Nightside flow enhancement associated with solar wind dynamic pressure driven reconnection

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[1] Over the past few years the prominent role of solar wind dynamic pressure in enhancing dayside and nightside reconnection and driving enhanced ionospheric convection has been documented by both ground and spaceborn instruments. Super Dual Auroral Radar Network (SuperDARN) observations show that solar wind pressure fronts induce significantly enhanced ionospheric convection in the dayside ionosphere. In parallel, Defense Meteorological Satellite Program (DMSP) precipitating particle measurements and POLAR Ultra-Violet Imager (UVI) images have demonstrated that sudden solar wind pressure increases also significantly reduce the size of the polar cap, especially on the nightside, suggesting an enhancement of magnetotail reconnection. MHD models of the interaction of the magnetosphere with solar wind pressure fronts have reproduced the enhancement of dayside reconnection but have failed so far to account for the observed closing of the polar cap on the nightside and the suggested magnetotail reconnection increase. We use SuperDARN measurements of ionospheric convection within the nightside polar ionosphere, including near the magnetic separatrix, to evaluate the strength of the observed nightside reconnection enhancement after an abrupt increase in solar wind dynamic pressure on 6 November 2000 and compare it with similar observations on the dayside. We show that an enhancement of nightside convection occurs after a sudden increase in solar wind pressure, delayed by about 40 min compared with the observed dayside convection enhancement. The nightside enhanced flows are observed crossing the open-closed boundary determined by POLAR UVI data, indicating an enhancement of tail reconnection that is possibly due to the pressure increase and is, in addition to the tail reconnection, associated with the more immediate closing of the polar cap.


1. Introduction

[2] The importance of magnetic reconnection in the terrestrial magnetosphere was first recognized by Dungey [1961] and through the decades it was established as the main mechanism of energy transfer to the magnetosphere. The Interplanetary Magnetic Field (IMF) and its changes have been traditionally viewed as the main drivers of reconnection and magnetospheric convection. Even though its crucial role is undisputed, recent research has established that, in addition to changes in the IMF, sudden solar wind dynamic pressure enhancements also have profound effects on the magnetosphere-ionosphere system [e.g., Boudouridis et al., 2003; Liou, 2006], and have been shown to induce enhanced dayside and nightside reconnection [e.g., Boudouridis et al., 2004a, 2007].

[3] In a recent study, Boudouridis et al. [2007] used Super Dual Auroral Radar Network (SuperDARN) observations of ionospheric convection in an effort to understand the response of dayside ionospheric convection and reconnection after the impact of a solar wind dynamic pressure front. Their results show a significant increase in ionospheric velocities coinciding with the time of the pressure front impact. Furthermore, the variation in the average flow magnitude exhibits a remarkable correlation with the respective variation in solar wind pressure, suggesting a direct association of dayside convection and, by extension, of the dayside reconnection rate with the solar wind dynamic pressure.

[4] On the nightside, a reconnection enhancement immediately after a sharp increase in solar wind dynamic pressure has been inferred in many recent studies by the observation of shrinking of the polar cap region of open flux. These studies employ either particle precipitation data from low-altitude, polar-orbiting spacecraft or global auroral images
however, they interpreted their results solely in terms of a transient inductive response of the dayside reconnection rate to the increase in pressure, with no evidence in their simulation supporting an involvement of magneto-tail processes. In a follow-up article, Ober et al. [2007] concluded that the enhanced tail reconnection inferred by the polar cap closing observations and the transpolar potential response both occur in conjunction with the solar wind pressure increase, but the two do not seem to be directly related. The MHD simulations by Ober et al. [2006, 2007] did not show any significant increase in the nightside reconnection rate in response to sudden enhancements in solar wind dynamic pressure, and thus were not able to account for the closing of the polar cap seen in observations.

[6] Boudouridis et al. [2008] evaluated the transpolar potential evolution after a long-lasting (~4 hours) solar wind pressure step increase. The potential was to first rise to a maximum value of more than double the prefront potential within an hour, and to then slowly decrease (within 2.5 hours) to lower values even though the solar wind pressure remains steady high. Boudouridis et al. [2008] suggested that tail reconnection might play an important role in the potential temporal evolution, if a nightside reconnection enhancement resulting from the sharp increase in solar wind pressure is of a transient nature, lasting as long as it takes for the magnetotail to adjust to the new external pressure level.

