

# **YIELD ESTIMATE IN THE OPERATIONAL Crop Monitoring System and Contribution of Sen2 products (10m NDVI & LAI)**

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# Project objective

- Validation of Sentinel 2 satellite image with field in situ data
- • Utilizing the latest technology and Earth Observation (EO) to estimate crop production of summer as well as winter grain crops. The key question is; "How much (tons) is produced within a specific geographical region (province, former homeland, municipality etc.?). This will also measure the success of cropping projects implemented by DAFF or focus on any areas of interest.
- Improving Objective Yield Determinations: The key question to be answered here is what would all the hectares of crops that were planted produce in terms of tons? Exploring the use of crop yield and growth models to reduce variance and error in current yields estimates. Furthermore, this will allow crop performance over time to be monitored.

## Partners



# Significance of the project to ARC and the Country

- **Promotes** promotes sustainable use and management of the agricultural natural resources through research, technology development and technology transfer
- Earth observation is practical ,reliable and cost effective technique to understand the state ,evolution and productivity of agricultural systems( Key variable such as crop yield, crop types ,crop quality.
- Crop yields forecasts are necessary to give an early indication of the expected productions of grains to decisions makers in the agriculture sector.
- The grain industry needs to know in advance the size of the crop ,to prepare for marketing ,storage of crops ,
- It is important to know early if there will be surplus or deficit ,because without this information SA will not be able to compete on international markets.

# FROM CROPLAND TO CROP SPECIFIC

Crop-specific is hampered by

- Mismatch between landscape and satellite sensor
  - Not knowing where the crops are'
- 
- Assimilation of satellite data in crop-specific models is a challenge
  - Need for rapid within-season crop mapping
  - Can be used for estimating crop area (requisite for total production)

# FIELD WORK

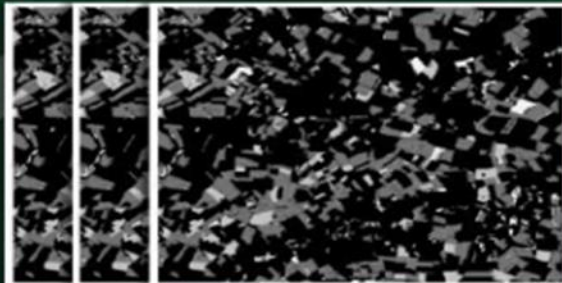
Field work was carried out from Mid October last 2016 to 05 May 2017

- Visited commercial and subsistence farmers in Mpumalanga province.
- Mainly commercial farmers in Free state province (Bethlehem , Bothaview , Welkom areas)
- Northern Cape as well
- North west province (as well)
- We collected GPS points of all the non crop land and crop land . Record and identified all crops .
- Take samples of LAI from major crops , ( Maize , Soya beans, and Sunflower.
- We travelled over 10 000 km



