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Interactive comment on "Spatial and temporal characterization of SCIAMACHY limb pointing errors during the first three yearsof the mission" *by* C. von Savigny et al.

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General comments

The paper of Von Savigny et al. aims at a detailed description of the pointing errors involved in limb observations from the SCIAMACHY instrument on-board Envisat. The paper is purposed to be included in the special issue of Atmospheric Chemistry and Physics on SCIAMACHY calibration, validation and first results. Pointing inaccuracies are among the main error sources when retrieving atmospheric trace gas concentrations from satellite limb observations. Therefore, a discussion on the spatial and tem-

poral characteristics of these errors form a valuable contribution to the afore-mentioned ACP special issue.

The authors of the Von Savigny et al. paper manage to discuss the main characteristics of the SCIAMACHY limb pointing errors in a clear and direct way. The paper is well-structured and provides the ingredients that a scientist needs to deal with pointing errors when doing trace gas limb retrievals. Although focused on SCIAMACHY, the subject of temporal and spatial pointing uncertainties is to be addressed when doing trace gas retrievals with any limb-viewing instrument. Users of data from future limb instrument missions may therefore profit from this discussion. Furthermore, intercomparison of pointing characteristics and statistics among current limb instruments (SCIAMACHY, OSIRIS, SOLSE/LORE, SAGE III) my provide insight in the quality of retrievals with a specific instruments and the physical background of its pointing inaccuracies.

In order to study the errors in the tangent height values provided in the SCIAMACHY data (the engineering tangent heights), the authors apply an independent method to accurately retrieve tangent height (TH) values directly from SCIAMACHY limb radiance measurements. This so called knee-method uses the maximum (the 'knee') in limb radiance profiles in the UV, due to ozone absorption. The authors use an optical-estimation scheme to fit simulated radiance profiles to the observed ones in order to derive tangent-height values. This is done simultaneously for multiple wavelength values in the UV-B spectral range. The method assumes a well known ozone profile. Therefore, the method is only applied to measurements within the -20 to +20 geographical latitude range, for which the horizontal variation in ozone concentration is relatively small.

As an indicator for the errors involved in the satellite pointing, the so-called tangent height offset is introduced. This quantity is defined as the tangent height value provided by the SCIAMACHY data (the engineering tangent height value) minus the TH value retrieved from SCIAMACHY limb radiance measurements. For each Envisat orbit an

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average TH offset value is determined.

What follows in the paper is a study of the tangent height offset. The analyses is done for all available orbits within the first three years of SCIAMACHY observations. A parameterization is fitted to the temporal evolution of the monthly mean TH offset values, to account for the seasonal variation in the TH offset. The fitted function is composed of a sinusoidal term, a linear trend and a constant offset, leading to convincing results for the temporal behavior of the mean TH offset values. Clearly visible are the reduction of the sinusoidal amplitude and the enhanced value of the constant fitting term after the December 2003 correction of the orbit model. This provides valuable information for scientist doing trace gas retrievals from SCIAMACHY limb measurements.

At the same time, the study of the TH offset evolution remains somewhat phenomenological. Although informed about the behavior of the TH offset, the reader remains wanting to get a feeling about the physical origin of the TH offset patterns. In particular, the authors should elaborate more on the background of the remaining seasonal variation and constant offset after the December 2003 orbit model improvement. It remains unclear whether these quantities are due to remaining errors in the orbit propagator model or that uncertainties intrinsic to the TH retrieval method may be involved. For example, the authors rightfully refer to Kaiser 2004 for a detailed discussion on the error budget in the retrieval method. That paper clarifies that the main error source in the TH retrieval comes from the uncertainty in the assumed stratospheric ozone profile. It would therefore be interesting to see some discussion on the ozone profile error with respect to the remaining TH offset in the post-2003 SCIAMACHY data.

A discussion of such a kind is indeed present when the authors talk about the longitudinal variation of the TH offsets (section 3.4). This section is convincing and clearly shows instrumental effects in the TH offset as function of geographical longitude.

Section 4 shows the improvements that can be made in the retrieval of vertical ozone profiles with help of the derived TH offsets. This is done by comparing TH corrected

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and uncorrected retrieved ozone profiles from SCIAMACHY limb data with an ozone profile obtained from LIDAR measurements. The authors show clearly that the application of a TH offset correction improves the accuracy of the ozone profile.

In summary: the paper very well describes the characteristics off pointing offsets in SCIAMACHY limb data and the results are generally convincing. It is mentioned that the error due to pointing uncertainties in the retrieval of ozone profiles can be limited to 5% if the tangent heights are known within a 250 m precision. In that respect, good knowledge is required of the error budget of both engineering and retrieved TH values. The paper needs to elaborate more on the physical nature of the observed TH offset characteristics. Also, some more attention should be payed to the uncertainties involved in the applied TH retrieval method.

Specific comments

Page 3703, line 25: It is stated that larger inaccuracies in the retrieved ozone profile in the mesosphere are due to the small scale height in the vertical ozone number density profile, as compared to the stratospheric scale height. However, when expressed as number density (molecules / cubic cm), the mesospheric ozone gradient with altitude is often small. The authors may have meant to express the large gradient in sensitivity of (measured and simulated) radiance to the ozone concentration in the mesosphere in the considered UV-B wavelength range.

Page 3710, line 22 Please mention briefly the possible influence on the profile agreement of the 12:05 hour time difference between the SCIAMACHY and LIDAR measurements.

Technical corrections

Page 3708, line 9 Typo: an period –> a period

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 3701, 2005.