Satellite imagery for Agricultural sustainability

NEOSS-Community of Practice (COP)-Integrated Workshop

4 – 6 June 2024, ARC-NRE (Geoinformatics Division)

Solomon Newete and Dr George Chirima

Mapping woody bush encroachment and invasive alien plants

❖Drone multispectral camera 5-bands

- Blue
- Green
- Red
- Red edge
- Infrared

❖ Field survey

- Woody species data
- Ancillary habitat data

❖ Soil data

- SOC and basic soil information (clay, pH, soil salinity and sodicity)

Data Collection

- Game farmed savanna
- Cattle farmed savanna
- *Dichrostachys cinerea* and other small leaved encroacher sites, and *Terminalia sericea* and other broad leaves savanna encroacher) encroached sites

Engagement with communal farmers on bush encroachment

Mapping the distribution of Medicinal plant (*Artemisia afra*)

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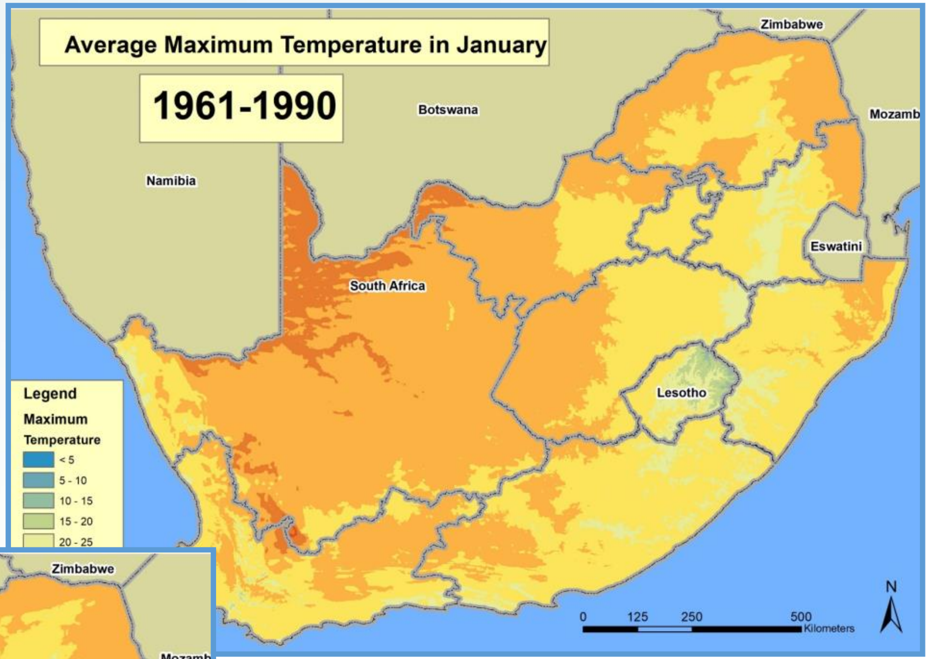
Combining satellite data with ARC weather stations

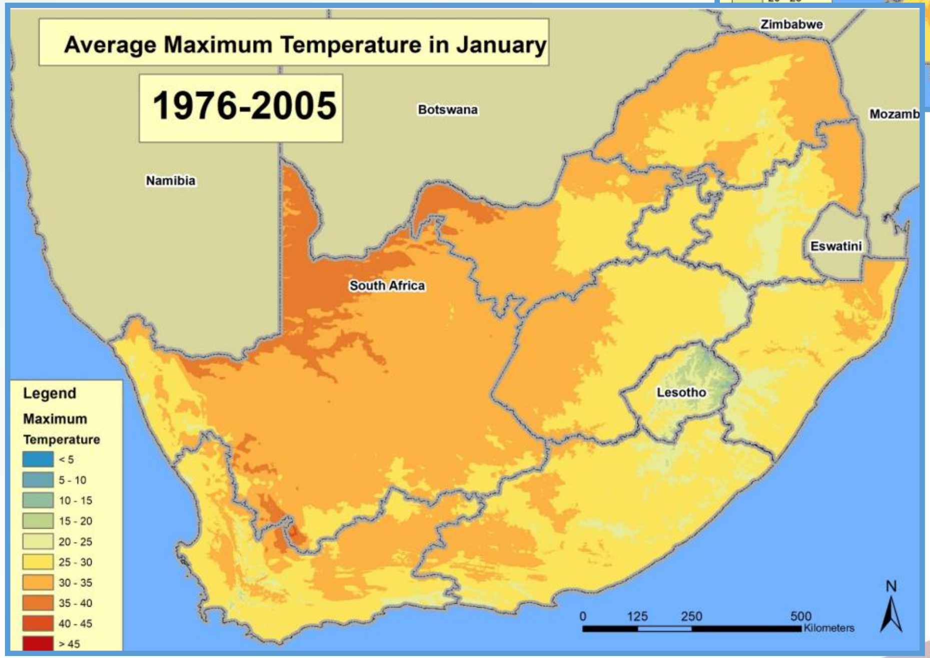
Monthly Long-term average maps prepared from observed data:

