Improving Flash Flood Monitoring and Forecasting Capabilities in West Africa with Satellite Observations and Precipitation Forecasts

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IIHR—Hydroscience and Engineering

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The team

Project: Machine learning based flash flood forecasting in West Africa with satellite observations

Satellite Hydrometeorology

Lead PI

RUTGERS

GEORGE MASON UNIVERSITY

Machine Learning

FLORIDA TECH

Hydrologic Modeling

IOWA

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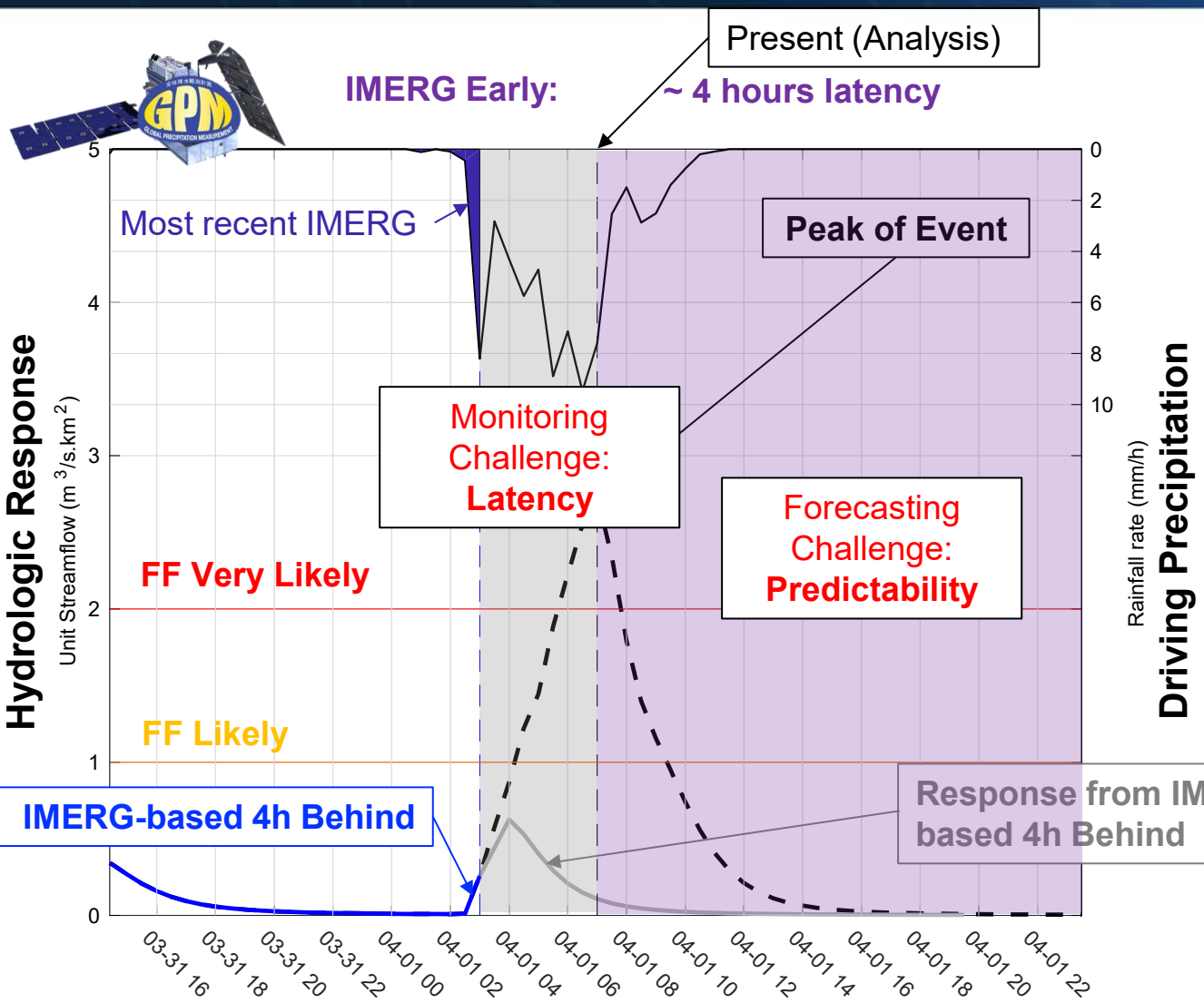
Flash Flood Warning