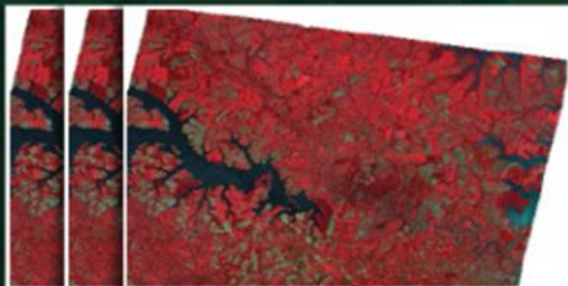
# Sen2-Agri products along the season

## DYNAMIC CROPLAND MASK



Growing season →

## CLOUD FREE SURFACE REFLECTANCE COMPOSITES

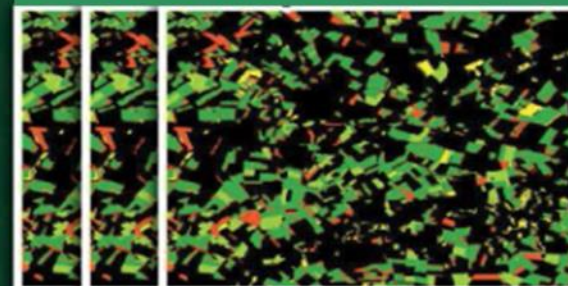


Open source toolbox  
Capacity building and training

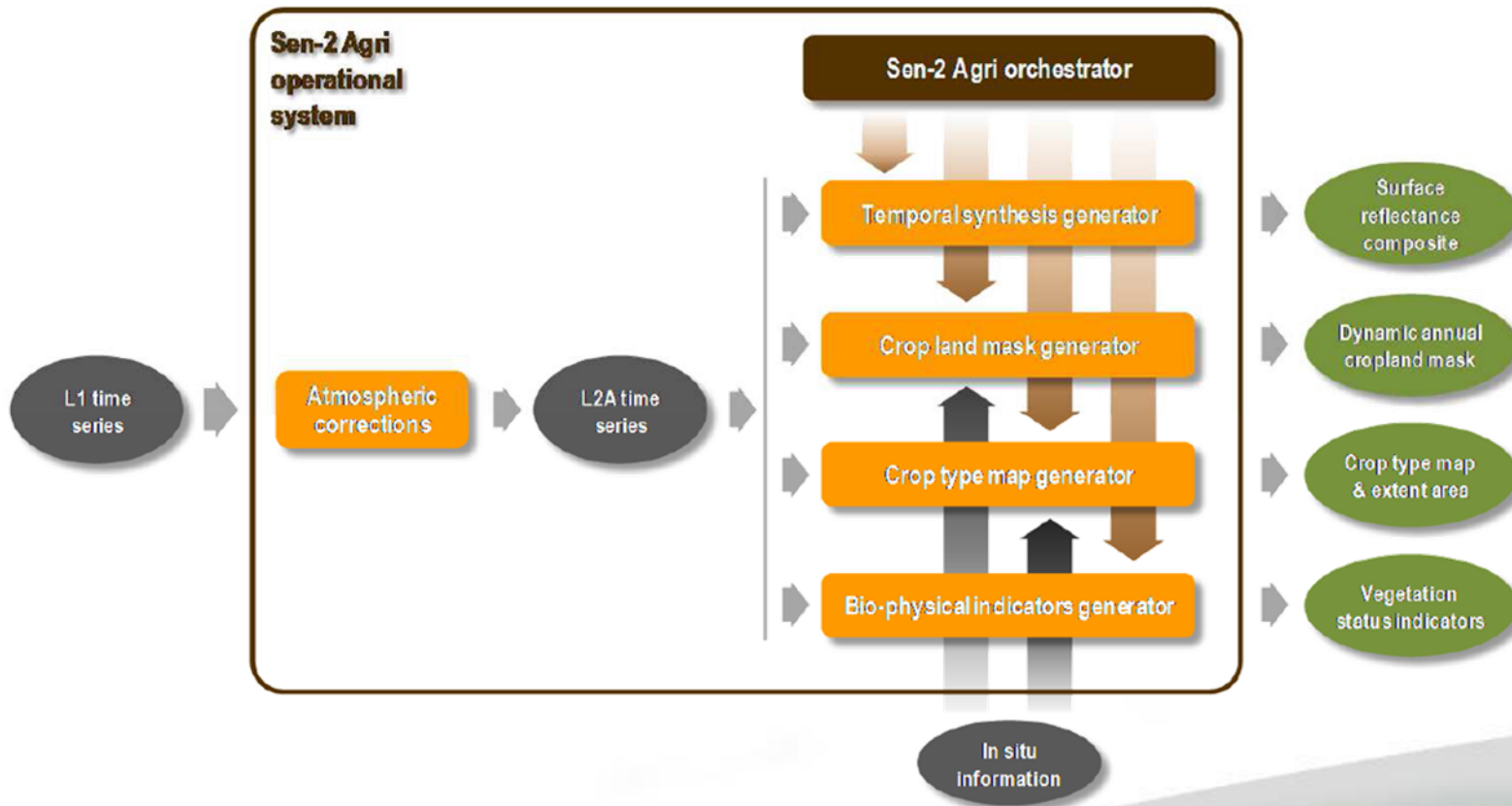
