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Ideas that work

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The Paardefontein Vicarious Calibration Site (and Beyond)

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Optronic Sensor Systems
DPSS, CSIR, Nov 2015

Outline

- Review of desirable vical target properties
- Introduction to Paardefontein calibration target site
  - Advantages/Disadvantages
  - Infrastructure
- Vical Exercise and Training Campaign, July 2014
- Maintenance and permanent instrumentation
- Possible natural sites in Southern Africa, opportunities and prospects

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Vical Target Properties

- Desirable Properties (Thomé)
  - The higher the spatial uniformity of the area, the less the impact of assigning a “generalised” reflectance value to represent the full test site.
  - A high-reflectance results in higher signal-to-noise ratio (SNR), which, in return, increases overall accuracy.
  - Spectral uniformity of the site simplifies the calibration process.
  - Temporal uniformity of the site enables greater flexibility in usage.
  - A Lambertian reflecting surface is preferable as it simplifies corrections due to solar and view geometry.
  - The site should have little or no vegetation as this can affect spectral, spatial and temporal uniformity.
  - High elevation reduces the error due to aerosols.
  - High probability of cloud free days increases usability.
  - Long distance from densely populated areas and/or industrial facilities decreases the effect of anthropogenic aerosols.
  - A location far from the seas or other large water bodies minimizes the influence of atmospheric water vapour.
  - Having a site in an arid region minimizes probability of precipitation, which in turn may change the surface BRDF. Also, in arid regions, the probability of cloudy weather is at a minimum.
  - A large site minimizes the effects of scattered light from areas outside the target area.
  - Easy access to the site is an advantage.
  - Instrumented test sites are preferable and a key requirement for CEOS endorsement as a reference standard for radiometric gain.

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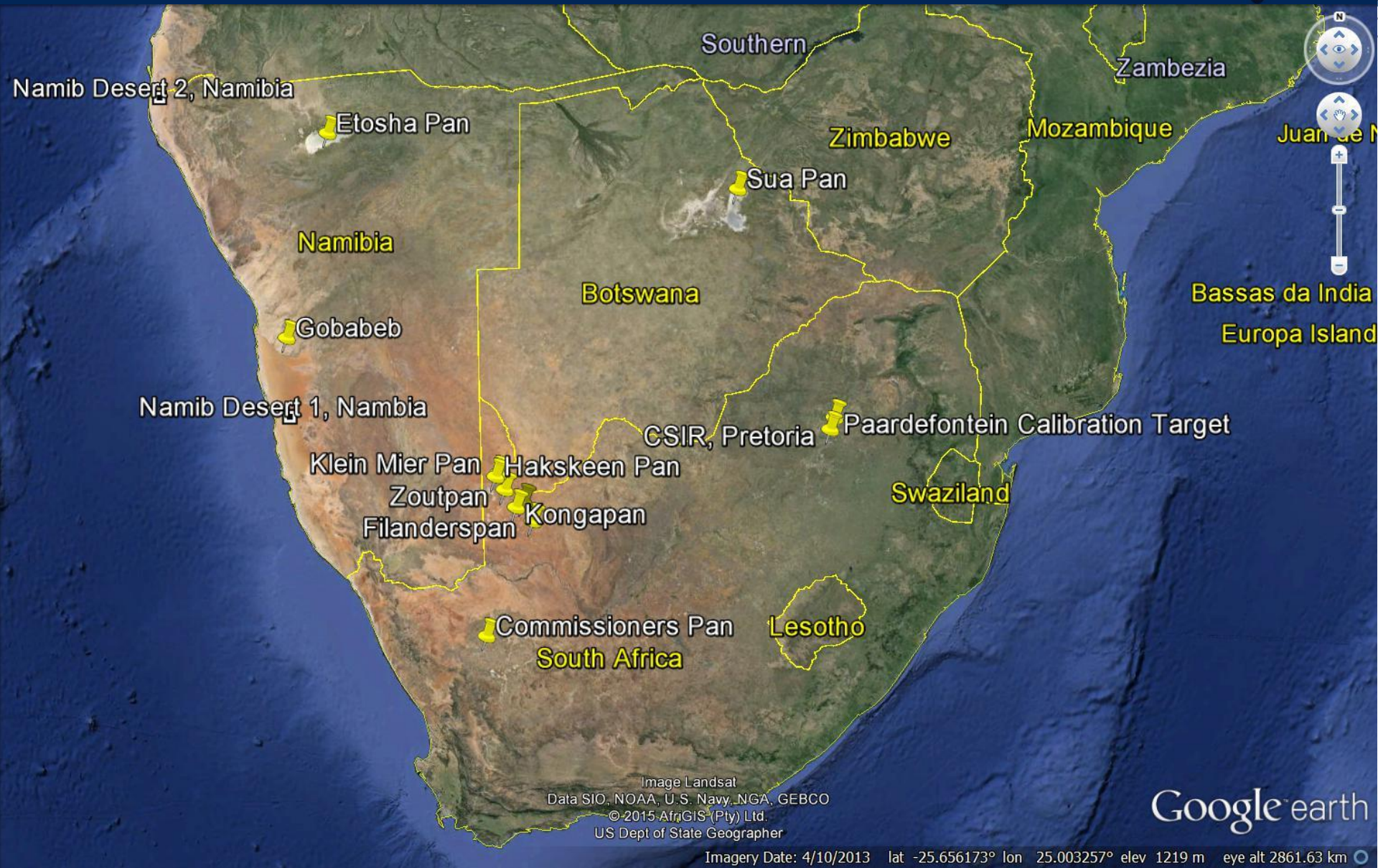
Southern Africa - Orientation



Paardefontein Vical Site

- Established by CSIR/DPSS/OSS with DST funding
- Site Features
  - 100 m by 100 m Concrete Paved Radiometric Cal Target
  - Flat Terrain, slight slope for good drainage
  - 30 km North of CSIR (~ 40 minutes drive)
    - Accessibility for HCD and methodology development considered very important
  - Surrounded largely by grassland, 1200 m AMSL
  - Fenced, and within secured area operated by CSIR
  - High availability in dry, winter season
  - Additional area available for other targets e.g. spatial

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Paardefontein Vical Target

- Relatively flat spectral response and reasonable spatial uniformity, modest BRDF effect
- Useable for sensors with GSD <= 15 m GSD
- Aerosols, biomass burning in winter
- June-July the best months, clear, low aerosol loading, compared to typical peak in September

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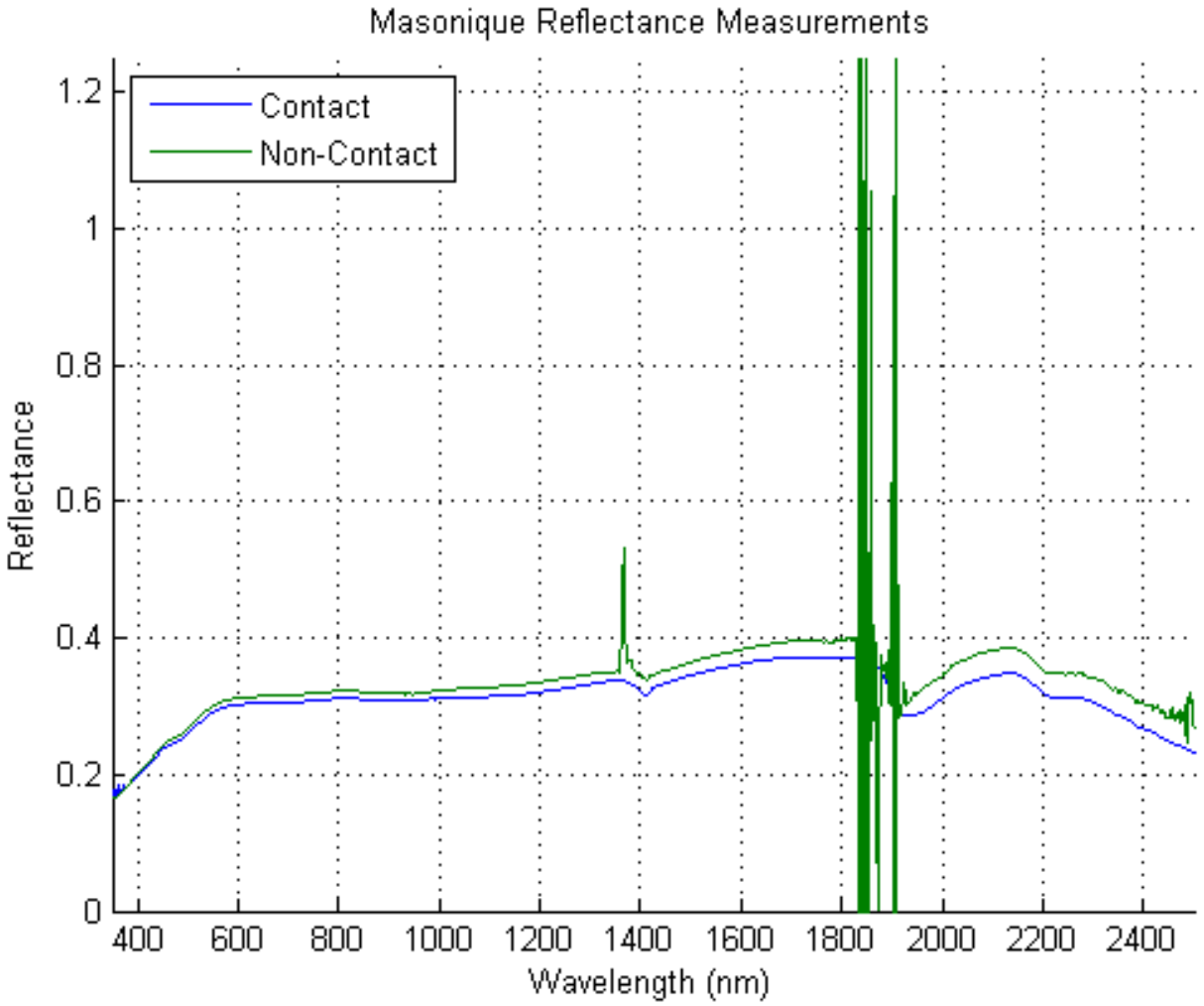
Paardefontein, Spectral Reflectance