NSSL NATIONAL SEVERE STORMS LABORATORY

Flash flood warnings require high-resolution/low latency information



Rainfall-driven short fused hazard

- High rainfall rates
- Rapidly evolving/Small spatial scales

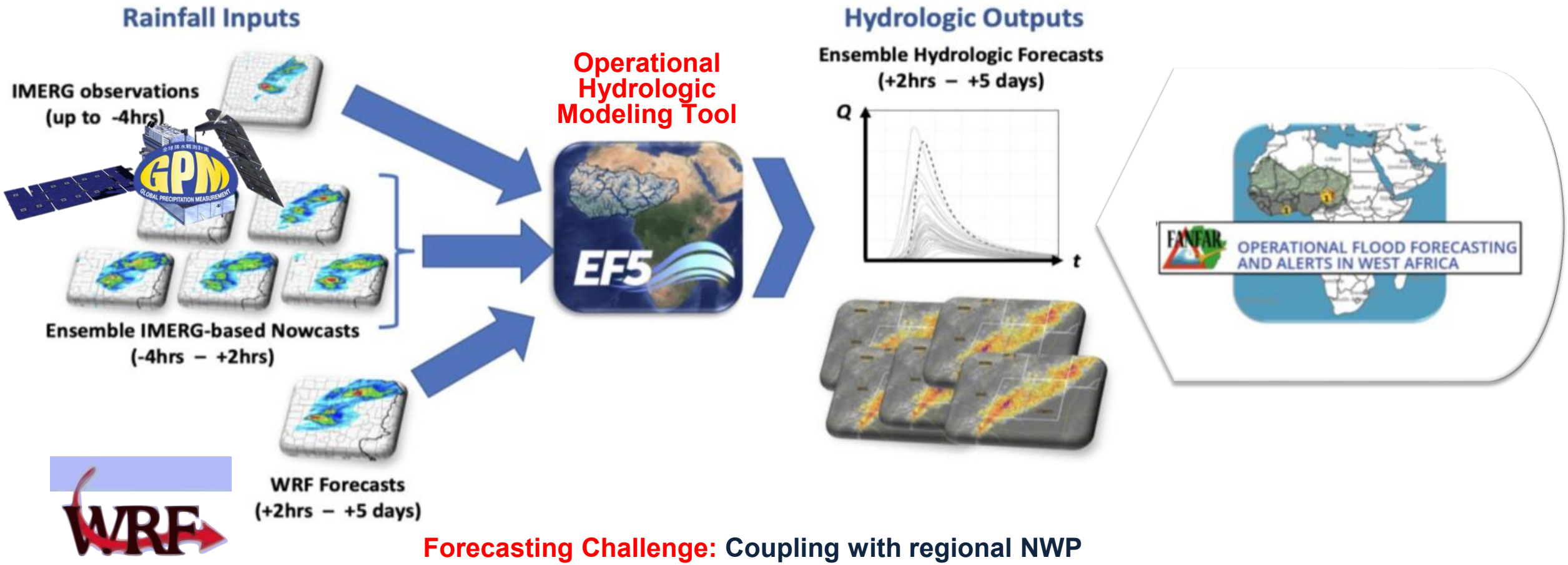
Desperate search for survivors after flash flood/landslide event in Mocoa, Colombia: 250 fatalities/100s injured Source: (BBC World, 2017)

A ML-based Flash Flood Forecasting System for West Africa

Development of a SERVICE for West Africa

Monitoring Challenge: Short-term QPFs based on satellite inputs

Improving capabilities: Integration into existing operational system (WA partners)



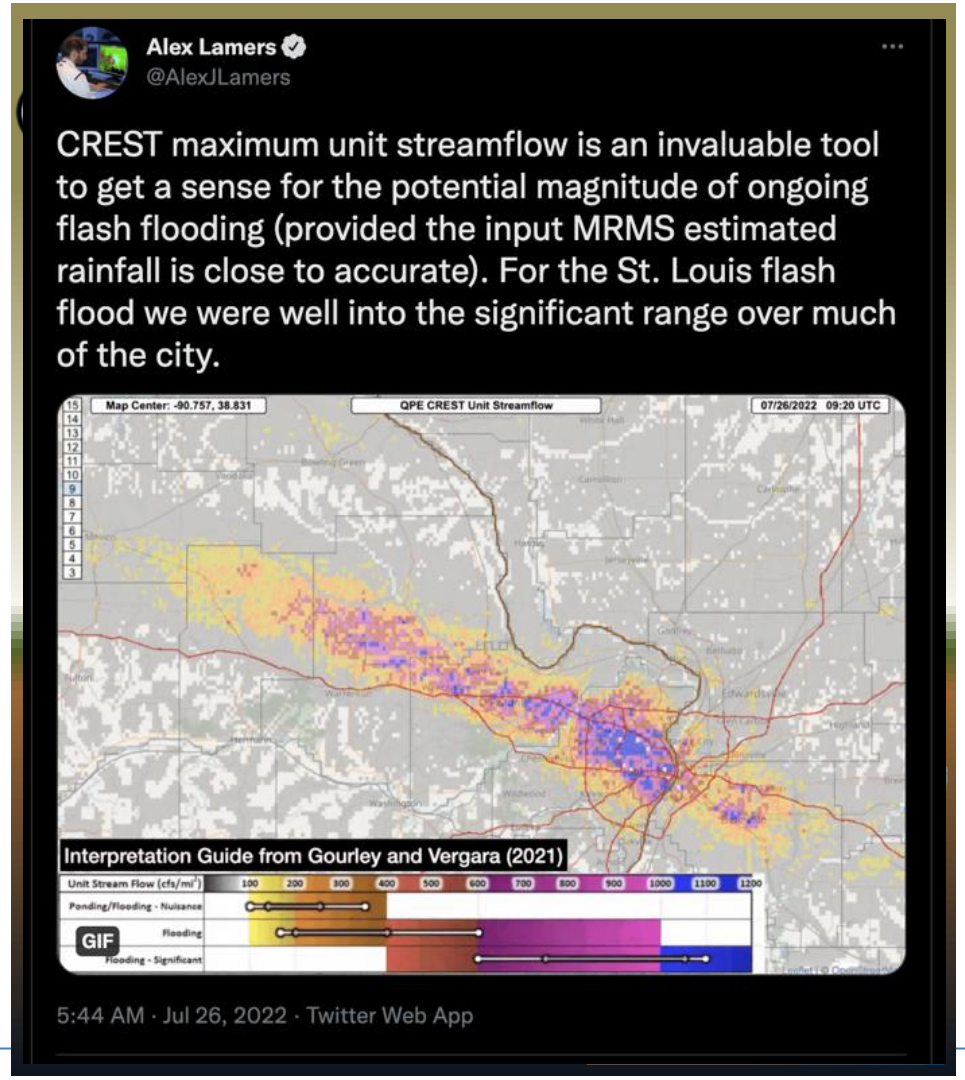
Forecasting Challenge: Coupling with regional NWP

