



## Celebrating 25 years of International Collaboration and Capacity Building

**nSight-1: a Reliable nano-satellite platform for  
Remote Sensing Capacity Building**



**Sias Mostert**  
**[sias@scs-space.com](mailto:sias@scs-space.com)**

# 25 years of International Collaboration

Satellite heritage

SCS Aerospace Group today

International Collaboration

Sunsat

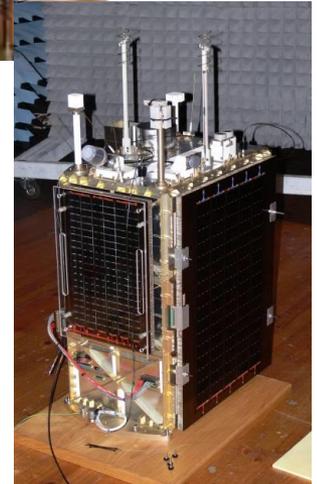
SumbandilSAT

Micro Satellite Multi-sensor Imager

African Resource Management Constellation

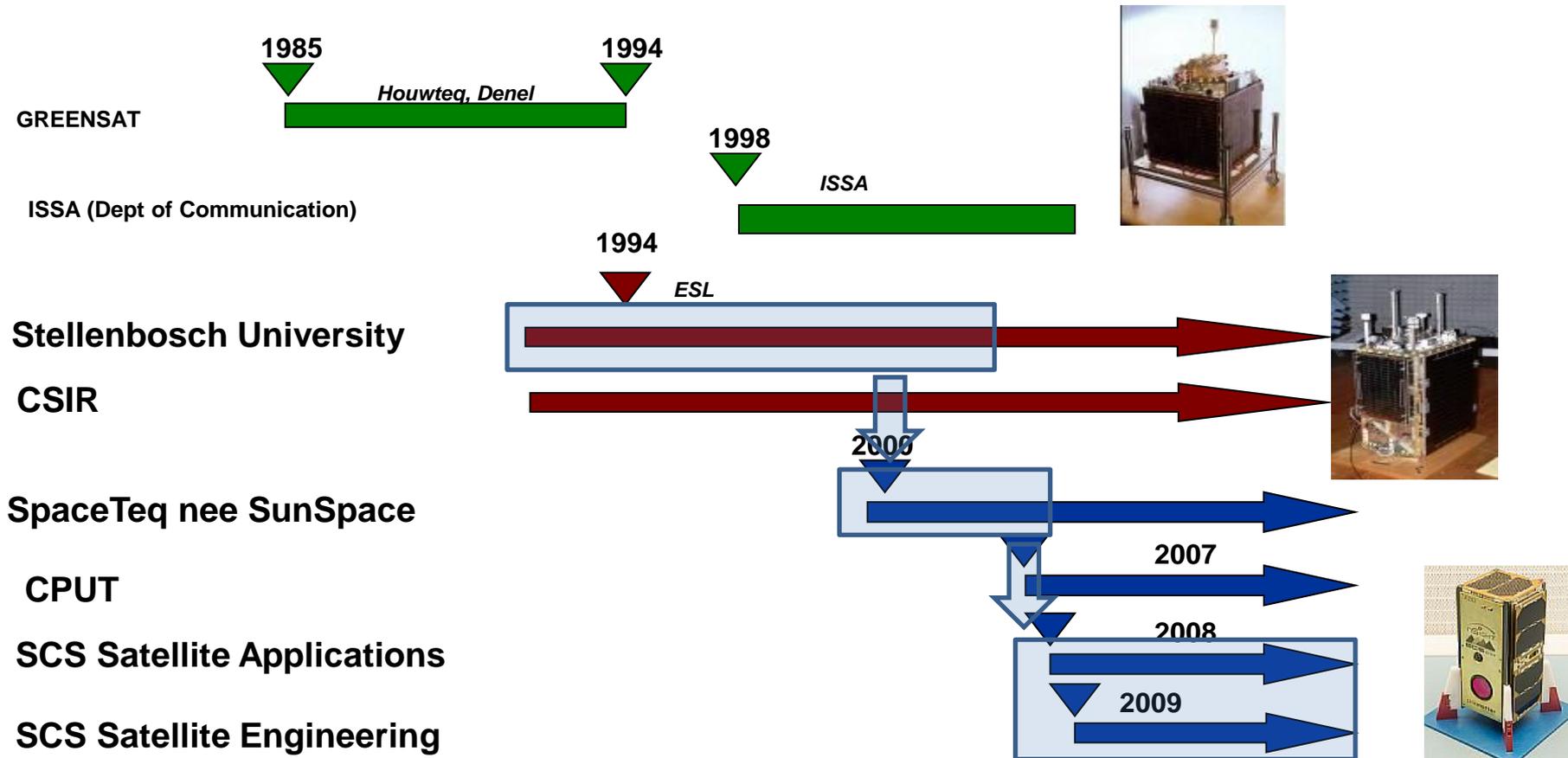
nSight 1

nSight 2 and nSight 3



# SCS Aerospace Group

## 25 Years of Small Satellite Heritage



**Space Commercial Services Holdings (Pty) Ltd**  
 Chairman and Executive Director [Sias Mostert]  
 Group MD [ Francois Denner]

**SPACE**  
 advisory company

**Space Advisory Company (Pty) Ltd**  
 CEO [Duncan Stanton]

- Specialist Consulting and Design
- Systems Engineering
- Program Management
- Digital AGCS, Mechanical, Power

**RESEARCH&DEV**

- SMART User/Buyer support
- Satellite Mission & Constellation
- Independent Program Review
- Training

**SCS Space (Pty) Ltd**  
 CEO [Hendrik Burger]

- Turnkey Micro and Small LEO Satellites
- Small Geostationary Satellites

**INDUSTRIALISE**

- Responds to South Africa Needs

**NEWSPACE**  
 SYSTEMS

**NewSpace Systems (Pty) Ltd**  
 CEO [James Barrington-Brown]

- Lean Manufacturing
- Satellite Component Production

**PRODUCTION**

# Integration & Test Facilities

- Houwteq continues to provide excellent facilities for designing and testing small satellites
- These facilities include:
  - Metrology Facility
  - Integration Facility
    - Thermal Vacuum Facility
    - Optical Integration Facility
    - Optical Calibration Facility
  - Vibration/Acoustic Noise Test Facility
- The anechoic room part of the EMC (Electromagnetic Compatibility) Facility

