

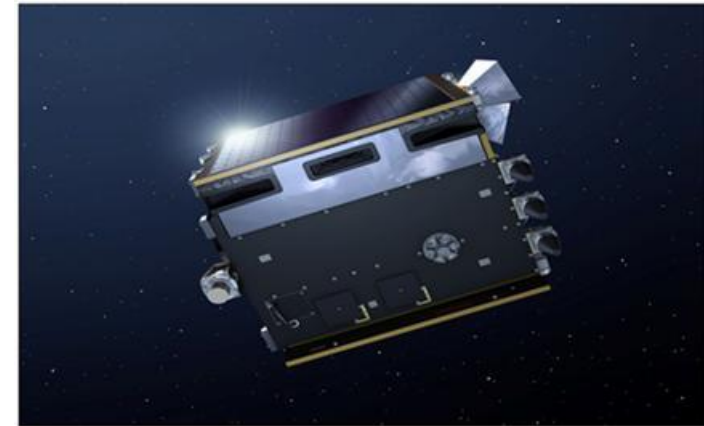


PROBA-V Commissioning: Radiometric Calibration

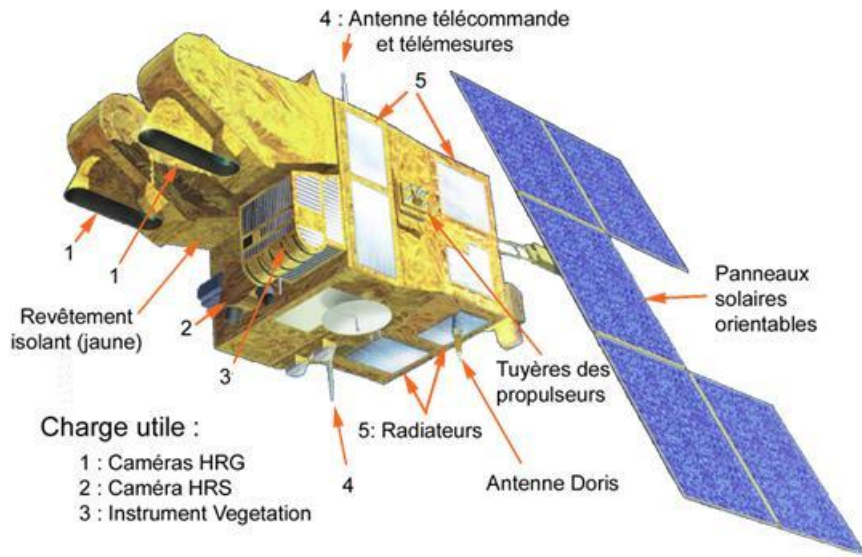
Stefan Adriaensen, Wouter Dierckx, Stefan Livens, Sindy Sterckx

- » Belgian-ESA mission
- » Mission objective :
 - » Continuity of SPOT VEGETATION data (Blue, Red, NIR, SWIR)
 - » Daily global coverage of land masses (56°S 78°N)
 - » 100m at-nadir resolution
 - » 1/3km and 1km products

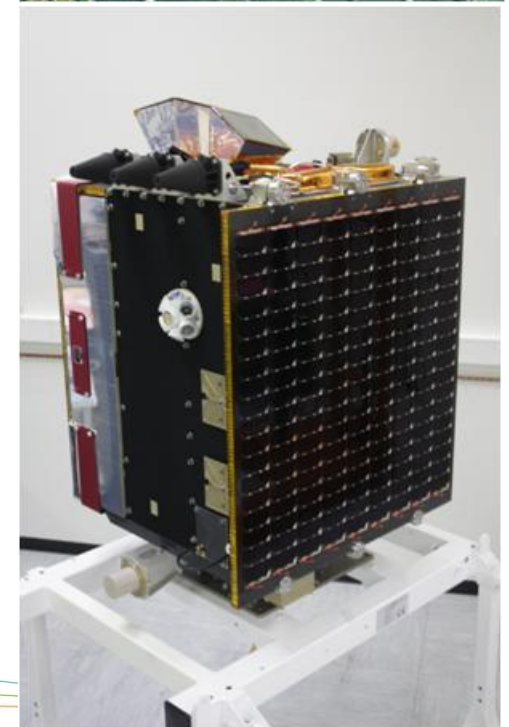
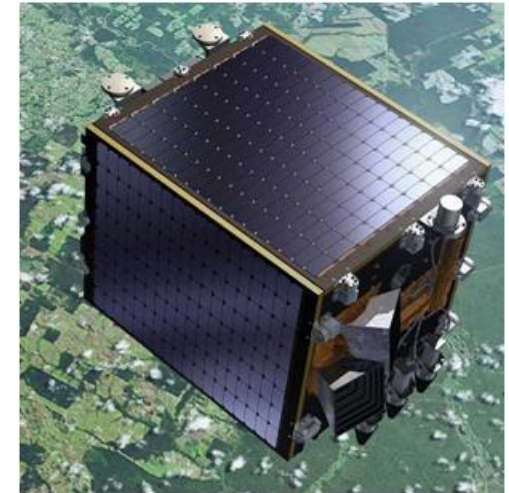
- » Launch :
 - » May 7th 2013 (02:06 GMT)
 - » VEGA VV-02 flight, perfect launch
 - » 5-year mission



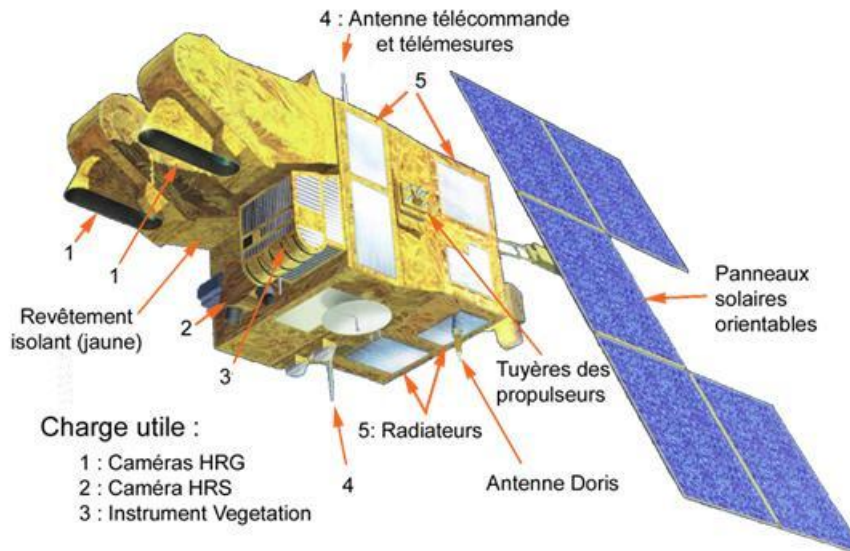
PROBA-V is not SPOT



- 200 x smaller
- 20 x lighter
- Developed in only 5 years
- Cost of only 60M€
- TMA instrument (3 cameras)
- No on-board calibration devices!