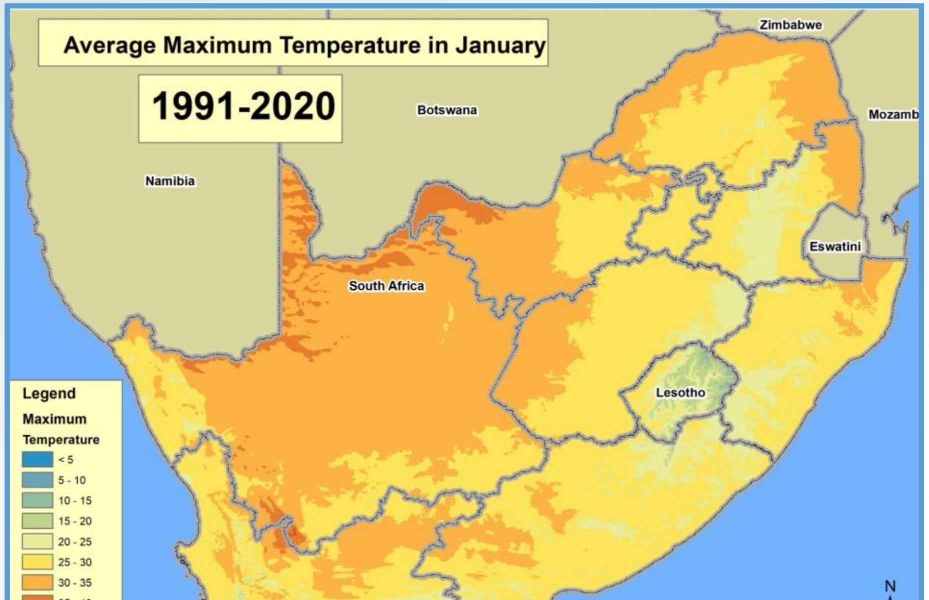
1961 to 1990

1976 to 2005

1991 to 2020







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Potential yield maps for 6 grain crops simulated with DSSAT for the summer grain production region

- DSSAT crop model for all 4 focus regions extracted formaize and stored in DSSAT format
- Weather data cold eastern-, temperate eastern-, western- and western water table areas
- Soil information
- Cultivar trial data being collected
- Test simulations conducted for generic maize cultivars completed

Weather Input for DSSAT

@DATE	SRAD	TMAX	TMIN	RAIN
14001	31.0	33.0	17.0	0.0
14002	32.0	35.0	16.0	0.0
14003	30.0	36.0	17.0	1.0
14004	26.0	33.0	18.0	3.0
14005	29.0	33.0	18.0	8.0
14006	14.0	26.0	17.0	0.0
14007	28.0	31.0	18.0	0.0
14008	24.0	32.0	18.0	0.0
14009	29.0	33.0	17.0	0.0
14010	33.0	32.0	12.0	0.0
14011	33.0	34.0	12.0	0.0
14012	33.0	36.0	12.0	0.0
14013	32.0	36.0	19.0	0.0
14014	30.0	35.0	17.0	0.0
14015	27.0	35.0	17.0	6.0
14016	31.0	36.0	17.0	0.0
14017	31.0	36.0	17.0	0.0
14018	25.0	36.0	20.0	0.0
14019	22.0	34.0	17.0	1.0
14020	31.0	35.0	14.0	0.0
14021	30.0	35.0	16.0	4.0
14022	24.0	32.0	16.0	6.0