**Integration Cleanroom Specifications:**

Location: Houwteq, 50 km from SAC

Size:  $\pm 2$  200 m<sup>2</sup>

Length: 50.4 m  
Width: 13.7 m  
Height: 13.3 m

Crane Capacity: 5 ton (10 m hook height)

Cleanroom Std: FED STD 209D Class 100 000



**Optical Instruments Specifications:**

Location: Houwteq, 50 km from SAC

Collimator:

- Scanning and stationary target sources
- MTF test bench
- Vacuum adaptation possible

Interferometry test instrumentation

Optical integration and alignment instrumentation

Other calibration equipment:

- Integration sphere
- Monochromator
- Photo-spectrometer



**Shaker Specifications:**

Location: Houwteq, 50 km from SAC

Static Load: 1 363 kg

Force: Random 160 kN  
Shock 320 kN

Frequency: 5 Hz to 2 kHz

Slip Table: 1.5 m x 1.5 m  
Head Expander Diameter: 1.5 m

Crane Capacity: 10 ton (10 m hook height)

Standards: Mil Std 810D  
Clean Room Class 100 000



**TVC Specifications:**

Location: Houwteq, 50 km from SAC

Working Dimensions:

- Large Chamber: 3.4 m (diam.) x 3.8 m (length)
- Medium Chamber: 0.7 m (diam.) x 0.9 m (length), with separately controlled thermal plate (-70 °C to 70 °C)

Temperature (for both A & B):

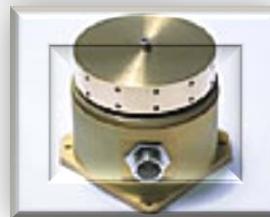
- Controlled: -145 °C to +120 °C
- Uncontrolled: -190 °C
- Rate (up & down): 1.5 °C/min

Vacuum: 10<sup>-6</sup> mbar @ 120 °C

Standards: Clean Room Class 100 000  
ESA PSS-02-301



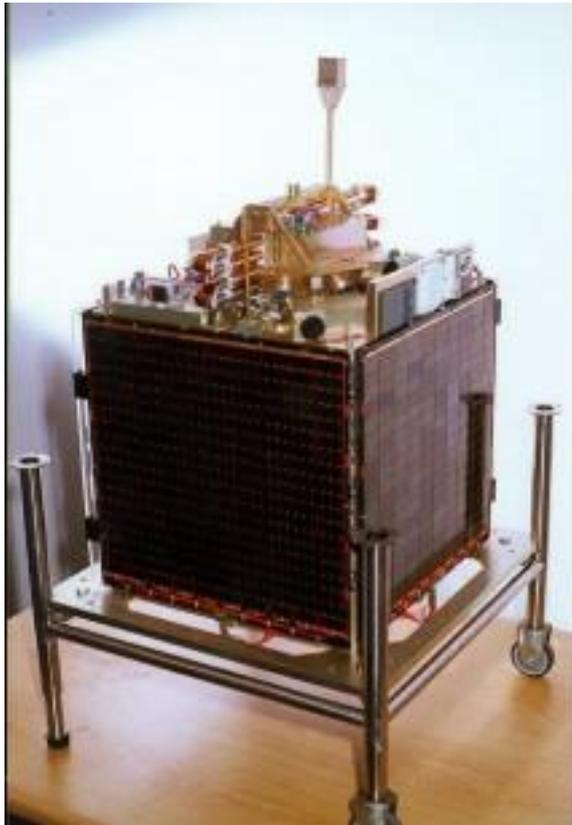
# South African Heritage



# SUNSat Programme

## Pioneering Micro-Satellite Performance

SUNSAT



- 12 m multi-spectral GSD from 600 km
- 64 kg satellite
- Developed in South Africa
- Joint mission with NASA
- Launch 1999

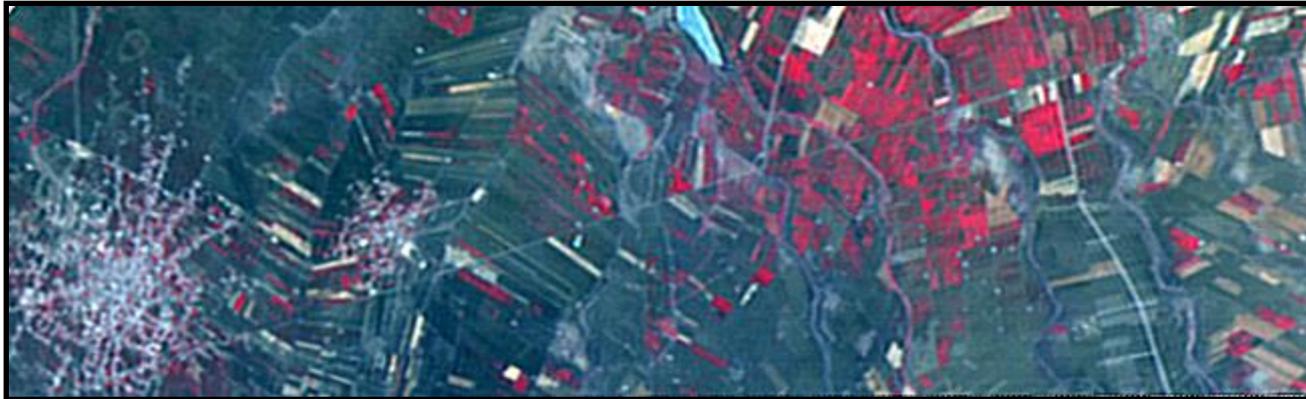
# SUNSAT Imager specifications

Sensor: TC104	3456 pixels
Lens focal length	570 mm
Aperture	10 cm
Ground pixel resolution	15 m
Swath width	51.7 km
Spectral bands	Green: 520-620 nm Red: 620-690 nm NIR: 730-900 nm
Overall MTF	> 20%
Power consumption	5 W
Mass	4 kg





