

MOVIT : MTG-IRS L2 offline monitoring toolkit

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Introduction

The upcoming Infrared Sounder (IRS) aboard the Meteosat Third Generation sounding satellite (MTGS) is designed to significantly enhance weather forecasting capabilities by providing high-resolution, four-dimensional data on atmospheric temperature, water vapor, and ozone profiles. Operating with high vertical, horizontal, and temporal resolution (every 30 minutes over Europe), IRS aims to improve the accuracy of numerical weather prediction (NWP) models, leading to more reliable forecasts. To ensure the effectiveness of IRS measurements for accurate forecast models, the quality of L2 products requires rigorous validation and continuous monitoring. EUMETSAT has developed a dedicated offline monitoring toolkit—MOVIT (MONitoring & Validation Integrated Tool)—for this purpose. MOVIT will undertake thorough validation during the commissioning phase of IRS and will continue to serve as a routine monitoring tool thereafter.

In this poster, we present an overview of MOVIT's capabilities including cross-validation with other sounding instruments such as IASI, comparisons against climate models, and quality control measures.

IRS L2 Cal/Val Strategy

The MTG-IRS L2 Cal/Val strategy ensures Level 2 product accuracy by calibrating retrieval algorithms and validating results against EUMETSAT standards. Products include temperature, humidity, and ozone profiles, surface parameters like skin temperature and emissivity, cloud properties and atmospheric composition.

Validation relies on comparisons to numerical models (e.g., ECMWF for T, q, and Ts, CAMS for GHG/air quality), satellite datasets (e.g., IASI L2, MSG SEVIRI), and in-situ measurements (e.g., radiosondes, Lidars). Statistical metrics like bias and standard deviation are computed for each Local Area Coverages (LACs) and the full-disk views produced in line with the LAC acquisition cycle (full LAC in 15 minutes, LAC4 revisited every 30 minutes). The approach combines existing IASI tools (MAP_GII and MONALISA) with new methods tailored to MTG-IRS requirements.

MOVIT-IRSL2 : MOnitoring & Validation Integrated Tool

MOVIT-IRSL2 is a comprehensive toolbox designed to prepare for the commissioning of MTG-IRS L2 products. Building upon the IMOEN, MOVIT functions as a modular toolkit that can be integrated into a processing chain to meet the monitoring requirements.

Development:

- Developed from scratch in Julia to address unique granularity handling and detector geometry of MTG-IRS compared to EPS instruments.
- Aimed at ensuring sanity checks, consistency tests, and validation of the operational L2 processor outputs.

Scope of Application:

- Sanity and Consistency Checks - Perform fundamental validation to ensure logical coherence in outputs daily.
- Numerical Data Comparisons - Compare L2 products with

atmospheric and surface data from ECMWF and CAMS.

- Land Surface Emissivity Comparisons - Validate against the CAMEL Land Surface Emissivity Atlas, ensuring accuracy for surface emissivity analysis.
- Spaceborne Reference Dataset Comparisons - Validate results against datasets from other spaceborne instruments, such as IASI L2, focusing on surface, vertical profile, and cloud characterization retrievals.

Why Julia?

- Performance: Julia's speed and efficiency allow for rapid data handling and processing.
- Upgradeability: Its modern programming environment helps the seamless integration of updates and new features.
- Existing Modules: Pre-existing functionalities from the EUMETSAT IRS L2 processor prototype, ensuring reliability and reducing development time.

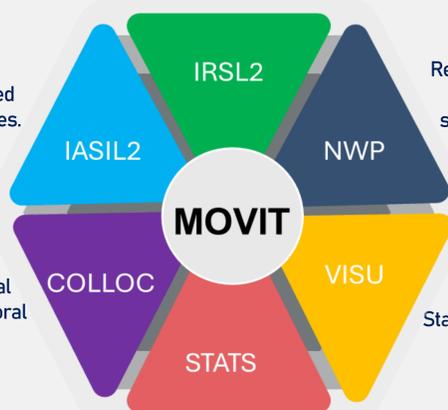
MOVIT sub-modules

Reads and stores required IRS L2 products. Select/stratify different scenes e.g. Land/Sea, Night/Day, Zenith angles, quality indicators etc.

Reads and stores required products from IASI .nat files.

Retrieves required products from ECMWF/CAMS Grib files and stores in structures needed for collocation.

Collocation Algorithm: Spatial (regular grid/bins,) and temporal co-registrations with ECMWF/CAMS and IASI L2 products



Plotting functions: Statistical results, Full Earth disc for Sanity checks

Calculates statistics : binned- statistics, differences, bias, standard deviation etc.