## VEGETATION STATUS



## CULTIVATED CROP TYPE MAP EARLY AREA INDICATOR

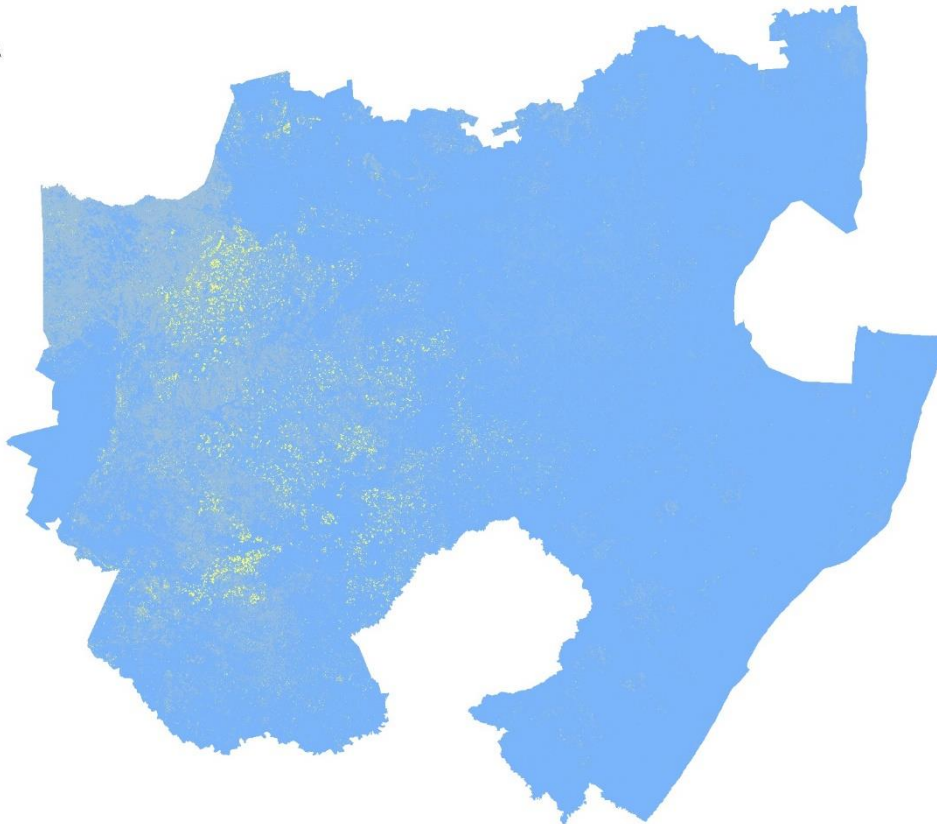


# SEN2-AGRI SYSTEM DEVELOPMENT






# CROP LAND MASK N REGIONS OF SA

Crop Land Mask for Northern Regions of South Africa



## Legend

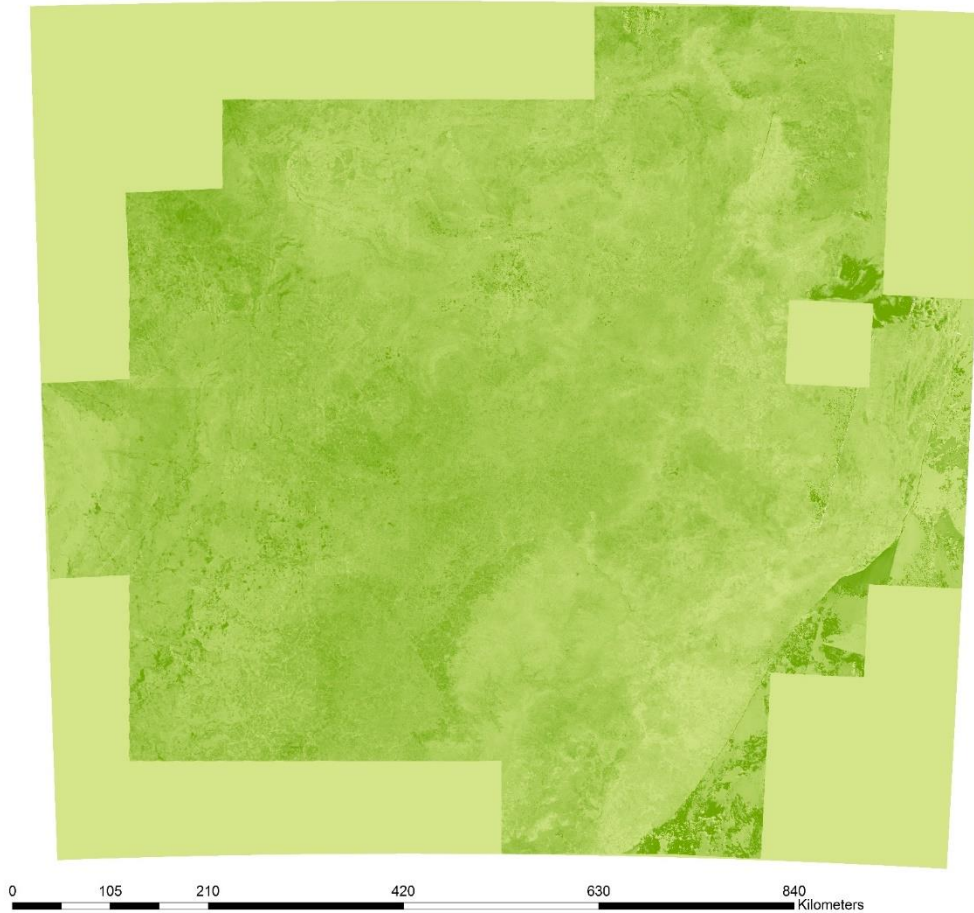
Crop Land Mask	
	Crop land
	None crop land
	None crop land

