

<http://QA4EO.org>

Initiated (2008) by “space-community” on behalf of GEO to facilitate harmonisation and interoperability

– Quality does not have to be “best” simply quantified

- 2012 NPL CCM (supported by UKSA) took on role of QA4EO secretariat

Applicable to all  
EO activities  
Including in-situ  
& modelling

### QA4EO Principle

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



Led strategy

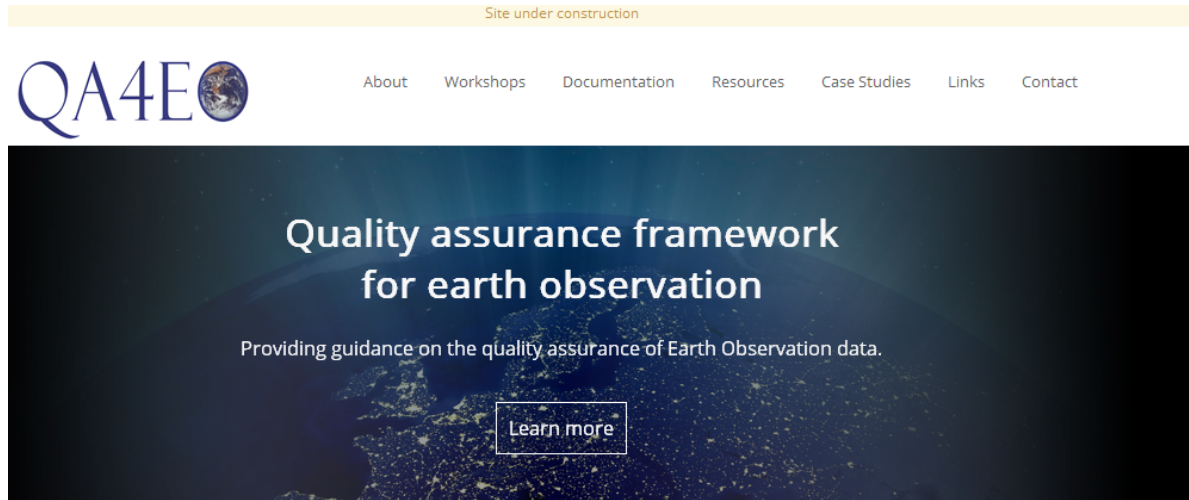
Quality Indicator

Traceability

Supported by an initial set of key guidelines – based on NMI best practise

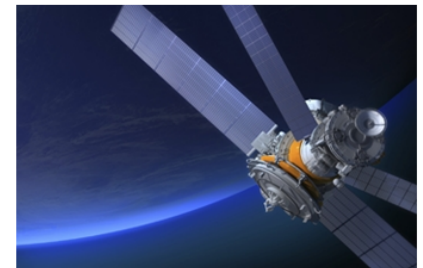
### Progress:

- New-look website ([Http://www.QA4EO.org](http://www.QA4EO.org))
- Establishment of concept and template for case study based promotion of Cal/Val/QA to different audiences
- Developed 'show case for CEOS SIT workshop'
  - Support writing of examples
- Developed generic downloadable poster as community resource
  - Presented at conferences
- Promote concept across CEOS, GEO, (ESA/EU) etc
  - Included in ESA CCI
  - Also EU Copernicus and climate service (QA4ECV proj)
  - Now being reported on by many space agencies
  - Presented at conferences



#### QA4EO is about:

- Working with experts in the various EO communities to harmonise best practices in their respective areas.
- Cataloguing, advertising and disseminating best practice across all levels and scales.
- Provide top-level QA guidance to all GEO communities.

