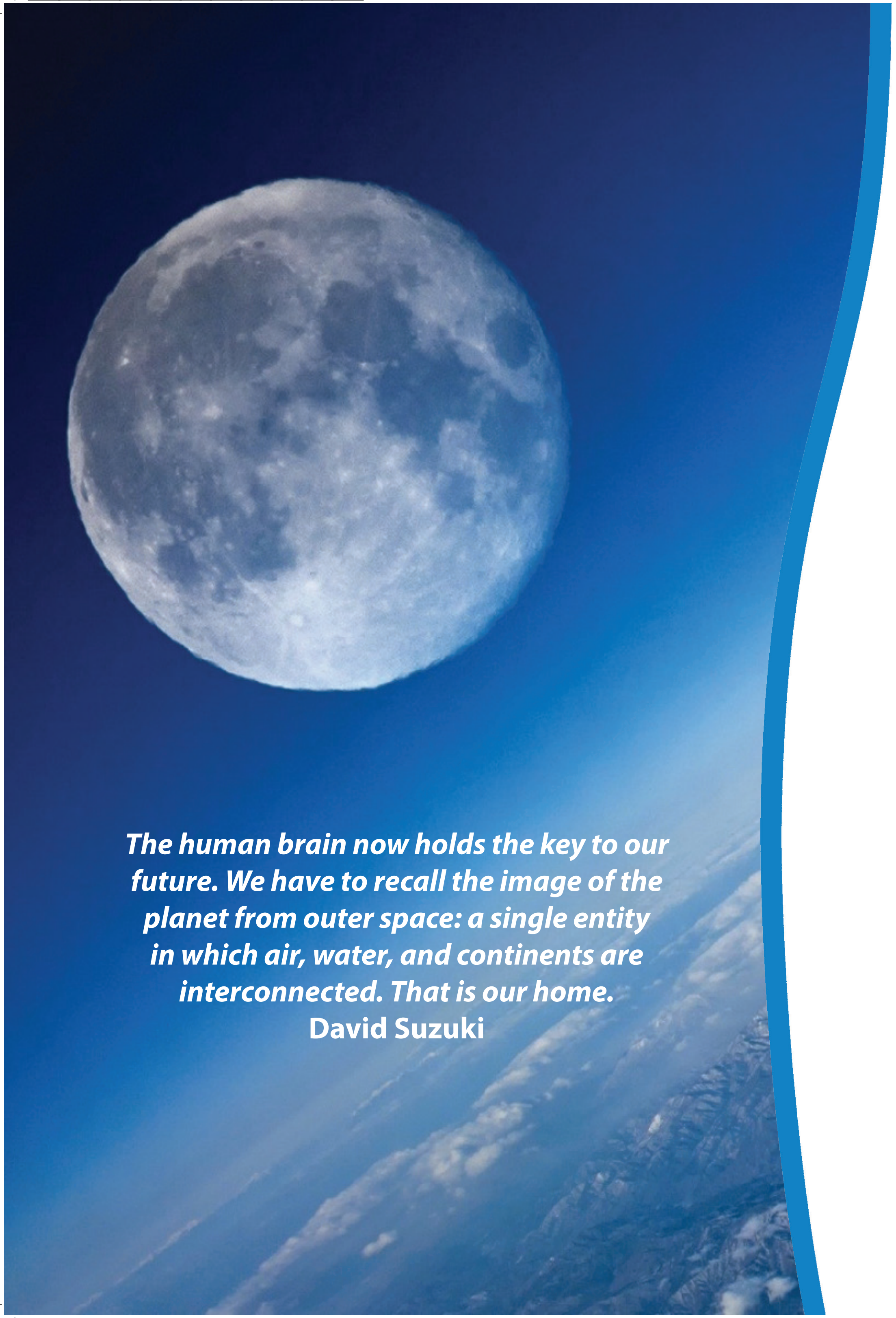
SOUTH AFRICAN REMOTE SENSING ATLAS

science & technology
Department:
Science and Technology
REPUBLIC OF SOUTH AFRICA

sansa
SOUTH AFRICAN NATIONAL
SPACE AGENCY



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Forword

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Foreword

Dr Jane Olwoch
Managing Director: SANSA Earth Observation

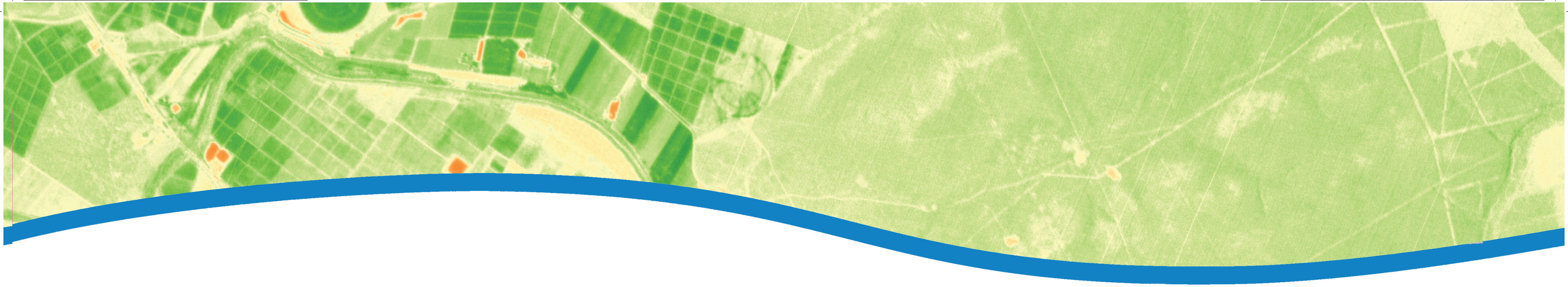
The important role played by Earth observation in achieving sustainability of environmental, social and economic systems is more pressing than ever before.

Population growth and its subsequent growing demand for resources, especially in some of the world's most populous countries, continues to deprive the environment of its natural ability to regulate itself. Very high consumption rates in the majority of rich nations contribute to the increase in greenhouse gases: the biggest contributor to climate change. Water pollution and high consumption rates expose human development to increasing vulnerability as usable water dwindles to almost a vanishing point.

As a result of high industrialisation, energy needs are growing in both developed and developing countries. Additional energy demand and use is a result of global inequality through which developing countries aspire to catch up with developments in the Western world.

Mineral resources are under strain as a result of unprecedented exploitation, with some of them nearing exhaustion or are already undergoing irreversible changes. This leads to a vicious cycle of poverty and global environmental change from overexploitation of fossil fuel, pollution, climate change and all its negative impacts on social and economic sectors, including livelihoods.

Water **pollution** and high consumption **rates** expose **human** development to **increasing** vulnerability …



From its advantage of non-intrusive observation, uniformity, rapid measurements and data continuity, satellite Earth observation allows for the collection of data, without compromising national sovereignty, over sites that cannot be accessed by other means. The uniformity also allows for the same sensor to be used in different places in the world, thus helping to ensure that the data collected are comparable as it is generated by the same instrument. Moreover, rapid measurement capacity allows sensors to be targeted in relatively short order at any point on Earth, including remote and hostile areas, while continuity with single sensors or a series of sensors provides long-time series that can be collected over the lifetime of the spacecraft. Such continuity is particularly important for climate studies. It allows for satellite-derived Earth-observation data, products and tools to offer key information to aid effective decision-making across a range of fields, including agriculture, irrigation, water-resources management, forest and wildlife management, environment and climate change, health, coastal and maritime environment management, transport and logistics, disaster management and safety and security.

Mineral resources are under strain from unprecedented **exploitation**, with some of them **nearing exhaustion** or already undergoing **irreversible changes**

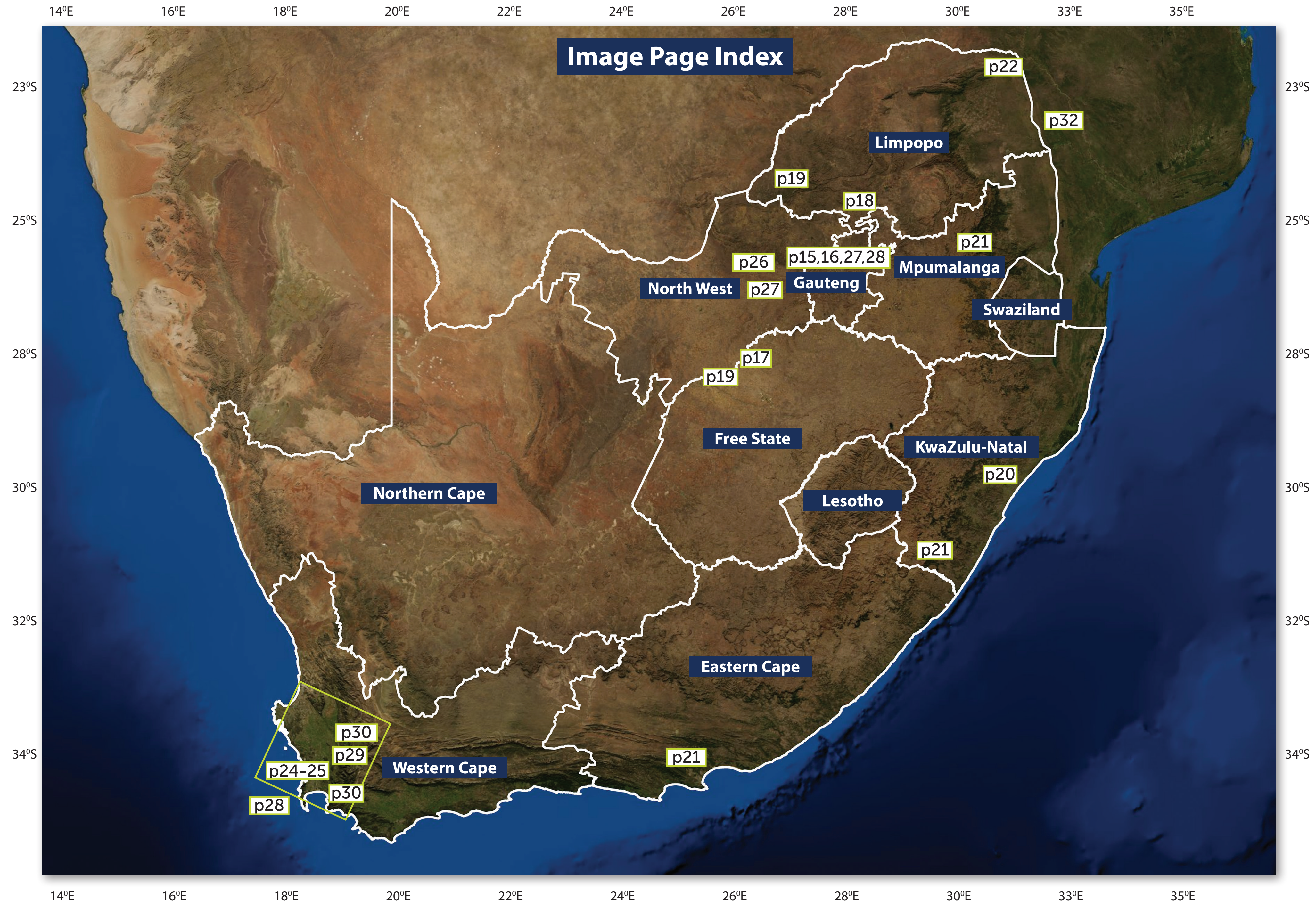
We do **not inherit** the **Earth** from our **Ancestors**, we **borrowed** it from our **children**

Indian Proverb

The biggest challenge to be tackled is to reduce the gap between scientists on the one hand and policy-makers, students and the public at large on the other. One way to do so is through targeted capacity-building activities and better communication of satellite Earth observation capabilities in a way that meets the needs of each stakeholder.

The images presented in this launch edition of the SANSA Space Atlas demonstrate the immense power that satellite Earth observation has in depicting the status of the environment and resources in time and space. Each pixel or a group of pixels represents a story that is a live story of the ever-changing status of the environmental ecosystems, functions and the natural resources within them. As human beings have the ability and need to use the environment and resources, they should also uphold a noble responsibility to protect the environment for us and future generations.

Atlas Footprint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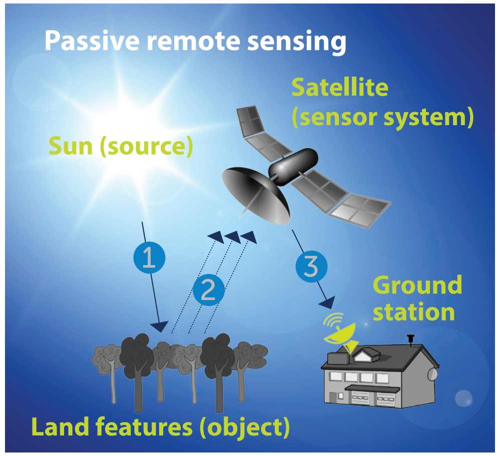
Introduction to Remote Sensing

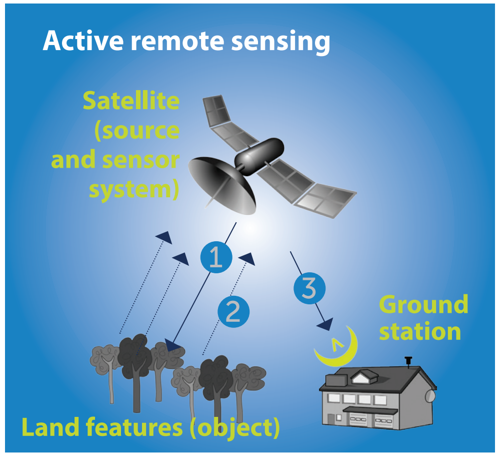
Remote sensing refers to the science of acquiring information about an object without being in physical contact with it. The term is commonly used to refer to the acquisition of information on objects on Earth from a raised platform, such as an aeroplane or a satellite in space. As humans, three of the senses we use to interact with our surroundings do not require physical contact, which are the senses of sight, smell and hearing. However, it is the sense of sight that is comparable to remote-sensing due to the mechanism of the optics used by both systems. As a result, humans actively participate in remote sensing in their every-day lives.

Passive systems rely on the sun to illuminate target objects. The sensor then records the reflected radiation emanating from the objects' surfaces, primarily in the visible and near-infrared regions of the electromagnetic spectrum. Due to their dependence on the sun, these sensors are predominantly effective during the day. However, some passive sensors measure thermal radiation, which can also be measured during night time.



Examples of passive sensors include Sumbandila and Landsat satellites.

Active sensors generate and transmit their own energy towards the target objects and then record the returning signals. As a result, they are not dependent on the sun for illumination. Such a mechanism allows active sensors to acquire information on the Earth's surface at any time of the day and in any weather conditions, as the transmitted signals can penetrate through haze, fog and clouds. Active sensors are also effective at night time.



Examples of active sensors include TerraSAR-X and RADARSAT 2.

There are multiple remote-sensing applications cutting across different disciplines, such as monitoring and understanding vegetation and weather conditions, ocean dynamics, and disaster risk and reduction. These applications use satellite images from different satellites that orbit the Earth at three different altitudes: Low Earth Orbit (2 000km), Medium Earth Orbit (20 000km) and the Geostationary Orbit (36 000km). The altitude at which a satellite will orbit the Earth is determined by different factors, such as the principal objective of the satellite – whether it will be used for navigation, telecommunication or earth observation. For most Earth-observation satellites the orbital altitude is determined by the size of the image, the size of each image pixel (spatial resolution), the time taken by the satellite to capture an image of the same point on Earth (temporal resolution) and the extent of the ground to be covered by each image (swath).


Low Earth Orbit
Geosynchronous Orbit
Medium Earth Orbit

History of Space Technology in South Africa

Space activities in South Africa started as Project Vanguard, America's contribution to the International Geophysical year (IGY) in 1958. Project Vanguard was managed by the American Naval Research Laboratory (NRL) and the objective was to launch the world's first "artificial" Earth satellite and to determine its orbit accurately, thereby yielding completely new information about the Earth's gravity field and shape.

