

Remote Sensing Applications:

Agriculture, biodiversity & water resource management

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UNOOSA Training
27 September 2023

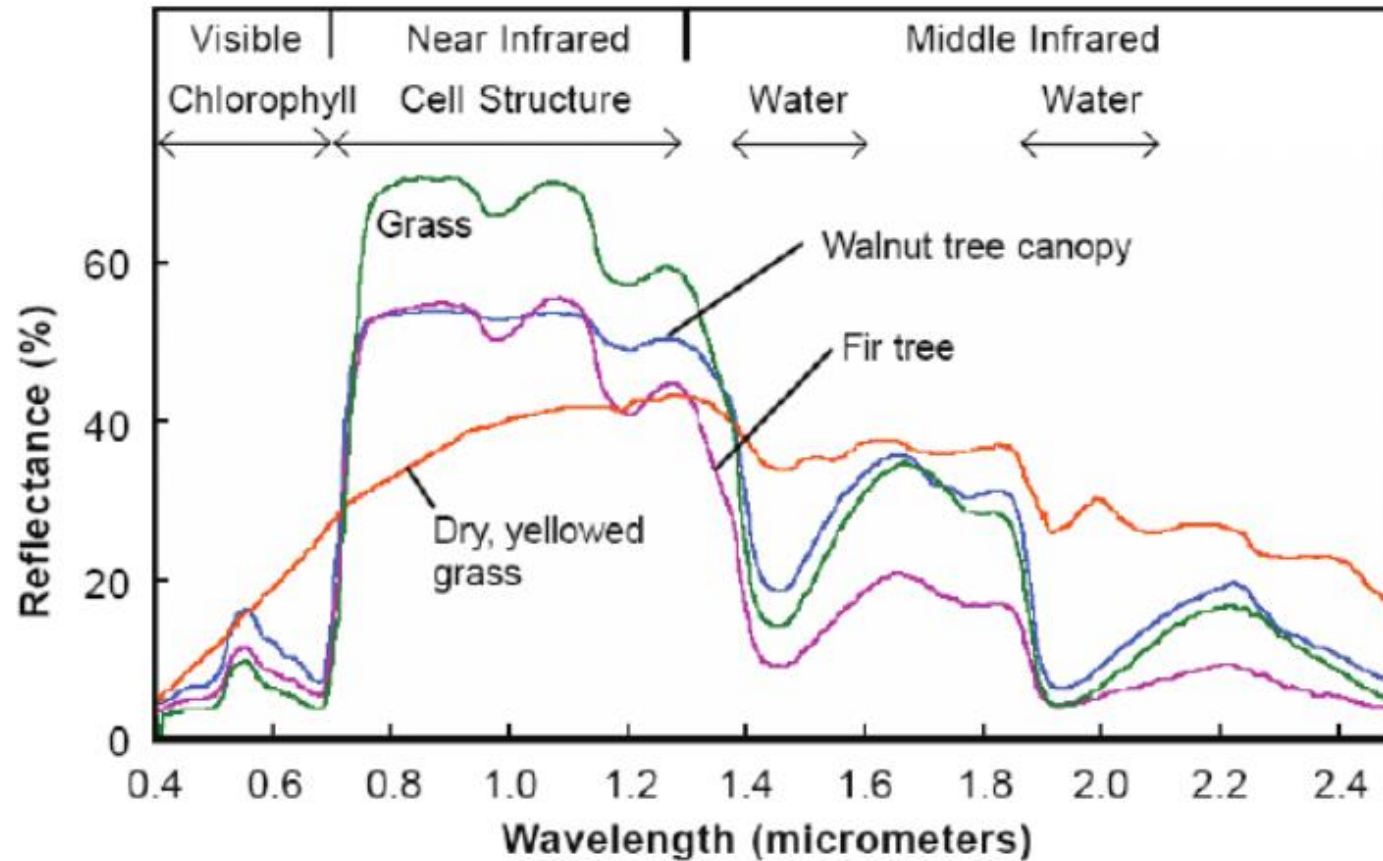


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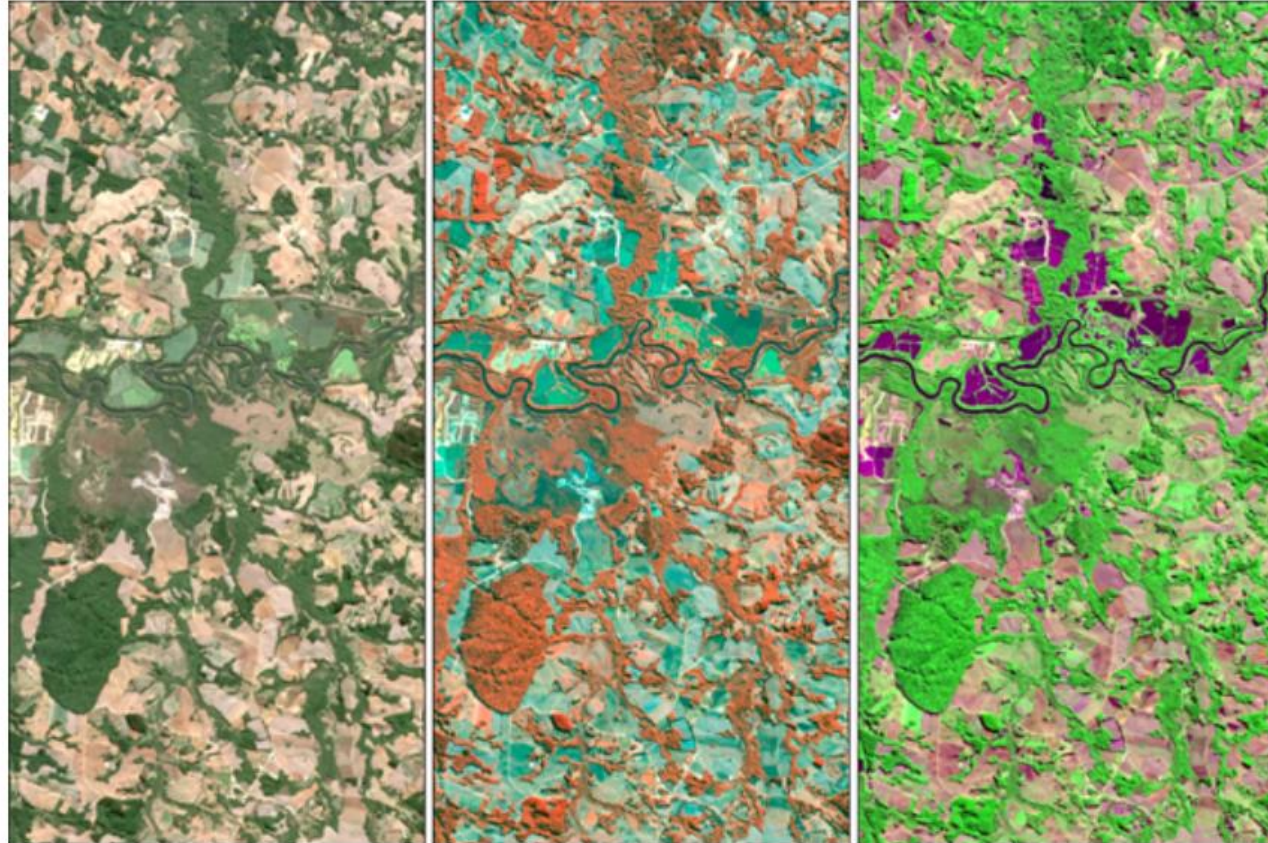
Vegetation Remote Sensing



Source : <https://certi.org.br/blog/en/remote-sensing-for-monitoring-vegetation/>

Healthy leaves absorb some red energy, and reflect green and NIR energy. The green reflected energy is the reason why vegetation appears to have a green color. Since humans are unable to 'see' reflected NIR energy, we use NIR sensors to detect reflected NIR energy.

Vegetation Remote Sensing



Examples of colored compositions used for the visual identification of vegetation in multispectral images. True color, false color with vegetation in red and false color with vegetation in vibrant green (MSI/Sentinel image)

Source :
<https://certi.org.br/blog/en/remote-sensing-for-monitoring-vegetation/>



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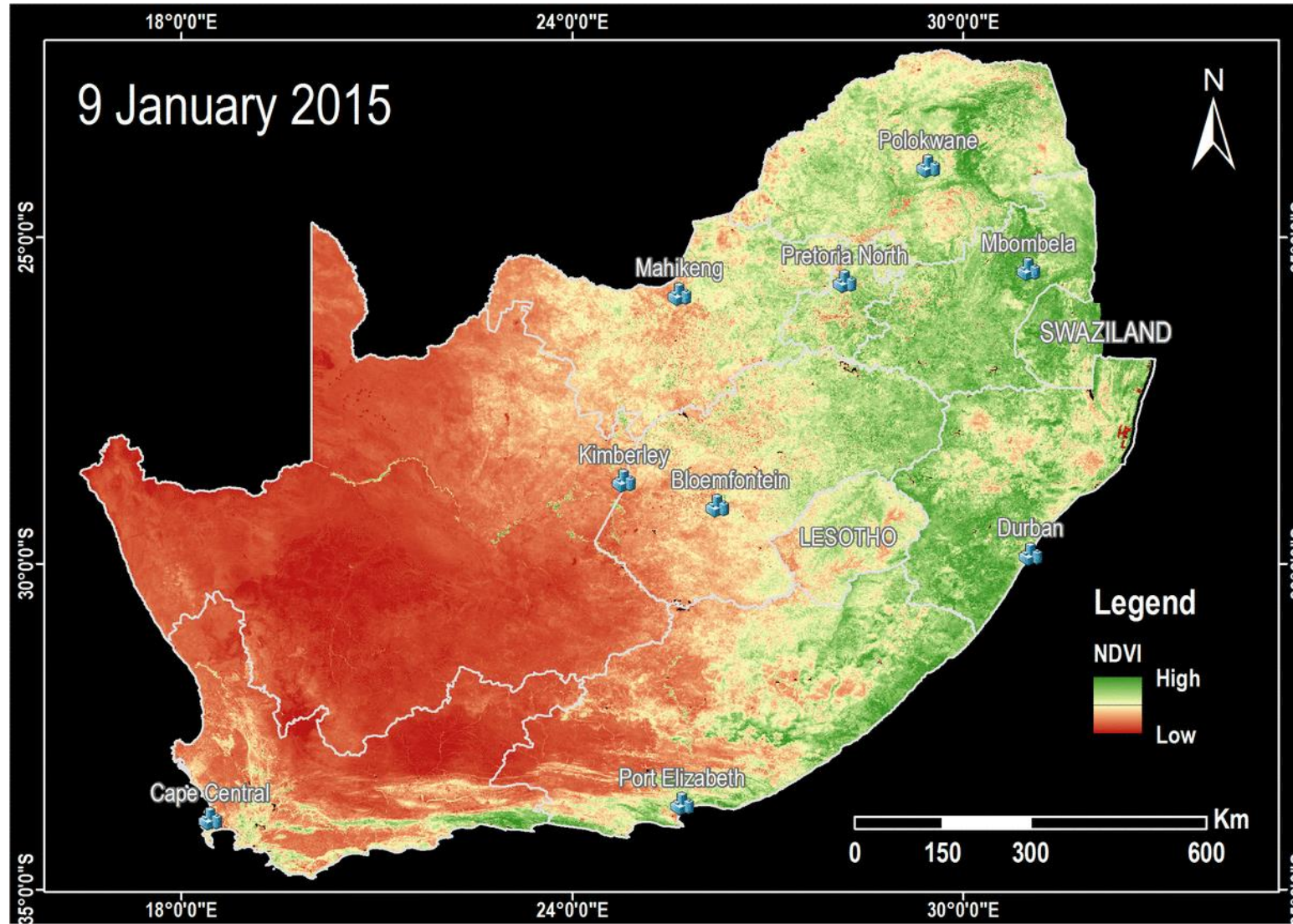


APPLICATIONS

Remote sensing images allows not only the simple detection of vegetation, but also estimating the properties and qualitative aspects of vegetation that are relevant in various types of **monitoring**, such as:

- Height of the vegetation;
- Plant vigor;
- Water and nutrient stress;
- Biomass and carbon content; and
- Identification of species.

