
S
A
F Net
AFIS
ADVANCED FIRE
INFORMATION SYSTEM
Southern Africa Fire Network overview - 2017
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10h Southern African Fire Network (SAFNet) Meeting

16th to 20th April 2018

Venue: Kruger National Park

Strengthening the ties with ongoing initiatives on fire research and management within the region:

Science in Action

Collaborative fire information, resource sharing, training and research in support of integrated fire management in Southern African countries

Background GOFC- GOLD and SAFNET

Global Observation of Forest and Land Cover Dynamics (GOFC-GOLD) is a coordinated international effort working to provide ongoing space-based and in-situ observations of forests and other vegetation cover, for the sustainable management of terrestrial resources and to obtain an accurate, reliable, quantitative understanding of the terrestrial carbon budget. GOFC/GOLD is operating under the Global Terrestrial Observing System (GTOS) program, which is sponsored by the Integrated Global Observing Strategy (IGOS). The main goal of GOFC/GOLD is to provide a forum for international information exchange, observation and data coordination, and a framework for establishing the necessary long-term monitoring systems. Potential users of GOFC-GOLD products include global change researchers, international agencies, national governments, non-governmental organizations, and international treaties and conventions (such as the Framework Convention on Climate Change). One of the most important challenges facing GOFC-GOLD is to develop methods and implement systems that provide both research and operational information on a regular sustained basis.

MESA
MONITORING FOR ENVIRONMENT AND SECURITY IN AFRICA
SADCTHEMA

MESA Wildfire Service

MESA
Monitoring for Environment and Security in Africa
SADCTHEMA

Wildfire

Service Description

The Wildfire Service consists of three main components:

- Prediction of fires (Before a fire)
- Detection/Monitoring of fires (During a fire) and
- Assessment of fire damage fire (after a fire)

These components (before, during and after the fire) provide Ministries of Environment with the information to develop effective Fire Information Management plans.

The products generated and distributed by the Wildfire service can be used to:

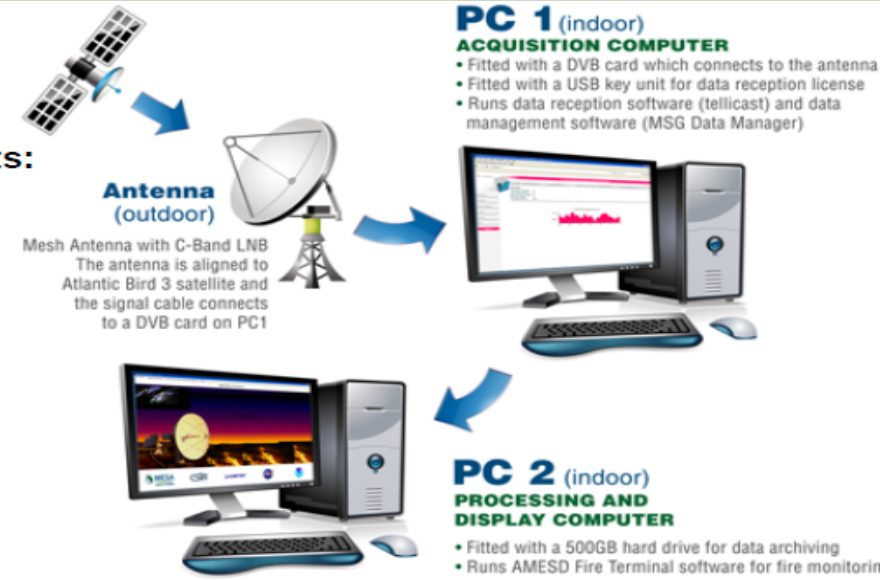
Define the fire season

Assess the likelihood of fire occurring

Determine fire suppression response and resources

Issue or cancel burn permit

Plan and conduct controlled burning, etc



Estimation of live fuel moisture content

- Implementation of Dr Marta Yebra's FMC algorithm
- Currently running om MODIS MCD 43 c6
- Applied on Sentinel 2 and Landsat 8 in 2018 for South Africa
- Field campaign currently underway in the western and southern Cape

1. LIVE FUEL MOISTURE CONTENT

- LFMC estimates are **physically-based** using reflectance data from MODIS satellite and radiative transfer models Look-up Table (LUT) inversion techniques(Fig. 1).
- The algorithm is able to explain 64% of the measured LFMC with an RMSE of 31% evaluated using existing field measurements of LFMC across Australia (Fig. 2) (Yebra et al. 2016).

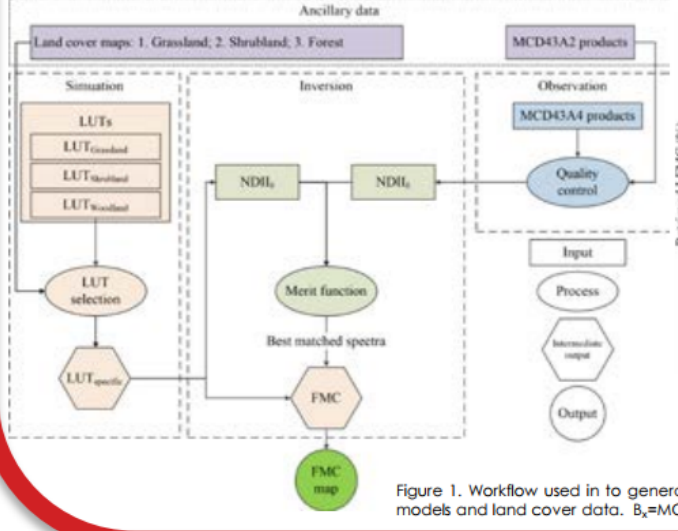


Figure 1. Workflow used in to generate a map of LFMC from MODIS, radiative transfer models and land cover data. B_x=MODIS band number x. $NDII_6$=(B2-B6)/(B2+B6)

