

September 2017 has been the most active month in the sense of solar activity during the current Solar Cycle 24. A number of 56 CMEs has been spotted, with four CMEs with angular width $90^\circ < w < 180^\circ$ and three HALO CMEs with angular width 360° resulting into distinct modulation of the galactic cosmic rays (source <http://sidc.oma.be/cactus/catalog.php>). September was also the most active month in the sense of proton flux levels of solar flares (SFs). After almost 11 years an X-class solar flare was produced again. Between September 6 and September 10 produced 19 M-class and 4 X-class solar flares (Fig. 1). The characteristics of X-class solar flares are presented in Table 1. In particular, a number of 145 SFs were spotted, the most energetic one being an X9.3 on 06/09/2017 at 11:53 UT (start time) from AR2673 with coordinates S09W34 (Fig. 2). This solar flare is the most energetic one of the current solar cycle. The X-class solar flares were associated with HALO CMEs and when they arrived produced strong and severe geomagnetic storms.

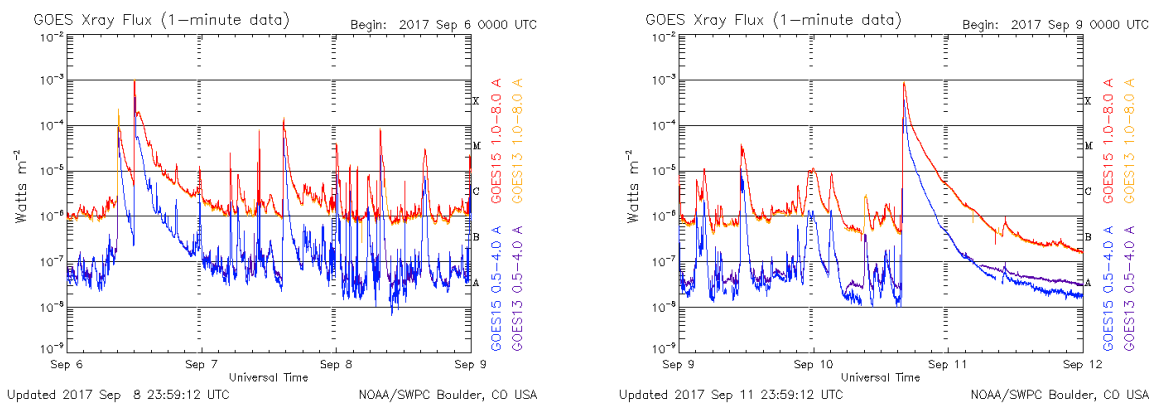


Figure 1: The series of M- and X-class solar flares during the period from 06/09/2017 to 10/09/2017 (ftp://ftp.swpc.noaa.gov/pub/warehouse/2017/2017_plots/xray/)

Flare Class	Start time YYYY/MM/DD, hh:mm	End time (UT)	Peak time (UT)	Active Region/ Coordinates
X2.2	2017/09/06 08:57 UT	09:17	09:10	AR2673 /S08W32
X9.3	2017/09/06 11:53 UT	12:10	12:02	AR2673 / S09W34
X1.3	2017/09/07 14:20 UT	14:55	14:36	AR2673 / S08W48
X8.2	2017/09/10 15:35 UT	16:31	16:06	AR2673 / S08W88

