



Digital maintenance for sustainable and flexible
operation of HYDROpower plant

Inflow Forecasting

Technical Session:
Digital Twins and Forecasting for Flexible Hydropower
(Forecasting for System Resilience)

4th Brussels Hydropower Day - 8th September 2026

Fabio Pilotti



WATERJADE
value in every drop



This project has received funding by the European Union's Horizon Europe research and innovation programme under Grant Agreement N° 101122311



WATERJADE
value in every drop



Sectors:



**WATER
UTILITIES**



**HYDROPOWER
COMPANIES**



**INDUSTRIAL
COMPANIES**



**polomiti
energia**



kallpa



**PRIMERO
ENERGIA**
hydro



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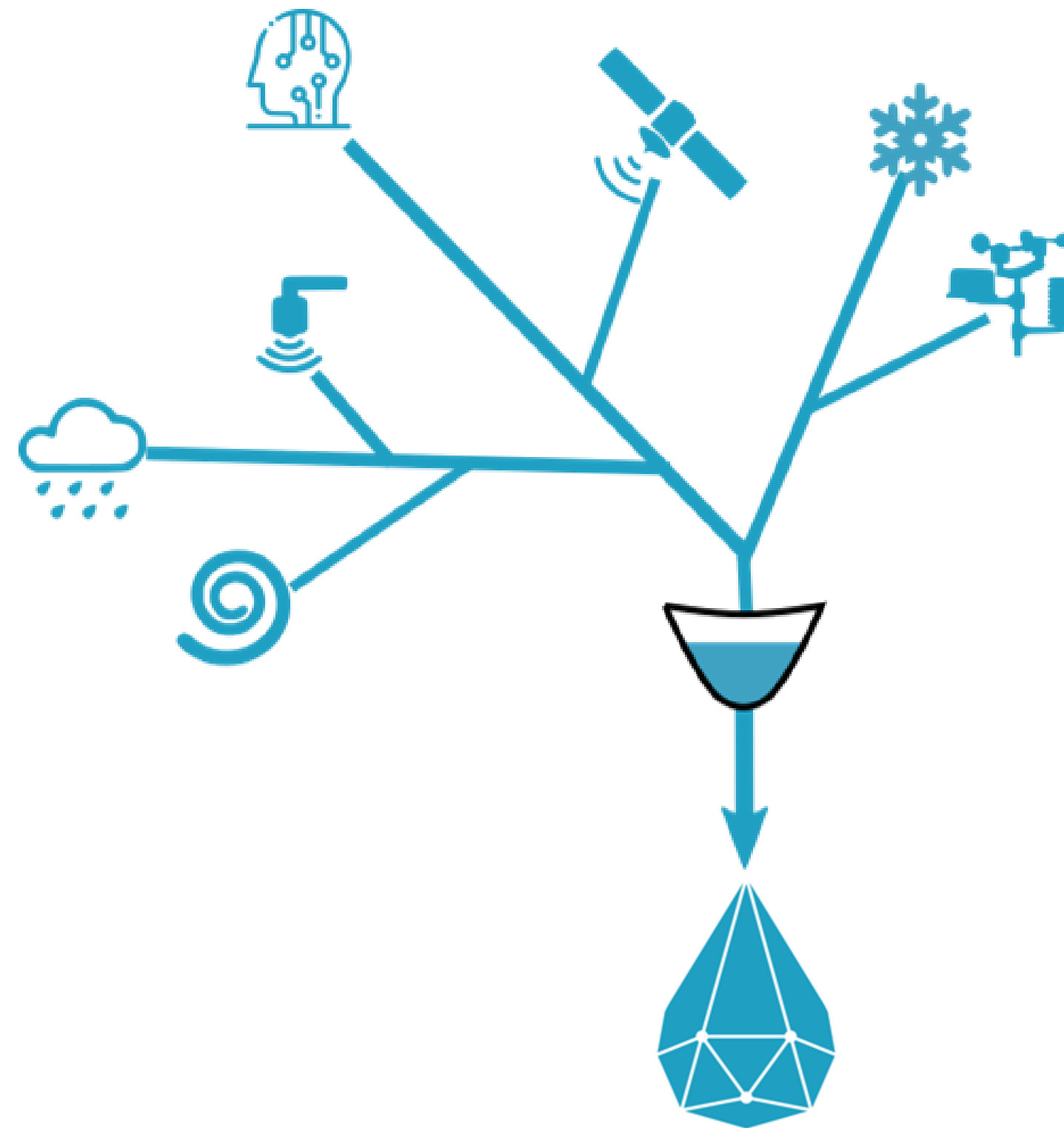
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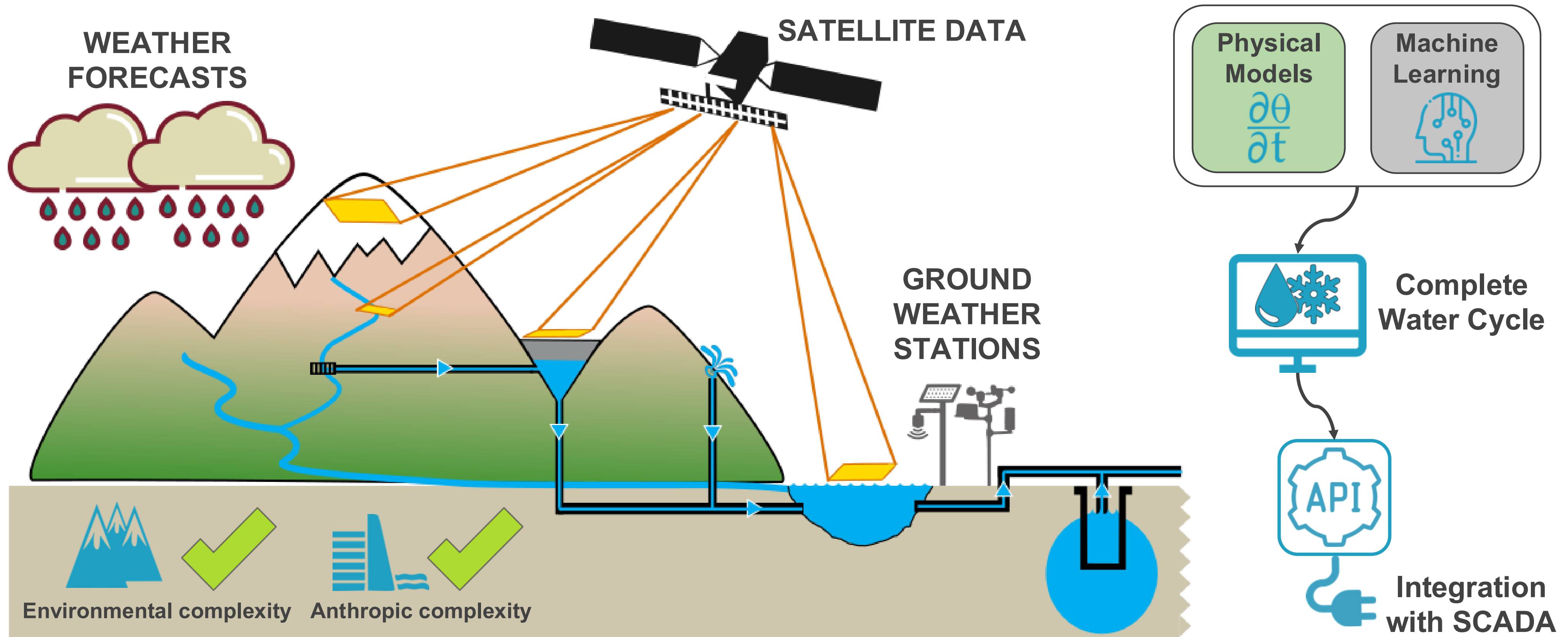
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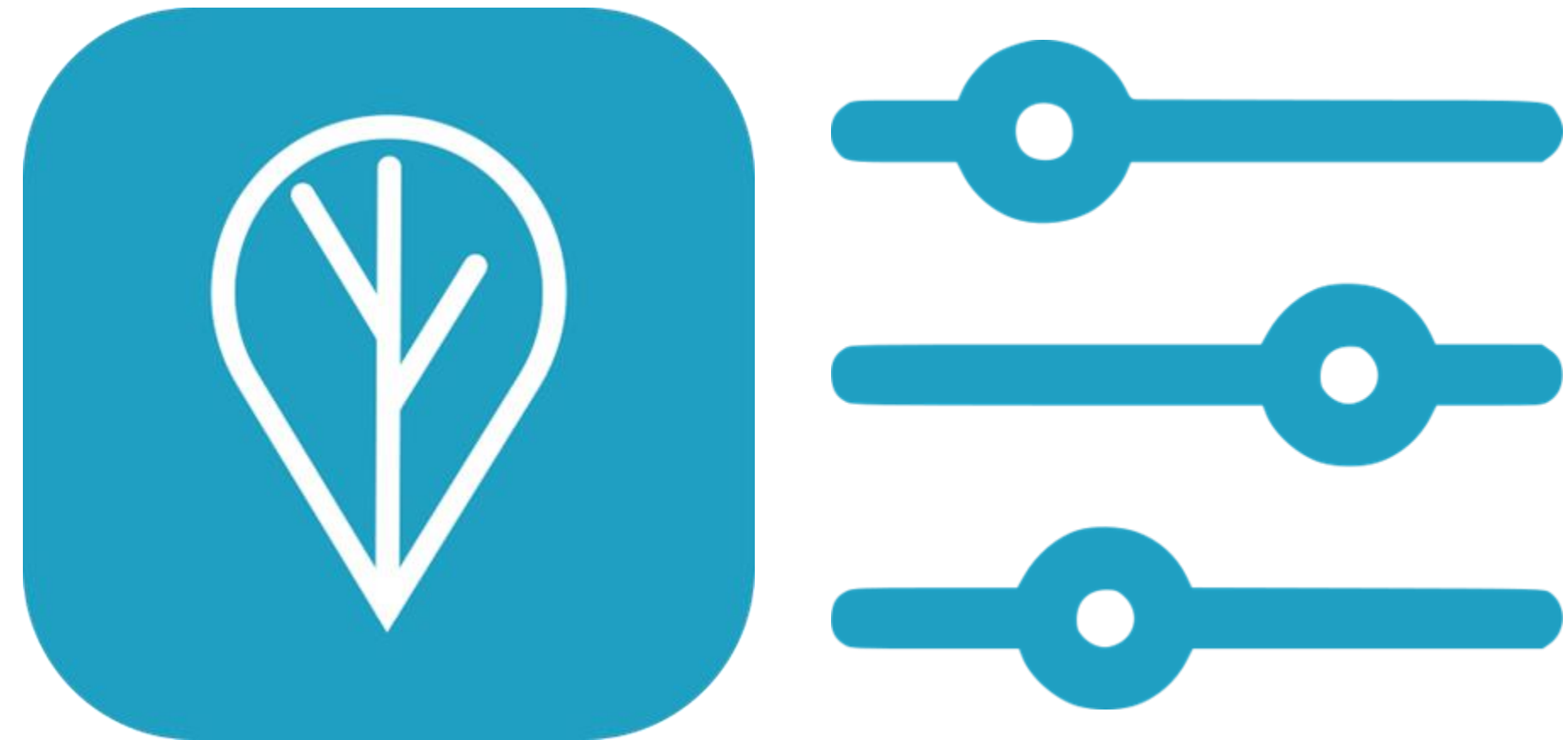
Introduction to the technology



