Agency will facilitate collaboration between South African and UK commercial space organisation to build commercial activities between the nations*

# Current Areas of Interest

**Two areas located in the Free State**

**Bothaville AOI**  
Area of approx. of 64,031 km<sup>2</sup>

**Harrismith AOI**  
Area of approx. 4,358 km<sup>2</sup>

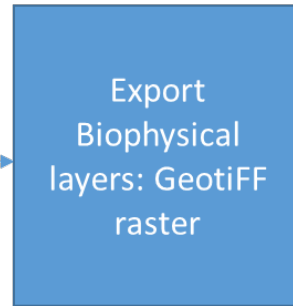
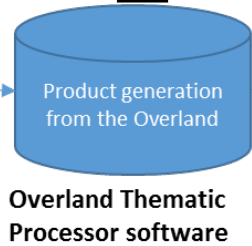
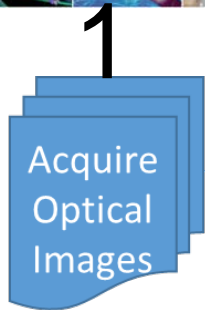


## Overview of the CW4SA System Functionalities and workflows

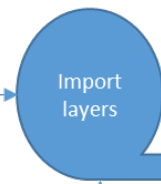
- ❖ Create fraction of crop area/classification
- ❖ Definition/Extract of region of interest
- ❖ Spatial/temporal compositing
- ❖ Time statistics: Derive map with Min/Mean/Max over a series of images
- ❖ Phenology: Define start/end of seasons from a time-series/historical images
- ❖ Anomalies: Difference of current images (e.g., LAI, FAPAR...) against of historical/previous season/year

# CW4SA production workflow

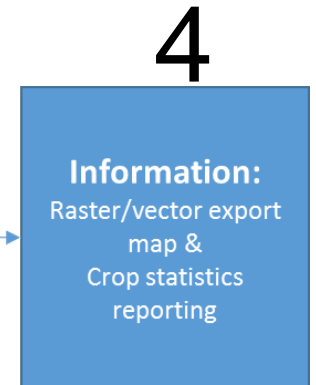
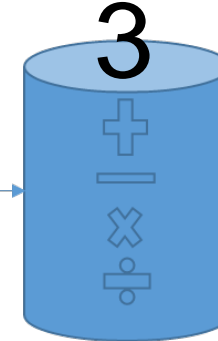
## Multi-sensor



Defined file path & storage folders



Ancillary data: e.g. cropland mask



Visualizing and Estimations

# 1. Data Requirements

**Multitemporal imagery (frequent repeat imaging throughout the growing season)**

**Multisensor data: (DMC-2, SPOT6/7, Landsat8, Sentinel 2, CBERS)**

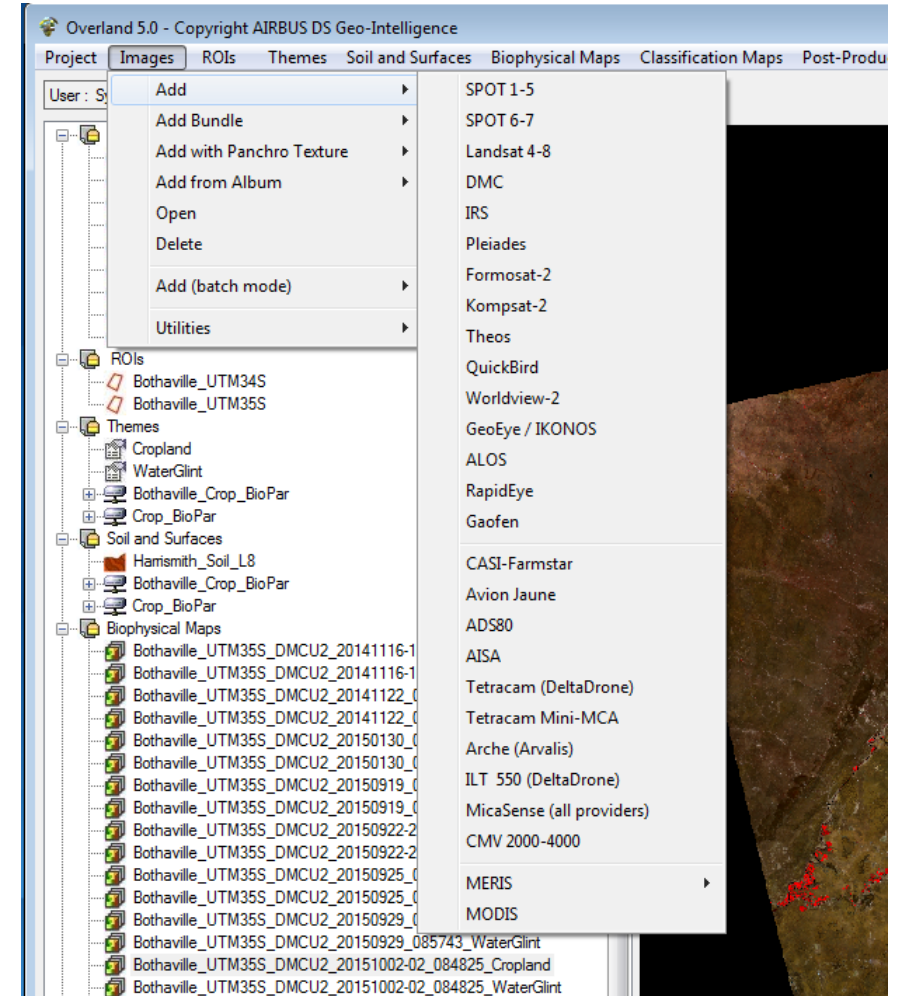
**High Resolution Data**

**Ancillary Data**

	<b>DMC-2</b>	<b>Spot 6</b>	<b>Landsat 8</b>	<b>Sentinel 2</b>
Spatial Resolution	22m	6m	30m	10/20m
Spectral Bands	3	5	11	13
Swath	650km	60km	180km	290km
Revisit	5 days	1 day	16 days	10 days

# Overland

- ❖ Developed by Hervé Poilvé at Airbus DS in Toulouse
  - ❖ Built with IDL, running on freely available IDL Virtual Machine
  - ❖ Used in previous land cover mapping campaigns, as Geoland2
- ❖ Large number of optical data can be imported:
  - ❖ Landsat, DMC, Spot, RapidEye, etc.
- ❖ Biophysical parameters
  - ❖ Soil reflectance model used as input to calculate vegetation model.  
In this case a soil model has been developed from Landsat 8 imagery before growing season
  - ❖ In-built atmospheric correction module, based on Lowtran model
  - ❖ Large number of biophysical parameters can be selected, like Fcover, Fbrown, LAI, Fsoil, CSF, Fwater
- ❖ XML scripting developed to use Overland in automated processing chain



