2nd Lunar Model Inter-comparison Exercise — Planned Approach

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GSICS Lunar Subgroup Webmeeting
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Motivation

Lunar models form the radiometric reference for lunar calibration.
The most-used quantity is the spatially integrated spectral irradiance.

Some Recent Developments in Lunar Irradiance Modeling

- A goal: enabling the Moon as a high-accuracy reference standard for absolute calibration
  - tenths-percent uncertainty is technically feasible, only needs further development effort
    - CGMS-44 Working Group II paper (2016) — called for acquiring new lunar measurements to anchor the absolute scale
    - two projects dedicated to acquiring fiducial reference measurements of lunar spectral irradiance have been developed and operated: air-LUSI and ARCSTONE
- Current modeling efforts are working to incorporate air-LUSI data
  - also, to include lunar measurements from spacecraft instruments, e.g. SLIMM, LESSR
- Model validation possibility through application to nighttime aerosol OD retrievals, e.g. LIME

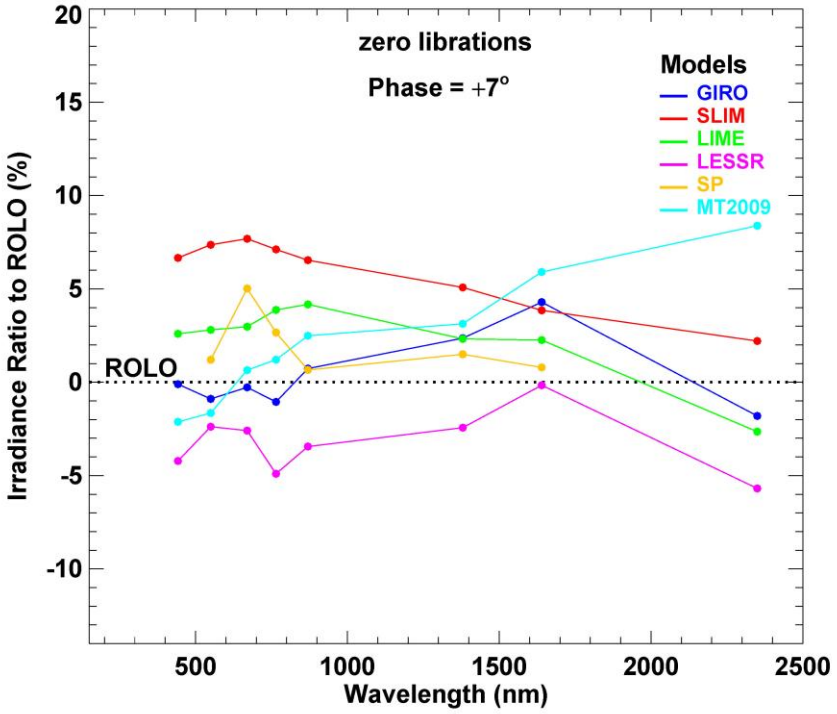
These topics to be covered at the upcoming lunar workshop at EUMETSAT

