QA4EO framework and a metrological approach to FRMs, FDRs and TDPs

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The QA4EO framework

QA4EO was endorsed in 2010 by the Committee on Earth Observation Satellites (CEOS). It is a framework that brings metrological principles to Earth Observation and implements recommendations from the 2010 BIPM-WMO workshop.

The QA4EO principle

It is critical that data and derived products are easily accessible in an open manner and have associated with them an indicator of quality traceable to reference standards (preferably SI) so users can assess suitability for their applications, i.e., the 'fitness for purpose'.

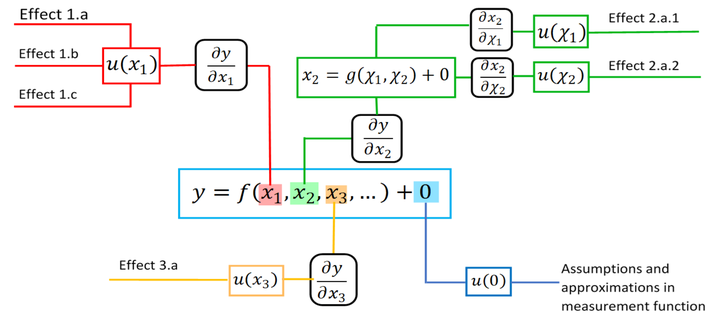
Implementing QA4EO for FRMs, FDRs and TDPs

The terms "Fiducial Reference Measurements" (**FRMs**) – for in situ observations used in the calibration and validation of satellite observations, "Fundamental Data Records" (**FDRs**) – for level 1 satellite data products, and "Thematic Data Products" (**TDPs**) – for higher level satellite data products – are used for Earth Observation products that have implemented QA4EO principles.

Since 2010, several projects have developed methodologies for implementing QA4EO principles for a wide range of FRMs, FDRs and TDPs. E.g. FIDUCEO, GAIA-CLIM, RadCalNet, FRM4STS, FRM4SOC, FRM4VEG, FDR4ALT, FDR4ATMOS, St3TART, ASELSU.

Step-by-step guidance available

Recently, www.qa4eo.org was updated with a consolidated set of guidance materials, software tools and training courses on how to implement metrological uncertainty analysis for FDRs, TDPs and FRMs. Tools include the "uncertainty tree diagram" (right) that visualises the sources of uncertainty, and the "effects table", that documents error correlation structures.
The CoMet toolkit (www.comet-toolkit.org) consists of several open-source python tools which were developed for handling, storing and propagating error-covariance information in the analysis of measurement data.



Error correlation structures

Earth Observation data is always multidimensional (measurements are taken in different locations, as time series, often also with spatial, spectral and angular information). A correct propagation of uncertainties must pass information on error correlation structures through processing chains involving different scientific groups. QA4EO tools provide ways (conceptual framework, and software) for determining and sharing such information.

Recommendations for next steps

- Application of QA4EO principles to a wider range of measurement systems and processed data.
- Development of methods to propagate uncertainties through processing involving machine learning and/or classification algorithms.
- International discussion, sharing and development of the QA4EO methodologies, which have so far been mostly implemented in Europe. Standardisation of data formats for storing uncertainty (covariance) information.

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