

# GLOBAL PERSPECTIVES ON THE MAY 2024 GEOMAGNETIC STORM IMPACT ON HIGH-PRECISION POSITIONING BASED ON GEODETIC GNSS OBSERVATIONS

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A geomagnetic storm involves a complex interplay between the solar-magnetosphere-ionosphere coupling system and may significantly impact satellite navigation and positioning systems through ionospheric responses. The severity of these storms varies across different events, as the ionospheric electron density fluctuates with different spatial and temporal scales. This study focuses on the geomagnetic storm that occurred on May 10–11, 2024, recognized as one of the most intense storms during the past two decades. Due to its long-lasting effects on both the interplanetary and terrestrial environments, it has gathered considerable attention from both the scientific community and the public sector.

We present a comprehensive analysis of the ionospheric response to the May 2024 storm and its impacts on precise point positioning (PPP) for geodetic GNSS receivers on a global scale. Unlike previous studies, this investigation focuses on the effects on positioning accuracy at the centimeter level, which is an aspect often overlooked in previous research. The results suggest that this storm caused long-lasting and widespread ionospheric disturbances across the North and South American, Asia, Australian, and European sectors. Consequently, high-precision GNSS positioning with a common processing strategy for PPP ambiguity resolution experienced a significant outage. These PPP outages coincided with the growth and decay of the SYM-H index and persisted for over a day at numerous stations located in North America and Australia. This highlights the vulnerability of high-precision positioning applications to the risks imposed by ionospheric disturbances during periods of intense geomagnetic activity.