Build and evaluate climate change adaptation with a parsimonious integrated agro-hydrological model over a catchment in northeastern France

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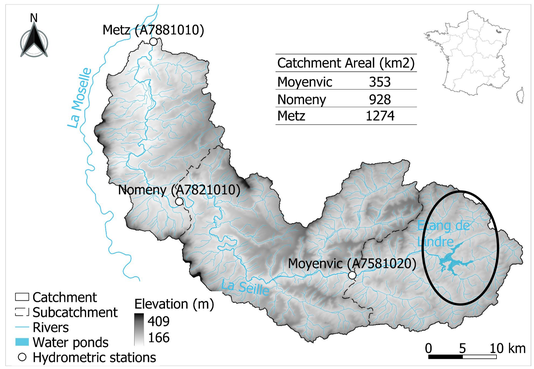
Aims of the study

Use a combination of:
- scenarios (use of a prospective approach)
- parsimonious modelling

To:
- build and evaluate local adaptation strategies to climate change
- consider uncertainties

The Seille catchment



Catchment location and morphology

Annual hydroclimatic characteristics (1989-2018)

Precipitation	Evapotranspiration	Flow (Metz)
800 mm	660 mm	9,6 m³/s

Anthropic characteristics:
- Mainly covered by **croplands** (77.4 % of catchment area)
- **No irrigation**
- Release of **discharge from the Lindre Lake** at autumn (every 2 or 3 years) for fishing
- Metz city (290 000 inhab.) at the outlet

Preliminary results

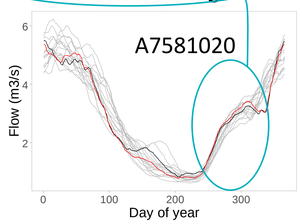
Current situation and constraints:
- No water shortages historically, but **droughts in recent years** (2019, 2020, 2022…)
- Farmers plead for agriculture **modernization** (**methanization**, ploughing pastures…)
- **Conflicts** between farmers and environment actors about the Lindre lake management
- **High** water **salinity**: water for irrigation should be stored during high-flow periods

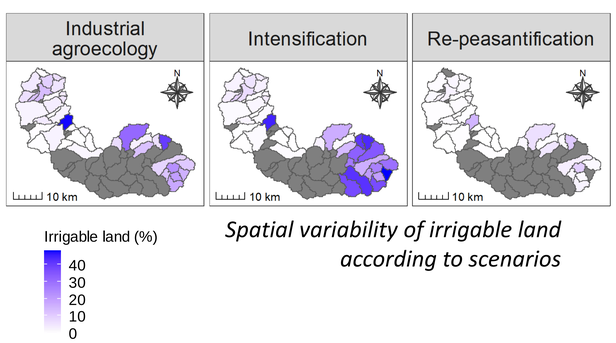
Designed scenarios for explanatory variables / *Contrasted modelling hypotheses*

	Industrial agroecology	*Intensification*	*« Re-peasantification »*
Public action	Compromise	Low leadership	High leadership for environment
Local socio-economy	Diversification but exportation	Industrial farming for exportation	Resettlement, diversification
Natural heritage	Conservation	Disengagement	Back to old agroecosystems
Crops	Diversification of field crops	Cereals ↗	Grassland ↗ Vegetables ↗
Irrigation	Only for strong droughts	+++	Only for vegetables
Lindre objectives	Fishing, irrigation	Irrigation	Fishing, irrigation

Implementation of the model on the Seille catchment taking into account influence of **Lindre lake discharge**

