Summary

Swiss Climate Change Scenarios CH2011

C2SM Center for Climate Systems Modeling

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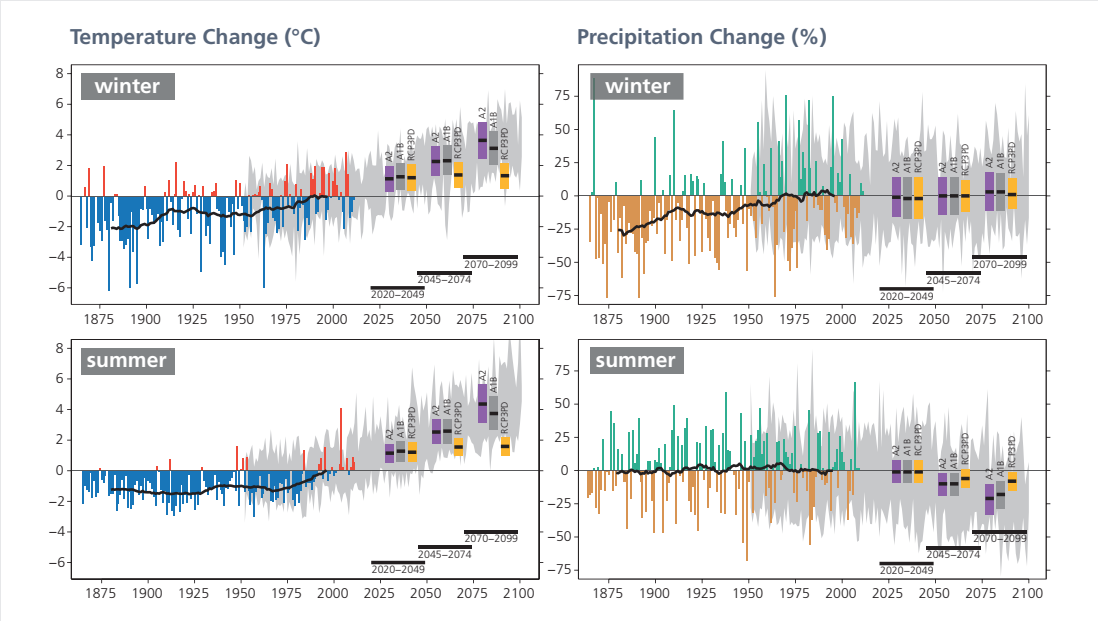

Figure 1: Past and future changes in seasonal temperature (°C) and precipitation (%) over northeastern Switzerland. The changes are relative to the reference period 1980–2009. The thin colored bars display the year-to-year differences with respect to the average of observations over the reference period, the heavy black lines are the corresponding smoothed 30-year averages. The grey shading indicates the range of year-to-year differences as projected by climate models for the A1B scenario (specifically, the 5–95 percentile range for each year across the available model set). The thick colored bars show best estimates of the future projections, and the associated uncertainty ranges, for selected 30-year time-periods and for three greenhouse gas emission scenarios.

The climate of Switzerland is changing. The Swiss Climate Change Scenarios CH2011 provide a new assessment of how this climate may change over the 21st century. They are based on new generations of climate models with higher resolution, improved statistical methods, and an account of all recent relevant studies as well as the assessments by the Intergovernmental Panel on Climate Change (IPCC).

Future Swiss climate

In the course of the 21st century, Swiss climate is projected to depart significantly from present and past conditions. Mean temperature will very likely increase in all regions and seasons. Summer mean precipitation will likely decrease by the end of the century all over Switzerland, while winter precipitation will likely increase in Southern Switzerland. In other regions and seasons, models indicate that mean precipitation could either increase or decrease. The projections of future temperature and precipitation are consistent with past observations.

The magnitude of climate change in Switzerland depends on region and season, and particularly on the pathway of future global greenhouse gas emissions. This report uses two non-intervention emission scenarios (A2 and A1B) that anticipate increases in emissions, and one climate stabilization scenario (RCP3PD) that supposes emissions are cut by about 50 % by 2050. As an illustration, Figure 1 shows observed seasonal temperature and precipitation changes in northeastern Switzerland, as well as projected changes for the three different emission scenarios and selected time periods.

