Image Quality monitoring For Vegetation Sensors

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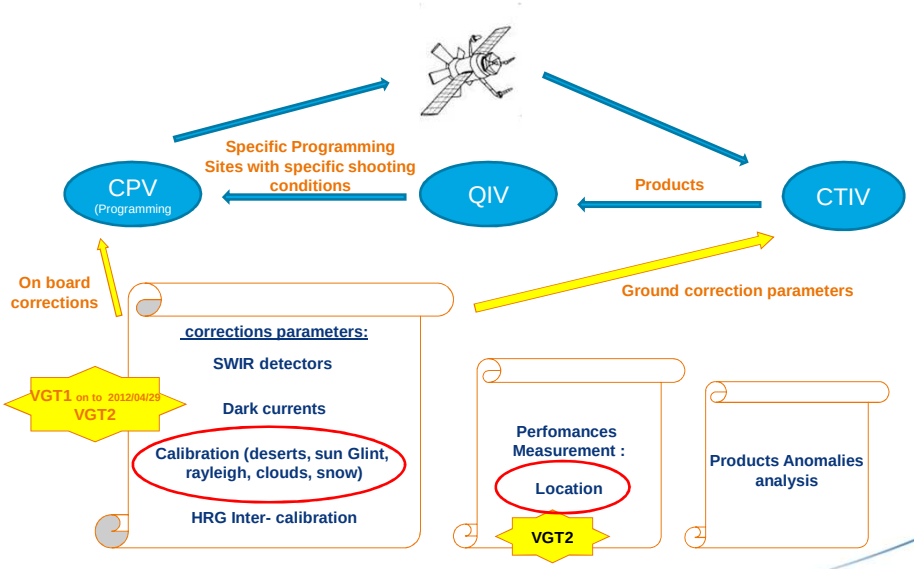
CNES background in image quality monitoring of operational Earth observation systems

- **Since the launch of SPOT1 in 1986, CNES has cumulated more than 130 years of in-orbit sensors quality monitoring**
  - **SPOT1, SPOT2, SPOT3, SPOT4, SPOT5 (HR)**
  - **VGT 1 & 2**
  - **POLDER 1&2, PARASOL**
  - **Scarab 1&2, Scarab on Megha Tropiques**
  - **Calipso/IIR**
  - **Helios series**
  - **Pleiades 1A&1B**
  - **IASI1 & 2 On METOP A&B**
  - **Madras, Saphir on Megha Tropiques**
- **Different resolution, different types of mission, different thematic…**
  - **Different skills to develop (geometry, radiometry, MTF, polarized geometry…)**
  - **Different tools (as generic as possible)**

15 Years Operational Global VEGETATION monitoring - Antwerp – July. 4-5, 2013

Vegetation Image Quality Missions



Summary

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- ***Location Performances***
- *Vegetation calibration*
- *Perspectives and Conclusion*

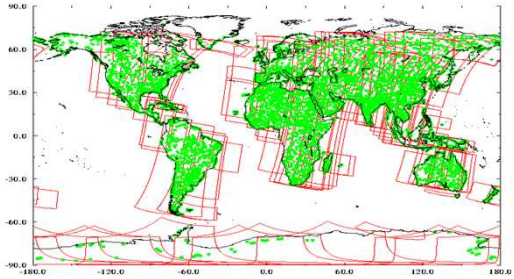
Location Performance Measurement

To allow :

- very accurate multitemporal registration required for VGT1
- Monthly monitoring of location performance

