S5P MPC

Sentinel-5p Mission Performance Centre

Automated Validation Facility

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TROPOMI

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**

machine based
⇨ VDAF

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

Human ⇨
MPC VAL Team

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

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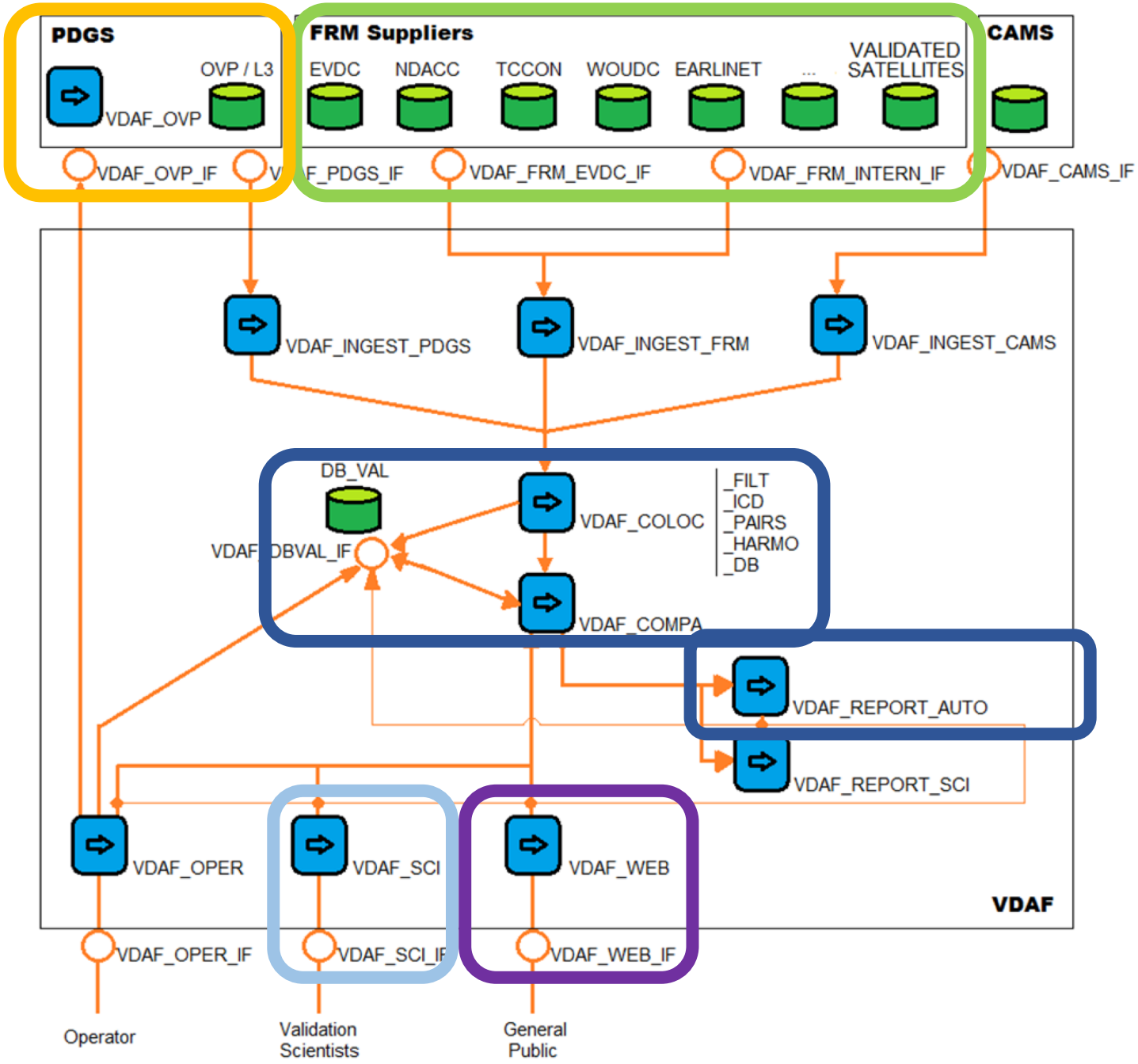
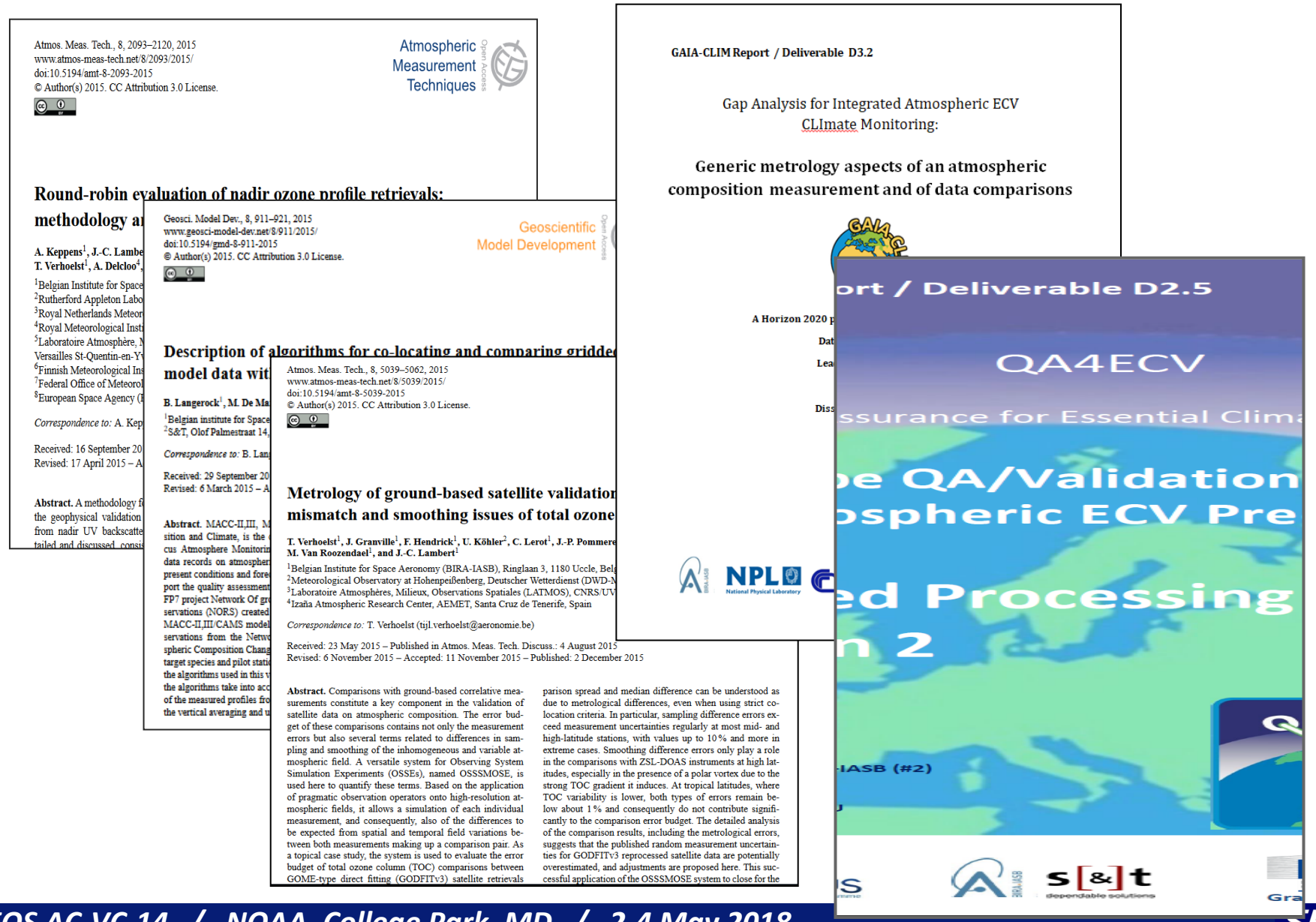
+ lessons learnt from GSICS, CNRS ICARE, NOAA NPROVS

