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3D limb tomographic retrieval: accounting for horizontal gradient effect across track caused by scattered sunlight

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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 2002 to April 2012.
Limb measurements allow retrieving 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. However, measurements in the UV/VIS spectral range are also influenced by any region traversed by photons before they are scattered into the line of sight. The distribution of the additional sensitivity across track is mostly determined by the solar zenith and solar azimuth angles, i.e. it is largest for large solar zenith angles and the Sun sideward the flight direction (relative solar azimuth angles close to 90°). Therefore a consideration of the horizontal gradient across track in the retrieval might be important.
For the near polar orbital geometry of SCIAMACHY with equator crossing time of 10:00 LT (descending node), the horizontal gradient effect across track is expected to be largest at polar regions and may influence retrieval of trace gases with large gradients at these regions (e.g. OClO, NO_2, BrO).
In this study we quantify the horizontal gradient effect across the satellite track for SCIAMACHY limb measurements and propose a 3D tomographic algorithm to correct for this effect by resolving and combining SCIAMACHY measurements across track in one inversion.