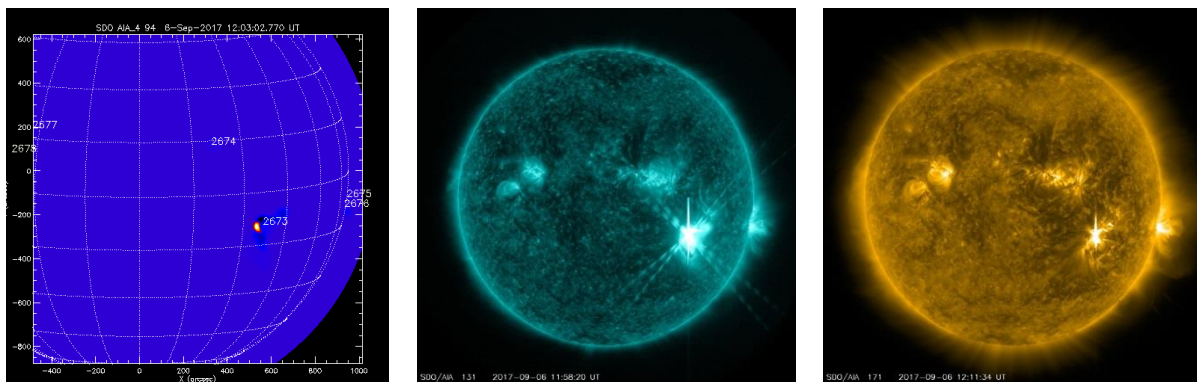


Figure 2: The X9.3 SF of 06/09/2017 at 12:02 UT peak time (from <http://www.lmsal.com/solarsoft> and <http://sdo.gsfc.nasa.gov/data/aiahmi/>)

The HALO CME associated with the X9.3 solar flare was produced on September 6 at 12:24 UT and arrived on Earth on September 7 at 22:30 UT producing a strong (G3) and a severe (G4) geomagnetic storm (Fig. 3). The HALO CME associated with the X8.2 solar flare produced on September 10 at 16:00 UT and arrived at Earth on September 12 at 19:26 UT producing a minor (G1) and moderate (G2) geomagnetic storms. For both of the CMEs a prediction for the arrival time of the associated shocks prepared using EAMv2 model. The first event arrives earlier almost 12 hours and the second one almost 7 hours, indicating that the initial speeds of the CMEs were greater than initially estimated by the CACTUS database.

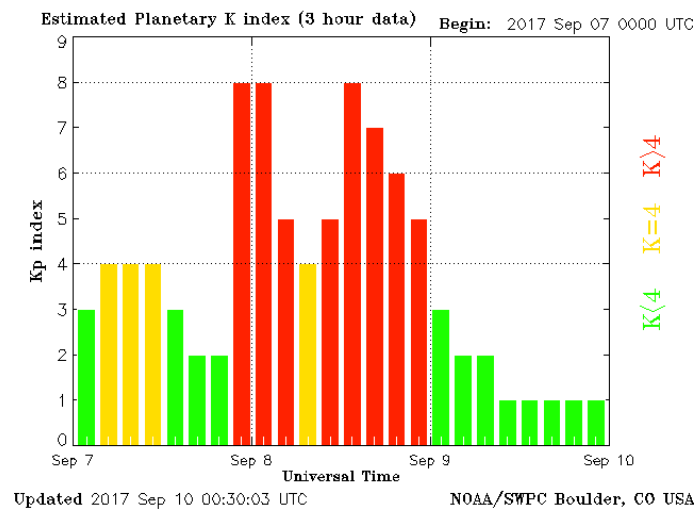


Figure 3: The Kp index values during the severe geomagnetic storm (G4) of September 7-8, 2017 (ftp://ftp.swpc.noaa.gov/pub/warehouse/2017/2017_plots/kp/)

The X8.2 solar flare produced a strong solar storm of S3 level and a strong radio blackout of R3 level. The proton flux and the radio blackout map are presented in Fig. 4.

