QA4EO | A QUALITY ASSURANCE FRAMEWORK FOR EARTH OBSERVATION

A means to establish and promote best practise for QA (Cal/Val)

Internationally harmonised approach

Moving Forward

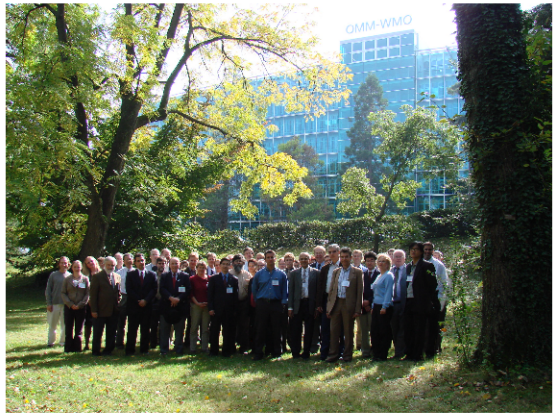
GEO

CEOS

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*)

Inc WMO +

CEOS endorsed – Nov 08

Further workshop at Harwell UK in 2011

QA4EO A QUALITY ASSURANCE FRAMEWORK FOR EARTH OBSERVATION

What is QA4EO?

Applicable to all EO Activities inc "In-situ"

QA4EO Principle

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

Led strategy

Measurement has no meaning without an uncertainty statement "can be a guess!"

Quality Indicator (QI)

Traceability

KEY Requirement

- **An Uncertainty (budget)**
- **Accessible documentation of what has been done to achieve it**

Key Benefits / Aims

- Bias removal / understanding
  - Data collection & algorithms
- Physical robustness (confidence) of resultant knowledge/information
- Cost saving – no need to re-evaluate / sharing of best practise & infrastructure
- Community learning / transparency
- Awareness raising to ALL of importance of QA Cal/Val
- Highlights areas of weakness – need for investment/research
- Facilitates informed choice – Assess suitability for use.

DATA to DECISION

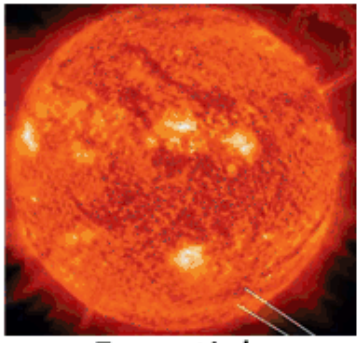
Preflight calibration

Fundamental Climate Data Record

Post-launch validation

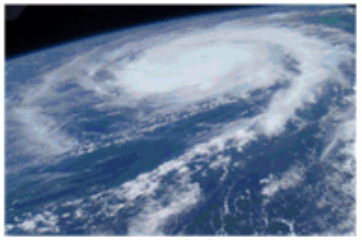
Every step introduces new uncertainty

Processing

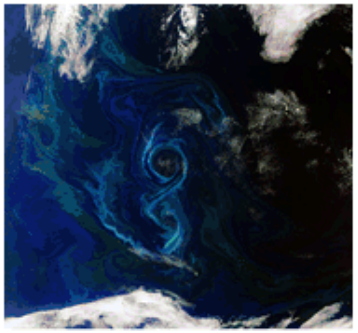


Essential

Climate

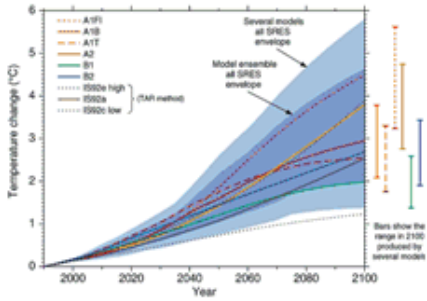


Variables



Climate Models

Predictions



Governments

Action

Operational framework:

Principles and scope (space example)

All activities which contribute to the delivery of an end product derived from an input measurand