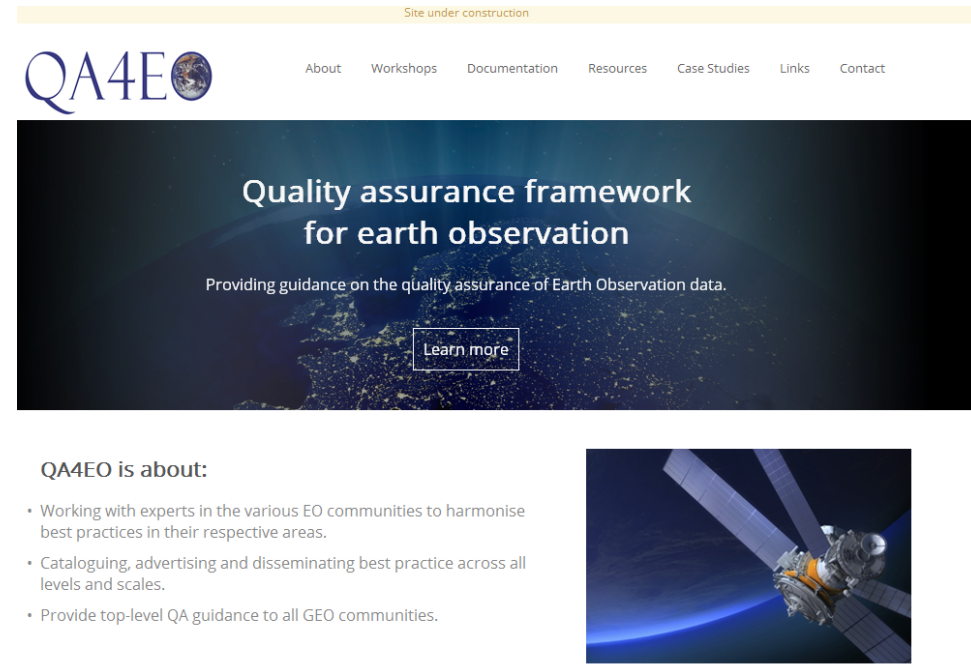




# A QUALITY ASSURANCE FRAMEWORK FOR EARTH OBSERVATION

## New-look website up online:

- Website redesign completed
- It has been updated and is now more dynamic and interactive
- New case studies page
- Comprehensive documentation
- Links to other international initiatives
- Going forward - Will be developing a graphical 'easy access' to guidelines and key QA information
- Expand scope and awareness to broader GEO SBAs

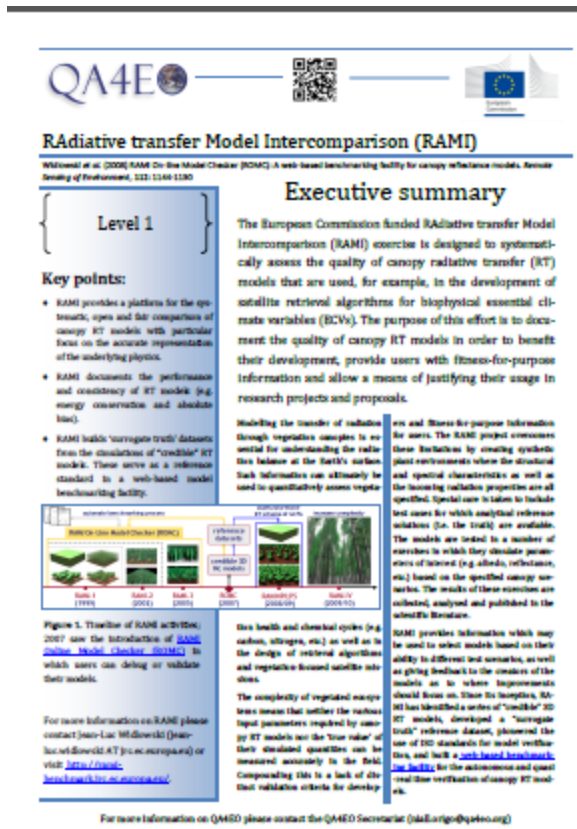




# QA4E

# A QUALITY ASSURANCE FRAMEWORK FOR EARTH OBSERVATION

## Case studies:

- Case studies corresponding to best practice examples are published online
- Split into three tiers and three broad categories
- Categories include software/methods, datasets and initiatives
- Higher 'levels' correspond to greater detail for different target audience
- Focus on getting examples of all three levels of detail



