Merging and calibration of radar rain products for quantification of input uncertainty in urban drainage the Haute-Sûre catchment in Luxembourg

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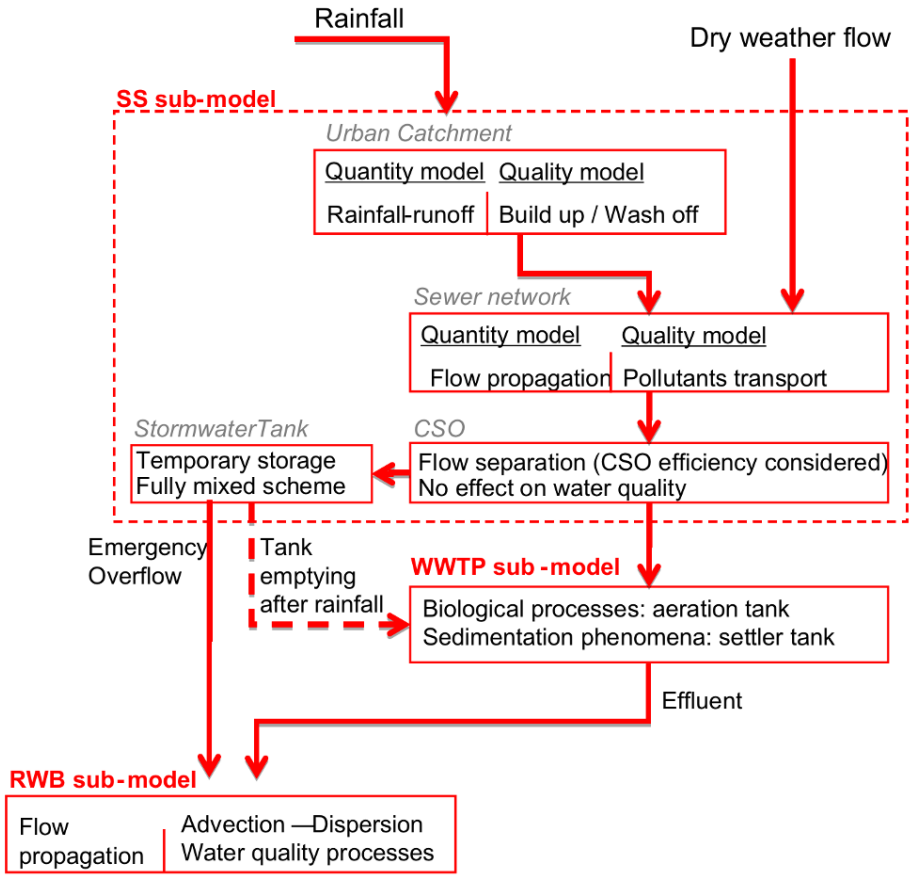
LIST

Integrated urban drainage modelling

Different sub-models, processes and interconnections



[Freni and Mannina, 2010].

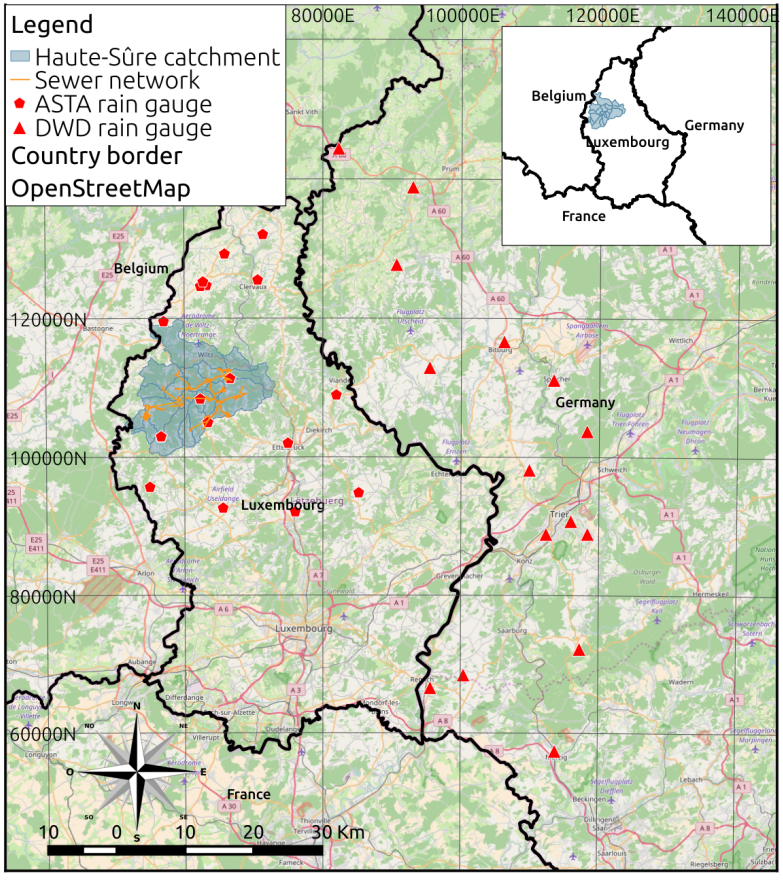
Challenges in Urban Drainage Modelling, UDM