0 90 180 360 540 720 Kilometers



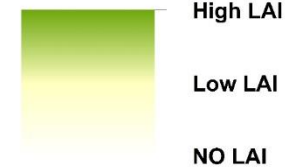
# LEAF AREA MASK N REGIONS OF SA

Leaf Area Index Mask for the Northern Region



## Legend

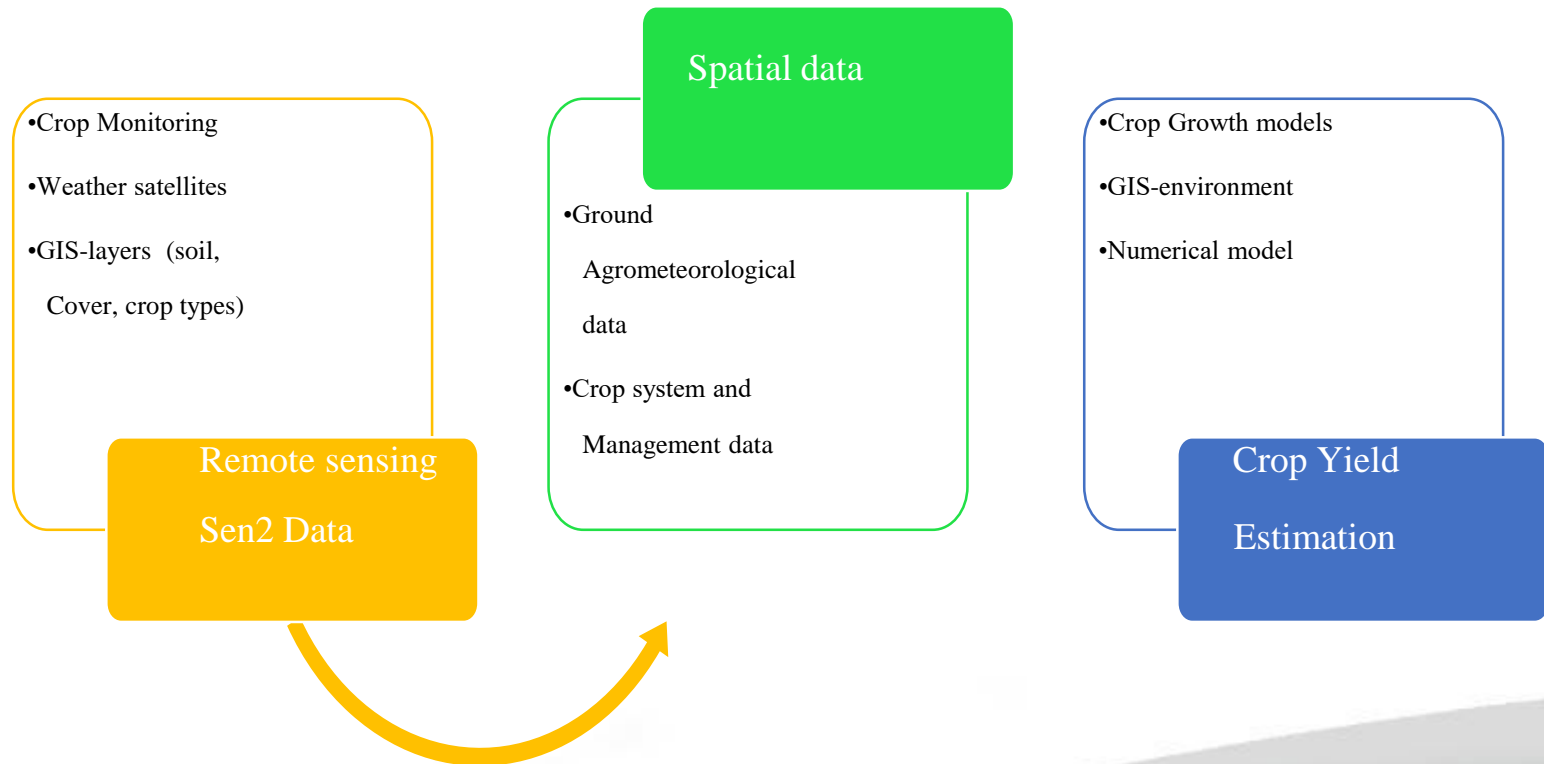
Leaf Area Index



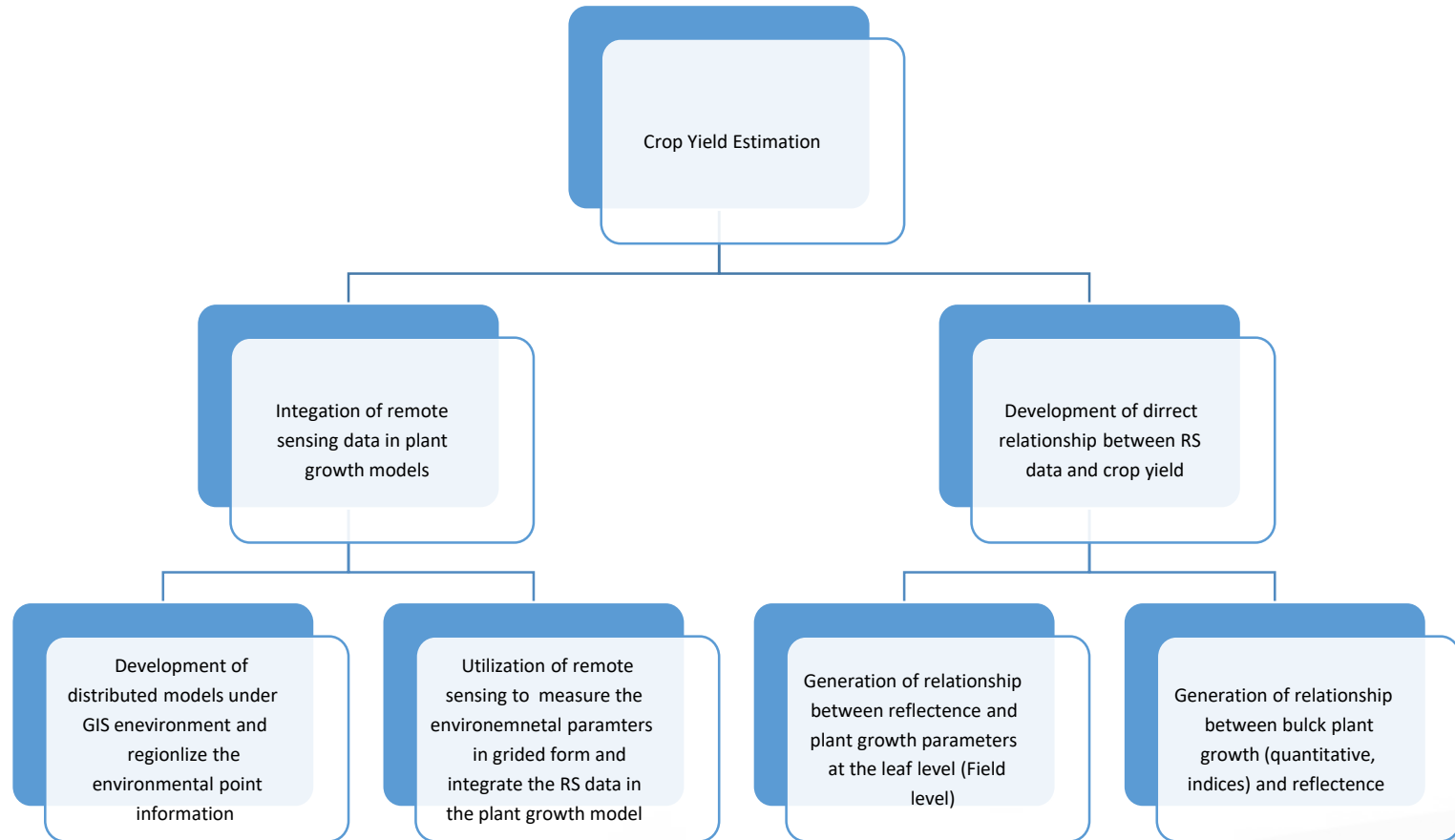
