Atmos. Chem. Phys. Discuss., 15, C811–C814, 2015
www.atmos-chem-phys-discuss.net/15/C811/2015/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Impact of the 2009 major stratospheric sudden warming on the composition of the stratosphere" *by* M. Tao et al.

Anonymous Referee #1

Received and published: 16 March 2015

This case study analyses the impact of the most intense major stratospheric sudden warming (MW), which has been observed up to now, during January 2009 on the concentration of O_3 and N_2O. The Chemical Lagrangian Model of the Stratosphere (CLaMS) is used to demonstrate the influence of a strongly disturbed polar vortex on transport, mixing and chemistry. Some aspects of the model results are compared to MLS data.
Only some minor issues should be considered in the revised manuscript before publication in ACP.

1 General comment

Can the authors give an estimation about the influence of the type of this specific 2009 MW (vortex split) on the results? Is it possible to generalise the results, i.e. is the analysing method (tracer–tracer correlations) sensitive enough to be applicable also to MWs which are less intense than the exceptionally strong 2009 MW?

2 Specific comments

- Page 4386, line 8:
  Your description of atmospheric transport refers to the modelling perspective of this process. This should be emphasised in this context.
- Page 4386, line 6:
  Are the result of Sofieva et al. (2012) related only to a specific MW (if yes, which one?), or are these results obtained by analysing several MWs?
- Page 4388, lines 4–6:
  Unlike you have stated, a negative temperature gradient between the North Pole and 60°N at 10 hPa is characteristic for an undisturbed polar vortex. This situation is present during the second half of December 2008 and the first half of January 2009.

  You should start with a more general statement about the stratospheric winter 2008/09, instead of starting with a sentence about the Minor warming, which is present during the first week of December 2008, indicated by a slightly positive temperature difference between the North Pole and 60°N at 10 hPa and a deceleration of the stratospheric jet.

- Page 4391, lines 19–23: description of model runs;
  You should try to reformulate this section, to clarify your experimental setup.
  As far as I understood this paragraph, you performed two simulations with CLaMS, one with mixing and one without mixing. Both simulations are performed with full chemistry, and in both simulations, besides the ozone calculated with full chemistry, also a passive ozone tracer is present.

  Or have there been four different CLaMS simulations: two sets of simulations, first set (full chemistry) with mixing and without mixing, second set (passive ozone tracer) with mixing and without mixing.

  A table, summarizing the experimental setup with unique labels for each simulation would be helpful. Using these labels consequently in section 5 could help the reader to better follow your argumentation.

- Page 4395, line 6:
  Please give a short description of the Nash criterion here.

- Page 4402, lines 8–11: chlorine induced ozone loss;
  More explanation is needed here to follow your argumentation. Figure 7a (situation from December 18–28) and 7b (situation from January 18–28) both display situations during mid–winter. How can these figures be used to analyse the chlorine induced ozone loss, mainly occurring in late winter and spring?

3 Technical corrections

- Page 4385, line 26: insert article;
  ... over the Pacific.

- Page 4385, line 26: delete article ;
  ... before the MW and strongest after ...

- Page 4386, line 1: delete article ;
  ... trend of occurrence of NH MWs ...

- Page 4388, line 11: insert article;
  ... the sudden rise of the polar cap temperature ...

- Page 4388, line 16: insert article;
  ... while the disturbance of wind and temperature ...

- Page 4389, line 12:
  Correct the unit for the eddy heat flux to K m s^{-1}.

- Page 4389, line 13: date format changes;
  Change 6 January to January 6. Also change the date format in line 13 and 14 on the same page and at subsequent pages, to be consistent.

- Page 4395, line 1: correct;
  ... stable vortex ...

- Page 4417, text displayed within figure 5:
  To make the information more readable please plot the text within figure 5 in white.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 4383, 2015.