Agricultural Research Council & National Crop Statistics Consortium

- SA has an Operational System (PICES)
  - **main components:** Satellite imagery, Aerial Eye ball, Point Frame sample, In field Yield survey
  - Continual Improvement philosophy

- **Objective:** Can this “Disruptive Technology” Improve the SA Operational System?
• 50 mill people live on 1.2 mill sq km,
• 12% is arable, 0.8% permanent (Horticulture), only 1.5 mil Ha is irrigated
• Rainfall is unreliable and very variable.
• Large fluctuations in annual rainfall are the rule
• Below-average annual rainfall is more commonly recorded than above-average total annual rainfall.
• Severe and prolonged droughts often end in severe floods.
• Summer and Winter Grain producing areas of SA
• Agricultural practices
  – Commercial Agriculture and Small holders
  – Rotation of crops – Disease, Soil nutrition, Yield
• Key crops winter (wheat, barley, canola)
• Key crops summer (Maize, Sunflower, Soya, Sorghum, Dry Beans)
• Other specificities
  – Seasonal variability
    • Area Planted
    • Yield
    • Influenced by Climate and Price
    • Maize dries in field
Site features

Google stock images
• Currently GTI downloads all Landsat & Sentinel 2 Imagey (50 Tb/yr)
• Used routinely for Field boundary updates (and Land Cover .....)

EO dataset
MID SEASON PRODUCTS
(By ROAD)

END SEASON PRODUCTS
(From PICES, Land cover and road)
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 (Bethelem, Bothaville, Welkom areas)
- Northern Cape & North west province (as well)
- We collected GPS points of all the non crop land and crop land. Record and identified all crops.
- Took samples of LAI from major crops, (Maize, Soya Dry Beans, and Sunflower.
- We travelled over 10 000 km
SA Operational Crop Monitoring (PICES)

- Based on Point Sample Frame
- Cultivated fields mapped from high res imagery
- Point frame overlay
- Sample selection
- Observation from Very Light Aircraft / Helicopter
- Subset selection for yield (in field)
- Opportunistic points for training classifiers
- Survey only once in Season (winter & summer)
- Continual improvement over 10 years

**PROVIDES GRD FOR SEN2Agric CALIBRATION / VALIDATION**
In Situ dataset

Legend
- Towns
- PICES points WC
- PICES points NR

Provinces
- Western Cape
- Northern Region

PICES Points

3rd Sen2Agri User Workshop - Rome, 28-29 June 2017
Crop boundaries with PICES points

- Crop fields with PICES points were selected
- Apply negative 15m buffer to eliminate edge effect
- PICES legend was translated to the Sentinel-2 Agri legend
Sample of fields were selected

- Sample of crop fields were selected to merge with non-cropland samples
- Add and apply Sentinel-2 Agri legend and attributes
Creating non-crop samples
Using SA Landover data
Creating non-crop samples

Non-crop points were created by:

- Creating random point polygons in the non-field boundary area
- Selecting points in homogeneous non-crop land over areas
- Re-interpretation and classification of the points to comply with class definitions of Sentinel-2 Agri legend
In Situ dataset

**Process**

**Annual crop area**
- Crop boundaries
  - Negative 15m buffer
  - Field crop polygons
  - Intersect
  - Add Sentinel-2 Agri attributes
  - Annual crop boundaries
  - Merged sample data set for each study area

**Non-Crop area**
- Random points
  - 500m Buffer
  - Polygons
  - Reclassified Land cover
  - Intersect
  - Zonal attributes
  - Quality control & interpretation
  - Non-crop polygons
Western Cape composite Imagery
(at 10 m resolution of Sentinel-2A images for the period from 5 August to 25 September 2016.)
Cropland mask

- First mask delivered at the middle of the season, then updated on a monthly basis
- Available 5 days after the acquisition period
- Cropland and Non-Cropland F1-Score reach 82% and 91% respectively at the end of the season (based on independent in situ dataset)
**CROP TYPE**

- First product delivered at the middle of the season, then updated at the end.
- Available 2 weeks after the end of the acquisition period.
- Overall accuracy 89% for the summer crop area and 81% for the winter crop.
Sen2-Agrí products assessment

Leaf Area Index

Time series of Leaf Area Index at 10 meter spatial resolution, derived from Sentinel-2 and Landsat 8 over the 2016-2017 growing season, for all land cover types (top) and for wheat only (bottom)
CropType map products -- Western Cape

• The overall accuracy of 81% with the following F-Scores for individual crop types:
  – Wheat : 82%
  – Barley: 69%
  – Oilseed crops : 92%
  – Vegetables and melons : 63%
  – Lupines : 44%
  – Beverage and spice crops : 66%
  – Grasses and fodder crops : 83%
Crop type Summer Crop Area

- The overall accuracy of the map is 89% with the following F-Scores for individual main crop types:
  - Maize: 94%
  - Sunflower: 80%
  - Soya beans: 82%
  - Sorghum: 45%
  - Grasses and fodder crops: 89%
Infrastructure

- ARC acquired a large capacity server
- LINUX operating system
- Limited Linux experience constrained implementation
- 1st fully Operational exercise July – Western Cape
• Quick Response Test
• Background
  – Record crop
  – Silos need to be supplemented
  – Extra storage for SHF in EC
  – Where to place silo-bags
• Criteria:
  – Road for delivery (optimal location)
  – Rail for removal to processors (optimal location)
  – Close to fields with Maize
• Three weeks – Request to Results
Use Case: Eastern Cape

Crop Type product combined with rail and road infrastructure used to select locations for Silo bag placement.
Use Case: Eastern Cape

Comparison MODIS cultivation with Sen2Agric Crop type
• Workshop of stakeholders
  – Potential Application of products identified
    • Logistics planning (Transport, Storage space)
    • Futures Trading (Timely information)
    • Food security planning (imports strategy)
• Course to VKB (Agric Company)
• Still to be presented to CEC (July)
• Real time WC (July) – Input to CEC
Thank you for your presentations at VKB’s GIS and Remote Sensing Day.

Comments received:
- “There is different resolutions of satellite images and the applications that you use it for”.
- “Maize has a wavelength pattern! and we know how it look 😊”

But the highlight was that we finally know how to get a yield estimation form satellite images.

It was excellent and very informative.

A Free State Agricultural Company that operate Grain Silos

3rd Sen2Agri User Workshop - Rome, 28-29 June 2017
Feedback on system and products

• **Constraints**
  – Lack of Linux experience
  – Users want 3 column spreadsheet

• **Recommendations**
  – Public domain license - commercial use?
  – Extra layers of ancillary (DEM, Climate. Crop Regions)
  – Yield forecasting (Models – biophysical parameters)
  – Rangeland - Graze capacity - LAI on other land cover classes
• Need for Training and Support (Confidence)
  – End user need to be confident (CEC)
  – Service provider needs to deliver (NCSC)

• Cloud based option
  – Provincial Departments Pilot
  – SAGNET Pilot on ARC Cloud?

• Use for Rangelands (Grazing Capacity)
  – SADC – Livestock more NB than Crops
• Our sincere appreciation to ESA & UCL led consortium.
• Demonstrating disruptive EO technology and it’s practical beneficial use
• Agriculturalists in southern Africa are showing increasing enthusiasm for EO imagery (SAGNet workshop)
• Private sector Investment in Agriculture in Africa is information driven.