Climate Change and Switzerland in 2050

Impacts on Environment, Society and Economy

The report describes mean vulnerabilities of the environment, the economy and the society in Switzerland with regard to climate change until the year 2050. Based on a regional climate model potential impacts on various subject areas like for example water supply, agriculture or tourism are presented. Different measures and adaptation strategies are discussed. All projections for the future are based on assessments of today's knowledge.

Climate change scenarios for 2050

The report assumes a warming of approximately 2 °C in autumn, winter and spring (with a range of uncertainty between 1 and 5 °C) as well as just under 3 °C in summer (with a range of uncertainty between 2 and 7 °C) as you can see in Fig 1 showing the results of the regional climate model.



Fig. 1: Temperature change for Northern and Southern Switzerland in 2050 compared with 1990 in winter (DJF: December-February), spring (MAM: March-May), summer (JJA: June-August) and autumn (SON: September-November). The horizontal lines show the mean estimate (median). The warming will be within the range of the colored bars with a probability of 95 % (confidence interval 95 %). Source: C.Frei, MeteoSchweiz, Zurich

With regard to precipitation in winter an increase of about 10% is expected. In summer a decrease of about 20% can be assumed (see Fig. 2). The number of extreme precipitation events is very likely to increase and therefore also the number of floods and mudslides. They will occur particularly in winter, but possibly despite smaller total precipitation amounts also in summer. In summer heat waves will generally increase, and probably droughts as well. In contrast, in winter cold spells will decrease.



Fig. 2: Relative change of the mean seasonal precipitation for Northern and Southern Switzerland in 2050 compared with 1990 (logarithmic scale; definition of seasons see fig. 1). A value of 0.50 indicates a decrease by 50 %, a value of 1.25 an increase by 25 % compared with today's conditions. Source: C.Frei, MeteoSchweiz, Zurich

Contention for water supply

In comparison to other countries Switzerland disposes of substantial water reserves. Climate change will affect these reserves: Less water will be available in summer and autumn, more pronounced during drought periods. At the same time the demand for irrigation in agriculture will increase causing contention between ecosystems, different users and regions. This may lead to losses in agriculture and electricity production, mainly in river power plants. Water supply can probably be ensured by an optimized water management.

As precipitation increasingly falls as rain instead of snow, floods become more frequent and more severe, particularly in winter. Possible measures include sustainable flood protection by renaturing and broadening rivers and the limitation of damage potential. An adequate cultivation of lakes and the use of storage reservoirs as backing mean a reduction and shift of fluctuation.

Agriculture can adapt to moderate warming

A moderate warming of less than 2 to 3 °C may overall have a positive effect on Swiss agriculture. The production of meadows and the potential crop yield of many cultivated plants will increase as a result of the longer vegetation period, provided that the supply of water and nutrients is sufficient. On the other hand, water supply will decrease in summer, weeds and insect attacks will occur more often. By means of an adequate choice of cultivated plants, cultivation methods and management, agriculture will be able to adapt to a moderate rise of the *mean* temperature by 2 to 3 °C until 2050. If temperature rises by more than 2 to 3 °C until 2050 the disadvantages will outweigh the advantages of the warming: During the vegetation period water scarcity will become more frequent, and the faster plant development will result in harvest losses for crop and grain legumes. The damage caused by extreme events like extreme drought periods or heavy precipitation will increase.

Changes in terrestrial ecosystems

In Switzerland flora and fauna will continue to approach those at lower elevations and in more southern areas. Temperature-sensitive species will move to cooler areas at higher elevations if possible. Less mobile species will be reduced or will disappear.

Most of all the combination of effects, for example high temperatures and little precipitation, may reduce the productivity of forests and permanent grassland. The disposability of water will be of increasing importance to ecosystems in the future, in particular to those situated in valleys and hilly areas.