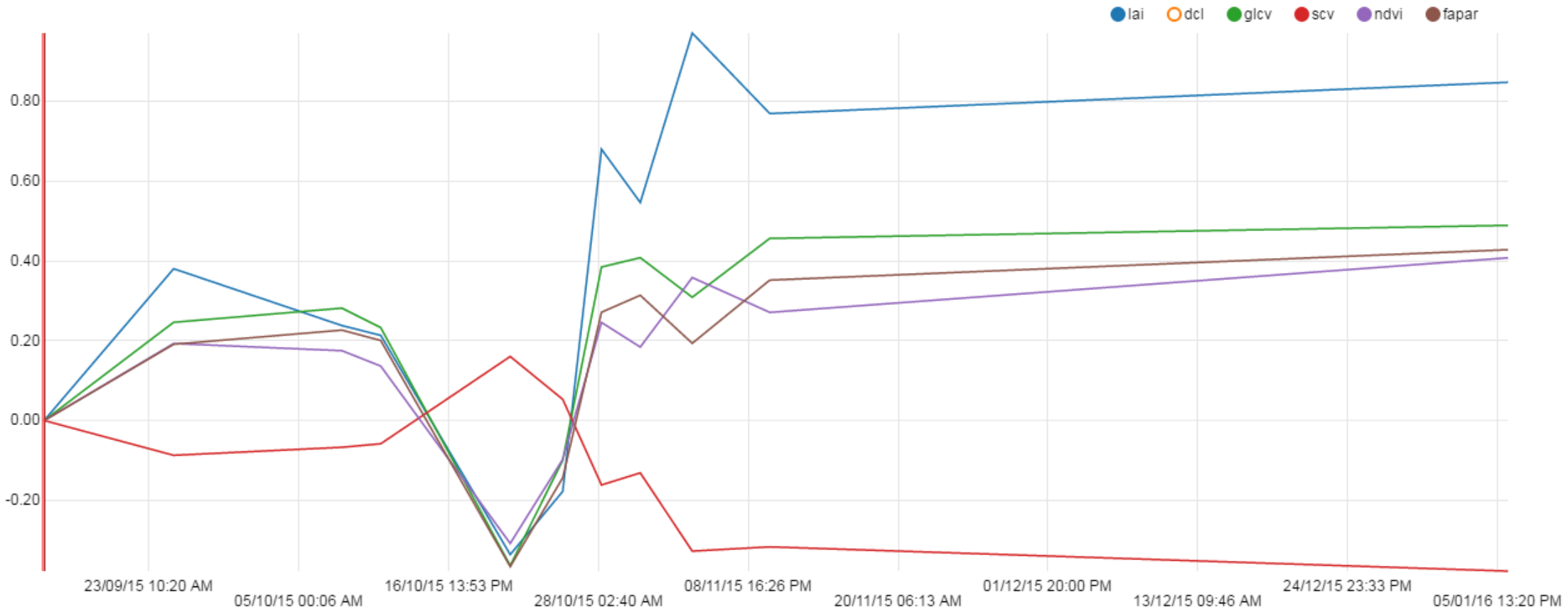


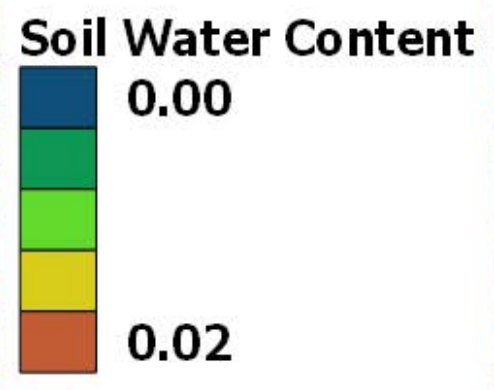
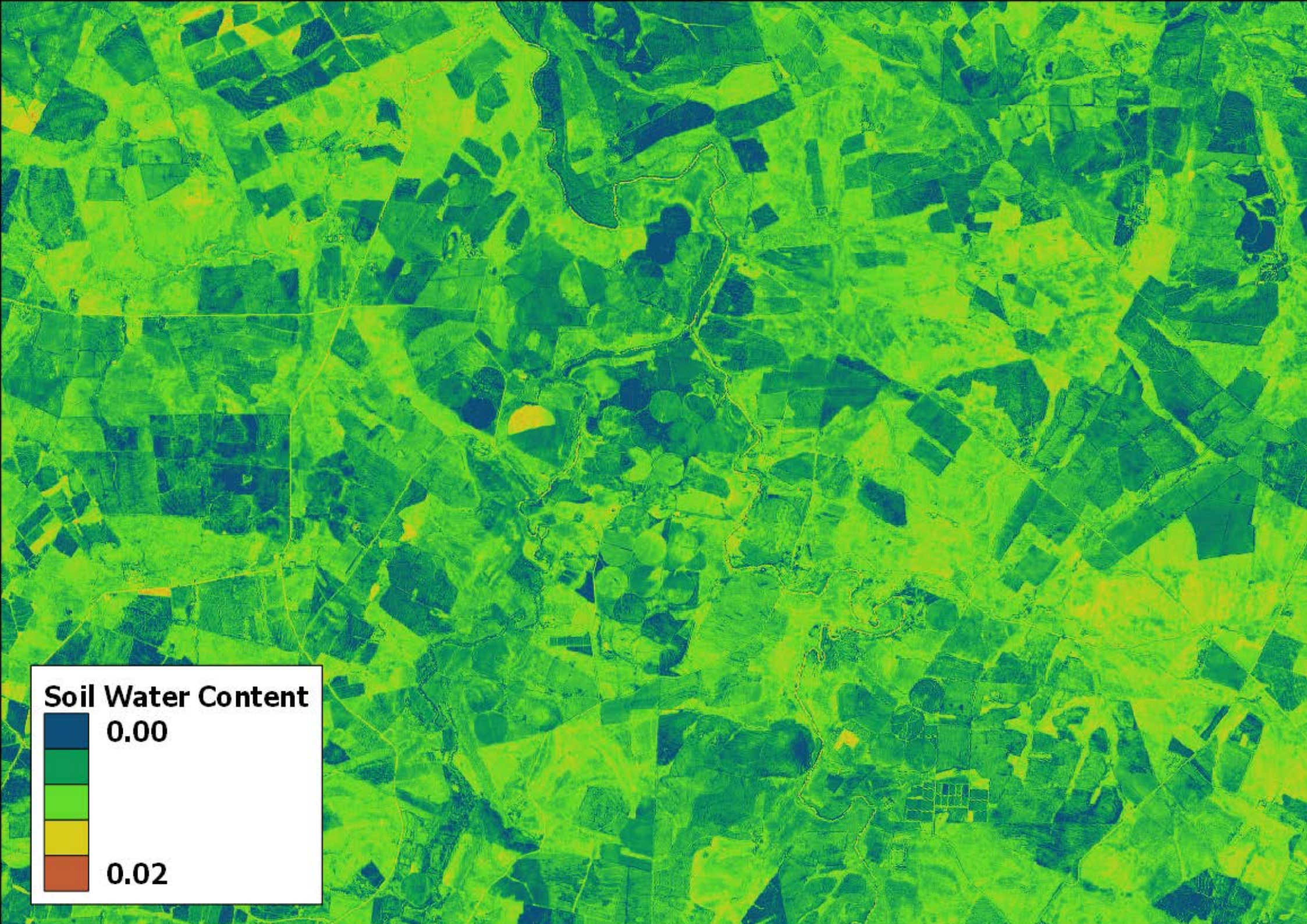
## 2, Calculated Biophysical parameters

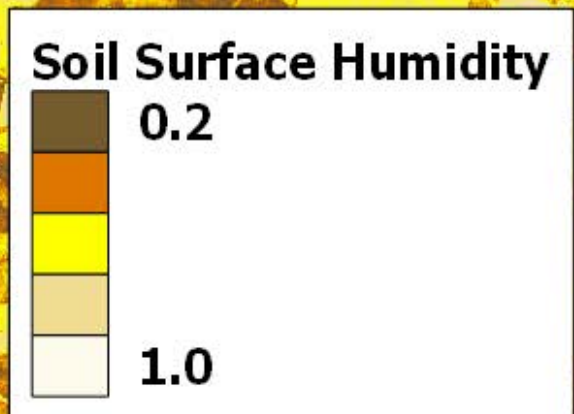
- ❖ Canopy Shadow Factor
- ❖ Fraction of Absorbed Photosynthetically Active Radiation (FAPAR)
- ❖ Fraction of Brown Vegetation Cover
- ❖ Fraction of Vegetation Cover
- ❖ Fraction of Soil
- ❖ Leaf Area Index (LAI)
- ❖ Green Leaf Area Index
- ❖ Leaf Chlorophyll Content (CHL)
- ❖ Leaf Water Content
- ❖ Soil Brightness
- ❖ Soil Fraction
- ❖ Soil Surface Humidity
- ❖ Soil Water Content



