

ESA SPACE WEATHER NETWORK SERVICE

REPORT of ANEMOS/NKUA TEAM

Geomagnetic conditions Service Center -G.171 Product

“Automated Process of the ap Prediction tool”

The Severe Geomagnetic Storm (G4) on September 17, 2024

1. Solar Activity

On September 17, 2024, a severe geomagnetic storm (G4) was occurred during the 25th solar cycle. This storm was noticed due to the effects of the CME that was observed on the Sun on September 14, 2024 at 15:36 UT ([CME Scoreboard \(nasa.gov\)](https://cme.scoreboard.nasa.gov/)), associated with a powerful X4.5-class solar flare from AR3825 peaking on September 14 at 15:29 UT (Figure 1). This CME was expected to reach Earth on September 16 at 15:50 UT according to EAM (Effective Acceleration Model) predictions of National and Kapodistrian University of Athens (Paouris and Mavromichalaki, 2017 a; 2017b). The actual shock arrival time of above CME was noticed on September 16, 2024 at 22:49 UT and producing geomagnetic storm of level G4. Moreover, during these days another faint CME was observed on the Sun on September 13, 2024 at 10:12 UT and the actual shock arrival time was noticed on September 16, 2024 at 04:54 UT.

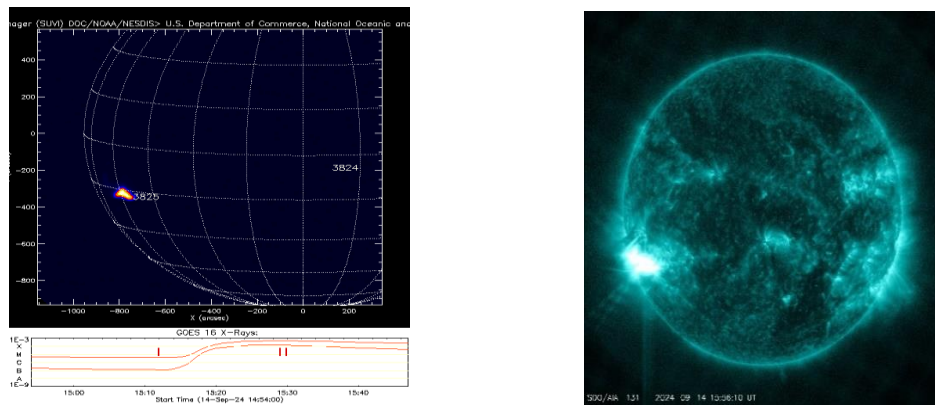


Figure 1: The X4.5 solar flare on September 14 at 15:29 UT peak time (from <https://www.lmsal.com/solarsoft> and <http://sdo.gsfc.nasa.gov/data/aiahmi/>).

2. Solar Energetic Particle Events

GOES Proton Flux for particles with energies above 10 MeV exceed the SWPC 10 MeV warning threshold on September 17 at 07:30 UT and ended at 16:15 UT. A solar radiation storm of level S1 was also observed.

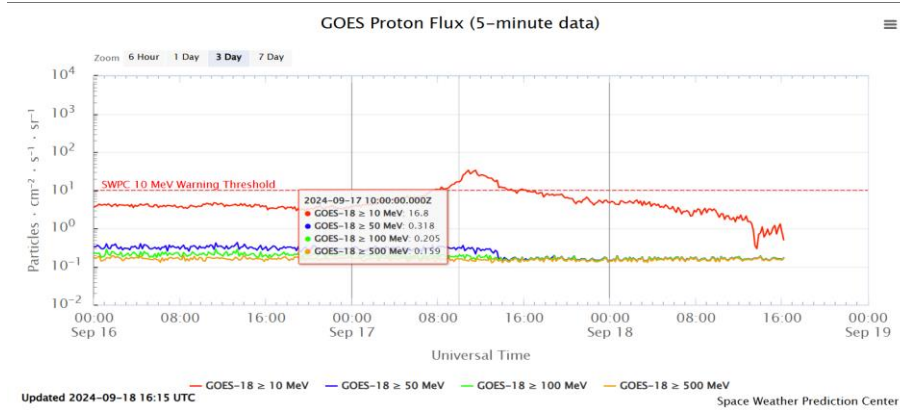


Figure 2: Alert signal issued by Space Weather Prediction Center (SWPC) of NOAA. (<http://www.swpc.noaa.gov/products/goes-proton-flux>)