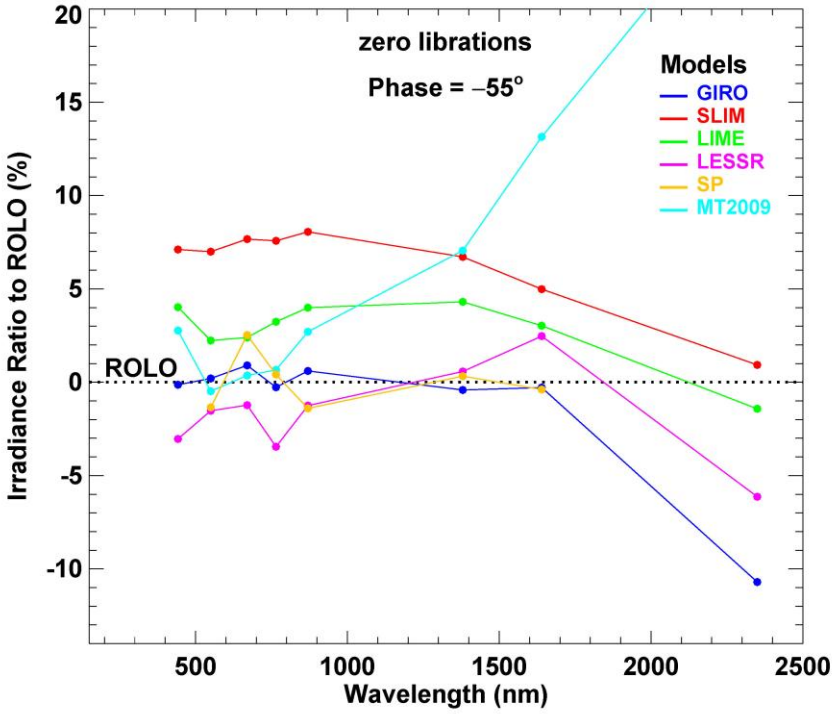
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First GSICS Lunar Model Inter-comparison Exercise — 2023

- Presented at the 4th Lunar Calibration Workshop — EUMETSAT, December 2023
- Participation by 7 lunar models: ROLO, GIRO, SLIMM, LIME, LESSR, SP, Miller-Turner
- Common model inputs: a specified grid of phase angles and librations
  - synthetic SRFs for 8 bands: 442, 550, 670, 765, 870, 1380, 1640, 2350 nm
- Comparison results (ca. 2023) showed a range of differences between the models:

Irradiance Ratio = ((model / ROLO) − 1) x 100%





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New Development: Lunar Spectral Irradiance Calibration System (LSICS)

See earlier talk by Sébastien Wagner

LSICS: a framework for operating lunar models in a controlled program environment

- Configurable to specify which lunar disk reflectance model to operate
  - disk equivalent reflectance (DER) is the kernel of lunar irradiance models
  - implementation of different models in LSICS is accomplished using code interfaces with the LSICS Disk Reflectance module
    - LSICS v1.0 has implemented SLIMM v1.0
    - in progress: LIME, LESSR v2, GIRO v2.0 (now aligned with the current ROLO)
- Capability to use any of the LSICS modules as the starting point:
  - Ingest & Geometry Calculation module (observation inputs)
  - Disk Reflectance module, Spectral Irradiance module (LSICS intermediate file inputs)

