On-Line River Flow Forecasting with Hydromax: Almost Thirty Years of Experience

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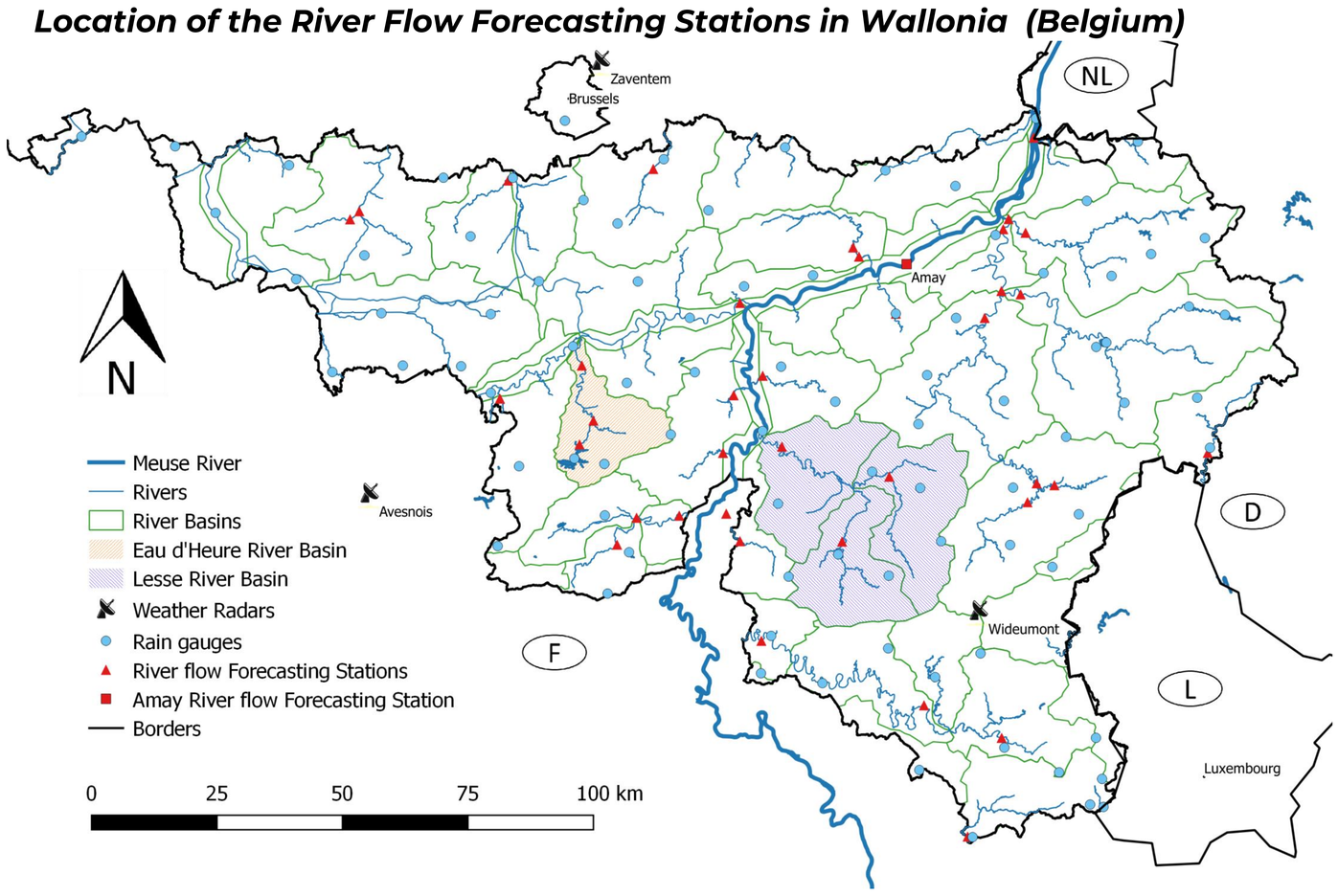
Location of the River Flow Forecasting Stations in Wallonia (Belgium)



Hydromax is the river flow forecasting application for the early warning of extreme hydrological events (floods as well as low waters) in the Meuse river basin and its tributaries.

Since 1994, Hydromax provides in real-time short-term predictions of river flows based on past rainfall and river flow measurements, and long-term river flow forecasting based on weather forecasts.

The Hydromax forecasting model structure involves three submodels: a conceptual reservoir submodel, a statistical ARX prediction submodel and a long-term forecasting submodel.

The Hydromax operation is discussed through experimental data from the Meuse River at Amay station.

