An optimisation tool to support consultation on water uses

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Water and Energy – a common issue

90% of EDF's dispatchable generation (hydropower, nuclear and thermal plants) is directly dependent on water. The long-term variability of water resources is a major issue for EDF, which has adopted a specific commitment to water management as part of its corporate social responsibility:

« As a responsible user and a major player in water resource management, the EDF Group is committed to helping preserve water resources in order to promote the resilience of environments and satisfy uses in a concerted and sustainable manner. »

Morgane – an in-house EDF tool to optimize hydroelectric valley

EDF Hydro currently stores 6 billion cubic meters of water in its French reservoirs **and 2/3 of its hydroelectric concessions already have at least one other use of water.**

Multi-purpose Hydropower reservoir optimization must adress a **multi-scale approach** : from a local/regional scale for water management to national/european scale for energy.

To optimize the generation plan for its hydroelectric valleys or to conduct long-term investment studies on hydropower, EDF uses an internal tool named Morgane developed by its research and development department.

This tool is coupled with a large-scale electric system modeling which determine the optimal use (at least cost to the power system) of a set of generation assets. **Thanks to the model ability to represent the multiple uses of water, it is increasingly used in consultations on water use, and climate change in hydroelectric valleys.**
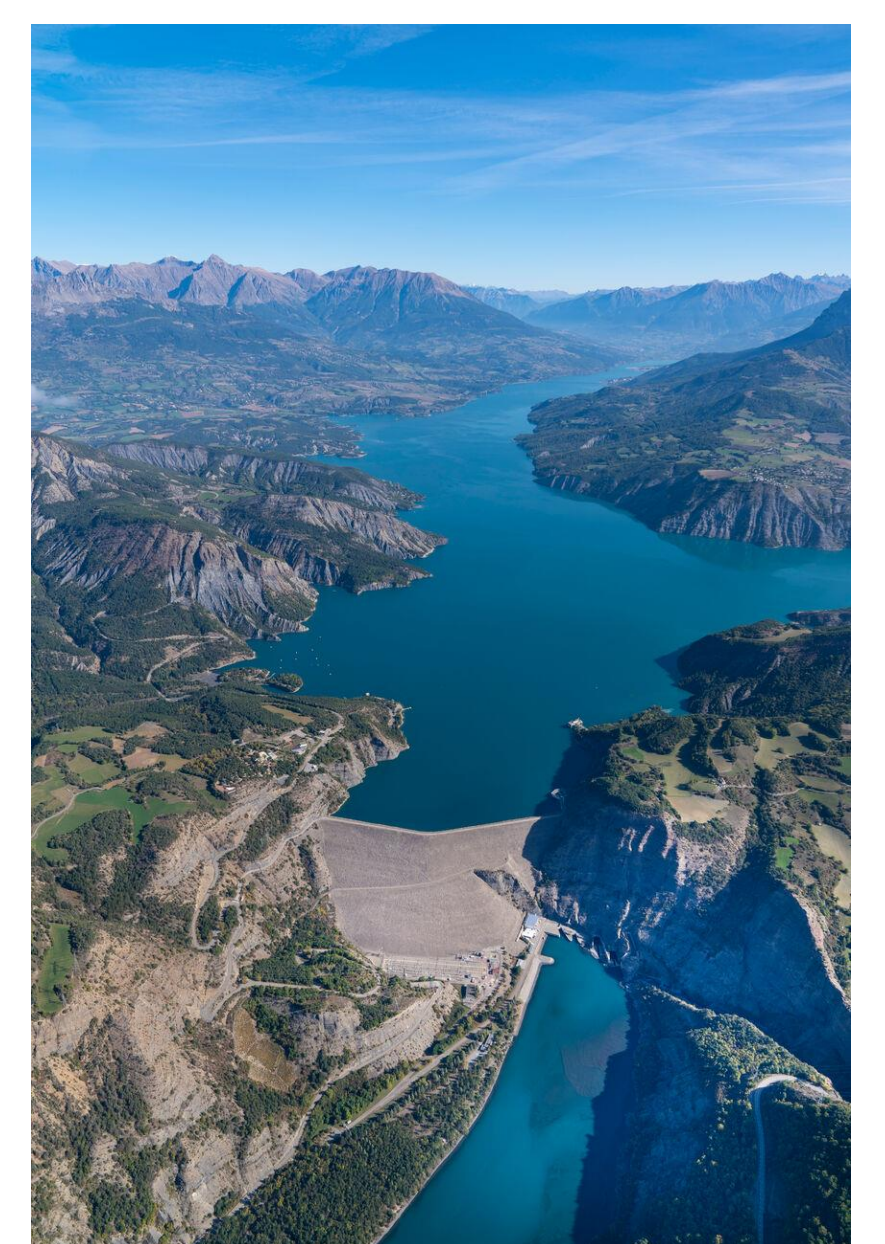
Serre-Ponçon reservoir upstream of the Durance valley

