

# Workshop objectives & implementation

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<b>Tuesday 6 May 2008</b> <i>Green Auditorium</i>	<b>Wednesday 7 May 2008</b> <i>Lecture Room A</i>	<b>Thursday 8 May 2008</b> <i>Lecture Room A</i>
<p><b>8:30 Coffee &amp; Refreshments</b></p> <p><b>09:00 Registration &amp; Introduction</b></p> <p>09:30 NIST Introduction (Raju Datla, NIST)            09:40 NIST Welcome (Katharine Gebbie, Director, NIST)            09:50 CEOS (Changyong Cao, WGCV chair)            10:10 GEO (Michael Rast, GEO Secretariat)</p> <p>10:30 Guest Presentation (Tom Armstrong, Head of Climate Change, USGS)</p> <p><b>11:00 Coffee</b></p> <p>11:30 The need for a QA strategy (Pascal Lecomte, ESA)            12:00 Methodology &amp; guidelines for Cal/Val (Nigel Fox, NPL)</p>	<p><b>7:45 Coffee &amp; Refreshments</b></p> <p><b>Harmonisation (Chairs: Nigel Fox, NPL &amp; Gyanesh Chander, SGT/USGS)</b></p> <p>08:30 Guest speaker (Jeffrey Morisette, NASA)            09:00 Discussion</p> <p><b>10:15 Coffee</b></p> <p>10:45 Guest speaker (David Llewellyn-Jones, University of Leicester)            11:15 Discussion</p>	<p><b>7:45 Coffee &amp; Refreshments</b></p> <p><b>Implementation (Chairs: Pascal Lecomte, ESA &amp; Gregory Stensaas, USGS)</b></p> <p>08:30 Guest speaker (Pasky Pascual, EPA)            09:00 Discussion</p> <p><b>10:15 Coffee</b></p> <p>10:45 Guest speaker (Irwin Alber, IEEE)            11:15 Discussion</p>
<p><i>12:30 Lunch</i></p>	<p><i>12:30 Lunch</i></p>	<p><i>12:30 Lunch</i></p>
<p>14:00 Cal/Val sites (Gregory Stensaas, USGS)            14:30 Satellite &amp; <i>in situ</i> data access (Bojan Bojkov, NASA)            15:00 Harmonisation of quality information (Pascal Lecomte, ESA)</p> <p><b>15:30 Coffee &amp; Refreshments</b></p> <p>16:00 Actions &amp; Guidelines (Marie-Claire Greening, GC/ESA)            16:30 Report from WGCV taskforce to address governance for Cal/Val processes / guidelines (Stephen Mackin, DMCI)            17:00 Discussion &amp; questions            17:30 Workshop objectives &amp; implementation (Pascal Lecomte, ESA)</p>	<p><b>Data Policy (Chair: Bojan Bojkov, NASA)</b></p> <p>13:30 Guest speaker (Mark Schoeberl, NASA)            14:00 Discussion</p> <p><b>15:15 Coffee &amp; Refreshments</b></p> <p>15:45 Discussion</p>	<p><b>13:30 Conclusion &amp; Wrap-up</b></p> <p>Open panel session moderated by Stephen Ungar, NASA</p> <p>Panel:</p> <ul style="list-style-type: none"> <li>• Harmonisation: Nigel Fox (NPL) &amp; Gyanesh Chander (SGT/USGS)</li> <li>• Data Policy: Bojan Bojkov (NASA)</li> <li>• Implementation: Pascal Lecomte (ESA) &amp; Gregory Stensaas (USGS)</li> </ul>
<p><i>17:45 Special Session – Invited Guest Speaker – Dr. James F. Schooley, NIST Alumni – “Early history of National Bureau of Standards”</i>  <i>18:00- 20:00 NIST MUSEUM Tours and Reception</i></p>	<p><i>17:00 Close</i>  <i>17:00 – 18:30 NIST Laboratory Tours</i></p>	<p><i>16:30 Close</i></p>



