CEOS IVOS Sub-group
(Infrared, Visible and Optical Sensors)

Report to CEOS WGCV 34

Chair: Nigel Fox
National Physical Laboratory
UK

with support from UKSA

IVOS MISSION statement

Mission

“To ensure high quality calibration and validation of infrared and visible optical data from Earth observation satellites and validation of higher level products”

IVOS Terms of Reference

1. Promote international and national collaboration in the calibration and validation of all IVOS member sensors.
2. Address all sensors (ground based, airborne, and satellite) for which there is a direct link to the calibration and validation of satellite sensors;
3. Identify and agree on calibration and validation requirements and standard specifications for IVOS members;
4. Identify test sites and encourage continuing observations and inter-comparison of data from these sites;
5. Encourage the preservation, unencumbered and timely release of data relating to calibration and validation activities including details of pre-launch and in flight parameters.
6. In the context of calibration and validation encourage the full consideration of "traceability" in all activities involved in the end-to-end development of an EO product including appropriate models and algorithms.

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Operational Structure Modified after IVOS 23 (April 11) see work plan

- **Agency reports to be encouraged but not presented except in exceptional circumstances or if a new member.**
- **Detailed Technical theme each meeting (0.5 – 1 day)**
- **Community technical workshops ~ tri-annual**
- **Theme Champions**

Sector themes:

- Land (reflectance) – Chander USGS
- Ocean (reflectance) colour – Zibordi JRC
- Surface temperature – Corlett Uof Leic

Also more general activities at plenary
e.g. sensor pre-flight calibration

Cross-cutting

- Atmospheric corn – Thome NASA
- Geo/Spatial Quality – Helder UofSD
- Geometric image Quality – TBD
- Sensor to Sensor biases – Fox NPL
- RT code – Widlowski JRC
- Communication/portal – Goryl ESA

- **IVOS as Conduit for existing "community expert groups" - Need to increase engagement**
- **Serving Cal/val needs of constellations - e.g. org of comparison, interface to CEOS**

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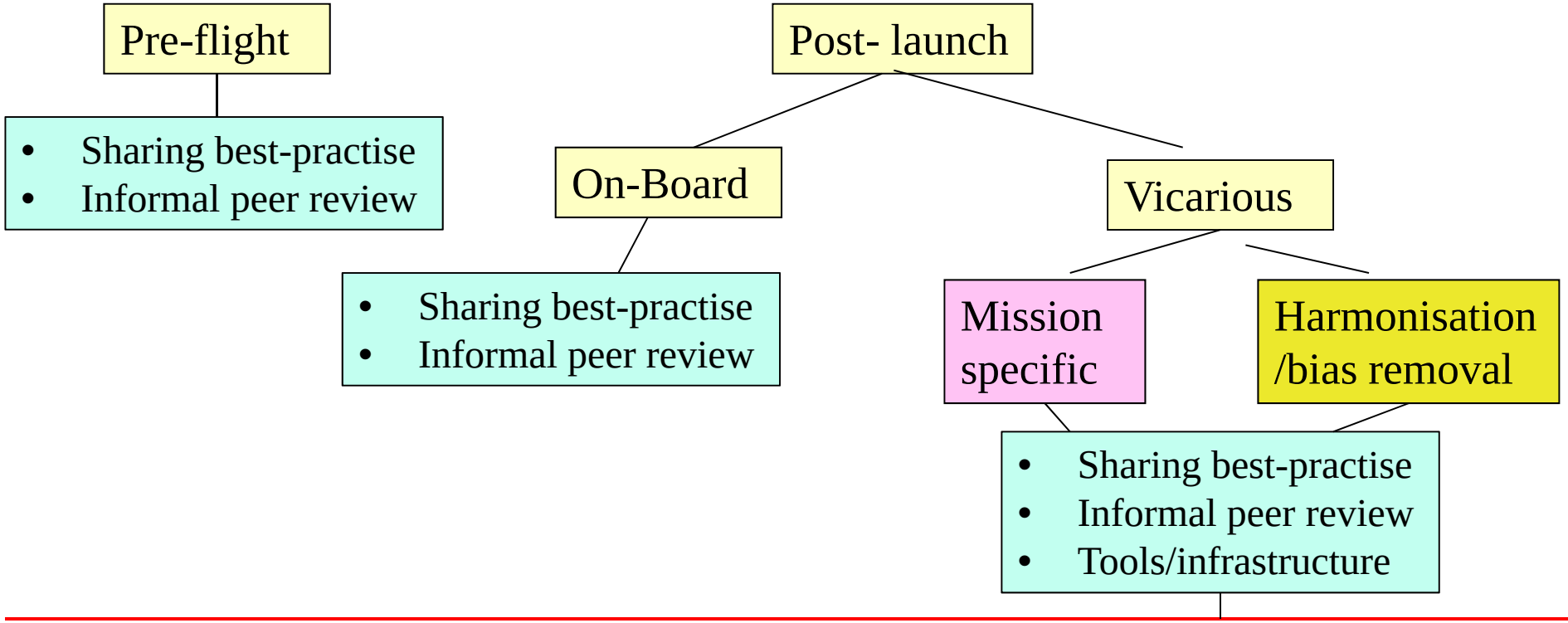
Work plan for optical sensors: (land/ocean)



- Consistency
- Cost
- Suitability
- Usability

- Comparisons
- Traceability

IVOS: Vision

To facilitate the provision of 'fit for purpose' information through enabling data interoperability and performance assessment through an 'operational' CEOS coordinated & internationally harmonised Cal/Val infrastructure consistent with QA4EO principles.

- *Pre-flight characterisation & calibration*
- *Test – sites*
- *Comparisons*
- *Agreed methodologies*
- *Interchangeable/readable formats*
- *Results/metadata - databases*

Key Infrastructure to be established and maintained independent of sensor specific projects and/or agencies

CEOS IVOS 24

May 8-10 2012

USGS – EROS Center / South Dakota State University

- Attendees: 32
- Highly productive
- Team well motivated to coordinate and deliver an international shared work plan
- Various intra-meeting activities
- Identified various challenges where CEOS agency support is needed (~14 Recs)

- IVOS 35 to be hosted at ESA ESRIN Frascati Mar 19-21 2013
- IVOS workshop on 'Libya 4' CNES Paris Oct 4-5 2012
- IVOS workshop on sensor "pre- and on-board" Cal/Val Sep/Oct 2013 (linked to SPIE Europe)

24 th Meeting: objectives

Information exchange and facilitating international collaboration on Cal/Val related activities

- **Review actions/progress on work plan/activities**
  - All sub themes
  - Conclude on strategy to establish land network of test sites for radiometric gain
  - Progress on comparisons and methodologies
  - Particular focus on ‘sensor to sensor to test site’ comparisons/methodologies and infrastructure
- **Interactions of IVOS with other CEOS/GEO activities**
  - WG-Climate
  - Constellations
  - GEO
- **Progress towards an internationally coordinated Cal/Val infrastructure**
  - QA4EO
  - Portal
  - Tools/systems/databases
- **workshop planning**
  - **pre-flight calibration strategies of sensors**
- **Membership, actions, and intra-meeting progress**

IVOS interactions with WGs and constellations etc

IVOS 24 Presentations and discussions from:

WG-Climate
LSI VC
OCR VC
SST VC

IVOS can:

- Provide access to advice on Cal/Val and common interface to CEOS
- Organise /coordinate access to comparisons /infrastructure for interoperability
- Support the development of 'best practises (QA)'
- Effective vehicle to share Cal/Val concepts between VC / WGs
- Single point of contact for CEOS for Cal/Val issues (up & down)

IVOS needs:

- Clear priorities / wish lists / requests from WGs/VCs
- Regular dialogue
- Support to obtain necessary Resources
- to know it is not duplicating

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Recommendation 1: Climate

Background:

- **GCOS requirements specify – accuracy & stability**
- **Interpretation and method/strategy for demonstration of stability, in particular, is thought to be inconsistent between ECVs and disciplines.**
    - **Reference to a mean over a measurement period?**
    - **“ a baseline measurement at start?**
    - **Expressed as +- or an assumed bias/trend?**
    - **How is uncertainty of reference assessed?**
    - **Derived from trend of overlapping data sets**
        - **Uncertainty of linkage / natural variability / duration of overlap**
        - **….**

Recommendation:

- **Subject to confirmation of issue from WG-C establish a joint task group of WG-C and WGCV and GCOS? to develop a consistent approach for ECVs that is fit for purpose/transparent & consistent with QA4EO principles.**
- **Could be addressed as QA4EO CEOS action.**

