

QA4EO: status and progress

Towards Allowing:

Users (customers) to assess suitability of data (information) for their application “fitness for purpose” at “face-value”

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- Chair CEOS WGCV IVOS
- UK Rep on CCPR (international committee advising on SI for Radiometry and photometry)
- Lead on EU project to establish “European Metrology Centre for Earth Observation and climate” (EMCEOC)



“Community” requirement



All themes, all applications, all “levels”:

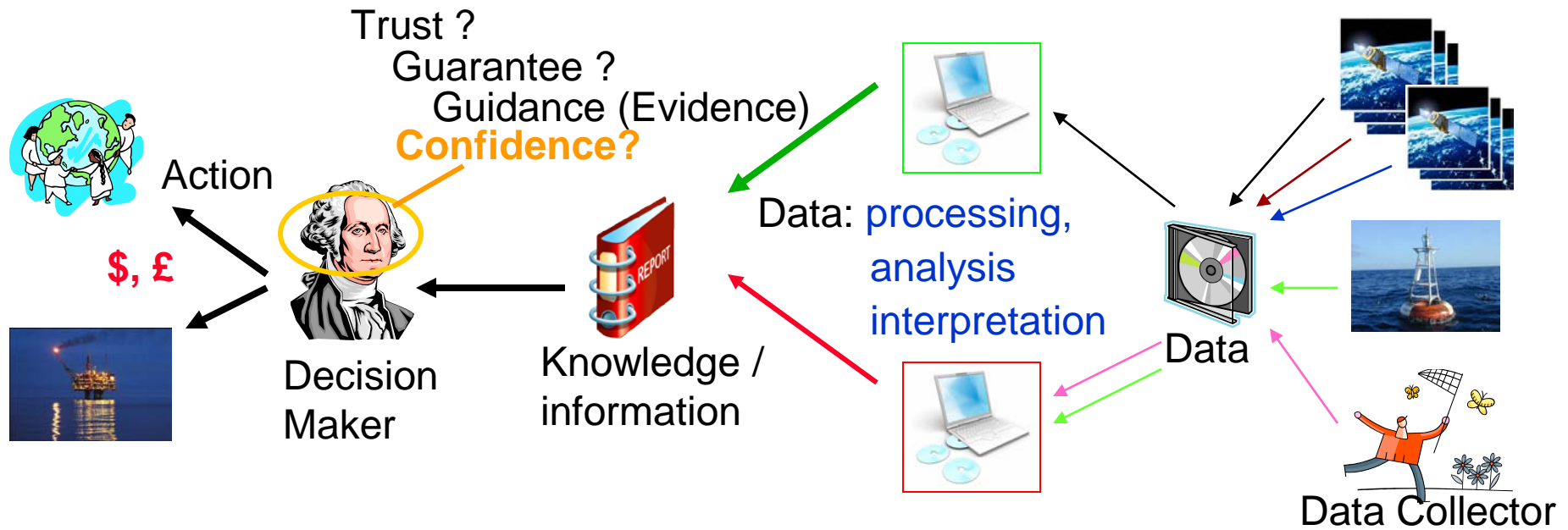
Measured data and all processes leading to Knowledge/information products are in scope

- The Group on Earth Observations (GEO)’s (founded 2002) Global Earth Observation System of Systems (GEOSS) must deliver comprehensive “knowledge / information products” worldwide and in a timely manner to meet the needs of its nine “societal benefit areas”.

- This will be achieved through the synergistic use and combination of data derived from a variety of sources (satellite, airborne and *in-situ*) through the coordinated resources and efforts of the GEO members.

- Achieving this vision (2015) requires the establishment of an operational framework to facilitate interoperability and harmonisation. **Fundamentally, requires an unambiguous, consistent “quality indicator / metric”.**

Why a Quality indicator?



- Process / Effort only needs to be “fit for purpose” – depends on criticality of decision
 - Ideally consider ALL potential decisions / uses
 - What is the meaning of a result without an uncertainty/confidence statement?
 - Can be based on a guess
- Does NOT necessarily require “best quality”/ Low uncertainty only knowledge of what it is?
- Supplier provides information & Evidence of “quality” in an understandable manner
 - “User” (Customer) assesses suitability for their application (can take independent advice)

Key Definitions: Simplified

- **Accuracy** – a qualitative term describing the closeness of the agreement of the result of a measurement with the “true” value
 - **Error** – difference from a “true” value or a “bias” can often be corrected for.
 - **Uncertainty** – how well we believe we know the value
 - ◆ “Type A” or random – statistically determinable by experiment
 - ◆ “Type B” – any other means of estimating uncertainty (can be educated guess)
 - **Quality Indicator (QI)** – an indicator of performance or quality of the result of a process/activity derived from an uncertainty estimate but can be a text descriptor / flag / numeric value. Can be binary
 - **Traceability (metrological)** – documented evidence of uncertainty of the result of a process to a community agreed “reference standard” through comparison
 - **Traceability (document link)** – Archived and accessible, complete documentary linkage of all steps in a process chain tied to a result
-

Key Definitions: Simplified

- **Standard (reference)** – “reference” against which performance can be determined
- **Repeatability (Precision)** - Closeness of agreement (statistical) of a set of measurements taken under the same defined conditions
- **Reproducibility** – Closeness of agreement (statistical) of a set of measurements of the same entity under changed but defined conditions
- **Calibration** – Establishes a relation (quantitative link) and associated uncertainty of a measurement result with a defined reference standard.
- **Validation** – Verification that a “result” is consistent with “reality” or meets its specified requirements as determined by some independent means

Formal Definitions from ISO guide “Vocabulary for International Metrology” (VIM) ISO99:2007

Terminology: Issue

- **Many use error instead of Uncertainty - Very different**
Can correct for an error – uncertainty is how well we think we know the answer
- **Traceability often thought of as: “I bought a standard so I am traceable”**
- **Different countries, groups and communities use different names for similar things**
- and/or same name for different things (sometimes originating from subtleties in translation)
- **We need to establish a common dictionary and encourage its use across communities**
- or at least be sure we clearly define our meaning in context of use.

