Influence of river routing methods on integrated catchment water quality modelling.

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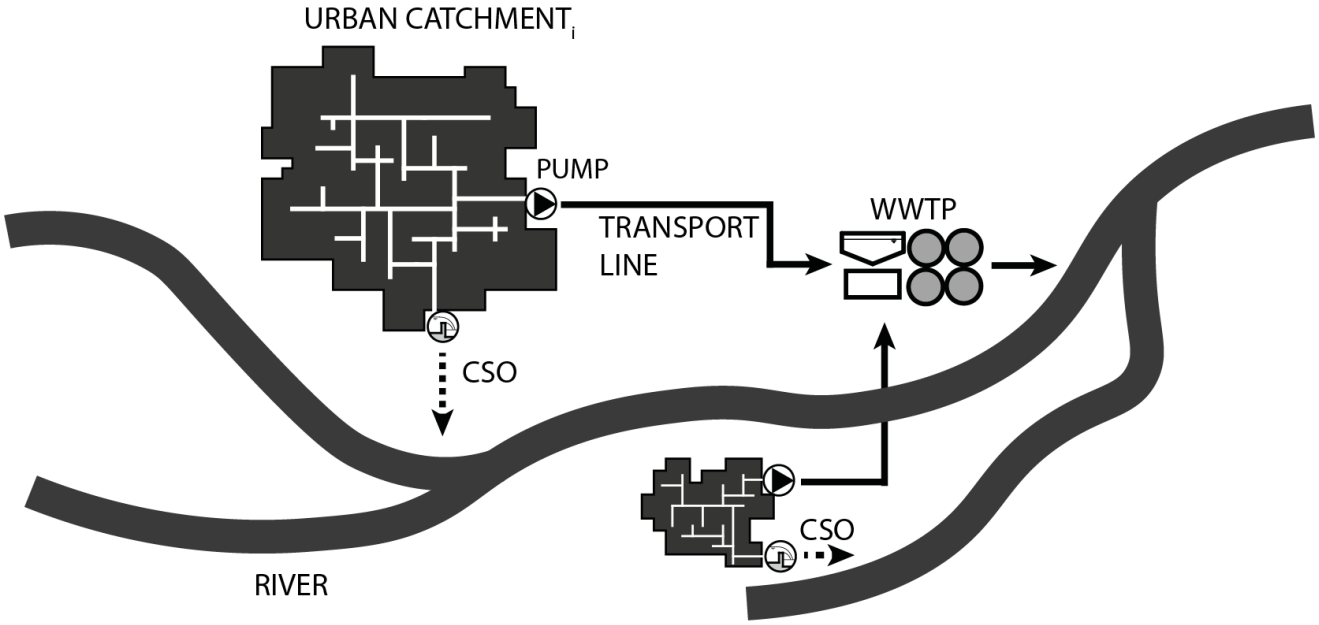
QUICS

1- Integrated Catchment Modelling

1.1 Context



2- River model structural uncertainty

Model structure:

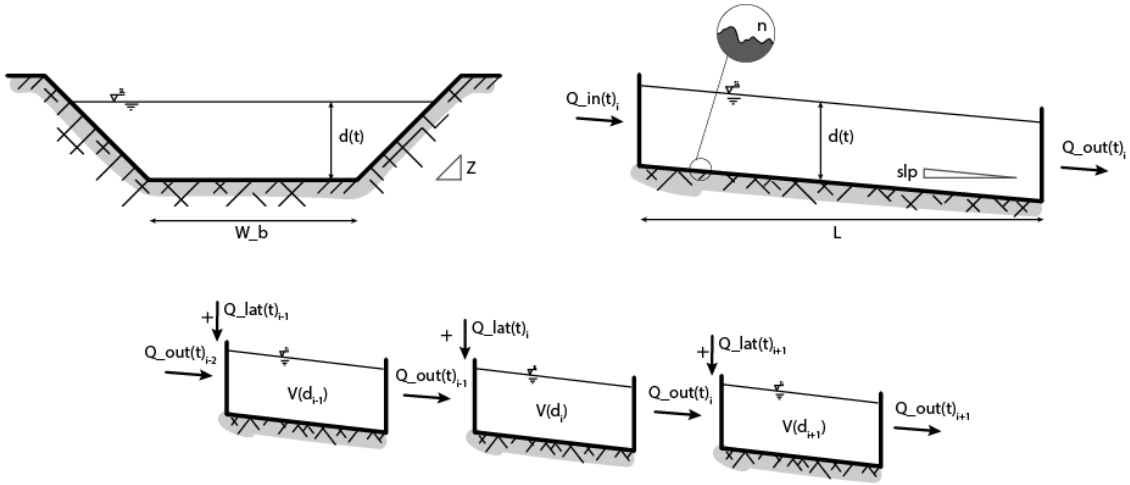
- Fast model
- Parsimonious
- Spatially lumped processes

