LSICS development and status

Sebastien Wagner and LSICS development group:

T. Stone (USGS), H. Kieffer, M. Krijger (ESS), B. Basnet (NOAA), F. Yu (ERT/NOAA), J. Gaton (Univ Valladolid), S. Adriansen (VITO)

GSICS Lunar Sub-Group Web Meeting – 07 October 2026



The LSICS project

- **LSICS = activity within the GSICS Lunar Calibration subgroup ➔ LSICS = GSICS deliverable**
- **Development group, roles and responsabilities:**
  - Project leader / coordinator : T. Stone (USGS)
  - Main developers : NOAA (B. Basnet) till December 2024 / EUMETSAT (S. Wagner, V. Debaecker) since January 2025
  - Support: JMA (M. Takahashi) till March 2026, NOAA (F. Yu, X. Wu – till December 2024), Celestial Reasoning (H. Kieffer), Earth Space Solutions (M. Krijger)
  - Since end of October 2025, involvement of the LIME development team: S. Adriaensen (VITO), J. Gaton (Univ. Valladolid), M. Bouvet (ESA), G. Lichtenberg (DLR) ➔ implementation of LIME in LSICS
- **Coordination and meetings:**
  - Regular meetings (every 2 or 3 weeks)
  - Minutes are available
- **Infrastructure**
  - Gitlab repository with main and development branch hosted by EUMETSAT
    - “Main” to host the official version to be used
    - “Development” branch for enhancements / new functionalities development and testing

Objectives

- Replace the GIRO (GSICS Implementation of the ROLO model) with a model agile system to operate lunar reflectance model(s) as proposed in 2014
- Achieve better absolute accuracy
- Maintain purpose of GIRO:
  - Provide the lunar calibration community with a GSICS common reference for lunar calibration
  - Standardised input / output to ensure inter-operability ➔ System can be operated on any mission matching the input standards
  - Common “applicator” to derive the lunar in-band irradiance
- Ensure continuity with GIRO ➔ backward compatibility

