Calibration of blended instantaneous and accumulated precipitation products

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The EUMETSAT *Hydrology Satellite Application Facility* (H SAF) provides satellite-based operational products to support hydrology and water management, including precipitation estimates derived from both Low Earth Orbit passive microwave (LEO-PMW) and Geostationary infrared (GEO-IR) observations. Within this suite, blended precipitation products based on MTG-FCI combine the high-frequency GEO-IR sampling with precipitation retrieved from LEO-PMW observations to generate surface precipitation estimates on the native MTG-FCI full-disk grid, with 2 km spatial sampling at the sub-satellite point. In the instantaneous precipitation product provided every 10 min, consistent with the MTG-FCI temporal sampling, the 10.5 µm channel brightness temperatures (Tb) are converted into surface rain rate (RR) using a Tb–RR relationship that is dynamically updated from the most recent match-ups between GEO-IR Tb and LEO-PMW–derived RR via a probability matching technique. The subsequent accumulated blended products are then derived by temporal integration of the instantaneous precipitation product, producing 1-h and 24-h accumulations, provided at hourly and 6-hourly intervals, respectively.

In the 5th Continuous Development and Operations Phase (CDOP 5) of H SAF, covering the March 2027–February 2032 period, a bias-adjustment activity for the blended products has been proposed. As a first step, this activity would focus on the instantaneous product, using precipitation estimates from the GPM Core Observatory Dual-frequency Precipitation Radar (DPR) as the reference, given its broad coverage over both ocean and land, including remote regions where ground validation is limited. From an operational perspective, the adjustment could follow a stepwise approach, starting with simple, robust methods and increasing in complexity only if needed, based on the accuracy achieved on independent test datasets. The simplest methods could rely on pixel-based comparisons to derive adjustments, ranging from additive offsets or multiplicative scaling factors to more general linear or exponential transfer functions. Alternatively, distribution-based approaches, such as quantile mapping, could be explored to align the cumulative distributions of the blended and reference estimates. Stratification by latitude band, land–sea surface type, season, time of day, and precipitation intensity could further tailor the adjustment to distinct conditions. More advanced solutions could rely on machine-learning methods, such as random forests or neural networks, used either for pixel-based adjustment or to derive a more detailed, data-driven stratification by clustering environmental conditions and precipitation regimes. Additional refinements could account for the spatial structure of precipitation fields and their temporal evolution using 2D or 3D convolutional deep-learning architectures. In the subsequent time integration, it would be evaluated whether the adjustment of instantaneous precipitation carries over to the 1-h and 24-h accumulations with acceptable accuracy, or whether an additional correction based on rain-gauge accumulations would be required. If the typical limitations of this approach, mainly related to the highly intermittent nature of instantaneous precipitation and to residual spatial and temporal collocation mismatches between the instantaneous blended and reference precipitation estimates, do not allow the adjusted estimates to reach the desired accuracy, an alternative pathway could be considered. This would involve adjusting accumulated precipitation first, leveraging the greater statistical stability of time-integrated fields, and then deriving consistent adjustments for instantaneous precipitation accordingly. Furthermore, all the considered adjustment strategies could also be static, that is computed once and applied consistently, or dynamic, that is regularly updated to track temporal variability and improve adaptability to changing conditions.

The proposed study aims to review and outline the overall intercomparison and adjustment strategy and the main candidate methods, building on relevant literature and commonly adopted solutions. It will address the evaluation metrics, the space–time collocation strategy, the stratification variables and approaches, and whether the adjustment should be static or dynamically updated over time.