Groundwater level prediction using AI

7e - Digital Tools and innovative methods for groundwater and well monitoring

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EMI : A solution to preserve water resources

A digital solution coupled with environmental expertise

Anticipate the risks of drought to take security actions

Guarantee the sustainable use of water resources and wells in full transparency

Maintain and guarantee the production capacities of your wells (extand their life span)

Optimize your investments and reduce your costs related to your water production assets

Facilitate communication with citizens and state services

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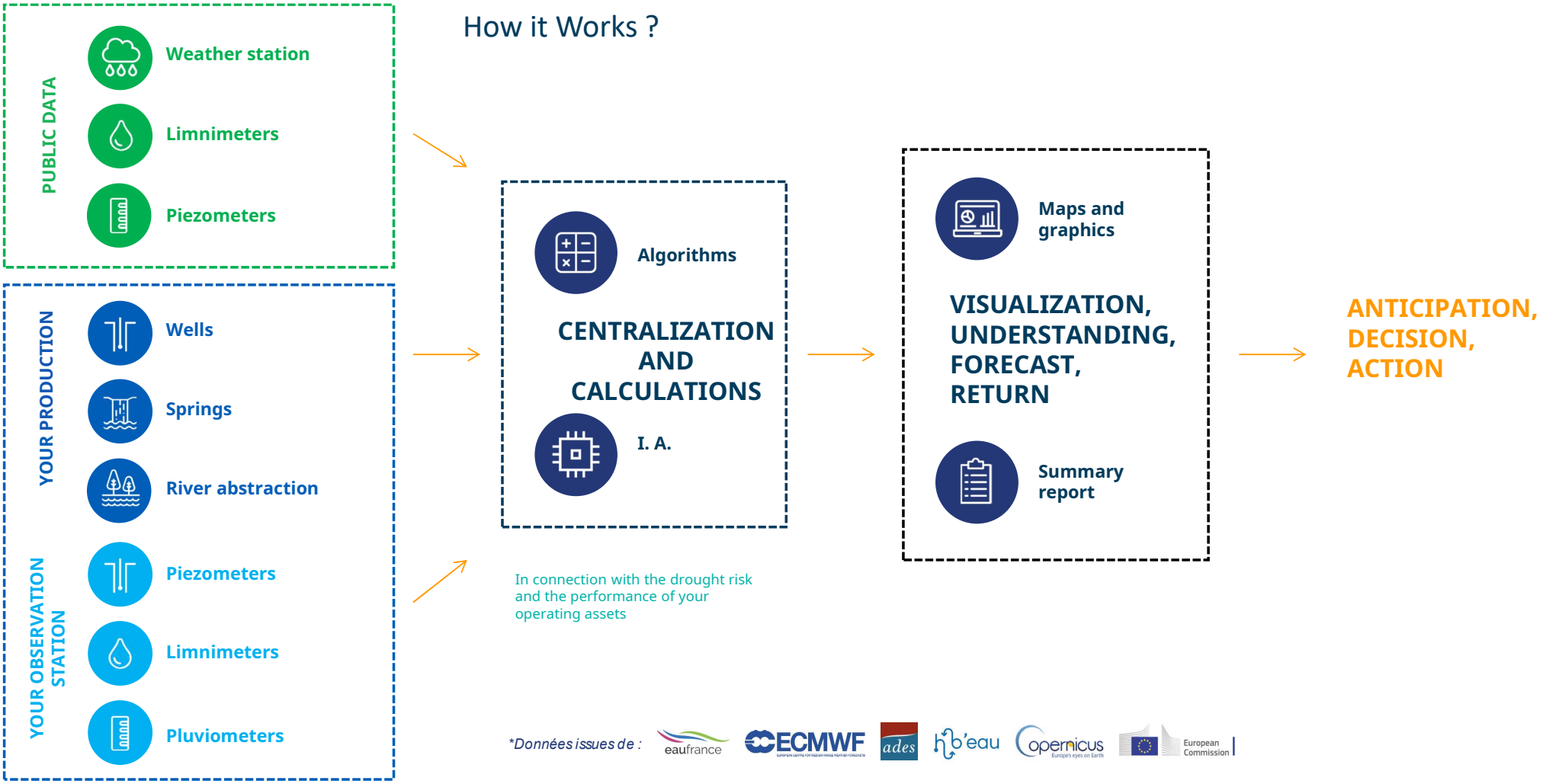
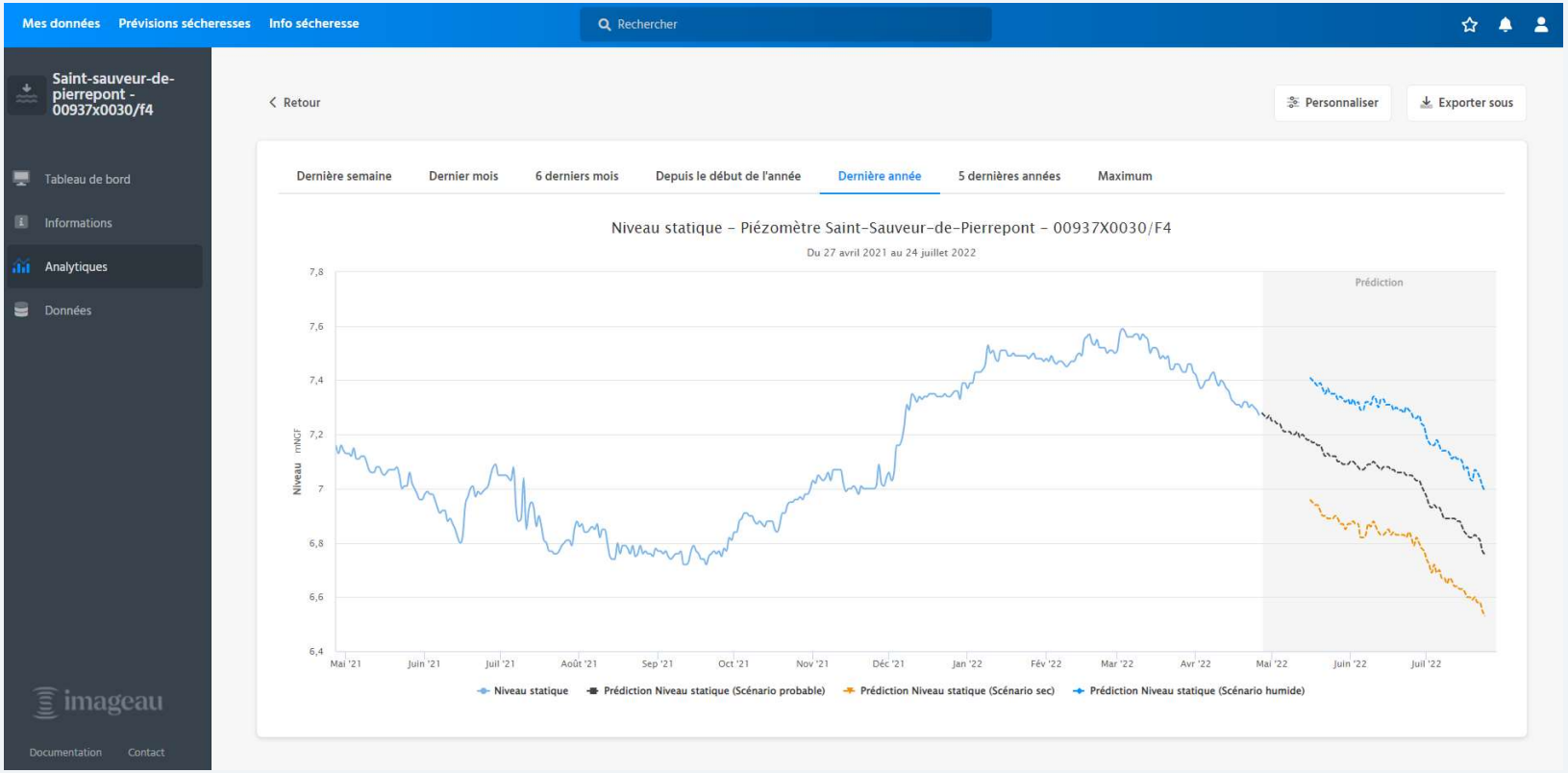
How it Works ?



