Geomagnetic Disturbance Report – Reeve Observatory

Event type: Geomagnetic disturbances due to recurrent coronal hole high-speed stream

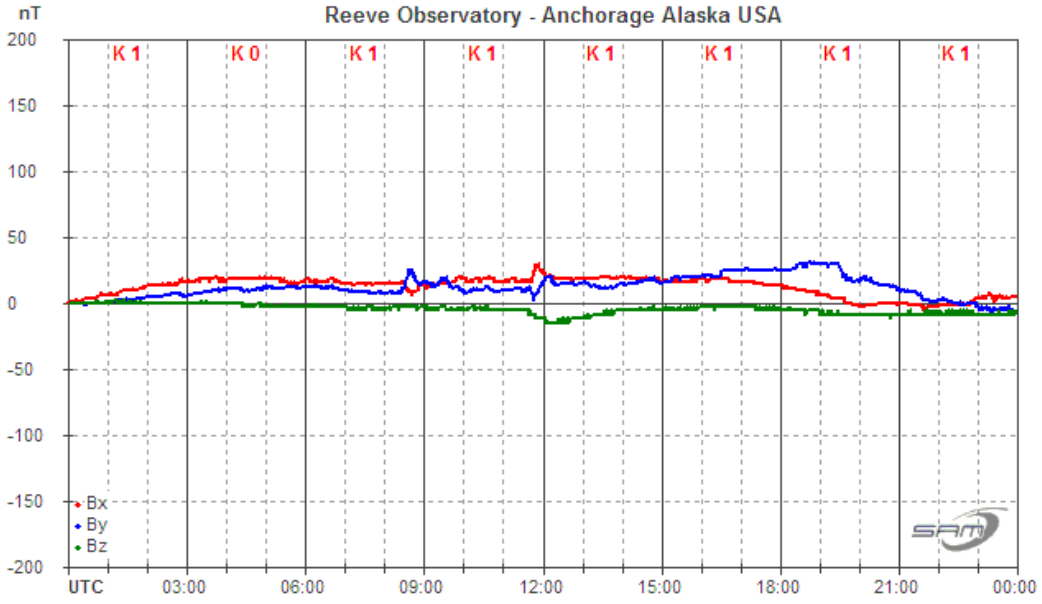
Background: This background section defines the events covered.

> A coronal hole is a large dark region of less dense and colder plasma in the Sun's corona where the solar magnetic field lines are able to stretch far out into the inter-planetary medium. These field lines may connect with Earth's magnetic field, causing a geomagnetic disturbance. During periods of sunspot minimum, the coronal holes usually are found in the Sun's polar regions, but as solar activity increases the coronal holes can be found at all latitudes. A *coronal hole high-speed stream* is high solar wind flow are attributable to coronal holes.

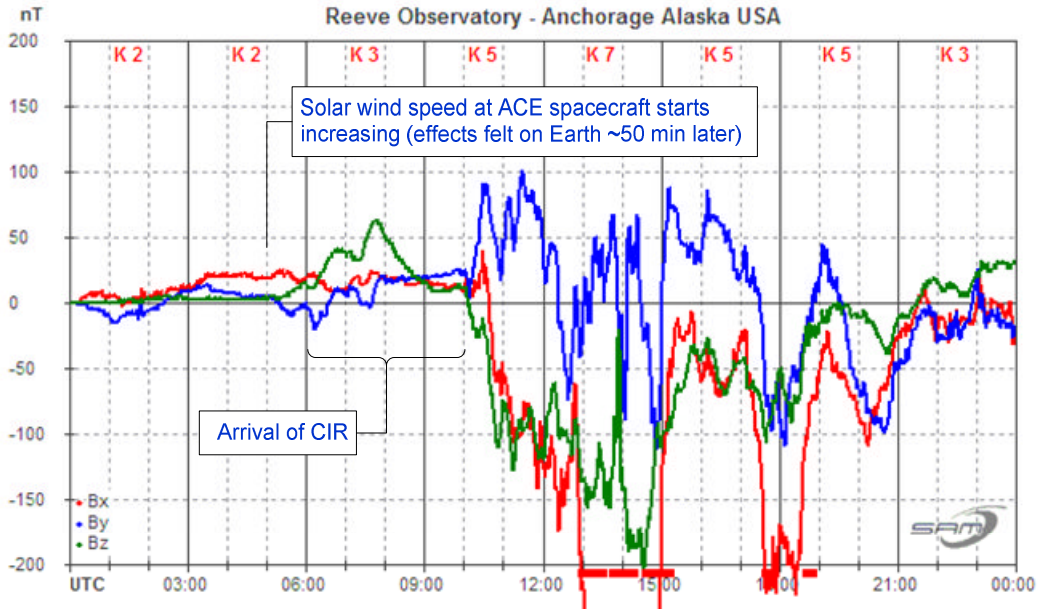
Activity: The 6 d period from 28 February to 5 March 2011 contained a series of geomagnetic disturbances related to the recurrent coronal hole high-speed stream reported in the previous solar rotation period (1 to 6 February 2011). All dates and times are in UTC.