S5P MPC Validation Data Analysis Facility (VDAF)

System Architecture



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



Cross GEOSS EO Cal/Val

WGCV-28/…/31

Prototyping ESA Multi-TASTE and CCI_Ozone

Community feedback / endorsement

ACC-8/…/11

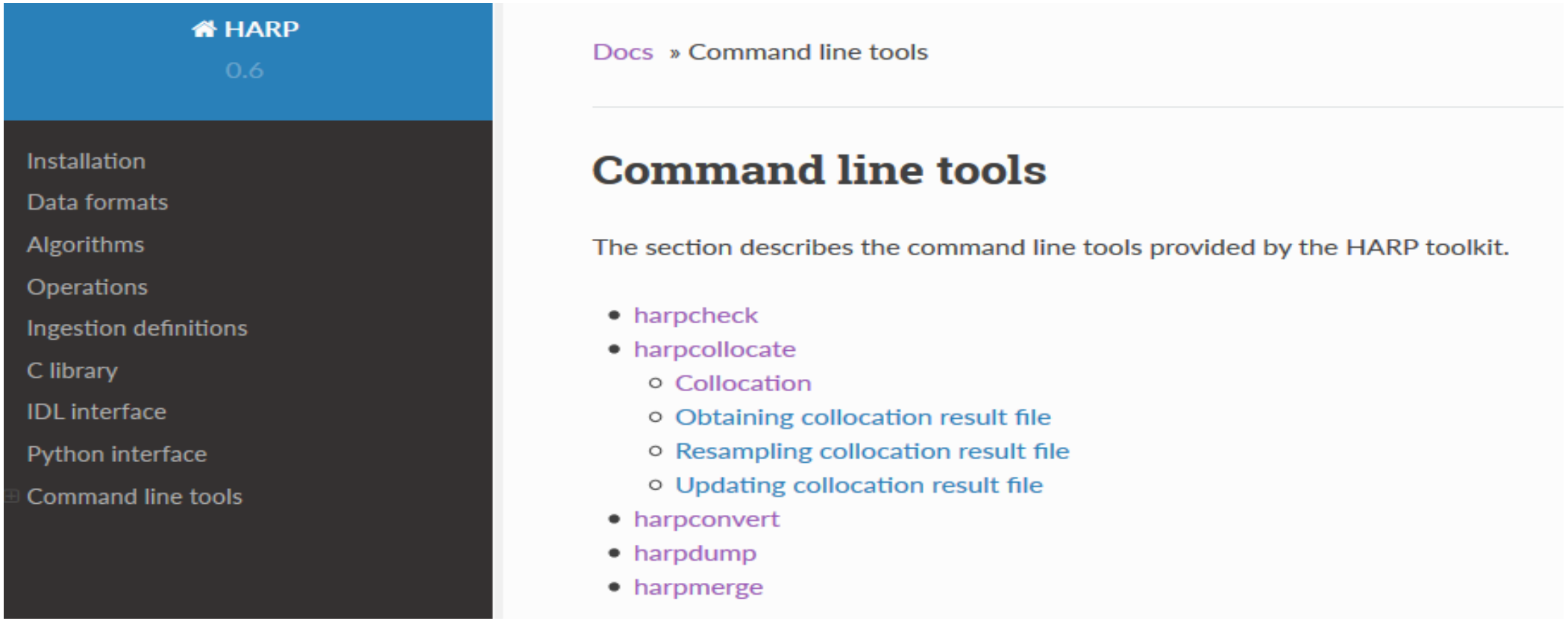
Implemention in FP7 QA4ECV-AVS, H2020 GAIA-CLIM, C3S_312a#ozone, S5P MPC/VDAF, CAMS-84/27, CCI+

