



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:

1. To carry out a detailed review of the results of sensor-to-sensor (optical imager) 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 (including bi-laterals) over the last decade or so.
 - To agree upon the relative biases in radiometric gain, between in-flight sensors and publish as CEOS endorsed values (bias correction factors) for a set of “standard conditions”.
 - 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, with a view to serving the needs of the CEOS virtual constellations, GEOSS and QA4EO.
2. To review existing and conceptual limitations to the uncertainty achievable in the post-launch calibration/validation of sensors through use of vicarious methods (Land and Ocean), and to identify priorities for the research efforts of the community and facilitate international collaboration in achieving them.

Background:

The last decade has seen a major increase in the number of space based Earth Observation (EO) optical imagers for both scientific and operational activities. It is also notable that these sensors are increasingly being built and operated by newly emerging space agencies and commercial organisations, complementing the efforts of the major space agencies. It is imperative for the continued growth of the EO sector and more fundamentally the needs of the user community, that the products from each sensor are linkable together in a seamless transparent manner. This requirement is even more critical when the long-term monitoring requirements associated with climate change are also considered. These requirements are central to achieving the goal of the Group on Earth Observations (GEO) - a Global Earth Observation System of Systems (GEOSS).

The new Quality Assurance Framework for Earth Observation (QA4EO) <http://QA4EO.org> has been established to facilitate the above processes in an internationally harmonious manner. QA4EO is built around one key principle: that “to each data product there should be assigned a quality indicator (QI) based on documented evidence of its traceability to internationally agreed (where possible SI) reference standards”.

It is well known that even after considerable effort is expended on traceable pre-flight calibration of space bound optical sensors, this does not by itself lead to a reliable estimate

of their post-launch characteristics, and is often the subject of much debate. This is largely due to instrument performance changes arising before and during launch and compounded during operation in-flight. Many schemes exist to attempt to evaluate and correct differences from pre-flight calibrations, ranging from on-board systems to the use of vicarious methods. Some provide absolute radiometric values and others stable references against which degradation can be monitored or used to facilitate cross-comparisons. Whilst there will always be debate about the relative merits of having on-board calibration systems, particularly for some of the more demanding applications, some form of vicarious calibration, or at least validation, of a sensor performance using a terrestrial target is clearly unavoidable. Since the function of any Earth viewing sensor is to measure a particular parameter of the Earth, it is fundamental that an assessment be made of how well it achieves this objective, at least under ideal conditions. The distinction between whether this is calibration or validation being purely dependent on the relative uncertainties that can be attributed to the various components of the task.

Obviously this validation process requires different strategies and targets for different types of observations – Oceans, Land, and in many cases these processes will be further subdivided for specific parameters. Each cal/val activity may well involve different instrumentation and of course different target characteristics and of course be carried out by many different methodologies. However, if we as a community are going to assign a meaningful QI to satellite derived data products we have to agree on consistent ways to assess them. As a first step this means that we need to evaluate any differences that exist between different methods for determining such QI and more fundamentally differences in the values obtained for both the QI (uncertainty) and any biases (to SI and/or other methods/groups/sensors) in values assigned to the parameter being measured.

Workshop activities

This workshop will seek to draw upon the experience and results obtained from experts over the years, but particularly (in the case of land surface imaging sensors) analysis of the data from the recent CEOS comparison activities over DOME-C (Dec 08 – Feb 09) and Tuz-Golu (Aug 18-24, 2009) to carry out the first stage of this quality assurance (QA) process. To agree on the relative sensor to sensor biases for level 1 top-of-atmosphere (TOA) spectral radiances/reflectances when viewing spatially uniform bright targets. Although this will not address the real goal – without agreement on this first step it is impossible to progress to higher-level products or more complex targets.

