Mapping and Integrating African River Observations into GloFAS : Bridging Data Gaps for Improved Flood Forecasting

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ABSTRACT

Reliable flood forecasting depends on accurate hydrological observations and on ensuring that these observations are correctly linked to the model grid. The Global Flood Awareness System (GloFAS), an Early Warning System for floods within the Copernicus Emergency Management Service (CEMS) of the European Union, uses in-situ river discharge data from national hydrological services to calibrate and validate its global hydrological model, the physics-based distributed hydrological model LISFLOOD. To make sure that simulated and observed discharges refer to the same hydrological area and river catchment, each gauging station must be mapped to the right GloFAS grid cell at 3-arcmin resolution since version 4.

To make this process faster and more consistent, ECMWF, the Computational Centre of GloFAS, developed a toolkit that automatically finds the best grid cell in the model's river network for each station by comparing the difference between the observed and the corresponding modelled upstream area. Users can define three key parameters that control the search: (i) the maximum search distance, which defines how far the tool will look from the station location; (ii) the maximum allowed upstream-area difference, which sets the largest acceptable mismatch between the observed and modelled drainage area; and (iii) the minimum accepted difference, which defines when the search can stop if the match is already good enough. The tool uses the station coordinates, the observed upstream area defined by data providers, and the upstream area grid from the GloFAS river network as inputs. It then performs nearest-cell and best-cell searches, computes distances and upstream-area differences, and produces results in text (CSV) and georeferenced (GIS layer) formats for further validation.

Although automated, the process still requires manual checks. Automatic mapping cannot fully correct errors such as inaccurate coordinates, river migration, or errors in the base hydrographic data. For stations that remain uncertain, an additional check compares the observed discharge with historical model simulations. Statistical metrics such as the Kling-Gupta Efficiency (KGE) are used to evaluate how well the mapped station matches the model results before using the data for calibration or validation.

In the current operational version of GloFAS (version 4), 2985 stations are mapped worldwide, including 777 in Africa. The next release expected during 2026, GloFAS 5.0, will increase the total to more than 12873 mapped stations, including 2220 in Africa, all candidates to be shown on the GloFAS MapViewer as reporting points. The upgraded tool will also allow the transfer of mapped stations across different river network resolutions of 1, 3, and 6 arcminutes so that each station only needs to be mapped once and can then be upscaled automatically to coarser resolutions if necessary.

This development is especially important as new AI-based hydrological models emerge and rely on large, well-referenced datasets. The developed tool provides a practical, scalable, and repeatable way to integrate river observations into hydrological models, supporting better flood forecasting and stronger hydrological research capacity, particularly in Africa where observation networks remain limited.

Keywords: Global hydrology; Forecasts; Station mapping; GloFAS