Vegetation condition monitoring



Changes in vegetation health throughout the year. The brown represents unhealthy vegetation or bare soil. Green represents healthy vegetation

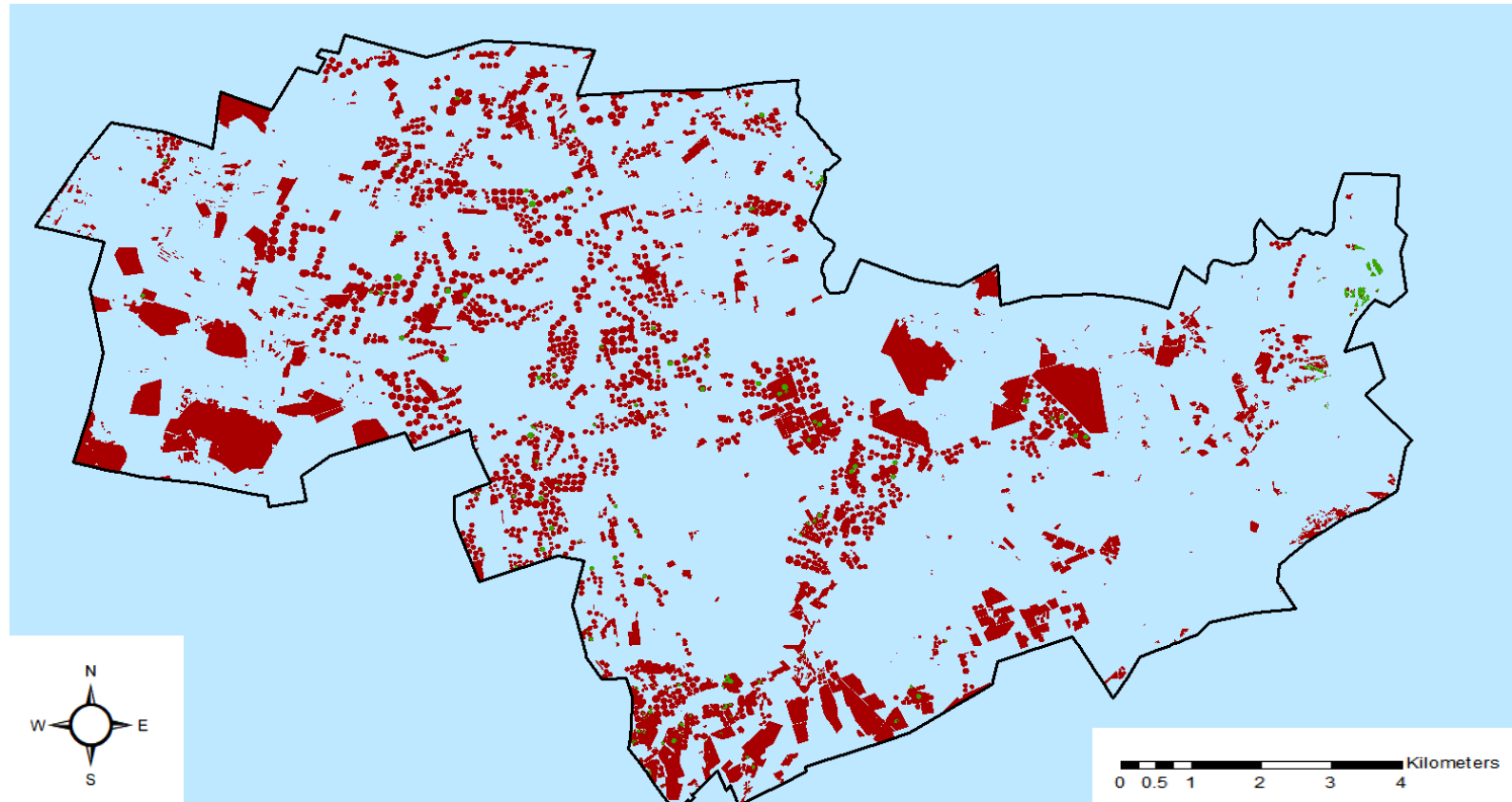





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Cropped Arable Land



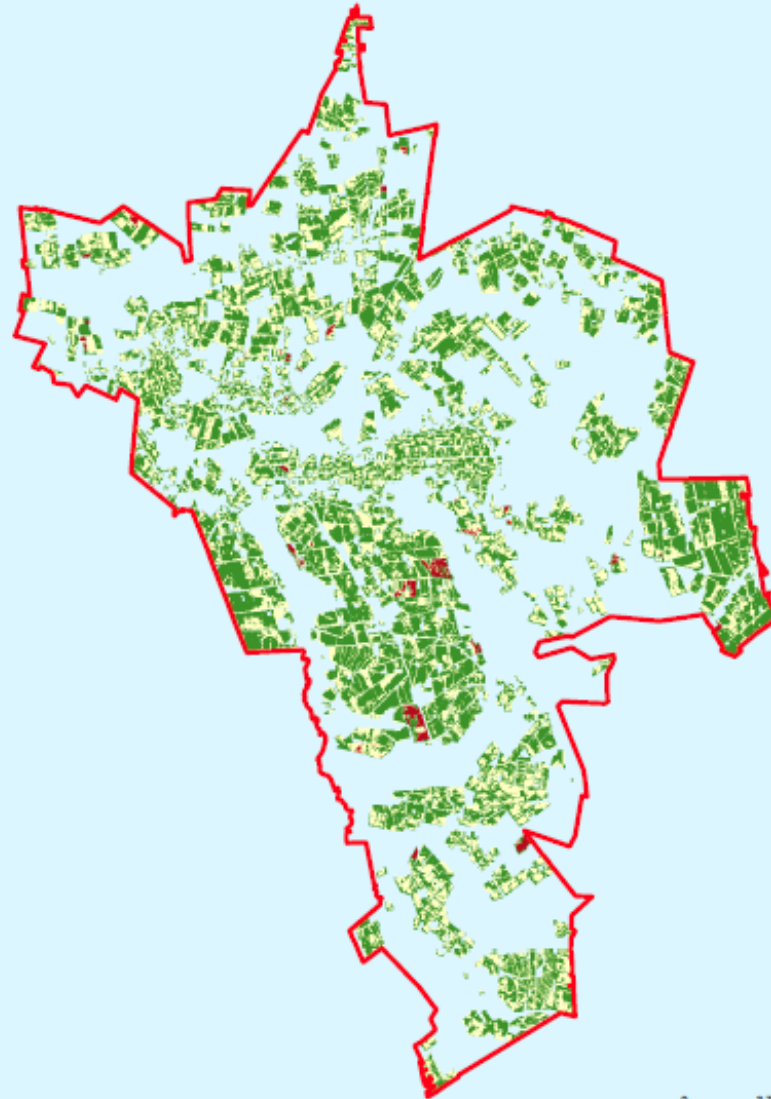
-  Molemole Border
-  Planted
-  Fallow




PLANTED AND FALLOW AREAS IN CAPRICORN DISTRICT



Cropped Area Estimates within Koppies




Legend


 Senwes_Silo_Service_Area

Koppies

Class

 Fallow

 Crop Spatial Anomaly

 Healthy

Projection: Universal Transverse Mercator
Central meridian: 27°E
Datum: WGS 1984
Date: 16/02/2017
Paper size: A4

SANSA, Farm No 502JQ, Hartbeesthoek,
District Krugersdorp | P.O. Box 484, Silverton, 0127,
T: +27 12 842 7800 | F: +27 12 842 7809,
Email: earthobservation@sansa.org.za,
<http://www.sansa.org.za>

Crop Area Estimates

Service Area	Sum (excluding Pivot Irrigation, Horticulture / Viticulture & Shadenet)	Area: Pivot Irrigation, Horticulture / Viticulture & Shadenet (ha)	Planted (ha)	Fallow (ha)	Sum (excluding Pivot Irrigation, Horticulture / Viticulture & Shadenet) - P.Pastures	P.Patures	% Planted	Image Date
Bloemfontein	146950.69	9854.68	9277.01	137673.68	143113.69	3837.00	6.48	06-12-2016
Bultfontein	125527.90	4622.97	8277.18	117250.72	118827.90	6700.00	6.97	06-12-2016
Hoopstad	211018.85	10954.49	30988.69	180030.16	204621.85	6397.00	15.14	06-12-2016
KOPPIES	30016.07	461.15	11726.49	18289.58	29561.07	455.00	39.67	03-12-2016
KROONSTAD	32311.63	412.99	18598.99	13712.64	32133.63	178.00	57.88	03-12-2016
VENTERSDORP	64289.82	4821.76	31709.65	32580.17	64096.82	193.00	49.47	06-12-2016
VIERFONTEIN	29920.77	916.21	7849.11	22071.66	29859.77	61.00	26.29	06-12-2016
Wesselsbron	128143.98	5543.07	15017.74	113126.24	122169.98	5974.00	12.29	06-12-2016



Service Area	Sum (excluding Pivot Irrigation, Horticulture / Viticulture & Shadenet)	NODATA	Area: Pivot Irrigation, Horticulture / Viticulture & Shadenet (ha)	Planted (ha)	Fallow (ha)	Sum (excluding Pivot Irrigation, Horticulture / Viticulture & Shadenet) - P.Pastures	P.Patures	% Planted	Image Date
Bloemfontein	149919.80	132.32	9854.68	71743.50	78043.98	146082.80	3837.00	49.11	16-02-2017
Bultfontein	127252.98	310.75	4622.97	87122.73	39819.50	120552.98	6700.00	72.27	16-02-2017
Hoopstad	220380.8756	2819.00	10954.49	178521.7051	39040.17	213983.8756	6397	83.43	16-02-2017
KOPPIES	30596.65	68.38	461.15	30210.66	317.61	30596.65	455.00	98.74	09-02-2017
KROONSTAD	33048.82	25.57	412.99	32557.68	465.57	32870.82	178.00	99.05	09-02-2017
VENTERSDORP	65890.13527	406.76	4821.76	65402.41	80.97	65697.14	193	99.55	16-02-2017
VIERFONTEIN	30315.5676	56.04	916.21	30235.95	23.58	30254.5676	61	99.94	16-02-2017
Wesselsbron	132564.1547	276.12	5543.07	127991.88	4296.15	126590.1547	5974	96.75	16-02-2017