*Données issues de : eaufrance ECMWF ades hb'eau Copernicus European Commission

AI model purpose



A **daily** prediction of the **piezometric level** for the next **90 days**

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AI modeling in EMI : the steps

The prediction model follows these pipeline steps :

- **Feature engineering :** find features from data and select the most important variables
- **Calibration** and **tuning of the model parameters**.
- **Measure performances** and keep the best model.
- **Deploy** the model on the web platform
- **Monitor** the models and retrain it if necessary

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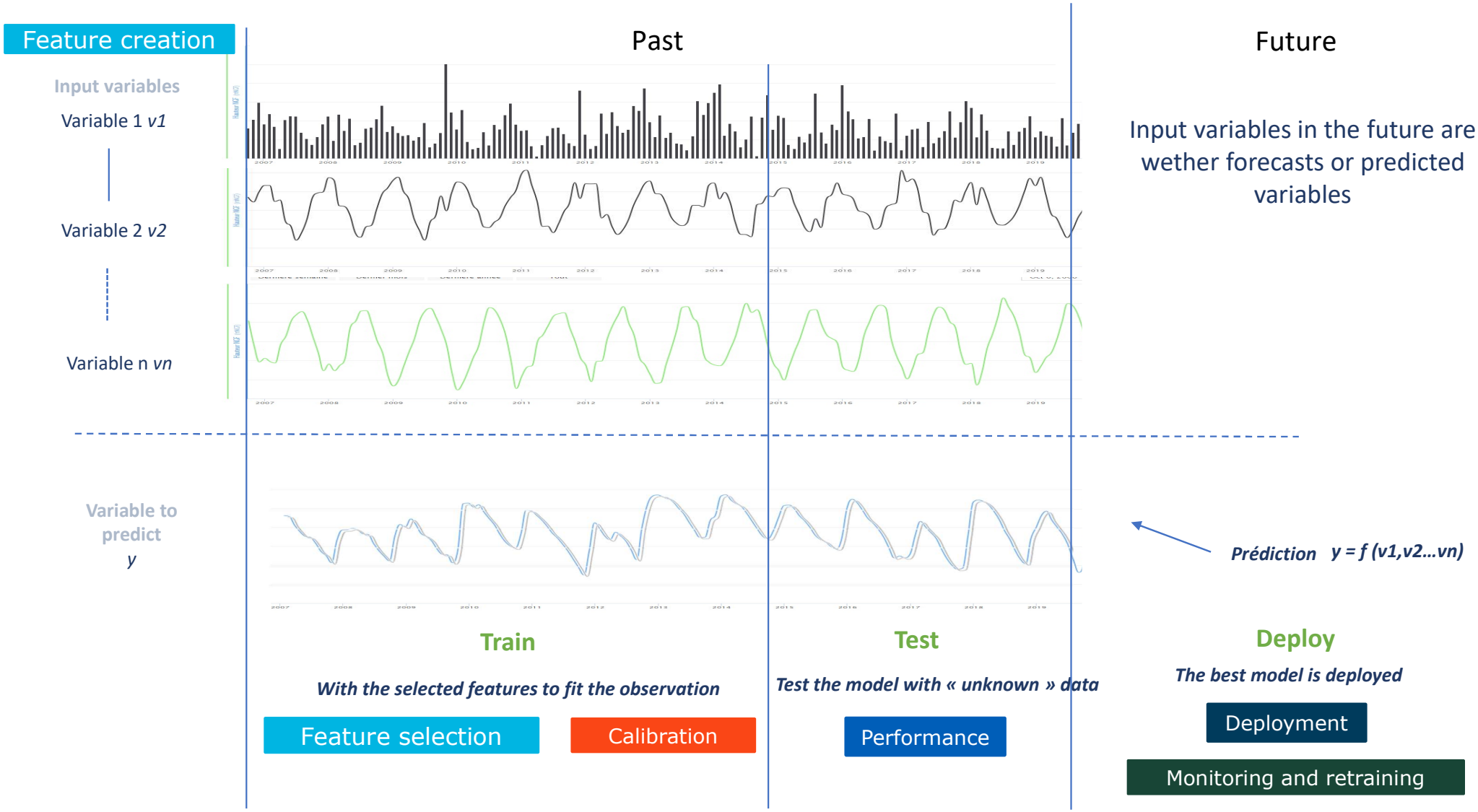
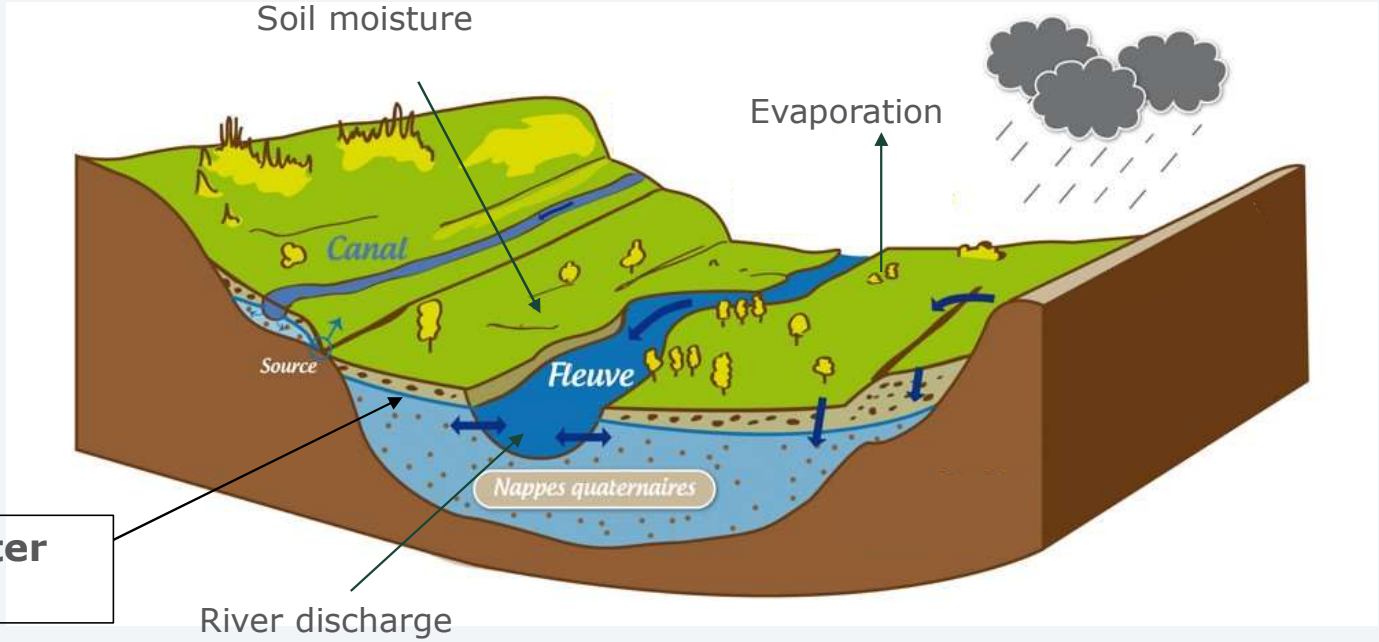