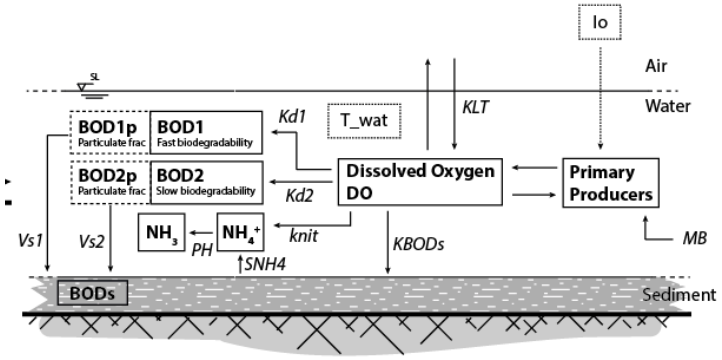
How does the river routing model structure influences dissolved oxygen simulated dynamics?

3- River model structure

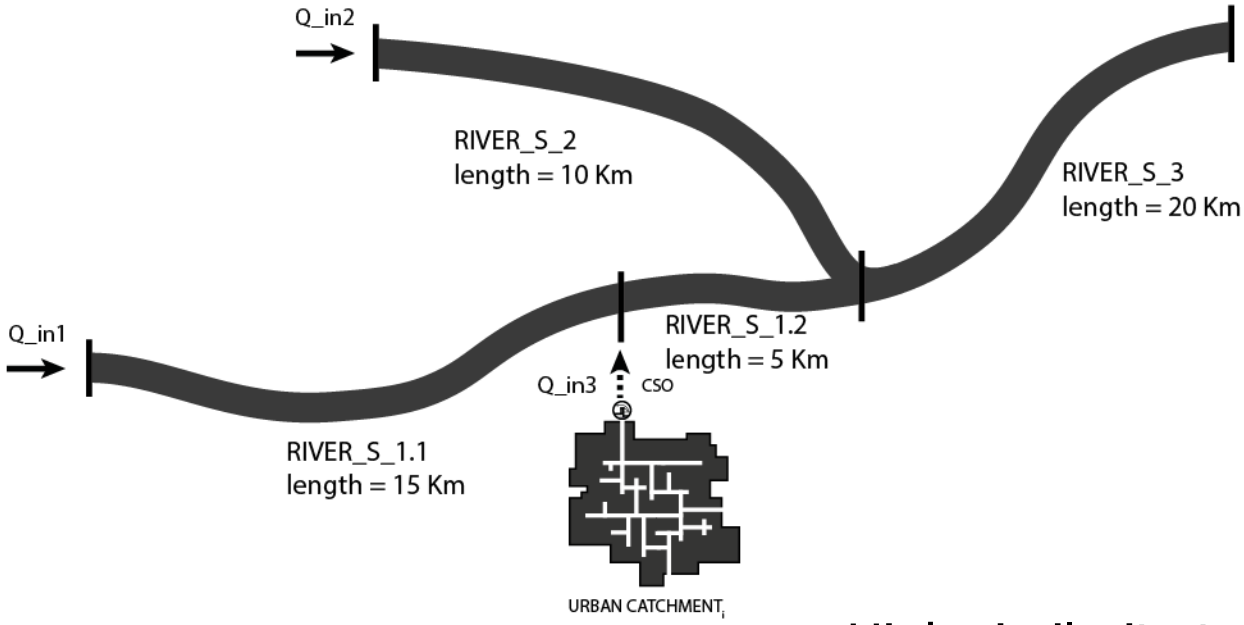
-Storage Method (SM)

-Varying Parameters McCarthy Muskingum method (VPMM)





