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Influence of solar magnetic activity on climate ? comparison between different geomagnetic activity indices

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Introduction. The relation between the aa index and surface temperatures has been long reported, but it is a kind of mystery in a sense that its mechanism is unknown, and hence, has been regarded as unconvincing. We, however, recently showed that a local-based short-term approach is useful to elucidate the relation [1]. For instance, winter aa index has high positive correlation with spring surface temperature of Scandinavian regions, and high negative correlation with southern regions of Greenland. We explained this result considering the participation of the Arctic Oscillation.

In this report, we consider geomagnetic indices other than the aa index, and show the possibility of similar observations. Furthermore, we use solar wind data to make further discussions.

Method. Geomagnetic indices used are, the aa index, the AE index, the ap index, the Dst index etc. By utilizing the open data base such as OMIN 2 [2], the relations between these indices and between the indices and the surface temperature data were examined.

Moreover, BV^2 that is calculated from solar wind magnetic field B and solar wind speed V, and P_{alpha} calculated as energy extracted from the solar wind [3], are utilized for the correlation studies.

Results and discussion.

It was observed, for instance, that daily changes of ap and AE were well correlated. Correlations between the geomagnetic indices and solar wind parameters such as BV^2 and P_{alpha} were high as well. Thus, different geomagnetic indices should show correlations against the surface temperatures. In fact, for instance, ap (January) and Dst (January) shows high correlation with the surface temperature (March) of Sodankyla, Finland as high as the case for the aa index.

AE is a measure of the Aurora electro jet, and Dst is a measure of the equatorial ring current, and thus, the hourly time course of their changes are different [4, p. 59]. However, considering that the magnetic field changes such as AE, aa and ap due to currents in the ionosphere are linearly correlated with P_{alpha} [3] and that Dst is proportional to the energy accumulated in the magnetosphere [4, p. 172], we consider it reasonable that the difference between the geomagnetic indices becomes small when daily and/or monthly average data were concerned.

References.
1) For instance, Kiminori Itoh, 2011 Meeting of Japan Geophysical Union.
2) OMNI2, solar wind data, http://omniweb.gsfc.nasa.gov/ow.html
3) I. Finch and M. Lockwood, Ann. Geophys., 25 (2007) 495-506
4) S. Kokubun, *Solar Terrestrial System Physics*, Nagoya University Publishing, 2010

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