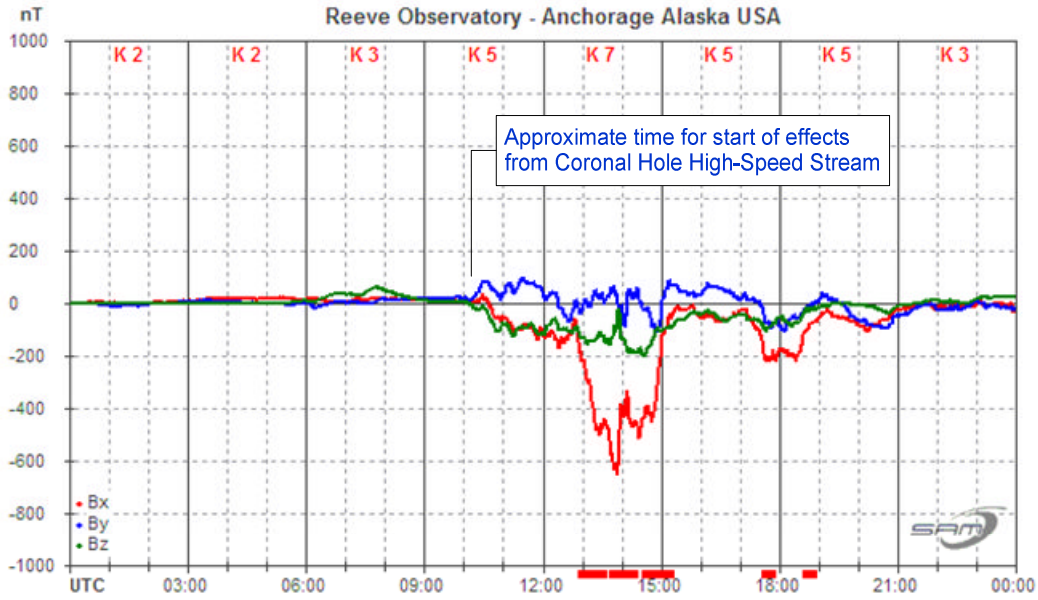
SAM Data: The SAM_VIEW images are for the 24 h periods from 28 February through 5 March 2011. The scale is the same on all magnetograms except an additional chart is shown for 1 March with larger scale to show the full amplitude swing. The caption for each magnetogram describes the events as they were reported by Space Weather Prediction Center (SWPC) with additional information specific to Reeve Observatory.

28 February 2011 (below)
The geomagnetic field ranged from quiet to minor storm activity levels during the period. Solar wind speed at the ACE spacecraft began to rise from 310 km/s at approximately 01/0500Z and ended the period near 500 km/s. The Bz component of the interplanetary magnetic field turned south coincident with the increase in solar wind speed, temperature, and density. These events suggest the arrival of a corotating interaction region between 01/05-12Z in advance of a coronal hole high speed stream. Bz averaged -10 nT for several hours, bringing two periods of minor storm levels at middle latitudes.