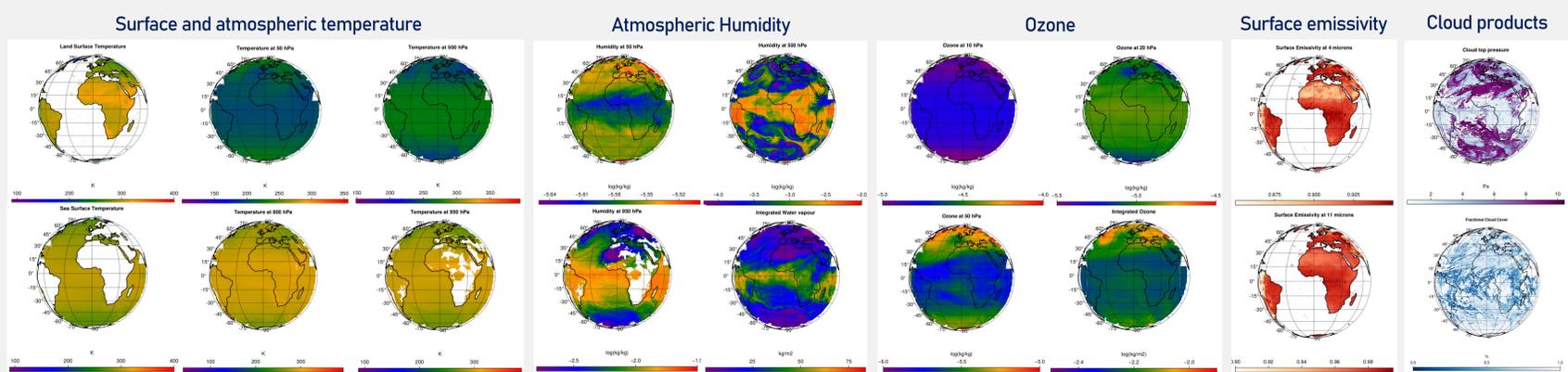
CAMEL

Retrieves Land Surface Emissivity from CAMEL (Modis+Aster) atlas

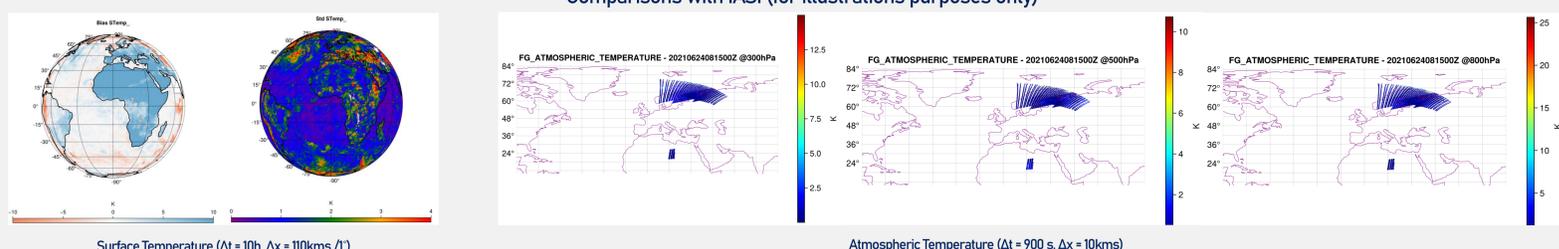
| Products | Tests handled by MOVIT |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| Verification, self-consistency & sanity check | L2 products verification Sanity Check |
| Temperature profile | Verification of temperature profile against numerical models Consistency with IASI temperature profile |
| Humidity profile | Verification of specific humidity profile against numerical models Consistency with IASI humidity profile |
| Water vapour total column | Consistency with IASI water vapour total column |
| Ozone profile | Consistency with IASI ozone profile |
| Carbon dioxide | Verification of carbon dioxide column against numerical models. |
| Cloud Detection/Characterization | Verification of cloud detection and cloud fraction against IAS cloud mask by visual inspection |
| | Consistency with IASI cloud fraction Visual inspection of cloud top height and pressure |
| Sea Surface Temperature | Consistency with IASI SST |
| Land Surface Temperature | Consistency with IASI LST |
| Land Surface Emissivity | Consistency with IASI LSE |
| Obs-Calc | Residual (OBS-CALC) monitoring with PWLR3 |

Sanity Checks

Sanity checks and consistency checks are conducted to ensure that all IRSL2 products are functioning correctly and to identify any anomalies, particularly during the commissioning phase. These checks focus on detecting any unexpected features in the IRS-L2 retrievals, such as discontinuities, discrepancies, aberrant values, and interruptions. We also compare these results with IASI L2 data to spot any abnormal differences. The following plots illustrate typical results from these activities, using the IRS L2 full disk test data to generate the visuals.



Comparisons with IASI (for illustrations purposes only)



Surface Temperature ($\Delta t = 10h, \Delta x = 110kms/1'$)

Atmospheric Temperature ($\Delta t = 900 s, \Delta x = 10kms$)