Distributed hydrological modeling for flash flood prediction

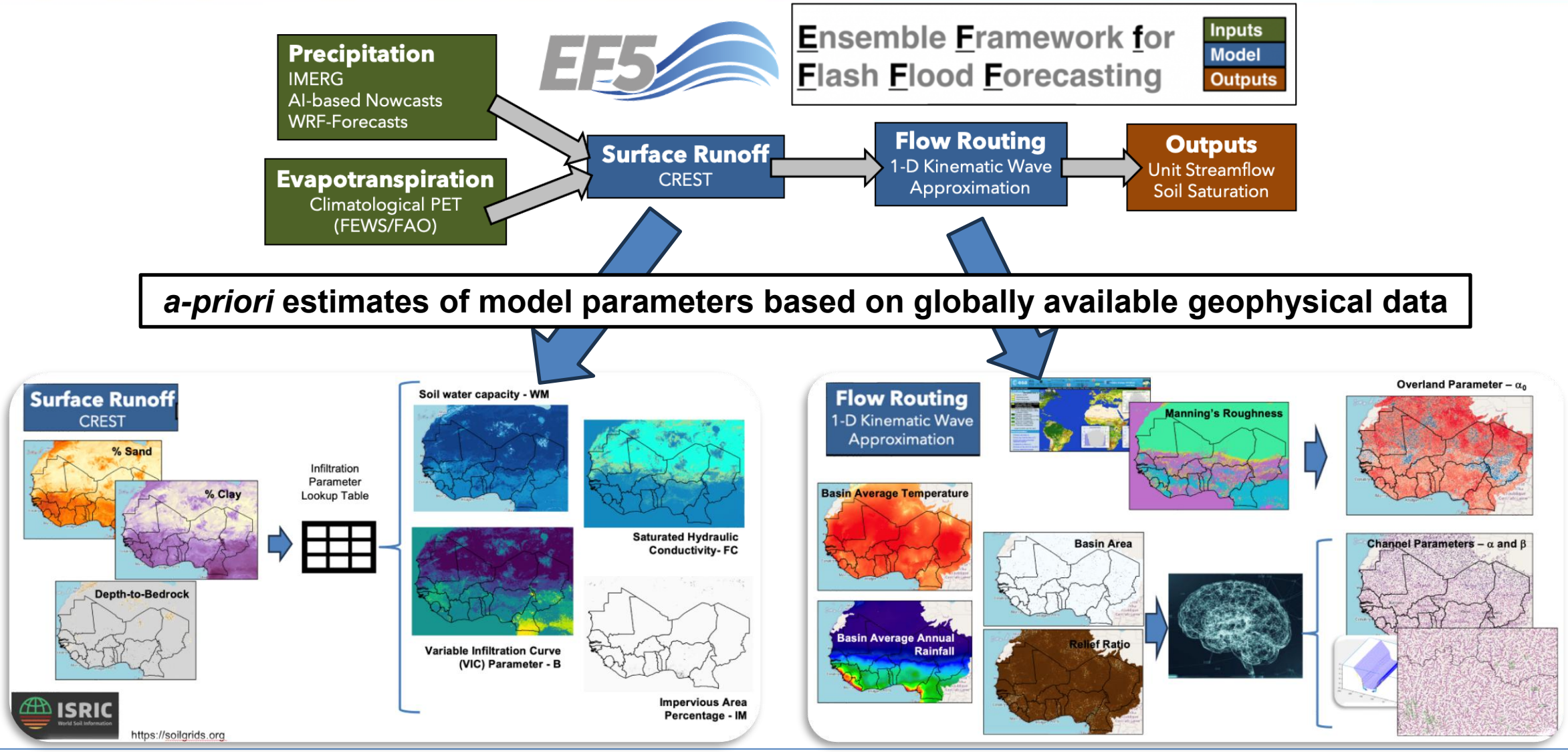
EF5 Ensemble Framework for Flash Flood Forecasting

Flamig, Z.L., Vergara, H. and Gourley, J.J., 2020. The Ensemble Framework For Flash Flood Forecasting (EF5) v1.2: Description and Case Study. *Geoscientific Model Development Discussions*, 13, 4943–4958, https://doi.org/10.5194/gmd-13-4943-2020, 2020.