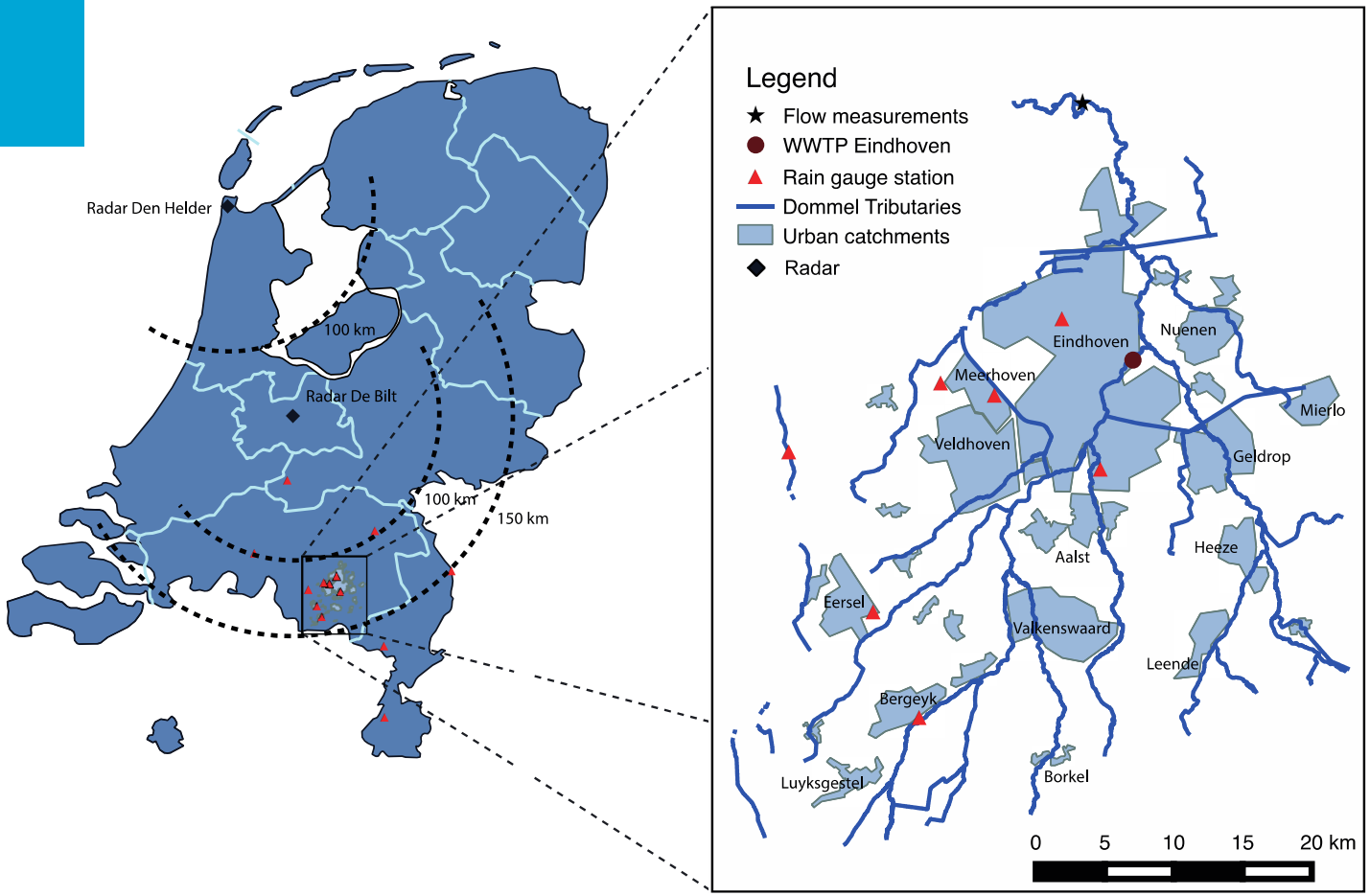
4- Synthetic experiments



- 40 km trapezoidal channel
- Lateral inflow from a urban-like discharge and a 10 km river tributary.

- High similarity to 1D-SWE for several channel characteristics
- SM presents a dependency on the spatial discretization
- Validated lateral inflow

5- Study area



- 5-25 m3/s
- 30 municipalities
- ~200 CSO
- WWTP 750,000 p.e.