Feature creation
Input variables
Variable 1 v1
Variable 2 v2
Variable n vn
Variable to predict y
Past
Future
Input variables in the future are wether forecasts or predicted variables
Prédiction y = ƒ (v1,v2…vn)
Train
With the selected features to fit the observation
Feature selection
Calibration
Test
Test the model with « unknown » data
Performance
Deploy
The best model is deployed
Deployment
Monitoring and retraining

Input data – feature creation

Cloudiness
Rainfall (past and forecast)
Temperature



Target variable

Groundwater level

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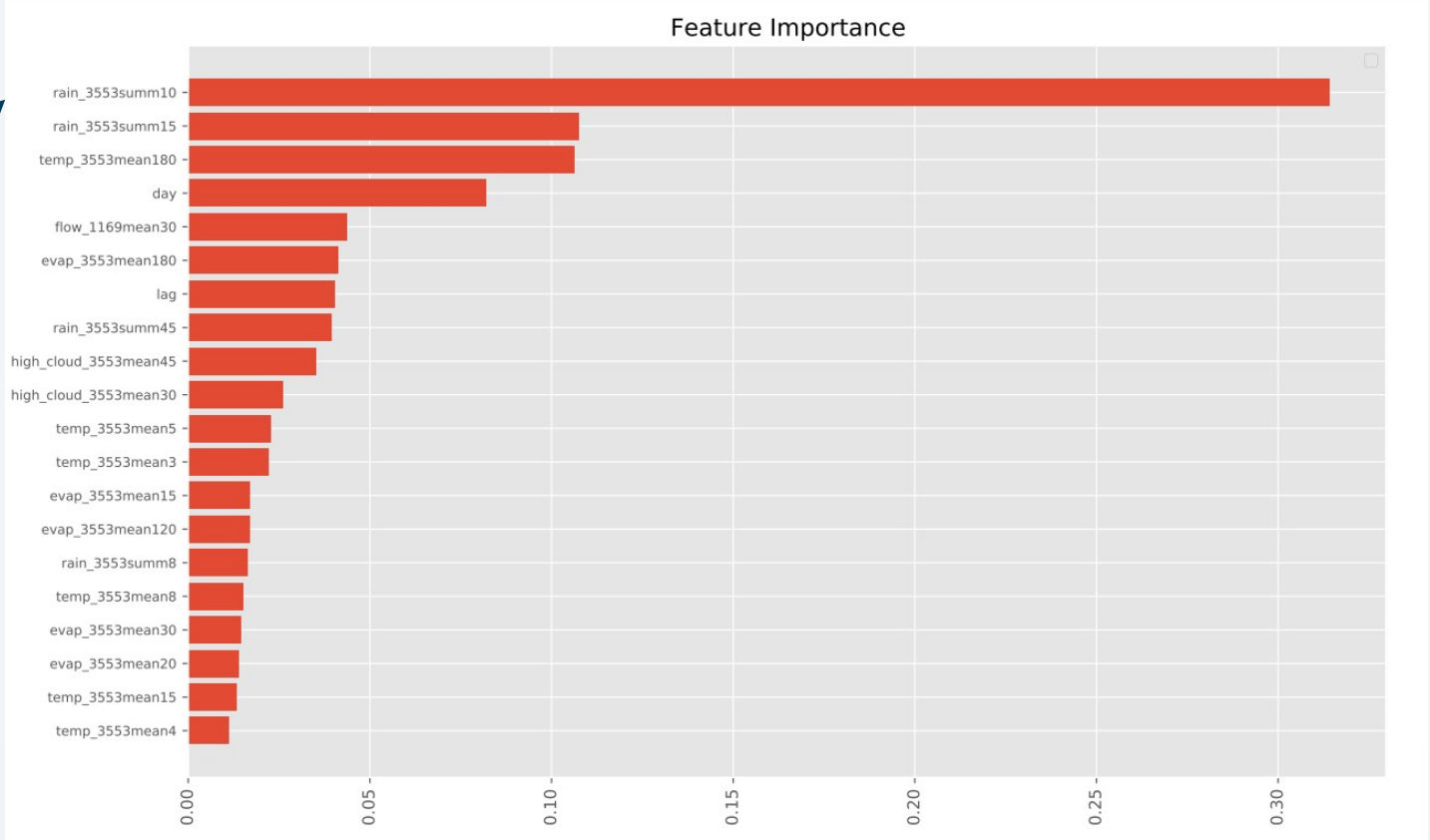
Feature importance example : d+10 prediction