- Sub-models at different spatial and temporal scales
- Requires up- and down-scaling to connect sub-models correctly
- Uncertainties associated to model inputs, model parameters, and model structure
- Uncertainties propagate across scales to effect the final model outputs

Current research

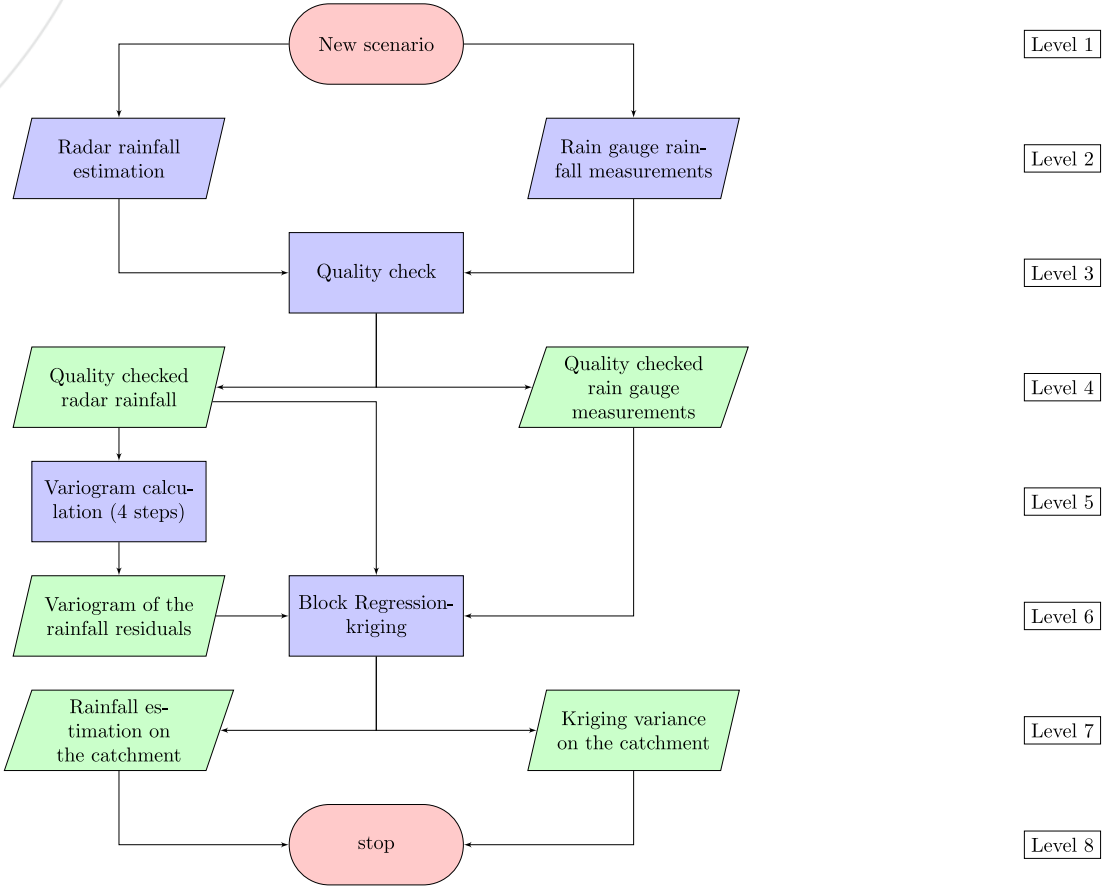
- Specific research questions:
  - What is the most appropriate workflow to calibrate five-minute rainfall radar imagery with ground rain gauges at one-minute resolution?
  - can we demonstrate that the space-time high resolution precipitation and run-off maps will provide much more detailed inputs at the correct location and timing so that the simulations become more realistic in particular when we do uncertainty propagation where we need to sample from realistic input space-time distributions and consider the correct scale (or space-time support).