Shifts in the energy sector

Less heating energy will be required in winter and more cooling energy in summer (see Fig.3). This means a shift in the energy demand from fuel to electricity. Newer buildings normally dispose of a good heat insulation that reduces the heating demand during the cold season. However, dissipation of waste heat (produced by equipment, people etc.) is limited and requires cooling, in particular with increasing temperatures and heat waves in summer. Energy-efficient devices, air-conditioning and sunscreen may provide relief amongst others. Construction standards should be adjusted to the future climate. Measures are also possible in urban development, for instance by the creation of aeration corridors.



Fig. 3: Annual heating degree days from 1990 to 2004 standardized to the average value of the period 1984 to 2004. For the years 2030 and 2040 the bars represent the expected values according to a scenario of the Swiss Federal Office of Energy SFOE.

The small runoff and the decreasing cooling effect on rivers, in particular in summer, will have an adverse effect on hydropower and nuclear energy. Annual production is expected to decline by a few per cent until 2050.

New Renewable energy will become more competitive due to higher energy demand, the demand for CO_2 -free energy and increasing energy prices. The focus is primarily on energy gained from windmills and timber. In consideration of long-term trends and the development of forestry and timber industry the potential of timber may triple.

Impact on tourism

In winter the rising snow line means that ski resorts in the foothills of the Alps may not operate profitably anymore. Ski resorts situated at high elevations may benefit. With the increasing threat of traffic routes by extreme events the accessibility of tourist resorts in the Alps becomes more difficult. The attractiveness of alpine tourist areas will also be influenced by the decreasing snow reliability and the expected changes in the natural scenery, in particular the retreat of glaciers (see Fig. 4).



Fig. 4: The glacier decrease had already started in the 19th century due to natural reasons. The human caused warming has been dominating the continuous ice decrease of the alpine glaciers in the 20th century. Left: Lower Grindelwald glacier in 1858 (picture: F. Martens, Alpine Club Library London, H.J. Zumbühl). Right: Lower Grindelwald glacier in 1974 (picture: H.J. Zumbühl). The little picture shows the glacier in 2006 (picture: S. U. Nussbaumer).

Melting permafrost means a costly risk for a number of mountain railways, as at higher elevations the foundations of masts and stations are often anchored in the frozen loose stone. The risk of rock slides increases as well. In order to maintain the attractiveness of tourist destinations, the offer needs to be adjusted to new conditions.

Health effects

In Switzerland the increase in heat waves, in combination with an elevated ozone concentration, represents the most important sanitary consequence of climate change. It is possible, though, to counter the increase in mortality caused by heat with adequate measures. Heat waves also impair the efficiency of the working population and thereby have economic effects.

The development of various vector-borne illnesses is rather uncertain. In Switzerland the dissemination of malaria or dengue is quite unlikely. On the other hand, West Nile fever is on the advance. Higher temperatures could also generate new vectors or cause a vector to change its host. Regarding illnesses transmitted by ticks, there may be changes in the range of vectors, infection rates and period of activity.

Conclusions

From today's perspective the consequences of climate change until 2050 seem to be manageable in Switzerland without severe societal problems, provided that the warming does not exceed the expected magnitude. To this day, however, there are no precise estimates of the costs for the adaptations and measures mentioned, which, for some fields, may be of economic relevance. In particular, the tourism sector will have to face drastic changes.

Having said that, there are many countries in the world, in particular developing countries which, on the one hand, are hit by more serious consequences and, on the other hand, do not dispose of the financial resources to adapt. The emerging geopolitical developments may well have consequences on Switzerland.

The report "Climate Change and Switzerland in 2050 - Impacts on Environment, Society and Economy" is published by the Swiss Advisory Body on Climate Change (OcCC) and ProClim- (Forum for Climate and Global Change, Swiss Academy of Sciences). The full report (170 p.) can be downloaded as pdf in German and French on www.occc.ch or www.proclim.ch. The Summary is translated in English and Italian. You can order a printed version at <u>proclim@scnat.ch</u>.

By Gabriele Mueller-Ferch and Esther Thalmann, ProClim-, Forum for Climate and Global Change, Swiss Academy of Sciences, <u>mueller@scnat.ch</u>