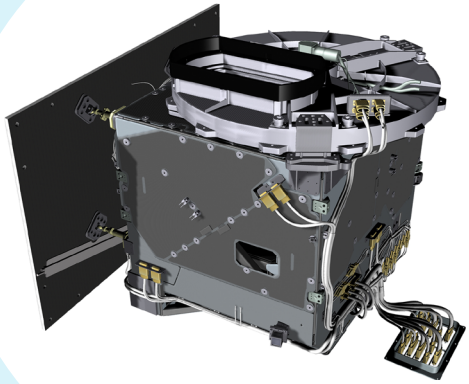
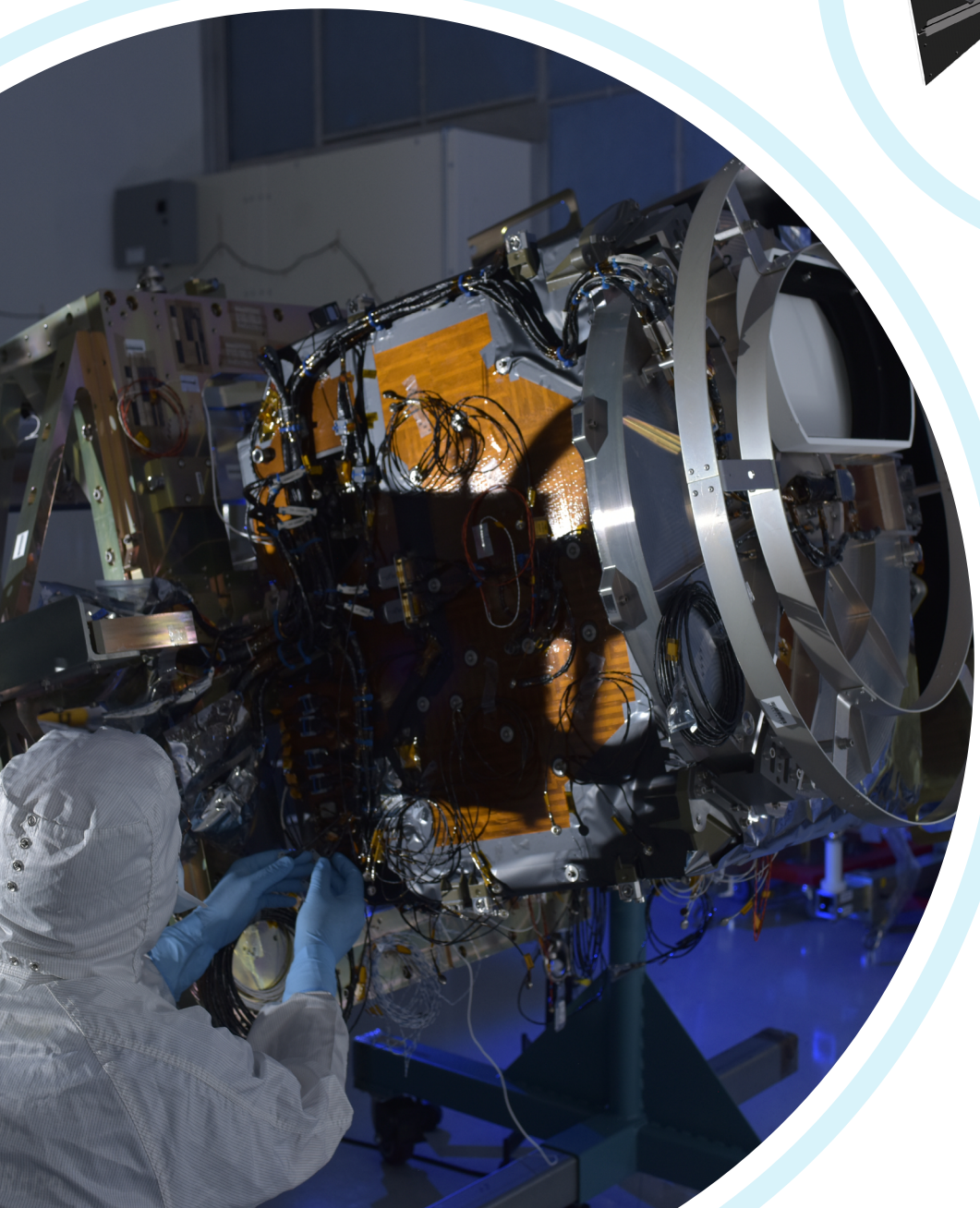
GEMS