Post launch cal val

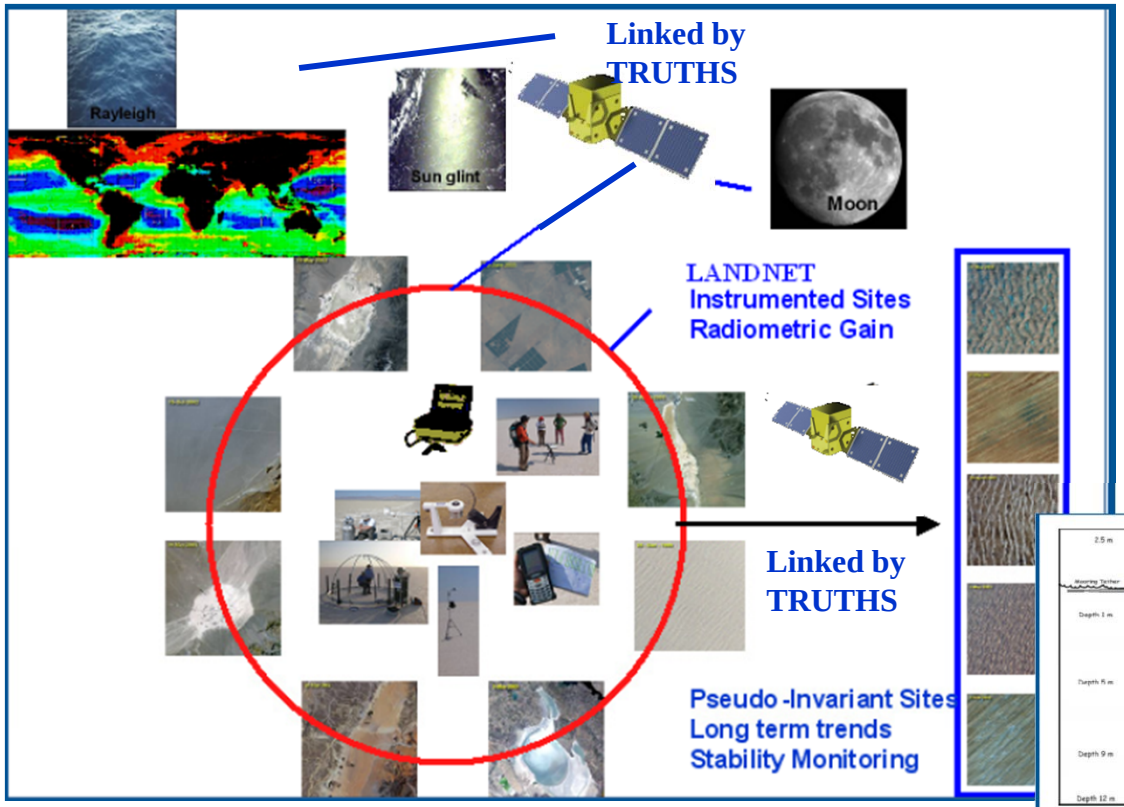
Interoperability

Bias assessment/removal

Sensor drift monitoring/correction

End to end performance check

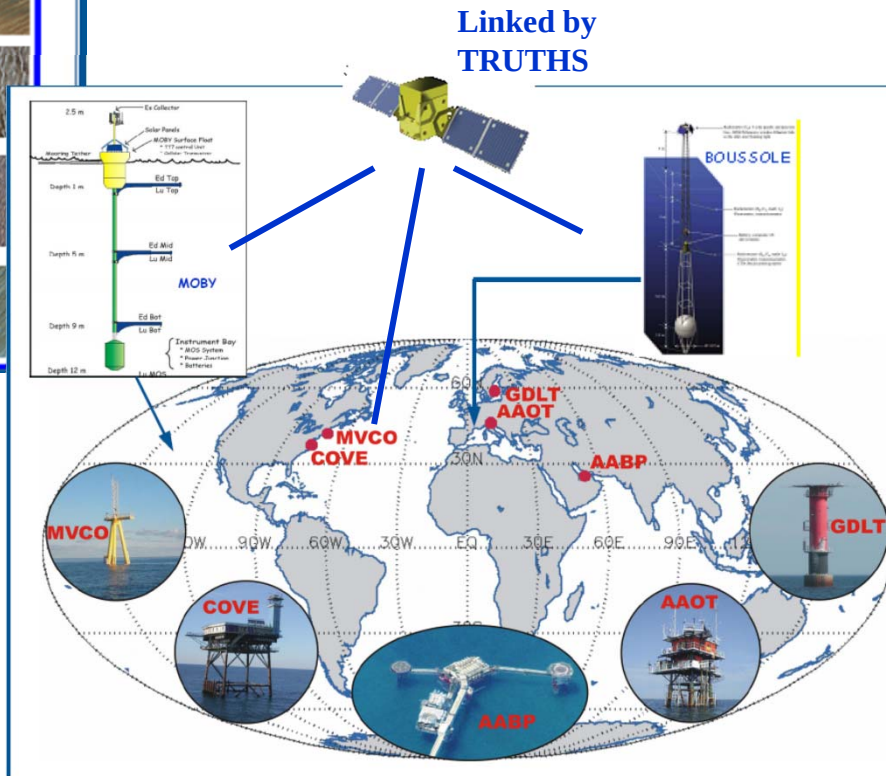
Vision: Operational calibration service through "CEOS standard" sites/methodologies



Networks of test sites and methodologies can become operational calibration service

improved through use of reference standard SI traceable sensor e.g. TRUTHS/CLARREO

(Part of Climate architecture doc)



CEOS endorsed test sites for Land and Ocean can be used as standards to cross-compare between sensors and to ground data providing each site is compared to each other

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CEOS infrastructure: Needed to support interoperability and long term data continuity & reliability

- **'Test sites' / Intrinsic methods** - with documented methodology including how to do uncertainty assessment
  - Facilitate sensor performance testing/correction
  - Sensor to sensor bias evaluation/removal

- Catalogue of 'sites'/methods and relative usefulness for sensor/application
  Major progress (radiometric aspects)
- Access to results of sensor comparisons to/or using site/method
  Have a data base template not progressing
  Will need CEOS infrastructure (SADE, DIMITRI, CAL/VAL portal)
- Longevity of site availability (non-mission specific)
  Key area of concern
- Comparability of information from use of site/method
  Have identified minimum instrumentation for Land
- Evidence to underwrite 'site' characteristics/usefulness
  Regular comparisons between sites/methods 'traceability'
- Operationally delivered activity
  need autonomous data collection/provision from site (& sensor) & analysis data policy, (Aeronet like)

CEOS WGCV IVOS workshop: To identify, quantify and verify the post-launch performance and relative biases of Earth Observation sensors

Hosted by:

Joint Research Centre (JRC), Ispra, Italy

October 18 – 20, 2010

OBJECTIVES

- To carry out a detailed review of the results of sensor-to-sensor comparisons with emphasis on the outcome of the recent CEOS land based intercomparison/intercalibration exercises carried out using Dome C and Tuz-Golu but also others as appropriate.
  - To agree upon the relative biases in radiometric gain, between in-flight sensors and publish as CEOS endorsed values (bias correction factors).
  - To agree on optimum procedures/strategy to ensure long-term stability of sensor performance characteristics and their relationship with observations of other sensors: past, present and future.

To review existing and conceptual limitations to the uncertainty achievable in the post-launch calibration/validation of sensors through use of vicarious methods (solar reflective), and to identify priorities for the research efforts of the community.

IVOS - Land and Ocean

http://calvalportal.ceos.org/cvp/web/guest

ViCaSEOOS

Long term objective of ViCaSEOOS:

Create a vicarious calibration system for GEOSS

We should start focused:

a) EO optical sensors and medium resolution sensors
b) Only aim at:

- Agreeing upon and documenting standard vicarious calibration methodologies restricting to those exploiting terrestrial sites observations and that do NOT require in-situ data
- Defining a data format to exchange data over these sites
- Defining the overall architecture of ViCaSEOOS ('roadmap')

WGs on methodology and data format

- **WG1:** Use of Deep Convective Cloud
  Lead: D Doelling (NASA)
  Participant:

  Call for participants & leads still open……

- **WG2:** Rayleigh Scattering
  Lead: P Henry (CNES)
  Participant: M Bouvet (ESA)* , L Bourg (ACRI)

  CNES & VITO others?

- **WG3:** Sun Glint
  Lead:
  Participant: S Lavender (ARGANS)

- **WG4:** Use of fixed ground sites e.g. SADE, DIMITRI, Landnet, invariant desert sites (but not requiring ground measured data)
  Lead: X Briottet
  Participant: D Smith (RAL), P Henry (CNES), M Bouvet (ESA)*, L Bourg (ACRI)

- **WG5:** Simultaneous Nadir Observation
  Lead:
  Participant: S Kumar (ISRO), S Saunier (Mag)

WORKING GROUPS NEED INPUT FROM OTHER AGENCIES TO ENSURE HARMONISATION AND BEST PRACTISE/EXPERTISE

Proposed WG Terms of Reference

- Write a consensus **documented procedure/protocol** describing how to carry out comparisons using the particular methodology **with a view to CEOS endorsement** at level of a "detailed processing model";

- Document should **follow guidance in QA4EO** guideline …DQK-002 i.e.
  - Include detail on how to carry out
  - Any input parameters
  - Principles of any algorithm / model / (established software)
  - Sources of uncertainty and how to evaluate
  - How to establish evidence that process has been implemented consistently.
  - Define scope of applicability and likely uncertainties for range of situations.
  - ➢ Allow someone of reasonable knowledge in the field to be able to implement (might require writing own software/include different algorithms but should ensure *consistent use of key variables and processes* or ability to demonstrate differences);

- Evaluate applicability of method through at least one implementation using **test-data sets**, where possible the same data sets should be used by all methodologies;

- Consider **results from existing comparisons** using methodology (from Action A2) for community discussion.

