Evolution of reverse convection cell responding to changes in the IMF as derived from SuperDARN observations and MHD simulations

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The evolution of the reverse convection cells in the dayside polar cap during northward IMF is examined with SuperDARN HF radar data and three-dimensional MHD simulation. When the IMF angle was larger than 40 degrees, the two-cell convection was well developed. A new reverse cell emerged in the post-noon sector as the IMF angle became smaller than 40 degrees. We found that there was a demarcation angle of about 40 degrees between two-cell and four-cell convection pattern. We compared the observations with the three-dimensional MHD simulation. The calculated steady-state convection pattern has a demarcation at 30 degrees in good agreement with the observed demarcation at 40 degrees.

The evolution of the reverse convection cells in the dayside polar cap during northward IMF is examined with SuperDARN HF radar data and three-dimensional MHD simulation. While the northward IMF lasted for about 10 hours on September 23, 2000, IMF By component was mostly positive and the B total was about 15 nT. We examined the correlation between the orientation angle of IMF measured from the north to the east and evolution of reverse convection cells. When the IMF angle was larger than 40 degrees, the two-cell convection was well developed. At the angle of nearly 40 degrees, the dusk cell expands into the dawn sector. A new reverse cell emerged in the post-noon sector as the IMF angle became smaller than 40 degrees. The two-cell convection pattern changed to the four-cell pattern through three-cell pattern consisting of the well-developed dusk cell, the dawn cell, and the new reverse cell at post-noon. We found that there was a demarcation angle of about 40 degrees between two-cell and four-cell convection pattern during the event period of ten hours. We further present another example of changes in the convection pattern from a multi-cell to two-cell on November 17, 1996. The total IMF intensity was about 5 nT that is smaller than that of the first event. As the IMF angle increased, the reverse cell at pre-noon developed more significantly than the reverse cell at post-noon. The reverse cell at pre-noon merged with the normal dusk cell at the IMF angle of 90 degrees. The reverse cell at post-noon was pinched off by the evolving two cells. We compared these observations with the three-dimensional MHD simulation. The steady-state convection pattern calculated as a function of the IMF angle has a demarcation at 30 degrees that is in good agreement with the observed demarcation at 40 degrees during the event on September 23, 2000. On the other hand, the MHD simulation carried out with the solar wind parameters observed during the event on November 17, 1996 shows that the four-cell pattern changed to the two-cell pattern at 90 degrees, which agrees again with the observed evolution of the convection cells. The good agreement between the SuperDARN observation and the MHD simulation for the two distinct events suggest that the demarcation angle between the two-cell and four-cell convection pattern is variable significantly, which may be controlled by the intensity of the IMF.