10 days rainfall accumulation



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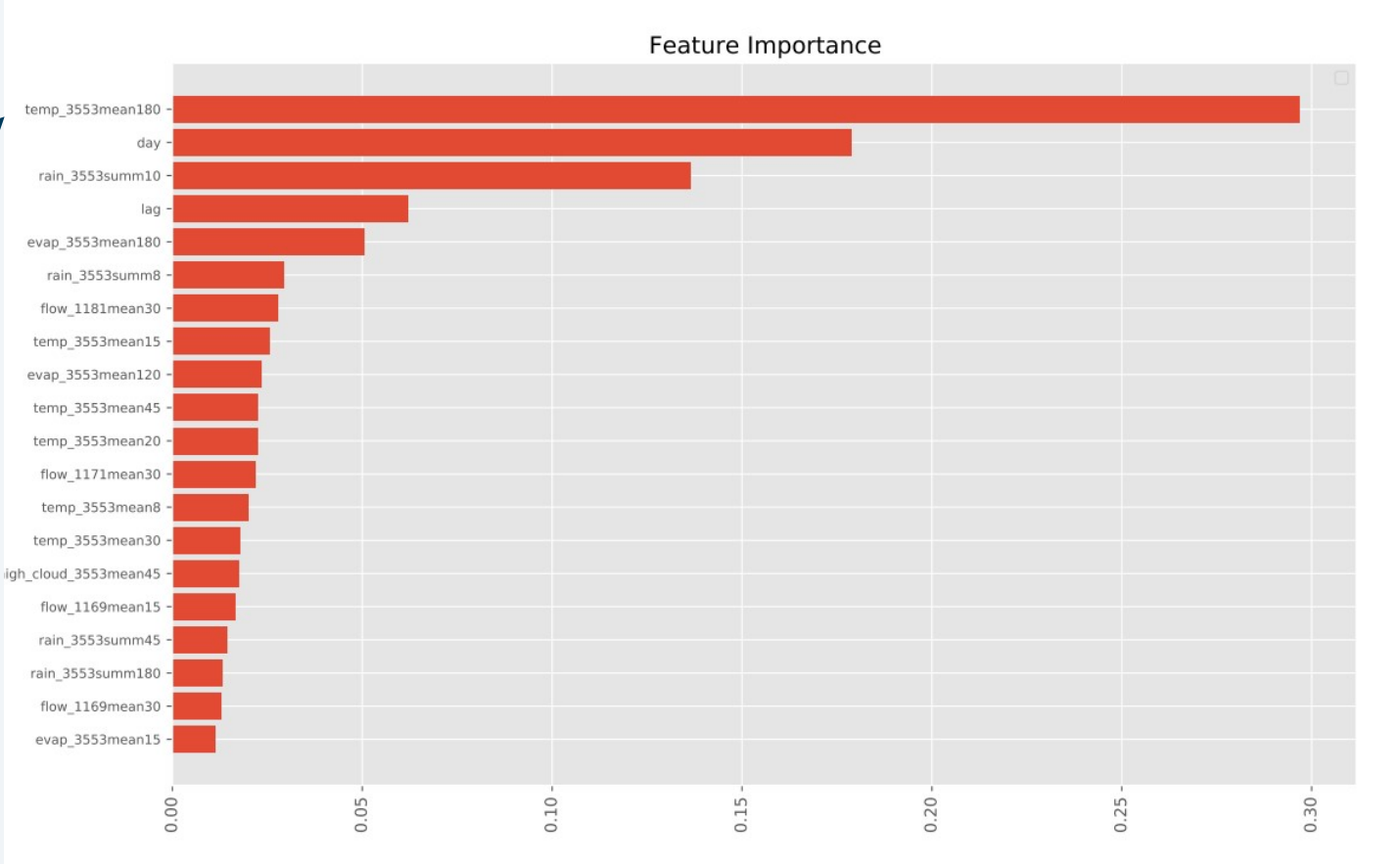
Feature importance example : d+20 prediction

