Reviewer 2: We thank this reviewer for their comments and technical corrections. Our response appears after the comment in italics. We have corrected all the technical questions that they raised in the supplement.

The manuscript gives a detailed summary of the instrumental setup, analysis procedure, calibration and validation of initial measurements performed with a new Airglow wind measurement technique in the altitude range of about 87 to 97 km. The new developed ERWIN II instrument shows superior performance to previous airglow wind measurement techniques.

The manuscript is well written and nice to read. The paper is worth publishing and seems well suited for AMT after some minor modifications.

I have two minor comments (see below) and some technical notes that are supplied in the annotated manuscript that can be found in the supplement.

Minor comments: 1. The comparison to other instruments is difficult (as stated already in the manuscript), and the authors have found a reasonable way to compare totally different measurement techniques. However the text on pages 8294,8295 should be revisited, taking into account that other instruments might be designed to measure other properties in addition to wind. For example wind, temperature, density, . . . Or they are designed for altitudes in addition to the E-Region . . . or during day/night. Rocket techniques for wind measurements in the E-Region are not mentioned (e.g. chemical tracer release)?

We have modified the first few sentences of the paragraph starting on line 9 of page 8294 as follows:

"Rockets, lidar and radar are three other techniques used to measure winds in the mesopause region. Although comparisons with the precision of the wind measurements associated with these techniques are undertaken below, other important aspects of the dynamical fields are measured using these instruments (for example temperature and density with lidar and diffusion with rockets and radar). In addition, their measurements may be more extensive that those undertaken with ERWIN II (i.e. inclusion of day/night observations or a greater height range and vertical resolution).

Rockets provide short term wind observations in this region with a wind precision of 5-10 m/s, a temporal resolution of 3 s and a height resolution of ~ 1 km over about 10 minutes [Larson, 2002; Chu et al., 2007 and references therein]."

This brings out the fact that other instruments provide information on quantities other than winds and may provide a broader measurement range and better vertical resolution. It also includes mention of rocket measurements (along with references) as suggested by the reviewer.

2. The authors highlight that there is a set of instruments available at PEARL, some of them with the potential to verify the results of ERWIN II. At least a note in the manuscript why such a comparison is not done here seems necessary.

A comparison with the winds associated with the meteor radar (the other mesospause region wind measuring instrument at PEARL) is being undertaken and will be published separately. There are issues associated with identifying the best height for comparisons, the height weighting associated with the

airglow profile and the spatial weighting of the meteor trails which are used for each hourly average wind which are complex enough that we felt they would be best dealt with in a paper devoted solely to this comparison. Initial comparisons show that the two instruments are in reasonable agreement (within 5 m/s).

To address this question we have added the following sentence to line 2, pg 8296 of the manuscript: "Initial comparisons between ERWIN II and the meteor radar show them to be in reasonable agreement (a comparison which deals with the complexities of the observational filters of each instrument will be published separately). "

3. Pg 8272 line 10: abstract – It might make sense to add the altitude range covered by the instrument.

We added the nominal peak heights of each of the emissions to the abstract so the reader has a sense of where we are observing and the range of heights involved.

4. Pg 8272 line 14: Location of latitude and longitude coordinates.

These have been added.

5. Pg 8272 line 15: It might make sense to give the date of the initial wind observations that are shown in the manuscript

These dates have been added.

6. Pg 8273 second paragraph: This paragraph seems to be a summary and is misplaced in the introduction.

We disagree with the reviewer in this instance. We feel that a summary of the instrument capabilities is appropriate in the introduction and serves to provide the reader with a clear idea of the specifics of the instrument which is the subject of the paper. We do not see a better place to place this information and prefer to see it in its current location as part of the introduction.

7. Pg 8276 line 25: increased

This has been corrected.

8. Pg 8277 line 16: a value smaller than the precision.

This has been corrected

9. Pg 8277: What is the range of solar elevations that can be used for ERWIN observations?

ERWIN II observations are curtailed when the solar elevation is above the horizon. We have added the following sentence to the end of line 10, pg 8280. ". ERWIN takes measurements as long as the solar elevation is less than 0 degrees."

10. Pg 8278: It is unclear how the calibration lamps are fed into the optical path.

We have added the following to the end of line 21, pg 8278 to explain this query:

"The calibration lamps are located outside of the Michelson housing, and are not pictured in the schematic shown in Figure 1. The lamps are connected to fibre optic cables, which are directed at the calibration lamp screen. This screen is acts as a shutter, when it is closed, atmospheric measurements cannot be taken. To take calibration lamp measurements, this shutter/screen is closed, and illuminated by the calibration lamps, and thereby acting as a source for the calibration lines."

11. Pg 8279 line 13-14: Please revisit this sentence.

We have eliminated the first "because" in this sentence so that It now reads smoothly.

12. Pg 8279 line 25: ERWIN-II.

Corrected.