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HYPERBOLA Cutting through the orbital debris

Search results for "proba-v"



ADS-B air traffic signals successfully received by Proba-V

by David Todd on 18 June, 2013 in E&A, Science, Technology

While its main role is vegetation mapping, the European Space Agency's Proba-V spacecraft is also being used to carry an aircraft tracking payload. While primary radars can give direct positioning of aircraft by their radar returns, and transponders can give "squawk" identifying information, the latest improvement Automatic Dependent Broadcast – Surveillance (ADS-B) system.

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SEARCH

Search...



SPACETrak

The space industry's
leading events based launch
and satellite database

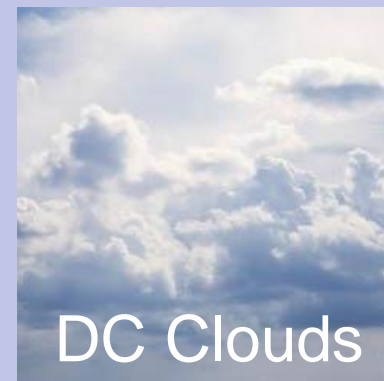
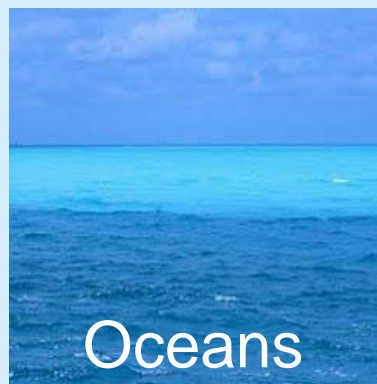


RC – IQC: Vicarious Calibration Concept

OSCAR* (Optical Sensor Calibration with simulated Radiances)

- » Combines methods (Livens *et al.*, 2010)
- » Verifies requirements

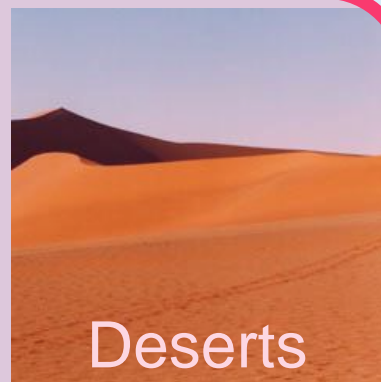
Absolute



Interband



Multi Angular



Deserts

RC-IQC: First results

- » Work in progress!
- » First calibration report by end of August
- » Focus on Deserts, Clouds trends
- » Special calibrations : Linearity check, Moon

Requirements

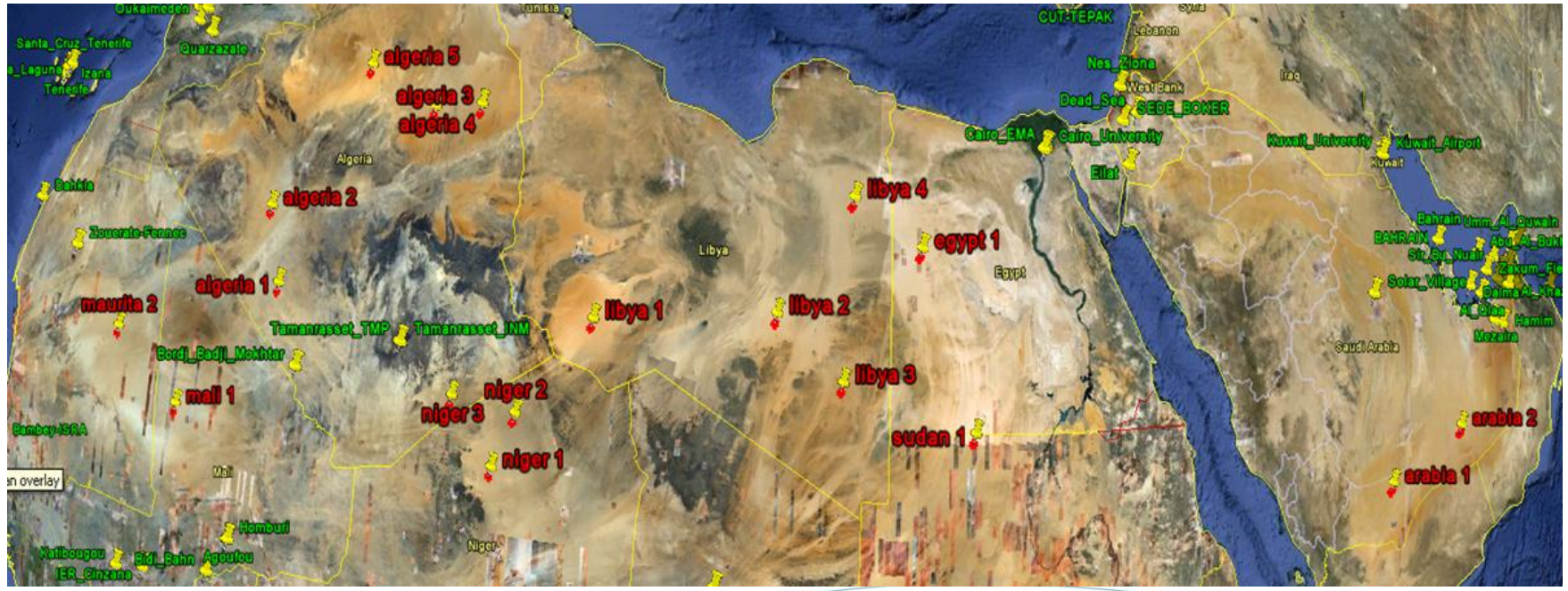
- » 5 % absolute accuracy
- » 3 % relative accuracy
 - » inter-band
 - » multi-temporal

Desert calibration

Target: stable, homogenous desert sites

Method: compare TOA radiances to **simulated** values

Usage : Operational absolute calibration for all bands , cross mission calibration, multi-temporal