[7] So far, the idea of enhanced magnetotail reconnection after a sudden upward jump in solar wind dynamic pressure has been largely inferred from the poleward motion of the nightside polar cap boundary and the temporal evolution of the transpolar potential. Here we evaluate the magnetotail reconnection response using simultaneous dayside and nightside SuperDARN observations of ionospheric convection during a dynamic pressure enhancement on 6 November 2000, while tracking the motion of the polar cap boundary using concurrent POLAR UVI images of the aurora. The event is the same for which Boudouridis et al. [2007] found a direct correlation between dayside convection and reconnection and the solar wind dynamic pressure. Section 2 summarizes the relevant results by Boudouridis et al. [2007] on the dayside convection and reconnection response for this event. In section 3 we present the nightside UVI and SuperDARN observations, and in section 4 we discuss our results and state our conclusions.

2. Effect of Solar Wind Dynamic Pressure on Dayside Reconnection

[8] The 6 November 2000 pressure-front event exhibits two large pressure enhancements that reached the Earth’s magnetopause at 1800 and 1842 UT, respectively. In Figure 1 we show the relevant solar wind and IMF quantities for 1700–2100 UT on 6 November 2000, measured by ACE at (219, 15.7, −23) R_E in the undisturbed solar wind, and propagated to X_{GSE} = 17 R_E by the minimum variance technique of Weimer et al. [2003] (J. M. Weygand, private communication, 2006). From top to bottom we plot IMF magnitude, B_y and B_z components, solar wind velocity, density, and dynamic pressure as a function of time. The two vertical lines at 1800 UT and 1842 UT denote the two pressure enhancements. Before the first pressure enhancement
the solar wind pressure was stable at ~5 nPa. At impact the pressure rises quickly (within 5–10 min) to 20–25 nPa for about 5–10 min and then drops down to ~10–15 nPa, still higher than before the pressure front impact, for about 35 min. At this point the pressure exhibits another peak, rising up to almost 20 nPa for ~20 min. During this period the IMF is steady southward in the (−8–12) nT range, except for a brief (~5 min) positive excursion at the time of the first pressure peak. IMF $B_z$ is positive and exhibits short-lived decreases during the two pressure peaks, becoming negative for a few minutes during the second pressure increase.

[9] Boudouridis et al. [2007] analyzed the individual 2-min resolution SuperDARN convection measurements during both these pressure peaks (see section 3 for a brief description of the SuperDARN flow measurements). They observed an enhancement of ionospheric convection in the prenoon sector, which reached a maximum ~4 min after each corresponding pressure enhancement maximum and then subsided when the pressure returned to more moderate values. The flow enhancement was most visible near the expected location of the cusp, consistent with the prevailing direction of IMF $B_z$, [Crooker, 1979], which was positive during the entire period of observation. Also, by using a suitable average of the observed velocities within a specific area (06–12 MLT and above 68° MLAT), they demonstrated a clear correlation between the dayside convection, and thus dayside reconnection, and the solar wind dynamic pressure.

3. Effect of Solar Wind Dynamic Pressure on Nightside Reconnection

[10] In this section we present observations that support the idea of enhanced nightside reconnection after the pressure enhancements on 6 November 2000. First we show UVI observations of the nightside closing of the polar cap, and then present nightside SuperDARN flow measurements and their comparison with both the dayside SuperDARN observations of the previous section and the UVI-deduced polar cap boundary.

3.1. UVI Observations on 6 November 2000

[11] In Figure 2 we show four keograms of the UVI emissions for the entire 17–21 UT interval. For each individual UVI image, the UV emissions are averaged within four 2-hour MLT sectors and plotted as a function of time and MLAT, with color indicating the energy flux of the aurora precipitation in mW/m² [Lummerzheim et al., 1997]. Counterclockwise from the top left are the MLT sectors 20–22, 22–24, 0–2, and 2–4. The MLAT range for each individual panel is 45°–90°. The two vertical black lines at 1800 and 1842 UT mark the solar wind pressure enhancement impacts.