# Sunsat Micro satellite 15m resolution 3 Band Colour image



**Lat: 33.195**  
**Long: 36.6**  
**Date:**  
**01/07/1999**  
**Time:**  
**09:46:56 UTC**

**Syrian  
Agricultural  
Area**

# Sunsat

## Incoming

NASA joint mission

Delta 2 launch

Visiting students from Europe

Batteries from deep storage

## Outgoing

Imager for Kitsat 3

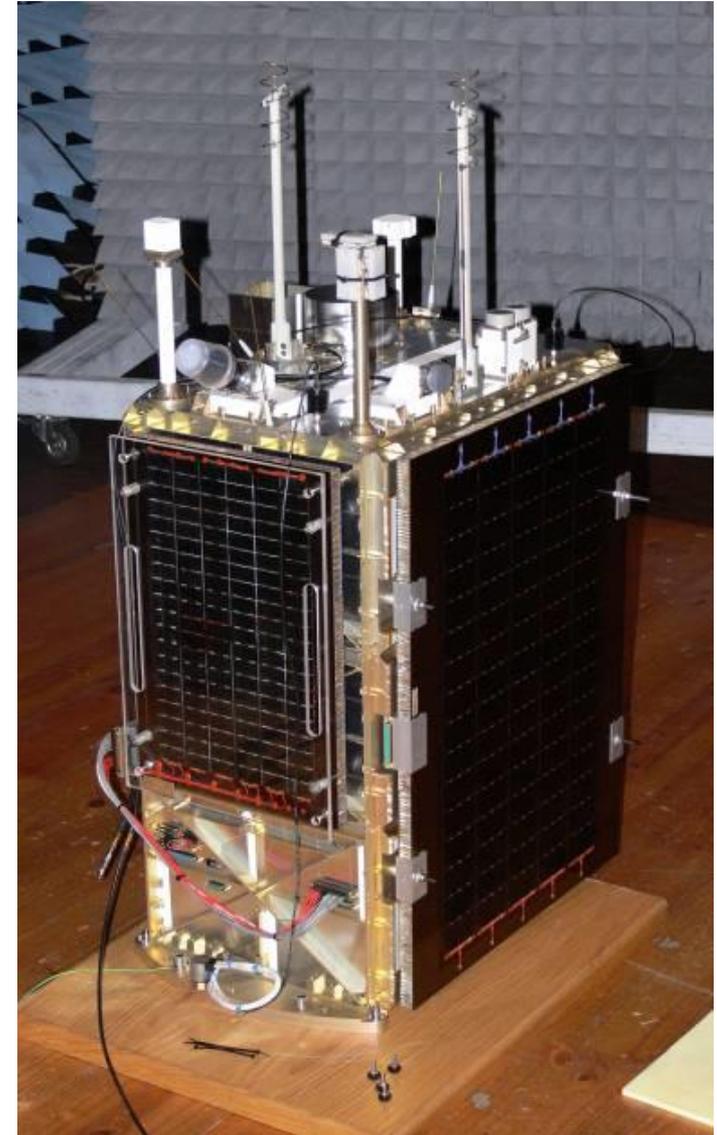
Starimager for Fedsat

Deployable Boom for Fedsat

Strong amateur radio network

# SumbandilaSat

- Achievements
  - **Dedicated launch.....**
  - **One year contract**
  - **New generation bus scalable to 400kg**
  - **Total mission cost < \$9M**



# Affordable Dedicated Launches



Pioneering..... dedicated launch on Shtil 2.1

- 80 kg to 135 kg in 500km orbit
- More than 50 successful launches
- Based on submarine ICBM
- Launched from submarine