CEOS IVOS Working Group 4: Fixed Sites

Methodology intercomparison initial results summary

Chair: (Marc Bouvet)

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CEOS/IVOS WG4 (Use of Fixed Sites) comparison Protocol

❖ A reference dataset will be produced by ARGANS and CNES consisting of extractions in the CNES SADE format, from 3 sites, 5 sensors and over 4 consecutive years.

❖ Validation of dataset by sample comparison of independent extractions from SADE and DIMITRI - Key activity initially differences found

❖ The common reference dataset will consist of TOA reflectances averaged over a region of interest. The reference dataset will consist of cloud screened data.

❖ No further cloud screening should to be applied by participants to focus the comparisons on the core of the methodologies rather than the cloud screening approach.

❖ Each participant will systematically apply their method to the reference dataset and produce a set of standardised results.

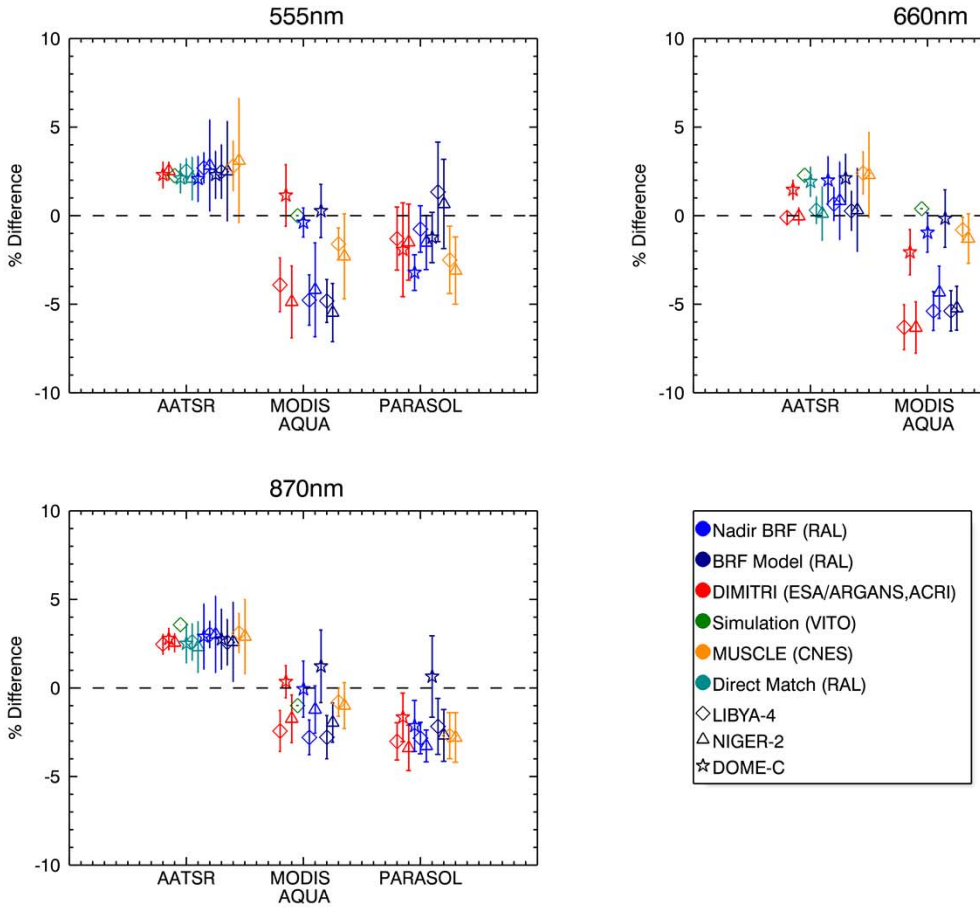
Libya 4 Niger 2 Dome-C	Polder-3 AATSR MERIS VGT 2 MODIS-A	2006 2007 2008 2009	**ACRI/RAL/ONERA/ESA:** DIMITRI **CNES:** SADE (Desert methodology) **RAL:** Drift Monitoring. **VITO:** RTM simulation over Deserts

The methodologies

- **DIMITRI (ESA):** run in this study by ACRI-ST (L. Bourg), D. Smith (RAL) and ARGANS Ltd (C. Kent).
- **MUSCLE (CNES):** run in this study by P. Henry and B. Fougnie (both CNES);
- **Drift Monitoring approach (RAL):** run in this study by D. Smith (RAL); This comprises comparisons via a a) a near nadir BRF reference model, b) a full BRF reference model and c) simultaneous nadir observations (for MERIS and AATSR only).
- **OSCAR (Optical Sensor Calibration with Simulated Radiances):** run in this study by Y. Govaerts, S. Sterckx, S. Adriaensen (all VITO).

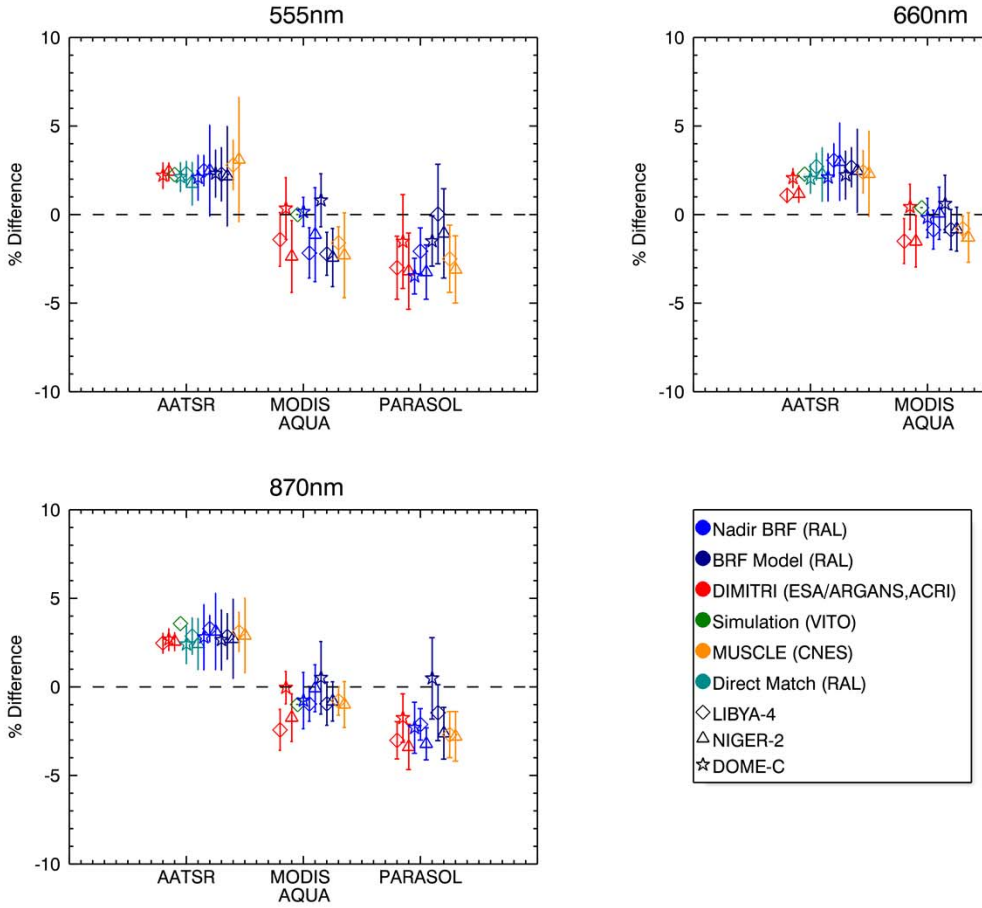
NB: While MUSCLE and OSCAR do explicitly account for sensor spectral response differences when comparing two sensor radiometry, DIMITRI and the Drift Monitoring methodologies do not.

The results: a summary



- MERIS 2nd reprocessing used as reference
- The error bar is NOT the uncertainty. It is the standard deviation associated to the computation of the mean difference.
- Site dependant biases are visible for methodology

The results: including a correction for Type B uncertainties identified



- Here a correction for Type B (=systematic) uncertainties identified is added to the results from DIMITRI and RAL

What else can be done with the reference dataset?

