EPFL Design Project – SIE 2023

REPUBLIQUE ET CANTON DE GENEVE
POST TENEBRAS LUX

Modélisation hydrologique pour le traitement de la donnée manquante

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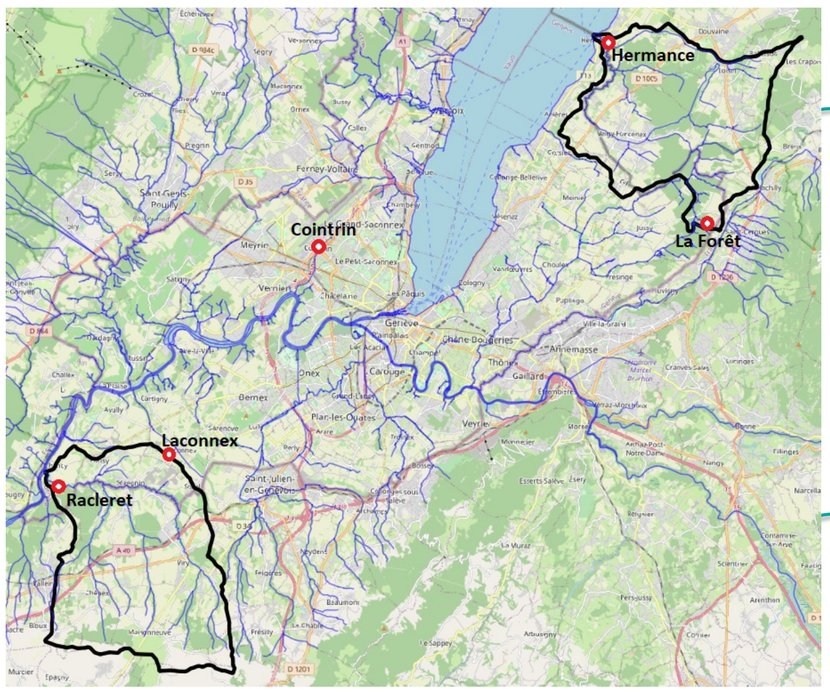
Introduction

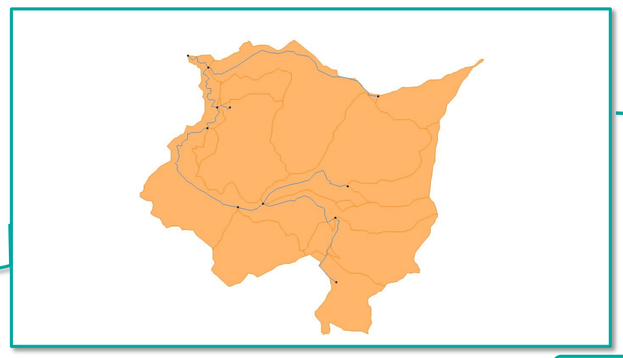
River monitoring networks can suffer from gaps or insignificant data due to instrument disfunction or limitations. Besides that, climate change modifies the seasonal river flow patterns. In this context, hydrological modeling is an interesting tool that allows to better understand the rivers regimes. It may, for example, help better investigating past events, future scenarios or in decision making regarding severe droughts and their impacts on riparian fauna.

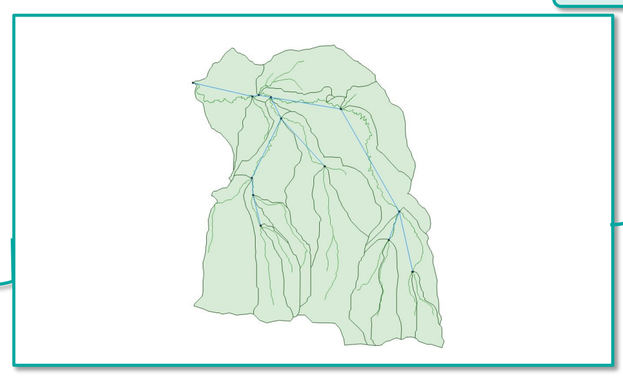
This project aims to use and compare two hydrological models (HBV, SOCONT) to simulate flows with the RS Minerve software for two rivers in the canton of Geneva : the Laire and Hermance river. Those two natural catchments face different issues related to measurements. Simulating over several years allow to bring more finesse to unreliable data and to compute hydrological statistics.

