

Space Weather Impacts on End User Communities

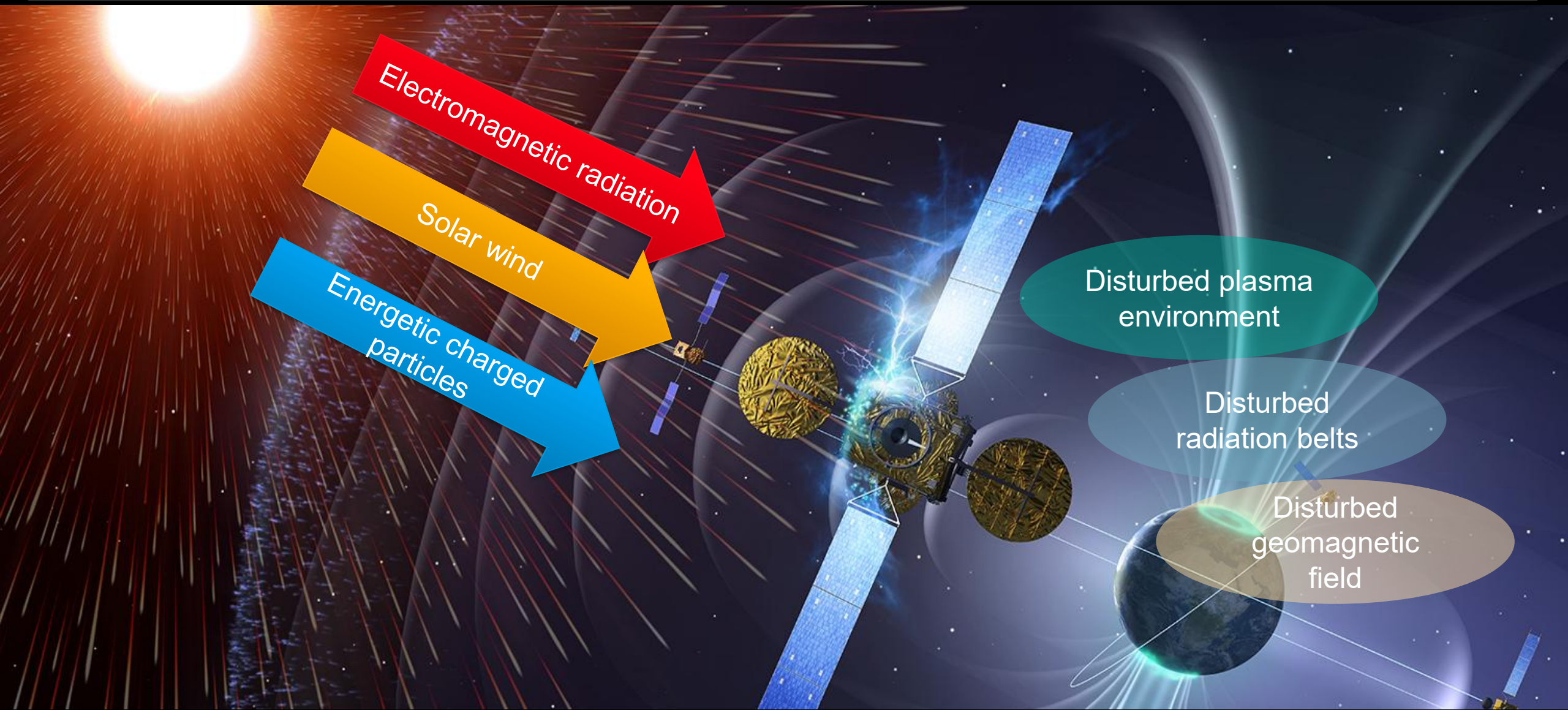
Space Weather Days for Spain, 8-9 June 2026