- Reference data set made available to all on Cal/Val Portal from Oct - inc report, sensor bands etc
  - Potential research on:
    - The sensor blue bands
    - The sensor SWIR bands
    - The large spectral bands of VEGETATION
    - Sensor to sensor wide separation Bands (spectral correction)
    - Minimal time series for valid results
- New methodologies and/or new sensors can be added
  - Please add new sensor data on sites (in specified format) and acknowledge any useage to Marc.bouvet@esa.int

Monitoring Stability of VIIRS Radiometric Response

Slawomir Blonski, Changyong Cao, Sirish Uprety, and Xi Shao

NOAA / NESDIS / STAR

Presented at the CEOS IVOS-24 Meeting, Sioux Falls, South Dakota, May 8-10, 2012

Terra ASTER

r the CEOS calibration sites

4

n Sioux Falls

O (GSJ),

A (ITRI),

(GSJ)

l and Science Technology

Toulouse, France
April 13 – 15, 2011

Gyanesh Chander (SGT/USGS EROS)
Email: gchander@usgs.gov

Absolute Calibration of Optic Using Pseudo Invariant Calib (PICS) Initial concepts

Dennis Helder
Nischal Mishra
Sandip Shrestha
Image Processing Laboratory
SDSU

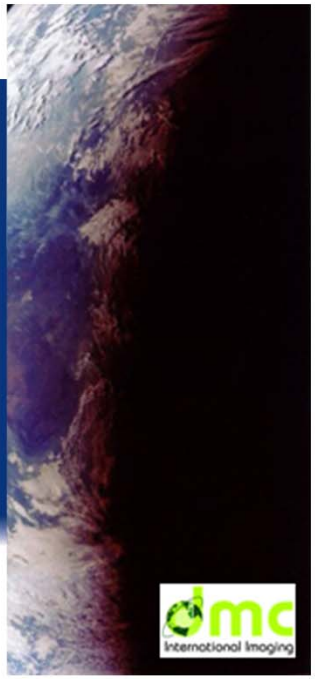
South Dakota State University
Image Processing Lab

IVOS

cnes
CENTRE NATIONAL D'ÉTUDES SPATIALES

ETM+ vs Terra/MODIS Cross Calibration over Desertic Sites & Accuracy Assessment using Hyperion Data

Patrice Henry, Bertrand Fougnie, Sophie Lacherade,
Philippe Gamet, Denis Blumstein - CNES
Thomas Colin – CS
Gyanesh Chander - USGS



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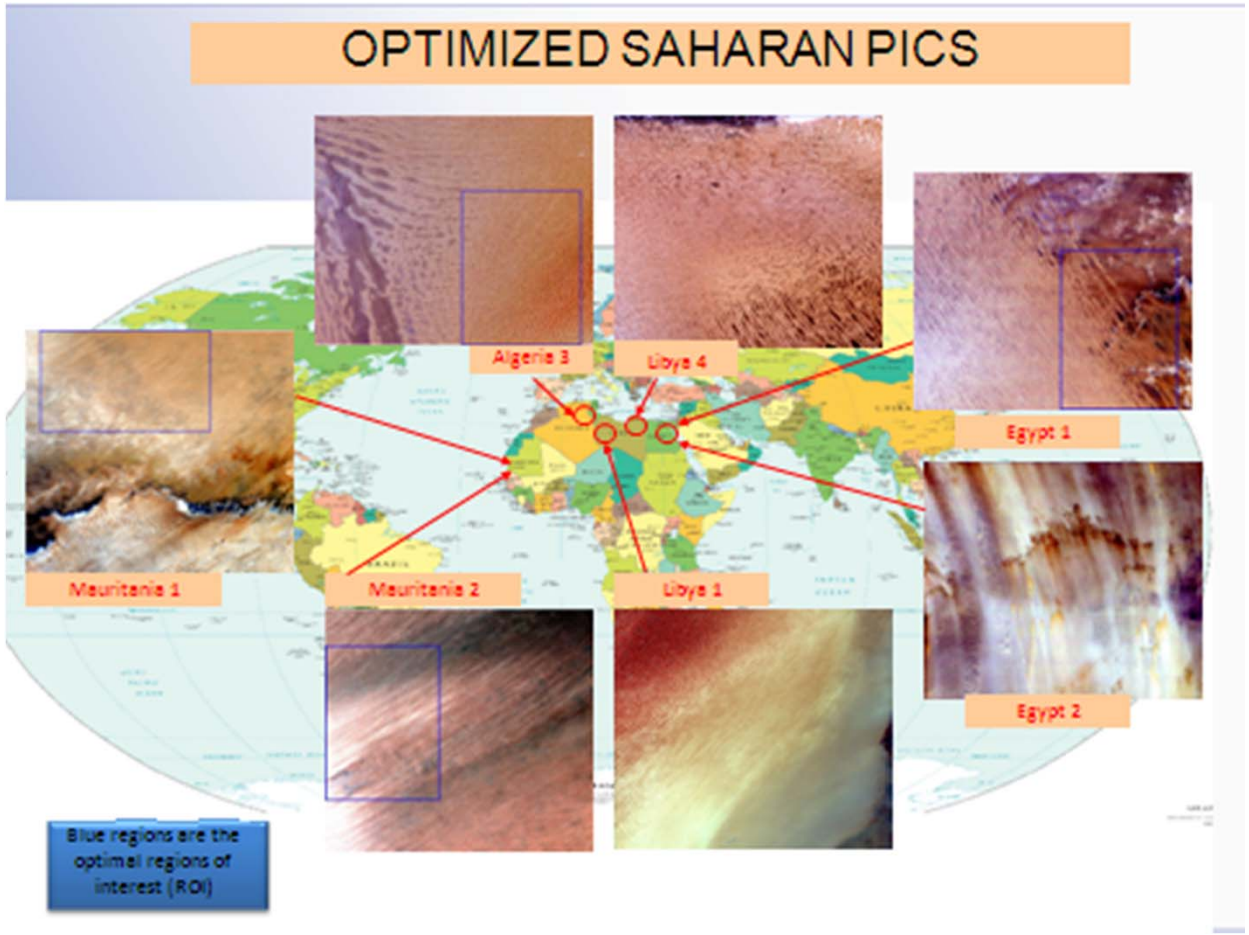
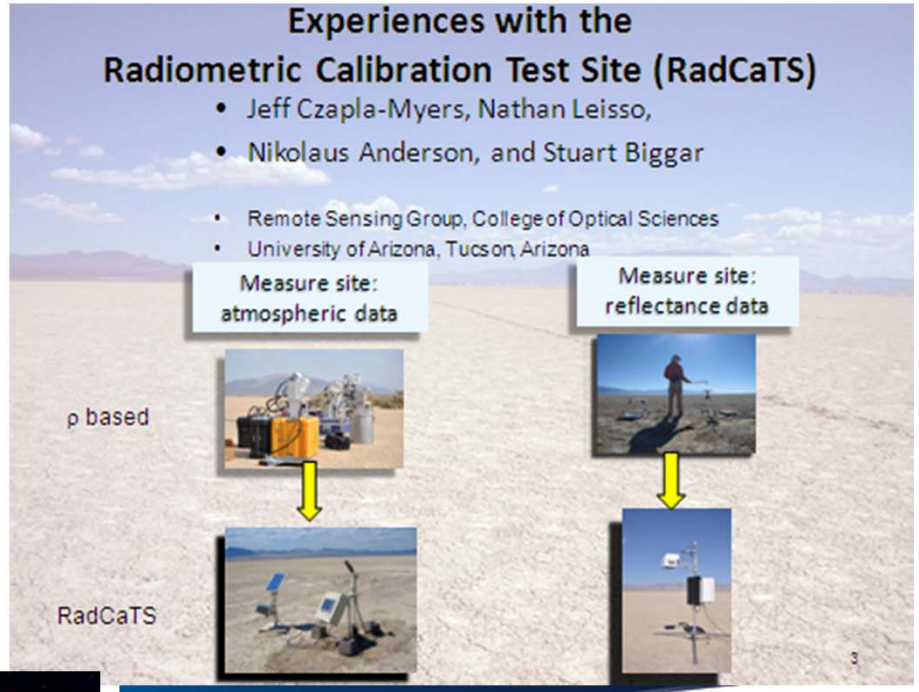
CEOS IVOS workshop on: Libya 4 (Oct 4-5 2012 CNES Paris

CEOS 'non-instrumented' Test sites for Stability and sensor to sensor cross-comparison