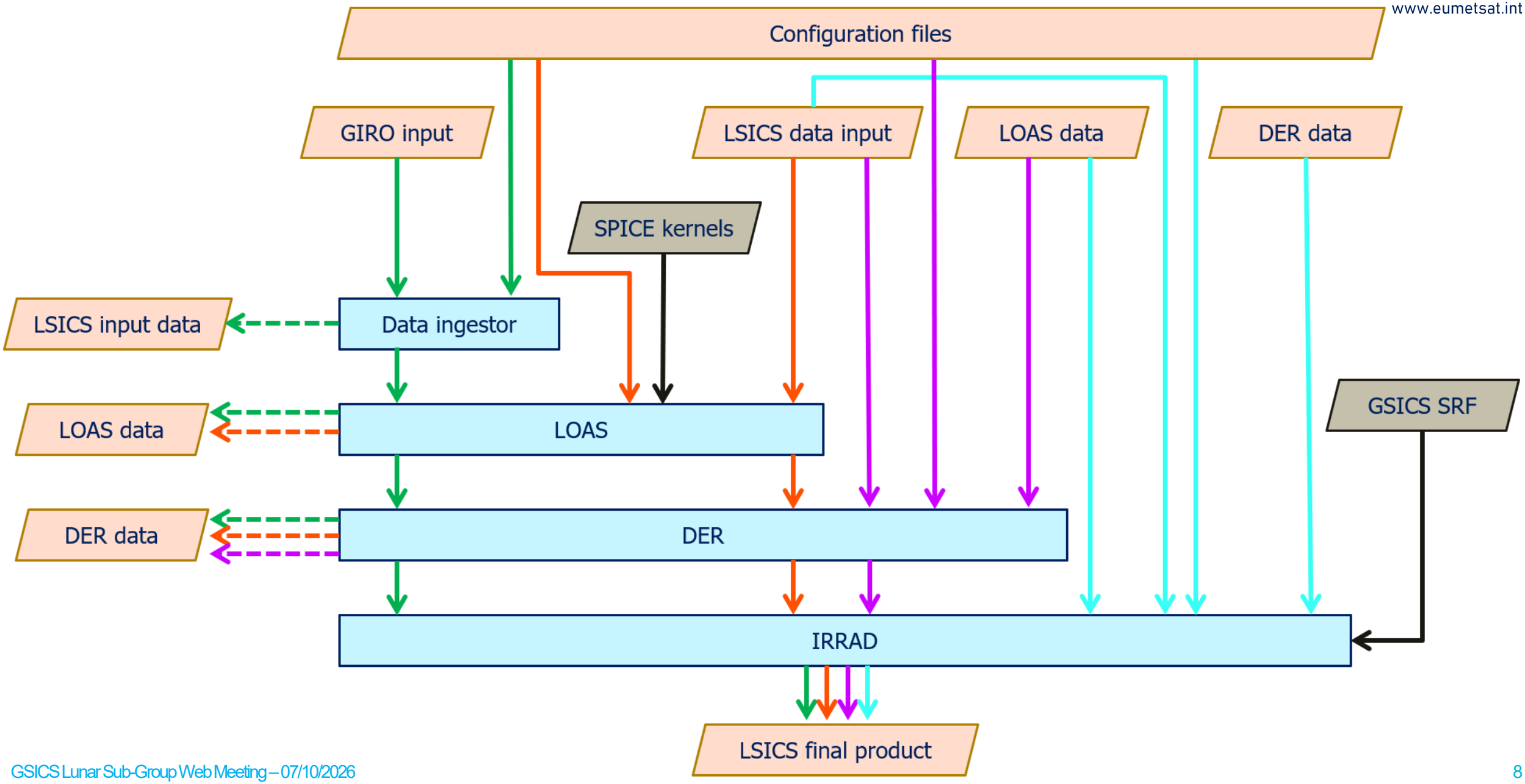
Objectives

- Capitalise on GIRO experience to define a more agile system:
  - Modular approach to ease maintenance + testing of new approaches / models
  - Specific interface for lunar reflectance models to allow an easy implementation in the framework
  - Common “applicator” to derive also and if needed the lunar in-band reflectance
  - Agile handling of the solar irradiance spectrum to ensure LSICS can be up-to-date with latest solar irradiance spectrum reference (currently TSIS at 0.25nm resolution)
  - Easier access to the source code (GitLab / GitHub)

LSICS vs GIRO

- GIRO = C/C++ code ➔ LSICS = Python 3
- GIRO = license with EUMETSAT ➔ LSICS = Apache 2.0
- GIRO = implementation of the ROLO model ➔ LSICS v1.0 implements the SLIMM model
- GIRO = Wehrli solar spectrum ➔ LSICS = TSIS
- GIRO = ITRF93 + J2000 coord. ➔ LSICS = ITRF93 + J2000 + WGS84
- LSICS is NOT a lunar model ➔ LSICS = advanced framework to operate lunar reflectance models
- Possibility to start LSICS from each module involved in the processing

LSICS dataflows and input/output interfaces



Implementation of digital markers

- Digital markers and public signature key
  - to ensure that output products have been generated by the official agreed version of LSICS
  - implemented using JSON tokens
- Purpose: to raise awareness on the traceability to a common community reference
  - If LSICS is modified in a local implementation, the output of this implementation shall not be named after LSICS to ensure visibility and traceability

Status

- Preparing version 1 release (Q4 2026 ➔ Target is before the Lunar Workshop!)
  - Finalising the code
  - Drafted documentation
  - LSICS v1 will be released on EUMETSAT Gitlab/GitHub (to be defined) ➔ no contribution allowed to the repository
- Version 1.0 will include:
  - SLIMM model v2.0
  - Documentation + test report (including DER model implementation)
  - Specifications for setting the LSICS virtual environment
- Version 1.0 = baseline for model developers to interface their models to LSICS in order to participate the 2nd lunar model inter-comparison exercise (target = LCWS#5 in Nov. 2026)
  - SLIMM v2.0
  - GIRO v2.0 (GIRO realigned with ROLO) / command line version
  - LESSR v2.0
  - LESSR v3.0 (= LESSR v2.0 + tied to Air-LUSI)
  - LIME

Status

- SLIMM v3.0 expected later in 2026 ➔ interface remains the same
- Development of functionalities (as required) to handle hyperspectral instruments
- Development of a python-based toolbox to display the LSICS intermediate + final output, and extract relevant information such the run history (➔ traceability)