**QA4E**  

### Radiative transfer Model Intercomparison (RAMI)

Waldow et al. (2008) RAMI On the Model Checker (RAMI): A web-based benchmarking facility for canopy radiance models. *Remote Sensing of Environment*, 112: 1244-1250

**Level 1**

**Key points:**

- RAMI provides a platform for the systematic, open and fair comparison of canopy RT models with particular focus on the accurate representation of the underlying physics.
- RAMI documents the performance and consistency of RT models (e.g. energy conservation and absolute bias).
- RAMI holds 'surrogate truth' datasets from the simulation of 'reference' RT models. These serve as a reference standard in a web-based model benchmarking facility.

**Executive summary**

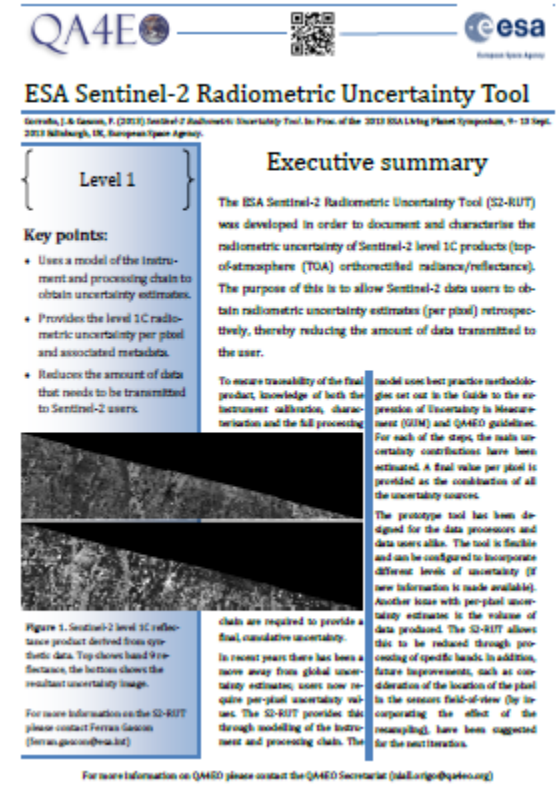
The European Commission funded Radiative transfer Model Intercomparison (RAMI) exercise is designed to systematically assess the quality of canopy radiative transfer (RT) models that are used, for example, in the development of satellite retrieval algorithms for biophysical essential climate variables (ECVs). The purpose of this effort is to document the quality of canopy RT models in order to benefit their development, provide users with fitness-for-purpose information and allow a means of justifying their usage in research projects and proposals.



Modeling the transfer of radiation through vegetation canopies is essential for understanding the radiative balance of the Earth's surface. Such information can ultimately be used to quantitatively assess vegetation and forest for purpose information for users. The RAMI project encompasses these limitations by creating synthetic plant environments where the structural and spectral characteristics as well as the incoming radiative properties are of specified, typical use relations to include test cases for which analytical reference solutions (in the form of the true value) are available. The models are tested in a number of exercises in which they estimate parameters of interest (e.g. albedo, reflectance, etc.) based on the specified energy scenarios. The results of these exercises are collected, analyzed and published in the scientific literature.

RAMI provides information which may be used to select models based on their ability to different test scenarios, as well as giving feedback to the creators of the models on to where improvements should focus on. These test scenarios, RAMI has identified a series of 'reference' RT models, developed a 'surrogate truth' reference dataset, planned the use of ISO standards for model verification, and built a [web-based benchmarking facility](#) for the autonomous and quasi-real time verification of canopy RT models.