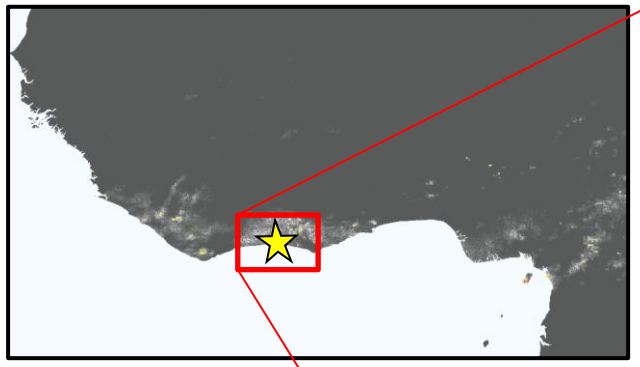
EF5 models the macro-processes of the water cycle

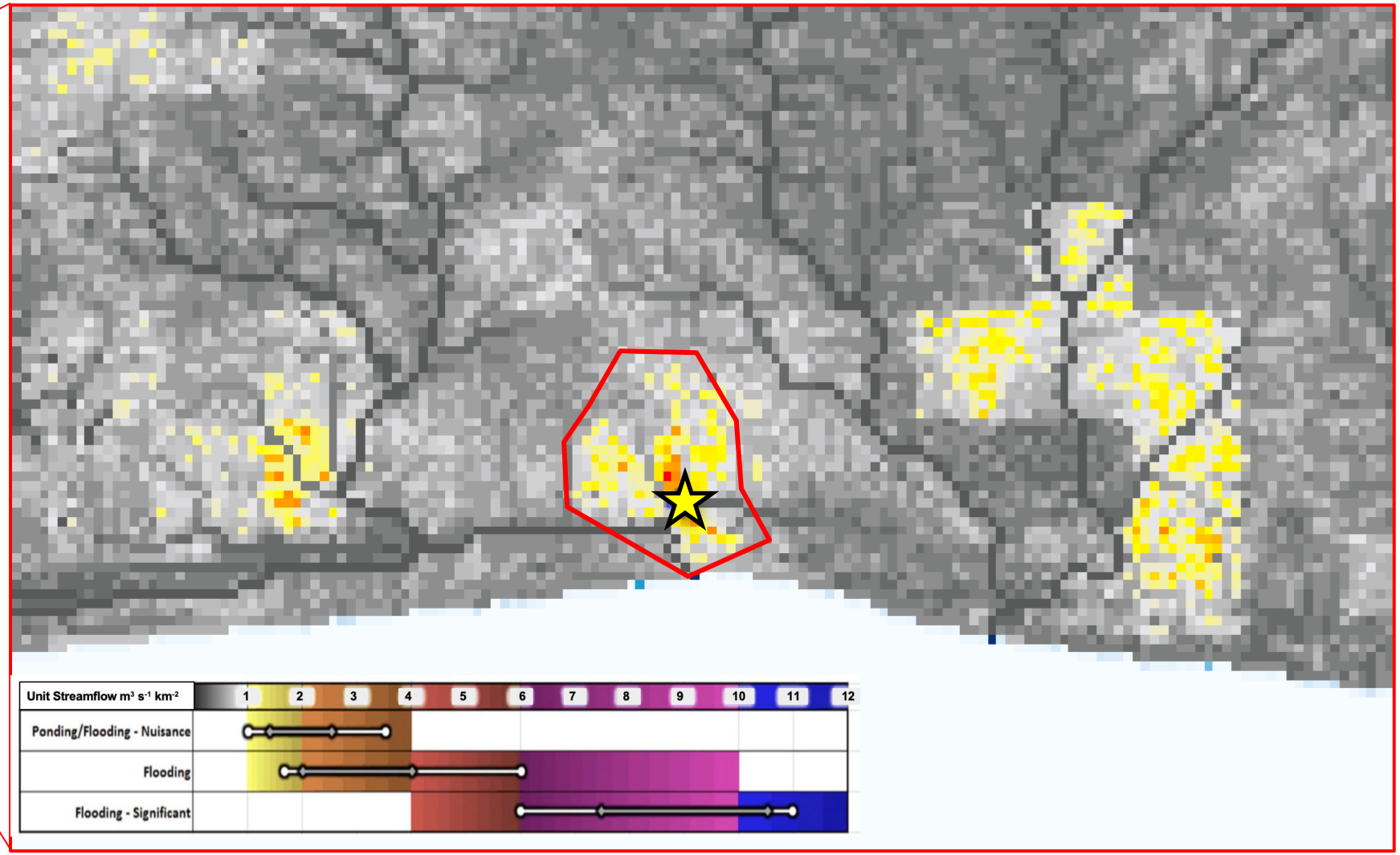


Distributed hydrological modeling for flash flood prediction



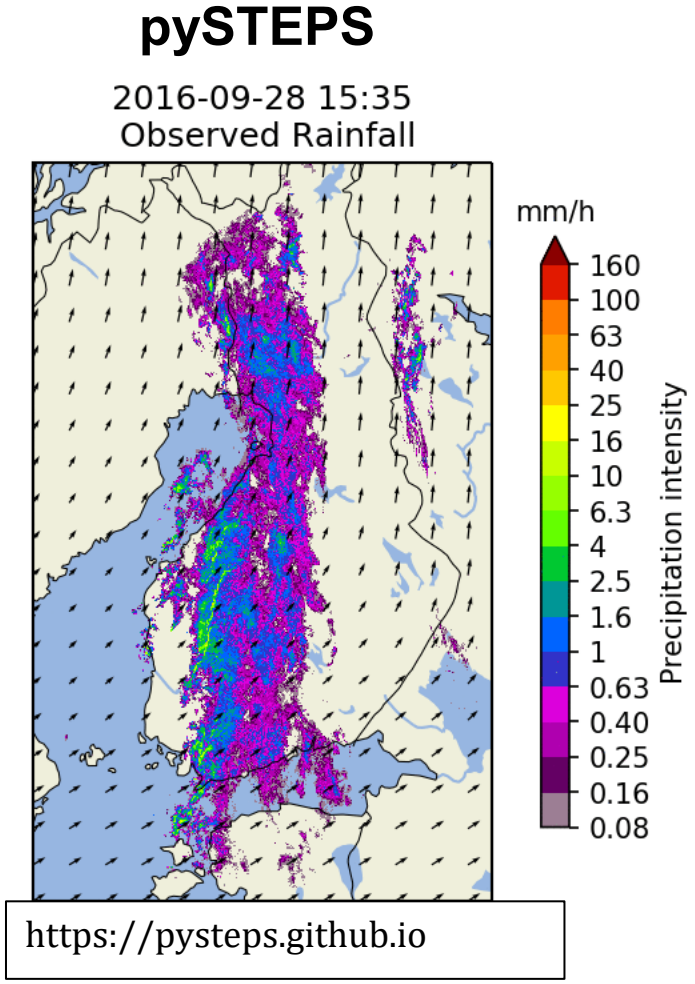
Côte d'Ivoire Flood June 2018: EF5 outputs



