Sentinel-5p Mission Performance Centre

Automated Validation Facility


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Contributions from DLR, IUP-UB, KNMI, MPI-C, NILU, RAL, SRON
Background and Objectives

S5P Mission Performance Centre (MPC) to provide validation service during Copernicus S5P Routine Operation:

- **Automated, routine** comparison of S5P data vs. FRMs
- Generation of **S5P validation database** for MPC Teams
- Automated generation of **on-line quick-look reports**

- Validation-based **detection of** L2 products **health issues**
- Generation of **quarterly** consolidated **validation reports**
- Validation support to Level-1-to-2 **algorithm QA & evolution**
Background and Objectives

Heritage validation systems at BIRA-IASB

- **Multi-TASTE**: expert validation system for GOME/TOMS/SBUV, Envisat, 14 Limb/Occ... in ACVE, S5PVT, SPARC, WMO/UNEP, CCI_ozone, C3S_312a#4...

- **OSSSMOSE**: Observing System of Systems Simulator (for OSSSEs) with detailed metrology, including error budget closure for data comparisons

- **EUMETSAT AC-SAF**: GOME-2 and IASI trace gas data validation server

- **FP7 NORS**: automated comparison of MACC vs. NDACC
- **CAMS-84/27**: routine evaluation of CAMS vs. NDACC and TCCON
- **FP7 QA4ECV**: ECV QA System + Atmospheric ECVs Validation Server

+ lessons learnt from GSICS, CNRS ICARE, NOAA NPROVS
S5P MPC Validation Data Analysis Facility (VDAF)

System Architecture
State-of-the-Art Validation Chain, Co-locators, Comparators…

Cross GEOSS EO Cal/Val

Prototyping ESA Multi-TASTE and CCI_Ozone

Community feedback / endorsement

Implementation in FP7 QA4ECV-AVS, H2020 GAIA-CLIM, C3S_312a#ozone, S5P MPC/VDAF, CAMS-84/27, CCI+
Data Handling, Co-location and Comparison Toolset

HARP


Command line tools

The section describes the command line tools provided by the HARP toolkit.

- harpcheck
- harpcollocate
  - Collocation
  - Obtaining collocation result file
  - Resampling collocation result file
  - Updating collocation result file
- harpconvert
- harpdump
- harpmerge
S5P VDAF

S5P TROPOMI

and

FRM

Data Streams
S5P Data Streams

- Overpass data extractor in S5P PDGS
- Generic approach, specific parameters
- Optimization of data volumes

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Figure 4. Co-located ground-satellite measurement pairs near summer and winter solstice (dashed and dotted lines, respectively) and near the autumn and spring equinox (solid line). The station is indicated by a red dot, the ground observation operators in magenta, the satellite pixel in dark blue and the full satellite observation operator in cyan.
## FRM Data Streams into S5P VDAF

**ESA FRM programme + WMO GAW contributing networks**

<table>
<thead>
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<th>ID</th>
<th>S5P Data Product</th>
<th>Fiducial Reference Measurements</th>
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<td>O$_3$ total column</td>
<td>Brewer, Dobson, ZSL-DOAS, MAX-DOAS, Pandonia</td>
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<td>B</td>
<td>O$_3$ profile (incl. troposphere)</td>
<td>ozonesonde, stratospheric DIAL, tropospheric DIAL</td>
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<td>C</td>
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<td>ozonesonde</td>
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<td>D</td>
<td>NO$_2$ stratospheric column</td>
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<td>F</td>
<td>HCHO total column</td>
<td>MAX-DOAS, Pandonia</td>
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<td>CO total column</td>
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<td>Aerosol Layer Height</td>
<td>EARLINET aerosol lidar</td>
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</table>
FRM Data Streams into S5P VDAF: O₃ column data
FRM Data Streams into S5P VDAF: Stratospheric NO$_2$ column data

**FRM Archiving Rate report_v3_20180412**

NO2 Column Network - All archives

Faster delivery organised through:
LATMOS-SAOZ,
CAMS-27/84,
ESA FRM4DOAS
ESA Pandonia

NDACC standard archiving rate
FRM Data Streams into S5P VDAF: CH₄ column data

Date of last archived measurement
- <= 1 day
- <= 1 week
- <= 1 month
- > 2 year

Time since last archive update
- <= 1 day
- <= 1 week
- <= 1 month
- > 2 year

Faster delivery organised through CAMS-27/84

NDACC & TCCON standard archiving rate
S5P VDAF

MPC dedicated Automated Validation Server

and

Public Validation Website

Synergies with similar developments for AC-SAF, QA4ECV and CAMS-84/27
S5P VDAF Automated Validation Server

Step 1: select product type

Step 3: select a location

Correlative plot
compare miscellaneous quantities

Settings

X-axis variable

Y-axis variable

Correlative plot at Xianghe

Automated Validation Facility
S5P MPC Validation Website

Preliminary data and results – S5P in Commissioning Phase...
Many synergies with similar developments for CAMS-27

BIRA-IASB SQL database tailored to CAMS-27, now being ported to S5P MPC VDAF
Conclusion (1/2)

• S5P VDAF Automated Validation Server builds on integration of heritage state-of-the-art satellite/CAMS validation systems (long-term support from BELSPO, EC, ESA, EUMETSAT, ECMWF)

• VDAF-AVS = core of S5P MPC routine validation service
  ➢ implemented in MPC environment
  ➢ tailored to Copernicus and S5P needs
  ➢ developed in synergy with other Copernicus elements

• Starting soon routine validation service for S5P trace gas data, with continuous verification of L2 health and quarterly validation reporting
Conclusion (2/2)

• VDAF/HARP tools expandable virtually to all atmospheric species, and possibly to other domains and applications

• Valuable synergies/convergence between Copernicus space, (FRM) data procurement and service components

• Enhanced coordination desired for approach to/funding for FRM gap analysis, deployment, data generation and delivery

• Support needed for operationalization of scientific systems, service set-up, improvement of tools and methods, harmonization of uncertainty expression, implementation of comparison error budget closure...

• Automated or not, EO (L1/L2/L3/L4) data validation always requires substantial interpretation by (human) scientific experts!
Thank you!