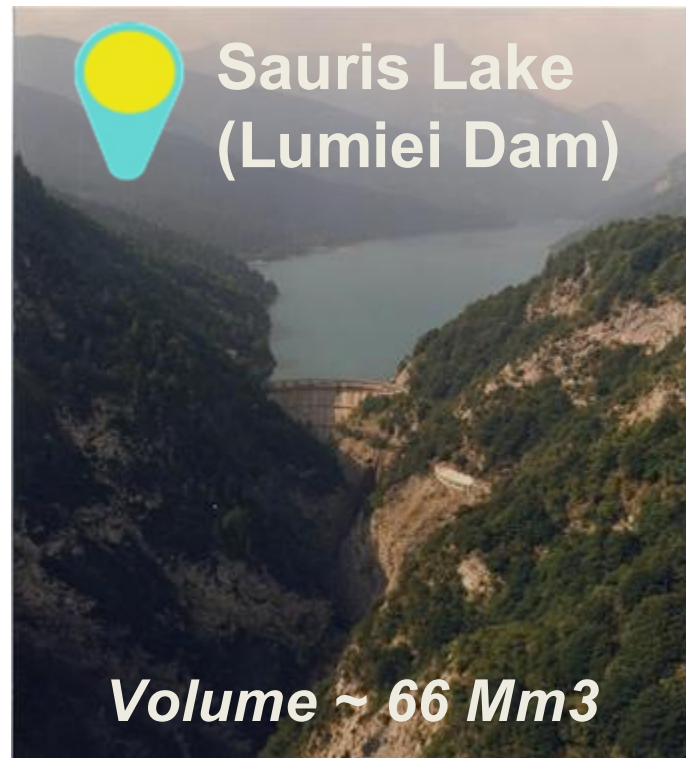
Technology: the Digital Twin of the catchment



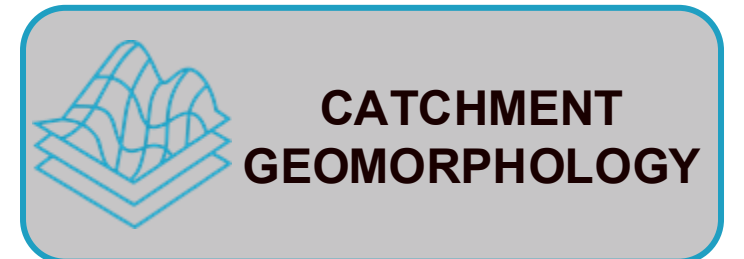
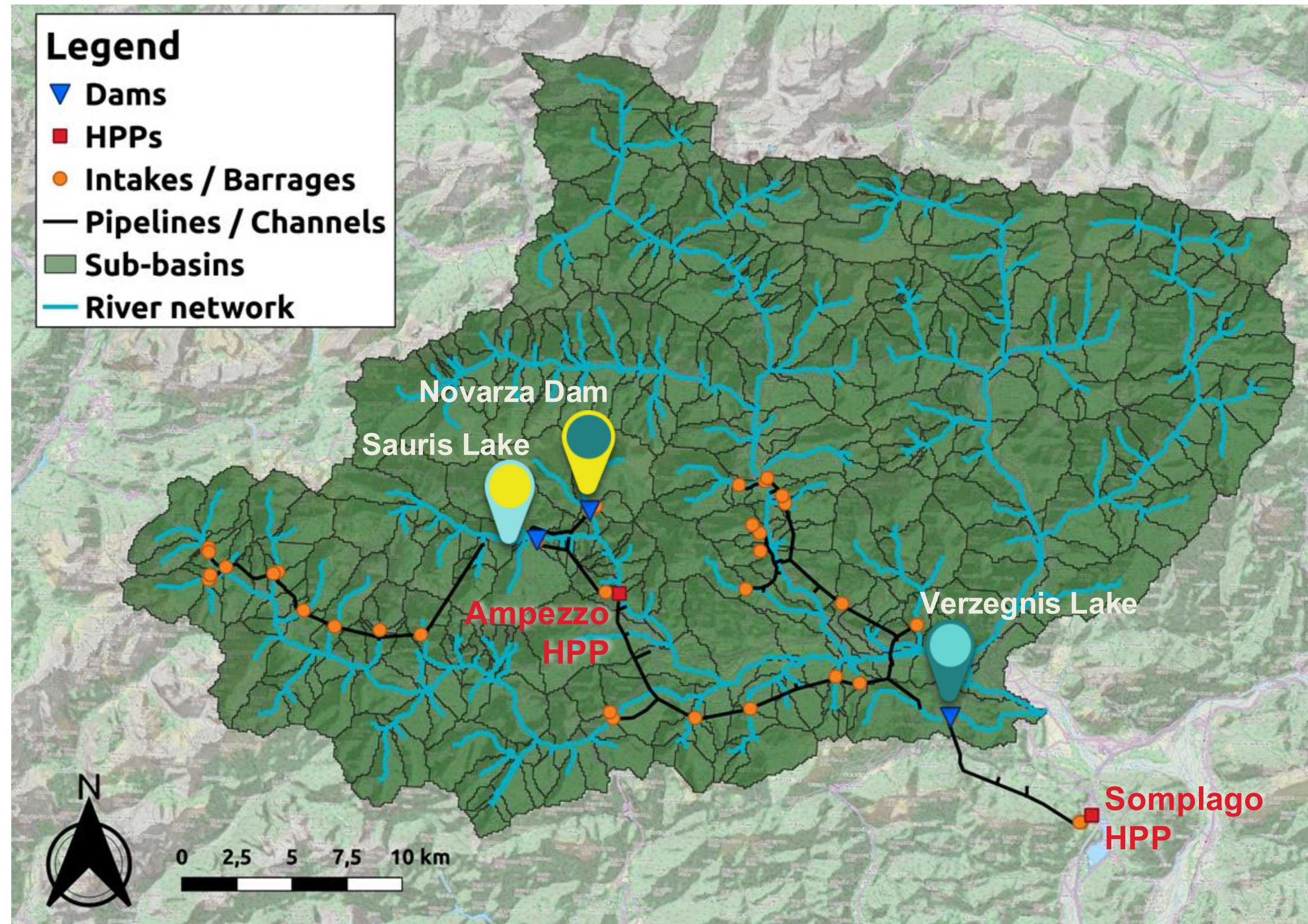
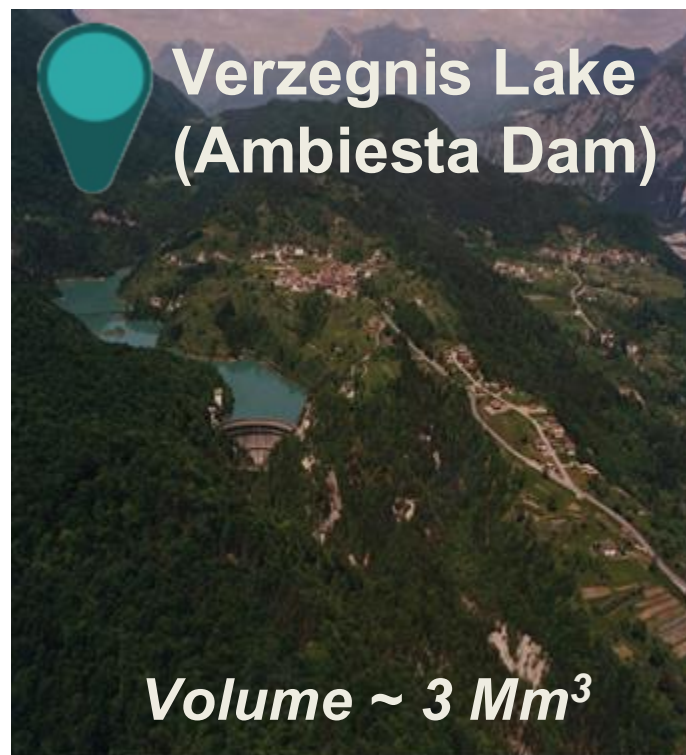
Set-up of the hydrological model



