

[Keynote]

Monitoring a Changing Earth from 36,000 km: *Progress, Opportunities, and Challenges*

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As Earth faces unprecedented climate volatility and extreme weather, continuous global-scale monitoring has never been more urgent. Operating at an altitude of 36,000 kilometers, geostationary (GEO) meteorological and environmental satellites provide a unique, persistent vantage point to observe rapid atmospheric and planetary dynamics in real time—bridging critical temporal gaps left by Low-Earth Orbit (LEO) constellations. Over recent years, advanced instruments aboard next-generation missions, such as Himawari-8/-9 and GK-2A, have significantly elevated our capabilities. Featuring enhanced radiometric, spatial, and temporal resolutions, these platforms enable scientists to track severe convective weather, pre-convection atmospheric thermodynamic states, and fast-moving wildfires with minute-by-minute fidelity. Furthermore, integrating artificial intelligence and cloud computing has transformed raw telemetry into actionable insights for real-time disaster response and climate policy.

Despite these breakthroughs, significant opportunities and complex challenges lie ahead. The next frontier invites unprecedented multi-sensor synergy—fusing GEO persistence with LEO spatial resolution, airborne data, and ground-based IoT networks to construct a holistic digital twin of Earth. However, capitalizing on these opportunities requires addressing major technical and operational hurdles. Key obstacles include high mission development costs, extreme data transmission bandwidth limitations, orbital debris management, and the establishment of robust international frameworks for open data sharing.

Ultimately, this keynote highlights how remote sensing from 36,000 kilometers is evolving beyond passive monitoring. By addressing these key technological dimensions and operational challenges, geostationary Earth observation is actively equipping humanity with the intelligence needed to foster global resilience and sustainable planetary stewardship.