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Global Network Observations of Electric and Magnetic Field Variations for Space Weather Study

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In order to understand the solar wind-Earth's magnetosphere-ionosphere coupling system, and to clarify global nature of penetration and/or propagation mechanisms of electromagnetic disturbances from the polar to the day- and night-side equatorial ionospheres and/or from outside the magnetosphere into the dip equator, the CPMN (Circum-pan Pacific Magnetometer Network) group is planning to build up a FM-CW (Frequency-Modulated Continuous Wave) radar array along the 210 deg. magnetic meridian. This project also focuses on contribution to the Space Weather study especially around the earth's space environment.

In this paper we will demonstrate DP 2-range variations as an example, which has a complex nature and cannot explained by the existing model. It is well known that daytime DP 2 magnetic variations observed on the ground are well correlated with changes of the solar wind Bz component (Nishida, 1968 a & b). Electric fields caused by the solar wind interaction with the Earth's magnetic field are believed to be imposed on the polar ionosphere and penetrate into the equatorial ionosphere (Nishida, 1968b; Kikuchi et al, 1996). DP 2 magnetic variations are clearly seen on the ground in the dayside equatorial region where the ionospheric Cowling conductivity is zonally enhanced.

Two-type DP 2 magnetic variations are found to correlate with quasi-periodic changes of the solar wind pressure and the IMF Bz component. A new type DP 2 magnetic variation shows a good correlation with changes of the solar wind pressure, which can produce intensity variations of the Chapman-Ferraro current at the magnetopause and then global in-phase magnetic variations in day and night sector. The ordinary DP 2 electric fields caused by the IMF Bz variations must be imposed on the polar ionosphere, and the ionospheric electric fields may penetrate instantaneously from the polar ionosphere into both the day- and night-side equatorial regions. The expected magnetic variations produced by the penetrated electric fields should be anti-parallel in the day and night sectors, which is not consistent with magnetic variations observed at night-side equator. The observed DP 2 magnetic variations may be produced by a zonal ionospheric current at lower latitudes, which must be induced by the IMF Bz variations.