# SumbandilaSat

## Incoming

Russian submarine launch nee

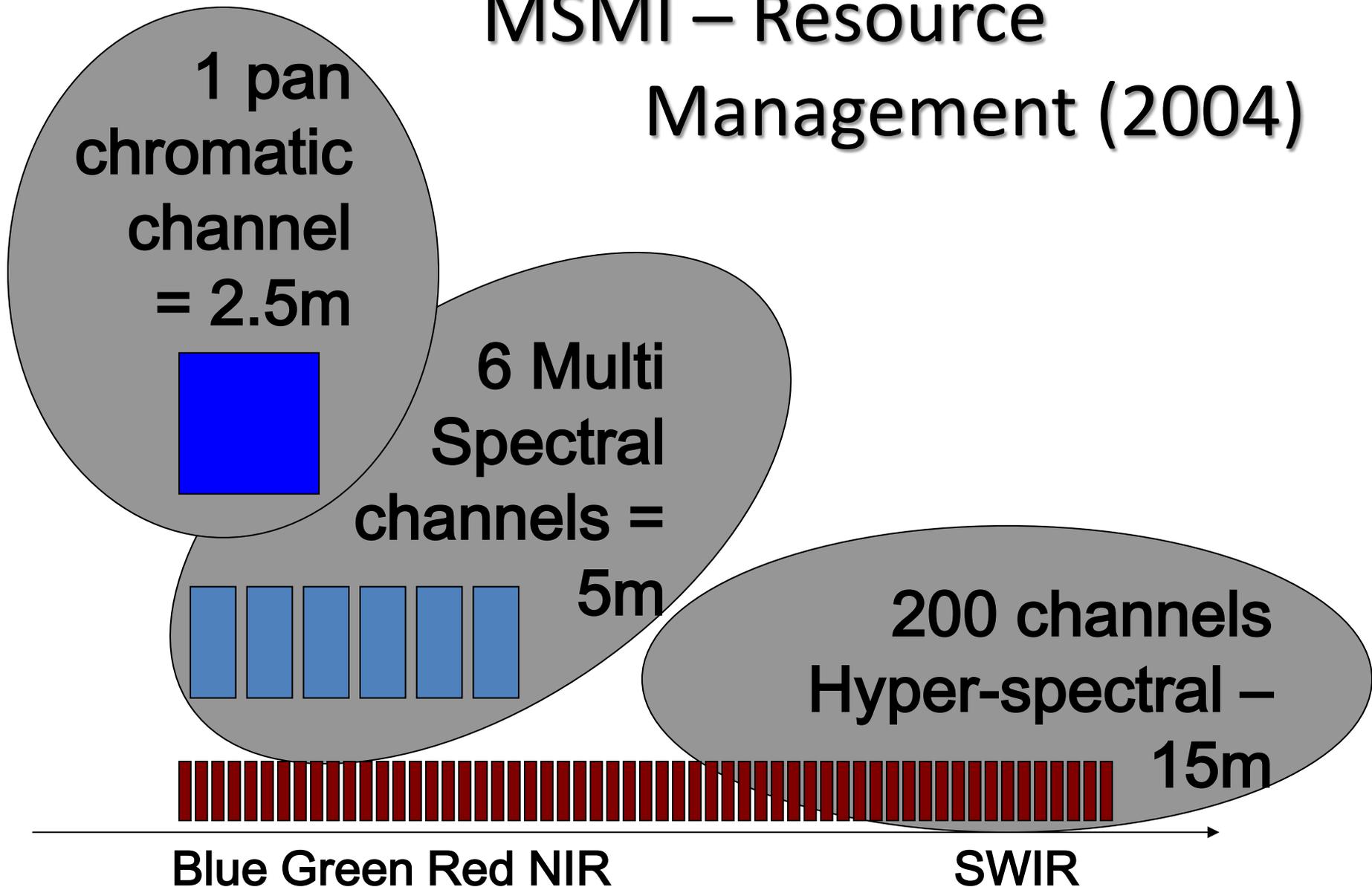
Soyuz launch

Visiting students from Europe

## Outgoing

SA part of CEOS

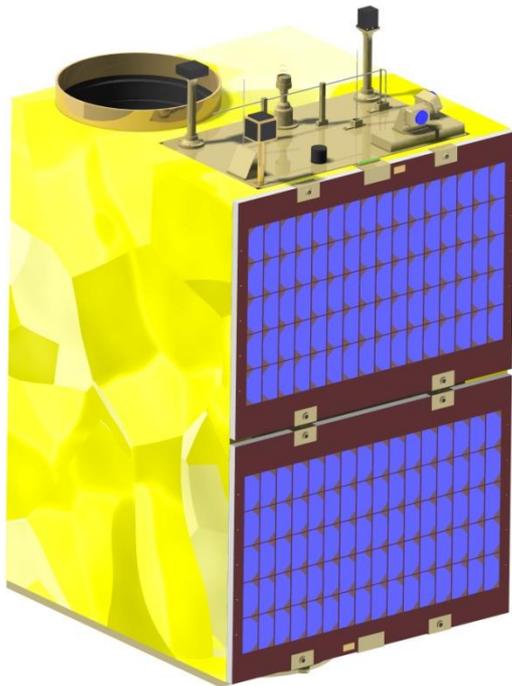
# MSMI – Resource Management (2004)



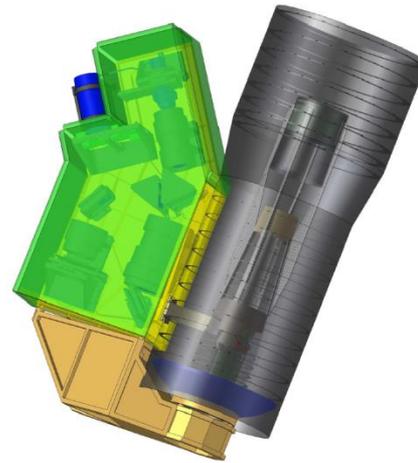
# Deploying MSMI Space Segment

## Technology Heritage

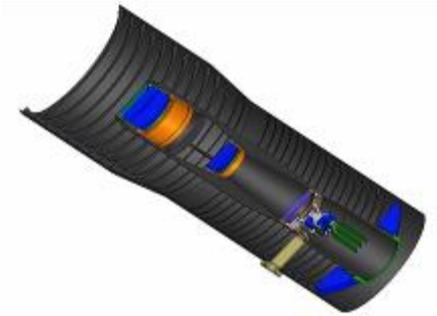
ESA Apex airborne HS



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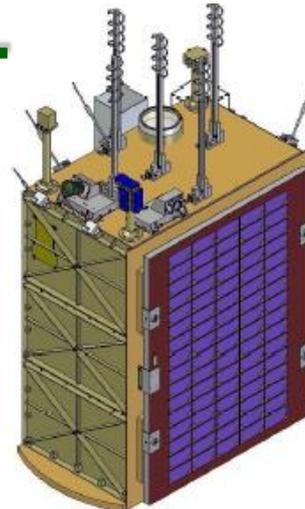


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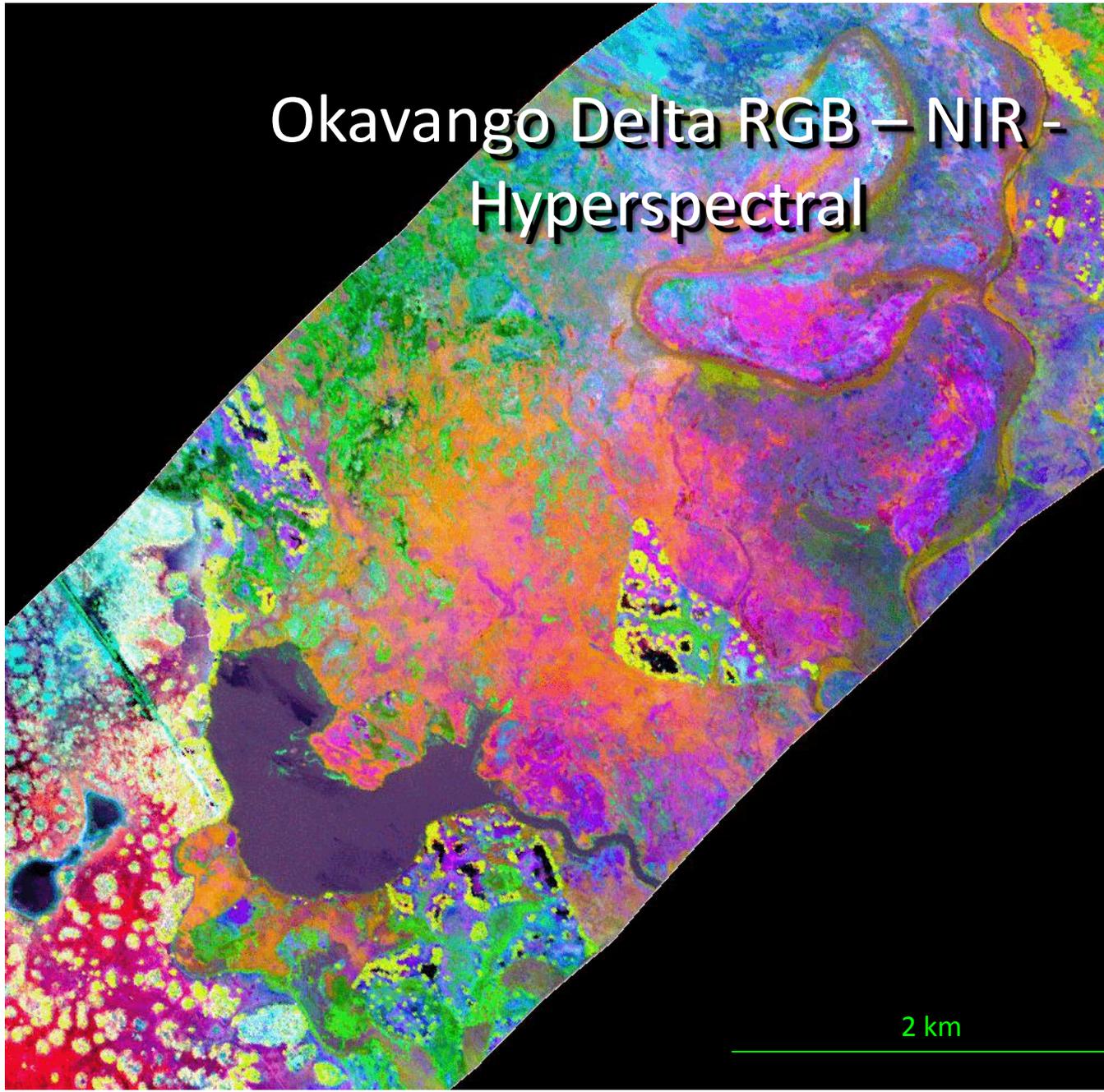
**MSMI Telescope**

