



ESA Agency Report

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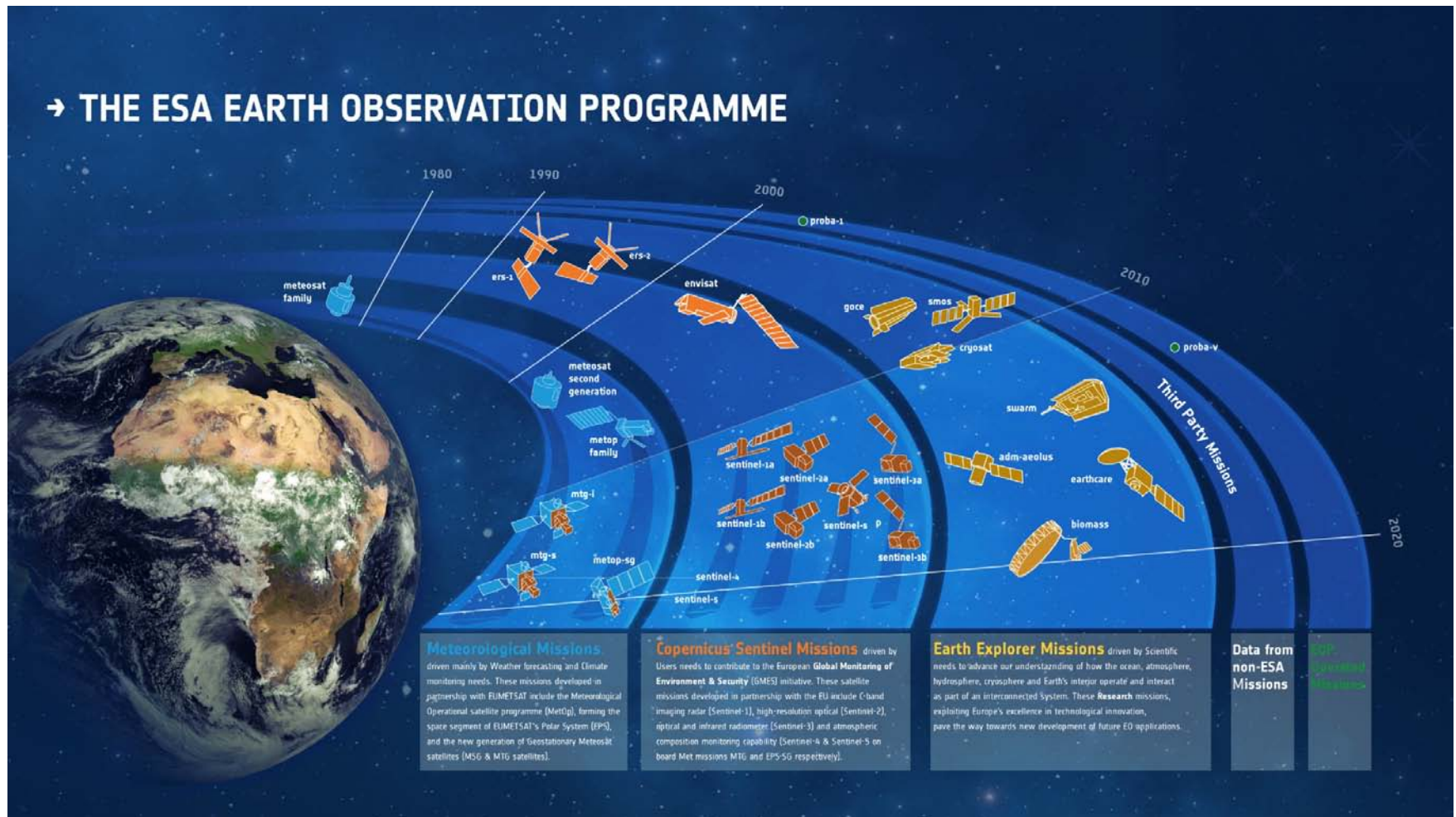
Directorate of Earth Observation Programmes

European Space Agency (ESA/ESRIN)

ESRIN/CSG/37 - Frascati, 17-21 February 2014

- Latest on the ESA Earth Observation programme
- Review of recent ESA Cal/Val activities
- Introduction to the Cal/Val Infrastructure working group - CVI

→ THE ESA EARTH OBSERVATION PROGRAMME



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 (2009-2013) - Gravity Field and Steady-State Ocean Circulation Earth Explorer mission

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

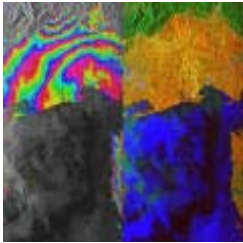
CryoSat (2010-) – Land/sea ice thickness and ocean Earth Explorer mission

SWARM (2013-) – Three satellite constellation measuring the magnetic field

ADM-AEOLUS (2015) – Wind fields (and aerosols) LIDAR mission

EarthCARE (2016) – Aerosol, cloud properties and radiation budget (4 instruments)

