Using the gLOWCOST Muon Detector Network to Study Geomagnetic Storm Precursors and Geomagnetic Field Variations

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Overview of gLOWCOST Network

The **gLOWCOST** (**g**lobal **LOW–CO**st cosmic ray muon detector network for monitoring of dynamic changes in **S**pace and **T**errestrial weather) Cosmic Ray Muon Detector Network, led by Georgia State University, provides continuous, ground-based monitoring of space weather using a globally distributed array of low-cost detectors.

cosmic.gsu.edu

gLOWCOST network as of June 2026: 25 detectors distributed in 11 countries spanning 5 continents.

Major strength of the gLOWCOST:

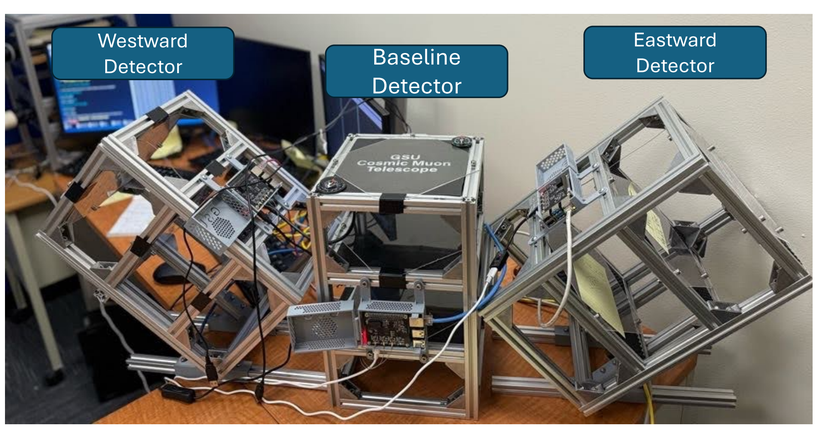
- Portability and easy installation – an easily scalable network.
- Ability to capture geomagnetic disturbances on a global scale.
- Broaden the range of primary energies sampled by ground-based cosmic ray measurements.

Key Observations:

- Clear observations of associated Forbush decreases.
- Detectors in North America registered the Ground-Level Enhancement (GLE) event in November 2025.
- Forbush decrease amplitudes ranged from approximately 0.9% to 4% during the November events and from 2% to 7% during the January event.

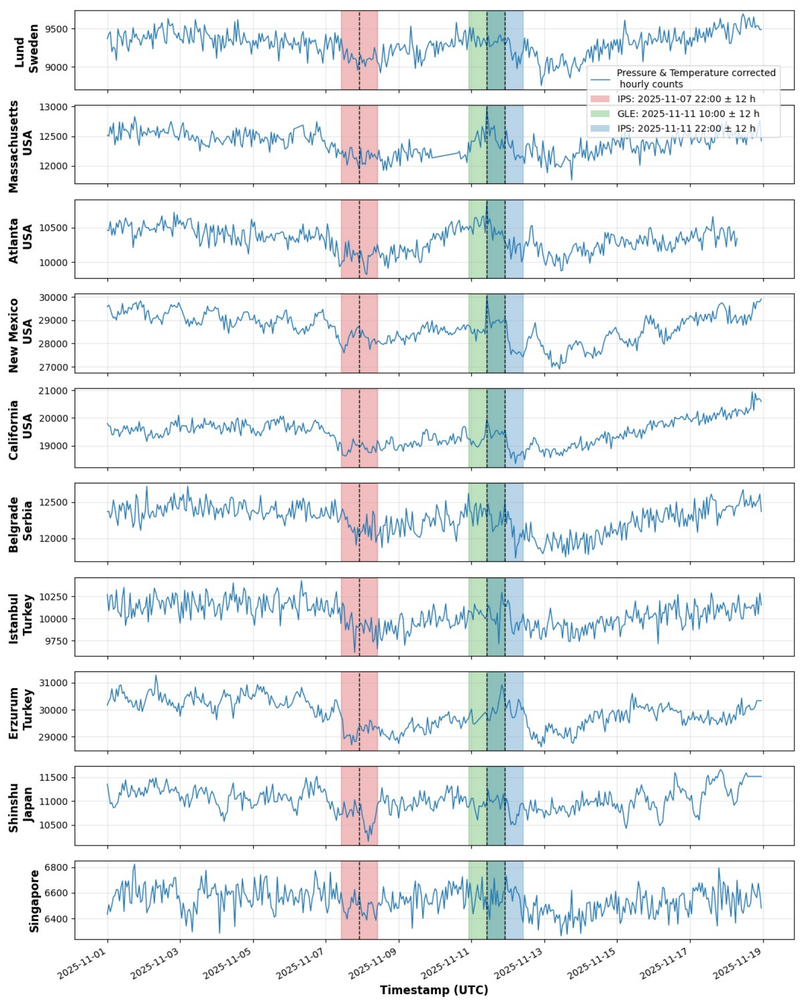
Current Study :