# Overland Outputs







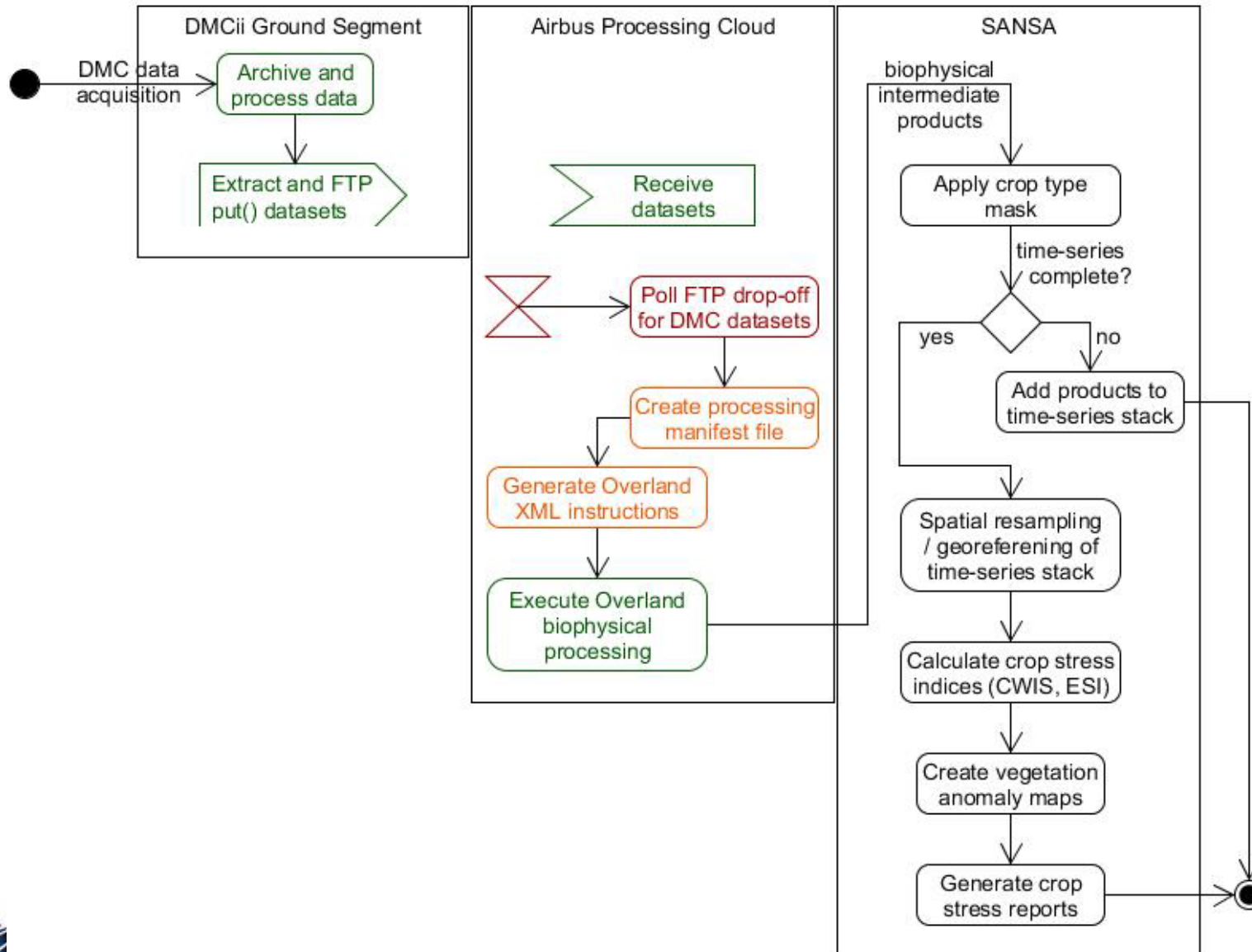
# Overland Instructions

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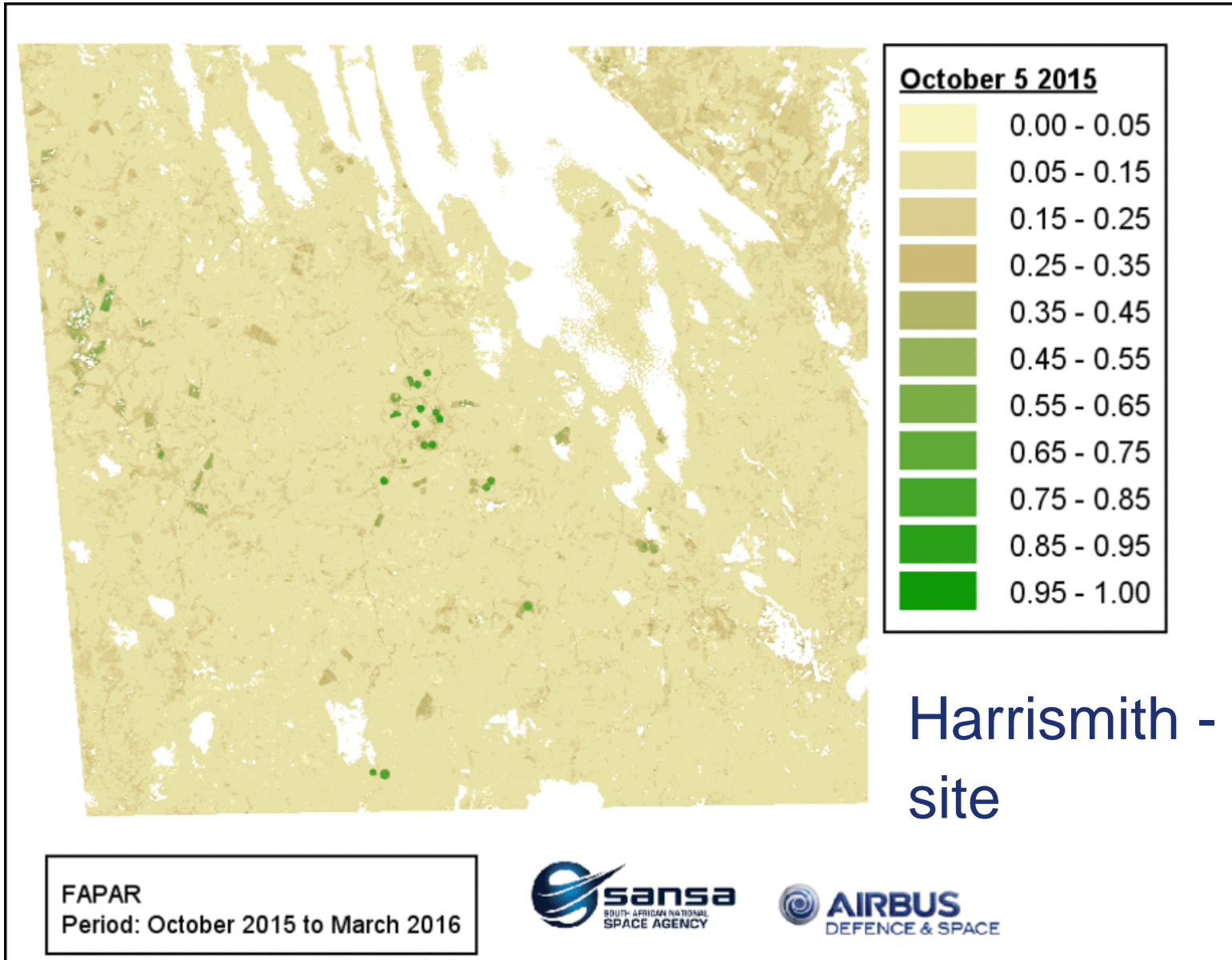
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```

