We would like to thank the reviewer for their careful consideration of the manuscript and their valuable and detailed comments. Our responses are provided below.

Comment 1: *I therefore recommend that the paper is restructured to reduce the early discussion of asymmetric tail untwisting, and not to interpret the observations as a departure from that (since the spacecraft seem to be in a location where the tail By component is dominated by flaring, rather than IMF penetration), but instead to frame the interpretation in terms of the negative Vperp_y values departing from the expected duskward convection at this location.*

Response 1: We agree that the expected flow at the pre-midnight location of the spacecraft is duskward, and that the departure from this, in the southern hemisphere observations in particular, is the main inconsistency between what is 'expected' and what is seen. However, we argue that the pre-midnight location does not necessarily preclude dawnward flow in the southern hemisphere in the case that a strong IMF $B_y < 0$ twist is present. Critically, previous studies (such as those by Pitkänen et al., 2013, 2017) have based their interpretation of similar fast flows on this very assertion. So, we think that it is still important to rule out the possibility that C1 is actually observing tail untwisting due to IMF $B_y < 0$ penetration. We will attempt some restructuring along the lines suggested, including mentioning the expected duskward convection at the spacecraft location (even in the case of no large-scale asymmetry) and bring in the concept of magnetotail flaring much earlier in the manuscript.

Comment 2: *Lines 65-8: This is the predominant behaviour, but it is location dependent (i.e. flaring dominates away from midnight).*

Response 2: We agree with the reviewer that the flaring effect will dominate further away from midnight. As noted above, previous studies such as Pitkänen et al. (2013, 2017) have investigated IMF B_y control of magnetotail flows at up to ~ 7 R_E towards the dusk-dawn flanks which revealed a clear dependence of the flows on IMF B_y, so we do think it is important to at least mention this here. However, we will make clearer that this behaviour is expected to be dominant close to midnight, but that other sources of B_y (away from midnight), such as flaring, are expected to be significant.

Comment 3: *Line 218: This is the first sign that flaring may be dominant, as I think the By sign reversal here is not what is expected in the tail twist scenario (near to midnight)? Similarly for the observations described at lines 223-5*

Response 3: We agree with the reviewer that this suggests that the flaring is dominant, both at line 218 and lines 223-225. We will make it clearer at these points in the manuscript that these observations are consistent with magnetotail flaring. The reviewer is also correct in that closer to midnight, one might expect to observe $B_y > 0$ irrespective of hemisphere (see Fig. 5b), in the case of IMF $B_y > 0$ tail twisting.

Comment 4: *Line 220: I think it is important to mention in the text that the solid lines in Fig 2b iv-vi are the field-perpendicular component, and the dotted lines are the total velocity components. This information is in the figure caption, but it only becomes apparent in the main body of the text at line 242.*

Response 4: We will amend this in the revised manuscript.

Comment 5: *Lines 258-62: Here, you are again describing observations that are consistent with flaring.*

Response 5: Here, does the reviewer mean 'inconsistent' with flaring? In the pre-midnight sector, one would expect to observe $B_y > 0$ where $B_x < 0$ due to the flaring. Instead, C1 observes $B_y < 0$. We do allude to the inconsistency with flaring on line 260: '…this is inconsistent with what we would expect based on the location of the spacecraft…'. Of course, this is also unrelated to any IMF B_y-effect and is instead related to the presence of a localised perturbation.

Comment 6: *Line 278: I think it might be worth rewording this slightly, as the periods of positive Bx also include observations of Vperp_y that are close to zero or even negative (particularly from 00:30-00:31 UT).*

Response 6: We think generally, positive Vperp_y is observed when positive B_x is observed (e.g. 00:30:00 UT, 00:31:20 UT, 00:31:40 UT), but we agree with the reviewer that particularly from 00:30 – 00:31 UT, a mix of positive and (weakly) negative Vperp_y is observed when C1 measures positive B_x. We will tweak this statement accordingly in the revised manuscript to be less definite, e.g. 'At times when B_x became positive, indicating that C1 was above the neutral sheet, C1 observed positive (duskward) $v_{\perp y}$ a majority of the time, although this flow barely reached 100 km s^{-1}.'

