Magnetometric Measurements at Mt. Aragats

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Magnetometric Measurements at Mt. Aragats

Tigran Karapetyan

Yerevan Physics Institute

ktigran79@yerphi.am

Abstract. Magnetometric station LEMI-018, and LEMI-417 commissioned by Lviv center of Space Research Institute of Ukrainian Academy of Science, have been installed on the slope of mountain Aragats (Armenia) at heights 2000 and 3200m above sea level. Operation of magnetometric station started on July 2009 and 2011 accordingly. LEMI-417 is measuring also components of the electric field. One second time series of the 3-dimensional measurements of the geomagnetic field enter the data base of the Aragats Space Environmental Center (ASEC) and will highly improve research of correlations of the geomagnetic parameters, and changes of the fluxes of secondary cosmic rays by ASEC monitors and interplanetary magnetic field (IMF) measured by facilities on board space station located 1.5 mln km from Earth will assist to understand Solar influence on the Earth environments. Measurements of geomagnetic field at Nor Amberd (2000m) and Aragats (3200m) research stations of A.Alikhanyan national lab will support forewarning of the upcoming major geomagnetic storms. We present the detection of the first geomagnetic storms of the 24 solar activity cycle detected by new installed magnetometric stations.

1. Introduction

Interplanetary coronal mass ejections (ICMEs) are known as major drivers of severe space weather conditions when arriving at the Earth. On their way to the Earth, ICMEs also ‘‘modulate’’ the flux of galactic cosmic rays (GCRs) introducing anisotropy and changing the energy (rigidity) spectra. These anisotropies of GCRs manifested themselves as peaks and deeps in time series of secondary cosmic rays, detected by surface particle detectors. Presence of a strong and long-duration southward magnetic field component in the sheath region of ICMEs is the primary requirement for their geoeffectiveness [1, and references therein]. The size and magnetic field strength of ICMEs are correlated with the ICME modulation effects on the energy spectra and the direction of GCRs [2]. Therefore, simultaneous measurements of the particle fluxes and disturbances of magnetic field will allow better understanding solar modulation processes and helping to build the model of solar-terrestrial connections. Facilities of the Aragats Space Environment Center (ASEC) [3] observe charged and neutral fluxes of secondary cosmic rays by the variety of particle detectors located in Yerevan and on slopes of Mount Aragats at altitudes 1000, 2000 and 3200 m. ASEC detectors measure particle fluxes with different energy thresholds starting from 2 MeV and register solar modulation effects in wide range of secondary particle energies and types. We present results of detected geomagnetic storms by new magnetometric stations operated on slopes of Mt. Aragats and also comparisons of Nor Amberd and Aragats magnetometers data with Baksan, LVIV, Furstenfeldbruck, and Novosibirsk magnetometers as well as with geomagnetic Dst index.

2. The main technical parameters of magnetometer LEMI -018 and LEMI-417

In Table 1 are shown the main technical parameters of magnetometer LEMI-018 and LEMI-417. LEMI-417 magnetoteluric station has the same main technical parameters of measuring magnetic field as LEMI-018.

Table 1. The main technical parameters of magnetometer LEMI-018 and LEMI-417

Measured range of total magnetic field	± 65000 nT
Resolution along each component both at the display and registered into the internal FLASH-emory	0.01 nT
Temperature drift	<0.2 nT/°C
Frequency band	DC-0.3 Hz
Magnetometer output noise in frequency band(0.03…0.3)Hz	< 10 pT rms
Magnetic sensor components orthogonality error	<30 min of arc
Automated offset compensation band along each magnetic component	±65000 nT
Noise of electric meter in the frequency band 0.03 – 0.3Hz	<0.5 µV rms
Sample rate (LEMI018)	1.2. 4. 10. 60 sec
Volume of the internal FLASH-memory	Up to 2 GB
Digital output	RS-232
GPS timing and coordinates determination	
Operating temperature range	-10 to +50°C
Temperature sensors (both in magnetic sensor and electronic units) resolution	0.1 °C
Power supply	9…12 V
Power consumption	<0.7 W

3. Observations

On 01.08.2010 around 0855 UT, Earth orbiting satellites detected a C3-class solar flare. The origin of the blast was sunspot 1092. At about the same time, an enormous magnetic filament stretching across the sun's northern hemisphere erupted. A coronal mass ejection (CME) produced by the event is heading directly for Earth (http://spaceweather.com) . Two days later on 3 August there have been Geomagnetic storm. In figures 1 is shown comparison of 1 minute data of Nor Amberd and Baksan magnetometers.

Another active sunspot 1401 erupted in Jan. 19th, on 2012 between 15:15 and 16:30 UT. The long-duration blast produced an M3-class solar flare and a CME heading towards Earth (http://spaceweather.com). At Jan. 22th has been registered geomagnetic storm, see Figures 2, where we present 1-second time series of geomagnetic field components measurements in Nor Amberd (Armenia), LVIV (Ukraine), Furstenfeldbruck (Germany), Novosibirsk (Russia). Data of Lviv, Furstenfeldbruck, Novosibirsk, stations were taken from web page of *International Real-time Magnetic Observatory Network* (*intermagnet.org*). As we can see in figures our data are in good agreement with others.

