Regular daily variations of the geomagnetic field in the Z component during geomagnetically active periods

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Under geomagnetically quiet conditions, the daily record of the geomagnetic field smoothly changes with primarily 24-, 12-, 8- and 6-hour spectral components. These regular daily variations of the geomagnetic field were defined as SR by Mayaud (1965). It has been established that the SR variations are mainly caused by electric currents flowing at about 100 km altitude in the ionosphere and its inducing current in the conductive Earth. During geomagnetically active periods, it is difficult to detect SR variations in the horizontal components of the geomagnetic field because of additional disturbances from some other current sources (such as ring current). However, even during geomagnetically active periods, the pattern of SR variations in the vertical component (Z component) is very stable. It is not known what controls the Z-component SR variations during geomagnetically active periods. Thus, it is of great interest to examine SR(Z) fields to find out what controls its spatial and temporal changes.

In the present paper, we examined the Z-component SR variations based on these extended magnetometer networks along the 210 degree magnetic meridian: (1) Circum-pan Pacific Magnetometer Network [Yumoto et al., 2001], (2) INTERMAGNET [Kerridge, 2001] and (3) WDC for Geomagnetism, Kyoto. The observed SR(Z) fields are mapped into LT-LAT diagram (Local time-Latitude diagram) for each day from 2000 to 2002. The LT-LAT diagram provides us with a 2D view of the SR(Z) distribution. The following characteristics were discovered:

[A] The intensity pattern of SR(Z) fields shows considerable day-to-day variations which can not explained by changes of geomagnetic activity.

[B] For monthly mean values, there is an anti-correlation between the intensity of SR(Z) fields and the Dst index.

We will propose possible mechanisms for these characteristics.