# INDICES THAT CAN BE DERIVED FROM SENT2 FOR MODEL DEVELOPMENT

Index	MODEL	REFERENCE
Water deficit index	$WDI = 1 - \frac{\lambda ET_c}{\lambda ET_p}$	MORAN ET AL (1994)
Ratio Vegetation Index	$RVI = \frac{R}{NIR}$	Pearson and Miller (1976)
Yellow Vegetation Index	YVI=-aB+bG+cR-DNIR	Kauth and Thomas (1976)
Leaf Area Index		Zhao et al (2012)
Redness	$RI = \frac{(R - G)}{(R + G)}$	

# INTEGRATION OF SEN2 DATA INTO MODELS



# An Integrated Framework for Crop Monitoring and Yield Estimation



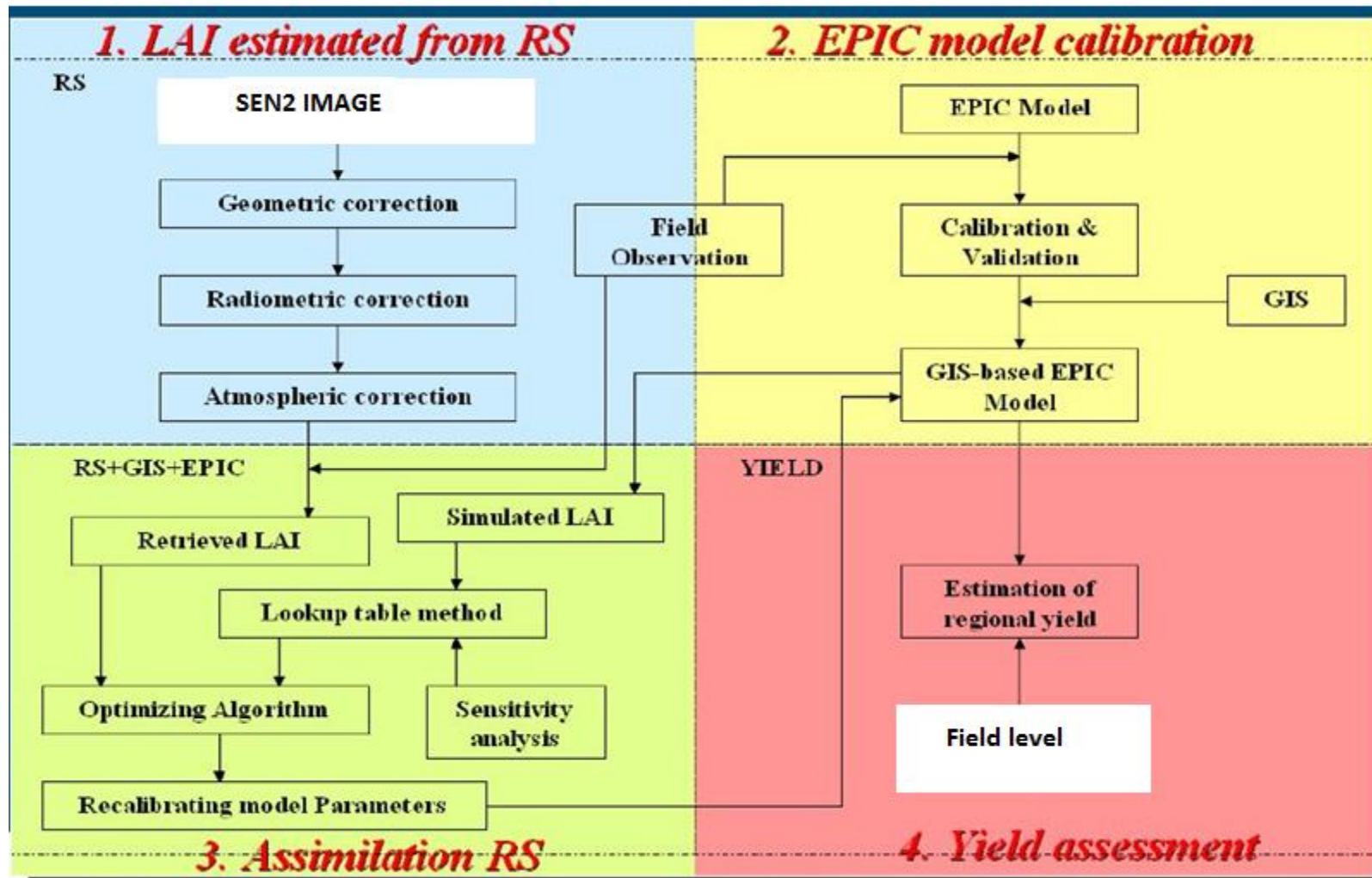
# Models application for crop monitoring and yield