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**Sumbandila Satellite**

# Okavango Delta RGB – NIR – Hyperspectral



Natural  
Colour IR

2 km

# Micro Satellite Multisensor Imager

## Incoming

Belgium principle investigator

Hyperspectral focal plane

Joint technology development

Visiting students from Europe

## Outgoing

Basis for export contracts

# ARMC - An African Space Programme

## South Africa, Nigeria, Kenya, Algeria

1. NEPAD: development, transfer and application of regional indigenous knowledge
2. Apply the full potential of existing space technology capacity in Africa
3. Monitor and manage African resources
4. Contribute to the body of International Knowledge Africa



# African Resource Management Constellation (ARMC)

## Incoming

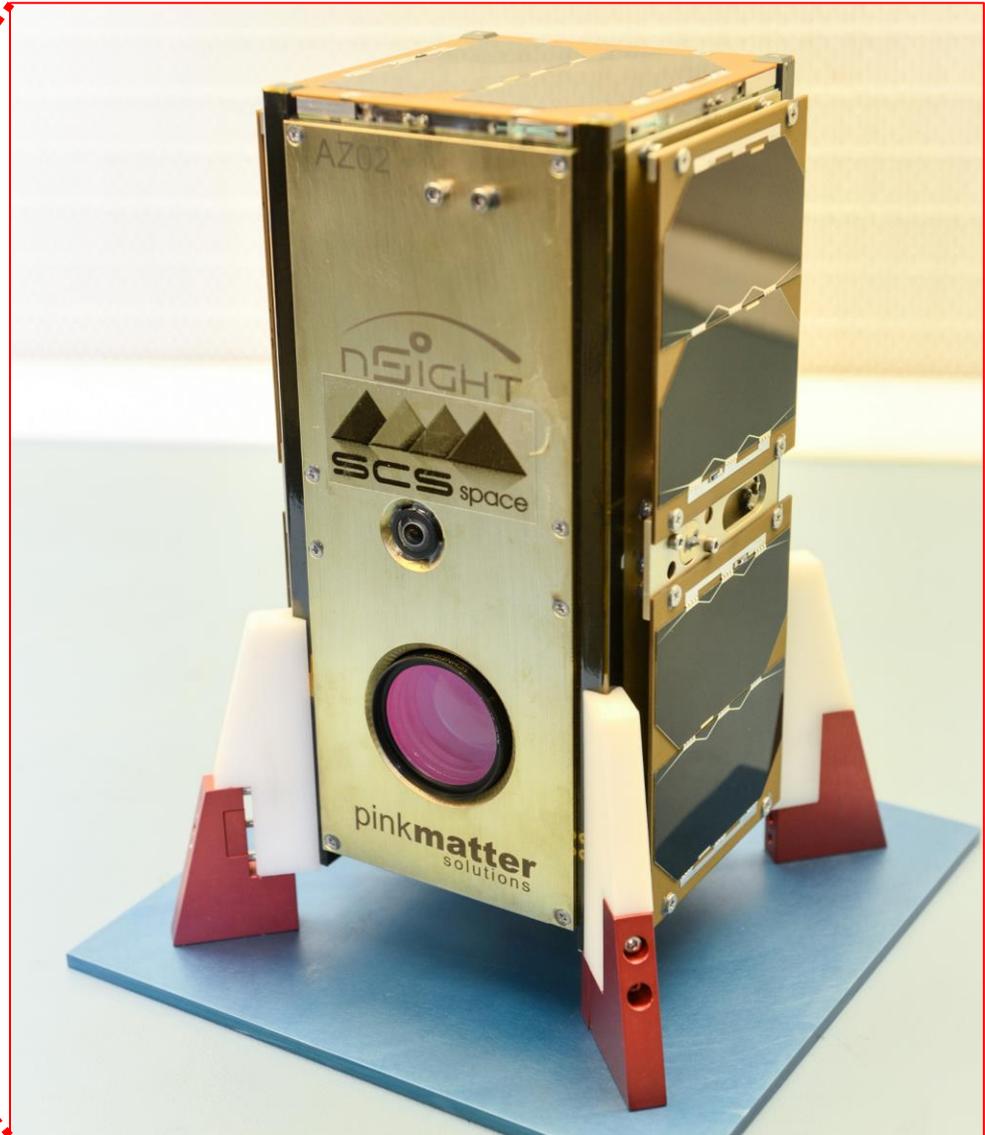
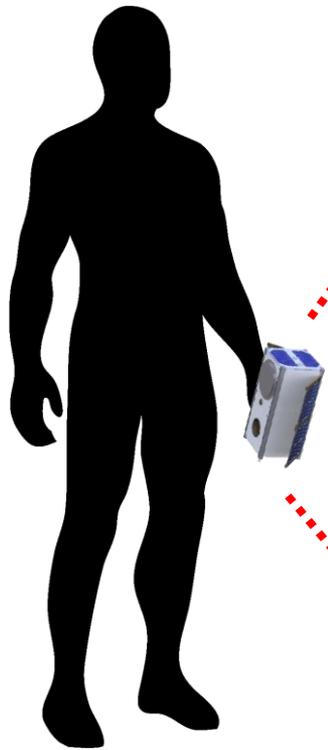
Capability established in Africa

