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Comment

## ***Interactive comment on “Correlations of mesospheric winds with subtle motion of the Arctic polar vortex” by Y. Bhattacharya and A. J. Gerrard***

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We would like to thank Prof. Tim Kane, (Referee # 1) for reviewing our paper and appreciate his helpful suggestions.

I have some thoughts/queries which I would like to see addressed prior to publishing (these are NOT in any order of importance):

- \* "OH" is in italics in line 2 of page 16552; it is not italicized anywhere else.
- \* Line 13, same page, spell out "Section"
- \* Line 19, same page (2nd line of Section 2)... ERWIN should be capitalized.

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We have made all the changes as suggested. The abbreviation of “Section” was made by the editorial staff at ACPD.

\* Line 1, page 16553... the accuracy is expressed for our unfounded belief! Line 3 uses the word "excellent" to describe a correlation... this whole paragraph could (and should) be reworded to inspire more confidence!! :-)

We have modified the text (page 16553, lines 1-6) as follows:

*Observations from the ERWIN Michelson Interferometer are of high quality. Accuracy of measurements is typically 1 m/s for a single observation, with an integration time of 1-2 seconds. A full set of measurements – zonal and meridional winds – takes about 20 minutes in the instrument configuration used for this paper. An excellent correlation was found in simultaneously measured wind velocities (corresponding to the 97 km green-line airglow emission) from ERWIN and a ground-based Fabry-Perot instrument (CLIO), also located at Resolute Bay (Fisher et al., 2000). Uninterrupted measurements are possible during darkness (polar winter) without significant cloud cover or bright moonlight within the instrument field-of-view.*

\* OK, one of my bigger beefs: last paragraph of page 16553, why only look at 2 years??? Instrument drift could explain differences just as well, without a baseline of stability to compare to.

\* 1st line of Section 3... you mention 3 years; then only use two??

Observations were only available (over this period) for these two years (1995 and 1996).

We have modified the following text (page 16553. lines 19-22) to clarify:

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*Figure 1 shows the mesopause region winds ( $85\pm 5$  km) measured by Erwin for the months of November and December, for years 1995 and 1996 over a period of 46 days (only periods for which data is available, relatively long duration compared to typical MLT observations of wind velocities).*

\* Line 7, page 16555; do you mean 95-96 ??

This is an error on our part. We imply November-December of 1996. (as seen in Figure 1, lower panel). We have modified the text accordingly.

\* I found myself wondering, both from a data as well as a physical point-of-view; would you expect any better correlations in this study if you looked at wind COMPONENTS ??

The shape and day-to-day movements of the centre of the stratospheric polar vortex makes it very difficult to meaningfully interpret wind components, which result in spurious correlations. Stratospheric assimilations were only available once a day (noon). Hence we have stated in the text (page 16553, lines 26-29)

*It should be noted that traditional notion of “zonal” and “meridional” components of winds breaks down in the context of rapid polar vortex movements and distorted dynamical co-ordinates. Therefore, wind magnitudes have been considered for this analysis.*

\* 1st line of Section 5; I would include the word "suggesting"... correlation does NOT always imply causality.

We agree with the referee that any direct cause-and-effect is not implied by the analysis of correlation. Therefore, we have changed the text (Section 5, 1st paragraph) as follows:

*Our analysis suggests a possible (but not proven) downward propagating, synoptic, dynamical signatures in wind fields traced from the MLT region in the Arctic polar cap to the upper stratosphere. This should be interpreted as a possible indication of only downward signal propagation, since causal effect cannot be determined. To determine a causal effect would require further, detailed investigation of observations from similar situations – simultaneous measurements and underlying cause of mesospheric wind behaviour as well as causal relations between relative movements of a relatively undisturbed stratospheric polar vortex off the pole and movement back to “normal” – centered at the pole. Before a causal relationship can be deduced, the forcing(s) experienced by the polar vortex would have to be separated into those that can be traced in the troposphere – and the residual movements that could be attributed to alternative forcing mechanisms. The observed change in the mesospheric winds, correlated with planetary wave activity associated with the Aleutian High, appears to sequentially progress towards a displacement of the polar vortex which is later identified in stratospheric analyses.*

\* Figure 1; the one day averaging does not capture the variance very well... is there any useful information being overlooked here??

We agree that one-day averaging does not capture variance well, hence we have included raw data in Figure 1. We have modified the text which describes the variance (page 16553, lines 23-25):

*Day-to-day variance of scalar winds is higher for 1995 (208 m/s) than 1996 (155 m/s). Average daily winds range between 13.9–88.1 m/s for 1995, and 16.4–76.1 m/s for 1996. This could be a consequence of proximity to polar vortex location which impacts wind variance in the stratosphere and very likely also in the mesosphere – the*

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*variability being higher in the vortex jet (e.g. Whiteway et al. 1997).*

\* Figure 2... MAKE THEM WHITE CROSSES!!! the whole black on black theme is not working for you!

As suggested by the referee, we have changed the colour of the crosses in Figure 2 to red – as it shows a better contrast.

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