The Cal/Val Interest working group

Status update to the GSICS #12

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The importance of data quality in EO: the Cal/Val context

Starting with the first EO satellite TIROS-1 in 1960, a rigorous instrument calibration, a continuous monitoring of sensor performance and an extensive validation of the derived products, have been key to any successful mission.

Long-term data quality requirements, such as for climate change or for data preservation, have added to the importance of the continuous characterization of sensors and the validation of products.

In recent years, the development of "down-stream" applications and services using space-borne data have increased the need for documented end-to-end characterization of the EO sensors and their derived products.

Interoperability between EO sensors and products have led to coordinated efforts in the Cal/Val methodologies through CEOS/WGCV and WMO/GSICS – *leading to the establishment of QA4EO guidelines by CEOS/WGCV and the subsequent adoption by GEO.*

Sensor calibration and characterization

The understanding of a sensor's behaviour, and its products, can only be achieved through:

1. *A complete instrument calibration and performance characterization prior to launch:*
   - Internationally agreed procedures, methodologies and protocols exist and are followed (at times partially);
   - Bilateral and international cooperation are long-standing (for example sharing of calibration sphere and lamps).

1. *A continuous in-flight sensor performance monitoring:*
   - Using targets (ice, moon, deserts, rail lines, ocean buoys, cruises, aircraft, dedicated sites, etc.) , specialized radiometric activities, L2-to-L1 "feedback", etc.;
   - Increasing international coordination on procedures/"best practice" being followed through the CEOS WGCV and the Virtual Constellations, the WMO GSICS, and relevant scientific groups such as the IOCCG, GHRSST, WMO GAW, etc.

Validation of fundamental measurements and derived products

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

Continuous "in situ" validation 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.***

On "specialized" validation

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

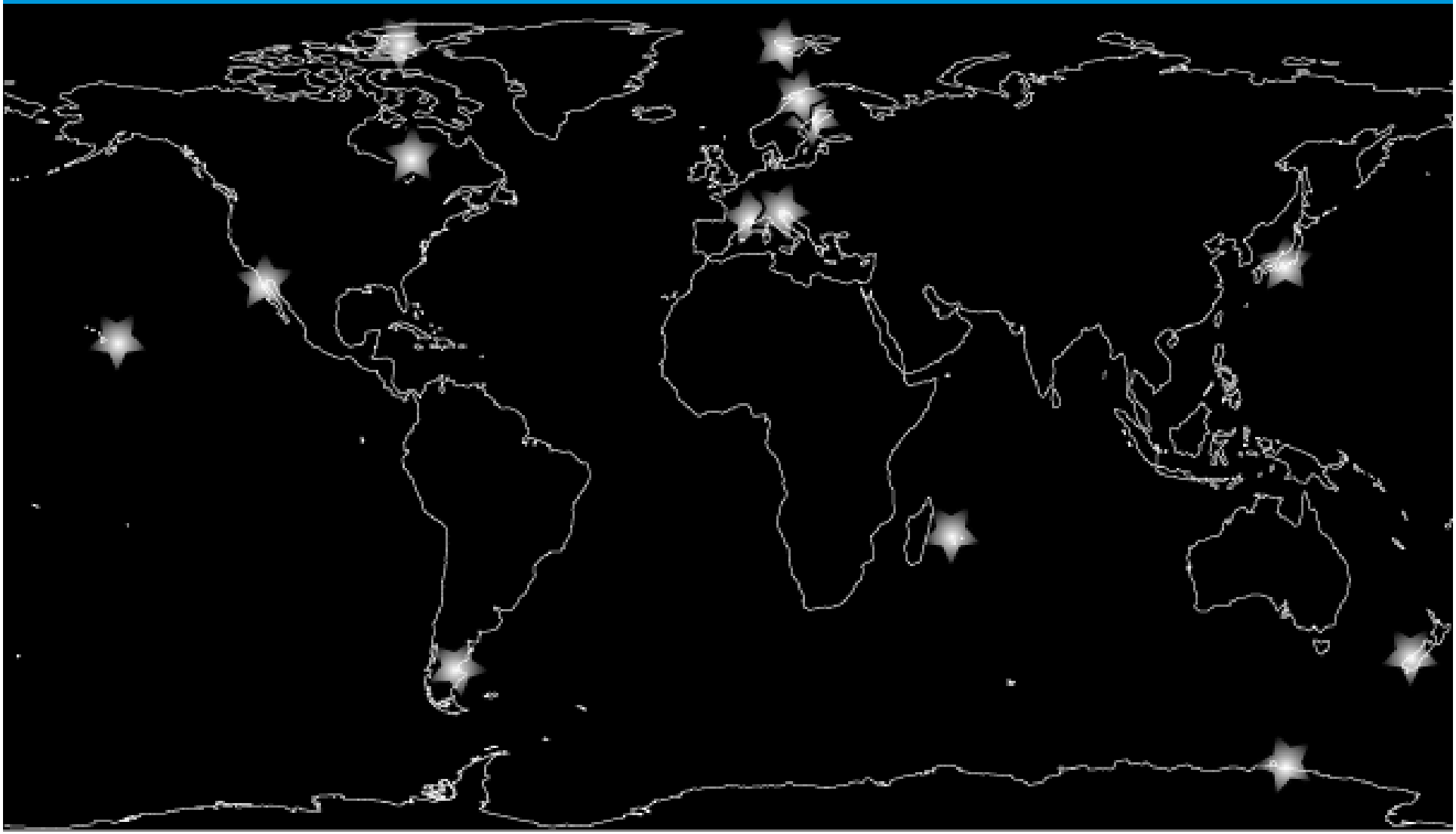
The instrument operations, and the data evaluation and interpretation, involve highly trained scientific and technical staff.

