

We would like to thank the reviewer for useful comments. In the following we answer the specific comments (included in “**boldface**” for clarity) and, whenever required, we describe the related changes implemented in the revised manuscript.

#### **Anonymous Referee #4**

**I think that this is a useful and important paper which is well suited to publication in ACP. There has been a lot of interest in atmospheric CCl<sub>4</sub> because of an apparent ‘budget gap’. An important sink term for CCl<sub>4</sub> is atmospheric loss and to evaluate our understanding of that process profile observations into the stratosphere are required. This paper presents such data from the MIPAS instrument which has the benefit of a lot of observations to average over.**

**I think that the paper can be published subject to my comments below.**

#### **Main points**

**1) Throughout the paper could benefit from a thorough proof-reading. There are some simple spelling errors that any spell checker should find. There are also some other sentences where the English is poor. The quality does vary through the paper (e.g. the abstract in particular had many typos). I have mentioned some below, but in addition the paper needs careful proof reading.**

Probably the reviewer refers to the initially submitted version of the paper. The version published in ACPD was carefully proof read and the language was also revised. We hope that the revised paper we are submitting to ACP is further improved.

**2) Stratospheric trends. A number of recent papers have shown that the trends in stratospheric trace gases are affected by variability in the stratospheric circulation. This has been shown for a number of halogen source gases and the complementary degradation products such as HCl and HF. This is bound to be playing a role in the stratospheric trends shown in Figure 11 and will be at least part of the explanation of why the trend does not simply follow the tropospheric trend (with a lag). I know there is mention in the Conclusions (page 26 line 5) but more should be added near Figure 11. It is a case of adding in some mention of past work. Examples to cite are:**

**Harrison, J.J., M.P. Chipperfield, C.D. Boone, S.S. Dhomse, P.F. Bernath, L. Froidevaux, J. Anderson and J.M. Russell, Satellite observations of stratospheric hydrogen fluoride and comparisons with SLIMCAT calculations, Atmos. Chem. Phys., 16, 10,501-10,519, doi:10.5194/acp-16-710501-2016, 2016.**

**Mahieu, E., M.P. Chipperfield, J. Notholt, T. Reddman, J. Anderson, P.F. Bernath, T. Blumenstock, M.T. Coffey, S. Dhomse, W. Feng, B. Franco, L. Froidevaux, D.W.T. Griffith, J. Hannigan, F. Hase, R. Hossaini, N.B. Jones, I. Morino, I. Murata, H. Nakajima, M. Palm, C. Paton-Walsh, J.M. Russell, M. Schneider, C. Servais, D. Smale and K.A. Walker, Recent northern hemisphere hydrogen chloride increase due to atmospheric circulation change, Nature, 515, 104-107, doi:10.1038/nature13857, 2014.**

**Ploeger, F., Riese, M., Haenel, F., Konopka, P., Müller, R., and Stiller, G.: Variability of stratospheric mean age of air and of the local effects of residual circulation and eddy mixing, J. Geophys. Res.-Atmos., 120, 716–733, doi:10.1002/2014JD022468, 2015.**

We thank the reviewer for the useful comment. We partially included the above sentences in Sect. 5.2: “Recently some studies (Harrison et al., 2016; Mahieu et al., 2014; Ploeger et al., 2015) have shown that the trends in stratospheric trace gases are affected by variability in the stratospheric circulation. This has been shown for a number of halogen source gases and the complementary degradation products (i.e. HCl and HF). This variability can partially explain why the stratospheric trend does not simply follow the tropospheric trend with a lag.” The references to the three suggested papers are now included in the revised paper.

**3) Figure 6 does not make sense to me. Normally the N-S IHG is presented based on an average over the two hemispheres. How is Figure 6 constructed? Is it the difference between corresponding latitudes (e.g. 80S minus 80N)? That does not make sense as the high latitudes get more and more distant from the other hemisphere so the scope for differences is much larger. There is also less mass at high latitudes so the differences are not so important in a budget sense. I think that this figure is flawed and should be removed.**

Figure 6 is constructed as a mean on seven years of the differences between CCl<sub>4</sub> VMR profiles in the Northern Hemisphere (NH) and Southern Hemisphere (SH) at corresponding latitudes. The large differences at high latitudes are due to the fact that the subsidence of air in the SH has a longer duration than in the NH. Generally subsidence occurs until November in the SH, but only until March in the NH. Usually the North-South IHG is defined as single number representing the difference between the average VMR in the two hemispheres. In the case of MIPAS, however, we have the great opportunity to compute the temporal average of the North-South VMR differences for each pressure level and latitude bin. This is why we would prefer to keep Fig. 6, although we agree that its description should be improved.