3. Interplanetary conditions

Due to the effects of the CME the solar wind speed reached a peak of about 582 Km/s on September 17, 2024 at 00:15 UT as detected from ACE. The arrival signature was characterized by sharp decrease of the vertical component of IMF Bz reaching -17nT on September 17, 2024 at 00:35 UT (Figure 3).

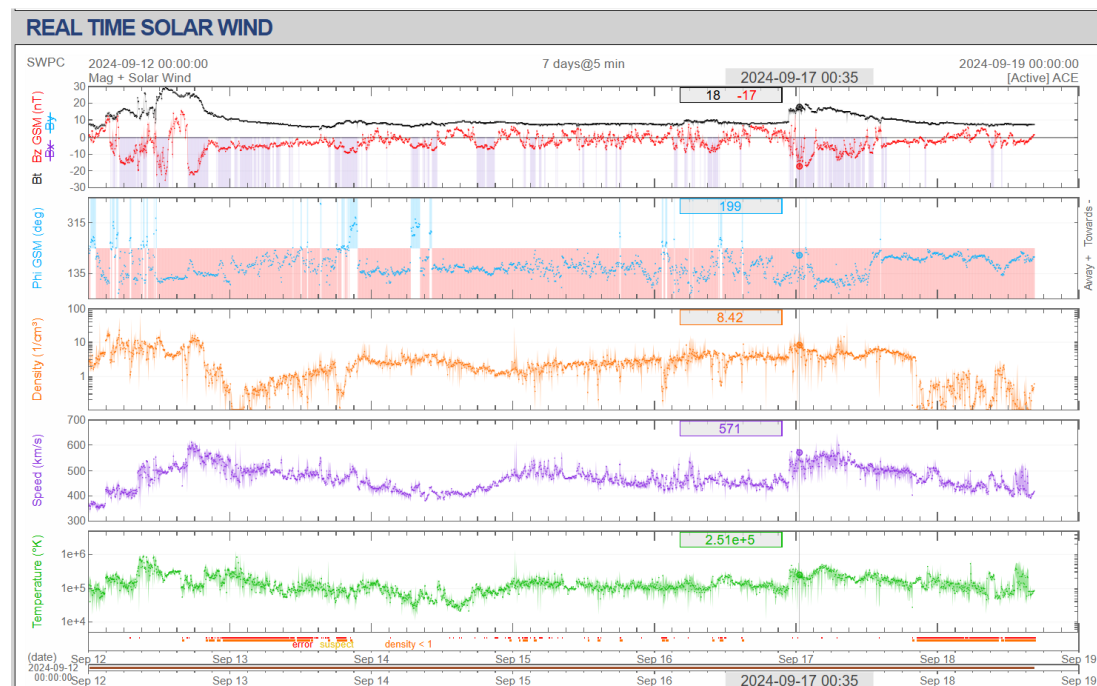


Figure 3: Solar wind speed and vertical component of IMF Bz from DSCOVR spacecraft. (<http://www.swpc.noaa.gov/products/real-time-solar-wind>)

4. Geophysical Activity

The arrival of the above CMEs was forecasted and reported from Athens Space Weather Forecasting Center ([ASWFC \(uoa.gr\)](http://www.uoa.gr)) (figure 4).