Case study



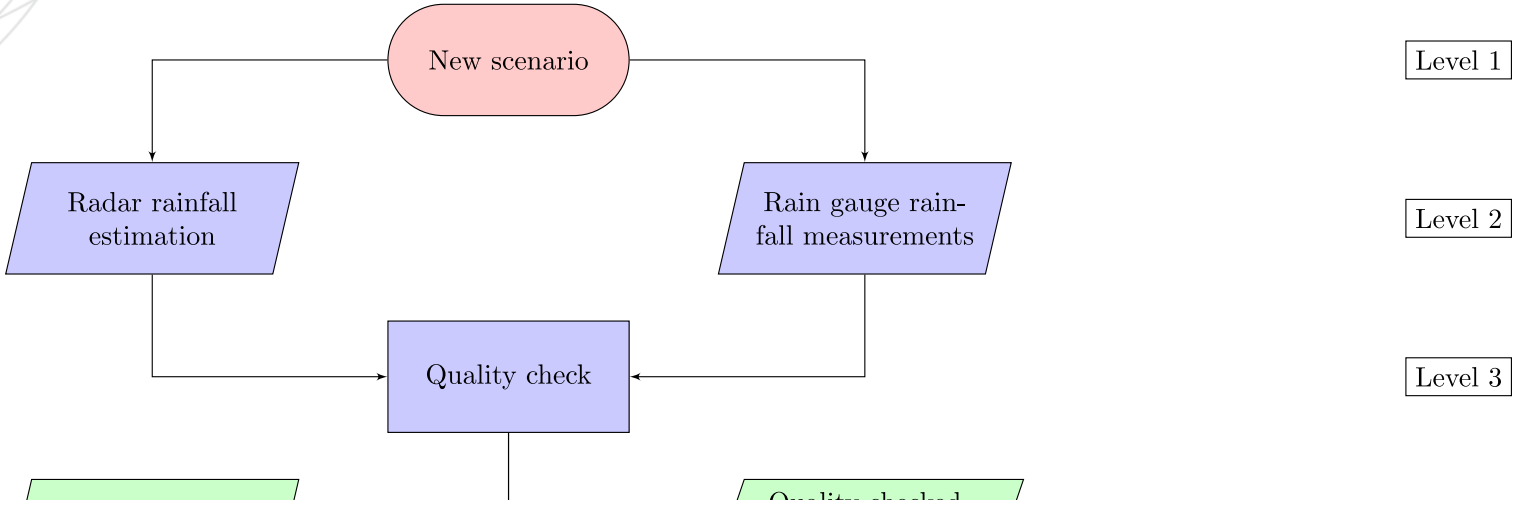
Haute-Sûre catchment, ASTA and DWD rain gauge networks. The radar imagery from the Neuheilenbach radar is not presented but it covers the whole extend of the map presented here.