Data Handling, Co-location and Comparison Toolset

HARP

BASIC ENVISAT ATMOSPHERIC TOOLBOX

harp documentation https://cdn.rawgit.com/stcorp/harp/master/doc/html/index.html



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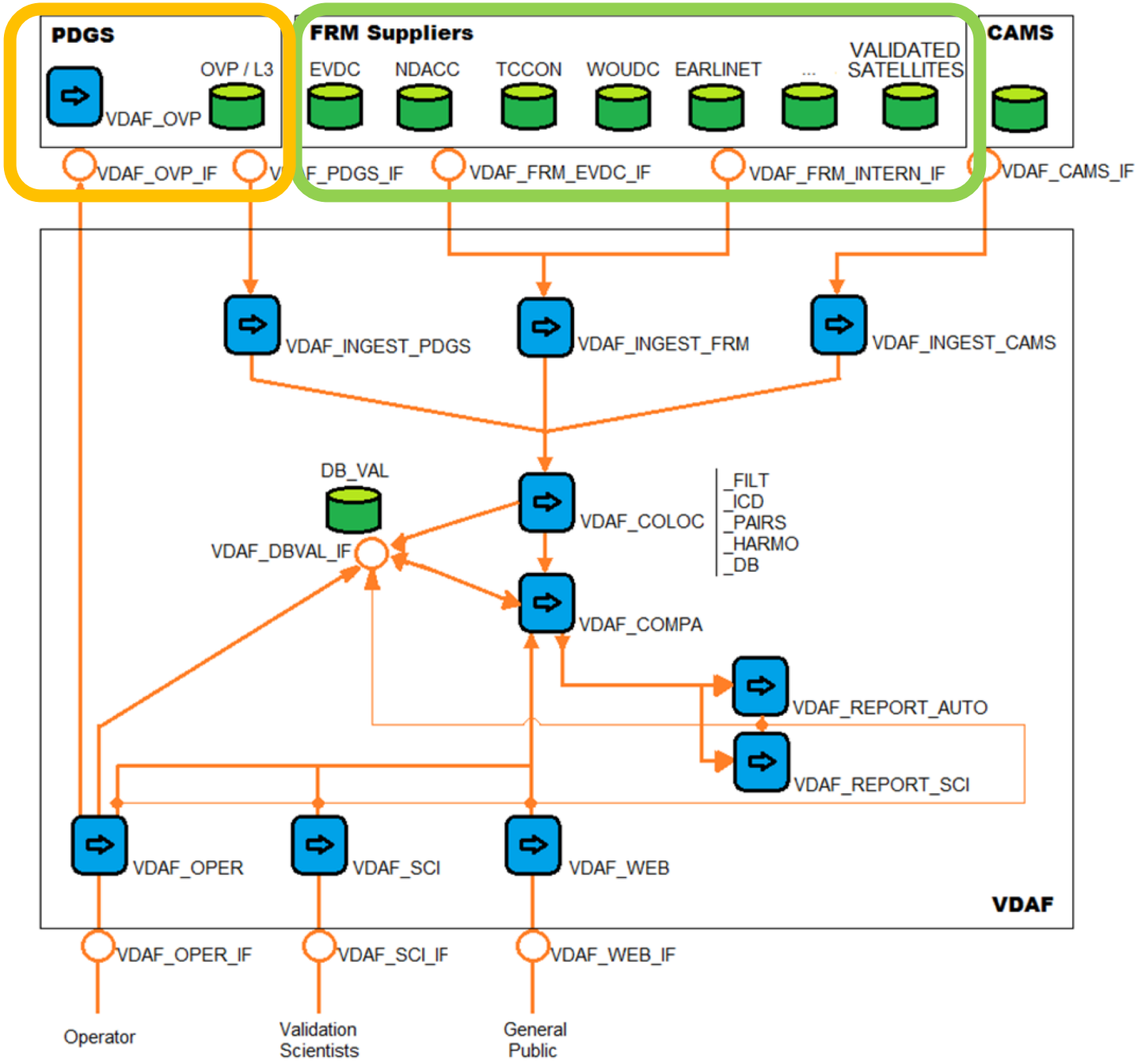
S5P VDAF