The NRL designed and manufactured a precision radio interferometer tracking system called Minitrack. Minitrack could determine a radio source in space accurately to one thousandth of a degree. Seven of these Minitrack systems were deployed in North and South America to form an "electronic fence" through which a satellite transmitting in the 136MHz to 137MHz frequency band could not pass without detection.

The Satellite Applications Centre had its origins in 1958 when the national Telecommunications Research Laboratory (TRL) of the Council for Scientific and Industrial Research (CSIR) agreed to operate a Minitrack in South Africa, which is strategically situated relative to the launch facilities in Cape Canaveral, and could give early confirmation that a satellite launched from Cape Canaveral is in orbit.

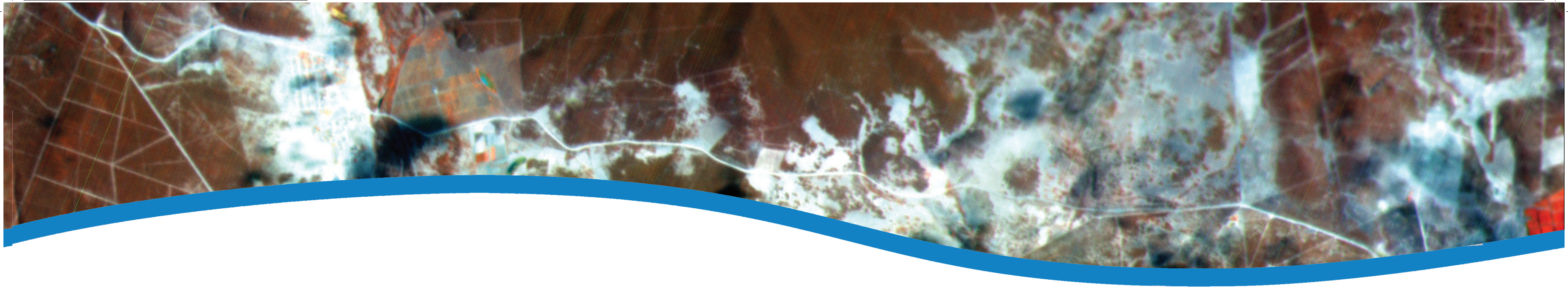
The Minitrack system was installed with the help of engineers from the NRL and became operational in January 1958. The Joburg Minitrack Station – as it was known – tracked its first Project Vanguard satellite, code-named 1958 Beta, in February 1958. Although the emphasis was on determining the position of the first satellites accurately, this soon became of secondary importance as more sophisticated instruments were placed in orbit to measure a host of physical and geophysical phenomena. To receive telemetry data from instrumented satellites soon became the primary function of the Minitrack Network.

It soon became apparent that the ground of the Railway College at Esselen Park was not an ideal electromagnetic environment in which to receive weak telemetry signals from space, because of its close proximity to high-voltage lines and electric mains. With the IGY something of the past, the American National Aeronautics and Space Administration

Minitrack was designed and manufactured in 1958

(NASA) was established and space research gained rapid momentum. The Joburg Minitrack Station became part of NASA's worldwide satellite tracking and telemetry network operated by NASA's Goddard Space Flight Centre (GSFC) in Greenbelt Maryland.

In 1960 operations were transferred from Esselen Park to Hartebeesthoek and the Joburg Satellite and Tracking and Data Acquisition Network station (JOBURG STADAN) was born. This became one of the busiest network stations in the GSFC satellite tracking telemetry and command (TT&C) network. It



In 1960 Minitrack was moved to Hartebeesthoek

STADAN at Hartebeesthoek (1961)

From 1961 to 1975 Minitrack supported NASA space missions

was eventually equipped with three receiving links at 136MHz and later five-band and two powerful VHF transmitting systems. During its 15 years as a GSFC satellite TT&C network station, the Johannesburg STADAN received more than eight million minutes of data recorded on half a million reels of tape, tracking 400 000 satellite passes, sent millions of commands and supported more than 250 NASA launches. NASA ceased operation in South Africa at the end of October 1975. The CSIR established the Satellite Remote Sensing Centre (SRSC) in 1976 for the reception of geo-information from satellites. The first images were received from a European meteorological satellite, METEOSAT in 1977, followed by LANDSAT in 1980, and ERS 1 and 2 in 1994.

In 1983 the SRSC became part of the worldwide tracking network of the French National Space Agency (CNES). The SRSC has supported more than 100 Ariane launches from Kounou in French Guinea. During the restructuring of the CSIR in 1988/1989, the SRSC became the Satellite Applications Centre (SAC), a programme of the CSIR. Since then SAC has grown to provide TT&C services to a multitude of international space agencies and aerospace companies as well as providing remote sensing data and value-added products to the geo-information sectors.

In 2008 the Department of Science and Technology (DST) set out to establish a national space agency. This was realised after the approval of the National Space Agency Bill, which paved the way for the establishment of the South African National Space Agency (SANSA), launched in December 2010. The existence of SANSA is to foster research in space science, advance scientific engineering through human capital and

History of Space Technology in South Africa

In 1963 NASA built a 12-metre antenna

In 1975 NASA handed over Minitrack to the CSIR

The first METEOSAT image taken in 1977

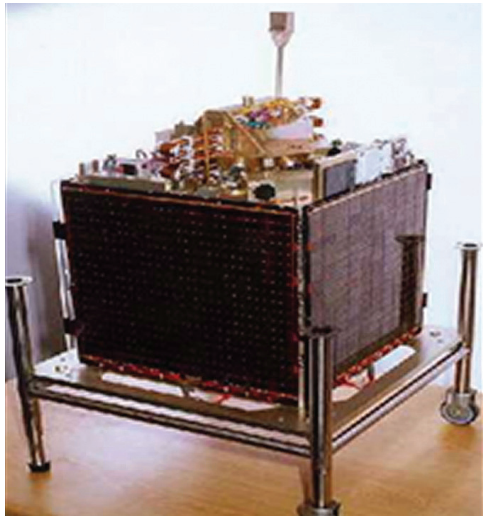
support the creation of an environment conducive to industrial development in space technologies within the framework of national government policy. The Corporate office at SANSA is responsible for the overall operations at the three SANSA directorates.

The former SAC at Hartebeesthoek became SANSA's Space Operation directorate; the Earth Observation directorate in Pretoria and, finally, the Magnetic Observatory at Hermanus became the Space Science directorate.

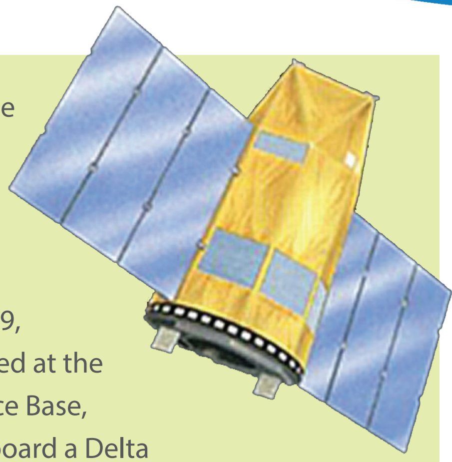
In 1983 became a Centre National d'Etudes Spatiales (CNES) ground station partner

In 2011 CSIR SAC migrates to SANSA.

South African Satellites

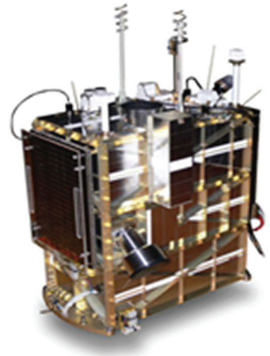


GreenSat was the first project to develop a South African Earth Observation satellite. The project started in 1985 as a military reconnaissance satellite to be launched on the indigenous RSA-3 rocket, but in 1991 it was changed into the civilian **GreenSat**. **GreenSat** would have been about 2,3m high, with a mass of 330kg and would have carried panchromatic and multi-spectral cameras. The resolution would have been 2,5m for the high resolution camera. The RSA-3 rocket was cancelled, as a result, the Russian Start-1 rocket was identified as a replacement. Although engineering models had been built, the project was cancelled in 1994 due to lack of funds.



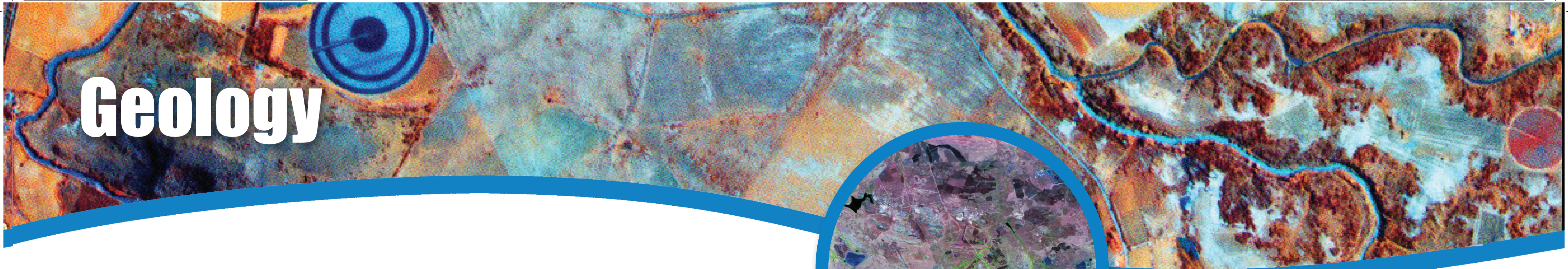
SunSat was the first satellite built in South Africa to make it into orbit. On 23 February 1999, **SunSat** was launched at the Vandenberg Air force Base, California, USA on board a Delta II rocket. The satellite successfully operated in space, fulfilling all mission objectives. Designed and built almost in its entirety by postgraduate students of the University of Stellenbosch, **SunSat-1** heralded South Africa's entry into the Space Age. **SunSat** was a low Earth orbit (LEO) microsatellite, weighing 64kg, with dimensions of 45cm x 45cm x 60cm. The satellite's payloads included NASA experiments, amateur radio communications, a high-resolution imager, precision altitude control and school experiments. It followed an elliptical polar orbit of between 620km to 850km above the Earth's surface and circled the globe approximately once every 100 minutes at a travelling speed of nearly 7,5km/s, or 27 000km/h.

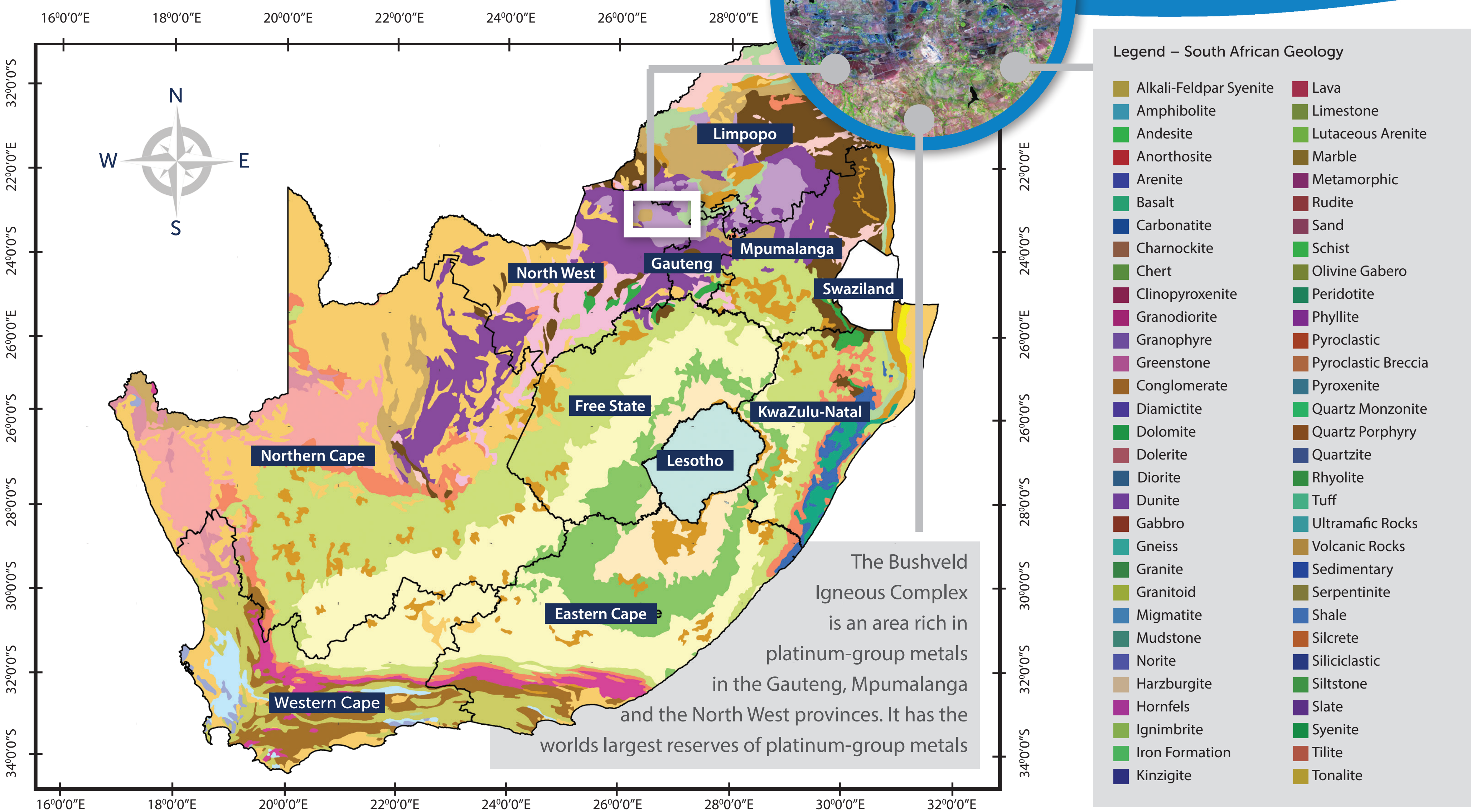
SumbandilaSat, initially known as ZA SAT-002, was developed by SunSpace in conjunction with the University of Stellenbosch. "Sumbandila" is a Venda word that means "lead the way". The Sumbandila project was a government-funded project aimed at advancing the South African space programme and building capacity in space technology in the country. Sumbandila was launched on 17 September 2009 at the Baikonur Cosmodrome launch facility in Kazakhstan. **SumbandilaSat** contained a high resolution (6,25m) optical sensor that recorded reflected radiation in six spectral bands: the visible, red-edge and near-infrared region. In June 2011, **SumbandilaSat** was damaged by solar storm that damaged power supply to the on-board computer, preventing the satellite from transmitting images to the ground receiving station. Over its life span, **SumbandilaSat** delivered up to 1 150 global images covering areas such as Sossusvlei pan in Namibia, the Palms islands in Dubai, Cape Town and East London.