Geo Task

DATA Management:

DA-09-01a: GEOSS quality assurance strategy Co leads: CEOS & IEEE

“Develop a GEO data quality assurance strategy and implementation process, beginning with space-based observations and expanding to in-situ observations taking account of existing associated GEOSS QA work, and including the quality issues of Earth Observation information products”

“....It is proposed that GEOSS data set registration include QA information to enable harmonisation and interoperability, which during the transitional phase could be a voluntary self declaration of compliance with QA4EO and/or at least its underlying principles.”



Strategy development: community engagement

Strategy development led by small CEOS team through two community workshops, CEOS sub-groups and ad-hoc meetings

“GEO/CEOS workshop on quality assurance of calibration and validation processes”:



“Guiding principles”
(Geneva Oct 07)



“Establishing an
operational framework”
(Washington May 08)

QA4EO
→



“Facilitating
implementation”
(Antalya Oct 09)

CEOS endorsed – Nov 08

Inc WMO +

Now evolving to meet all EO needs of GEO inc in-situ



A QUALITY ASSURANCE
FRAMEWORK FOR
EARTH OBSERVATION



What QA4EO is...

it's a general **framework**

based on **1 essential principle**

and composed of **7 key guidelines**

V4.0

These are “living documents” (i.e. ~~v.3.0~~) and they offer a **flexible approach** to allow the **effort for the tailoring** of the guidelines to be **commensurate with the final objectives.**

It is a **user (customer) driven** process.

...and what is not

...not a certification body

...not a set of standards for QC/QA activities and processes that would limit competitiveness or innovation and evolution of technology and methodologies

...not a framework developed with a top-down approach

...the QA4EO process and its implementation should **not be judgemental and bureaucratic**

QA4EO Principle

Data and derived products shall have associated with them a fully traceable indicator of their quality

**Quality Indicator
(QI)**

Traceability

- Supported by set of seven key guidelines – including templates

Data Quality

All data and derived products must have associated with them a Quality Indicator (QI) based on documented quantitative assessment of its traceability to community agreed reference standards. This requires all steps in the data and product delivery chain (collection, archiving, processing and dissemination) to be documented with evidence of their traceability.

Traceability: *property of a measurement result whereby the result can be related to a **reference** through a documented unbroken chain of calibrations, each contributing to the measurement **uncertainty** (ISO guide 99:2007)*

Note: A **RESULT** has **NO MEANING** without an associated **UNCERTAINTY** (can be a guess)

supported by a set of 7 QA4EO Key- Guidelines:

- are intended to be generic in scope to cover all EO data-related activities
- Provide guidance (and indicative templates) on how to establish a QI and the means to obtain and document associated evidence.
- Encourage / anticipate community specific interpretations
- Need to be supplemented by community/organisation specific “best practises” or “procedures” (operational in nature).
- Based on formal quality management systems

(Does not seek to replace, only complement existing QA standards procedures, most are fully consistent with QA4EO principles)

Data Quality guidelines: QA4EO-QAEO-GEN-DQK-....

...001: A guide to establishing a Quality Indicator on a satellite sensor derived data product **Definition of requirements (space example)**

...002 A guide to content of a documentary procedure to meet the Quality Assurance requirements of GEO **Template to ensure all information is documented**

...003 A guide to “reference standards” in support of Quality Assurance requirements of QA4EO **What is a standard for different situations**

...004 A guide to comparisons – organisation, operation and analysis to establish measurement equivalence to underpin the Quality Assurance requirements of QA4EO **Best form of evidence - advice based on “best practise from NMIs**