For more information on RAMI please contact Jean-Luc Waldow (jean-luc.waldow@at.jrc.ec.europa.eu) or visit [http://rami.jrc.ec.europa.eu/](#)

For more information on QA4E please contact the QA4E Secretariat ([info@qa4e.org](mailto:info@qa4e.org))



**QA4E**  

### ESA Sentinel-2 Radiometric Uncertainty Tool

Scrobbels, J. & Green, P. (2013) Sentinel-2 Radiometric Uncertainty Tool. In Proc. of the 2013 ESA Living Planet Symposium, 9-13 Sept. 2013 Nottingham, UK, European Space Agency

**Level 1**

**Executive summary**

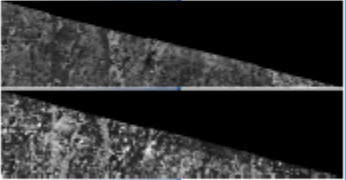
The ESA Sentinel-2 Radiometric Uncertainty Tool (S2-RUT) was developed in order to document and characterise the radiometric uncertainty of Sentinel-2 level 1C products (top-of-atmosphere (TOA) orthorectified radiance/reflectance). The purpose of this is to allow Sentinel-2 data users to obtain radiometric uncertainty estimates (per pixel) retrospectively, thereby reducing the amount of data transmitted to the user.

To ensure traceability of the final product, knowledge of both the instrument calibration, characterisation (GIM) and QA4E guidelines. For each of the steps, the main uncertainty contributions have been estimated. A final value per pixel is provided as the combination of all the uncertainty sources.

The prototype tool has been designed for the data processor and data users alike. The tool is flexible and can be configured to incorporate different levels of uncertainty (if new information is made available). Another issue with per-pixel uncertainty estimates is the volume of data produced. The S2-RUT allows this to be reduced through processing of specific bands. In addition, future improvements, such as consideration of the location of the pixel in the sensors field-of-view (by incorporating the effect of the sun-sensor geometry), have been suggested for the next iteration.

**Key points:**

- Uses a model of the instrument and processing chain to obtain uncertainty estimates.
- Provides the level 1C radiometric uncertainty per pixel and associated metadata.
- Reduces the amount of data that needs to be transmitted to Sentinel-2 users.



For more information on the S2-RUT please contact Ferran Garcia ([ferran.garcia@esa.int](mailto:ferran.garcia@esa.int))

For more information on QA4E please contact the QA4E Secretariat ([info@qa4e.org](mailto:info@qa4e.org))