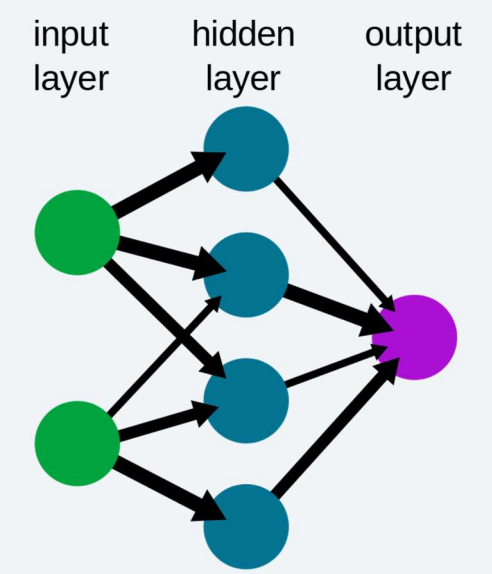
Mean Temperature



Machine learning models : 1 to 20 days

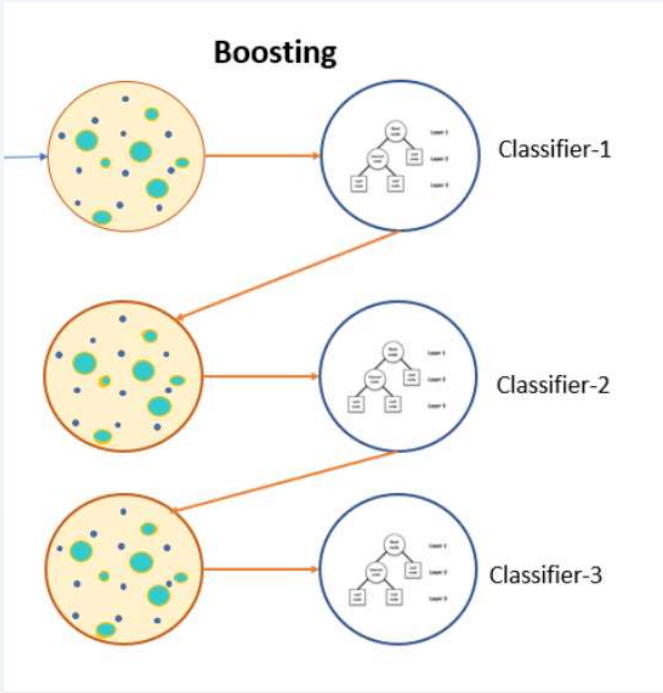
Neural Network

Based on a collection of connected units or nodes called artificial neurons, which loosely model the neurons in a biological brain



Gradient Boosting

Produces a prediction model in the form of an ensemble of weak prediction models, typically decision trees.



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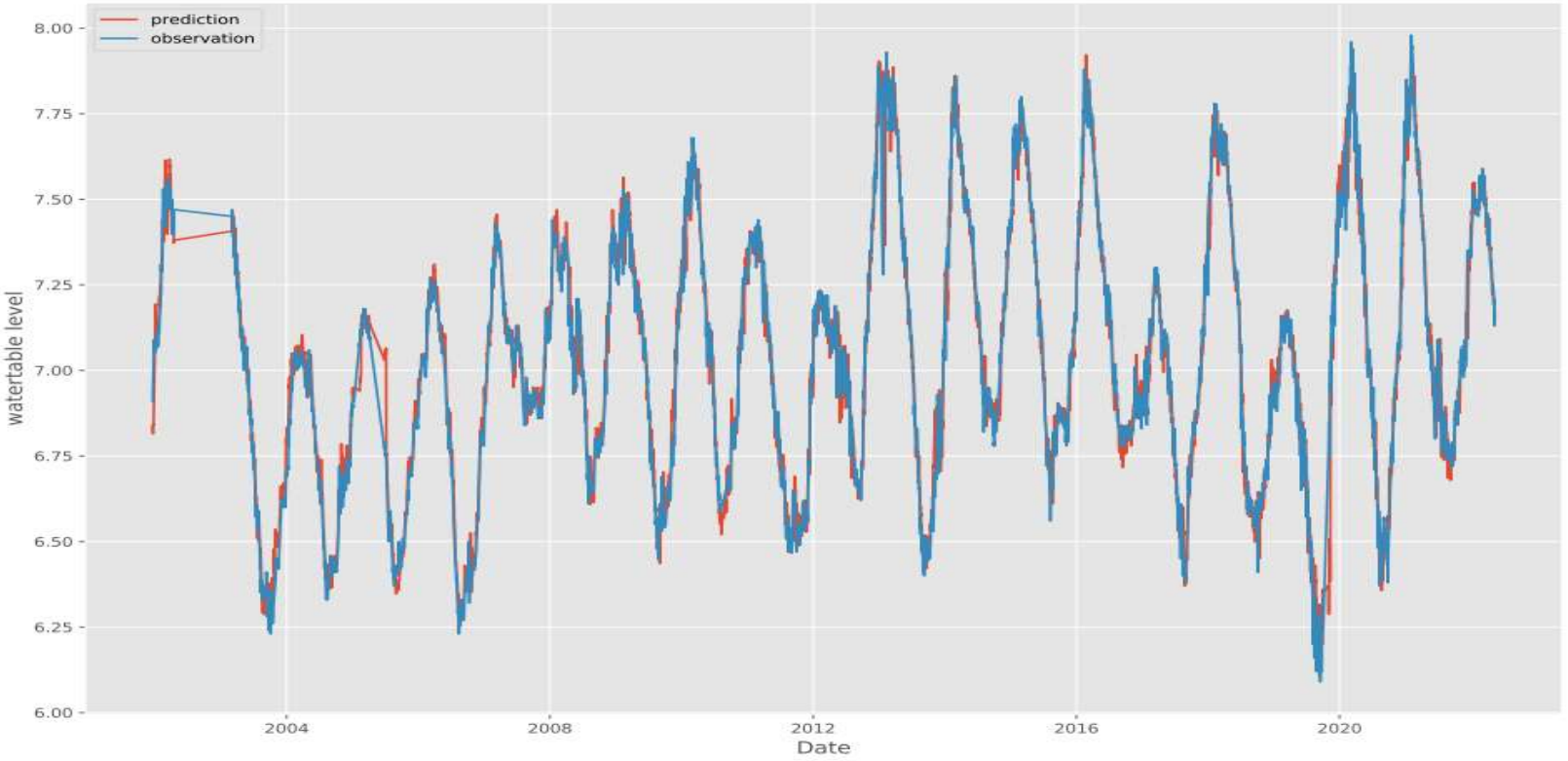
Example : d+10 prediction