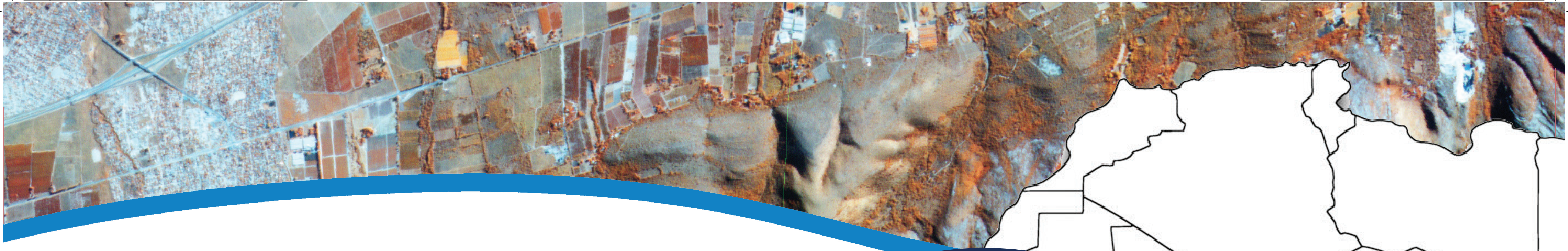
Applications of Satellite Images

Geology





The Bushveld Igneous Complex is an area rich in platinum-group metals in the Gauteng, Mpumalanga and the North West provinces. It has the worlds largest reserves of platinum-group metals



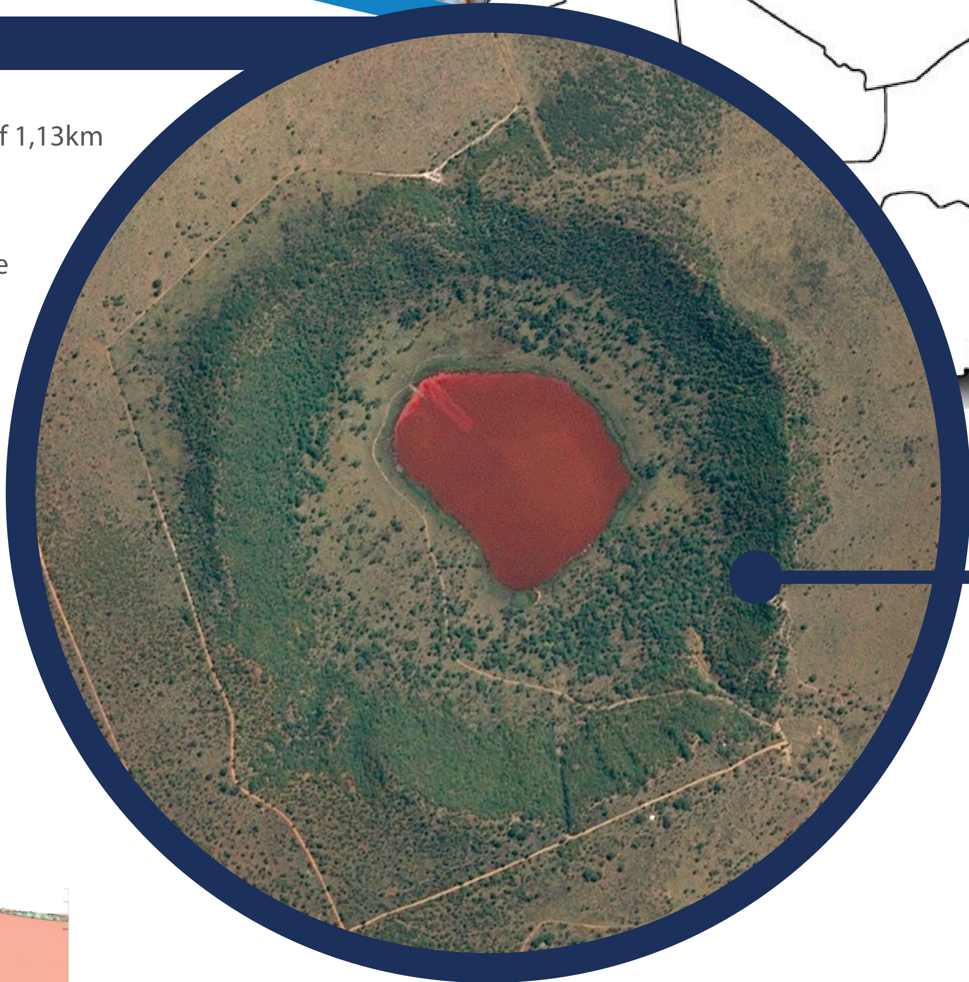
The Tswaing Crater

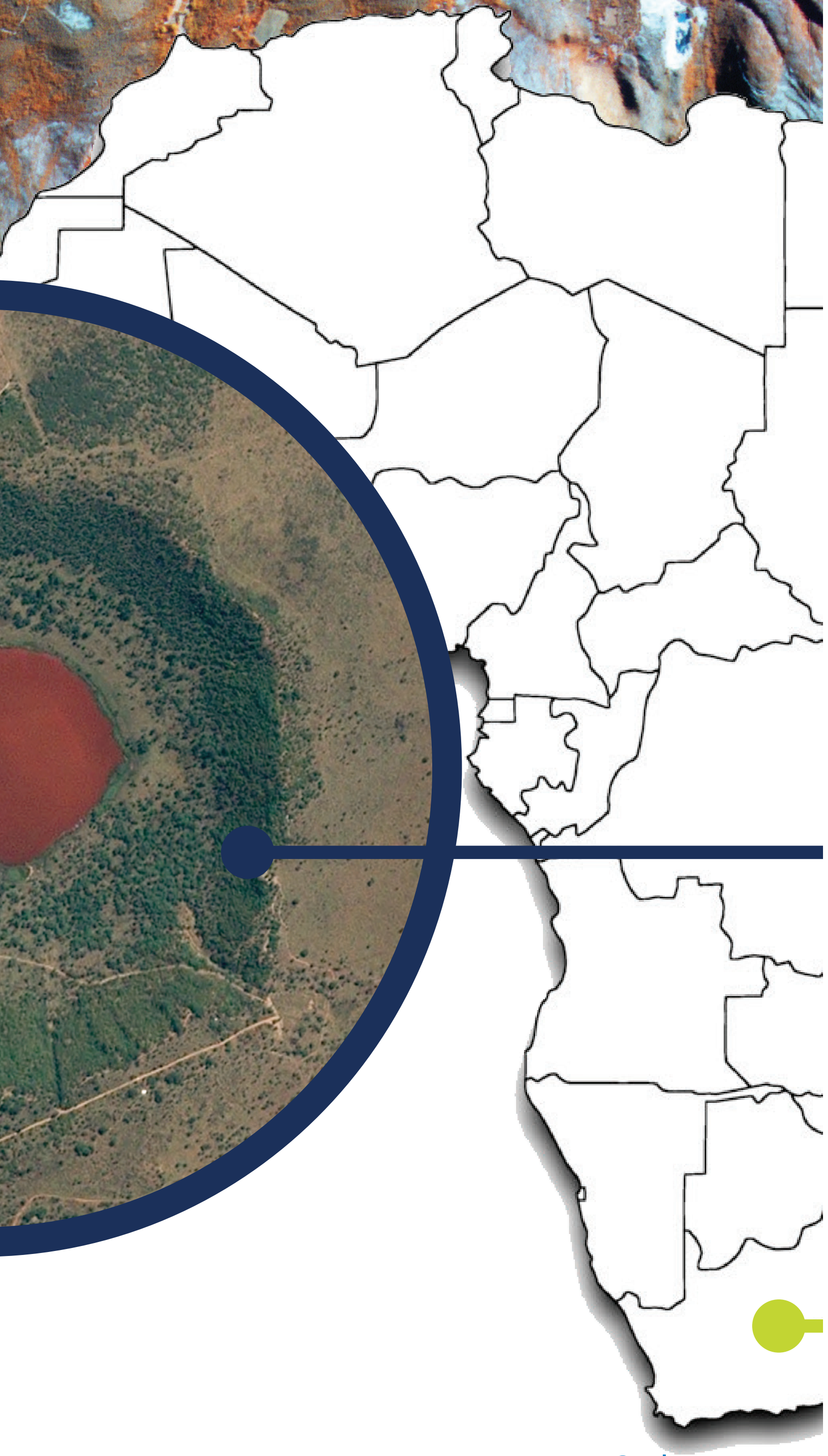
The **Tswaing Crater** is 40km northwest of Pretoria with a diameter of 1,13km and is 100m deep. The crater formed as a result of a meteorite strike believed to have been between 30m and 50m wide. As a result the **Tswaing Crater** is classified as an impact crater. Tswaing means Place of Salt in Tswana, hence its former name of Saltpan Crater.

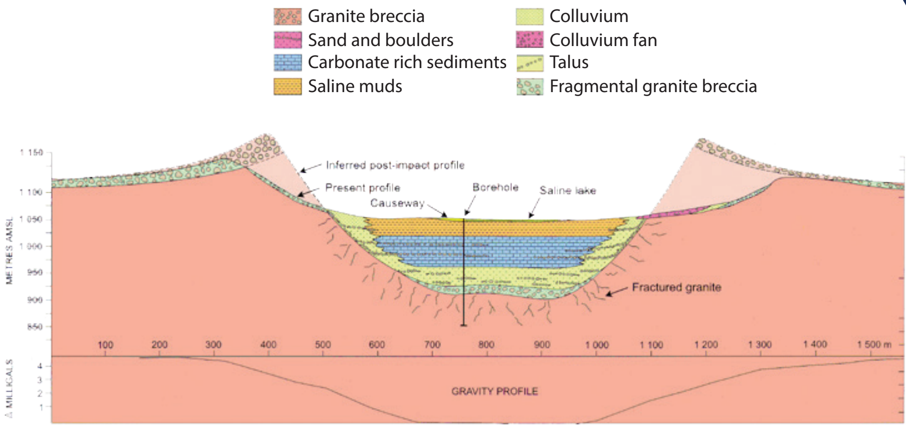
The **Tswaing Crater**
is about

220 000

years old





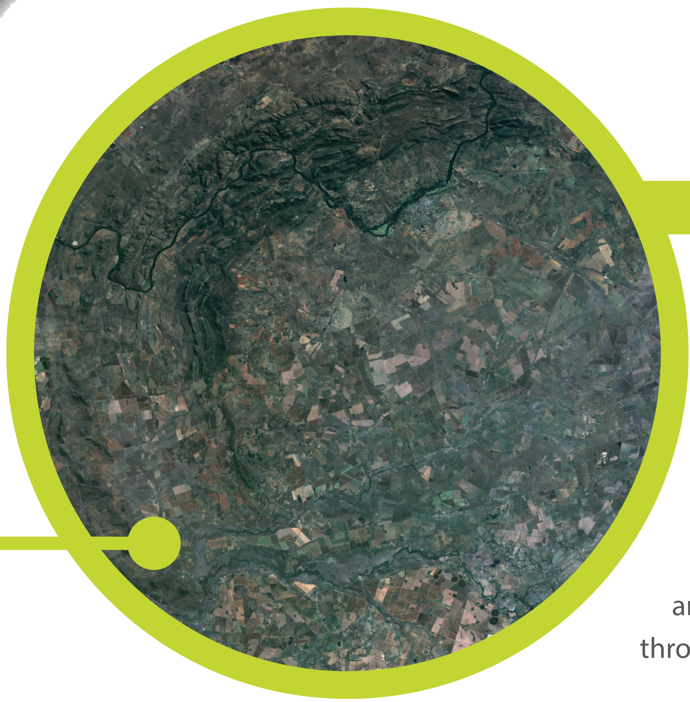


Source: David A. Kring (USRA-LP)

The Great Dyke

The **Great Dyke** is a linear geological feature found in Zimbabwe. It stretches for about 550km from the northeast to the south western part of the country and is clearly visible from medium resolution satellite images. The dyke is rich in mineral ore deposits such as asbestos, gold, platinum, silver and chromium.

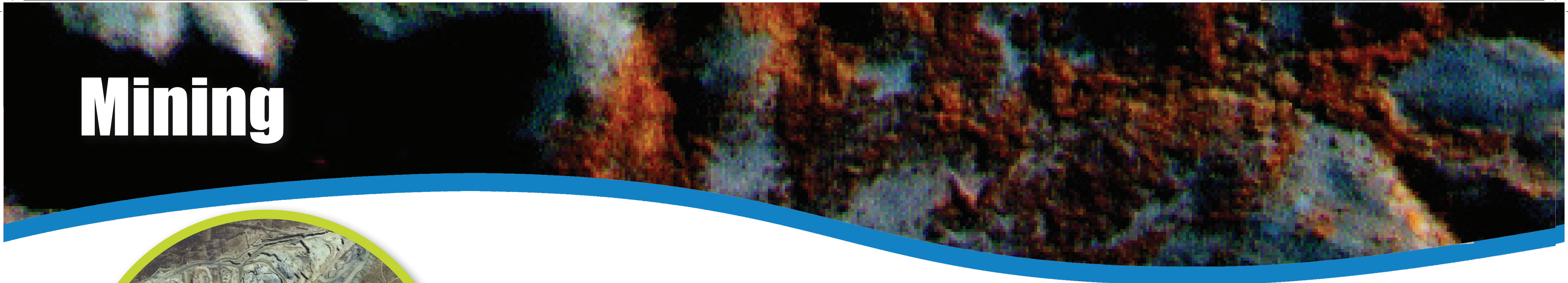
The **Great Dyke** spans about **550** kilometres



The Vredefort Dome

The **Vredefort Dome** was formed after a meteorite strike dating back about 4 million years ago, making it the second know oldest impact crater on Earth. It is situated in the Free State province about 120km southwest of Johannesburg. The dome is so enormous, covering a distance of 300km wide. Due to the immense area covered by the dome, it can only be appreciated through satellite imaging.