# 2 & 3 CW4SA production workflow



# 4. Visualizing and Estimations



# Crop Monitoring & Assessment

## ◆ Crop Type Identification and Mapping

## ◆ Crop Condition Assessment



### Crop Monitoring

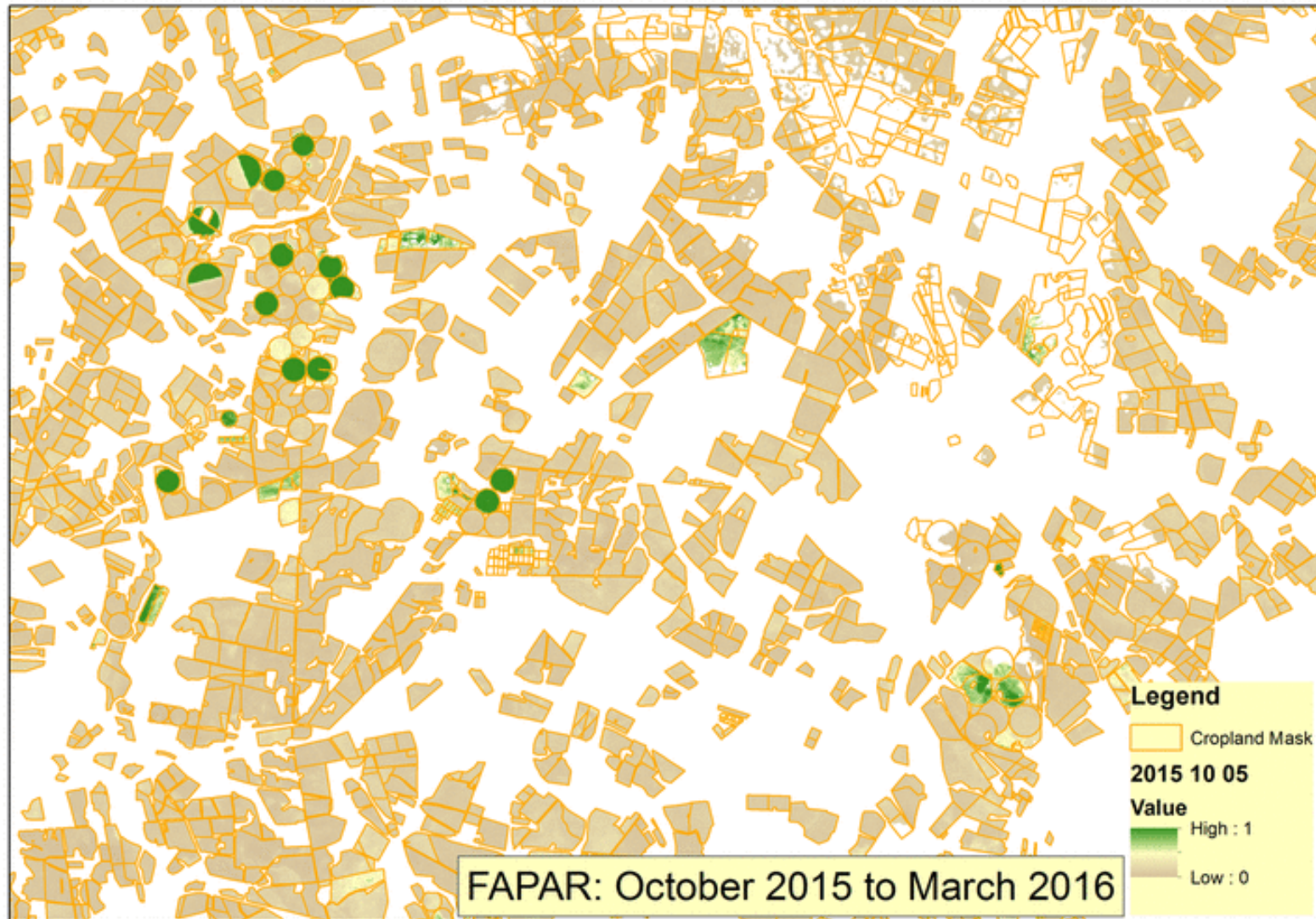
- ◆ Crop area estimation
- ◆ Crop growth monitoring
- ◆ Crop yield forecasting