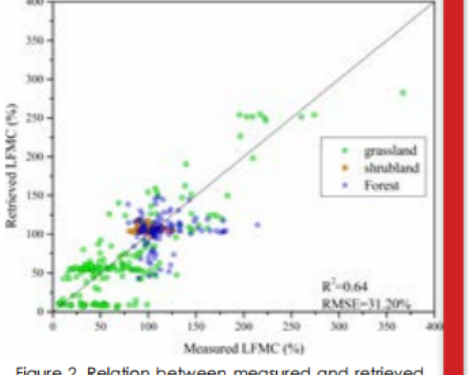
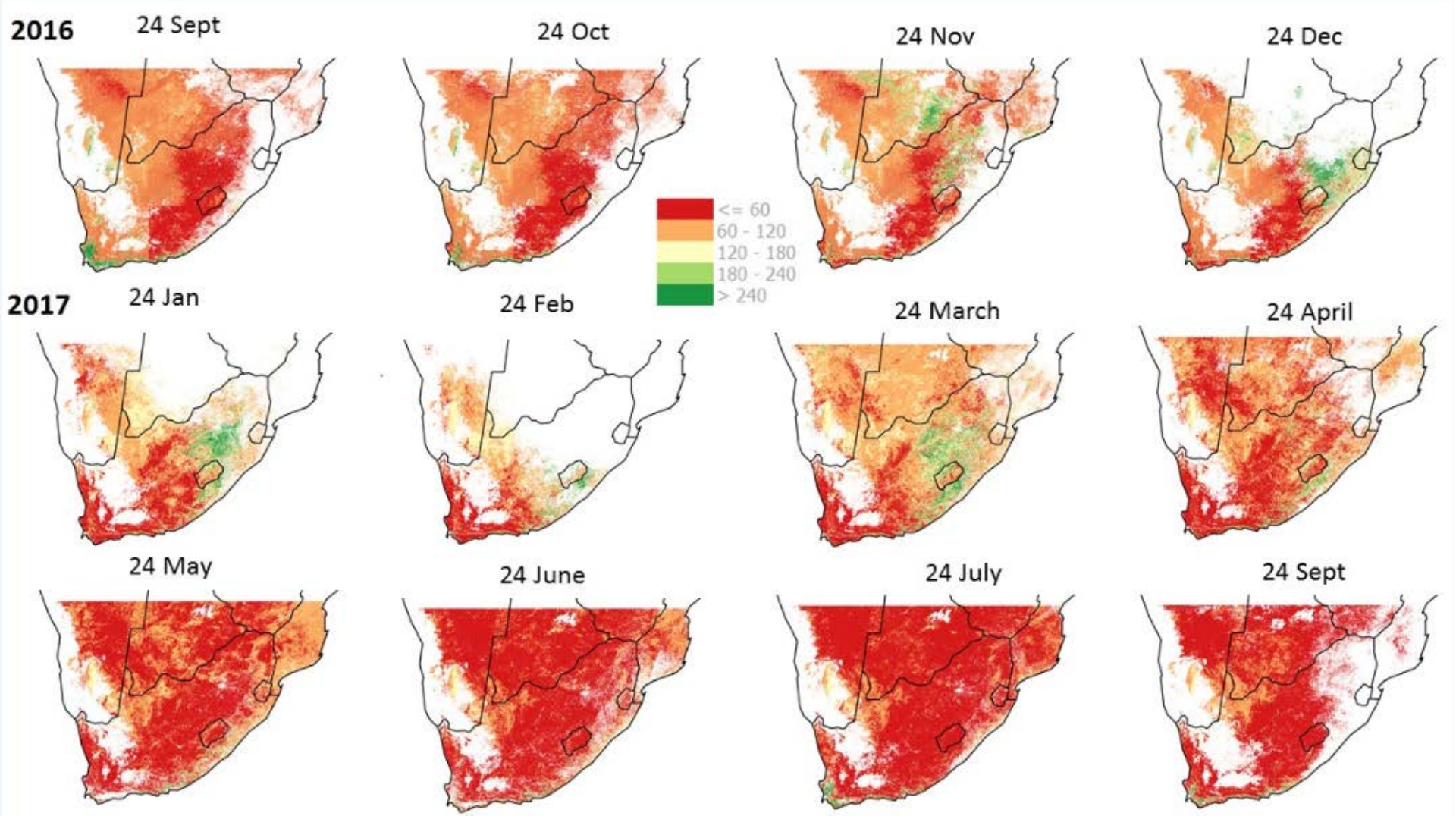
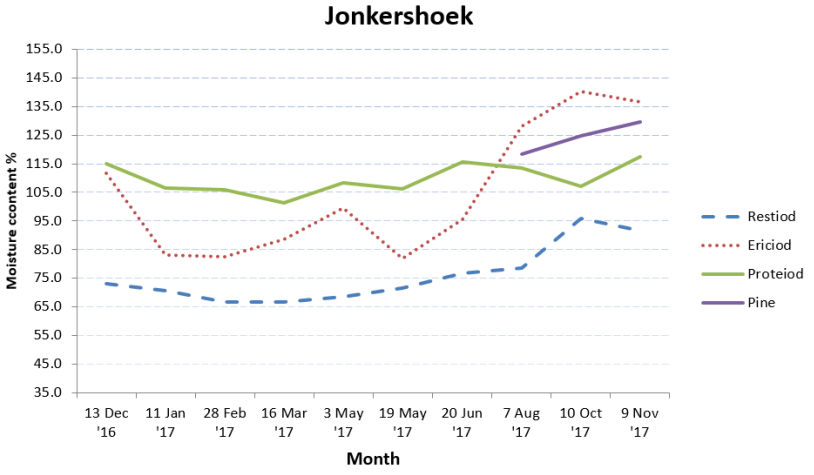