The **Vredefort Dome** is about **300** kilometres wide

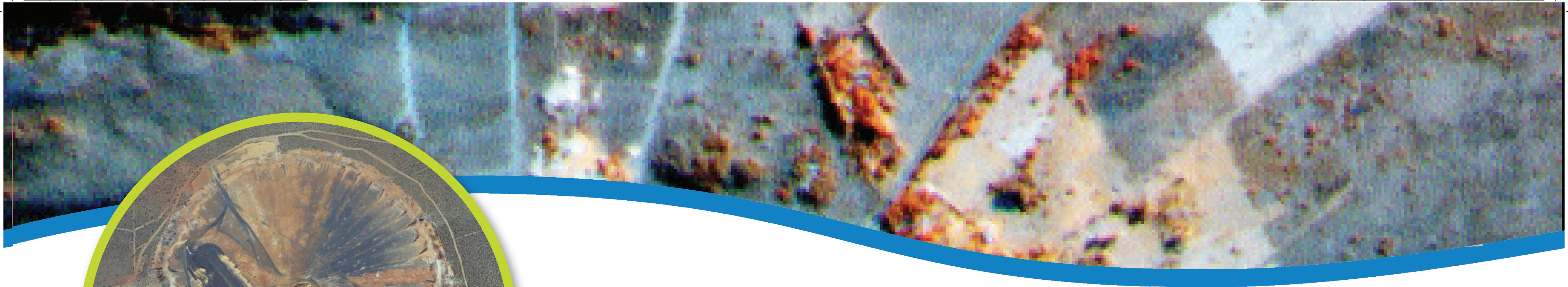


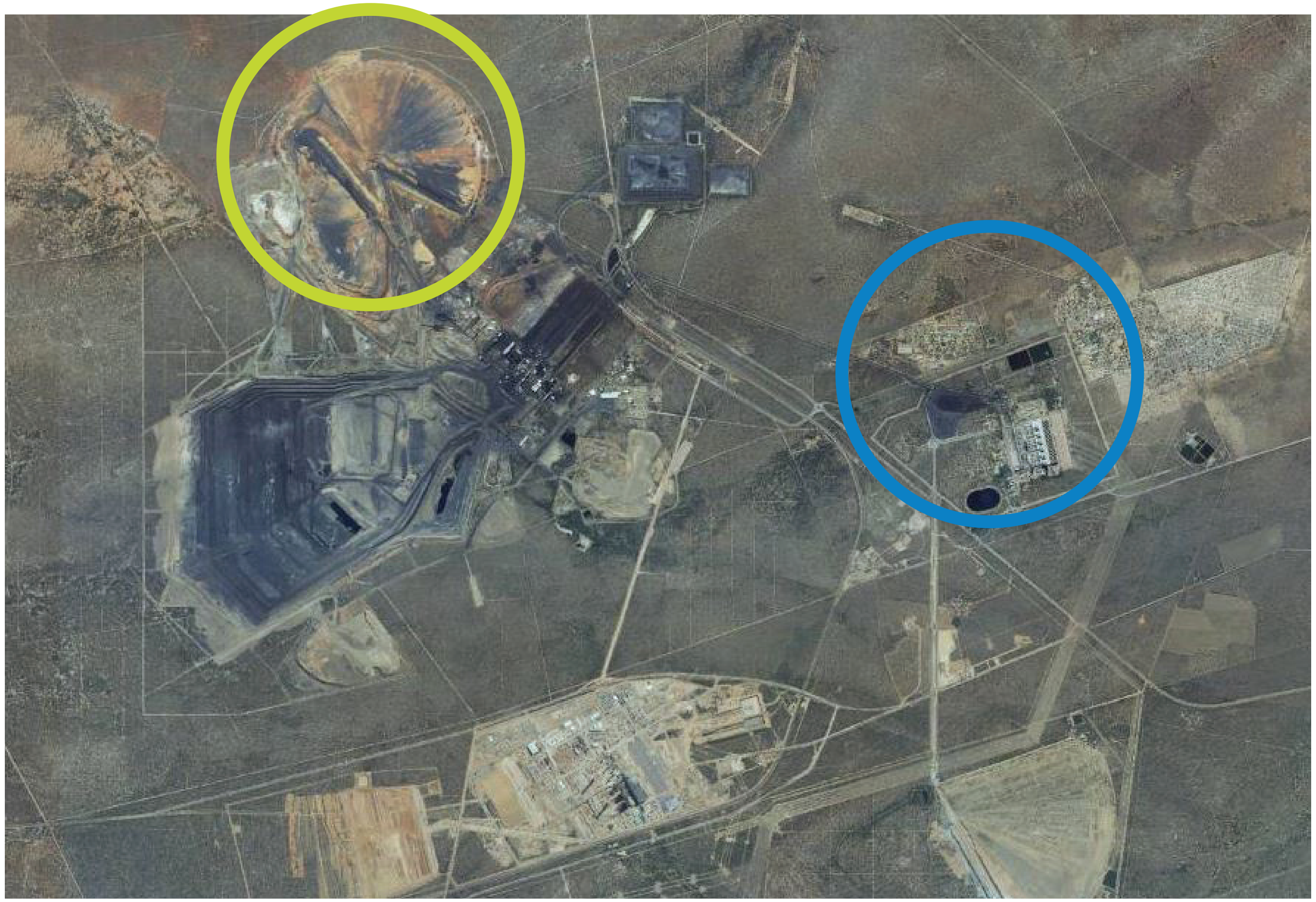
Mining

A detailed aerial photograph showing open-pit mines and ore stockpiles.

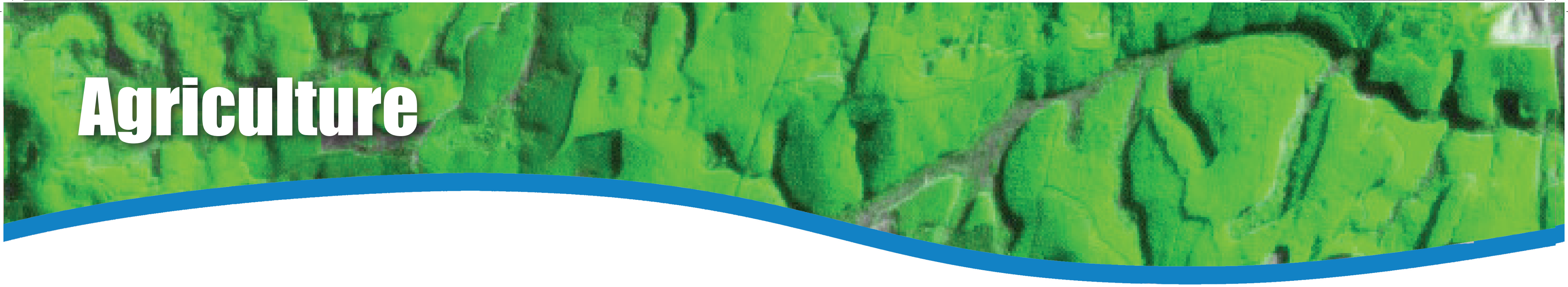
The Mogalakwena open-pit mine, as seen from a 0,5m aerial photograph, is 30km northwest of Mokopane in Limpopo Province. Visual interpretation of the image shows land features such as rock outcrops, settlements and mine infrastructure. The three inserts (green, blue and grey) illustrate in greater detail the activities in the mine when zoomed in.

A zoomed in aerial image showing the mine processing plant with conveyor belt, buildings,mineral stock pile, dam and other infrastructure.



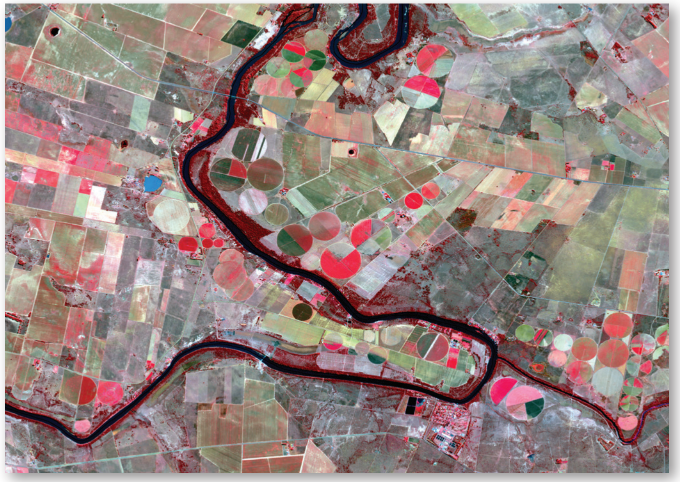


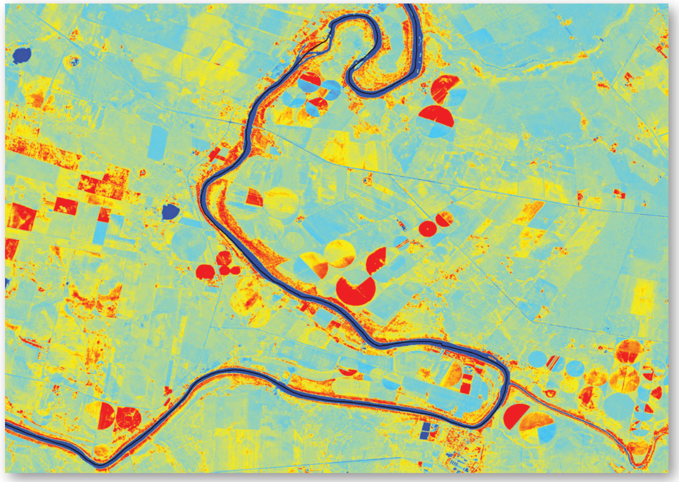
Aerial photograph (0,5m) of Grootegeluk open-pit coal mine situated 25km from Lephalale in the Limpopo Province. The Matimba Power Station and the mine can be seen in greater detail from the zoomed-in images on the left.



Agriculture

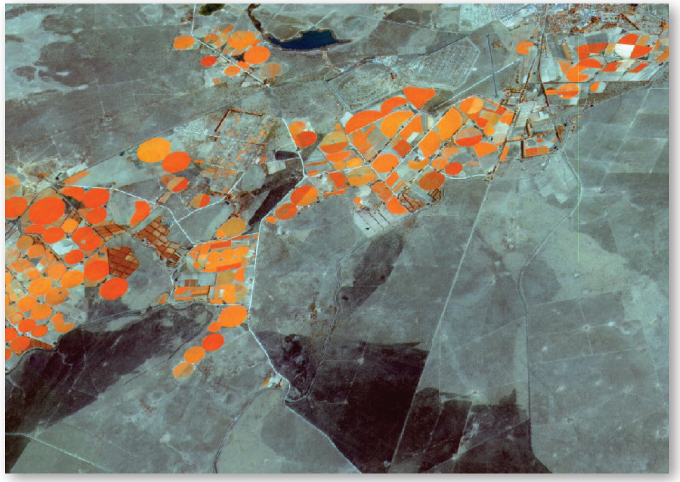
LandSat 8 false colour composite image showing agricultural fields at Bothaville in the Free State. The colour combination used shows healthy vegetation in deep red, water bodies in black and non-cultivated areas in different shades of green.

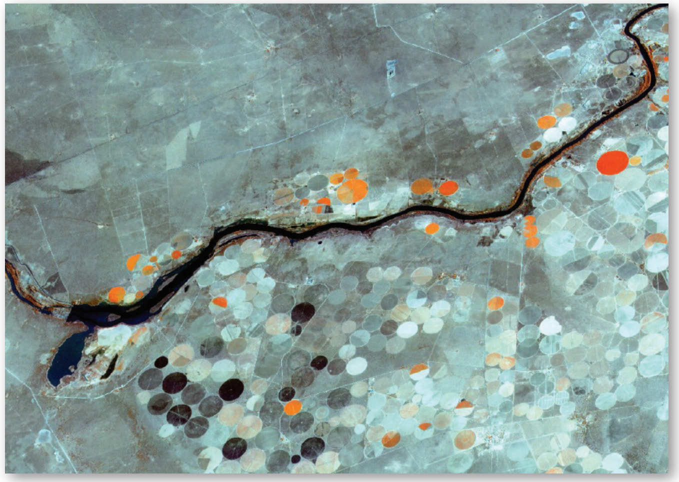




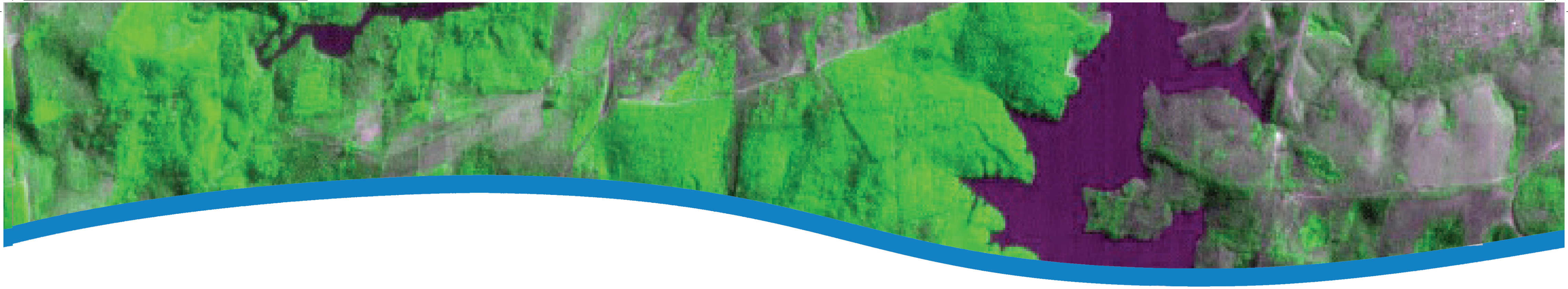
A Normalised Difference Vegetation Index (NDVI) of LandSat 8 image was calculated by using the near infrared and visible spectral bands using the following formula (NIR-R/NIR+R). The image shows healthy vegetation in red, water bodies in blue and non-cultivated areas in cyan.

A false colour composite of SumbandilaSat image of Jan Kempdorp in the Northern Cape shows agricultural fields in different shades of orange. At the bottom of the image, burnt areas (scars) can be seen in black.

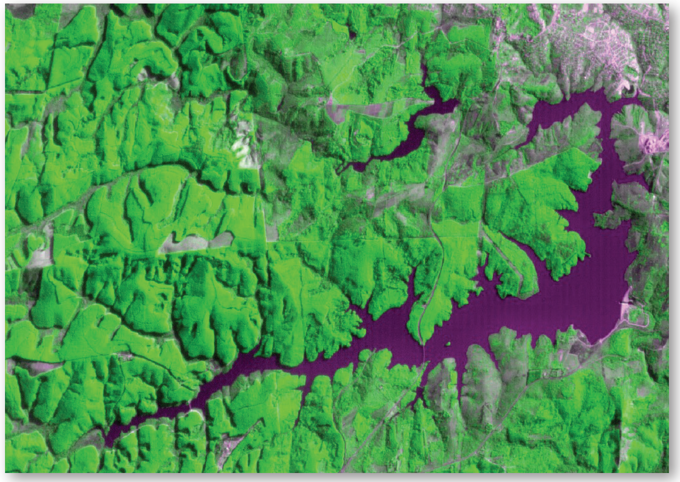




SumbandilaSat False colour composite of agricultural fields at Warrenton in the Northern Cape. Uncultivated fields in the image shown in different shades of grey whilst the river is shown in black.

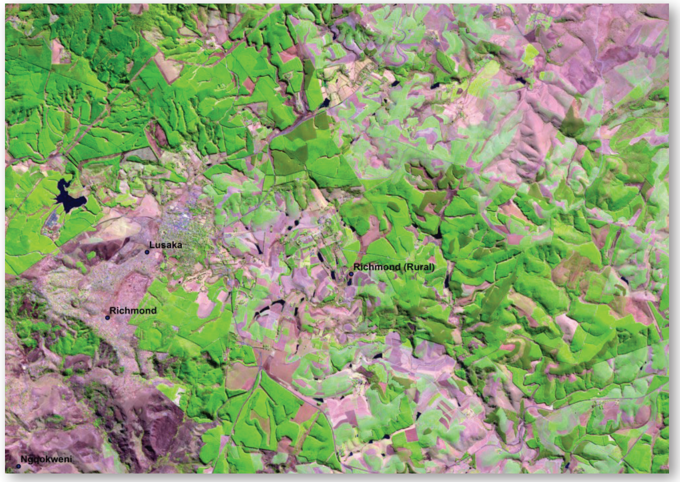


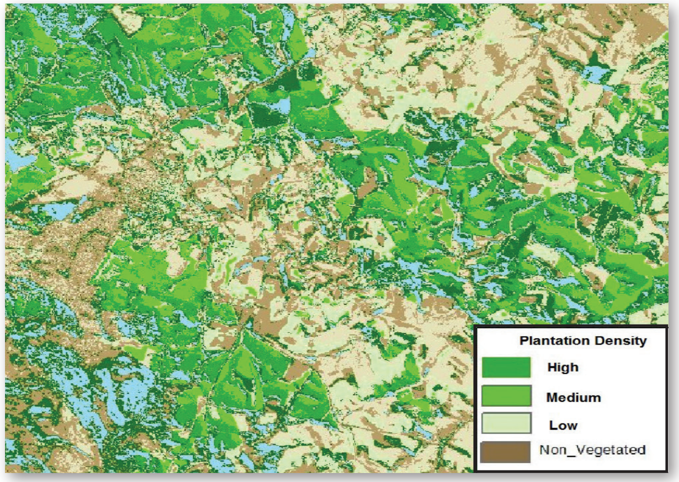
Injaka Dam at Bushbuckridge is shown in blue surrounded by forest plantations.



Agricultural plantations at Kirkwood in the Eastern Cape Province.

Sugar cane plantations in the Richmond area in KwaZulu- Natal.





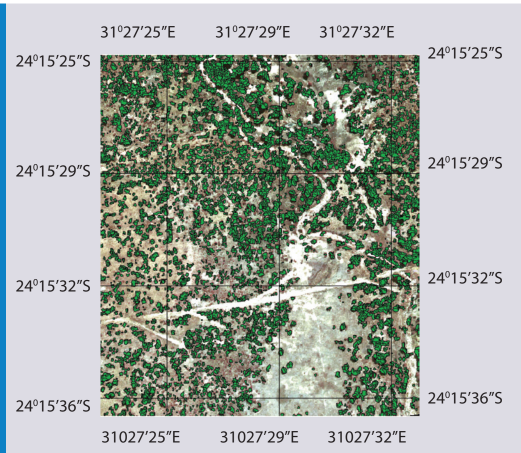
Classification of the sugar cane plantation, showing three classes of plantation density.