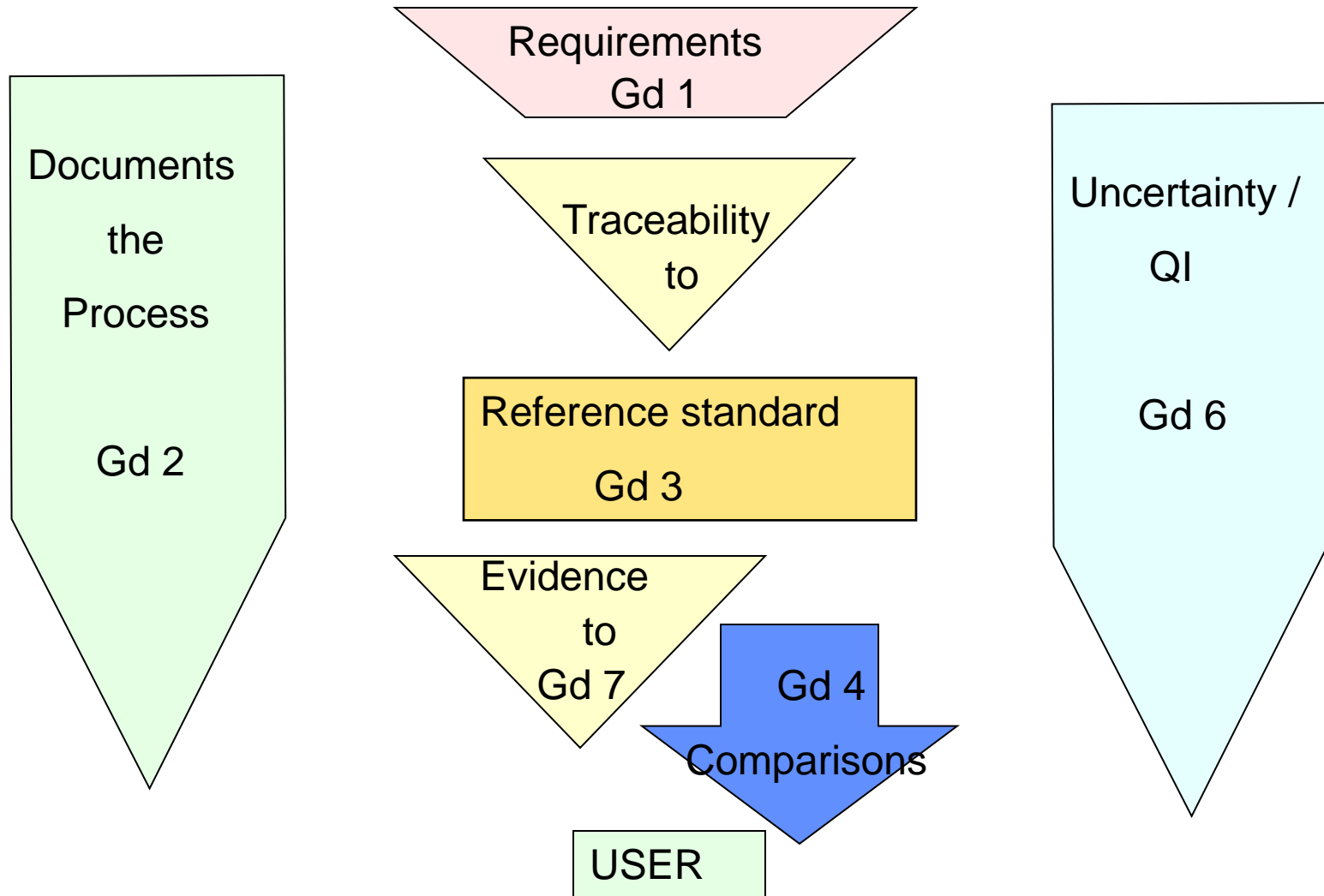
...005 A guide to establishing validated software, algorithms and models to underpin the Quality Assurance requirements of QA4EO **Links to other QA guidance docs**

...006 A guide to expression of uncertainty of measurements **Link to ISO GUM**

...007 A guide to establishing quantitative evidence of traceability to underpin the Quality Assurance requirements of QA4EO **Types of evidence that communities might find**



Guideline aims



Documenting evidence: QA4EO-QAEO-GEN-DQK-002

Commonality of Content (minimum)/ format (QA4EO TEMPLATE)

- simplifies development and transferability
- ensures a minimum set of key information (quality parameters) a “checklist”
- Enables easy review and development into “best practise”
- Not just a procedure of how to do but also a report of what was done
- **Can be a ppt, video, set of bullets ”level to be appropriate to need”**

Content

Identifier (ref number / authority etc)

Description of task (Scope)

- requirements/aims/objectives
- inputs
- outcomes (including performance indicators e.g.accuracy
- means to evaluate results (test plan with identified ref “standards”)

Method to carry out activity (greater detail for protocol)

Results and evidence of traceability

Uncertainty table (key components in a template)

STANDARDS: World stds day Oct 14

"In today's world we need to have a high level of expectation that things will work the way we expect them to work. We expect that when we pick up the phone we will be able to instantly connect to any other phone on the planet. We expect to be able to connect to the Internet and be provided with news and information... instantly. When we fall ill, we rely on the healthcare equipment used to treat us. When we drive our cars, we have confidence that the engine management, steering and braking, and child safety systems are reliable. We expect to be protected against electrical power failure and the harmful effects of pollution."

"International standards give us this confidence globally."

International
standards

Creating
CONFIDENCE
globally



World
Standards
Day

14
October
2011



Developed by Leonardo Foresti, Rome, Italy
Project #1 000000000

“Reference standards”: uses (QA4EO-QAEO-GEN-DQK-003)

Functional testing

- can be simple, not formally calibrated
- for components/sub-systems
- internal consistency
- specified by service provider

Performance testing (e.g. to a specn)

- needs some characterisation, ideally calibrated traceably
- Specified by provider, funder,
- for components sub-systems
- independent operation
- could be considered a calibration

International harmonisation/bias correction

- internationally / community agreed
- Well characterised (and non bias inducing)
- if assigned a value ideally SI traceable
- accessible, relatively few,
- test “systems”

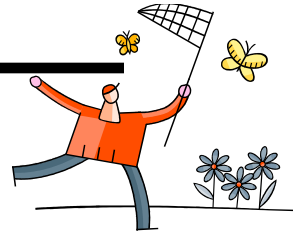
REFERENCE (MEASUREMENT) STANDARD KEY PROPERTIES & EXAMPLES

- Must be characterised (and documented) for the property for which they are a reference
 - ◇ At level commensurate with application
 - ◇ Temporally stable over the period of use
 - ◇ If assigned a value must be SI traceable or community agreed
- Can take any form: data, artefact, gas, natural, man-made, methodology,
- Can be formally endorsed for “community” use
- Must be accompanied by procedure on use



How many yellow Butterflies in south west England? Compared to south East? Absolute number?