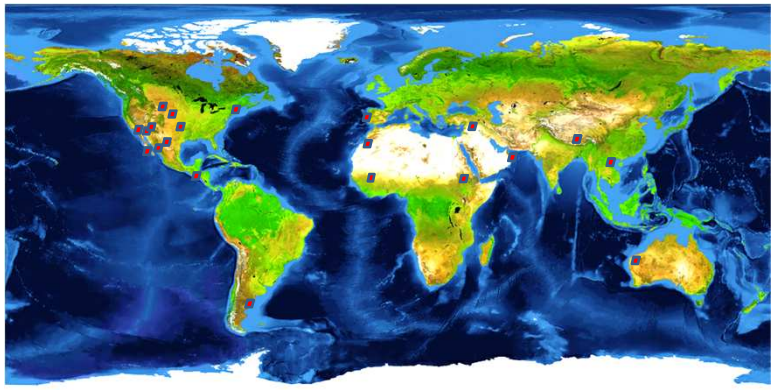
➔ Before VGT1 launch, generation of a global **Ground Control Points (GCP) data base** using space triangulation method

- using SPOT Images localised at 100 meters
- resolution degraded to allow correlation with VGT images
- the main part of database used for geometric corrections at CTIV
- a selected group of ground control points reserved for monitoring at QIV



Location Performance Measurement

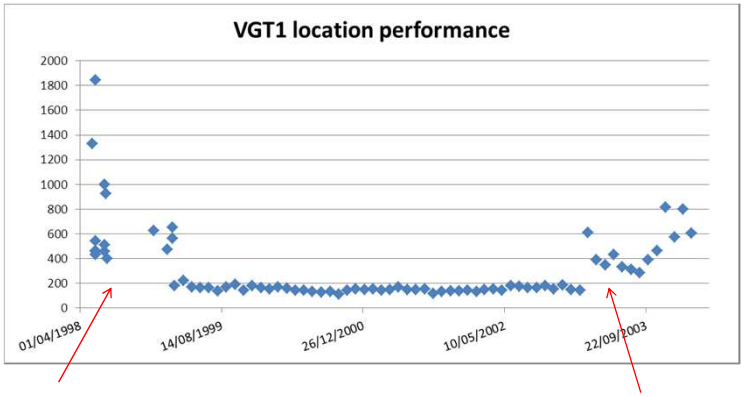
20 reference sites (not used in VGT1 geometric corrections)



- Measurements made twice a month
- Correlation between ground control points and VGT images on selected sites

VGT1 location performance

Specification required location performance less than 500 m

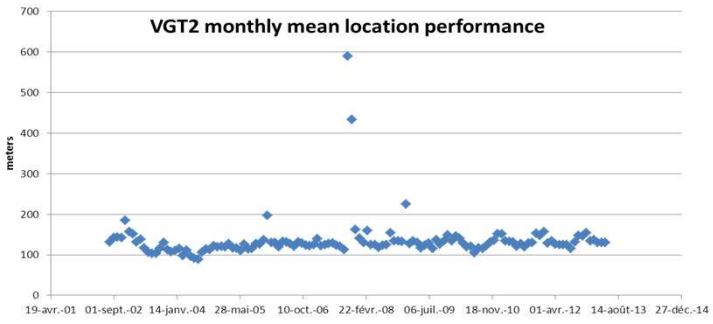


Commissionning phase and
Processus optimisation phase

End of GCP correction in CTIV

VGT2 location performance

Specification required location performance less than 500 m



Few déviations due to the lack of star trackers information

Summary

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Vegetation radiometric calibration activities

Since 1990's, CNES has developed different calibration methods over natural targets for visible and NIR optical sensors.

- Rayleigh scattering over ocean
- Sun glint over ocean
- Deep convective clouds (DCC)
- Stable African deserts
- Antarctica (Dome C area)
- Lunar calibration (pléiades)
- Autonomous calibration station (for high resolution sensors)

Each method has its own spectral validity and need some times another sensor as reference

•Most of them are used on an operational basis

- Monitoring the CNES sensors calibration (SPOT(s), VGT(s), POLDER(s), Pleiades(s)…)
- Monitoring of other agencies sensors (MERIS, MODIS, SeaWiFS, AVHRR, Formosat2, Kompsat2, Theos, SPOT6, …)

Vegetation radiometric calibration activities

In-flight (commissionning and exploitation phase) absolute calibration was performed using different methods :