Woody cover mapping

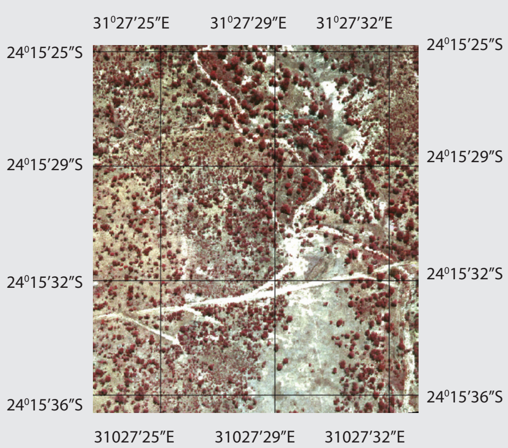
Historical mapping of woody cover

With increased concerns on the impact of climate change on vegetation, it is useful to monitor how vegetation has changed over time. Woody cover vegetation is of interest for both conservation and rangeland management. It is therefore useful to understand historical canopy cover to predict future changes. Making use of historical aerial photography and object-based image analysis in small areas, it is possible to create models and upscale these to larger areas using medium-resolution images such as Landsat & CBERS imagery. In this example we mapped woody cover vegetation in the Kruger National Park from an aerial image acquired in 1991.

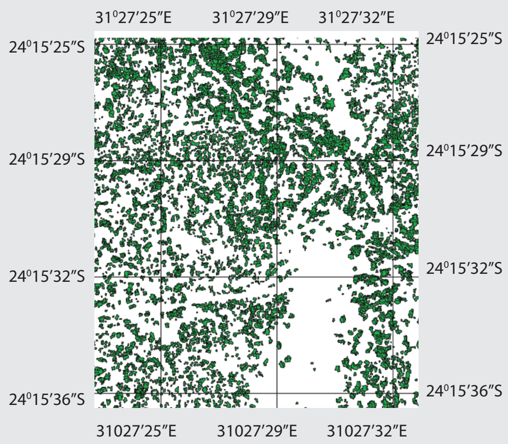
A NIR aerial photograph (0.5m resolution) acquired in 1991 by KNP Scientific Services.



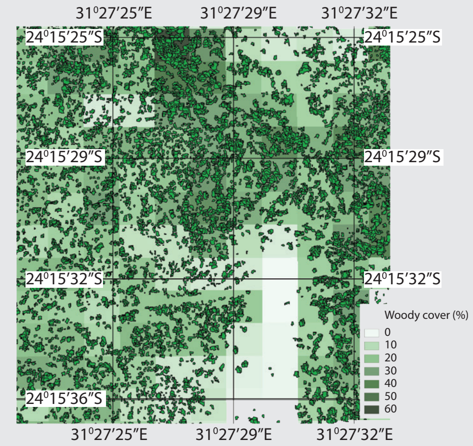
Using Object Based Image Analysis (OBIA), which makes use of both spectral and object properties, the woody trees are extracted from the aerial photograph.



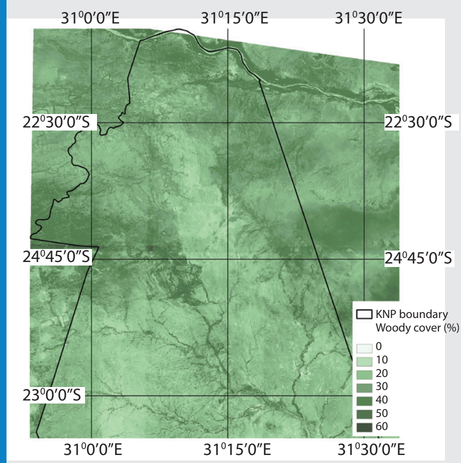
The mapped woody cover as extracted from the aerial photograph.



Based on the extracted wood cover, it is possible to calculate the percentage of woody cover at medium resolution that can be used to create models to map woody cover of the entire KNP.



Using modelling techniques with input from Landsat 5 imagery (30m resolution) from the summer and winter of 1991, and the woody cover maps created from aerial photos, a historical woody cover map for the northern region of the KNP was created.



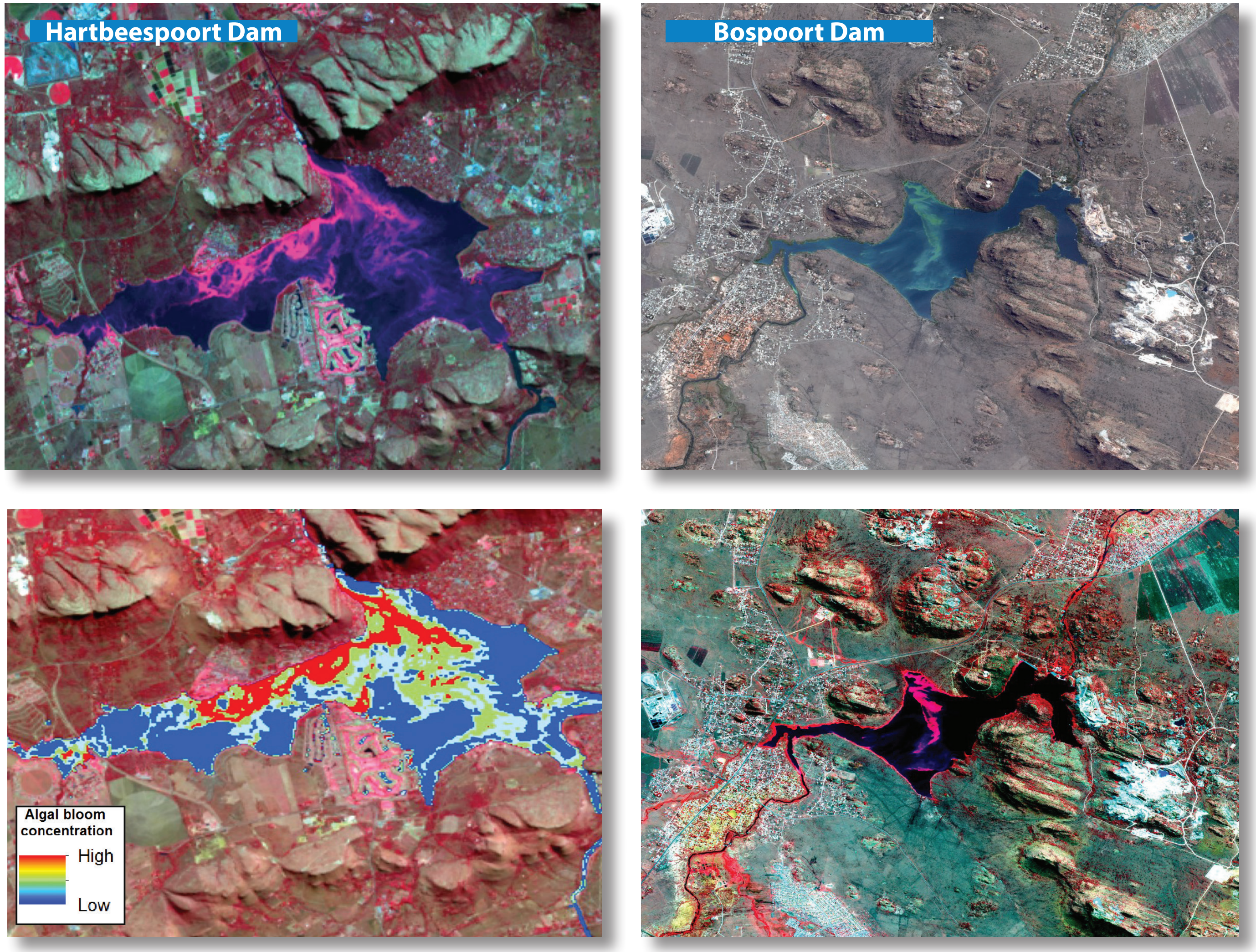
Water quality

Algal blooms are ecological disasters that threaten the aquatic ecosystem. As a result it is important to identify and monitor their development for the protection and management of the water biome.

Conventional in-situ methods are not ideal for such an activity as they are time consuming and require substantial resources. Remote sensing is therefore the appropriate technology for such an application because of its ability to cover wide areas at different temporal scales. The different satellite images taken at various wavelengths, including the infrared region, make it possible to identify algal bloom because of their high chlorophyll concentration.

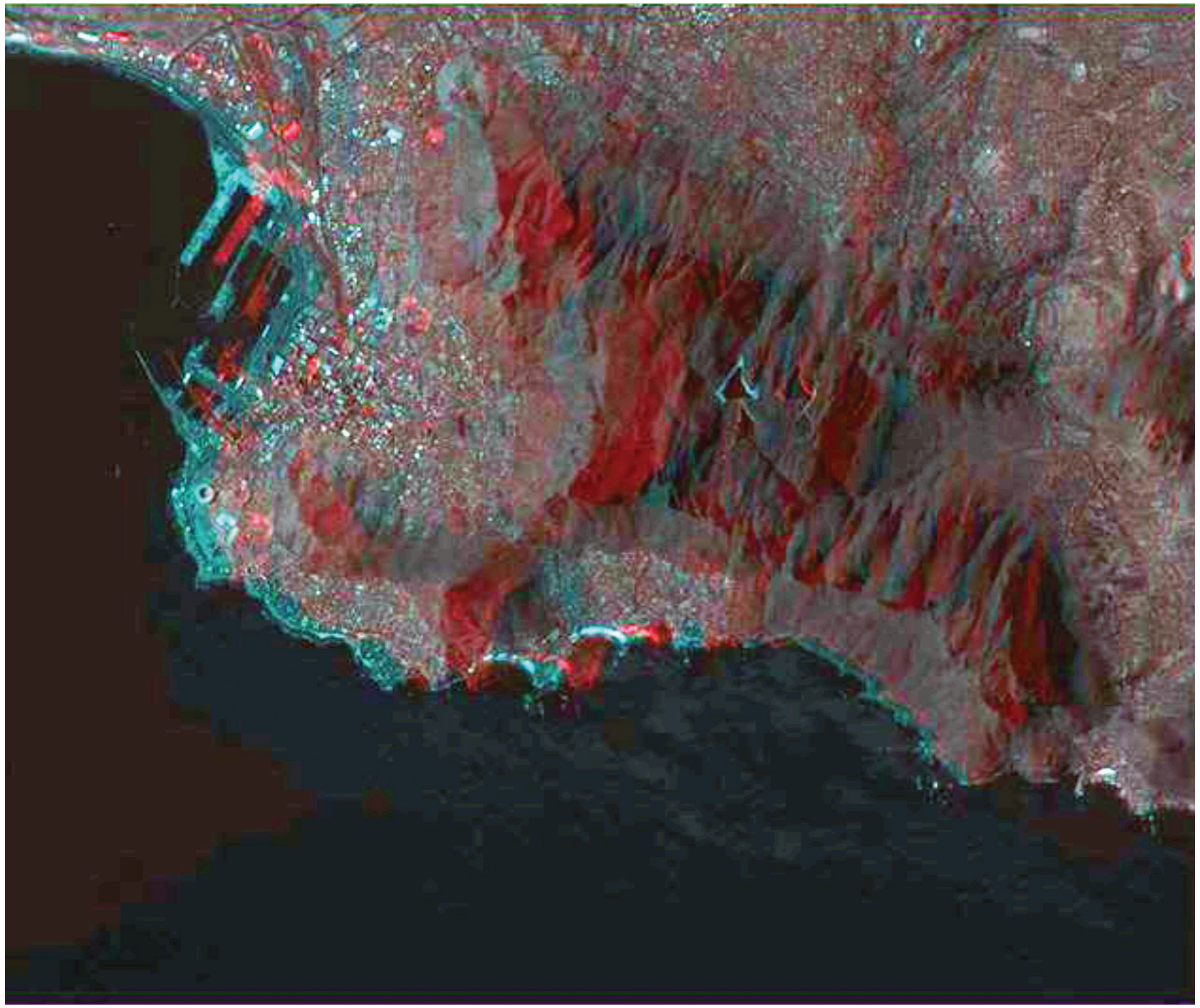
The Hartbeespoort Dam and the Bospoort Dam situated north and northeast of Pretoria respectively, are affected by algal bloom.

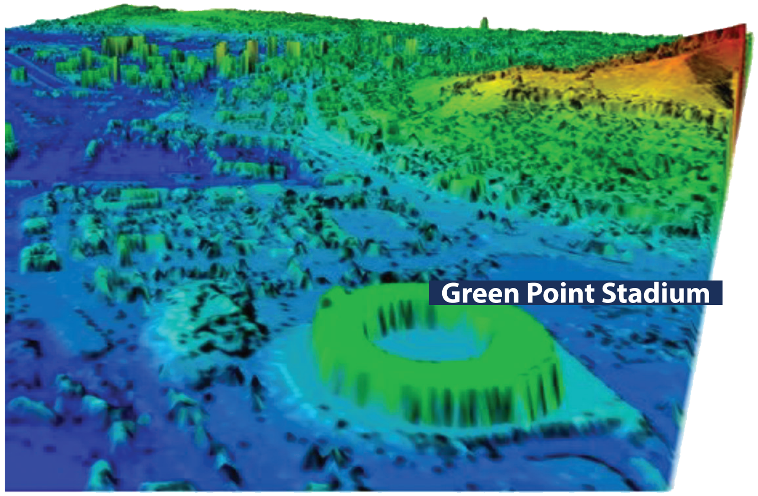
An **algal bloom** is a rapid increase or accumulation in the **population of algae** (typically microscopic) in a water system.



