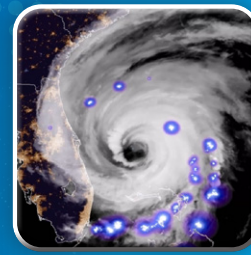
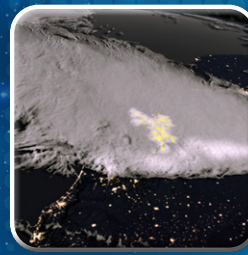
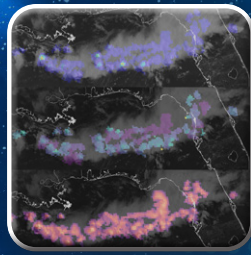




# Geostationary Lightning Mapper

GOES-R Series



**The Geostationary Lightning Mapper, or GLM,** onboard the Geostationary Operational Environmental Satellites – R Series (GOES-R), is the first instrument of its kind flown in geostationary orbit. The instrument detects and maps total lightning — in-cloud, cloud-to-cloud, and cloud-to-ground — continuously over the Americas and adjacent ocean regions.

GLM offers insights beyond the presence of a lightning strike, revealing the extent of lightning flashes and the distance they travel. This information helps forecast developing



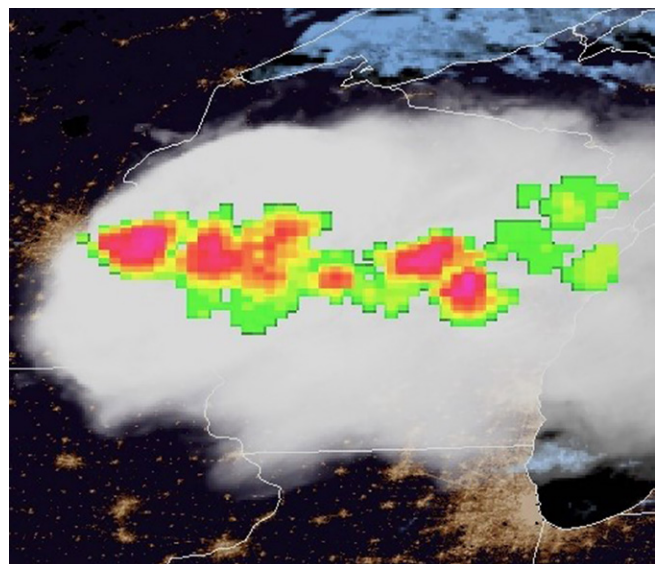
Geostationary lightning Mapper (GLM)

severe storms and a wide range of high-impact environmental phenomena, including hailstorms, microburst winds, tornadoes, flash floods, snowstorms, and fires.

Technicians install the GLM on the GOES-R spacecraft. Credit: Lockheed Martin

## EARLY WARNING OF SEVERE WEATHER

Rapid increases in total lightning activity often precede severe and tornadic thunderstorms. Characterizing lightning activity in storms allows forecasters to identify intensifying storms before they produce damaging winds, hail or tornadoes. GLM data allow forecasters to detect electrically active storms, determine the extent of the lightning threat, identify strengthening and weakening storms, monitor storm evolution, and supplement radar data where coverage is poor. Integrating GLM data into the severe weather warning process also leads to fewer false alarms, especially during radar outages and in regions with poor radar coverage.



GOES-16 visible imagery with GLM overlay of a powerful derecho that swept across the Midwest on July 28, 2021. Credit: NOAA

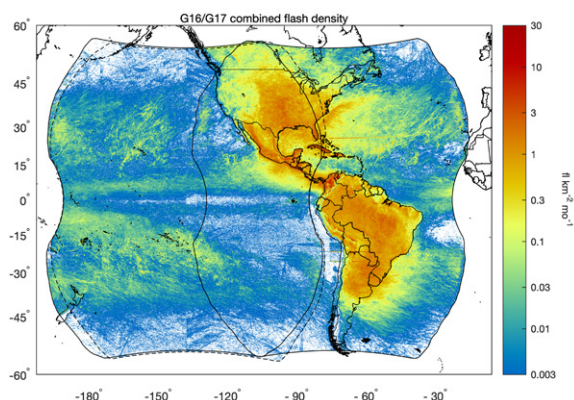
In large, long-lived storm systems, lightning may travel hundreds of miles before striking the ground. GLM can show forecasters areas far from the main line of storms where the risk of ground strikes presents a public safety hazard.



GLM observations also improve satellite precipitation estimates, benefiting flash flood forecasting in significant portions of the western continental U.S., Hawaii, and U.S. territorial islands that lack adequate radar coverage.

### MITIGATING AVIATION HAZARDS

GLM data help characterize lightning risks for aviation operations and increase confidence for suspending and resuming flights. The GLM's broad coverage and rapid updates help pilots identify and avoid thunderstorm hazards, especially over oceans. This leads to enhanced safety, improved efficiency, and cost savings.



Combined GOES East and GOES West GLM flash density. Credit: NOAA

### HURRICANE INSIGHTS

GLM aids hurricane analysis and forecasting by clearly conveying convective patterns below the cloud tops. This information helps forecasters diagnosis the structure and evolution of tropical storms, leading to more accurate forecasts of hurricane track and intensity.

### BEYOND WEATHER

Lightning-initiated wildfires account for more than half of the acreage burned in the continental United States. Many lightning-ignited fires occur in less populated areas, resulting in delayed detection and suppression.

GLM is uniquely able to monitor vast areas to identify the sustained "continuing current" lightning flashes most likely to ignite fires. This information enables emergency personnel to find small and even smoldering fires before they grow, reducing forest and property loss, lowering firefighting costs, and improving air quality.

Intense fires can produce large plumes of heat and smoke that can generate lightning and ignite additional fires. GLM helps characterize these pyrocumulonimbus clouds that

threaten firefighters by spawning erratic winds and severe weather near wildfires.

GLM can also identify potentially catastrophic non-weather events such as meteors entering Earth's atmosphere and lightning accompanying explosive volcanic eruptions.

Lightning is an essential climate variable needed to understand and predict changes in climate. Data from GLM contributes to a long-term record tracking decadal changes in lightning activity.

### BENEFITS



Lightning caused a home to become engulfed in flames in St. George, Utah, on Aug. 3, 2017. Photo by Nakavius Jaks, St. George News

GLM provides a vast array of benefits for forecasting severe weather and a wide range of environmental hazards. GLM data both complements radar observations and fills data gaps where radar is

unavailable, providing decision-makers with information they need to forecast, monitor and react to thunderstorms, hurricanes, and volcanic hazards. Lightning is a significant threat to life and property and is particularly hazardous for those working outdoors and participating in recreational activities. GLM data are freely available, providing broad access to lightning information and helping people make more informed lightning safety decisions.

- ✓ **Early warning of severe storms and tornadoes**
- ✓ **Detection of heavy rainfall and flash flooding**
- ✓ **Data to diagnose hurricane structure, evolution, and rapid intensification**
- ✓ **Data for aviation route planning, ramp operations, and reducing weather-related flight delays**
- ✓ **Early warning of ground strike hazards**
- ✓ **Identification of lightning strikes most likely to ignite fires**
- ✓ **Characterization of pyrocumulonimbus clouds that threaten firefighters**
- ✓ **Detection of meteors entering Earth's atmosphere**
- ✓ **Data for long-term climate variability studies**