These assets are costly to build, to deploy and to operate. Examples of assets currently used by ESA:

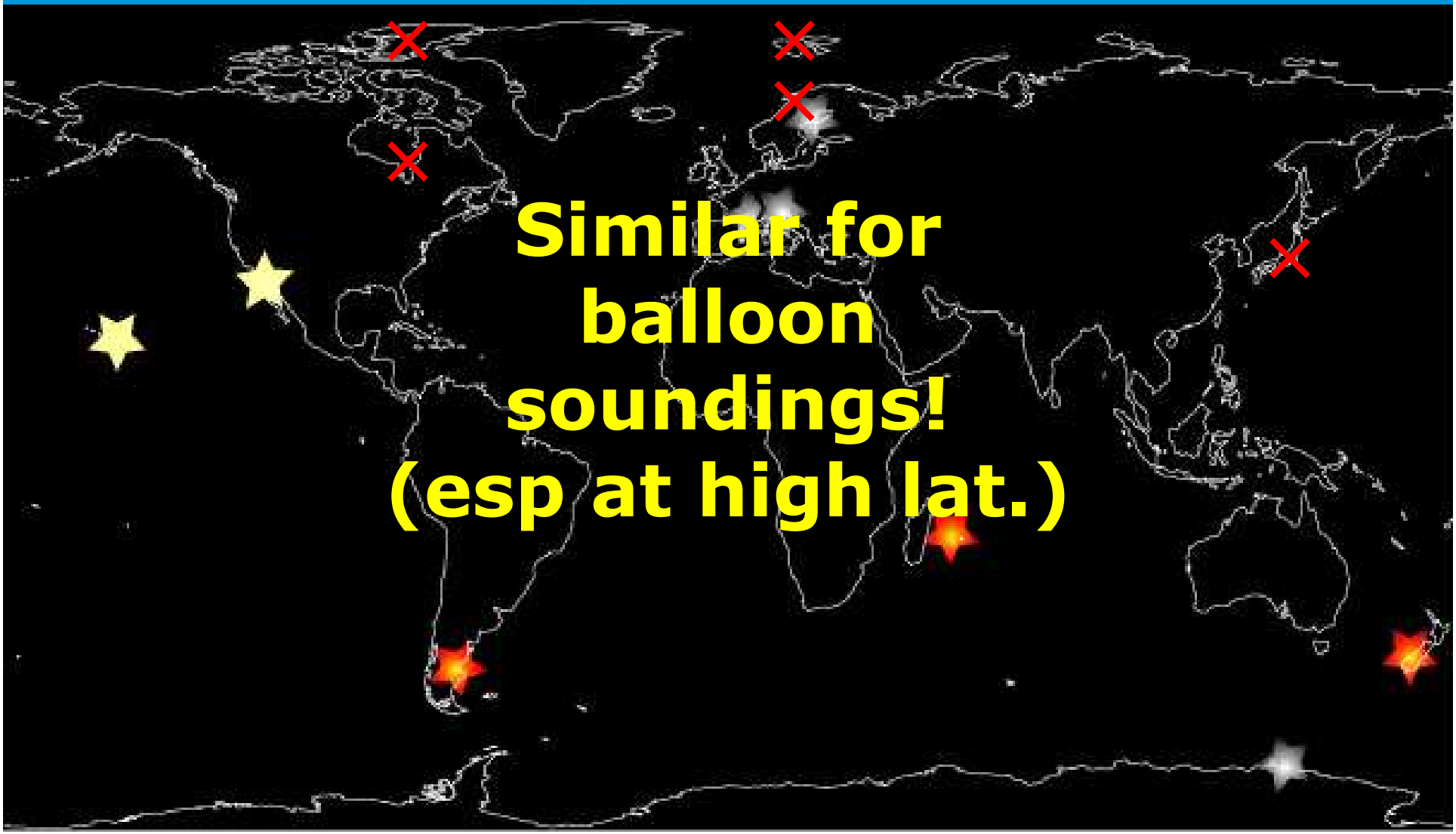
- *MOBY ($2.5M/y for ops.)/BOUSSOLE (€700k/y for ops.) for ocean colour;*
- *NDACC FTIR/MWR/LIDAR (±€500-750k to build, €200k/y to operate per unit) for atmospheric composition;*
- *ISAR (€50K-€80K/y to operate) or SISTeR (€200K/y) for SST;*
- *SAR transponders (±€1M, ±€100k/y to operate).*