[12] The effect of the two compressions on the auroral emissions is clear in the two postmidnight sectors on the right. The 2–4 MLT sector energy fluxes show a remarkable correlation with solar wind pressure, exhibiting an increase by a factor of ~2 after each pressure enhancement. The energy flux responds within ~5 min after the first pressure peak. In between the two pressure peaks the energy flux remains elevated at 15–20 mW/m² as the aurora is still under the influence of the first pressure enhancement, and the solar wind pressure is higher than its prefront values as mentioned in the previous section. The energy flux rises again very quickly to reach ~25 mW/m² after the arrival of the second pressure enhancement. The same response is seen in the 0–2 MLT sector after the first pressure peak, with the pressure rising by a factor of ~2 in just 5 min. The response is a little less clear after the second pressure peak but again we observe an auroral enhancement that tops ~25 mW/m² in a very short time. The two premidnight sectors, 20–24 MLT, show a weaker response to the two incoming pressure fronts. Even so, the UV emissions substantially increase, by a factor of 2–3, after the initial pressure enhancement. However, the picture is not as clear after the second pressure peak which leads to a moderate energy flux increase in the 20–22 MLT sector, and a weak increase, if at all, in the 22–24 MLT sector.

[13] Simultaneously with the increase in UV emissions we observe a poleward expansion of the auroral oval. The poleward motion of the high-latitude aurora boundary is most clearly observed in the 2–4 MLT sector where it moves by several degrees MLAT in response to each pressure enhancement. A similar picture emerges in the 0–2 MLT sector with a clear poleward motion of the poleward boundary after the first pressure enhancement, and a smaller but still considerable poleward motion after the second pressure peak. The situation is more complicated in the two premidnight sectors, 20–24 MLT. The auroral oval is observed to grow and expand poleward after the first pressure increase, more so in the 20–22 MLT sector than in the 22–24 MLT sector. This motion is, nevertheless, more limited and less obvious compared to the two postmidnight sectors. After the second pressure peak the motion of the poleward boundary is unclear, and it even seems to retract equatorward in the 22–24 MLT sector. We will present more quantitative poleward boundary determinations with 15-min wide MLT sectors in section 3.2, and show that the poleward aurora boundary moved poleward after the second pressure peak in the 21–23 MLT sector where enhanced nightside flows are observed.

[14] In general, the poleward motion of the nightside poleward aurora boundary after each pressure peak is consistent with previous observations and strongly suggests a corresponding enhancement of tail reconnection in each case, with the increase in auroral emissions suggesting that there is particle precipitation from newly closed and filled flux tubes.

3.2. SuperDARN Observations on 6 November 2000

[15] Before we proceed with the analysis of the nightside SuperDARN observations, it is worth pointing out that a study of this nature is quite difficult as SuperDARN backscatter on the nightside tends to disappear following increased geomagnetic activity. This effect has been documented mostly in the case of substorms [Wild and Grocott, 2008, and references therein] when it is mainly attributed to absorption of High Frequency (HF) radio waves by the enhanced electron densities in the substorm precipitation region, and/or rapid changes in HF propagation conditions. A more general study of the decrease in radar backscatter with geomagnetic activity was undertaken by Milan et al. [1997]. They found that the dependence of backscatter on geomagnetic activity is more pronounced during the months
of March to October, and is again due to either increase in wave absorption or loss of the orthogonality condition which means that the far-range F region is no longer illuminated by the radar. Our event occurs during the month of November when less signal reduction is observed during disturbed conditions. It is also likely that a solar wind pressure front induces less auroral precipitation than a substorm, allowing for nearly uninterrupted coverage of the nightside convection.

First we look at how the average nightside flows compare with the dayside flow peaks. In Figure 3 we plot the average SuperDARN flows above 68° MLAT in eight 2-hour MLT sectors for the interval 1700–2000 UT on 6 November 2000 (there is no significant SuperDARN data in the 00–08 MLT sectors), together with solar wind pressure and IMF $B_z$ as measured by Geotail in the magnetosheath (bottom two panels). The Geotail data have been shifted backward in time by 6 min to account for the solar wind propagation from the nose of the magnetopause to Geotail’s position. The morning sectors are at the bottom, above the solar wind data, with afternoon sectors in the middle and the night sectors at the top. The two purple lines indicate the times of the magnetopause impact of the two main pressure peaks. The average flows are color-coded according to the scale at the left of each panel for every 200 m/s.

The ionospheric convection response to the incoming pressure pulses is clearly seen in the two morning sectors, 08–10 and 10–12 MLT, and to a lesser degree in the 12–14 MLT sector. Moving into the afternoon sectors the two convection peaks seem to fade or perhaps merge. However, the two premidnight sectors, 20–22 and 22–24 MLT, show two clear convection enhancements (marked by red arrows in each panel), significantly shifted in time and reduced in magnitude. Both nightside convection peaks appear to be delayed by ~40 min from the dayside convection enhancements to which they may be related.

