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Comparison of geoeffectiveness of coronal mass ejections and corotating interaction regions

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A detailed comparison of the geomagnetic responses to interplanetary coronal mass ejection (ICMEs) and corotating interacting regions (CIRs) during solar cycle 23 was performed using geomagnetic indices Dst, Ap, and AE.
The peak values of the plasma characteristics of ICMEs and CIRs
(velocity V, magnetic field B, and BV related to the electric field), and
geomagnetic indices were investigated by applying the linear and power-law cross correlation analysis.
The influence of the time-resolution on the results was performed for two time resolutions obtained by one-hour (three-hour for Ap) and six-hour data averaging.
For ICMEs the power-law fits are found to be important only for the relationships between BV and geomagnetic indices.
For Ap and Dst, there is no difference between the one-hour (three-hour for Ap) and six-hour option.
For AE, the one-hour data distribution shows more clearly the non-linear dependence on BV.
Our data set shows that for ICMEs BV below 5 mV/m have practically no geomagnetic
effect at low and mid latitudes, but at high latitudes at least some geomagnetic activity will be
triggered.
For all HSS/CIRs dependencies, a power law is found to better describe the data than the linear fit.
The data distributions show that BV has to reach 4 mV/m in order to drive at
least some geomagnetic activity at all latitudes.
We observed that there are fast CMEs that have almost no geomagnetic effect at low and mid latitudes.
On the other hand, at high latitudes, fast CMEs always trigger some geomagnetic activity.
This might be have implications for space weather forecasting.
Our study shows that magnetospheric response to both solar drivers (ICMEs and CIRs) is different at various latitudes, thus
results in different development of various current systems within the Earth's magnetosphere and ionosphere.
Furthermore, we show that ICMEs and CIRs cause different geomagnetic activity.
In the case of ICMEs equatorial current system responses in a linear manner,
while the response of the polar-current system is likely to be non-linear.
For HSS/CIRs, apparently all current systems respond in a non-linear way, especially the polar current system.