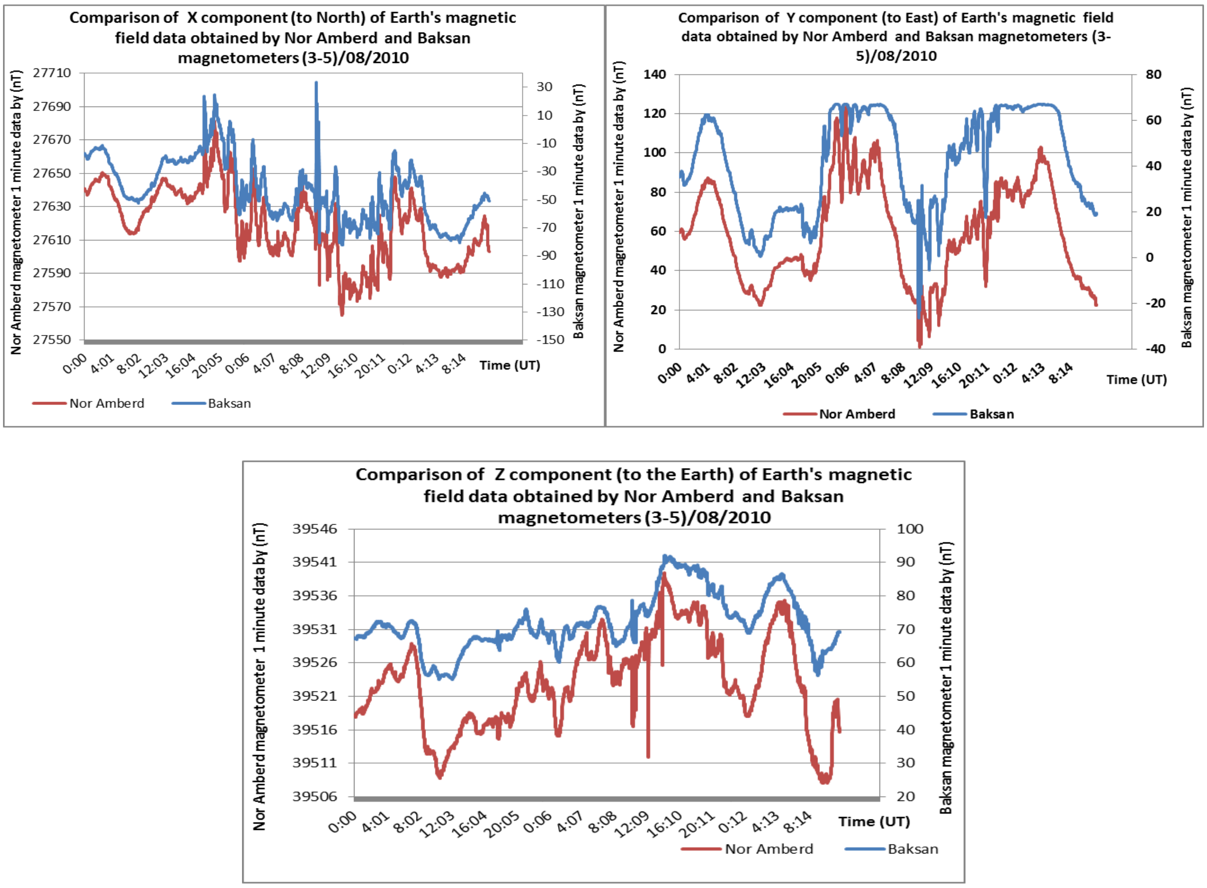

Figure1. One minute data comparison of Bx, By and Bz components of the Earth's magnetic field of Nor Amberd and Baksan magnetometers in August 2010

Solar activity is now high and during March 2012 there were several strong solar flares detected. On March 5 at 0413 UT an X1-class_eruption occurred on the SUN, another X5 flare occurred on March 7th around 0400 UT and a CME propelled toward Earth. Another M6, M8 and M7 flares have occurred accordingly on 9th, 10th and 13th of March and in all mentioned cases the blasts have hurled a coronal mass ejections. In Figure 3 we present disturbances of total geomagnetic field measured by Nor Amberd magnetometer, Aragats magnetometer, Dst index of Kyoto and Bz component of ACE Satellite magnetometer for period of time from March 5th to March 17th in 2012. As we can see in figure 3 the detection of geomagnetic storms by Nor Amberd, Aragats magnetometers and Dst index are in good agreement with each other.