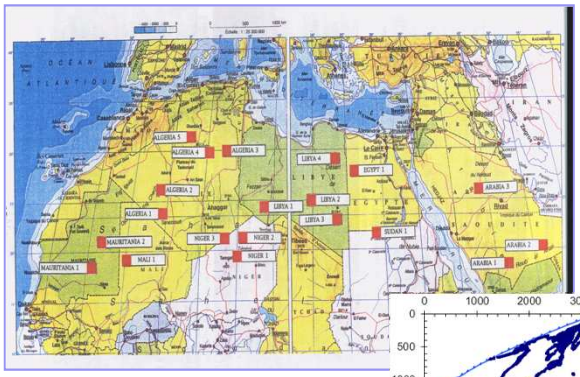
- Rayleigh scattering over ocean
- Sun Glint Interband calibration
- Clouds interband calibration
- Intercalibration over desertic areas
- On board calibration device

Monthly calibration monitoring made using the on-board lamp calibration device
Intercalibration over desertic area every month (daily acquisition)
Ocean Campaign once or twice a year over Rayleigh and sun glint areas
Every year acquisitions over Antarctica

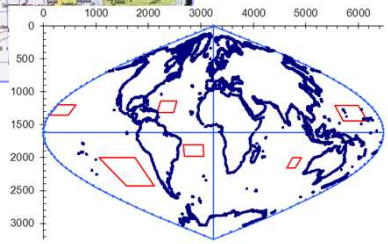
➔ Procedure well validated with *VGT1*

Updated calibration coefficients delivered each month to CTIV

Vegetation radiometric calibration activities



Desert Sites



Rayleigh Sites

VGT radiometric Calibration method

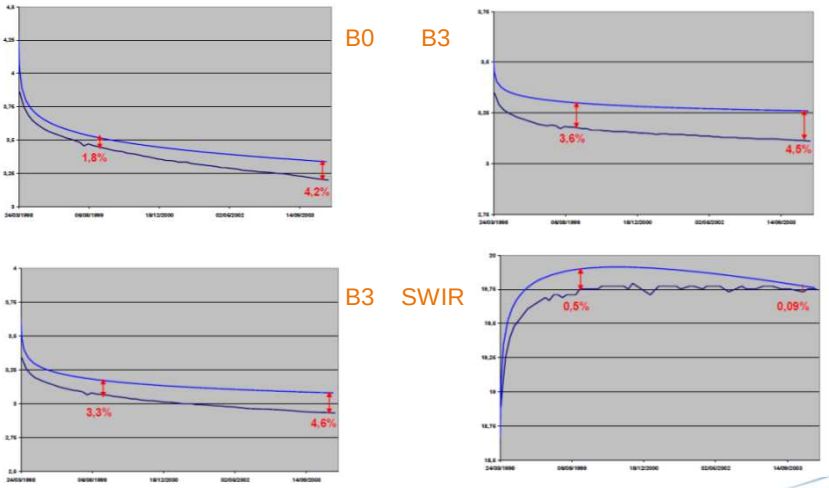
VGT1

On-board calibration device proved to be efficient for the VGT1 calibration monitoring (6 years) thanks to regular comparison to vicarious calibrations
➔ till 2004

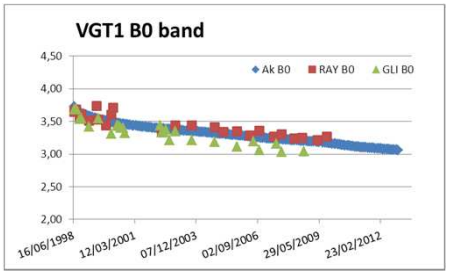
In 2007, the VGT1's calibration was fully reprocessed, using intercalibration over desertic area with a reference to VGT2 (insure a good continuity between VGT1 and VGT2 from 2002 to 2003).
3 deliveries made to CTIV :
➔ 1 in 2008 : the first reprocessing of vgt1's data from 1998 to 2003
➔ 2 in 2009 : data from 2004 to 2009
➔ 3 in 2011 : data from 2009 till end of life