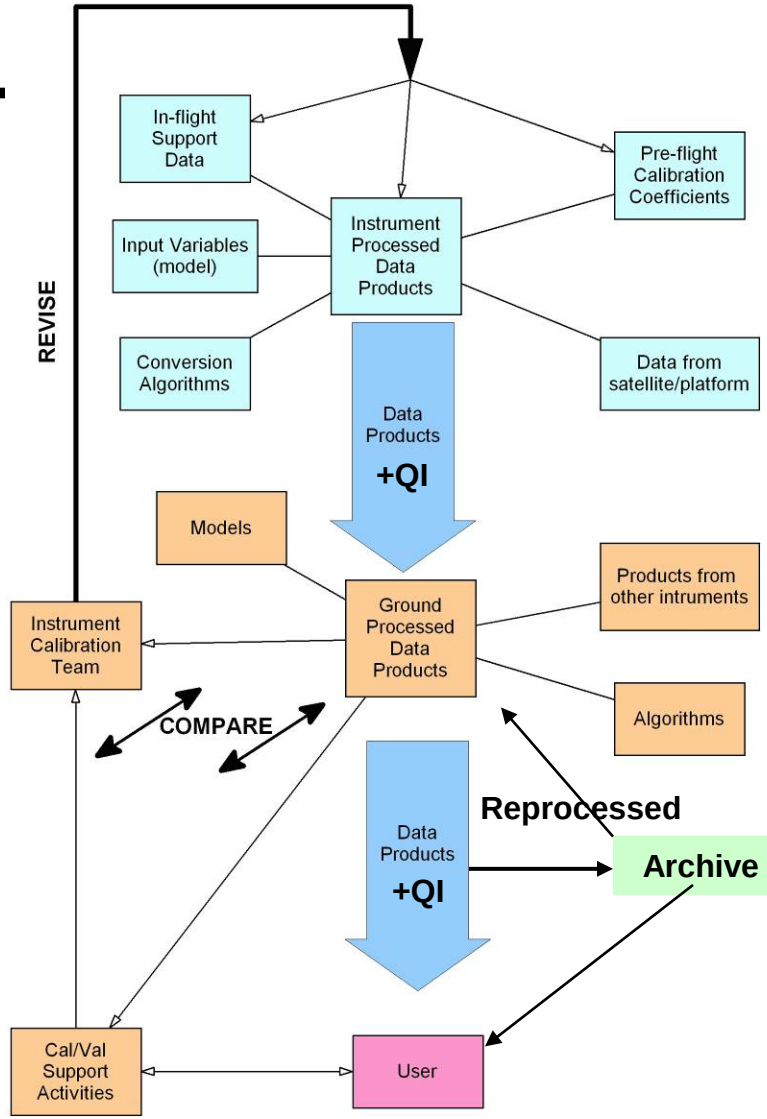
Pre-Flight

- Requirement/Design Specification
- Instrument build: characterisation/calibration
- Data processing: algorithms, ref/support data,