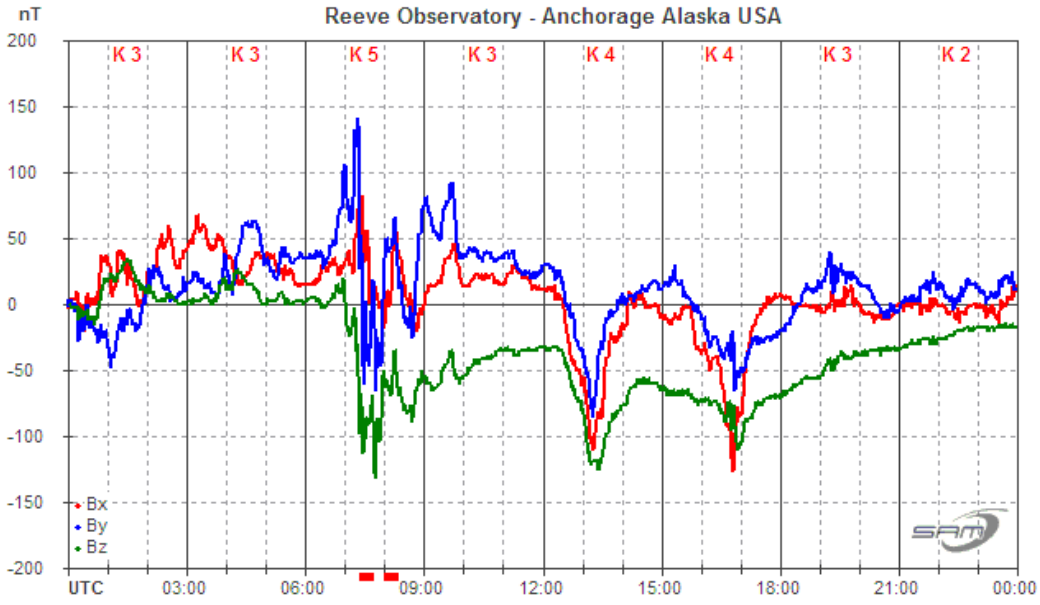


1 March 2011 (below)
Two magnetograms are shown below for the same date, the first with ±200 nT scale to show storm detail and the second at ±1000 nT scale to show full amplitude variations during the storm. The geomagnetic field was reported by SWPC to range from quiet to minor storm activity levels during most of the period but high levels were reached at Reeve Observatory. Solar wind speed at the ACE spacecraft began to rise from 310 km/s at approximately 0500 and ended the period (2100) near 500 km/s. The Bz component of the interplanetary magnetic field turned south coincident with the increase in solar wind speed, temperature, and density. These events suggested the arrival of a co-rotating interaction region between 0500-1200 in advance of a coronal hole high speed stream. Bz averaged –10 nT for several hours, bringing two periods of minor storm levels at middle latitudes. SWPC reported K4 warning at 1032 and K5 warnings at 1321 and 1738 but K5, K7 and K5 were reached at Reeve Observatory at about these times.