More Information about Hydromax :
https://sites.uclouvain.be/hydromax

Structure and Equations of the Short Term Forecasting Model

$$E1_{(t)} = \min[PB_{(t)}, ETP_{(t)}]$$

$$E2_{(t)} = \max[0, \min(ETP_{(t)} - PB_{(t)}, S_{(t-1)} + W_{(t)} - I_{(t)})]$$

$$W_{(t)} = [S_{max} - S_{(t)}]\left[1 - exp\left(-\beta \frac{PB_{(t)} - E1_{(t)}}{S_{max} - S_{(t)}}\right)\right]$$

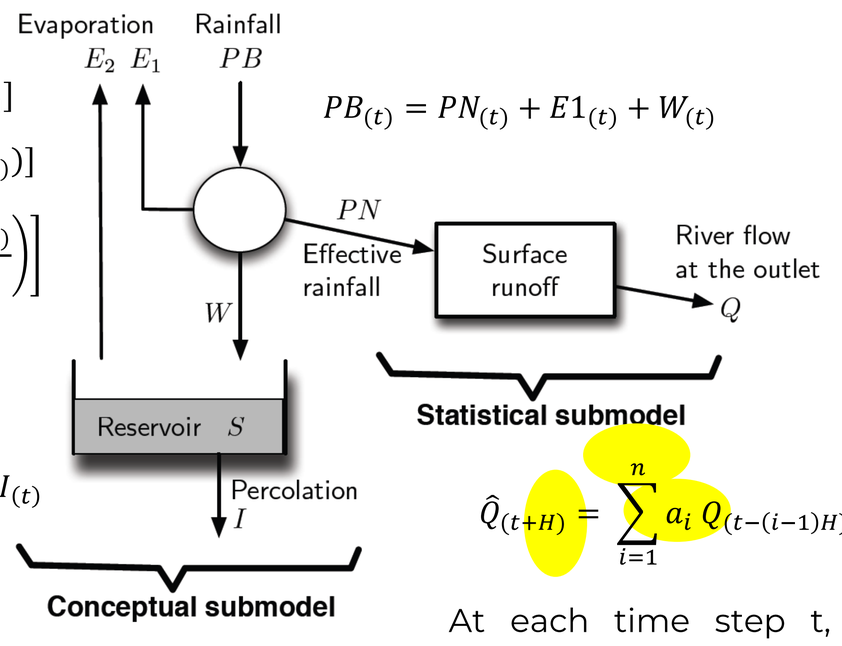
ETP: Seasonal potential evapotranspiration

S_{max}: Upper limit of the amount of stored water
β : Specific runoff parameter
α : Specific percolation parameter

The three positive parameters (S_{max}, α, β) are calibrated for each considered watershed.

$$S_{(t)} = S_{(t-1)} + W_{(t)} - E2_{(t)} - I_{(t)}$$

$$I_{(t)} = \alpha(S_{(t-1)} + W_{(t)})$$



$$\hat{Q}_{(t+H)} = \sum_{i=1}^{n} a_i \, Q_{(t-(i-1)H)} + \sum_{j=1}^{m} b_j \, PN_{(t-(j-1)H)}$$

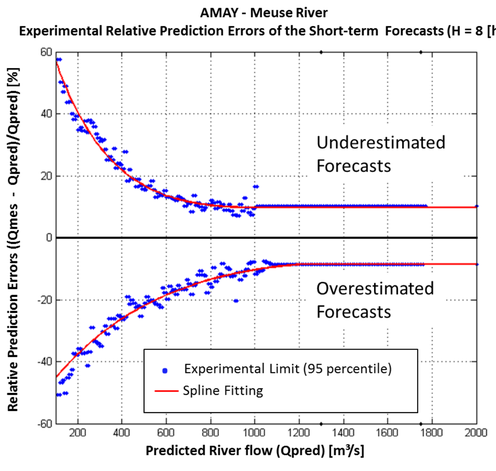
At each time step t, a forecast $\hat{Q}_{(t+H)}$ is computed for the future time instant (t+H) (where H is the short-term prediction horizon of H measurement time steps)

