Partial Reference List for September 2017 Storms

September 2017's Geoeffective Space Weather and Impacts to Caribbean Radio Communications During Hurricane Response

- R. J. Redmon et al. 25 July 2018

Key Points

- The September 2017 solar events impacted high-frequency radio links for ground and aviation communication
- Radio communications used in hurricane emergency and disaster relief management were affected, especially in the Caribbean
- Active region AR12673 released four X-class flares, three coronal mass ejections, and a solar energetic particle event with ground level enhancement

The Solar Particle Event on 10 September 2017 as observed onboard the International Space Station (ISS)

- T. Berger et al., 28 June 2018

Key Points

- A solar particle event—also seen as GLE 72 on Earth—was measured in September 2017 inside the International Space Station
- Data were provided by two detector systems, DOSIS 3D-DOSTEL and ISS-RAD, both in close proximity to each other in the Columbus Laboratory
- The additional absorbed dose due to the 10 September 2017 solar particle event was in the range of 67.8 to 146.2 µGy in Si

Radiation Dose Nowcast for the Ground Level Enhancement on 10–11 September 2017

- Ryuho Kataoka et al., 25 May 2018

Key Points

- The radiation dose during the ground level enhancement on 10–11 September 2017 (GLE 72) was manually nowcasted

- The maximum radiation dose rate of GLE 72 at flight altitude was estimated to be 3 μSv/h
- The exceptionally soft proton energy spectrum at 0.1–10 GeV range during GLE 72 may have been caused by a parallel shock acceleration

Formation and Evolution of Low-Latitude *F* Region Field-Aligned Irregularities During the 7–8 September 2017 Storm: Hainan Coherent Scatter Phased Array Radar and Digisonde Observations

- Han Jin et al., 21 May 2018

Key Points

- Low-latitude ionospheric observations by seven-beam (east-west plane) VHF radar operated at Fuke, China, and a nearby digisonde
- Storm-induced PPEF is responsible for postsunset FAIs, and substorm-related overshielding *E* field leads to postmidnight FAIs
- Plasma bubble irregularities showed dominantly westward drift rather than the eastward drift normally observed under quiet conditions

Shock Connectivity and the Late Cycle 24 Solar Energetic Particle Events in July and September 2017

- J. G. Luhmann et al

Key Points

- Observer shock connectivity explains the SEP observations during the July and September 2017 events
- The July and September 2017 solar and SEP events had similar characteristics due to similar source region and eruptions
- The July and September 2017 events seemed to arise in conjunction with the appearance of a pseudostreamer, a possible alternate ICME source

Long-Lasting Geomagnetically Induced Currents and Harmonic Distortion Observed in New Zealand During the 7–8 September 2017 Disturbed Period

- Mark A. Clilverd et al., 25 May 2018

Key Points

- Analysis of a transformer in New Zealand shows a sequence of large geomagnetically induced currents (GIC) associated with a storm period
- Unique combination of measurements show primarily even harmonics generated by transformer saturation when GIC > 15 A
- During study period only longer-lasting GIC generated observable harmonics but limited GIC impact from impulsive solar wind shock events

Midlatitude Plasma Bubbles Over China and Adjacent Areas During a Magnetic Storm on 8 September 2017

- Ercha Aa et al. 09 March 2018

Key Points

- Postsunset midlatitude plasma bubbles were observed over China and adjacent areas using GNSS TEC, Swarm Ne, and ionosonde data
- The plasma bubbles were triggered by PPEF and TID in equatorial regions and extended along the magnetic field lines to 50°N (45.5 MLAT)
- Plasma bubbles might reach an altitude of 6,600 km over the magnetic equator with the upper limit of upward drift speed being around 700 m/s

Update on the Worsening Particle Radiation Environment Observed by CRaTER and Implications for Future Human Deep-Space Exploration

- N. A. Schwadron et al 22 February 2018

Key Points

- GCR radiation doses are rising faster than predicted previously
- SEP radiation events are large despite low solar activity
- Radiation environment is a significant factor for mission planning

Flares at Earth and Mars: An Ionospheric Escape Mechanism?

