New potential sources of hydroelectricity in mountain

Stream flow, wastewater and water drinking network

1. Introduction of main scenarios of the pilot area

The Northern French Alps have significant freshwater resources which provide hydroelectric power . However, the impacts of dams raise environmental and ecological questions. All the most favourable sites for hydroelectricity production are already used.

Technological progress could lead to an increased number of local scale projects, some of them using drinking water and waste water pipe networks for hydroelectricity production .

Within the recharge.green project we analyse the relevance of an increased contribution of local hydroelectricity production in the energy production mix. We define trajectories of renewable energy development through a decision-support system that takes into account multiple objectives, such as :

-constraints (that have to be respected): environmental legal framework, legal priorities in water uses (drinking water vs. other uses), management constraints and objectives of widely distributed local small hydropower production plants,

-criteria (that can be optimized): increase of potential use of renewable energy , increase of ecosystem services restoration or preservation, economic viability considering investments costs and energy market.

We include projections of the impacts of different climatic scenarios to better anticipate possible conflicts and find an optimal trajectory for maximal renewable energy production considering all ecological and social constraints.

2. Description of the conflicts in the pilot area between eco system services and renewable energy form for the main scenarios

Conflicts could be different considering expected levels of territory management and hydroelectricity production from rivers, drinking water or waste water pipe networks:

-water sharing issues : drinking water vs. turbine discharges, environmental legal framework (water uses priorities, stream flow),

-wetlands and minimal ecological discharges - surrounding aquatic ecosystems both upstream and downstream of the micro-plant site, due to irregular stream flows and diversion of parts of the flow, possible pollution,

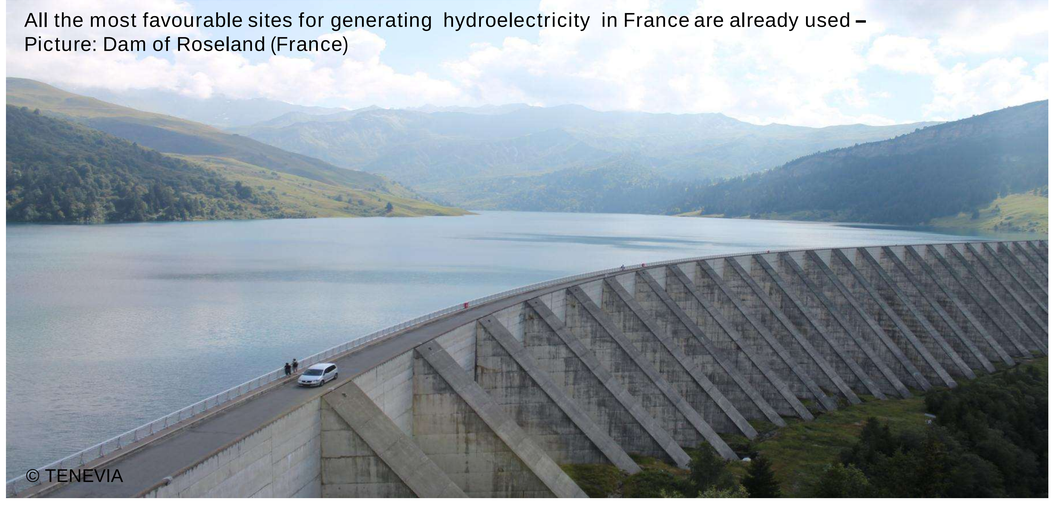
-constraints due to temporal variability of waste water inputs (i.e. during holidays),

-uncertainties on hydrologic regimes considering climate change while aiming at preserving and restoring ecosystem services (e.g. soils and biodiversity),

-impacts on land-uses and urbanization plans (i.e. networks, reservoirs and civil construction),

-cultural aspects.

All the most favourable sites for generating hydroelectricity in France are already used – Picture: Dam of Roseland (France)



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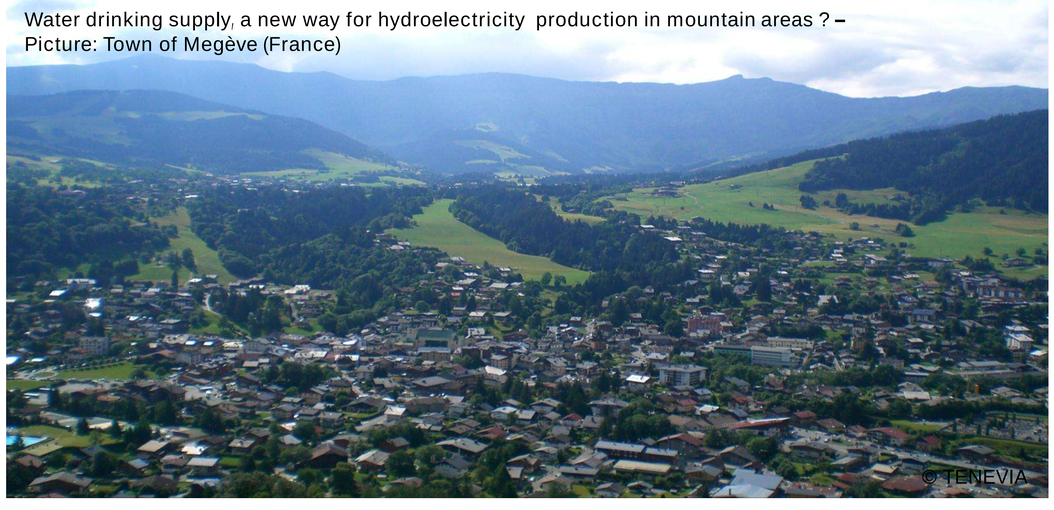
Water drinking supply, a new way for hydroelectricity production in mountain areas ? – Picture: Town of Megève (France)



