

MHD Simulation of Interaction of the Solar Wind with Earth's Magnetosphere for the Magnetic Storm Event in December 2006

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A three-dimensional global MHD simulation of interaction between the solar wind and the earth's magnetosphere has been executed to study the magnetic storm events on space weather problem for December 13-16, 2006, when large interplanetary disturbances were generated in association with the strong solar activity of X-class flares. Characteristic features of the event are two X-class flares on 12/13 and 12/14 in the interval of rather quiet solar activity, north-south fluctuation of IMF and a long duration of southward IMF from 12/14, arrival of a high speed solar wind during the time for southward IMF.

In the simulation, arrival of the shock wave with high speed suddenly compresses the dayside magnetopause and drives oscillations then successively compress the whole magnetosphere. At the same time twin vortices transiently generate in polar convection, propagate from day to night in a few minutes and gradually disappear. Such twin vortices repeatedly generate depending on variations of the IMF and solar wind dynamic pressure. Therefore magnetic fluctuations with periods of 3-5 minutes are easily excited in the magnetospheric boundary. Magnetic reconnection which occurs in the tail is stressed by compression and magnetospheric convection complicatedly varies by IMF orientation. For rapid southward turning of IMF from northward IMF, tail reconnection is enhanced and hot plasmas are injected around the geosynchronous orbit from the plasma sheet.