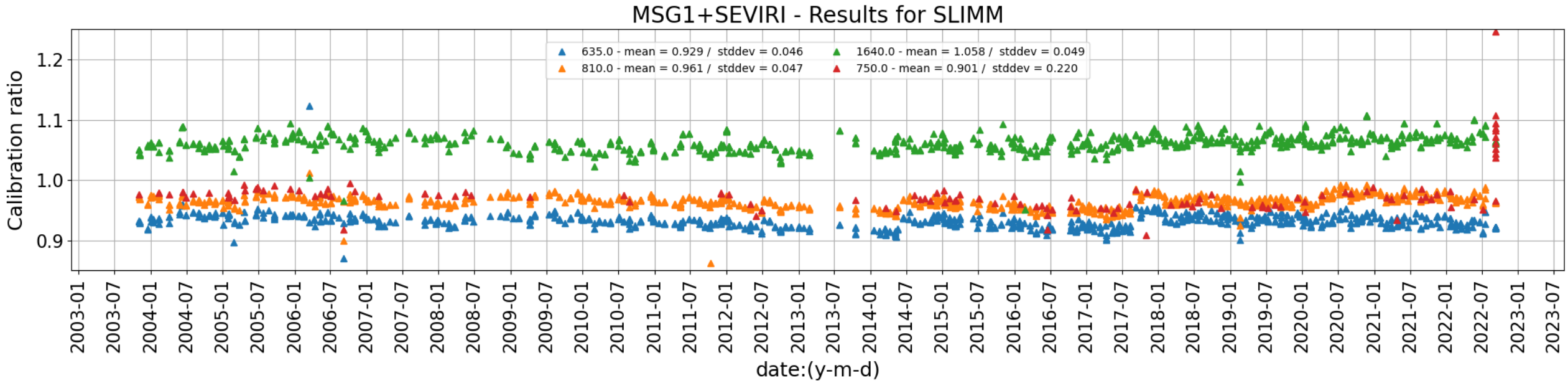
Preparation of LCWS#5

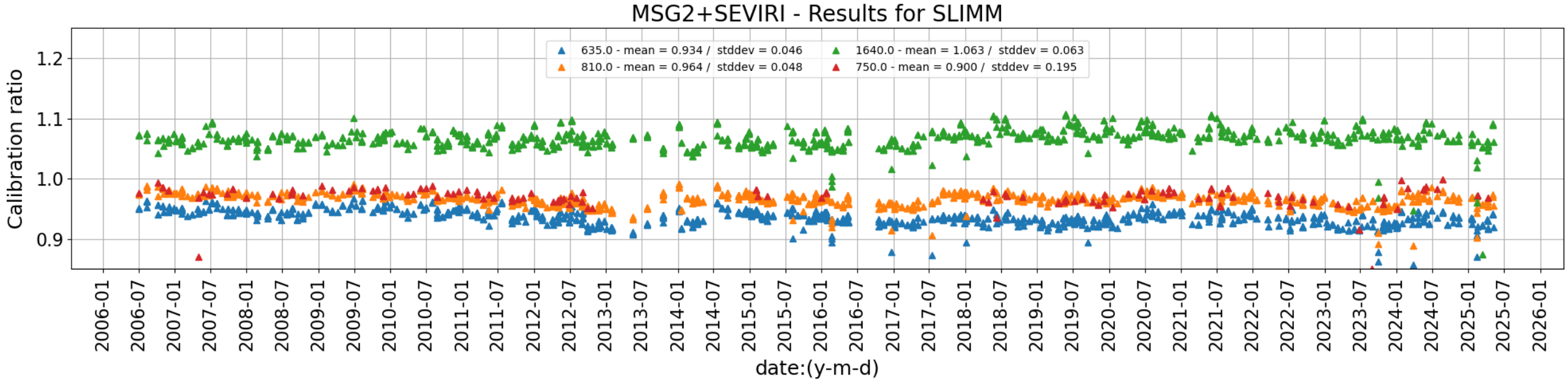
- LSICS Input/Output format document in its last review loop
- In order to prepare the workshop
  - LSICS Input/Output document will be shared
  - Mission teams to prepare input (GIRO or LSICS input format + SRF files)
  - Possibility to iterate with LSICS development group to test the formats