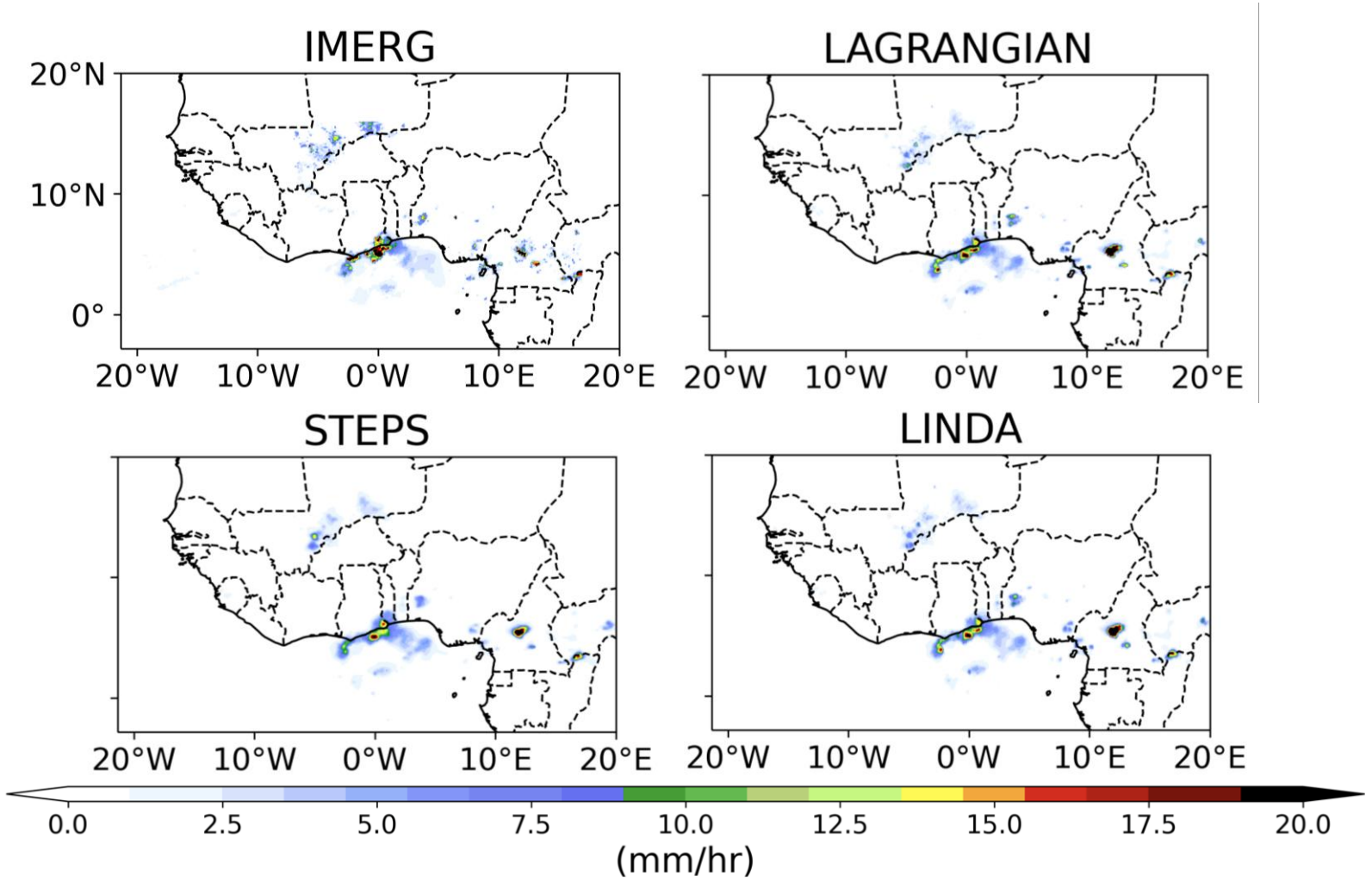


- **Impacts**: 18 reported fatalities and severe material damage
- **Sources reporting this event:** Flash Flood Database, Flood List