## Outgoing

International collaboration – South Africa,  
Nigeria, Algeria and Kenya

Key pillar in various country space programs

# nSIGHT



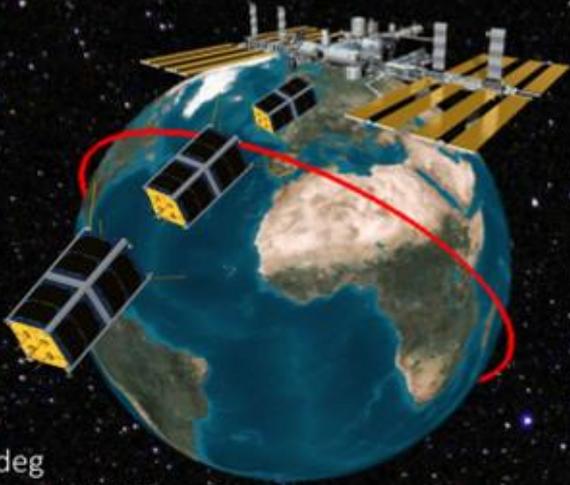


, an



Project

### 28 CUBESATS FROM THE INTERNATIONAL SPACE STATION



- QB50-ISS**
- 28 CubeSats
  - Altitude 415km
  - Inclination 51.6deg
  - Launch on 16<sup>th</sup> March 2017
  - Atlas-V Rocket from Cape Canaveral (USA)

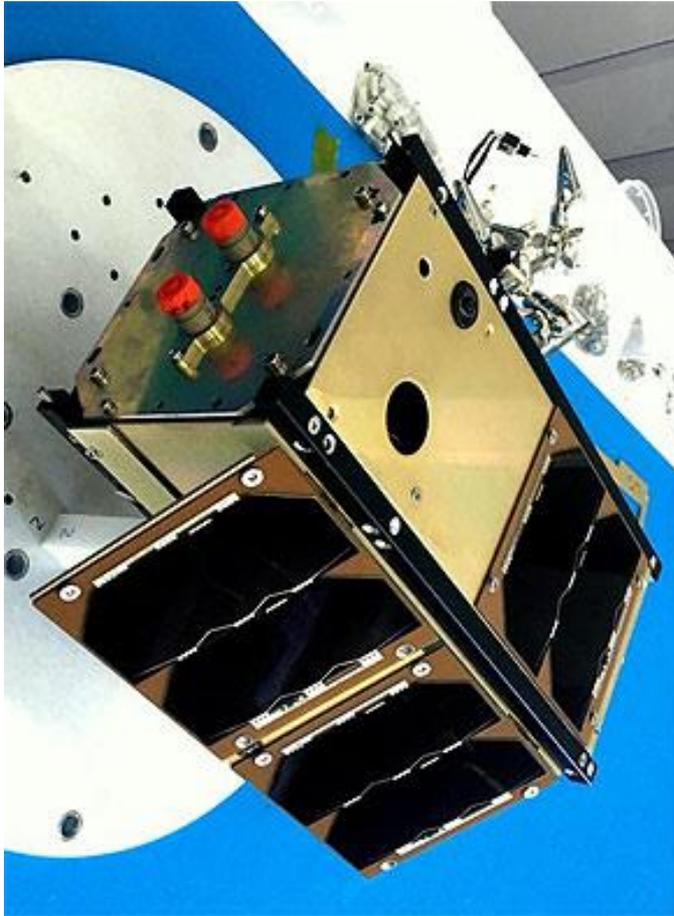
### 8 CUBESATS ON THE PSLV INDIAN ROCKET



- QB50-PL**
- 8 CubeSats
  - Altitude 500km
  - Sun Synchronous Orbit 97.1deg
  - Part of the Science Campaign
  - Launch on 21<sup>st</sup> April 2017
  - PSLV Rocket from Satish Dhawan Space Centre



# South African QB50 Satellites:



ZA AeroSat (QB50 AZ01)  
Stellenbosch University



nSight 1 (QB50 AZ02)  
SCS Space

# nSIGHT 1 Overview

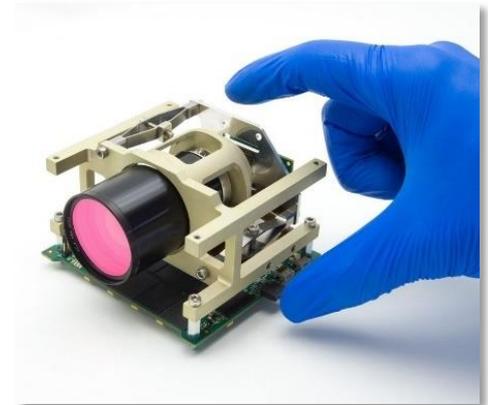
Complete satellite weighs only 2.5 kg

- Part of the international QB50 constellation
- Deployed from the ISS
- Satellite built in six months in 2016



## Payloads

- SCS “Gecko” imaging payload
  - Integrated data storage
  - Integrated image processing
- FIPEX atmospheric science instrument (supplied by University of Dresden)
- Radiation tolerant digital design (NMMU)



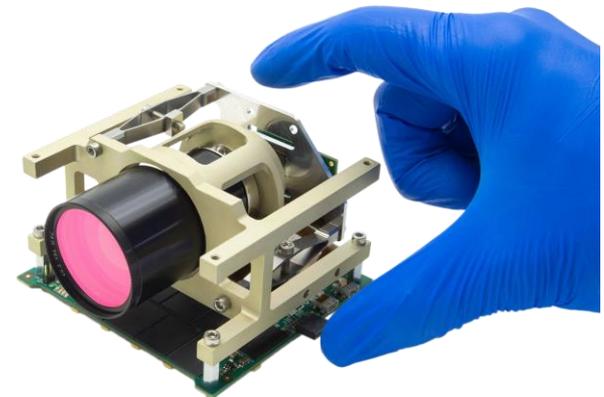
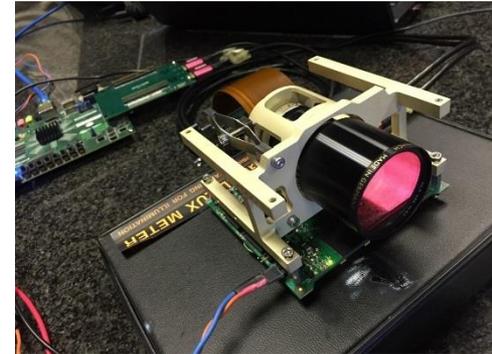
# Gecko Imager Payload