R^2 = 0.976

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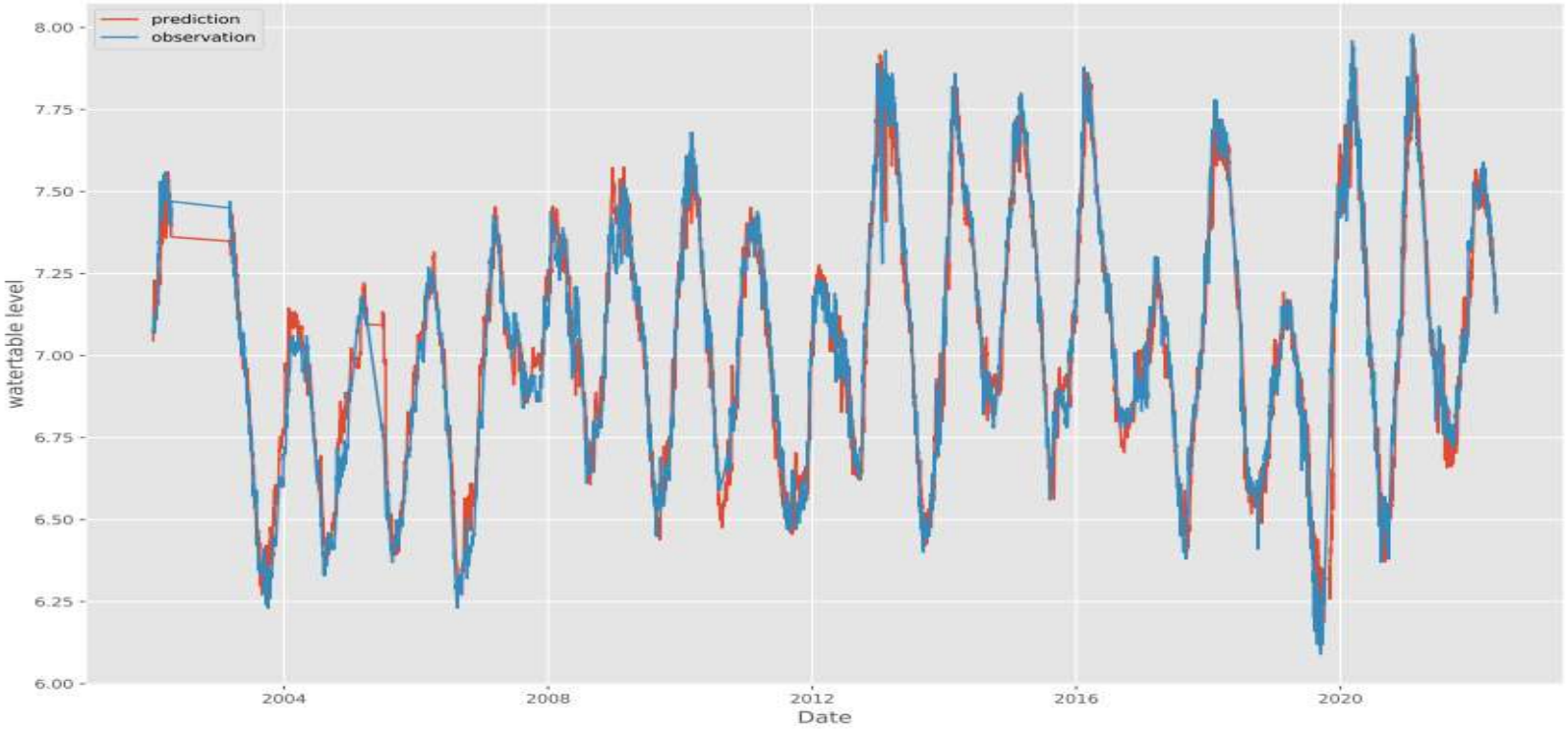
Example : d+20 prediction



R^2 = 0.946

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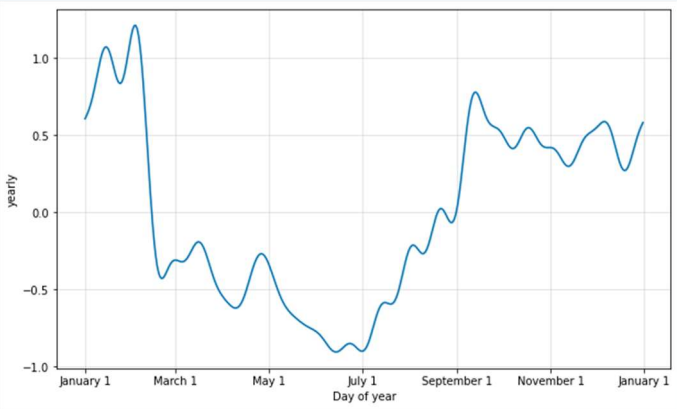
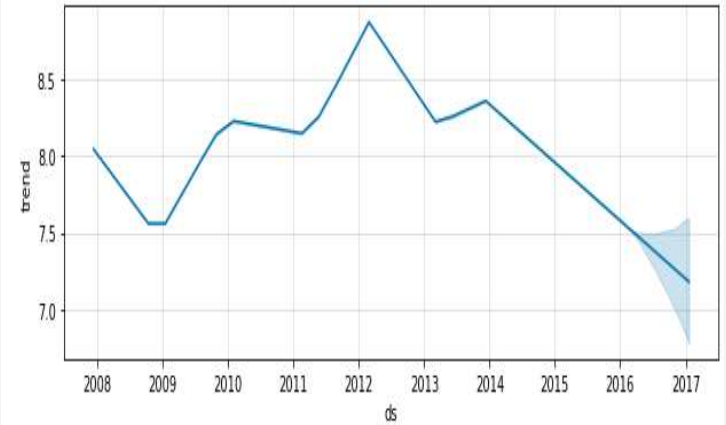
FB Prophet model : 21 to 90 days

