Adaptive Earth Observation-Based Data Assimilation for Near-Real-Time Flood Forecasting over the Niger Basin within the ESA EO4Flood Project
(Oral)

Malak Sadki[1]*, Vanessa Pedinotti[1], Osvaldo Luis Barresi[1], Yonas Alim[1], Ana Carmona Bardella[1], Gilles Larnicol[1], **EO4FLOOD Team[2]**

[1] Magellium-Artal Group, France

[2] EO4FLOOD Consortium (see project partners below)

*Corresponding author: malak.sadki@magellium.fr

ABSTRACT

Floods are among the most destructive natural hazards worldwide, with impacts expected to increase under climate change. In large river basins, especially in data-scarce regions, flood forecasting remains uncertain because of limited in-situ observations and the complexity of hydrological and hydraulic processes. In this context, the ESA-funded EO4Flood project (https://eo4flood.org/) aims to assess how advanced Earth Observation (EO) products can improve flood forecasting at regional to continental scales through their integration into hydrological and hydrodynamic models.

Within EO4Flood, our work focuses on the Niger River basin and investigates the use of EO-based data assimilation for near-real-time hydrological forecasting with the MGB-HYFAA large-scale forecasting system. The objective is to improve river state estimation and short-term flood prediction by assimilating satellite-derived water surface elevation (WSE) and discharge products into an Asynchronous Ensemble Kalman Filter (AEnKF), which is better suited to EO revisit times and data latency than a classical sequential filter.

Reforecast experiments are carried out over the Niger basin using operational precipitation forecasts and soil moisture forcings from the EO4Flood dataset (https://zenodo.org/records/17787732), built from the latest high-resolution satellite products from ESA and non-ESA missions over nine basins worldwide. Forecasts are initialized from analysed states and evaluated at 1-, 3-, and 7-day lead times. A particular focus is placed on the impact of observation latency, defined as the delay between the real observation time and its availability for assimilation, as well as on the role of observation uncertainty under degraded EO conditions.

The main objective is to quantify how much EO-driven data assimilation can improve flood timing, discharge magnitude, and forecast uncertainty under realistic near-real-time conditions. This work is expected to contribute directly to EO4Flood's objective of improving flood prediction skill and better quantifying uncertainty in data-scarce environments.

Keywords: Data Assimilation, Earth Observation, Flood Forecasting

[2] EO4FLOOD Team: A. Tarpanelli[3], G. P. Schumann[4], C. M. Kittel[5], J. Andersson[6], S. Barbetta[3], P. Bauer-Gottwein[7], T. Bertrand[4], É. Cantoni[8], A. Carmona[1], P. Casas[9], C. Chewning[5], L. Ciabatta[3], D. Dettmering[10], O. Elmi[11], P.

Filippucci[3], L. Gal[9], G. Gallion[4], M. González-Jiménez[8], D. Gustafsson[6], L. B. Hansen[5], Y. Hundecha[6], S. J. Köhn[12], K. Larnier[9], G. M. Martín[8], F. Marti[1], C. Massari[3], A. Murray[5], K. Nielsen[12], R. Palmitessa[5], A. Paris[9], C. B. Pedersen[5], P. Saemian[11], D. Scherer[10], C. Schwatke[10], P. Tamagnone[4], C. Toettrup[5], M. Toro Bermejo[8], M. J. Tourian[11], S. Zaprzala[8], J. Benveniste[13], A. Vrettou[14], K. Douch[15], E. Volden[15]

[3] CNR-IRPI, Italy
[4] RSS-Hydro, Luxembourg
[5] DHI-GRAS, Denmark
[6] SMHI, Sweden
[7] University of Copenhagen, Denmark
[8] GMV, Spain
[9] Hydro Matters, France
[10] DGFI-TUM, Germany
[11] University of Stuttgart, Germany
[12] DTU Space, Denmark
[13] COSPAR / CNES, France
[14] Serco Italia / ESRIN, Italy
[15] ESA-ESRIN, Italy