CEOS-WGCV-IVOS / GSICS Discussion on   
whether and how to establish community-agreed bias / interoperability coefficients for L1 data

**At NPL,** Hampton Road, Teddington Friday 17th June 2016. 10:00 – 16:30  
**Attendees:** Nigel Fox, Marc Bouvet, Philippe Goryl, Tim Hewison, Aimé Meygret, Kurtis Thome, Emma Woolliams, Jack Xiong

# Meeting scope

At the 27th CEOS-WGCV-IVOS meeting a decision was made to hold a focused discussion of CEOS WGCV IVOS and relevant GISCS members, where different, on whether to establish a coordinated/community system for collating information about biases between sensors and the desirability/means of providing consensus information on those biases in a common way to aid understanding and interoperability of level 1 products and how best to communicate that information. It was expected that this meeting would open to a wider community and start with a scientific workshop, but that there was a need for a pre-meeting of a small sub-group of CEOS member agencies prior to such a workshop to establish the scope of the work. . This describes the outcomes of that pre-meeting. The agenda is given on the final page.

# Conclusions of meeting

This group shares a common vision:

: *to work towards establishing a community agreed* ***reference*** *(****s****, potentially to reflect different applications/observation characteristics) for level 1 TOA radiances and the means of how sensors can and should link to it and subsequently communicate results.*

To achieve this it will look to set up a project\* (set of activities) to prototype, in conjunction with GSICS†, a system that will deliver this vision. Noting that some of the activities that form part of this vision are already underway and will form elements of this vision. This vision will be presented at the WGCV-IVOS in Beijing to get a full membership view and to scope out a way to achieve this vision (projects, tasks). We will then present this to the WGCV to allow the involvement of other subgroups as desired and where appropriate for some of the more generic aspects. However, at this prototype stage, limited to the optical sensors, we are not looking for this to necessarily be anything more than an IVOS and associated relevant GSICS members activity, any reference and linking method will, by definition, be sensor technology specific.

†GSICS here is shorthand – WGCV-IVOS will work directly with the subgroups of GSICS, particularly the UV, Vis/NIR and IR sub-groups of the GSICS research working group

\* The project is a coordinated work effort focussed on working towards enabling interoperability of L1 data from optical sensors in an internationally consistent manner.

The overall objective in establishing a reference will be to provide information to satellite operating agencies and potentialyl their customers in a common manner but interpretation of this information will be for individual agencies as they have the expertise and responsibility for their own sensors.

We seek to provide is a single CEOS (community)-reference for L1 data products (probably radiance) and the means for comparing sensors to that reference. Our audience are two types of users:

* Satellite operators (agencies and commercial) who can use the information about their sensor to inform (but not replace) their own decisions on calibration coefficients for their sensors, and
* Users of satellite L1 data products (e.g. L2 data producers, producers of data cubes, and long term climate data records) who can use the information to obtain consistency across sensors and between sensor bands and over time when producing products that are independent of the sensor

# Elements that would make up such a ‘service’

1. ***Understanding of user needs and characteristics of sensors that would use such a service***
   1. Find users for this service (needing interoperability)
      * GEO, CEOS-VCs, WG Climate, WGCV,
      * Operating agencies, Commercial operators
   2. Find applications for this service
      * Datacubes
      * Gap filling
      * FCDR and CDR production
   3. Understanding what their requirements are
      * How they want to combine sensors, which sensors,what they will use information for
      * Scoping service range: Spectral bands, absolute / relative stability, update frequency, interchannel
      * [Not geolocation / PSF etc]
      * How they would like to access the information, their involvement as providers (options for types of users)
   4. Decide on scope / service requirements (initial / longer term), feasibility [producing service requirement specification]
2. ***Development of a means of formulating a reference and its associated uncertainty***
   1. Define required characteristics of a reference
      * Temporal stability, accessibility to users, political neutrality, dynamic range, wavelength range, spectral resolution, spatial resolution, geographic location
   2. List of possible reference approaches and evaluation of these approaches

* Sites, models, a sensor, a combination of sensors, SI
* Heritage information
  1. Stability of reference due to its formulation / re-realising the reference
  2. Traceability of reference
* Approaches / methods: natural phenomena, PICS, instrumented sites
  1. Reference choice (Relative vs absolute radiometry) considering
     + Sensor to sensor (within series, different series) effects
     + Band to band effects
     + Temporal (within orbit, seasonal, diurnal, long-term drift) effects
     + Geographic / geometric sensitivities (e.g. cross swath consistency, inter-scene consistency, geographic representativeness / accessibility of reference)
  2. Dynamic range and nonlinearity
  3. Combining to a single reference
  4. Uncertainty analysis on reference

