

Supplementary Material S4 - Uncertainty analysis

The uncertainty analysis was performed using the GLUE methodology (Generalized Likelihood Uncertainty Estimation) [1]. This methodology is as follows:

- 2 A series is generated for each simulated date, where each element of the series represents the value of the simulated variable for that specific date. In other words, if there are simulations with 100 different parameterizations, a series of 100 elements is generated, each containing the value of the variable for the evaluated date.
- 2 Each of these simulations has an associated performance statistic. Based on this statistic, the method assumes that the probability of occurrence of that simulation corresponds to the inverse of the normalized statistic (1/Normalized Statistic).
- 2 The series constructed in step 1 is rearranged from highest to lowest according to the probability of occurrence, and with this probability, the cumulative distribution function is generated.
- 2 For the 5% confidence limit, the value of the variable whose associated value in the cumulative distribution function is closest to 0.05 is then taken. A similar approach is used for the 95% confidence limit: the value of the variable associated with the cumulative distribution value closest to 0.95 is taken.

For the uncertainty analysis of the hydrological model, this procedure is iterative and is performed for each of the dates in the simulated period. Thus, for each date, there are values of Q5 and Q95, which enables the generation of a complete series for the upper and lower ranges. In the case of sediment and water quality module, this procedure is only performed once, and the median of the 5% and 95% data is calculated. This is because for this calibration process there are specific observed records, so the simulated series are filtered for specific dates, and time series are not evaluated as in the case of hydrology.

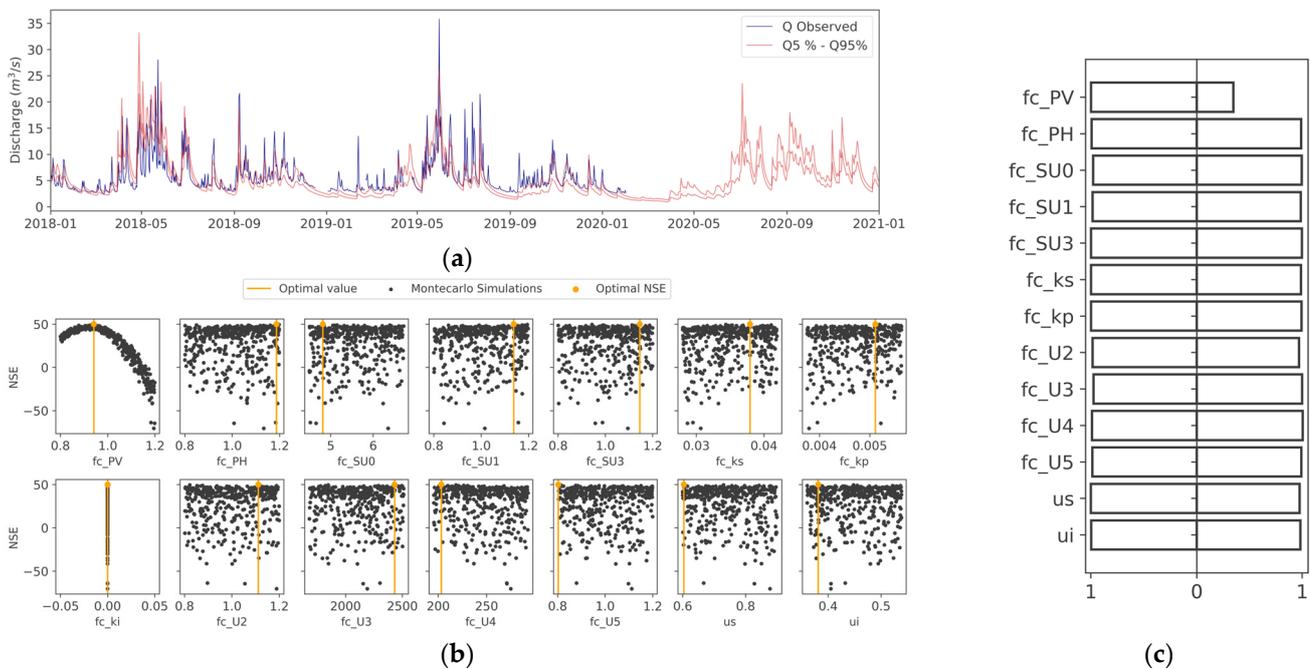


Figure S19. Calibration and sensitivity analysis for the stream flow module: (a) confidence intervals obtain using the GLUE methodology; (b) dispersion plots and optimal parameters after Monte Carlo simulations; and (c) sensitivity assessment for each parameter.