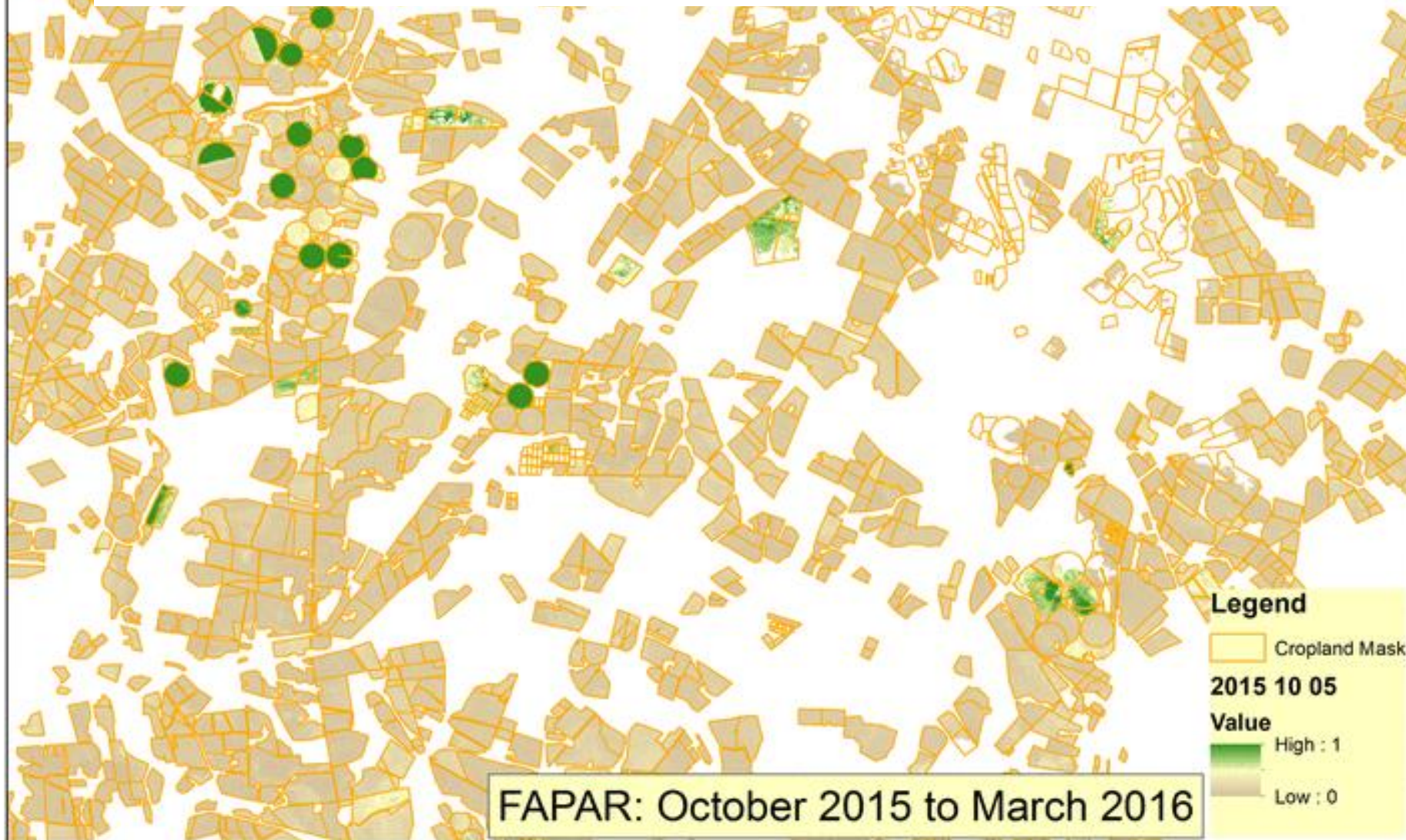


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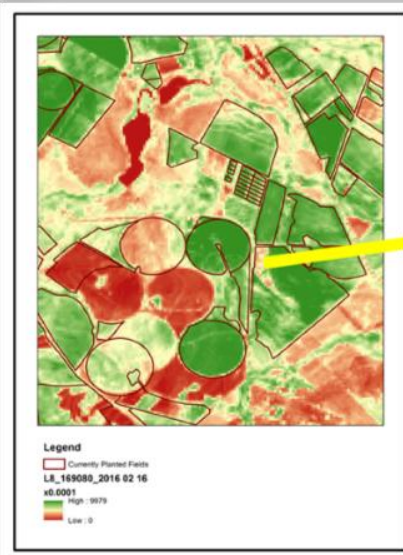
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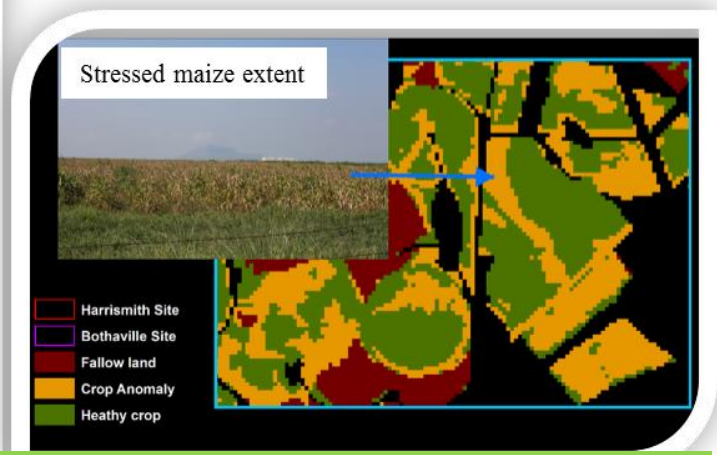
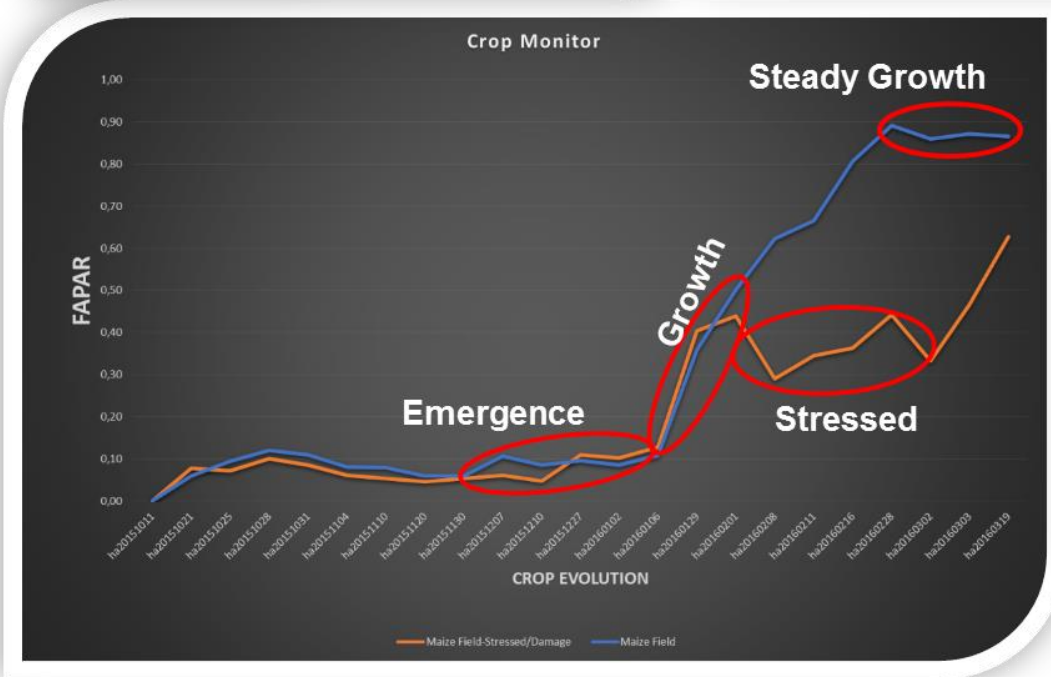
Field Crops Evolution Monitoring



Crop Condition & Growth Monitoring



CROP STRESS DUE TO :
hail, pests, diseases,
water & nutrient
deficiency, etc



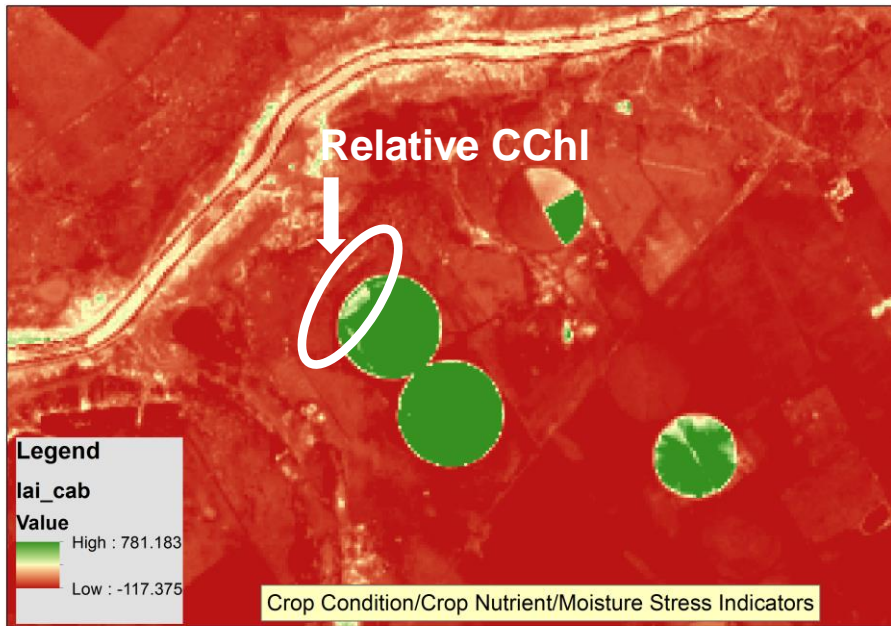
Biophysical parameters such as Leaf Area Index, canopy chlorophyll, fAPAR, canopy water, etc are used.



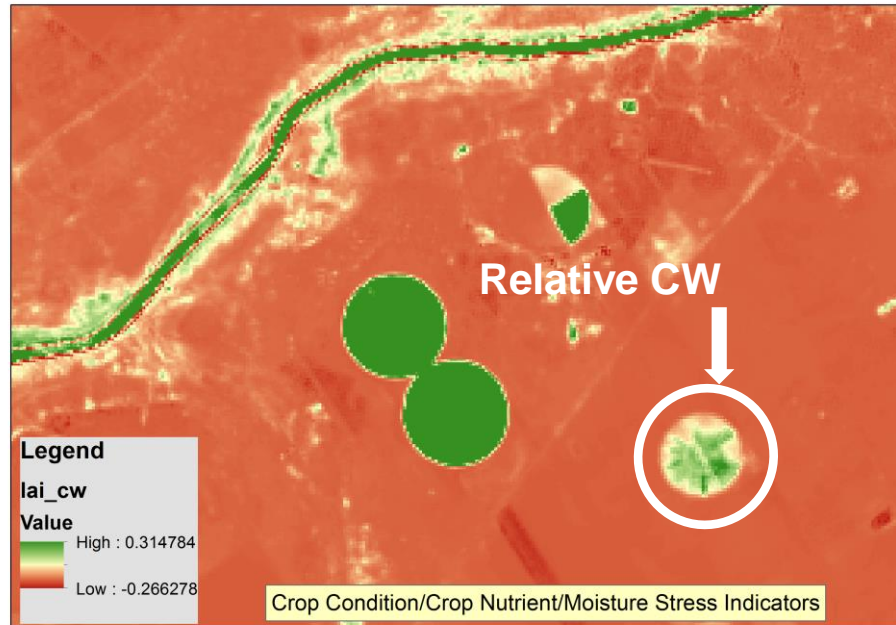
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Relative Canopy Leaf Chlorophyll stress

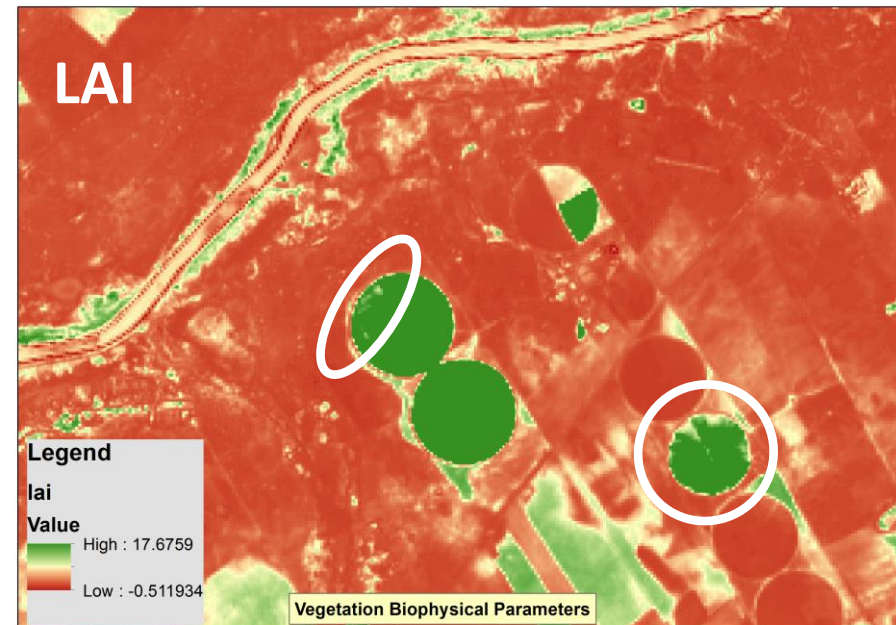


Relative Canopy Leaf Water Stress

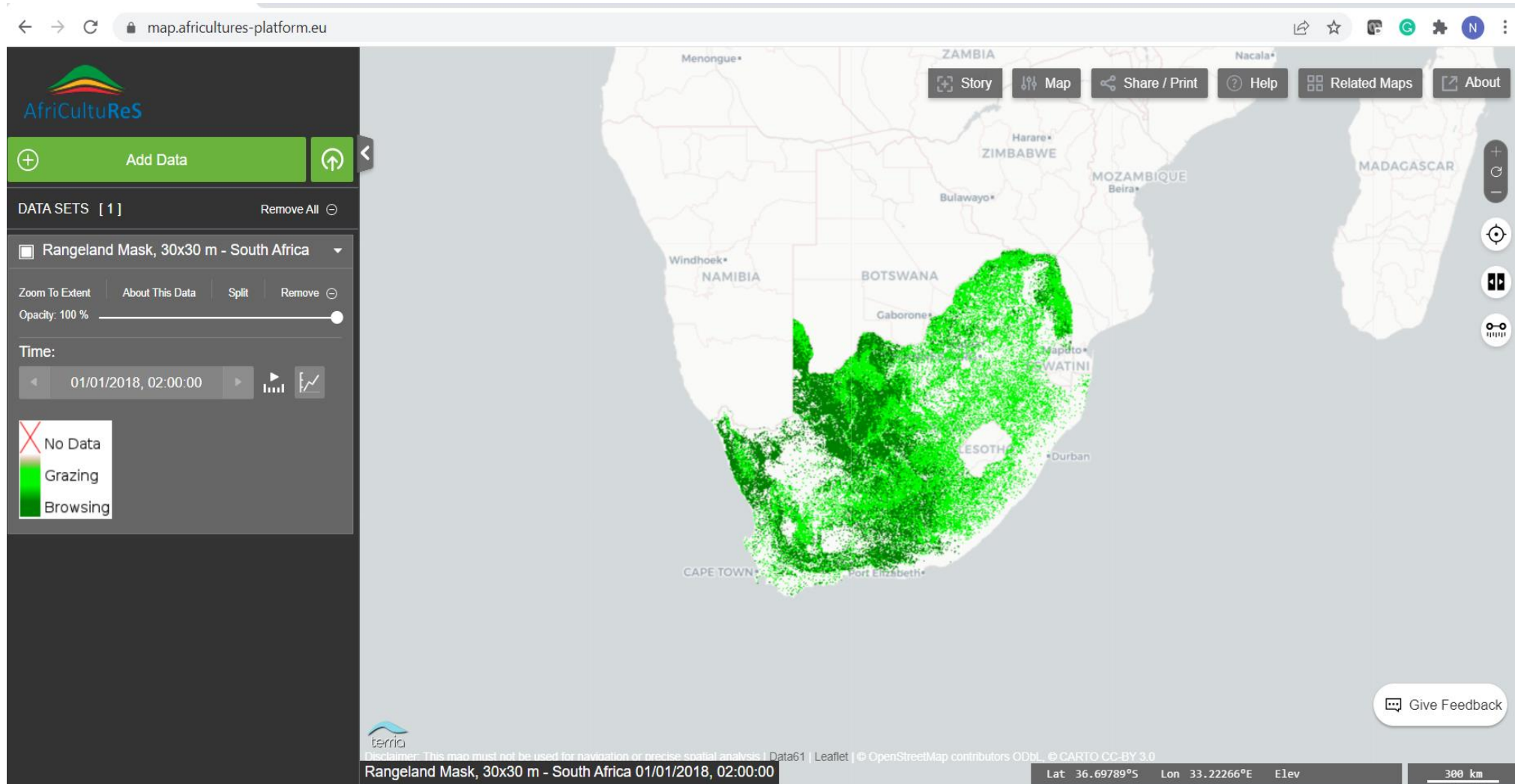


Summary

The two crop fields assessed above displayed symptoms of vegetation stress due to low relative canopy **leaf chlorophyll (CChl)** and relative canopy **leaf water (CW)** values. These two fields were analyzed using retrieved biophysical parameters from sentinel 2 image. The CChl and CW were modelled with the Leaf Area Index (LAI) values to assess whether the low values were, in fact, a cause of stress or a result of a sparse vegetation cover/density.