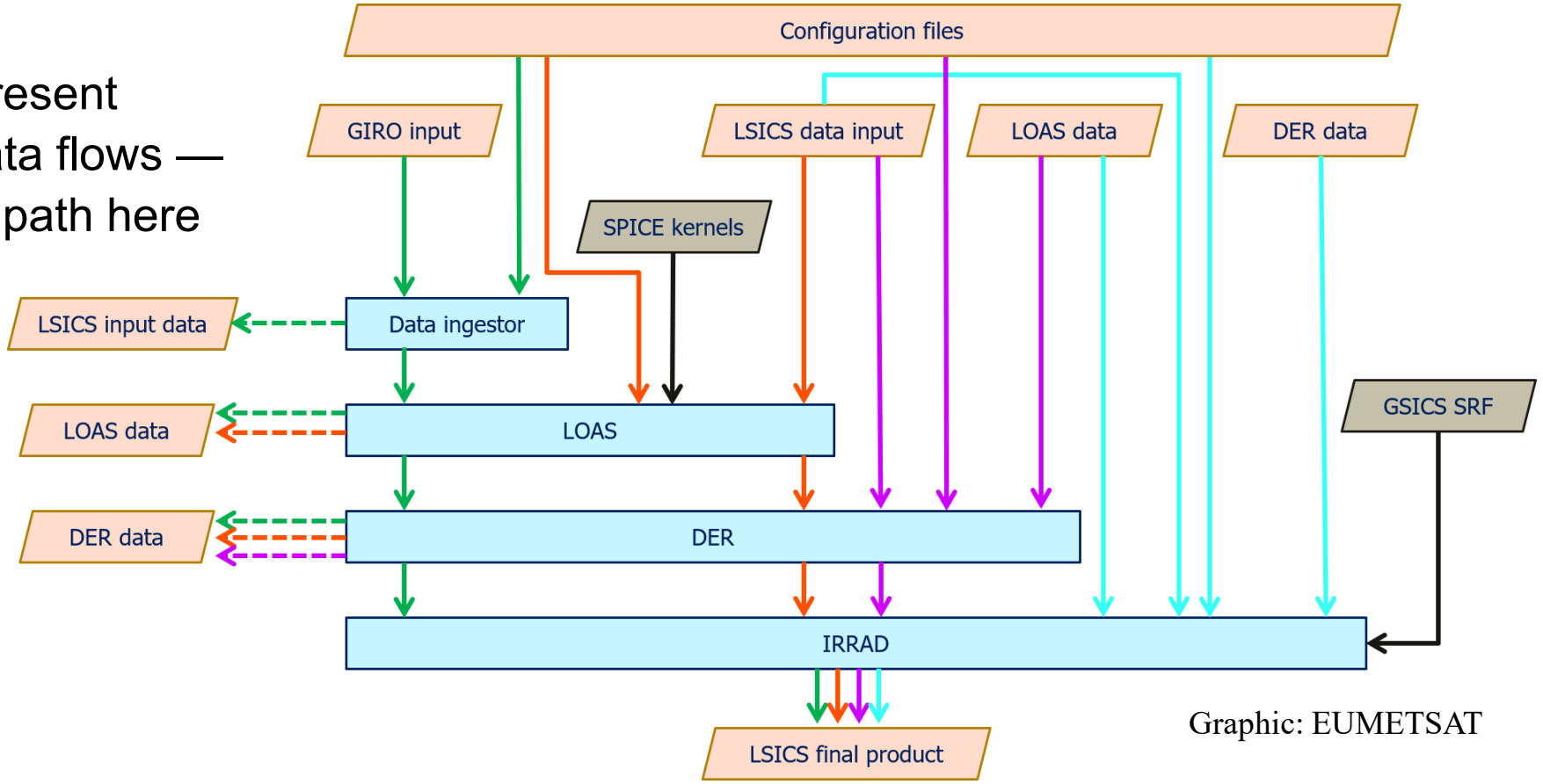
The LSICS framework structure is well-suited for making comparisons between models

2nd Lunar Model Inter-comparison Exercise

Approach: Use LSICS framework configured to operate each lunar model in turn

- Identical inputs for each: synthetic geometries to specify phase angles and librations
  - start LSICS at Disk Reflectance module, using a pre-generated LOAS intermediate file