1. ***Development of a means of linking sensor measurements to this reference (and associated uncertainty)***
   1. Define required characteristics of linkage approach
      * Temporal stability, accessibility to users, political neutrality, dynamic range, wavelength range, spectral resolution, spatial resolution, geographic location
      * Approaches / methods: natural phenomena, PICS, instrumented sites
   2. List of possible linkage approaches and evaluation of these approaches
   3. Necessary additional information reviewed and agreed
      * Reference solar spectra,
      * Radiative transfer models and inputs
   4. Adjusting for different characteristics
      * Band convolution techniques
      * Temporal interpolation (within orbit, seasonal, diurnal, long-term drift)
      * Spatial interpolation and matching
   5. Uncertainty analysis on linkage
      * Ensure traceability is maintained through to sensor
   6. Operational feedback (defining how data from linkage comes back into system)
2. ***Methods for communicating information and data***
   1. Information
      * The reference and its associated uncertainty
      * The way to link to the reference
      * Results of comparison to reference (provided by operator/contributing users) [“table”]
      * ATBDs, monitoring reports, standards, conventions, file formats
   2. Tools
      * Software routines? Or algorithms and pseudocode?
   3. Communication methods
      * Web portal
      * Servers – including GSICS?
      * Papers and conferences
   4. Validation reports / QA / Peer review reports
   5. Opportunity for feedback from users
3. ***Governance, review mechanisms and quality control (all to be defined!)***
   1. Scope of implementation
   2. Path forward within WGCV-IVOS
   3. Linkage to GSICS
   4. Possible means for implementation
   5. Possible mechanisms for review, quality control, responsibilities,
   6. How open / public is the data, methods etc? Data policy?

# What we need to do first

We start by focussing on four key aspects (some of these are to be started within CEOS-WGCV-IVOS, others we request CEOS-WGCV to consider directly. These can be done in parallel with each other.

* Agree terminology / vocabulary. This is part of a wider initiative which this community can get involved in and needs to be done at a higher CEOS level and in collaboration with GSICS
* Have the conversations with users to understand their requirements and approaches (point 1, above). We recommend that this is done by WGCV at both a general level and in terms of the specific requirements that relate to an early IVOS-based prototype.
* Collect existing information on sensor-comparisons in a common format and provide these on a restricted (password protecting) section of the calval portal. This will be IVOS led and will be discussed at the CEOS-WGCV-IVOS meeting in Beijing. It could be that WGCV wishes to do this on a wider multi domain based in which case it would fall to WGCV.
* Continue to develop and evaluate any differences in how individual methods operate.
* Consider how we can combine the existing methods (PICS, DCC, sunglint, RadCalNet,… …) that IVOS members use to perform comparisons to get a single value. This will start as an IVOS activity

We will

* Share these notes within IVOS and then WGCV
* Consider (through the IVOS meeting) holding a day on different approaches and how they may be combined as part of the subsequent IVOS meeting (2017)
* Discuss with WGCV how to start conversations with the different users / applications of such a “service”
* Discuss with WGCV how to start conversations with GSICS and others about vocabulary and terminology

# Soft agenda (capable of adjustment, if appropriate)

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| --- | --- |
| 09:30 – 10:00 | Coffee / tea available, arrival |
| 10:00 – 10:15 | Introduction   * *Welcome to NPL, practicalities, review of agenda, meeting roles and notetaking approach, openness / privacy of this discussion etc.* * *Introduction (Nigel) to technical discussion and reminder of what has been said before* |
| 10:15 – 11:30 | Harmonisation and interoperability – what does it involve?   * *Who is the ‘audience’?* * *What could this look like (ideal / long term)? Databases of comparisons without recommendations or recommended bias corrections for pairs of sensors? Common references? E.g. “averages” (mean, weighted mean, median)? Close spectral bands or across bands?* * *What is done at the moment? Within agencies? Across agencies? GSICS? WGCV?* * *What might be the problems (technical and political) in making this public in these different possible forms?* |
| 11:30 – 11:50 | Coffee / tea break |
| 11:50 – 13:00 | The elements of a service   * *From the things considered in the last session, which elements are most useful/practical? Where might there be problems – technical or political?* * *What do we want short term, medium term, longer term? Can we sketch a basic outline for a roadmap?* |
| 13:00 – 13:45 | Lunch break |
| 13:45 – 15:30 | A strategy   * *Filling in the roadmap – what does this mean, what is the direction, sequence?* * *Collaborations between CEOS-WGCV(-IVOS) and GSICS* * *Involving a wider community, when and how?* |
| 15:30 – 15:45 | Coffee / tea break |
| 15:45 – 16:30 | Conclusions   * *What is the specific next step? Who will do what when?* * *What do we want to do with the notes – summary only or all notes and to participants only or more public?* |
| 16:30 – 17:30 | Optional  *We anticipate closing the meeting at 16:30, however, if there are those who wish to stay longer, we have the room and Nigel and Emma are available until 17:30.* |