Geomorphological extraction and hydropower system configuration



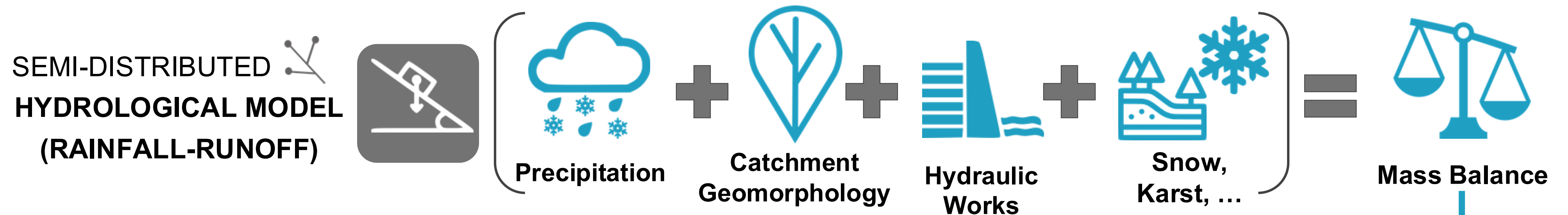
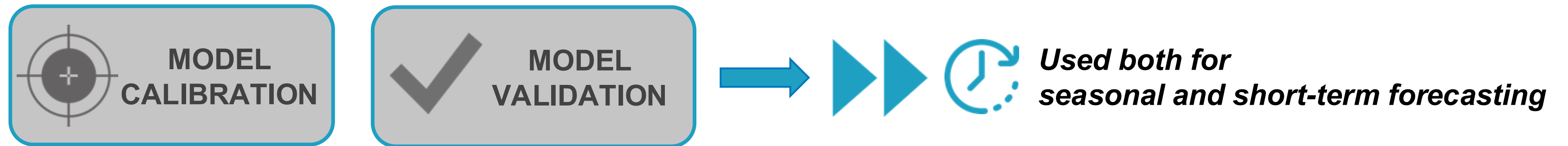
 **a2a USE CASE**



A2A Italy Use Case in Di-Hydro: <https://dihydro-project.eu/uc2-italy-a2a/>

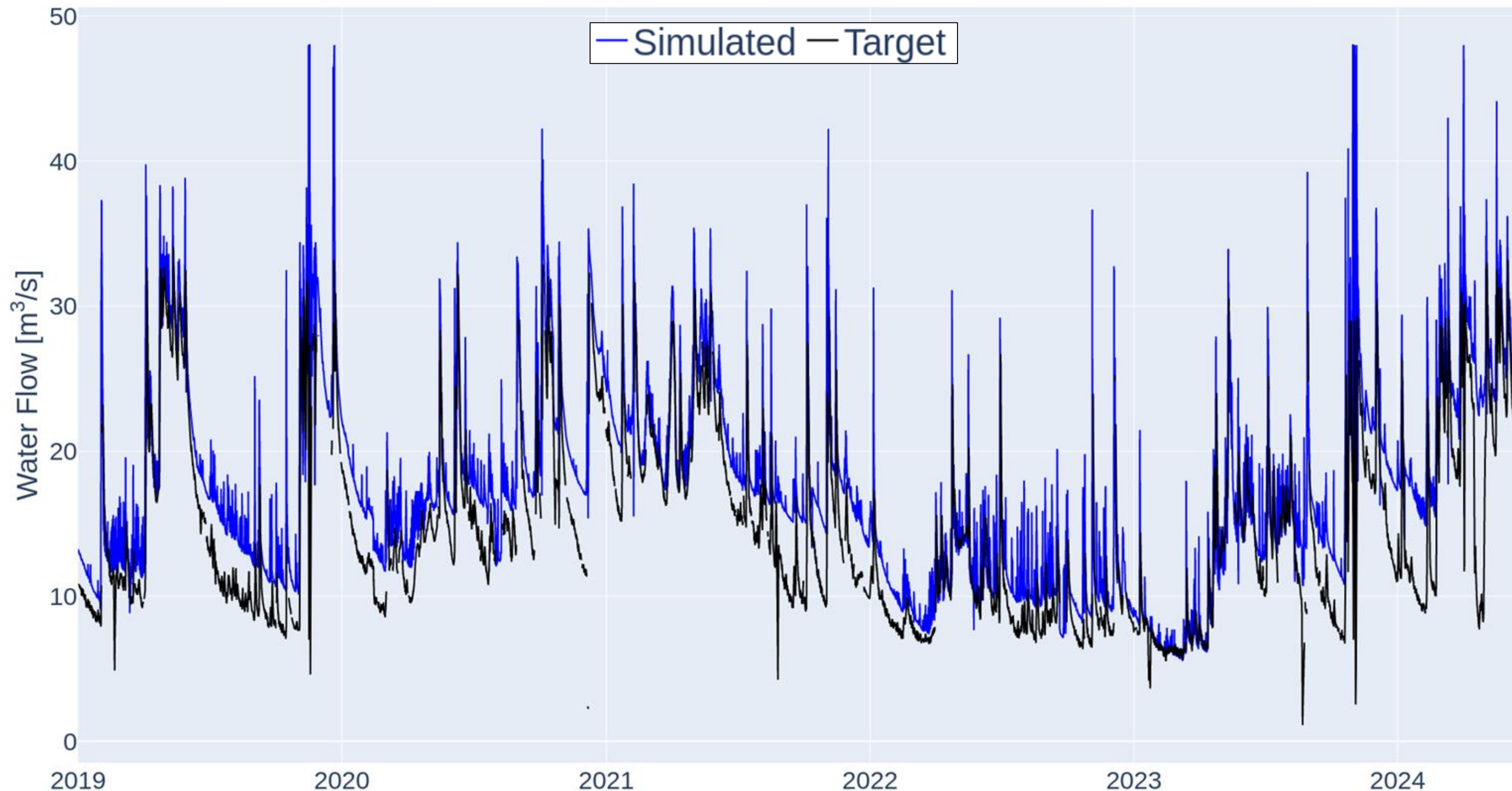


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WATER CYCLE COMPONENTS





 **Reservoir Intake Inflow**

 **MODEL CALIBRATION**

Hourly Resolution

KGE = 0.82

 **MODEL VALIDATION**

Gupta, Hoshin V., Harald Kling, Koray K. Yilmaz e Guillermo F. Martinez (2009), "Decomposition of the mean squared error and NSE performance criteria: Implications for improving hydrological modeling", Journal of Hydrology, 377, 1, p. 80-91.



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ARX Model (*AutoRegressive with eXogenous inputs*) *Used for short-term forecasting*

