

Interactive comment on “Study on the impact of sudden stratosphere warming in the upper mesosphere-lower thermosphere regions using satellite and HF radar measurements” by N. Mbatha et al.

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Received and published: 22 January 2010

This paper presents results from the SANA E HF radar system of mesopause winds at 72 oS before and during the Antarctic sudden stratospheric warming (SSW) of 2002. The HF wind data are compared to SABER middle atmospheric temperature data and NCEP reanalysis products. The authors report on the reversal of climatological winds in the mesopause ~ 7 days before the signature of the stratospheric warming in NCEP data. They also show potential evidence of increased planetary wave activity at 5-, 10-, and 14-day periodicities preceding the SSW.

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Interactive Discussion

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This reviewer finds the work important because our understanding of mesospheric precursor signatures of stratospheric warmings can greatly enhance our predictive synoptic tropospheric weather forecasting. To date, there are few observations of mesospheric precursors and our understanding of the dominate factors involved in “seeding” SSW activity is severely lacking. This is especially important in regard to the work of Baldwin, M. P. and Dunkerton, T. J., Downward propagation of the Arctic Oscillation from the stratosphere to the troposphere, *J. Geophys. Res.*, 104, 30, 937-30, 946, 1999 and Baldwin, M. P. and Dunkerton, T. J., Stratospheric harbingers of anomalous weather regimes, *Science*, 294 (5542), doi:10.1126/science.1063315, 2001.

Generally, I find the paper in adequate shape for publication to ACP but have a number of concerns that need to be addressed. These issues are highlighted in the Major Comments section below and I please ask the authors to consider them in some detail. Minor issues, including improvements to figures, suggested word changes, grammatical issues, etc. are listed in the Minor Comments sections. These Minor Comments are merely my own personal suggestions and their inclusion in the final paper is ultimately up to the authors.

Major Comments: 1) How does this work fundamentally differ from the work of Dowdy et al. [2004]? That is, it seems that the physical observations being presented herein (i.e., the occurrence and timing of the mesospheric wind reversals, the observations of planetary wave signatures, etc.) are the same as those reported in Dowdy et al. [2004]. The only difference is that herein the authors have used a single HF radar as opposed to the 3-MF radars used in Dowdy et al. [2004]. I would request that the authors specifically identify how this work is fundamentally different than this previous study.

2. In Figure 3 the averaged 2003-2006 winds need to have their corresponding daily sample variance associated with each daily mean value included. Though the 2002 wind reversal can be seen, it is unclear if this reversal is unique and outside the climatological variance (i.e., the variance of the 2003-2006 periods).

3. The authors should discuss these results in light of the two Baldwin and Dunkerton papers listed above. This reviewer feels that this topic of downward coupling mechanisms has not been adequately explored in the literature.

4. pg 23061, line 22-23: Regarding the increase in stratospheric temperatures, please reference why this is an “uncommon increase”. What is the rate of increase?

5. pg 23061, line 28+: Regarding the detection of mesospheric inversion layers, please reference MIL literature [e.g., Meriwether, J. W., and A. J. Gerrard, Mesosphere inversion layers and stratosphere temperature enhancements, Rev. Geophys., 42, RG3003, doi:10.1029/2003RG000133, 2004.]. In addition, this result is very interesting unto itself, as it shows the MIL formation in the absence of the polar vortex system at high latitudes. That is, it is often thought that the lack of MIL observations at high latitudes is due to the removal of planetary wave activity due to the refraction of such waves off the polar vortex. Once the polar vortex is disrupted, the signature of MIL activity at high latitudes in winter is very interesting!

6. Please provide more details on how the power spectra of Figure 5 were computed. Was the 28-day window a Hamming or Hanning-type window? What are the confidence levels of the observed spectra? What are the units on the color bar? Please add more “tick marks” to the x-axis so that the reader can better see the values on various days (e.g., the data at day 262).

Also, what is the spectral resolution of the figure? How did the authors get such high spectral resolution of periods between 14-days and 28-days with a Fourier analysis using only a 28-day data window?

7. Just because one sees 14-day periodicities doesn't mean that planetary waves are being observed. These periodicities could be the natural mode of oscillation of the polar vortex system. I think the authors need to provide such caveats.

Minor Comments:

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- 1) Throughout the text, the common usage of commas is "...item 1, item 2, and item 3..." For example, on pg 23055, line 11 the list would read: "... significant changes before, during, and after the occurrence...". That is, there is a comma missing after the word "during". This missing commas is missing in 3-4 other locations in the text.
- 2) Throughout the text: I recommend that the authors refrain using the word "proved" and instead use the words such as "showed", "demonstrated", etc. [e.g., pg 23055 line 25; pg 23057, line 12; etc.]
- 3) pg 23053, line 2: suggest "The occurrence of a sudden..."
- 4) pg 23053, line 5: Why is the "degree" symbol of 2 different sizes on the location of SANAE?
- 5) pg 23053, line 11: suggest: "...at the MLT shows reversal approximately 7 days..."
- 6) pg 23053, line 22: suggest: "...event the 60 oS winds at 10 hPa reversed on the..."
- 7) pg 23054, lines 28+: Please verify the statement of how Labitzke and Nanjokat [2000] defined a minor warming. I was under the impression it was ONLY below 10 hPa, not "at any stratospheric level".
- 8) pg 23055, line 13: suggest "... occurrence of a SSW..."
- 9) pg 23057, line 8: suggest "... and the pulse sequence is..."
- 10) pg 23058, line 1: What is "overage?" Please define.
- 11) pg 23058, line 15: Why are the details of the NCEP data being given here when they were presented in Figure 1, some pages previous? Shouldn't this information be associated with Figure 1?
- 12) pg 23059, lines 1-9: Please denote the actual days your are referring to in this data presentation. That is, what specific days where westward winds observed?
- 13) pg 23059, line 10: suggest "... and persisted for a few days before..."

14) pg 23060, line 4: The beginning of this sentence is awkward. I suggest: “As discussed in Matsuno [1971], Andrews et al. [1987], Dowdy et al. [2004, etc., the dynamical mechanisms...”

15) pg 23062, line 27: suggest “... took place in a few days...”

15) pg 23062, line 27: “thermosphere”? I think the authors mean mesopause or MLT.

Figure 1: Does this figure really have to be in color? Also, the caption should indicate the figure shows “zonal mean” values.

Figure 2: The quality of this plot is rather poor. The authors should increase the figure resolution, and convert the x-axis values to “day-of-year” as opposed to “Hour of Month”, which really doesn’t make a lot of sense.

Figure 3: The daily variance of the average 2003-2006 zonal and meridional data needs to be indicated on this plot so that the reader can better assess when the 2002 winds are indeed outside the realm of “typical” variability.

Figure 4: Please include the daily variability of the mean zonal winds. Also, the last comma is not necessary.

Figure 6: Please consider plotting this data in a contour plot instead of the current plot. It is very difficult to see the temperature changes and to distinguish individual days.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 23051, 2009.

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