## nSight Gecko Imager

Spatial resolution	31 m GSD (from 400 km)
Swath	64 km
Image Sensor	2.2 Megapixel RGB Bayer
Data format	RAW 8-bit or 10-bit JPG (4:4:4 or 4:2:2) Thumbnail (1:8)
Frame capture rate	5 fps full-frame imaging
Integrated mass data storage	128 Gigabyte
Data interfaces	LVDS, SPI and I2C
Dimensions of imager	< 1U (97 mm x 96 mm x 60 mm)
Power Usage	< 3.5 W (imaging mode) < 2.5 W (readout mode) 5 V power supply
Mass (incl. mass storage)	< 480 g

## Downlink Data per Image Frame

- RAW – 2.2 MB
- JPG - ~330KB
- Thumbnail – 4KB - 10KB





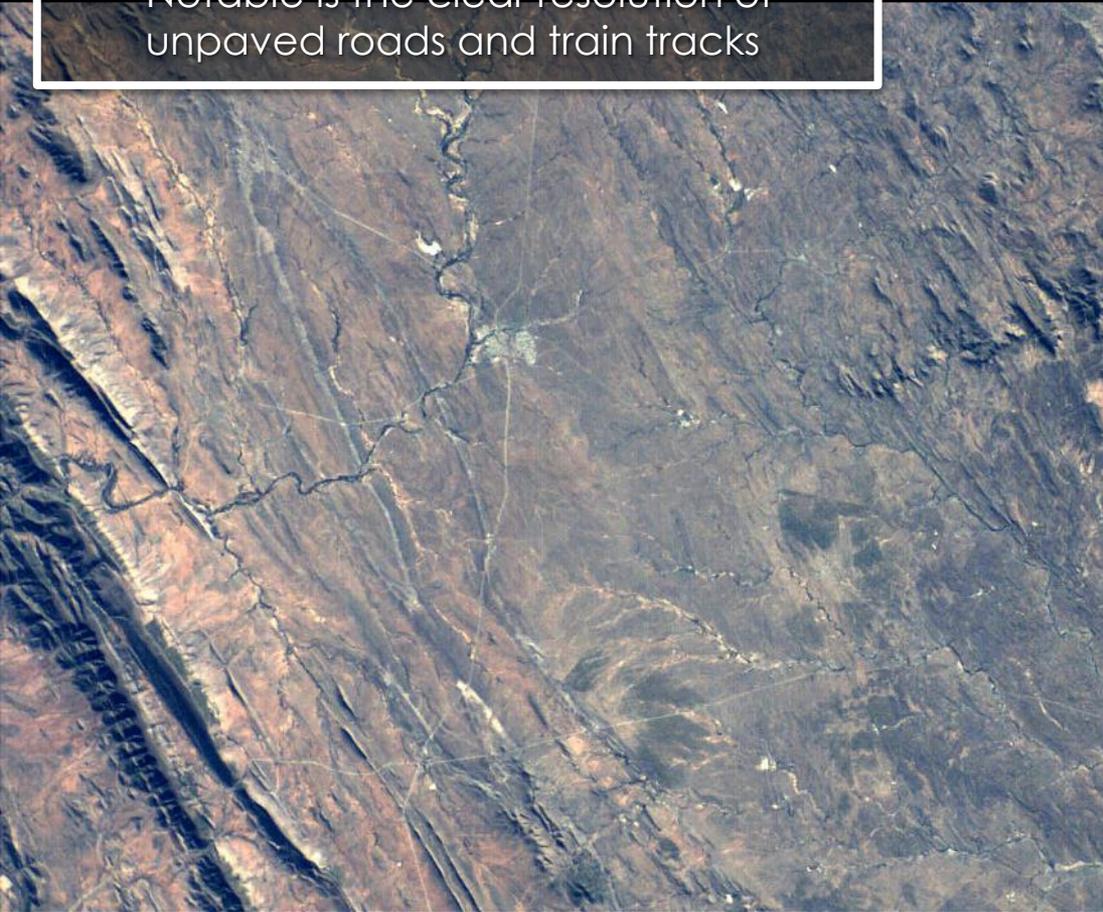
# First Image



- JPG 503.7KB (4:4:4) (Within two overpasses)
- RAW 2200 KB (Within 5 days)



- 11 July 2017 - image taken over the Eastern Cape Province, South Africa
- Notable is the clear resolution of unpaved roads and train tracks



# What does it mean for the future?

## nSight 1 Experimental Platform



Nanosatellite Platform



Imager Payload



HumanCapital Development



Data Management Platform



Ground Station



**nSIGHT 1  
Experimental Platform**

**nSight 1**

**Incoming**

**20% of international cubesat components**

**New sensor technology**

**Outgoing**

**Demonstrating remote sensing from 2.5 kg  
satellite**

**Kick off of nSight 2 and nSight 3 missions**

**Continue on from 25 years of Capacity Building**

# Demonstrating the Results of 25 years of Capacity Building



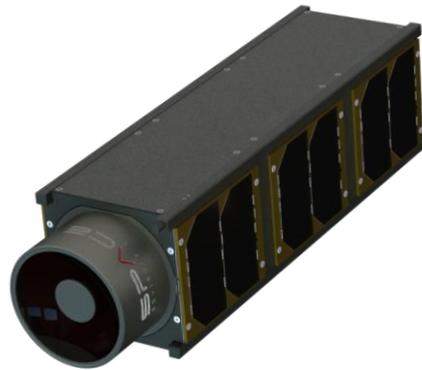
1992	2017
1 university post graduate program	3 university post graduate programs
1 university research program	six universities with research programs in space
one technology demonstration satellite, Sunsat	an experimental platform, nSight 1
University satellite plus Science council	Industry plus University plus Science council
Greensat program - AIT plus sub-system suppliers	No fewer than fourteen contributing partners from the Space Hub in South Africa

# Satellite Engineering Education – an Overview

	Subsystem	Functional	Mission
<b>Hands-on Satellite Engineering Training</b>			
<b>Specialised Satellite Engineering Training</b>			
<b>Training with Full Satellite Mission</b>			
<b>Courses in Satellite Applications</b>			