Consultations on Water uses – a permanent challenge

A good understanding of the methodological principles of the model is a key success factor for co-developing scenarios to be modeled, establishing evaluation criteria, to decide on and then implement, with the many stakeholders involved in water management, management rules that are more resilient to climate variability, while also taking account of energy issues and in particular the need to preserve the flexibility of hydroelectricity.

Illustration of Morgane's basical methodological principles

Based on dynamic programming principle applied to energetic reservoir optimization, **the Morgane model distinguishes itself by considering the other water uses preliminary to energetic optimization through the calculation of envelope curves.**

These envelopes represent the minimum/maximum target volumes at each time step to satisfy the other water uses specific to each hydroelectric valley.

A simulation phase enables the model to be run with historical hydrological inputs or hydrological projections for future climate resulting from the coupling of climate models with rainfall-runoff hydrological models.
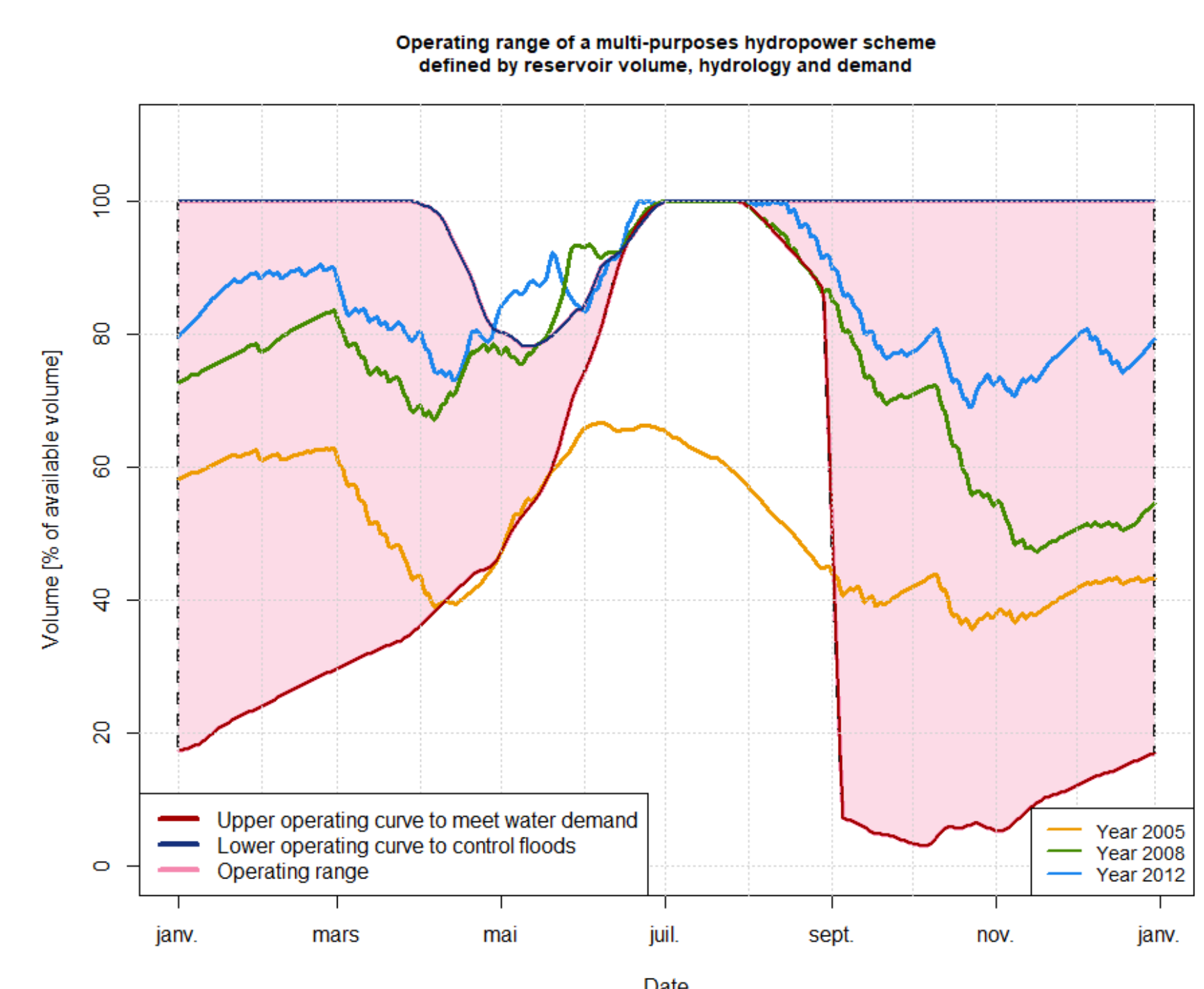
(1) Envelope curves
of the optimal lake management
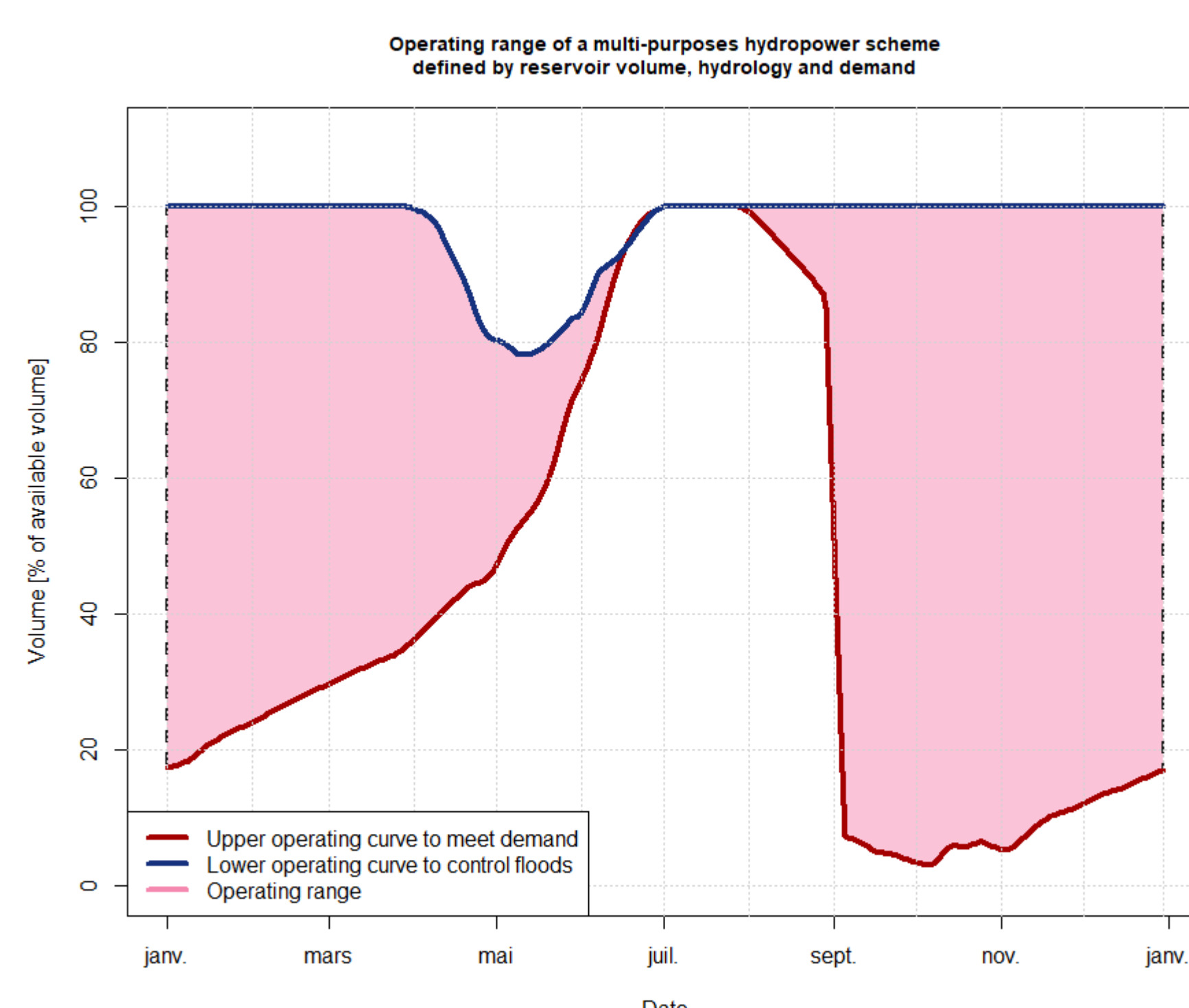
(2) Optimization phase
calculation of water values (energy)
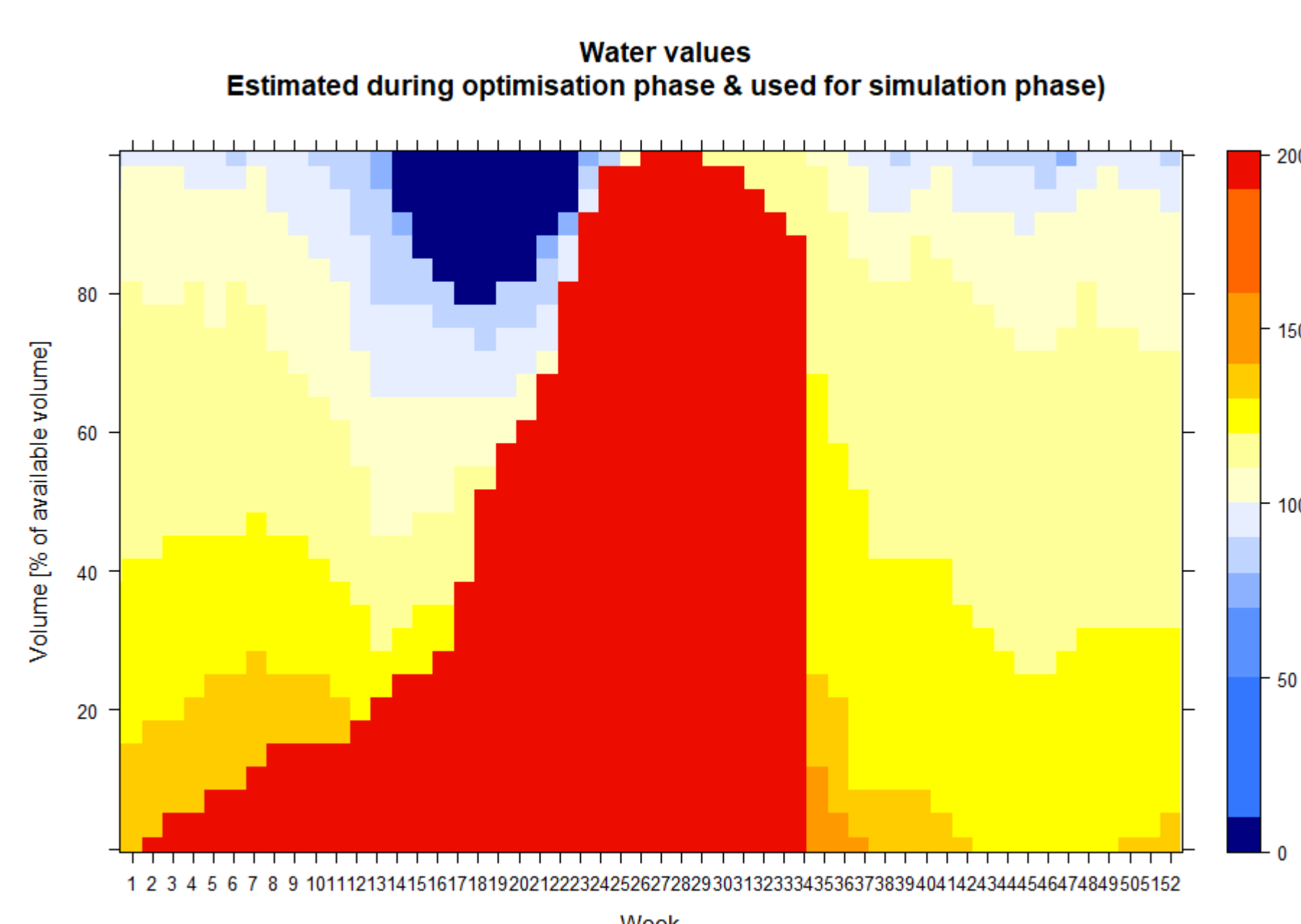
(3) Simulation phase
with several hydrological scenarios