Features: **eXogenous inputs**

METEOROLOGICAL INPUTS



Precipitation



Temperature

HYDROLOGICAL MODEL OUTPUTS



Runoff



ET



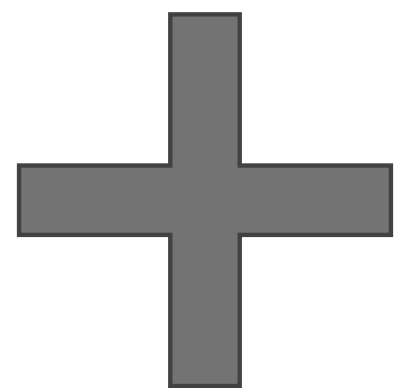
Soil Water Content



SWE



Snow Melting



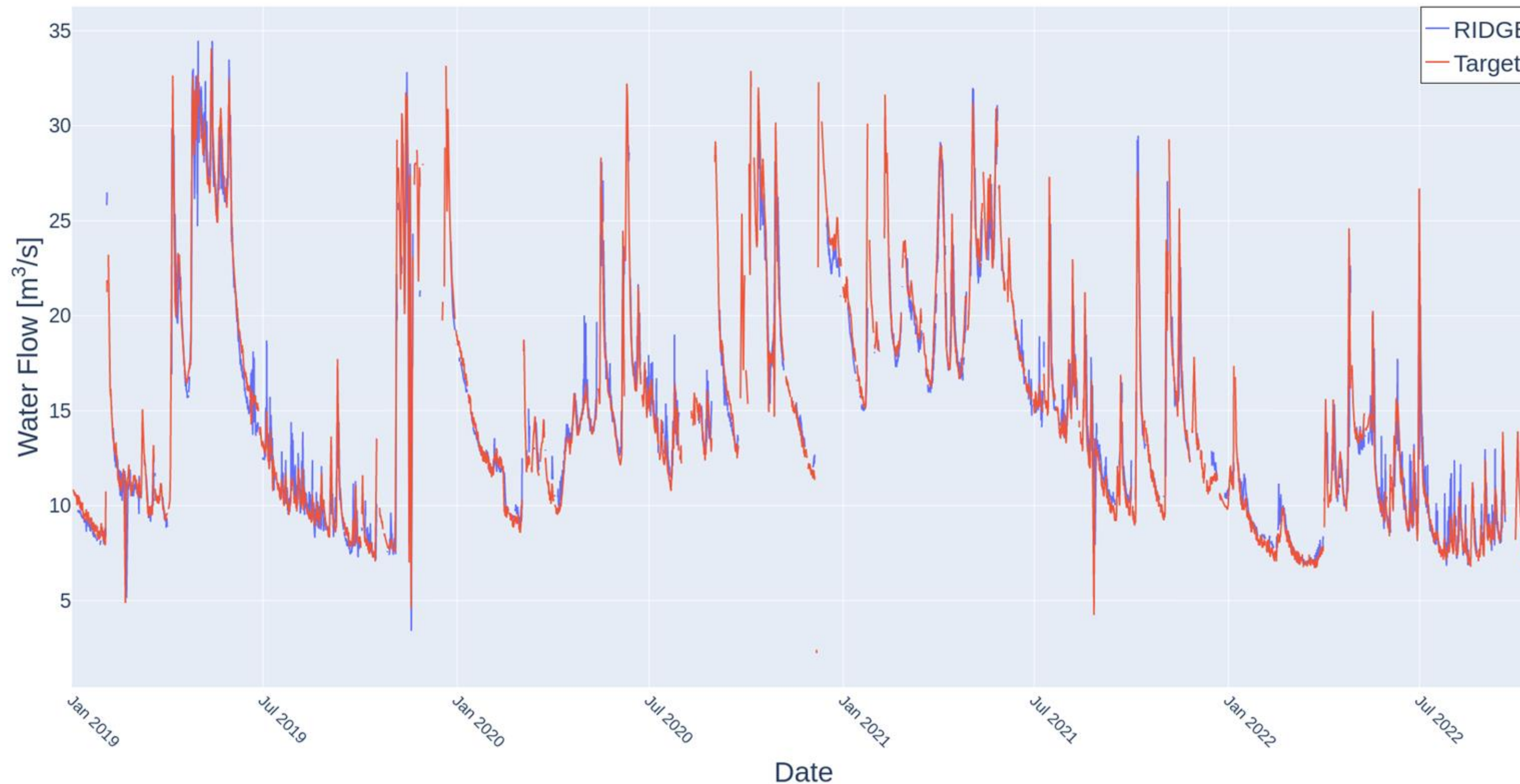
Features: **AutoRegressive**



Intake
Water Inflow

Time-lagged versions of the target
and/or
Rolling-average versions of the target



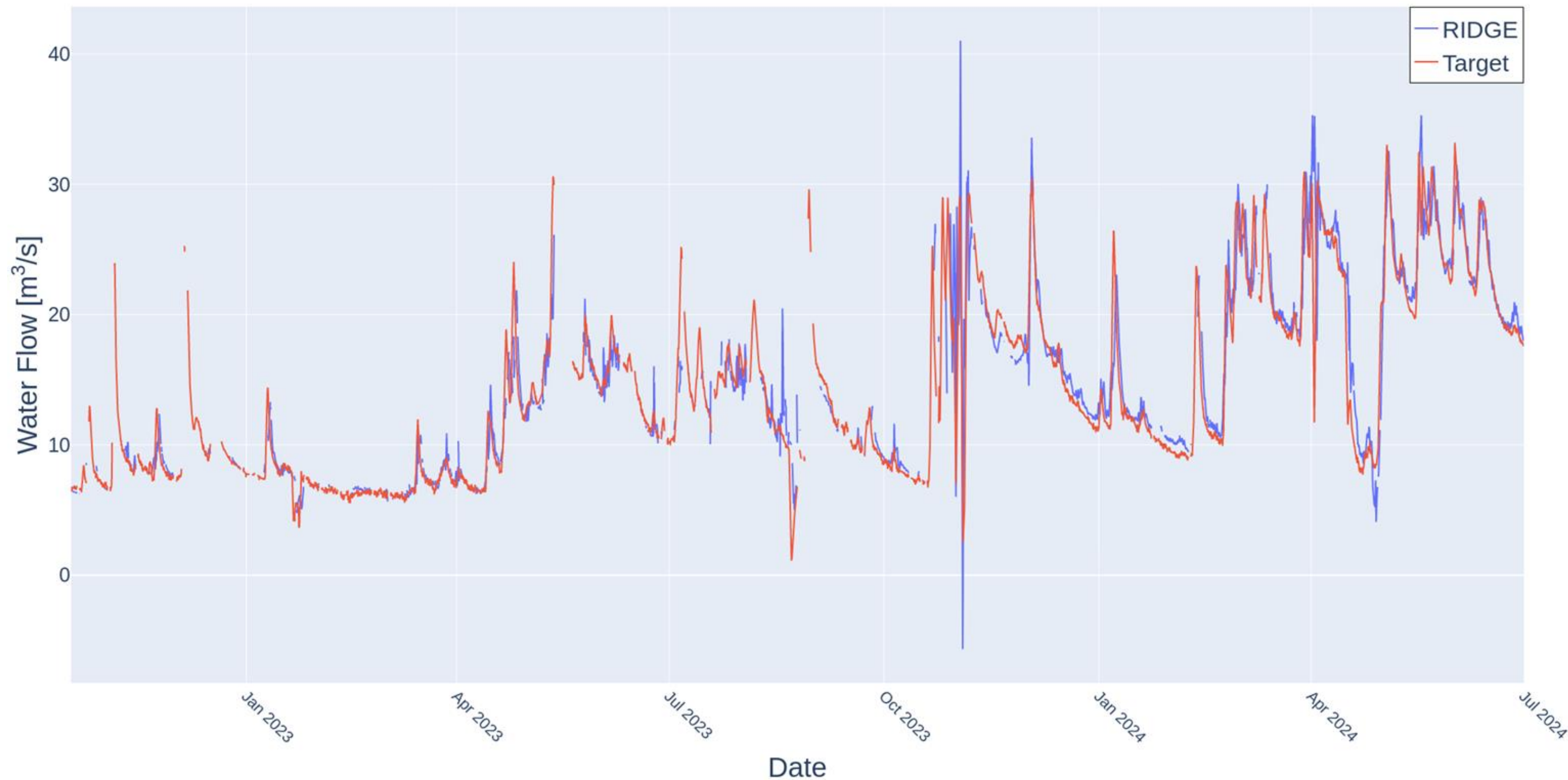


 Reservoir
Intake Inflow