### Damage/Stress Assessment



# Field Crops Monitoring

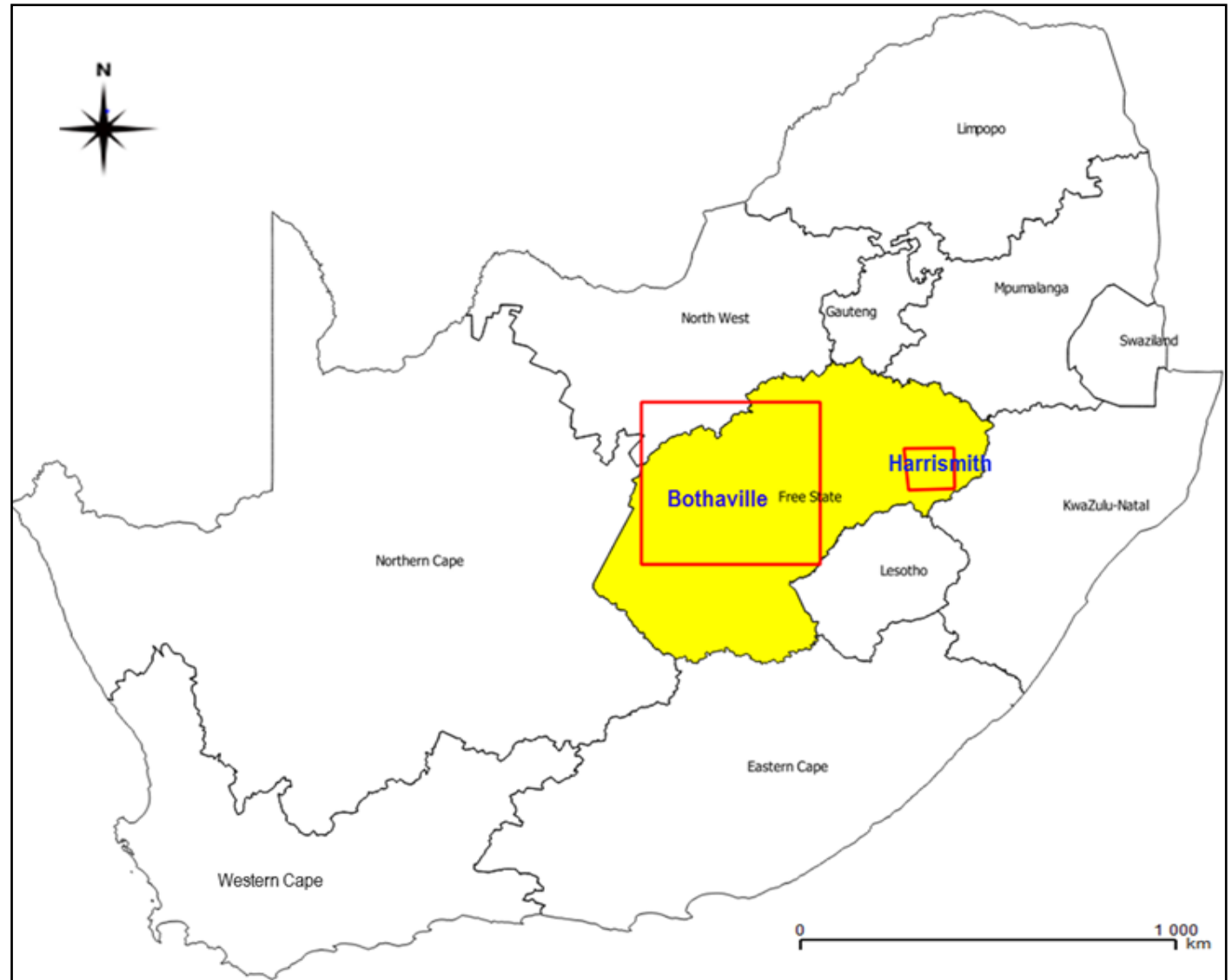


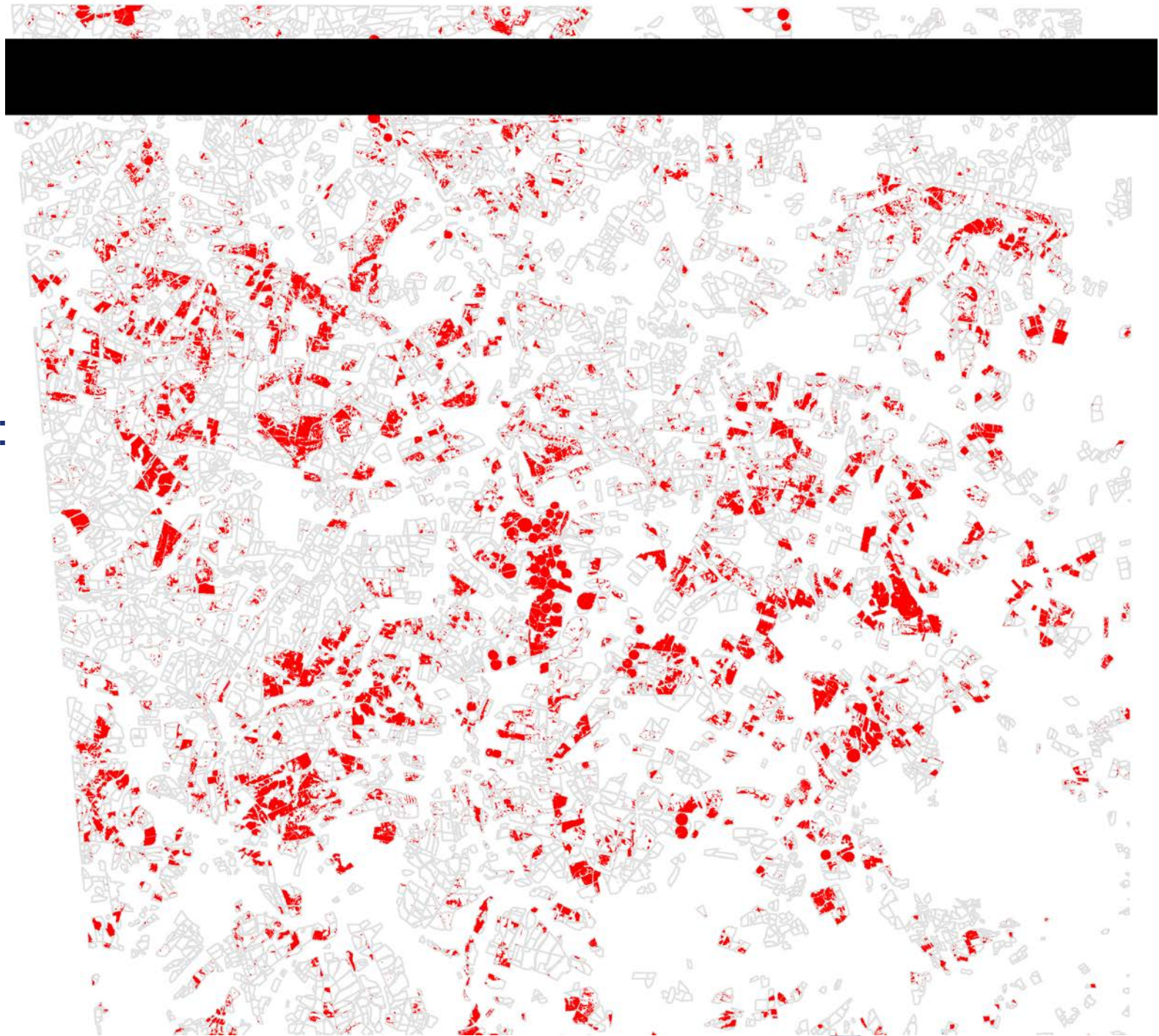
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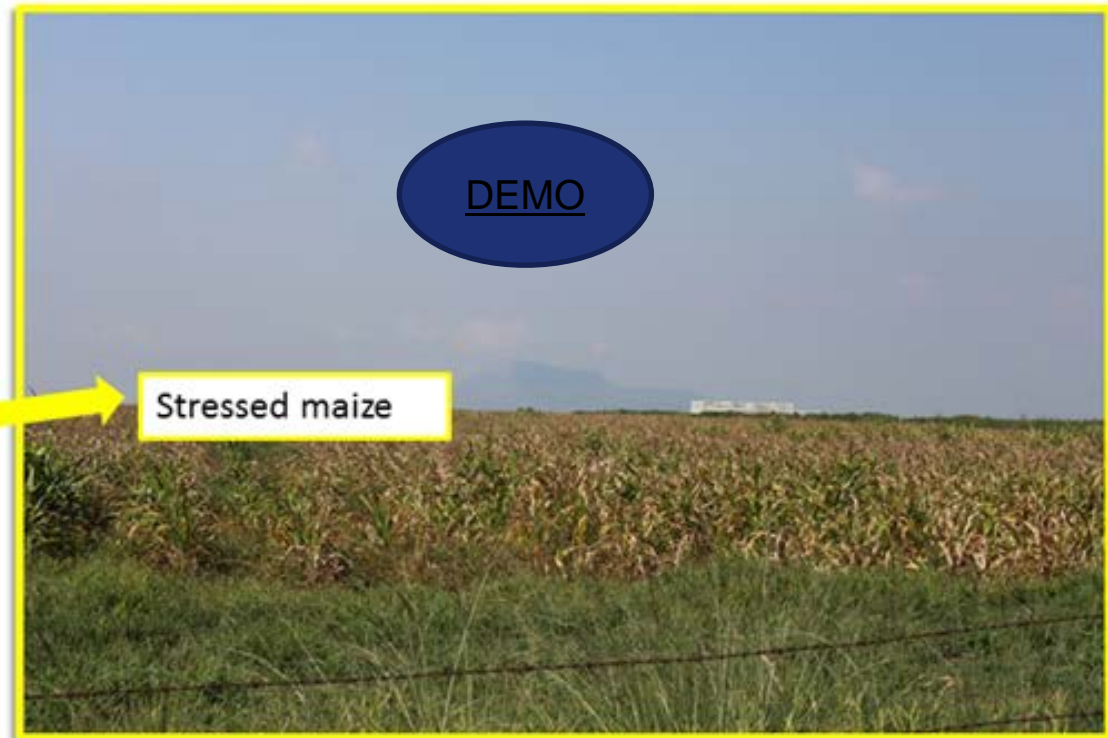
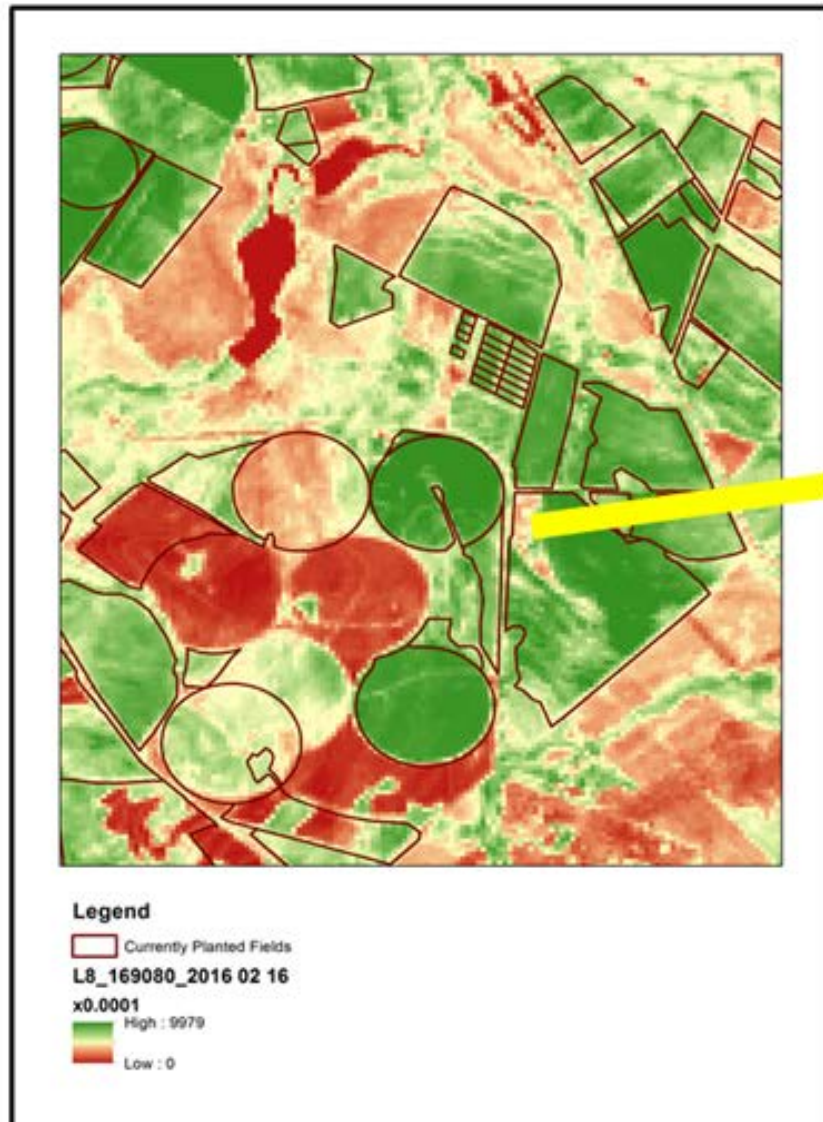




