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Reversed two-cell convection in the northern and southern hemisphere during northward IMF

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This paper presents a case study of high-latitude ionospheric convection in the northern and southern hemispheres under strongly northward interplanetary magnetic field (IMF) conditions on 9 November 2004. Using a comprehensive data set from both ground- and space-based instruments, the study shows the formation of reversed two-cell convection in both northern and southern hemispheres that lasted for nearly two hours. Examination of the concurrent satellite energy-time spectrograms of precipitating particles reveals that reverse convection occurs in the region filled mostly with the boundary plasma sheet (BPS) type precipitating electrons except that the electron number flux is much smaller than that in the normal BPS. We have named this region the northward Bz boundary layer (NBZBL), which we interpret as a consequence of double lobe reconnection. This interpretation is corroborated by the global MHD simulations, which show that the NBZBL consists of mostly closed field lines, resulting from double lobe reconnection in both hemispheres, together with intermittent presence of overdraped open field lines, resulting from single lobe reconnection in one of the hemispheres. In addition to reversed two-cell convection, the distribution of field-aligned currents (FACs) shows clearly the presence of a pair of the northward Bz (NBZ) currents near the central polar region in both hemispheres. Intense downward Poynting flux with a peak value around 100 mW/m2 is also seen in the high-latitude polar region, which tends to surround the upward leg of the NBZ currents. Finally, the potential drop between the two reverse convection cells exceeds 100 kV, which is far larger than the values reported in any previous studies of reverse convection under northward IMF conditions. The unusually large reverse potential drop in this case is attributed in part to the strong northward Bz component of 35$\sim$40 nT and in part to the unusually large solar wind dynamic pressure that is about 5 times its nominal value.