**Atmospheric
Chemistry
and Physics
Discussions**

Interactive comment on **"Retrieval of global water
vapour columns from GOME-2 and first
applications in polar regions"** *by* S. Noël et al.

S. Noël et al.

Reply to referee 1

Answers to general comments:

We thank the referee very much for the overall positive judgement and will consider the comments in the revised version of the paper.

We agree with the referee that an investigation of potential East-West biases in the GOME-2 data due to calibration issues would be very useful to separate different effects of GOME and SCIAMACHY data. As far as we know such investigations are currently already ongoing on EUMETSAT side as scan angle dependencies have also been reported from other data users. However, from the position of a data user – and

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this is what we are – such an investigation is not possible because only fully calibrated GOME-2 data are provided to the end users. Therefore the effect of certain calibration steps (like scan angle corrections) will not be assessed by us.

Furthermore, as mentioned in the paper, the derived East-West variations are very small and below the assumed accuracy of the AMC-DOAS water vapour product. Therefore the AMC-DOAS water vapour retrieval – which is in general very insensitive to geometrical issues – is probably not the best method to assess scan angle dependencies of the GOME-2 data. On the other hand, the fact that such small variations between GOME-2 and SCIAMACHY can be observed shows the high precision of the AMC-DOAS products, and this is why we included the results in the paper.

Because of the small amplitude of the variations it is – from the retrieval side – very difficult to determine the reasons. Nevertheless, we will include a rough ranking of the possible sources in the revised version of the paper although a more quantitative assessment is currently not possible for the reasons mentioned above.

For this purpose the following paragraph will be added at the end of section 3:

Based on our current knowledge we think that most of the variation in the mean differences is caused by the calibration of the GOME-2 data. This is because a) the East-West asymmetry seen e.g. in the swath data (Fig. 1) appears to be larger than expected from the simulations (Fig. 5), and because b) the validation of SCIAMACHY AMC-DOAS water vapour data (see e.g. Noël et al., 2004) shows no systematic periodicity of deviations when comparing to independent data sets from the European Centre for Medium-Range Weather Forecasts (ECMWF) or the Special Sensor Microwave Imager (SSM/I), whereas Fig. 5 suggests that there should be a considerable effect also for the smaller SCIAMACHY swath range (approximately corresponding to ground pixels 7 to 18).

The scan angle dependency of the AMC-DOAS method may add some

additional variation, but because of the air mass correction this a second order effect.

Systematic local time differences between GOME-2 and SCIAMACHY are expected to play (on global average) a minor role. This is supported by the observation that smallest deviations do not occur at days of smallest time differences.

We will include a figure of the relative time differences between GOME-2 and SCIA-MACHY in the revised version of the paper to support the last statement.

We agree with the referee that comparisons with other water vapour products (including MetOp instruments) would give additional information on the quality of the GOME-2 water vapour data. Such inter-comparisons are surely required for a full validation of the GOME-2 water vapour product. However, such a complete validation is not the scope of the present paper. The main aim of this paper is to show the potential of GOME-2 as an additional source for water vapour information, especially in the polar regions. For this purpose we think a comparison with one validated product (in this case SCIAMACHY) is sufficient. However, we will include the need for further validation in the conclusions via the following paragraph:

For a full assessment of the quality of the GOME-2 AMC-DOAS water vapour product additional validation using other water vapour data products is required. Especially, comparisons with the results from other nadir viewing MetOp instruments (like the Advanced Microwave Sounding Units AMSU-A1 and AMSU-A2, the High-resolution Infrared Radiation Sounder HIRS/4, the Infrared Atmospheric Sounding Interferometer IASI, and the Microwave Humidity Sounder MHS) providing water vapour data at minimum temporal and spatial offsets will be very useful in this context.

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Answers to detailed comments:

1. *Line 17 pg 17540*
   replace "have a look at" with "see"

   Will be done in the revised version.

2. *Line 24 pg 17540*
   Please clarify the altitude range for which temperature increase in the Arctic is expected to be largest.

   We are talking about surface temperatures here (stratospheric trends may be different). To clarify this, we will add "surface" in the paper.

3. *Line 20 pg 17541*
   Replace "sun-fixed" with "sun-synchronous"

   Will be done in the revised version.

4. *Line 4 pg 17452*
   were any modifications to the AMC -DOAS algorithm required to accommodate the wider swath of GOME-2?

   No additional modifications were required to accommodate for the wider GOME-2 swath because this is (in first order) handled by the air mass correction. Second order effects are discussed in the context of Fig. 5.

5. *Line 14 pg 17544 Which version and configuration of SCIATRAN is used - pseudo-spherical?*

   We used SCIATRAN Version 2.2 in pseudo-spherical mode. This information will be added in the paper.

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6. *Lines 8 - 20 pg 17545*
   This hypothesis would explain the difference between GOME-2 and SCIAMACHY data however on pg 17544 there is an indication that there is an East-West asymmetry in GOME-2 data itself which may arise from the AMC-DOAS algorithm as discussed on pg 17544 or from calibration effects. An clear analysis of whether there is a systematic bias in the GOME-2 data itself, either from AMC-DOAS or calibration, would be useful as a starting point before assessing the hypothesis that the GOME-2/SCIA effects due to different temporal sampling.

   As mentioned above, we will add a discussion of possible sources for the differences. Temporal sampling effects are considered to be less probable (see above).

7. *Line 25 pg 17545*
   note that the frequency of GOME-2 narrow swath data has been reduced to once per month

   We will add this information in the revised version of the paper.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 17537, 2007.