Atmos. Chem. Phys. Discuss., 12, C2199–C2202, 2012
www.atmos-chem-phys-discuss.net/12/C2199/2012/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "The sudden stratospheric warming of the Arctic winter 2009/2010: comparison to other recent warm winters" *by* J. Kuttippurath and G. Nikulin

Anonymous Referee #2

Received and published: 5 May 2012

Review of the Manuscript "The sudden stratospheric warming of the Arctic winter 2009/2010: Comparison to other recent warm winters" by J. Kuttippurath and G. Nikulin

This paper describes the sudden stratospheric warming that occurred in the Arctic winter 2009/2010 based on meteorological analyses, and compares its characteristics to other Arctic winters with stratospheric warmings since 2003/04. It further correlates the occurrence of stratospheric warmings with ozone loss derived from ozone column measurements over the last 15 years. Stratospheric warmings have been numerous in recent years, and their characterization is important to better understand the occurrence of these events, in particular in the framework of a changing climate. As such,

the paper fits very well within the scope of "Atmospheric chemistry and physics".

The paper is well structured and reasonably well written. My comments are mostly minor in nature. I suggest, though, that the authors spend some more work on the correlation of ozone loss with stratospheric warmings and the conclusions they draw from it. I will point this out in my detailed comments below.

pg. 7244, lines 25,26: Change "phenomenon" to "phenomena", delete "high" and change "extreme" to "extremely"

pg. 7245, lines 17,18: This statement should be supported with a reference.

pg. 7245, line 22: Clarify whether "beloW" refers to lower pressure or lower altitude.

pg. 7246, line 18: Change "than" to "compared to"

pg. 7246, line 29: Change "Since" to "While"

pg. 7249, line 13: Insert "the" between "and" and "evolution" as well as between "of" and "polar"

pg. 7250, line 25: Insert "the" between "recommend" and "presence"

pg. 7252, lines 10-12: Considering Figs. 1 and 3, the minor warming feature the authors are talking about seems to have taken place in early to mid-December 2009, not early January. The former also seemed to be stated in the abstract.

pg. 7252, line 16: Concerning EP flux divergence, it will help the reader to briefly discuss implications of positive vs. negative EP flux divergence at this point.

pg. 7254, line 5: "illustrated in the figure." I assume this is Fig. 5 - should be stated.

pg. 7254, lines 17,18: The statement about no vortices around (by?) mid-February in 2005/06 and 2009/10 is not well supported by the choice of Figures. I only see Figures for 060205 and 060315 at 850 K. The authors should reconsider their choice of days for the figures to better support their statements.

pg. 7254, line 23: Insert "an" between "where" and "even"

pg. 7255, line 4: Insert "are" between "periods" and "normally"

pg. 7256, line 16: The choice of January for showing averages of temperature and other quantities is not motivated. Why didn't they take February, or the average of Dec.-March, like for Apsc? The authors should investigate other time periods and report the results. If the conclusion is that January gives the best correlation then the authors should discuss why this might be the case.

pg. 7256, line 26: The statement "next 5 years" can be confusing, the authors should state the actual time period they are referring to.

pg. 7257, lines 19-20: Which time periods are we talking about? This statement needs to be explained or removed. Note also: "is" instead of "are", "has been" instead of "have".

pg. 7257, lines 25-29: A discussion of timing of SSWs and its influence on ozone is interesting but not done in sufficient detail here, especially as it is also mentioned in the abstract. The authors should consider adding another panel to Fig. 7, or a table, that shows the timing of the different events. They should then discuss in detail the influence of the timing on the observed ozone depletion.

pg. 7258, first 2 paragraphs of discussion: It would be nice if the authors could provide more discussion on the distinction between vortex displacement and vortex splits, and the relation to wave 1 and wave 2 activity. The SSW of 2003/04, with strong wave 1 characteristics, had been studied in detail by Liu et al., Atmos. Chem. Phys. 9, 2157-2170, 2009, who also present a comparison to the previous winter, which had a stronger wave 2 characteristics and was studied by Kleinboehl et al., Atmos. Chem. Phys. 5, 1291-1299, 2005. The authors should consider these references and clarify their discussion, also with reference to the work by Charlton and Polvani (2007), which they already cite in their paper.

pg. 7259, last paragraph: Suggesting ozone loss as a proxy for MWs sounds kind of backwards to me. The interesting point is how SSWs impact polar ozone depletion, and how this will influence polar ozone in the future as the occurrence of SSWs might change in a changing climate. The authors should re-orient their discussion in this direction.

Fig. 7: It would be helpful for the reader if all winters with MWs were marked in the Figure, not only the ones that were studied in detail in the paper.

Abstract: The abstract is somewhat wordy and could should be more to the point. For example, I don't think that mentioning the minor warming in mid-December is neccerary in the abstract, and certainly not in the first 2 sentences. The authors should remove the statement about ozone being a proxy for MWs (see my previous comment).

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 7243, 2012.