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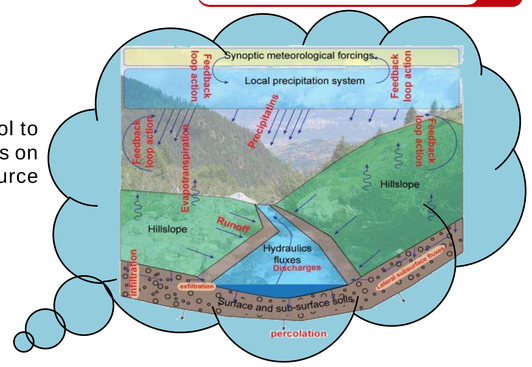
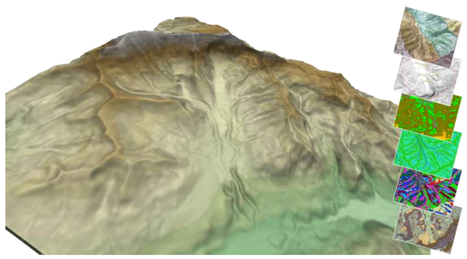
A developed tool to evaluate impacts on the water resource



3. Representation of conflicts and hydrological processes

Use of drinking water and wastewater networks to produce electricity raises questions concerning water availability and the impact of these new practices on the water resource. Indeed, the development of these practices in mountains has to be reconciled with already ongoing uses (artificial snow production, irrigation, drinking water supply, …) and environment conservation requirements.
We must define indicators for the development of these practices that allow us to integrate multiple factors in the planning process.



4. The regional communication strategy: How the pilot area involves the stakeholders and citizens

Analysis of available solutions and development of the decision support tool will be tested in 3 pilot municipalities (Megève, Valloire, Belledonne mountain massif). The analysis includes interviews, workshops and training sessions to facilitate knowledge transfer between key stakeholders (citizens, authorities & decision makers and renewable energy producers).

Also, the French Mountain Institute involves several partners or organisations that may be directly interested in the results of the project in the context of local energy and project meetings, such as public authorities and elected representatives from the pilot areas and other French mountain regions.

Our participation in the C3-Alps (Capitalising Climate Change Knowledge for Adaptation in the Alpine Space) may be an opportunity to offer dissemination and capitalization opportunities and promote recharge.green in cross-sectoral capitalization effort.

The communication strategy also includes press texts about activities, and regular reports via the French Mountain Institute web site: ***www.institut-montagne.org***

5. Ideas/ solutions to solve the conflicts

Whatever type of hydropower installation is chosen (small river, wastewater network or drinking water supply) it should be based on the valuation of natural resources & anthropogenic pressure.

Rather than focus on technological equipment, we suggest to study through integrated hydrological model simulations the surrounding natural environment and the water uses that govern the variability of the pressure on available water resources. Our main challenge is to estimate these contributions by implementing an approach to perform a prospective analysis in the context of climate change and changes in water uses, representing flows and stocks in anthropic watersheds.

<u>The main advantages of this approach are</u>:

-a flexible modelling framework that can "easily" adapt existing models to specific contexts,

-a formulation based on the description of physical processes,

-this formulation is spatial in the sense that it predicts different hydrological flows (runoff, infiltration, percolation, evapotranspiration) at all points in a basin,

-the definition of a hydrological similarity index that allows an elegant and numerically very efficient calculations resolution .

The main anthropogenic effects are represented by the introduction of sources and sinks or by changes in the pattern of drainage. In contrast to overall conceptual models , distributed modelling based on the description of physical processes is much better suited to the analysis approach in non-stationary hydro- climatic conditions.

This work will allow us to establish vulnerability and opportunity indicators, pressures on water resources and hydropower potential of the sites according to different scenarios of climate change, water resource management and water consumption .

Potential of socio-hydrological models for addressing long term and short term critical issues for stakeholders