Figure 4 shows six consecutive plots of 2-min resolution SuperDARN flow data between 1916 and 1928.
UT, around the time of the second nightside flow peak at ~1920 UT (the first nightside flow peak does not have good SuperDARN coverage near the separatrix). Each panel shows a polar plot of the horizontal line-of-sight velocities from all Northern Hemisphere radars on an altitude-adjusted corrected geomagnetic (AACGM) latitude-longitude grid [Baker and Wing, 1989; Ruohoniemi and Baker, 1998]. Noon MLT is at the top, and dawn on the right. The dotted coordinate system is an MLAT/MLT grid. The velocity vectors have a small dot at the center of the grid cell at the origin of the vector and point toward the direction of the flow. The length of the line denotes the velocity magnitude according to the scale vector on the right. For easy comparison, the vectors are colored in six velocity bins, each with bin size of 200 m/s, according to the color scale on the right. The bigger blue dots indicate the radar locations.

Figure 3. Average SuperDARN-measured flows above 68° MLAT in eight 2-hour MLT sectors for 1700–2000 UT on 6 November 2000 (top eight panels). The bottom two panels show the solar wind pressure and IMF $B_z$ measured by Geotail. The two vertical purple lines at 1800 and 1842 UT mark the times of the two pressure peaks. The two convection peaks can be clearly seen in the morning-to-noon sectors immediately after. They are also detected in the two night sectors, 20–22 and 22–24 MLT (marked by the red arrows).
Before the time of the first panel on the top left, the ionospheric velocities in this region were generally in the 0–200 m/s velocity bin (1912–1914 UT, not shown), and abruptly increased to 200–600 m/s at 1914–1916 UT (also not shown). In the first two panels at the top of Figure 4, 1916–1920 UT, the enhanced flows are located equatorward of \(70^\circ\) MLAT with flow speeds in the range of 400–800 m/s. Beginning with the next frame, 1920–1922 UT, the convection enhancement grows further, with a significant portion of the observed flows now above 600 m/s. At the same time, the enhanced flow patch expands poleward beyond the \(70^\circ\) MLAT circle, and in the 1922–1924 UT panel it included many vectors with magnitudes above 800 m/s. It finally attains its maximum strength in the 1924–1926 UT panel, when the flows reach in excess of 1000 m/s, and expands as high as \(73^\circ\) MLAT. By the last

**Figure 4.** Six SuperDARN plots of the convection over the Northern polar region starting at 1916 UT on 6 November 2000. The convection enhancement observed in the average flows on the nightside is marked here with a red oval in the premidnight sectors.
time shown, the convection enhancement has been reduced to well below its peak value, declining even further in the next few 2-min SuperDARN intervals (not shown).

[20] These observations show an enhancement of ionospheric convection occurring near 22 MLT, and about 40 min after the second solar wind pressure peak at 1842 UT. In order to assess if this convection enhancement corresponds to an increase in the nightside reconnection rate we have to examine its location relative to the nightside separatrix or the open-closed field line boundary (OCB). In Figure 5 we magnify the 1924–1926 UT SuperDARN frame, in which the nightside convection enhancement attains its maximum magnitude and extent. Unlike Figure 4, in this plot we combine the line-of-sight flows measured by two different radars at the same location for all the points where two radar measurements are available. These full-flow vectors are marked with bigger diamonds, while the single-radar, line-of-sight vectors are denoted by smaller dots as before.

[21] In addition to the horizontal velocities we also plot the poleward boundary of the aurora as determined by POLAR UVI observations. Previous studies have shown that auroral boundaries determined from global UV images agree within a few degrees MLAT with DMSP precipitating particle boundaries [Kauristie et al., 1999; Baker et al., 2000; Carbary et al., 2003]. In particular, the statistical study of Baker et al. [2000] has shown that the POLAR UVI poleward auroral boundary is on the average about 1° MLAT poleward of the DMSP-based discrete aurora poleward boundary in the evening sector (with a standard deviation of 1.2° MLAT). The DMSP discrete aurora poleward boundary is considered to be the best estimate of the OCB [Newell et al., 1996], lying on or slightly equatorward of the OCB, and thus rendering the UVI-based poleward auroral boundary an excellent locator of the OCB. Baker et al. [2000] also identified the ratio technique, with values 0.2–0.3 of the maximum UVI intensity, to be the
Figure 6. MLAT of the poleward oval boundary determined by POLAR UVI images as a function of time for 1830–1930 UT on 6 November 2000. The boundary is determined for eight 15-min wide MLT sectors in the 21–23 MLT range where the enhanced nightside SuperDARN flows are observed. The black and red lines correspond to 20% and 30% value of the maximum average UVI intensity within each 15-min MLT sector, respectively. The solid blue line indicates the second pressure peak time, and the dashed blue lines bound the enhanced nightside flow interval of Figure 4.