Rangelands type mapping



africultures-platform.eu

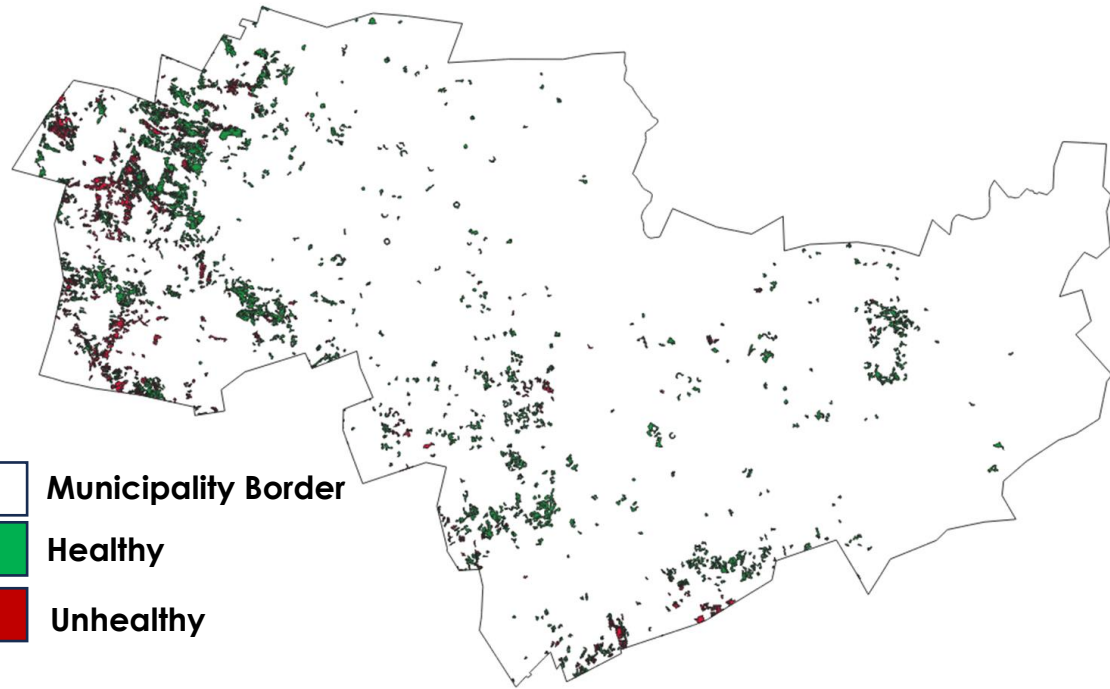


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Rangelands Health monitoring



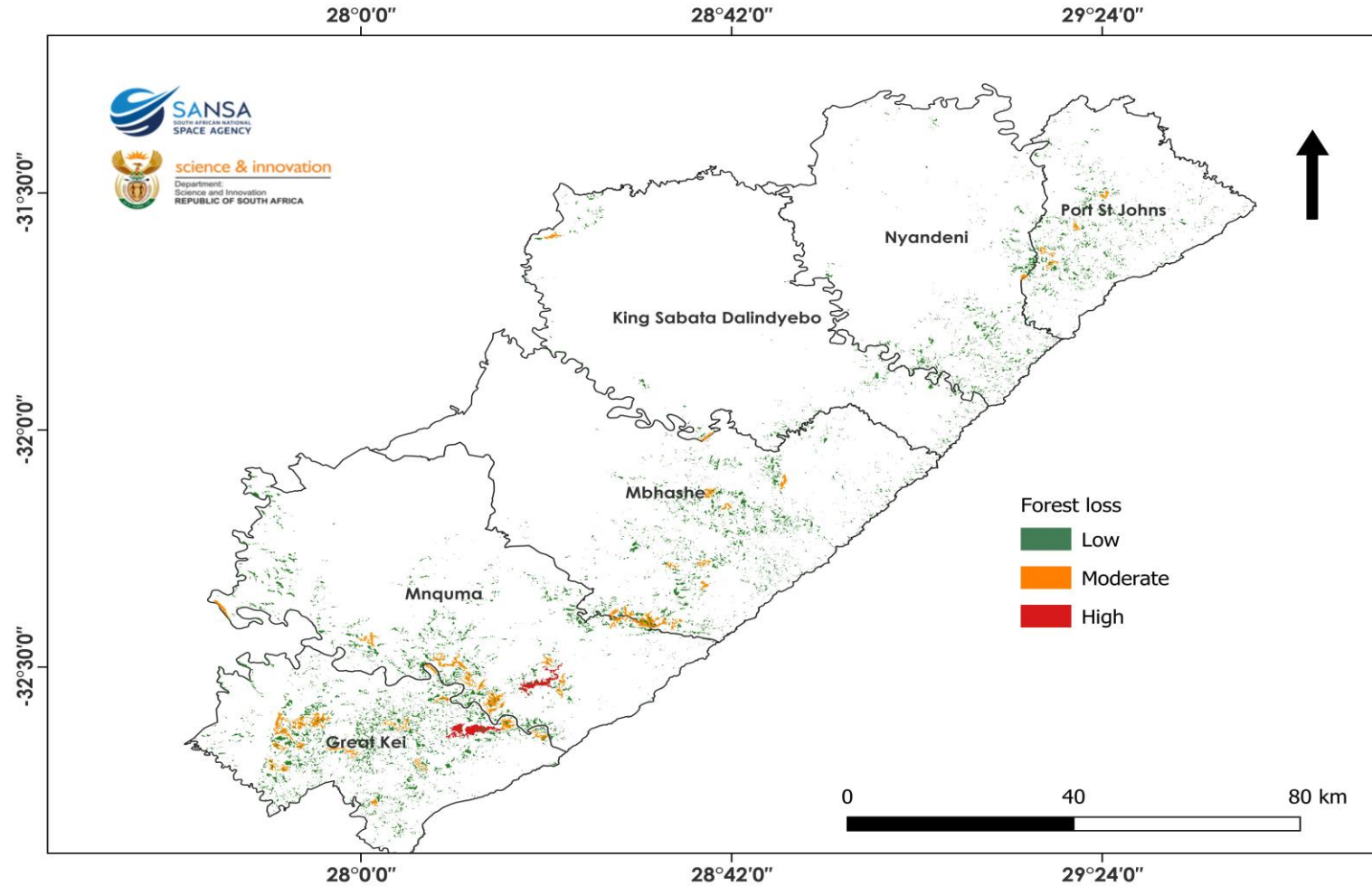
- Assist livestock farmers with development of risk management and coping strategies.
- Support implementation, improvement and update of policies and assessing their effectiveness.

Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983)(CARA)
 "the grazing/browsing capacity of veld and the maximum number and the kind of animals which may be kept on veld."

Rotation/rest grazing system

	Dec/Jan/Feb	Mar/Apr/May	June/July/Aug	Sept/Oct/Nov	Rest
Year 1	Camp A	Camp B	Camp C	Camp A	Camp D
Year 2	Camp B	Camp C	Camp D	Camp B	Camp A
Year 3	Camp C	Camp D	Camp A	Camp C	Camp B
Year 4	Camp D	Camp A	Camp B	Camp D	Camp C

Deforestation Mapping



Mapping the extent and intensity of deforestation



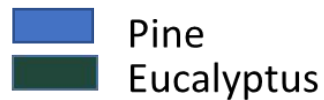
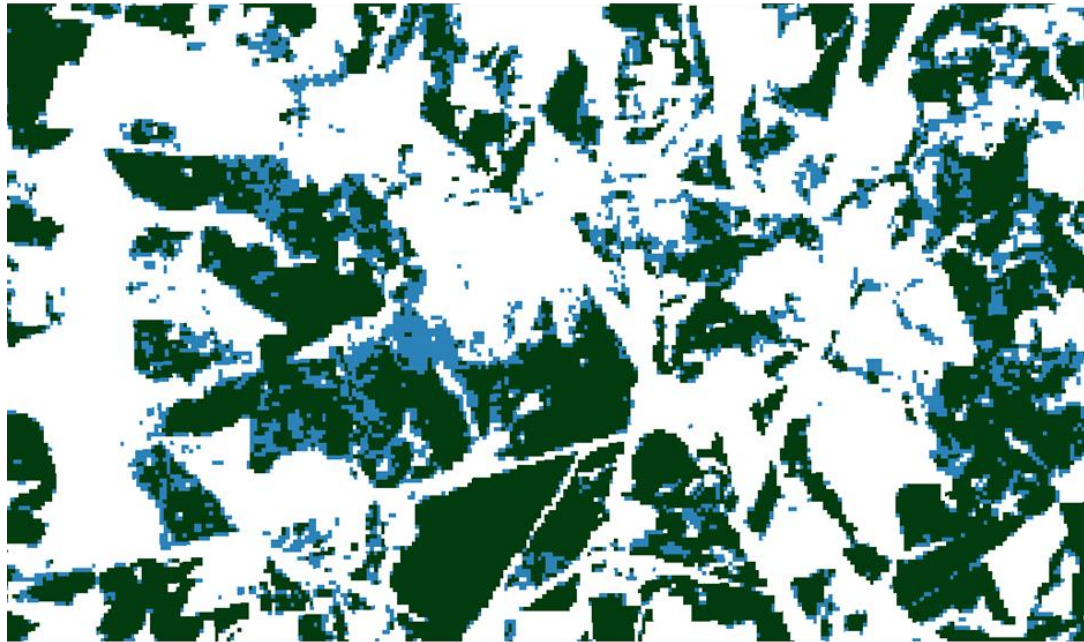
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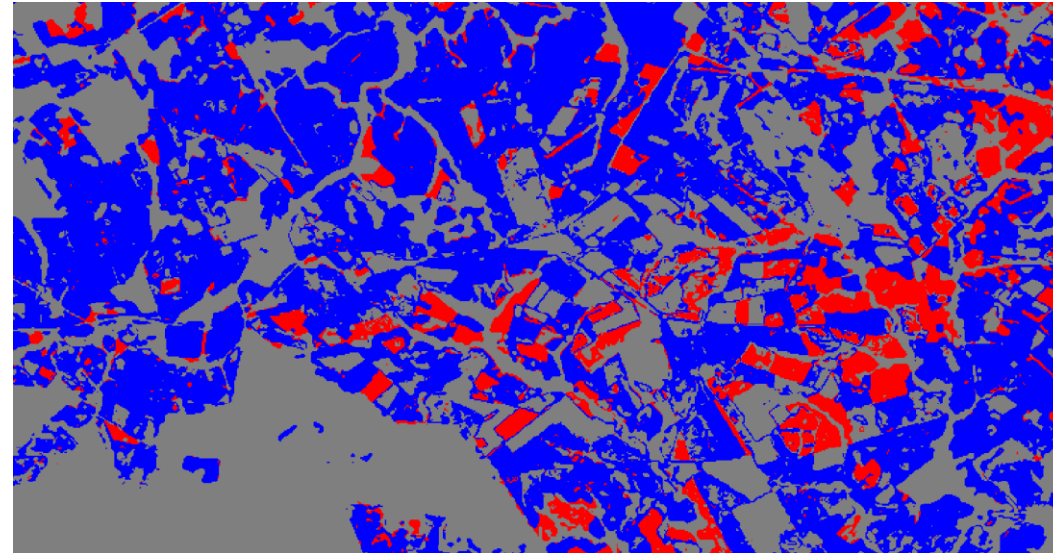
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Forest type & change mapping