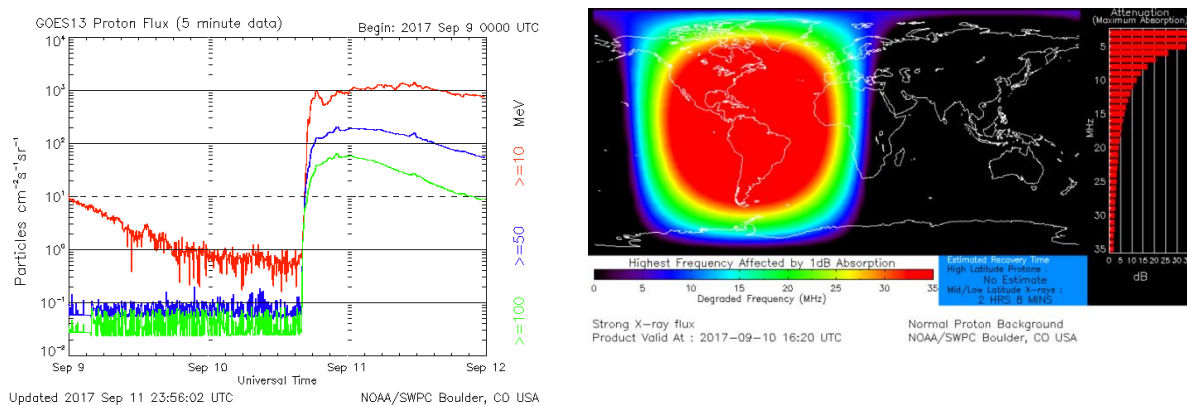


Figure 4: The proton flux (left panel) and the map of radio blackout (right panel) for the associated strong X8.2 solar flare (ftp://ftp.swpc.noaa.gov/pub/warehouse/2017/2017_plots/proton/ - NOAA)

This event triggered a ground level enhancement (GLE) of the galactic cosmic-ray intensity recorded by the neutron monitor stations of the worldwide network (<http://www.nmdb.eu>). The Neutron Monitor situated at South Pole Bare (SOPB) recorded this event with the greatest amplitude, while Apatity (APTY) was the first station that recorded the arrival of high energy relativistic particles at the Earth. As it is shown in Figure 5 seven (7) neutron monitor stations from those of the GLE ALERT Plus recorded a clear rapid rise in their intensity-time profiles.