- Define a Requirement – How well do we want to know the result?
- How will we get the info? Use volunteers to count them &
- Define a procedure to be sure everyone counts the same thing in the same way
 - - time and area of observation, method of observing and recording, photo,
- How do I QA the process - Mrs Jones is equivalent in counting to Mrs Smith
 - Mrs Smith and Mrs Jones swap locations
 - Compare Mrs Smith and Mrs Jones with similar observers in similar area
 - Bring them together to observe the same area, have a “standard video” as a control
 - Only use averages of a large number of observers
 -
- Determine an uncertainty for the method and results based on variances?
- Publish result, together with statement of uncertainty and where the procedure can be found



GdInDQK-007: “Establishing evidence”

- QA4EO process designed to allow organisations to demonstrate validity and reliability of a QI in a transparent and efficient manner
 - ◆ Allowing “customer” / user to have confidence (without checking)
- Emphasises that type of evidence required is “fit for purpose”
- Stake holders of Community define what is acceptable
 - ◆ Regulatory impact may require independent audit
 - ◆ Comparisons (concept of key comparisons)
 - ◆ Following standard procedures
 - ◆ Peer review
 - ◆ ISO or standards
- Is a place holder and pointer for the community to define “satisfactory evidence”
- Provides a framework to encourage how this evidence will be defined, agreed and made visible to the specific and GEO community.
- Needs infrastructure to facilitate practical implementation

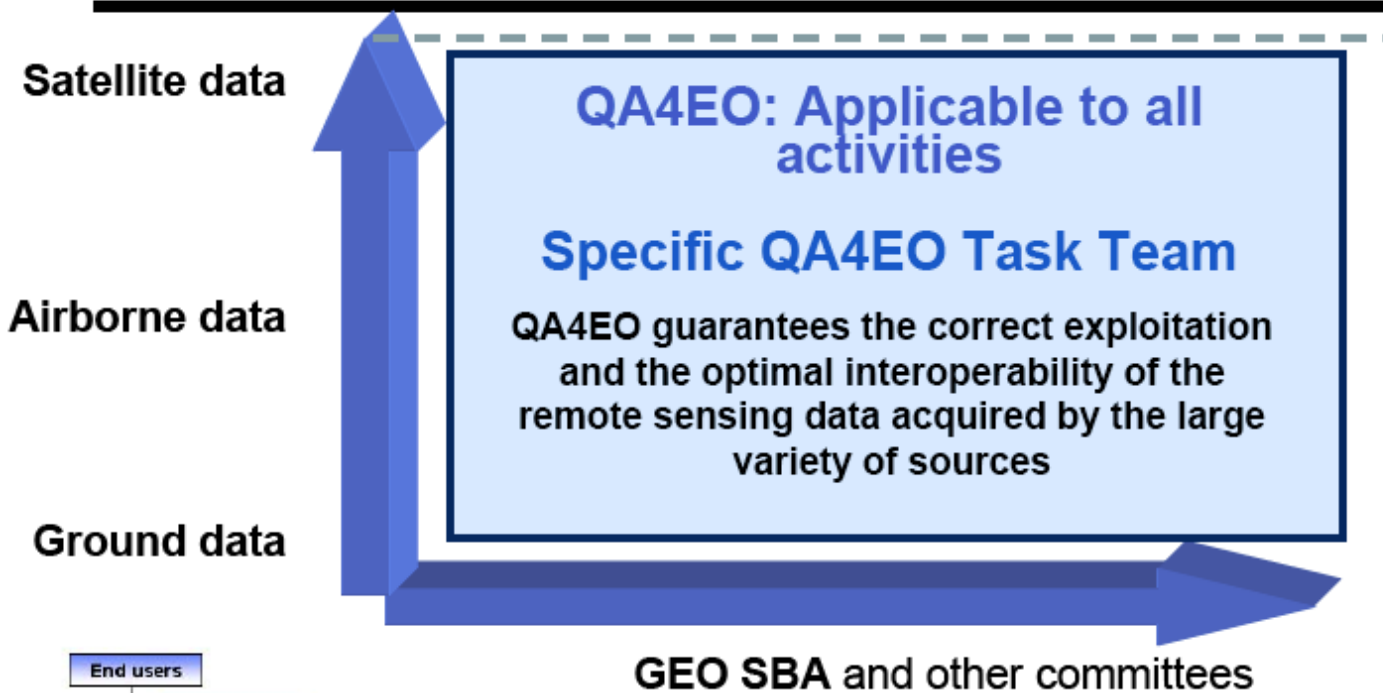
Summary

The Data Quality Guidelines:-

- Are to aid EO communities
 - Not compulsory
 - Unless specified as requirement
 - Make it easier to specify a QA process
 - Allow a QI to be propagated through complete process chain
 - For complex processes may ideally lead to a “software model”
 - Facilitate transparency and consistency (international)
 - Require detailed procedures etc based upon them
 - Can and will evolve
 - Serve as an educational framework
 - Need to be translated & require training in use for specific EO communities
 - Require some infrastructure/coordination
-