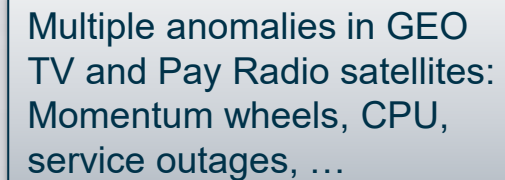
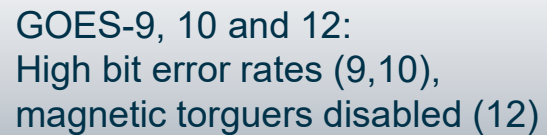
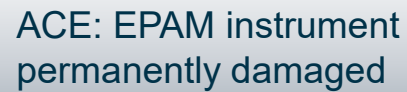
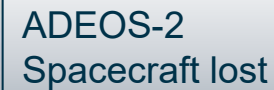
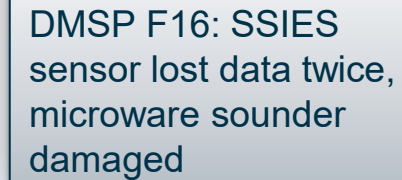
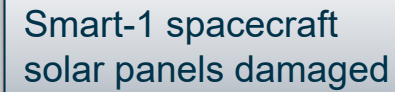
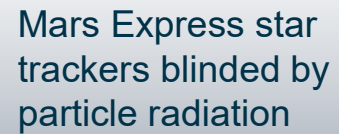
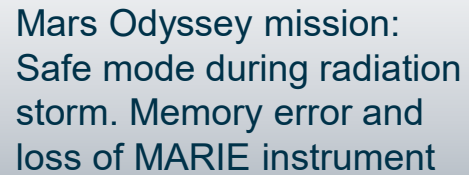
Juha-Pekka Luntama

Alexi Glover



Space is a hazardous place





Space Weather Impacts on Ground



Image credit: NASA/PSE&G

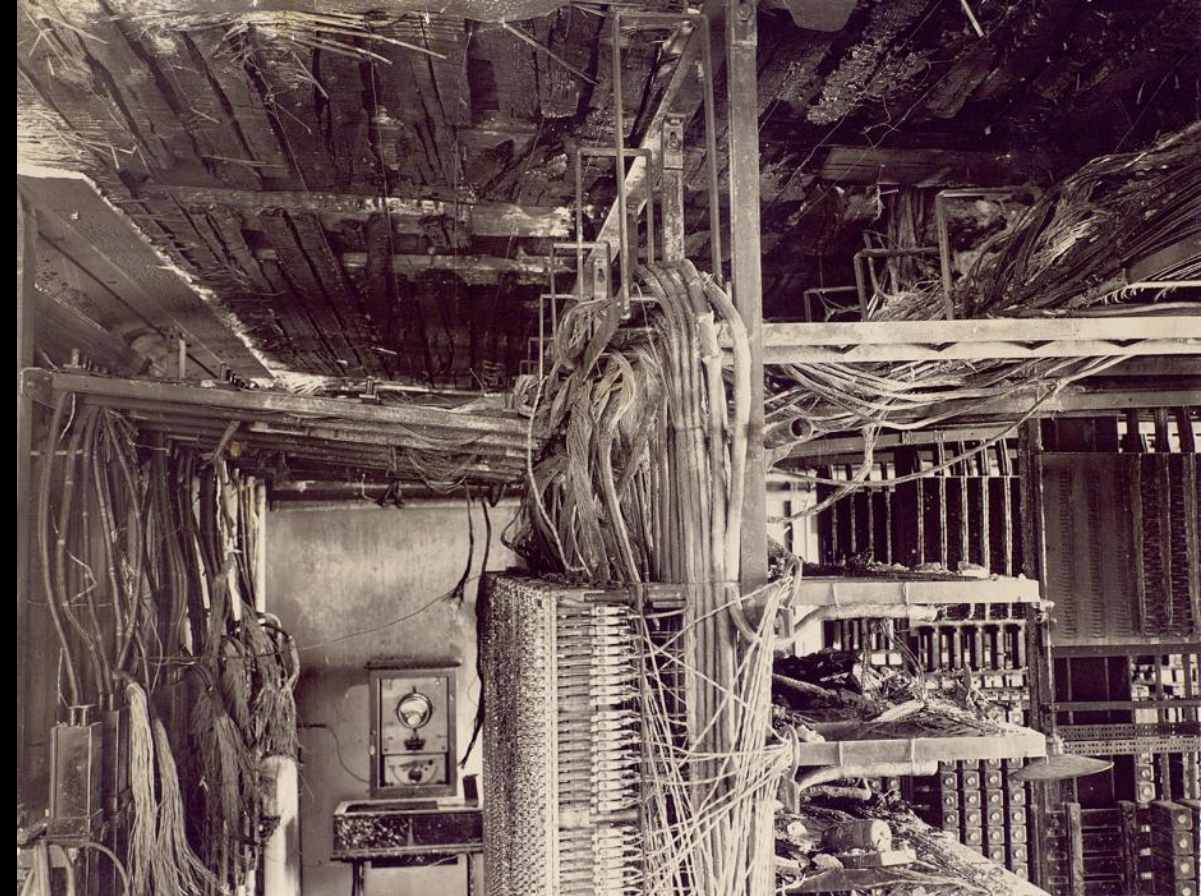
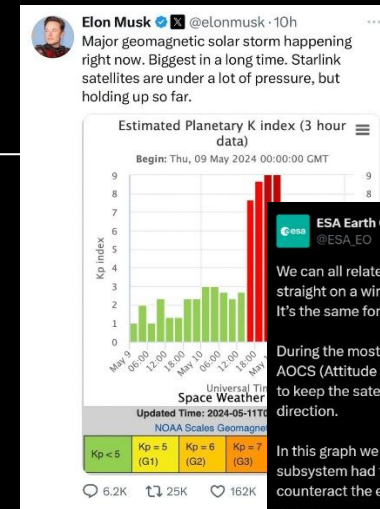