S5P TROPOMI

and

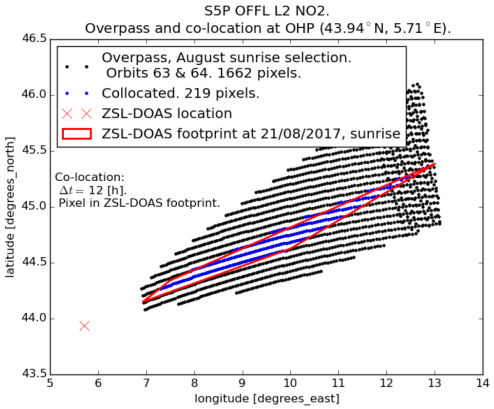
FRM

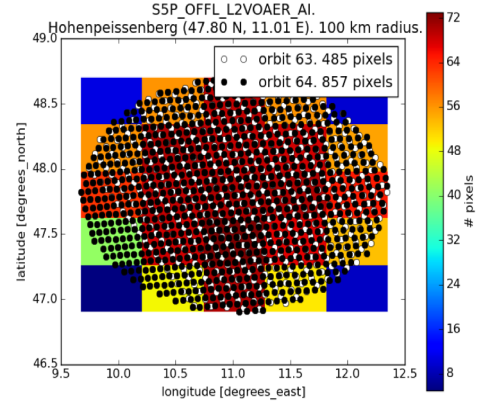
Data Streams

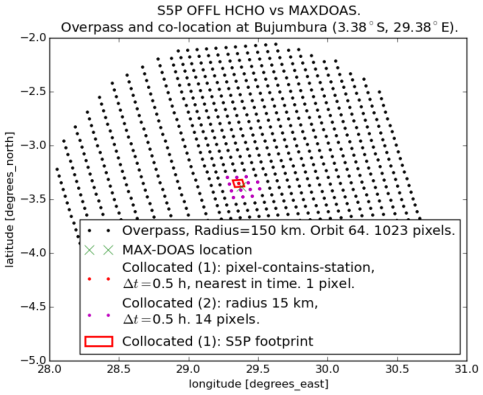


S5P Data Streams

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







T. Verhoelst et al.: Co-location mismatch and smoothing issues of total ozone data comparisons **AMT 2015**

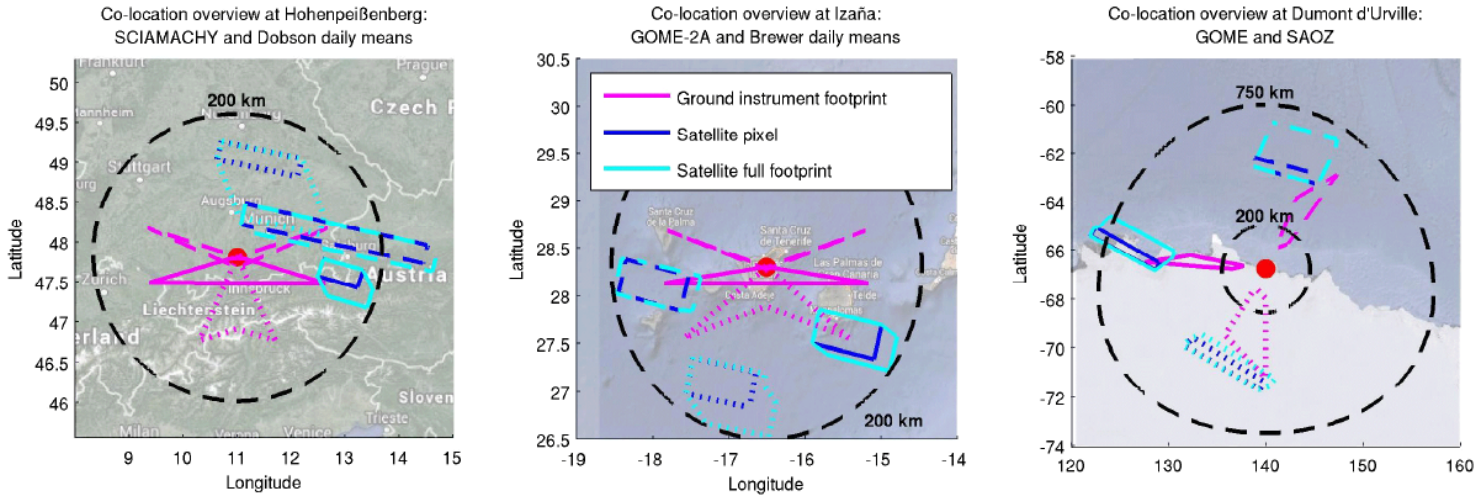


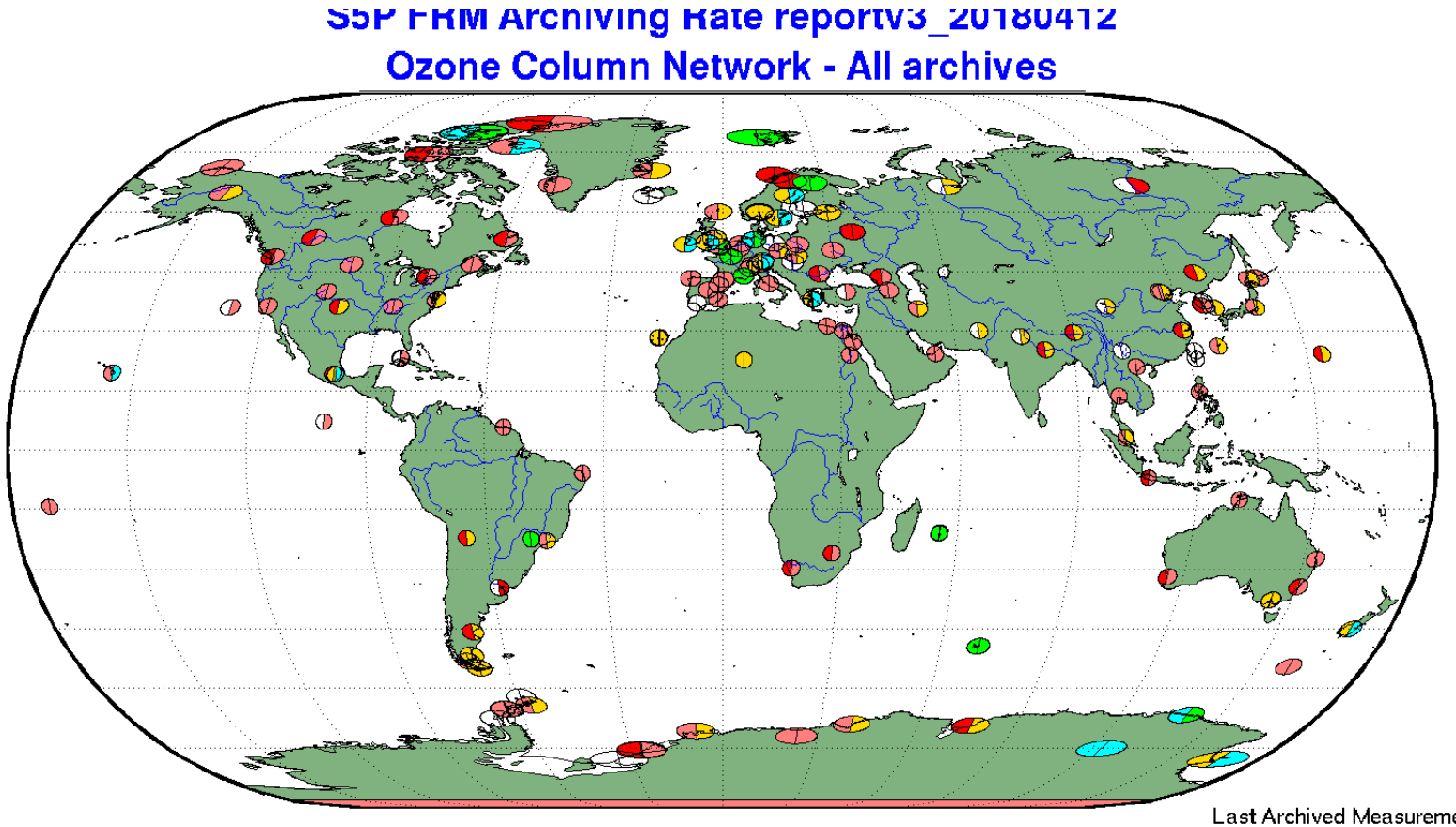
Figure 4. Co-located ground-satellite measurement pairs near summer and winter solstice (dashed and dotted lines, respectively) and near the autumn and spring equinox (solid line). The station is indicated by a red dot, the ground observation operators in magenta, the satellite pixel in dark blue and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