Figure 2. Relation between measured and retrieved LFMC at all validation sites symbolized by fuel class.

FMC: MODIS


2016
24 Sept
24 Oct
24 Nov
24 Dec
<= 60
60 - 120
120 - 180
180 - 240
> 240
2017
24 Jan
24 Feb
24 March
24 April
24 May
24 June
24 July
24 Sept

Field validation: Cape Fynbos



Implementation of an automated burned area mapping system using historical Landsat TM and ETM+ time series data in South Africa

Karen Steenkmap,, Derick Swanepoel, Riaan Stegmann, Konrad Wessels, Linda Kleyn, Lufuno Vhengani, Frans van den Bergh, Prince Sibanda, Philip Frost, Melissa Hankel

CSIR Meraka Institute

and

Lisa Collett, Dan Tindall, Neil Flood, Nicholas Goodwin

Remote Sensing Centre, Queensland Government, Australia

Methodology

Goodwin, N.R., Collett L.J. (2014). Development of an automated method for mapping fire history captured in Landsat TM and ETM + time series across Queensland, Australia, *Remote Sensing of Environment*, 148, 206-221.

- Local implementation of Remote Sensing Centre (RSC) code for automated burned area mapping,
- Testing and validation in fire prone biomes in South Africa,
- Development of ‘days since last burn / veld age’ product for SA National Fire Danger Rating System.

Automated Burned area mapping by the Remote Sensing Centre, Queensland Government, Australia

System

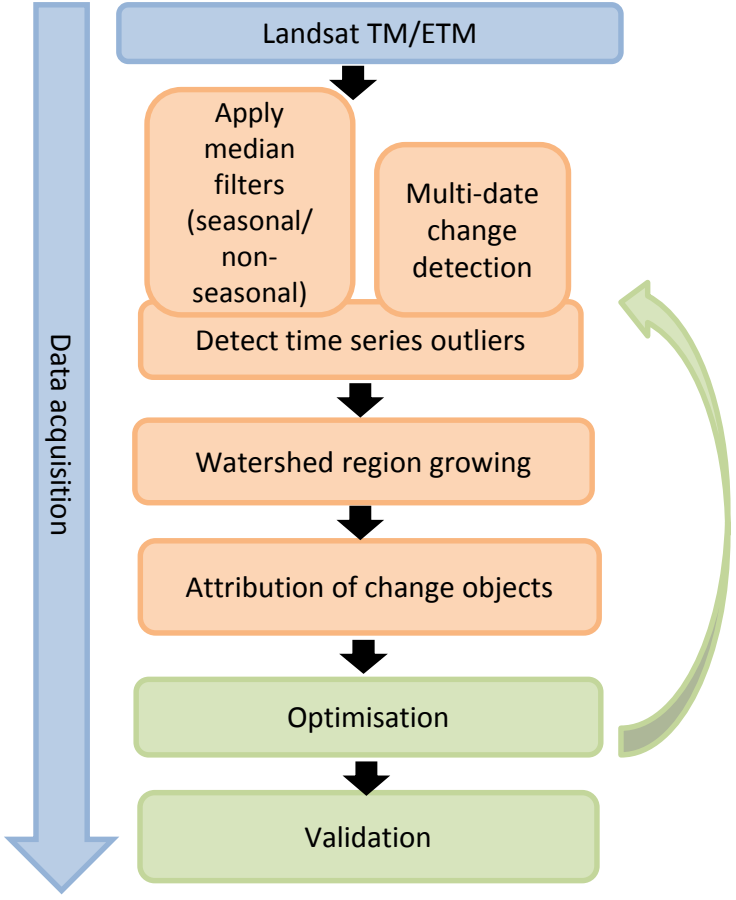
- Automated burned area mapping system utilizing temporal, spectral and contextual information in hierarchical framework
  - processes entire time series of Landsat 30m resolution data acquired since the mid 1980's
  - Accommodates TM/ETM sensors on board Landsat 4,5,7,8 platforms
- System produces atmospherically, BRDF and terrain corrected surface reflectance data
- Cloud + cloud shadow, topographic shadow - masking