    ➔ Data (samples) will be run through LSICS for checking purposes

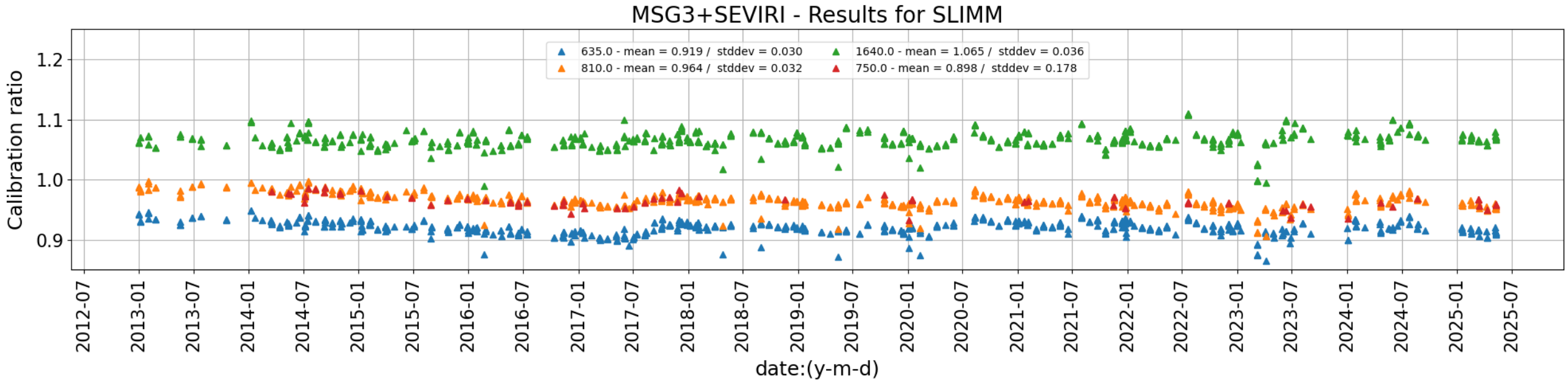
    ➔ No disclosure of the data send to us for testing ☺
  - Once LSICS v1.0 is ready, the groups will be ready to run it and could report at the workshop (similar to what was done for GIRO in 2014!)

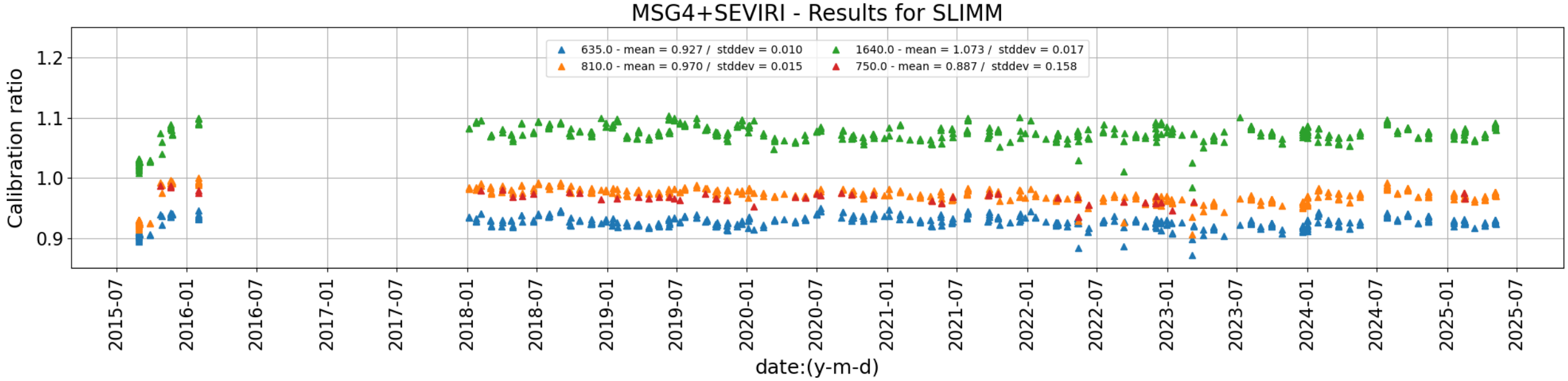
Some tests and results - MSG/SEVIRI





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Summary

- LSICS I/O document will be shared asap ➔ please consider implementing input formats for observations + SRFs
- LSICS = framework to operate validated models + using a common applicator to calculated the modelled irradiance ➔ no modification allowed to ensure outputs can be compared
- LSICS to come with more models in the future
- LSICS v1.0 before LCWS5
- Available to the community, but please acknowledge / refer
- No deep modifications to the code if you want to refer to LSICS ➔ feedback to the development team for bugs / enhancements



Thank you!

Questions are welcome.