Soil Input for DSSAT

```
*GC00930001  SCS         CL      160 HELENA
@SITE        COUNTRY          LAT     LONG SCS FAMILY
 POTCHEFSTRM RSA           26.000  27.050 WESTLEIGH
@ SCOM  SALB  SLU1  SLDR  SLRO  SLNF  SLPF  SMHB  SMPX  SMKE
    BK  0.09  24.3  0.05    76  1.00  1.00 IB001 IB001 IB001
@  SLB  SLMH  SLLL  SDUL  SSAT  SRGF  SSKS  SBDM  SLOC  SLCL  SLSI  SLCF  SLNI  SLHW  SLHB  SCEC
    10    A1 0.113 0.308 0.428  1.00   -99  1.43  1.15  29.1  14.3   0.0   -99   6.3   -99  10.9
    20    A1 0.113 0.308 0.428  1.00   -99  1.43  1.15  29.1  14.3   0.0   -99   6.3   -99  10.9
    30    A1 0.130 0.308 0.428  1.00   -99  1.43  1.08  29.1  14.3   0.0   -99   7.5   -99  10.9
    40    B1 0.130 0.332 0.429  1.00   -99  1.43  1.08  34.0  14.3   0.0   -99   7.5   -99  11.8
    50    B1 0.179 0.385 0.438  0.75   -99  1.41  1.00  45.6  15.5   0.0   -99   7.6   -99  15.4
    60    B1 0.179 0.385 0.438  0.75   -99  1.41  1.00  45.6  15.5   0.0   -99   7.6   -99  15.4
    80    B1 0.220 0.385 0.438  0.43   -99  1.41  1.00  45.6  15.5   0.0   -99   7.6   -99  15.4