Comment 7: *Line 280: To my eye, the positive enhancements in Vperp_y do not seem to be associated with negative enhancements in By. They mostly seem to be associated with either no particular By signature, or a reduction in negative By or positive By turning.*

Response 7: We think the reviewer is correct here. Perhaps, the only exception to this is at ~00:30 UT, where there is a clear decrease in B_y in association with the positive Vperp_y enhancement. We think this is easily remedied by changing our statement on line 280 to: 'The negative enhancements in $v_{\perp y}$ were generally accompanied by negative enhancements in B_y', as this is clearly much more apparent.

Comment 8: *Lines 357-9: Emphasising the expectation from IMF penetration here seems inappropriate, as the observations so far seem to establish that tail flaring is the dominant source of By at this location.*

Response 8: It is important to highlight that our assertion here (lines 357-359) is based *solely* on the IMF data. We do agree with the reviewer that the observations have shown that the flaring is dominant at this location. However, given that previous studies (Pitkänen et al., 2013) have shown an IMF B_y-effect on convection to exist at this location, we think it is important to at least consider. Of course, what we go on to show is that the IMF and ionospheric convection observations do point towards there being a large-scale IMF $B_y > 0$ asymmetry, or certainly, the absence of any IMF $B_y < 0$ effects; which could have explained the dawnward flow observed by C1 in the southern hemisphere.

Comment 9: *Lines 420-3: I was confused by this sentence, as surely even when untwisting happens, the convection cell to which a spacecraft is connected also depends on its local time? Even with untwisting, there are two convection cells (i.e. some field lines return via dawn, and others via dusk), it's just they're asymmetric.*

Response 9: The reviewer is correct that in actuality, the flows that a spacecraft is expected to observe in association with the untwisting are dependent on MLT. However, in the study of Pitkänen et al. (2013), when considering e.g. IMF $B_y > 0$, in the northern hemisphere, only a dawnward flow (in association with the extended dawn cell) would be counted as a flow which agrees with the untwisting hypothesis. A duskward flow in the northern hemisphere, meanwhile, would have been considered to be a flow which disagrees with the hypothesis. Clearly, this is problematic, as it may simply be the case that the spacecraft is located pre-midnight and is observing return duskward convection associated with the dusk cell. This is why our attention is focused on the southern hemisphere, where the observed pre-midnight dawnward flow could only feasibly be explained by a strongly negatively (IMF $B_y < 0$) twisted tail. This is again why we think is important to address and rule out the possibility of an IMF B_y effect. Consequently, the evidence of a large-scale IMF $B_y > 0$ asymmetry is clearly inconsistent with the observed dawnward flow in the SH – which we instead suggest is associated with the flapping current sheet.

Comment 10: *Lines 440-2: I don't think this statement is correct. The northern hemisphere footprints map close to the boundary between the dusk and dawn cells, and the lack of scatter at the northern hemisphere footprint makes it hard to be specific about which convection cell the footprints actually lie in. The authors seem to acknowledge this as a possibility in the lines that follow, but I think the sentence here is too definite. I do agree, though, that the duskward flow seen at the southern hemisphere footprint conflicts with the generally negative Vperp_y observed by C1 in Figure 3 (though it agrees with the generally positive Vperp_y observed by C3, and also by C1 earlier, in Figure 2).*

Response 10: In terms of the specific map that we are referring to (00:30 – 00:32 UT), we do think that the spacecraft footpoints appear to map closer to the dawn cell. But we agree that this statement may be too definite, so we will tweak it slightly to: 'the spacecraft appear to map closer to the dawn cell than the dusk cell, such that the predominantly duskward flow that C1 observed in the northern hemisphere plasma sheet would seem to be inconsistent'.

