

# The Future of Hydrology: Towards Data-Driven Global Models



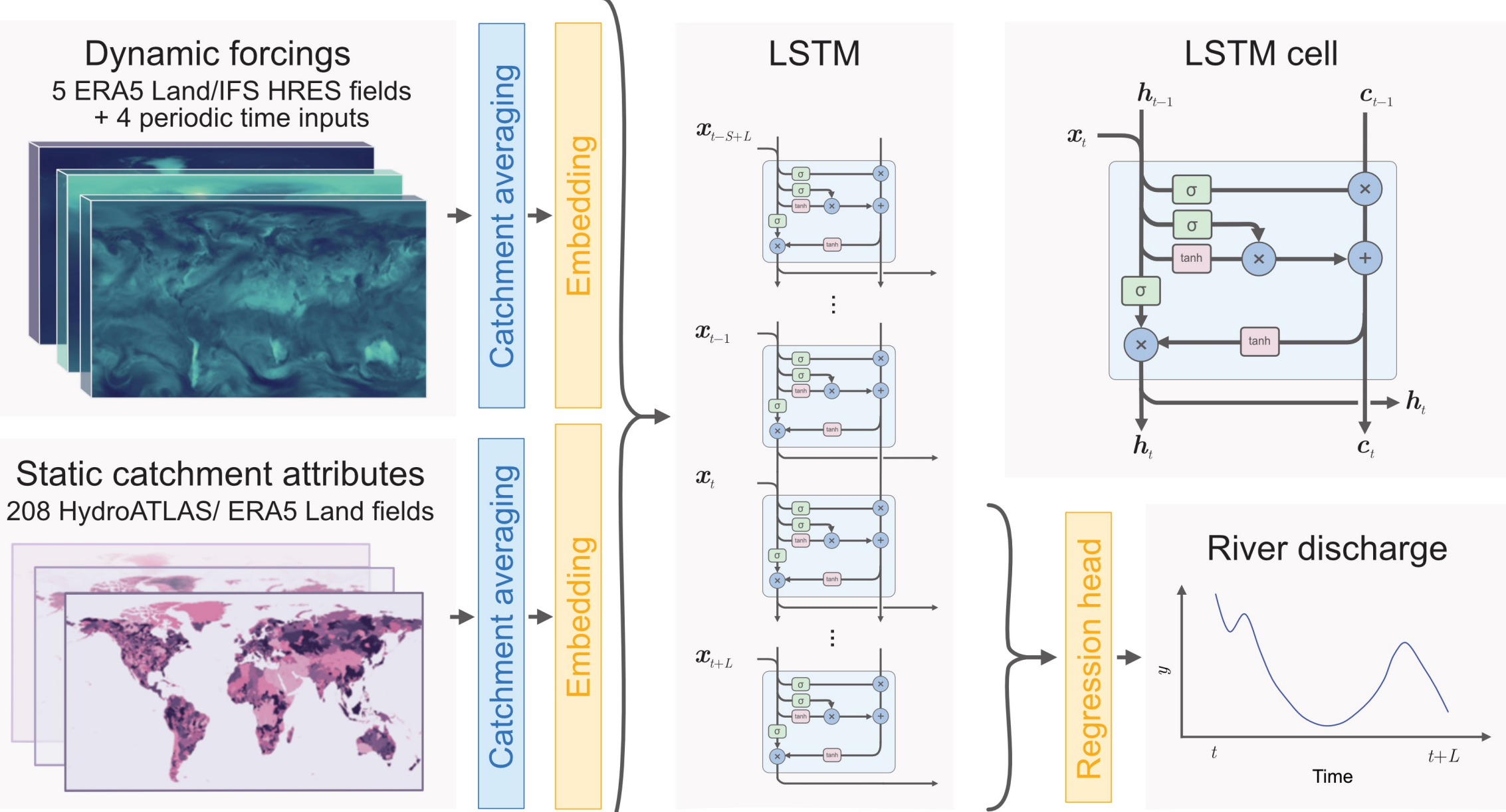
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## 1. Introduction

- Hydrology is entering a new era driven by data availability and high-performance computing.
- Machine learning (ML) offers new ways to represent hydrological processes and integrate a wide variety of data sets.
- At ECMWF, we are exploring how ML can enhance flood forecasting and uncertainty estimation.

