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Solar cycle dependence of the solar wind control on the geomagnetic activity

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In this study, we examined the correlations between solar wind parameters and geomagnetic indices over solar cycle 23 and 24. The interplanetary magnetic field (IMF) magnitude, B, and the geocentric solar magnetospheric (GSM) By and Bz components, as well the solar wind velocity, Vsw, dynamic pressure, P_{DP}, and calculated epsilon parameter are used to signify the solar wind parameters. In order to understand the control of these parameters over the geomagnetic activity on the Earth, we used the geomagnetic indices from different latitudes represented by PC index for the polar region, AE index for the auroral region, Kp index for middle latitudes and Dst index for low latitudes. The yearly correlation coefficient between these solar wind parameters and geomagnetic indices is calculated with the aim to study the energy transfer process and the solar cycle dependence. The result obtained shows that the response time for energy transfer is increasing with decreasing latitude in which 0 hour for polar region, 1 hour for auroral region, 1 hour for middle latitude and 2 hours for low latitude. The time delay represents the necessary period for current system to build up. The total period required for energy transfer process is less than 1 hour for all the regions except for the low latitudes where the total period is up to 5 hours after response time. As for the solar cycle dependence epsilon is highly correlated during solar minimum and weakly correlated during solar maximum for all the regions except for the low latitudes, where only Vsw shows the same dependence. At the same time, for the polar and auroral regions, Bz component shows a high correlation during solar maximum and a low correlation during solar minimum, meanwhile for the middle latitude region, B and Vsw show high correlations but the correlations have no clear solar cycle dependence. The results obtained explain the solar wind control on the geomagnetic activity at different latitudes by means of the energy transfer along high to low latitudes. More detailed study is required to understand the enquiries of solar wind parameters correlation dependence on solar cycle. The OMNI data were obtained from the GSFC/SPDF OMNIWeb interface at http://omniweb.gsfc.nasa.gov. We also thank N. F. Ness for the ACE magnetic field data, D. McComas for the ACE plasma data and the Danish Meteorological Institute for the PC index data.

Keywords: solar wind parameters, geomagnetic indices, correlation coefficient, energy transfer, response time, solar cycle dependence