Comment 11: *Lines 464-8: Just to note that the duskward flow observed by C3 is also consistent with the duskward convection that would be expected in the absence of tail* *twisting, given the spacecraft location. But I agree with the statement on lines 468-72 that the difference between C3 and C1 means something more local is happening at C1*

Response 11: We agree with the reviewer on this point, and we will make this clearer in the revised manuscript: '…and therefore consistent with the southern hemisphere location. It should also be noted that this observation is consistent with the expected duskward flow in a pre-midnight location in the absence of a large-scale asymmetry (e.g. Kissinger et al., 2012)'

Comment 12: *Lines 477-8: Since C2 and C4 are in the northern hemisphere (from Bx), their negative By seems to be consistent with flaring.*

Response 12: We agree with the reviewer here. This is alluded to on lines 528-532, but we will ensure this is clarified earlier on in the revised manuscript.

Comment 13: *Line 537: I think the word "crossing" is superfluous here.*

Response 13: We are grateful to the reviewer for pointing this out. We will remove 'crossing' from the revised manuscript

Comment 14: *Line 696: Do the authors mean Figure 7d?*

Response 14: Here, we are referring to Figure 6d – the schematic in Figure 7d is trying to depict a 'snapshot' which encapsulates the physics & observations across the time window (green shaded region in Fig. 6d).

Comment 15: *- Point 1 (lines 700-2) says that the IMF, ionospheric convection and plasma sheet observations all lead to the expectation of an IMF By > 0 asymmetry. This is true (with respect to the IMF and ionospheric convection) on a global scale, and indeed the ionospheric observations do show asymmetric flows across midnight. But I feel the sentence is a bit misleading, as the IMF and ionospheric observations do not give us grounds to suggest we observe distinct tail untwisting at the location of Cluster (because the northern hemisphere footprint cannot be confidently placed on the dawn cell, given its proximity to the dusk cell and the lack of local scatter, and the southern hemisphere footprint is at a location that would observe duskward flow even without untwisting). Furthermore, I think the sentence is incorrect in saying that the plasma sheet observations show a large-scale asymmetry - the magnetic field observed by C2/C3/C4 (and also C1 before the flapping) seem entirely consistent with flaring and do not show evidence of the penetrated By component being dominant here. Likewise, the convective flows observed by C3 (and C1 before the flapping) are duskward, consistent with the spacecraft being far enough from midnight that flaring is the dominant cause of By, and hence the field lines convect sunward in the same sense as they would in the symmetrical case.*

Response 15: There are a couple of points raised in this comment, and so we address each one in turn (reviewer comment in italic):

I feel the sentence is a bit misleading, as the IMF and ionospheric observations do not give us grounds to suggest we observe distinct tail untwisting at the location of Cluster (because the northern hemisphere footprint cannot be confidently placed on the dawn cell, given its proximity to the dusk cell and the lack of local scatter, and the southern hemisphere footprint is at a location that would observe duskward flow even without untwisting)

We agree with the reviewer that the IMF and ionospheric observations do not allow us to suggest that we are observing tail untwisting at the location of Cluster. What the IMF and ionospheric data do allow us to provide evidence of, however, is a large-scale IMF $B_y > 0$ asymmetry (and a clear absence of any IMF $B_y < 0$). This is a critical detail, because if the C1 observations *were* evidence of tail untwisting, they could have been consistent with tail untwisting for a situation where we had a strongly negatively (IMF $B_y < 0$) twisted tail. This is why it is particularly important for us to rule out this possibility. The fact they were not consistent with this, however, and instead appeared to be associated with the flapping of the current sheet, means that we cannot be observing flow associated with tail untwisting at C1. In terms of C3, the reviewer is correct that the observed duskward flow in the southern hemisphere could simply be consistent with the spacecraft location.

