Magnetic Storm 23 January, 2012

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On 19 January a solar flare was observed in an active region surrounding a high-latitude sunspot. At about the same time, a coronal mass ejection (CME), a concentrated blast of electrically-conducting solar-wind plasma and tangled magnetic-field lines, was observed, estimated to be headed for Earth. The CME arrived at Earth on 22 January at 06:14 UT (02:15 Eastern). In characteristic fashion, this caused as a positive initial phase geomagnetic disturbance, which was registered by low-latitude USGS magnetic observatories and as recorded by the 4-station USGS storm-time disturbance index Dst. This initial phase is the signature of compression of the Earth's magnetosphere by the pressure of the solar wind. NOAA reports that the solar wind of the CME reached 450 km/s, from a background of 325 km/s. The initial phase reached Dst = 62 nT (only 10% of initial phases are this large or larger). What followed over the next 24 hours was the normal main-phase of a small magnetic storm: a west-ward-directed, equatorial magnetospheric electric current was activated, giving a characteristic depression in low-latitude magnetic disturbance, with maximum depth of –Dst = 66 nT at 23 January at 00:45. NOAA reported a Kp= 5 magnetic index, a generic measure of mid-latitude activity for a single 3-hr period on 22 January, corresponding to a "minor" magnetic storm. It is noteworthy that at high-latitudes magnetic disturbance can be much greater in amplitude and intensity. The direction of the magnetic field at Barrow, Alaska, the most northerly USGS observatory, changed by about 6.0 degrees over a period of 15 minutes. Such variations, large enough to be seen on an ordinary compass, would have been a nuisance for directional-drilling operations on the North Slope. This storm also produced beautiful displays of aurora at high latitudes. As we leave the quiet period of the last solar minimum and head into the next solar maximum, predicted for 2013, and over the next 3 years or so we can expect more storms, some of which will probably be much larger than the 23 January 2012 storm.

On 23 January, another solar flare and CME was observed. This might cause another magnetic storm at Earth on late 24 January.

For perspective: The largest storm of the 20th century occurred on March, 1989 -Dst = 574 nT. This storm induced electric currents in the Earth's crust that found their way through ground connections into the high-voltage Canadian Hydro-Québec power grid, causing transformer failure and resulting in the loss of electric power to more than 6 million people. The same storm also damaged and disrupted the operation of satellites and it severely disrupted GPS systems and over-the-horizon radio communication systems used by the US military. The storm of March 1989, large though it was, pales in comparison to that of September 1859, the largest storm in recorded history occurred, -Dst = 1600 nT (approximately). If such a storm were to occur today, the economic impact to the United States because of disrupted technological systems could exceed $1 trillion (Baker et al., 2008).

In addition to supporting internal USGS operational needs, real-time USGS data are used by NOAA's Spaee Weather Prediciton Center, the Air Force Weather Agency, the Air Force Research Laboratory, NASA's Goddard Space Flight Center, Japan's National Institute of Information and Communications Technology, and several private companies for space weather diagnostics and directional drilling.

Additional information:

USGS Geomagnetic Dst: geomag.usgs.gov/dst

Intermagnet data: www.intermagnet.org

Solar images: National Solar Observatory http://www.nso.edu/current_images.html

NOAA Space Weather Prediction Center: swpc.noaa.gov

NOAA Space Weather forecasts: http://www.swpc.noaa.gov/forecast.html

Baker, D. N., et al. (2008), Severe Space Weather Events—Understanding Societal and Economic Impacts, Natl. Acad. Press, Washington, DC.

Press Report: 23 January 2012, Associated Press