Colors represent different data flows — use purple path here



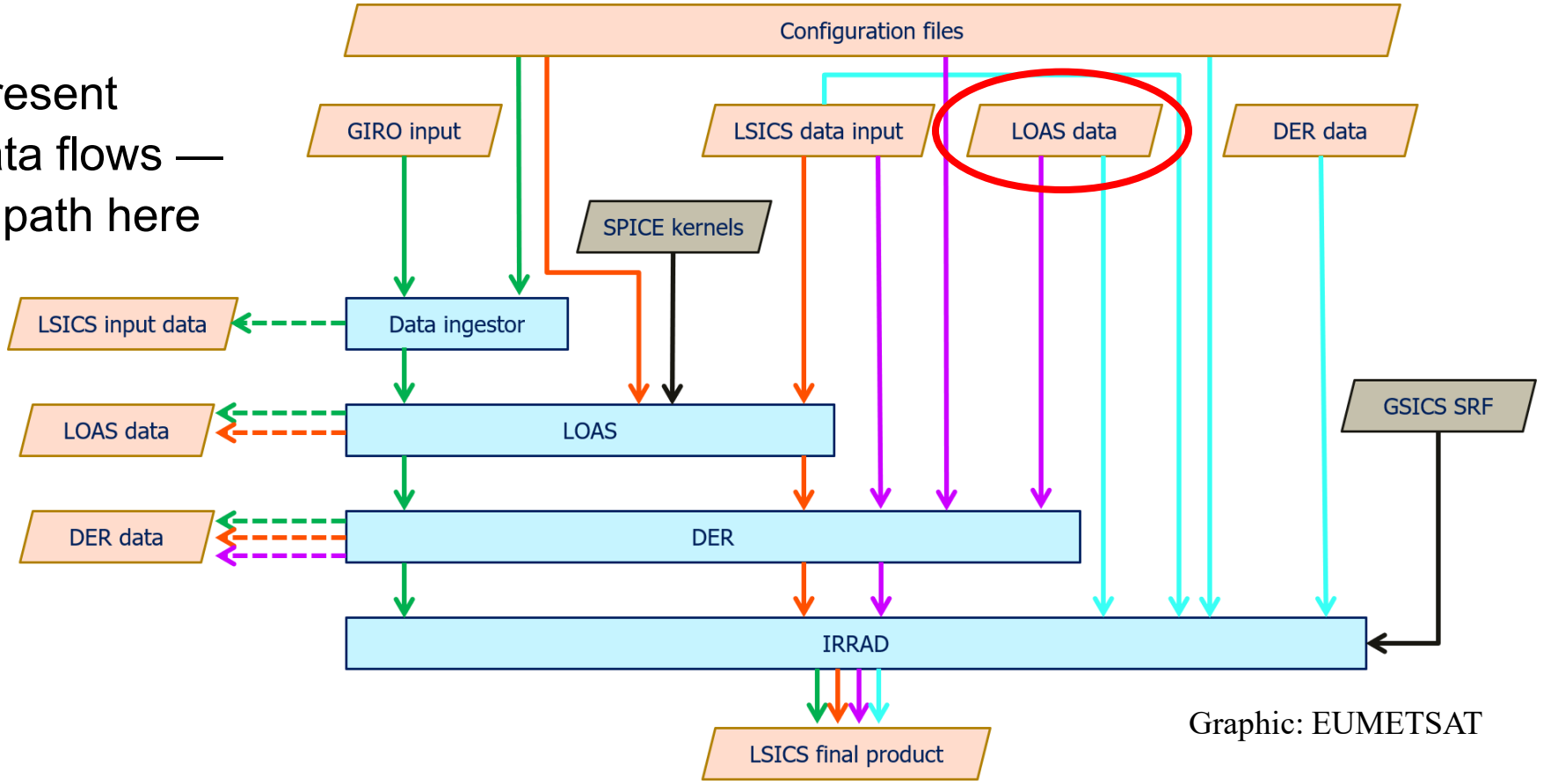
Graphic: EUMETSAT

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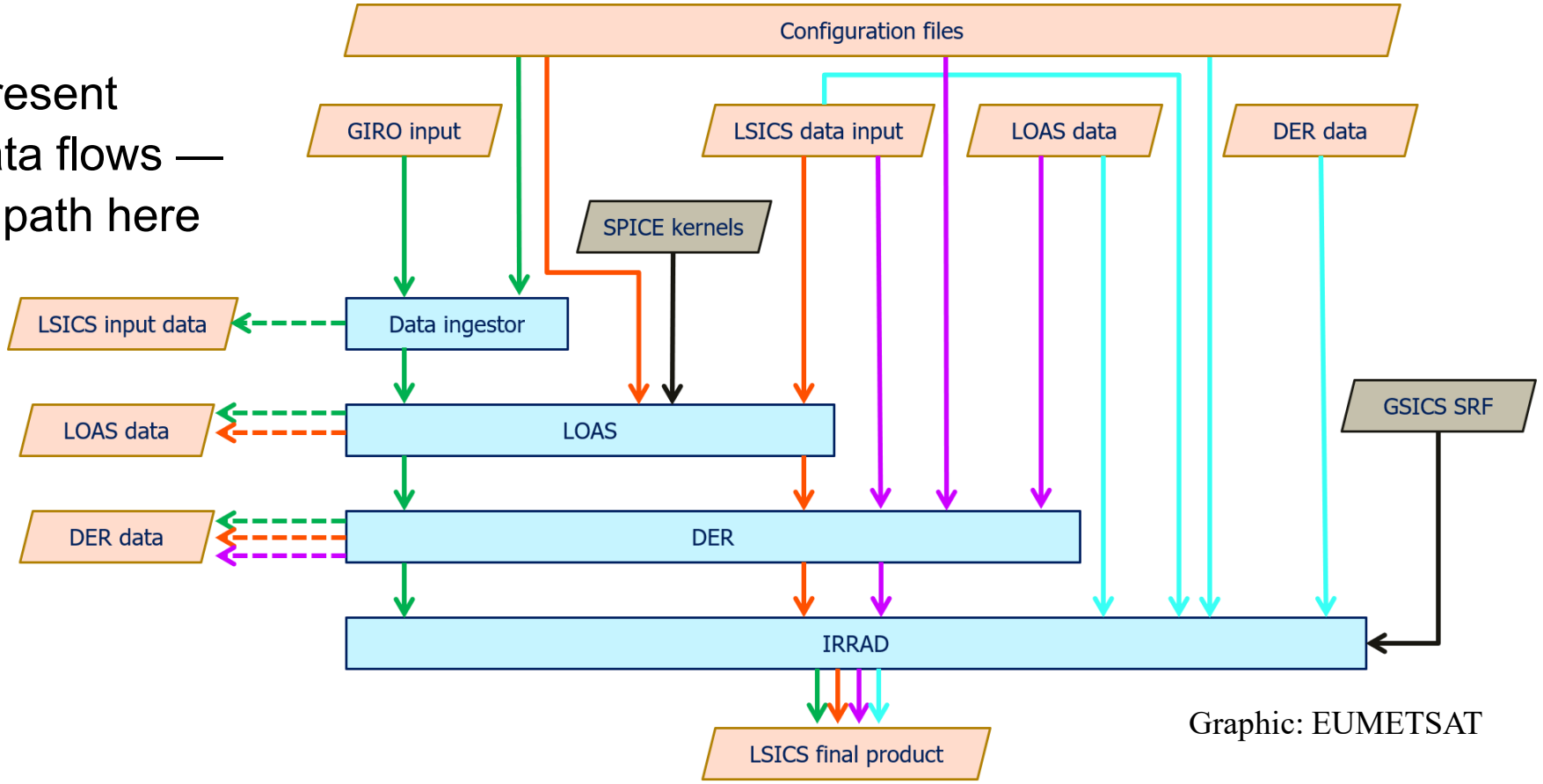
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2nd Lunar Model Inter-comparison Exercise

Approach: Use LSICS framework configured to operate each lunar model in turn

- Identical setup for Spectral Irradiance module: same SRF, same solar model
- Result: irradiance outputs (final product) can be compared directly

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Graphic: EUMETSAT

2nd Lunar Model Inter-comparison Exercise

Current status

- Verified the ability to start LSICS at the Disk Reflectance module, given LOAS inputs
- Testing the ability to complete irradiance processing with artificial observation data inputs
- Revising the SRFs and the phase angle and libration grid from the first exercise
  - active discussions within the LSICS development group
  - some suggestions:
    - slew a range of phase angles at zero libration
    - slew a range of librations at selected phase angles, possibly corresponding to common s/c acquisition geometries: ±7°, ±55°
    - specific phase and libration values, e.g. corresponding to air-LUSI acquisitions
  - expanded spectral band coverage, potentially full spectral resolution (hyperspectral)
- Potential participation of other lunar models, e.g. CNES
  - a significant hurdle: writing an interface to the LSICS Disk Reflectance module

Thank You!