The Interplanetary Causes of Magnetic Storms, HILDCAAs and Viscous Interaction

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We review work on (he interplanetary causes of great ($D_{ST} \leq$ -250 nT) and intense ($D_{ST} \leq$ -100 nT) magnetic storms. The empirical relationship of $E_{dawn-dusk} \geq 5$ mV/m (B_Z - -10 nT) and T ≥ 3 hours apparently still holds for both solar maximum and solar minimum, allowing easy storm intensity predictions using real-time data from an upstream spacecraft monitor, Great storms can occur in moderate solar wind streams, so it is the B_Z component that is of paramount importance. The origins of [hc IMF B_Z events will be discussed. High Intensity Long Duration Continuous AE Activity (HI LDCAA) events occur during [he declining and minirnttm phases of the solar cycle. These substorm events are caused by IMF Alfvénic (BJ fluctuations that are intrinsic to high-speed streams emanating from coronal holes. High latitude geomagnetic activity duc to the Alfvén waves can be higher during this phase of the solar cycle than during solar maximum. The substorms effects on the Earth's ring-current will be discussed. Finally, we examine a promising mechanism for viscous interaction: cross-field diffusion of magnetosheath plasma. Using Polar plasma wave, low energy ion, and UV imaging data, we determine the properties of broadband Polar Cap Boundary Layer (PCBL) waves, potential wave generation mechanisms, discuss resonant wave-particle interactions, cross-field diffusion rates, and the resulting dayside auroral brightnesses. The role that ionospheric oxygen ions plays in magnetic storms, substorms and in the dayside LLBL, will be illustrated using Polar data,