MLT and IMF dependence of the SC amplitude-3

Atsuki Shinbori[1]; Takashi Kikuchi[2]; Tohru Araki[3]

[1] Solar-Terrestrial Environment Laboratory, Nagoya Univ.; [2] STELab; [3] PRIC

1. Introduction

It has been generally believed that the SC amplitude observed in low and middle latitudes on the ground and at the geostationary orbit in the magnetosphere tends to be larger in the dayside sector than in the nightside sector [e.g., Russell et al., 1994; Kokubun, 1983]. On the other hand, there have been some reports on a night-time enhancement of the SC amplitude on the ground in resent years [Russell et al., 1994]. Araki et al. [2006] found that the SC amplitude in the case of the southward IMF Bz is more enhanced in the night sector, compared with that in the case of the northward IMF Bz. However, in these studies, statistical signature of local time dependence of the SC amplitude on the direction and magnitude of the IMF Bz has not yet been clarified due to the lack of SC events. In the present study, we analyzed 7657 SC events which have been identified in term of the SYM-H index within a period from 1989 to 2006 in order to clarify the dependence of the SC amplitude on magnetic local time and solar wind parameters.

2. Data analysis

We picked up these SC events as a rapid increase of the SYM-H value with more than 5 nT within ten minutes in the SYM-H index data. For each SC event, the precise onset time, rise time, and amplitude were identified by referring the H-component geomagnetic variation from the rapid sampling records with the time resolution of 1 second obtained at Kakioka Magnetic Observatory. In the present analysis, the SC amplitude obtained at Kakioka has been normalized by the amplitude in the SYM-H index in order to minimize the contribution of the rapid change in solar wind dynamic pressure. On the other hand, we used solar wind data obtained from the IMP-8, Geotail, Wind and ACE satellites within the data analysis periods from 1989 to 2006, from 1993 to 2006, from 1994 to 2006 and from 1998 to 2006, respectively.

3. Results

The SC amplitude normalized by the SYM-H value showed a clear dependence on magnetic local time, which indicates that the two peak amplitudes appear in the dayside sector of 10-15 MLT and in the midnight sector of 22-02 MLT, respectively. The peak value of the SC amplitude in the midnight sector tends to be two or three times larger than that in the dayside sector. The trend also showed the two minimum values in the morning sector of 5-7 MLT and in the evening sector of 16-18 MLT, respectively, and represented a clear morning-evening asymmetry in the minimum values.

Next, we investigated the dependence of the SC amplitude on the IMF condition for 4212 SC events. Here, we classified the average variations of the IMF Bz direction about 10 minutes before and after the solar wind shock or discontinuity into four types: from northward to northward (type I), from northward to southward (type II), from southward to northward (type III), and from southward to southward (type IV). As a result, the trends of the normalized SC amplitude as a function of the magnetic local time do not very change for all the cases of the IMF conditions; however, the maximum value of the SC amplitude in the type IV tends to be most enhanced in the night sector of 20-04 MLT. The SC amplitude in the dayside sector of 11-14 MLT is also about 10% smaller than that in the type I. On the other hand, the trend of the SC amplitude for the type III events showed that the magnitude is mode enhanced in the post-midnight to morning sectors of 00-05 MLT and depressed in the afternoon to dusk sectors of 14-19 MLT. This trend suggests the superpose of the magnetic field disturbances created by the DP-1 type ionospheric current due to the occurrence of the substorms associated with the northward turning of the IMF Bz. Therefore, from these results, a possible mechanism which amplifies SC in the nightside sector is magnetic field disturbances which are produced by the enhanced Region-1 current associated with magnetic reconnection (type IV) or positive bay of SC triggered substorm (type III).