Equation of the Long Term Forecasting Model

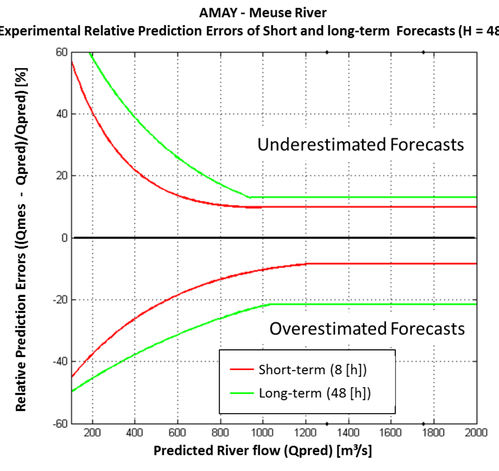
$$\hat{Q}_{(t+kH)} = \sum_{i=1}^{k-1} (a_i \, \hat{Q}_{(t+(i-1)H)} + b_i \, \widehat{PN}_{(t+(i-1)H)}) + \sum_{j=k}^{n} a_j \, Q_{(t-(j-1)H)} + \sum_{j=k}^{m} b_j \, PN_{(t-(j-1)H)}$$

with $\widehat{PN}_{(t+(i-1)H)}$: the Rainfall Forecast

Performance and Confidence Intervals for Amay Station (based on 16 years of forecasting)



Experimental 95 percentile limits of relative prediction errors for the short term forecasts (H = 8 [h])



Smoothed 95 percentile limits of relative prediction errors for the short-term (H = 8 [h]) and long-term forecasts (H = 48 [h])

For Information about how to use confidence intervals to improve the river flow forecasting (work in progress) :
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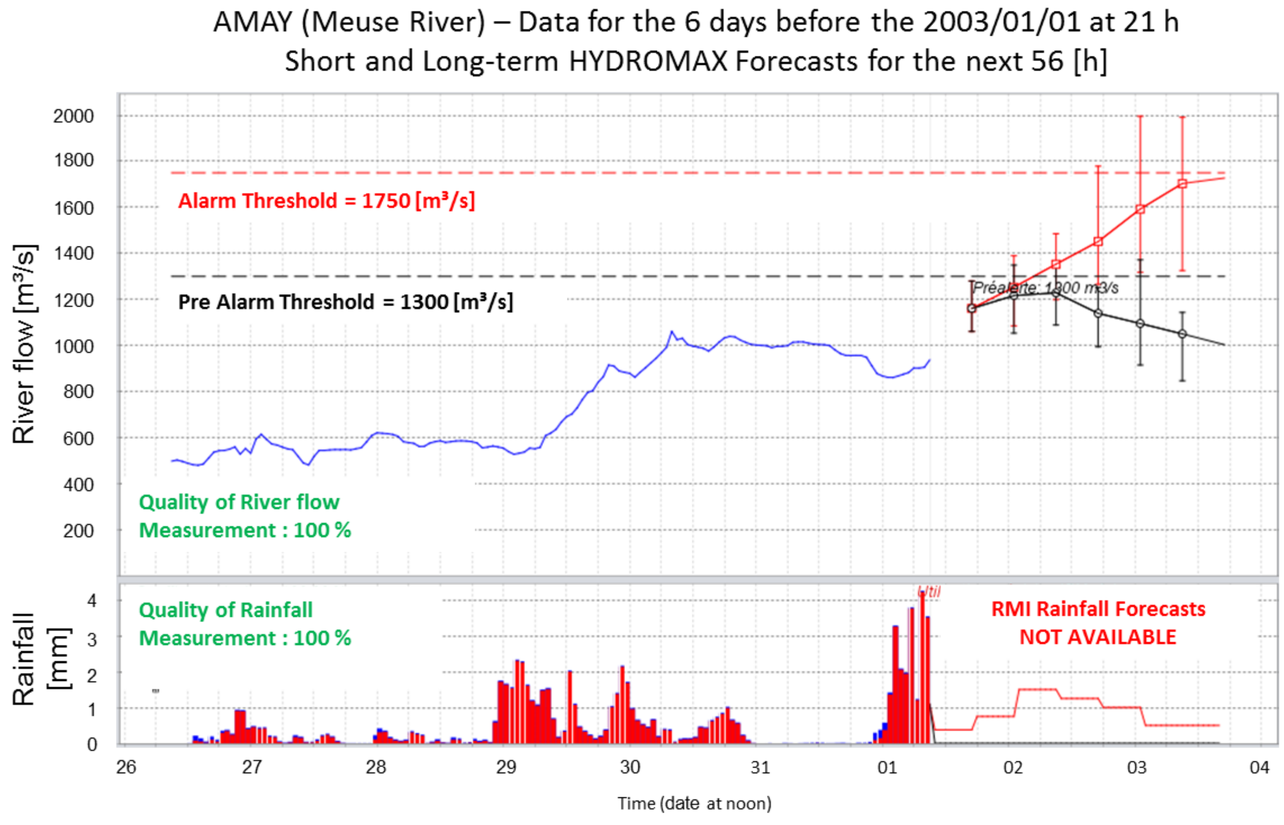
Forecasts at Amay Station in High Flow Conditions. Graph with Confidence Intervals and Additional Information for the Forecaster



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