FRM Data Streams into S5P VDAF

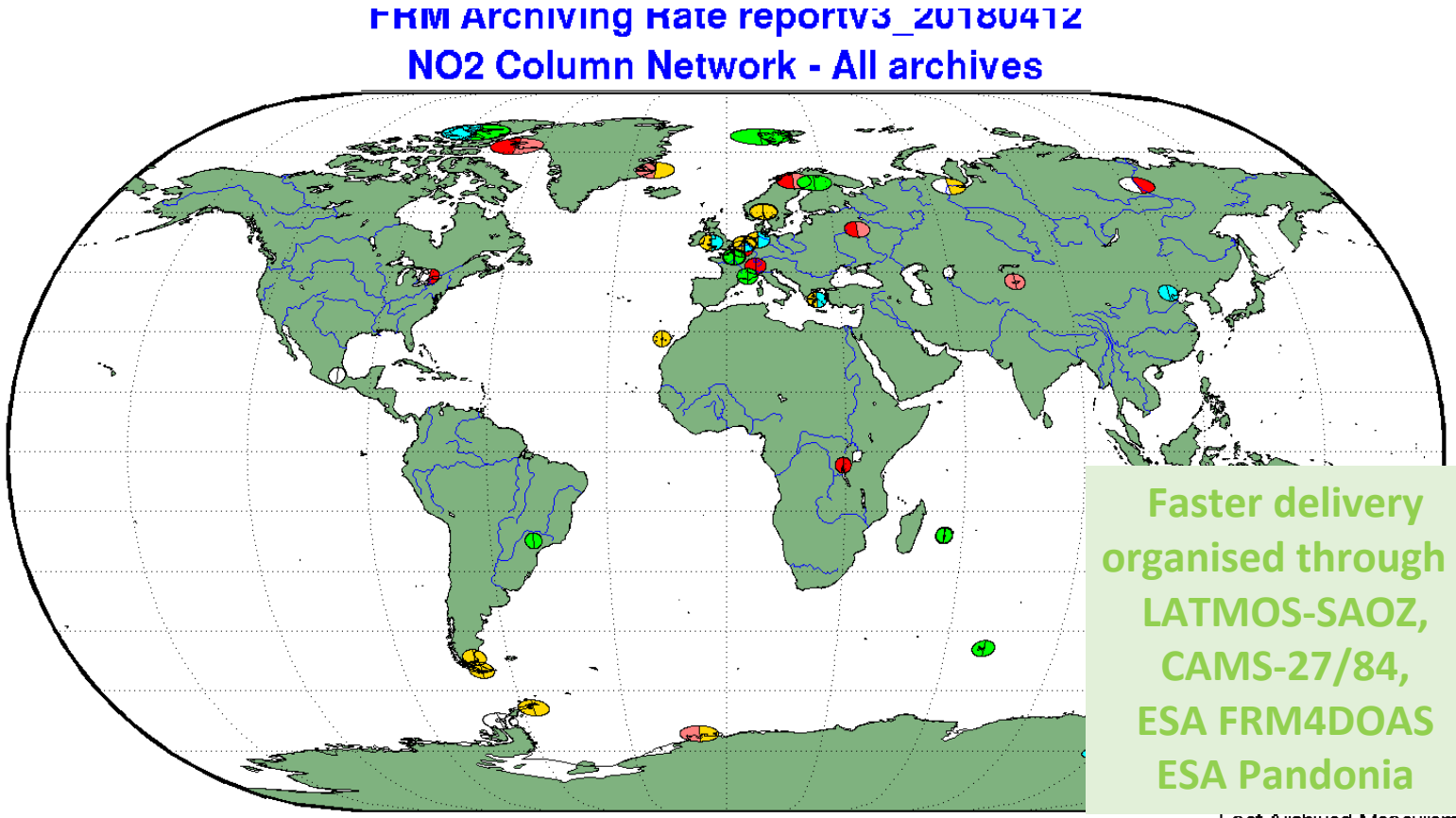
ESA FRM programme + WMO GAW contributing networks

ID	S5P Data Product	Fiducial Reference Measurements
A	O_3 total column	Brewer, Dobson, ZSL-DOAS, MAX-DOAS, Pandonia
B	O_3 profile (incl. troposphere)	ozonesonde, stratospheric DIAL, tropospheric DIAL
C	O_3 tropospheric column	ozonesonde
D	NO_2 stratospheric column NO_2 tropospheric column NO_2 total column	ZSL-DOAS MAX-DOAS Pandonia
E	SO_2 total column	Pandonia
F	HCHO total column	MAX-DOAS, Pandonia
G	CO total column	TCCON FTIR (NIR), NDACC FTIR (MIR)
H	CH_4 total column	TCCON FTIR (NIR), NDACC FTIR (MIR)
I	Cloud Fraction	*not available*
	Cloud Height (pressure)	Cloudnet lidar/radar
	Cloud Optical Thickness	*not available*
J	Aerosol Absorbing Index	*not available*
	Aerosol Layer Height	EARLINET aerosol lidar