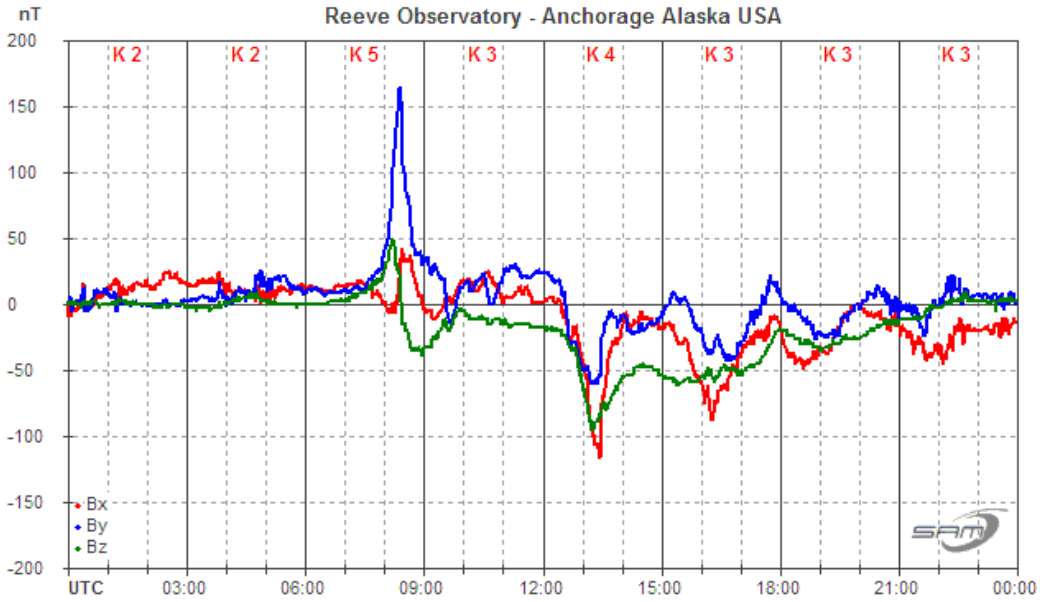




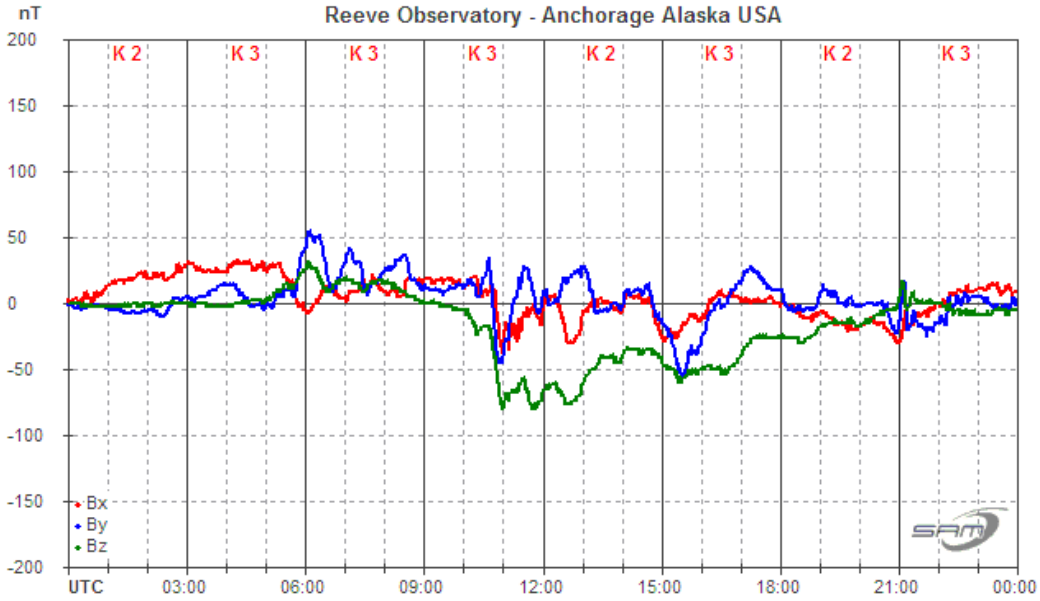
2 March 2011 (below)
The geomagnetic field was reported by SPWC at active to minor storm levels for the first 12 hours of the period and at quiet to unsettled levels for the remainder. However, at Reeve Observatory storm conditions were observed a little after 0700. A recurrent coronal hole high speed stream remained geoeffective during the period. Solar wind speed at the ACE spacecraft remained elevated at 640 km/s. The Bz component of the interplanetary magnetic field began the period near –10 nT but slowly returned to near neutral values by the end of the period. The greater than 2 MeV electron flux at geosynchronous orbit reached high levels during the period.