   100    B1 0.220 0.385 0.438  0.24   -99  1.35  1.00  45.6  15.5   0.0   -99   6.9   -99  15.4
   120    B1 0.220 0.428 0.462  0.14   -99  1.35  1.00  54.1  18.3   0.0   -99   6.9   -99  18.5
   150    B1 0.160 0.360 0.444  0.07   -99  1.42  1.00  43.1  27.8   0.0   -99   5.0   -99  36.4
   180    B1 0.160 0.360 0.444  0.03   -99  1.42  1.00  43.1  27.8   0.0   -99   5.0   -99  36.4
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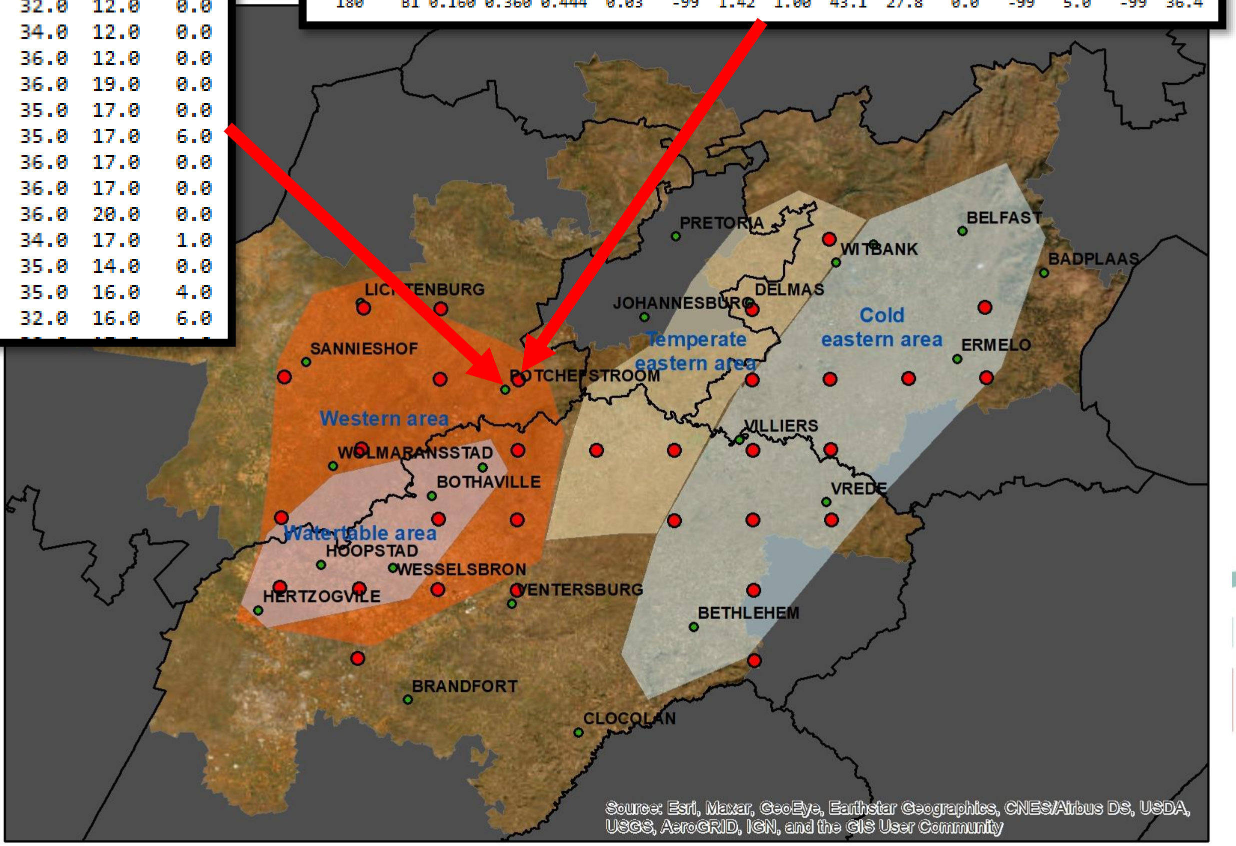
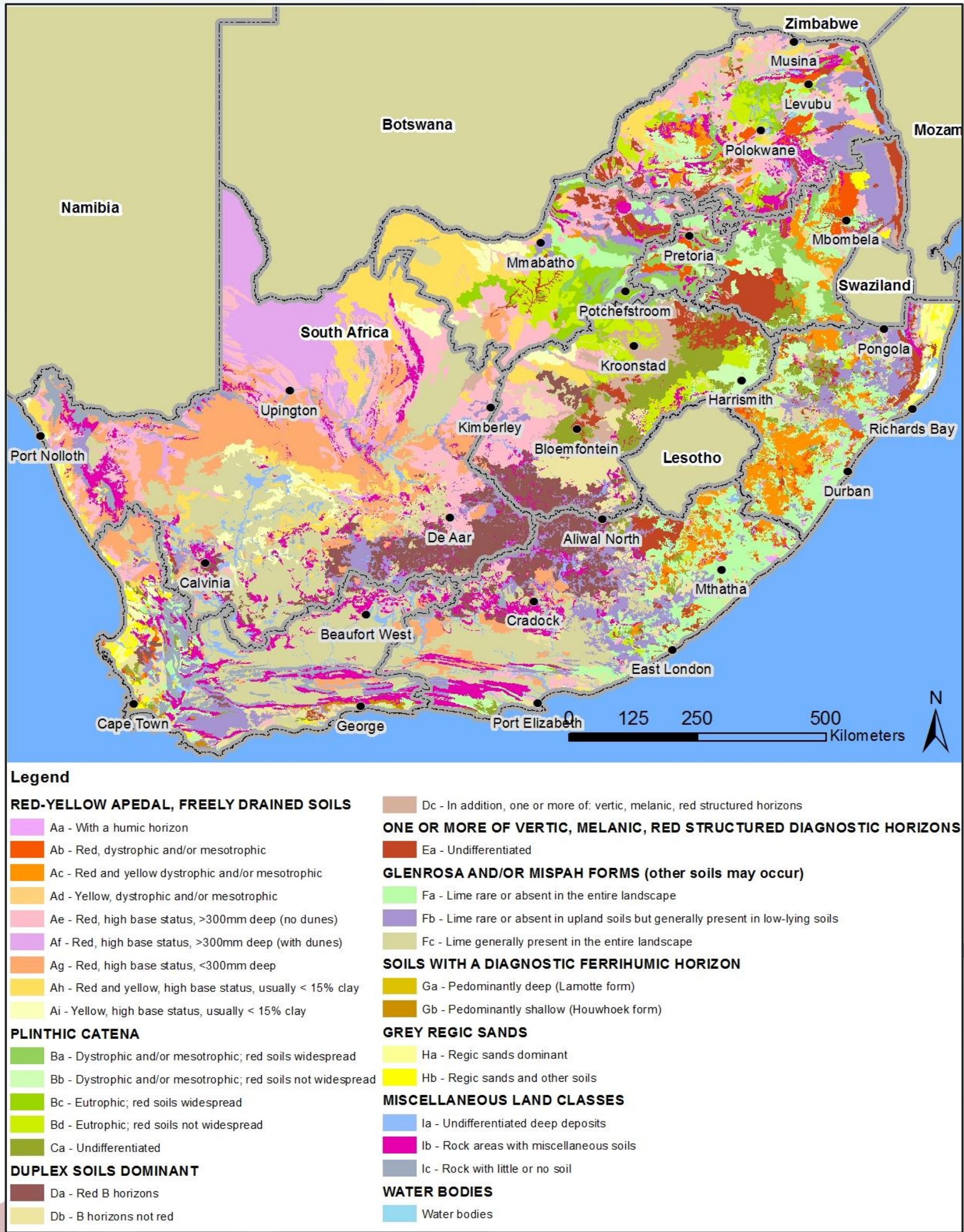


Application: Determine the impact of climate change on the vulnerable Fynbos Agricultural Biome

- Rooibos and honeybush are Endemic to the Cape Floristic Region, with a limited growing area
- Popular for herbal teas leading to a commercial scale production
- subsequently a need to optimize production based on climatic and soil requirements.

Determine the impact of climate change on soil resilience

- A report titled “An overview of the importance of soil in agricultural production in South Africa ” is currently being finalized