FRM Data Streams into S5P VDAF: O_3 column data

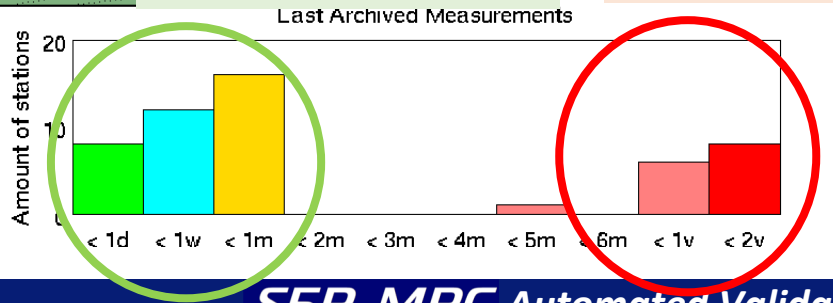


FRM Data Streams into S5P VDAF: Stratospheric NO_2 column data

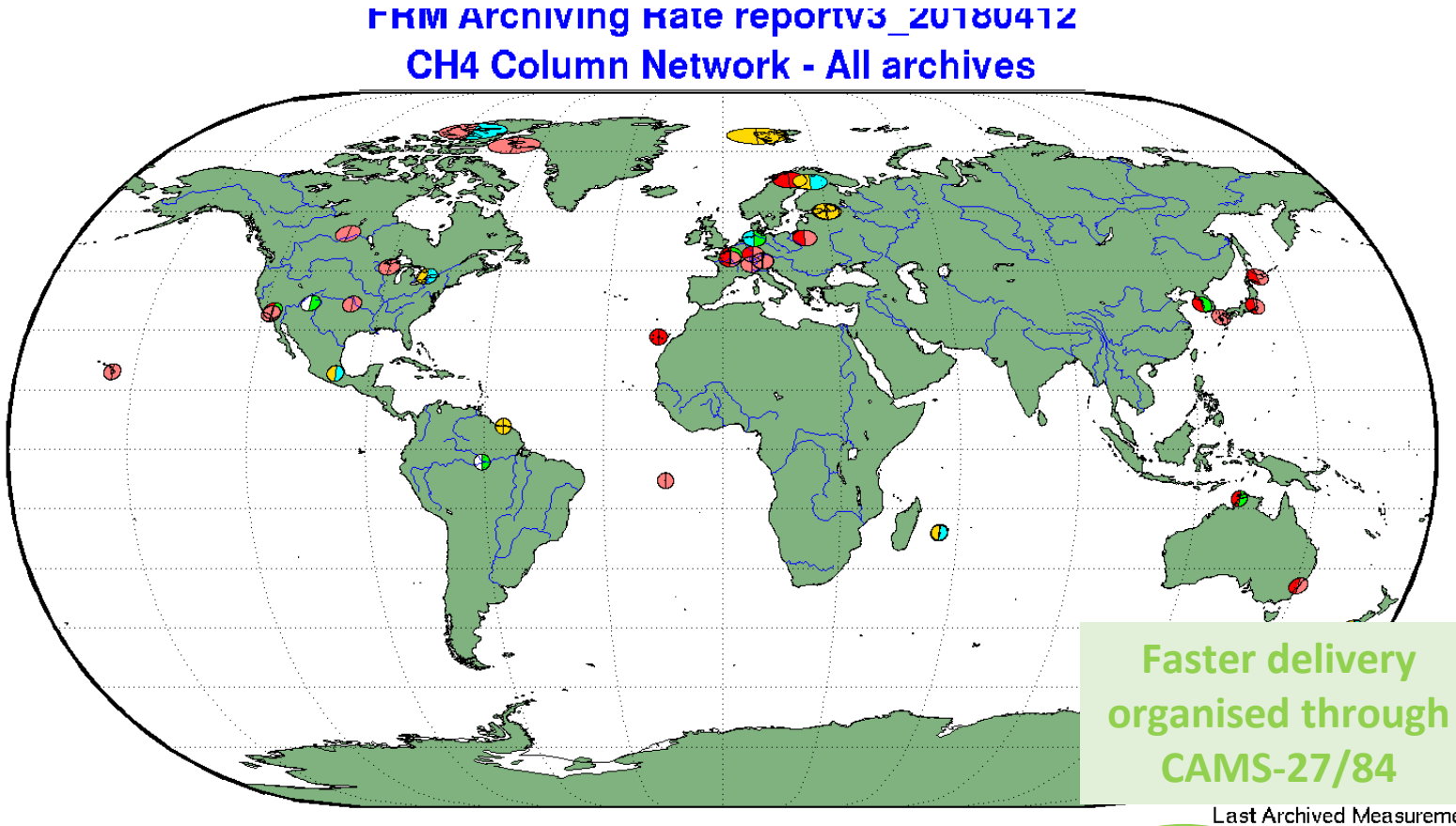


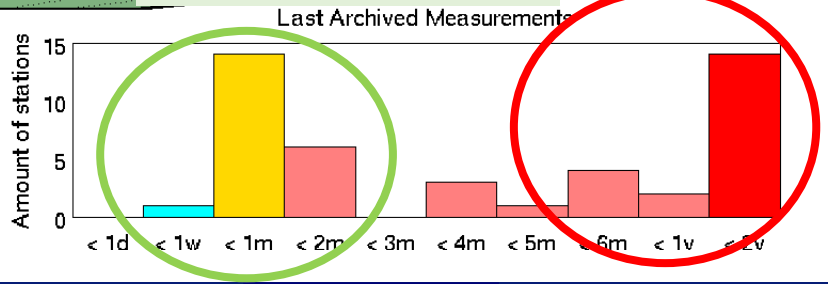
Faster delivery organised through : LATMOS-SAOZ, CAMS-27/84, ESA FRM4DOAS ESA Pandonia