BIOMASS (2018) – Forest carbon budget estimation



Sentinel 1 (*March 28, 2014*) – SAR imaging

- *All weather, day/night applications, interferometry*

Sentinel 2 (2015) – Superspectral imaging

- *vegetation, forestry, security*

Sentinel 3 (2015) – Ocean/land monitoring

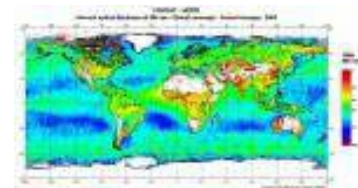
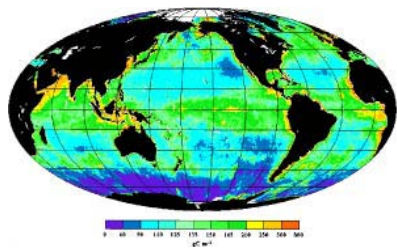
- *Wide-swath ocean color, surface temperature and vegetation sensors, altimeter*

Sentinel 4 (2019) – Geostationary atmospheric

- *Atmospheric composition monitoring, trans-boundary pollution*

Sentinel 5p/5 (2015/2020) – Low-orbit atmospheric

- *Atmospheric composition monitoring*



ESA has numerous bi-lateral agreements with space agencies and certain ESA Member States covering data collection, data production and operations, for example:

- *USGS Landsat-series data collection over Europe and Africa*
- *JAXA Alos data distribution for Europe*
- *NASA MODIS NRT broadcast for Europe (Spain, Finland)*
- *Operations of the PROBA-series (Belgium) of mini-missions*
- *etc.*

Note, this portfolio is expanding, especially with the “Copernicus Data Warehouse” that facilitates access to commercial datasets (paid by the European Commission)

Review of recent ESA Cal/Val activities

Main objectives of ESA with respect to Cal/Val are to develop sustainable EO R&D capabilities for ESA *and it's Member States*

Cal/Val at ESA is an iterative process involving calibration scientists, algorithm developers, validation specialists *and the user communities*

Special attention is given to traceability, documentation and long-term data preservation *of all Cal/Val activities*

For a mission's Phase E2 ("operations"), this activity is lead by the Sensor Performance, Products, and Algorithms (SPPA) team at ESA/ESRIN

The SPPA team relies on

- 1. External feedback from researchers, institutions, users and through proactive efforts by ESA (i.e. workshops, "bug" reporting, etc.)*
- 2. Contractual support from mission Quality Working Groups (QWG) supported by instrument and algorithm teams (the Expert Support Laboratories – ESLs)*

to meet a mission performance and evolution needs

To address the evolving calibration, algorithm and validation needs, ESA/SPPA initiated a series of topical and thematic “Validation and Evolution” Workshops to identify and consolidate mission dataset requirements:

1. *ACVE – Atmospheric Composition Validation and Evolution WS, March 2013, ~130 participants from Europe and North America*
2. *L1 WS – L1 and calibration WS, June 2013, ~25 participants from across Europe*
3. *LPVE – Land Product Validation and Evolution WS, January 2014, ~ 120 participants from Europe, North-America and Asia*
4. *Arctic Validation WS, November 2014 (Ottawa), April 2015 (Scandinavia/Finland/Russia - TBC)*
5. *(S3VT – Sentinel-3 Validation Team in cooperation with ESA/ESTEC and Eumetsat, March 2012 and November 2013, ~ 100 participants from around the world)*

The outcome/recommendations of these R&D and user driven workshops directly impact activities of historic (ERS, Envisat, Vegetation), and future missions (Sentinels or Earth Explorers)

Some concrete recommendations from ACVE, LPVE and S3VT
ESA will implement in 2014-2016:

- Continued funding of AQ groundbased intercomparison profile algorithm development for 2014-2017
- GHG groundbased instrument intercomparison
- Consolidation of trace gas spectroscopy (HARMONICS)
- Extended support of RadCall for 2016-2017
- SST/LST radiometer calibration intercomparison campaign for 2014-2016
- Co-funding with European ocean colour reference buoy (BOUSSOLE) 2015
- Support of modern fully characterised retrieval for SWR (altimetry tropospheric humidity correction)
- Co-funding of a Level-1 WG
- End-to-end characterisation of Sentinel-2/Sentinel-3 Radiometric Uncertainty Analysis
- etc.

Each activity listed here is also a direct contribution to the WGCV or WGCV sub-groups

Introduction to the Cal/Val Infrastructure working group - CVI

Validation of fundamental measurements and derived products



Validation, using independent datasets of known and constantly monitored quality (or “in situ”), is essential in achieving a full characterization of the satellite EO “products”.

Continuous validation using “in situ” datasets also contributes to understanding of intra-sensor differences and may be used as a “**transfer standard**” in the event of satellite mission gaps (for example MOBY/BOUSSOLE for ocean colour, in situ radiometers for SST).

Two data approaches/sources exist:

1. *Use of routine network data (e.g. meteorological measurements) – **achieving the statistics by numbers**;*
2. *Specialized (targeted) activities (e.g. land targets, balloons/aircraft, specialized assets, instrument intercomparisons) – **understanding of processes or measurement technique differences**.*

Typically “specialized” assets that are “one of a kind”, specifically developed for satellite validation needs.