Image credit: Tekniska Museet, Sweden

May 2024 Solar Event Impacts

- Widespread disturbances across multiple sectors
- Significant GIC: some measurements were the highest on record
- High frequency radio was significantly disrupted
- GNSS-dependent solutions degraded around the world
- The storm severely compromised satellite-positioning services in parts of northern Europe.
- Substantial impacts on LEO satellite orbits
- Payloads offline as protective measure by some satellite operators

Effects of the storm still visible in the Earth's radiation belts in September 2024!

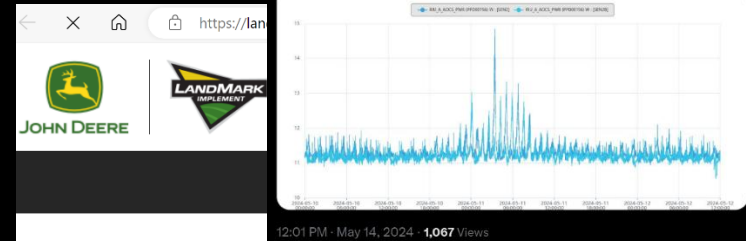


ESA Earth Observation [@ESA_ED](#)

We can all relate to how much more difficult it is to keep our bike straight on a windy day, while being pushed around. It's the same for satellites during a solar storm!

During the most recent intense solar storm, [@CopernicusEU](#) #Sentinel2 AOCs (Attitude Orbit Control Subsystem) had to work harder than usual to keep the satellite at the right altitude and pointing in the right direction.

In this graph we can see that the remote interface unit of the AOCs subsystem had to use more power on 11 May during the solar storm to counteract the external perturbations.