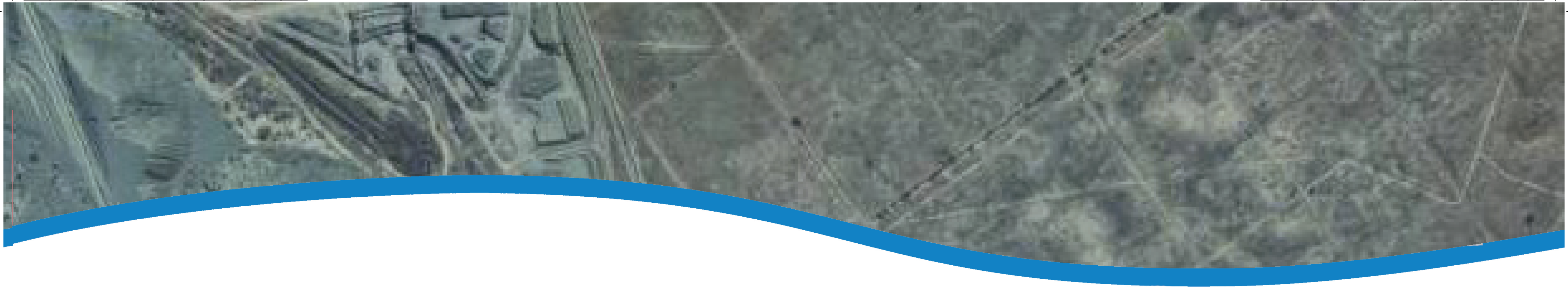
Urban planning

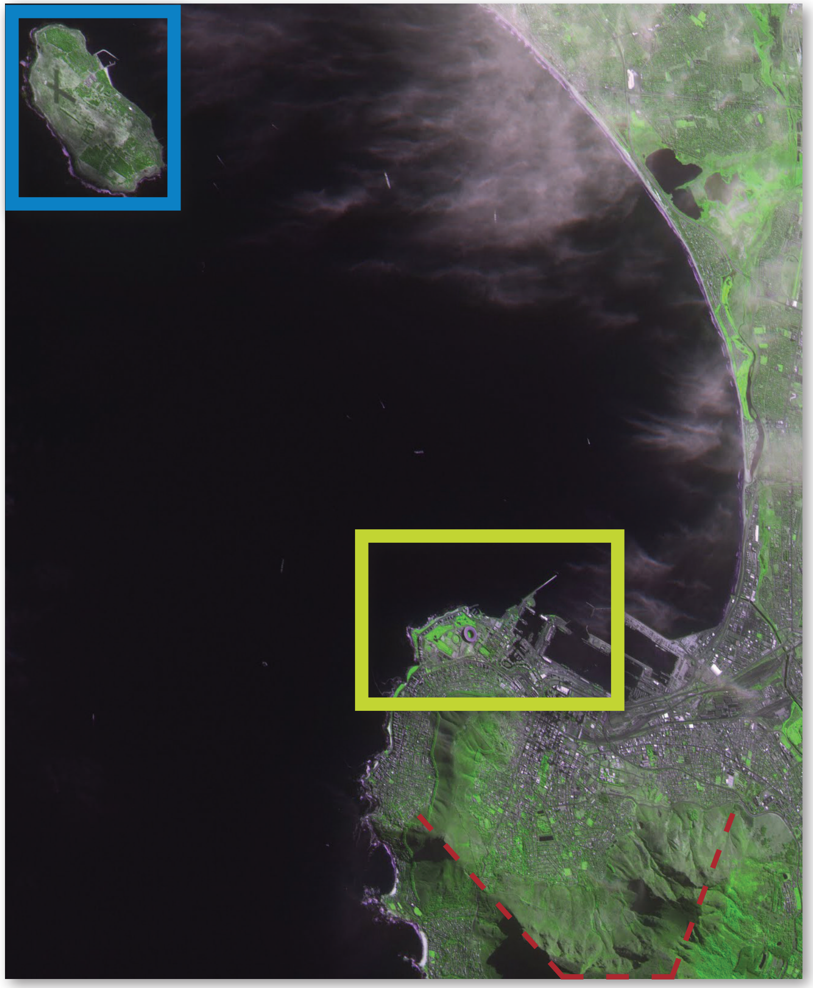
Stereo optical image of Cape Town





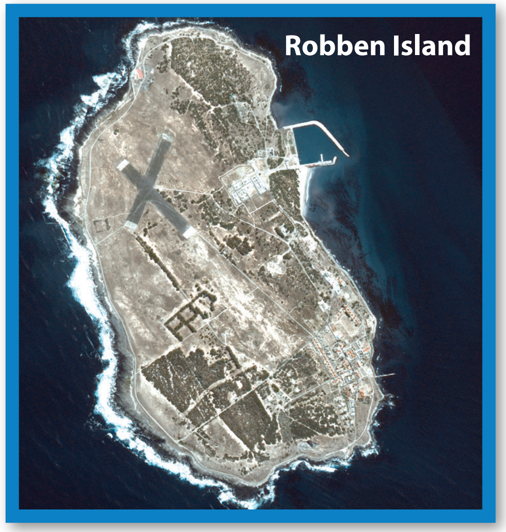
Stereo optical imaging is a technique that displays images in three dimensions (3D). It is increasingly becoming an important application in heritage preservation, archaeology, urban planning and city development. In remote sensing, 3D images are created by taking satellite images of the same area from different angles and fusing them to create an anaglyph. *To view the images in three dimensions, 3D anaglyph glasses are used.*

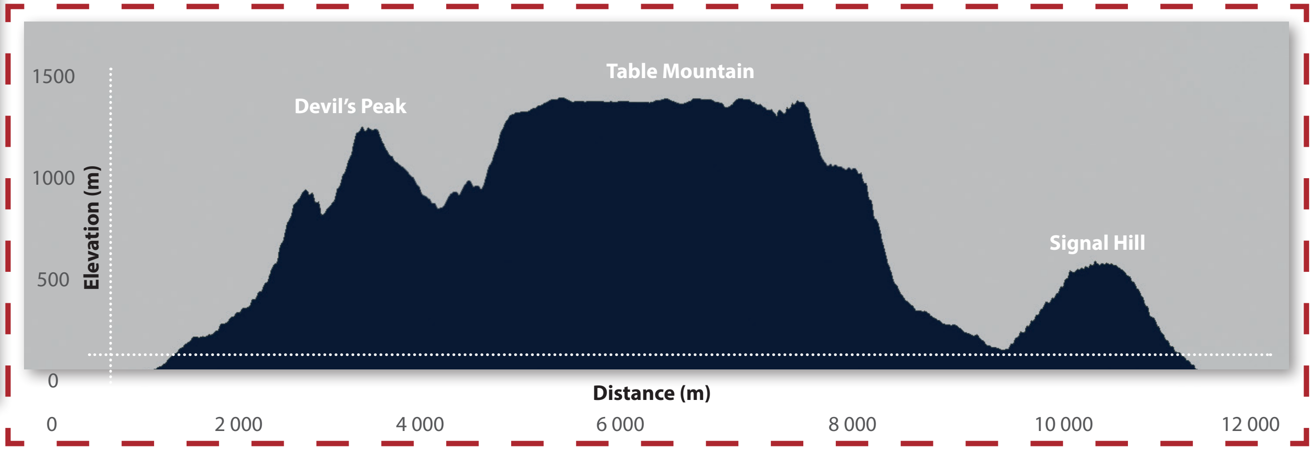




Cape Town and Robben Island as seen from a SumbandilaSat Image

Green Point Stadium and the Waterfront.

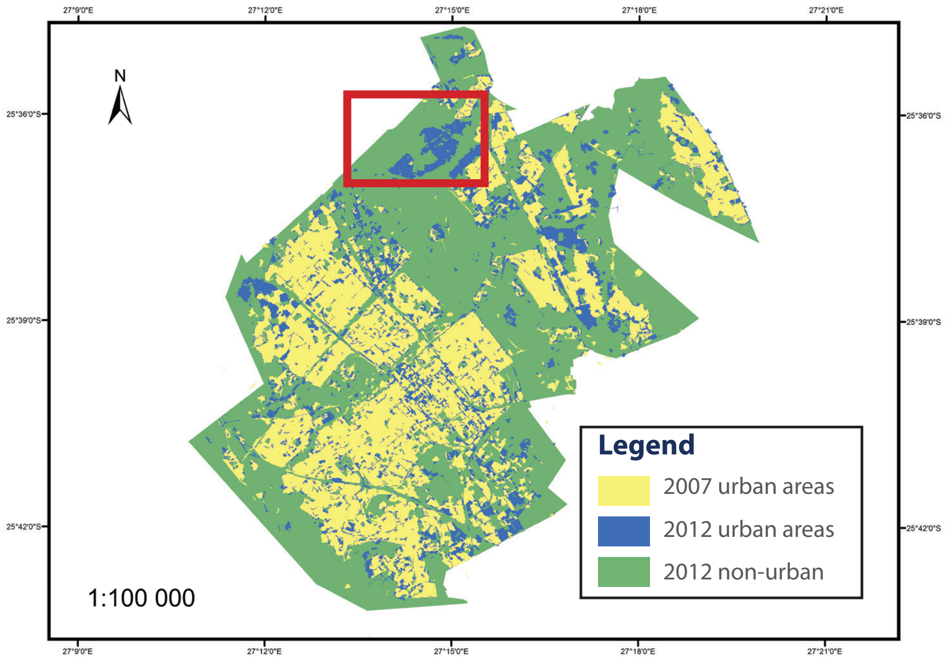




Cross section profile of Table Mountain, Devil's Peak and Signal Hill

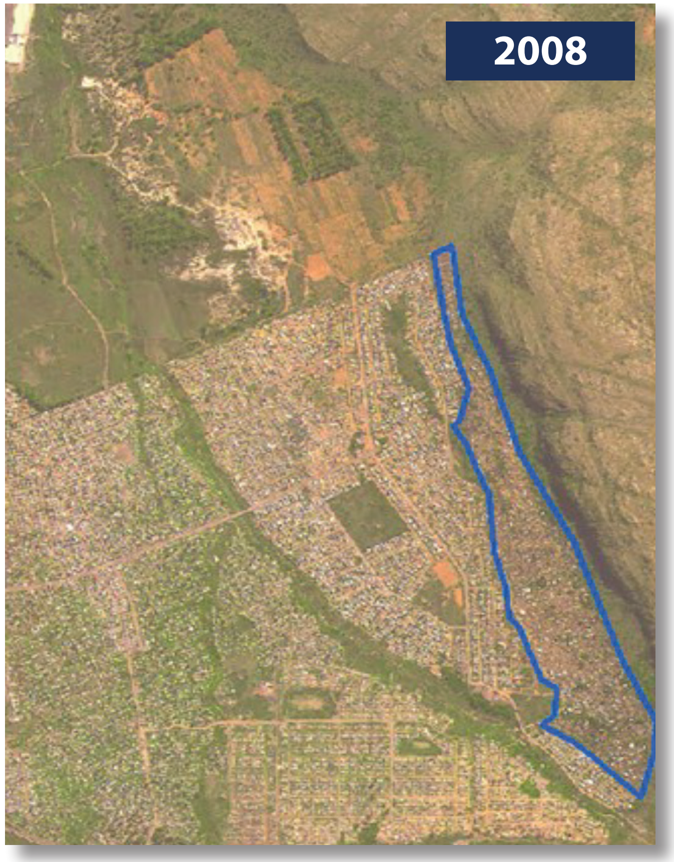
Urban development

Rustenburg spatial urban growth



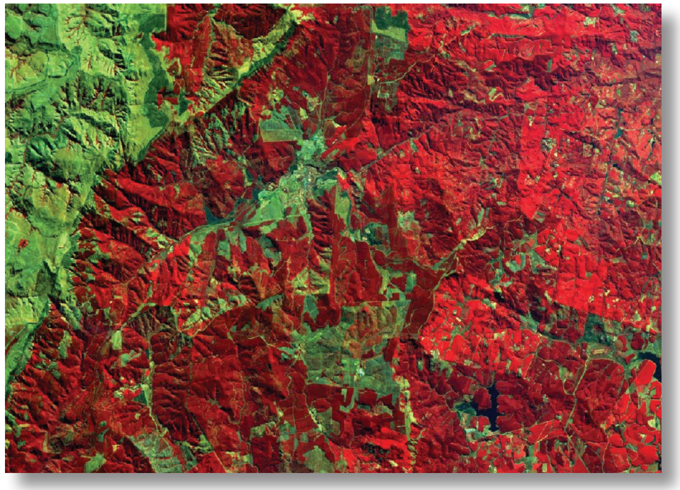
Satellite images are significant in monitoring urban development. This application involves the acquisition of satellite images of the same area at different periods. Continuous acquisition at different time intervals ultimately builds a time series database of the area. The images are then interpreted to identify changes, in this case development in building structures. Such an application is critical to advance and support government and environmental programmes such as social upliftment and climate change, and monitoring service-delivery projects, such as the constriction of low-cost housing.

Acquiring imagery of the same area over time provides us with data required to study changes in human settlements. Some of the changes that we can observe currently are settlement expansion (informal and formal), decline or conversion of informal into a township and development of new informal settlements. SANSA and the National Department of Human Settlement have conducted informal settlement change detection between 2006 and 2011. The results show that even though there were a number of informal settlements that were upgraded (in-situ or relocation), new informal settlement developments and expansion were observed during this period.



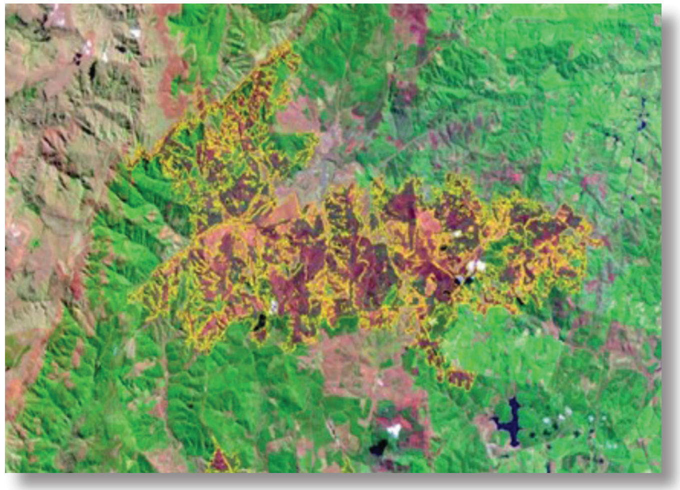
The Union Buildings are in Pretoria on the Meintjieskop hill overlooking the suburb of Arcadia. The buildings have an important significance to South Africa, as a result it is a national heritage site. The offices of the president are housed in the Union Buildings.

Burnt scar mapping



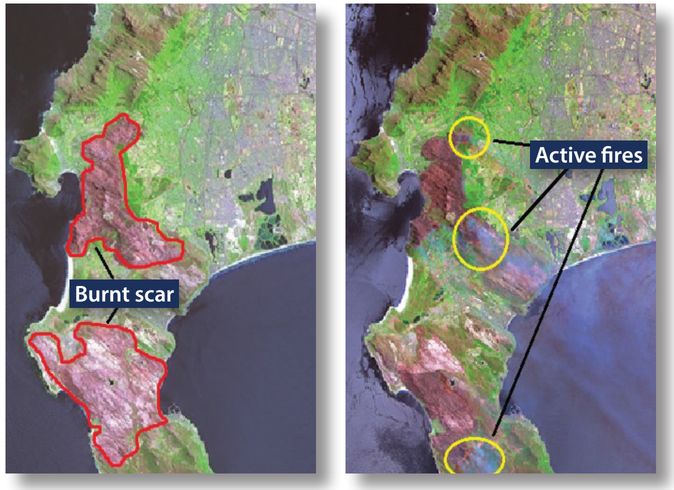
Before the fire

During the fire

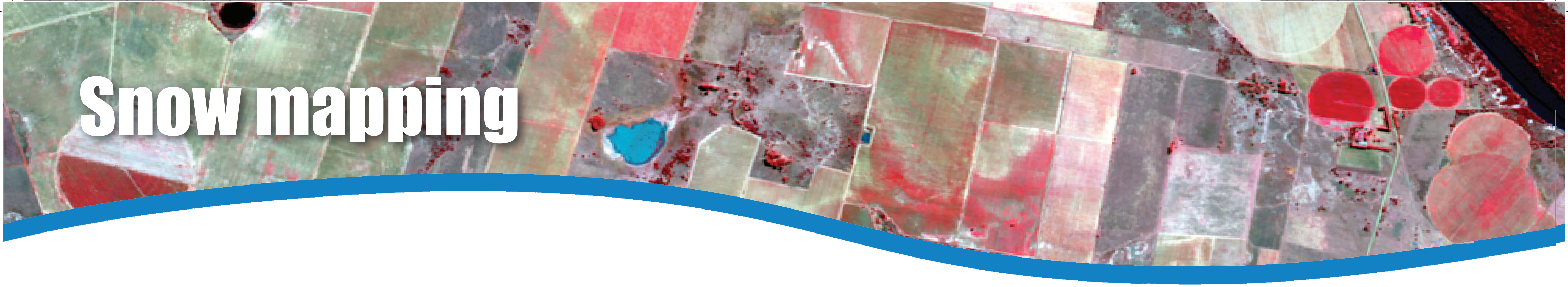


After the fire

Natural disasters are devastating events that result from natural processes of the Earth. Remote sensing has the capability to map and monitor the impact of catastrophic events such as landslides, volcanic eruptions and veld fires. With the use of satellite imaging, different views of the affected areas before, during and after the fire can be acquired. Such information provides a different yet valuable perspective of the disaster-affected area. The LandSat 8 images above and the MODIS images on the right show veld fires in the Western Cape. The fires were captured while still actively burning on the ground and subsequently the satellites captured the burnt scars during their next overpass.