Work flow 1: Rainfall estimation and uncertainty quantification

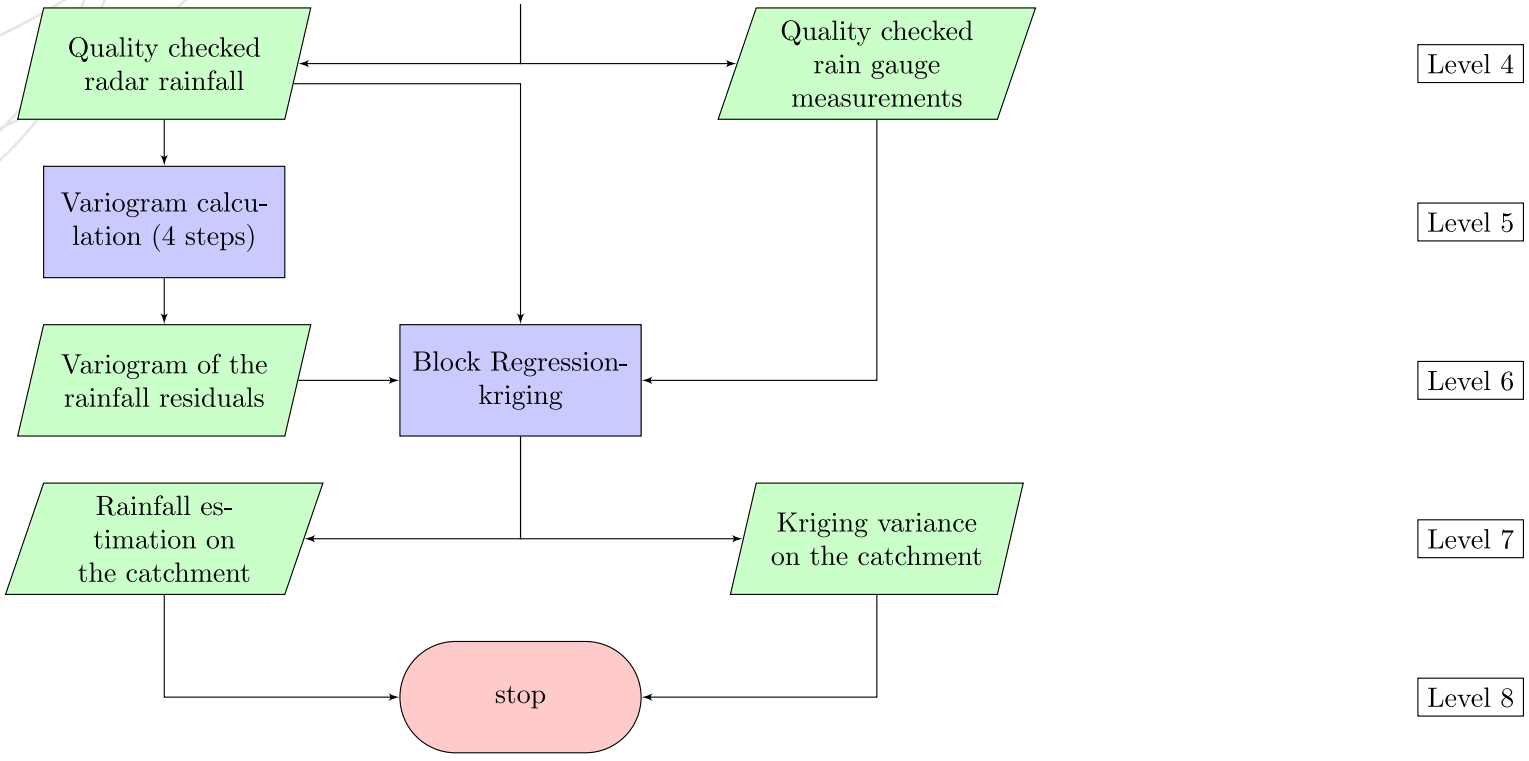


Red node = terminal; blue rectangular node = process; blue trapezoidal node = input; green trapezoidal node = output.