 **MODEL
CALIBRATION**
(TRAIN: 70%)

KGE = 0.94


 **MODEL
VALIDATION**



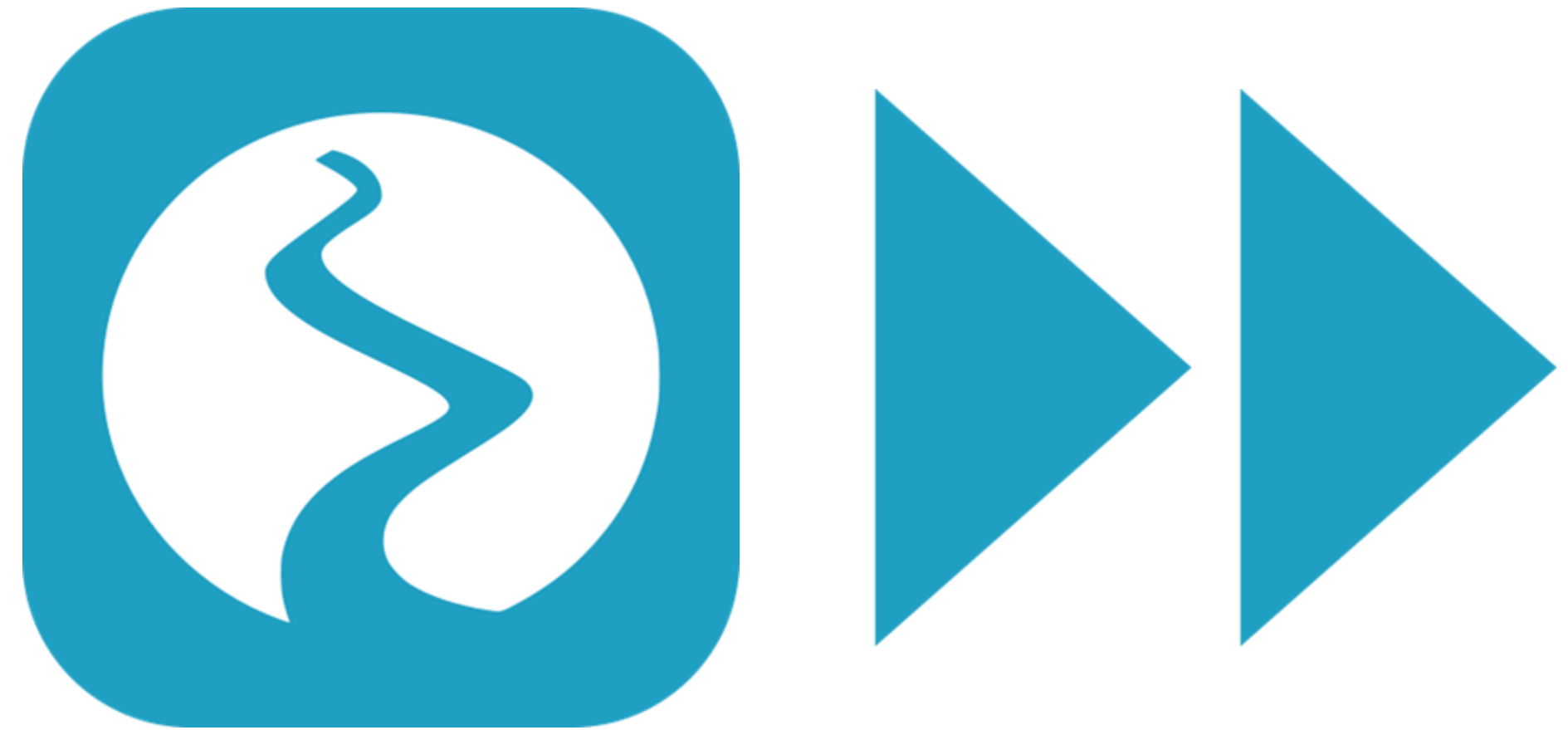
 Reservoir
Intake Inflow

 **MODEL
CALIBRATION
(TEST: 30%)**

KGE = 0.92

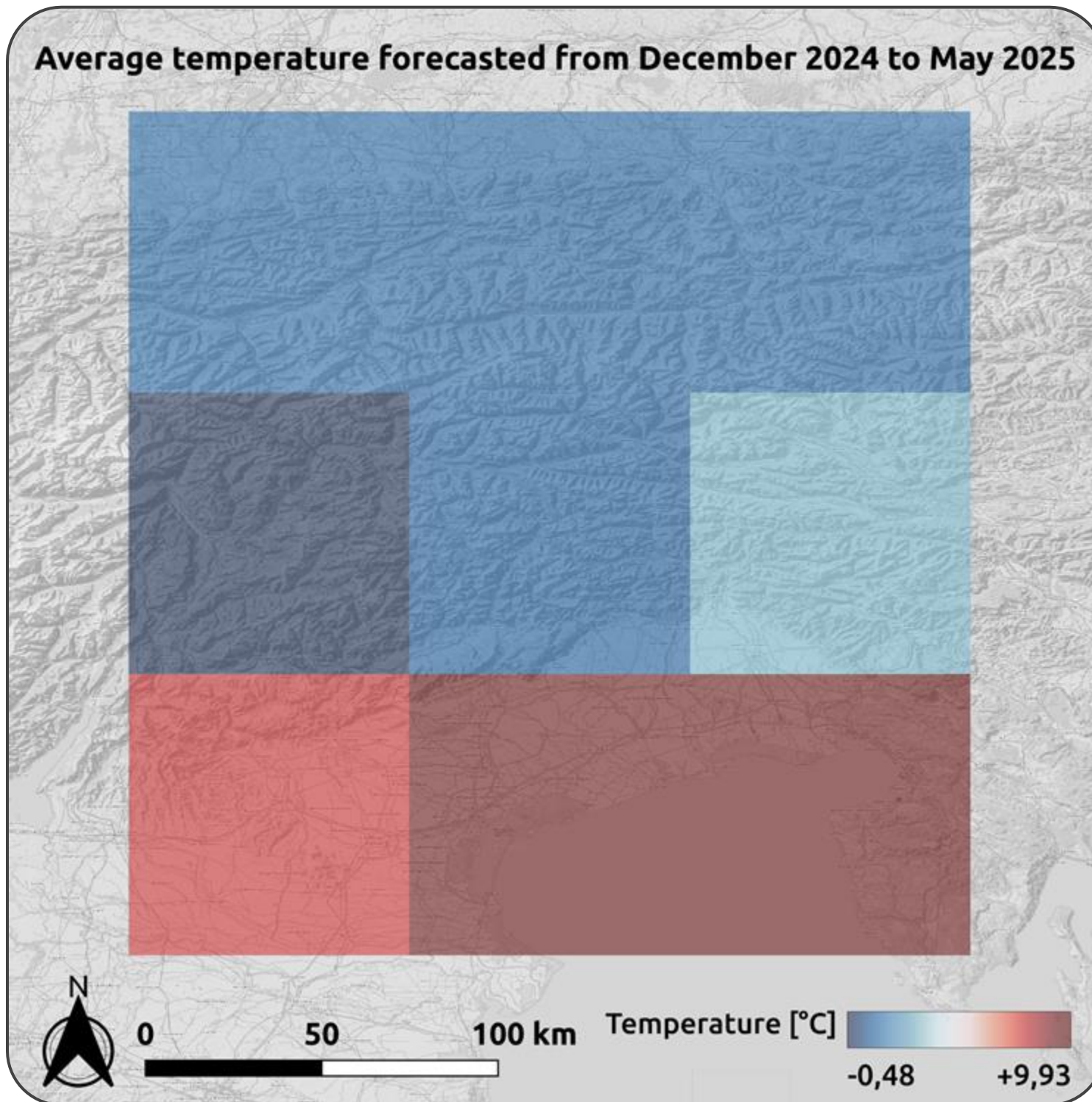

 **MODEL
VALIDATION**

Seasonal inflow forecasts



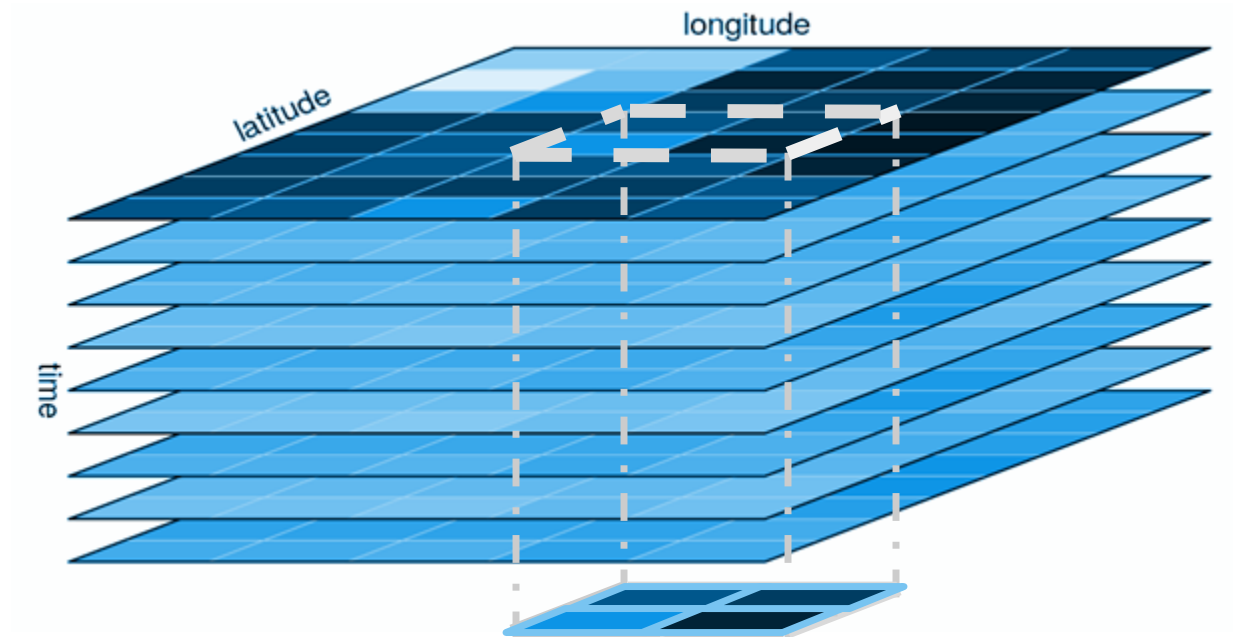


GRIDDED WEATHER FORECASTS

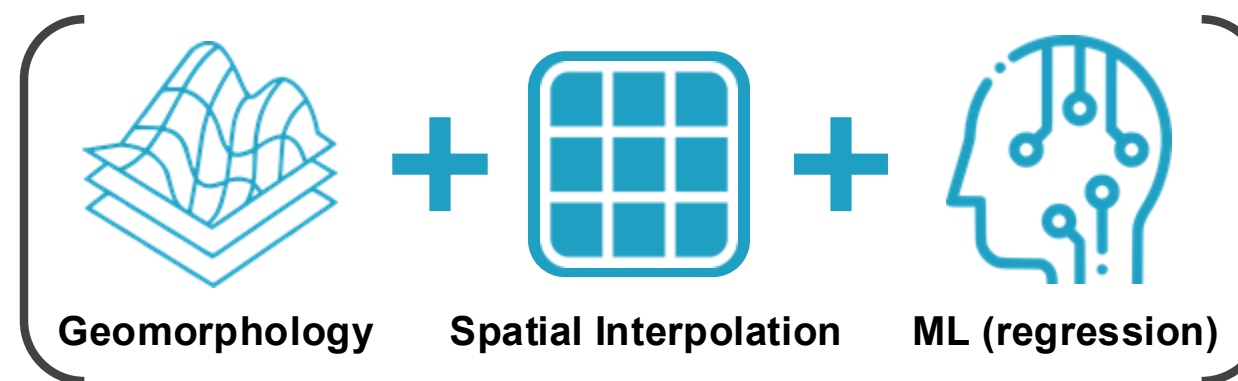


ECMWF 51-members ensemble forecasts
(+ 6 months, monthly update)

