Response to Reviewers

Dear editor and reviewers,

Thank you for your reviews of our manuscript, we have amended the paper according to your suggestions. Please see below for our response to each comment, which is given in **bold**. Line numbers in reviewer comments refer to the originally submitted manuscript, whilst numbers in our comments refer to the amended manuscript.

Reviewer 1

Figure 6b and line 265 show that “the correlation of the zonal disturbance wind is highest when there is no lag and steadily decreases up to a lag of 180 mins”. This “no-lag” phenomenon is quite surprising and needs to be carefully checked again. Even if the MH FPI is right within the SAPS channel with the ion drag being the dominant force, there should still be some time lag between the plasma drift and neutral wind response, as shown in previous observational and/or modeling results (e.g., Zhang et al., 2015; Aa et al., 2021; Ferdousi et al., 2019; Zou et al., 2022). Can you add similar panels in Figure 3 or somewhere else to show the actual temporal variation of the fitted zonal/meridional plasma drifts at VT and MH so that readers can make a comparison between plasma and neutral wind response? Did the enhanced westward plasma drift (SAPS) and zonal neutral wind reach their peak value at the same time between 04-06 UT with no delay? Whether the cross-correlation coefficient was calculated using neutral wind (FPI) or (FPI-HWM)? This might cause different results. Anyway, it is hard to understand the physical mechanism of “no lag” between plasma drift and neutral wind. More explanation is needed if it were proved true.

We agree that "no lag" on neutral winds does not make sense physically, assuming that all other forces barring that directly caused by enhanced plasma (in this case, the SAPS) is removed. For Figure 6b, we believe that correlation is highest when the lag=0 due to a limitation of the cross-correlation technique itself. That shortcoming being that a large part of the neutral wind timeseries is being compared to a large part of the plasma velocity timeseries and only a single number (the correlation coefficient) is being produced. Therefore, peaks and troughs in the data are being considered as a whole, which in this case, happens to cause the correlation to be highest when lag=0.

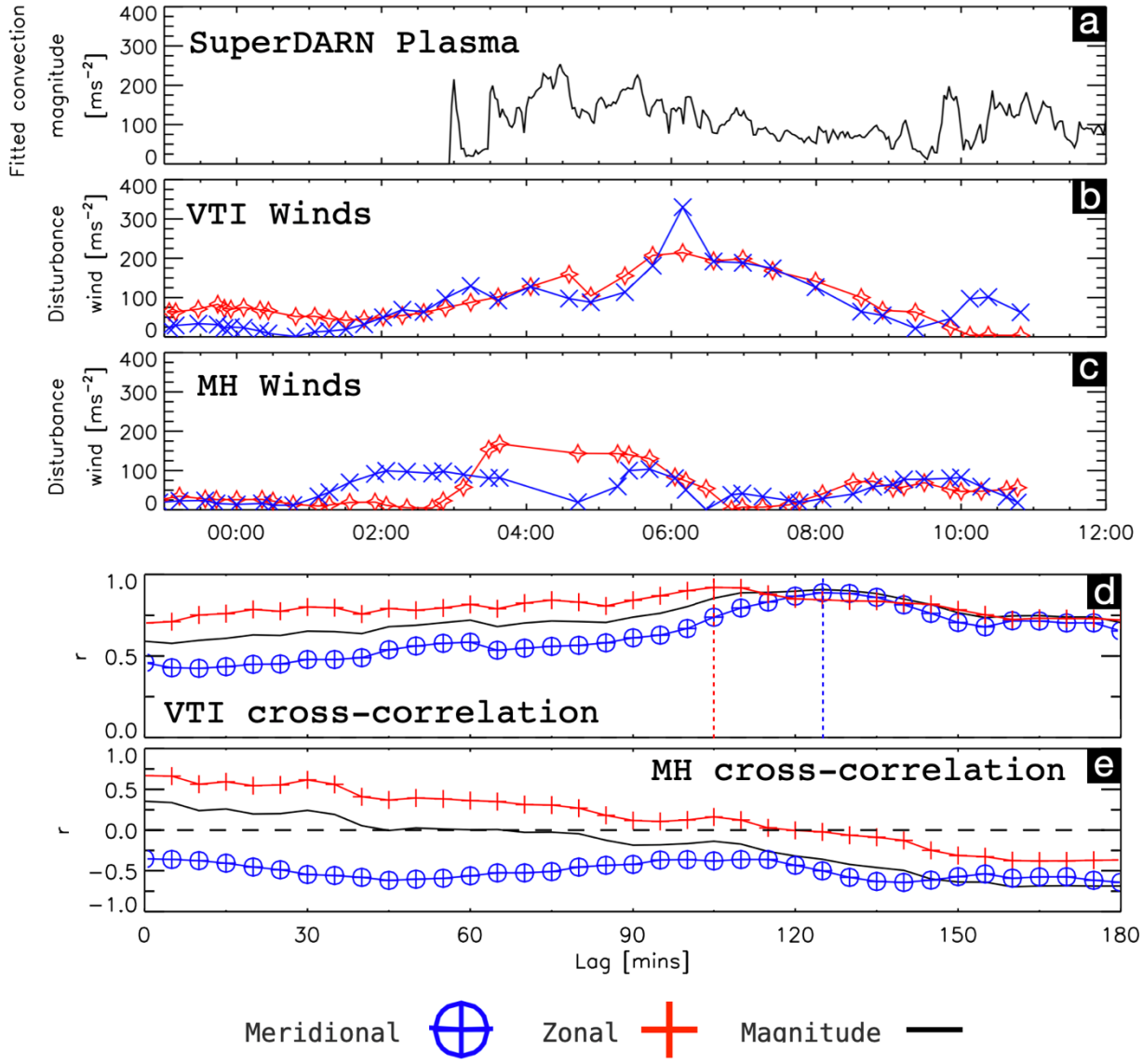
Below is the amended Figure 6, which shows the plasma and disturbance wind timeseries used to perform the cross-correlation. It is the zonal winds at Millstone Hill which gives high correlation with the fitted convection plasma at zero lag. However, these new panels show that the lag for the very first wind enhancement, beginning around 03:00UT for the Millstone zonal winds, is probably closer to 30 minutes.