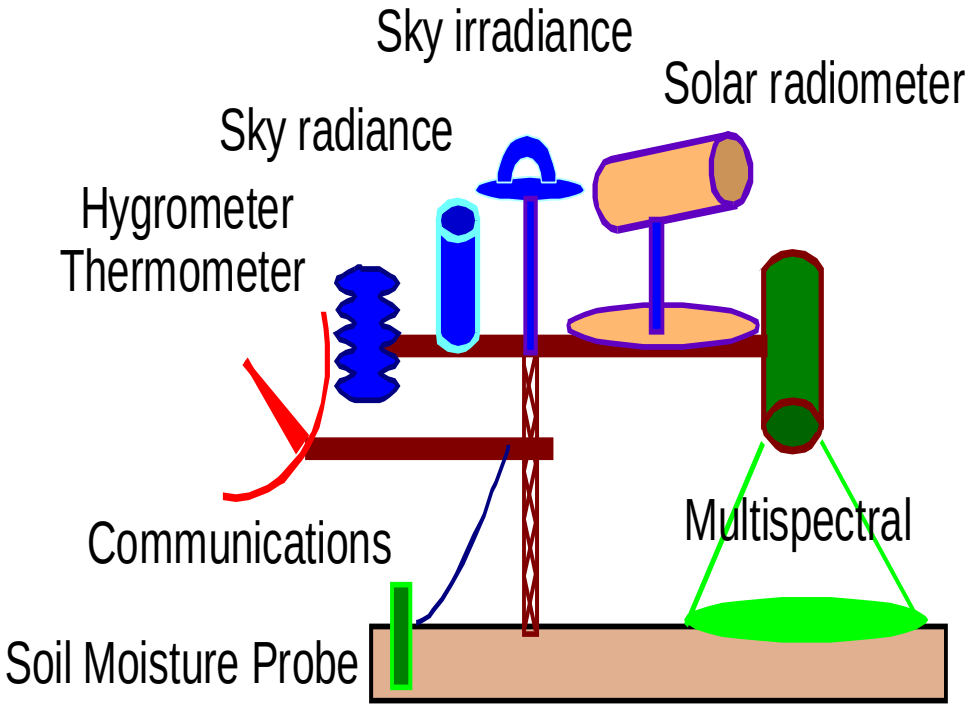


- **25 attendees**
- Working meeting
- Focus on one site
- Share ideas
- Different sensor
- Cal/comparison methods
- Site characteristics – observed/modelled
- High and medium res
- What can & might be achievable?

Ground characterised test sites



LANDNET: CEOS autonomous network of ~5 (minimum) instrumented (traceable) test-sites



Set up costs ~ $80k – 500 k
- systems exist others low cost options under development

Need annual long term maintenance ~ 0.5 person year 20+ years

Central coordinating facility
- QA / Data collation /processing …

Regular traceability and comparisons (appropriate facilities and reference standards)

Minimal specification of equipment on site:

- **Master and nodes (1 per ~500 m2)**
- **May not always need atmosphere measurements**
- **~ Min 10 channels**

K Thome NASA

IVOS-24

Infrared and Visible Optical Sensors Subgroup to WGCV, CEOS

May 8-10, 2012 at USGS Earth Resources Observation and Science (EROS) Center

Development of a Comprehensive Site for Remote Sensing Payload Performance and Data Quality Testing

Basis and Prospects

Chuan-rong LI

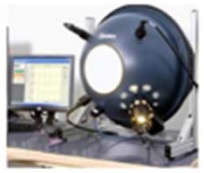
Academy of Opto-Electronics (AOE),
Chinese Academy of Sciences (CAS)

8 May 2012

1. General View of the Comprehensive C&V Site

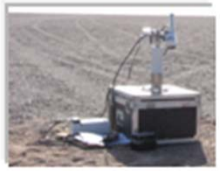
- **Auxiliary support systems**- Ground-based standard test equipments


An omni-directional and multi-angle automatic observing systems


USS-200C Integrating sphere system


Leica TCR1202 Total Station


Three-dimensional turntable (Zolix PSAG 15 + RAK 3500)


Automatic sun tracking photometer, CE318


SVC Spectroradiometer


LAI-2000 Plant Canopy Analyzer


Radiosounding balloon


Dynamet Weather Station

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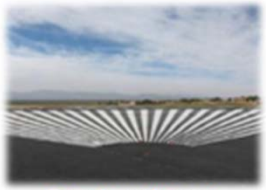
1. General View of the Comprehensive C&V Site

- **Validation site** - Standard artificial target for optical payload

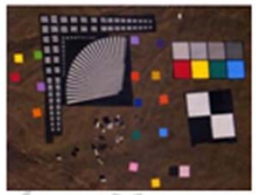

Knife-edge target


Fan-shaped target


Three-bar target


Gray-scale target


Colored target


Layout of targets

1. General View of the Comprehensive C&V Site

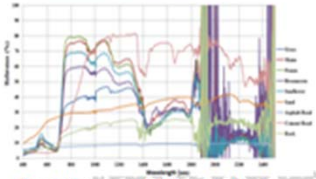
- **Validation site** - Natural ground targets
  - The object types included: *maize, rice, potato, sunflower, soil, et al.*
  - The land surface parameters, such as reflectance, LAI, fPAR et al., were measured by instruments before and after flight day.


(a) Rice


(b) Maize


(c) Potato


(d) Sunflower


Spectral curves of different objects

3. Future Activities and Plans on Test Site Construction

Relay satellite

Airborne platform

Data process vehicle

Command vehicle

Ground receive station

Command hall

Aircraft Hangar

Equipment storehouse

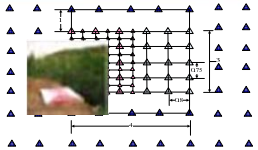
Tower

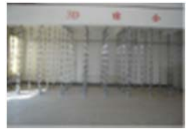
T&C vehicle

Real-time monitoring of flight status

Artificial target

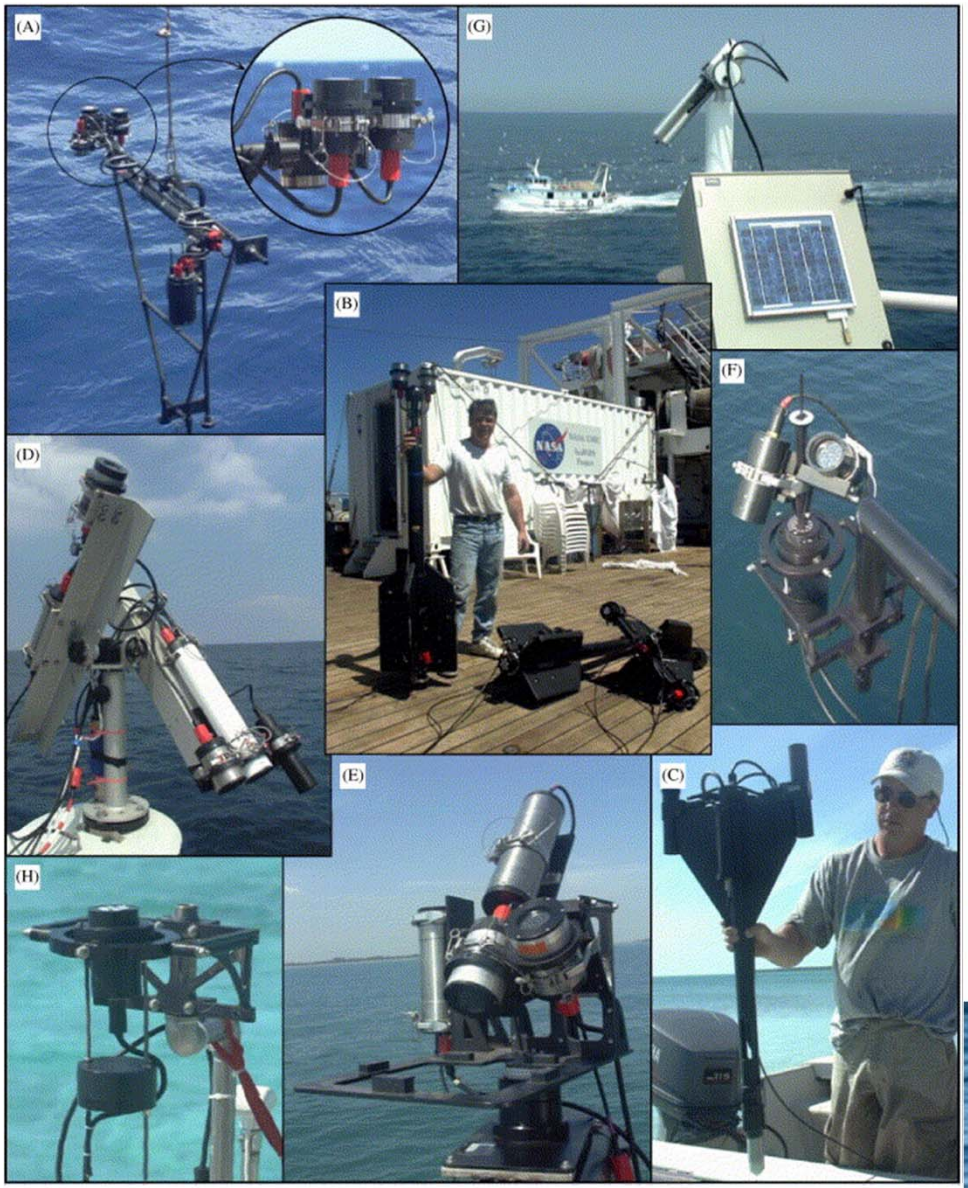
Natural scene





Inflight and preflight geometric calibration

OCEAN Test-sites for SST and OC



Recommendation 2-4: Establish and maintain a set of core CEOS instrumented test sites to support sensor interoperability & long term continuity of data for Climate

Background All sensors require as a minimum post-launch verification of performance - L1 radiances & L2 products as appropriate

- Calibration of most optical sensors drifts
- Long term data continuity and operational services require sensor harmonisation
- CEOS role to facilitate international harmonisation through shared infrastructure
- Bridging of potential Data gaps needs long-term 'invariant'/traceable references
- Full Infrastructure costs to any single agency can be large and often mission linked

Recommendation 2 Agencies establish (with long term ideally 20 yr maintenance commitment) a network of 5 to 10 land test sites (LANDNET) with an autonomous set of SI traceable instruments (minimal common specification defined by IVOS). These can build upon existing efforts at – Frenchman flats NASA-JPL, Rail Road Valley UofAriz & La Crau CNES and others under development e.g. in China.