<https://cds.climate.copernicus.eu/datasets/seasonal-original-single-levels?tab=overview>

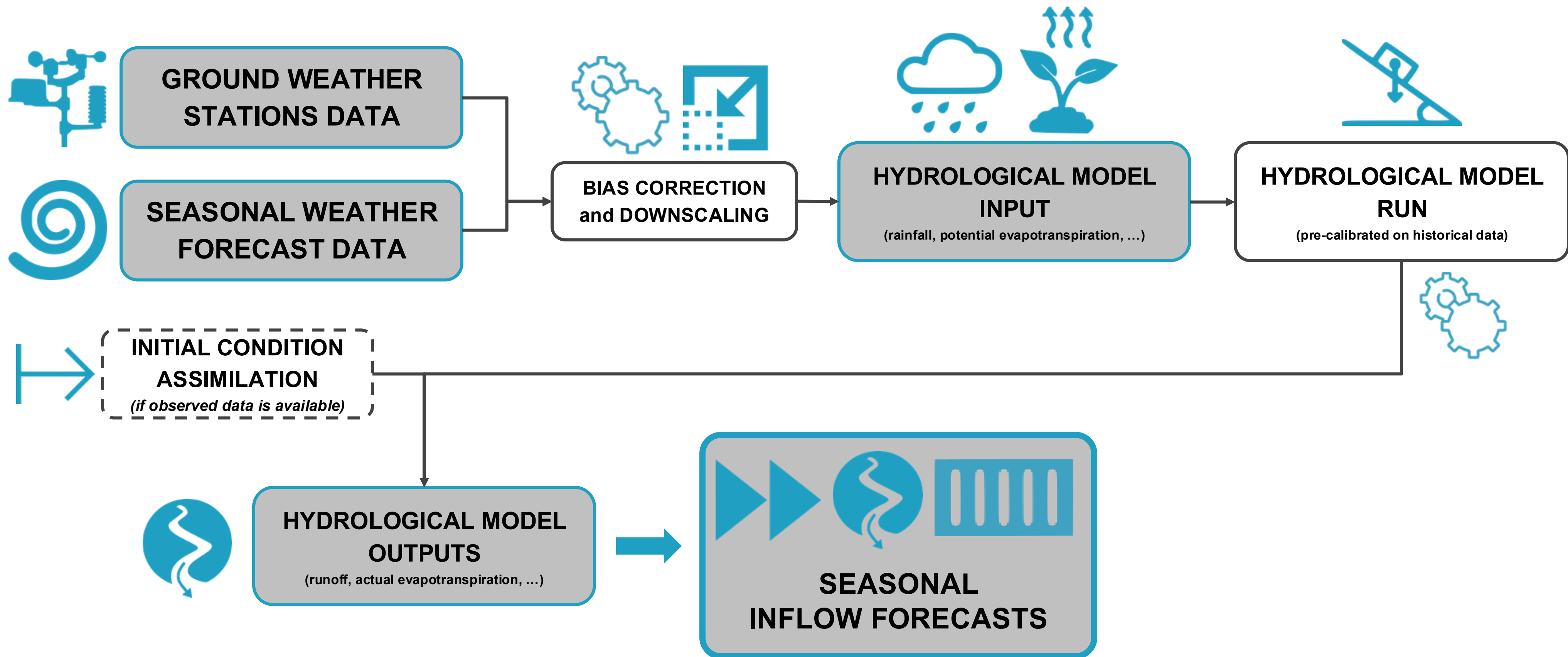


Bias Correction and Downscaling

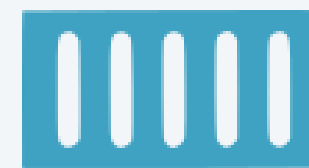
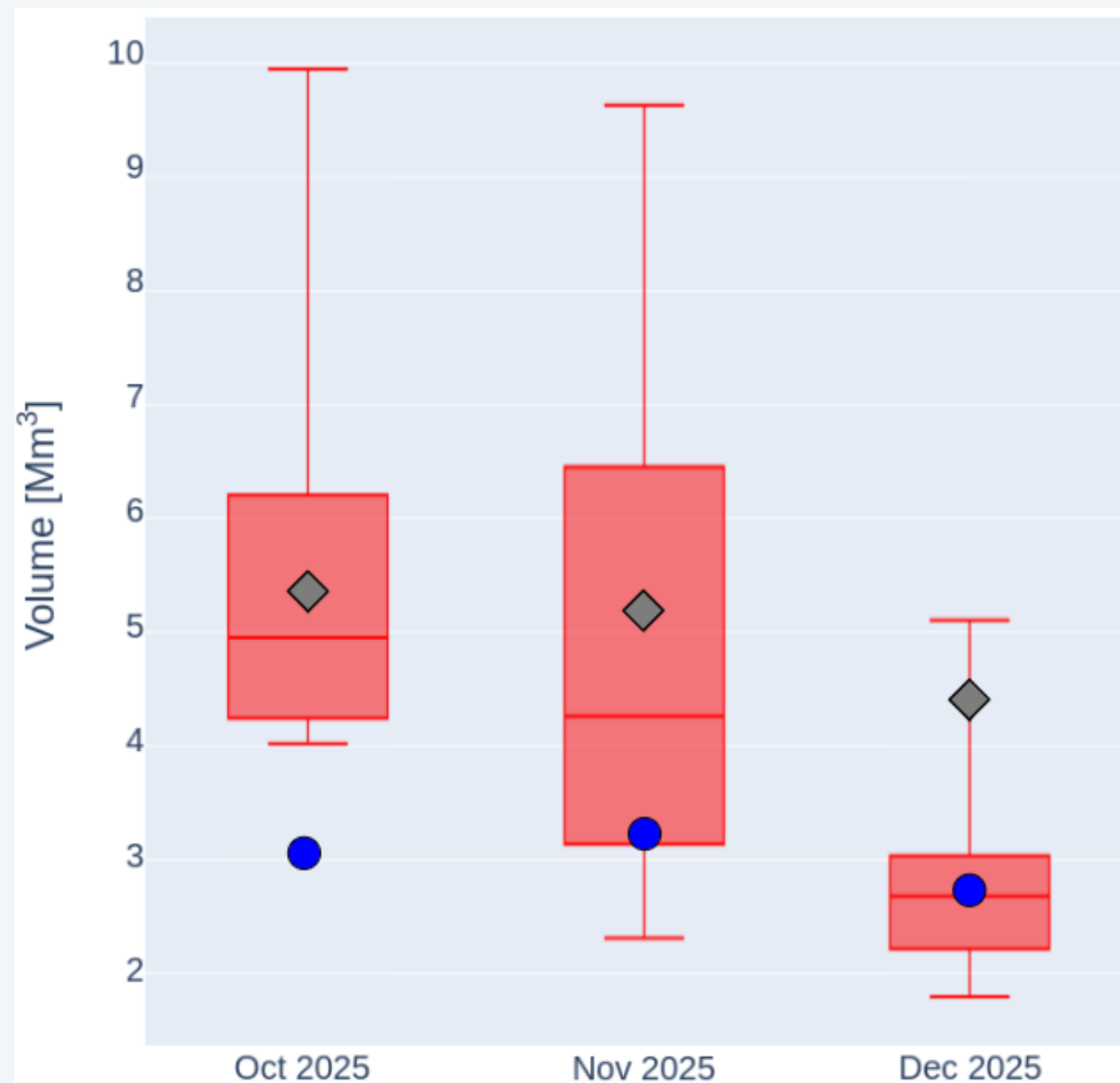


WEATHER FORECASTS ON THE CALCULATION MESH (SUB-BASINS)

