

## ***Interactive comment on “Surface pressure retrieval from SCIAMACHY measurements in the O<sub>2</sub> A Band: validation of the measurements and sensitivity on aerosols” by B. van Diedenhoven et al.***

**B. van Diedenhoven et al.**

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First, we thank the referee for the helpful comments. Here, we reply to all comments addressed.

### **Reply to "Specific comments"**

1.- The referee suggested that the conclusions based on the case-study data should be verified with additional data. Therefore, in addition to the case study

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dataset, an extended dataset including the SCIAMACHY and GOME measurements from four orbits from August 2002 and January 2003 around Northern and Southern Europe and Africa will be analysed. This extended dataset includes a wide range of geometries and atmospheric conditions. As suggested, a table will be added to the paper giving the mean  $\Delta P$  retrieved from this extended dataset within several surface albedo bins and the standard deviation. This additional analysis confirms the conclusions made from the case study already presented in the paper.

2- The referee asked for a conclusion regarding the accuracy of the surface pressure retrieval and the validation from meteorological data. The surface pressures derived from the meteorological data are expected to have a precision in the order of a few hPa.

The error on the retrievals due to instruments measurement noise is negligible. Thus, the accuracy of this method is determined by the impact of the aerosols on the radiative transfer, as discussed in the paper. We will further comment on this in the next paragraph.

3- More comments on the uncertainties up to 20–30 hPa seen in the retrieved surface pressures at high surface albedos are requested. These differences between retrieved and reference pressures are expected to be mainly due to the presence and variability of aerosols. In the revised paper, we will show that a variation in aerosol optical thickness combined with the variation in viewing geometry results in an expected uncertainty of  $\sim 30$  hPa. For this, the study using synthetic measurements as presented in Fig. 2 will be extended with a discussion on the dependence of solar/viewing geometry, as suggested by referee 2. Furthermore, the overestimation of the surface pressure increases when aerosol particles decrease in size. We will add this statement as well. We agree with the referee that the high spectral resolution of SCIAMACHY does not improve the retrieval of true surface pressures compared to broadband spectrometers such as MERIS. However, Figs. 3 and 11 indicate

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information about aerosols can be retrieved from these high spectral resolution measurements, as we have stated. Moreover, Fig. 11 also indicates that the observed residuals mainly are due to the neglect of aerosols.

On top of this residual, systematic high frequency structures are seen, as mentioned by the referee. These structures are present at all wavelengths with significant Oxygen absorption needed for the surface pressure retrievals, hampering the suggested selection of wavelengths. Moreover, changing the selection of wavelengths will change the sensitivity of the retrievals on aerosols. Please note that selecting the wavelengths where the residuals in Fig 11. are lowest will not necessarily result in lower values in  $\Delta P$ . The high frequency structures do not influence the surface pressure retrievals significantly, because the residuals are dominated by the residuals due to the neglect of aerosols.

As suggested, we will calculate the cross-sections using the HITRAN2004 data in the revised version of the paper. Additionally an increased spectral resolution of the forward model is used. The difference with the retrieved surface pressures as shown in the current version of the paper are below 5 hPa. Furthermore, the high frequency structures in the residuals are only slightly changed.

### Reply to "Additional comments"

- We will include the single scattering albedo of the aerosols in Table 1.
- The SRON radiative transfer code uses Gauss-Seidel iteration to solve the plane-parallel radiative transfer equation. We will add this statement. This code includes full coupling of absorption and scattering.
- The cross-sections are sampled at 0.02 nm resolution. Because the HITRAN2004 data includes many extra spectrally narrow lines, in the revised paper we will use a 0.005 nm sampling. We will add the word 'sampled'.

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- We will include the scale height of Rayleigh scattering.

- The cloud filter is tuned using cloud retrievals from MODIS. For our case-study, comparisons with MODIS cloud retrievals show the used cloud filter is working well. However, the minimal optical thickness for cloud detection is difficult to estimate. For more details we refer to the reference Krijger et al. We agree that thin cirrus clouds have an influence on the surface pressure retrievals. The outliers at high surface albedos seen in Fig. 9 are probably due to undetected clouds, as we have stated in the paper.

The suggested technical corrections are implemented.

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