Compared to the past 30 years, and for all Swiss regions considered, the best estimates for the non-intervention scenarios project increases of seasonal mean temperature of 3.2–4.8°C by the end of the century for the A2 scenario and 2.7–4.1°C for the A1B scenario. Summer mean precipitation is projected to decrease by 21–28 % for the A2 scenario and 18–24 % for the A1B scenario. For the stabilization scenario, Swiss climate would still change over the next decades, but is projected to stabilize at an annual mean warming of 1.2–1.8°C and a summer drying of 8–10 % by the end of the century. Uncertainties due to climate model imperfections and natural variability typically amount to about 1°C in temperature and 15 % in precipitation.

Along with these changes in mean temperature and precipitation, the nature of extreme events is also expected to change. The assessment indicates more frequent, intense and longer-lasting summer warm spells and heat waves, while the number of cold winter days and nights is expected to decrease. Projections of the frequency and intensity of precipitation events are more uncertain, but substantial changes cannot be ruled out. In addition a shift from solid (snow) to liquid (rain) precipitation is expected, which would increase flood risk primarily in the lowlands.

The European perspective

The projected increase in temperature for Switzerland is consistent with large-scale warming over Europe for all seasons (Figure 2). In winter, the warming is amplified in Northern Europe, partly due to decreased snow cover. In summer, stronger warming is predicted in Southern Europe, partly driven by drier surface conditions. Northern Europe will likely get wetter and Southern Europe will get drier, which is consistent with the global picture of drier subtropics and wetter high latitudes. In between those opposing trends, precipitation in the Alpine region could either increase or decrease in all seasons – except summer, when Mediterranean drying likely encompasses the Alps and Central Europe.