Implemented

- Repeatable burned area maps for entire archive of Landsat for Queensland , Australia (> 60 000 images)
- Over 80% of burned area were detected with less than 30% commission error in savanna dominated area

Remote Sensing Centre's system

- System specifically developed for savannas
- Time series of Landsat TM band 4 (B4) and sum of reflectance band 4 + band 5 (B45)
- 3 key processing stages
  - Detection of time series outliers
  - Region growing of change clusters
  - Attribution of change objects



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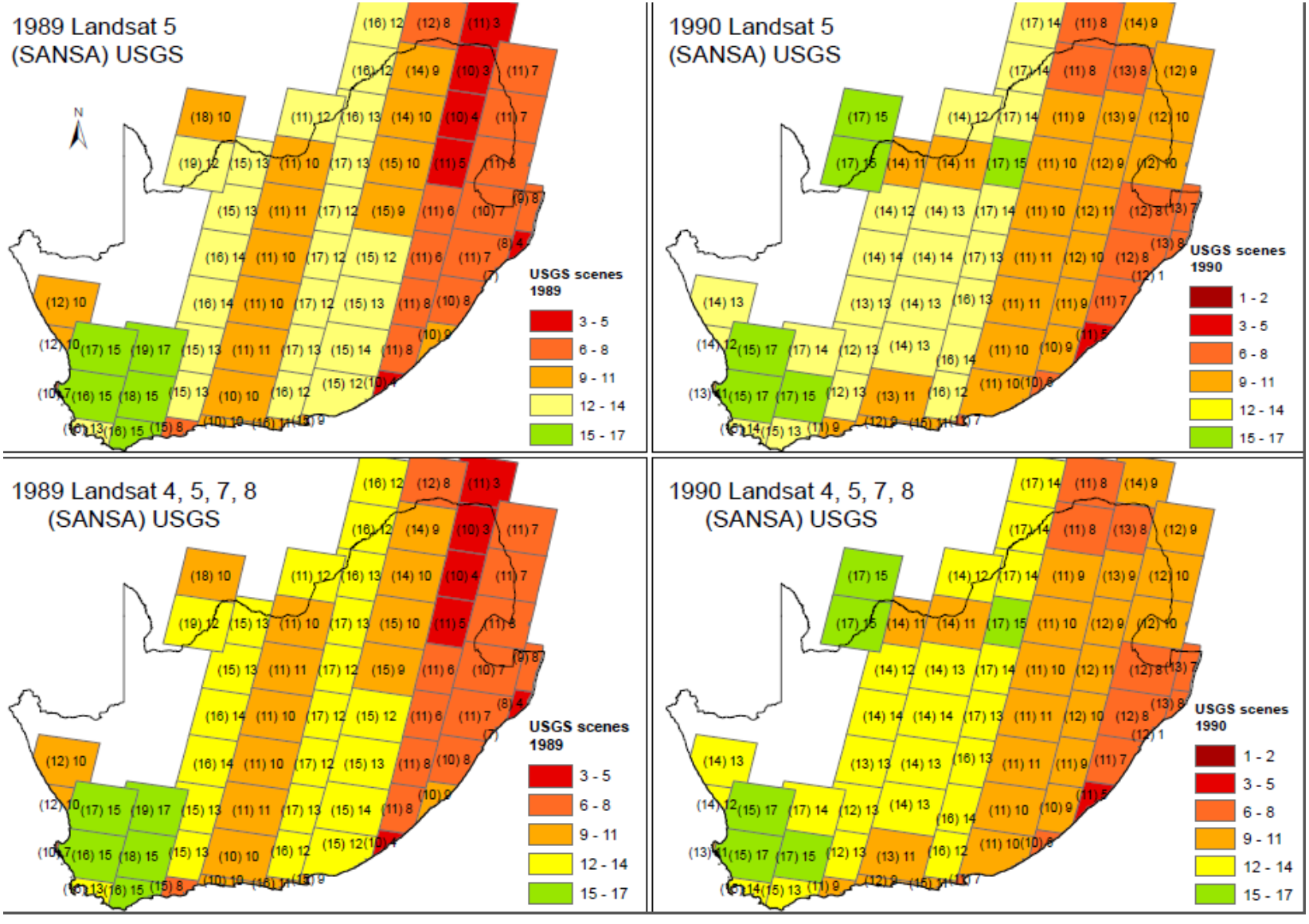
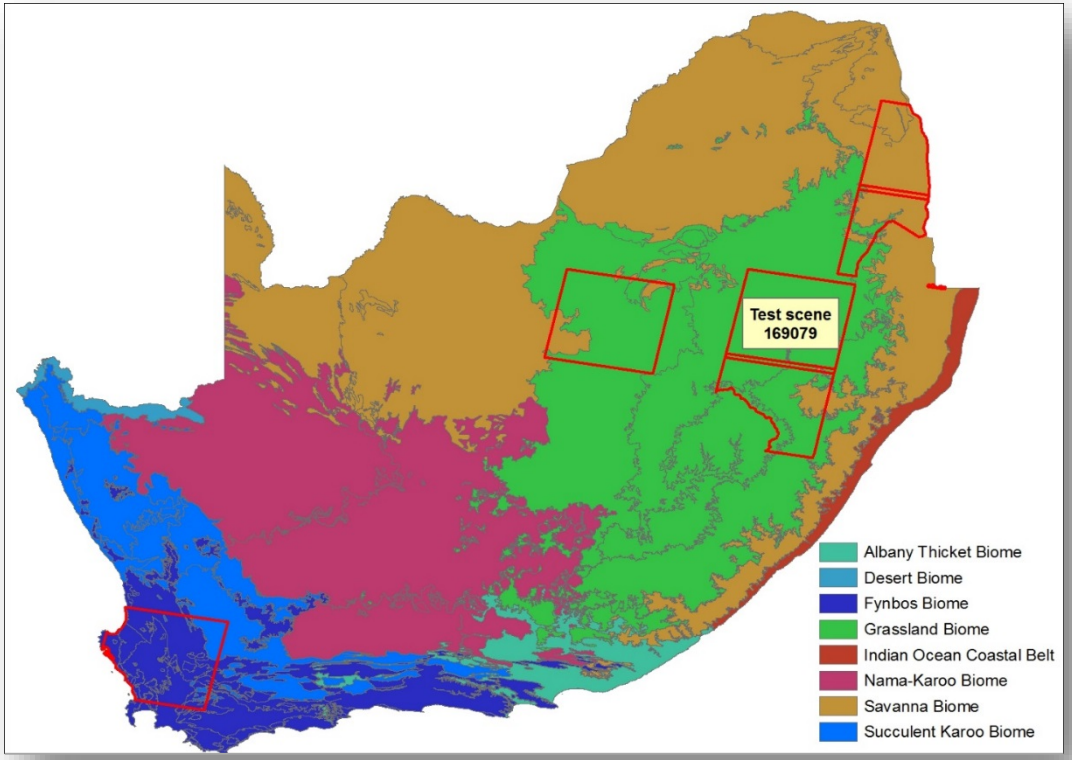

