Evaluation of GloFAS river discharge reanalysis and forecast skill

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Background and Introduction

- Global Flood Awareness System (GloFAS; http://www.globalfloods.eu) can monitor and forecast floods across the world.
- Part of European Commission Copernicus Emergency Management Service (CEMS); ECMWF is the computational centre.
- GloFAS-ERA5 river discharge reanalysis 1979-present.
- Ensemble forecasts out to 30 days (based on ECMWF IFS).
- Can support humanitarian response to devastating floods (e.g. tropical cyclone Idai in March 2019).

Objective

Evaluate the GloFAS river discharge reanalysis and forecast skill.

Production of GloFAS

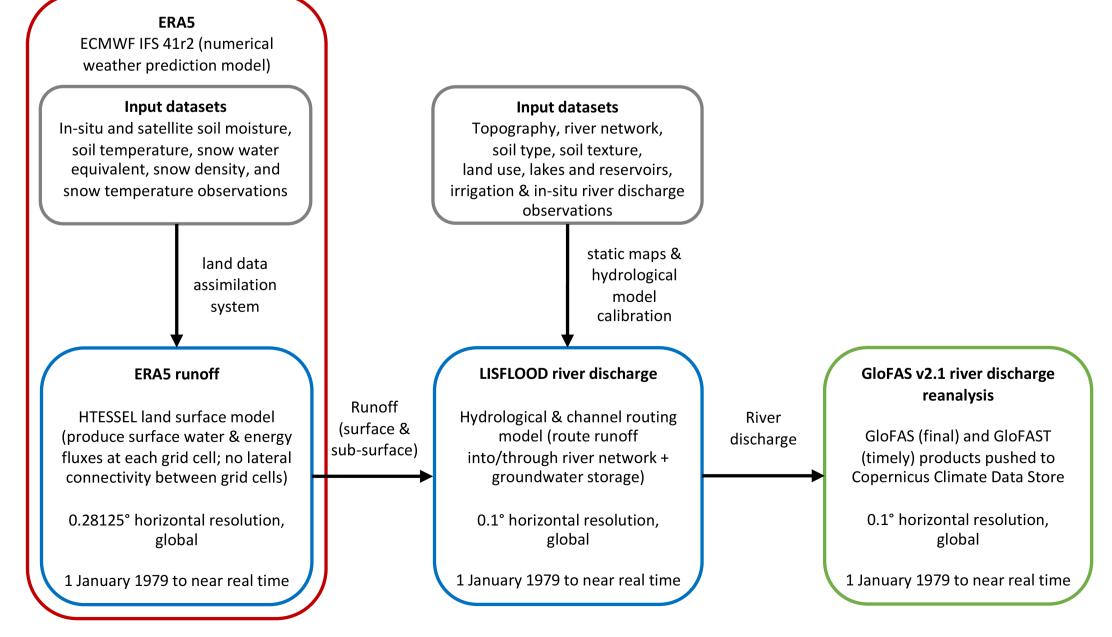- Reanalysis and reforecasts based on GloFAS v2.1 (released 5 November 2019)