BUT...

Temperature and ozone lidars used for validation (2002)



Temperature and ozone lidars used for validation (2012)



Objectives

The CVI will specifically:

"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."

Objectives (ii)

The CVI 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*

WG membership and interfacing

Membership:

- *Currently, nominees are from CNES (P. Henry), CSA (S. Srivastava), DLR (A. von Bargen), ESA (B. Bojkov), FMI-ARC (J. Poulianen), Eumetsat (D. Klaes), Norwegian Spacecenter (E. Herland), UKSA (N. Fox).*
- *Representatives from other interested agencies in Member States and organizations who contribute to cal/val activities will be welcomed, for example the EEA or WMO.*

Interfacing:

- *Depending on the meeting agenda, non-members could attend to address a specific topic (e.g. from Academia and/or Industry engaged in satellite instrument design, on-ground cal/val infrastructure design, etc.).*
- *Regular international coordination with NASA, NOAA and JAXA are foreseen.*

Foreseen actions through 2013

Land/radiometric sensor monitoring:

- *Maintenance of "land targets" and comprehensive instrumentation (atmospheric correction/characterization) of targets for SPOT 6/7, PRISMA, EnMAP, SEOSAT, Landsat (as TPM) and Sentinel-2 (incl. joint land campaigns);*
- *Development of Land Surface Temperatures (LST) validation capabilities.*

Atmosphere:

- *Mitigate the decommissioning of European LIDAR systems in Norway, the Netherlands/New Zealand - a potential impact on Envisat/ADM/EarthCARE;*
- *Facilitate the deployment and characterization of MAX-DOAS and mini-spectrometer (PANDORA) – impact on Air Quality and Atmospheric Composition products of GOME-2, IASI, MEGHA-Tropiques, and Sentinel 5p;*
- *Extension of GHG validation capabilities in anticipation of MERLIN, MICROCARB, CarbonSat, and Sentinel 5p (as well as TPMs).*

SAR:

- *Calibration devices development for next generation missions sharing similar characteristics (e.g. carrier frequency), for example S1-RadarSat-2, SEOSAR-TerraSAR-X, etc.*

Foreseen actions through 2013 (ii)

Earth Explorers:

- *CryoSat ocean product validation;*
- *Explore synergies between SMOS/Aquarius/SMAP;*
- *EarthCARE aerosol and cloud product validation preparations.*

Sentinel-3:

- *Ocean Colour (OC)*
  - Ensure MOBY/BOUSSOLE funding for Sentinel-3;
  - Coordinate AERONET-OC deployment in the Mediterranean, Black Sea, tropical waters.
- *Sea Surface Temperature (SST)*
  - Fund continued operations to the autonomous ISAR and SISTER radiometer deployments aboard ships of opportunity through the Sentinel-3 period.

And many more examples for future activities beyond 2013

Way forward

Formal kick-off with agency nominees at ESRIN July 3 with the goal of:

- *Finalise the Cal/Val Interest Working Group Terms of Reference;*
- *Discuss interfacing with other agencies and bodies;*
- *Address pressing cal/val infrastructure issues (tentative):*
  - Ensure Ocean Colour calibration infrastructure for 2013-on;
  - Mitigate uncertainty of the total ozone calibration and data collection;
  - Consider the deployment of an air quality/atmospheric composition instrumentation network specifically tailored to future satellite validation.

Thank you!

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