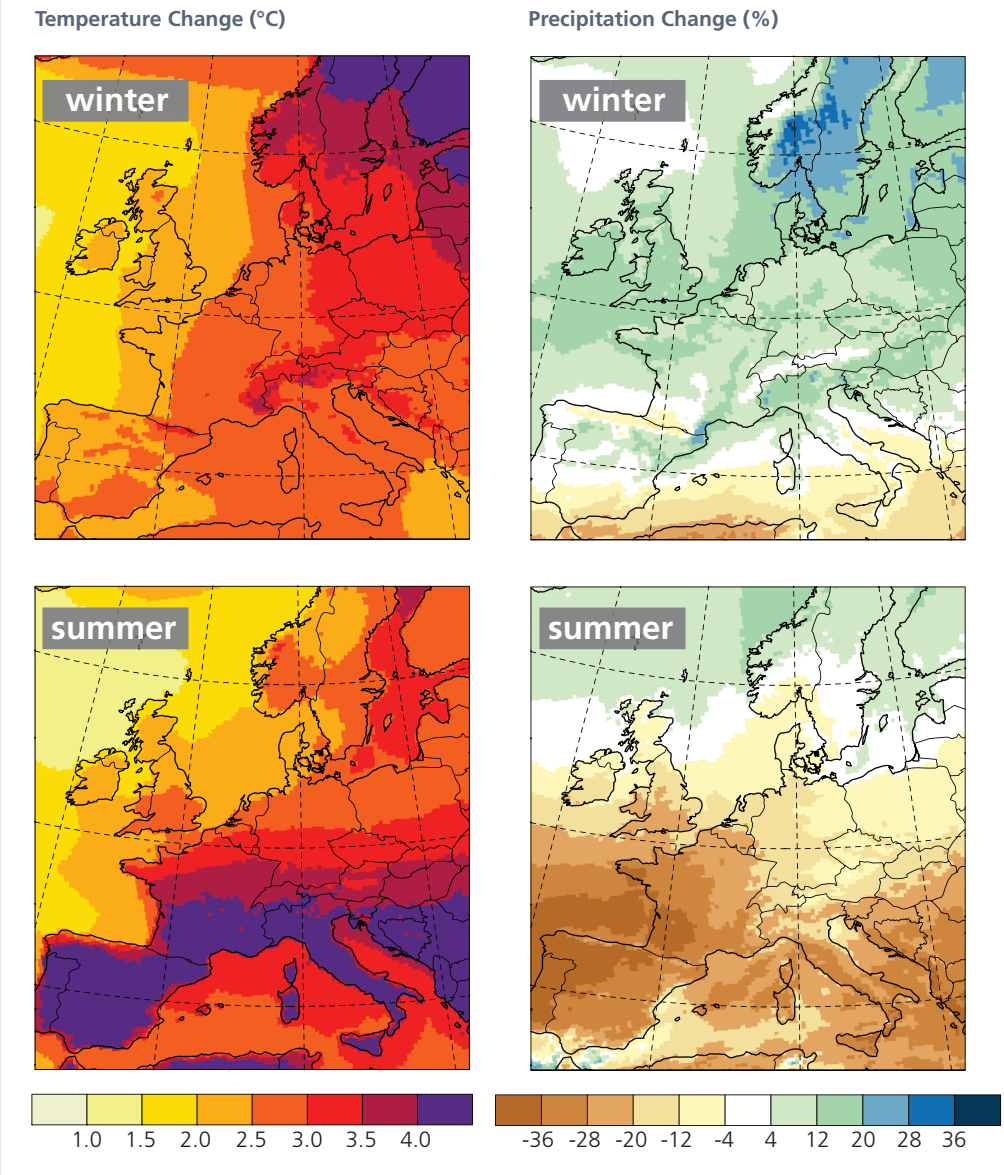

Figure 2: Change of temperature and precipitation for winter and summer as simulated by climate models. Large scale patterns are similar but details differ between models, time period and scenarios. The figure shows the multi-model mean change for 2070–2099 relative to 1980–2009, for an intermediate (A1B) greenhouse gas emission scenario.

The role of emission scenarios

Toward the end of the 21st century, Swiss climate will be strongly affected by the future course of global greenhouse gas emissions. Even if global temperature change is stabilized below 2°C relative to pre-industrial levels through strong mitigation efforts (the RCP3PD emission scenario, which requires cutting global greenhouse gas emissions by at least 50 % by 2050 relative to 1990), models project further warming for Switzerland of 1.4°C toward the end of the century (most probable value with respect to 1980–2009). This is about the same magnitude of warming as already observed. In the two scenarios without mitigation, the warming would be twice to three times as large (Figure 3).

Development and application of climate change scenarios for Switzerland

The CH2011 scenarios are based on a new generation of global and European-scale regional climate models. The model data have been provided by several international projects. New statistical methods were used to generate multi-model estimates of changes, and associated uncertainties, in seasonal mean temperature and precipitation for three representative Swiss regions. This was also done for changes in daily mean values at individual meteorological station sites. Along with the CH2011 assessment, digital scenario data is provided for the three different emission scenarios.

The new CH2011 scenario data can serve as a basis for a variety of climate change impact studies in Switzerland, addressing ecologic, economic and social impacts. They should help guide decision making related to future Swiss climate adaption and mitigation strategies. Well established national climate scenarios allow end users to explore possible impacts and adaptation strategies in a coherent manner.

The new CH2011 assessment is largely in agreement with the preceding scenarios released in 2007. Differences can be attributed mostly to a new generation of climate models, to improved statistical methods, and to the use of a more recent reference period. Climate models and statistical methods will undergo further significant developments in the years to come. In addition, more observational data will become available. As a result, regular updates to climate change scenarios will be required with intervals of a few years.

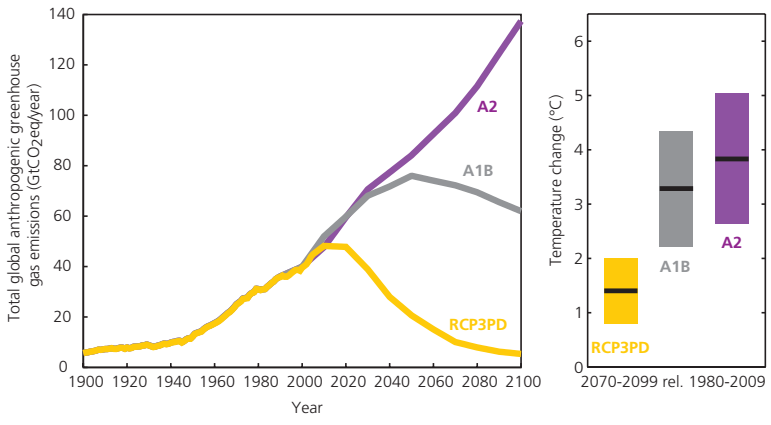

Figure 3: The three pathways of past and future anthropogenic greenhouse gas emissions, along with projected annual mean warming for Switzerland for the 30-year average centered at 2085 (aggregated from the four seasons and three representative regions). These pathways are based on assumptions about global demographic and societal development, energy demand, technologic and economic trends, and corresponding decisions and choices that our world is taking now and may take in the future. The unit «CO_2eq» is a reference unit by which other greenhouse gases (e.g. CH_4) can be expressed in units of CO_2.

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