Establishing a robust baseline for short-term QPFs

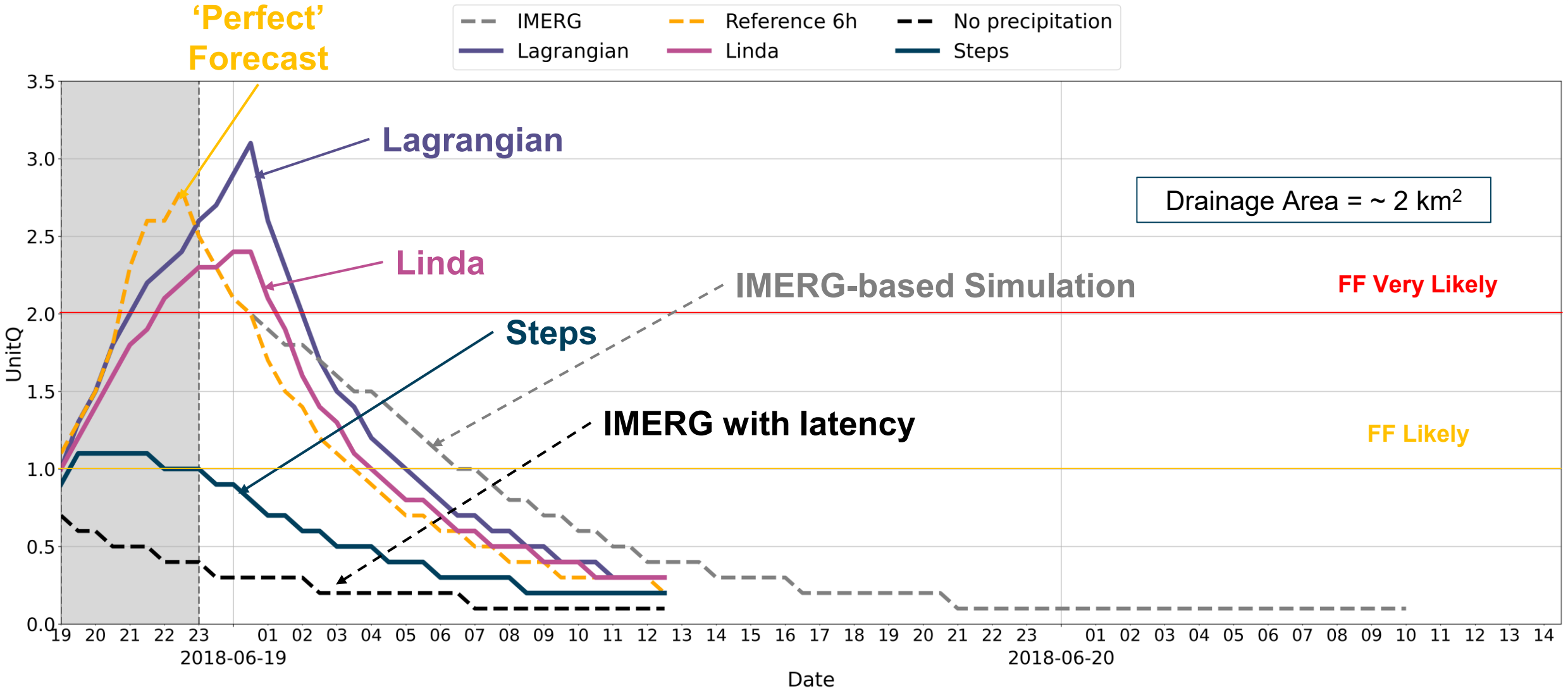


https://pysteps.github.io

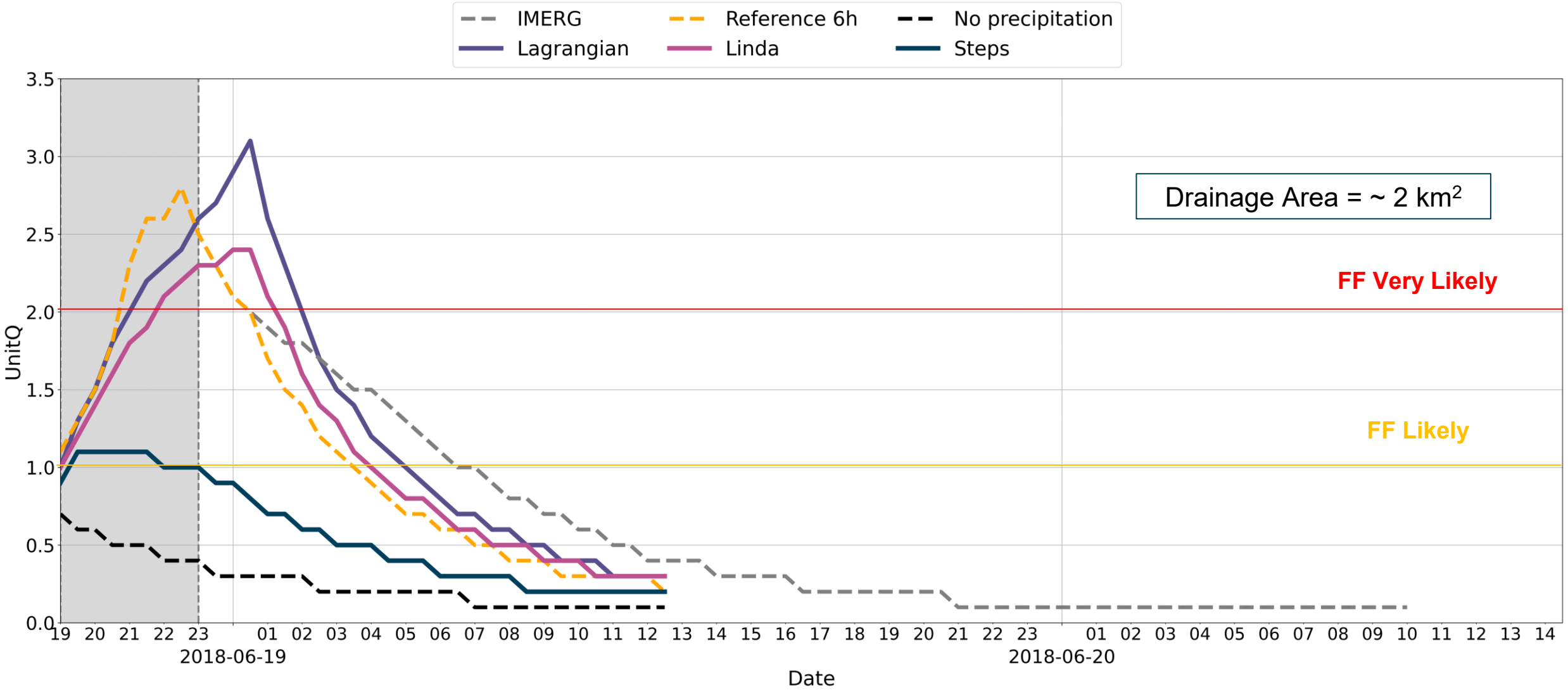


Pulkkinen, S., D. Nerini, A. Perez Hortal, C. Velasco-Forero, U. Germann, A. Seed, and L. Foresti, 