Model	Corp	Areas where it has been applied	Reference
Cropping System (CERES)	Wheat, Maize, Soya Bean	Indiana (USA)	Fang et al ( 2007)
DSSAT	Any crops	China, Sri Lanka	Jones et al (2001),Zheng et al (2015)
Regression Model	Wheat, Rice	Montana (USA)	Labus et al (2010)
WOFOST	Maize,Wheat,Soya bean	Belgium, Northern, France and Luxemburg	Allardde Wit et al (2012)
EPIC	Rice ,wheat	North China and Belgium	Allard de Wit
AquaCrop Based application	Maize, Wheat	Belgium	Joost Wellens (et al,2017) (book chapter)

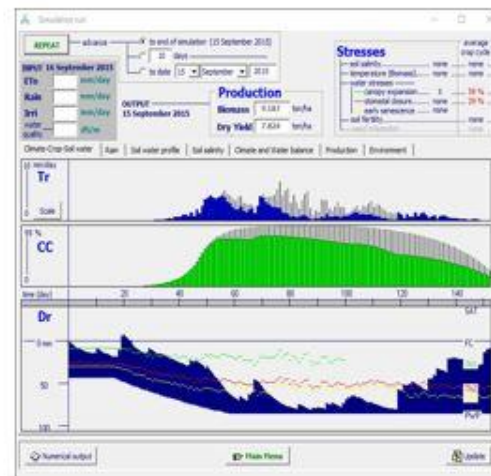
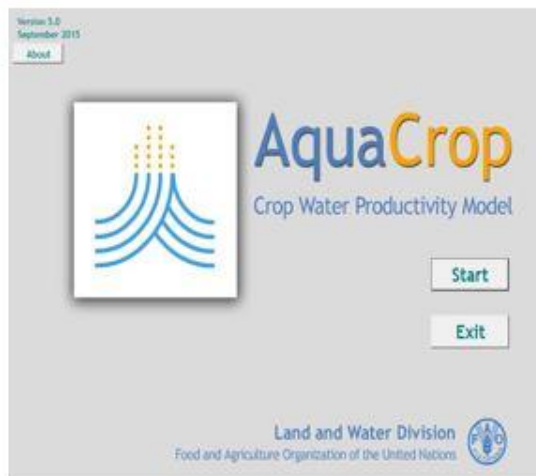




