Shear layers in solar winds affect Earth's magnetosphere

July 31 2012

Human society is increasingly reliant on technology that can be disrupted by space weather. For instance, geomagnetic storms can cause high-latitude air flights to be rerouted, costing as much as $100,000 per flight; induce errors of up to 46 meters (151 feet) in GPS systems; and affect satellites and the International Space Station. Space weather is determined by how the solar wind, a stream of hot plasma from the Sun, interacts with Earth's magnetic field. In studying space weather, scientists have largely neglected the fact that the solar wind contains layers of very strong velocity shear. Scientists understand very little about how these wind shears affect space weather.

Combining statistical analysis of solar wind data from the Advanced Composition Explorersatellite, which measures solar particles approaching Earth, with a series of magnetohydrodynamic simulations, used to model the behavior of the Earth's magnetosphere, Borovsky characterizes the properties of the shear layers that travel past the Earth and the reaction of the Earth to those passing layers.

The author finds that as many as 60 of these shear zones can pass by Earth each day at velocities above 50 kilometers per second (31 miles per second). Passage of a shear layer perturbs the entire magnetosphere and ionosphere, which could produce a comet-like disconnection of the Earth's magnetotail (the tail-like extension of Earth's magnetic field on the side facing away from the Sun). Although the velocity shears will not cause a geomagnetic storm, they may determine how such a storm works. Hence, the author recommends several follow-up studies of the

reaction of Earth to sudden wind shear.

More information: "The effect of sudden wind shear on the Earth's magnetosphere: Statistics of wind shear events and CCMC simulations of magnetotail disconnections" *Journal of Geophysical Research-Space Physics*, doi:10.1029/2012JA017623 , 2012

Provided by American Geophysical Union