1989 Landsat 5
(SANSA) USGS
N
USGS scenes
1989
3 - 5
6 - 8
9 - 11
12 - 14
15 - 17
1990 Landsat 5
(SANSA) USGS
USGS scenes
1990
1 - 2
3 - 5
6 - 8
9 - 11
12 - 14
15 - 17
1989 Landsat 4, 5, 7, 8
(SANSA) USGS
USGS scenes
1989
3 - 5
6 - 8
9 - 11
12 - 14
15 - 17
1990 Landsat 4, 5, 7, 8
(SANSA) USGS
USGS scenes
1990
1 - 2
3 - 5
6 - 8
9 - 11
12 - 14
15 - 17

Implementation of automated system in South Africa

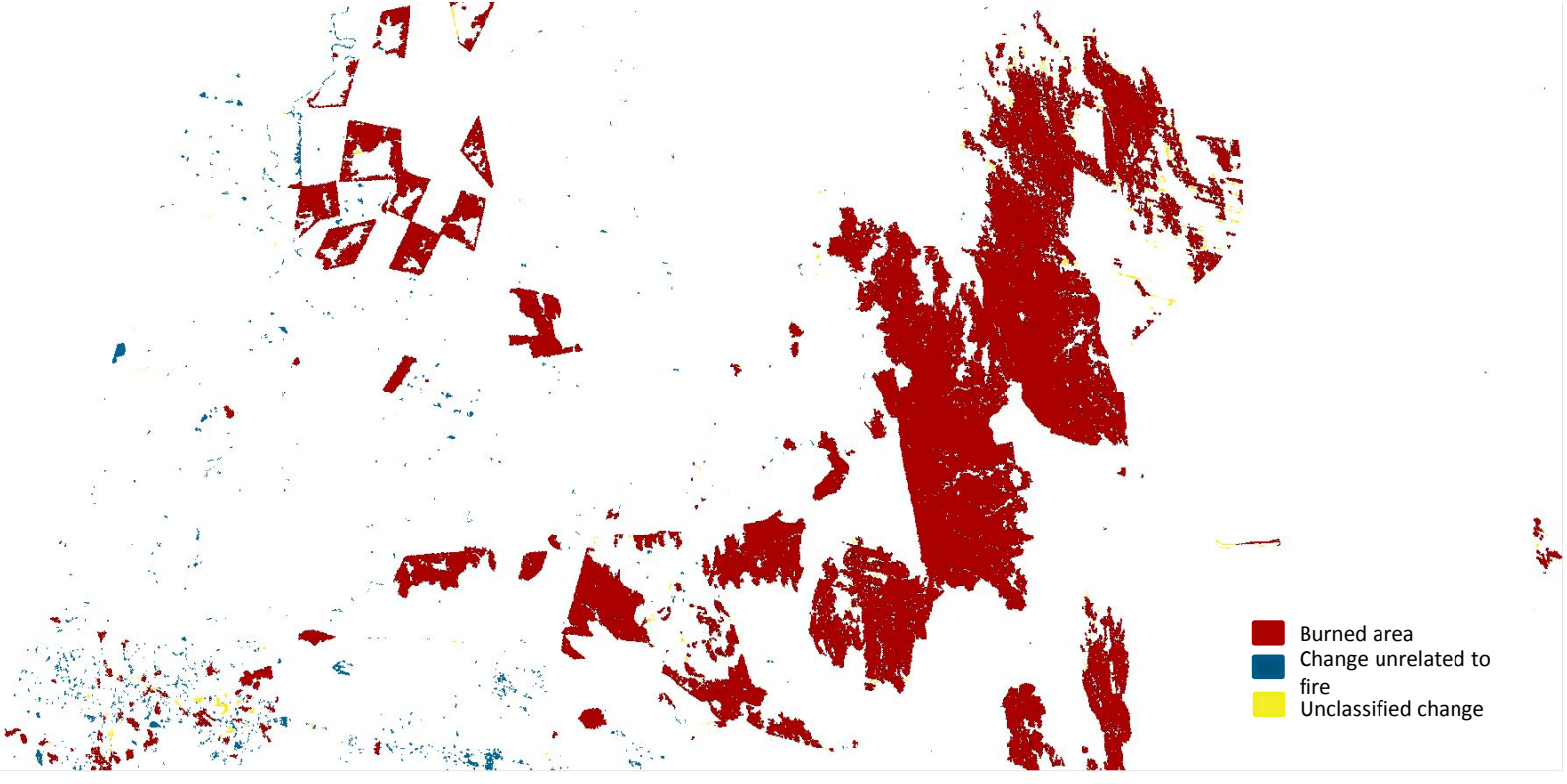
- 6 Path/ Row selections based on high fire risk area, biomes, available ground truth data and high income land use



