

Interactive comment on “Re-analysis of ground-based microwave ClO measurements from Mauna Kea, 1992 to early 2012” by B. J. Connor et al.

Anonymous Referee #1

Received and published: 20 January 2013

Review of "Re-analysis of ground-based microwave ClO measurements from Mauna Kea, 1992 to early 2012", by B.J. Connor, T. Mooney, G.E. Nedoluha, J.W. Barrett, A. Parrish, J. Koda, and M.L. Santee, Atmos. Chem. Phys. Discuss., 12, 30571-30588, 2012.

General

The paper describes an improved analysis of the unique ClO data record obtained from ground-based microwave measurements at Mauna Kea (Hawaii) over the last 20 years. The presentation quality is good and the updated ClO trend is certainly worth publishing in ACP. I have however several specific remarks which I feel are important

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to be addressed before the manuscript can be recommended for publication.

Firstly, the obtained trend results for ClO should be put into better perspective and compared/discussed with respect to published results obtained by other authors. Secondly, the employed method for estimating the uncertainties of the ClO trend should be better described. Uncertainties of the ClO trend could be compared to uncertainties estimated from other studies. Lastly, the effect of the mesospheric diurnal cycle of ClO on the measurements and applied correction method (involving day-night differences) should be evaluated and discussed. See my specific remarks below.

Specific and technical

Introduction

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l3-4 "while upper stratospheric ClO shows little diurnal variation"

This statement is misleading as the ClO diurnal cycle increases with altitude in the mesosphere (but with ClO minimum during daytime). The ClO diurnal variation in the middle/upper stratosphere and lower mesosphere based on observations by the SMILES instrument on the International Space Station is shown in several recent publications. See e.g. Sato et al., Atmos. Meas. Tech., 5, 2809-2825, 2012, and Khosravi et al. Atmos. Chem. Phys. Discuss., 12, 21065-21104, 2012.

An up-looking ground-based measurement system would measure emissions from the entire atmosphere and would likely not be able to distinguish the different stratospheric and mesospheric diurnal cycles. It would be worthwhile to discuss the limitations of the here applied spectral ClO day-night correction method (aiming at improving the retrieval of mid-stratospheric ClO) arising from the mesospheric ClO emissions. What is the effect on the stratospheric ClO retrieval?

Section 3

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I15

Clear illustration of the instrumental issue (related to long-term stability). However, please indicate also if this is solely a problem of the 2009 to 2010 period, or whether there were other periods when the baseline has changed and affected the ClO retrieval. Fig 5 (upper plot) seems to indicate this (e.g. "jumps" in 2004-2005 and 2008). Are there other instrument effects which have been corrected? Please add some more information.

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I9 A more detailed discussion and comparison with results from other recently published observational studies is required, in particular as there are more recent estimates of the ClO trend than those from Solomon et al. 2006. For example, Jones et al., Atmos. Chem. Phys., 11, 5321-5333, 2011, derived zonal mean mid-stratospheric ClO and HCl trends based on satellite measurements which could easily be compared to the results of this study, if the ground-based ClO trends were also derived for the periods corresponding to the Jones et al. study (2001-2008 for ClO and 1997-2008 for HCl). Other results are summarised in WMO 2011. Are the results of the different trend studies consistent?

I10 The discussion of the method and in particular the assumptions made for estimating the uncertainties in the derived trend should be expanded. For example, uncertainties reported by Jones et al. are much larger than those reported from the ground-based measurements. An explanation why the ground-based instrument is more sensitive is needed. Or are the error estimations based on different assumptions? Also note in this context that here reported uncertainties are 1-sigma, whilst 2-sigma uncertainties (95% confidence) are often used in published trend studies.

I25 One could check whether the short-lived variation in mid-stratospheric ClO in 2003

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can also seen in other ClO data sets (e.g. Jones et al., 2011).

Section 4

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Please indicate which Aura and UARS MLS data versions are used.

I5 I suggest to show typical averaging kernels of the ground-based instrument and to discuss implications in the text. This is also relevant for my earlier remark whether competing stratospheric and mesospheric diurnal effects can be distinguished or not.

I18-19 "UARS and Aura ClO can be used as a single data set without correction": This could be misunderstood. For example, do these data sets have the same vertical resolution? Suggest to add an explanation why this should be the case and within which limits.

A discussion of the results obtained here versus the results published by Jones et al should be added. See my comment above.

Summary and conclusions

Conclusions and abstract should be updated after revisions, notably concerning uncertainty of trend and consistency with earlier studies.

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I20 suggest to remove "as shown ... text."

Figure 4:

Check pressure unit "mb" (1000mb at 50km?).

Table 2: Suggest to add more information, e.g. results for 1997-2008 and 2001-2008 period (for comparison with results of Jones et al., 2011). Both tables are very sparse and could possibly be combined to present information in a more comprehensive way.

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