Veld and pasture management

Grazing lands in Gauteng, during fieldwork

grasses

MDPI

Article

Grassland Monitoring with Google Earth Engine: A Bibliometric Analysis

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Abstract: Grasslands cover approximately 40% of the Earth's surface. Thus, playing a pivotal role in supporting biodiversity, ecosystem services and human livelihoods. These ecosystems provide crucial habitats for specialized plant and animal species, act as carbon sinks to mitigate climate change, and are vital for agriculture and pastoralism. However, grasslands face ongoing threats from factors like land use changes, overgrazing, and climate change. Geospatial technologies have become indispensable to manage and protect these valuable ecosystems. This review focuses on the application of Google Earth Engine (GEE) in grassland monitoring. The study presents a bibliometric analysis of research conducted between 2017 and 2022. Findings from the analysis reveal a significant growth in the use of GEE for grassland studies. Additionally, China leads in research contributions, followed by the United States and Brazil. However, the analysis highlights the need for greater involvement from developing countries, particularly in Africa. Furthermore, it highlights the global distribution of research efforts, emphasizes the need for broader international participation, and identifies key datasets that can advance our understanding of these critical ecosystems.

Keywords: Google Earth Engine; grassland; bibliometric analysis; remote sensing; monitoring

1. Introduction

Grasslands cover a vast expanse of the Earth's surface; they play a critical role in supporting both biodiversity, ecosystem services and human livelihoods. These ecosystems provide essential habitats for a wide range of plants and animal species, some of which are highly specialized to thrive in grassland environments [1,2]. Moreover, grasslands serve as carbon sinks, helping mitigate the impacts of climate change by sequestering carbon dioxide from the atmosphere [3]. They are also important for agriculture and pastoralism, supplying food