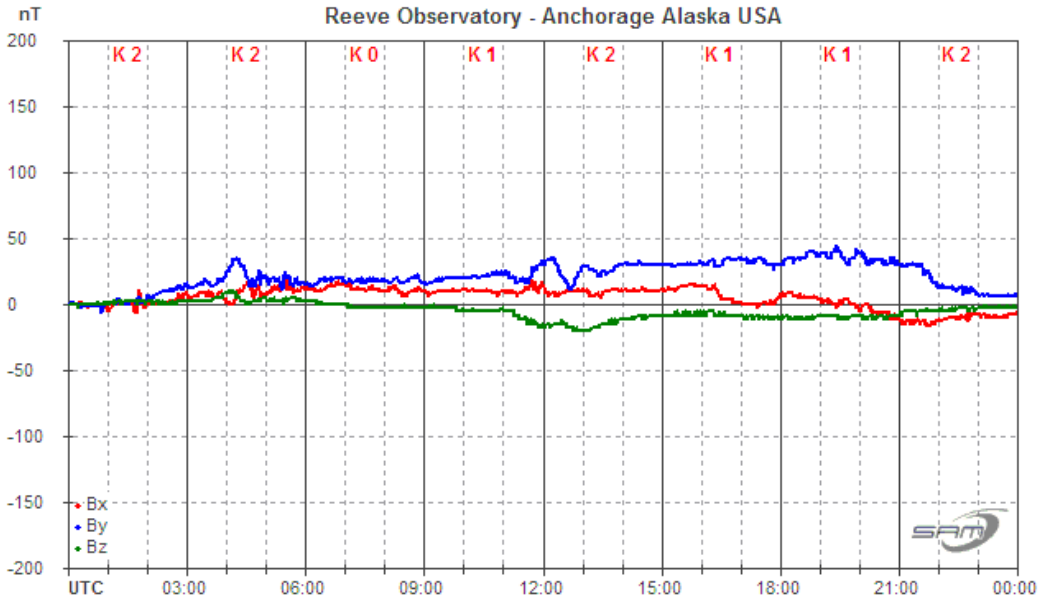
3 March 2011 (below)
Geomagnetic field activity ranged from quiet to major storm conditions. The storms were confined to high latitudes while middle latitudes experienced quiet to active levels. The disturbed conditions were the result of the continued influence of the recurrent coronal hole high speed stream that became geoeffective earlier in the week. Solar wind values at the ACE spacecraft ranged between 560 to 660 km/s during the period. The Bz component of the interplanetary magnetic field was predominantly southward from 0500 to /1700, reaching –7 nT. The greater than 2 MeV electron flux at geosynchronous orbit was at high levels throughout the period. SPWC reported K4 warning at 0830 but it was observed at K5 at Reeve Observatory.



4 March 2011 (below)
The geomagnetic field was quiet to unsettled. A waning coronal hole high speed stream remained geoeffective and solar wind speed at the ACE spacecraft was approximately 500 km/s. The greater than 2 MeV electron flux at geosynchronous orbit was at high levels throughout the period.



5 March 2011 (below)
The geomagnetic field has been quiet to unsettled. Observations from the ACE spacecraft indicate very little influence is left from the coronal hole high speed stream which has dominated for the past five days. Solar wind speeds at end of period averaged below 500 km/s. The greater than 2 MeV electron flux at geosynchronous orbit was at high levels throughout the period.