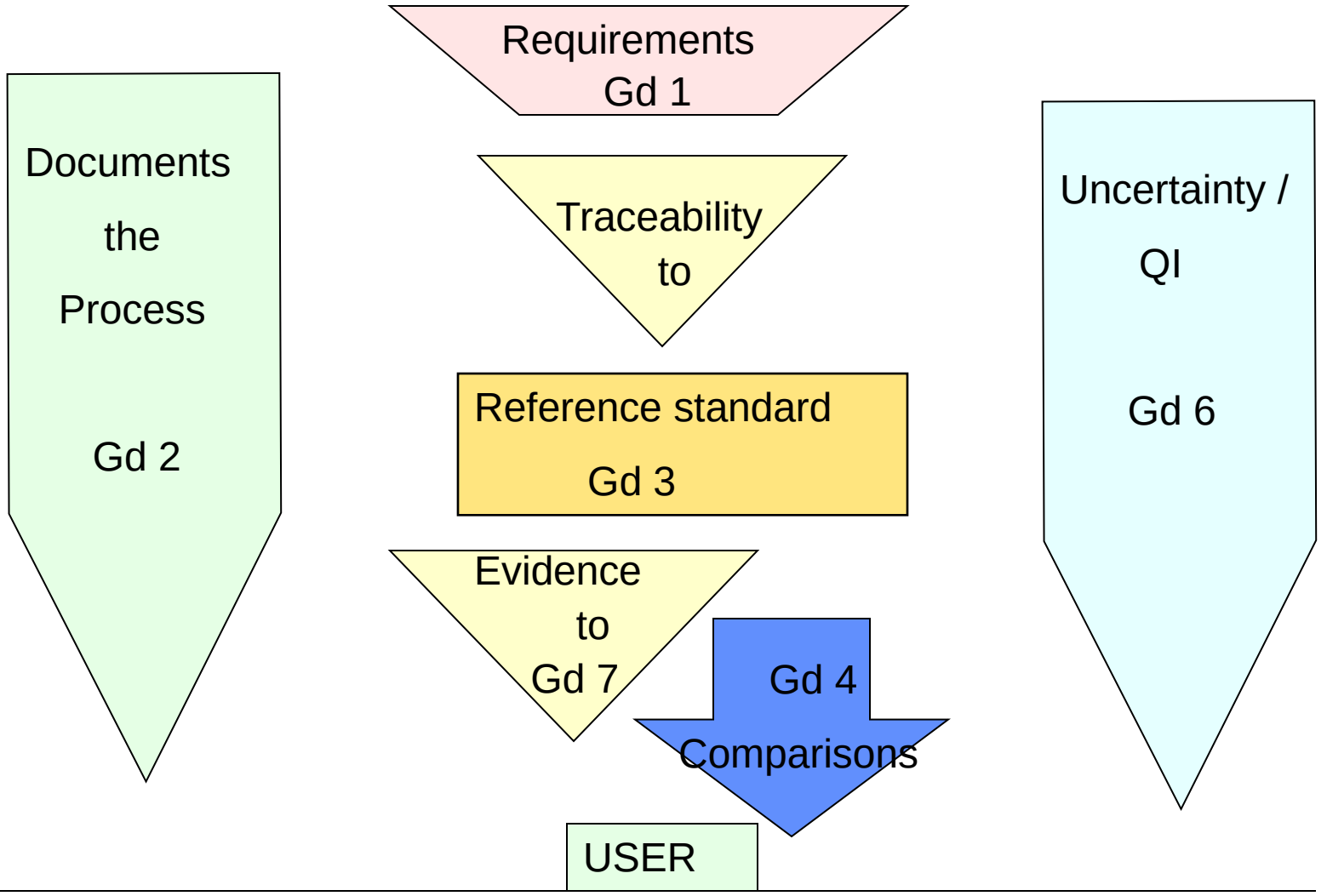
Post-Launch

- Instrument performance
- Output data quality characteristics:
  - accuracy
  - equivalence to others (sensors/in-situ)
- Processing – high level products
- Data distribution/archive …

Collection – Processing – Validation - Delivery



Guideline aims: to provide advice



What have we done?

- We have community test sites
- We have and continue to carry out comparisons
- We are starting to produce uncertainty budgets
    - Addressing Type A and Type B (statistical and other)
    - Missions/projects are starting to ask for evidence of traceability
    - Climate parameters particularly active
- Cal/Val & QA is a topic on the agenda
    - LTDP
    - EU QA4ECV
    - CEOS workplan

However:

- We have not made clear the benefits
- Process is sometimes perceived as bureaucratic or complex
- Maybe tried to expand too quickly (all GEO)

Where do we go from here?