## 2. AI for Flood forecasting (AIFL)

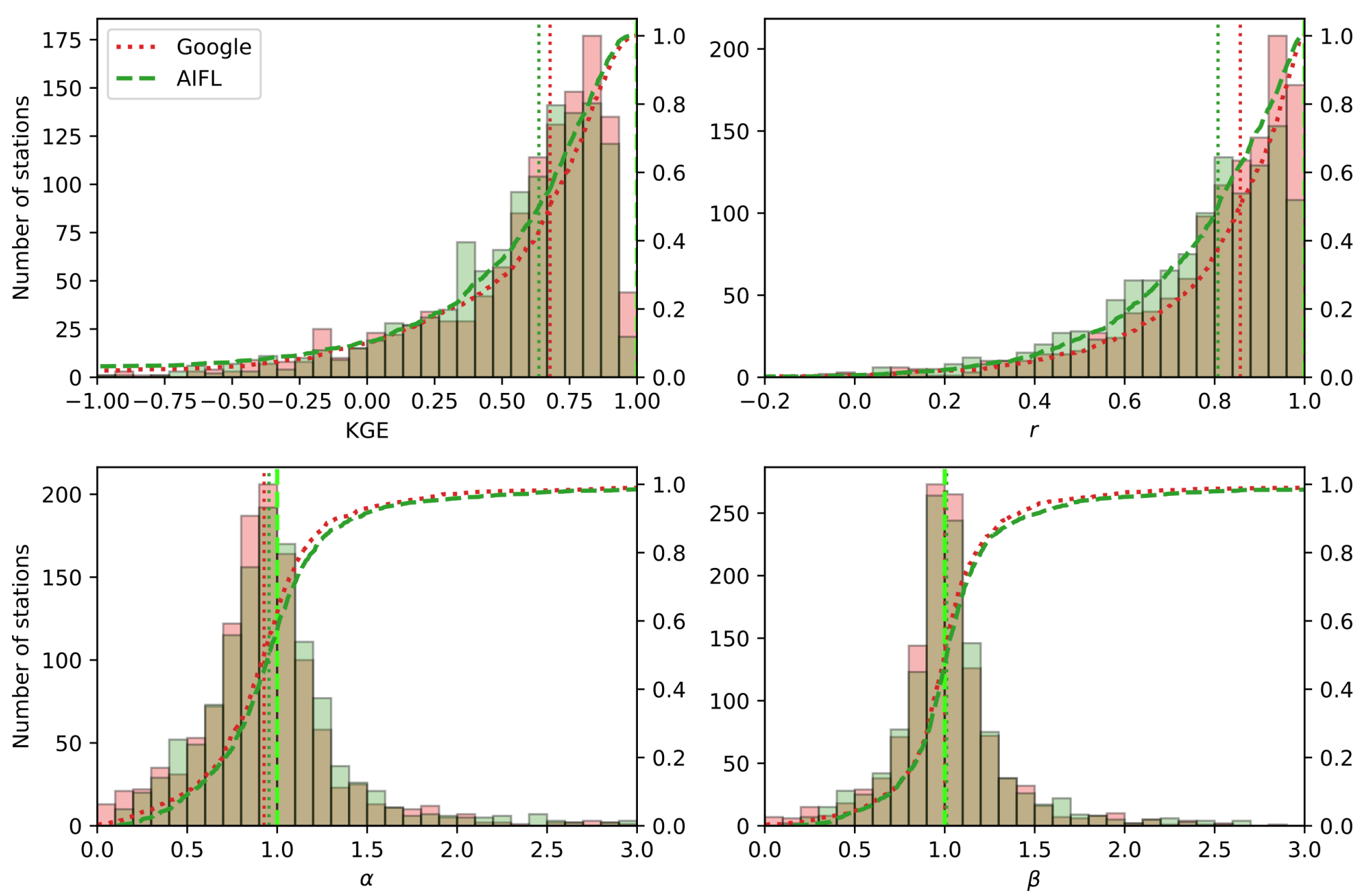
AIFL is a lumped discharge machine learning model built with a Long-Short Term Memory (LSTM) architecture to forecast daily river discharge



Performance is competitive with other data-driven global flood forecasting models.