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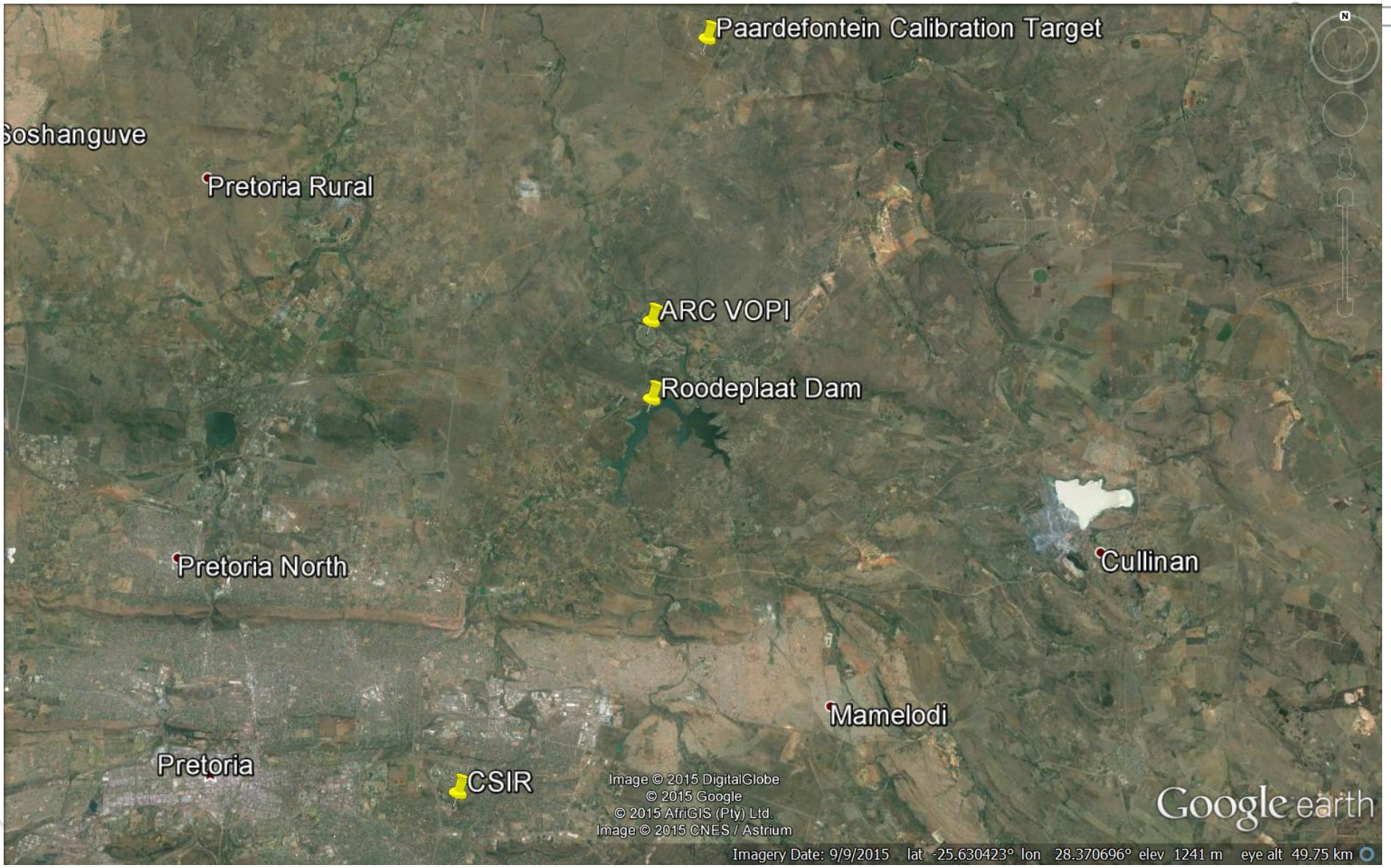
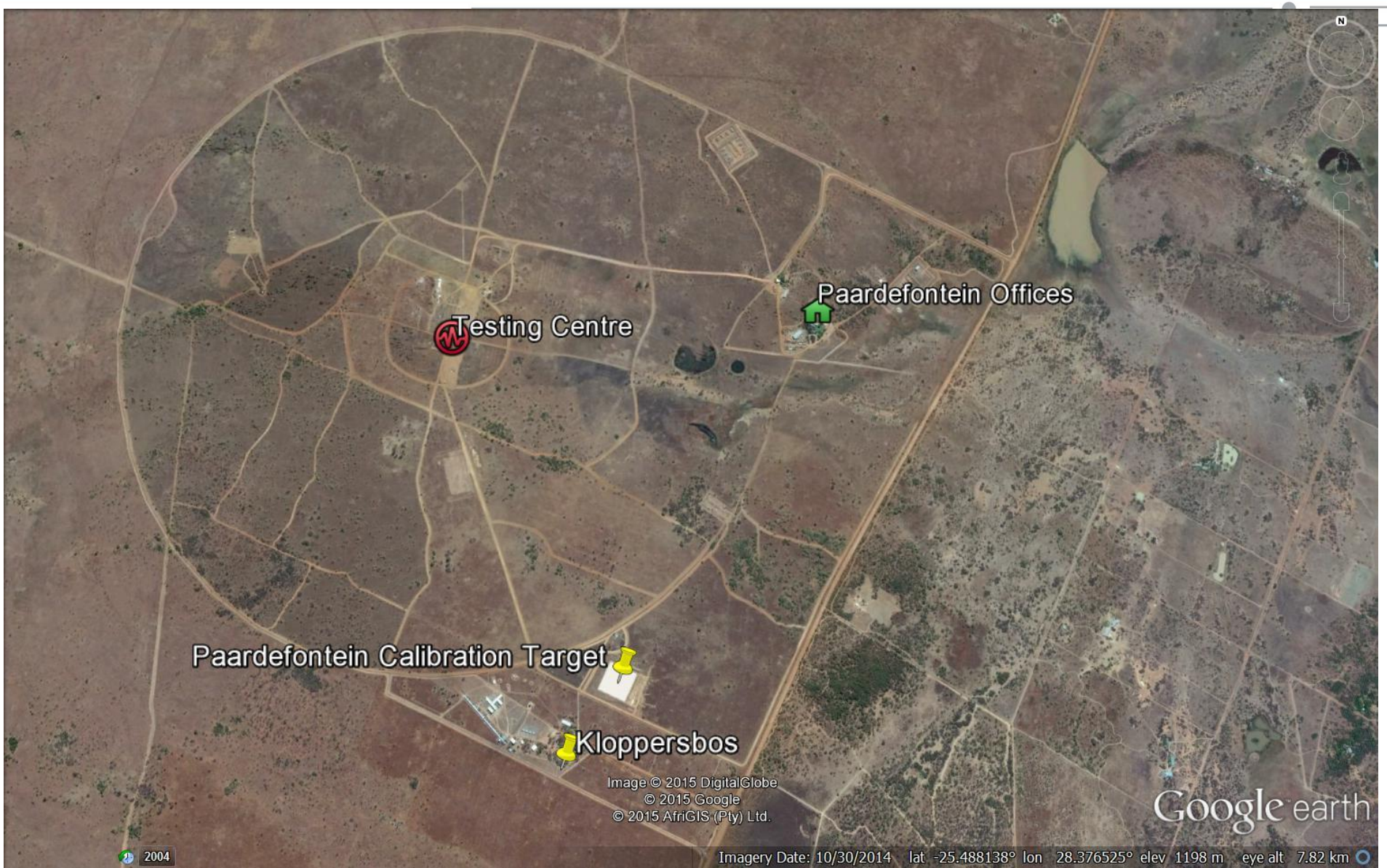
Paardefontein Location