Desert calibration

Target: stable

Method: cor

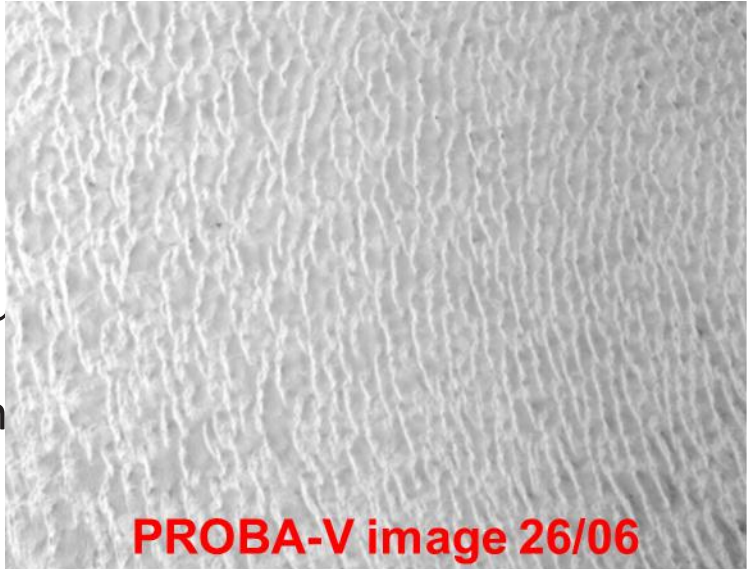
Usage : Ope

multi-ten

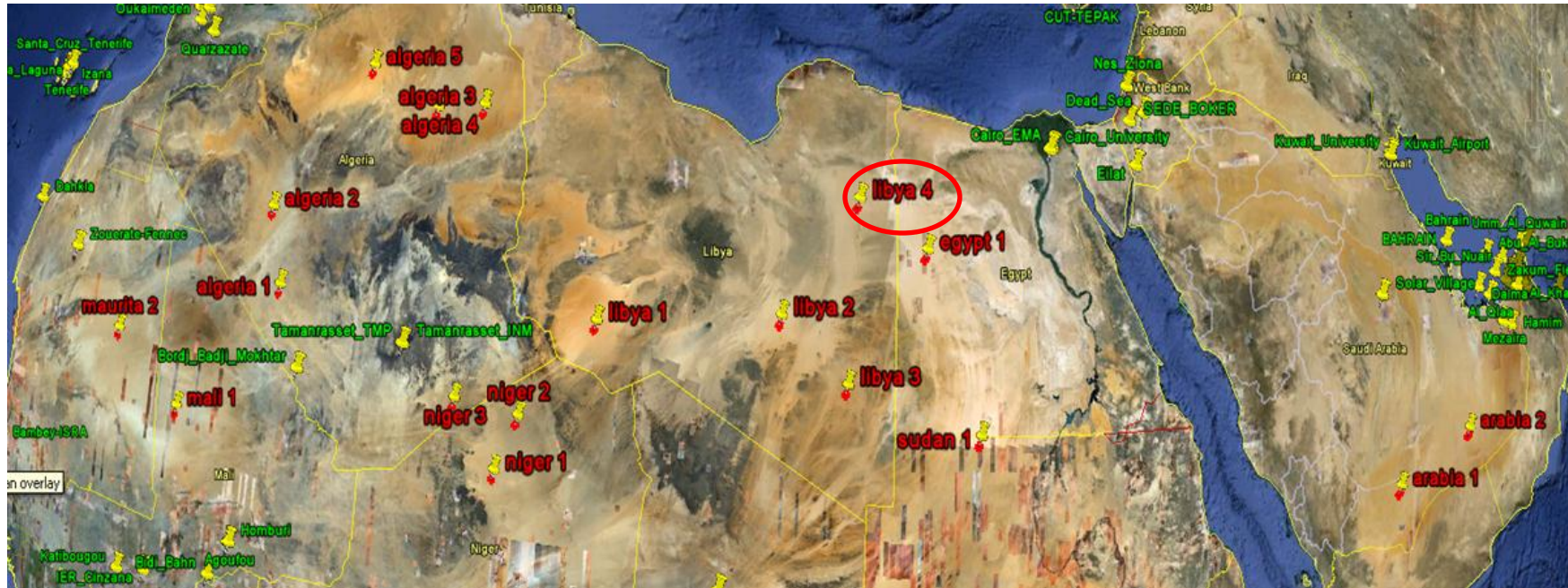


valu

ban



PROBA-V image 26/06

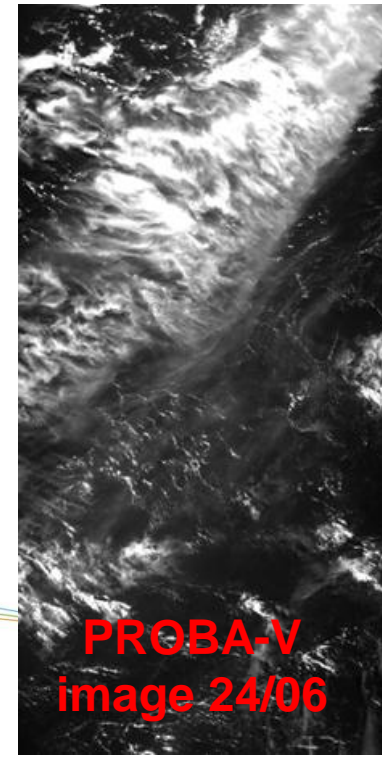
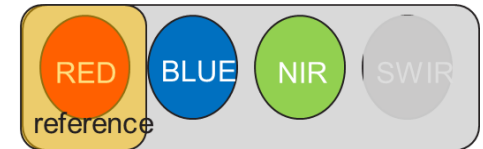


Deep Convective Clouds calibration

Target: reflection of deep convective clouds over oceans

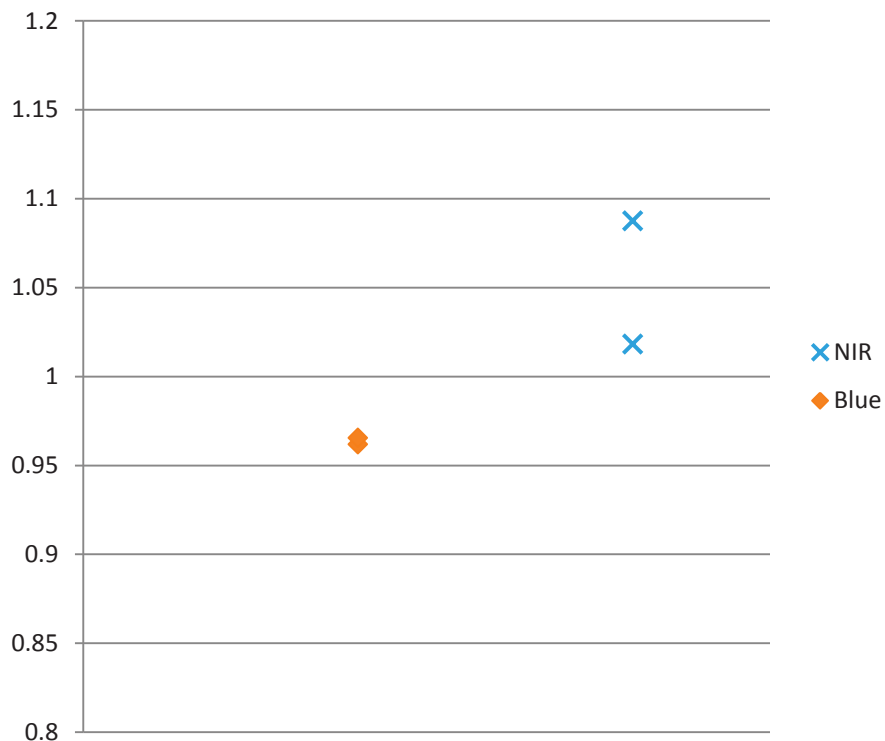
Method: Compare PROBA-V TOA data to **simulated** data using RED reference band to retrieve cloud optical thickness”

Usage: inter-band (absolute if combined)