and livelihoods to millions worldwide [4,5]. Despite their importance, grasslands are under constant threat from various anthropogenic factors, including land use change, overgrazing, and climate change [6,7]. It is estimated that the global cost of grassland degradation on livestock was $6.8 billion between 2001 and 2011 [7]. The study by Yan et al., [8] identified Africa as leading in terms of grassland degradation, while Asia was leading in grassland improvements. Climate change and human activities were identified as main driving factors in both cases. Understanding the global significance of grasslands is vital for exploring their sustainable management through ge-

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Review paper, to be submitted in March

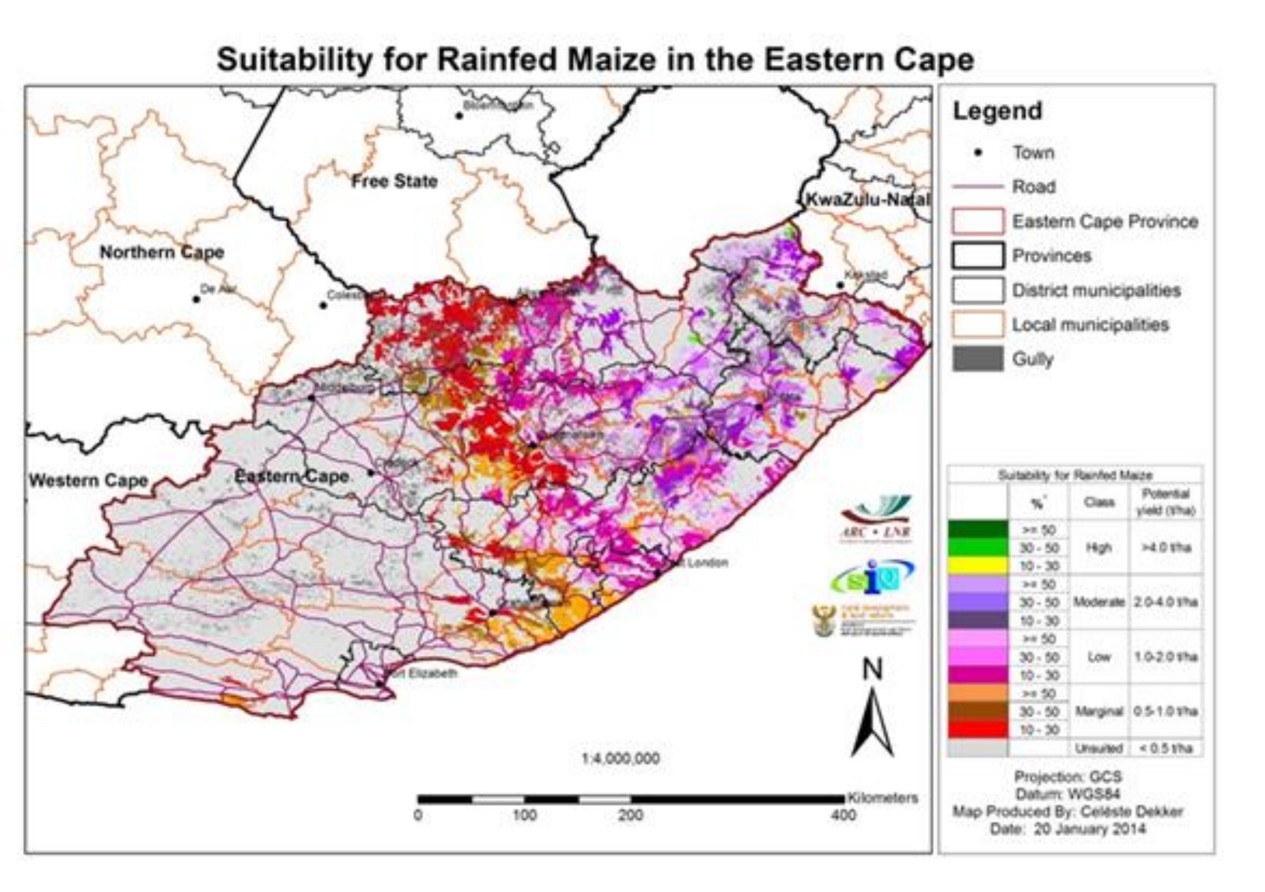
The Integration of Big Data Analytics and Geospatial Techniques for Mapping Small-Scale Crop Farms

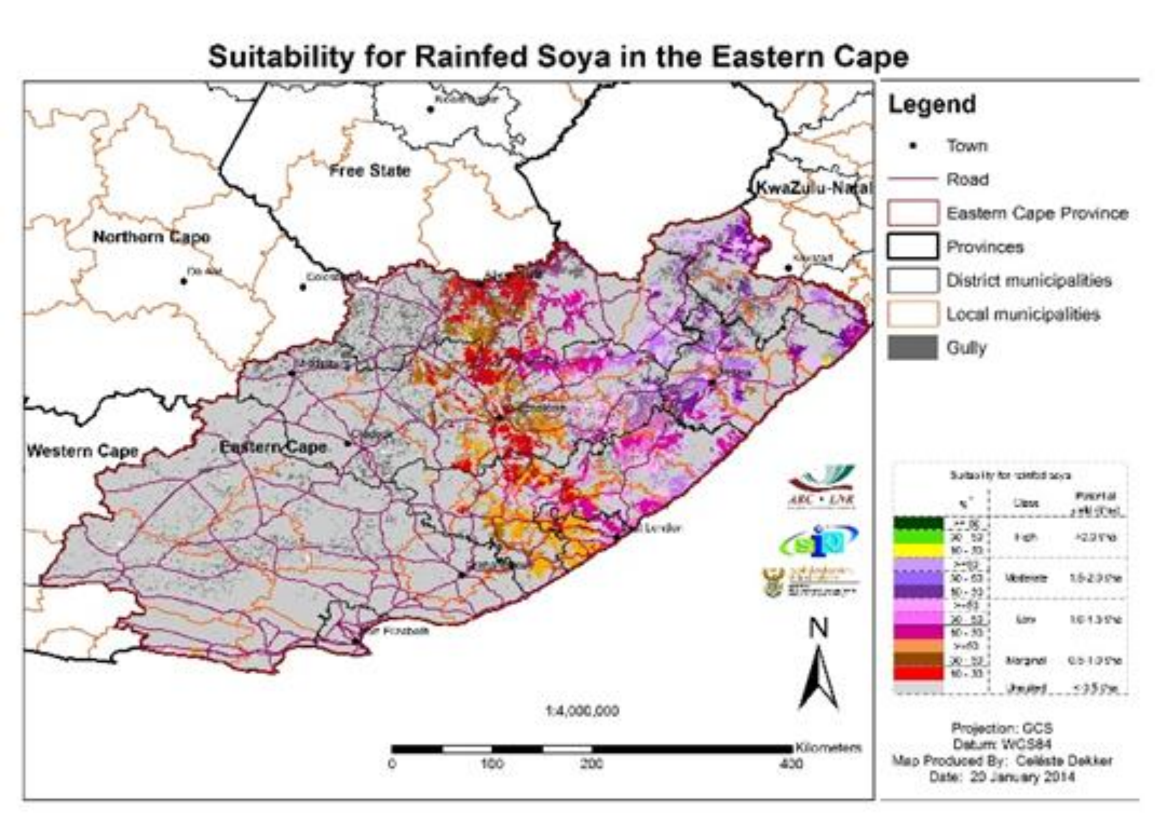
❖Ground truthing data which includes:

- 1- fields area
- 2- crop type
- 3- Crop biophysical parameters.

