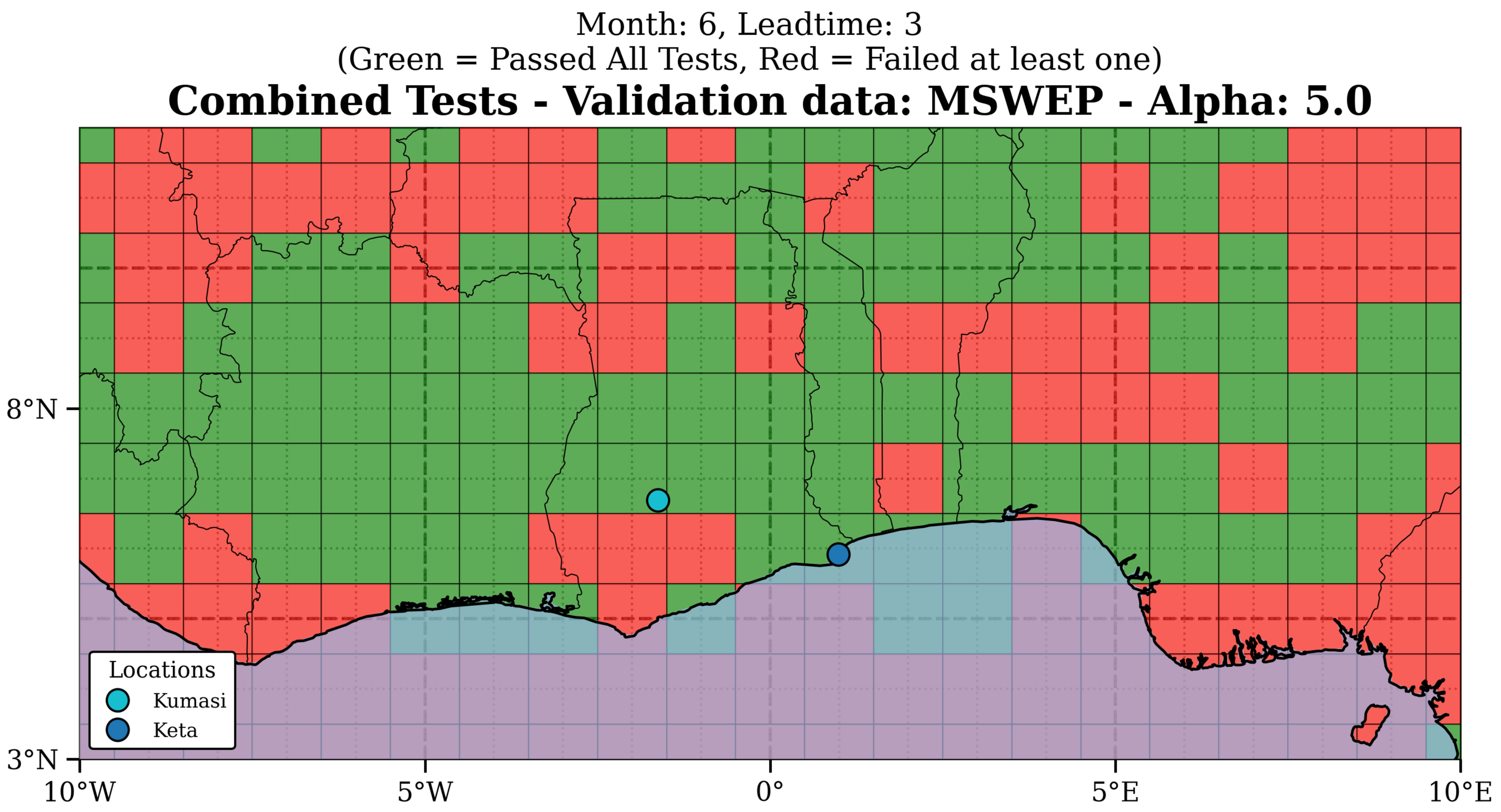
Kumasi

Extreme Flood Preparedness Service

albatross-project.eu

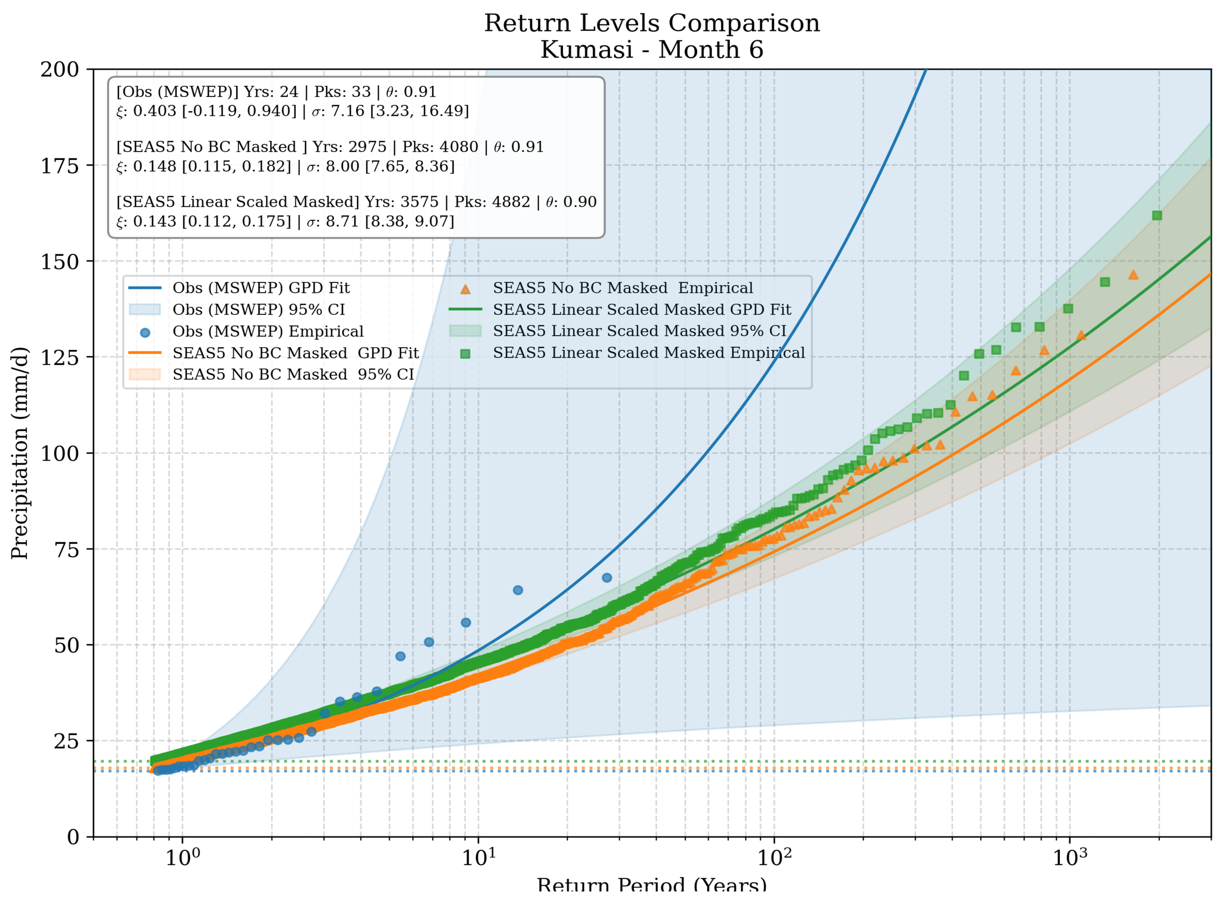
The UNSEEN framework (Unprecedented Simulated Extremes Using Ensembles; Osinski et al. 2026; Thompson et al., 2017) is an established methodology that leverages ensemble prediction systems to generate large event sets of physically plausible, yet unrealized weather-related extremes. The core advantage of UNSEEN lies in the ability to overcome the limited availability of historical extreme events by treating ensemble predictions as alternative realizations of the past climate. The resulting event sets are typically used to explore counterfactual developments of observed events or to better infer the frequency and characteristics of the most impactful events.