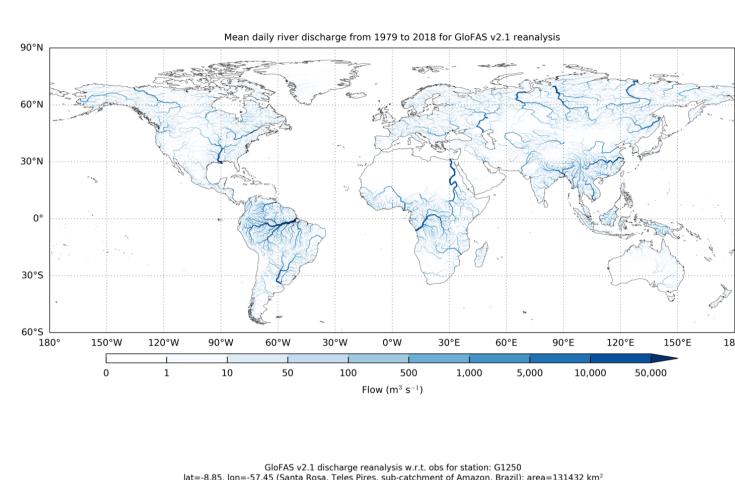**Figure 1:** A schematic of the key components in the production of GloFAS river discharge reanalysis dataset.
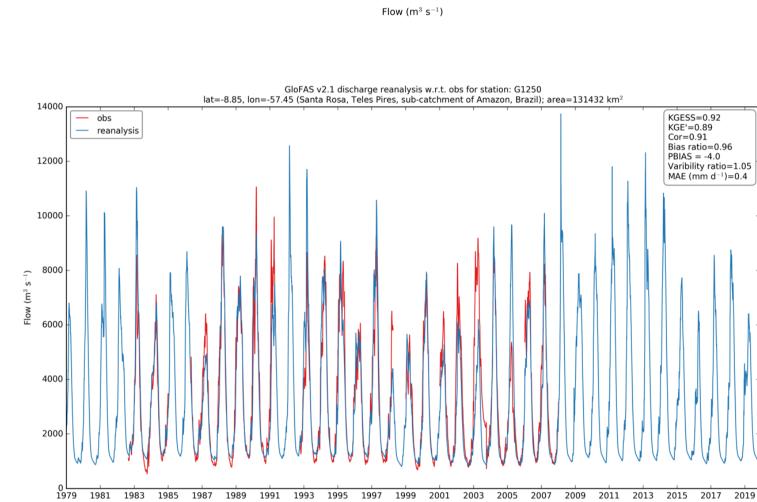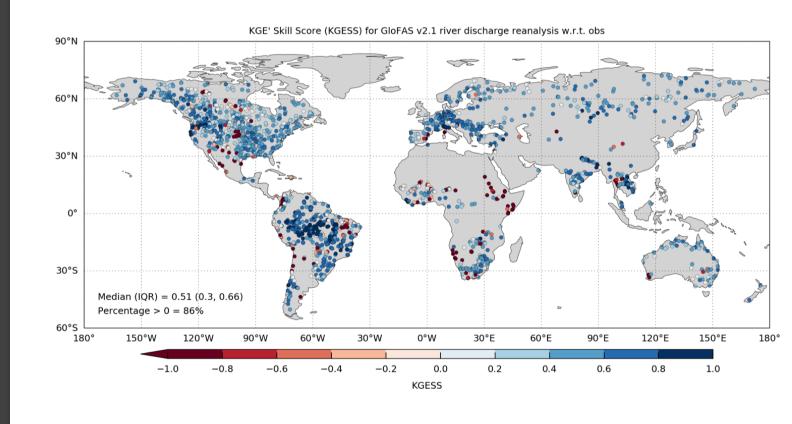
GloFAS-ERA5 reanalysis

Figure 2: Mean GloFAS-ERA5 daily river discharge over 1979–2018 for each GloFAS river grid cell with an upstream area greater than 1000 km^2. Darker blue river sections have larger river discharge.

Figure 3: Hydrograph for GloFAS-ERA5 river discharge reanalysis (blue) from 1 Jan. 1979 to 2 Nov. 2019 and observations (red), when available, for the Santa Rosa gauge on the Teles Pires River, in the Amazon, Brazil.
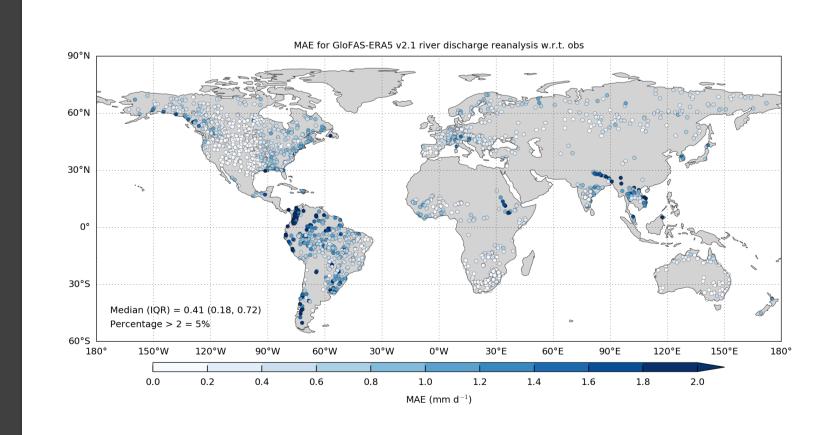
GloFAS-ERA5 reanalysis skill