Geostationary Environment Monitoring Spectrometer

The Geostationary Environment Monitoring Spectrometer (GEMS) provides measurements of air quality over South Korea and the greater Asia-Pacific region by measuring tropospheric air pollution from space. GEMS' 10-year mission will investigate chemical concentrations critical to air quality and climate change, such as nitrogen dioxide, sulfur dioxide, glyoxyl, formaldehyde, ozone and aerosols.





Left: Geostationary Environment Monitoring Spectrometer; Top: GEMS rendering

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Overview

The GEMS mission enables Korean scientists to assess and forecast air quality, monitor regional trans-boundary pollution and Asian dust, as well as understand the long-term effect of aerosols on human health. This information will help decision makers understand the domestic trans-border sources of air pollution, inform pollution mitigation strategies, improve air quality forecasts and ultimately improve human health.

Our Role

Ball Aerospace designed, built and tested GEMS in collaboration with the Korea Aerospace Research Institute (KARI) for the National Institute of Environmental Research in the Ministry of Environment of South Korea. Integrated onto KARI's GEO-KOMPSAT-2B satellite, GEMS launched successfully on February 18, 2020.

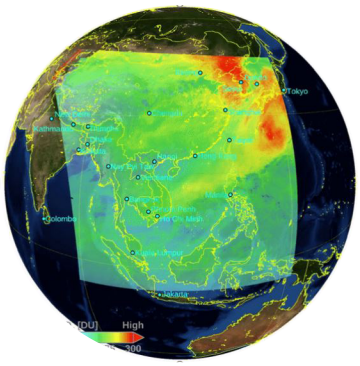
In geostationary orbit at 35,786 km (22,236 miles) above the Earth, GEMS collects images over an 8-to-12-hour period. GEMS scans a 5,000 km east/west area in less than 30 minutes, collecting air quality measurements with unprecedented spatial and spectral resolution. The instrument has a two-axis scan mirror and a 1k x 2k focal plane array using a Charge Coupled Device (CCD) to image the ultraviolet/visible spectrum.

Ball also built the Tropospheric Emissions: Monitoring of Pollution (TEMPO) instrument, NASA's contribution to the worldwide air quality monitoring constellation. TEMPO is scheduled to launch in 2022. Building GEMS alongside TEMPO offered benefits through similar hardware development, common ground calibration and data processing, and interchangeable retrieval algorithms.

Ball has a 30-year history as an established leader designing and building advanced spectrometers. We developed the Ozone Mapping and Profiler Suite (OMPS) instruments for the Suomi National Polar-orbiting Partnership and Joint Polar Satellite System-1 (now known as NOAA-20). In addition, Ball was the primary developer of spectrometers for the Hubble Space Telescope, including the Goddard High Resolution Spectrograph, Space Telescope Imaging Spectrograph and the Cosmic Origins Spectrograph.

Instruments

- GEMS was the first air quality sensor in geostationary orbit
- GEMS was developed jointly by a unified team comprised of KARI and Ball engineers
- GEMS was developed in tandem with the Ball-built TEMPO instrument
- GEMS is a scanning ultraviolet/visible (UV/Vis) spectrometer
- GEMS can scan across a selectable 5000 km east/west swath in less than 30 minutes with high spatial and spectral resolution, and high signal-to-noise ratio across 300 to 500 nm
- GEMS collects images of the required geographical locations at least 8 times per day
- GEMS launched on the GEO-KOMPSAT-2B satellite along with the GOCI-2 ocean color sensor



Images (Top): First published GEMS images Credit: NIER; (Bottom): GEMS Electromagnetic Interference/ Electromagnetic Compatibility (EMI/EMC) testing.

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