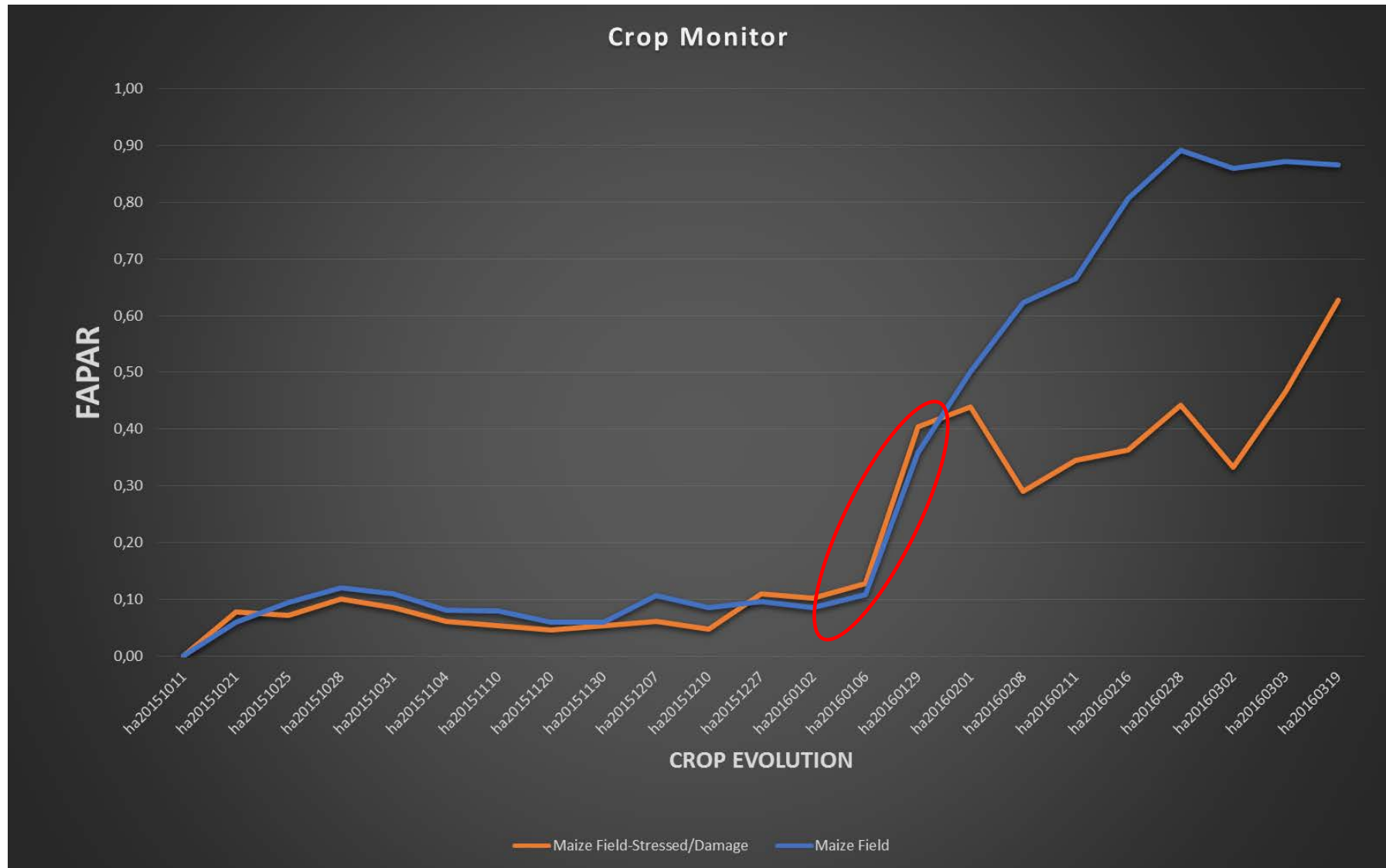
Fraction of crop  
area Harrismith-site:

