S5P formaldehyde product: version status and first comparisons with OMI QA4ECV product









Mattia Pedergnana, Zhibin Cheng, Walter Zimmer, Klaus-Peter Heue, Lok Chan, Diego Loyola.







Second S5p Products Release Workshop (teleconference) - Friday Sep. 28

HCHO Product Status

Processor Version	In operation from			
01.01.00	NRT: orbit 02955	Initial Version		
	OFFL: orbit 03202			
01.01.01	NRT: orbit 03947, 18/07/2018	Implementation of the HCHO algorithm updates during		
	OFFL: orbit 03848, 11/07/2018	phase E1: fitting interval 328.5-359, updated background correction (see the ATBD [RD02]).		
		Solving issue of no correctly application of the scan angle correction in CLOUD (it does affects HCHO quality)		
01.01.02	NRT: orbit 04243, 08/08/2018	Solving issue in computing the correct delta_time (it		
	OFFL: orbit 04158, 02/08/2018	does affects HCHO quality)		
	RPRO: orbit 02818-04147, 30/04/2018-01/08/2018			

- OFFL and RPRO processors should be exactly the same.
- Cannot be tested since there is no overlap orbit (for HCHO).
- But differences are found by looking in the attributes of PRODUCT/INPUT_DATA/PROCESSOR

Two important differences between OFFL and RPRO processor settings:

- <u>Background correction: https://dev.knmi.nl/issues/11641</u>
 - The selection of the days is not the same, and is better set in the OFFL product.
 - For example, different days are used for the background correction of the data of 30 July 2018:
 - RPRO: /mnt/data1/storage_offl_l2/pp_bghcho_repro/S5P_OFFL_AUX_BGHCHO_20180719T105129 _20180725T131825_20180917T055444.nc (10 days, no overlap!)
 - OFFL:

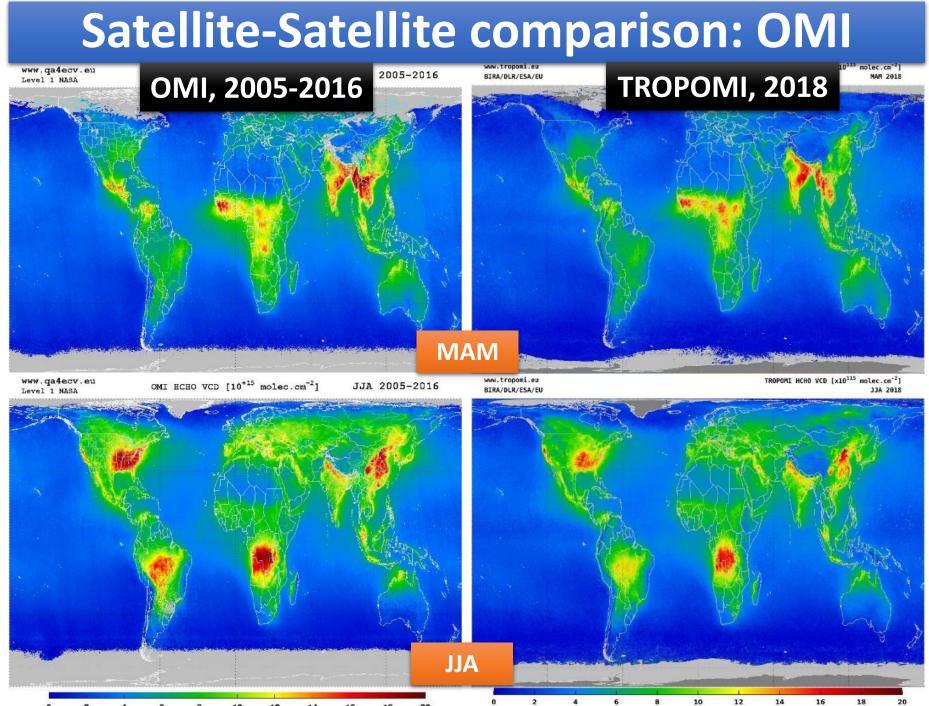
/mnt/data1/storage_offl_l2/pp_bghcho/S5P_OFFL_AUX_BGHCHO_20180726T120056_20180 730T215157_20180806T000003.nc (5 days, overlap, ok)

- <u>A priori profiles: https://dev.knmi.nl/issues/11701</u>
 - The more recent TM5 profile is used, instead of the closest to the sensing day.
 - RPRO: up to 15 days past the sensing time.
 - OFFL: aux-data coverage expected 5 days after the sensing time.