Remote sensing offers the **ability to monitor** the impact of **disastrous events** such as veld fires

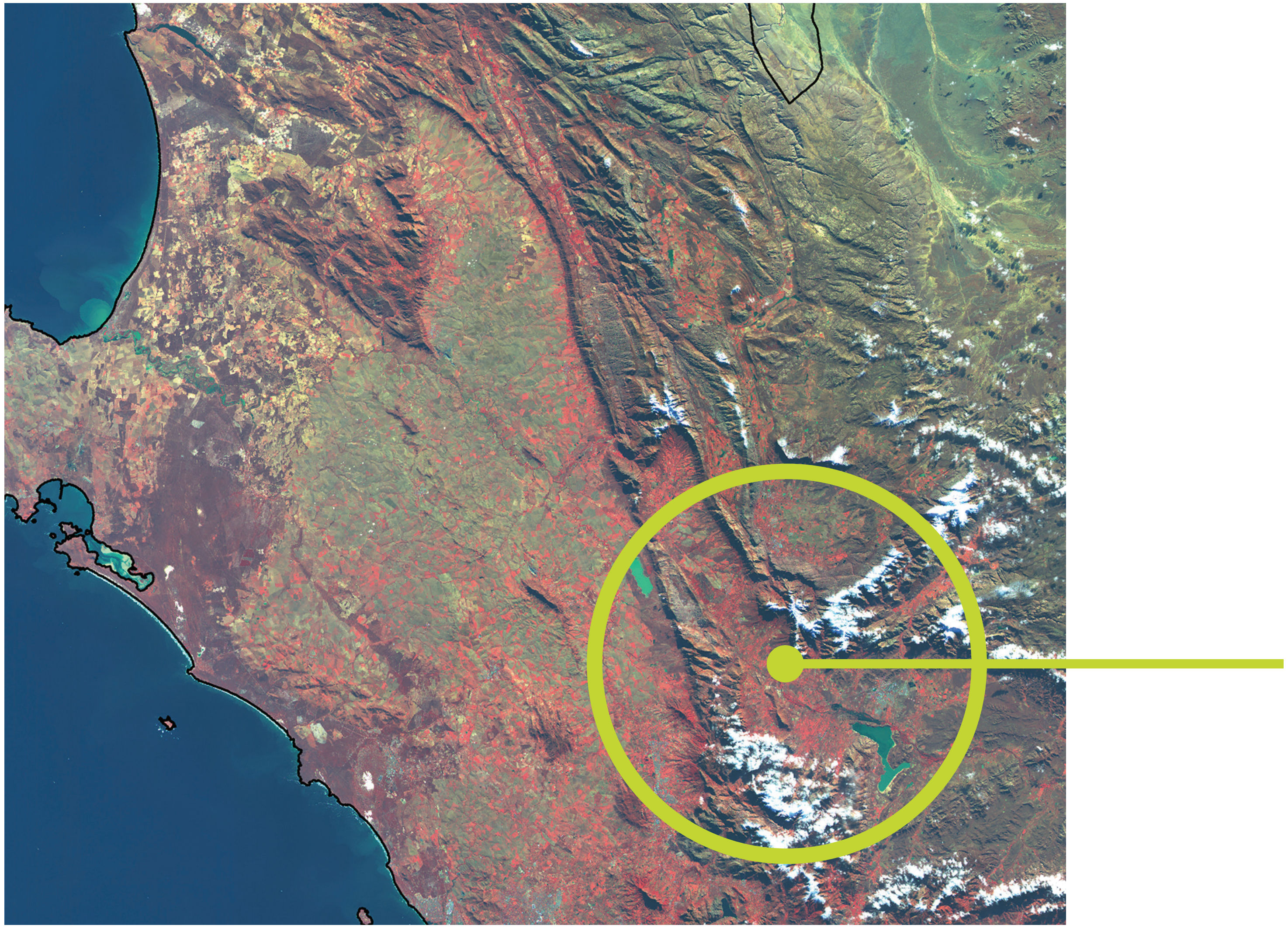


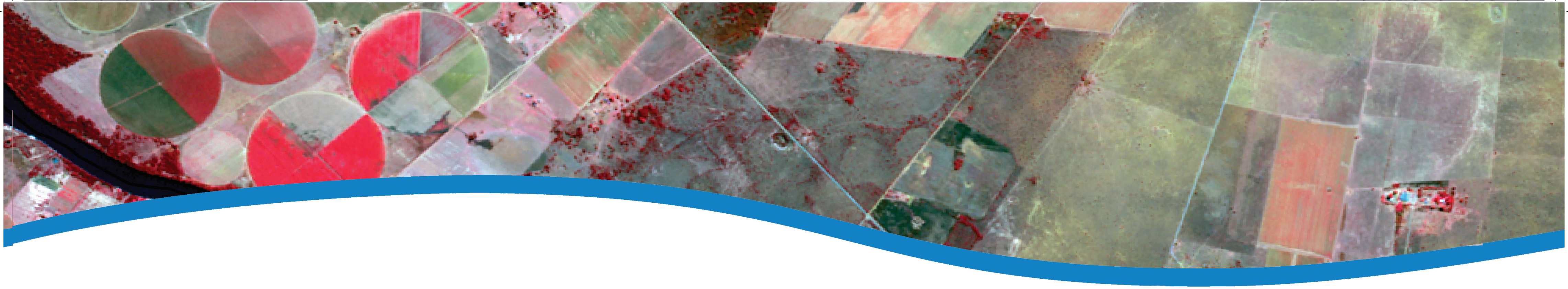
Snow mapping

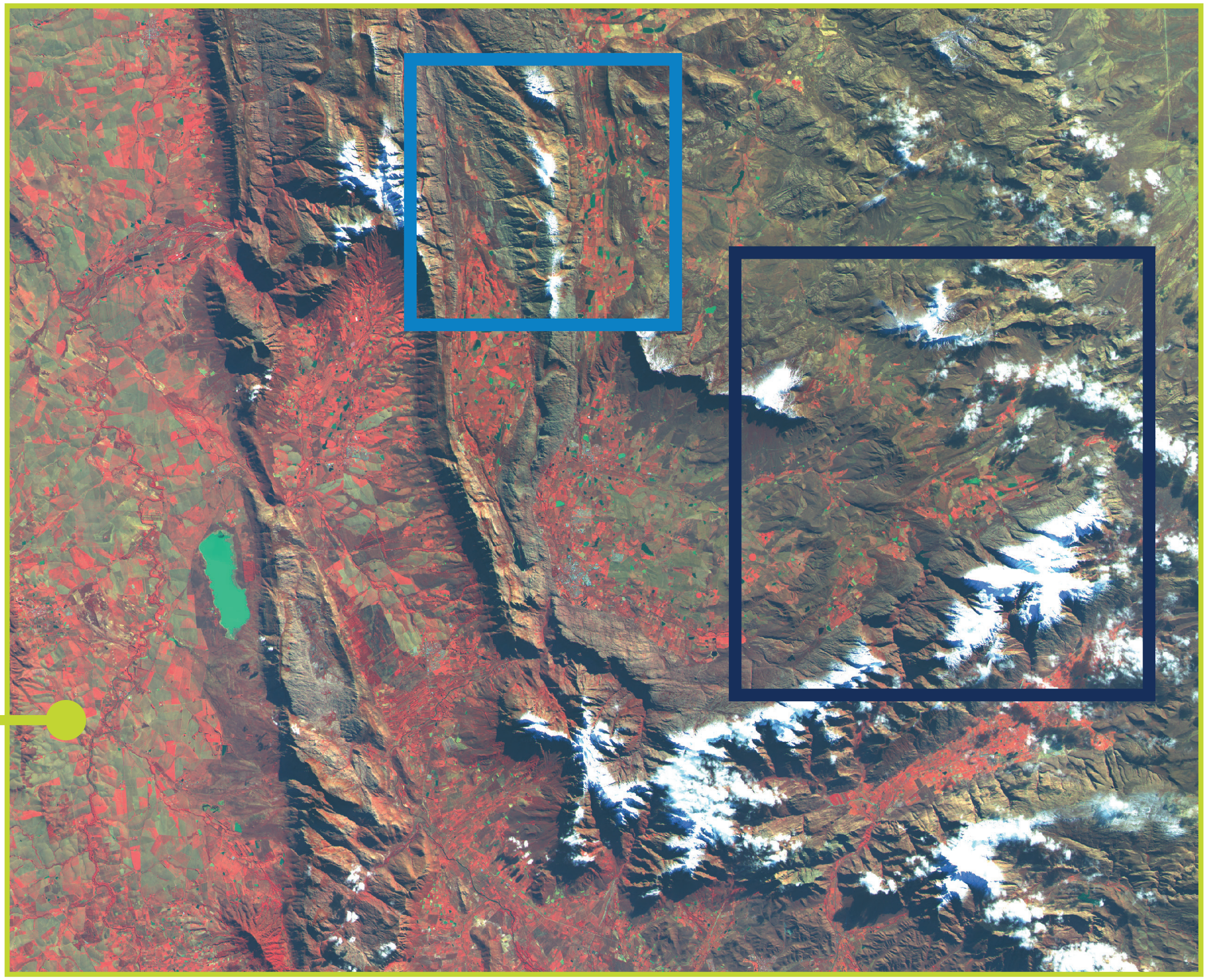
Satellite images serve as a vital source of information to understand and investigate different weather phenomena. As the climate changes, historical satellite images are analysed to better understand how weather conditions have changed over the years. This helps to understand weather dynamics that contribute to changes in climatic conditions making it possible to predict and monitor catastrophic events related to climate change such as droughts, floods and snow.

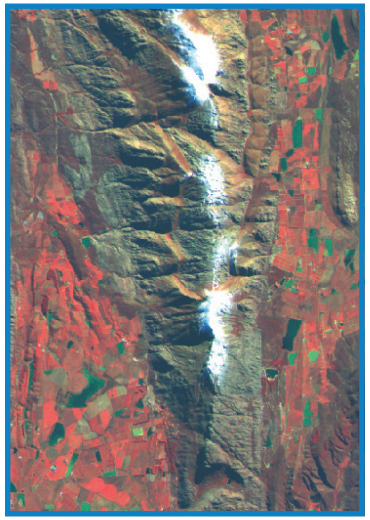
Satellite images serve as a vital source of **information** to **understand** different **weather phenomena**.

Right: Snow covers the mountain ranges at Ceres in the Western Cape as captured by LandSat 8 on the 9th of June 2013.



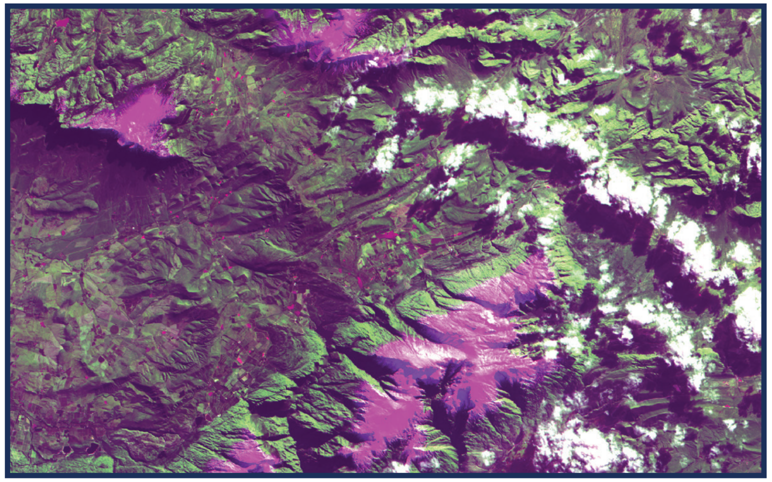




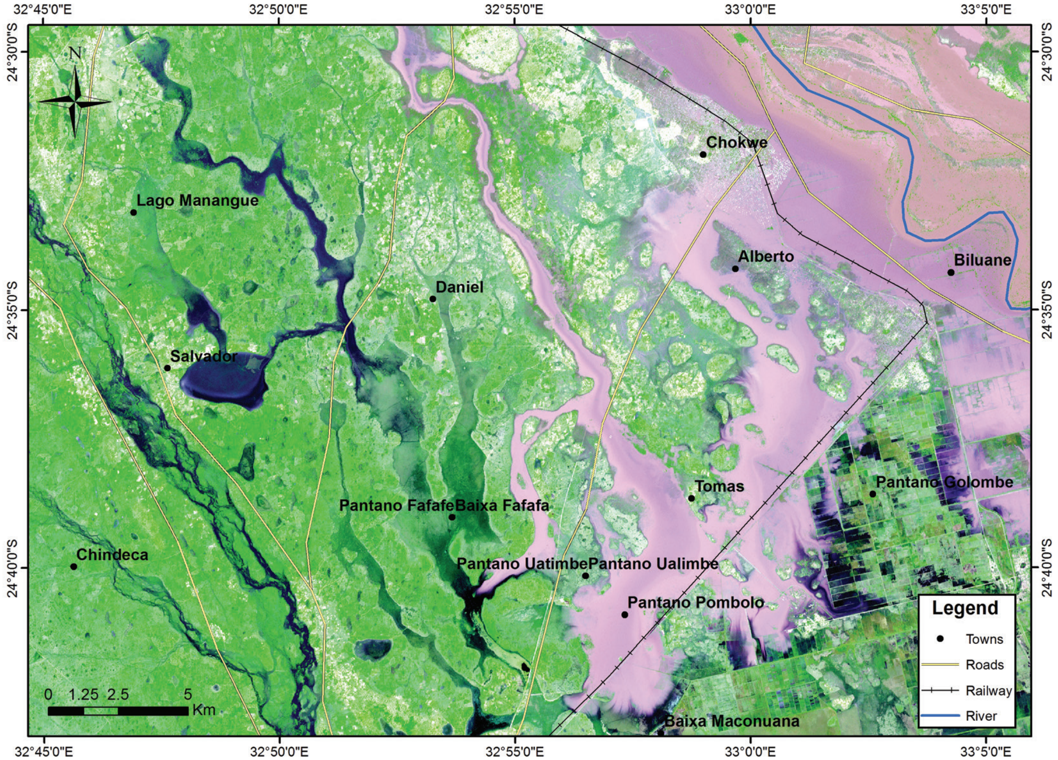


LandSat 8 false colour composite showing snow cover. This colour combination shows snow as white, different from other land cover types.

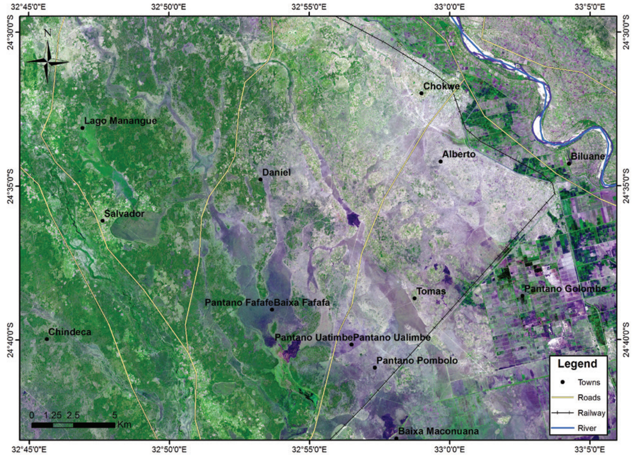
LandSat 8 false colour composite showing a clear distinction between clouds in white, shadows in black and snow in purple.



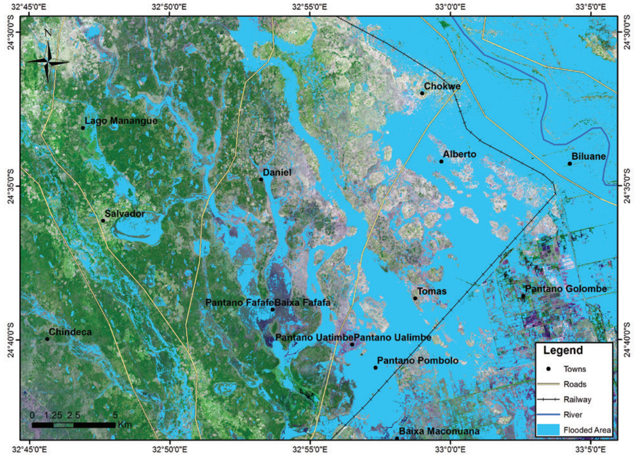
Post-flood analysis



Flooded areas within and around Chokwe, the satellite image shows how the road and railway infrastructure were affected. Such information is critical in identifying alternative routes during rescue and recovery operations.