- Still Recognition by CEOS agencies of importance and aims of activity
- Have established a governance process/implementation team
  - Maybe perceived as too bureaucratic
  - Perhaps need to focus down on real active implementation team
  - Regular telecons
- Have funded secretariat
- Have a draft implementation plan and priority actions
- Need to identify clear benefits and promote widely
- Need all agencies to move forward and show progress (under a common Label)

Example of progress: Some was happening all may have happened but QA4EO has facilitated

Land surface imagers: Bias removal/understanding

Need common infrastructure to harmonise post-launch L1 Radiances/reflectances

Establish concept of CEOS reference test sites; Instrumented & Invariant

Need protocol to select and characterise sites

Best practise guide written (based on existing knowledge)

Need to establish consistency of teams/methods / traceability of instruments/site results

Comparison organised – Protocol, SI traceable standards & analysis

Need to establish use of a test site for sensor comparison

Comparison organised – Protocol & analysis for several CEOS sites

Need to establish use of a test site for sensor comparison

Comparison organised – Protocol & analysis for several CEOS sites

Need to harmonise/understand effects of atmospheric correction process

Comparison being organised – Protocol & standard test data

Land surface imagers example cont

Need to establish ‘group’ / network of sites as global common infrastructure to provide international coefficients

Established baseline of instruments/

-Using previous ‘QA4EO activities’ to start network - LandNET

- ESA, CNES, NASA, AOE, NPL

- inc new sites & CEOS coordination centre & traceability & outputs to selected sensors

- All Agencies to collect data over sites

- Add new sites

Need interface to provide results to community & satellite operators

- CEOS harmonisation coefficients

Database under-construction – population of results – analysis method being developed - need to prove before release

Land surface imagers example cont

In parallel

Pseudo–invariant sites for bias removal

Sites Defined –Studies (e.g. SADE) been happening for long time

Need to evaluate/harmonise different methods of using such sites

Comparison organised – Protocol, common data set for few sites & sensors - document results and methods

Expand knowledge and comparison

Make tools/database/test data/protocol available to all

Look to develop/improve

Dedicated workshop @ CNES focussed on one site – Libya 4

Identified common challenges – site BRF/reflectance etc

Comparison organised – standardised model

Harmonise with LandNET & other methods

Future to link with uncertainties different methods sensor comparisons

Land surface imagers example cont

However: Although this is critical –
benefit & QA4EO not visible to consumers/user
MAJOR WEAKNESS

Need to link L1 radiances/reflectances to products L2, L3 etc
- models/retrieval algorithms
Comparison organised – Protocol, common data set for few sites & sensors
- document results and methods

Establish traceability/biases of retrievals
Historical comparisons of RT codes RAMI
Plans to establish comparison of retrievals for LAI etc

Link benefit of L1 harmonisation/uncertainties with user products
Albedo (GlobAlbedo project) ?
Forest Carbon (project in progress) ? More to follow ?
Land cover change?

Demonstrate benefit of L1 harmonisation/uncertainties & product QI to user applications
NEED TO DO! How?

Next steps

Progress:

- Concept of QA and traceability is now increasingly widely used (not necessarily linked directly to QA4EO)
- Benefit of a harmonised approach is clear / challenge is to remove perceived complexity & get widespread declaration of following principles

Implementation Plan/strategy

- Create awareness momentum
- Requirement to report progress on QA related activities of agencies at CEOS SIT/plenary
- Adopt and promote existing activities consistent with QA4EO principles
  - Climate maturity (NOAA)
  - Community Comparisons e.g. RAMI
  - Agencies to declare what they have done and reference how it meets QA4EO principles
- GEO to include requirement to state basis of QA for data/information
- GEO secretariat to ask SBAs what there challenges are and how they are demonstrating/indicating their ‘fitness for purpose’

Next steps (cont)

Implementation Plan/strategy (cont)

- Establish, document and promote case studies on implementation of QA4EO principles (pre-dated or current)
- Engage with CEOS WGs to look for opportunities to demonstrate
- Review & update promotional material indicating benefits (poster/slides)

Website

- can be adapted to allow case studies to be promoted with links to originators
- add best practise examples and links to them
- Add new guidelines e.g. for LTDP
- Include a help/ask questions - FAQ
- Climate WG needs to push requirements

Implementation team telecons – monthly/ 6 wkly?