- A procedure for forecasting time series data based on an additive model where non-linear trends are fit with yearly, weekly, and daily seasonality
- Works best with strong seasonal effects and several seasons of historical data
- Prophet is robust to missing data and shifts in the trend, and typically handles outliers well.



Seasonality component



Trend component

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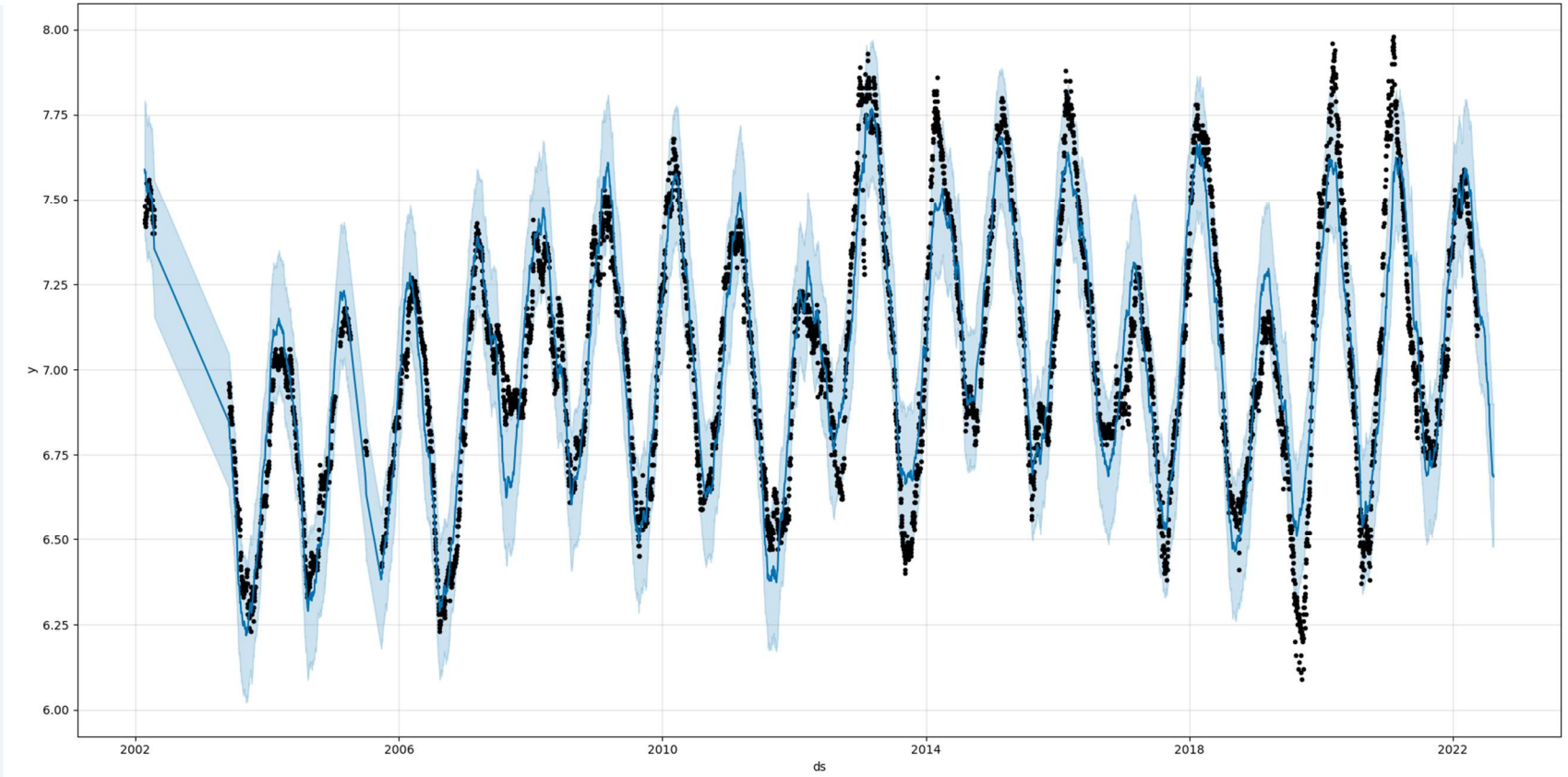
Example : Prophet



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Conclusion

- **20** piezometers deployed on EMI with daily predictions
- **High performance** for 1 to 20 days forecasts
- Good for **scalability**
- Improvements are still needed for **long term forecast** (ex : Mix of hydrogeological and AI model)

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Thank you !

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