

Review of “Connection between the length of day and wind measurements in the mesosphere and lower thermosphere at mid and high latitudes”

General comments

A topic of this manuscript, study of correlation between a length of a day and zonal mean winds, is very interesting. However, I concern about three points.

Although data analysis results are presented in 6 figures in the manuscript, all of them are about mean zonal winds from meteor radars. Among them, only 3 figures overplot lengths of a day. Trends of lengths of a day and zonal mean winds look somehow correlated in the figures, but correlations are not presented numerically. Because mean winds are presented in terms of seasonal and interannual variations. I would like to have seen them for lengths of a day, too.

Zonal mean winds are presented using meteor radar measurements at 3 sites in the northern hemisphere and the high latitude southern hemisphere, and Aura/MLS. I expected that Aura/MLS data results are compared with radar results for a validation and then would present any global variations. However, Aura/MLS results are used only for comparisons of radar results in the northern hemisphere. Because authors conclude zonal mean winds agree between MLS/Aura and radar measurements, I do not understand motivation of presenting trends of lengths of a day and zonal mean winds from both meteor radars (Figure 6) and Aura/MLS (Figure 7).

Lastly, authors compare zonal mean winds using Andenes and Davis in the northern and southern hemisphere in a same season and conclude that a difference is caused only by lengths of a day between northern hemisphere summer and winter. However, I believe that mean winds from ground measurement only one site include zonal mean wind and stationary planetary waves and difference of stationary planetary wave amplitudes largely results to a difference of mean winds of ground measurements. I also believe that main reason of interhemispheric differences in atmospheric dynamics is a difference of topography. It makes a difference of atmospheric waves with interact with mean winds. The difference of topography makes an interhemispheric difference of chemical composition in the atmosphere, such as water vapor, ozone, and carbon dioxide, which makes an interhemispheric difference of viscosity and then winds.

I report that this manuscript needs further consideration and discussion.

Specific comments

Line 24 on page 4: What is d ? Because equation (7) shows $d(t)$, it must be a variable parameter depending on time (I expect that t stands for time). Can authors change “ d ” to another symbol or acronym because it is very confusing with integral and differential symbols?

Lines 21 to 24 on page 5: I am suspicious if you can estimate winds at 78 (or below ~85 km) and 100 km by meteor radars. What is an altitude resolution, and every how much in km did authors determine hourly mean winds? Is there any threshold for a determination, such as elevation angle, range, minimum and maximum radial velocities, and minimum number of sampling meteor echoes? Although authors mention uncertainties as “between 2 and 6 m/s”, weightings of uncertainties are very different between 50 m/s wind with 6 m/s uncertainty and 5 m/s with 6 m/s uncertainty.

Line 31 on page 5: Please check a vertical resolution. In my knowledge, Aura/MLS data are every 1.3 km up to 50 km, 2.7 km up to 62 km and 5.4 km above.

Line 18 on page 6: Juliusruh and Collm are at nearly same location in a global sense. What causes a difference of reversal altitudes by 3 km? Are they systematic difference?

Lines 9 to 10 on page 8: How was “the fluctuation in the LOD” obtained? Was it by equation (7)? If so, what is $d(t)$, as asked above? Was $d(t)$ obtained from measurements or some simulation models?

Line 22 on page 8: What is “the F10.7 solar cycle”? Is it the 11-year cycle, the 27-day cycle, or both cycles?

Line 29 on page 8: LOD (either length of a day or fluctuation in a length of a day) must have unit of time (probably second from Figures 6 to 8). Why is an LOD unit ms (millisecond or meter times second)?

Line 33 on page 8: Again, please make sure what “the solar cycle” is, 11 year, 27 day, both, or some other cycle? Also, how much does “the solar cycle” influence on a fluctuation of a length of a day? It means how much important to remove a solar cycle influence.

Line 12 on page 9: What is “the size range”?

Line 25 on page 9: I do not see that the authors showed affects on mesospheric winds by expansion/shrinking of the upper atmosphere in this work. I saw that the authors showed correlations between zonal winds in the mesosphere and fluctuations in a length of a day. Stober et al. inferred that fluctuations in a length of a day are correlated with a variation of a thickness of the upper atmosphere. It is possible to expect that zonal winds in the mesosphere are related to a thickness of the upper atmosphere. Please revise it.

Figure 2 and 3: Why do they exclude Davis in Figure 2 and southern hemisphere?

Figure 2 and 3 captions: Correct to “positive”.

Figure 6: Please describe what black and blue dashed lines are in a caption.

Technical corrections

Line 10 on page 1: Do authors use LOD as “length of a day” or “fluctuations in a length of a day” in this manuscript? Line 24 on page 4 says “length of day (LOD)”. However, “LOD” is used in a subsection 3.2 and a caption of Figure 6 although most of them must imply “fluctuation of LOD”, except for lines from 9 to 10 on page 8 say “fluctuation in the LOD”. Please make it consistent.

Lines 9 to 10 on page 2: “shrinking of the middle atmosphere between solar minimum and solar maximum” is very confusing. Does the middle atmosphere shrink at the solar minimum, the solar maximum, or both at the solar minimum and maximum?

Line 19 on page 2: Does “conversation” mean “conservation”?

Line 8 on page 5: What does “on an in average” mean?

Line 4 on page 6: I feel that “combined 04 data from the international Earth Rotation and Reference System Service (IERS)” is more appropriate.

Line 24 on page 6: “qualitatively”?

Lines 24 to 25 on page 6: I do not understand the sentence and suggest revision.

Line 30 on page 6: Are MLS data shown in a geopotential height? If so, why “above 90 km” is suddenly described in geometric height?

Lines 6 to 7 on page 7: It is very ambiguous. Does a density increase occur in summer OR winter, and at the solar minimum OR maximum?

Line 16 on page 7: Change “the northern and the southern hemisphere” to “the northern and southern hemispheres”.

Line 16 on page 7: Remove comma between “opposite” and “fluctuations”.

Lines 20 to 21 on page 7: What is “between two locations on the same latitude”? Does it mean “at the same latitude in the northern and southern hemispheres”?

Line 21 on page 8: It should be “additionally”.

Line 22 on page 8: It should be “relatively”.

Line 29 on page 8: Please make sure if “seasonal fluctuation” means “seasonal variation of a fluctuation”, “seasonal means of fluctuation”, or something else.

Line 33 on page 8: What does “as result as” mean?

Line 19 on page 9: “This reversal can be explain can be explain” must be “This reversal can be explained”.

Lines 20 to 21 on page 9: First, “station” on line 21 must be “stations”? What are “the polar and the second midlatitude stations”? “the polar stations” include both Andenes and Davis? Is “the second midlatitude station (I think not “stations” in this case)” Juliusruh or Collm? Did the authors define “first” and “second” stations previously?

Line 1 on page 10: “hemisphere” must be “hemispheres”.

Lines 6 to 7 on page 10: Why do authors specify “the middle latitude stations” as Collm and Juliusruh? Is “the polar station” only Andenes? How about Davis?

Line 10 on page 10: “not figured out” must be “not be figured out”.

Line 13 to 14: I do not understand this sentence. Please revise it.

Line 1 on page 11: “ssignal” must be “signal”.

Line 20 on page 11: “datadata” must be “data”.