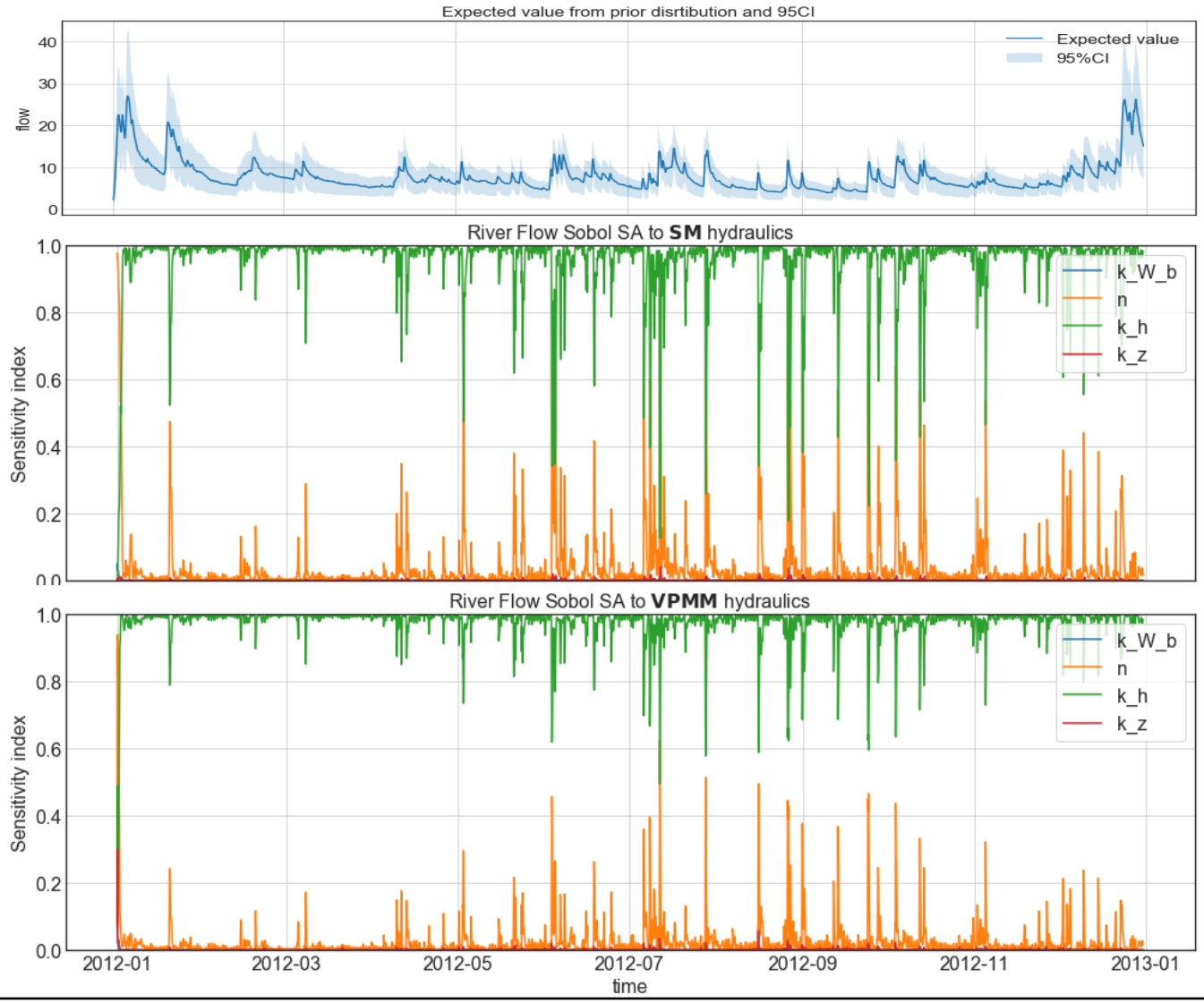
6- Model structural error comparison

1. Set up the SM and VPMM model structures
2. Sensitivity Analysis to flow and dissolved oxygen
3. Calibration (flow-depth-Dissolved oxygen)
4. Bayesian parametric inference (flow) $Y = M(x, \theta) + \varepsilon$

