Development of a harmonised multi sensor retrieval scheme for HCHO within the Quality Assurance For Essential Climate Variables project: QA4ECV.

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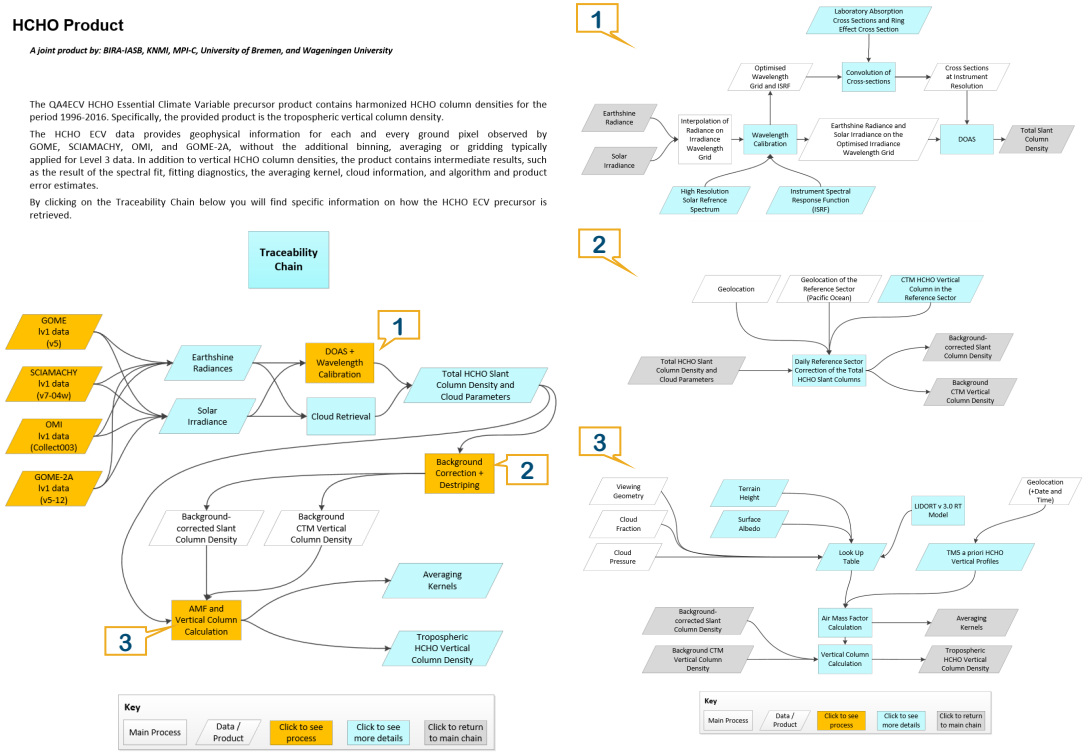
One of the main goals of the **QA4ECV** project is to define **community best-practices** for the generation of multi-decadal ECV data records from satellite instruments. QA4ECV develop retrieval algorithms for the **Land ECVs** surface albedo, leaf area index (LAI), and fraction of active photosynthetic radiation (FAPAR), as well as for the **Atmosphere ECVs** ozone and aerosol precursors nitrogen dioxide (NO_2), formaldehyde (HCHO), and carbon monoxide (CO).

Here we assess best practices and provide recommendations for the retrieval of **HCHO**. Those are established based on (1) a detailed intercomparison exercise between the QA4ECV partner's for each specific algorithm processing steps, (2) the feasibility of implementation, and (3) the requirement to generate consistent multi-sensor multi-decadal data records.

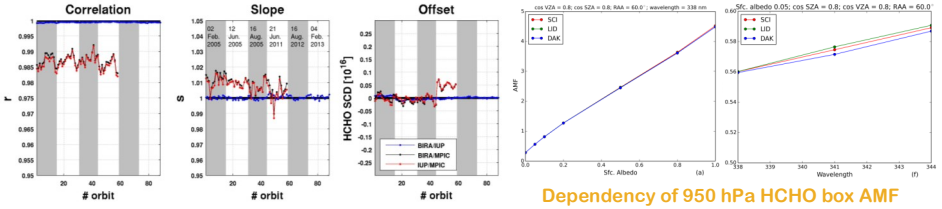
Traceability Chain for HCHO: http://www.qa4ecv.eu



All references and details are provided QA4ECV deliverables (http://www.qa4ecv.eu/node/9):

- D4.2 : Recommendations on best practices for retrievals for Land and Atmosphere ECVs.
- D4.4: Harmonised. Sensor independent retrievals (software) for HCHO and NO2. Report on MOPITT-IASI CO total column consistency.

⇒ Demonstrate consistent retrieval codes



Comparison of HCHO SCD results (after background correction) using harmonized fit settings.
3 DOAS codes: QDOAS, NLIN and MPIC.

Dependency of 950 hPa HCHO box AMF to surface albedo and wavelength.
Comparison between 3 RTM codes: SCIATRAN, LIDORT and DAK.

⇒ Apply consistent retrieval settings to multiple sensors

Fit window	328.5-346 nm (GOME, SCIAMACHY, GOME-2, OMI) 328.5-359 nm (*GOME,* GOME-2, OMI) *328.5-346 nm with BrO prefit (optional for GOME, GOME-2, OMI)*
Reference spectra	HCHO, O3 223K and 243K, BrO, NO2, O2-O2, Ring, NL O3 terms.
Background spectrum	Daily earthshine radiances in the Equatorial Pacific ([-5°, 5°], [180° 200°]) per LoS (GOME, SCIAMACHY, GOME-2) / per row (OMI).

⇒ Optimise the consistency of NO_2 and HCHO Data Records

Forward model parameter	GOME, SCIAMACHY, GOME-2	OMI
Terrain albedo	SCIAMACHY, GOME-2 climatology [Tilstra et al., 2016]	OMI 5-yr climatology [Kleipool et al., 2008]
Terrain height	GTOPO30 terrain height	GMTED terrain height [Danielson and Gesch, 2011]
Cloud fraction/pressure	FRESCO+ v7 [Wang et al., 2008]	O_2-O_2 cloud retrieval v2 [Veefkind et al., 2016]
HCHO and NO_2 profile	TM5-MP 1° × 1 interpolated to pixel center [Williams et al., 2016]	

More information on satellite HCHO retrievals: De Smedt et al.: Diurnal, seasonal and long-term variations of global formaldehyde columns inferred from combined OMI and GOME-2 observations, Atmos. Chem. Phys., 15(8), 12241–12300, doi:10.5194/acpd-15-12241-2015, 2015.

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