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# Climate change impact on the management of water resources in the Seine River basin, France

David Dorchies (1), Guillaume Thirel (2), Mathilde Chauveau (3), Maxime Jay-Allemand (1), Charles Perrin (2), and Florine Dehay (1)

(1) IRSTEA, Montpellier, France (david.dorchies@irstea.fr), (2) IRSTEA, Antony, France (guillaume.thirel@irstea.fr), (3) Brl Ingénierie, Nimes, France (mathilde.chauveau@brl.fr)

It is today commonly accepted that adaptation strategies will be needed to cope with the hydrological consequences of projected climate change. The main objective of the IWRM-Net Climaware project is to design adaptation strategies for various socio-economic sectors and evaluate their relevance at the European scale. Within the project, the Seine case study focuses on dam management.
The Seine River basin at Paris (43800km$^2$) shows major socio-economic stakes in France. Due to its important and growing demography, the number of industries depending on water resources or located on the river sides, and the developed agricultural sector, the consequences of droughts and floods may be dramatic. To mitigate the extreme hydrological events, a system of four large multi-purpose reservoirs was built in the upstream part of the basin between 1949 and 1990.
The IPCC reports indicate modifications of the climate conditions in northern France in the future. An increase of mean temperature is very likely, and the rainfall patterns could be modified: the uncertainty on future trends is still high, but summer periods could experience lower quantities of rainfall. Anticipating these changes are crucial: will the present reservoirs system be adapted to these conditions? Here we propose to evaluate the capacity of the Seine River reservoirs to withstand future projected climate conditions using the current management rules.
For this study a modeling chain was designed. We used two hydrological models: GR4J, a lumped model used as a benchmark, and TGR, a semi-distributed model. TGR was tuned to explicitly account for reservoir management rules. Seven climatic models forced by the moderate A1B IPCC scenario and downscaled using a weather-type method (DSCLIM, Pagé et al., 2009), were used. A quantile-quantile type method was applied to correct bias in climate simulations. A model to mimic the way reservoirs are managed was also developed.
The evolution of low flows, high flows and annual flows were assessed under natural condition (i.e. without the inclusion of the reservoirs in the models). Then, the impact of reservoirs and their management were accounted for in the modeling chain. Results will be discussed relatively to future hydro-climatic conditions and current mitigation objectives within the basin.

Reference:
Pagé, C., L. Terray et J. Boé, 2009: dsclim: A software package to downscale climate scenarios at regional scale using a weather-typing based statistical methodology. Technical Report TR/CMGC/09/21, SUC au CERFACS, URA CERFACS/CNRS No1875, Toulouse, France. Link : http://www.cerfacs.fr/∼page/dsclim/dsclim_doc-latest.pdf