QA4EO Applicability and Relation to other Entities



Progress: Many now recognise criticality of data quality

– challenge to have a harmonised, but flexible process

- **Inclusion/adoption in other GEO tasks/themes workplans**
 - ◆ Architecture and Data
 - ◆ Capacity building
 - ◆ Science and Technology (Geo Label)
- **ISO standards (space)**
- **Space other agencies**
 - ◆ ESA
 - ◆ NASA
 - ◆ WMO (CIMO framework already more than compliant)

ISO Cal Val and QA Standards

CEOS WGCV and QA4EO teams need to review and provide input to:

- **ISO -19159 - Geographic information - Calibration and validation of remote sensing imagery sensors and data**

http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=32577

- This International Specification defines the calibration and validation of identified airborne and space borne remote sensing imagery sensors and data.
- The term calibration refers to geometry and radiometry, and includes the instrument calibration in a laboratory as well as in-situ calibration methods.
- The validation methods are split into process- and product-validation, and include the prerequisites for installing a validation environment.

- **ISO -19157 - Geographic information -- Data quality**

http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=32575

- This Technical Specification defines a set of measures for the data quality sub-elements identified in ISO 19113 Geographic information - Quality principles.
- The measures will be applicable when evaluating the quality of geographic datasets and assessing their fitness for their intended purpose. Multiple measures will be defined for each data quality sub-element, and the choice of which to use will depend on the type of the data and its intended purpose.

QA4EO implementation

- QA4EO implementation is supported by a framework document and a set of key guidelines to assist in its interpretation and implementation
 - Principles and Guidelines Version 4.0 and Implementation management
 - CEOS, IEEE, agency support and workshop revisions
 - QA4EO Website <http://qa4eo.org/>
- Organizations that fund and oversee the development and execution of Earth Observation programs are responsible for implementing QA4EO principles
- CEOS Strategic Implementation Board Panel
- GEO Strategic Implementation Board Panel
 - GEO Panel/Team to be composed of diverse members representing the EO community
 - Responsible for managing QA4EO documents and communicating QA4EO concepts to data providers and users alike



A QUALITY ASSURANCE
FRAMEWORK FOR
EARTH OBSERVATION

QA4EO Strategic Implementation Board for GEO

- | | |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> • GEO Secretariat • GEO DA-09-01a task team co-chairs • WMO • FAO • GSICS • Metrology
NIST • CEOS/GEO | <p>TBD</p> <p>CEOS WGCV & IEEE
Jérôme Lafeuille
John Latham
Mitchell Goldberg
Nigel Fox / Carol Johnson NPL/

SBA Leads</p> |
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Social Benefit Areas - POCs

- Disasters
- Health
- Energy
- Climate
- Water
- Weather
- Ecosystems
- Agriculture
- Biodiversity