Eucalyptus and Pine extent - 2021

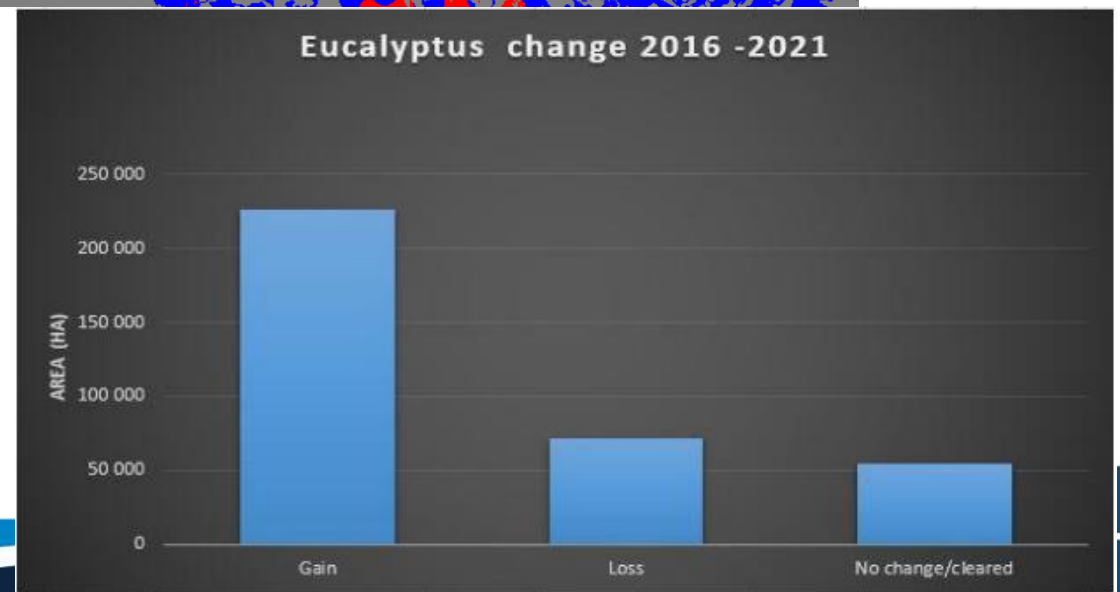


Changes in eucalyptus between 2016 and 2021



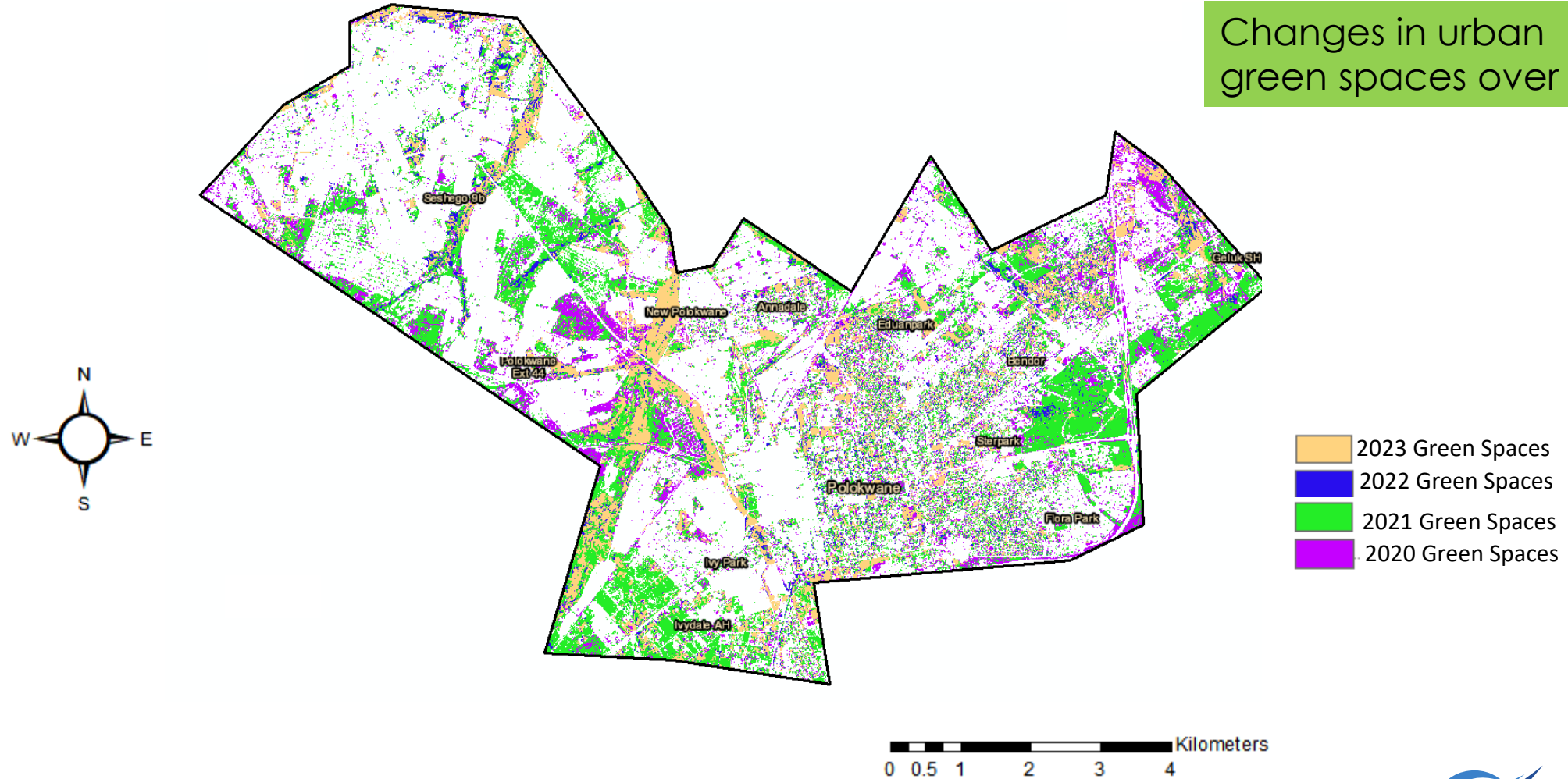
- Provide information about the size of the plantation area for water use monitoring.
- Monitor changes from one plantation to another for compliance purposes.

Eucalyptus change 2016 -2021



Urban Green Spaces

Changes in urban green spaces over time



Water Resource Management



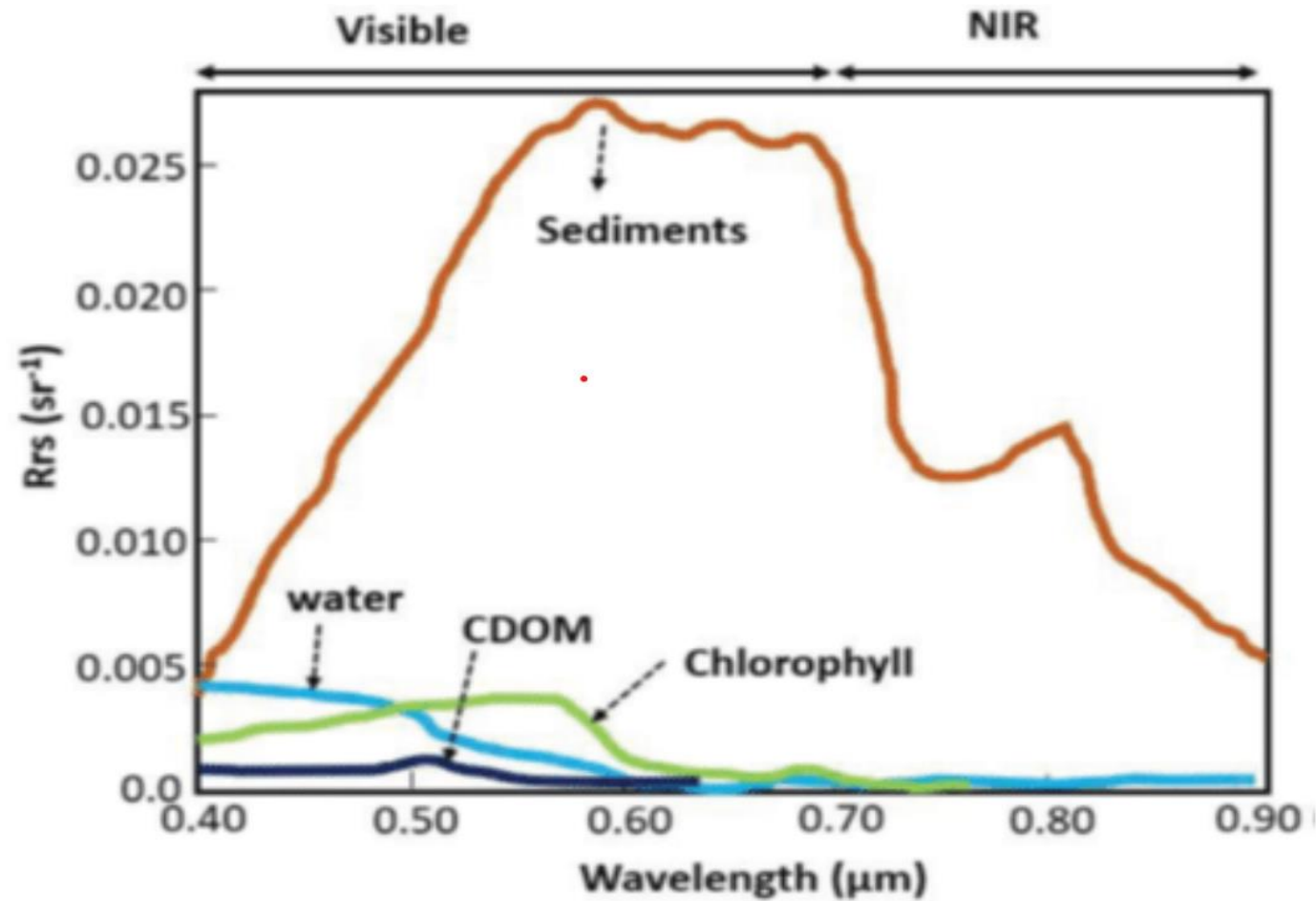
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Remote Sensing for water



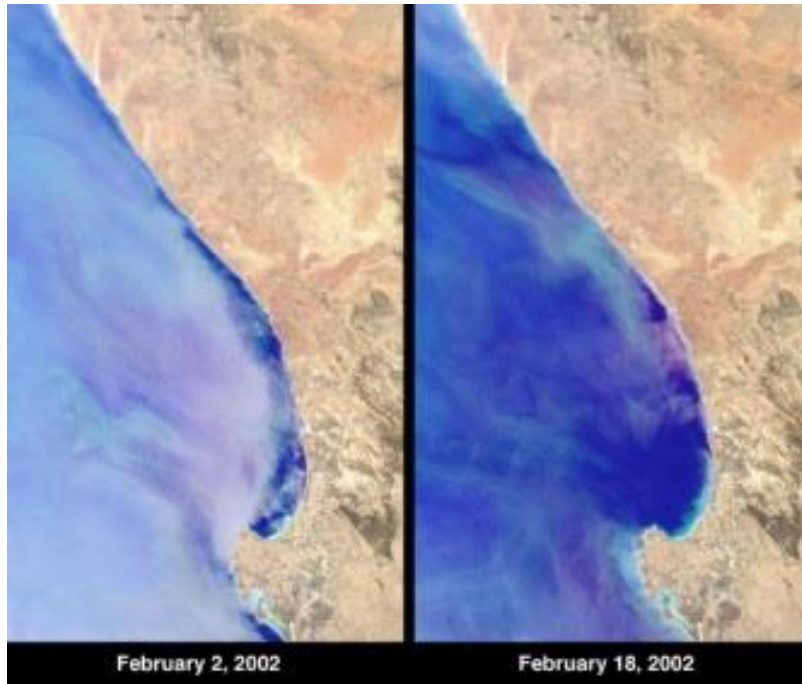
Spectral signatures of water with sediments (orange), clear water (blue), water with chlorophyll content (green), water with Chromophoric Dissolved Organic Matter - CDOM (black). R_{rs} is the reflectance registered by the sensor. Source: Hafeez et al. (2018).

APPLICATIONS

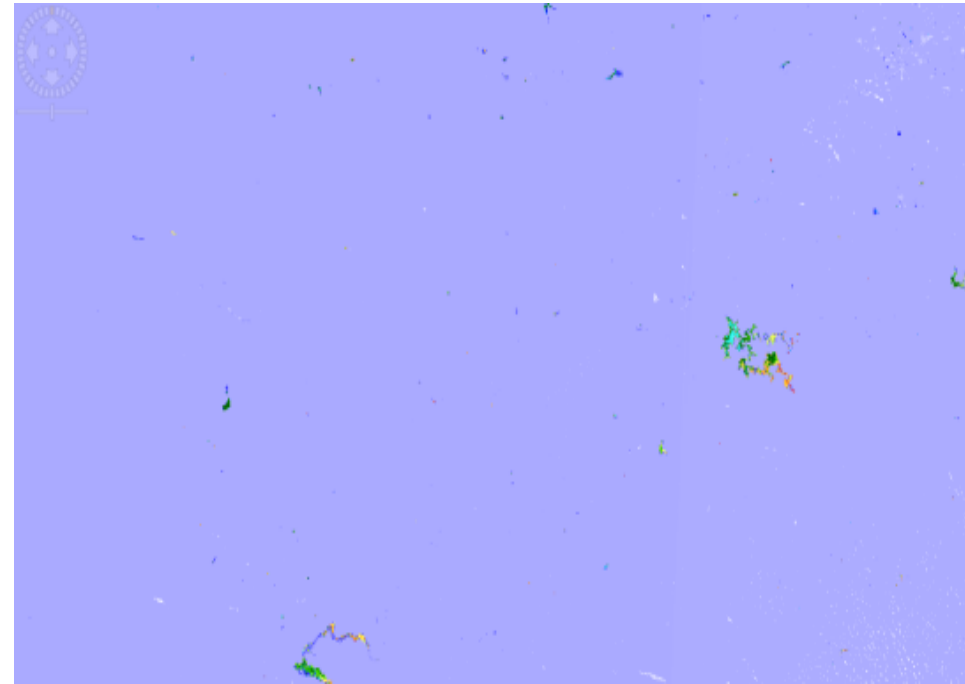
Various applications of remote sensing to water resources include:

- Water quality monitoring;
- Watershed Management;
- Flood plain management;
- Groundwater exploration;
- Irrigation management;
- Water body mapping.