Chokwe before the floods



Chokwe during the floods

Natural disasters are catastrophic events which result from natural processes of the earth affecting human livelihood and at times claiming lives. Remote sensing is significant in disaster management to prepare, recover and respond to disasters such as floods. Remote sensing makes it possible to do a post analysis assessment of the area affected after the floods by identifying the affected infrastructure and the extent of the flooded area.

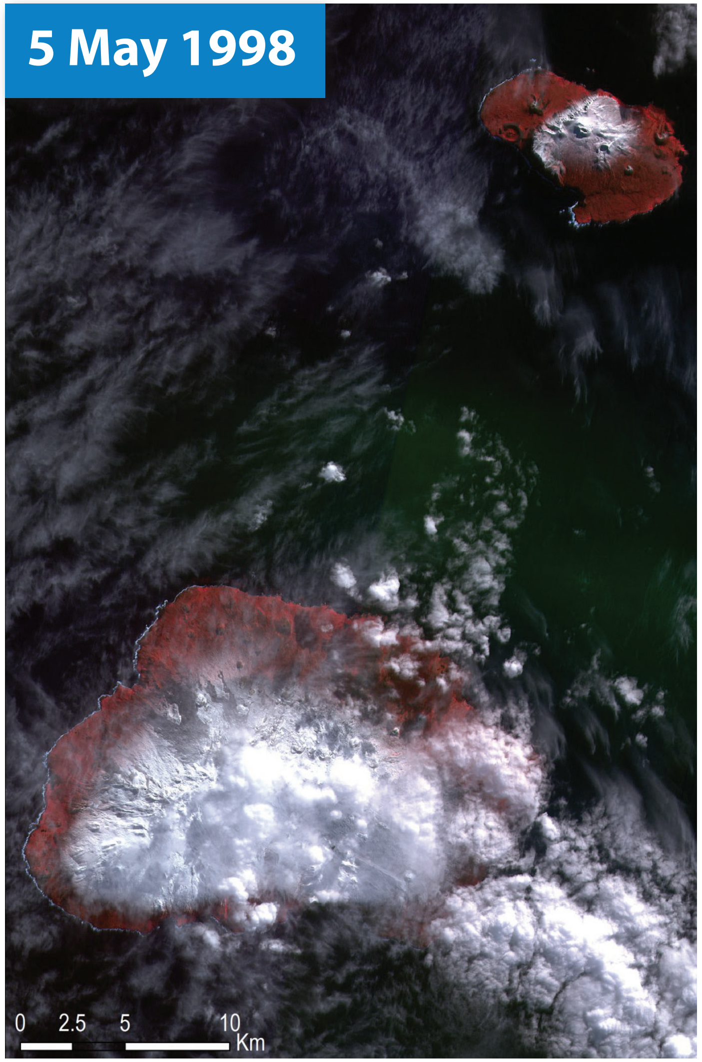
Climate change

An 11-year comparison of Marion and Prince Edward Islands indicate the disappearing ice cap. A SPOT-2 false colour composite satellite image, acquired in May 1998, and an EO-1 ALI image, acquired in May 2009, demonstrate the changes in snow cover within an 11-year period. The disappearance of the ice cap at these islands is astounding – this is visible evidence of the consequences of climate change. Studies conducted at the islands have indicated that between 1948 and 2009, about 42-million cubic meters of ice melted from the mountain top. Furthermore, the ice continues to melt at a rate of between 1 to 1.5m every year.

This is **visible evidence**

of the consequences of

climate change.



Satellite specifications

Sensor	Launch date	Spatial resolution	Spectral bands	Swath
SumbandilaSat	17 September 2009	6,25m	Blue, Xanthophyll, Green, Red, Red-Edge, NIR	40km
ASTER	18 December 1999	VNIR 15m SWIR 30m TIR 90m	VNIR, SWIR, TIR	60km
SPOT 5	3 May 2002	Pan 2,5m MS 10m SWIR 20m	Pan, Green, Red, NIR, SWIR	60km
SPOT 6	9 September 2012	PAN 1,5m VNIR 6,0m	PAN, VNIR	60km
LandSat 8	11 February 2013	SWIR 30m Cirrus 30m TIRS 100m	Pan, VNIR, SWIR, Cirrus, TIR	185km
GeoEye-1	6 September 2008	Pan 0,46m MS 1,5m	Pan, VNIR	15,2km
RapidEye	29 August 2008	5m	VNIR, Red-Edge	77km
Worldview 2	8 October 2009	0,5m	VNIR, Red-Edge, Coastal, Yellow, NIR2	16,4km

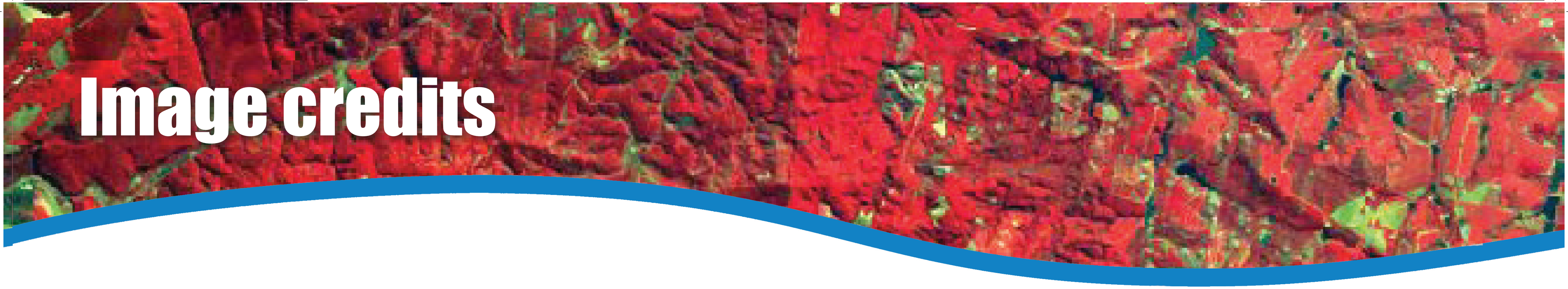


Image credits

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- Global Map, Source: Esri, DigitalGlobe, GeoEye, i-cubed,USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo and GIS user community.

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- Design: Tarina Coetzee

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- Simplified geology of South Africa, courtesy of the Council for Geoscience (CGS), South Africa.
- The Bushveld Igneous Complex, courtesy of NASA/GSFC/METI/JapanSpaceSystems, and US./Japan ASTER Science Team.

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- Vredefort Dome: SPOT 6 ©Airbus Defense and Space 2015. All rights reserved.
- The Great Dyke: ASTER,NASA/GSFC/MITI/ERSDAC/JAROS, and U.S./Japan ASTER Sci-ence Team. 20-meter Digital Elevation Model, Vredefort dome courtesy of SANSA Earth Observation.

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- Aerial photograph of Mogalekwena Mine courtesy of National Geo-spatial Information (CD NGI), South Africa.

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- Aerial photograph of Lephalale Mine courtesy of National Geo-spatial Information (CD NGI), South Africa.

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- Jan Kempdorp in Northern Cape: SumbandilaSat, Copyright © Sunspace. Bothaville: Landsat 8, Copyright © USGS.

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- Bushbuck ridge and Kirkwood: SumbandilaSat, Copyright © Sunspace.

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- Chokwe, Mozambique: ASTER, NASA/GSFC/METI/JapanSpace Systems, and U.S./Japan ASTER Science Team.

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- Prince Edward Islands. SPOT-2, Copyright © CNES 2002, Distribution Airbus DS / Spot Image. All rights reserved.EO-1 ALI: NASA Earth Observatory image created by Jesse Allen, using EO-1 ALI data provided courtesy of the NASA EO-1 team and the United States Geo-logical Survey.

Visit the SANSA online catalogue for more satellite images and the SANSA Fundisa Student Portal for interaction with SANSA personnel. http://catalogue.sansa.org.za/ and http://fundisa.sansa.org.za

Abbreviations

SANSA (South African National Space Agency)

Our vision is to position South Africa as an international Hub for Space Solutions for the world of the future. SANSA's mission is to Lead and Inspire the South African Space Community to create a better future.

CNES (Centre national d'études spatiales) (English: National Centre for Space Studies)

CNES is the French government agency responsible for shaping and implementing France's space policy in Europe. Its task is to invent the space systems of the future, bring space technologies to maturity and guarantee France's independent access to space.

NASA (National Aeronautics and Space Administration)

The National Aeronautics and Space Administration (NASA) is the United States government agency responsible for the civilian space programme as well as aeronautics and aerospace research.

NSDI (National Spatial Data Infrastructure)

National spatial data infrastructure is a South African data infrastructure implementing a framework of geographic data, metadata, users and tools that are interactively connected to use spatial data in an efficient and flexible way.

NOAA (National Oceanic and Atmospheric Administration)

NOAA uses cutting-edge research and high-tech instrumentation to provide citizens, planners, emergency managers and other decision-makers with reliable information when they need it – from daily weather forecasts, severe storm warnings and climate monitoring to fisheries management, coastal restoration and it supports marine commerce.

USGS (United States Geological Survey)

The USGS is a science organization that provides impartial information on the health of our ecosystems and environment, the natural hazards that threaten us, the natural resources we rely on, the impacts of climate and land-use change, and the core science systems that help us provide timely, relevant, and useable information.

ERS (European Remote Sensing)

ESA's two European Remote Sensing (ERS) satellites, ERS-1 and –2, were launched into the same orbit in 1991 and 1995 respectively. Their payloads included a synthetic aperture imaging radar, radar altimeter and instruments to measure ocean surface temperature and wind fields. ERS-2 added an additional sensor for atmospheric ozone monitoring. The two satellites acquired a combined data set extending more than two decades.

TRL (Technology readiness level)

Technology Readiness Level (TRL) is a method of estimating technology maturity of Critical Technology Elements (CTE) of a program during the acquisition process. They are determined during a Technology Readiness Assessment (TRA) that examines program concepts, technology requirements, and demonstrated technology capabilities. TRL is based on a scale from 1 to 9 with 9 being the most mature technology. The use of TRL enables consistent, uniform, discussions of technical maturity across different types of technology.

TTC (Telemetry, Tracking and Command)

Satellites are a big investment and making sure they stay on target and operate for as long as possible is essential. TTC antenna systems are critical to maintaining and addressing satellite "housekeeping" items to ensure optimal performance. The antennas can do everything from adjust the satellite's orbit, realign the solar panels, perform system back-up, and more.

CSIR (Council for Scientific and Industrial Research)

The CSIR is one of the leading scientific and technology research, development and implementation organisations in Africa. Constituted by an Act of Parliament in 1945 as a science council, the CSIR undertakes directed and multidisciplinary research, technological innovation, as well as industrial and scientific development to improve the quality of life of the country's people. The CSIR is committed to supporting innovation in South Africa to improve national competitiveness in the global economy. Science and technology services and solutions are provided in support of various stakeholders, and opportunities are identified where new technologies can be further developed and exploited in the private and public sectors for commercial and social benefit. The CSIR's shareholder is the South African Parliament, held in proxy by the Minister of Science and Technology.

Glossary

Acquisition
When a satellite in space takes a picture of the Earth.

Astrobleme
An eroded remnant of a large crater made by the impact of a meteorite or comet.

Classification
The computational process of assigning individual pixels in a digital image into different groups.

Change detection
The process of monitoring an event and observing its changes over time.

Digital Elevation Model (DEM)
An image representing the Earth's altitude from sea level.

Dome
A circular feature consisting of symmetrically dipping anticlines.

Earth observation
A process of looking down at the Earth and capturing images of the Earth using an elevated platform such as an aircraft or satellites of various sensors.

Electromagnetic radiation
Energy propagated from the sun or through material media in the form of an advancing interaction between electrical and magnetic fields.

Electromagnetic spectrum
The range of energy in the visible, infrared, ultraviolet, microwave, gamma ray, x-ray and radio, which travels at the speed of light.

False colour composite
An image colour combination not representing a true colour.

Geostationary orbit
The circular path around the Earth equator at a distance of 36 000km following the movement of the Earth.

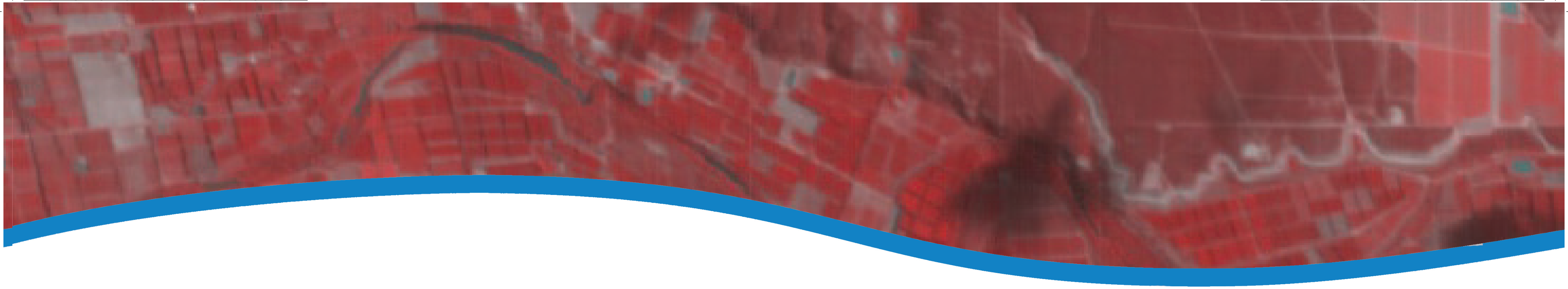
Gravity field
A model used to explain the influence that a massive body extents into space around itself, producing a force on another massive body.

High-resolution camera
See Spatial Resolution.

Launch vehicle
A rocket used to carry a payload from the Earth's surface into outer space.

Low Earth Orbit (LEO) Satellite
A satellite that circumnavigate Earth at a distance of between 160km and 2 000km.

Minitrack station
See Receiving Station.



Multispectral cameras
A section of cameras that captures image data at specific frequencies across the electromagnetic spectrum.

Meteorite
A meteorite is a solid piece made up of fragments, from asteroids or comets, that originates in outer space and survives its impact with the Earth's surface Before impact it is called a meteoroid.

Orbit
The gravitational curved path traced by a satellite as it passes around a planet.

Panchromatic band
A higher-resolution image of a satellite.

Rocket
An aircraft or a vehicle that is used to propel satellites to orbit.

Spatial (geometric) resolution
The distance each image pixel covers on the ground.

Sensor
A scanner and/or camera that records a remote-sensing image.

Spectral band
Satellite image captured at a specific wavelength of the electromagnetic spectrum.

Swath width
The linear ground distance in the across-track direction that is covered by a sensor on a single overpass.

Satellite
The platform that carries imaging sensors in space orbiting the Earth.

Subset
A section cut off from a larger satellite image or a scene.

Temporal resolution
The length of time it takes for a satellite to complete an entire orbit cycle or the period it takes a satellite sensor to capture the same area.

Telecommunications
Communication at a distance by technological means, particularly through electrical signals or electromagnetic waves.

Tracking Telemetry and Command
Provides the monitoring of the health and status of the satellite through the collection, processing and transmission of data from the various satellites.

Transmitting
To send signals or commands to a satellite in space or from space to ground receiving stations.

True Colour Composite
An image colour combination representing a true colour.