S5P HCHO Product Verification Using the IUP-UB Verification Algorithm

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S5P V1.1 HCHO Slant Columns are in good shape*

*but perfect they are not





- Some self-consistency checks of S5P HCHO products
- Comparison of S5P OFFL HCHO slant columns with IUP-UB S5P results
- Comparison of S5P OFFL HCHO vertical columns with IUP-UB S5P results







Details of Verification (read later)

- IUP-UB HCHO fitting for S5P:
 - 323.5 361 nm
 - NO₂, 2xO₃, 2xO₃ Pukite, O₄, BrO, HCHO, Ring, linear offset
 - Linearised DOAS fit, polynomial degree 5
- Daily Pacific radiance background
- Reference sector correction
- Adding of model SC over reference region
- OMI LER
- AMF based on daily TM4-ECPL model run for 2017 (!)
- No cloud correction, just screening





HCHO coverage

S5P NRTI formaldehyde number of values 09.08.18 - 08.09.18



- HCHO OFFL data have
 systematic gaps over the Pacific
- HCHO NRTI have less gaps
- IUP-UB product based on OFFL Iv1 data has even more data









HCHO QA-value



- QA value should be low over snow and ice but is high over Greenland
- Not all clear cloud patterns appear to be flagged by low QA value
- There is a funny pattern of QA values getting good again at SZA > 75°





HCHO cloud top dependence



- There is a clear dependence of HCHO tropospheric vertical columns on cloud top pressure
- The effect is much reduced but not removed if only data with QA > 0.75 are used
- The remaining effect appears to come from the SC as it shows a similar pattern as the quality assured VC





- Variable time_utc is empty
- Attribute time_coverage_start is missing 'Z' at the end
- Attribute time_coverage_end is missing 'Z' at the end
- Attribute time_reference is missing 'Z' at the end
- Values of attributes should be homogenized between products:

```
processing_status = Nominal
product_version = 1.1
references = https://atmos.eoc.dlr.de/tropomi
title = TROPOMI/S5P Tropospheric Formaldehyde HCHO
```

```
processing_status = OFFL-processing nominal product
product_version = 1.0.0
references = http://www.tropomi.eu/data-products/nitrogen-dioxide
title = TROPOMI/S5P NO2 1-Orbit L2 Swath 7x3.5km
```

NO2

HCHO





Comparison to IUP-UB: SC



- Overall good agreement in pattern
- OFFL S5P HCHO SC is larger in USA, South America, Africa, Asia, Siberia and smaller in Europe
- More negative values in IUP-UB product





Comparison to IUP-UB: VC



- Overall good agreement in pattern
- Higher background values in IUP-UB product
- Higher values in Canada, US, Siberia
 => difference in data selection includes more high HCHO events





Summary & Conclusions

- S5P HCHO product looks reasonable
- QA values do not appear to be doing what one would expect
- Some small things in the files need to be fixed
- Comparison with IUP-UB SCs shows qualitatively good agreement
- Comparison with IUP-UB VCs shows qualitatively good agreement, some marked differences which can in part be understood from data selection

Only small things need to be fixed prior to release of HCHO product