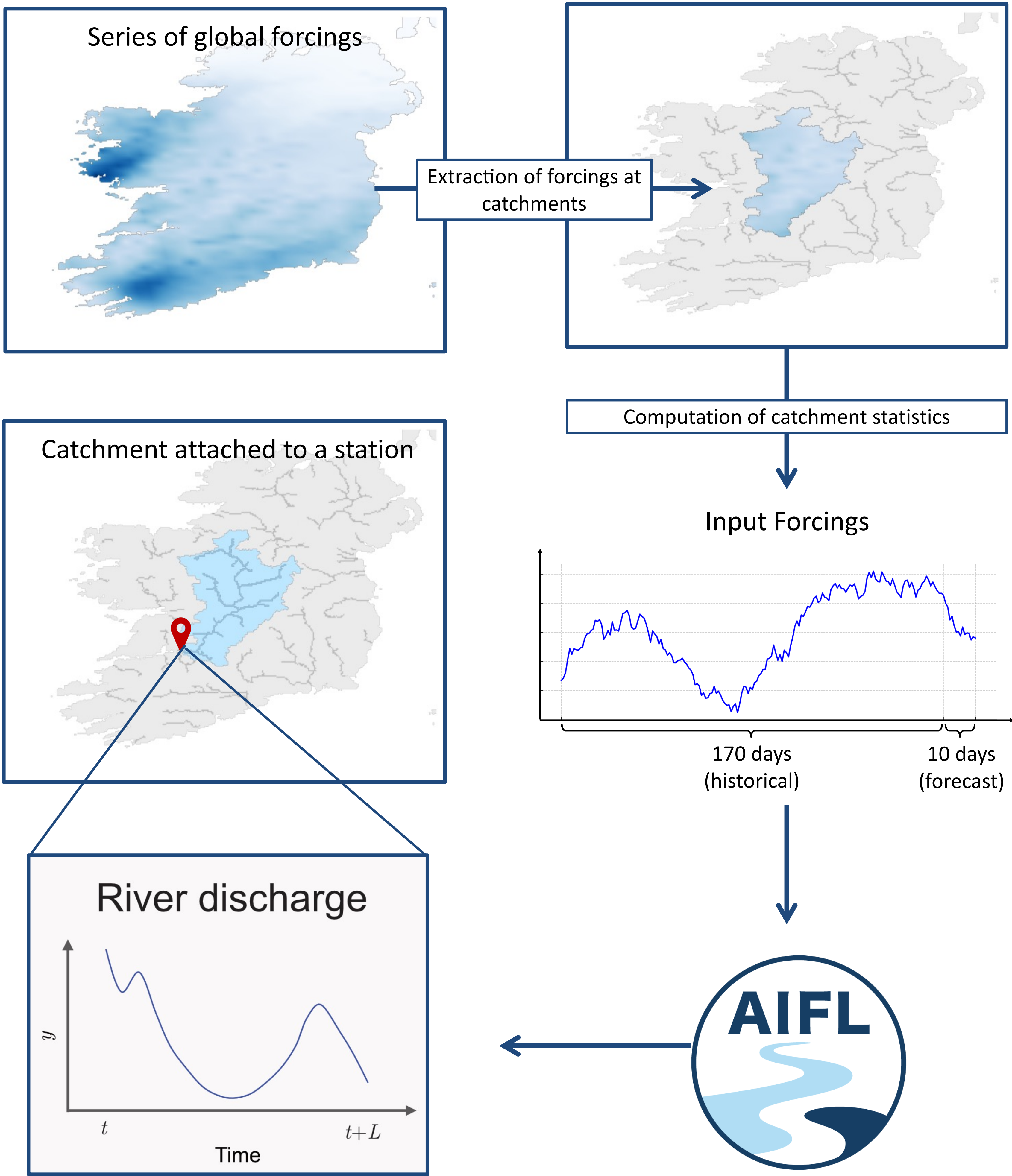
\* Nearing et al. "Global prediction of extreme floods in ungauged watersheds." *Nature* 627.8004 (2024): 559-563

	Google*	AIFL
NSE	<b>0.624</b>	0.518
KGE'	<b>0.678</b>	0.636
r	<b>0.857</b>	0.808
$\alpha$	0.927	<b>0.955</b>
$\beta$	<b>1.000</b>	1.007