Water Quality (Oceans and Inland)



MERIS observation of the red tide 2002



Chlorophyll A mapping in in-land dams 2012

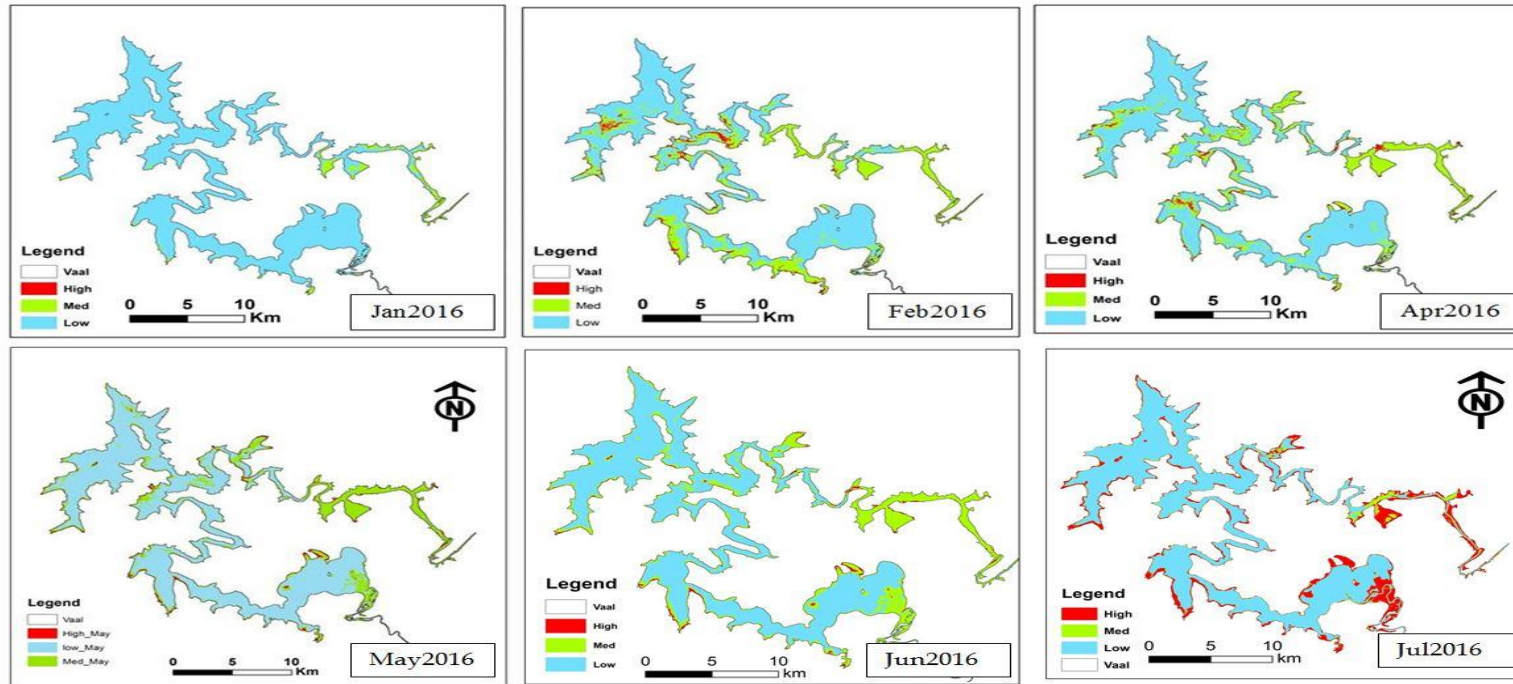


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Water Quality: Algal bloom monitoring

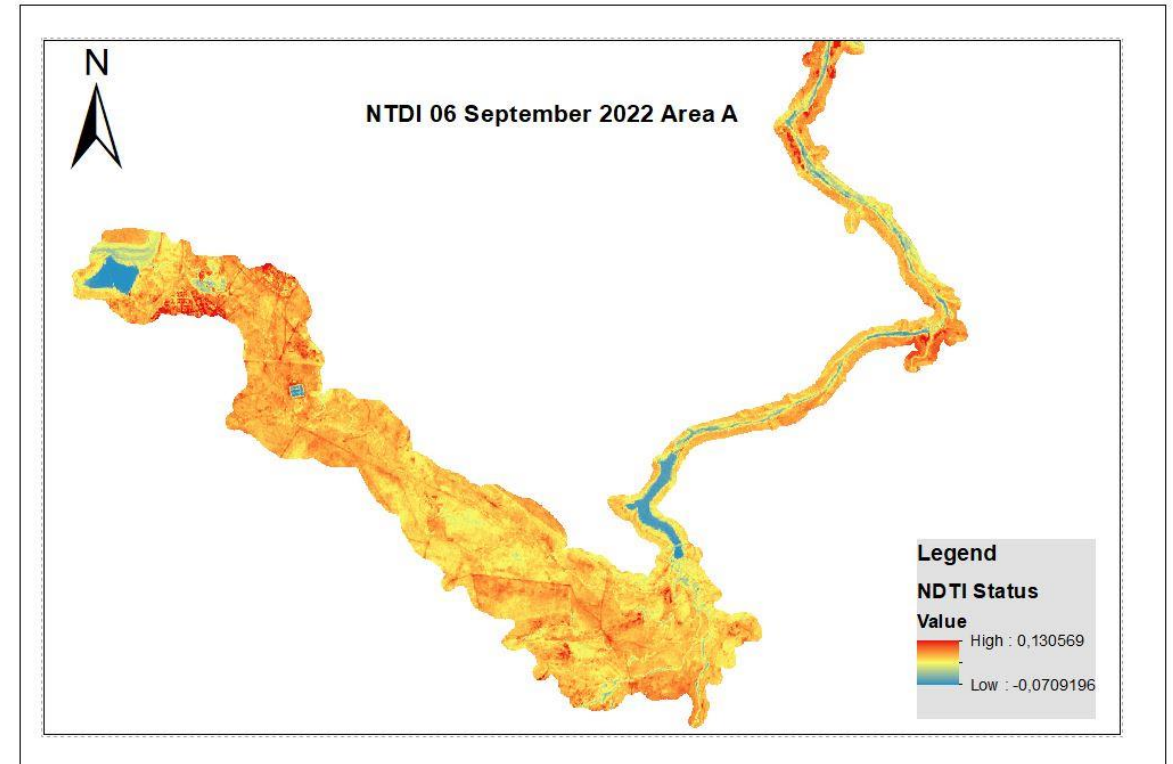
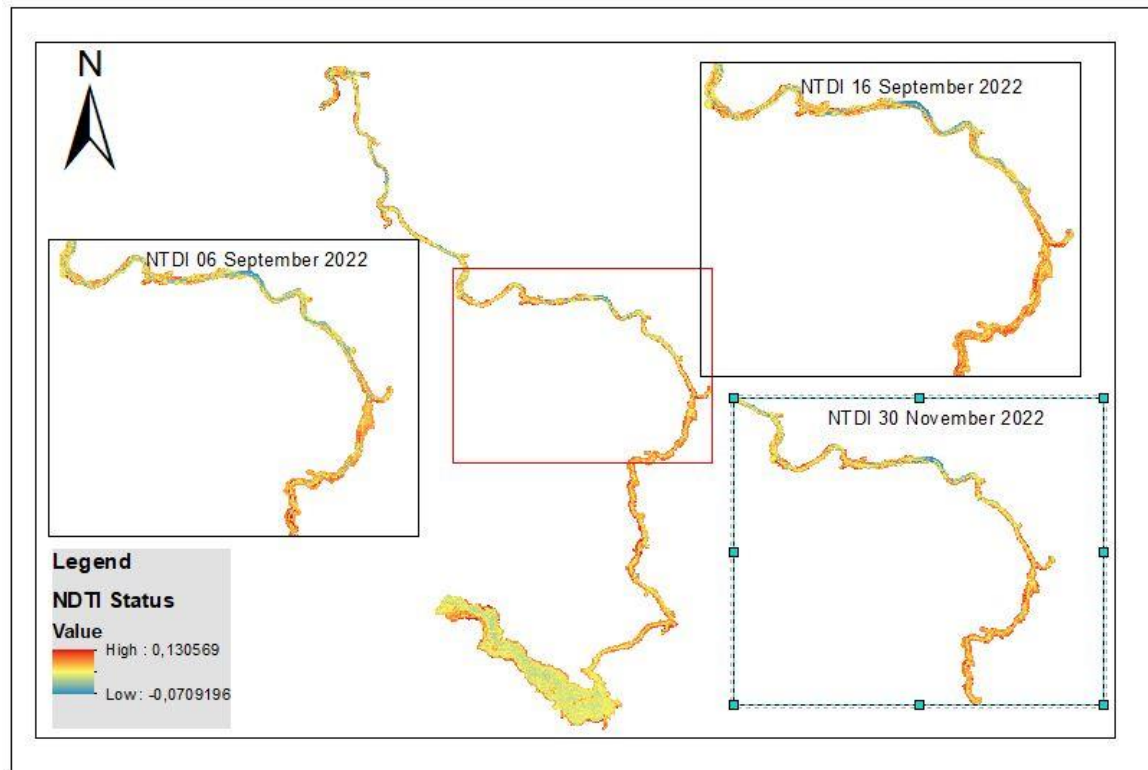


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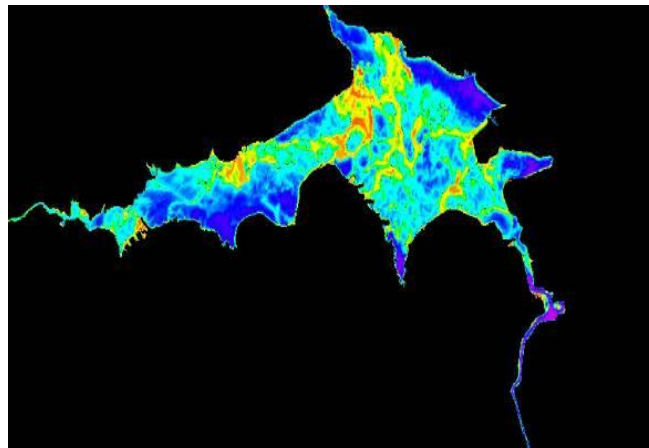
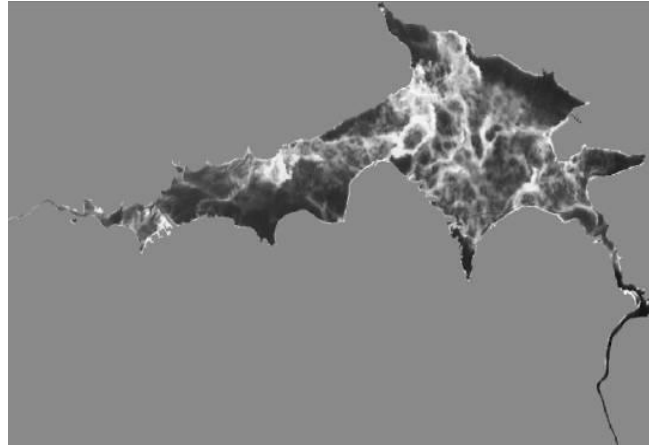
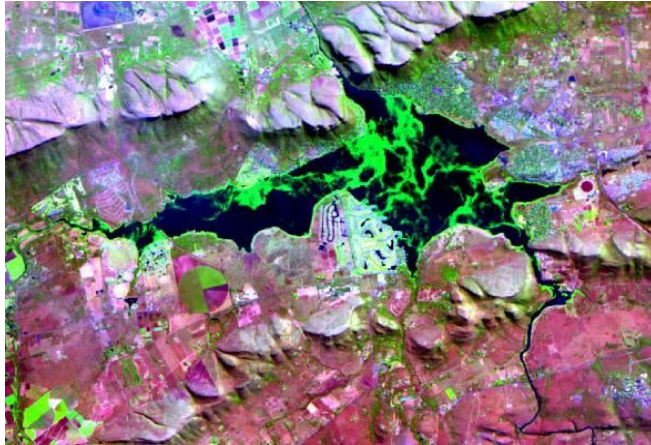
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Water Quality: Turbidity monitoring



Water quality (Cont.)