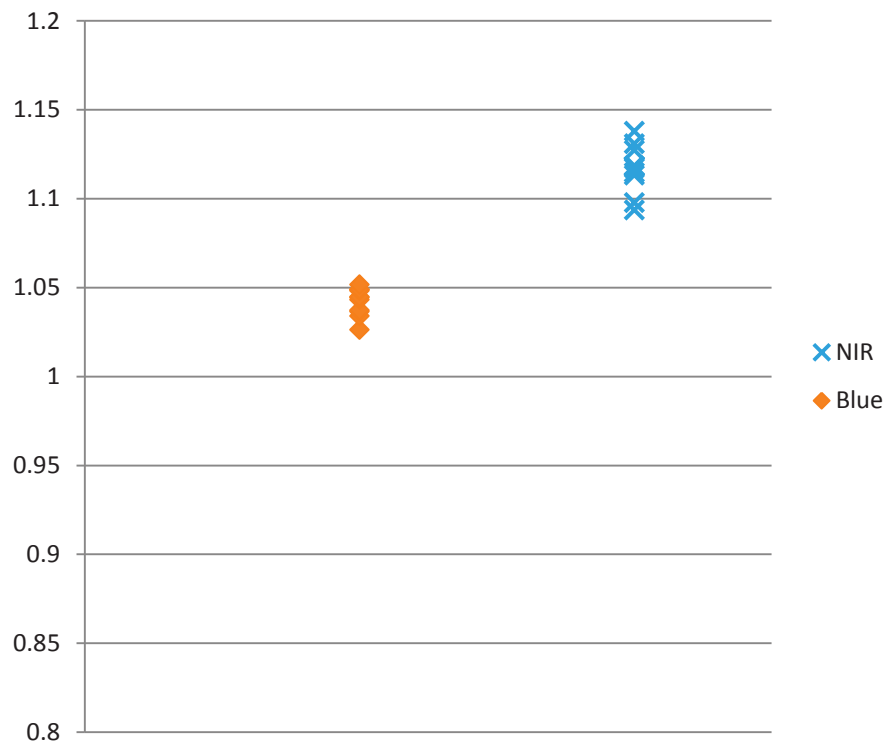


Clouds/Desert calibration (inter-band)

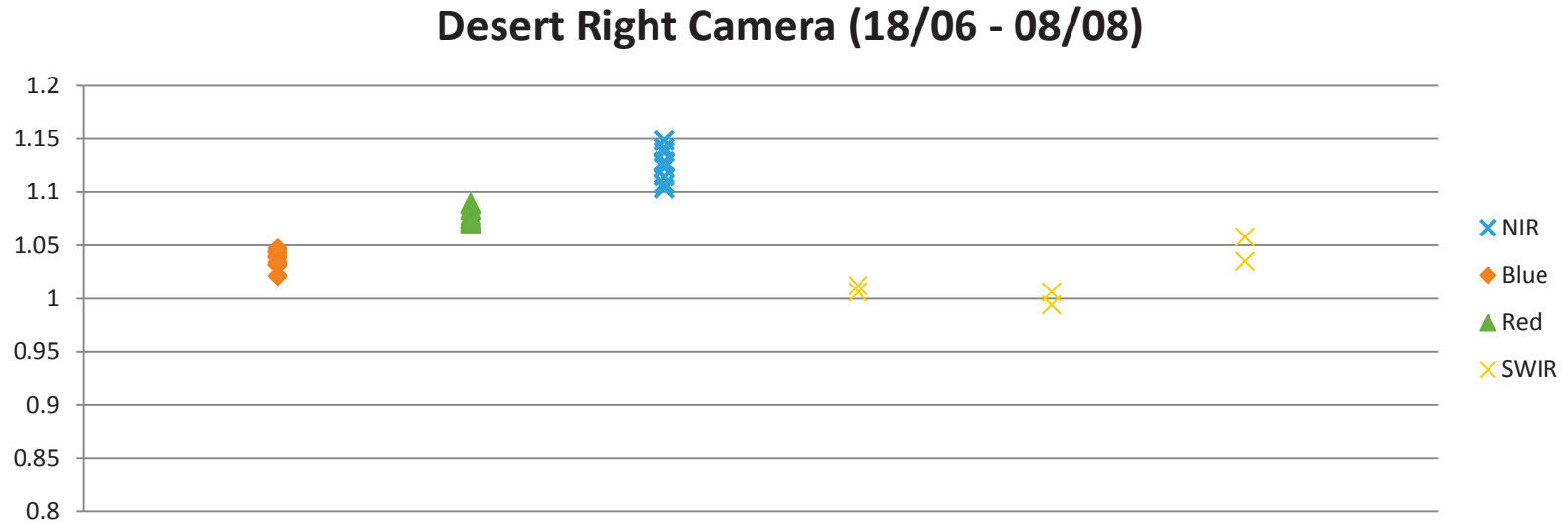
Clouds Right Camera (18/06 - 08/08)



Desert Right Camera (18/06 - 08/08)



Desert calibration (absolute)



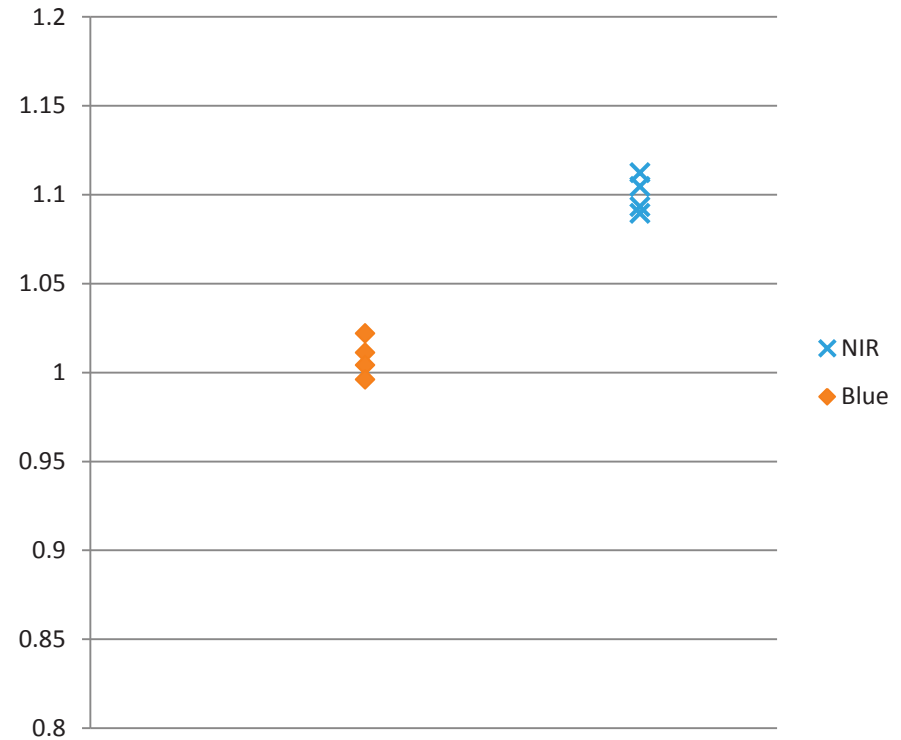
- » All observations on Libya-4
- » Blue and Red: some deviation but very stable (3%)
- » NIR: stronger deviation and more scattered (5%)
- » SWIR: few observations (ROI extraction issue)

