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Operational aerosol products for Sentinel-5 Precursor: Aerosol Layer Height and UV Aerosol Index

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Aerosol Layer Height (ALH)

New aerosol product that intends to provide the height of optically thick aerosol layers in the free troposphere (e.g. desert dust, volcanic ash).

Spectral fit of reflectance in the oxygen A band at 760 nm.



First evaluation of the ALH algorithm with observations from GOME-2A

We are developing an aerosol height retrieval algorithm based on absorption of incoming sunlight in the O₂ A band. The algorithm setup has been applied to observations from GOME-2A in a number of case studies.

1. Retrieval setup

· Fit of reflectance between 758 nm and 770 nm.



- · Profile parameterization: single layer with fixed pressure thickness.
- Generic aerosol model: HG phase function with *q*-parameter 0.7 and SSA 0.95
- Oxygen spectroscopy: three isotopologues, LM and CIA included, scale Xsec by 1.03 (Butz et al. 2013; Crisp et al. 2012)

· Fit parameters: P_{mid} - τ (760 nm) - $A_s(\lambda)$?

2. Should the surface albedo be a fit parameter?



The uncertainty in external surface albedo information has to be smaller than about 10⁻³ to constrain retrieval solution.



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...but correlations between errors in fit parameters are high (typically above 0.9).

Precision errors are small, but retrieval will be sensitive to the many systematic errors in real data.

3. GOME-2A retrievals

- Sixteen three-minute orbit granules: various aerosol types, land and sea.
- Cloud-free pixels selected using an AVHRR cloud mask.

Two example scenes (non-convergent retrievals in white)

Fix surface albedo in retrieval, take albedo from meris-bsa climatology (Popp et al. 2011)



Retrieval for 56% of all pixels converged. Retrieved aerosol pressures show realistic values.

Fit the surface albedo



Convergence improves substantially (retrieval for 94% of all pixels converges).

But retrieved aerosol pressures often get unrealistically low (layer high in atm.).

(1) Currently, the operational baseline for the S5P ALH product Conclusion will not fit the surface albedo. Then the retrieved layer height parameter is probably most meaningful as an average particle height. (2) Single-layer profile parameterization particularly suited for elevated aerosol layers.

UV Aerosol Index (UVAI)

Index calculated from reflectances in the ultraviolet wavelength range that provides information about the presence of elevated absorbing aerosols.

UVAI will be provided for the heritage wavelength pairs 340/380 nm (TOMS, GOME, SCIAMACHY) and 354/388 nm (OMI).



Global UVAI map from SCIAMACHY

Smoke and Dust weak events





5. GOME-2A retrievals: Comparison with lidar observations

Two examples:



6. Effect of two scattering layers

Target aerosol layer at 650 hPa and τ 0.3.

Presence of two elevated layers



Retrieval simulation

Retrieved aerosol height may be interpreted as an average particle height.

Presence of elevated and boundary layer



Retrieval simulation

When the surface albedo is fitted, large biases in retrieved elevated layer height.