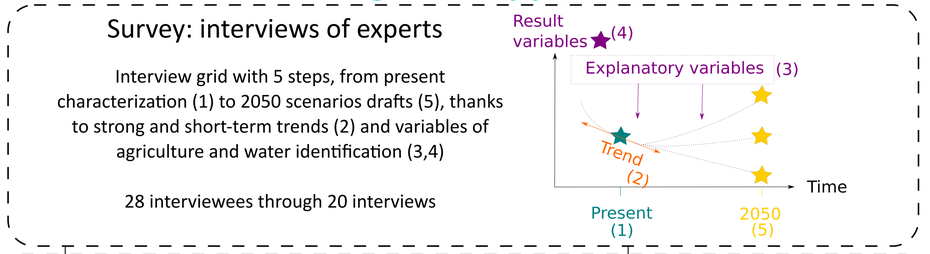
Interannual discharge rolling average (Period: 1989-2018; black: observation, red: simulation with observed climatic inputs, grey: simulation with historical projections)

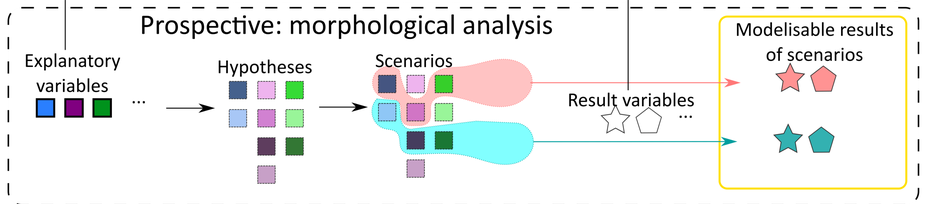


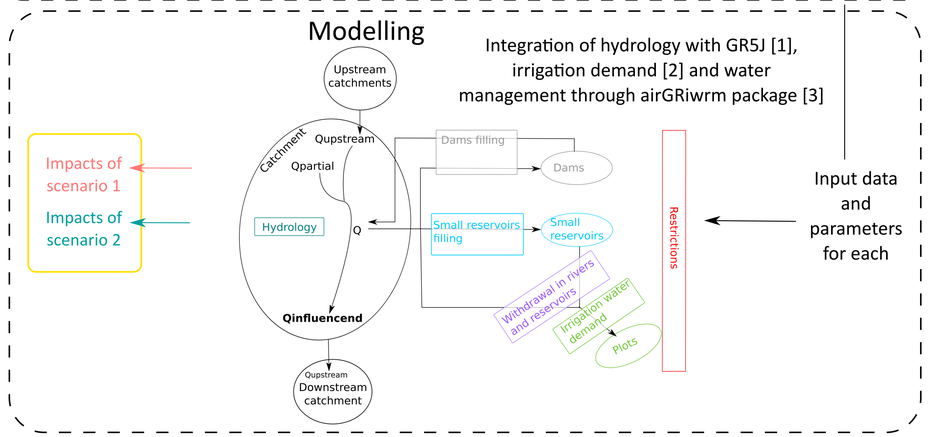


Spatial variability of irrigable land according to scenarios

Our integrated approach







Conclusions and perspectives

A prospective approach provided **three relevant and plausible, contrasted scenarios** on the Seille catchment, enabling to take into account the uncertainty relative to the evolution of agriculture on the study area.

Simulation of scenario hypotheses with future climate projections will help answering the following questions:
- What is the biggest impact factor between climatic and anthropogenic change?
- Should some anthropogenic changes be avoided, or favoured?
- Is a parsimonious modelling approach satisfying to study climatic and anthropogenic changes at this scale?

[1]Le Moine, N., 2008. Le bassin versant de surface vu par le souterrain : une voie d'amélioration des performances et du réalisme des modèles pluie-débit ? (Thèse de doctorat). Université Pierre et Marie Curie, Paris.

[2]Soutif-Bellenger, M., Thirel, G., Therond, O., Villerd, J., 2023. As simple as possible but not simpler?: the case of irrigation modeling at catchment scale in southwestern France. Irrig Sci. doi: 10.1007/s00271-023-00846-x

[3]Dorchies, D., Delaigue, O., Thirel, G., 2022. airGRiwrm: Modeling of Integrated Water Resources Management based on airGR. R Package version 0.6.1. doi:10.15454/3CVD1I