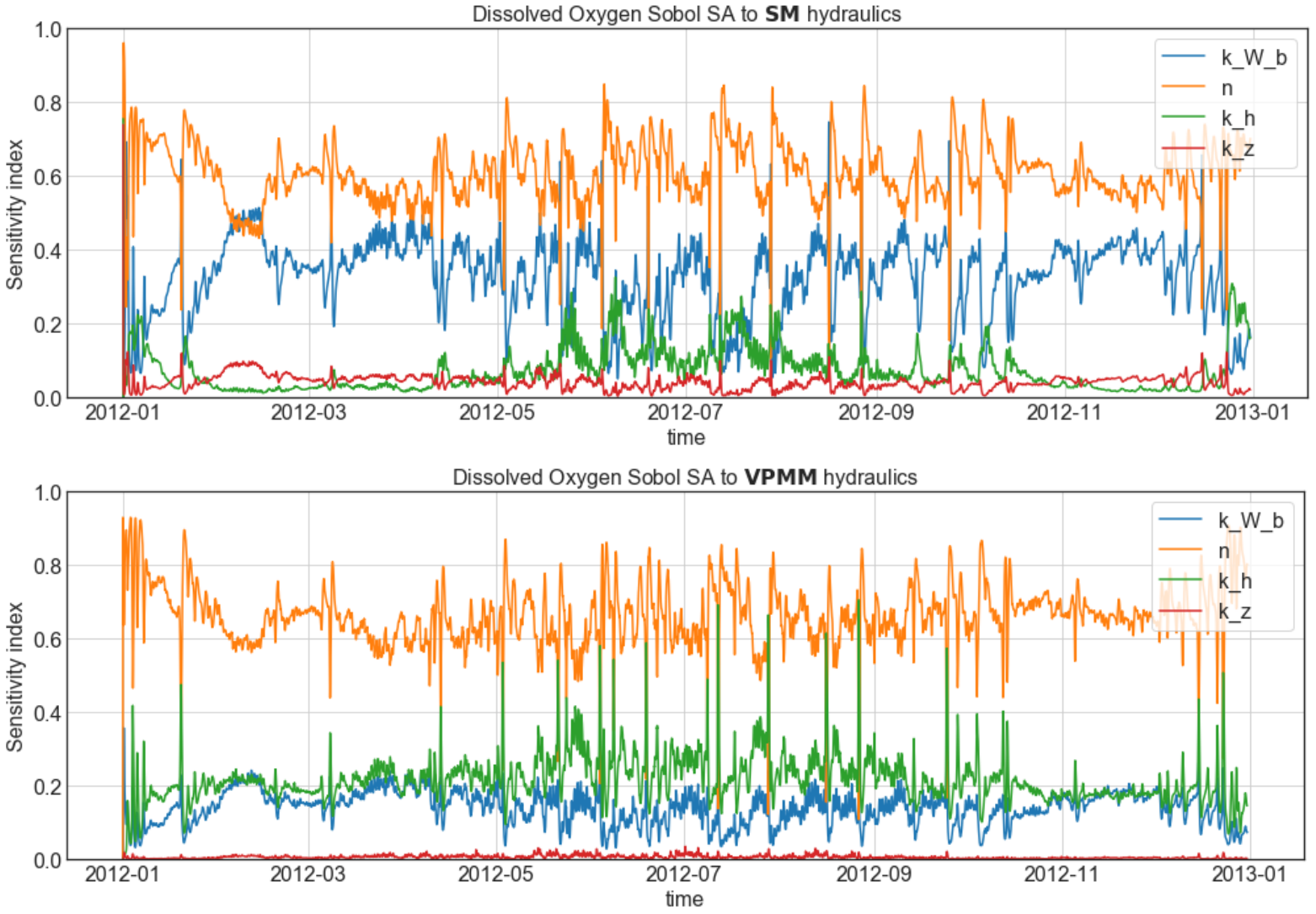
Table 1 Parameter Prior distribution

Parameter	Pdf	Range	Description
n	Uniform	0.02-0.2	Manning
k_W_b	Uniform	0.3-2	Width section multiplier
k_z	Uniform	0.3-2	Embankment slope multiplier
k_h	Uniform	0.3-2	Hydrology input multiplier

7- Sensitivity Analysis (River Flow)



7- Sensitivity Analysis (Dissolved Oxygen)

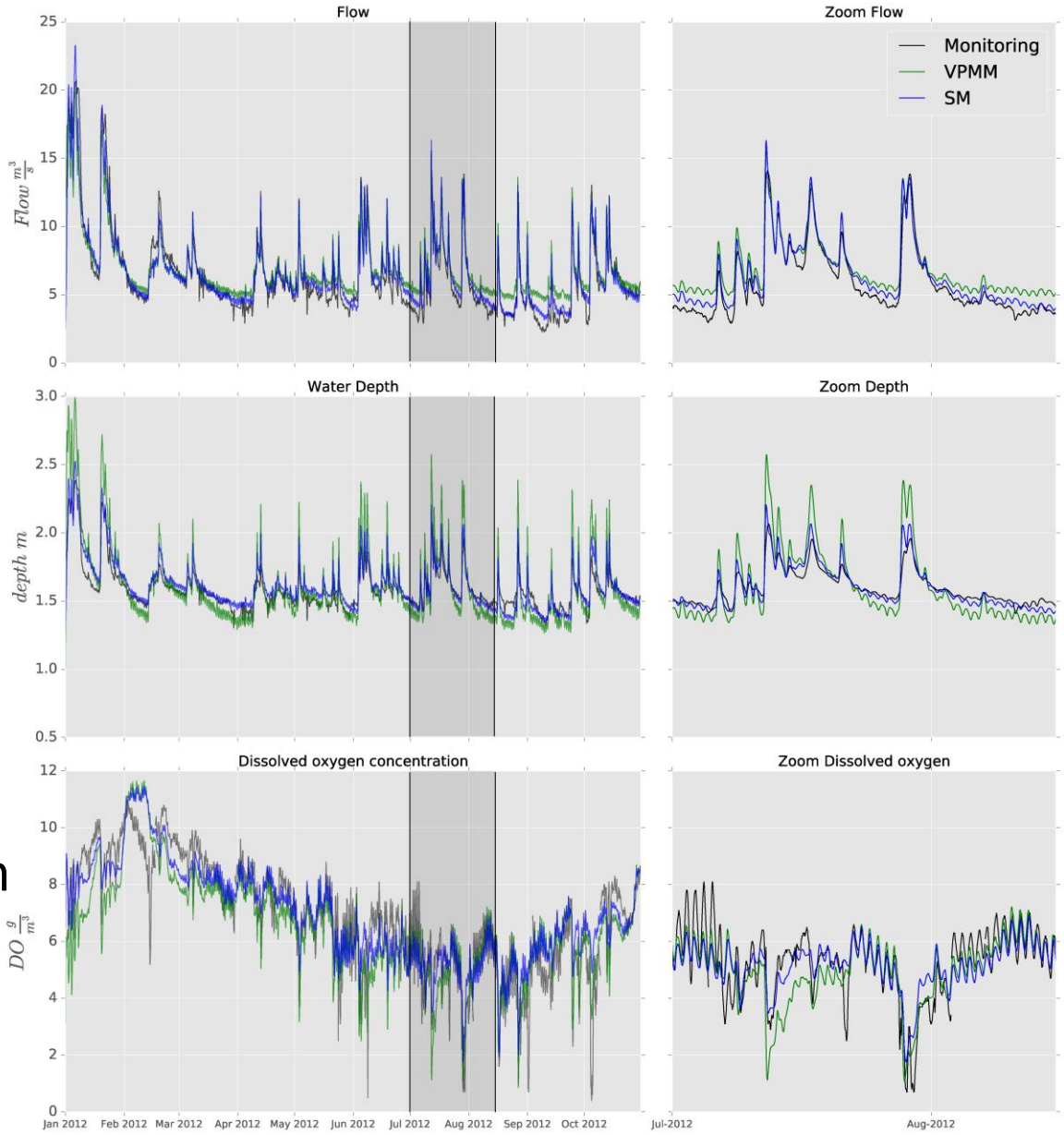


8- Calibration

- Flow
- Depth
- DO

Maximization of
N-S efficiency.