- Establish a coordinating centre (s) for QA- Review protocols, comparisons …
- Data base for collating and distributing results from sites and sensors
- Encourage maintenance of complimentary 'time limited 'campaign' sites e.g. Dome –C, Tuz Golu ….

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Recommendation 2-4: Establish and maintain a set of core CEOS instrumented test sites to support sensor interoperability & long term continuity of data for Climate

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- Bridging of potential Data gaps needs long-term 'invariant'/traceable references
- Full Infrastructure costs to any single agency can be large and often mission linked
- The very high radiometric accuracy required for OC ECVs requires at least 2 open water SI traceable reference Buoys & network of validation sites in other waters.

Recommendation 3

Noting the criticality of surface Cal/Val for satellite based OC measurements agencies are encouraged to:

- Commit to the long term support of the maintenance and evolution of CEOS endorsed reference standard test sites e.g. OC Buoys MOBY and BOUSSOLE
- Continue to develop the network of Aeronet-OC for validation in coastal waters

For the benefit of the CEOS community

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Recommendation 2-4: Establish and maintain a set of core CEOS instrumented test sites to support sensor interoperability & long term continuity of data for Climate

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- Long term data continuity and operational services require sensor harmonisation
- CEOS role to facilitate international harmonisation through shared infrastructure
- Bridging of potential Data gaps needs long-term 'invariant'/traceable references illustrated by the recent loss of one of the key SST satellite reference sensors AATSR on Envisat and links to its heritage predecessors.
- Full Infrastructure costs to any single agency can be large and often mission linked

Recommendation 4

- Agencies to support the deployment of a set of traceably calibrated drifting buoys at a cost of ~$300k to underpin satellite based SST measurements.
- Continue and where possible expand the regular collection of ship borne brightness temperature measurement of the Ocean through deployment of SI traceable radiometers to maintain the data continuity and complementarity necessary to reliably bridge data gaps in the CDR of SST

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CEOS Comparisons: to provide evidence to support traceability and develop best practise

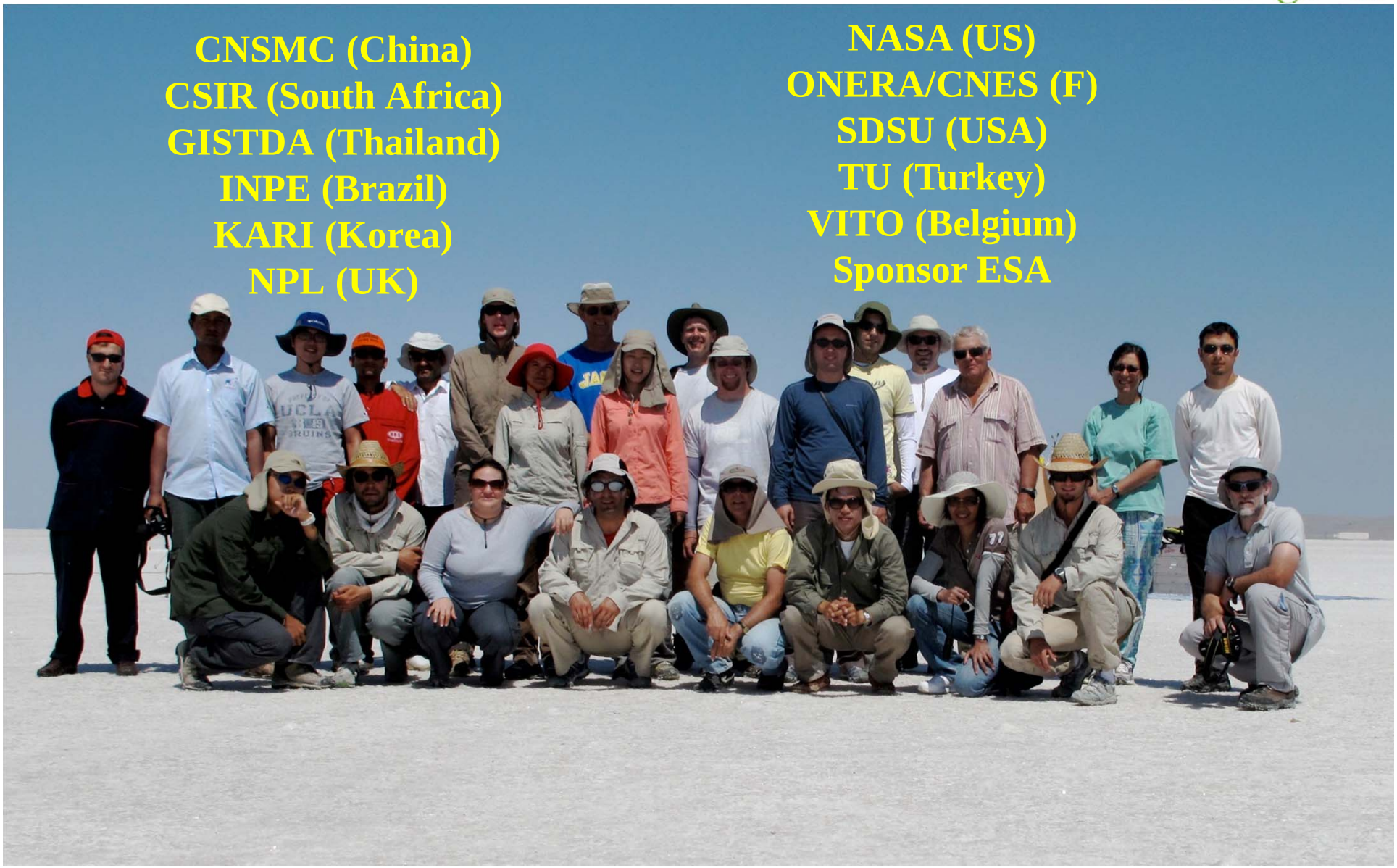
Regular comparisons necessary

- to maintain confidence in existing measurement teams and techniques
- Evaluate new teams and methodologies
- Ensure and document traceability
- Improve capabilities and expertise – seek state-of-the-art
- Opportunity to expand Cal/Val infrastructure