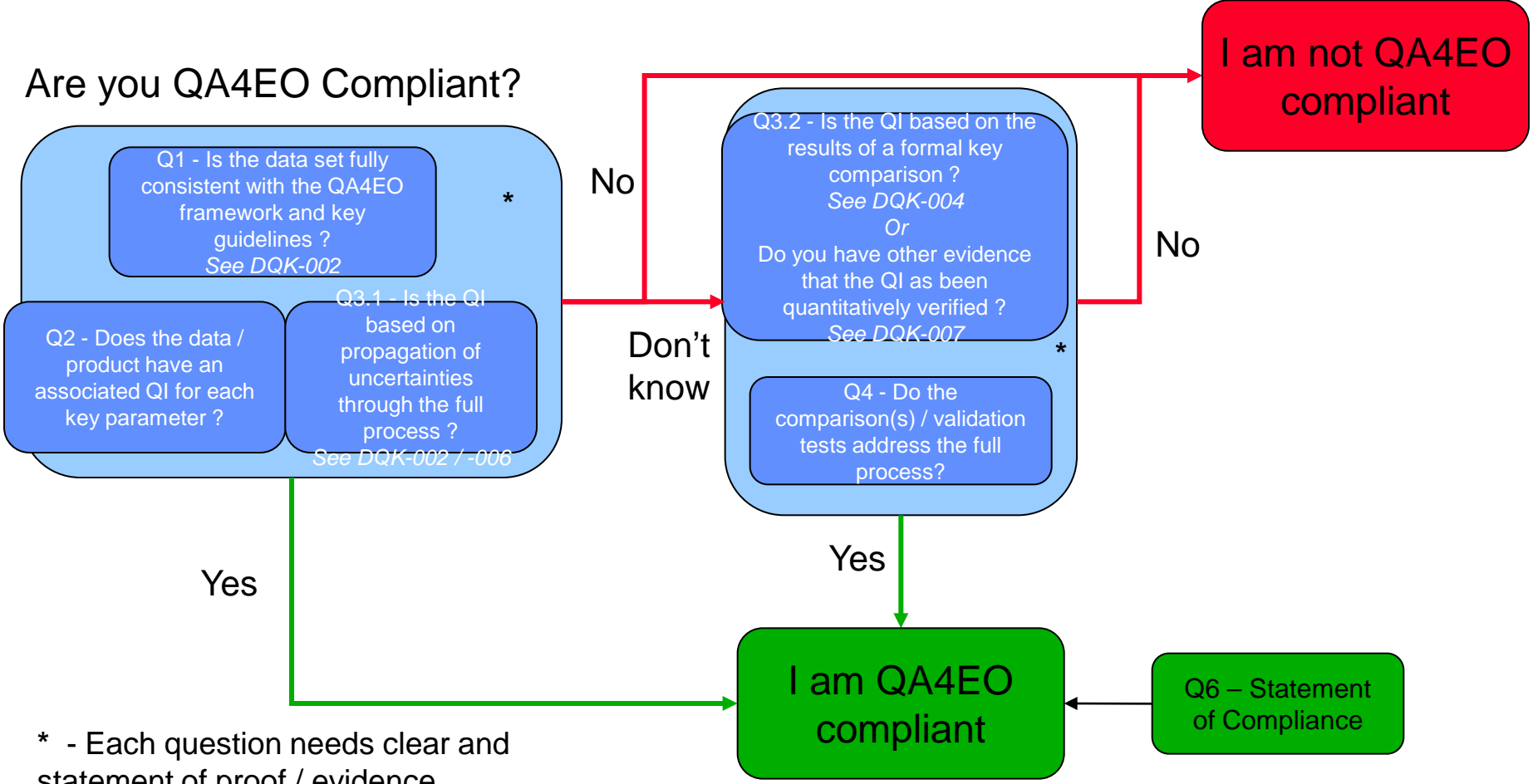
Observers

- GEO Architecture and Data Committee
- GEO Data Sharing Taskforce
- INSPIRE
- OGC
- GMES
- GCOS
- ISPRS

WGCV-33 – ROSCOSMOS, MOSCOW, Russia

Possible QA4EO compliancy questionnaire: for Geo datasets

Are you QA4EO Compliant?



* - Each question needs clear and statement of proof / evidence



Requirements from database

- **Declaration should be obligatory. If no questionnaire is filled in on submission, the dataset should be marked as not QA4EO compliant with a flag to say why (i.e. no questionnaire submitted).**
- **At the discovery stage (to users) it should be highly visible whether the data provider has completed the QA questionnaire and thus what the QA statement is for that dataset.**
- **There should be the facility to store alongside the dataset the associated QI and its associated evidence, or a link to where this information is stored externally.**

Promotional material

A single page flyer

A four page summary



The Global Earth Observation System of Systems (GEOSS) must deliver comprehensive and timely "knowledge / information products" worldwide to meet the needs of its nine "societal benefit areas" (SBAs). The GEOSS community represents a wide variety of disciplines, which utilise a multitude of monitoring methodologies and procedures. These all require an association of a quality metric to their outputs to enable them to be reliably integrated into the various systems and services that support the Earth Observation (EO) needs of Society. The fundamental principle of the Quality Assurance Framework for Earth Observation (QA4EO) - "that all EO data and derived products has associated with it a documented and fully traceable quality indicator (QI)" - addresses this core requirement and is universally applicable to all disciplines. This principle is not in itself novel and is already being practised by many. QA4EO seeks to ensure it is implemented in a harmonious and consistent manner throughout all EO communities to the benefit of all stakeholders. The end-user - "customer" - is the driver for any specific quality requirements and will assess if any supplied information, as characterised by its associated QI, are "fit for purpose".

QA4EO Core Principle
 Data and derived products shall have associated with them an indicator of their quality to enable users to assess its suitability for their application - "fitness for purpose"

Quality Indicators
 Quality Indicators (QIs) should be ascribed to data. A QI should provide sufficient information to allow all users to readily evaluate its "fitness for purpose"

Traceability
 QI needs to be based on a documented and quantifiable assessment of evidence demonstrating the level of traceability to internationally agreed (where possible SI) reference standards

The QI needs to be unequivocal in its interpretation and derivation, yet sufficiently flexible, to be implemented across the full range of EO activities that are coordinated through the Group on Earth Observations (GEO). This is the purpose of QA4EO, established to assist this task. A set of documentation is available (from the QA4EO website - <http://QA4EO.org>) to assist the user in interpreting and implementing QA4EO into their specific working arena. A framework document provides information on the fundamental principles and concepts that underpin the QA4EO philosophy. This is complemented by a set of key guidelines to assist the adoption of the QA4EO ethos into operational working. These are further enhanced by numerous (and ever-evolving) detailed community-specific guidelines that provide assistance in the practical implementation of QA4EO at the working level.

Funding organisations that oversee the development and execution of EO programs are responsible for implementing the QA4EO key principles in the generation and delivery of data products for their sphere of influence. Data users (at all stages) are responsible for the utilisation of QA4EO to assess the appropriate level of evidence in determining the "fitness for purpose" of that data and derived information provided to them for their specific applications. They are also responsible for adhering to the data sharing principles outlined in the QA4EO guidelines.



QA4EO secretariat – sec@QA4EO.org QA4EO website – <http://QA4EO.org/>



The Guide

INTRODUCTION
 The Quality Assurance Framework for Earth Observation (QA4EO; <http://QA4EO.org>) was established and endorsed by the Committee on Earth Observation Satellites (CEOS; <http://ceos.org/>) as a direct response to a call from the Group on Earth Observations (GEO; (<http://earthobservations.org>)). GEO had identified the requirement to establish an internationally harmonised Quality Assurance (QA) strategy to enable interoperability and quality assessment "at face value" of EO data. QA4EO encompasses a framework and set of ten key guidelines, derived from best practices and with example templates included to aid implementation. Each GEO stakeholder community is responsible for its own overall governance within the framework. QA4EO provides guidance to enable individual organisations to document, in a consistent manner, the necessary evidence of compliance, thereby allowing those commissioning the work to assess its adequacy and "fitness for purpose". QA4EO-compliant processes would unequivocally assure data quality and would encourage harmonisation across the whole GEO community.