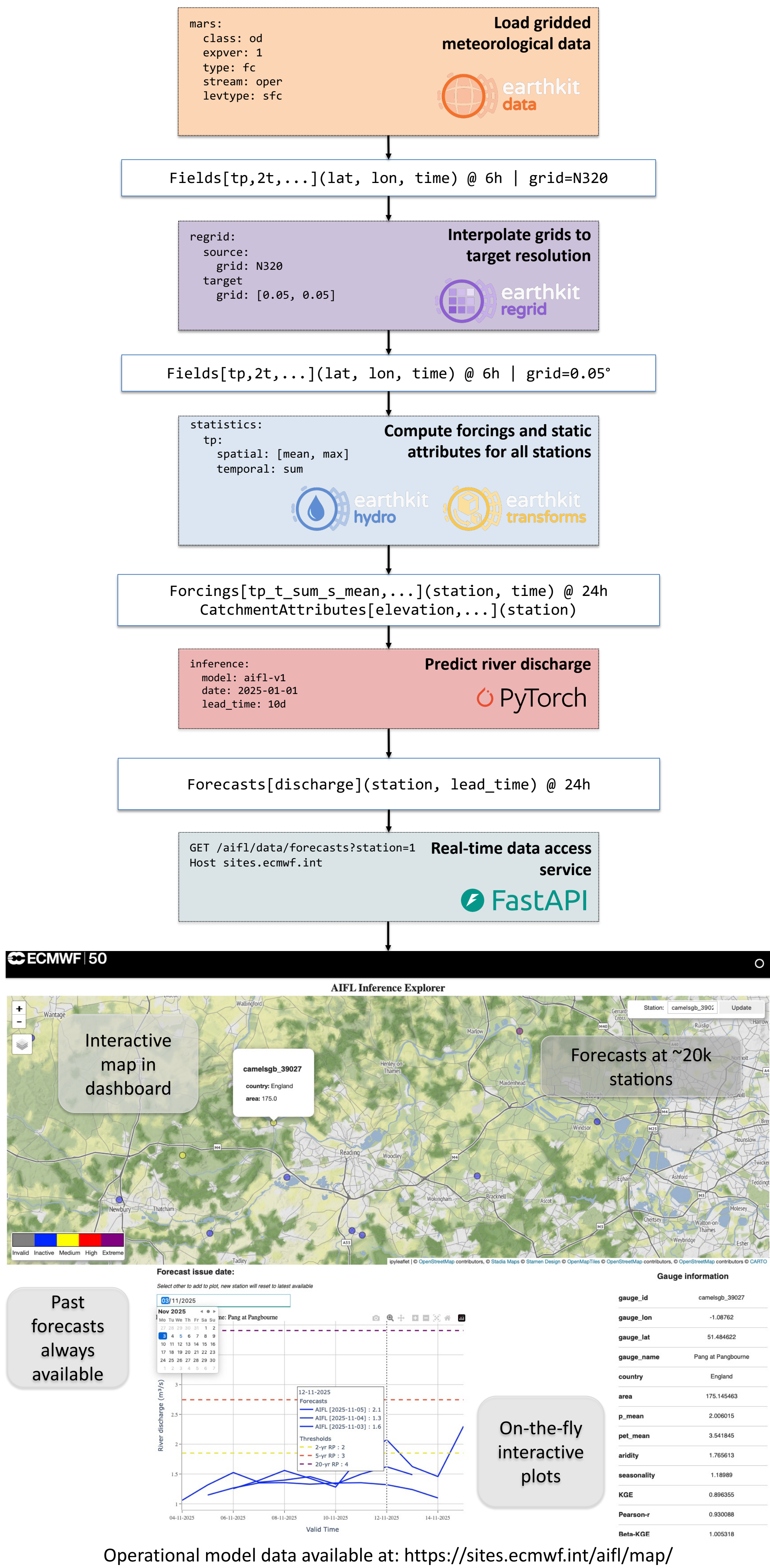
## 3. Workflow overview

The model predicts river discharge for selected stations using statistics derived from catchment properties, 170 days of historical meteorological forcings, and 10 days of forecasted meteorological forcings. For each catchment associated with a station, the relevant forcings are extracted and summary statistics are computed.



## 4. Forecast pipeline

Our forecast pipeline builds on ECMWF's open-source stack. Workflows are defined with pyflow and orchestrated by ecFlow.



Operational model data available at: <https://sites.ecmwf.int/aifl/map/>

## 5. Summary and further work

First steps towards hybrid forecasting ecosystem combining physical insights with data-driven adaptability.

### Model development

- In-house predictive fields
- Sub-daily
- Probabilistic

### Operational pipeline

- Ensemble forecast
- New prediction locations

### Products and services

- Dashboards for any experiment
- Applications for training and model comparison analysis

Destination Earth blog post



Check the latest forecast