# Harmonisation

## Scope:

- **Methodologies/guidelines/procedures/protocols**
- **Data collection (Sensor/in-situ), Data processing, Dissemination**
- **All sensor domains**
- **Reference standards inc Test sites**
- **Quality assurance/control**
- **Quality indicator “fitness for purpose” of data product for all stakeholders**
- **Terminology**
- **International operation and compatibility of “system”**

## Key Session Objectives

- **To agree on “key guidelines” needed to scope QA framework**
- **Agree on adoption/adaptation of existing guidelines (in principle)**
- **Agree on scope/content of any missing key guidelines**
- **Assign authors (task force) for completing necessary guidelines**
- **Prioritize targets for any detailed “technically specific” guidelines from sub-groups**
- **Identify case studies for promoting, benefits of adoption and/or consequences of not doing, of a harmonised QA framework**

# Harmonisation

- Presentation 1: Jeff Morrisette

## Guidelines data Quality

- **Guideline 1.** A guide to content of a documentary procedure to meet the Quality Assurance requirements of CEOS  
**Draft exists**
- **Guideline 2(a,b):** Establishing a QI for satellite sensor delivered data product through traceable pre-flight and post-launch calibration, Validation and comparison  
**High level guideline agreed subsequent detailed guidelines are sensor specific and for sub-groups to establish as necessary.**
- **Guideline 3:** Organization and analysis of a measurement comparison  
**Propose to base on international guidelines established by std labs.**
- **Guideline 4:** Establishing a reference standard  
**Process needs to be established**

## Guidelines data Quality

- **Guideline 5: Evaluating and expressing uncertainty of measurement**  
**ISO guide**
- **Guideline 6: Writing and validating models and algorithms**  
**Modify and adopt existing guidelines**
- **Guideline 7: Writing and validating software**  
**Review, modify and adopt existing best practises**
- **Guideline 8: Establishing and assessing quantitative evidence of traceability**  
**To be defined**