- M. Mendillo et al. 13 July 2018

Key Points

- Observations and models for Earth show that flare-induced ionospheric enhancements of N_e and T_e lead quickly to plasma escape
- September 2017 flares confirm terrestrial pattern at early times (~10 min), but observations at Mars only available after ~2 hr
- For Mars, analytical 1-D model predicts upward plasma drift capable of escape; new observations for "early time" flare effects needed

The 6 September 2017 X-Class Solar Flares and Their Impacts on the Ionosphere, GNSS, and HF Radio Wave Propagation

- Y. Yasyukevich et al., 13 July 2018

Key Points

- We investigated effects of the 6 September 2017 X-class solar flares on the ionosphere, GNSS-based navigation, and HF propagation
- The solar flares had a significant impact on the ionosphere, and the ionospheric effects lasted longer than the enhanced EUV emission
- The SRB associated with the X9.3 flare did not impact on the GNSS communication, but the X-ray emission caused blackout in HF propagation

The Solar Particle Event on 10–13 September 2017: Spectral Reconstruction and Calculation of the Radiation Exposure in Aviation and Space

- Daniel Matthiä et al., 17 July 2018

Key Points

- In September 2017 a solar particle event was recorded as GLE by neutron monitors and also measured by several space-borne detectors
- Proton spectra during the event are derived from GOES data and validated through comparison to neutron monitor measurements
- Dose rates are derived for different exposure scenarios in space and aviation. The results are compared to measurements, where available

Solar Cosmic Ray Dose Rate Assessments During GLE 72 Using MIRA and PANDOCA

- Kyle Copeland et al., 20 July 2018

Key Points

- GLE 72 caused concern among aircrew members and reached S 3 on the NOAA scale, but at and below 12.2 km the solar *D* index remained at zero
- Solar cosmic ray effective dose rates calculated using MIRA and PANDOCA during GLE 72 agreed well where vertical cutoff rigidity was low
- In addition to GOES data, solar radiation alert system models for aircrews can benefit from neutron monitor or other data

Solar Energetic Proton Access to the Magnetosphere During the 10–14 September 2017 Particle Event

- T. P. O'Brien et a., 02 August 2018

Key Points

- The angular distribution of SEPs in the magnetosphere is dominated by the east-west effect
- Geomagnetic cutoff models do not capture the idiosyncratic and dynamic particle access to a satellite's location inside the magnetosphere
- Observed low-altitude cutoffs correlate well with high-altitude observations

Modeling the Evolution and Propagation of 10 September 2017 CMEs and SEPs Arriving at Mars Constrained by Remote Sensing and In Situ Measurement

- Jingnan Guo et al., 27 July 2018

Key Points

- The 10 September 2017 SEP event was the first GLE observed on the surface of two different planets: Earth and Mars
- The SEP and ICME impact on Mars is helping us better understand extreme space weather conditions at Mars
- Synergistic modeling of the ICME and SEP propagation advances our understanding of such complex events for improved space weather forecasts
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The 6 September 2017 X9 Super Flare Observed From Submillimeter to Mid-IR

- C. G. Giménez de Castro et al., 11 August 2018

Key Points

- SOL2017-09-06T12:00 is the most intense flare of cycle 24
- The IR emission has a similar time evolution as the white light and very different from the microwaves at 15.4 GHz
- The radio emission at 212 and 405 GHz comes from a different source than the microwaves

Precursors of Magnetic Flux Emergence in the Moat Flows of Active Region AR12673

- R. Attie et al., :01 August 2018

Key Points

- The moat flow of AR12673 is analyzed and segmented using innovative and automated tracking methods
- We detect four cases of perturbations of the moat radius preceding strong flux emergence by 2 to 12 hr
- No significant flux emergence is observed in the absence of these perturbations

SuperDARN Radar-Derived HF Radio Attenuation During the September 2017 Solar Proton Events

- Emma C. Bland et al., 10 August 2018

Key Points

- SuperDARN HF radars were strongly affected by polar cap absorption events in September 2017
- A novel method to estimate HF attenuation using SuperDARN atmospheric noise measurements has been developed
- Up to 14-dB attenuation at 12 MHz was measured in the polar caps, resulting in backscatter loss

O^+ Escape During the Extreme Space Weather Event of 4–10 September 2017

- Audrey Schillings et al., 23 August 2018

Key Points

- Multiple X-flares and three CMEs occurred in 4-10 September 2017, CMEs are the driver of the storm, whereas the X-flares might have preheated the ionosphere
- The O^+ outflow in the polar cap and cusp is estimated to be 10^{13} $m^{-2}s^{-1}$ during the main phase of the geomagnetic storm
- The entire magnetosphere is affected by space weather event, and the O^+ enhancement in the cusp might be a good indicator for satellite drag fluctuations

Effects of Phase Scintillation on the GNSS Positioning Error During the September 2017 Storm at Svalbard

- Nicola Linty et al., 23 August 2018

Key Points

- GPS L1 signals affected by scintillation were automatically recorded during the September 2017 geomagnetic storm
- Carrier smoothed positioning error was analyzed in the presence of phase scintillation
- Clustering of GPS positioning solutions was investigated for the detection of scintillation events

Ionospheric Response Observed by EISCAT During the 6–8 September 2017 Space Weather Event: Overview