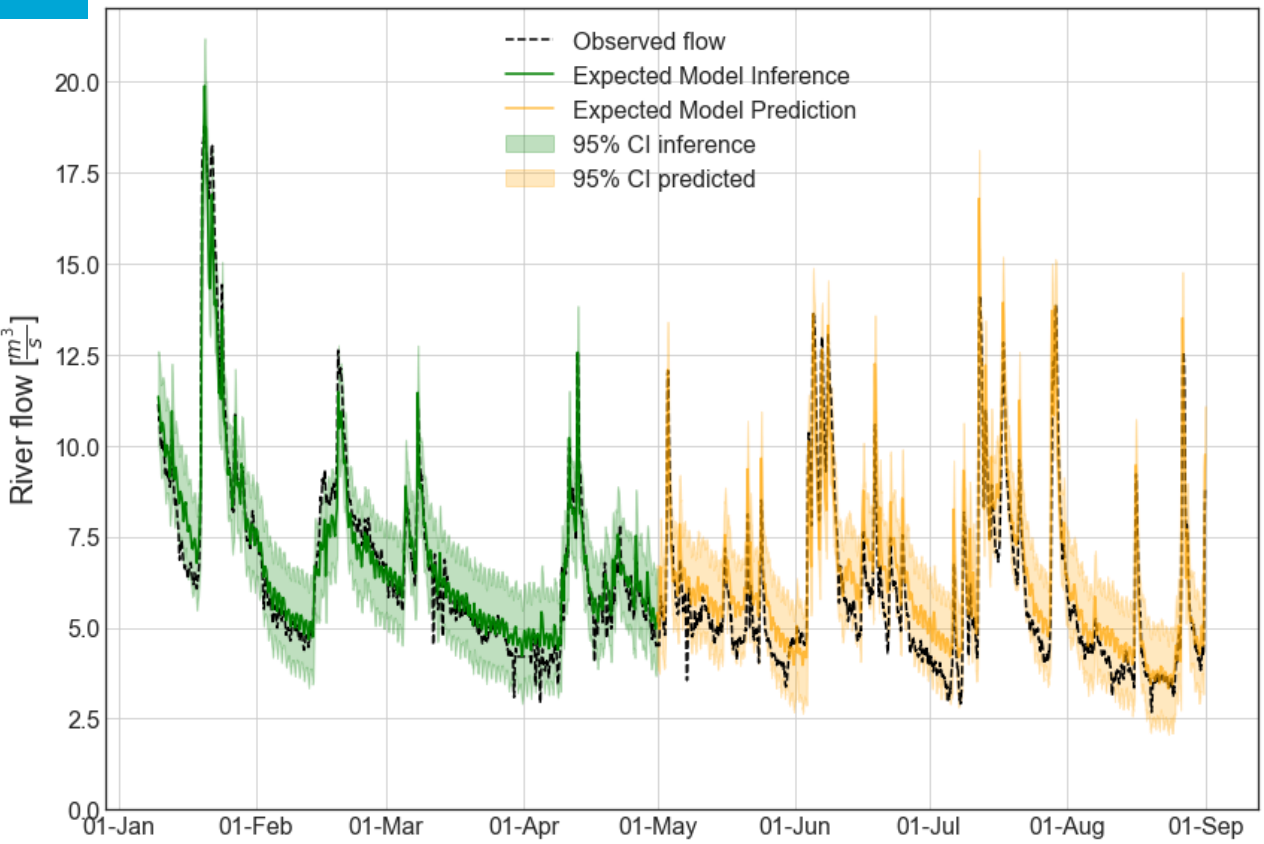
- Higher VPMM bias in dry weather conditions
- Higher depth dispersion in VPMM