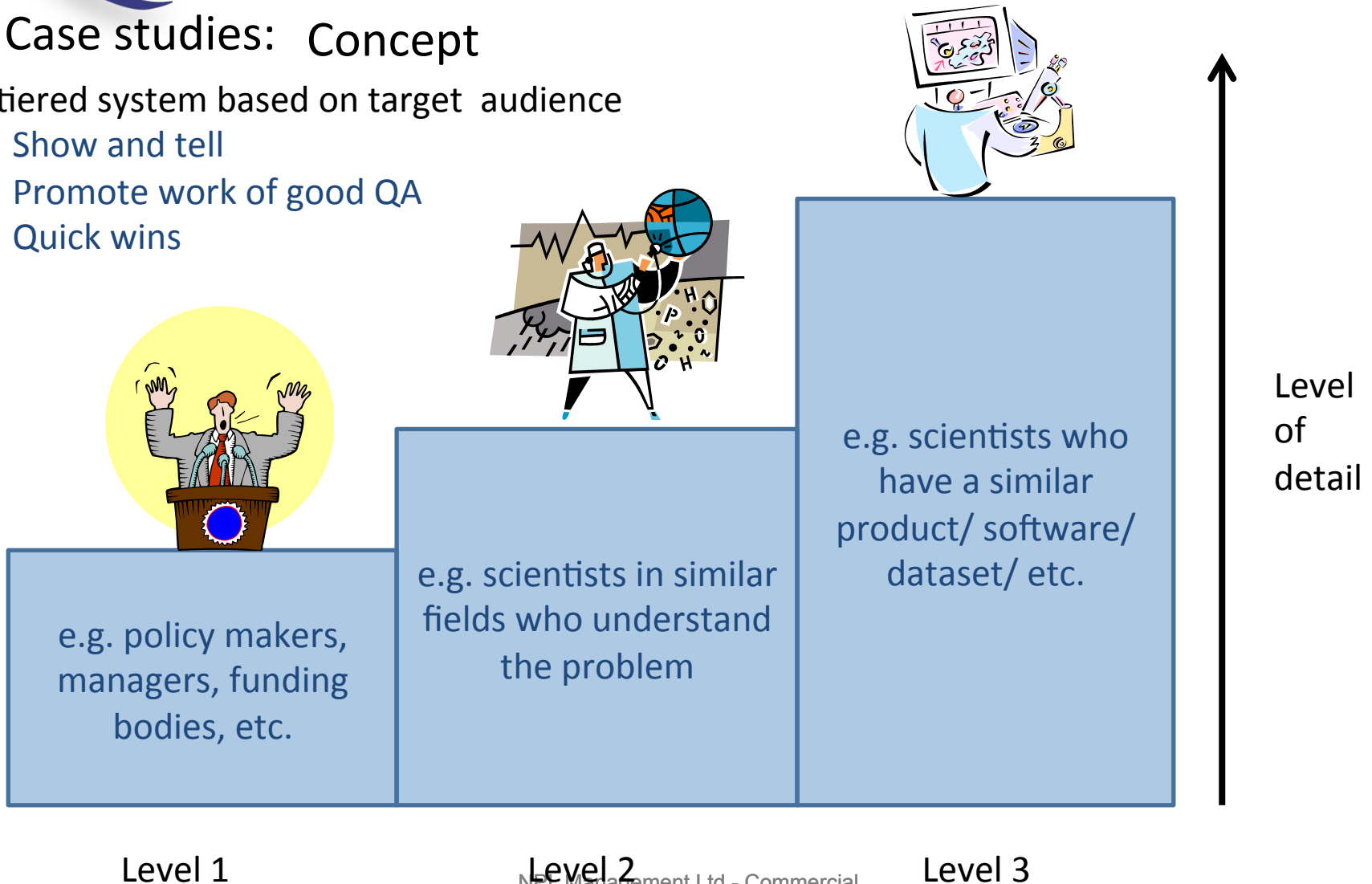
# QA4E

## A QUALITY ASSURANCE FRAMEWORK FOR EARTH OBSERVATION

### Case studies: Concept

A tiered system based on target audience

- Show and tell
- Promote work of good QA
- Quick wins



# QA4EO

- Promotional poster established for presentation at international conferences
- Implementation and awareness across worlds space agencies increasing
  - CEOS work plan to encourage agencies to regularly report on their progress
  - Work with GEO secretariat to build broad based implementation across all EO including in-situ
  - Develop broad range of examples to illustrate means of implementation
- Establish a reporting template to help 'self assessment' of Cal/Val QA based on concepts of 'maturity matrix'

# A QUALITY ASSURANCE FRAMEWORK FOR EARTH OBSERVATION



A QUALITY ASSURANCE FRAMEWORK FOR EARTH OBSERVATION

Nigel Origo (NPL), Nigel Fox (NPL) and Joanne Nightringale (NPL)  
 ©AQEO Secretariat, ©CEOS/GEOS/NOIS

## BACKGROUND

The Quality Assurance Framework for Earth Observation (QA4EO) is a Committee for Earth Observation Satellites (CEOS) Working Group on Calibration and Validation (WGCV) contribution to the Group on Earth Observations (GEO) vision for a Global Earth Observation System of Systems (GEOSS).

The role of GEOSS is to provide international coordination of current and future disparate Earth Observation (EO) sensors to create a harmonised, gap-free system-of-systems™ that can deliver comprehensive and timely information products on a global scale. GEOSS is intended to support the dissemination of information and software to aid GEOSS users to obtain benefit areas (SBAs): disaster, health, energy, climate, agriculture, ecosystems, biodiversity, water and weather.