Paardefontein



Paardefontein Target

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Paardefontein Infrastructure

- Site office
- Lattice mast, 39 m
- Network and power feed possible from Kloppersbos
- Good cellular coverage
- CSIR staff in close proximity
- Concrete platforms (box culverts) for mounting of instrumentation – e.g. AERONET Cimel

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Paardefontein Site Layout

Paardefontein Vical Exercise – July 2014

- Targeted acquisition of Pleiades (Airbus) image
- 0.5 m pan GSD, 2 m GSD multispectral
- Blue, green, red and NIR
- Near-nadir overpass, 17 July 2014
- Used MODTRAN to perform radiative transfer to TOA
- Reflectance-based method
- Compared within 5% of current Pleiades calibration coefficients in all spectral channels.

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Paardefontein – July 2014

- Ground Measurements
  - Surface spectral reflectance at nadir around time of overpass (ASD Fieldspec 3 spectroradiometer)
  - SANSA Spectral Evolution spectroradiometer PSR-3500
  - Aerosol Optical Depth with Cimel CE318 robotic sunphotometer (AERONET)
  - Direct normal and total solar irradiance (Kipp and Zonen pyranometer/pyrheliometer on tracker)
  - Weather station
  - Time-lapse sky camera

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Paardefontein Campaign – July 2014

- Radiometric
  - 100 m by 100 m concrete target
  - Black Tarp 8 m by 8 m
  - Red Tarp 8 m by 8 m
  - Blue Tarp 8 m by 8 m
- Spatial
  - Black strip (20 cm wide by 25 m) on concrete target
  - Red and blue solar reflectors
  - White and Fluorescent Red boards

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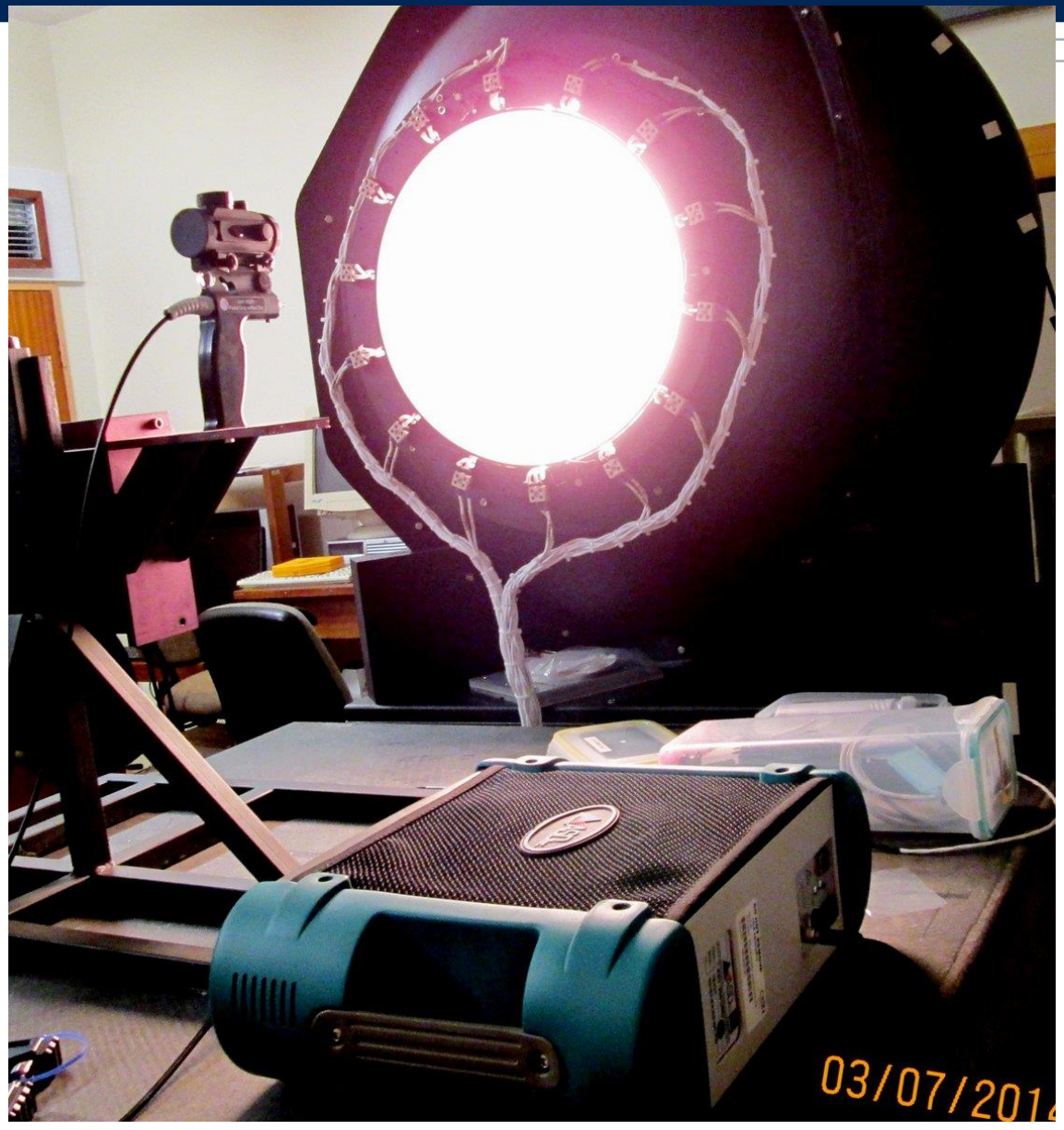
Paardefontein – Radiometer Comparison



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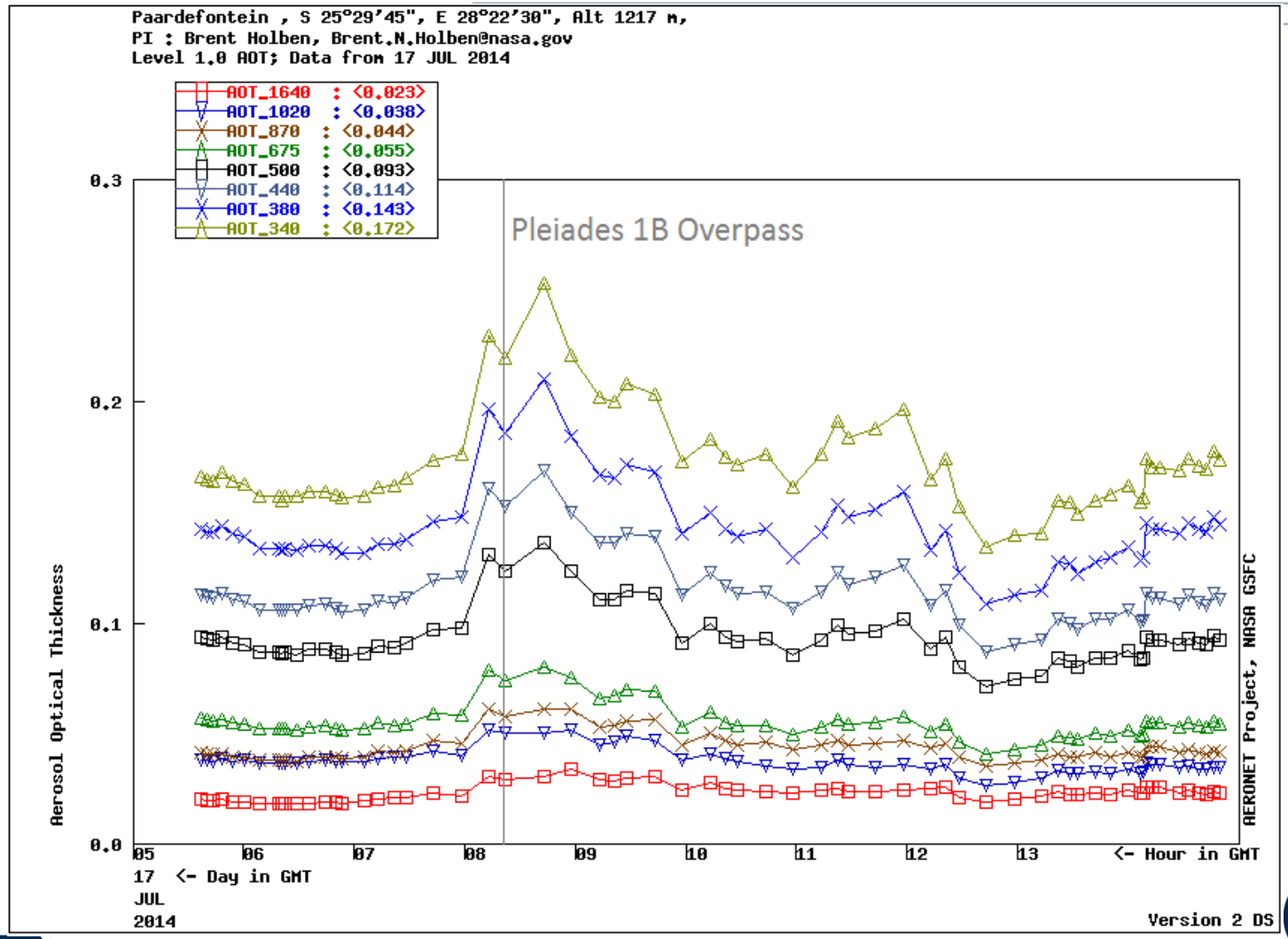
Paardefontein – Surface Reflectance