Clouds/Desert calibration (inter-band)

Clouds Center Camera (18/06 - 08/08)



Desert Center Camera (16/05 - 08/08)



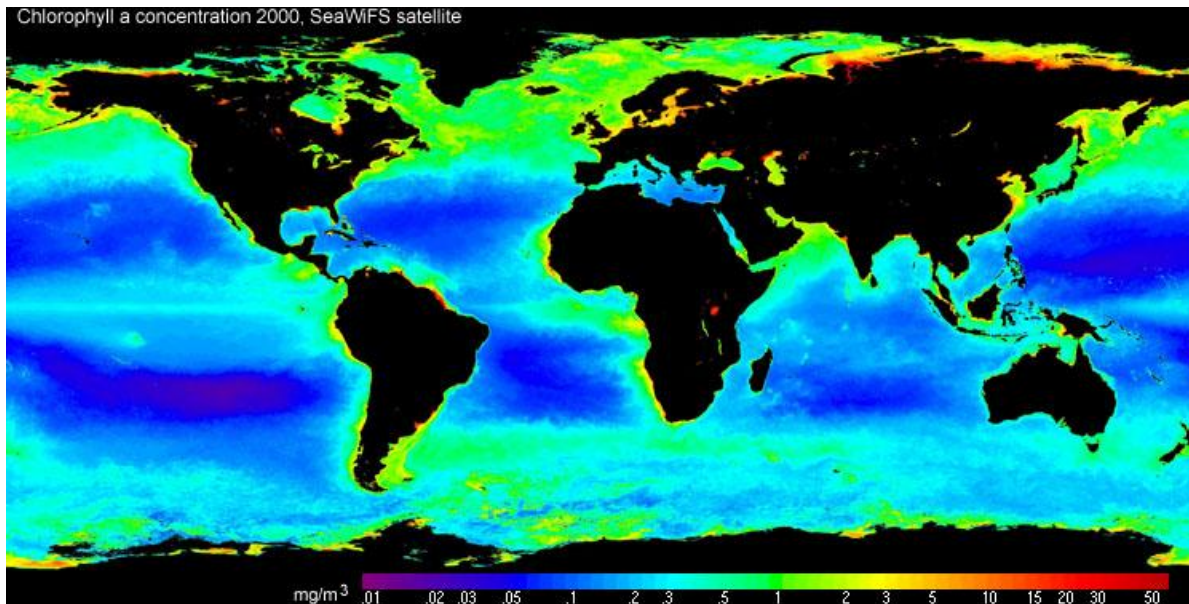
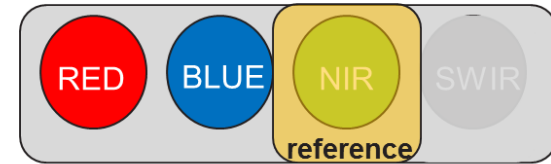
Same trend in Clouds as in Desert

Rayleigh calibration

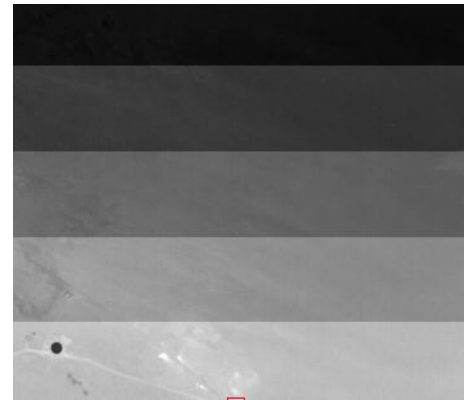
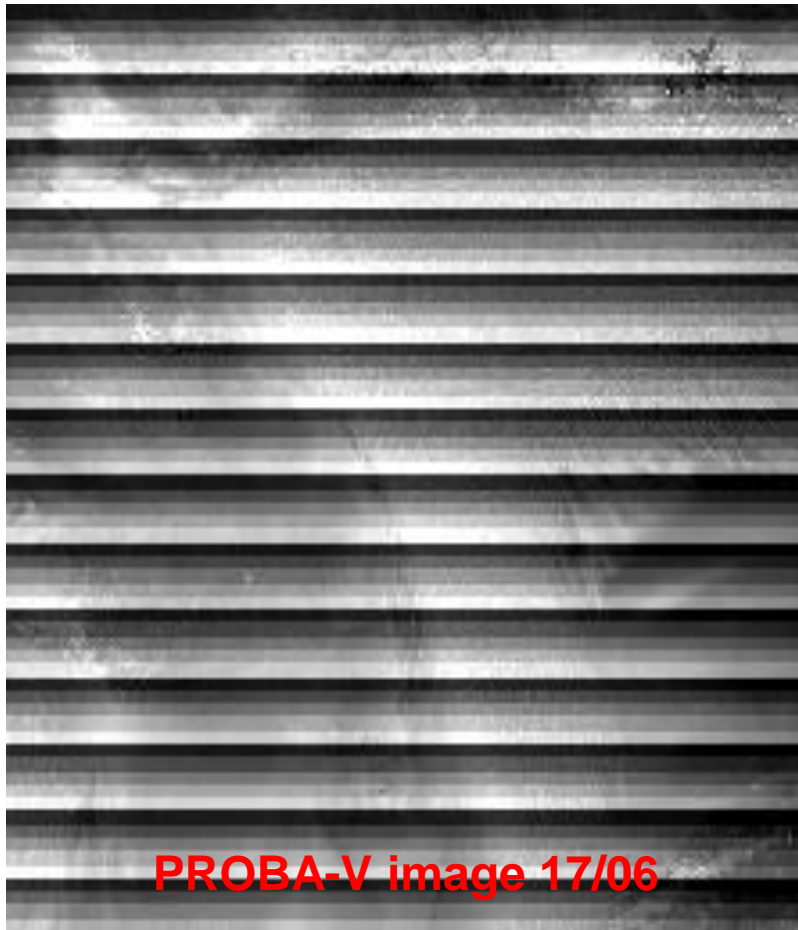
Target: stable, homogenous oceans

Method: compare TOA radiances to **simulated** values,
using NIR band to retrieve aerosol optical thickness

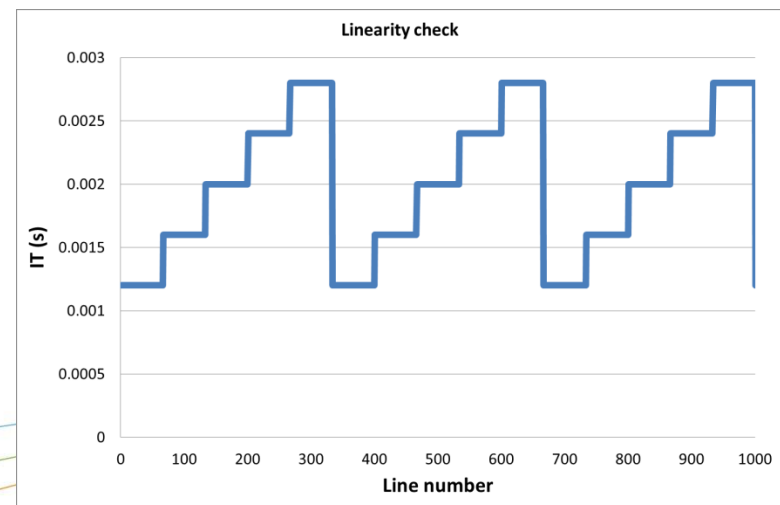
Usage : Operational absolute calibration, for RED and BLUE
combine with inter-band to transfer results to NIR, SWIR