most suitable method for correctly reproducing the location of the DMSP discrete aurora poleward boundary, and therefore this is the limit we use in our study. For each UVI image within the 2-min SuperDARN integration time, and every 15 min MLT sector, we identified the position of the poleward boundary as the point of 20% (black line) or 30% (red line) value of the maximum auroral intensity within that 15-min MLT sector. We then took an average of these boundaries for all UVI images within the 2-min SuperDARN interval (3–4 images for the ~37 s UVI resolution).

[22] It can be seen from Figure 5 that the nightside convection enhancement occurs near the location of the OCB (72° MLAT) in the premidnight sector. The presence of echoes from two adjacent radars allows us to identify the predominant direction of the flow at this location. This is primarily equatorward and slightly eastward. The enhanced flows traverse the OCB revealing the initiation of enhanced magnetotail reconnection. This reconnection enhancement is in addition to the one we have previously inferred based on the nightside closing of the polar cap seen in the UVI data of Figure 2 at earlier times.

[23] The overall motion of the poleward aurora boundary in the 21–23 MLT range, that coincides with the enhanced nightside ionospheric flows, after the second pressure pulse is shown in Figure 6. In this figure we plot the MLAT of the poleward boundary in 8 15-min wide MLT sectors as a function of time for 1830–1930 UT. The same two boundaries as in Figure 5, corresponding to 20% (black) and 30% (red) value of the maximum average auroral intensity within each 15-min MLT sector, are shown. The solid blue line indicates the second pressure peak time, and the dashed blue lines mark the interval of the enhanced nightside flows of Figure 4.

[24] Immediately after the solar wind pressure increase, the bottom two panels, 2100–2130 MLT, show that the poleward boundary first moves equatorward before it starts moving poleward 10 min later, only to reach similar MLAT to that before the pressure peak. The next two panels, 2130–2200 MLT, also exhibit a slight decrease of the poleward boundary MLAT, but their recovery now brings the boundary 1–3° higher than before the pressure jump. Finally, the top 4 panels, 2200–2300 MLT, show a significant poleward motion of the boundary, ~2–4° MLAT, that occurs progressively faster at later MLTs, and is also faster for the 20% maximum intensity boundary than for the 30% boundary. All MLT sectors shown display a poleward moving displacement of the poleward aurora boundary starting less than 10 min after the solar wind pressure enhancement at 1842 UT. By 1855–1900 UT the 20% poleward boundary has reached about 70° MLAT in nearly all 8 MLT sectors. While there were data gaps beyond 1900 UT, this trend seems to continue and the 20% poleward boundary reached ~72° MLAT just before the initiation of the enhanced nightside flows. As the enhanced nightside convection starts, this boundary moves even higher, reaching 73° MLAT in all 8 sectors at 1922 UT. Similar results apply for the 30% boundary.

3.3. Summary of Observations

[25] In this section we used POLAR UVI and SuperDARN observations from the nightside ionosphere to study the effect of a double peaked abrupt pressure enhancement on the nightside auroral intensity, the polar cap boundary motion, and the ionospheric convection. Our observations suggest that after sudden enhancements in solar wind dynamic pressure, the magnetotail reconnection rate is enhanced, as is evidenced by both the poleward motion of the polar cap boundary and the plasma flow across this boundary. This implies a profound role of solar wind dynamic pressure enhancements in magnetotail dynamics.