Burned area mapped: Savanna

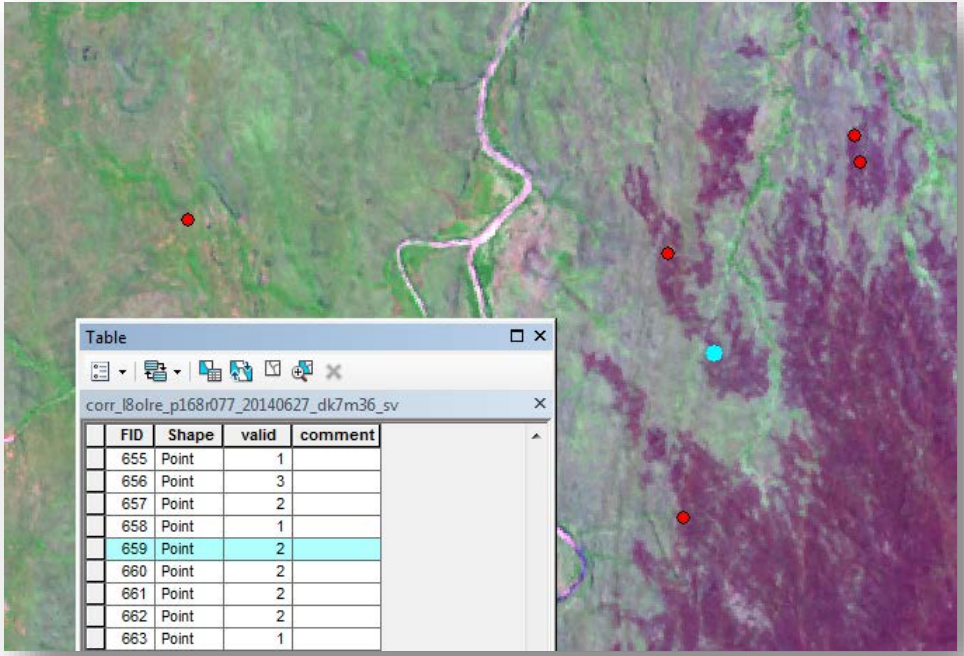
Landsat 8

27 June 2014



Validation

- Validation on 10 randomly selected images per Path/Row,
- 1000 stratified random samples per scene, 500 within burned area and 500 in unburned,
- 3 operators identifying burned vs unburned points



FID	Shape	valid	comment
655	Point	1	
656	Point	3	
657	Point	2	
658	Point	1	
659	Point	2	
660	Point	2	
661	Point	2	
662	Point	2	
663	Point	1	

Validation: Savanna

- User's accuracy for Savanna and Grassland more than 80% with less than 18% commission error

Biome	Path/Row	Commission (%)	Omission (%)	User's accuracy (%)
Savanna	168077	12.9	3.7	87.1
Grassland 1	169079	17.8	3.9	82.2
Grassland 2	169080	17.0	11.9	83.0
Fynbos	175083	42.1	2.0	57.9

- User’s accuracy for Fynbos is low at 58% and commission error high at 42%

Biome	Path/Row	Commission (%)	Omission (%)	User's accuracy (%)
Savanna	168077	12.9	3.7	87.1
Grassland 1	169079	17.8	3.9	82.2
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AFIS
FireFlies
Nanosatellite constellation