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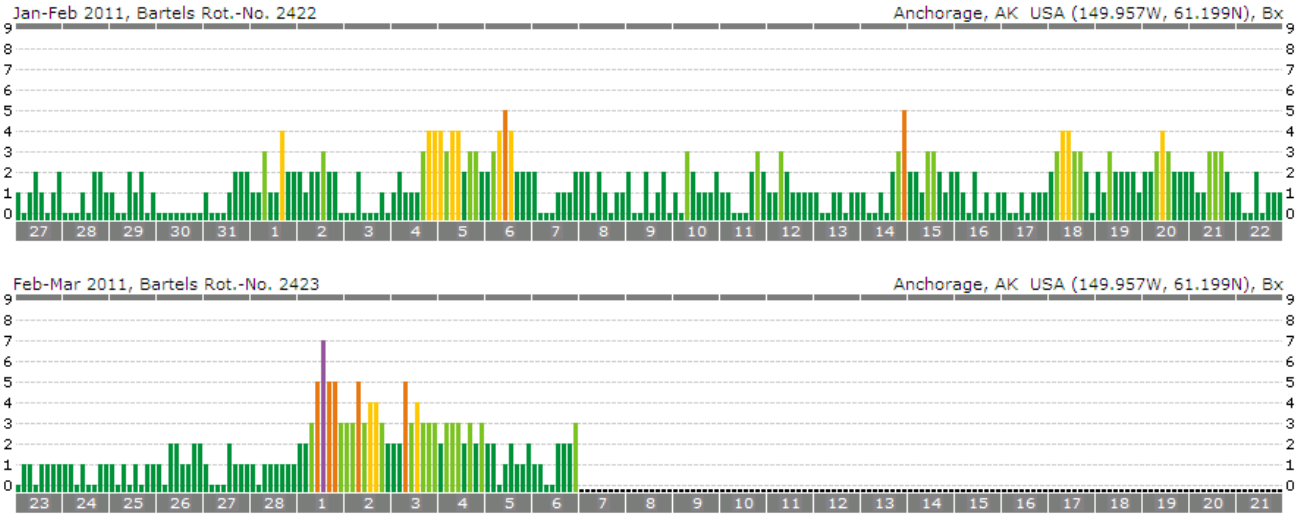
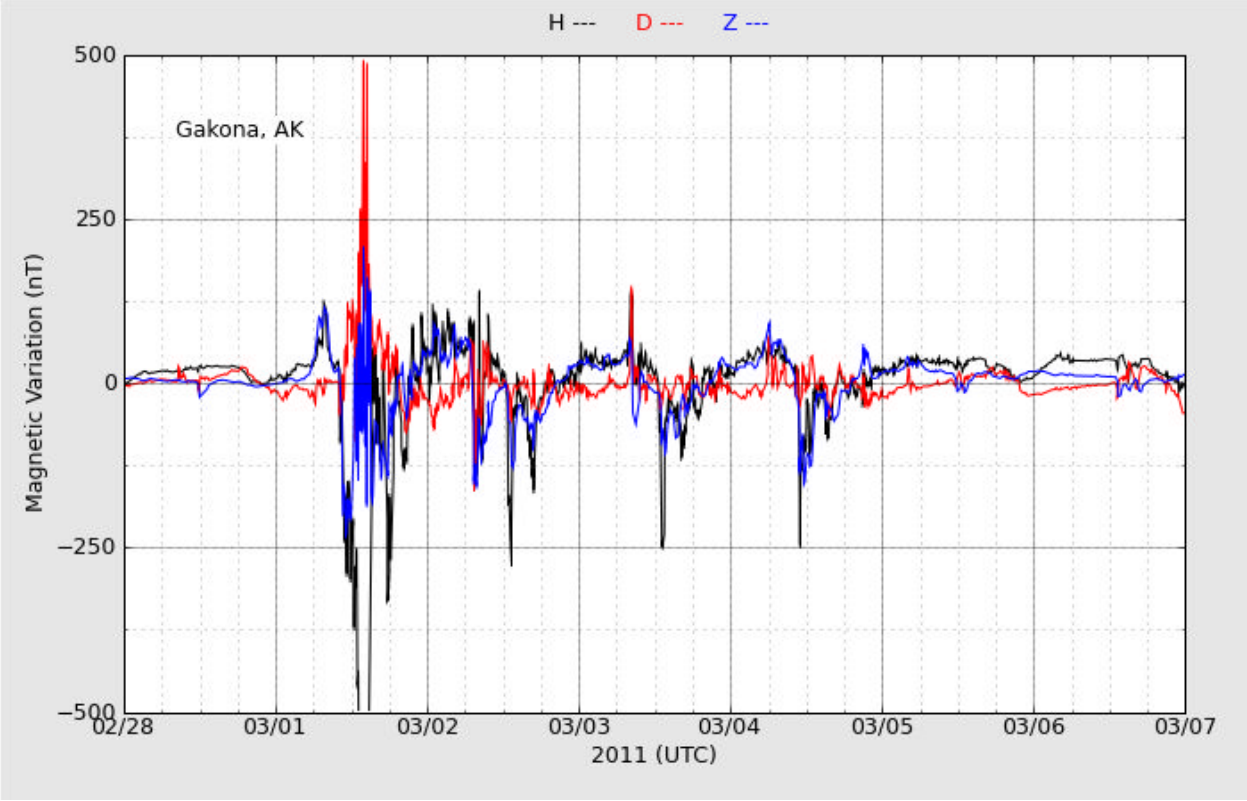
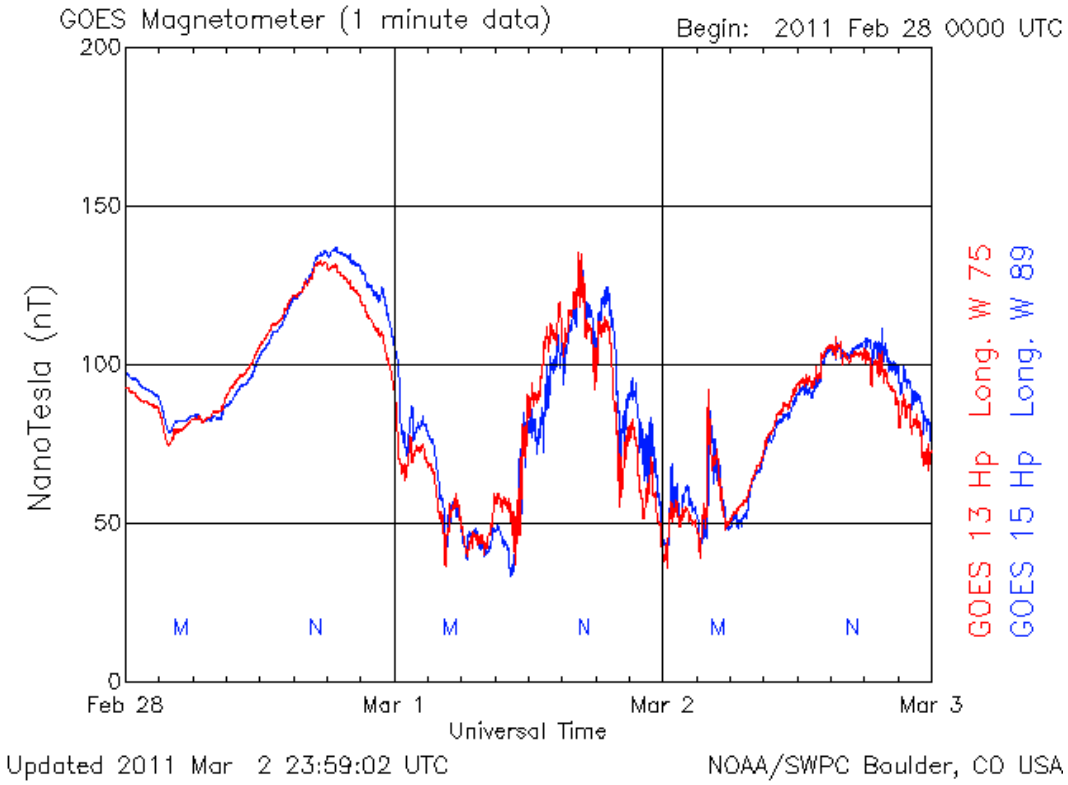
Statistics: The following SAM_STAT chart images cover Bartels Rotation 2422 and 2423 (27 January-22 February, 2011 and 23 February-21 March, 2001). Note that Rotation 2423 was not complete at the time of this report.