The instrument operations, and the data evaluation and interpretation, involve highly trained scientific and technical staff.

These assets are costly to build, to deploy and to operate.

Examples of assets currently used by ESA:

- *MOBY (\$2.5M/y for ops.)/BOUSSOLE (€700k/y for ops.) for ocean colour;*
- *NDACC FTIR/MWR/LIDAR (\pm €500-750k to build, €200k/y to operate per unit) for atmospheric composition;*
- *ISAR (€50K-€80K/y to operate) or SISTeR (€200K/y) for SST;*
- *SAR transponders (\pm €1M, \pm €100k/y to operate).*

In 2012 ESA with its Member States have established the Cal/Val Infrastructure Working Group (CVI) with objective to:

“The CVI is to work towards maintaining essential long-term validation capabilities across multiple missions, as well as review and prioritize future Cal/Val opportunities for ESA, its member states and partner agencies. The CVI is complementary to existing activities such as the CEOS/WGCV or the WMO/GSICS, and will provide a forum for discussion, coordination and promotion of Cal/Val initiatives among EO stakeholders. Regular topical workshops will be held to build consensus.”

The CVI WG will specifically:

- *Collect and update the EO mission and users needs regarding Cal/Val;*
- *Conduct regular reviews of the status of existing (and future) Cal/Val assets;*
- *Identify the opportunities for joint or coordinated efforts and investments in Cal/Val;*
- *Coordinate the development and the deployment of assets for both calibration and validation;*
- *Organize joint activities to evaluate/understand “in situ” capabilities, in particular with respect to the intercalibration of sensors;*
- *Share data across agencies in a timely fashion and with full quality information as outlined by QA4EO.*
- *Provide recommendations to the GSCB and its members regarding the all of the above*

Working group membership

Canada (S. Srivastava), France (P. Henry), Finland (J. Pulliainen) , Germany (A. von Bargaen), Norway (E.-A. Herland), United Kingdom (N. Fox), ESA (B. Bojkov) and EUMETSAT (D. Klaes/T. Hewison)

New members as of 2013:

Belgium (M. de Mazière), WMO (S. Bojinski)

Meetings to date:

- *Kick-off meeting held at ESRIN in July 2012*
- *Two side meetings held in conjunction with CEOS/WGCV plenaries (September 2012 and May 2013) addressing vicarious calibration instrumentation issues (land and ocean)*
- *CVI no. 2 held at DLR in December 2013*

Next full meeting planned for Q4 2014

Continued funding of the BOUSSOLE buoy by CNES and ESA through 2015

- *Confirmed by ESA in February 2014*

Cooperative effort by ESA and UK on SST/LST radiometer intercomparisons:

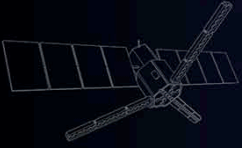
- *NPL to facilitate laboratory calibration work*
- *Ship and terrestrial aspects still being formulated (with UK DECC)*
- *Negotiations expected to wrap-up by March 2014*

Coordinate with Canada, Norway and Finland the Arctic Validation and Evolution Workshops (AVEs) in 2014 and 2015

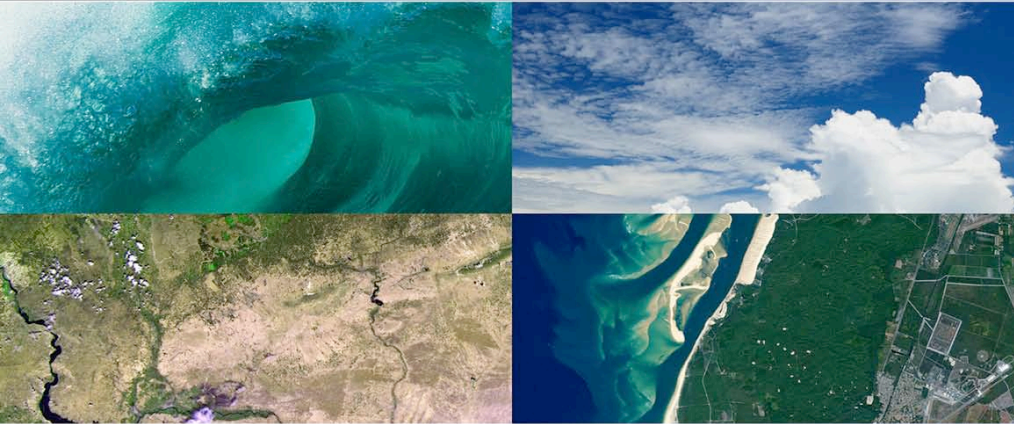
- *Preparations/planning started with two Canadian SMEs*

ESA-CNES co-funding of European RadCalNet site for 2016-2017

- *Additional ESA funding approved in February 2014, MOU under preparation*



→ CEOS WORKING GROUP ON CALIBRATION
AND VALIDATION PLENARY "WGCV-37"



17–21 February 2014 | ESA–ESRIN | Frascati (Rome), Italy

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Thank you for your attention!