Main lessons learned from using this tool in consultations

The flexibility of the modelling tool makes it possible to represent environmental issues (in quantitative terms), the different uses of water and energy aspects. **The main challenge for the modeler is to ensure that the indicators of interest for the various uses are clearly highlighted (or even developed jointly with the stakeholders)**. These models are used to support discussions on water management in some of France's most emblematic hydroelectric valleys, such as the Garonne and its tributaries, the Durance chain, and many other hydroelectric valleys. The experience acquired in France has also enabled this tool to be deployed in international studies.
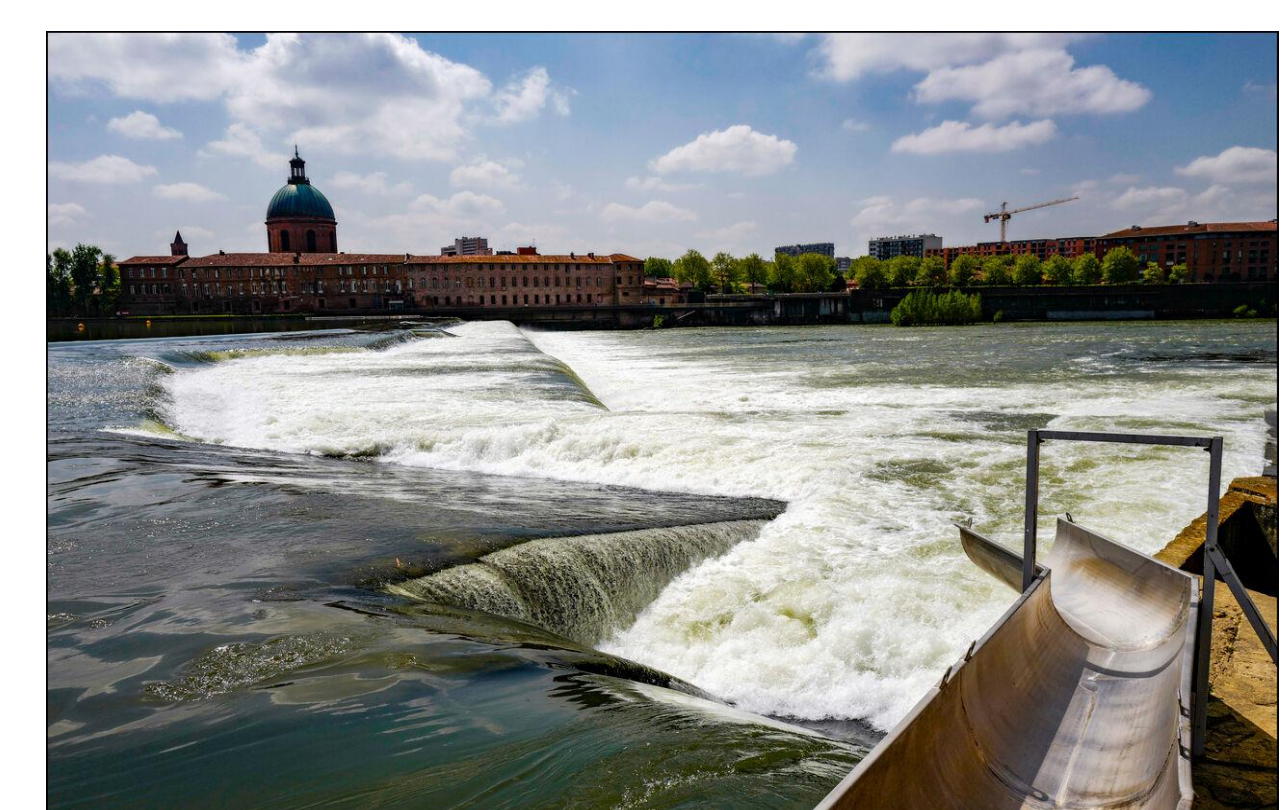
The Garonne river in Toulouse – a joint water management involving multiple actors