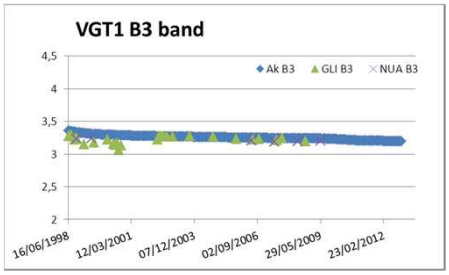
VGT radiometric Calibration method

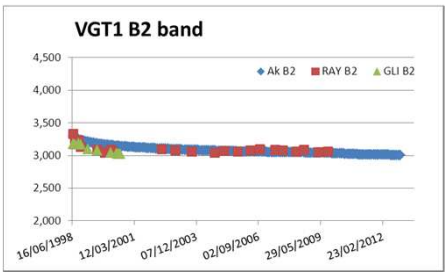
VGT1
Comparison between version 1 and 2 of calibration

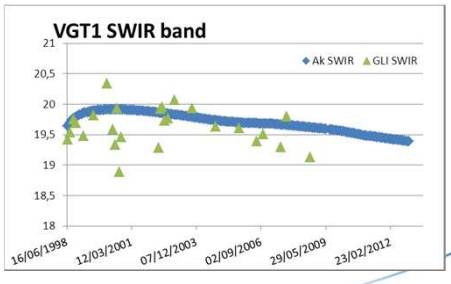


VGT radiometric Calibration method









VGT radiometric Calibration method

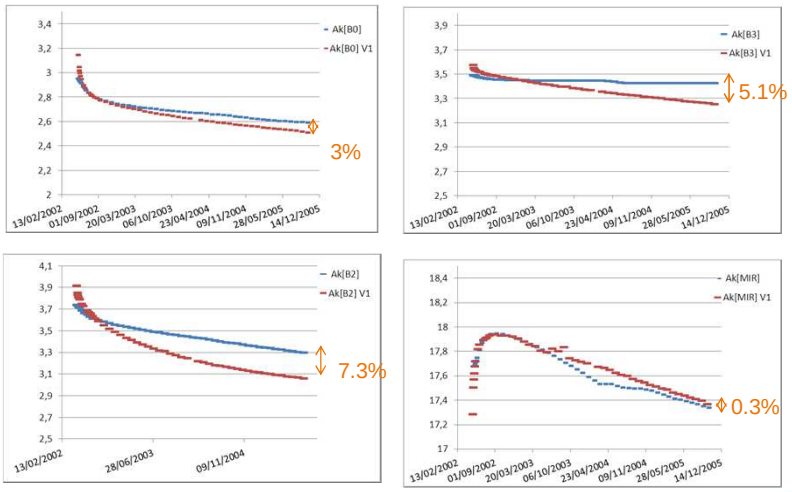
VGT2

No anomaly detected during VGT2 commissioning period (6 months): some discrepancies with vicarious calibration but in the order of magnitude of the methods accuracy

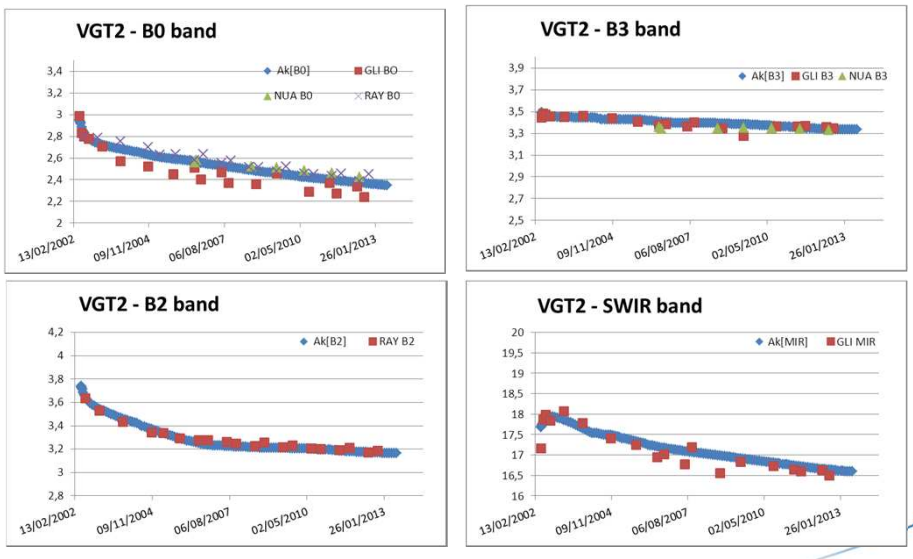
After 3 years in orbit, calibration errors confirmed by vicarious methods, impacting mainly B3.
➔ Switch to an operational monitoring over desert sites
➔ Reprocessing of all calibration coefficients since launch, delivered to CTIV