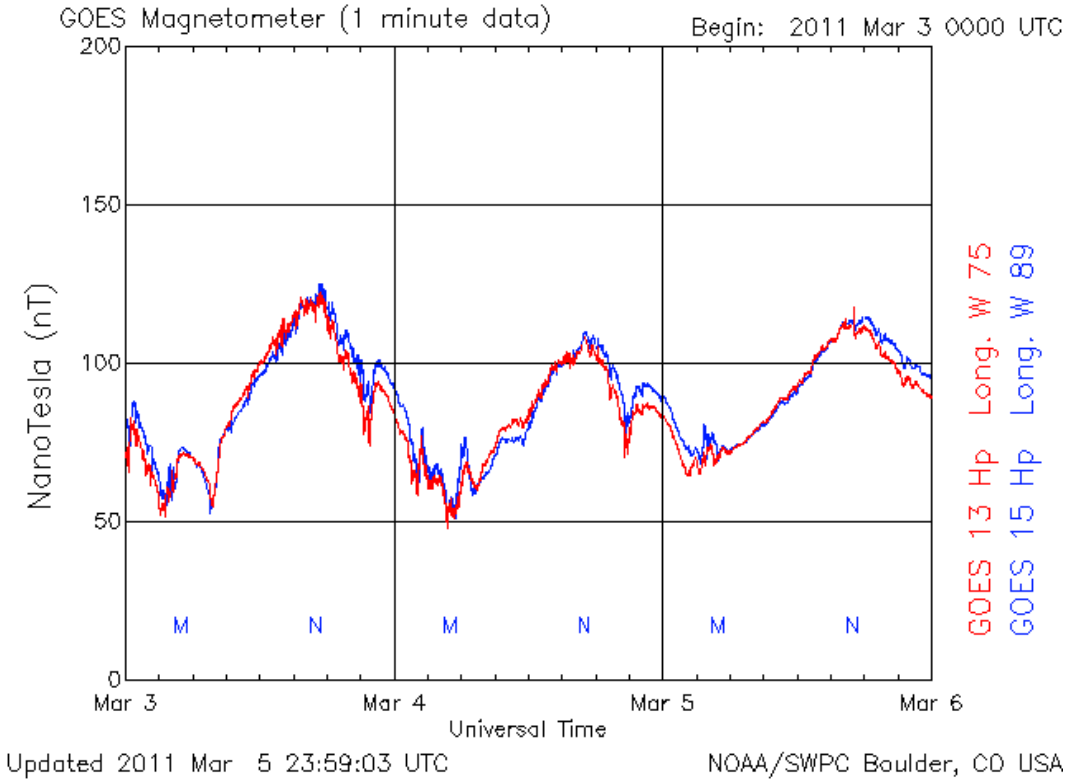


Alaska Magnetometer Chain: Gakona station (approximately 290 km ENE of Reeve Observatory) covering the 6-d period:

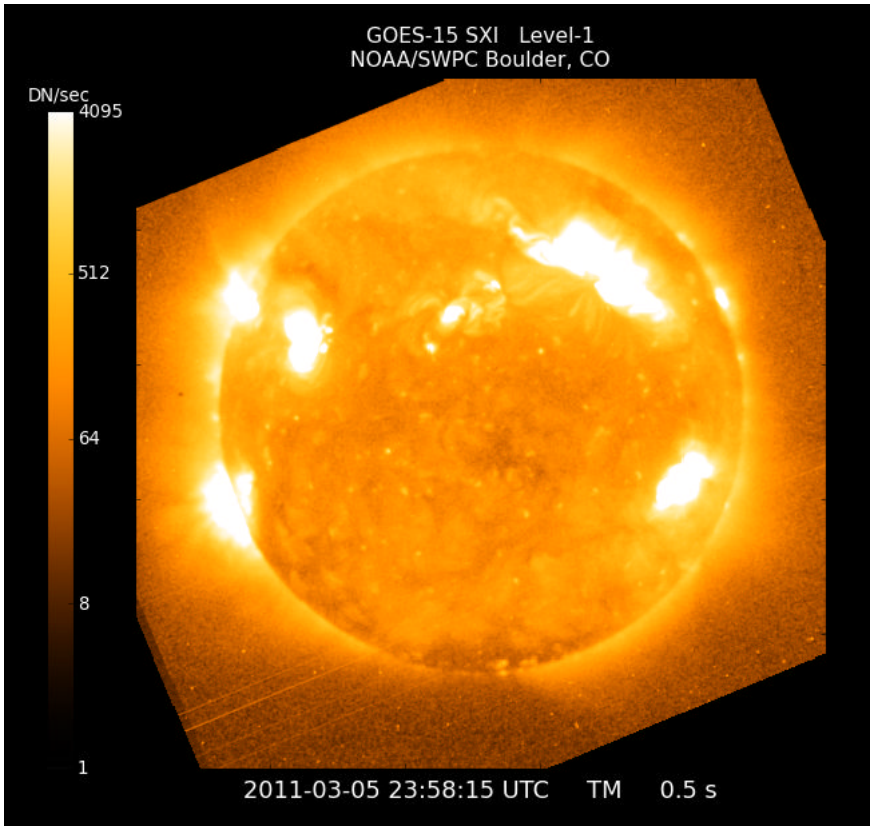


GOES data (GOES 11 is most relevant to Reeve Observatory):





GOES 15 SXI (Solar X-ray Imager) for 5 March 2011 showing coronal holes (dark regions):



Equipment:
Simple Aurora Monitor (SAM-III) located at geomagnetic coordinates: 61.63 °N : 262.89 °E
Equipment description: www.reeve.com/SAMDescription.htm

Resources:
Reeve Observatory SAM-III real-time data: www.reeve.com/SAM/SAM_simple.html
Alaska Magnetometer Chain – 137.229.36.30/cgi-bin/magnetometer/magchain.cgi
Geostationary Operational Environmental Satellites – www.swpc.noaa.gov/rt_plots/mag_3d.html
Space Weather Prediction Center – www.swpc.noaa.gov/
SOHO – http://sohodata.nascom.nasa.gov/cgi-bin/data_query
SDO – http://sdo.gsfc.nasa.gov/

Geomagnetism Tutorial:
www.reeve.com/Documents/SAM/GeomagnetismTutorial.pdf

Image sources:
GOES: NASA
Alaska Magnetometer Chain: University of Alaska Fairbanks, Geophysical Institute