- Searching for precursors of the geomagnetic storms with the pitch angle concept to improve the predictions of arrival time and geoeffectiveness of CMEs.
- Understanding the correlation between asymmetry measurement and geomagnetic field variations.



gLOWCOST East-West detector configuration in Atlanta, USA

Response to Recent Geomagnetic Storms



gLOWCOST muon detector network response for the two Forbush decrease events and the GLE event in November 2025.

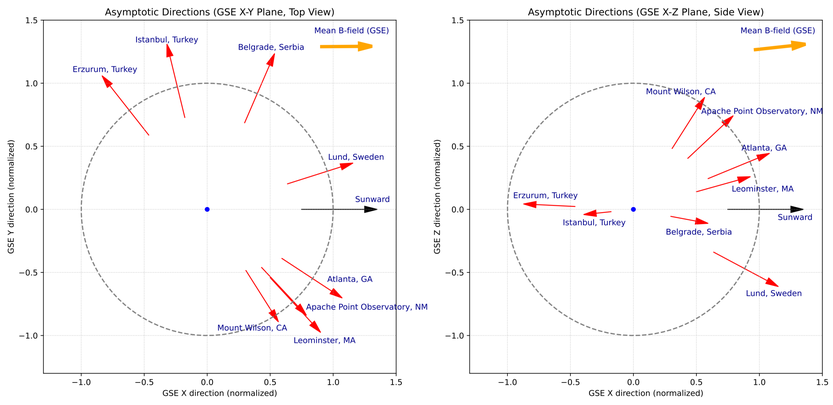
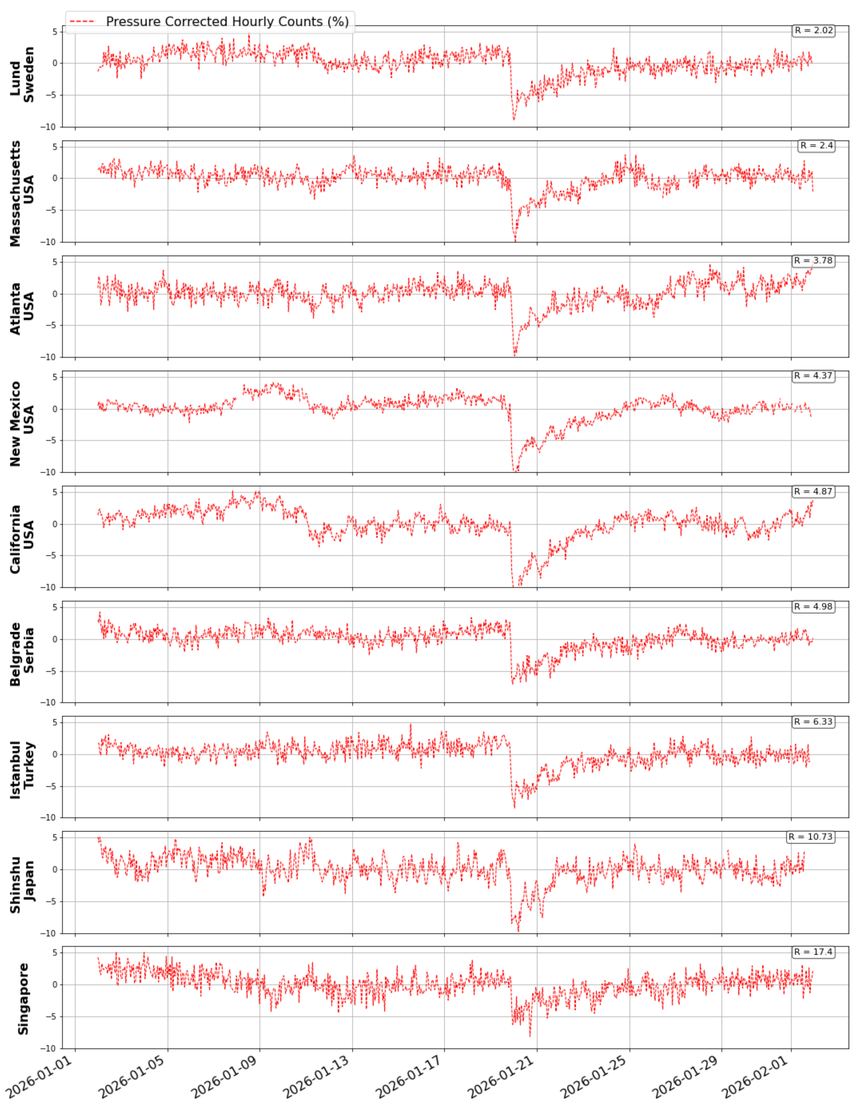