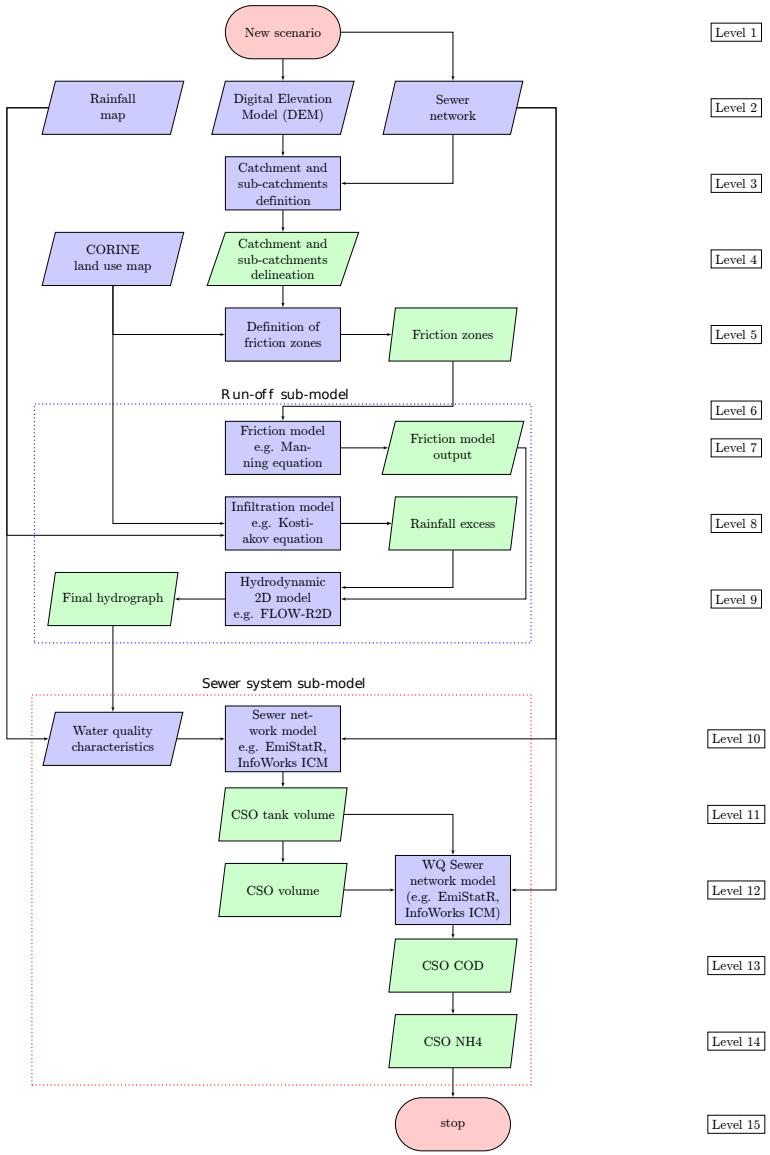
Work flow 1a: Rainfall estimation and uncertainty quantification



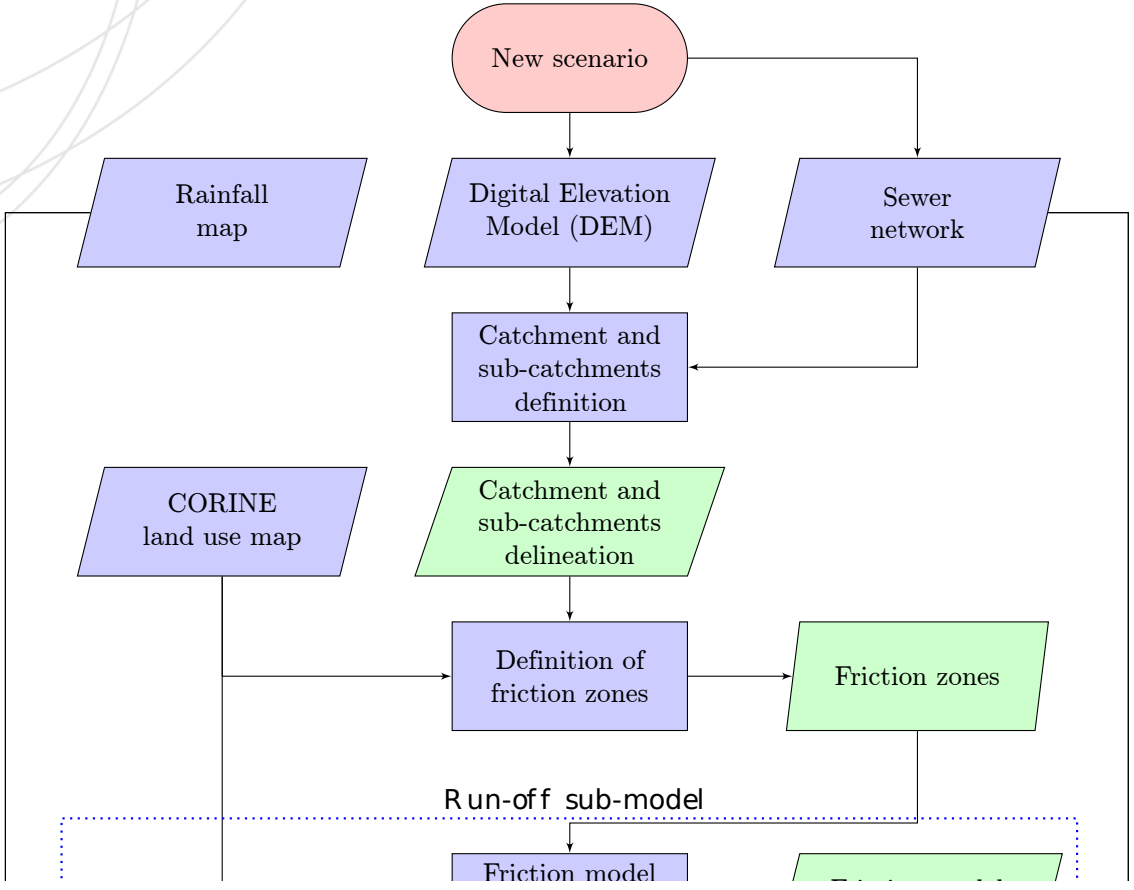
Work flow 1b: Rainfall estimation and uncertainty quantification