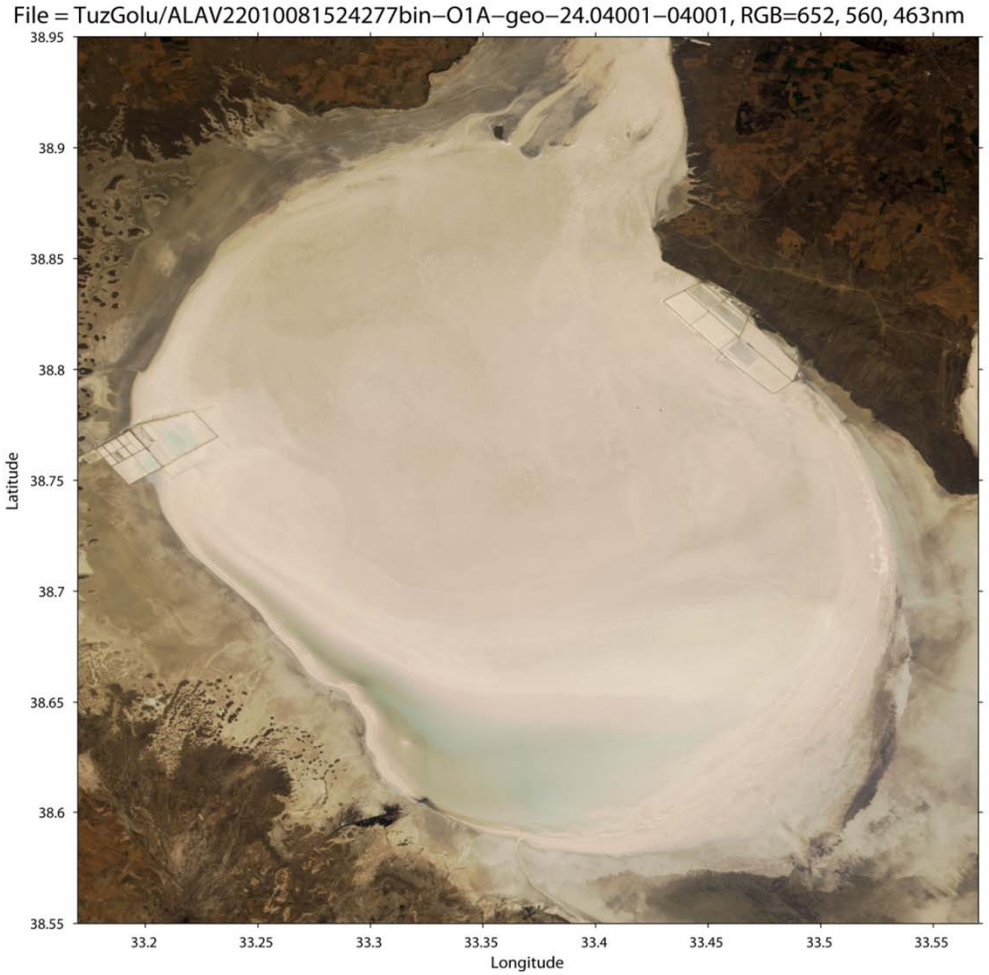
But

- Take time and effort to organise, analyse and participate
- Are for the benefit of the global EO community and ideally need cost sharing mechanism

Tuz Golu comparison: 2010



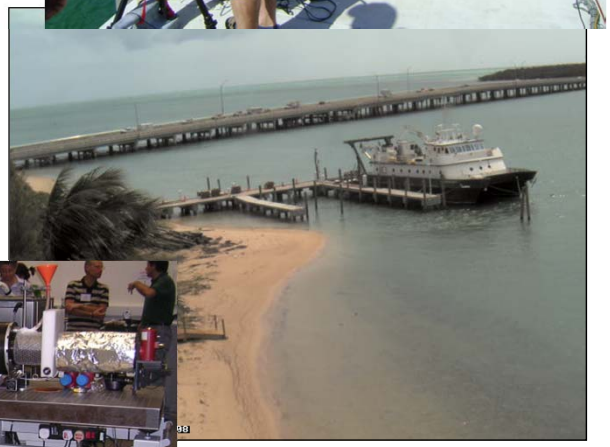
In case you'd forgotten!

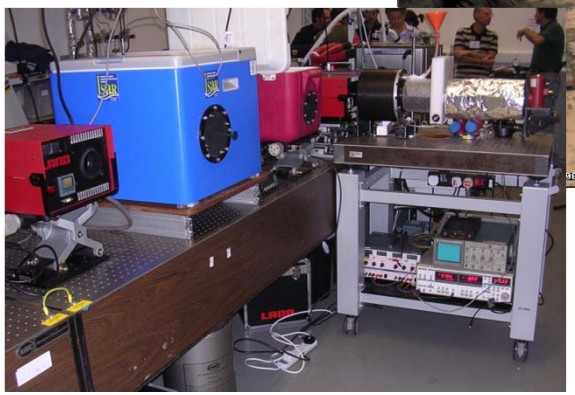


This is what we were measuring

MIAMI III: CEOS IR radiometer inter-comparison (2009)

- Third in a series of inter-comparisons establish degree of equivalence (biases) between participant's
  - Reference black bodies
  - IR radiometers under lab conditions
  - IR radiometers as used viewing Ocean (SST)
- Ensure robust traceability to SI (via NIST and NPL)
- Establish protocols based on QA4EO to facilitate future comparisons and strategy for maintenance of long-term traceability
- Pre-cursor for Land Surface Temperature community Need to establish
- Reports now available





EUROPEAN COMMISSION
DIRECTORATE-GENERAL
Joint Research Centre

CEOS

NPL National Physical Laboratory

esa

CEOS

Assessment of *In Situ Radiometric Capabilities for Coastal Water Remote* Sensing Applications (ARC)

Genesis:
Cal/Val ocean color activity proposed as a CEOS/CVWG/IVOS action, funded by ESA, planned and organized by the JRC in collaboration with NPL.

Objective:
Compare primary ocean color radiometric products (water leaving radiance) from *in situ* optical measurements applying different radiometers and measurement methods

Execution:
Field measurements at the AAOT (July , 19-23-10)
Laboratory calibrations at JRC (July , 26-29-10)

Site: Acqua Alta Oceanographic Tower (AAOT)
Region: Northern Adriatic Sea
Water type: Case-1/Case-2

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NPL

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ARC: Field (AAOT - July , 19-23 2010)

Instruments and Institutes (confined to European institutions contributing to MERIS validation activities):

1. **WiSPER** (in-water multi-spectral winched profiling radiometer system) – JRC (EU);
2. **SeaPRISM** (above-water multispectral system with ~1 degree FAFOV) – JRC (EU);
3. **TACCS-S** (in-water multispectral radiometer buoy) - University of Stockholm (Sweden);
4. **TACSS-P** (in-water hyper-spectral radiometer buoy) - Segremarisco (Portugal);
5. **TRIOS-B** (above water hyper-spectral radiometer system) – MUMM (Belgium);
6. **TRIOS-E** (above water hyper-spectral radiometer system) - Tartu Observatory (Estonia);
7. **TRIOS-J** (above-water hyper-spectral radiometer system with reduced field of view with ~3 degrees FAFOV)) – JRC (EU).
8. **JAWS** (above-water multi-spectral radiometer system with narrow field of view (3 degrees FAFOV)) - JRC (EU);

TRIOS-B
&
TRIOS-E

TRIOS-J
&
JAWS

TACSS-P

SeaPRISM

Recommendation 5: Comparisons to ensure a Globally consistent post-launch Cal/Val framework for CEOS sensors

Background All sensors require as a minimum post-launch verification of performance - L1 radiances & L2 products as appropriate

- Calibration of most optical sensors drifts
- Long term data continuity and operational services require sensor harmonisation
- CEOS role to facilitate international harmonisation through shared infrastructure
- Post-launch cal/val test-sites and campaigns must be carried out in a consistent and traceable manner which requires as a minimum regular comparison across and within geographical regions & it is the duty of CEOS agencies to facilitate access to such comparisons for the benefit of all

Recommendation 5 Following the success of the three previous CEOS comparisons of radiometers in support of satellite derived SST measurements (Miami 1, 2 &3) it is timely (5 yrs) that the next comparison be organised for 2014. This will be timely to serve the needs of the new SST VC and the expected launch of some new sensors.

- Resources are required from one or more agencies to enable effective detailed planning and preparations to commence in early 2013.
- CEOS IVOS and SST-VC and GHRSST have started initial planning and may look to build upon and extend the previous exercises to include more direct linkage to satellite sensors.

Recommendation 6: Comparisons to ensure a Globally consistent post-launch Cal/Val framework for CEOS sensors

Background All sensors require as a minimum post-launch verification of performance - L1 radiances & L2 products as appropriate

- Calibration of most optical sensors drifts
- Long term data continuity and operational services require sensor harmonisation
- CEOS role to facilitate international harmonisation through shared infrastructure
- Post-launch cal/val test-sites and campaigns must be carried out in a consistent and traceable manner which requires as a minimum regular comparison across and within geographical regions & it is the duty of CEOS agencies to facilitate access to such comparisons for the benefit of all

Recommendation 6 Following the success of the CEOS pilot comparison of OC radiometers in Europe in 2010 and the similar activity carried out in the USA it is timely that a formal global CEOS comparison be organised for 2014/15. This will be timely to serve the needs of the OCR-VC and the expected launch of some new sensors.

- Resources are required from one or more agencies to enable effective detailed planning and preparations to commence in 2013.
- With the relatively large number of potential participants the comparison may best consist of a number of linked regional comparisons.

Recommendation 7: Comparisons to ensure a Globally consistent post-launch Cal/Val framework for CEOS sensors

Background All sensors require as a minimum post-launch verification of performance - L1 radiances & L2 products as appropriate

- Calibration of most optical sensors drifts
- Long term data continuity and operational services require sensor harmonisation
- CEOS role to facilitate international harmonisation (of ALL EO sensors including commercial providers) through encouraging comparisons through provision of key infrastructure and providing access to the results in a timely and efficient manner
- Post-launch CEOS endorsed cal/val test-sites provide an effective means of ensuring international harmonisation.

Recommendation 7 Following the success of the recent CEOS sensor to sensor comparisons using Dome-C and Tuz-Golu and the establishment of a set of CEOS endorsed test sites agencies are encouraged to include, within their normal acquisition programs , regular collection over these CEOS sites and to provide access to the data via the CEOS Cal/Val portal or some other accessible data base e.g. SADE or Dimitri.