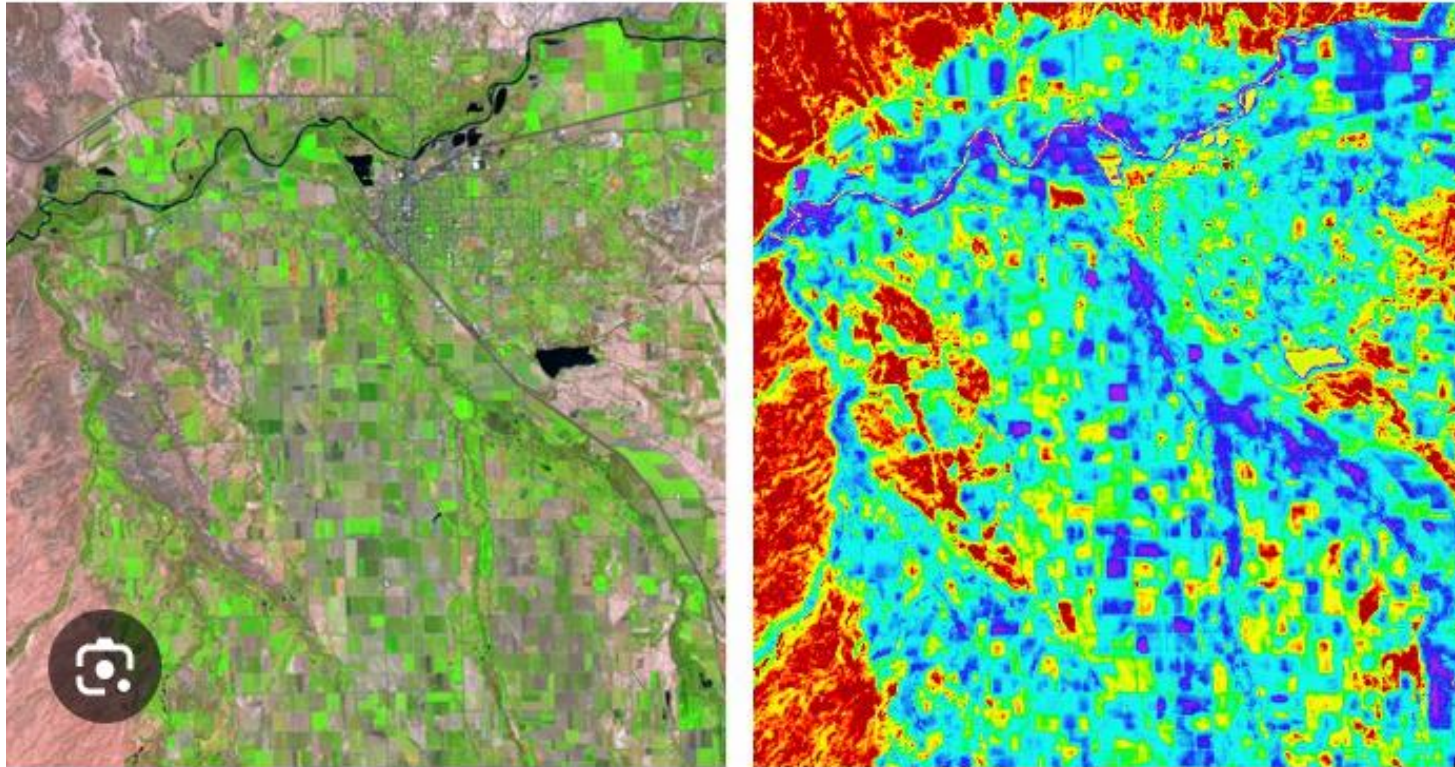
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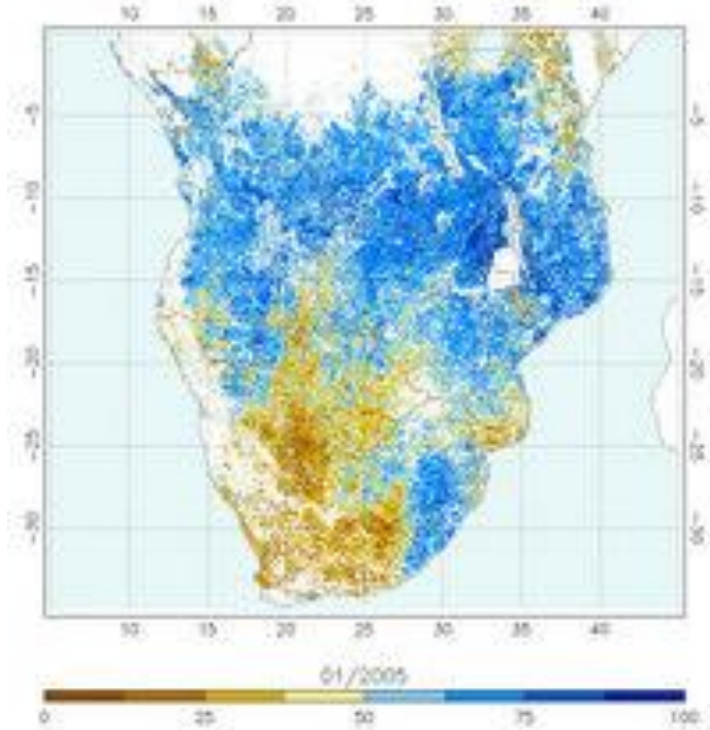
HYDROLOGY Evapotranspiration



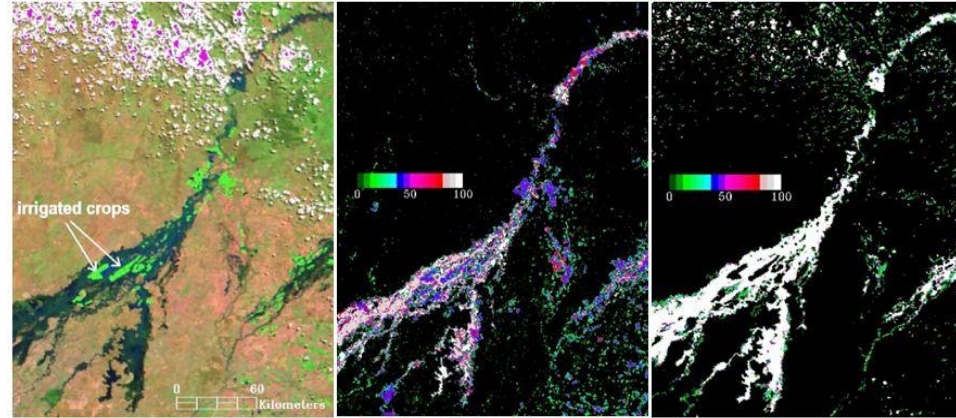
Source: <https://eros.usgs.gov/doi-remote-sensing-activities/2012/bor/mapping-evapotranspiration-upper-colorado-river-basin>

TM image of portions of the Uncompahgre and Lower Gunnison Valleys near Delta, Colorado (left) and 24-hour evapotranspiration image developed using a remote-sensing -based energy balance model (right). The TM image is displayed as TM bands 5,4,3 as R,G,B. The evapotranspiration image is color-ramped between red (0 mm ET) and purple (8 mm ET).

HYDROLOGY Soil Moisture



ASCAT Soil Moisture at 12.5km resolution



MODIS OWL index and ASAR GM gives the percentage of water within each pixel

- Irrigation scheduling,
- Plant disease forecasting
- Soil health monitoring
- Water balance studies

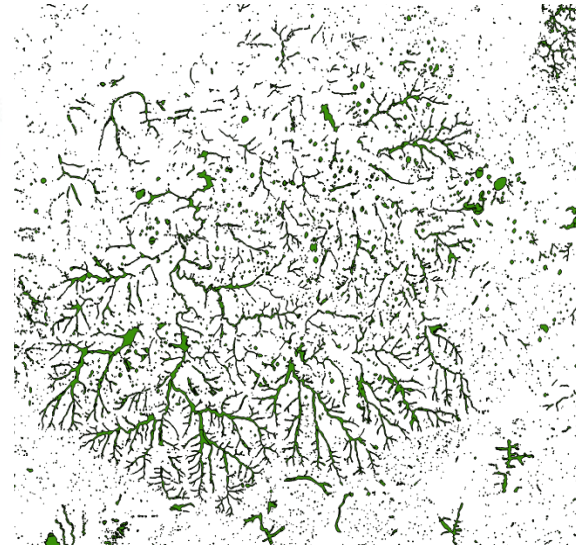
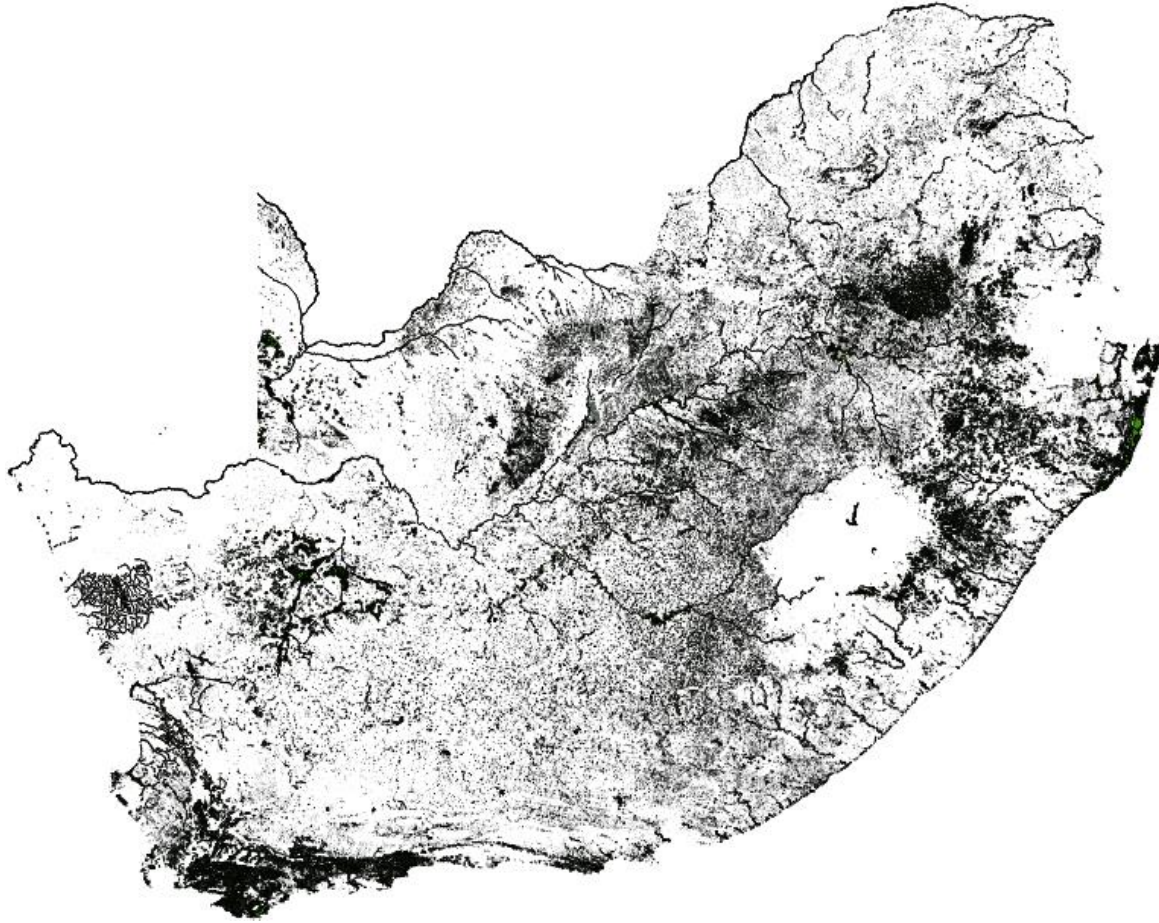


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HYDROLOGY Wetlands



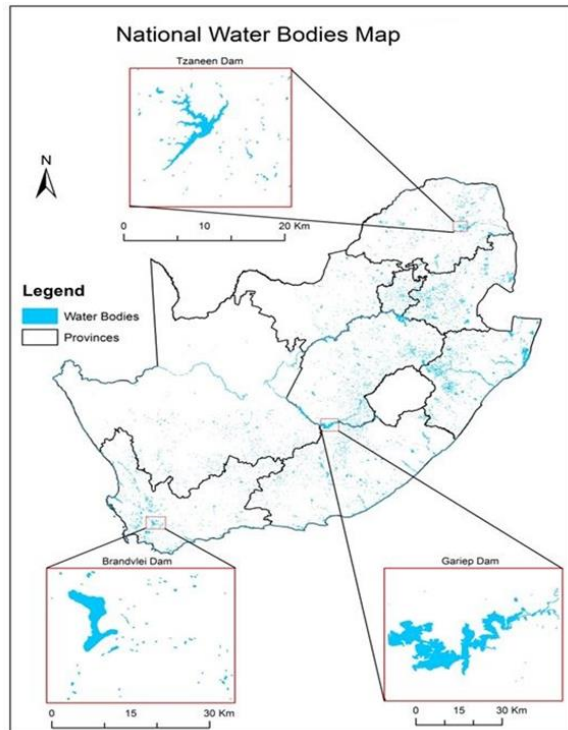
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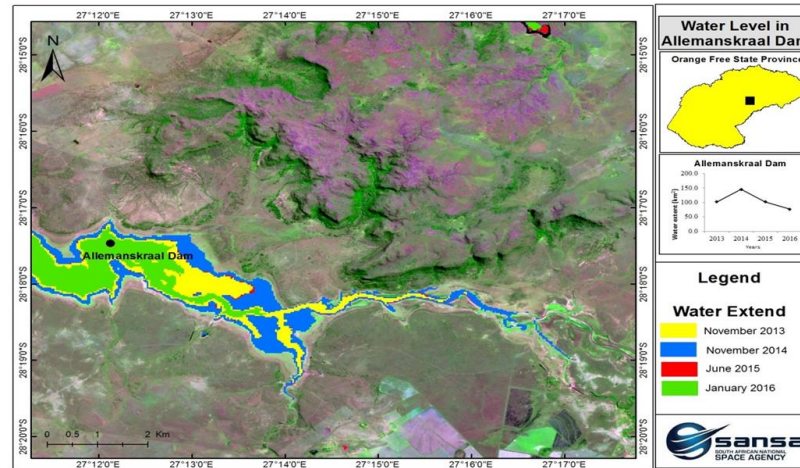
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Water body mapping



This is a screenshot of the "mzansiAmanzi" web application, which provides a monthly outlook of water in South Africa. The interface includes a map of South Africa with a legend for "Hydro Catchment", "Water Surface Area", "Cloud Obscured", and "Bright Bare Surface". On the right side, there are several interactive panels: "About This Webpage" and "Reset View" buttons; a dropdown menu currently set to "DAM"; a search bar for "Search for a place, town, ,city..."; "Toggle Monthly Water Data" with options for "October 2019", "September 2019", "August 2019", "Long Term Extent", and "Long Term Occurrence"; and "Toggle Catchment Boundaries" with radio buttons for "Quaternary Catchment", "Tertiary Catchment", and "None". The top of the page features the "GeoTerralmage EkoSource" logo and the text "A MONTHLY outlook of Water in South Africa! BETA 2."

