

Interactive comment on “Diurnal variations of stratospheric ozone measured by ground-based microwave remote sensing at the Mauna Loa NDACC site: measurement validation and GEOSCCM model comparison” by A. Parrish et al.

Anonymous Referee #2

Received and published: 4 February 2014

The diurnal variation of ozone in the stratosphere and lower mesosphere is analyzed using data from a ground-based microwave radiometer operating at the Mauna Loa NDACC station since the 1990s. Presented are considerations concerning the internal quality of the measurements, a verification study of the quality of the observed diurnal variability in comparison with external data sets obtained from different satellite instruments, and model comparisons aiming at testing the modelled ozone diurnal variation in a chemistry-climate model.

C11866

The paper presents an interesting new (reanalyzed) data set and successfully addresses primarily technical and validation aspects, but provides no or only little new analysis of the causes of the ozone diurnal variation in the stratosphere. The manuscript would thus much better fit into ACP's sister journal "Atmospheric Measurement Techniques" (AMT, same special issue). Apart from this I have only few specific and technical comments which are listed below. The technical comments raised in my initial quick-review have already been addressed and the paper is now of good quality in all relevant categories.

I think this paper can be recommended for publication once the specific and technical comments given below have been addressed.

Specific comments:

Analyzing the magnitude of the diurnal variation of stratospheric and mesospheric ozone is nothing really new. In the introduction I would have expected to see a more comprehensive summary of previous work (historical and recent) on the subject. Whilst most of the early work focussed on the mesosphere, some of these studies contain also results for the mid to upper stratosphere and at different latitudes. In order to place the new work in an appropriate (historical) context, I suggest that the authors amend this part and refer the interested reader to relevant earlier work addressing ozone diurnal variation.

Results obtained in this study on the magnitude of the ozone diurnal variation in the stratosphere (Sections 3 and 4) should then also be compared with results from previous studies by different authors. What is consistent with earlier work and what is new in this study?

Finally, in an ACP paper one would also expect a bit more discussion of the reasons for the diurnal variation in the stratosphere (in Section 4, GEOSCCM model comparison).

Concerning the abstract, the observed magnitude and characteristics of the observed

C11867

diurnal variation should be described before validation and model comparison results are summarized.

Some references:

Wilson and Schwartz, Diurnal variation of mesospheric ozone using millimeter wave measurements, JGR 86, 7385-7388, 1981

Vaughn G., Diurnal variation of mesospheric ozone, Nature 296, 1982

Zommerfelds et al., Diurnal variations of mesospheric ozone obtained by ground-based microwave radiometry, JGR 94, 12819-12832, 1989

Ricaud et al., Diurnal and seasonal variations of stratomesospheric ozone: Analysis of ground-based microwave measurements in Bordeaux, France, JGR, 96, D10, 18617-18629, 1991

Connor et al. 1994, Ground-based observations of ozone in the upper stratosphere and mesosphere, JGR 99, 16,757-16,770, 1994

Schneider et al., Seasonal and diurnal ozone variations: Observations and modelling, J. Atmos. Chem., 50, 1, 25-47, 2005

Haefele et al. Diurnal changes in middle atmospheric H₂O and O₃: Observations in the Alpine region and climate models, J. Geophys. Res., 113, 2008

Studer et al., A climatology of the diurnal variations of stratospheric and mesospheric ozone over Bern, Switzerland, Atmos. Chem. Phys. Discuss, 13, 22445-22485, 2013

Technical comments:

31859

7 "Further refinement of ozone records will reduce the time required to make the detection ..." I would argue that it is even more important to continue monitoring of O₃. An extension of existing ozone data records will considerably lower the error of trend

C11868

estimates.

31859, 16-27 and 31875, 25-26

When it comes to correcting the effect of ozone diurnal variation in satellite ozone time-series, the caveat is that ground-based microwave observations have only a relatively rough vertical resolution and cannot be used to obtain the magnitude of the ozone diurnal variation at a given altitude. Therefore, validation of atmospheric models with potentially high vertical resolution is essential.

31868

9-11: Simplify / reformulate this sentence. Are you referring to MLS daytime and nighttime profiles?

13 Suggest to move "plotted in black" to the Figure caption

31869

13 "the" amplitude

31870

6 Reference JAXA 2012. Please check whether this is the correct reference. I couldn't find the information on hydrostatic pressure and temperature retrieval in the document. There are two recent validation studies on SMILES ozone products which might be more relevant?

Figures 1 and 7 could be slightly larger. Should have the same size as Figures 2,5,6.

The multi-panel Figures 4 and 8 should be enlarged.

Caption Fig 2: "described" -> "described"

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 31855, 2013.

C11869