- M. Yamauchi et al., 03 September 2018

Key Points

- The X9.3 flare on 6 September 2017 triggered enhancements of ionospheric electron density and temperature but not ion upflow immediately
- Prenoon ion upflow at 400 km altitude increased over 6–8 September 2017, but its cause can be SEP event rather than CME or X flare

- Substorm-like auroral breakup was observed without notable geomagnetic signature when the interplanetary magnetic field was very weak

Space Weather on the Surface of Mars: Impact of the September 2017 Events

- D. M. Hassler et al., 30 August 2018

Key Points

- On 11 September 2017, MSL RAD observed the strongest solar particle event seen on the surface of Mars since landing in 2012
- Dose rates and neutral particle fluxes increased by factor of 2; proton and ^{4}He fluxes increased by factor of 30 and 10, respectively
- Integrated dose was only slightly greater than before the event, due to reduced quality factor during the event, and Forbush decrease after the event

Ionospheric Response to the X9.3 Flare on 6 September 2017 and Its Implication for Navigation Services Over Europe

- J. Berdermann et al., 04 October 2018

Key Points

- Solar flare events can have a significant impact on GNSS positioning
- The critical effects are based on rapid changes of the dayside ionosphere during the peak phase of the flare event
- The knowledge of the flare spectrum is very important in order to estimate its significance for GNSS users

Analysis of the Solar Flare Effects of 6 September 2017 in the Ionosphere and in the Earth's Magnetic Field Using Spherical Elementary Current Systems

- J. J. Curto et al., 01 October 2018

Key Point

- We analyzed the effect of the solar flare of 6 September 2017 in the ionosphere and in the Earth's magnetic field

Solar Eruptions, Forbush Decreases, and Geomagnetic Disturbances From Outstanding Active Region 12673

- I. M. Chertok et al., 23 September 2018

Key Points

- The total magnetic flux of the EUV arcades and dimmings of two solar eruptive flares from early September 2017 is used for geoeffectiveness diagnostics
- The estimated scales of the space weather disturbances caused by the flares are close to those of the observed Forbush decreases and geomagnetic storms
- The roles of a high-speed stream from an adjacent coronal hole and the interaction between two ICMEs near Earth are considered

Solar Ultraviolet Irradiance Observations of the Solar Flares During the Intense September 2017 Storm Period

- P. C. Chamberlin et al., 31 August 2018

Key Points

- The largest outburst, in frequency and magnitude, of Solar Cycle 24 occurred late in the cycle from 4 to 10 September 2017
- These solar flares were well observed in the EUV by SDO EVE and other solar EUV irradiance instruments and modeled by FISM
- The 6 and 10 September X-class flares are remarkably similar in physical evolution and irradiance spectral evolution

In Situ Data and Effect Correlation During September 2017 Solar Particle Event

- P. Jiggens et al., 21 November 2018

Key Points

- Corrected particle flux measurements taken by different instruments on-board different platforms at Earth and Mars show good agreement/correlation

- Dose calculations based on a full spectral fit to fluence indicate this was one of the 20 largest particle events of the past 45 years but still almost an order of magnitude below the largest events
- In situ single event observations show significant increases due to the enhancements and calculations show moderate enhancements for humans at aircraft altitudes

Merging of Storm Time Midlatitude Traveling Ionospheric Disturbances and Equatorial Plasma Bubbles

- Ercha Aa et al., First Published:16 December 2018

Key Points

- Postsunset EPBs driven by PPEF were observed to merge with midlatitude TIDs forming stream-like depletion structures over American sector
- Depletions reached 46 MLAT that map to 6,800 km over the equator and drifted westward reaching the equatorward boundary of the main trough
- Strong convection flow near SAPS region and disturbance thermospheric wind contributed to the westward drift of the midlatitude depletions

Real-Time Detection of the Ground Level Enhancement on 10 September 2017 by A.Ne.Mo.S.: System Report

- H. Mavromichalaki et al., First Published:25 October 2018

Key Points

- A ground level enhancement of cosmic ray intensity, identified as GLE72, was recorded by several stations of neutron monitor network
- This GLE event was successfully detected in real time by the GLE Alert plus System of the Athens Neutron Monitor Station (A.Ne.Mo.S.)
- Seven neutron monitor stations contributed to the GLE Alert plus System due to the functionality of this system and the data availability

Spectral Analysis of the September 2017 Solar Energetic Particle Events

- A. Bruno et al., 11 February 2019

Key Points

- Extreme solar activity occurred in early September 2017; three solar energetic particle events, including a GLE, were registered at Earth
- A comprehensive investigation is made of the proton energy spectra based on ACE, GOES, and STEREO observations
- Spectral features are interpreted in terms of acceleration, transport, and connectivity; results are compared with those of the previous GLE

High-Frequency Communications Response to Solar Activity in September 2017 as Observed by Amateur Radio Networks