~**4069/8757** Fields  
planted:  
October 2015 to  
March 2016

# Visualizing Crop Stress and Estimation

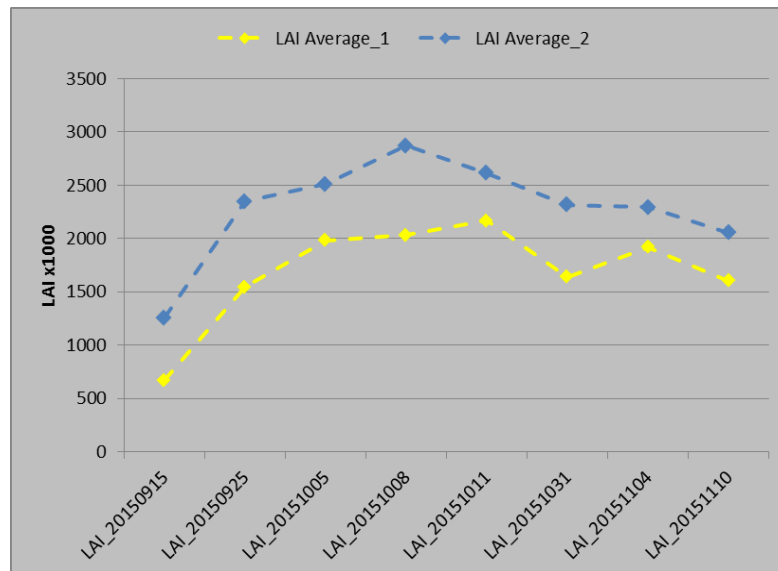
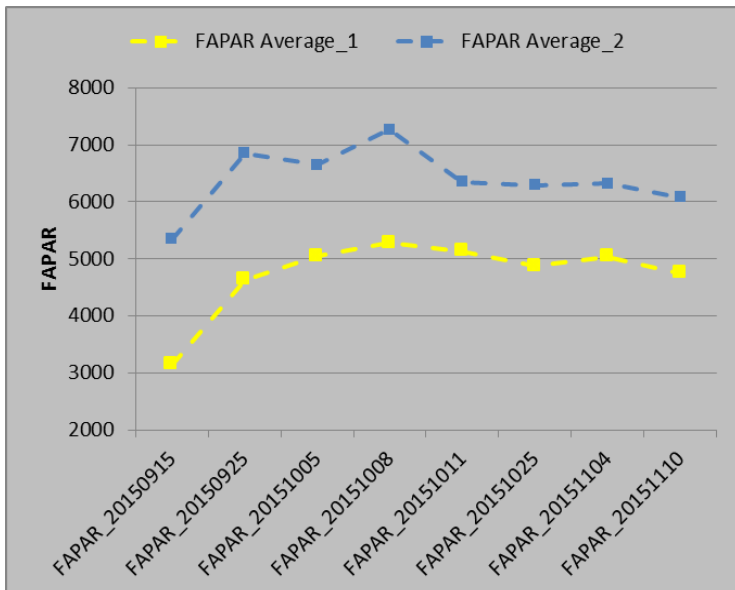
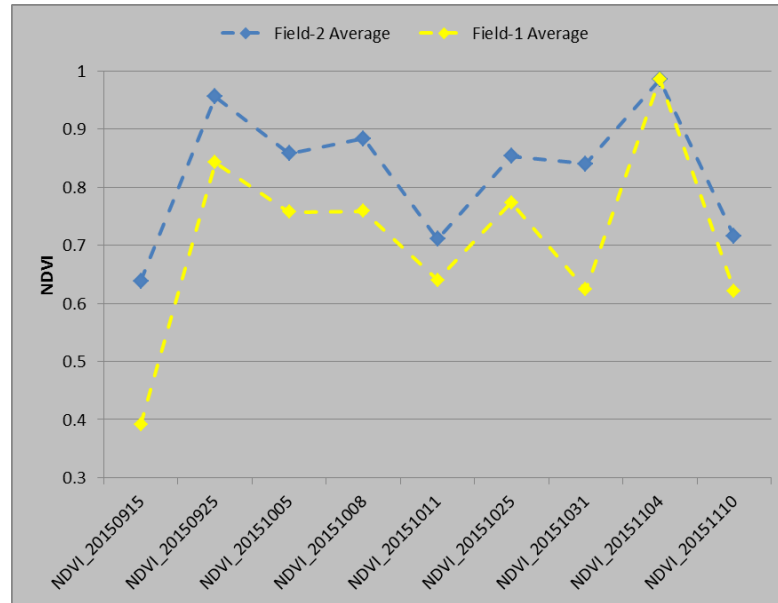
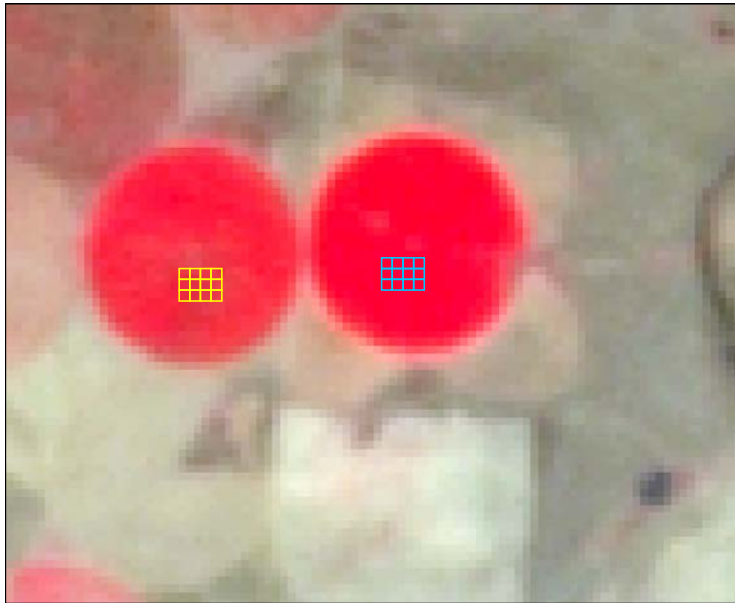


# CW4SA production workflow

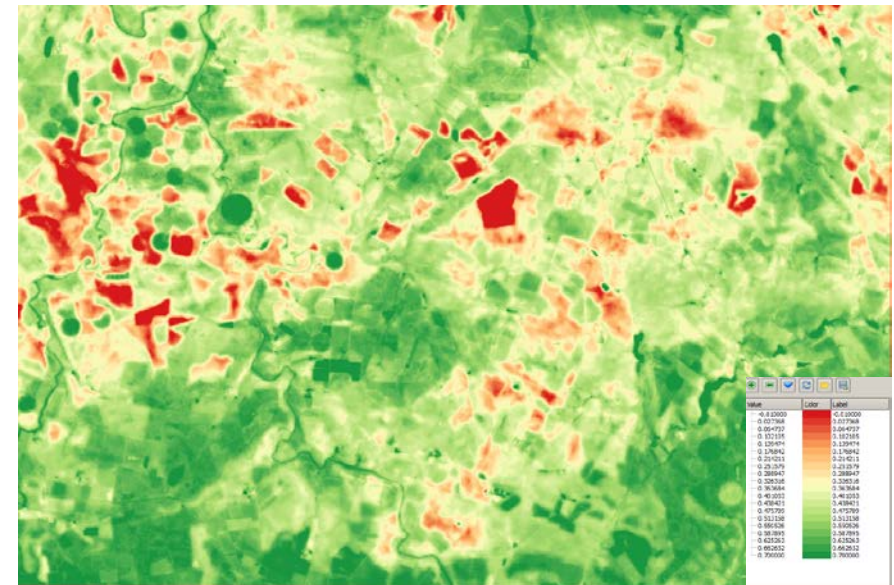
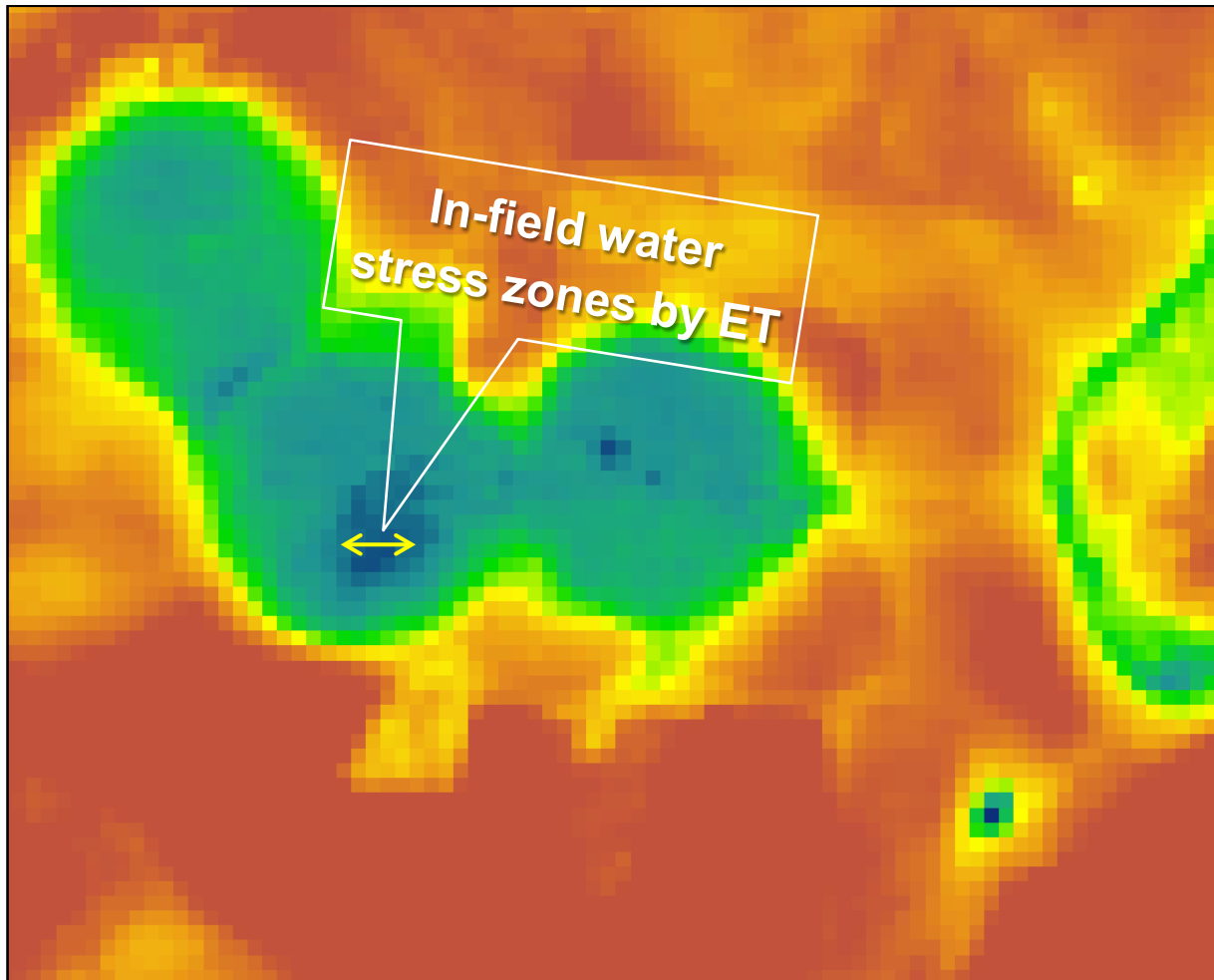


