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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Stratospheric winds: longitudinal distribution and long-term trends" *by* M. Kozubek et al.

**Anonymous Referee #2**

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This paper attempts to analyze the climatology and trends in the Northern Hemisphere mid-latitudinal stratospheric winds, and investigate the impact of QBO, NAO and the solar cycle. The manuscript shows a few interesting results but the paper is not well organized, it lacks consistent analysis of the statistical significance of the results presented and the authors fail to convey the relevance of their analysis. I recommend several major revisions before the manuscript can be considered for publication in ACP.

Major revisions:

- The introduction should be rewritten: instead on focusing on theories of stratospheric dynamics and how reanalysis datasets have issues, I would suggest providing concrete examples of why changes (whether human-induced or not) in stratospheric winds



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matters. The unprecedented ozone loss in the Arctic in 2011 caused by extreme meteorology comes to mind (see Pommereau et al., 2013). The introduction should also include previous studies of climatology and trends in the stratospheric dynamics based on reanalysis datasets (for example, Monier and Weare, 2011a), the impact of the QBO, NAO... and the analysis of longitudinal distribution of winds (for example, Weare, 2010).

- The analysis of Figure 2, along with Table 2, lacks a proper statistical significance test. For Figure 2, I would highly suggest that the authors plot the continuous time series (not split into three periods), then they can add trends for different periods, and they should provide the correlation/regression (over the whole period) to show in statistical terms how much of the year-to-year and decade-to-decade variability can be attributed to NAO. For Table 2, the authors need a statistical test showing whether the differences between solar min/max and phase of QBO are significant. Since the sample size of each case is different, I suggest following the method described in Weare (2010).

- The "winter" analysis is based on the average between October and March. Monier and Weare (2011a) show that the trend in the zonal mean zonal wind north of 50°N over the 1980-2001 period is negative from October to December and positive from January to March. In light of this result, I would strongly suggest redoing the analysis for these two periods (Fall, from Oct-Dec and winter, from Jan-Mar). The results might be different.

- One important result is the change in the trends between the pre-1995 and post-1995 periods. It is explained on line 207 as caused by the change in ozone. Ozone is only mentioned once in the entire manuscript. This seems particularly strange, since it follows form the analysis that ozone has a substantial impact on the trends in the stratospheric winds compared to that of the QBO, NAO and solar cycle. The authors should expand the discussion on the impact of ozone on wind and stratospheric dynamics. I would suggest the authors read and reference Monier and Weare (2011b), who discuss the climatology and trends of ozone and its dynamical transport.



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- The organization of the manuscript is strange. The authors start presenting a trend analysis and then show some climatology. I would suggest presenting the climatology first (for the 1980-2010 period, see below for an explanation of the choice of this particular period), and then discuss how this climatology has been changing and what is causing the change.

Minor revisions:

- The title should reflect the fact that the analysis is only for the Northern Hemisphere and the midlatitude. I would suggest something like: "Northern Hemisphere midlatitude stratospheric winds: longitudinal distribution and long-term trends"

- Abstract: Line 12, the authors state they use the MERRA reanalysis but later in the main text it is revealed they use NCEP/NCAR-1.

- Section 2: The choice of the NCEP/NCAR-1 reanalysis is not explained and it would be beneficial to discuss how the analysis of one single reanalysis might be indicative of any robust behavior. At least provide a few sentences on why the authors chose this particular reanalysis compared to ERA-40 or MERRA (which the authors state they used in the abstract, by the way)... but I would suggest citing Monier and Weare (2011a) would analyze the climatology and trends of stratospheric zonal mean flow in both the ERA-40 and NCEP/NCAR-1 reanalyses.

- I would suggest the authors not use the reanalysis data prior to 1980 because of the lack of satellite data. The manuscript should not change substantially if only using data from 1980 to 2010.

- Figure 1, Figure 2, Table 1 and Table 2: it is unclear why the authors choose these particular latitude bands. I would suggest averaging over different latitude bands (30-40, 40-50, 50-60, or even 30-60N) and then compute the different time series, trends and statistical tests for significance. The results should be more robust and more representative of the mid latitudinal behavior.



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- Line 179: "repeated the analysis of v wind component for each grid point from 60N to 20N" I don't understand how the authors have "repeated" any previous analysis (they are simply plotting the mean v over 1958-2012) and "for each grid point" since you are averaging over the latitudinal band.

- The impact of ENSO is mentioned in the abstract and introduction but never analyzed. Why?

- Figure 5 and Figure 6: I am not sure these graphs are needed. I would suggest just stating in the main text that there is no difference between the climatology at 00 UTC, 06 UTC and 12 UTC, thus indicating that diurnal or semidiurnal tides are not responsible for the dipole structure.

References: Monier, E. and Weare, B. C. (2011a) Climatology and trends in the forcing of the stratospheric zonal-mean flow, Atmos. Chem. Phys., 11, 12751-12771, doi:10.5194/acp-11-12751-2011 Monier, E. and Weare, B. C. (2011b) Climatology and trends in the forcing of the stratospheric ozone transport, Atmos. Chem. Phys., 11, 6311-6323, doi:10.5194/acp-11-6311-2011 Pommereau, J.-P., Goutail, F., Lefèvre, F., Pazmino, A., Adams, C., Dorokhov, V., Eriksen, P., Kivi, R., Stebel, K., Zhao, X., and van Roozendael, M. (2013) Why unprecedented ozone loss in the Arctic in 2011? Is it related to climate change?, Atmos. Chem. Phys., 13, 5299-5308, doi:10.5194/acp-13-5299-2013 Weare, B. C. (2010) TroposphericâĂŘstratospheric wave propagation during El NiñoâĂŘSouthern Oscillation, J. Geophys. Res., 115, D18122, doi:10.1029/2009JD013647

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