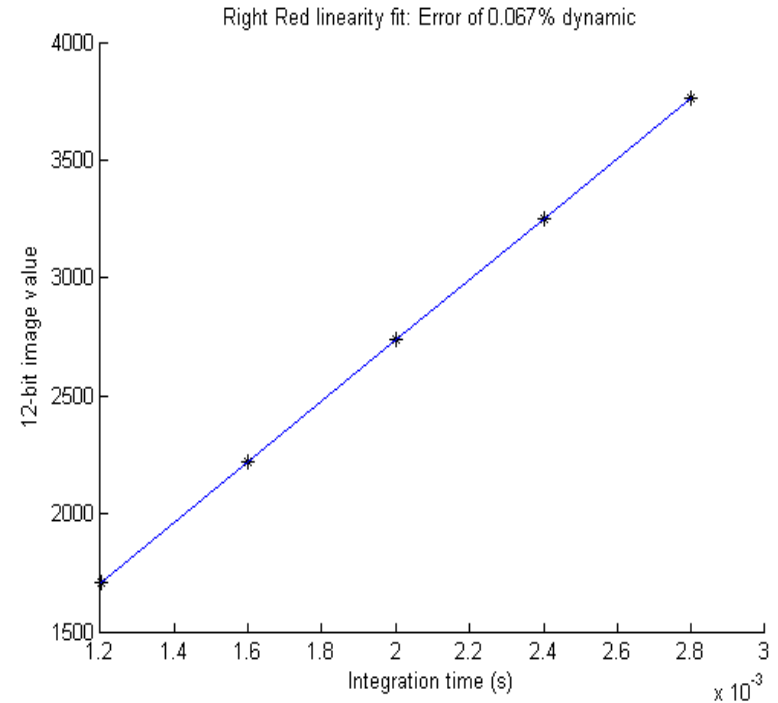
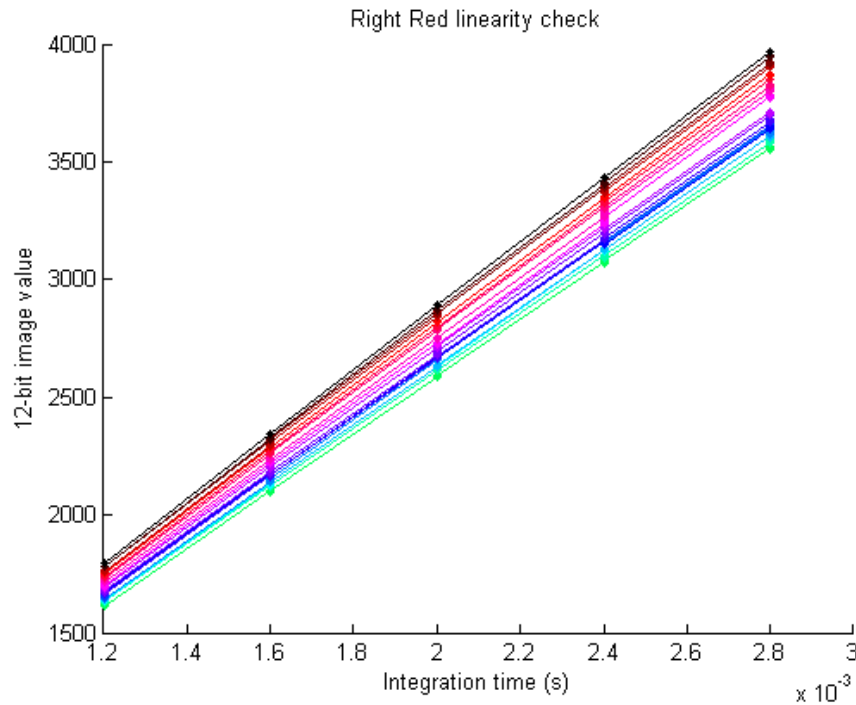
Experimental calibrations : the linearity check



Integration time changes in steps over homogenous areas

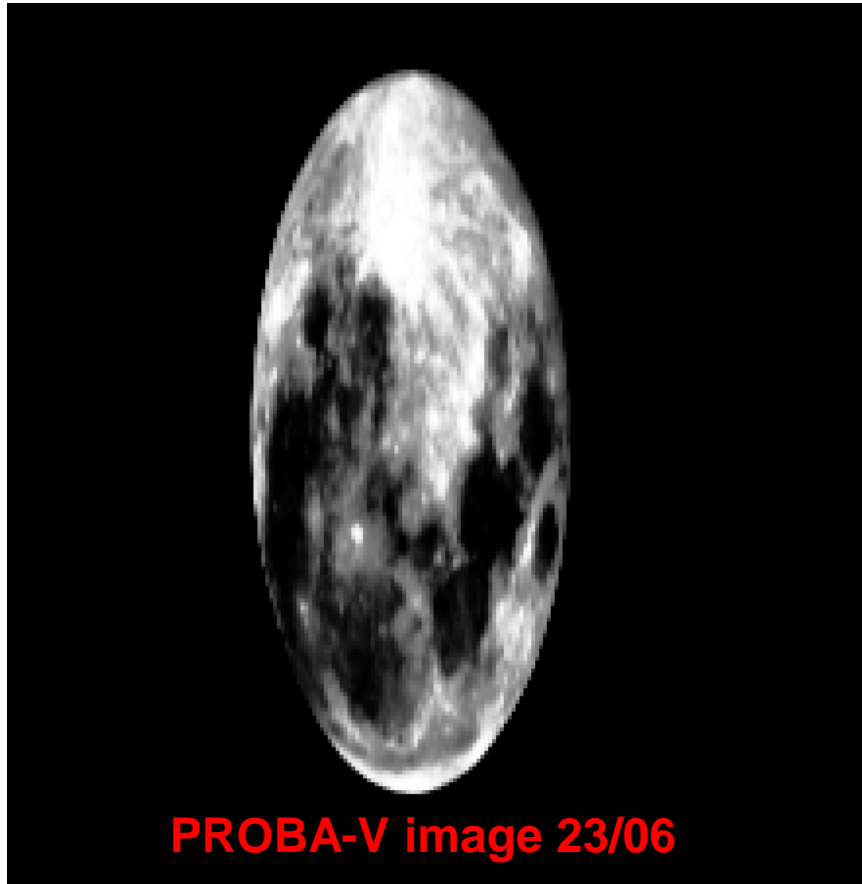


Linearity check (libya-4 desert)



- » Left plot: Sweeps of line averages
- » Right plot: Average result per integration time, and linear fit
- » 0.067% dynamic = 2.7 out of 4095
- » Still to be done for Blue and SWIR