BACKGROUND
 QA4EO has been endorsed by CEOS as a contribution to facilitate the GEO vision for a Global Earth Observation System of Systems (GEOSS). The aim of GEOSS is to deliver comprehensive and timely knowledge / information products worldwide to meet the needs of its nine "societal benefit areas" (figure 1). This can only be achieved through the synergistic use of data derived from a variety of sources (satellite, airborne and *in situ*) and the coordination of the resources and efforts of the GEO members.



Figure 1: GEOSS and the nine stakeholder societal benefit areas

To accomplish this vision, starting from a system of disparate systems that were built for a multitude of applications, requires the establishment of an internationally coordinated operational framework to facilitate interoperability and harmonisation. The success of this framework, in terms of data, is dependent upon the successful implementation of two key principles:

1. Accessibility / Availability and
2. Suitability / Reliability.

Success also requires effective communication of these principles to all stakeholders.



Figure 2: First Workshop of Cal/Val experts in 2007 hosted by GEO in Geneva

To implement these principles in a harmonised manner, CEOS (the space arm of GEO), through discussion with calibration and validation experts from around the world (see figure 2), established QA4EO to facilitate interoperability of GEO systems. QA4EO is based on the adoption of guiding principles, which are implemented through a set of key operational guidelines derived from best practices, for implementation by the GEO community. Although these guidelines were originally developed to meet the needs of the space community, they have been written with the aid of national metrology institutes of the UK and the USA and, where appropriate, are based on best practices of the wider non-EO community. They should therefore be readily adoptable by all GEO communities as a top-level framework that can subsequently be translated and implemented to serve each specialist need.

KEY PRINCIPLES
 If the vision of GEOSS is to be achieved, Quality Indicators (QIs) should be ascribed to data and, in particular, to delivered information products, at each stage of the data processing chain - from collection and processing to delivery. A QI should provide sufficient information to allow all users to readily evaluate a product's suitability for their particular application, i.e. its "fitness for purpose". To ensure that this process is internationally harmonised and consistent, the QI needs to be based on a documented and quantifiable assessment of evidence demonstrating the level of traceability to internationally agreed (where possible SI) reference standards. Such standards may be manmade, natural or intrinsic in nature. The documented evidence should include a description of the processes used, together with an uncertainty budget (or other appropriate quality performance measure). The guidelines of QA4EO provide a template and guidance on how to achieve this in a harmonised and robust manner.

One of the key guiding principles of QA4EO is appropriateness underlain by a community desire to:

- Achieve consistency amongst peers,
- Provide advice and training for newcomers,
- Provide transparency of approach, and
- Improve efficiency.

The QA4EO process and its implementation should NOT be judgemental, bureaucratic or costly.

A Poster



A QUALITY ASSURANCE FRAMEWORK FOR EARTH OBSERVATION

QA4EO Background

The Global Earth Observation System of Systems (GEOSS) must deliver timely, quality, long-term, global information to meet the needs of its size societal benefit areas (SBAs)

This will be achieved through the synergistic use of data derived from a variety of sensors (satellite, airborne and surface-based) and the coordination of resources and efforts of the Group on Earth Observations (GEO) members

Accomplishing this vision, starting from a system of disparate systems that were built for a multitude of applications, requires the establishment of an internationally coordinated framework to facilitate interoperability and harmonization

The QA4EO was established and endorsed by the Committee on Earth Observation Satellites (CEOS) as a direct response to a GEO Task DA-09-01A (GEOSS Quality Assurance Strategy)

What is QA4EO?

Measurement/processes are only significant if their "quality" is specified

All data and derived products must have associated with them a Quality Indicator (QI) based on documented quantitative assessment of its traceability to community agreed (and/or SI) reference standards

A QI should provide sufficient information to allow all users to readily evaluate a product's suitability for their particular application, i.e. its "fitness for purpose"

QA4EO encompasses a framework and set of guidelines, derived from best practices and with example templates included to aid implementation

Key Principle

Data and derived products must have associated with them an indicator of their quality to enable users to assess its suitability for their application "fitness for purpose"

Quality Indicators (QI)

should be ascribed to all data and products. A "QI" should provide enough information to allow all users to readily evaluate its "fitness for purpose"

Standards can take any form to meet the needs of a specific "community"

It's a general assessment

Based on essential attributes and composed of 21 key guidelines

These are "living documents" and they offer a flexible approach to allow the effort for the tailoring of the guidelines to be commensurate with the final objectives

It is a user (customer) driven process

Traceability

QI should be based on a documented and quantifiable assessment of evidence demonstrating the level of traceability to internationally agreed (where possible SI) reference standards

...it's not a certification body

...it's not a set of standards for COQA activities & projects that describe capabilities or limitations/variation of technology/methodologies

...it's not a framework developed with a top-down approach

...the QA4EO process and its implementation should not be judgmental and bureaucratic

QA4EO Workshops

CEOS Working Group on Calibration and Validation (WOCV) worked with many agencies/organizations to develop the QA4EO principles and operational implementation details during previous workshops