- **Other**

QA4EO Secretariat can help to facilitate above but can't do it all on its own

UK SPACE AGENCY

NPL National Physical Laboratory | Centre for Carbon Measurement

GEO

QA4EO A QUALITY ASSURANCE FRAMEWORK FOR EARTH OBSERVATION

CEOS

Discussion topics

- Do we still want to pursue?

- Implementation strategy - Is this the priority
  - Case studies as examples
  - Poster using examples
  - ‘maturity matrix’ (NOAA) as a checklist/indicator of top level QA
  - Showcases
  - Better use of website
  - Provide Advice to community
  - …..?

- Working implementation team
  - Telecons?

- Who is in copy of strategy development

- New guidelines?
  - Updates to guidelines

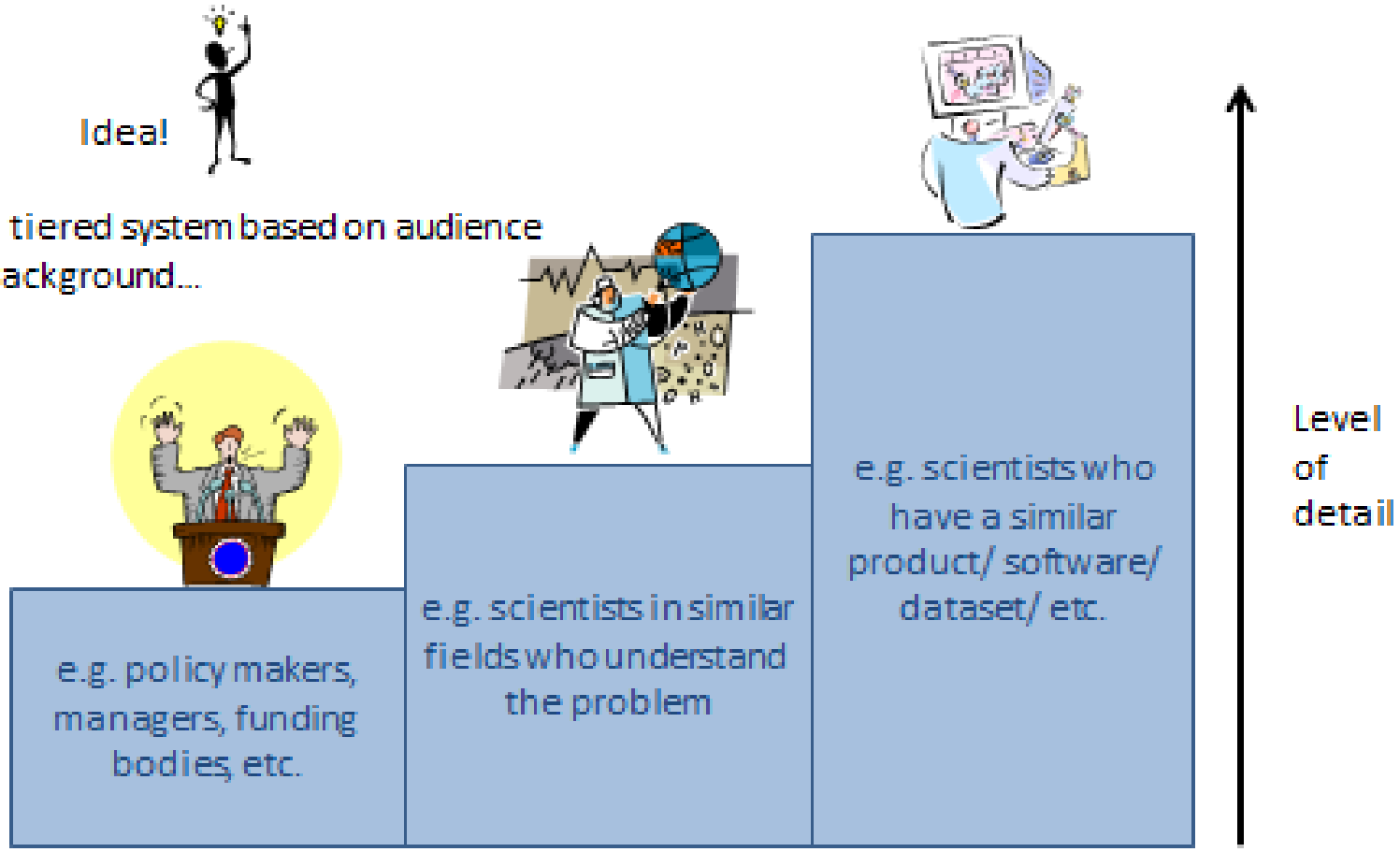
Case studies

- Short (1pg) documents to tell a QA story
- Available as printed or PDF or visual on web
- Differing depths
- Different sub-topics – could be a complete chain of different case studies for a theme like an ECV
- Logos of QA4EO and originator/sponsor
  - Win win - promotes:
    - Sponsor activites
    - Cal/Val & QA
    - Vehicle to raise profile and highlight benefit for all
    - Taster for other details
    - Helps sponsor get across their message
- Contact details of QA4EO & originator
  - Coordination/Credit/Details

Content/template for case studies

- Title: activity & context
- Originator ID
- QA4EO framework
