Calibration of blended instantaneous and accumulated precipitation products

12th Workshop of International Precipitation Working Group
July 7-10, 2026, Kraków Poland

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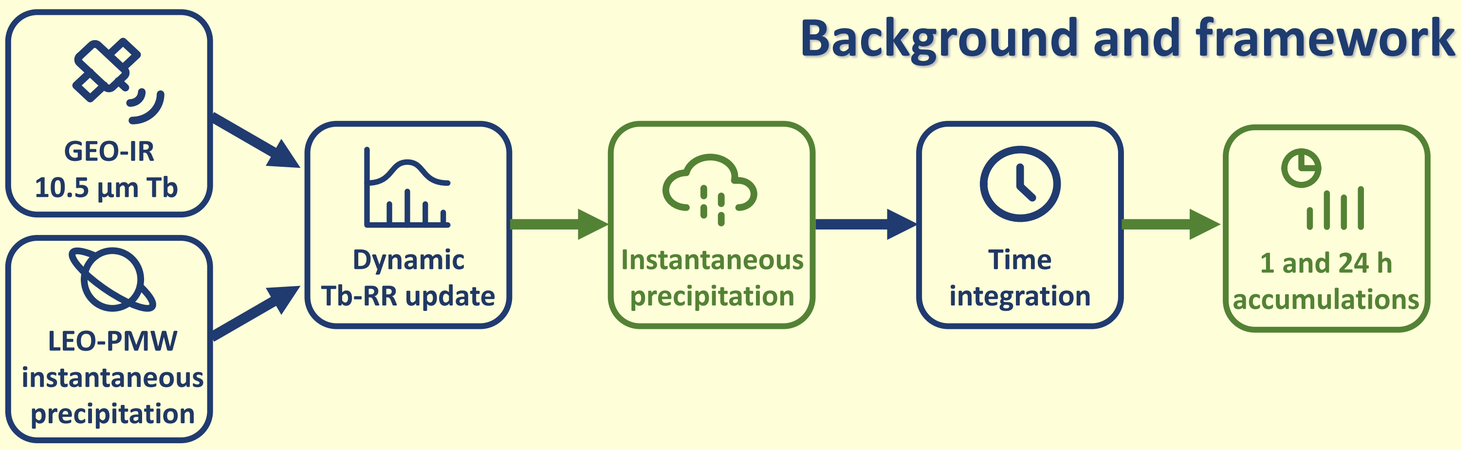
Within the EUMETSAT Satellite Application Facility on Support to Operational Hydrology and Water Management (H SAF), the Continuous Development and Operations Phase 5 (CDOP 5, 2027–2032) will include activities to improve operational precipitation products. In this framework, the present work develops the concept and proposed calibration strategy for MTG-FCI blended instantaneous and accumulated precipitation products, aiming to reduce systematic biases while preserving their operational value for near-real-time monitoring.

Background and framework



- H SAF provides satellite-based precipitation products for hydrology and water management.
- MTG-FCI blended products combine frequent, regular-grid GEO-IR observations with irregularly sampled LEO-PMW precipitation estimates.
- Instantaneous surface rain rate (RR) is estimated from the 10.5 µm brightness temperature (Tb) using a dynamically updated Tb–RR relationship.
- The resulting instantaneous precipitation product is provided on a regular grid across the MTG-FCI full disk with high spatial and temporal sampling.
- The 1 h and 24 h accumulations are obtained by temporal integration of this instantaneous product.

Products and operational context

- Products addressed: P-IN-FCI for instantaneous precipitation, and P-AC-FCI for 1 h and 24 h accumulated precipitation.
- Operational characteristics of the existing blended products: MTG-FCI full-disk coverage, 2 km sampling at the s.s.p., 10 min instantaneous estimates, hourly 1 h and 6-hourly 24 h accumulations, and near-real-time delivery.
- The blended products exploit the precipitation retrieval capability of LEO-PMW and the high spatial and temporal sampling of GEO-IR observations to support near-real-time monitoring.
- Operational constraint: any calibration strategy should improve product accuracy while retaining the operational strengths of the original blended products.
- Target users and applications: national basin authorities and water agencies, environmental agencies, policy makers, and near-real-time precipitation monitoring services.