Furthermore, I think the sentence is incorrect in saying that the plasma sheet observations show a large-scale asymmetry - the magnetic field observed by C2/C3/C4 (and also C1 before the flapping) seem entirely consistent with flaring and do not show evidence of the penetrated By component being dominant here. Likewise, the convective flows observed by C3 (and C1 before the flapping) are duskward, consistent with the spacecraft being far enough from midnight that flaring is the dominant cause of By, and hence the field lines convect sunward in the same sense as they would in the symmetrical case.

Perhaps we need to be clearer on this point. We are not suggesting that the plasma sheet magnetic field observations show evidence of the penetrated B_y component being 'dominant' over the flaring – we simply argue that (combined with the IMF and ionospheric data) they lead to the expectation of a large-scale IMF $B_y > 0$ asymmetry. By comparing the plasma sheet magnetic field data to the TA15 model data, the fact that the spacecraft observed coincident B_x, $B_y = 0$ was, in itself, evidence of 'weak' IMF $B_y > 0$ penetration. This is evidenced in Fig. 5, which shows that in the absence of an IMF B_y penetration (left panel) we ought to see a negative B_y when Cluster crosses the neutral sheet. In order to see zero B_y at the crossing points the right hand panel suggests that a weak positive IMF B_y must have penetrated. We will re-word this in the manuscript to be clearer: 'The IMF, ionospheric convection, and comparison of the plasma sheet magnetic field observations to the TA15 model field, all lead to…'. But, as above, we agree with the reviewer that the convective flows observed by C3/C1 prior to the flapping are consistent with the spacecraft location.

Comment 16: *- I think that referring to magnetotail untwisting specifically in point 2 (lines 702-6) is not justified, because of the fact that IMF penetration does not seem to be the main cause of the By components observed at the location of Cluster. But this is easily remedied by reducing the emphasis on tail twisting, and instead comparing with the duskward convection that is expected (and observed, by C3) at this location.*

Response 16: In our study, the IMF B_y had been generally positive for many hours prior to the interval. Previous studies (Pitkänen et al., 2013, 2015) have interpreted their spacecraft observations in the context of magnetotail untwisting (even up to Y_{GSM} ~ 7 R_E), which is why we too frame our observations in this context. We do agree that flaring is dominant over the IMF B_y -effect. However, the dawnward flows in SH are inconsistent with expected duskward convection at the C1 location but *would* be consistent with a strong IMF $B_y < 0$ twist. This is why we think that it is important to rule that the possibility of any IMF $B_y < 0$ penetration in the manner that we do in our study. We will, however, look to reduce the emphasis on this and introduce the concept of flaring much earlier in the paper.

Comment 17: *- I agree with point 3 (lines 706-8), but this is really with respect to the general duskward convection that would be expected at this location, given the local time, TA15 modelling, and the fact that Cluster observes predominantly By components consistent with flaring. I see no reason why, given the authors' results, similar local processes should not be observed nearer to midnight, and therefore act against the tail untwisting process, but I think that is a matter for suggestion for a future study.*

Response 17: We agree with the reviewer on these points.

Comment 18: *Figures (general): There is a standard colour legend for Cluster line traces, which does make it easier to keep track of which trace corresponds to which spacecraft. I would encourage the authors to use that in those figures with Cluster data or footprints, as it really does aid a reader who is familiar with Cluster data. Some of the figures would benefit from being larger.*

Response 18: We will use the standard colour legend for Cluster line traces in the revised manuscript.

Comment 19: *Figure 6: The y axis labels are somewhat crowded in some panels. Also, the green boxes (a) and (c) don't quite line up with the features that are discussed in the text - I think the features being highlighted here are the negative excursions in By, so I think both boxes should move a little to the right?*

Response 19: We thank the reviewer for pointing this out. We will tidy up the y-axis labels and move the boxes a little to the right.