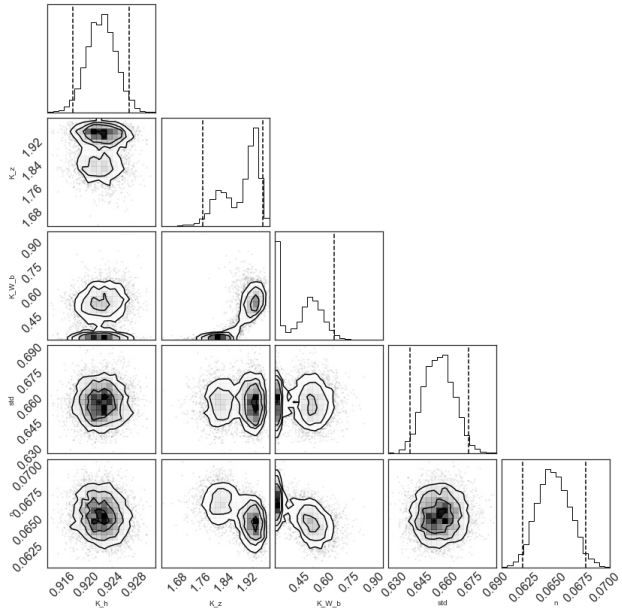


9- Model inference

Example **SM**

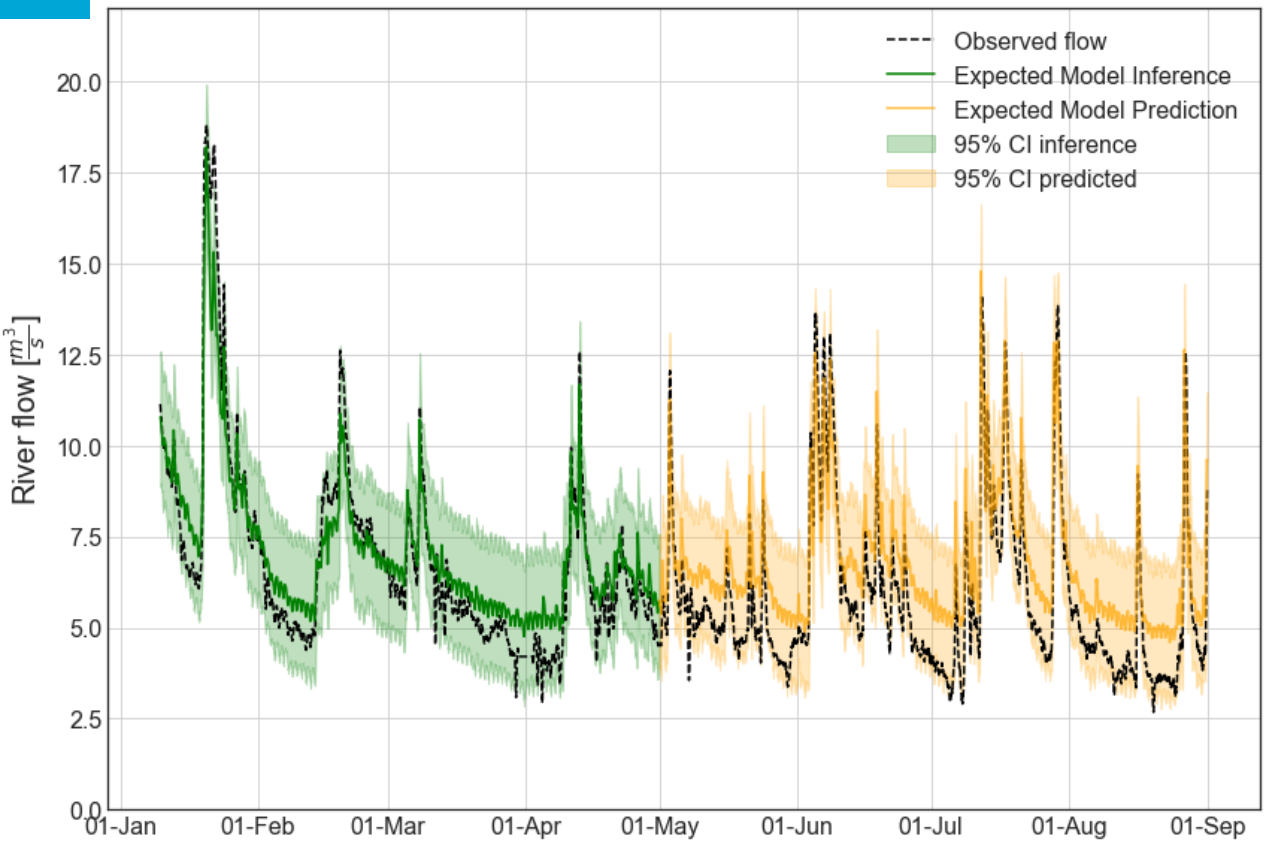
- iid Gaussian likelihood
- Polynomial Chaos Expansion emulator
- MCMC – metropolis hastings
- 50000 samples