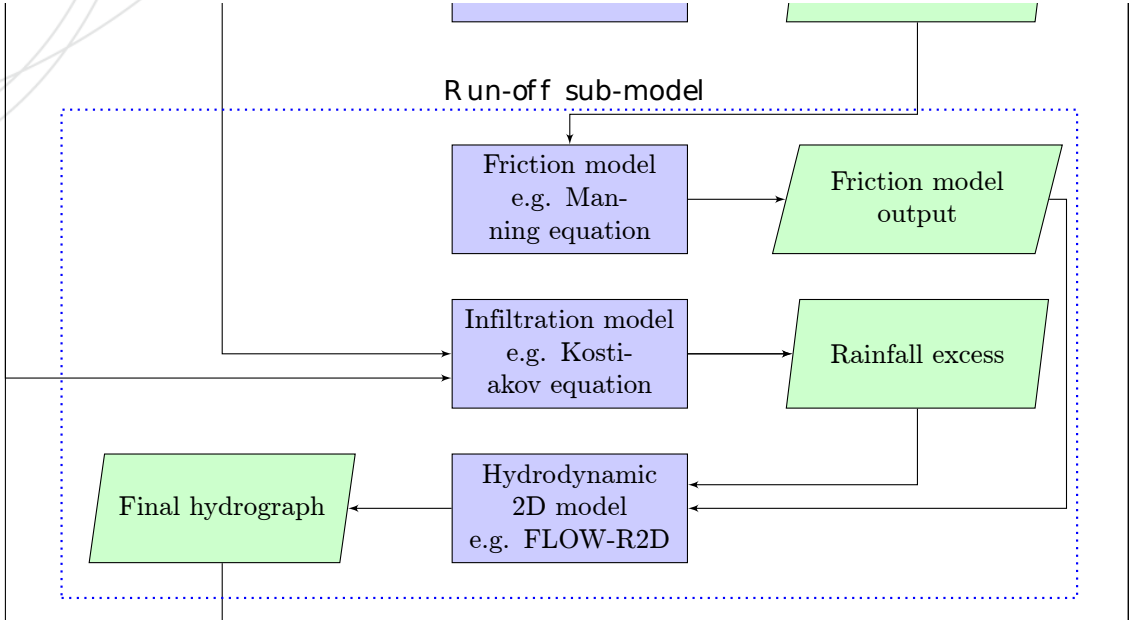
Work flow 2: Run-off and sewer system modelling



