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Comparison of ionospheric convection and the transpolar potential before and after solar wind dynamic pressure fronts: implications for magnetospheric reconnection

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The solar wind dynamic pressure, both through its steady state value and through its variations, plays an important role in the determination of the state of the terrestrial magnetosphere and ionosphere, its effects being only secondary to those of the Interplanetary Magnetic Field (IMF). Recent studies have demonstrated the significant effect solar wind dynamic pressure enhancements have on ionospheric convection and the transpolar potential. Further studies have shown a strong response of the polar cap boundary and thus the open flux content of the magnetosphere. These studies clearly illustrate the strong coupling of solar wind dynamic pressure fronts to the terrestrial magnetosphere-ionosphere system. We present statistical studies of the response of Super Dual Auroral Radar Network (SuperDARN) flows, and Assimilative Mapping of Ionospheric Electrodynamics (AMIE) transpolar potentials to sudden enhancements in solar wind dynamic pressure. The SuperDARN results show that the convection is enhanced within both the dayside and nightside ionosphere. The dayside response is more clear and immediate, while the response on the nightside is slower and more evident for low IMF By values. AMIE results show that the overall convection, represented by the transpolar potential, has a strong response immediately after an increase in pressure, with magnitude and duration modulated by the background IMF Bz conditions. We compare the location of the SuperDARN convection enhancements with the location and motion of the polar cap boundary, as determined by POLAR Ultra-Violet Imager (UVI) images and runs of the Lyon-Fedder-Mobarry (LFM) global magnetohydrodynamic model for specific events. We find that the boundary exhibits a poleward motion after the increase in dynamic pressure. The enhanced ionospheric flows and the poleward motion of the boundary on the nightside are both signatures of enhanced tail reconnection, a conclusion that is reinforced by the observation of the enhanced flows crossing the polar cap boundary in selected case studies when simultaneous measurements are available.