Recommendation 8: Comparisons to ensure a Globally consistent post-launch Cal/Val framework for CEOS sensors

Background All sensors require as a minimum post-launch verification of performance - L1 radiances & L2 products as appropriate

- Calibration of most optical sensors drifts
- Long term data continuity and operational services require sensor harmonisation
- CEOS role to facilitate international harmonisation (of ALL EO sensors including commercial providers) through encouraging comparisons and providing access to the results in a timely and efficient manner
- Post-launch cal/val must be carried out in a consistent and traceable manner though CEOS coordinated infrastructure, which requires calibration data, including necessary metadata to be provided in an accessible manner.

Recommendation 8 In carrying out the recent CEOS sensor to sensor comparisons using test sites DOME- C and Tuz Golu it was noted that in some cases it was difficult to get access to some of the necessary meta data associated with the sensor and/or acquisition. CEOS IVOS encourages agencies to:

- Provide all necessary acquisition meta data in the header of the data files e.g. view angles, time, solar angles etc
- To aid in planning and analysis of comparisons each agency is asked to provide a technical POC for each sensor – this POC can remain confidential to CEOS

A Framework for Geo/Spatial Quality

CEOS-WGCV-IVOS
May 2012

Dennis Helder
South Dakota State University
Dennis.Helder@sdstate.edu

Francoise Viallefont
ONERA
Toulouse, France

South Dakota State University
Image Processing Lab

Proposed Framework

- Definition and Importance (short introductory section)
- Measurement (background and basic theory)
- Pre-Flight Estimation(to be developed later)
- On-Orbit Estimation(substantial portion of document)
- Recommendations for Determining Geo/Spatial Quality(final effort)

Proposed Framework

On-orbit Estimation (substantial portion of document)

- **Field Methods Survey**
- Targets
  - Artificial/Man-made
    - Points
    - Lines
    - Edges
    - Pulses
  - Image feature-based
    - Linear ('Rich') features
    - Bridges
    - Moon
  - Matrix of Targets
    - Type vs. GSD
    - Availability/Maintenance
    - Point of Contact
    - Recommended for operational acquisition
  - **Database of 'Standard' Imagery for PSF/MTF estimation**
- Data Analysis, PSF/MTF Estimation
  - Image data format
  - Models
  - Parametric/Nonparametric Methods
  - **Database of 'Standard' estimation methods**

Proposed Actions

Recommendation 9: CEOS framework for GEO/Spatial Quality

Background CEOS IVOS has recently established a new technical theme to address the issue of geo/spatial quality of sensors under the leadership of Professor Dennis Helder of South Dakota State University. This is of particular importance for the increasingly higher resolution imaging sensors. It has been agreed to establish a CEOS best practise guide/framework for the benefit of the community.

To develop this guide requires support from member agencies to both join the thematic group and to aid in the development of the framework.

Recommendation 9 CEOS members are asked to nominate and allocate resource to technical POC to support the development of this key CEOS framework and in particular :

- An agency is requested to establish and maintain a website based data base of global MTF cal/val infrastructure/test sites similar to the radiometric gain test sites data based created by USGS
- Agencies are similarly asked to support the development of best practise by supporting the collection of any information in a timely manner.

Recommendation 10: CEOS framework for GEO/Spatial Quality

Background CEOS IVOS has recently established a new technical theme to address the issue of geo/spatial quality of sensors under the leadership of Professor Dennis Helder of South Dakota State University. This is of particular importance for the increasingly higher resolution imaging sensors. It has been agreed to establish a CEOS best practise guide/framework for the benefit of the community.

Noting the importance of this activity and the on-going development of sensors it is critical that developers of new sensors seek to ensure that optimum use can be made of their data products through appropriate pre-flight calibration and characterisation

Recommendation 10 Agencies are encouraged to ensure that sensors they develop and those that they may have influence over are subject to a full pre-flight characterisation of the sensor PSF/MTF and that this is made accessible to the user community.

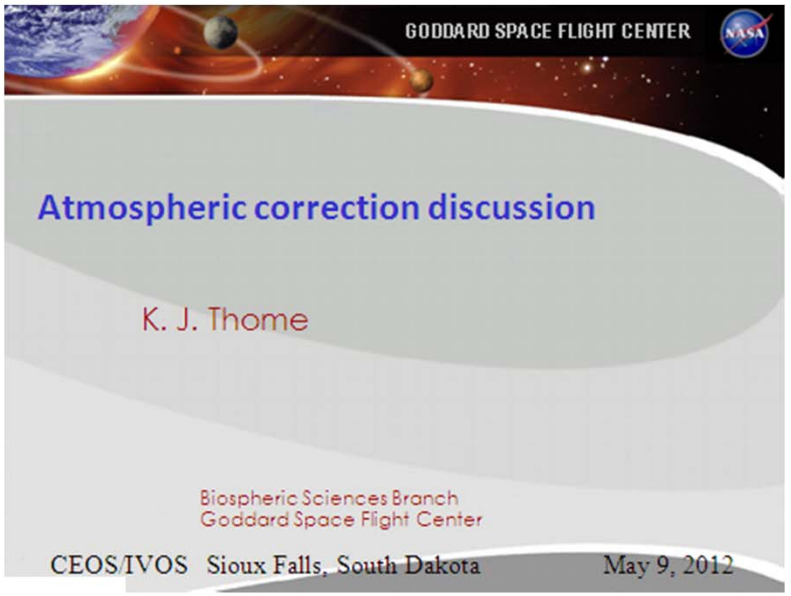
Other on-going activities

IVOS theme on:

Radiative Transfer codes

Jean-Luc Widlowski
(EC Joint Research Centre)

with contributions from
Tamás Várnai (GFCS)



SADE opening to GSICS and CEOS

Few feedbacks from beta-users : only one (very positive…)

SADE access through CNES scientific mission website

- *http://smsc.cnes.fr/CALIBRATION/ (free access)*
- *Password mandatory (for the "SADE data" page only)*

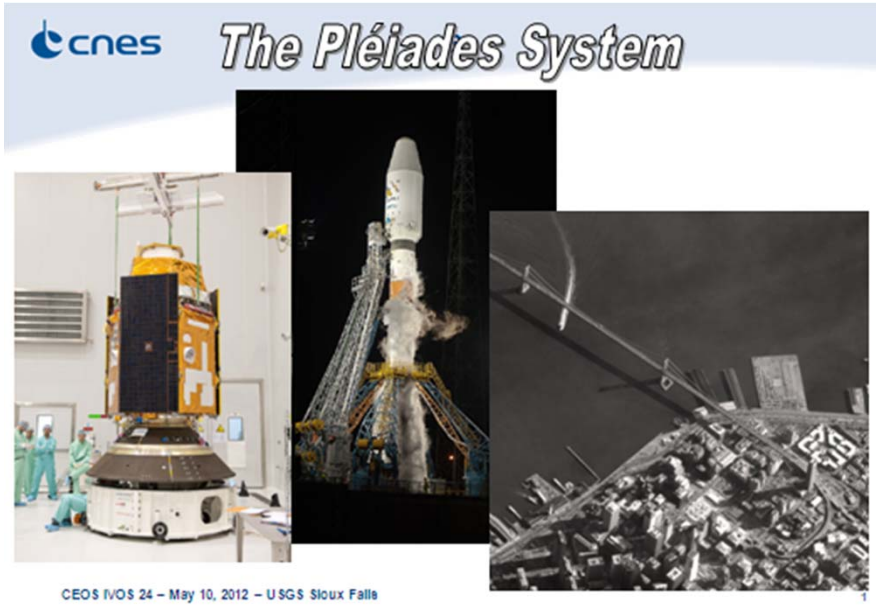
No procedure yet available for password delivery (contact Aimé Meygret or Patrice Henry)

A complete reprocessing of SADE exported files in March 2012

- *Data extension up to 2011*
- *New sensors :*
  - *Terra/Modis*
  - *Landsat 7*
  - *Theos*
- *New MERIS reprocessing (3rd)*
- *VGT1 updated calibration*

QA4EO A QUALITY ASSURANCE FRAMEWORK FOR EARTH OBSERVATION

Sensor Pre- and on-board calibration



IVOS technical workshop

Planning starting for next IVOS technical workshop

Sep/Oct 2013 - Linked to SPIE Europe

Topic: Pre-launch and on-board calibration of satellite sensors

Summary and WGISS

- **IVOS has a very active and motivated team from many agencies with a consistent vision and desire to work together to establish international shared infrastructure.**

- **Struggles to get necessary resource committed in a timely manner and for an appropriate time frame – CEOS SIT should look to establish strategies to enable resources to be more easily allocated perhaps based on a subscription type basis.**

- **To enable an operational cal/val system requires the combination of many software tools, the collation of satellite imagery, in-situ and auxiliary data and the assessment and subsequent propagation of uncertainties. This requires the expertise of WGISS to support that of WGCV.**

- **IVOS is willing and able to support the Cal/Val needs of VCs and other WGs but needs clear requirements and priorities and appropriate support to facilitate resourcing from member agencies.**