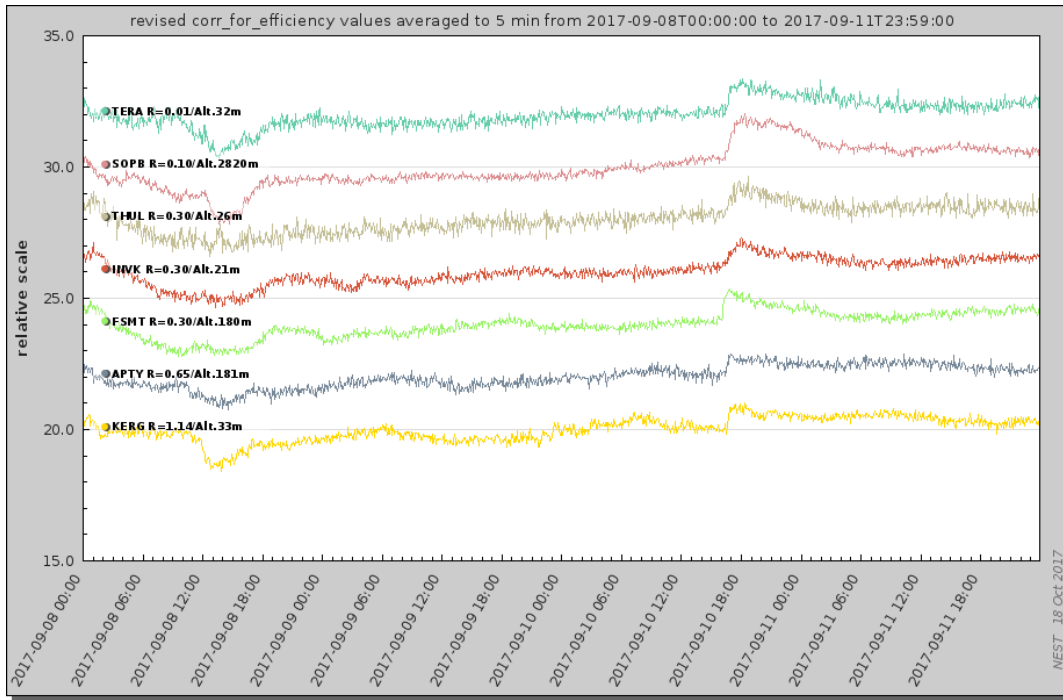


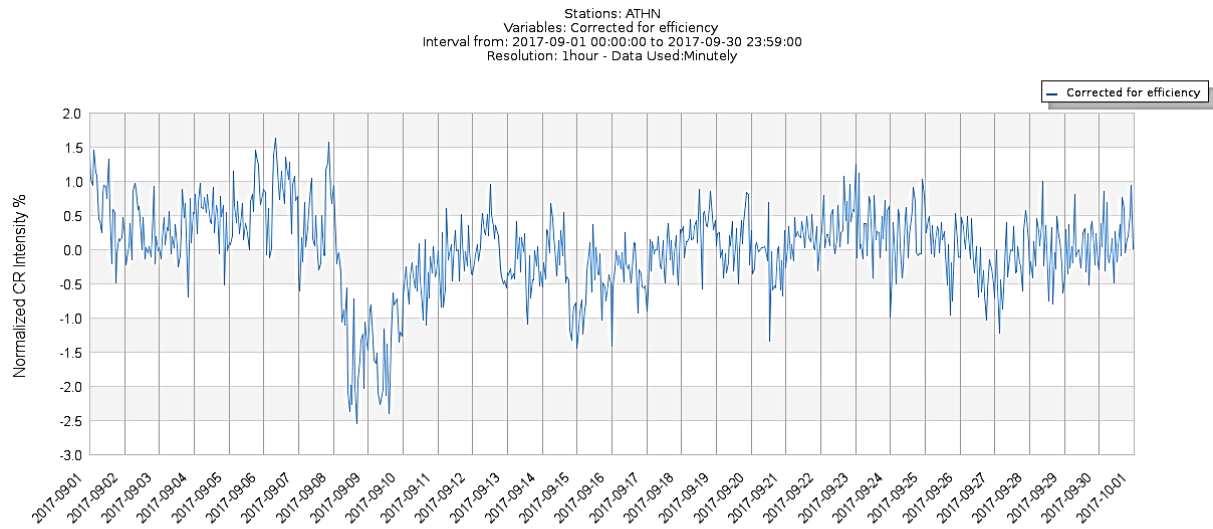
Figure 5: Intensity-time profiles of the ground level enhancement of 10.09.2017 (GLE72), as it was recorded by FSMT, SOPB, APTY, KER6, INVK, TERA and THUL neutron monitor stations.

Other stations recorded also the GLE72 with smaller amplitude. In general, the neutron monitors having nominal cut-off rigidity up to 3.9 GV, corresponding to proton energy of 3.2 GeV, presented an increase in their count rate relative to that rate between 15:00 and 16:00 UT. The GLE Alert Plus system of Athens neutron Monitor Station (ANeMoS) operated in ESA SSA R-ESC portal (<http://swe.ssa.esa.int/space-radiation>) recorded this event in real time and email notifications were sent to the subscribed users on 10 September 2017 at 17:03 UT. This event recorded by the neutron monitor stations of Apatity (APTY), Fort Smith (FSMT), Inuvik (INVK), Kerguelen (KER6), South Pole Bare (SOPB), Terre Adelie (TERA) and Thule (THUL). A snapshot of ANEMOS GLE72 Alert on 10 September 2017 taken in live, is presented in Figure 6.



Figure 6: A snapshot of the ANEMOS GLE Alert Plus System recorded the GLE on September 10, 2017 at 17:03UT.

The interaction of high-speed streams of solar wind from coronal holes on September 1-2, 14-18 and 27-30 as well as disturbed solar wind on September 4-5 was triggered geomagnetic storms of G1, G1-G2 and G1-G3 levels respectively. The results of these events were spotted on the cosmic ray intensity as Forbush decreases during this month, recorded at Athens Neutron Monitor Station (cut-off rigidity 8.53 GV) with amplitudes varied from 1.5% up to almost 3.5% (Fig. 7).



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Figure 7: Hourly corrected for pressure and efficiency values of the cosmic ray intensity recorded by Athens Neutron Monitor Station from 01-30/09/2017 (From the multi station data service of Athens NM Station).