Optimal and centralized reservoir management for drought and flood protection via Stochastic Dual Dynamic Programming on the Upper Seine-Aube River system

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Seine river region is an extremely important logistic and economic junction for France and Europe. The hydraulic protection of most part of the region relies on four controlled reservoirs, managed by EPTB Seine-Grands Lacs. Presently, reservoirs operation is not centrally coordinated, and release rules are based on empirical filling curves. In this study, we analyze how a centralized release policy can face flood and drought risks, optimizing water system efficiency.

The optimal and centralized decisional problem is solved by Stochastic Dual Dynamic Programming (SDDP) method, minimizing an operational indicator for each planning objective. SDDP allows us to include into the system: 1) the hydrological discharge, specifically a stochastic semi-distributed auto-regressive model, 2) the hydraulic transfer model, represented by a linear lag and route model, and 3) reservoirs and diversions. The novelty of this study lies on the combination of reservoir and hydraulic models in SDDP for flood and drought protection problems.

The study case covers the Seine basin until the confluence with Aube River: this system includes two reservoirs, the city of Troyes, and the Nuclear power plant of Nogent-Sur-Seine. The conflict between the interests of flood protection, drought protection, water use and ecology leads to analyze the environmental system in a Multi-Objective perspective.