Ideally the same approach would be carried out for Ocean viewing sensors but since at the present time these are relatively few in number, the workshop will instead concentrate on the methods and instrumentation used for validation and vicarious calibration, and issues related to their traceability and consistency. This workshop will limit itself to the needs of the Ocean colour community. The discussion will also consider protocols and plans for a full CEOS comparison in this field building on the European pilot which will be carried out in the summer of 2010.

A similar discussion on vicarious methods will be replicated for the Land community making use of the results from the CEOS comparison at Tuz Golu and others at the other Landnet sites.

Expected attendees

Scientists and engineers from both public and private funded organisations with an interest in the post-launch calibration and validation of radiometric properties of optical satellite sensors. In particular, attendance is sought from those with experience and expertise in carrying out or analysing results of sensor-to-sensor in-flight TOA cross-comparisons as well as those undertaking or using vicarious calibration and validation methods.

The workshop may also be of interest to those making use of such results as well as those responsible for funding and planning of such activities and future missions.

Workshop Format

The format of the workshop will take the form of invited presentations together with facilitated discussion in themed sessions. The meeting is scheduled to start in the afternoon of the first day to allow some participants to travel on the same day. Presentations from participants will be encouraged if appropriate to the session objectives but strictly limited to a few minutes (5 max) plus posters if required. If you think you may be interested in presenting then please indicate as such on the registration form.

The following sessions have been agreed and will include discussion on the topics indicated. A detailed agenda of invited presentations will be made available following confirmation.

October 18, 13:30

Session 1: Establishing consensus on uncertainty of vicarious calibration/validation methods for Land surface imagers and priorities for future research (1/2 day).

Outcomes: Objective 2 (Land)

Review results of Tuz Golu comparisons, and other landnet sites (linking with historical data from sensor cross-comparisons and outputs from session 1). In terms of best practise: consider sampling strategies, traceability, automation, instrumentation specifications, day to day variability, atmospheric correction

October 19

Session 2: Identify biases between sensors and establish CEOS endorsed difference factors (1 day)

Outcomes: Objective 1

This session will evaluate the methods of analyzing data between multiple sensors that have differing spectral responses, spatial and radiometric resolution differences, geometric registration, BRDF effects from differing view and illumination angles, acquisition time differences, and atmospheric effects. It will consider the results of recent and historical comparisons, sensor to sensor and to ground to establish a community consensus (CEOS endorsed) on the relative biases, in terms of radiometric gain, between Land viewing EO imagers.

October 20

Session 3: Establishing consensus on uncertainty of vicarious calibration/validation methods for Ocean colour imagers and priorities for future research (1/2 day)

Outcomes: Objective 2 (Ocean Colour)

Review uncertainty budgets of key calibration and validation sites: MOBy , BOUSSOLE and AERONET-OC and also results of cross comparisons of sites through use of in-flight sensors e.g. MERIS, SeaWiFS, MODIS, etc. ...

Consider issues such as traceability to primary standards and results of cross-comparisons of instrumentation (radiometers).

Session 4: Way forward (1/2 day)

Consider priorities for future IVOS workplan, strategies to aid international collaboration and implementation going forwards

Workshop outputs

The outputs of the workshop will be widely circulated and will be seen as key inputs to CEOS (WGCV and constellations), GEO and relevant funding and operational agencies. Whilst desirable to have formal peer reviewed publications, it is noted that these can take some time to publication and it is important that the results are not delayed. However, a citeable publication of the workshop outputs, containing written manuscripts, reviews from the workshop, edited by Session leads will be produced in a short timescale, with all source data available via the Cal/val portal. <http://calvalportal.ceos.org/cvp/web/guest>

Registration

Details of accommodation etc will be made available shortly but please complete the registration form at <http://calvalportal.ceos.org/cvp/web/guest/registration-form>,

For any further information related to the technical aspects/content of the workshop please contact the CEOS WGCV IVOS chair: Dr Nigel Fox at Nigel.Fox@npl.co.uk

For information relating to logistics please contact the hosts, the JRC at ISPRA: Teresita.FREDDI@ec.europa.eu