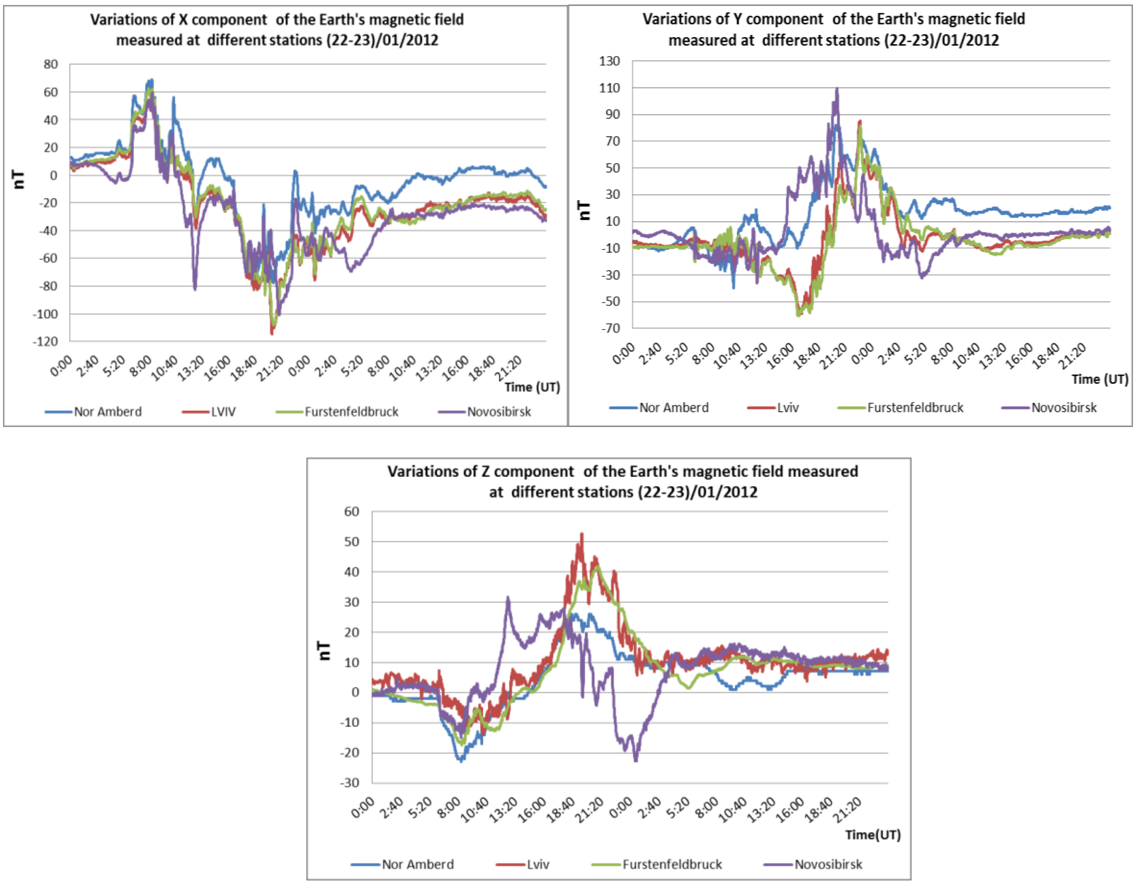

Figure2. One second data comparison of Bx, By and Bz components of the Earth's magnetic field of Nor Amberd, Lviv, Furstenfeldbruck, and Novosibirsk magnetometers

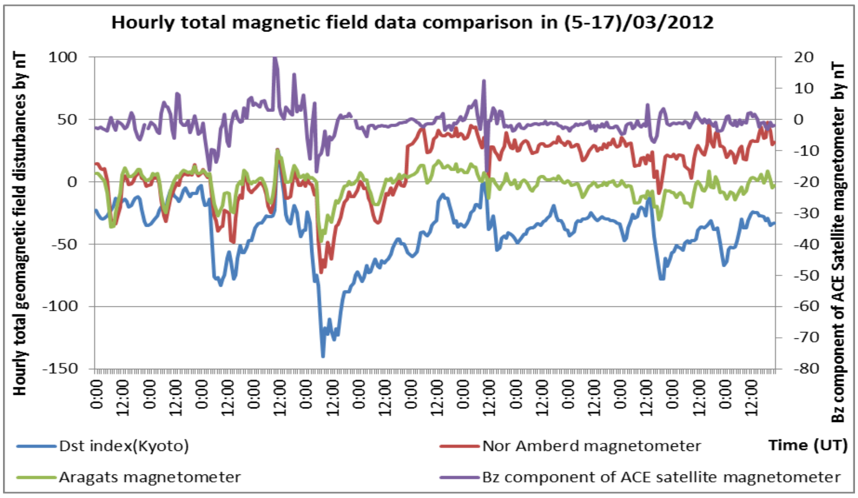

Figure3. Hourly total magnetic field data comparison of Nor Amberd magnetometer, Aragats magnetometer, Dst index of Kyoto and Bz component of ACE Satellite magnetometer from March 5th to March 17th in 2012

4. Conclusion

For the first time we present geomagnetic field measurements on the slope of mountain Aragats. The comparison of data from new installed magnetometers during strong solar activity with data from Baksan, Lviv, Furstenfeldbruck, Novosibirsk magnetometers as well as with geomagnetic Dst index proves relevance and applicability of new devices for global research of solar-terrestrial connections.

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