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Product: Daily Forecast of Geomagnetic Activity
Issued: 2024 September 16 07:11UTC
Prepared by the Athens Space Weather Forecasting Center
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I. Solar activity
--Current Status
Solar Flux (10.7cm) measured on 15.09.2024 at 23:00 UTC was 173 sfu.
The background X-Ray flux is at the class C1.5 level.
No obviously Earth directed CMEs were observed in available LASCO imagery on
September 11-12.
A coronal hole (CH1241) at southern hemisphere rotated into an Earth facing
position on September 12-13.
---CME arrival forecast
A CME was observed on September 13 at 10:12 UT. This CME could reach Earth on
September 16 between at 01:37 UT and 06:15 UT according to EAM predictions.
Another CME was observed on September 14 at 15:36 UT, associated with the
powerful X4.5-class solar flare. This CME is expected to reach Earth on September
16 at 15:50 UT according to EAM predictions.

II. Solar Energetic Particle Events|
Protons and electrons fluxes are quiet.

III. Interplanetary and Geomagnetic conditions
The solar wind speed measured by ACE satellite reached the max value 530 Km/s on
September 16 at 06:00 UT during the last 24 hours.
The solar wind speed from STEREO A was detected 400 Km/s during the last 24
hours.
The vertical component of IMF Bz reached the max value -9 nT on September 16 at
05:15 UT during the last 24 hours.
The geomagnetic field was at quiet to active levels during the last 24 hours.
The Kp index now is at active levels with Kp=4.

IV. 3-day Geomagnetic Activity Forecast
The geomagnetic field is expected to be at unsettled to strong storm (G3) with a
chance of severe storm (G4) levels on September 16 due to the effects of CMEs
from September 13 and 14 and the recurrent coronal hole high speed stream and at
quiet to moderate storm (G2) levels on September 17 and at quiet to unsettled
levels on September 18.

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Date	Ap index forecast	Geomagnetic Activity level
16.09.2024	65	Unsettled to Strong storm (G3)
17.09.2024	25	Quiet to Moderate storm (G2)
18.09.2024	10	Quiet to Unsettled

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Figure 4: Daily Space Weather Forecasting Report from A.NE.MO.S

Due to the arrival of the CME on September 17, 2024 the daily value of Ap index equal to 70 and the geomagnetic storm reached the level G4 (severe storm) with the corresponding Kp index equal to 7⁺ (Figure 5). During the study period of the storm the Dst index reached the minimum value – 116 nT on September 17, 2024 at 09:00 UT (Figure 6).