Method

1. Extract GIS files

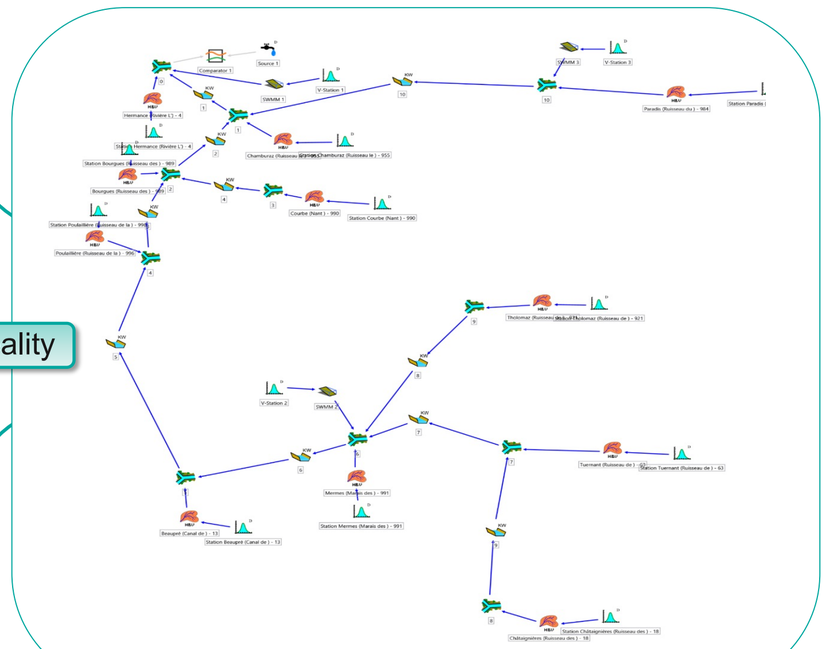






2. Build the model

Simplifed reality



Structure of an HBV model (l'Hermance)

3. Fill the database

Control, correct and enter input data (daily temperatures, hourly discharges and precipitations)

Watershed	Temperature site	Rain gauges	Flow mesaurement site
L'Hermance	Cointrin	La Forêt	Hermance
La Laire	Cointrin	Laconnex	Racleret

4. Test, calibrate and validate the model

- Test parameters sensitivity
- Reproduce annual cycles for each fictive reservoirs
- Find suitable initial conditions, based on those cycles
- Calibrate the model based on the chosen performance indicators, ideally starting in august and for one year
- Validate the model with the unused period

Results & analysis

Perf. indicators	Ideal value	Calibration	Validation
Nash	1	0.73 / 0.62 / 0.57	0.45 / 0.5 / 0.28
Nash-ln	1	0.57 / 0.7 / 0.5	0.74 / -1.33 / -0.21
RVB	0	0.06 / -0.03 / -0.005	0.46 / -0.28 / -0.48

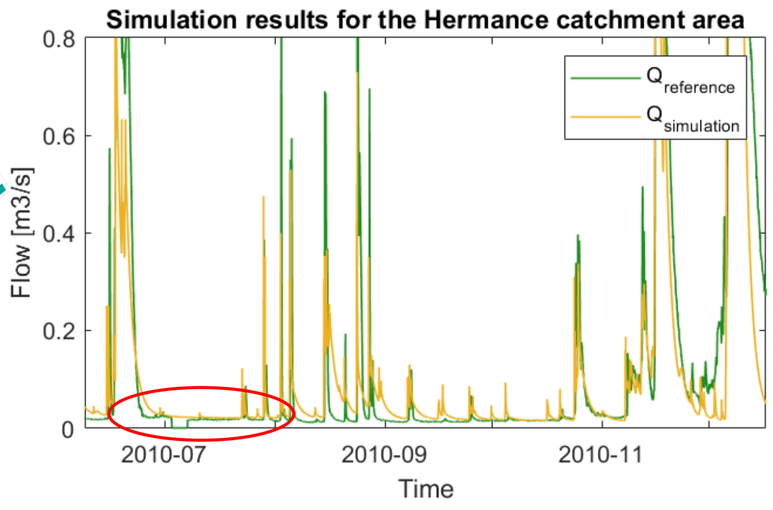
For calibration and validation columns: l'Hermance (HBV) / la Laire (HBV) / la Laire (SOCONT)

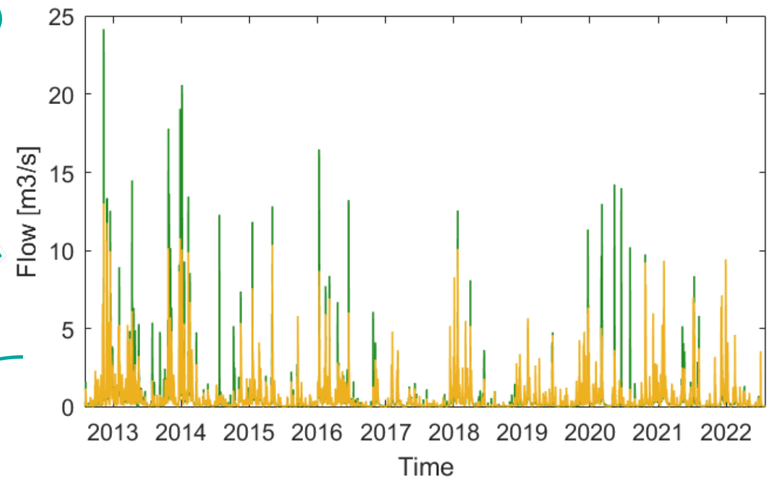
HBV: most appropriate model for natural catchments

Deficient measurement periods investigation

Time extended simulation

Long term analysis of low flows (Q347)





Q347 [l/s]	observed	simulated
La Laire	20	20.8
L'Hermance	10 ± 4	13.8

Conclusion

- More realistic representation of the surface and subsurface response to precipitation with HBV model
- Good estimations of the Q347 for both rivers
- Longer measured discharges series (from 2013), so better robustness and results for l'Hermance, where a cross validation was possible
- Trade off: good performances for low flows but poor fitting for higher discharges
- Limitations: rainfall and temperature data did not always reflect the situation over the whole catchment. Adding more rain gauges or temperature sensors may have improved the results

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