<https://www.water-southafrica.co.za/>



Water Level Mapping in Allemanskraal Dam



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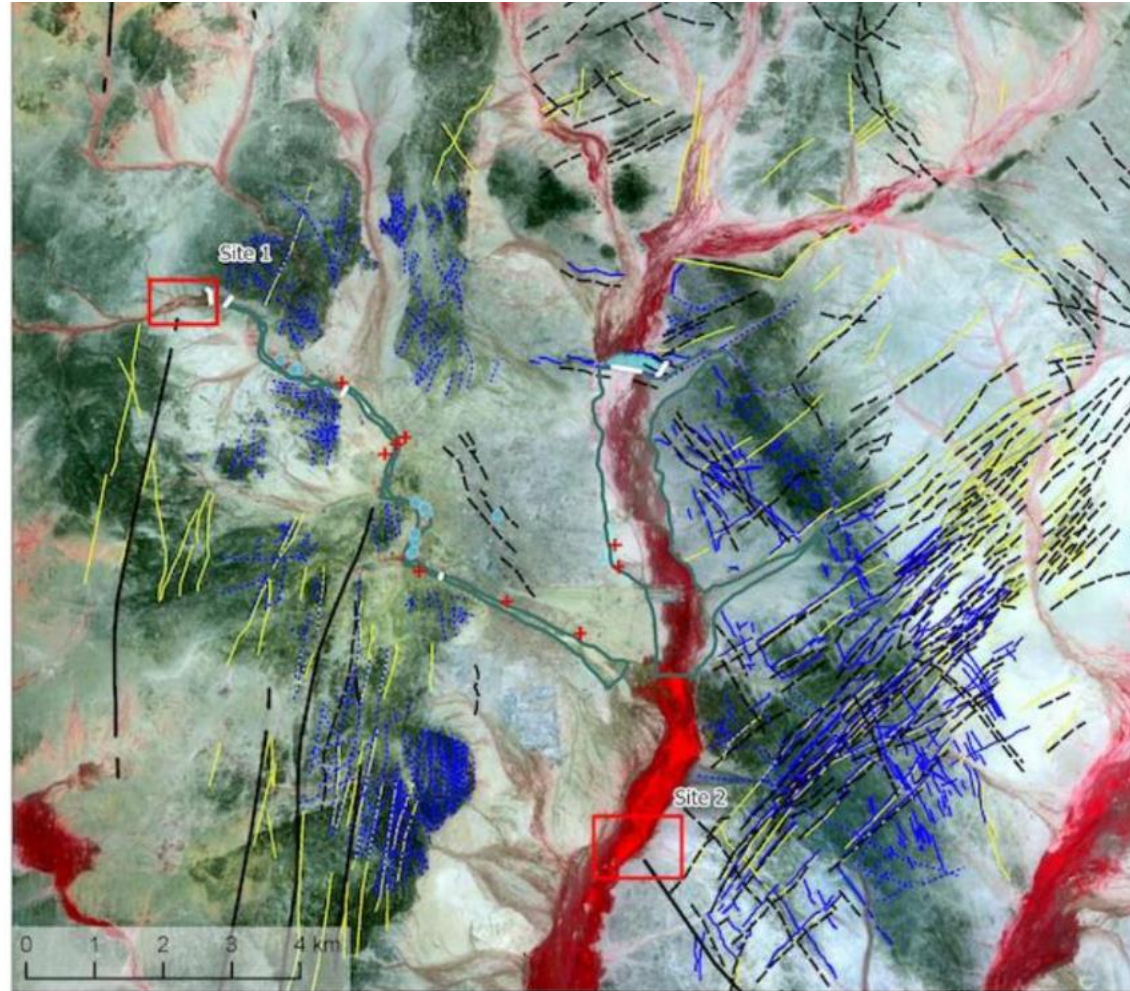
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Groundwater Exploration

Used for identifying zones of recharge in arid environments

Figure produced by E04HumEn+ as part of a Groundwater Assessment carried out on behalf of IFRC for Kidal, Mali



Legend

- + boreholes
- wells
- dams
- wadis
- suggested sites

Geology

- geological structures (geological map [Buscaïl & Caby 2004])
- - - dykes (geological map [Buscaïl & Caby 2004])
- geological structures (optical data)
- dykes (optical data)
- dykes and structures (SAR data)

Sentinel-2 false colour image (infrared-green-red) 20.08.2016

François Buscaïl and Renaud Caby (2004): Carte Géologique de L'Ardar des Iforas. 1:200.000 geological map. Ministère des Mines, de l'Energie et de l'Eau. République du Mali.

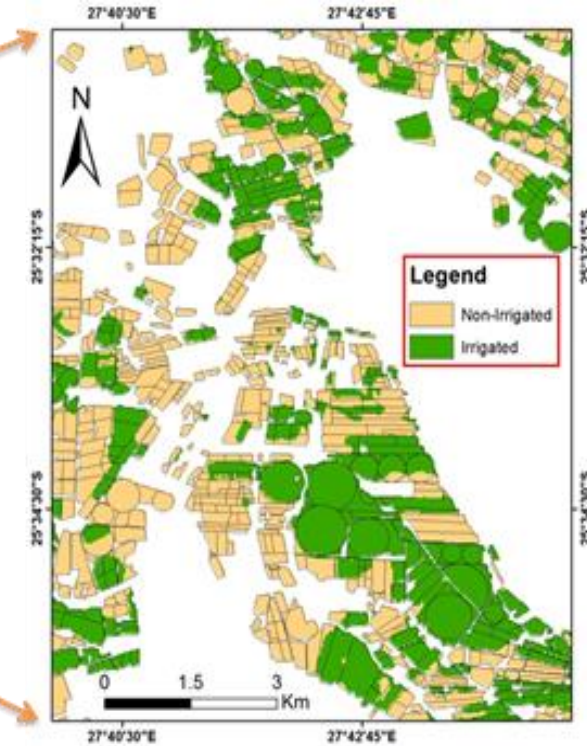
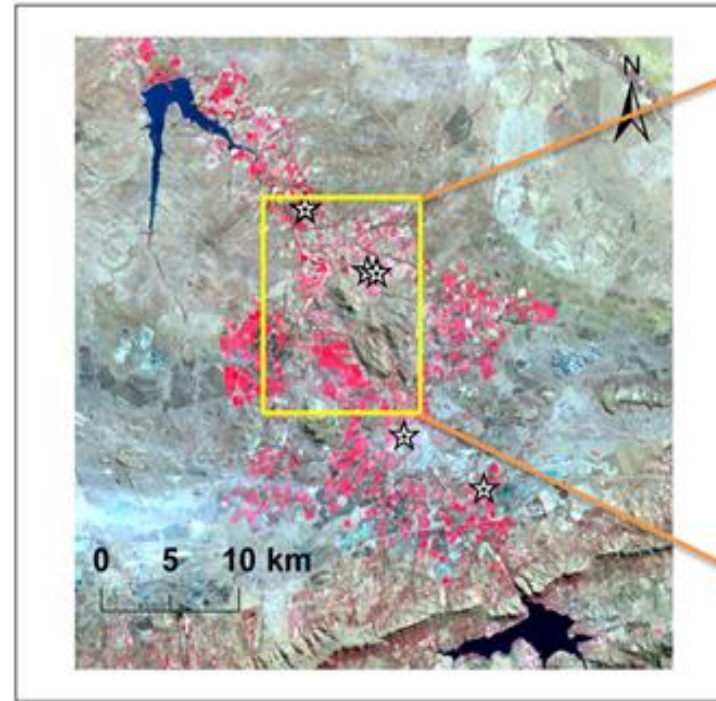
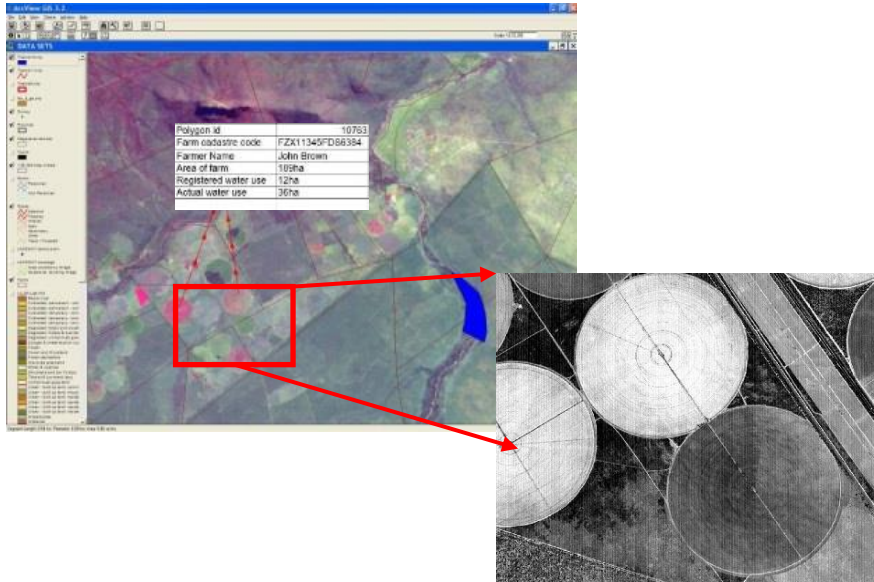


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Source : GERAIN-T-Islamabad_Presentation.pdf



Determination of existing lawful water use

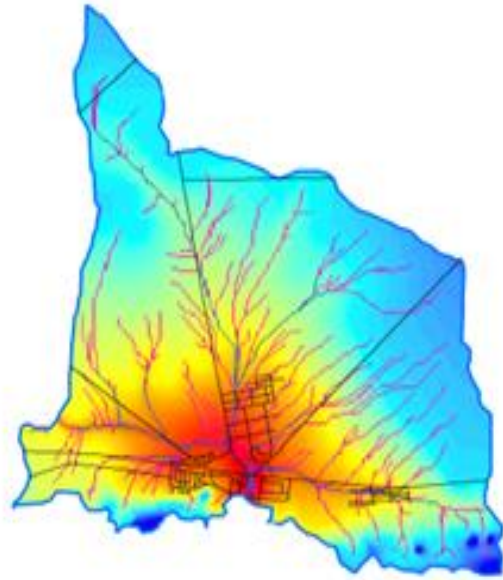


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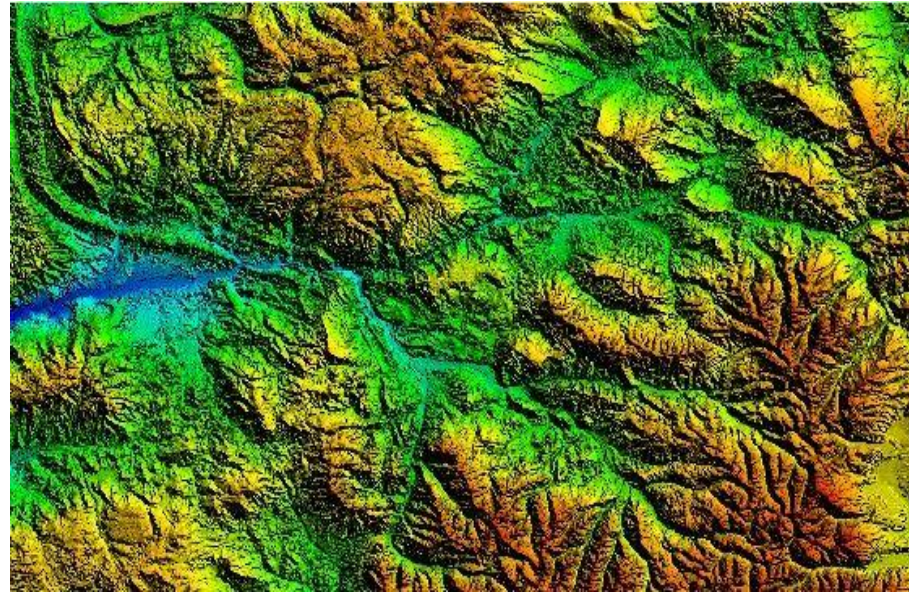
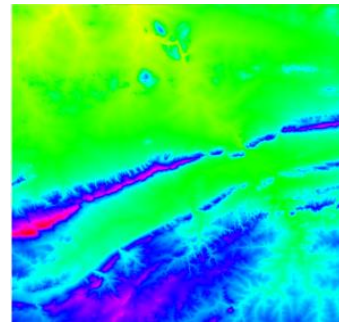
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DEMs – Water flow channel modelling



DEMs to model
water flow and
channels



High resolution DEMs generated from aerial photography



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Thank you

nmashiya@sansa.org.za – Agriculture & Biodiversity
Itsoeleng@sansa.org.za – Water resource
management



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