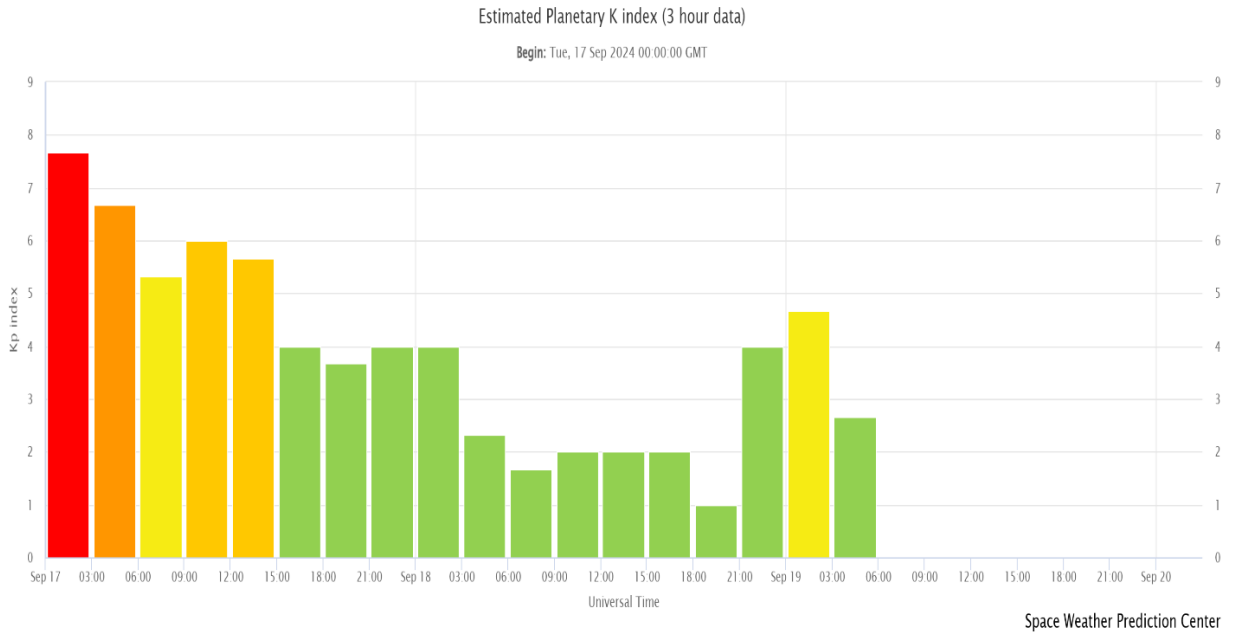


Figure 5: The Kp index values during the geomagnetic storm of September 17. (<http://www.swpc.noaa.gov/products/planetary-k-index>)

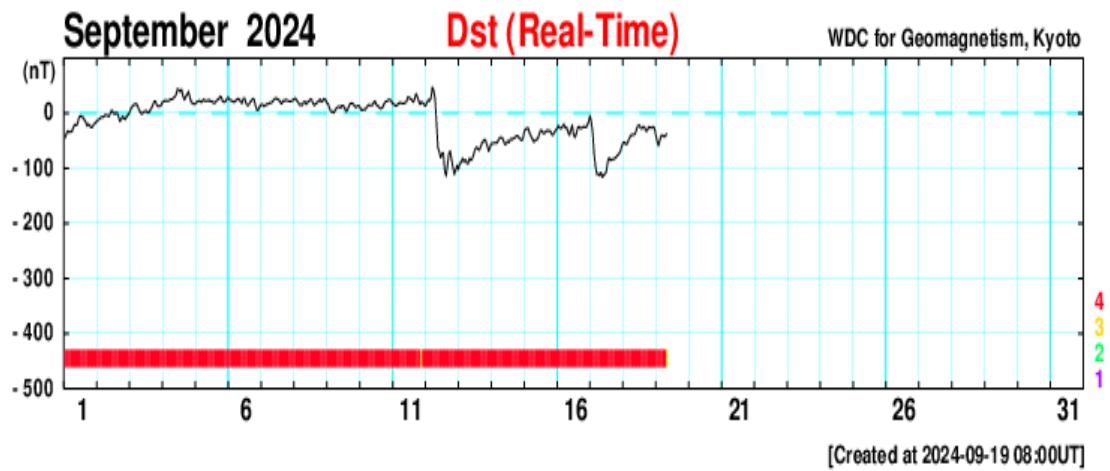


Figure 6: The variation of Dst index during the geomagnetic storm of September 17. ([Real-time \(Quicklook\) Dst Index Monthly Plot and Table \(kyoto-u.ac.jp\)](http://www.kyoto-u.ac.jp/~wdc/geomag/realtime/quicklook/))

5. Cosmic rays

The results of this event during September 17, 2024 were spotted on the cosmic ray intensity, recorded at Athens Neutron Monitor Station (cut-off rigidity $R=8.53$ GV) (Figure 7). Moreover, in Figure 8 the cosmic ray intensity at three other Neutron Monitor Station (Baksan, $R=4.84$ GV, Oulu, $R=0,81$ GV, Apatity, $R=0,65$ GV) are presented. Note that the behavior of the cosmic ray is almost same in all Neutron Monitor Stations, and it was shaped by solar activity.