NDACC standard archiving rate



FRM Data Streams into S5P VDAF: CH_4 column data





Faster delivery organised through CAMS-27/84

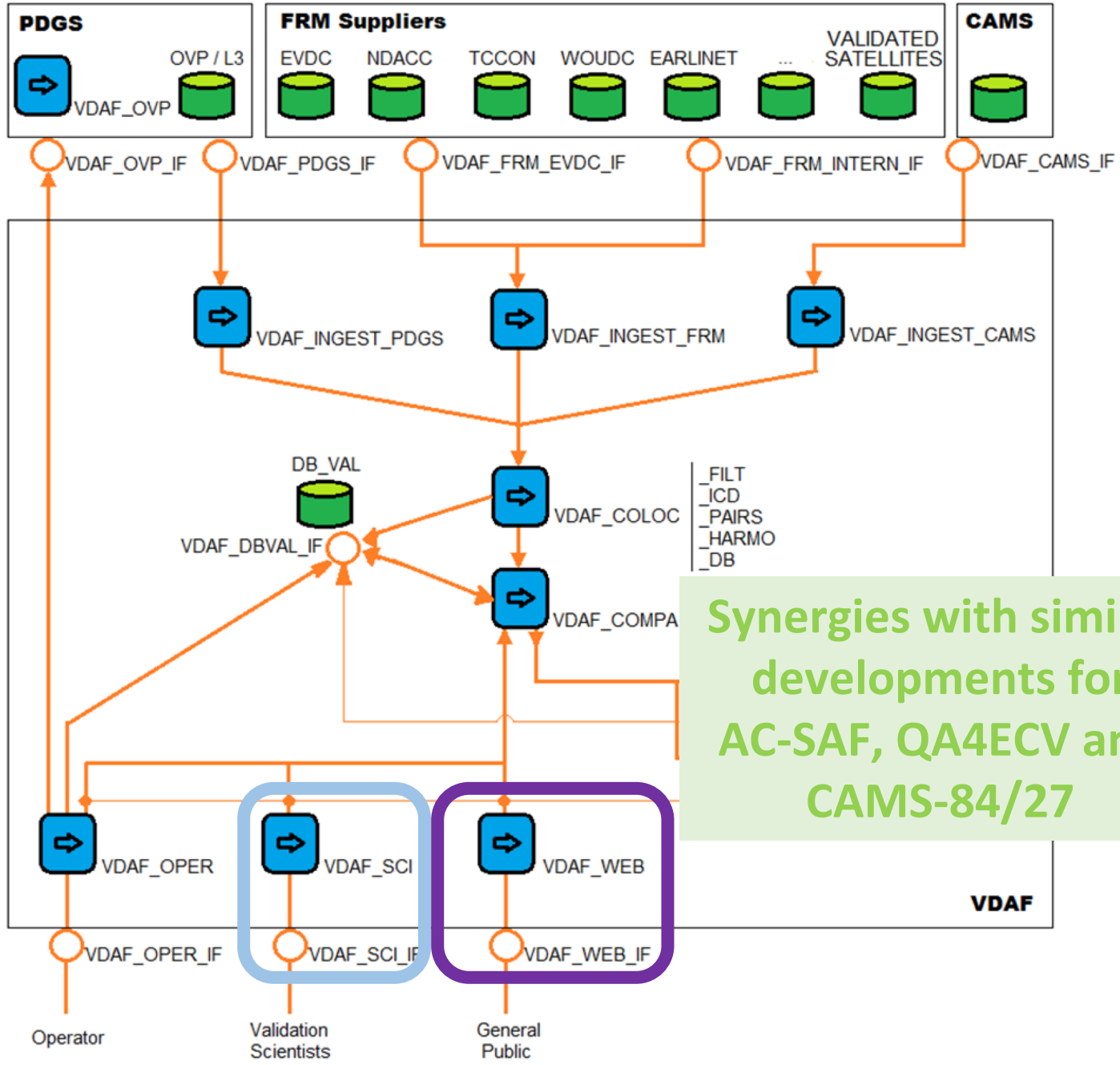
NDACC & TCCON standard archiving rate

S5P VDAF

MPC dedicated Automated Validation Server

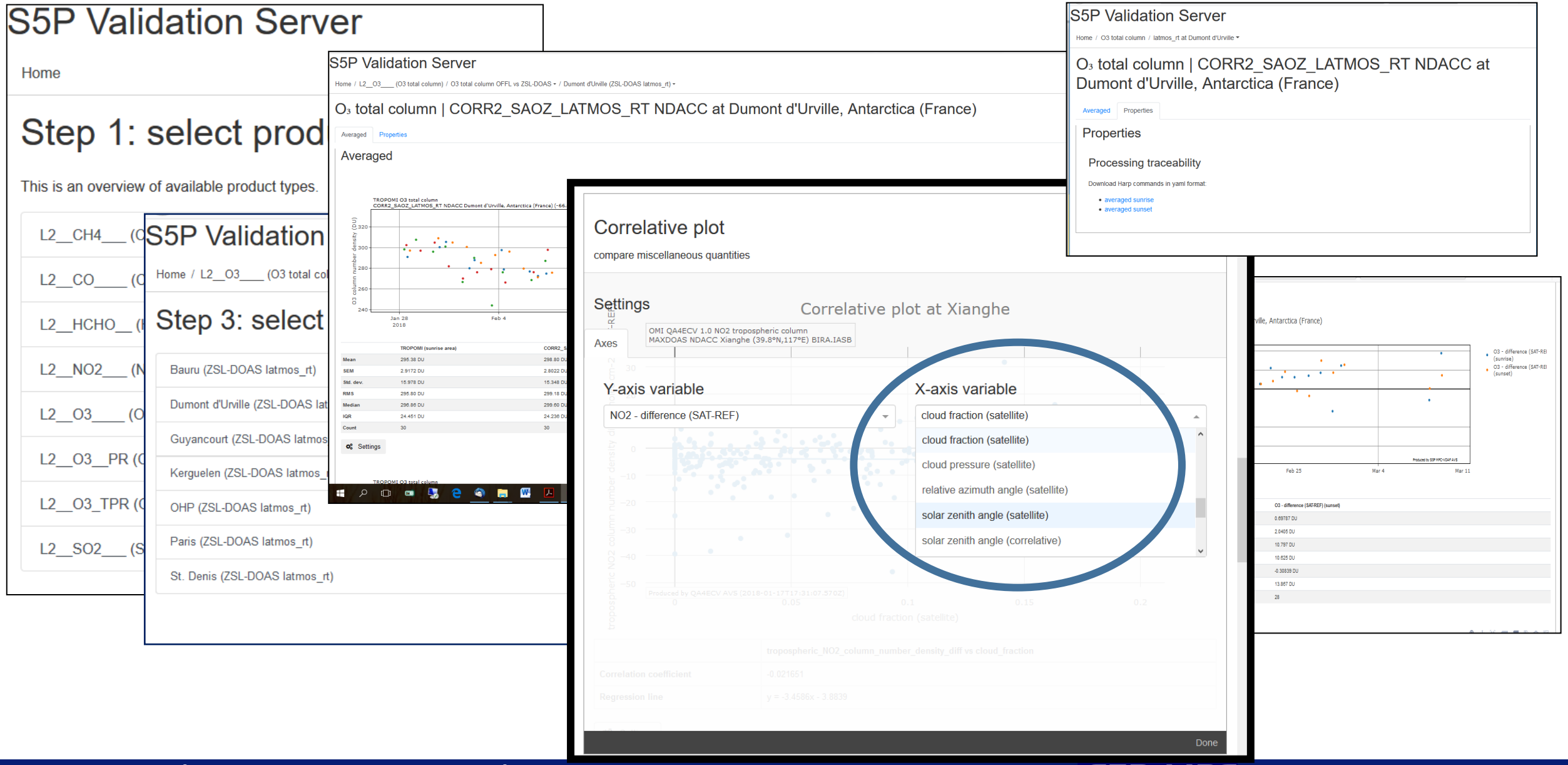
and

Public Validation Website