Figure 4: Modified Kling-Gupta Efficiency Skill Score (KGESS) for GloFAS-ERA5 river discharge reanalysis against 1801 observation stations. Optimum value of KGESS is 1. Blue (red) dots show catchments with positive (negative) skill.
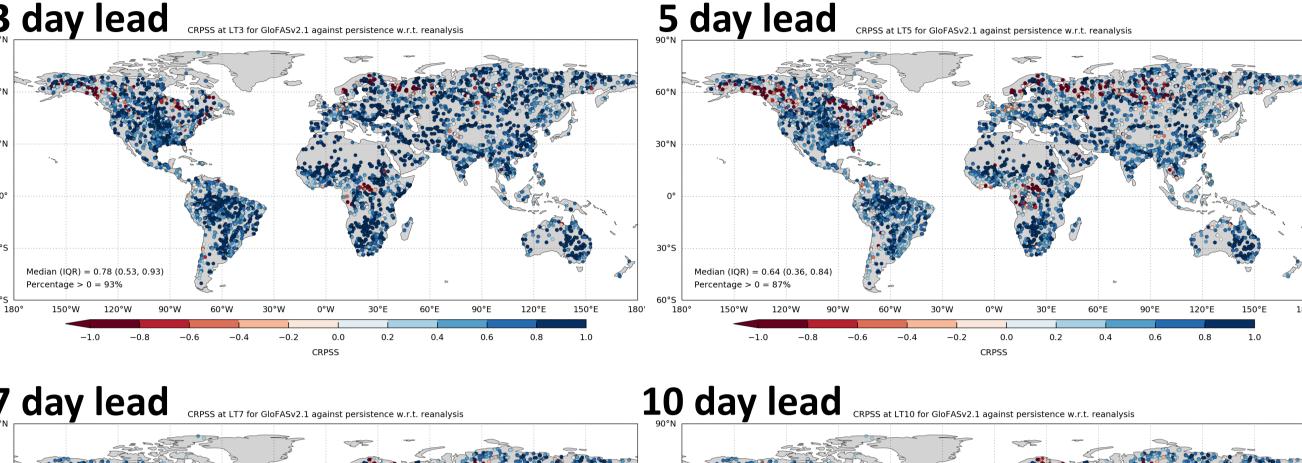
Figure 5: Mean Absolute Error (MAE) for GloFAS-ERA5 reanalysis against 1801 observation stations. Optimum value of MAE is 0, catchments with larger magnitude of errors are darker shades of blue dots.

GloFAS data availability

- Real-time forecasts (MARS, CDS (soon), ftp)
- GloFAS-ERA5 river discharge reanalysis (MARS, CDS)
- Reforecasts (MARS (soon), CDS (soon), ftp)
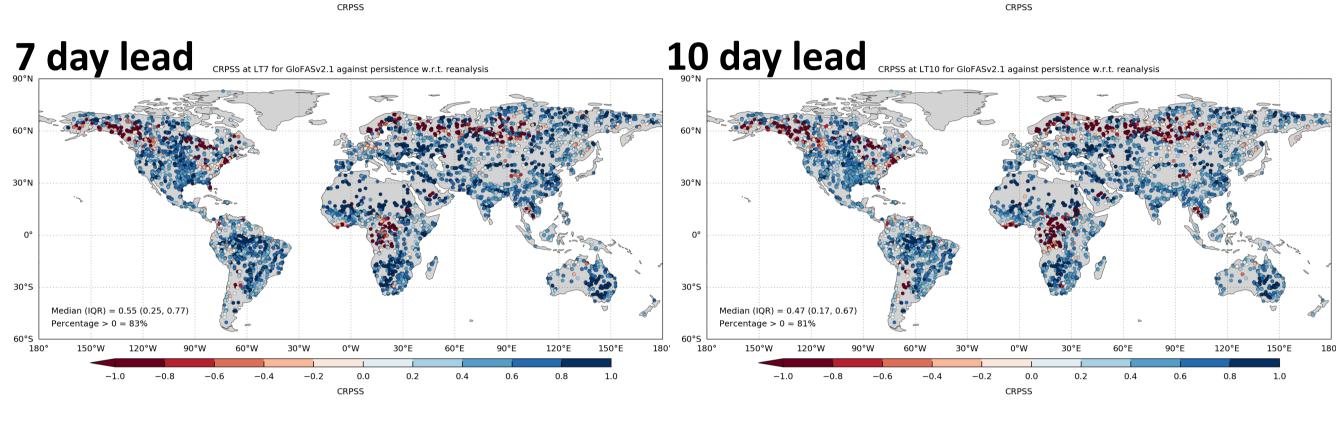
GloFAS forecast skill

Figure 6: Continuous Ranked Probability Skill Score (CRPSS) for GloFAS reforecasts against a persistence benchmark for short to medium lead times (3-, 5-, 7-, and 10-days) with respect to GloFAS-ERA5 river discharge reanalysis for 6013 catchments. Reforecasts are produced twice per week over 1997-2016 with 11 ensemble members each.

Conclusions

- GloFAS-ERA5 river discharge reanalysis shows hydrological skill in 86 % of catchments.
- Water balance errors have been identified in the reanalysis, e.g. western coast of S. America, Sudan and Ethiopia, and Ganges.
- Global median ensemble forecast skill using CRPSS ranges from 0.78 (3 day lead) to 0.47 (10 day lead).

Further Reading
Harrigan, S., Zsoter, E., Alfieri, L., Prudhomme, C., Salamon, P., Wetterhall, F., Barnard, C., Cloke, H., and Pappenberger, F.: GloFAS-ERA5 operational global river discharge reanalysis 1979-present, submitted to Earth System Science Data (ESSD), 2020.