Effects of Geomagnetic Reversals on Solar Wind-Magnetosphere Coupling

Robert L. McPherron Institute of Geophysics and Planetary Physics, University of California Los Angeles

Energy derived from the solar wind is eventually deposited in the atmosphere by a variety of processes leading to particle precipitation and Joule heating. While the total energy deposited is small compared to that of solar radiation it is deposited in a highly localized region around the geomagnetic poles. It has been suggested that there may exist some feedback mechanism with the neutral atmosphere that amplifies the effect of this energy so that subtle effects on weather produce a discernable signal in the climatic record. The input of solar wind energy as well as cosmic rays depends on the properties of the Sun and the solar wind as well as internal properties of the Earth's magnetosphere. The primary process responsible for energy coupling is magnetic reconnection. In this process the interplanetary magnetic field rooted in the Sun merges with the Earth's field whenever it is oriented antiparallel to the Earth's field on the dayside magnetopause. This allows the solar wind to draw out the field into a magnetotail behind the Earth. When these field lines reconnect becoming closed field lines they produce geomagnetic activity in the form of substorms and storms. It is during these events that energy deposition in the atmosphere occurs. Solar wind parameters that control this interaction include the dynamic pressure of the wind (nmV^2) and its electric field (VBs). Important magnetospheric parameters include the ionospheric conductivities (Σ_P and Σ_H), the density and temperature of ionospheric oxygen, the size of the magnetosphere (determined by dynamic pressure), and the strength of the Earth's dipole moment. During reversals of the Earth's field the dipole moment disappears and reappears with the opposite sign. A shrinking dipole moment alters the interaction with the solar wind and atmospheric energy deposition. The weak field also allows more cosmic rays to hit the Earth at lower latitudes than normal. When the field becomes dominated by higher order moments, e.g. quadrapole, the nature of the interaction changes and is very dependent on the orientation of the quadrapole. In this paper we briefly review the nature of the solar wind interaction with the Earth and how it depends on the strength of the dipole moment.