- Nathaniel A. Frissell et al., 11 January 2019

Key Points

- Solar flares and geomagnetic storms disrupted high-frequency (HF, 3–30 MHz) emergency radio communications in September 2017
- HF propagation recovered from solar flare radio blackouts in tens of minutes to hours
- HF propagation recovered from geomagnetic storms over a period of days

The Ground-Level Enhancement Event of September 2017 and Other Large Solar Energetic Particle Events of Cycle 24

- C. M. S. Cohen and R. A. Mewaldt. 10 October 2018

Key Points

- The 10 September 2017 event proton spectrum was a broken power law, typical of ground-level events but softer than usual at high energies
- Due to the event's high break energy, the 100-MeV proton fluence was within a factor of 4.5 of the largest ground-level events of cycle 23
- STEREO observed events larger than the largest cycle 23 ground-level event, but the top 10 events were smaller in cycle 24 than cycle 23

Space Weather Events, Hurricanes, and Earthquakes in Mexico in September 2017

- J. A. Gonzalez-Esparza et al., 17 October 2018

Key Points

- A unique combination of three natural hazards affected Mexico in September 2017, important lessons for civil protection management
- Comprehensive space weather observations were obtained from a ground-based instrumental network associated with SCiESMEX
- Geomagnetic and ionospheric disturbances were detected, and geomagnetic storm effects dominated in the ionospheric variations

Modeling the Multiple CME Interaction Event on 6–9 September 2017 with WSA-ENLIL+Cone

- A. L. E. Werner et al., 14 February 2019

Key Points

- A series of CMEs from 4–6 September 2017 interacted and formed two IP shocks reaching Earth on 6–9 September
- The solar wind plasma was preconditioned by several merged CMEs from 4–5 September to exert little resistance against the 6 September CME
- We propose a new tool with potential to greatly improve the arrival time prediction for fast single halo CMEs

Assessment of the Radiation Environment at Commercial Jet-Flight Altitudes During GLE 72 on 10 September 2017 Using Neutron Monitor Data

- A. L. Mishev and I. G. Usoskin, 15 November 2018

Key Points

- Rigidity spectra of solar energetic protons during the GLE 72 were reconstructed using data from the global neutron monitor network
- Time profiles of the effective dose rates at several altitudes during the GLE 72 were estimated

- Received doses for crew/passenger of a typical intercontinental high-latitude ~10-hr flight were estimated as ~100 μSv

Forbush Decreases and Geomagnetic Storms During a Highly Disturbed Solar and Interplanetary Period, 4–10 September 2017

- B. Badruddin et al., 27 February 2019

Key Points

- Forbush decreases and geomagnetic storms in the interval 4–10 September 2017 are studied
- Simultaneous high-resolution data of cosmic rays, *Dst* index, and solar wind are analyzed
- Time lag correlation analysis is performed, and possibility of its use in space weather forecast is indicated

Solar Radio Burst Events on 6 September 2017 and Its Impact on GNSS Signal Frequencies

- H. Sato et al., 8 May 2019

Key Points

- Strong L-band solar radio bursts associated with a severe solar flare interfered with GNSS signal frequencies at L2/L5
- The observed GNSS SNR reduction due to the radio bursts is not considered as the primary source of signal tracking loss
- Dual-frequency positioning was more affected than single-frequency positioning

Response of the Ionosphere-Plasmasphere Coupling to the September 2017 Storm: What Erodes the Plasmasphere so Severely?

- Y. Obana et al., 18 May 2019

Key Points

- An extreme erosion of the plasmasphere was observed by the ERG/Arase spacecraft (LPP=1.6~1.7).
- The trough minimum location identified in GNSS-TEC moved equatorward as low as ~48° magnetic latitude (L=~2.2).

- The observed erosion was qualitatively reproduced by the IPE simulation by including the effect of the penetration electric field.

The GIC and geomagnetic response over Fennoscandia to the 7-8 September 2017 geomagnetic storm

- A.P. Dimmock et al., 11 June 2019

Key Points

- The maximum peak GIC did not coincide with the sudden storm commencement
- Largest GIC peak did not occur during particularly strong driving conditions
- New comparison of 1D \& 3D models justify the past and future use of 1D models at Mäntsälä

Non Space Weather articles

Space Weather and Specific Features of the Development of Current Solar Cycle.
Ishkov, V. (2018). Geomagnetism and Aeronomy. 58. 753-767. 10.1134/S0016793218060051.

Lei, J., Huang, F., Chen, X., Zhong, J., Ren, D., Wang, W., et al. (2018). Was magnetic storm the only driver of the long-duration enhancements of daytime total electron content in the Asian-Australian sector between 7 and 12 September 2017? *Journal of Geophysical Research: Space Physics*, 123, 3217– 3232. https://doi.org/10.1029/2017JA025166