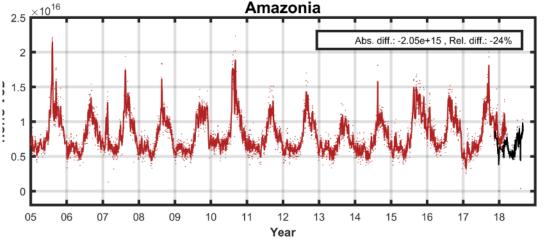
Side remark: very few CTMFCT and CTMANA files are provided on the HUB.

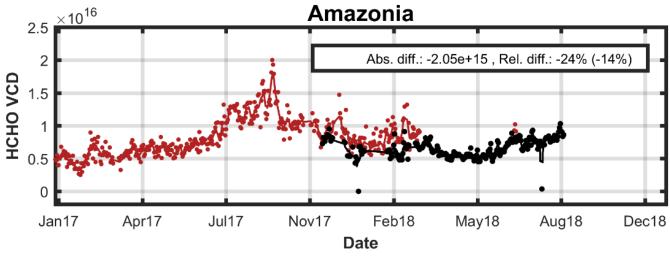
Other issues:

- <u>Background correction in RPRO: https://dev.knmi.nl/issues/11611</u>
 - The 10 first days are to be discarded because the processing starts by using an irradiance as reference on the 30 April, and it takes about 10 days for the resulting offset to be absorbed by the background correction.
- <u>Tropopause level: https://dev.knmi.nl/issues/11741</u>
 - For the products SO₂ and HCHO, it would be very useful for validators to have the vertical level where the tropopause starts indicated. In the NO2 product, this is called tm5_tropopause_layer_index. Will be included in the next product update.
- <u>Surface albedo climatology</u>
 - The current surface albedo climatology has a spatial resolution of 0.5° x 0.5°, and a time resolution of 1 month. This resolution is known to be too coarse compared to the much higher spatial resolution of S5P TROPOMI pixels.