2019: Pysteps: an open-source Python library for probabilistic precipitation nowcasting (v1.0). *Geosci. Model Dev.*, **12 (10)**, 4185–4219. doi:10.5194/gmd-12-4185-2019.

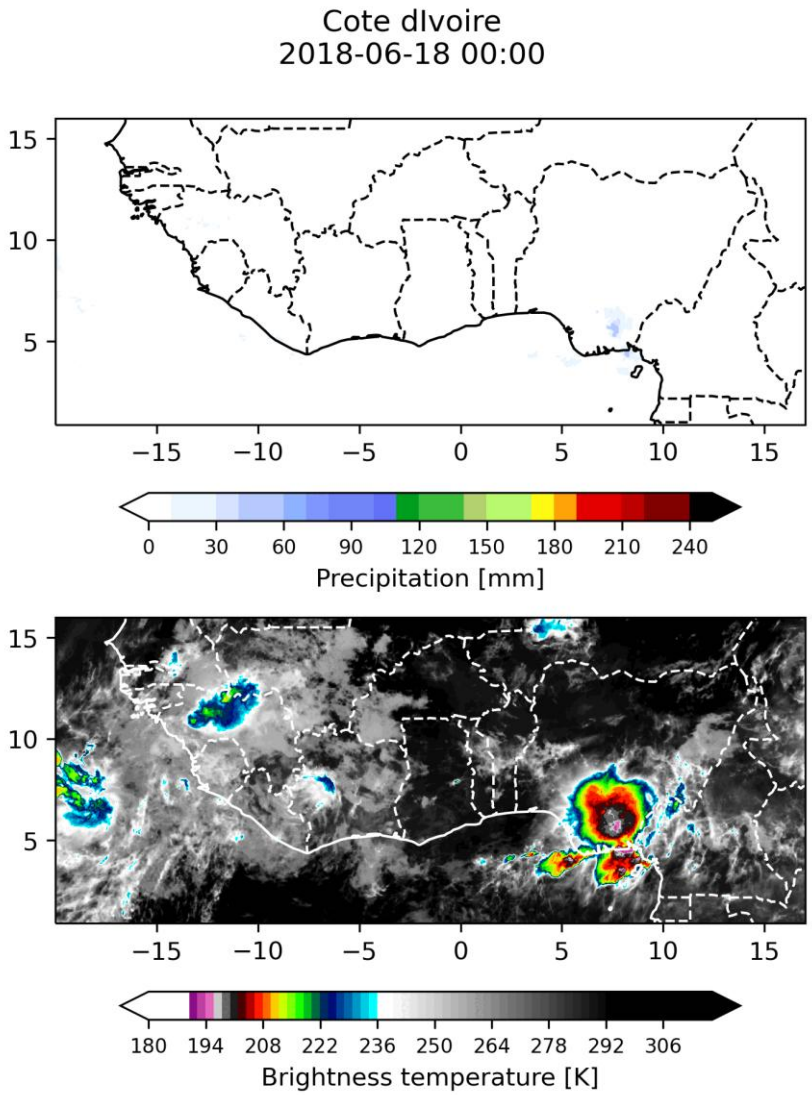
Establishing a robust baseline for short-term QPFs



