Schweizerische Eidgenossenschaft
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National Centre for Climate Services NCCS

Swiss Federal Institute for Forest, Snow and Landscape Research WSL

Aquatic ecosystems provide numerous ecosystem services, including drinking water, food, and biodiversity. The effects of climate change on aquatic ecosystems in Switzerland are manifold and affect, among other things, water temperature, fish stocks, water discharge, and hydropower production. This factsheet focuses on three key aquatic ecosystem services: available water quantity, sediment load, and nutrient load from nitrogen and phosphorus. To this end, the University of Geneva has developed the AquaREL app on behalf of the National Centre for Climate Services (NCCS). The functionality and sample results of the app are presented below.

IMPACTS OF CLIMATE CHANGE ON PRESSURES ON WATER BODIES

Climate change is altering both seasonal water availability and the nutrient and sediment loads released, to varying degrees depending on the area. With the AquaREL app, you can check how severely the various areas and regions of Switzerland are affected.

Nutrient and sediment loads are of central importance for the ecological functioning of water bodies. They enter aquatic systems both through direct human influences - such as agriculture and urban areas - and as a result of climate-related processes. Excessive phosphorus inputs into lakes, for example, can trigger algal blooms, lead to oxygen depletion, and ultimately impair biodiversity. Although sediments are a natural component of water bodies, an excess can damage habitats – for example, by silting up spawning grounds or increasing turbidity. Excessive nutrient and sediment inputs can therefore have a negative impact on the ecosystem and also impair the drinking water supply and the use of water bodies for leisure or agriculture. Continuing climate change is leading to more frequent heavy rainfall events, which means that soils are carrying more sediments and nutrients into water bodies, potentially impairing the water quality of surface waters. At the same time, more frequent and prolonged droughts are leading to reduced water availability.

The AquaREL app shows whether and to what extent nutrient and sediment loads and the amount of water available are changing in different areas and regions. The app is aimed at specialists in the public sector, companies, planning and consulting firms, researchers, and the interested public.

CONSEQUENCES OF CLIMATE CHANGE

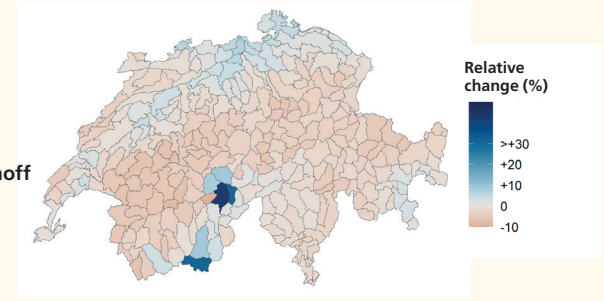
- **The amount of water available in Switzerland will increase by 10-50% in winter by the end of the century, but decrease by an average of 30-50% in summer without global climate protection measures. Overall, around 10% less water will be available.**
- **In general, heavy rainfall events cause increased nutrient leaching and soil erosion, which leads to higher nutrient and sediment loads in surface waters.**
- **Nutrient and sediment loads in low-lying areas are likely to increase due to higher precipitation, while they are likely to decrease at higher elevations because less precipitation is expected there.**

AVAILABLE INDICATORS IN THE APP

Water runoff

The app shows how the average annual water runoff in a region is changing. The maps provide indications of possible long-term changes in water availability in certain regions and are suitable for the rough classification of regional trends, for example with regard to increasing water scarcity. However, they do not replace detailed analyses of seasonal fluctuations or extreme events that are particularly relevant for water management.

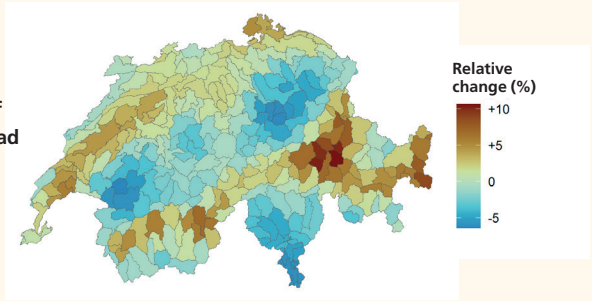
Example of annual water runoff
RCP 8.5*



Nutrient load

The app shows how nutrient inputs (nitrogen and phosphorus) change under different climate scenarios. The modeled nutrient discharge is influenced by annual precipitation amounts. Since the models are based on annual values, seasonal variability is not reflected. The indicator serves to raise awareness of possible long-term developments and can be used as a supplementary basis for overarching planning issues, such as nutrient retention.

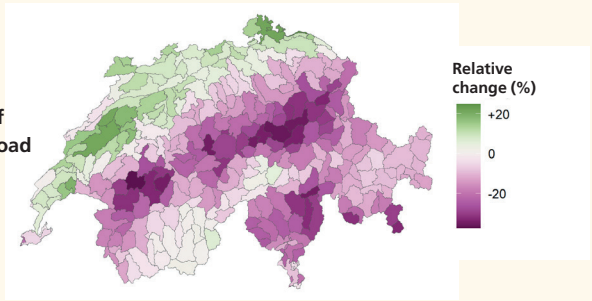
Example of nutrient load per year
RCP 8.5*



Sediment load

The indicator illustrates how sediment loads washed out of the soil into water bodies change under different climate scenarios. These data provide information on areas with increased erosion and sediment dynamics and can serve as a basis for the further development of land use and management practices.

Example of sediment load per year
RCP 8.5*



*Climate scenario without global climate protection
Change in the period 2045-2074 compared to the reference period 1981-2010

WHAT ARE ECOSYSTEM SERVICES?

Ecosystem services are benefits that humans derive from natural processes, e.g., available drinking water. These services ensure food, health, climate, and quality of life—often unnoticed, but indispensable. The cross-sectoral dashboard developed as part of this project shows how ecosystem services from forests, agriculture, and water bodies change over time and under different climate scenarios. It thus offers a unique overview for the whole of Switzerland.

Scientific basis of the app

The process-based modeling of climate change impacts on ecosystem services is still based on the older generation of climate scenarios (CH2018 climate scenarios). The new CH2025 climate scenarios are now available. However, the main qualitative statements in the two climate scenarios remain unchanged. The runoff models are based on data from the Hydro-CH2018 project. Nutrient and sediment retention were estimated using the InVEST nutrient transport model and the InVEST sediment transport ratio model, respectively. The same parameters previously calibrated by Külling et al. (2024) were used for both models. Key climate parameters were precipitation projections from the CH2018 climate scenario model ensemble. The technical report discusses the scientific findings in detail.

Technical report
CH2018 Climate scenarios for Switzerland
HydroCH 2018 – hydrological scenarios Natural
Natural Capital Project, 2025. InVEST 0.0.
Külling et al. (2024), Ecological Indicators

Further information

FOEN – Sediment in watercourses
Everything you need to know about the monitoring network for solids in watercourses in Switzerland.

FOEN - Water / Water quality
Summary of the current status and available water volume of aquatic ecosystems in Switzerland and information on monitored water quality.

MaLeFiX
AI-based model for predicting extreme drought periods in the near future as part of a project of the WSL program "Extremes."

National Drought Platform
The drought platform addresses the various factors influencing drought and shows the current state of drought in Switzerland.

Imprint

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More information about the programme	*NCCS-Impacts programme*

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Learn more about the project:
www.nccs-impacts.ch/ecosystems