Paardefontein July 2014 - Tarps

Paardefontein – July 2014 - AERONET

Paardefontein – 17 July 2014 - AERONET



http://aeronet.gsfc.nasa.gov

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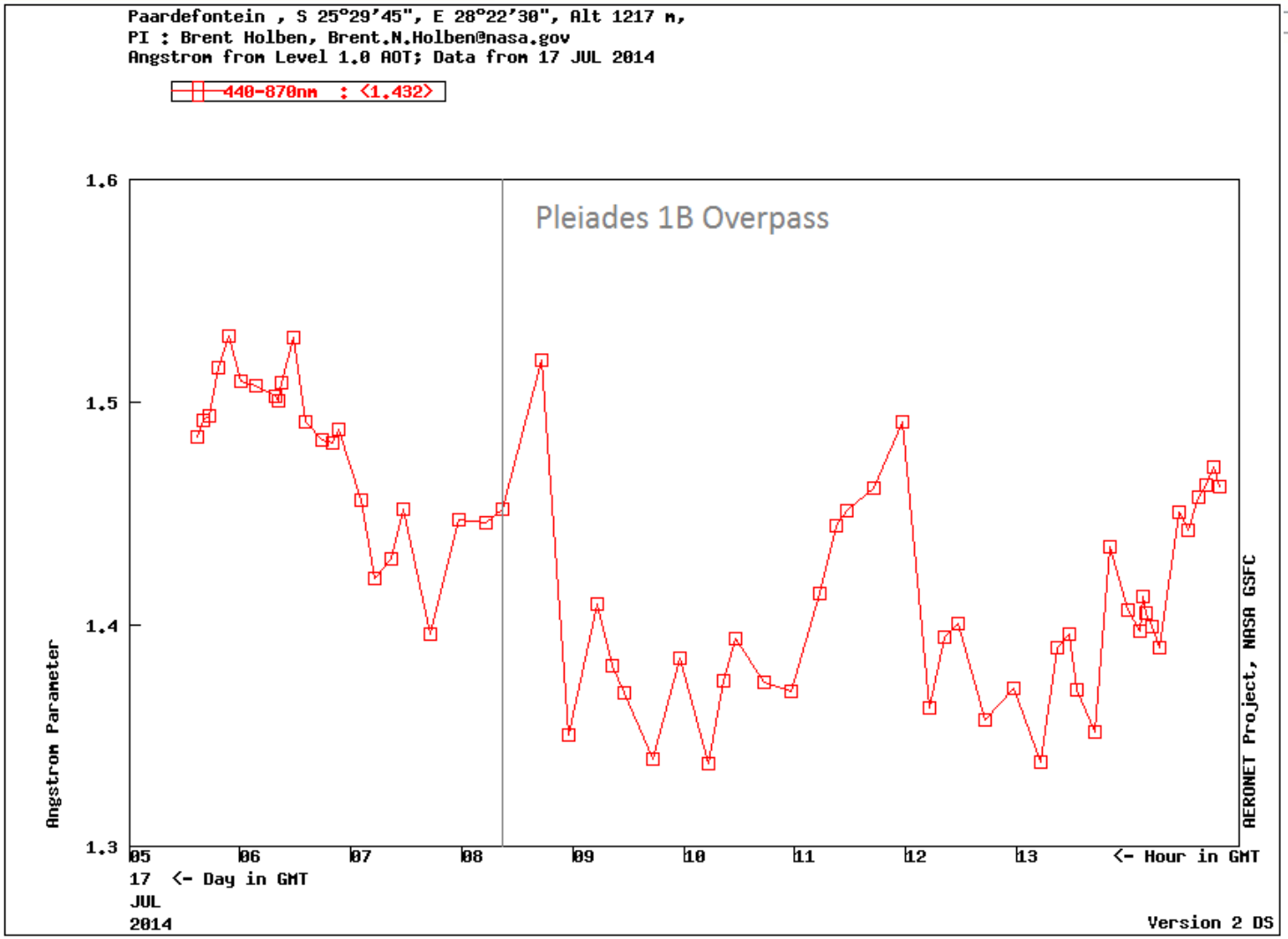
Paardefontein – 17 July 2014 - AERONET



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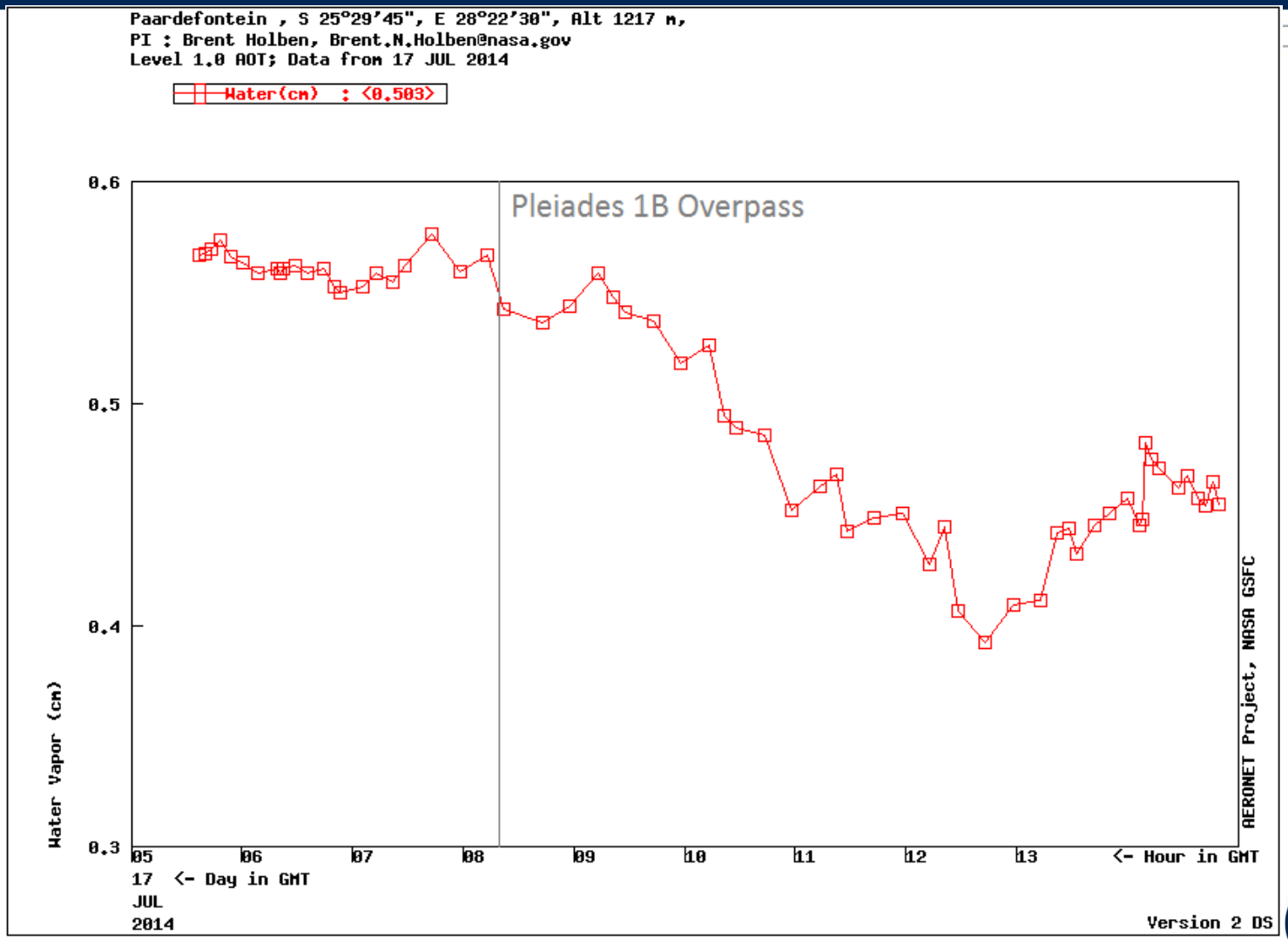
Paardefontein – 17 July 2014 - AERONET