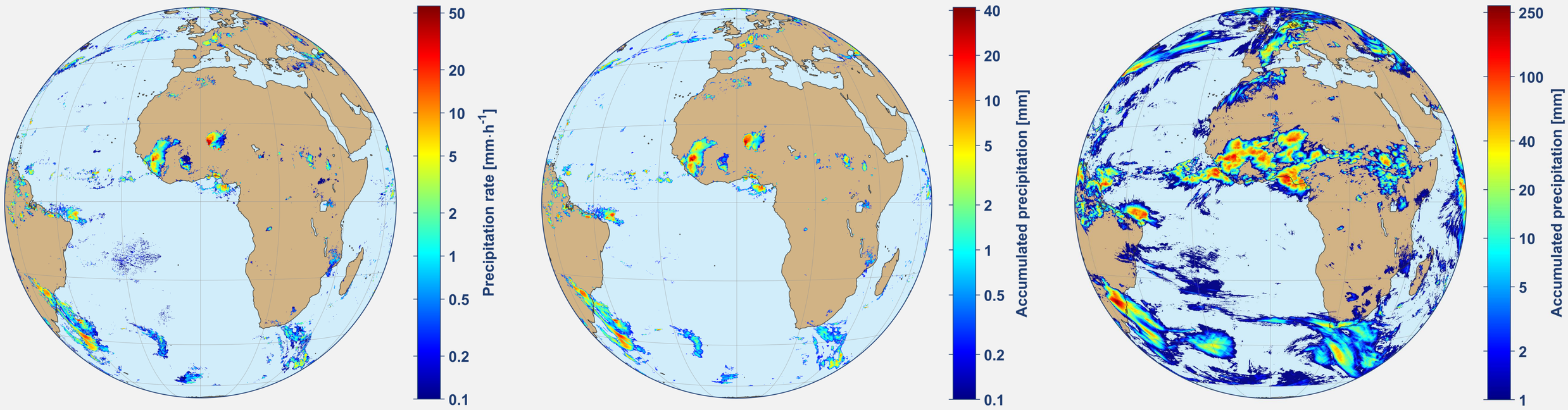
Motivation and objectives

- Blended GEO-IR/LEO-PMW precipitation products may be affected by systematic biases, mainly because cloud-top infrared brightness temperature is an indirect proxy for surface precipitation and LEO-PMW sampling is irregular in space and time.
- A dedicated calibration strategy is required to reduce these biases while preserving key operational strengths: full-disk coverage, regular-grid structure, high temporal sampling, and near-real-time delivery.
- Within the H SAF CDOP 5 framework, the activity will define, develop, and implement an intercomparison and bias-adjustment strategy for the blended precipitation products from reference-data collocation to operational correction design.
- The initial focus will be on adjusting the instantaneous precipitation product and assessing whether this correction reduces biases in the 1 h and 24 h accumulated products.
- The work will address the calibration pathway, static, dynamic, or hybrid updating, candidate correction methods, space-time collocation, possible adjustment classes, and assessment metrics.

Candidate adjustment approaches

- Candidate reference for intercomparison and adjustment: GPM Core Observatory estimates, used as a satellite-based reference with broad coverage over land and sea.
- Baseline pixel-based corrections: additive offsets, multiplicative scaling factors, and linear or exponential transfer functions to correct systematic differences at the pixel level.
- Pixel-based machine-learning corrections: random forests or neural networks to model non-linear error patterns and derive data-driven corrections.
- Distribution-based corrections: quantile mapping and related approaches to adjust differences in the precipitation intensity distributions.
- Spatial–temporal deep-learning corrections: 2D/3D CNNs to exploit the spatial structure and temporal evolution of precipitation systems.
- Adjustment classes, if needed: methods may be applied globally, by predefined classes such as latitude band, land/sea type, season, precipitation regime, phase, and intensity, or by data-driven clustering.
- Alternative or complementary pathway: adjust accumulated precipitation first, then derive consistent corrections for instantaneous precipitation.
- Update strategy: corrections may be computed once and applied statically, regularly updated through a dynamic approach, or combined in a hybrid approach.

Examples of P-IN-FCI and P-AC-FCI precipitation products



Instantaneous precipitation P-IN-FCI
29 June 2026, 00:00 UTC

1 h accumulated precipitation P-AC-FCI
29 June 2026, 00:00 UTC

24 h accumulated precipitation P-AC-FCI
29 June 2026, 00:00 UTC

Calibration workflow

1. Define the calibration pathway and updating strategy, considering options such as instantaneous-to-accumulated, accumulated-to-instantaneous, or combined correction schemes.
2. Define the blended/reference collocation framework, considering options such as fixed datasets for static correction, rolling matchup windows for dynamic parameter or model updates, or hybrid configurations.
3. Characterize systematic biases for instantaneous, 1 h, and 24 h precipitation products
4. Define adjustment classes, if required, using predefined conditions or data-driven clustering.
5. Select, develop, and assess the bias-correction method.
6. Assess corrected estimates and quantify bias reduction across instantaneous and accumulated products.
7. Define the implementation strategy for deploying the developed correction method within the H SAF CDOP 5 operational framework.

Expected outcomes

1. Calibration design covering the pathway, updating strategy, and adjustment classes, if required.
2. Blended/reference collocation framework and initial bias characterization for P-IN-FCI and P-AC-FCI products.
3. Bias-correction chain and bias-adjusted precipitation estimates for instantaneous and accumulated products.
4. Quantitative assessment of residual biases and bias reduction across instantaneous and accumulated products.
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