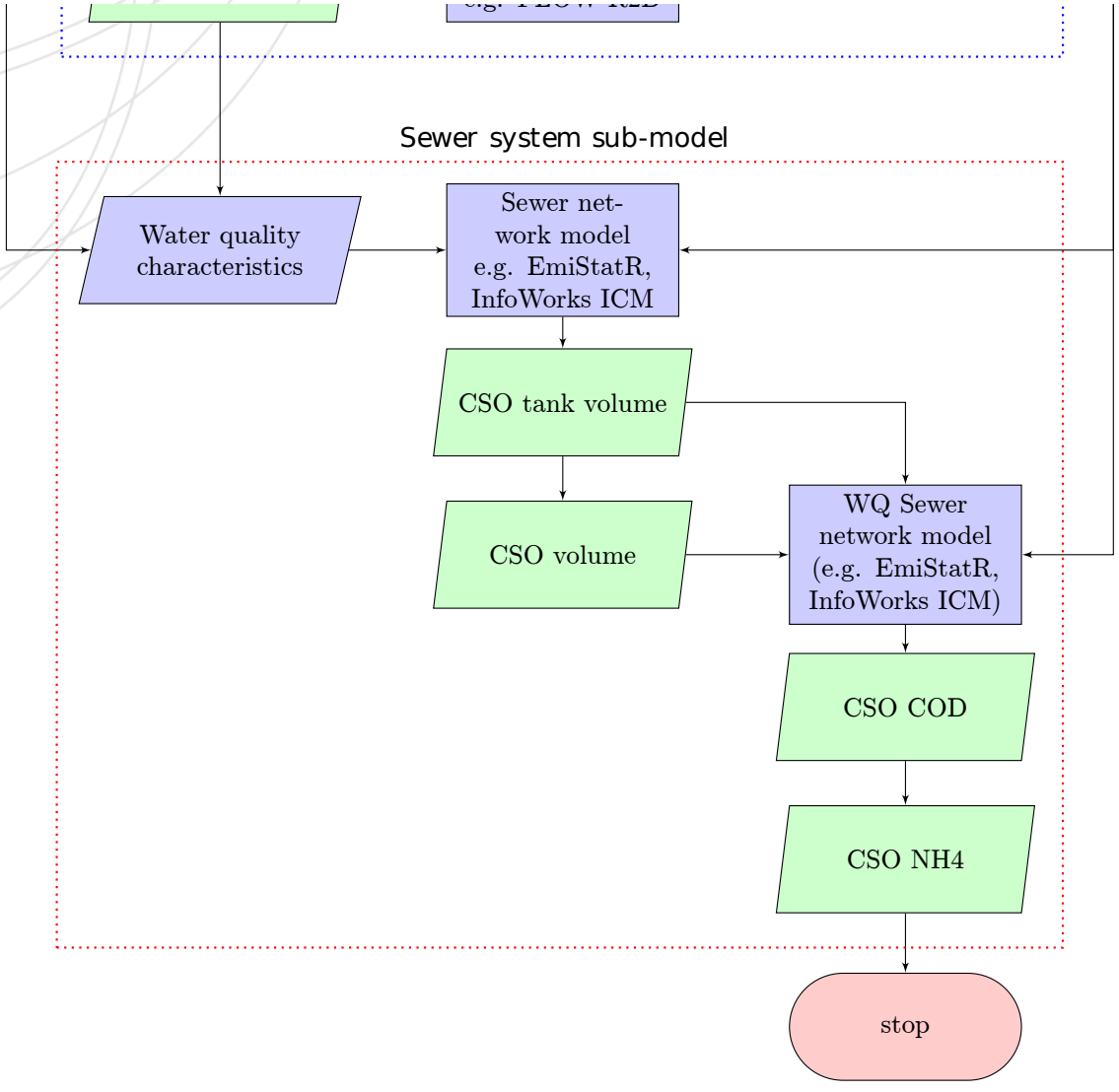
Work flow 2a: Run-off and sewer system modelling



Work flow 2b: Run-off and sewer system modelling



Work flow 2c: Run-off and sewer system modelling



Conclusions

- We proposed a work flow to build and calibrate a space-time geostatistical model of rain, using radar imagery as a covariate in regression-kriging based simulation. Also a work flow for run-off and sewer system modelling was presented.

- These work flows can be repeated as many times as the Monte Carlo (MC) simulation requires to obtain an ensemble of rainfall input maps and time series of quantity variables (volume of the CSO tank, and CSO volume) and quality variables (loads and concentrations of COD and NH_4).

- We expect that these work flows represents a more realistic simulated time series of rainfall originating run-off that enters the sewer system, and we can do the input uncertainty propagation and compare with previous studies we did.

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Thank you!

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Bibliography I

Gabriele Freni and Giorgio Mannina. Uncertainty in water quality modelling: The applicability of Variance Decomposition Approach. *Journal of Hydrology*, 394(3-4):324–333, 2010. ISSN 00221694. doi: 10.1016/j.jhydrol.2010.09.006. URL http://dx.doi.org/10.1016/j.jhydrol.2010.09.006.