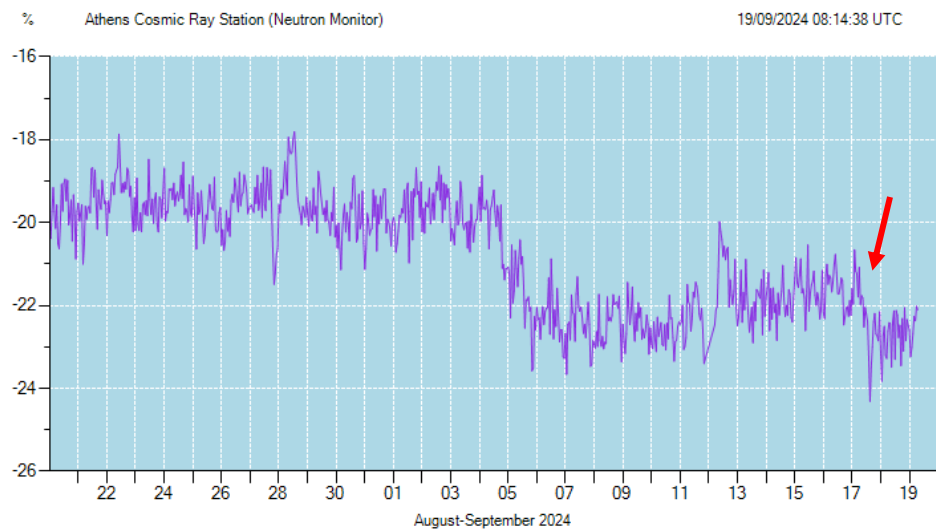


Figure 7: The counting rate of the Athens Neutron Monitor Station during the studied period. ([Home \(uoa.gr\)](http://Home(uoa.gr)))

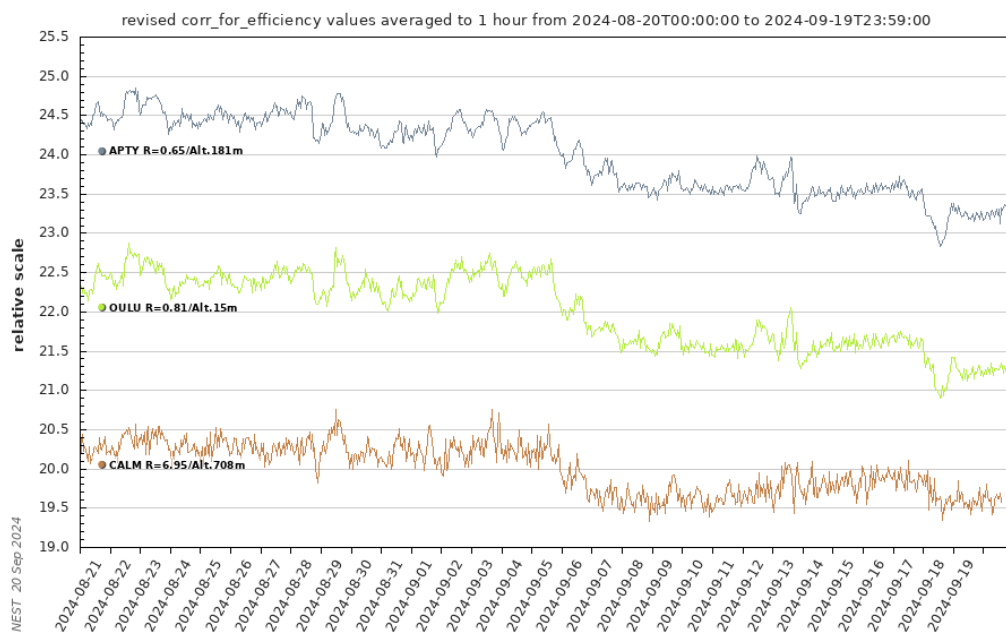


Figure 8: The counting rate of three Neutron Monitor Stations during the studied period. (nmdb.eu/nest/index.php)