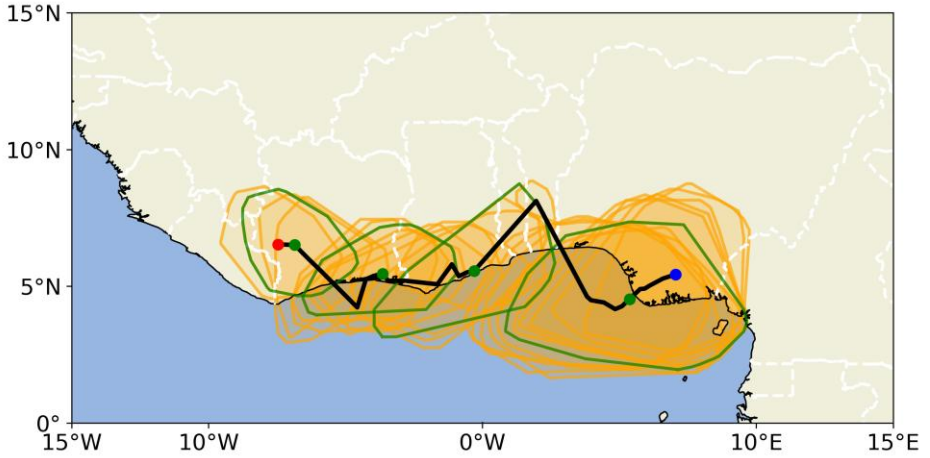
Establishing a robust baseline for short-term QPFs



Understanding flash flood predictability in WA



Studying rain storms events in the West Africa domain



Max. Precip. rates on current track

Individual storm objects

Estimated track from centroids

Duration (hr)	48
Distance (km)	1,754.37
Mean velocity (km/hr)	73.24
Mean area (km^2)	227,897.63
Mean precipitation (mm/hr)	7.39
Max precipitation (mm/hr)	63.42

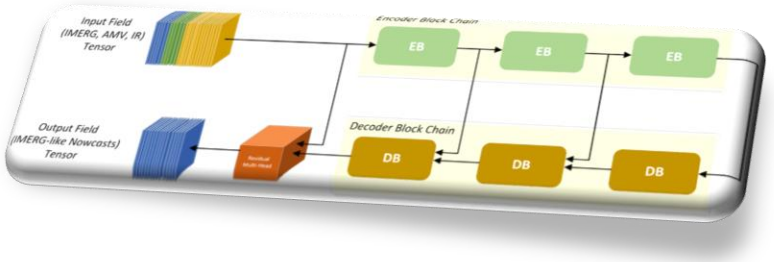
ATRACKCS
An Algorithm For Tracking Convective Systems

Ramírez-Cardona, A., **Robledo, V.**, Rendón, A., Henao, J. J., Hernandez, K. S., Rios, S. G., Mejia, J. F. (2022). Algorithm for Tracking Convective Systems (ATRACKCS) (v.1.0), *Zenodo*, 10.5281/zenodo.7025989

https://github.com/alramirezca/ATRACKCS

Summary and ongoing efforts

- ***We seek to realize the potential of satellite-based systems to provide timely flash flood warnings***
- ML-based nowcasting and very high resolution domain in Ghana
- Capacity building for West Africa partners



Contact

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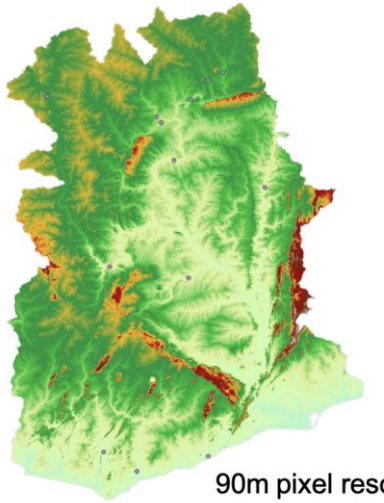
- Lab Website – https://ahwa.lab.uiowa.edu
- SERVIR Project (**Website coming soon!**)
  - Efthymios Nikolopoulos - efthymios.nikolopoulos@rutgers.edu

Ghana Domain
Very High Resolution National Domain



90m pixel resolution

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