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THE MTG-IRS INSTRUMENT: A BREAKTHROUGH FOR METEOROLOGICAL APPLICATIONS AND DETECTION OF EXTREME WEATHER EVENTS

Abstract

The Infra-Red Sounder (IRS) instrument is the primary payload of the Meteosat Third Generation Sounder satellite (MTG-S). The main objective of the MTG sounding mission is to enhance Numerical Weather Prediction (NWP) capabilities at regional and global scales, through the provision of Atmospheric

Motion Vectors (AMV) with higher vertical resolution and frequent information on temperature and water vapor profiles. Additionally, layer-by-layer analysis of the atmosphere will offer greater insight into its complex chemical composition and support atmospheric gas tracing applications, such as air quality and pollution monitoring.

The MTG-S satellite and the IRS instrument are being developed under the responsibility of OHB System (Germany), with TAS (France) as MTG's mission prime contractor and ESA/EUMETSAT as end customers. The IRS will be the first European hyperspectral sounding instrument in geostationary orbit and will be capable of scanning a full Earth's disc (over Europe and Africa) every hour with a spatial resolution of 4 x 4 km^2 at nadir, covering roughly 640 x 640 km^2 per stare every 10 seconds.

The design of the instrument is based on an imaging Fourier Transform Infrared Spectrometer (FTIR) and will deliver hyperspectral sounding information in two infrared bands: LWIR (700 - 1210 cm^{-1}) and MWIR (1600 - 2175 cm^{-1}), with a spectral channel interval of 0.625 cm^{-1}. The instrument incorporates two IR detectors of 160 x 160 pixels each, which leads to a total of 51,200 delivered interferograms per stare. The recorded interferograms will undergo pre-correction and data compression before being sent to ground. Once the data is received on-ground, the Level 1 ground processing algorithms will convert the measured interferograms into radiometrically and spectrally corrected spectra. Applications benefiting from the science data provided by the IRS instrument are manifold and await to be fully explored. For example, by delivering frequent four-dimensional information on humidity, temperature, and wind profiles, the IRS will significantly enhance regional and global NWP, thus improving early detection (and warning) of rapidly developing atmospheric instability like severe convective storms. The spectral range of the IRS will also allow to estimate and monitor the concentration of atmospheric trace gases like ozone and carbon monoxide, leading to enhanced information for air pollution forecasting. Moreover, through information on the composition and density of volcanic ash clouds, ash fallout prediction models will be refined. The first flight model of the instrument (IRS PFM) is currently in its AIT phase that will culminate with an optical performance test in vacuum starting in Q2 2022. The instrument verification follows a proto-flight approach, including tests successfully carried out on several development models (i.e. STM, Flat-EM and Core Spectrometer) and the achievement of the final qualification on the PFM. The first MTG-S satellite launch is planned by end 2023/early 2024.

This paper will provide a detailed overview of:

- the objectives, capabilities, and applications of the MTG sounding mission
- the design and development status of the IRS instrument
- the Level 1 science data provided by the IRS instrument and its expected performance