Solar Wind and Geomagnetic Activity.

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(ricevuto l'11 Marzo 1974)

Summary. — Interplanetary plasma and magnetic-field parameters, measured by the ESRO satellite HEOS-1, have been correlated with the $D_{st}$, taken as an index of the overall geomagnetic activity. It is found that two different states exist for the interaction between the solar wind and the magnetosphere: they correspond to quiet periods ($D_{st}$ positive) and to disturbed conditions (main phase of geomagnetic storms, i.e. $D_{st}$ negative). In disturbed conditions the magnetosphere appears to be much more sensitive to variations of the solar-wind dynamical pressure than in periods of positive $D_{st}$.

1. — Introduction.

Many authors have so far described the interaction between the solar wind and the geomagnetic field from a theoretical point of view (see (1-5)).

In the models of Mead (4) and Siscoe (5) the presence of a cold and highly conducting plasma flowing from the Sun modifies the Earth's magnetic field according to the equation

\begin{equation}
B_{e} = K_{0} \sqrt{N_{e} V_{e}^{2}} + B_{0},
\end{equation}

where $B_{e}$ is the horizontal component at the equator of the ground magnetic field and $B_{0}$ includes the Earth's field and the contribution of ionospheric

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and magnetospheric currents. The additional term \( K_0 \sqrt{N_p V_p} \), which is proportional to the square root of the dynamical pressure of the solar wind, is due to the system of currents flowing along the boundary of the magnetosphere, as a consequence of the reflection of the plasma against the Earth's field; \( N_p \) and \( V_p \) are respectively the solar wind density and bulk velocity and \( K_0 \) is a constant whose theoretical value is \( 0.0305 \, (\text{cm}^{-3})^{-1/2} \, (\text{km s}^{-1})^{-1} \) according to Mead (4).

It should be noted that a change in the solar-wind dynamical pressure modifies the boundary currents immediately and the ionospheric and magnetospheric ones with a certain delay time. As a consequence, the sharp discontinuities in \( B_z \), which can be ascribed to a variation of the plasma pressure, are related to the solar-wind parameters by the equation

\[
D_{st} = K_0 \sqrt{N_p V_p^2} + K_1.
\]

More generally the index \( D_{st} \) measures the total variation of \( B_z \) when the solar quiet daily changes, \( S_o \), have been removed; for the method of derivation of \( D_{st} \) from the observations, see Rostoker (6).

From an experimental point of view, since the first direct observations of the interplanetary plasma and magnetic field by space vehicles, a number of researches have been made on the relationships between geomagnetic activity and solar-wind parameters (see (7-13)).

Most of the correlations made so far have used the indices \( K_p, a_p, A_p \) to describe geomagnetic activity. It should be noted that the computation of the above indices is based on data taken by stations at high geomagnetic latitude (see e.g. (6)). These stations are strongly affected by local geomagnetic activity; on the contrary, \( D_{st} \), which is based on data collected by stations far from the influence of auroral currents, describes mainly the ring current intensity and thus the level of the magnetic storm activity. During a typical geomagnetic storm, the \( D_{st} \) jumps upwards (sudden commencement) and

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