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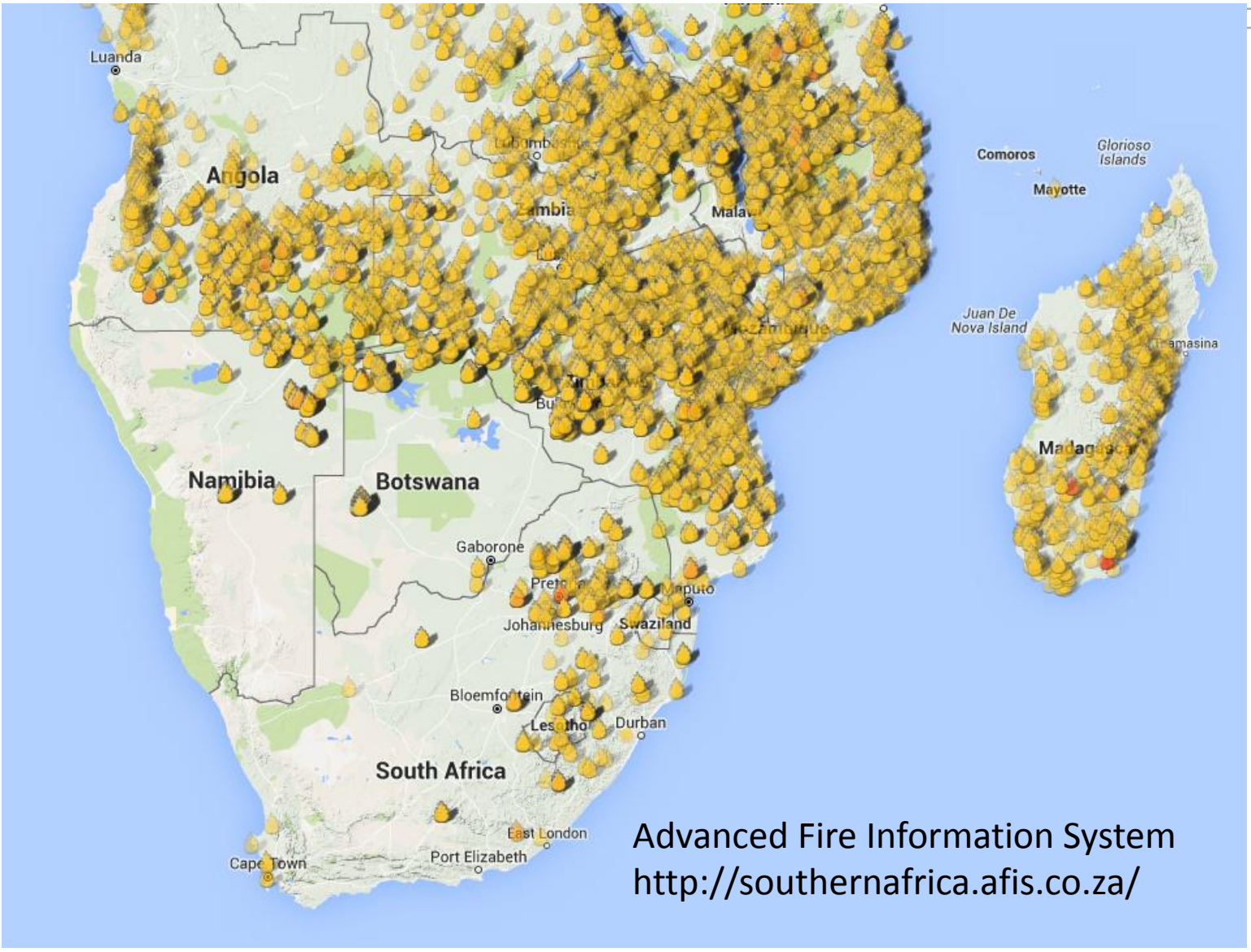
Paardefontein Aerosols – River of Smoke



Advanced Fire Information System
http://southernafrica.afis.co.za/

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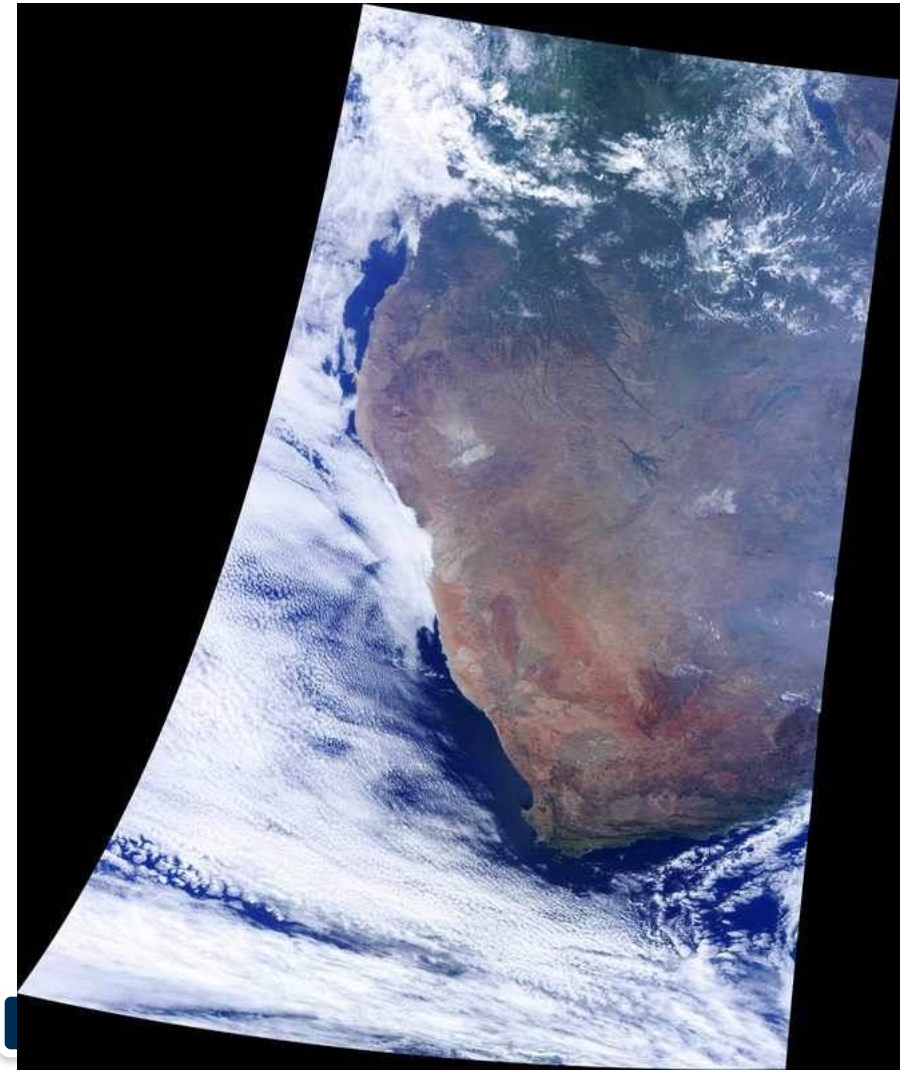
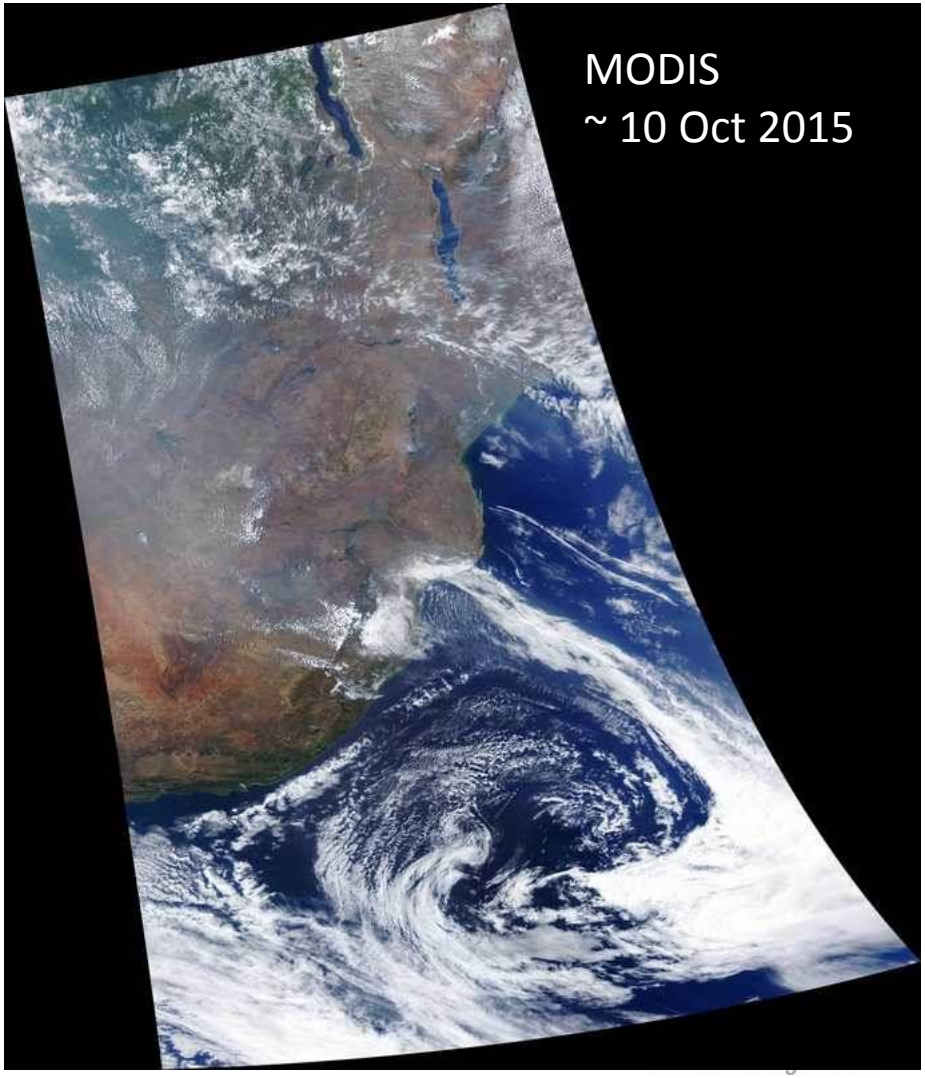
Paardefontein in the River of Smoke