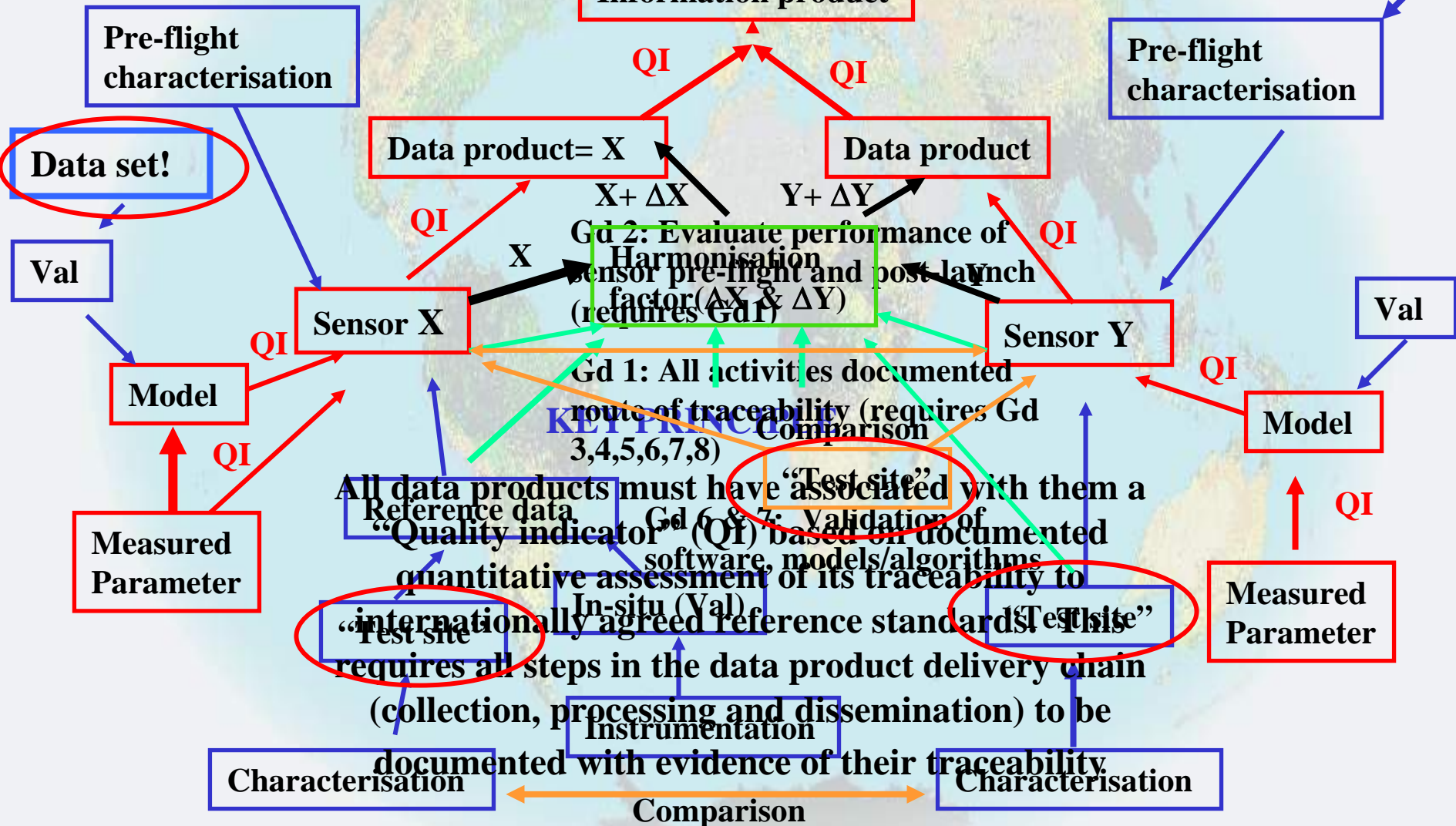
## Guidelines Communication and Education

- **Guideline 1. Definition and use of terminology for EO Cal/Val**  
**Consider means to implement**

**"fit for purpose" ↑ Quality indicator (QI)**

## Guideline 3: Comparisons

## Guideline 8: Evidence



## Guideline 4: Ref standards

- **Agree on principle that we only need a few “key guidelines” which if followed lead to an acceptable QI and these should be “endorsed” (TOP DOWN)**
  - *Can have others, but not essential and should derive from “key guidelines” and likely to be technically specific (BOTTOM UP)*
- **Any additional guideline topics needed to scope framework (data quality)?**
- **Concentrate effort on those where nothing exists, agree in principle on others?**
  - *Noting as a minimum need some modifications to numbering consistency.*

# Guideline 1 Data Quality: A guide to content of a documentary procedure to meet the Quality Assurance requirements of CEOS: Contents (1)

- **Identification/Document control (guideline)**
  - Classification Identifier
  - Title
  - Author
  - Issuing authority
  - Version number/Date
- **Overview/Scope (Abstract)**
- **Special Terminology/Definitions (guideline)**

- **Introduction**

- **Background/context/requirement**
- **Expected outcomes (quantitative in terms of required performance)**
  - Could be aims and objectives*
  - Indicate scale of difficulty in end result (state-of-art?)*
- **Inputs (starting parameters and supplementary)**
- **Standards and Traceability (overview) (guidelines)**
  - What will be used to demonstrate/test outcomes*
  - Upon what will the evidence to support this be based*

# Guideline 1 Data Quality: A guide to content of a documentary procedure to meet the Quality Assurance requirements of CEOS: Contents (3)