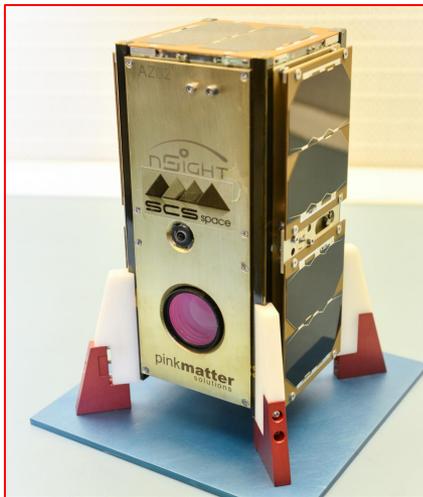


# nSIGHT 1, 2, 3



## nSIGHT - 2 HS

Ground Sampling Distance	20 m
Swath Width	20 km
Spectral Bands	100 bands (linear filter) 30 bands (pre-selected)
Ground Accuracy	500m (3 $\sigma$ ) without GCP



## nSIGHT - 3 MS

Ground Sampling Distance	10 m
Swath Width	40 km
Spectral Bands	Blue, Green, Red, NIR Red Edge 1, Red Edge 2, NIR2, Xantophil
Ground Accuracy	500m (3 $\sigma$ ) without GCP
Payload Data Downlink	2 Mbps (S-band)
Design Lifetime	2 Year
Orbit	500km Sun-synchronous
Mass	4.5 kg

# INSIGHT 2 and 3

## Multi-mission platforms

1. Experimental platform
2. Capacity building program
3. New technology development
4. Invitation to African Scholars to join program (three sponsored positions)
5. International collaboration
  1. New data sets
  2. New payloads
  3. New technology development
6. Establish Space Engineering Academy Laboratories



# nSight 2 and nSight 3

## Incoming

Capability established in Africa

80% of components from South African suppliers

## Outgoing

Capacity Building in Africa

International collaboration invitation

New Technology Platforms at Universities

Demonstration platform for new business cases

# Launch! (16 April 2017)

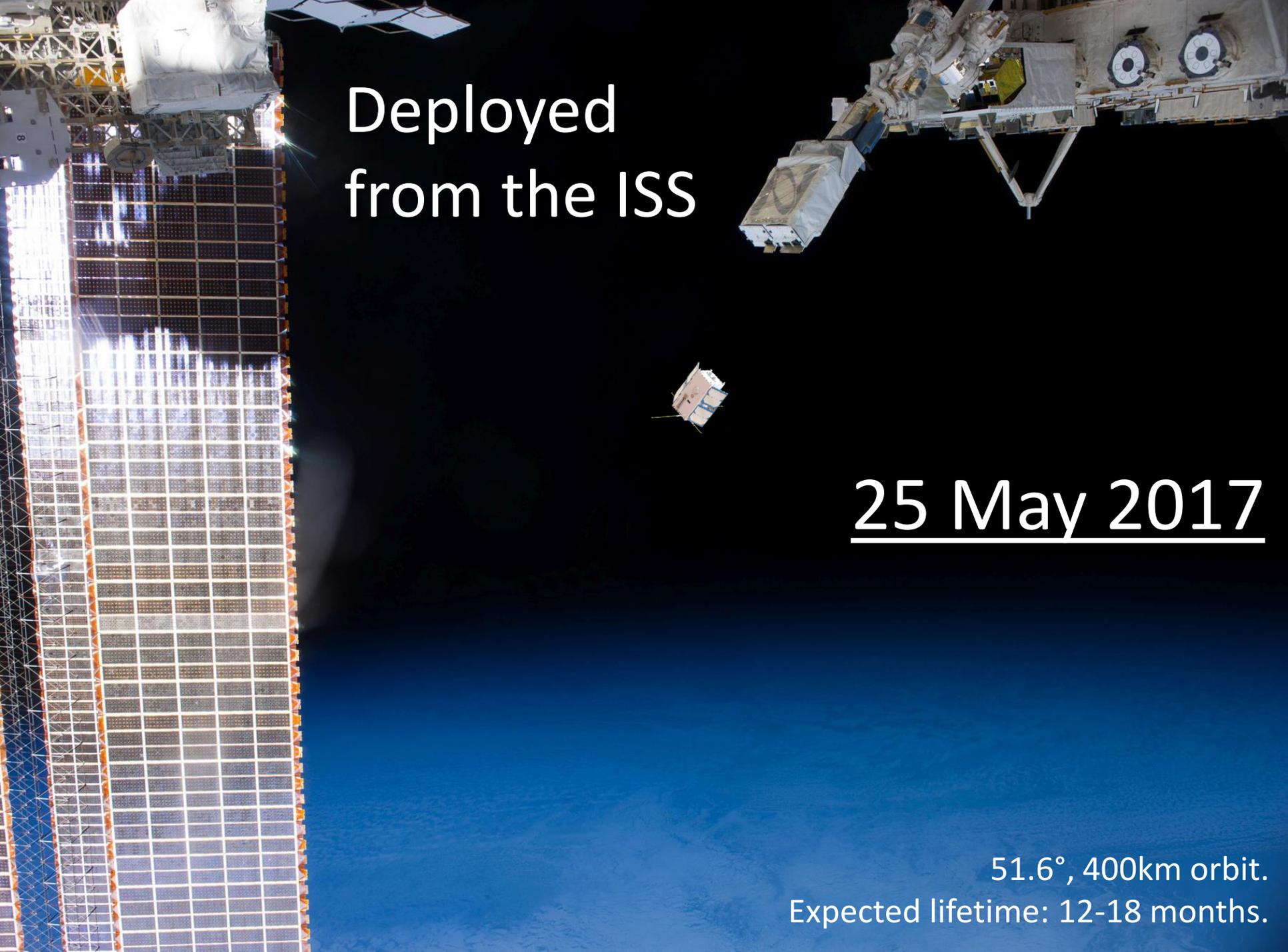


Atlas V OA-7 launch – Photo: United Launch Alliance

# Arrival at the ISS (22 April 2017)



OA-7 Cygnus capture at the ISS – Photo: NASA



Deployed  
from the ISS

25 May 2017

51.6°, 400km orbit.  
Expected lifetime: 12-18 months.



**International collaboration welcome in  
nSight 2 and nSight 3 missions**

**nSight-1: a Reliable nano-satellite platform for  
Remote Sensing Capacity Building**



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