- The target audience i.e.level of detail of specific case study example / For whom intended / practitioner or user of information.
- Summary of context/application
- Need / Benefit of QA/Cal/Val as part of activity
- Advance over previous situation
- Summary description of cal/val process – comparison, uncertainty evaluation…
- Other applications activity/process useful to (if appropriate)
- Further improvements/interfaces to other activities/case studies etc

Case study templates/style



A level based system:

- **Level 1: General Overview,** aimed at policy / program managers; so that those with the funding resources can see where the money is going and why it is important but don't necessarily need/want to know the technical detail.

- **Level 2: Technical information, characteristics and methodologies,** aimed at scientists, professionals; stating the applicable QA4EO guidelines, characteristics of the initiative/software/dataset, reference to methodology etc.

- **Level 3: Detailed technical information, characteristics, code, methodologies,** aimed at those who have a similar product who are interested in the technical implementation details, i.e. how the author/agency/group applied QA4EO

- A webpage would be an ideal platform to harmonise the three levels

Ideas:

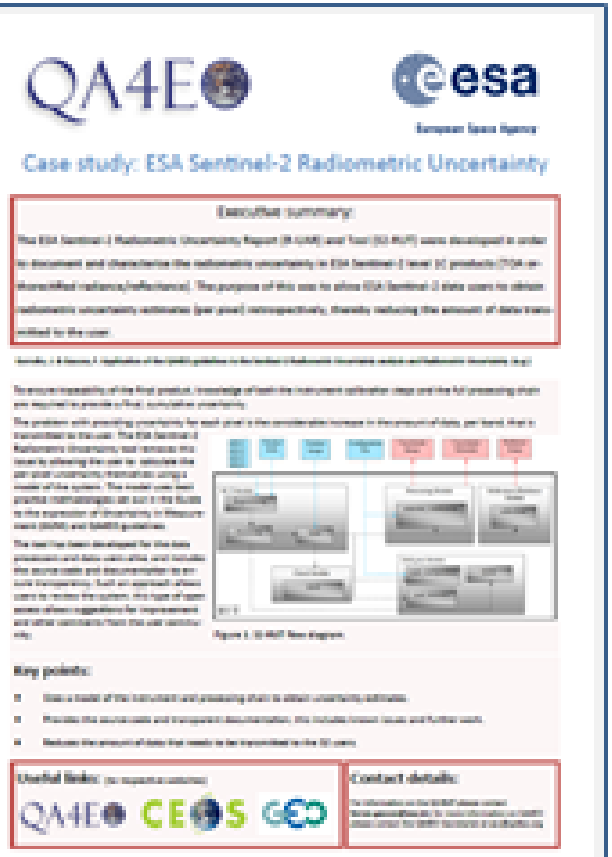
- Different templates depending on the nature of the work might be preferable
- Proposed:
  - Tool/software/methodology/etc.
  - Dataset
  - Initiative