Set-up of the seasonal forecasting modelling chain



◆ Historical Mean ■ Forecast ● Observed



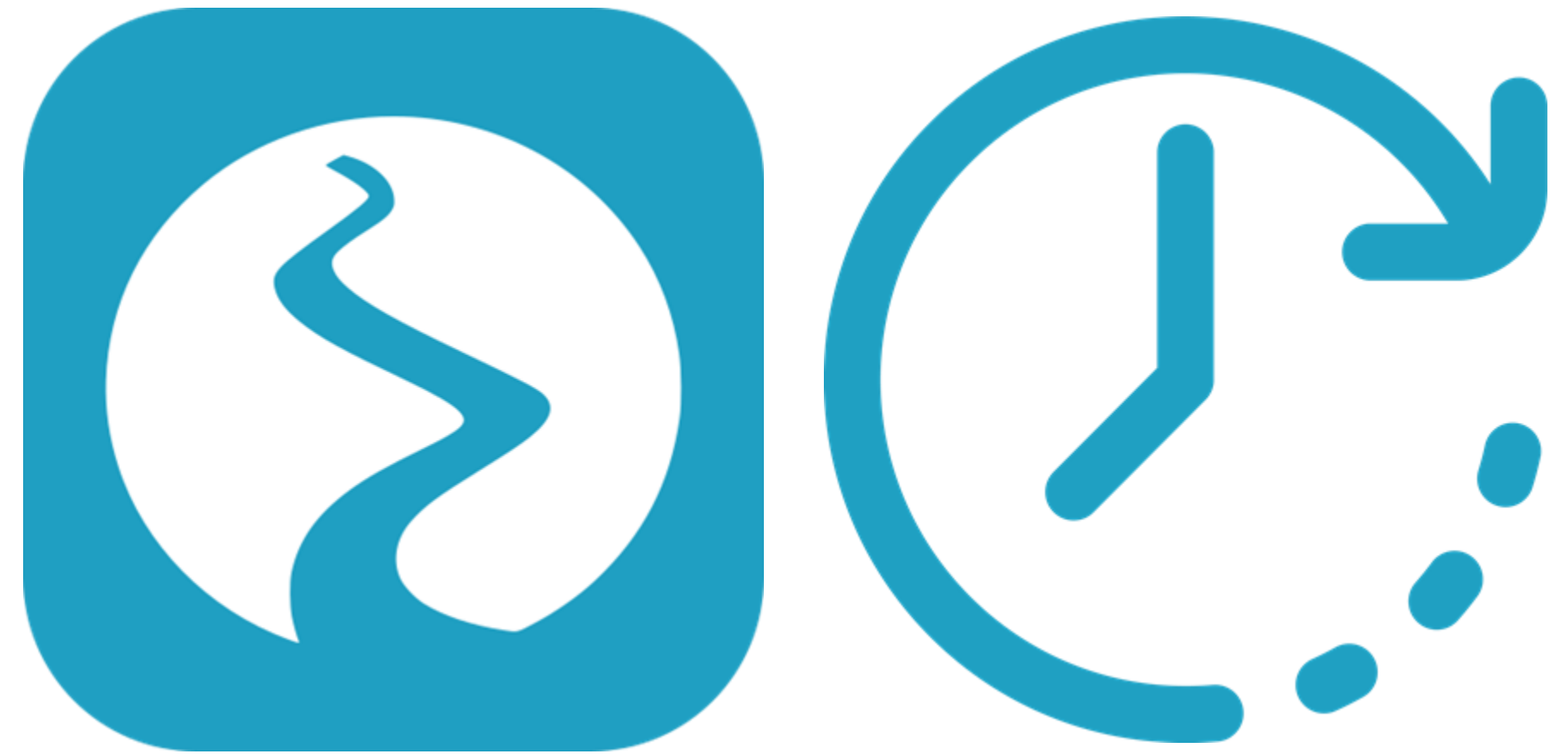
Reservoir
Intake Inflow



Forecast Horizon:
+ 3 months

Month	Historical Mean [Mm³] ◆	Quantile 0.5 [Mm³] ■	Observed [Mm³] ●
Jul 2025	1.35	1.88	1.95
Aug 2025	1.41	0.83	1.15
Sep 2025	1.14	0.73	0.93

Short-term inflow forecasts

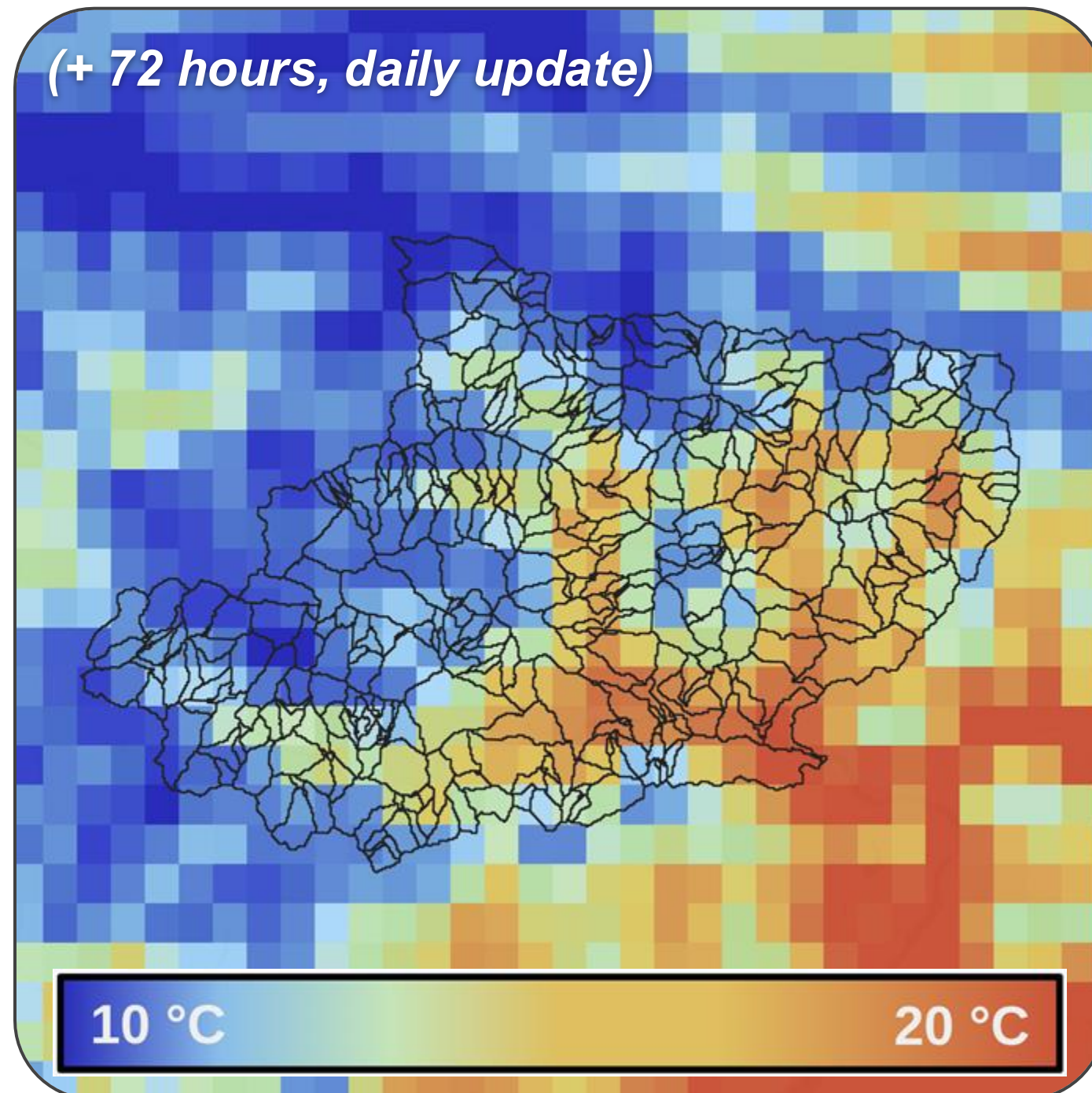




GRIDDED WEATHER
FORECASTS (ICON-2I)