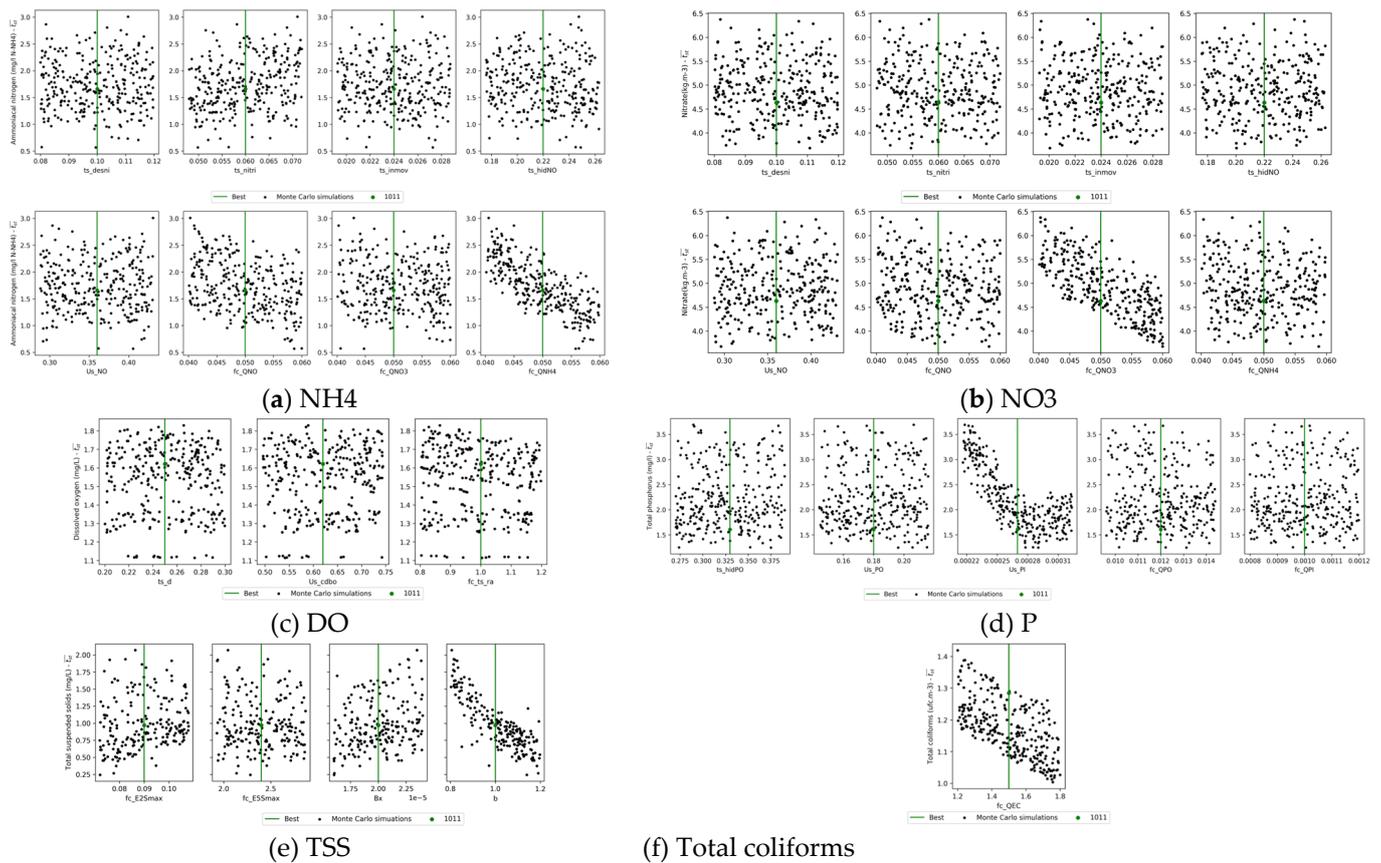


Figure S20. Dispersion plots and optimal parameters after Monte Carlo simulations for (a) ammonia (NH₄), (b) nitrates (NO₃), (c) dissolved oxygen (DO), (d) total phosphorus (P), (e) total suspended sediments (TSS) and (f) pathogen indicators (total coliforms).

References

1. Beven, K.; Binley, A. The Future of Distributed Models: Model Calibration and Uncertainty Prediction. *Hydrol Process* **1992**, *6*, 279–298, doi:10.1002/hyp.3360060305.