Implementation of the GEO vision for GEOSS is dependent on two key data principles: 1. Accessibility/availability 2. Sustainability/reliability

## IMPLEMENTATION

QA4EO is a relatively new entity based on the voluntary contributions of scientists working in calibration and validation (cal/val) areas. As such, the main focus during its development phases (the past couple of years) has been to promote the uptake of the QA4EO principles and perception of the QA4EO name. Currently, QA4EO is widely known among CEOS agencies and is increasingly recognised in broader cal/val communities particularly in Europe where ESA has supported a number of projects closely associated with the QA4EO name. However, effort is being expended to promote QA4EO outside of the so to the full EO community such that, with consultation from the experts in these fields, further community-specific Good Practice Guidelines (GPGs) may be produced and disseminated.

### NEED FOR QA & QA4EO

International society has become steadily more reliant on EO data and has recognised that in order to get the best out of EO technology, a harmonised, interoperable system of systems (SOS) is needed. In this guise, a SOS seeks to provide data for a plethora of questions at a variety of scales, transcending the individual focus of current efforts. To do this, detailed information on the quality and performance characteristics of each instrument and measurement must be available.

The quality of the calibration of individual instruments ultimately defines the quality of the downstream applications; for space-based sensors this is problematic, since it cannot be guaranteed that the launch and operating environment have not altered the measurement setup. As this is the case for all space-based EO sensors, validation (against an independent reference) of downstream products must be undertaken.

The importance of quality assurance (QA) is well known but relatively understated (at present) in a number of EO applications. QA4EO addresses this issue in three ways: 1) highlighting the work of individuals and groups that is consistent with QA4EO principles; 2) raising support for funding applications largely or completely involved in QA activities; and 3) through the general promotion of the importance of a harmonised approach to QA to scientific and non-scientific audiences. QA4EO also seeks to take on the role of coordinating the sharing and development of cal/val best practice for obtaining, documenting and assessing QA information.

## SCOPE OF QA4EO FRAMEWORK

QA4EO consists of one essential principle: "Data and derived products shall have associated with them a fully traceable indicator of their quality" (2, p. 4), and is supported by seven key guidelines. Further detailed guidelines and best practice addressing specific subject areas have also been developed by, and in consultation with, experts in those respective communities. QA4EO has been created by CEOS/WGCV in conjunction with the broader EO community.

<b>QA4EO:</b> is the main principle seven key guidelines producing and applying guidelines and/or certification based on an international consensus	<b>QA4EO Event:</b> a certification loop A top-down framework seeking to apply harmonised processes a set of formal standards that would set the scene of technology maturity
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## CASE STUDY EXAMPLES

The concept of a QA4EO case study was set out as a principle of promoting work consistent with QA4EO principles. The basic premise is that, depending on the level of detail, a QA4EO representative of the author can provide a short write-up of a piece of work that shows application of or preparation towards the underlying QA4EO principle.

In time, it is our aim that authors will strive to have their work summarised as a QA4EO case study. This will provide them with appropriate recognition and a more professional standing by raising awareness of EO value to appropriate agencies and organisations.

With this in mind, case studies are written according to varying degrees of detail accessible to different audience types.

Type	Level 1	Level 2	Level 3
software	overview	two page	> 20 pages
policy	summary	scientific	technical
policy	management	community	corporate
hardware	non-technical	data quality	in particular
science	summary	technical	technical



QA4EO case studies are only intended as promotional pieces – the ownership and responsibility of the original work remains with the authors. Current case studies can be found at [www.qa4eo.org/case-studies](http://www.qa4eo.org/case-studies).

## WEBSITE

The QA4EO website ([www.qa4eo.org](http://www.qa4eo.org)) forms the repository for all Good Practice Guidelines (GPGs). QA4EO related material and links to relevant websites. A recent initiative to update the website has recently been completed so that it can start to form the basis of a practical tool for the community in conjunction with the CEOS Cal/Val Portal (<http://calvalportal.org>).



# Next steps

- **Need case studies (best practise, Cal/Val successes, when things went wrong/well,**
  - Means to help promote need and value of Cal/VAL
- **Broader use of name (QA4EO) by all agencies when referring to key principles: ‘Documented evidence of traceability to international (SI) standards with full uncertainty budgets’**
- **QA4EO secretariat (there to help develop publicise story line).**