Geneva, WMO, Oct. 2007
Gathering principles



Göttingen, NRE, May 2008
Establishing an operational framework



Antalya, TCDETAK, Sept. 2009
Facilitating implementation

QA4EO Workshop on Providing Harmonized Quality Information in Earth Observation Data by 2015 to be held at Oxfordshire, UK, on October 18 – 20, 2011

QA4EO information/registration: <http://www.garden.csis/index.html>

QA4EO Documents

QA4EO framework and key guideline documents were peer-reviewed by representatives from different Earth Observation communities

Approved by WOCV (28th Plenary Meeting, Oct. 2008)

Endorsed by CEOS (22nd CEOS Plenary, Nov. 2008)

Reviewed by World Meteorological Organization (WMO) and Global Space-based Inter-Calibration System (GSICS) (early 2009)

A guide was issued in order to provide a new user with an overview and guidance on getting started with QA4EO

QA4EO documents including the framework, key guidelines, and the guide can be found on the QA4EO web site: <http://www.garden.csis/implementation.html>

The QA4EO principles provide the framework and introduce the key guidelines:

- QA4EO-QAEO-GEN-DQK-001 A guide to establish a Quality Indicator on a satellite sensor derived data product
- QA4EO-QAEO-GEN-DQK-002 A guide to content of a documentary procedure to meet the Quality Assurance requirements of GEO
- QA4EO-QAEO-GEN-DQK-003 A guide to "reference standards" in support of Quality Assurance requirements of QA4EO
- QA4EO-QAEO-GEN-DQK-004 A guide to competences – organization, operation and analysis to establish measurement equivalence to underpin the QA requirements of QA4EO
- QA4EO-QAEO-GEN-DQK-005 A guide to establishing validated models, algorithms and software to underpin the Quality Assurance requirements of QA4EO
- QA4EO-QAEO-GEN-DQK-006 A guide to expansion of uncertainty of measurements
- QA4EO-QAEO-GEN-DQK-007 A guide to establishing quantitative evidence of traceability to underpin the Quality Assurance requirements of QA4EO

QA4EO Implementation

Datasets provided to GEO will require information with Quality Indicators in order to support decision and policy makers

QA4EO builds upon "best practice" from all sectors, not just Earth Observation

The use of key guidelines within QA4EO should allow all stakeholders to have confidence in any assigned Quality Indicator (QI)

Harmonization and implementation is aided by a set of seven key guidance documents. These guidelines are living documents and will evolve and/or be added to over time

QA4EO is cross-cutting and is evolving to meet the needs of all SBAs by establishing case studies and training, currently, international partners are working this process via GEO/CEOS

A questionnaire is under-development to help providers/users assess their QA4EO compliance

Perform GEO/CEOS inter-comparisons and inter-calibration campaigns



QA4EO Future Activities

Each entity is responsible for implementing QA4EO in its program e.g. European Space Agency (ESA) carrying out many activities and QA4EO is now referenced in the Global Monitoring for Environment and Security (GMES) statement of work

International efforts and coordination for joint activities e.g. inter-comparisons, inter-calibrations/Long term data preservation

GEO/CEOS is developing showcases highlighting the need for QA4EO e.g. showcases on Forest Carbon Tracking (FCT), Atmospheric Composition (AC), and Global Digital Elevation Models (DEM)

The QA4EO Workshop on Providing Quality Information in Harmonized Earth Observation Data by 2015 will be held from October 18 – 20, 2011 at Rutherford Appleton Laboratory (RAL) near Oxford, UK

The workshop will present and discuss data quality assurance implementation examples across a wide variety of societal benefit areas. In particular how quality information should be derived, maintained, and presented following the QA4EO principle that "all data and derived products must have a QI and be traceable to absolute reference standards"

This event will establish a roadmap of key objectives that will cover technical, coordination, and governance aspects of QA4EO. Your active participation in this very important workshop is critical to moving forward with the GEO's vision for a GEOSS

QA4EO Information

For questions, please contact the QA4EO secretariat – sec@QA4EO.org
For documentation, please visit the QA4EO website – <http://QA4EO.org/>

Summary/Next steps?

- Have a key principle – **hard to challenge its general applicability**
- Have some guidance docs
 - ◆ Generalise with other examples
 - ◆ Emphasise **guidance and level of detail to be “fit for purpose”**
 - ◆ Support translation and adaptation for other communities
 - ◆ Not about BEST quality only declaration of what it is
- Promote through examples
- Challenge communities to demonstrate “quality of delivered information”
- Encourage customers/funders to ask for evidence of “performance” (QA) not assume
- Quick wins
 - QA4EO is not fundamentally new, it is an international badge that can be used to aid harmonisation and uptake
 - Need to avoid duplication and potential confusion - should look to adapt not establishment of new QA schemes
 - **those already compliant should use it,**
 - **funders wanting any level of QA to specify it “as shorthand”**

It does not have to be complex or costly

All data and derived products must have associated with them a Quality Indicator (QI) based on documented quantitative assessment of its traceability to community agreed reference standards. This requires all steps in the data and product delivery chain (collection, archiving, processing and dissemination) to be documented with evidence of their traceability.

- Must assign a QI (uncertainty) to a result
 - - where it comes from needs to be documented
 - the “evidence” supporting it should be appropriate (fit for purpose)
- i.e. exactly what we are taught to do in science lessons from the age of ~14