- **Description of task**

- **Could be text document / powerpoint / video or combination**
- **Methodology/Protocol/Procedure/guideline/best practise**
- **Level of detail in description depends on objective**
  - Process to allow something specific to be achieved (detail)*
  - Generic guidance (less detail)*
  - Sufficient to allow “informed reader” to carry out*
- **Where specific choices have been made to carry out process information on reason for choice should be given**
- **Ideally written before carrying out but can be iterative**
- **For QA evaluation, information provided is critical in report on what was done**
- **For process control needs to exist to guide user on what to do**

## Guideline 1 Data Quality: A guide to content of a documentary procedure to meet the Quality Assurance requirements of CEOS: Contents (4)

### • Performance (outcome) Evaluation

–How performance to outcome will/was evaluated (**guidelines**)

*Maybe Model of process (parameter inter-sensitivity)*

*Uncertainty components (indicative / achieved)*

*Against what standards*

*How performance deviated from planned and why (in final report)*

–Evidence to support performance indicator (**guideline**)

*What will / was done*

*comparison of technique with peers or previous process?*

*repeatability/reproducibility of process?*

*External peer review of process and results?*

*.....(to be decided)*

*Rigour depends on criticality of process*

*Quantitative*

– Review of process (lessons learned/ improvements)

*Feedback to author for revision*

To establish a Quality Indicator (QI) for satellite sensor delivered data products the following guidelines are recommended:

- a) **Pre-flight:** All Data producing aspects of a sensor should, where possible, be traceably calibrated/evaluated against international standards (ideally SI) at system level and as integrated “end-to-end”, and where appropriate, witness samples of key calibration sensitive components should be stored and maintained for later evaluation.
- b) **Post-Launch:** Sensors should seek to demonstrate their performance for the following three aspects:
  1. Characteristics compared to pre-flight specifications
  2. Biases to similar in-flight sensors
  3. Stability of delivered data products during mission life and its correlation with data from historical and future missions.

This can best be achieved through comparison to a CEOS endorsed reference standard using an endorsed methodology

The documentary evidence to support the above activities can best be achieved through following data quality guideline 1.

**This Guideline will lead to more detailed, sensor and technically specific, guidelines some of which May ideally be endorsed**

**All data products must have associated with them a Quality Indicator (QI) based on a documented quantitative assessment of its traceability to an agreed reference standard (ideally tied to SI).**

**Follow guidance doc. Draft exists**

**To establish a QI for a satellite sensor derived data product requires a knowledge of sensor performance and this can best be evaluated through the following guidelines:**

**Pre-flight:**

- Traceably calibrate all sub-systems
- Perform “end to end” system calibration
- Maintain witness samples of key components for later testing as necessary

**Post launch: Evaluate sensor performance for following aspects:**

- “Characteristics” compared to pre-flight
- Biases to other in-flight sensors“
- “Stability” of products (in mission, & link to history and future)

**Can be best achieved through comparison to “CEOS standard” using a “CEOS method”**

**e.g. LAND imager constellation**

**Characteristics e.g “Gain”**

- On board standard
- CEOS core test site
- Rayleigh scattering
- Clouds
- Moon
- .....

**Bias**

- SNO
- CEOS core test site
- CEOS invariant standard

**Stability**

- CEOS invariant standard (“Standard Desserts”, Moon)
- CEOS core test site (accuracy)
- On board standard

# Guideline 3: Organisation and analysis of a measurement comparison based on international best practise

## Key principles- organisation:

- **Identify a pilot (s) (organiser)**
- **Agree participants and any participation criteria**
- **Write and all participants agree, a technical protocol prior to start and if considered to be a “key comparison” this should be approved by CEOS? (appropriate sub-group) (examples/templates exist)**
  - *Participants*
  - *Methodology*
  - *Key uncertainty components*
  - *Method of analysis*
  - *Timetable*
  - *Agreement to being blind, publication of results and non withdrawal*
- **All Results to be accompanied by measurement description and uncertainty breakdown**
- **If a participant does not perform well then opportunities should be made to allow a bilateral**