Sky Camera - Video

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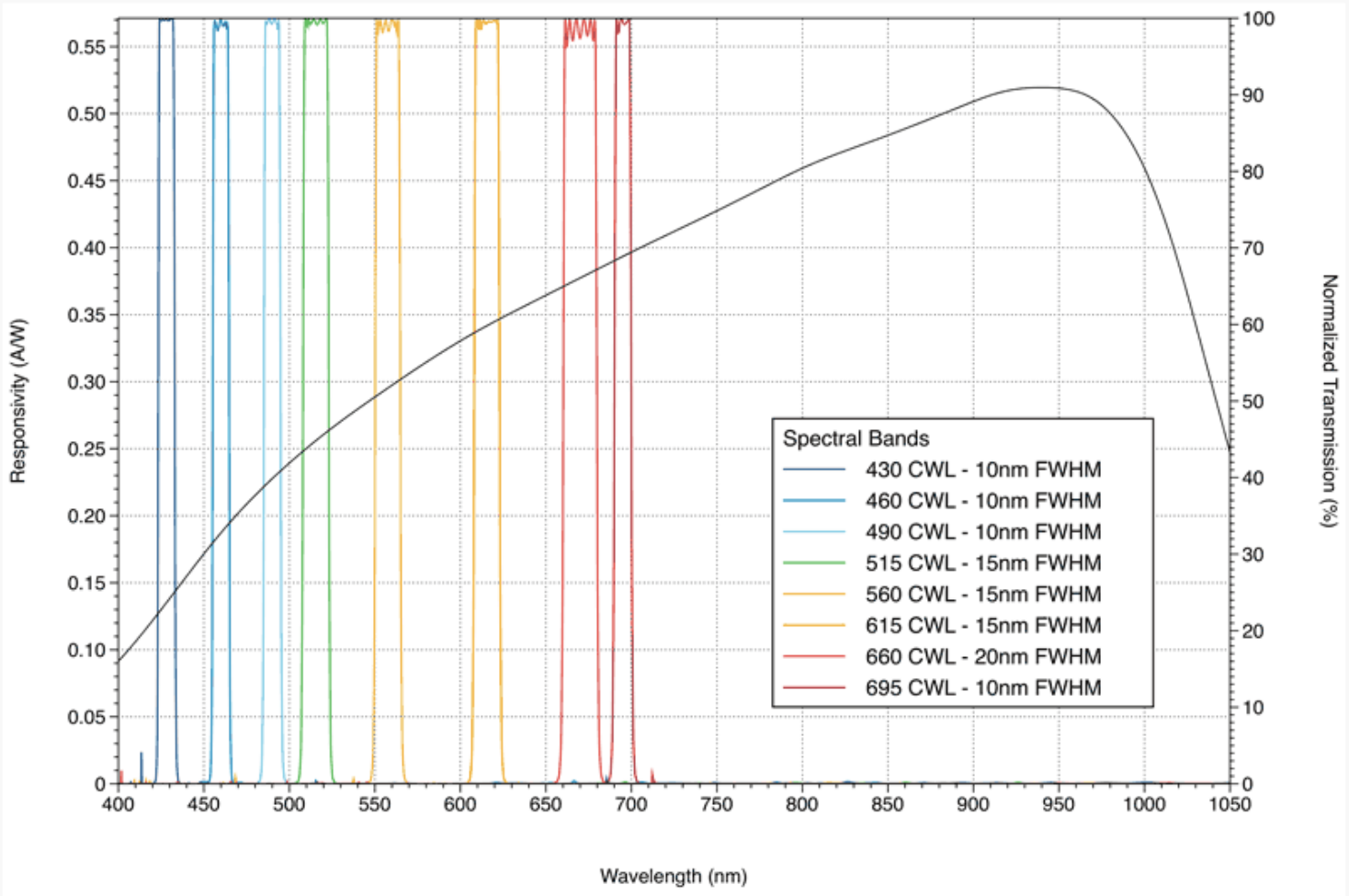
Paardefontein 2014 – Multirotor Drone

Paardefontein 2014 – Drone Radiometer



http://www.pixelteq.com

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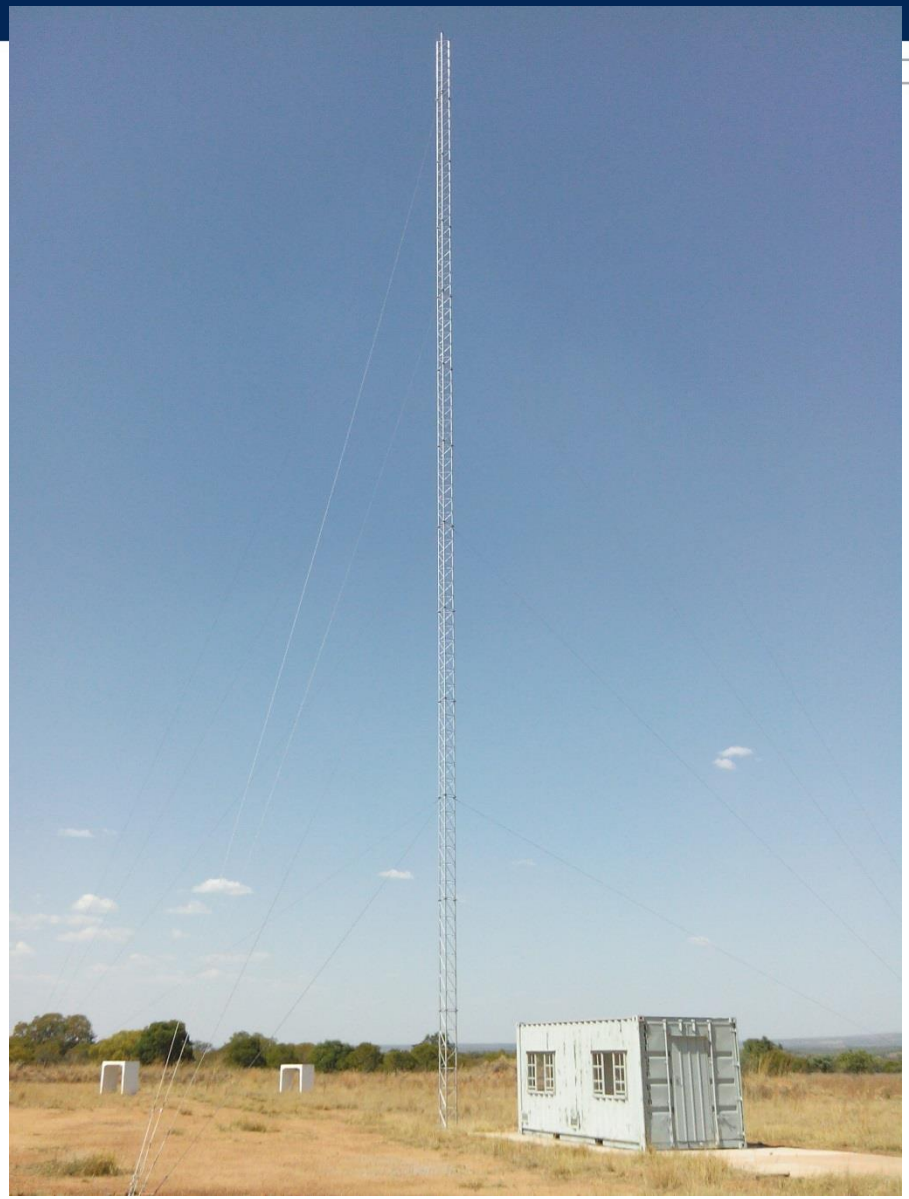
Paardefontein 2014 – Pleiades MS

