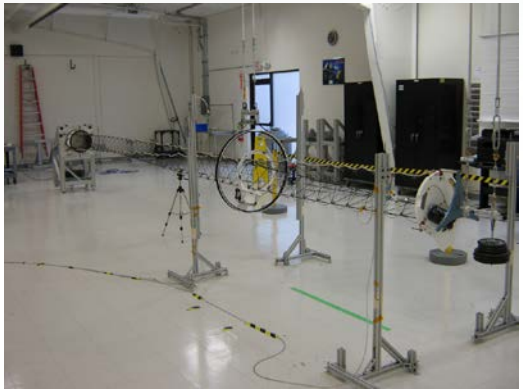
2016 Solar Storms with NASA/NOAA GOES-R Satellite Primed to Support Space Weather Predictive Capabilities

On 20 December 2016 Earth encountered a stream of energetic particles in solar wind flowing out from a giant Earth-facing coronal hole on the surface of the sun. A G2 class geomagnetic storm erupted in Earth's upper atmosphere - the thermosphere which includes the ionosphere on 21 December; this is an area many of our satellites, including the ISS, orbit. G2 storms are strong enough to affect spacecraft orbit predictions which can cause satellite drag. Here on the ground, long-term G2 storms can cause damage to our power systems.

Earth stayed within this steady stream of solar wind for six days, exiting it on 27 December. Not long after, on 31 December, Earth encountered another stream of solar wind causing more geomagnetic storms in our upper atmosphere. Aurora – a visible and beautiful indication of geomagnetic story activity, brilliantly colored icy polar stratospheric clouds (PSCs) and sun dogs were seen throughout the holidays.

Right: Aurora seen over Iceland on 1 January 2017. Credit: Shane Leach

Left: Icy PSCs seen on 31 December 2016. Credit: Laffen Jenson



GOES-R MAG instrument fully deployed. Credit: NOAA

Heliophysicists study visible phenomena such as aurora and PSCs as they are key manifestations of the kind of changes that can occur in Earth's upper atmosphere. This region is a multi-layered, dynamic environment affected by systems and processes originating both from Earth's surface and above in the space around us. Understanding how our atmosphere blocks and filters charged energy from the sun is crucial -- intense sun-Earth interactions can have detrimental effects on our satellites and astronauts near-Earth space orbit.

The recently launched GOES-R satellite, built in collaboration between NOAA and NASA, is designed to study Earth's atmosphere. Its data, along with data from a wide array of Heliophysics missions in near-Earth space, may allow us a deeper situational awareness of the space environment we live in as we learn to predict and respond to space weather events. Instruments on the solar-pointing platform of GOES-R, the Extreme Ultraviolet and X-ray Irradiance Sensors (EXIS), the Magnetometer (MAG) and the Solar Ultraviolet Imager (SUVI), will provide critical measurements of solar irradiance, the magnetic field of the space environment and contribute around-the-clock full-disk solar images respectively.

These kind of data are invaluable in helping us predict and prepare for impactful sun-Earth interactions. Scientists received preliminary data from the MAG instrument on 22 December 2016, which are important for space weather forecasting and modeling. All instruments will be operating by the end of January 2017. Heliophysics missions ICON and GOLD are both wholly dedicated to studying Earth's thermosphere and and ionosphere: our interface with space. They will soon be launching and contributing valuable science to help us better understand our near-Earth space environment.