## **Guideline 3: Organisation and analysis of a measurement comparison based on international best practise**

### **Key principles- Analysis:**

- **No result or uncertainty to be changed after results seen**
- **Analysis carried out by Pilot (blind to all others)**
- **Early visibility to all participants of measurement descriptions and uncertainties for discussion prior to seeing results (uncertainties can be increased at this stage following discussion)**
- **Results in general presented as differences to a common mean value (unless a priori one result is known or defined to be “true”)**
- **Final report to be agreed by all participants (all results visible even if indicating differences, comments to justify differences can be included)**
- **After approval by “appropriate authority” results made visible to all via portal**

# Harmonisation

- Presentation 2:  
Professor David Llewellyn-Jones

## Guideline 4: Establishing a “reference standard” – characteristics and “acceptance”

**Agree need for “CEOS reference Standards” (and associated methods of use) to facilitate evaluation of in-flight sensor biases and linkage to future missions (post launch).**

*- e.g. “LandNET test sites”, Moon, Amazon rainforest, microwave transducers, Mauna Loa atmosphere, Thuillier solar irradiance spectrum ...*

**Do we Need to define reference standards for pre-launch?**

**Properties of Reference standards:**

- Parameters adequate to test at required level*
- Appropriate parameters characterised*
- “ “ temporally stable between period of use and characterisation*

## Guideline 4: Establishing a “reference standard” – characteristics and “acceptance”

### What needs to happen for a reference standard to be accepted?

- For use in an experiment to support calibration traceability evaluations?
- Who needs to give acceptance?
- As an international “CEOS standard” for interoperability?
- Who needs to give acceptance?
- What is the route?

**Recommend use of of ISO guide 98: guide to expression of uncertainty.**

- **Implementation may need training material / case studies**
- **CEOS WG-Edu?**

**Best practise guidelines exist for many aspects, some specific for space e.g. ECSS (Europe) others more generic in terms of application e.g “NPL guides” (but more specific in validation).**

**Are there others?**

**How do we go forward quickly (as an interim measure)?**

**Longer term?**

**Guidelines 1, 2, 6 and 7 all imply that if followed they will allow a QI to be assigned**

- **All require a means of demonstrating quantitatively, traceability to a “ref standard”**

**Guideline 5 provides the means to determine a value for the QI (based on uncertainty)**

**Guideline 4 provides a means of identifying appropriate reference standards**

- **Comparison (with others or different approach) (supported by internal QA system for maintenance unequivocally provides quantitative “evidence” that such standards have been used appropriately and that results declared are consistent with others or have a known bias.**

**Guideline 3 gives guidance on how best to carry out a comparison (with others)**

## **Guideline 8: Establishing and assessing quantitative evidence of traceability**

**Does this (comparison) have to happen to “guarantee” the system?**

**Is there anything else that will do?**

**Do we have to compare everything?**

**Who provides the “guarantee”?**

**Who reviews the “evidence” (locally and internationally)?**

**How do we engage/encompass all providers (small and large)?**

# Demonstrating evidence through “selective sampling” using “key comparisons”

National Metrology Institutes offer 1000's of “calibration services”



For international trade must be able to accept “calibration” provided in one country as compatible with another



Searchable Database established listing all key services of all countries with uncertainties (considered acceptable and consistent with all other countries)  
(Optical radiometry ~ 1000 individual service categories listed)



Ideally all services need to undergo comparison to establish confidence

**NOT POSSIBLE**



Therefore establish a set of “key comparisons” to test principle techniques in the field to underpin system (optical radiometry has ~100)



Supported by some “supplementary comparisons” for particular key issues and peer review of evidence provided to support other services

### Guideline 1. Definition and use of terminology for EO Cal/Val

- **We agree on Need**
- **“Dictionary” should be available through portal**
- **How do we Collate / consolidate?**
- **Who?**