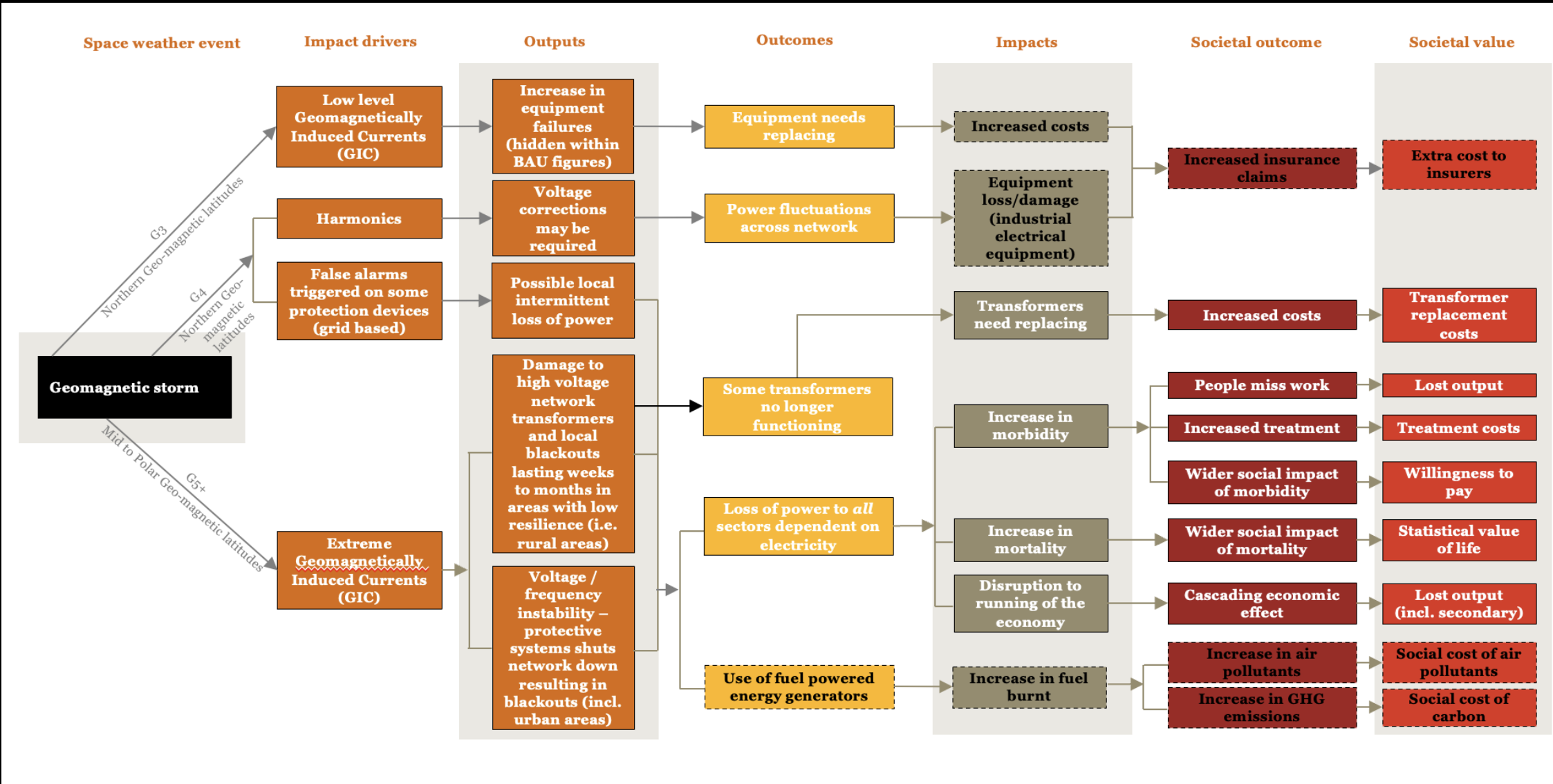
Geomagnetic Storm Affecting GPS Signals - May 2024

posted on Saturday, May 11, 2024 in [News/Blog](#)

Saturday, May 11 - 9:00am Update:

Yesterday, we sent out a text message advising customers to turn off their RTK and use a grace period of SF2 or SF3. We believe that the SF2 and SF3 accuracy is also extremely compromised as well due to this storm. Due to the way the RTK network works, the base stations were sending out corrections that have been affected by the geomagnetic storm and were causing drastic shifts in the field and even some heading changes that were drastic. Because SF2 and SF3 do not receive all of these corrections, those signals weren't affected as much, but we do suspect that the pass-to-pass accuracy is extremely degraded while still allowing customers to run. **We strongly advise you to keep an eye on your guess rows.** We experienced a pass where the guess row was 10" wide and the receiver was showing a PDOP value of 1.1 which would typically mean good accuracy. This can also affect your section control, but we don't expect it to create any excessively large overlaps or skips - however, the situation at hand is definitely not ideal.

Impact Pathways to Power Systems



Unavailability of GNSS

- Increased collateral damage
- Precision weapons systems not available
- Failing navigation, tracking, delayed transport

GNSS timing errors

- Failing time synchronization in comms
- Signal delays
- Reduced coordination and Situational Awareness

Communication failures

- HF radio
- Satcom

Space segment failures

- Satellite anomalies or failures
- Increased operation workload
- Data transmission delays

Radar disturbances

- Radar based weapons inaccuracy or unavailability
- Long distance warning systems failing
- Reduced Situational Awareness

Economic impact of a single extreme solar event on the EU economy:

Tens to hundreds of billions of EUROS

Impacted systems include:

- Power grids
- Satellite navigation
- Telecommunication
- Transport
- Aviation
- Resource exploitation
- Defence

Obtained by an independent socio-economic impact analysis under the technical responsibility of ESA for the European Commission



PROGRAMME OF THE
EUROPEAN UNION



IMPLEMENTED BY THE
EUROPEAN SPACE AGENCY

The background of the slide features a large, fiery orange and yellow sun on the left side, with a bright white ring of light. On the right side, there is a smaller, blue and white image of the Earth, showing the African continent. The text 'Thank You' is centered in the middle of the slide.

Thank You