Cape Peninsula University of Technology

CSIR
our future through sciences

CLYDE SPACE

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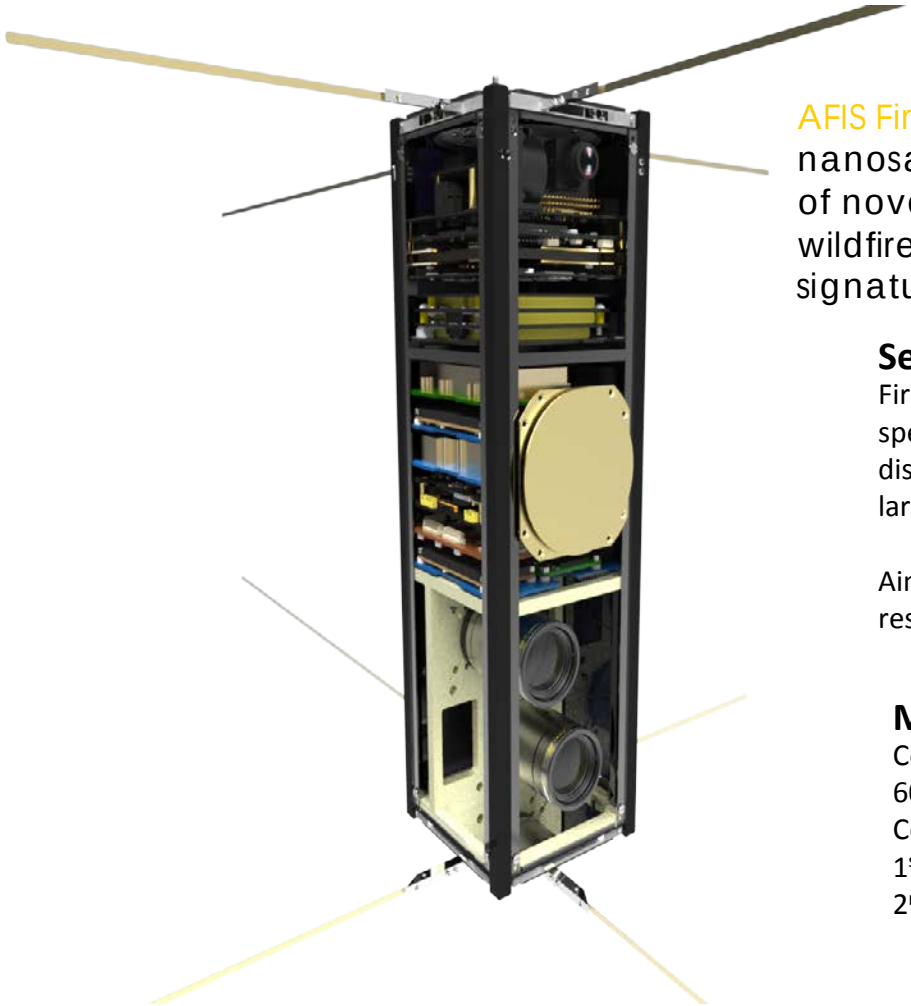
FireFlies Constellation



AFIS FireFly NanoSat is a custom designed nanosatellite optimised sensor making use of novel sensing technology to detect wildfires through potassium emission signatures (K-line)

Sensor Concept

FireSat sensor, operating at two very narrow spectral bands, designed to detect and discriminate emissions which originate from large vegetation fires

