The authors would like to take the opportunity to thank the reviewers for their comments and for taking the time to offer them. We believe the manuscript has been improved with the helpful input.

Response to Reviewer 1

The study significantly contributes to the derivation of the descent rate in the polar middle atmosphere. The authors find that previous studies underestimated the descent rate by a factor of 3 or more. Their data analysis is careful and the good agreement of the SD WACCM CO VMR time series with the observations are good reasons to believe their new finding of a fast descent rate. Thus, the study is appropriate for a publication in ACP and I only suggest some minor corrections.

1) I was not aware that the model descent rate differs so much from the observed descent rate. Straub et al. (2012) found a small descent rate of 325 m/day for the SD WACCM simulation. Please can you argue why SD WACCM is now faster in your simulation?
The value quoted by Straub et al. (2012) is for an average of the SD-WACCM w* over the altitude range of 0.6 hPa to 0.06 hPa (approx. 52 – 68 km), and over the time from 5 February to 5 March. This is to match the averaging from the ground-based instrument. The averaging information for the instrument is now included in the edited Table 1 of the new manuscript. Straub et al. (2012) also show the time-averaged profile of WACCM-SD w* with values ranging from 150 – 700/800 m/day. The daily values of w* and another trajectory analysis reach 1200 m/s at 0.06 hPa.
Tabe 1 has been edited to include information about the altitude ranges over which the descent rates were calculated and a whether averaging was used. Section 1 also now contains the following information:
"The altitude range over which the rates were determined, and whether averaging was performed, is also shown in Table 1. It is important to note that an average over altitude can mask the higher descent rates that are found in the mesosphere. For example, Straub et al. (2012) show a descent rate of -325 m/day from averaged modelled wind profiles, between 0.6 hPa (~52 km) and 0.06 hPa (~68 km), whereas the individual wind profiles often show descent rates larger than -1000 m/day at 0.06 hPa."

2) p.1 line 28 and at other places. I would not use "concentration" since you only work with the volume mixing ratios (VMR). I would introduce VMR in the beginning and then you can always write CO VMR instead of CO concentration.
This has been done.

3) p.3 line 8 it is unclear for me what you mean with a "quiet winter"
This has been changed to say *"a winter with a relatively stable vortex"*

4**) p.4 line 18 discuss instead of discusses**

This has been fixed.

5) p.7 line 17 "negative" means poleward? I guess the sign depends on the hemisphere and you mean the northern hemisphere?
The lines have been edited to clarify that the "negative" refers to the CO tendency, and the direction of v* is towards the winter pole. *"This is expected, considering the direction of* $\overline{\tilde{v}^*}$*, toward the winter pole, and the low-to-high gradient of CO from lower to higher latitudes in the winter hemisphere"*

6) p.7 line 28 Is it Hoffman or Hoffmann like in the Bibliography?
It should be Hoffmann. This has been fixed.

7) p.10 line 6 what do you mean with "fall short"?
This has been edited to *"are smaller than"*

8) Conclusions : I am missing a statement that trace gas monitoring by ground-based microwave radiometers in the polar region remains invaluable , e.g., for tuning of the SD WACCM model parameters. Otherwise the paper may give the impression that the observations are useless for derivation of the descent rate.
A line has been added to the end of the conclusion: *"Continuous ground-based and satellite measurements of trace gases remain an essential tool in understanding the short- and long-term evolution of the middle atmosphere, as well as for the validation and parameterisation of atmospheric models."*

9) Figure 1 The grey background should be changed by a white background since the contrast is not so good.
The figure has been edited to have a white background. The panels were edited and made larger to make the data more readable. The layout has been changed to landscape.

10) You may mention somewhere the connection between the polar descent rate and the Brewer-Dobson circulation.
Section 3.2 has been edited and now contains the statements: *"The magnitude of the TEM wind is larger for the higher altitudes, as is also shown in Smith et al. (2011), and the air parcels that arrive above 66 km altitude originate in the summer hemisphere. The parcels that arrive below this, which could be considered as part of the Brewer Dobson circulation (Brewer, 1949), originate at latitudes closer to the equator."*