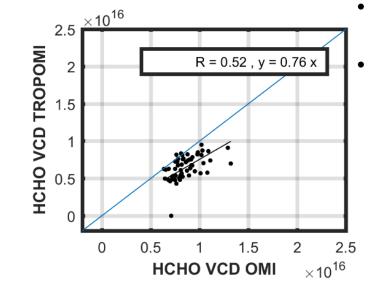


Amazon region: VCD



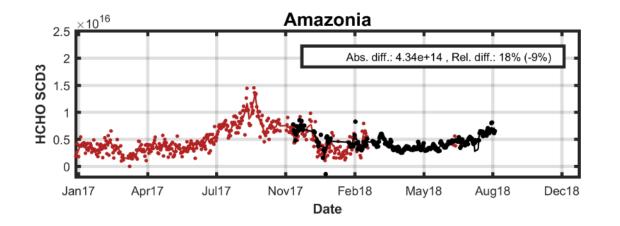


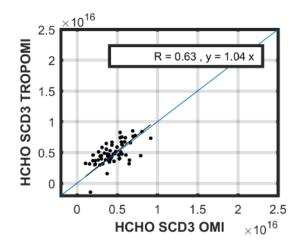
OMI / TROPOMI differences of about 20%



- -24% only considering common days
- -14% when comparing to an OMI climatology

Amazon region: bc-SCD

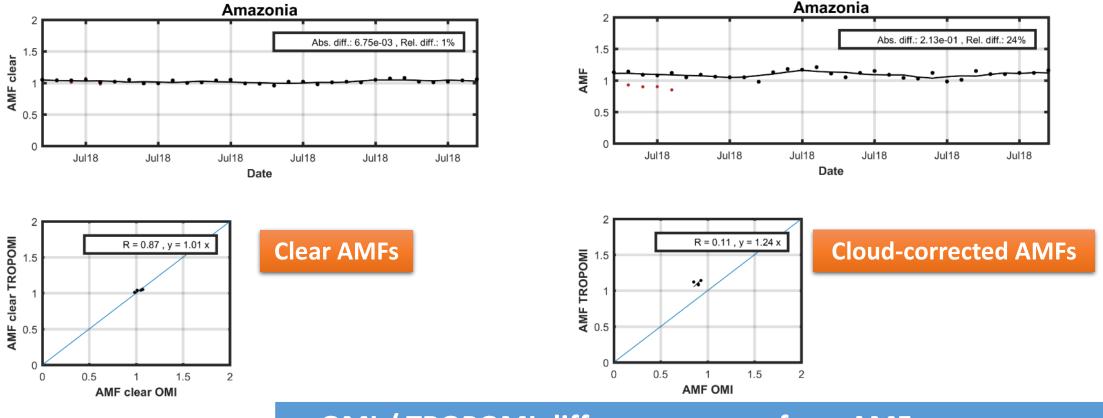




OMI / TROPOMI differences do not come from slant columns

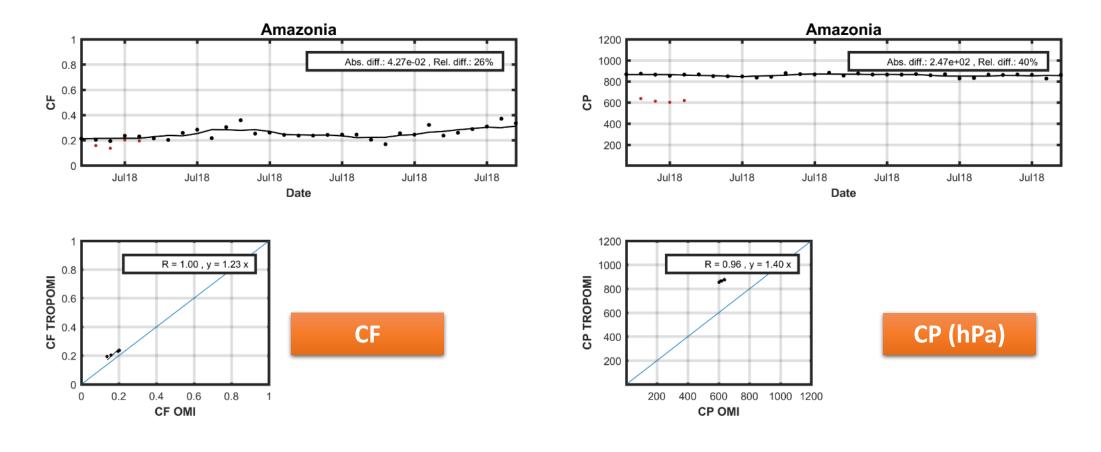
Amazon region: AMF

- 4 days of TM5 profiles (CTMFCT) to calculate OMI AMFs in July 2018
- TROPOMI: RPRO v01.01.02



OMI / TROPOMI differences come from AMF
Clear AMF are consistent => not an a priori profile effect
=> clouds?

Amazon region: AMF



• TROPOMI ROCINN cloud pressures are higher than OMI O₄ product of about 250 hPa (lower clouds in altitude).

Conclusions

- Number of identified issues to be fixed.
- OFFL: The PDGS-Level Production Rules to be corrected.
- RPRO: Reprocessing is needed.
- OMI validation:
 - Good agreement of background-corrected SCDs and of clear AMFs.
 - Systematic differences in cloud-corrected AMFs, leading to TROPOMI HCHO columns lower than OMI columns.





HCHO retrieval algorithm: DOAS

Slant columns: SCD			Current implementation	
Fit1: 328.5-359 nm	Air Mass Factors: Al		Proposed updates	
Fit2: 328.5-346 nm (BrO prefitted)	Altitude resolved AMF	Background correction: SCD ₀ , VCD ₀ Error estimates, AK,		
Mean radiance as I ₀ reference (averaged in the Pacific region) Adjusted ISFR using	TM5-mp profiles: daily forecast, 1°x1° S5P cloud product	Up to 1 we columns in region Global sour	the Pacific	QF $VCD = \frac{SCD - SCD_0}{AMF} + VCD_0$
TROPOMI solar irradiance	OMI albedo database	Global source of CH ₄ oxidation from CTM		AMF $VCD_0 = \frac{AMF_0}{AMF} VCD_{CH4}^{CTM}$

Algorithm Theoretical Baseline for formaldehyde retrievals from S5P TROPOMI and from the QA4ECV project

Isabelle De Smedt, Nicolas Theys, Huan Yu, Thomas Danckaert, Christophe Lerot, Steven Compernolle, Michel Van Roozendael, Andreas Richter, Andreas Hilboll, Enno Peters, Mattia Pedergnana, Diego Loyola, Steffen Beirle, Thomas Wagner, Henk Eskes, Jos van Geffen, Klaas Folkert Boersma, and Pepijn Veefkind AMT 2018, Special Issue: TROPOMI on Sentinel-5 Precursor: data products and algorithms