One year of S5p/TROPOMI glyoxal retrievals


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Abstract

The TROPOspheric Monitoring Instrument (TROPOMI) has been launched on October 13, 2017, aboard the polar orbiting platform Sentinel-5 Precursor (S5p). TROPOMI measures the Earth’s radiance in the ultraviolet, visible, near and short-wave infrared spectral ranges with an unprecedented spatial resolution of 7x3.5km², providing important information on natural and anthropogenic emissions of trace gases and aerosols. Glyoxal tropospheric columns can be retrieved from TROPOMI measurements in the visible spectral range. Such retrievals remain challenging owing to the low glyoxal optical depths but offer the potential to provide additional quantitative information on VOC emissions.

The BIRA-IASB glyoxal algorithm, successfully applied in the past to GOME-2/A and OMI, has been transferred to TROPOMI and we present here results of its application to one year of measurements. As part of the Sentinel-5 level-2 prototype processor development, we revisit the impact of uncertainties on water vapor absorption, a major interfering species for glyoxal retrieval. Verification activities involving the independent scientific algorithm developed at University of Bremen are finally presented using both synthetic and real S5p spectra.

Baseline DOAS Retrieval algorithm

1. DOAS Fit

- Illustration of fitted S5p glyoxal optical depth and associated residuals

2. AMF

- Box-AMFs calculated with VLIDORT at 448 nm
- A priori glyoxal profiles:
  - CTM IMAGES V3 over lands.
  - Fixed TORERO airborne MAX-DOAS profile over oceans (Volkamer et al., AMT, 2015).
- No cloud correction – stringent cloud filtering (CF<20%)

3. Background/destriping procedure

- Constant value added to all SCIs (N0) to ensure a mean glyoxal VCD in the Pacific sector of 1x10^16 molec/cm² (N0(avg))
- Normalization values determined separately for each row to reduce possible stripes.

Impact of water vapor cross-sections

- Uncertainties on the water vapor cross-sections impact significantly the glyoxal retrievals.
- Tests of various H2O cross-sections (and temperature/pressure effect) based on TROPOMI data and MAX-DOAS observations at Jungfraujoch.
- Optimal cross-section selected based on fit RMS and level of correlation between glyoxal and water vapor slant columns.
- Optimal cross-section based on HITRAN 2012. Reference temperature is important (273K is used).
- This choice impacts the glyoxal retrievals in equatorial regions (large water vapor content), but also in other regions (side effect of the background correction).

Scientific verification of glyoxal algorithms

- Performance of two different glyoxal algorithms have been compared: the prototype algorithm (PA) developed at BIRA-IASB and the verification algorithm (VA) developed at IUP-Bremen.
- They have been applied to a series of synthetic spectra for 18 scenarios, generated including RSS (Ring) features or not.
- Both algorithms offer good performance. For scenarios without Ring, VA columns agree better with true values, while PA is closer to the truth when Ring is included.
- Comparisons of the retrievals based on two days of S5p data has been initiated. Spatial patterns are generally consistent.
- Levels of noise are high as expected. It is slightly lower for the VA in synthetic data analyses, while the scatter is a bit smaller in the PA S5p retrievals.

TROPOMI Glyoxal tropospheric columns and comparisons with OMI

TROPOMI/S5p mean CHOCHO total columns (molec/cm²)

11/2017-10/2018

TROPOMI OMI (2005-2017)

2018 Northern America Wildfires

TROPOMI August 2018

Mean OMI August 2005-2017