Statistical identification of solar wind origins of magnetic impulse events (MIEs)

Ryuho Kataoka[1], Hiroshi Fukunishi[2], Louis J. Lanzerotti[3]

[1] Dep. of Geophysics, Tohoku Univ., [2] Department of Geophysics, Tohoku Univ., [3] Bell Labs.

http://pat.geophys.tohoku.ac.jp/~ryuho/indexj.htm

Magnetic impulse events (MIEs) are identified as solitary magnetic disturbances observed by ground-based magnetometers with durations of 5-15 min and amplitudes of 50-200 nT at dayside high-latitudes. Because of the solitary features, MIEs provide an important clue to the understanding of the transient response of the coupled magnetosphere-ionosphere system to solar wind disturbances. Traveling convection vortex (TCV) events, which are transient ionospheric Hall current loops passing overhead of ground-based magnetometers, are the best source of MIEs. In contrast to sudden commencements (SCs) that are produced by abrupt increases in solar wind dynamic pressure, there is no consensus on the solar wind origins of MIEs among researchers. Solar wind tangential discontinuity (TD) is one of the key phenomena because it causes abrupt changes of both dynamic pressure and interplanetary magnetic field (IMF).

We have preformed a statistical study on the solar wind origins of MIEs. We have analyzed fluxgate magnetometer data obtained from South Pole Station in Antarctica over 6 years from January 1, 1995 to January 1, 2001. Wavelet analysis is used to detect a large number of distinct MIEs automatically with high confidence. Solar wind tangential discontinuities (TDs) are also detected automatically for the same period using solar wind and IMF data from Wind and ACE satellites. The time delay from the satellite to the ground is determined as taking into account the normal vectors of the TDs. We have made complete lists of MIEs and TDs for the six-year interval. Statistical properties of solar wind background conditions for MIE occurrences presented in the past are confirmed. An important finding is that the seasonal variation of TD occurrences has a significant positive correlation (0.4-0.5) with that of MIEs. For a long interval covering a period from solar minimum to maximum, this study makes it possible to find not only the contribution rates of different types of solar wind origins but also the seasonal and even solar cycle dependences of MIE occurrences.