ESA Agency Report

Bojan R. Bojkov

Head, Sensor Performance, Products and Algorithms
Directorate of Earth Observation Programmes
European Space Agency (ESA/ESRIN)
ESA Earth Observation missions

ERS-1 (1991-2000) – Ice edge monitoring, cryosphere, sea and land surface temperature

ERS-2 (1996-2011) – ERS-1 plus global ozone monitoring

Envisat (2002-2012) – ERS plus atmospheric chemistry and ocean colour

GOCE (2009) - Gravity Field and Steady-State Ocean Circulation Earth Explorer mission

SMOS (2009) – Soil Moisture and Ocean Salinity Earth Explorer mission

CryoSat (2010) – Land/sea ice thickness and ocean Earth Explorer mission

SWARM (2013) – Measuring the magnetic field

ADM-AEOLUS (2014) – Wind fields

EarthCARE (2016) – Aerosol and cloud properties

BIOMASS (2018) - forest
**Sentinel 1 (2014)** – SAR imaging
- *All weather, day/night applications, interferometry*

**Sentinel 2 (2014)** – Superspectral imaging
- *vegetation, forestry, security*

**Sentinel 3 (2014)** – Ocean/land monitoring
- *Wide-swath ocean color and surface temperature sensors, altimeter*

**Sentinel 4 (2019)** – Geostationary atmospheric
- *Atmospheric composition monitoring, trans-boundary pollution*

**Sentinel 5p/5 (2015/2020)** – Low-orbit atmospheric
- *Atmospheric composition monitoring*
With the loss of Envisat in April 2012, ESA has implemented a new strategy for algorithm development and reprocessing in Phase “F” with the following goals:

- Maintain scientific capabilities across Europe
- Rigorous data consolidation and data recalibration
- Further development of algorithms (incl. new supporting products)
- Undertake at least one further reprocessing by 2015

Note: these are intermediate activities prior to Long-term Data Preservation (LTDP)
As part of Phase ‘F’, ESA also initiated a series of “Validation and Evolution” Workshops to identify and consolidate mission dataset requirements:

1. **ACVE – Atmospheric Composition Validation and Evolution WS, March 2013**
2. **L1 WS – L1 and calibration WS, June 2013** (based on ACVE requirements)
3. **LPVE – Land Product Validation and Evolution WS, November 2013**
4. **Arctic Validation WS, Spring 2014**

*Note: the outcome of these science driven workshops will also impact the Sentinel and Earth Explorer developments*
Continue to consider/incorporate WGCV (and sub-group) recommendations such as:

- *Continued funding of the Cal/Val portal (WGCV)*
- *Continued funding of AQ groundbased intercomparisons (ACSG)*
- *Funding of LandNet site selection study (IVOS)*
- *Funding of atmospheric and ocean hyperspectral validation instrumentation (ACSG, IVOS)*
- *Funding of advanced tropospheric humidity correction (MWR, ACSG)*
- *Support for “Miami IV” (IVOS)*
- *etc.*
ESA is supporting numerous QA4EO (or QA4EO related) studies:

- *Generic ESA mission documentation gap analysis with one case study (started Fall ’10 - €200+k)*
- *Long-Term Data Preservation (LTDP) procedures (started Nov ’11 - €200k+)*
- *Characterisation of SAR and radiometric calibration tools (kick-off Summer ’12 - €200+k)*
- *Fund the development of a “best practice/protocol” for intercomparisons of groundbased and satellite soil moisture data (TUW task lead in CVP, to be completed by 2014)*
- *End-2-end characterisation of Sentinel 2 Radiometric Uncertainty Analysis (18 month Fellowship, completed August ‘12)*
- *Study on geometric uncertainties and mixed pixel information for Sentinel-2/3 (2 year post-Doc, began May ‘12)*
• Establishment of “best practice” for atmospheric validation activities (for example profile, air quality), both for space and groundbased instrumentation (part of validation projects)

• GlobVapour (http://www.globvapour.info) algorithmic uncertainty characterisation and establishment of validation procedures (part of two year project, €1M)
  – Input and intercomparison guidelines to be used as the baseline for the new Global Energy and Water Cycle Experiment (GEWEX) Water Vapour Assessment - GVap
  – Impact of future reprocessing and Sentinel altimetry and atmospheric correction over land and ocean (follow-on projects €500+k)

• E2E per pixel uncertainty estimation requirement (similar to GlobVapour requirements) in the Climate Change Initiative cloud project (began Fall ‘10)
ESA QA4EO – way forward

ESA QA4EO activities have had mixed results - We conclude that:

- Clear targeted studies are needed to achieve concrete outcomes
- Use of best practices required (i.e. apply the “theory”)

We have also found that QA4EO principles can have a quick impact on Cal/Val by tuning existing procedures such as for example in data curation (i.e. data consolidation and version control procedures).

We have a QA4EO budget line for the EOEP-4 (2013-2016) and also within the Copernicus budget for 2014/5. The plan is to focus on clear targeted studies for Cal/Val and reprocessing:

- Ocean Colour buoy procedures and traceability with IOCCG
- Snow product intercomparisons with WMO/GCW
- Landnet best practise development (for instrumentation) with WGCV/IVOS
- Aeronet reprocessing scenarios
- Radiative Transfer studies
- etc.
Thank you for your attention!

bojan.bojkov@esa.int