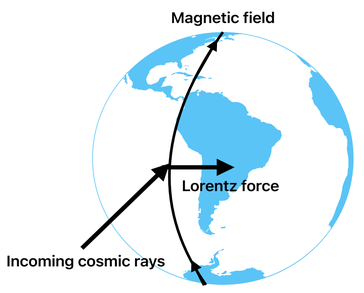
Illustration of asymptotic directions in the GSE (Geocentric Solar Ecliptic) for 10 GeV incident protons for the gLOWCOST detectors considered for November 2025 events.

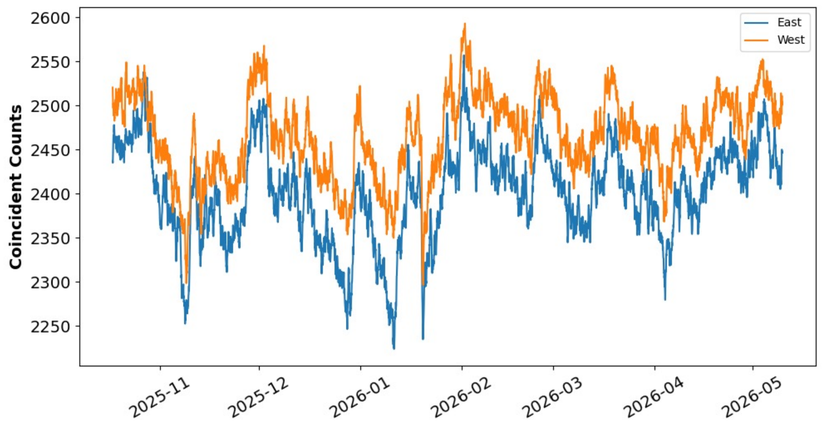


gLOWCOST muon detector network response for the January 2026 geomagnetic storm.