Crop Suitability in the Eastern Cape (DRDLR)

Assessment of land & soil capability in Eastern Cape





Coarse Resolution Imagery Database (CRID): Umlindi and early waring systems

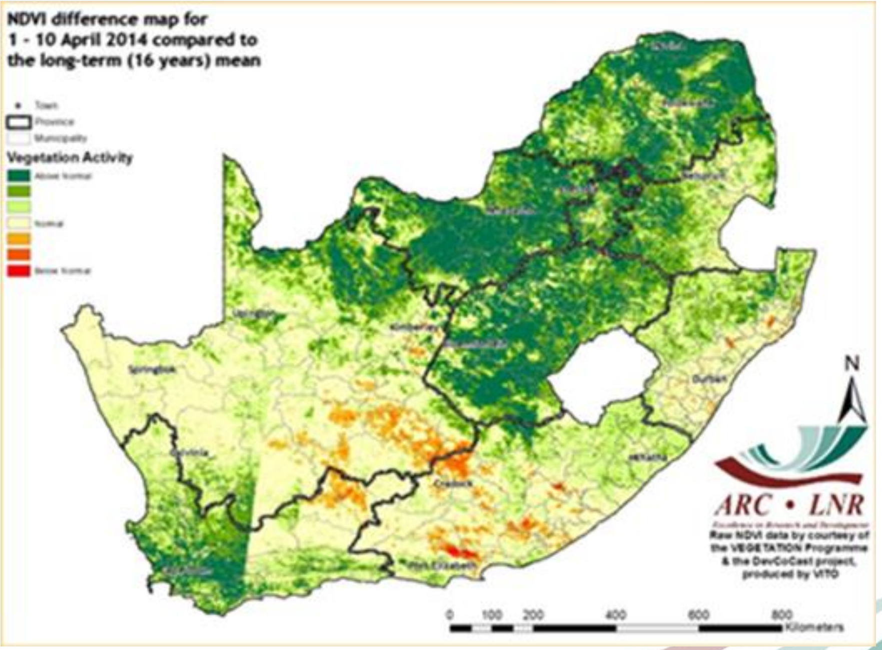
❖Improve food security under a changing climate:

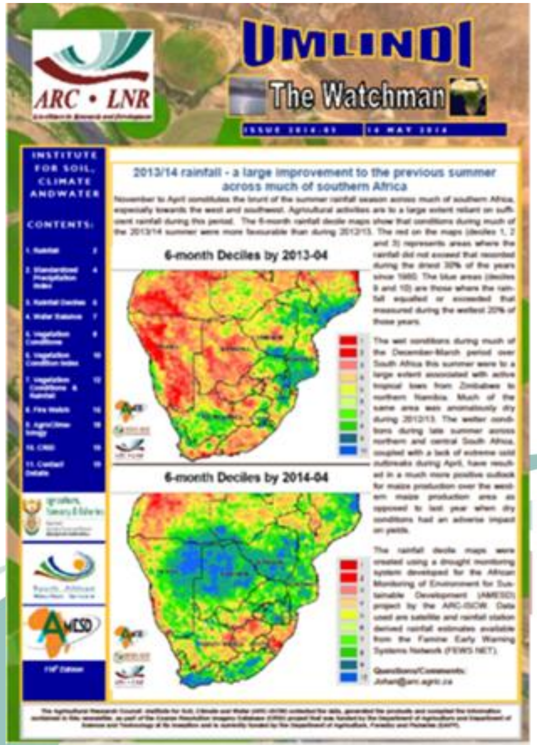
➢Early indication of vegetation response to climatic conditions

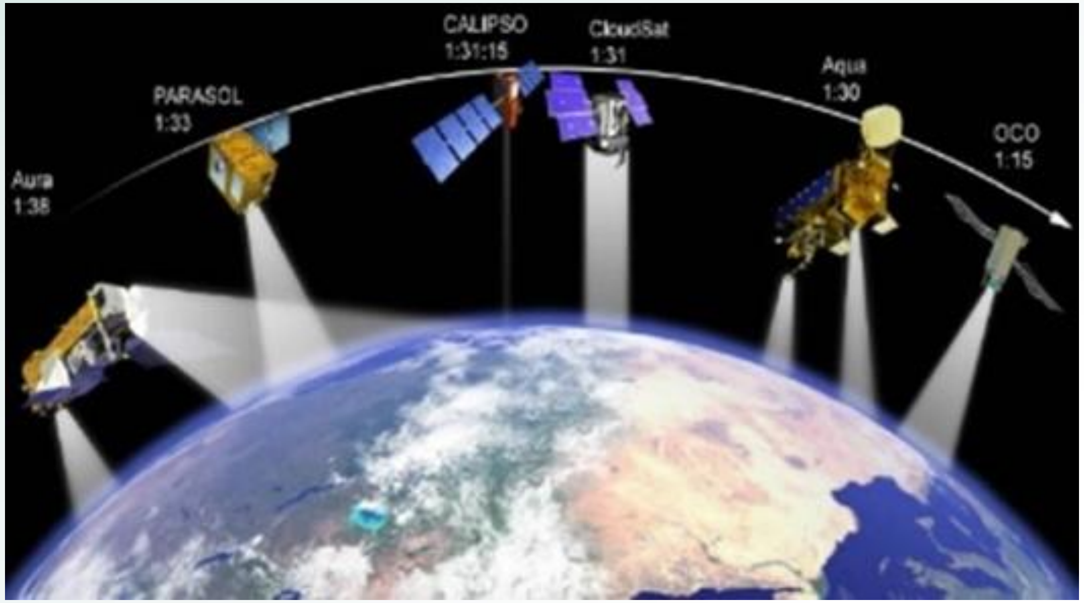
➢Insurance industry position themselves for possible payments later in the season

➢Provincial Departments of Agriculture screening during drought relief projects

➢Risk mitigation



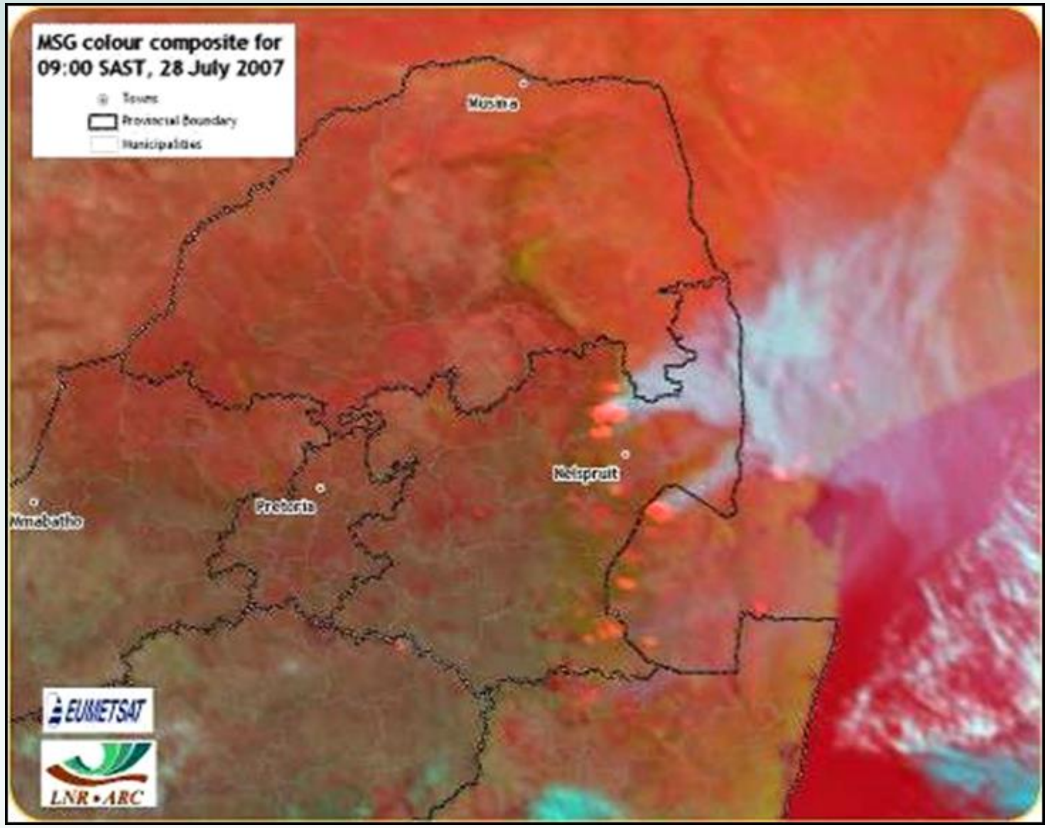




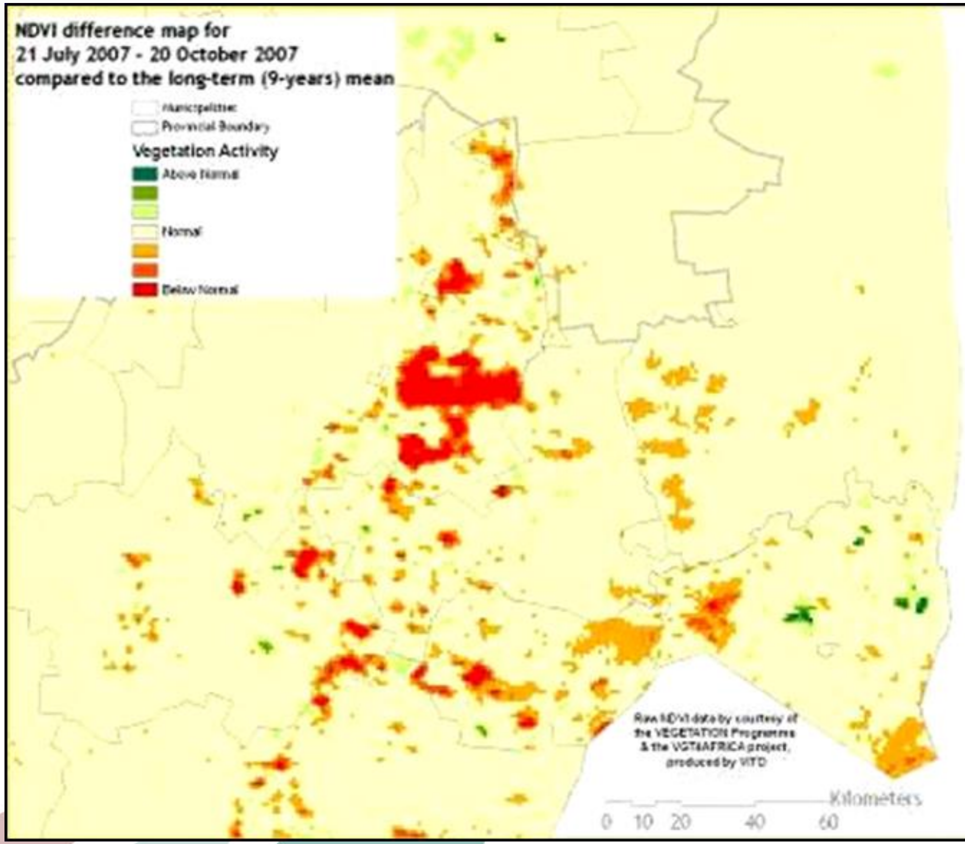
National Disaster management Council project

- Integrated information to improve management and decision support systems
- Using modelling, weather, and satellite data, to generate information for NDMC
- Wise disaster preparedness, and monitoring severity of disasters (droughts or fires)

Fire monitoring



Drought monitoring



THANK YOU

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