WEATHER FORECASTS
ON CALCULATION MESH



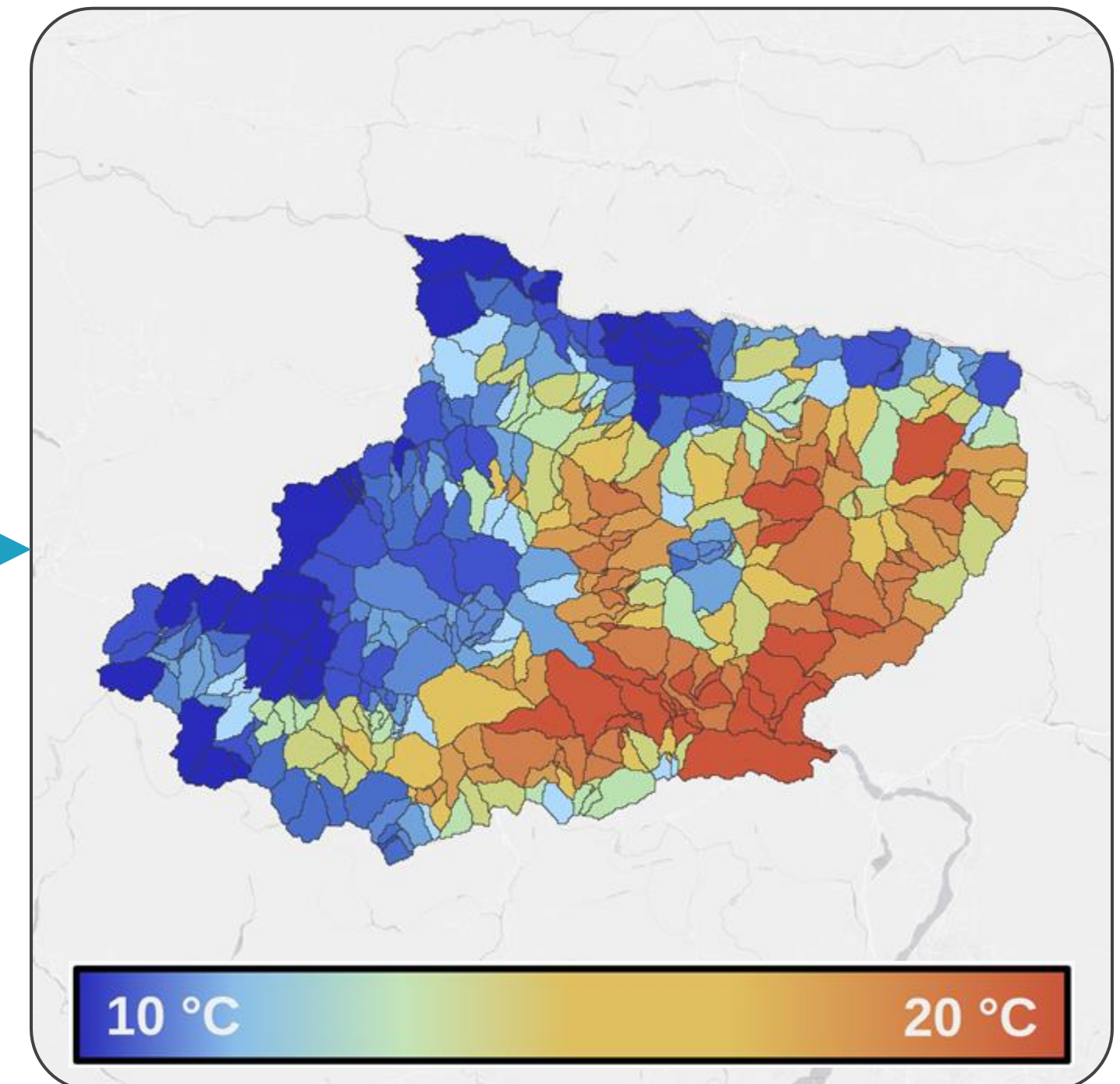
Downscaling



Geomorphology



Spatial Interpolation

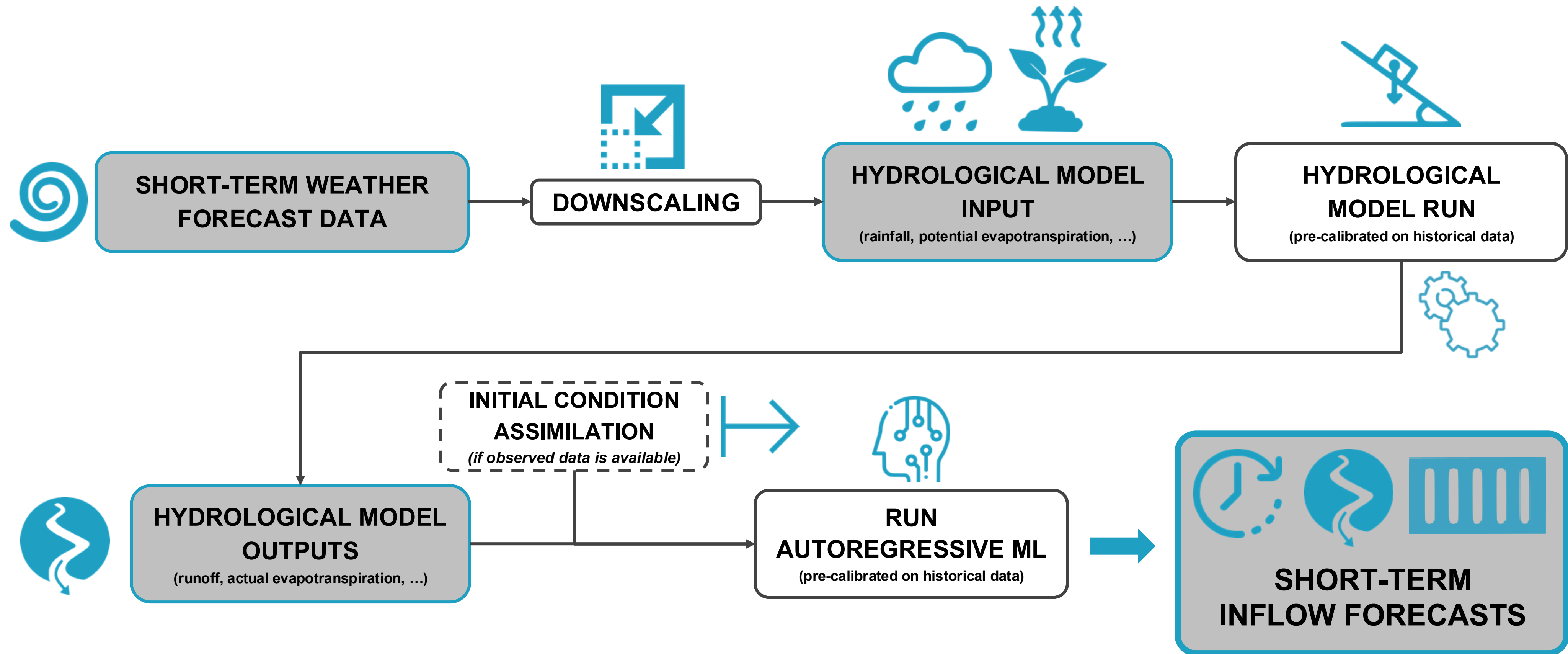


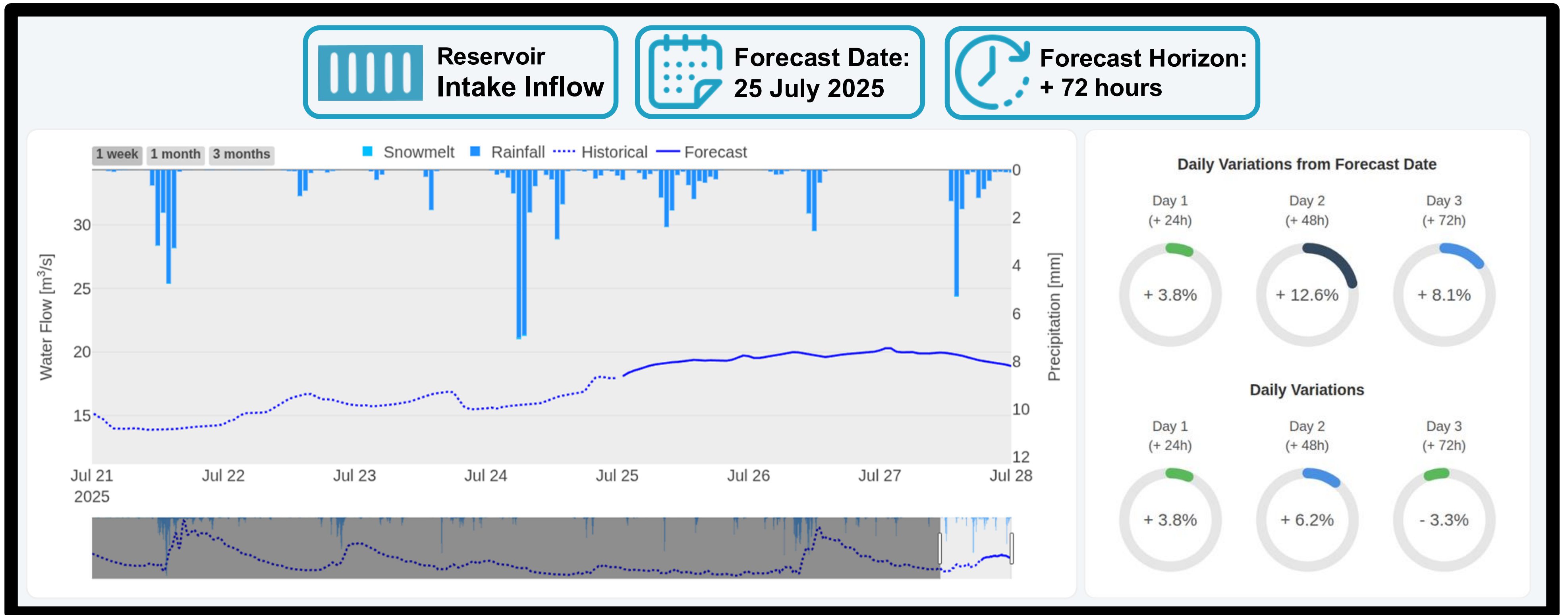
ICON-2I short-term forecasts: <https://www.agenziaitaliameteo.it/en/meteorology/forecasts/short-term-forecasts-italy/>



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Set-up of the short-term forecasting modelling chain





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Subscribe to our LinkedIn Newsletter:

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Check out the
Di-Hydro Innovation Handbook,
featuring the main results from the
project!



Digital maintenance for sustainable and flexible
operation of HYDROpower plant

Thank you.



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