- Clearly, these three categories would be reporting on different things; there may be more…

- Might also want to give case studies a ‘level of compliance’ depending on specific criteria:
  - How well does it conform to guidelines?
  - How good is the documentation?
  - How accessible is the product?
  - Etc.

e.g.

Level 1	Case study name 1
Level 2	Case study name 2
Level 3	Case study name 3
	Case study name 4
	Case study name 5
	Case study name 6
	Case study name 7
	Case study name 8
	Case study name 9

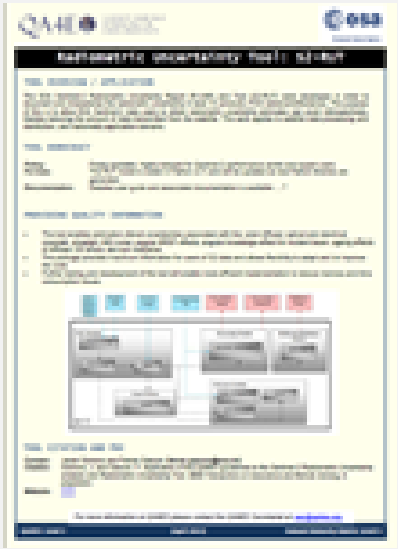


Level 1 Key Information:

Dataset	Tool	Initiative
Title	Title	Title
Short blurb / description	Short blurb / description	Short blurb / description
Key points	Key points	Key points
Contact details	Contact details	Contact details
Funding body	Funding body	Funding body
Basic metadata	Focus area	Locations
		Contributors

e.g.