The cross-correlation looks at entire windows of data, so peaks and troughs at times other that the first wind enhancement don’t correlate as well as at lag=0. This could be for a few different reasons:

- **There are uncertainties in the fitted plasma velocity timeseries. The velocity is set to zero at all times before ~03:00 because the convection fit does not expand into the latitude where the average (the box in Figure 5) was taken. This might not truly be the case, but the fit is being constrained by data elsewhere to a higher latitude.**

- **There is no time history in the convection fitting, causing a certain degree of jumpiness between sequential convection patterns. This is most prominent with the convection velocity spike at ~03:00, which may not be realistic. In reality, the convection velocity would evolve more smoothly.**
- **We assume that quiet time winds are fully removed to leave the disturbance winds using HWM14, but this is unlikely the case because it is only a climatology. Therefore, there is probably at least a small amount of forcing on the disturbance winds from non-SAPS related sources (e.g. solar heating pressure gradients, Coriolis, etc).**

In summary, in the revised manuscript we have added new timeseries panels to Figure 6. We have also included additional discussion about the caveats surrounding cross-correlation and the meaning of "zero lag", as described in our points above, from L248 onwards. We still use cross-correlation, as it is a good way to give an empirical lag value for the event as a whole, despite its shortcomings.



Reviewer 2

The surname of one of the co-authors is misspelled: Chariter should be Chartier.
Line 40: The digit ‘4’ is used here when referring to the SuperDARN radars used but in the rest of the paper ‘four’ has been spelled out.
Line 40: 'FPIs' is incorrectly written: ‘that the FPIFPIss both observed’
Throughout the paper the Wallops Island SuperDARN radar is referred to as ‘Wallops’ only, including in the relevant figures and their captions.
Line 99: ‘the “main phase” of geomagnetic’ change to ‘the “main phase of [a/the] geomagnetic’
(Optional) Line 103: When mentioning the plots in Figure 2 of the SuperDARN data, they can specifically be referred to as 2c-f.
Line 115: The units of this line do not need to be in italics: ‘where they reach approximately 30ms-1’.
Line 150: When defining what SSUSI stands for, the first S stands for ‘Special’.
Line 151: The D in DMSP is spelled ‘Defense’.
Line 168: ‘exist’ not ‘exists’.
(Optional) Line 196: For consistency with the rest of the paper, 11 UT could be written as 11:00 UT. Line 201: 03 UT could be written as 03:00 UT
Line 205: ‘lower-latitude winds is may…’, the ‘is’ should be removed.
Line 270: ‘Polarization’ with a ‘z’

We have fixed all the typographic errors and implemented the reviewers suggestions.