Paardefontein – 39 m Lattice Mast



- Steel, cable-stayed lattice mast
- Cable feed-throughs into site office/shelter

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Paardefontein – Future, Maintenance

- Site requires maintenance
  - Herbicide spray – early and late growing season
  - Sweeping/scrubbing before campaigns
- Should conduct annual exercises to maintain capability (part of the calval BOK/capability development plan)
- Could be considered for RadCalNet or permanent instrumentation and registration as CEOS vical site.
- Mast potentially very useful for permanent downward-looking radiometers.
- Depends on utility, since site is limited to high resolution sensors.

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Aerosol Vertical Profiling - ABL

- Vaisala CL51 lidar/ceilometer
- Measures laser backscatter intensity as a function of height above ground level
- Provides height of boundary/mixing layer
- Provides indication of vertical distribution of aerosols
- Does not provide aerosol optical properties – need AERONET as well
- Potentially important for adjacency effects
- Operated at Pretoria, currently at Simon's Town on False Bay near Cape Town
- Online at http://www.ossmeteo.co.za

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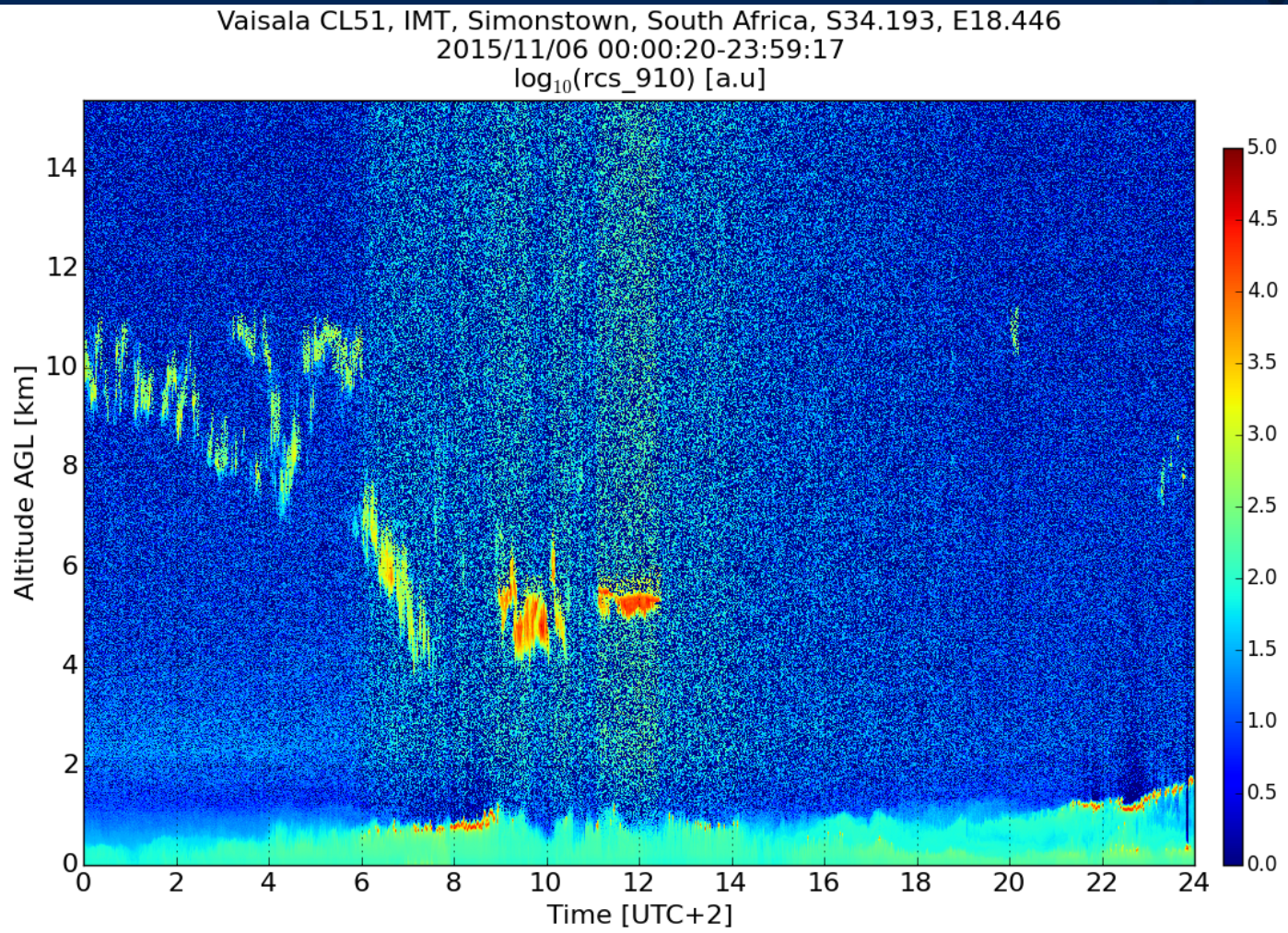
Aerosol Vertical Profiling - Lidar