# Farm Level Crop growth monitoring

## Management Options and the Need for a Stress-factor

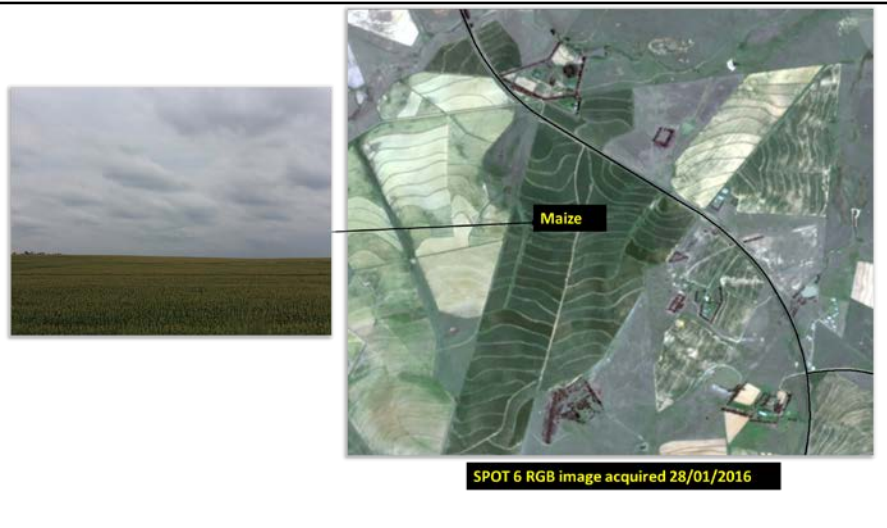
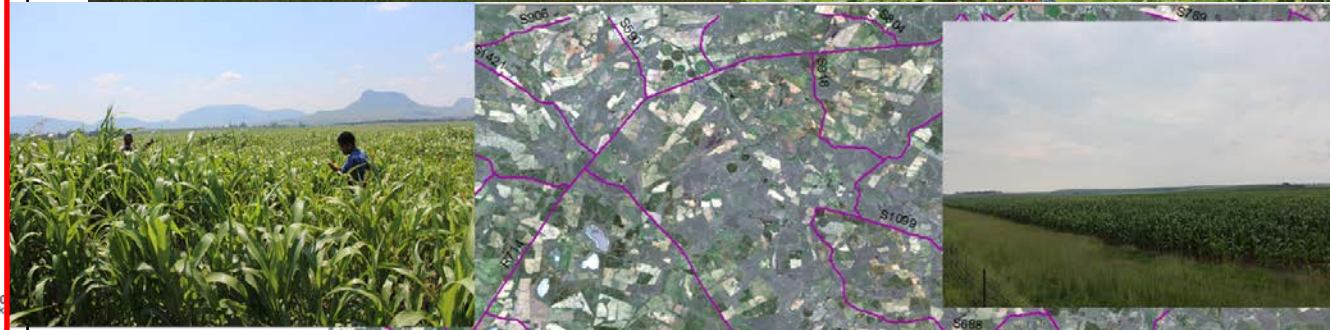
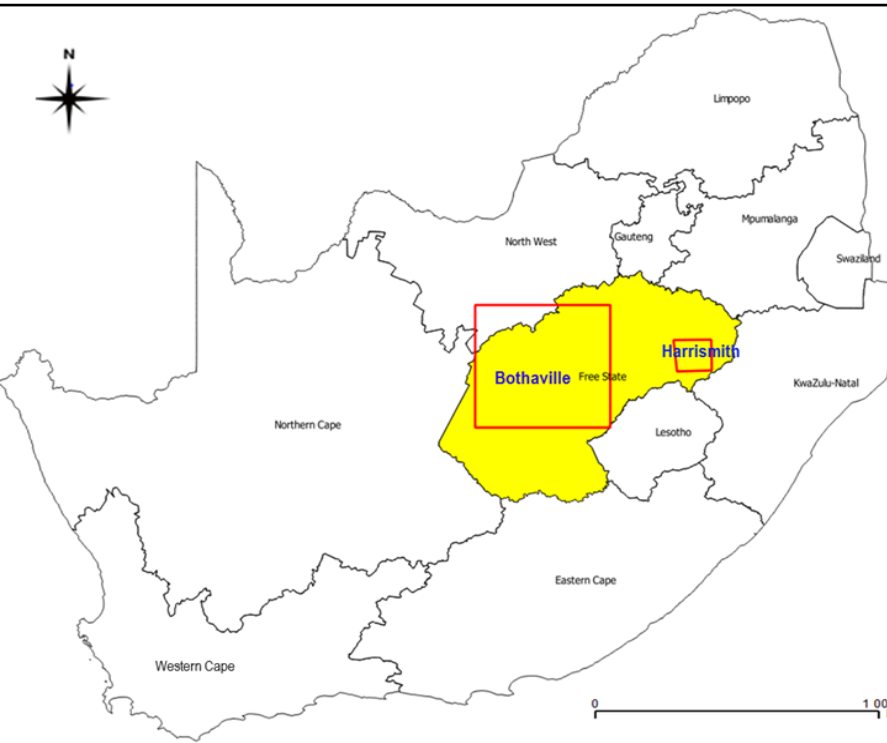


# Modelling LAI, FAPAR & ET (evapotranspiration)



Actual ET calculated from Landsat-8 data acquired over center-pivots irrigated corn field near Harrismith. Image date: 25-09-2015

# CW4SA Products (LAI, FAPAR & ET) Validation work is ongoing



SPOT 6 RGB image acquired 28/01/2016





Any Questions?