# Assimilating of LAI into the EPIC model



# Application of Sen2 into Aqua Crop

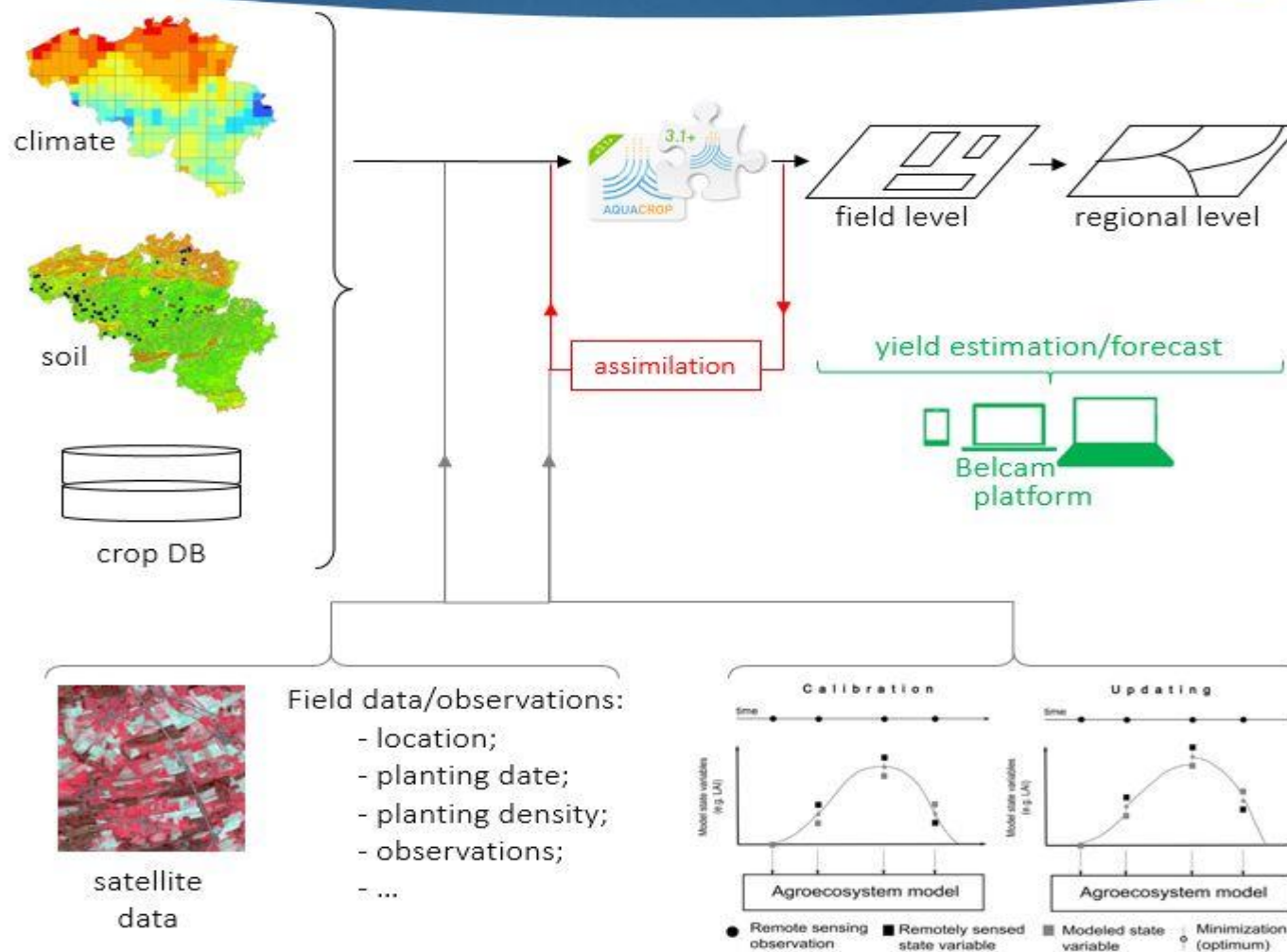


- Field level;
- ≠ crop types;
- Community ↗;

- Crops ↗ ;
- AquaCrop OS & AquaCrop plug-in;
- Assimilation.

- Water driven.

# Aqua Crop



# Importance of this program to ARC-ISCW

- ARC has dedicated 4 researchers and 2 technicians working on the project
- ARC added 1 million rands to the amount received from ESA to buy hardware and this will go a long way to improve and contribute for the efficient running of the system
- ARC Has been carrying out field work since October 2016 until 6 May 2017
- Two students from Belgium and 2 from ARC has been working on research aspects of the projects. They have been actively involved in collecting data for sen2 validation

# THANK YOU!