http://www.ossmeteo.co.za

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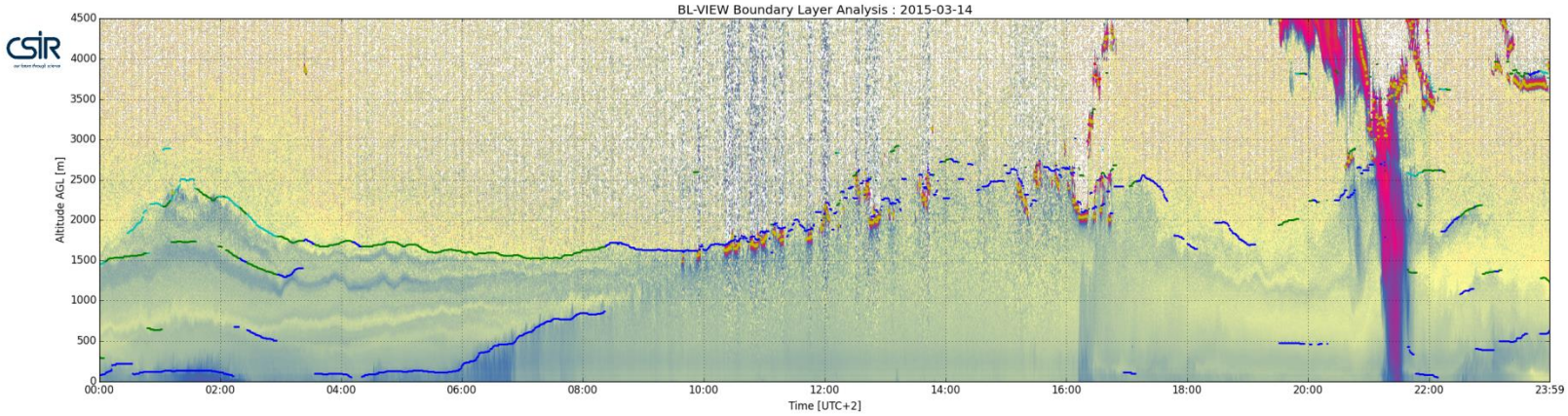
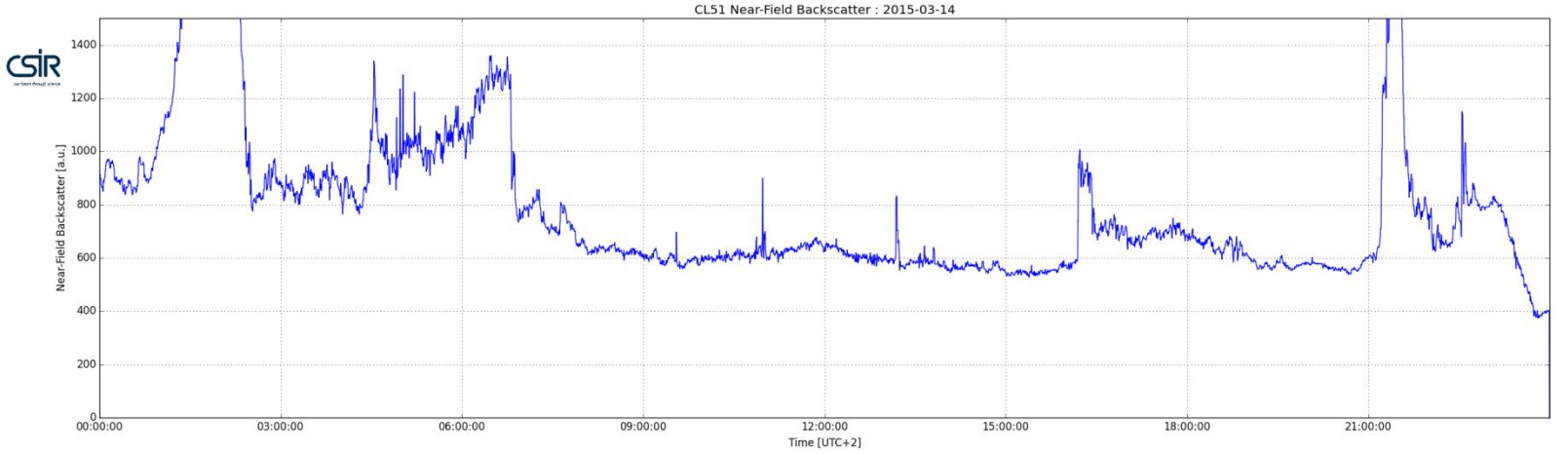
Aerosol Vertical Profiling - Lidar





http://www.ossmeteo.co.za

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Natural Site in Southern Africa

- Investigated salt pans
  - Sua Pan, Botswana, used in SAFARI 2000
  - Commissioner's Pan, Northern Cape, RSA
  - Zoutpan, Northern Cape, RSA
- Alkali pans
  - Klein Mier Pan, Northern Cape, RSA
  - Goeboegoeboepan, Northern Cape, RSA
- Accessibility, stability, small size

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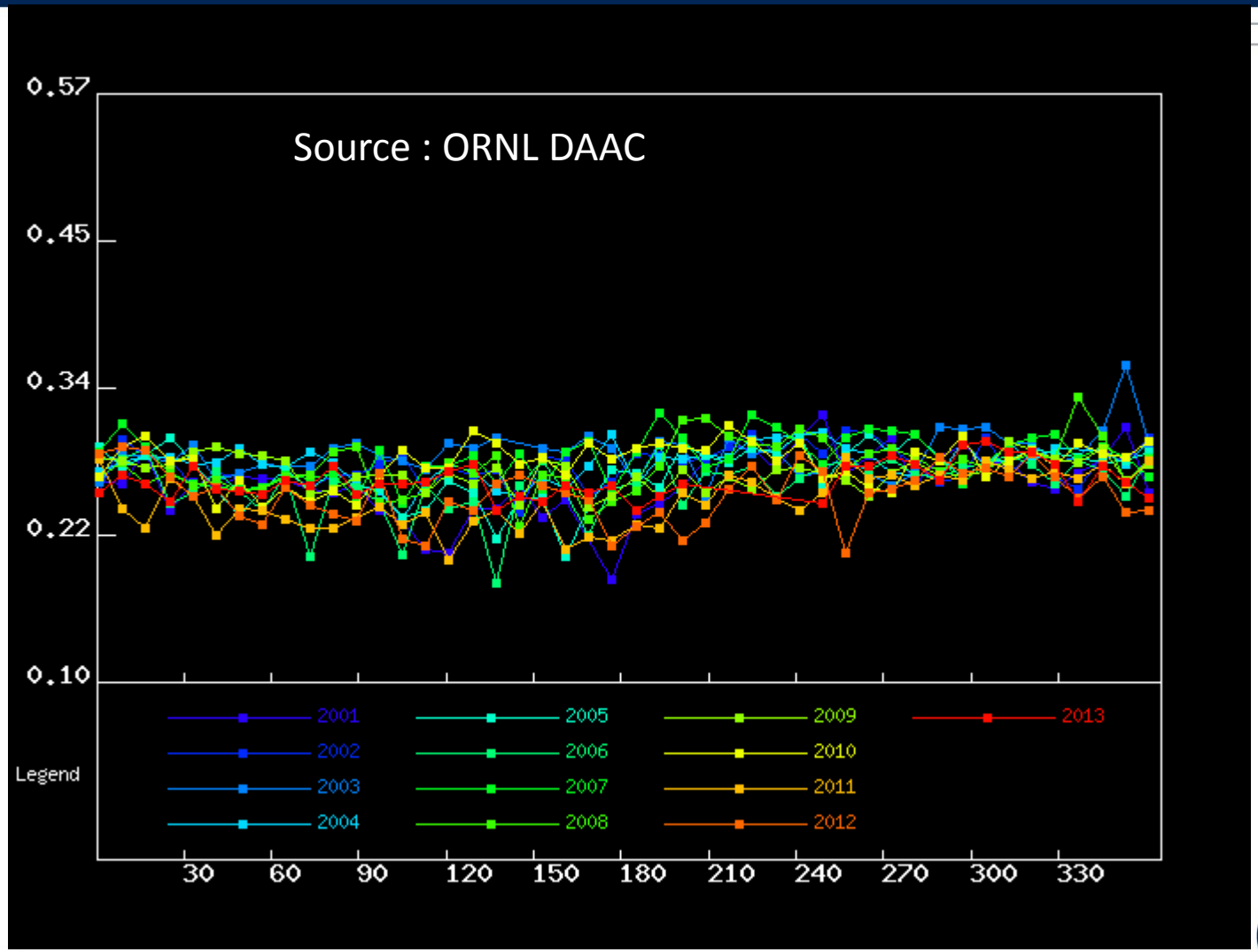
Northern Cape Pans

Klein Mier Pan

Klein Mier Pan – MODIS B01, Red



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SEALS-SA, COLA, Namibia

- COLA : CLARIFY-ORACLES-LASIC-AEROCLO, airborne/ground/satellite campaigns out of Namibia related to biomass burning, desert dust aerosols and climate impact : https://espo.nasa.gov/home/oracles
- SEALS-SA : Sea Earth Atmosphere Linkages Study in Southern Africa
- Shifted focus to possible sites in Namibia to support these campaigns
- Opportunity to leverage visibility and value of Gobabeb RADCALNET site

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Sentinel-2/3 – Inland Water Quality

- Sentinel 2/3 synergy opening new capability and applications in inland water quality
- Better calibration and validation crucial
- Dark targets, but not as dark as case 1 (open ocean)
- Adjacency effects troublesome
- Consideration of calval site for inland water quality well worth considering
- Concern on the part of user's about handling very large Sentinel scenes, especially for small targets such as inland water bodies
- Server-side subsetting and active archive services such as the NASA Giovanni platform very useful in compute capacity/network bandwidth scarce user environments

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Conclusions

- Satellite calval is still alive in South Africa
- Prospects for better support of satellite calval from DST and SANSA are good – proposal to DST end November
- Southern African region has satellite EO challenges in terms of biomass burning aerosols, loading, variability, climate impact
- Not just about calval but also AC for delicate applications such as inland and coastal water
- COLA and SEALS-SA campaigns excellent opportunity for visibility and impact – strongly support Gobabeb RADCALNET site
- Coastal and inland water applications very interesting and important for the region
- Sentinel 2/3 synergy very exciting for water, but challenges in terms of data access and capacity for assimilation
- How about an inland water calval site in Southern Africa ?

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Thank you

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