[26] The UVI data show a significant increase in auroral emissions and a poleward expansion of the auroral oval following the increase in pressure after each pressure peak, an observation that has been reported many times. The response is most evident in the 2–4 MLT sector, but is present in the other nightside sectors, especially for the first pressure enhancement at 1800 UT. The response time for the first pressure peak is about 5 min with the auroral intensity reaching its maximum in ~10–15 min. The response time of the auroral intensity and poleward boundary to the second pressure peak is more variable, perhaps because the nightside ionosphere is already under the influence of the first pressure enhancement.
4. Discussion and Conclusions

The SuperDARN data in the premidnight sectors show an interesting correlation with the dayside SuperDARN observations of Boudouridis et al. [2007]. The average sector flows in the 20–22 and 22–24 MLT sectors exhibit similar convection enhancement peaks with those in the morning-to-noon sectors, only delayed by about 40 min and significantly weaker. Detailed study of the individual flow vectors in the two premidnight sectors after the second pressure peak at 1842 UT shows that the convection enhancement began around 1914 UT, slowly gaining strength until ~1924 UT when it reached its maximum intensity and poleward extent. At this time, 1924–1926 UT, comparison of the enhanced flow vectors with the POLAR UVI-deduced polar cap boundary reveals that the enhanced ionospheric flows cross the OCB.

Our observations also suggest that, even though the nightside polar cap boundary responds fast to the incoming pressure increase, starting moving poleward in ~5 min, the nightside flow enhancement is not initiated until much later (~32 min after the pressure increase in the case of the second pressure peak). This implies that the tail reconnection enhancement closes open field lines on the nightside and fills them with plasma which precipitates to the ionosphere almost immediately after the increase in solar wind pressure, but suggests that the newly closed field lines are not set in motion until about half an hour later, with additional reconnection increases following as is evidenced by the flow vectors crossing the OCB in Figure 5. The initial tail reconnection enhancement (evidenced in the UVI data) corresponds to poleward motion of the OCB in the ionosphere, while the later reconnection enhancement (evidenced by the enhanced ionospheric flows crossing the OCB) corresponds to plasma convection through a separatrix that is relatively stationary as projected to the high-latitude ionosphere.

It is not immediately clear, however, why there exists such a delayed response between the two different types of tail reconnection enhancement. At first glance it might seem that the enhanced nightside flows are just the remnant of the dayside flows described by Boudouridis et al. [2007] after they convected across the polar cap to the nightside. However, the timing and evolution of the nightside flow enhancements are not consistent with this scenario. Boudouridis et al. [2007] showed that the second pressure peak that arrives at the magnetosphere at 1842 UT, produces enhanced flows in excess of 1000 m/s in the 10–12 MLT sector and near 75° MLAT. Assuming an enhanced flow magnitude of 1200 m/s, the closed magnetic field lines that open through dayside merging at 1842 UT will move over the polar cap to the nightside and reach 70° MLAT near 22 MLT, the location of the enhanced nightside flows, in about 54 min if they preserve their initial flow magnitude during this period. This is substantially longer than the observed 40 min separation between the dayside and nightside convection enhancements. In addition, the nightside flows grow first at lower MLAT, ~67° (as seen in Figure 4), before they expand poleward beyond 70° MLAT, indicating an independent flow enhancement associated with enhanced tail reconnection. The enhanced dayside flows could have been convected over the polar cap, but reaching only 80° MLAT on the nightside in 40 min, perhaps corresponding to a slightly enhanced patch of convection, below 400 m/s, seen in Figure 4 near 22 MLT.

A possible interpretation of the time delay between the pressure enhancements and the nightside convection excitation, or equivalently the nightside aurora and convection responses, might be that the conductivity enhancement resulting from the aurora intensification after the increase in solar wind pressure depresses the electric field, and thus the field-line motion can only take place once the auroral intensity begins to subside. In Figure 7 we test this idea by comparing the auroral intensity and the nightside flows during and after the two pressure enhancements. In the top panel we show a keogram of the UV emissions in the 21–23 MLT sector, where the most intense convection enhancement is observed, for 1745–1945 UT and in the same format as in Figure 2. The two black lines indicate the times of the pressure enhancements. The middle panel shows a line plot of the total UV flux as summed between 45° and 90° MLAT, for the same UT interval and MLT sector. In the bottom panel we plot the average SuperDARN flows above 65° MLAT in the same MLT sector. The red lines in the bottom two panels denote again the pressure fronts, while the blue hatched regions correspond to the intervals of enhanced convection. The clear anticorrelation observed between the total auroral flux and the nightside flows after each pressure peak suggests that the above mechanism has the potential of explaining the aurora/convection response delay. We should
during sudden enhancements of solar wind pressure are necessary to ascertain the accuracy and statistical validity of our conclusions. If such analysis provides verification of the associations suggested here, models of the interaction of such pressure fronts with the magnetosphere-ionosphere system will need to be reevaluated and, if necessary, modified to account for the polar cap boundary and convection observations on the nightside after sharp increases in solar wind dynamic pressure.

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