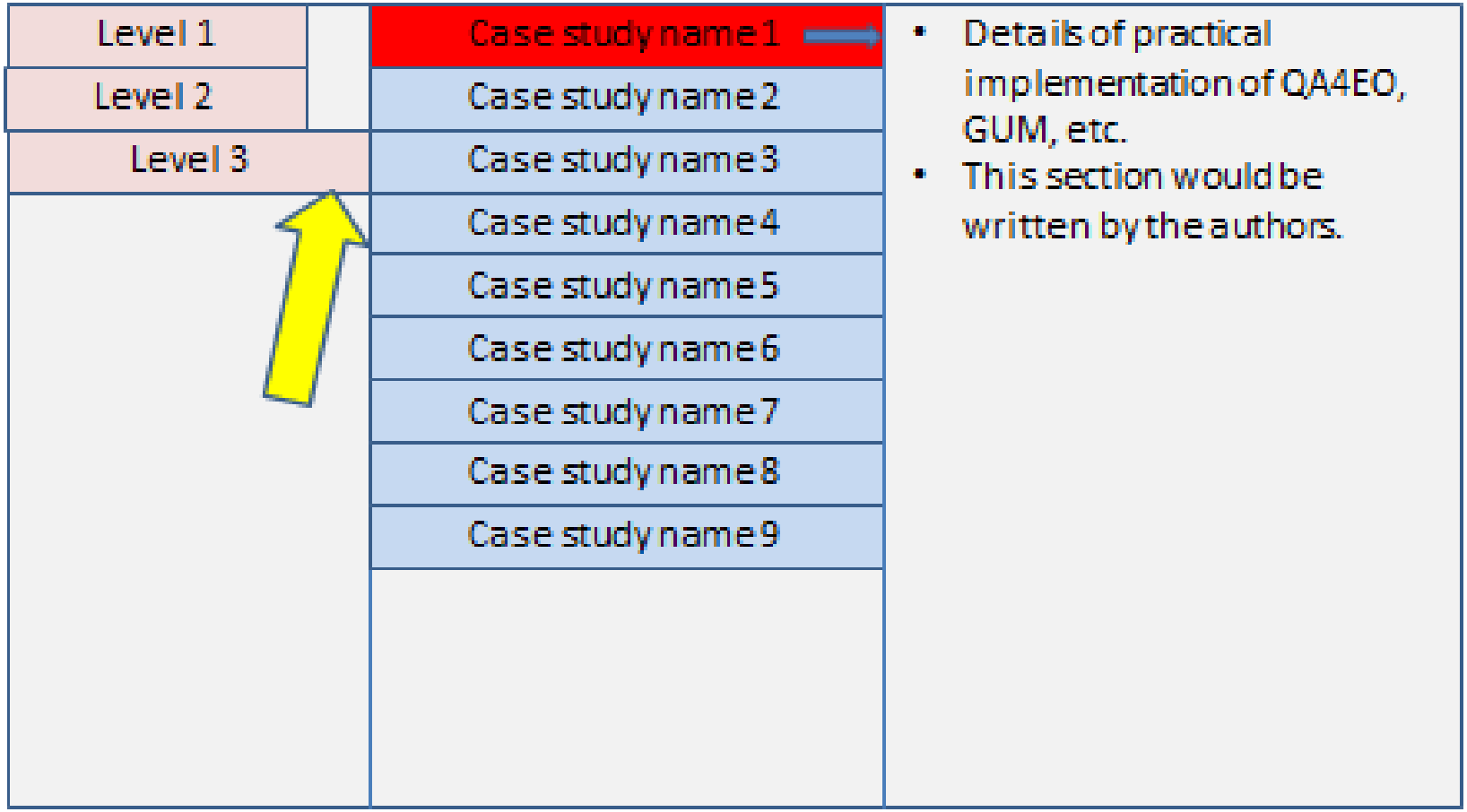
Level 1	Case study name 1	• Tool/dataset democracy • Technical specification • Links to documentation • Applicable QA4EO guidelines • Benefits • Known caveats
Level 2	Case study name 2	
Level 3	Case study name 3	
	Case study name 4	
	Case study name 5	
	Case study name 6	
	Case study name 7	
	Case study name 8	
	Case study name 9	



Level 2 Key Information: Level 1 + …

Dataset	Tool	Initiative
Algorithm overview	Code description	Datasets used
Data inputs	Methods	Site information
Methods	Data inputs	Links to other initiatives
Initial validation/methods		
Data location		

e.g.



Level 3 Key Information: Level 1 + 2 + …

Dataset	Tool	Initiative
QA4EO guideline	QA4EO guideline	QA4EO guideline
Algorithm code	Code	Datasets used
Data inputs and their QI	Quality information	Methods
Quality information	Methods	Validation results
Methods	Validation results	Links to applications
Validation results	Links to applications	References
Links to applications	References	
References		

ideas

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Potential case studies

- 3D Vegetation Lab (Michael Schaepman POC)
- ESA Sentinel-2 radiometric calibration tool (Bojan Bojkov/Javier Gorroño POC)
- GSICS GEO-LEO (Tim Hewison POC)
- NASA WELD (David Roy POC)
- NOAA Maturity Matrix (John Bates POC)
- RAMI exercise (Jean-Luc Widlowski POC)
- Sea surface temperature (Gary Corlett POC)
- TRUDAT (Nigel Fox/Joanne Nightingale POC)
- Glob-Albedo (J P Muller POC)
- Progress towards LandNET (Fox et al POC)
- ++++++