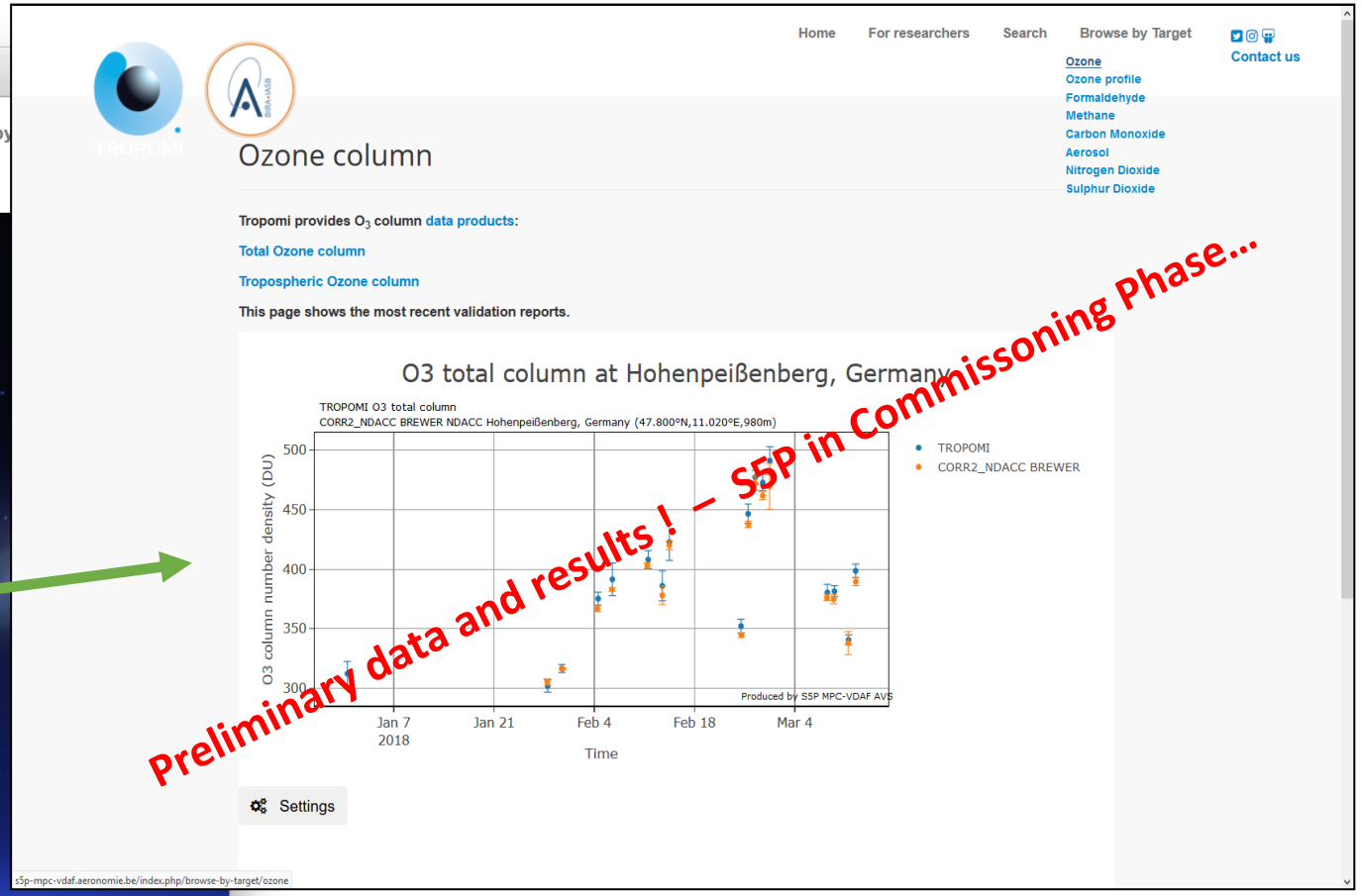
Synergies with similar developments for AC-SAF, QA4ECV and CAMS-84/27

S5P VDAF Automated Validation Server

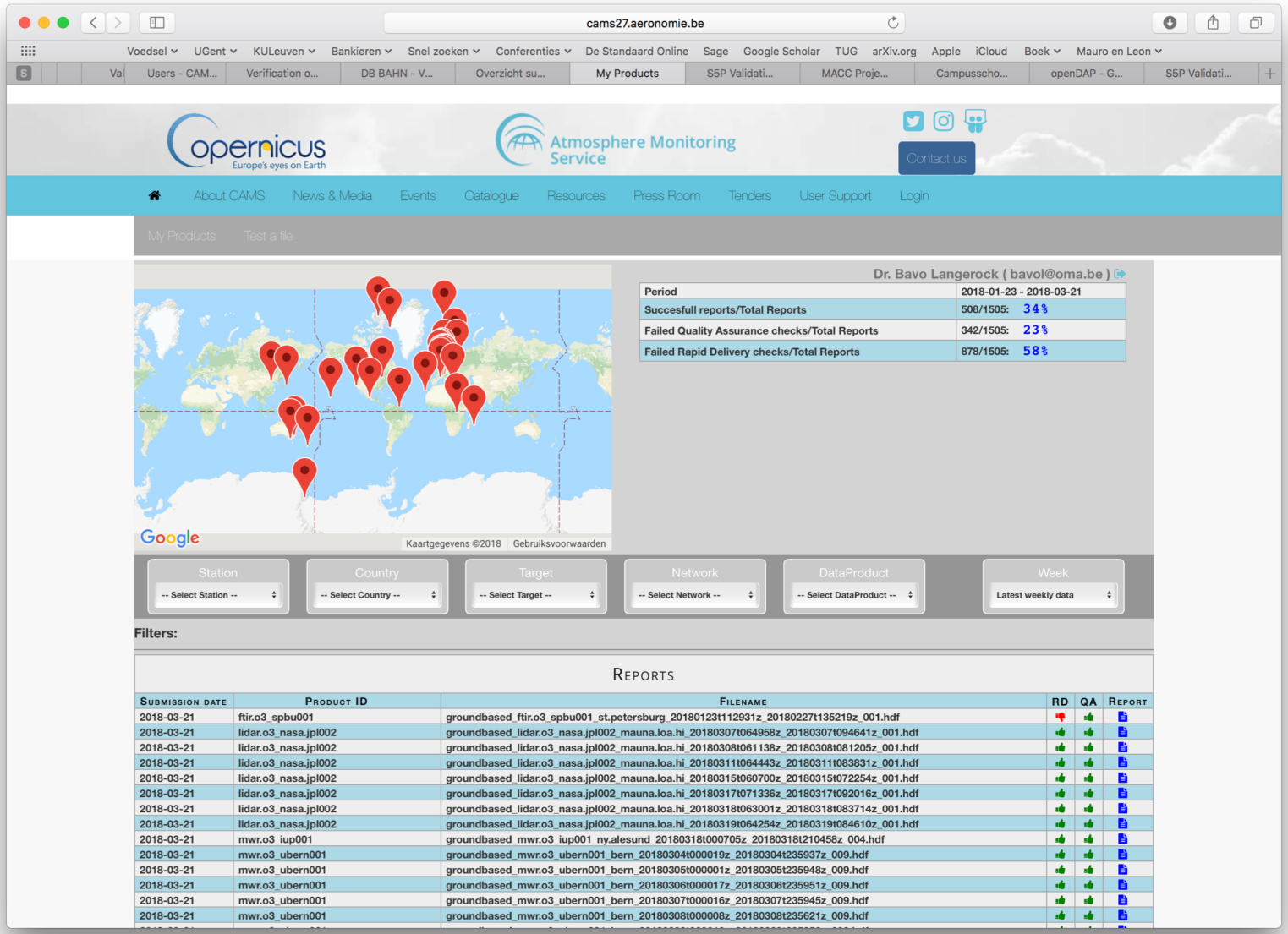


http://tropomi.eu => http://s5p-mpc-vdaf.aeronomie.be

S5P MPC Validation Website



S5P MPC Validation Website



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 !