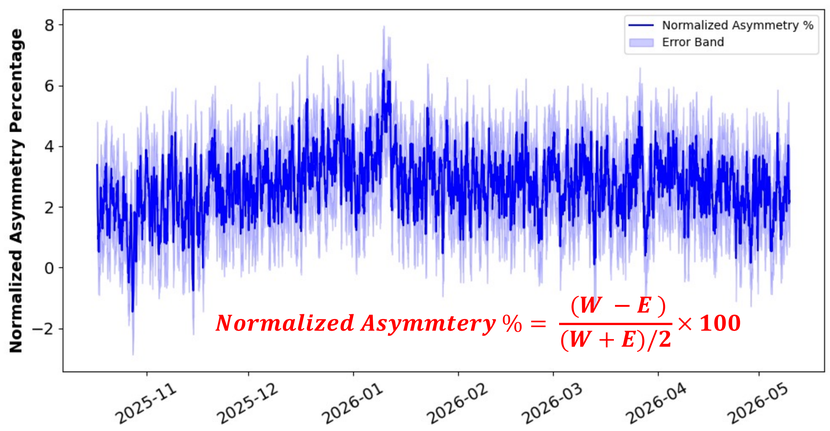
East-West Asymmetry Measurement

- There is a Difference in CR Flux coming from the West compared to the East, which is well known as the "East-West Asymmetry" of CR Flux.
- This asymmetry arises from the influence of the Earth's magnetosphere and heliosphere on the directional propagation of cosmic rays.

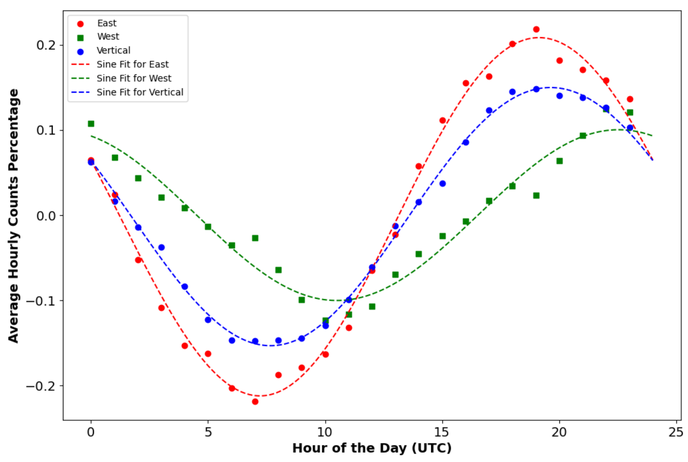




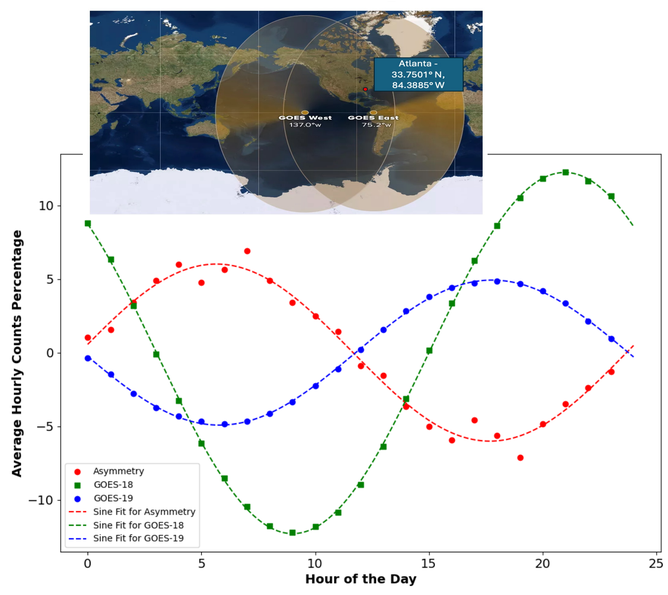
12-hour moving average of East-West detector configuration data from 2025-10-19 to 2026-05-19 (6 months)



Normalized asymmetry variation from 2025-10-19 to 2026-05-19 (6 months)



Daily variation of East-West detector configuration for the 6-month period



Comparison of daily variation of asymmetry with total magnetic field data from GOES magnetometer

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SHINE Workshop 2026, Madison, Wisconsin