Earth Observation data for Advancing Flood Forecasting: EO4FLOOD project

Angelica Tarpanelli¹, Guy Schumann², Cecile Kittel³, Jafet Andersson⁴, Silvia Barbetta¹, Peter Bauer-Gottwein⁵, Elia Cantoni Igomez⁶, Connor Chewning³, Luca Ciabatta¹, Denise Dettmering⁷, Omid Elmi⁸, Paolo Filippucci¹, Laetitia Gal⁹, Miguel González-Jiménez⁶, David Gustafsson⁴, Yeshewatesfa Hundecha⁴, Gilles Larnicol¹⁰, Kevin Larnier⁹, Christian Massari¹, Alexandra Murray³, Karina Nielsen⁵, Rocco Palmitessa³, Adrien Paris⁹, Claus Bjoern Pedersen³, Vanessa Pedinotti¹⁰, Beatriz Revilla Romero⁶, Malak Sadki¹⁰, Peyman Saemian⁸, Daniel Scherer⁷, Paolo Tamagnone², Marta Toro Bermejo⁶, Mohammad Javad Tourian⁸, Christian Toettrup³, Jérôme Benveniste¹¹, Artemis Vrettou¹², Karim Douch¹² Espen Volden¹²

The last two decades have seen a proliferation of available satellite remote sensing data providing near-global coverage of key hydrological variables as shown in the Figure below













MANAM







EO4FLOOD will test the impact of EO through calibration, forcing data, initial condition and data assimilation in three rainfall-runoff models (Hype, GHM, MGB) and one AI model. To optimize the use of the available tools for flood forecasting, we will develop a hybrid approach that integrates the strengths of a physics-based approach and advanced AI techniques.



magellium



1 CNR-IRPI, Italy; 2 RSS-Hydro, Kayl, Luxembourg; 3 DHI, Hørsholm, Denmark; 4 SMHI, Norrköping, Sweden; 5 DTU, Lyngby, Denmark; 6 GMV, Madrid, Spain; 7 TUM, Munich, Germany; 8 University of Stuttgart; 9 Hydro Matters, Le Faget, France; 10 Magellium, Toulouse, France; 11 COSPAR; 12 ESA-ESRIN, Frascati, Italy

Ś





RATIONALE

The numbers of displacements highlight the **collective inability** to adequately anticipate flood events, reduce vulnerability, and mitigate their impacts, underscoring the need for more effective strategies to reduce flood risk.

Real-time flood forecasting is critical for reducing immediate impacts and enhancing emergency response. Traditional flood forecasting relies on ground-based hydrological networks, but these systems often **suffer from data** gaps, particularly in vulnerable and datascarce regions. Satellite-based Earth **Observation (EO) data emerges as a** promising solution. Offering broad spatial and temporal coverage, EO technologies can bridge critical gaps in monitoring and improve the accuracy and reliability of flood forecasting systems. Despite their vast potential, the integration of satellite data into operational flood forecasting remains limited



TESTING BASINS

The testing modelling framework will be implemented over selected areas within five specific basins (Torne, Negro, Congo, Niger and Brahmaputra). The dataset of EO will be provided also in the bigger European basins like **Po**, **Danube**, **Rhine** and **Ebro**.



KEY PROPOSED INNOVATIONS

- Retrieval of multi-mission water level data, combining nadir, SAR, and SWOT altimeters; Utilization of multiple sensors for river discharge estimation, incorporating various water variables like level, width, reflectance indices and slope;
- Regionalization of parameters also for space-based river discharge estimation;
- Hybrid approach merging physical-based hydrological models with AI methods for robust flood forecasting;
- Integration of satellite data into established flood forecasting systems to evaluate their potential impact and benefits;
- Extensive model comparison to optimize application fields based on data and environmental factors;
- Provision of probabilistic flood forecasting results to simulate real-world conditions for stakeholders during early warning phases.

ACKNOWLEDGEMENT

EO4FLOOD project is supported by the European Space Agency (Contract No. ESA AO/1-12101/24/I-EB). Please, visit the website <u>www.eo4flood.org</u> for more information or contact:

- Angelica Tarpanelli <u>angelica.tarpanelli@cnr.it</u>
- Guy Schumann gschumann@rss-hydro.lu
- Cecile Kittel <u>ceki@dhigroup.com</u>



This work is distributed under the Creativ **Commons Attribution 4.0 Licens**