Aim: 60km Swath, with 60-90m ground resolution for fire detection

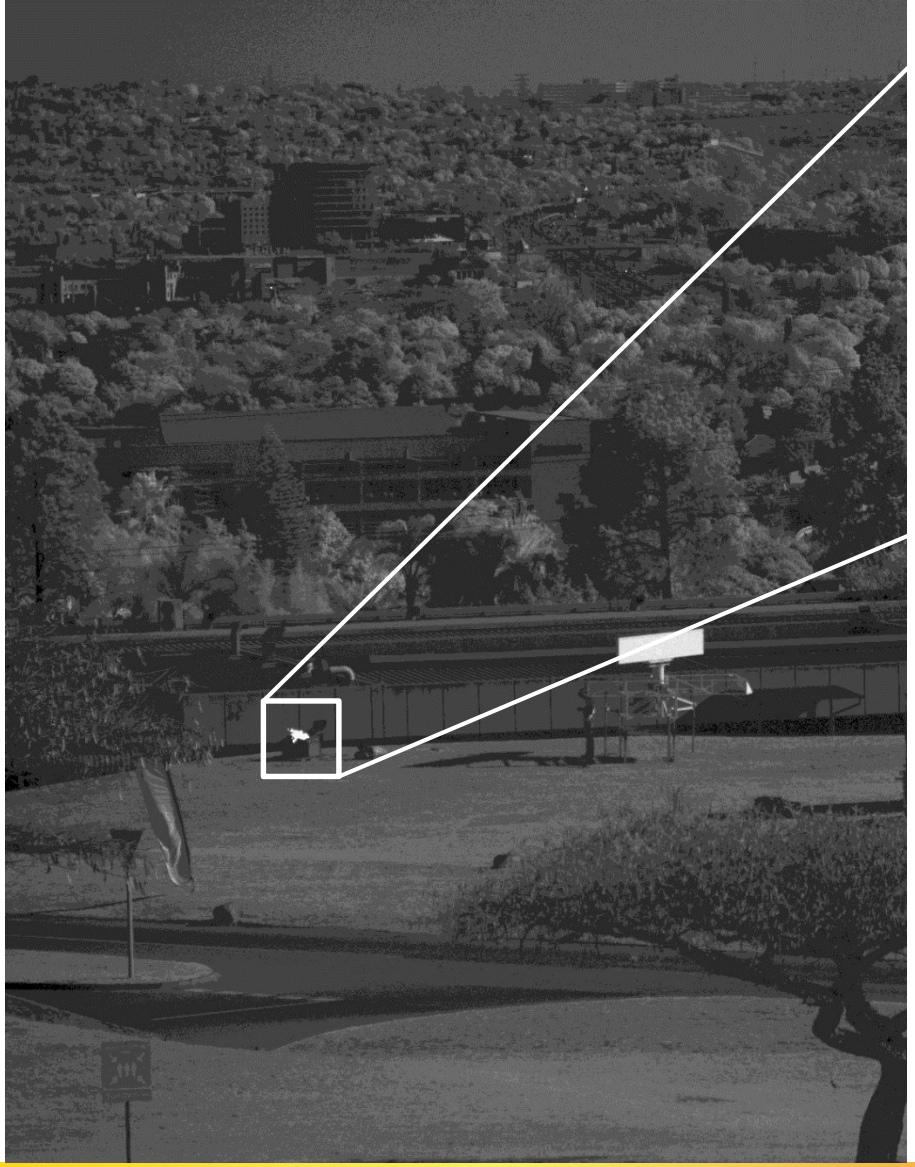
Mission Concept

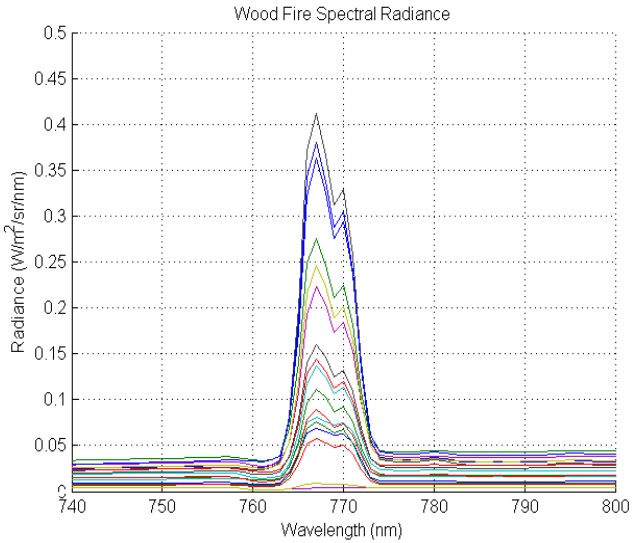
Constellation of nanosatellites flying at 500 – 600km

Concept mission in space April 2018

1st FireFly in Space March 2019

2nd and 3rd FireFly in Space March 2020





Sensor Concept

Investigation of the feasibility and optimisation of a vegetation fire sensor operating in the near-infrared that discriminates flame on the basis of spectral emissions from vegetation for implementation as a satellite payload on a cube satellite in low earth orbit

Imager Payload

- Ground sampling distance of 63.6 m from altitude of 600 km
- Satellite ground track velocity of 6.908 km/s
- Orbit period of 96.7 minutes
- Captures ±75 Mbyte of uncompressed images per pass over South Africa
- Data downlink takes ±2 minutes with highspeed S-band radio system (CPUT)
- Payload consumes less than 2 W average power
- Embedded Linux operating system

K-Line detection

Range : ~8 km
Exposure Time : 20 ms
Gain : 0
Total Period : 2 hours
Speedup : 60x

Meet our Team

Business and Technical skills that drive the AFIS development

CAM EO

Lee Annamalai
Competence Area Manager
Earth Observation Systems and ICT

14 years of experience in technology & business management. Internationally recognised in the Space and Geospatial domain.

Head of AFIS

Philip Frost
Product Manager
Innovation and R & D

14 years of involvement in Fire information system. Internationally recognised Deeply embedded in the fire management and response domain

Senior Developer

Cheewai Lai
Sys Admin
Satellite Product Production
Front End and User Admin
System Security

18 years of experience in hosted ICT System Administration and Geo-spatial and Satellite Product production systems

System Analysist

Linda Klein
System and Requirements analysis
Remote Sensing,
Innovation and R & D

20 years of experience in Remote Sensing, Geo-spatial and Satellite Product production systems

Meet our Team

Passionate team of Developers and R&D Remote Sensing Scientists

UI Developer

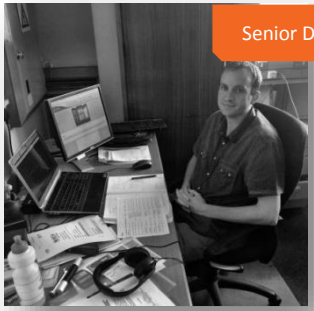
Werner Raath

Frontend and Android app developer
User Support

Report Engine Developer

Ndumiso Booi

Report and Stats Engine developer
User Pilot Projects



Senior Developer

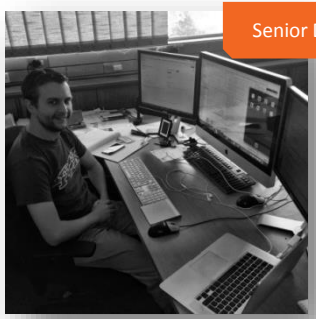
Riaan vd Dool

AFIS Backend Db and Web Front End
User Support

R&D Analytics Developer

Melissa Henkel

Remote Sensing modelling, Algorithm development



Senior Developer

Derrick Swanepoel

High performance Back End software, cube server. iOS app

R&D Analytics Developer

Lufuno Vhengani

Remote Sensing modelling, Burn area algorithm development

Contact details

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