Geophysical Research Abstracts
Vol. 17, EGU2015-7137, 2015
EGU General Assembly 2015

Tomographic retrieval for scattered light limb measurements: multiple spectral fit windows to improve the spatial resolution

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The Scanning Imaging Absorption spectroMeter for Atmospheric CHartographY (SCIAMACHY) on the ENVISAT satellite probed the atmosphere at the day side of Earth in alternating sequences of nadir and limb measurements from August 2002 to April 2012.

Limb measurements allow the retrieval of stratospheric profiles of various trace gases on a global scale. It has been shown that combining measurements of the same air volume from different viewing positions along the orbit, 2D distribution fields of stratospheric trace gases can be acquired in one inversion step.

Since the atmospheric scattering and absorption processes are wavelength dependent, the spatial sensitivity for limb observations also varies with wavelength. In general, for longer wavelengths, photons from more remote areas along the line of sight are contributing stronger to the measurement than for shorter wavelengths because of the lower probability of Rayleigh scattering. In addition, the radiative transfer is modified by the ozone absorption structures making longer light paths less probable within strong ozone absorption bands.

In this study, additional information on the spatial distribution of NO_2 is investigated by analysing results obtained by Differential Optical Absorption Spectroscopy (DOAS) in various spectral fit windows. Combing the fit results in one profile retrieval algorithm helps to improve the spatial sensitivity and resolution of the measurements.

The largest improvements for the spatial resolution and sensitivity are expected for the upper troposphere/ lower stratosphere (UTLS) region where the variation of the spatial sensitivity with wavelength is strongest.