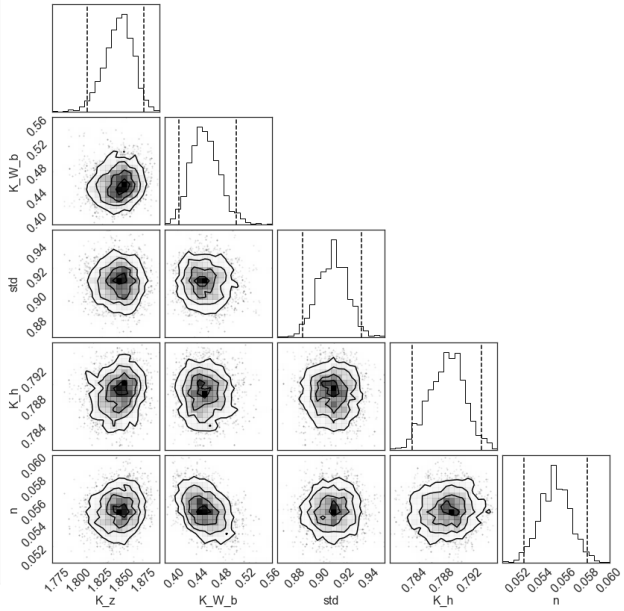




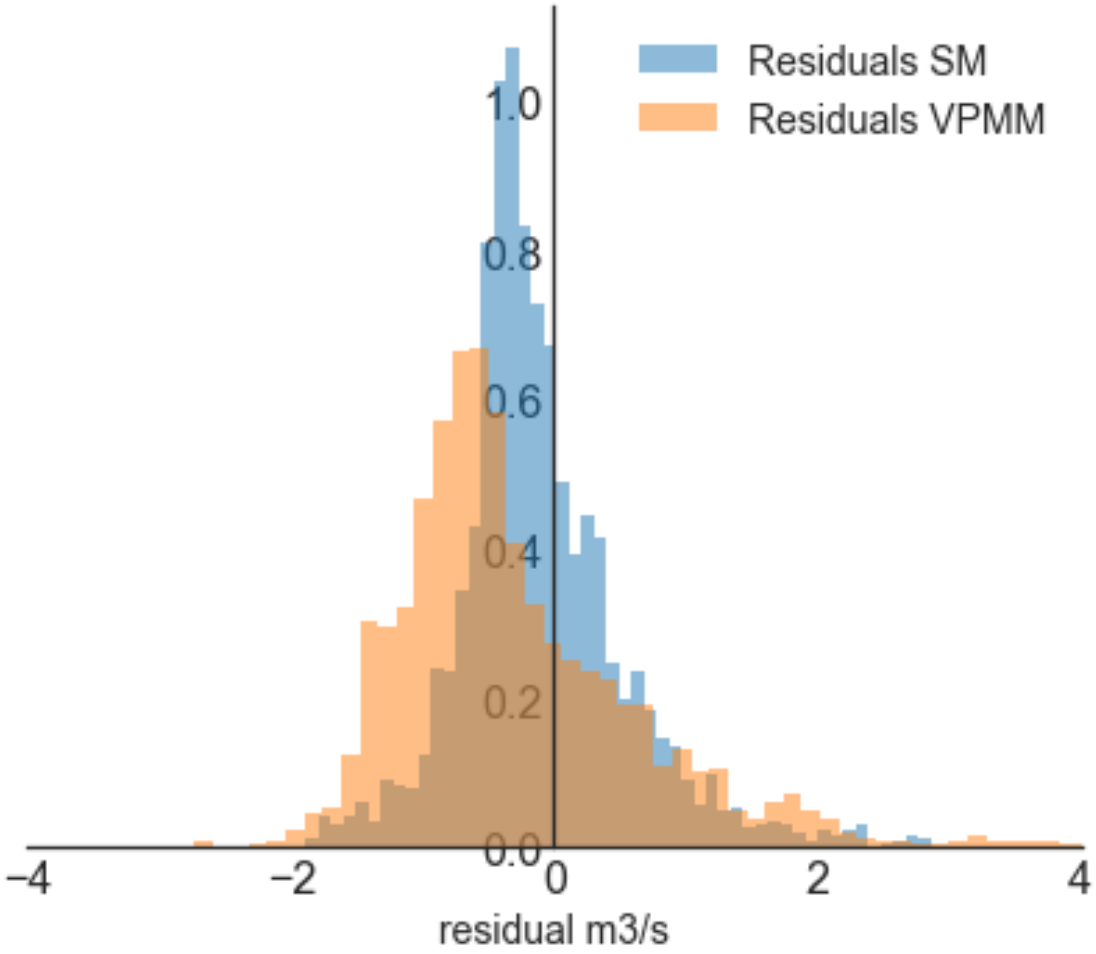
9- Model inference

Example **VPMM**





10- Residual exploration



11- Summary and conclusions

- Differences on DO patterns sensitivity to hydrology
- Water quality dynamics are affected (**parameters do not generalize**)

SM

- Good match of flow-depth dynamics in the real system.
- Sensitive to **tank length** (spatial discretization)
- Computational time ~280s for 1 year

VPMM

- Best match of 1D-SWE under **ideal conditions**.
- **Slower** average Computational time ~ 570s for 1 year

Thanks for your attention

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Annex 1 PCE fitted dynamics (performance check)