Lunar Calibration



Moon = stable over thousands of years

Usage : stability monitoring



Implementation :

- Compare full disc reflectance and compare with lunar model (like ROLO)
- Monthly acquisition at same phase angle to reduce uncertainty

Other usage :

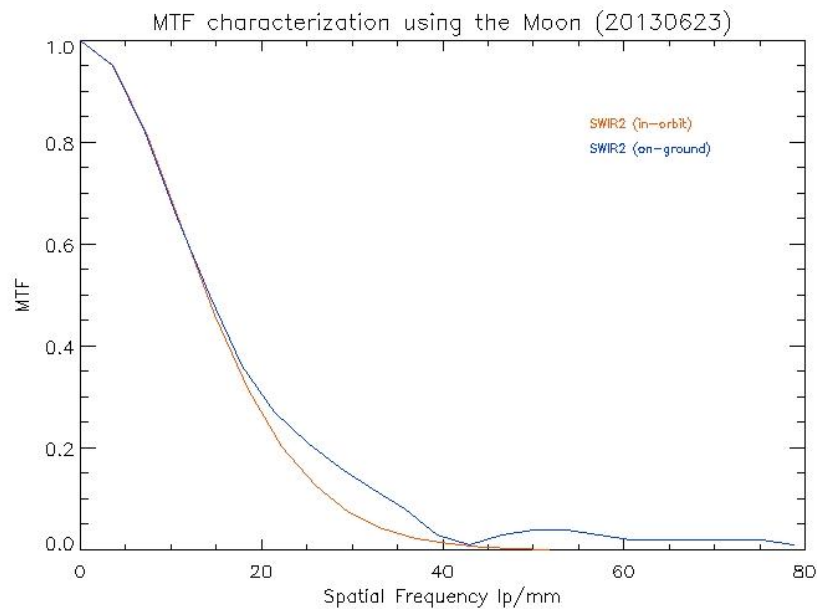
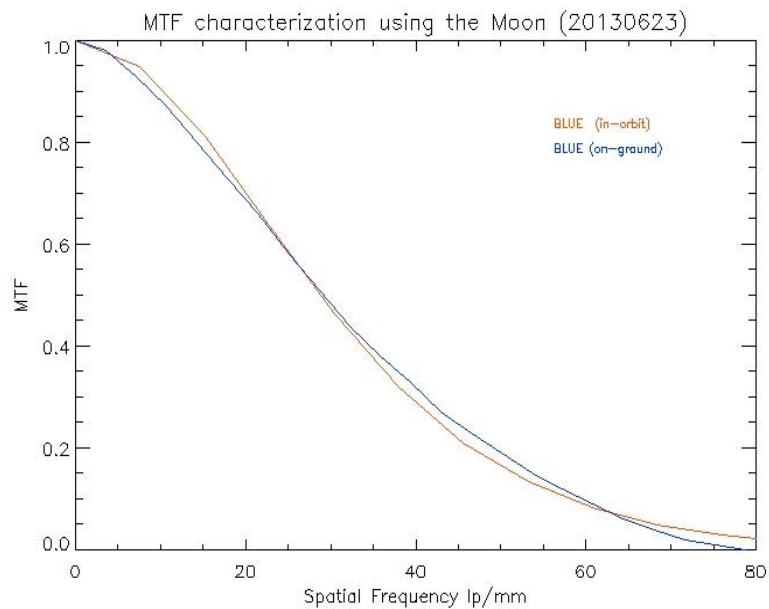
- MTF
- Dark current validation
- Straylight assessment



Lunar MTF assessment



- Based on MODIS approach (Wang et al. , SPIE 2011)
- Adapted by ESA (edge oversampling on a circular edge)





SWIR multi-angular issue



- Striping noticed in the SWIR data
- Analysed by instrument partner as a PRNU effect. Correction proposed



BEFORE CORRECTION



AFTER CORRECTION



SWIR multi-angular issue



- 70% of such striping pixels also has larger dark current
- About 0.6% of all pixels affected
- New dark current and PRNU coefficients provided by instrument partner
- Currently stability monitoring is being done

RC-IQC: Ongoing tasks

- » Desert, clouds: More statistics
- » Sun Glint calibration and Rayleigh
- » Multi-angular calibration (SWIR!)
- » MTF comparison with Landsat-8
- » Special calibrations : Multi-temporal analysis on moon

Requirements

- » 5 % absolute accuracy
- » 3 % relative accuracy
 - » inter-band
 - » multi-temporal

Questions?

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Publications

Adriaensen, S., et al. (2012). “CEOS IVOS WG4 intercomparisons”, [CEOS Cal/Val Portal](#).

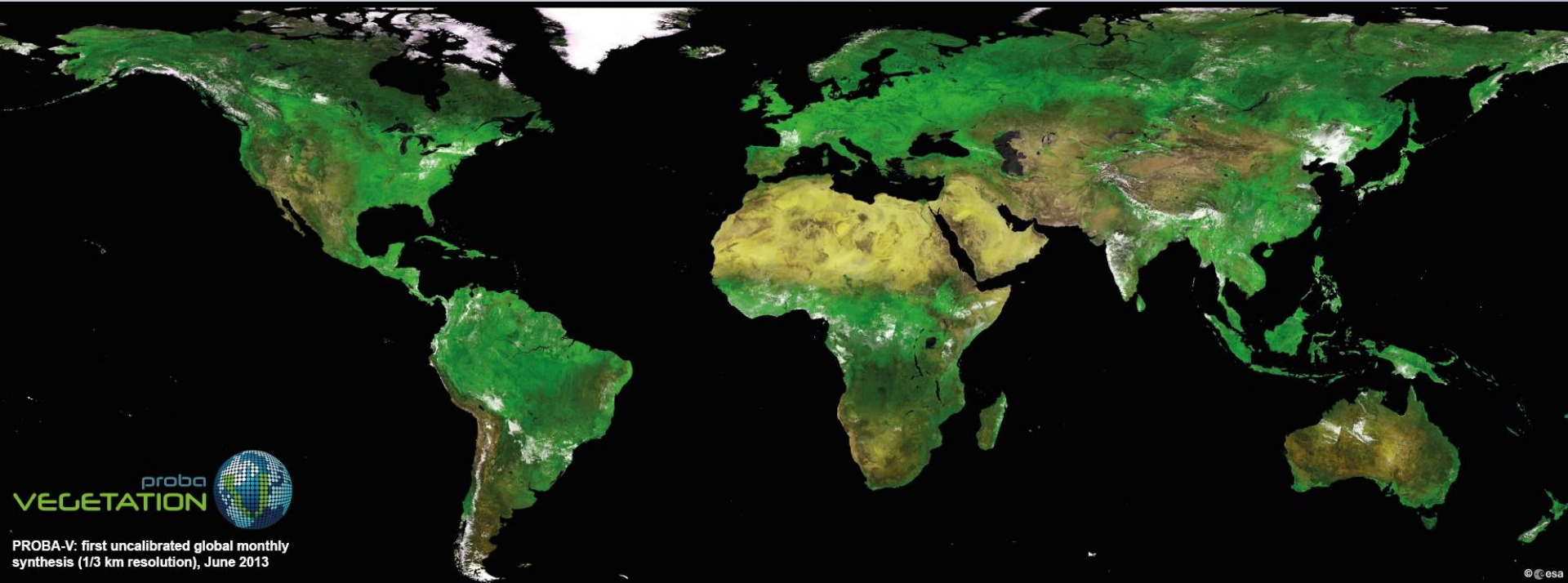
Govaerts, Y., S. Sterckx, S. Adriaensen (2013). “Use of simulated reflectances over bright desert target as an absolute calibration reference”. *Remote Sensing Letters* **4:6**, pp. 523-531.