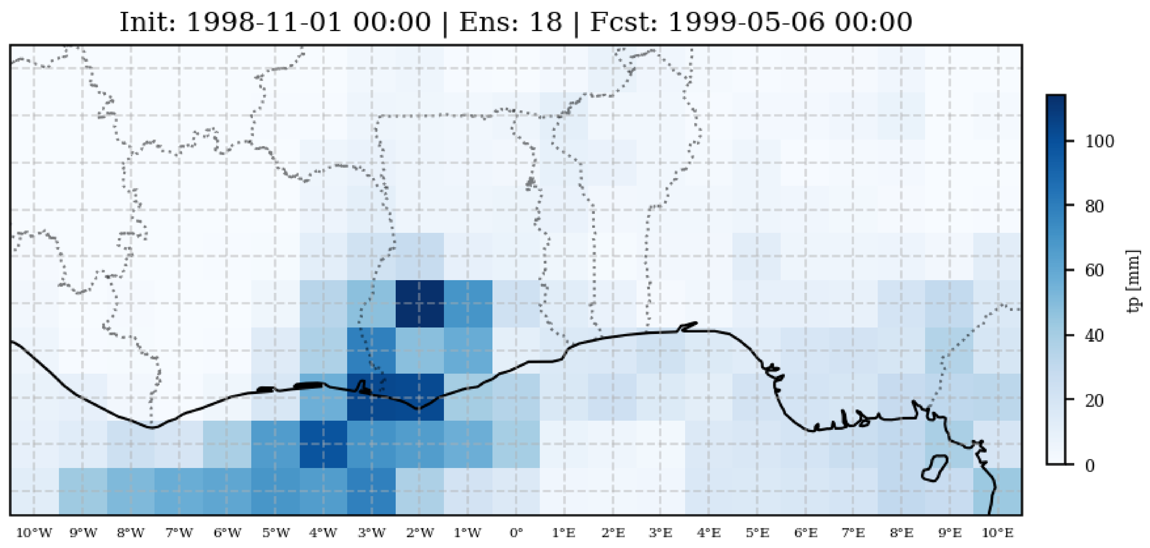


Multi-test validation framework for ECMWF System 5

This map displays the combined results of the validation framework applied to SEAS5 simulated days of June. The shown map corresponds to a 3-month lead time, meaning the model forecasts were initialized in March. The model outputs were evaluated against observations across multiple statistical dimensions: independence (to maximize the valid event pool), fidelity to the real climatology (comparing distributions via mean, standard deviation, skewness, and kurtosis), and temporal stability. Green grid cells indicate regions where the model successfully passed all validation tests, providing a reliable basis for subsequent methodologies. Red cells denote a failure in at least one test. The markers highlight our specific target locations, Kumasi and Keta, proving the localized good performance of the model in these key areas.

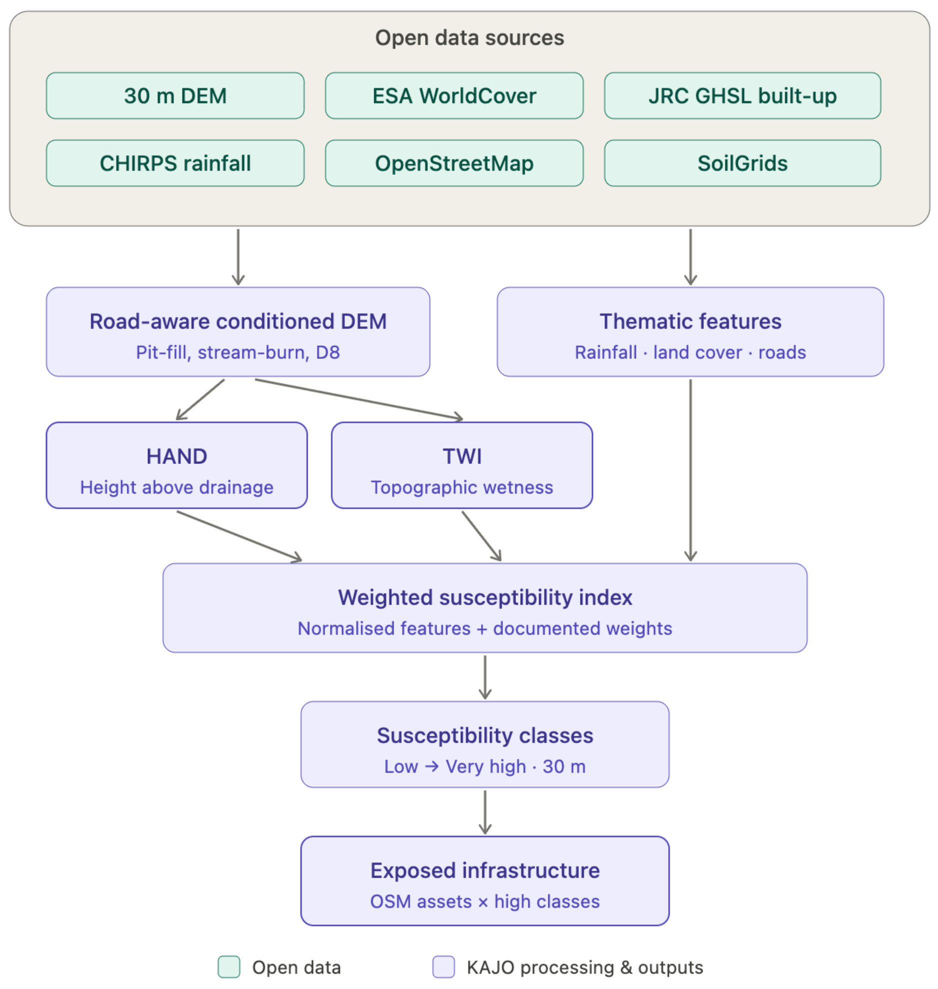
The product in a nutshell:

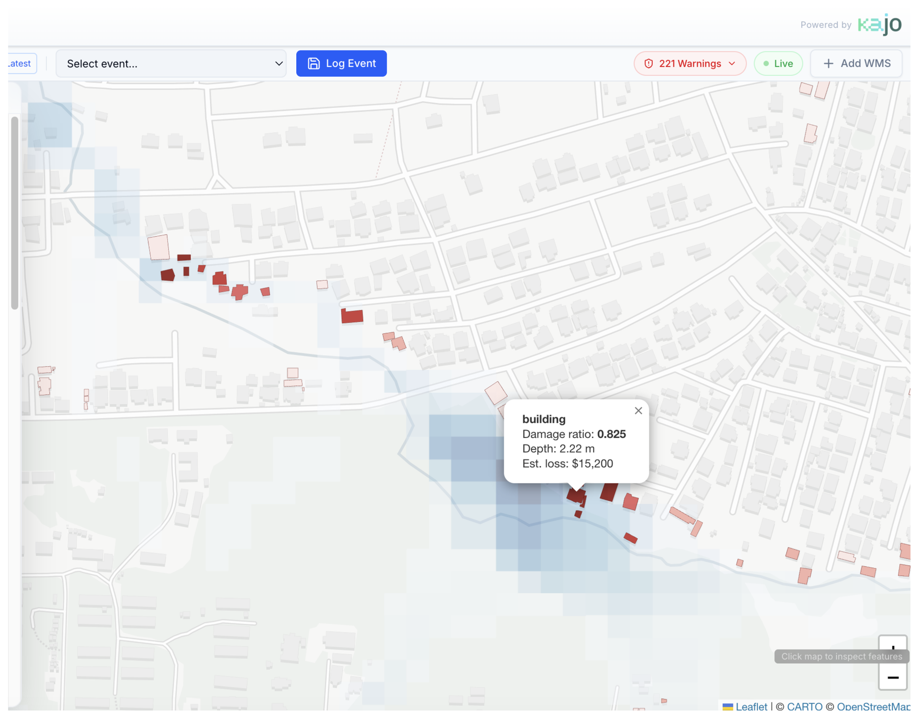




Extreme precipitation return levels and associated uncertainties.

The plot compares the probabilities of extreme daily rainfall events derived from observations (blue) against those estimated using the UNSEEN methodology (orange/green). Markers represent rare, high-intensity events exceeding the 95th percentile threshold. The limited observational record captures very few extremes, resulting in high uncertainty (wide blue shading) when estimating the probability of unprecedented events. Conversely, the UNSEEN approach leverages a vast pool of ensemble simulations to drastically increase the sample size. This significantly narrows the uncertainty (orange and green shading), providing a much more robust and accurate probability Estimation for both observed and unobserved extreme events.





As part of the ALBATROSS Kumasi Hub, we integrate multiple open data sources to strengthen flood risk awareness, preparedness, and decision-making.

Our approach combines several sources of flood information, including river flood forecasts from the Copernicus GloFAS and satellite-based flood observations from the Copernicus Global Flood Monitoring Service. To assess urban flood susceptibility, we developed a local flood susceptibility map using exclusively open datasets. The analysis incorporates elevation and terrain information, land cover and built-up area data, rainfall patterns, and drainage and road network information. These datasets are combined into a transparent **Flood Susceptibility Index**, which classifies areas according to their relative flood risk, ranging from low to very high susceptibility. In addition to river flooding, we address pluvial (rainfall-driven) flooding through a complementary rainfall–runoff model that estimates potential water depths during intense rainfall events. To better understand potential impacts, we overlay flood-prone areas with critical and non-critical infrastructure datasets. This enables the identification of assets and services that may be exposed to flooding, supporting targeted preparedness and risk reduction measures.

Expected users and uses cases

This CS targets a diverse network of end-users: **Civil Protection and Disaster Risk Managers** will leverage the hazard data to enhance early warning and emergency preparedness; **Local Authorities, Municipal Planners, and Technical Services** can integrate these climate insights into land-use planning. Technical experts, including **Meteorologists, Hydrologists, and Civil Engineers**, can exploit the simulations to model local hydrological responses and design climate-resilient infrastructure.

***References:** Zampella et al. (2027) In preparation*

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