In order to compare our results with the North-South IHG reported in the literature (Liang et al., 2014), in the revised paper we compute also the latitudinal-average of the NH-SH VMR differences. For each pressure level this is obtained by weighting the monthly mean VMR in a given latitude bin with its corresponding solid angle fraction. These results are now discussed in the revised paper.

## **Minor Points**

### **Abstract line 1. Change ‘strong’ to ‘potent’?**

Looking in the web, the construction “strong ozone-depleting substance” seems more popular than “potent ozone-depleting substance”.

### **Page 1. Line 4. Typo: mystery**

Already done in the last version of the discussion paper.

### **Page 1. Line 6. Typo: photolytic**

Already done in the last version of the discussion paper.

### **Page 1. Line 9. Typo: anthropogenic**

Already done in the last version of the discussion paper.

### **Page 1. Line 12. ‘proves’ is too strong. Could change to ‘gives confidence in’ (or similar).**

The sentence has been rewritten.

**Page 1. Line 16. Change scan to scans.**

Already done in the last version of the discussion paper.

**Page 2. Line 1. ODP is ozone \*depletion\* potential.**

Done.

**Page 2. Line 6. Typo: hydrofluorocarbons**

Already done in the last version of the discussion paper.

**Page 3. Line 4. Typo: where**

Done.

**Page 3. Line 5. Here you could cite a recent paper on modelling the CCl<sub>4</sub> budget using the latest lifetime data and limited ACE CCl<sub>4</sub> data to evaluate the model stratosphere. The availability of more stratospheric data would help constrain such model studies.**

**Chipperfield, M.P., Q. Liang, M. Rigby, R. Hossaini, S.A. Montzka, S. Dhomse, W. Feng, R.G. Prinn, R.F. Weiss, C.M. Harth, P.K. Salameh, J. Muhle, S. O'Doherty, D. Young, P.G. Simmonds, P.B. Krummel, P.J. Fraser, L.P. Steele, J.D. Happell, R.C. Rhew, J. Butler, S.A. Yvon-Lewis, B. Hall, D. Nance, F. Moore, B.R. Miller, J.W. Elkins, J.J. Harrison, C.D. Boone<sup>17</sup>, E.L. Atlas and E. Mahieu, Model sensitivity studies of the decrease in atmospheric carbon tetrachloride, Atmos. Chem. Phys., 16, 15,741-15,754, doi:10.5194/acp-16-15741-2016, 2016**

In the revised version of the paper we now cite also the above mentioned paper.

**Page 3. Line 21. 'operation' (singular).**

Done.

**Page 3. Line 32. Change to 'allowing the study of the evolution of atmospheric**

**composition in great detail’.**

Done.

**Page 4. Table 1. Spell out MW in the caption.**

Done.

**Page 4. Line 12. Change to ‘includes only one out of every two’.**

Done.

**Page 5. Figure 1 caption. Specify ‘coloured solid lines’.**

Done.

**Page 5. Line 4. ‘Apart from the “NLGAIN”...’**

Already done in the last version of the discussion paper.

**Page 6. Line 7. Do these errors ‘cancel out’ exactly? If not you should say something like ‘largely cancel out. . .’.**

Done.

**Page 7. Line 2. Typos: ‘. . .type of error, therefore, has no impact on the trend calculation’.**

Done.

**Page 7. Line 19. ‘We do not show..’**

Done.

**Page 7. Lines 25-29. These lines are not clear to me. I think it is the use of the word ‘compatible’. You should look into rephrasing this.**

Here we mean “compatible” from the statistical point of view. This terminology seems quite common in error analysis discussions.

**Page 8. Line 5. ‘continuing for inertia’. This does not make sense and needs to be rephrased.**

The section has already been rephrased in the last version of the discussion paper.

**Page 8. Line 11. ‘hemispheres’ (small h).**

Done.

**Page 8. Line 12. ‘troposphere’ must be a typo? At 130 hPa high latitudes will be in the stratosphere.**

Done. “in the troposphere” → ”at the lowermost pressure levels”.

**Page 8. Line 14. Change ‘notice’ to ‘note’.**

Done.

**Page 9. Line 7. Typo: ‘transport’.**

Already done in the last version of the discussion paper.

**Page 9. Line 8. ‘justify’ is the wrong word. Use ‘explain’?**

Already done in the last version of the discussion paper.

**Page 12. Line 7. ‘Further to’. ‘simultaneously’.**

Done.

**Page 12. Line 20. ‘incompatible’.**

Done.

**Page 13. Figure 7 (and 8). The caption should explain the red numbers on the left panel.**

The captions of Fig. 7 and Fig. 8 have been modified taking also into account this comment.