Livens, S., et al. (2010). “Multiple vicarious calibration using combined accuracy estimation.” *SPIE Proceedings* **7826**.

Sterckx, S. , S. Livens, S. Adriaensen (2013). “Rayleigh, Deep Convective Clouds, and Cross-Sensor Desert Vicarious Calibration Validation for the PROBA-V Mission”. *IEEE Transactions on Geoscience and Remote Sensing* **51: 3**, pp.1-16.

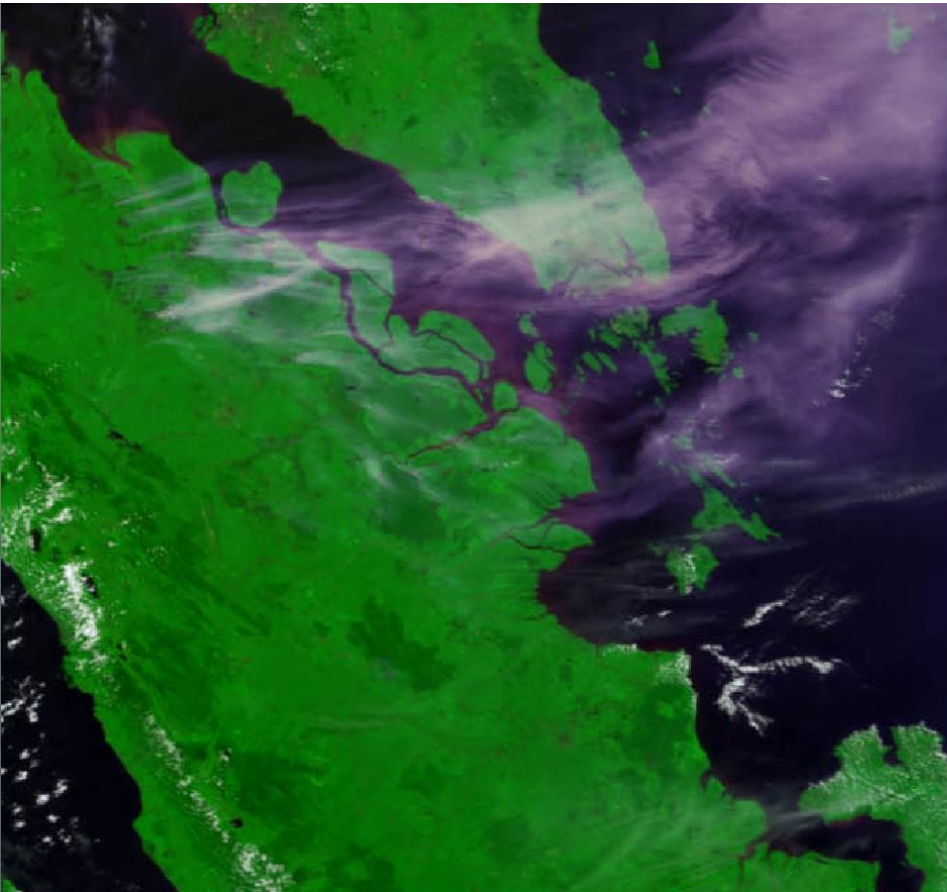
Sterckx, S. , I. Benhadj, et al. (in press). “The PROBA-V Mission: Image Processing and Calibration”. *International Journal of Remote Sensing*.

Thank you!

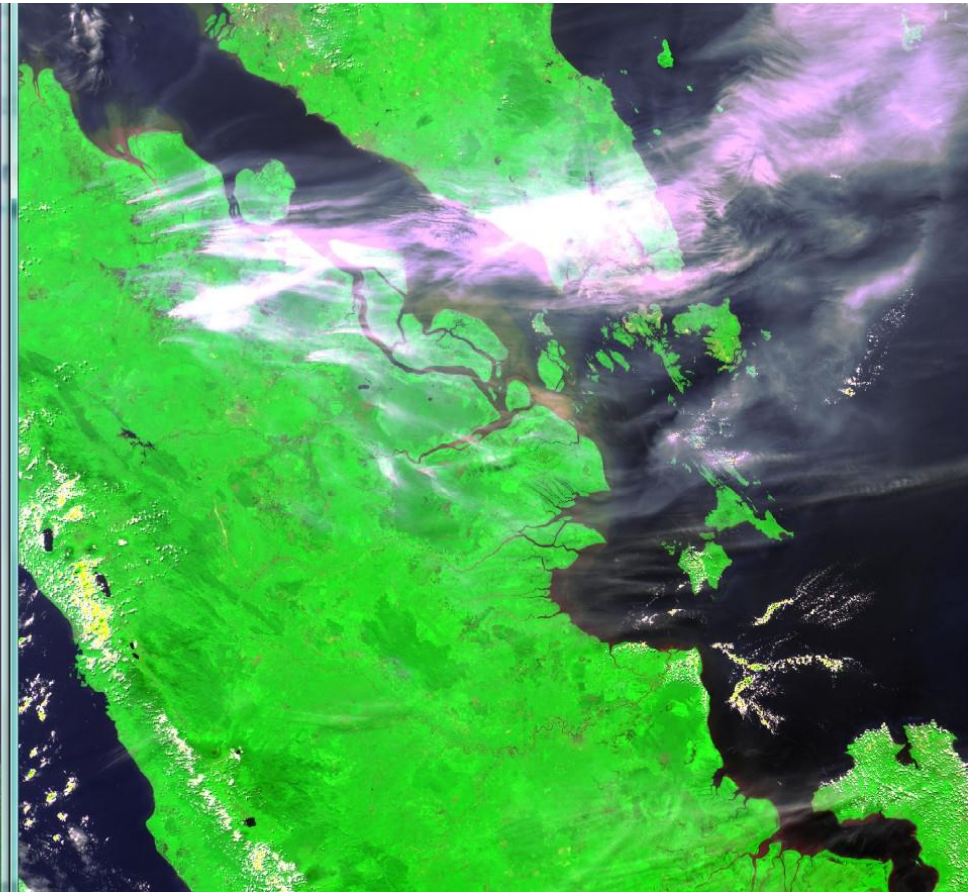


The VITO PROBA-V team

From 1km to 1/3 km resolution: Sumatra fires with plume extending over Singapore and Malaysia



SPOT-VGT 1 km



PROBA-V 1/3 km

SPOT- VGT

15 May 2013

1km projected

Proba-V first image

15 May 2013

100m unprojected