VGT radiometric Calibration method

VGT2 - Comparison between version 1 and 2 of calibration

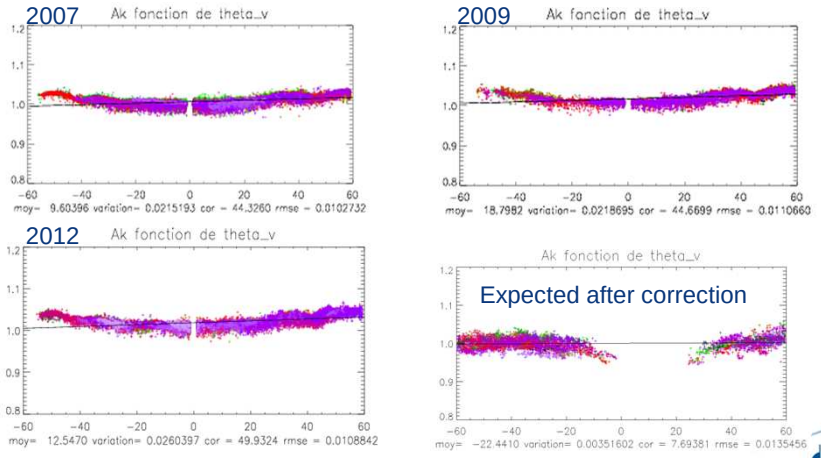


VGT radiometric Calibration



VGT radiometric Calibration method

VGT2 : the “smile” effect of B0
The B0 calibration coefficient shows dependancies to viewing directions for Rayleigh and clouds methods



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Conclusions and perspectives

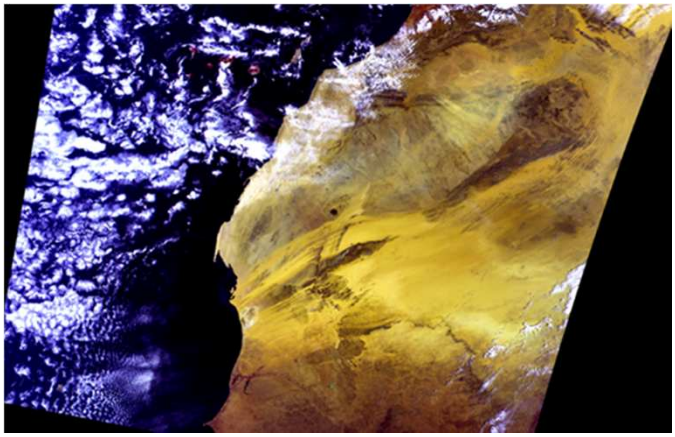
Conclusions

- Good performances of Vegetation sensors , simple , robust
- Daily monitoring easy : thanks to CTIV 's good behavior (easy data access, subscriptions, …) and to VITO's team

Perspectives

- Reprocessing : CNES will generate new calibration coefficients for both VGT1 and VGT2 :
  - Taking care of last calibration campagne
  - Insuring coherence with SPOT4 and SPOT5 sensors
  - Correcting smile effect and other small dependencies
  - Objective : 3rd quarter of 2014

Thanks you for your attention !



1rst VGT2 image

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