13. Pg 8280: It might be helpful to give numbers for cos(alpha) and sin(alpha).

We have added these values at the end of line 27 on pg 8280.

14. Pg 8281 line12: It might be a good idea to get a rough number of the distance here.

This distance is 250 km. We have added it as a parenthesis after the phrase "distance between the viewing points" on line 13, pg 8281.

15. Pg 8282 line 5: of the interferometer?

We have changed the sentence on lines 5-6, pg 8282 to deal with this concern to: "a term giving the thermal drift phase of the interferometer relative to the phase observed at a particular time (thermal drift term)."

16. Pg 8287 line 9: ERWIN-II

Corrected

17. Pg 8289 line 5: revisit sentence?

We have changed the sentence on lines 5-6, pg 8289 to "Using the value of 'α' appropriate for the 8 step scan, and substituting appropriately in equations (2) and (4), the following expression for the standard deviation (which we use as a measure of the wind precision) is obtained:"

18. Pg 8291 line 19: Add a reference here.

We added the reference Manney et al., 2009 (Manney, G. L., M. J. Schwartz, K. Krüger, M. L. Santee, S. Pawson, J. N. Lee, W. H. Daffer, R. A. Fuller, and N. J. Livesey (2009), Aura Microwave Limb Sounder

observations of dynamics and transport during the record-breaking 2009 Arctic stratospheric major warming, Geophys. Res. Lett., 36, L12815, doi:10.1029/2009GL038586.)

19. Pg 8291 line 23: Due to the extended field of view or misspointing of the "zenith" direction?

We think this is predominantly due to geophysical variations associated with waves and have inserted the following at the end of the sentence in line 23, pg 8291: "due to gravity waves and other high wavenumber phenomena."

20. Pg 8294 line 23: Franke et al. (2005)

Corrected

21. Pg 8295 line 1-2: This information about the field of view should be given earlier i.e. when discussing Figure 3.

We have added the following sentences to the end of paragraph on line 10 of pg 8280 so that this information is included when describing Figure 3.

"Based on this observing geometry, the ~5 degree lateral cross section of each beam, and a mean height of 90 km and a nominal vertical scale of ~5 km for the half width of the airglow layer, the volume of atmosphere sampled by ERWIN II is ~5 km in the vertical and 5km by 6km in the horizontal. (It will not be sensitive to vertical scales less than approximately half the thickness of the airglow layer (~5 km))."

We have also included a reference to Section 3 at the point where this information was initially located to make sure the reader is aware of the dimensions of the ERWIN II viewing.

22. Pg 8295 line 10-11: revisit sentence

This sentence has been revised to "With a vector wind measurement every 45 seconds at a precision of ~ 1m/s, ERWIN II has similar capabilities to these instruments."

23. Pg 8295 line 11: This summary seems short. How are the different lines (altitudes) of ERWIN-II taken into account for the comparison?

We have added the following sentences to the end of this paragraph to explain this comparison more clearly:

For a cycle through the three emissions, winds at nominal heights of 7, 93 and 97 km at the four cardinal directions and the vertical are obtained every three minutes at a precision equal to or better than these instruments and at a measurement cadence faster than either of these instruments. On the other hand these instruments provide better spatial resolution than ERWIN II (especially in the vertical) since the observation volumes associated with each measurement are smaller.

24. Pg 8295 line 12: This seems to be an abrupt change of topic from the instrumental comparison to the atmospheric science. Please insert a sentence to make a smooth transition.

To smooth this transition we have changed the start of this paragraph to:

"Some indication of the capabilities of ERWIN II for scientific purposes is shown in Figure 11. Here time series of the meridional and zonal winds observed by ERWIN II on December 22, 2012 for all three emissions are presented."

25. Pg 8296 line 5: There is at least one more station with similar capabilities/ combination of instruments in the northern hemisphere. Please revisit this statement.

We have changed "uniquely" to "especially" in this sentence to avoid the implication that PEARL is the only site with these capabilities (which was not our intention).

26. Pg 8302 Figure 2: What are the numbers on the x and y axes? Probably pixel numbers, it would be helpful if this were made clear.

We have noted that the x and y axes represent pixel numbers in the figure caption.

27. Pg 8304 Figure 4: The font numbers and text are very small.

In our original submission the fonts were fine. We have replaced these figures with ones with larger font. In addition, we will consult with the staff at AMT to ensure that the font on this figure is appropriate.

28. Pg 8305 Figure 5: What time zone is used here and in the following plots?

The time zone is UTC. We have added this information to the figure caption.

29. Pg 8307 Figure 7: Please be more precise here. In the text this is called "standard error estimated using Eq. (14)" or the symbol \sigma_w could be used.

Changed to \sigma_w.

30. Pg 8309 Figure 9: Font size too small.

We have made new figures with a larger font.

31. Pg 8310 Figure 10: North, South, East, West winds? The legend indicates that four directions are used. Please clarify.

Modified caption to include all four directions.