Generation of convection in the topological magnetospheric system

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It is widely believed that the coupling of solar wind plasma to the magnetosphere occurs through magnetic merging between the IMF and the geomagnetic field. However, exact location where this process occurs is not well known although a magnetic merging process is expected in the topologically critical region on the separating surface between the geomagnetic field and the solar wind. This separating surface encompassing the open and closed field line volumes is the separatrix surface which ensheathes the separator line. Magnetic merging is expected to occur on the separator line which joins two cusp nulls on northern and southern hemispheres. Convection both in the magnetosphere and in the ionosphere may be driven mechanically by the transfer of solar wind plasma onto geomagnetic field through merging. In the northward IMF case with non zero IMF By, the IMF merges with closed geomagnetic field line to generate the merging cell. The ionospheric merging cell surrounds the lobe cell which nests in the center of the polar cap and spans the polar cap boundary. On the magnetospheric side, magnetic field lines that radiate from or converge onto the cusp nulls generate the separatrix surfaces. The northern null point generates the dawnside half of open-closed boundary and duskside open-IMF boundary, and the southern null point generates duskside half of open-closed boundary and dawnside open-IMF boundary. In the merging cell convection, closed geomagnetic field lines must be recreated from the down stream merging. Dayside merging, convection and down stream merging must be understood as a whole. It is the purpose of this paper to consider the globally self-consistent structure of the merging cell convection under the northward IMF condition.