



Agricultural ecosystems in Switzerland are already being affected by climate change. This impacts key ecosystem services such as yields from arable land and grassland, pollination by bees, and carbon storage in the soil. Agroscope and the University of Geneva developed the CLIMAGS app on behalf of the National Centre for Climate Services (NCCS), which shows the impact of climate change with and without global climate protection on various ecosystem services. The app's functionality and sample results are presented below.

EFFECTS OF CLIMATE CHANGE ON AGRICULTURAL ECOSYSTEM SERVICES



Climate change is reducing yield stability and carbon in the soil. In addition, pollination potential decreases in spring, but increases in summer. The CLIMAGS app shows which areas and regions of Switzerland are particularly affected.

Agriculture is challenged to achieve reliably high crop yields while operating sustainably. Reliable food production is fundamental to food security.

Not only the level of yields is important, but also their stability in the face of climate extremes and other stress factors. In addition, soil carbon stocks play an important role for soil fertility, water retention capacity, and climate protection. Finally, pollination potential is of central importance for many crops. These ecological functions ensure the long-term performance of agricultural systems and require balanced management that takes both ecological and economic aspects into account.

Effects of climate change

Progressing climate change is reducing yield stability and soil carbon. Years of drought lead to high crop losses, and higher temperatures promote carbon degradation when soil moisture is sufficient. In addition, pollination of important early-flowering crops such as apples and cherries is no longer guaranteed under future climate conditions.

The CLIMAGS (Climate IMpacts on AGRiculture in Switzerland) app shows whether and to what extent these aspects will change in different areas and regions with and without climate protection measures. The scenarios were defined as part of the project. The app is aimed at specialists in the public sector, companies, planning and consulting firms, researchers, and the interested public.

CONSEQUENCES OF CLIMATE CHANGE

- **Winter crops tend to yield higher returns thanks to more favourable conditions during the growing season.**
- **Due to increasingly frequent and prolonged dry periods, crop failures are becoming more common. This reduces yield stability.**
- **Provided that soil moisture is sufficient, higher temperatures lead to greater degradation of the soil organic matter. In this case, soils can store less soil carbon leading to more CO₂ in the atmosphere.**
- **Under future climate conditions, pollination potential could decline in spring, as wild bees that are active early in the year are very sensitive to global warming.**

★ AVAILABLE INDICATORS IN THE APP

Annual yield

Indicator of agricultural productivity

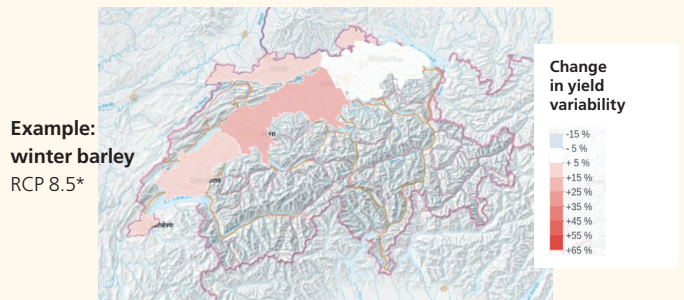
The app shows the change in average annual yield of grassland and the most important arable crops until 2060. This enables producers to make better decisions about which crops to prefer in the future.



Yield fluctuation

Indicator of food production stability

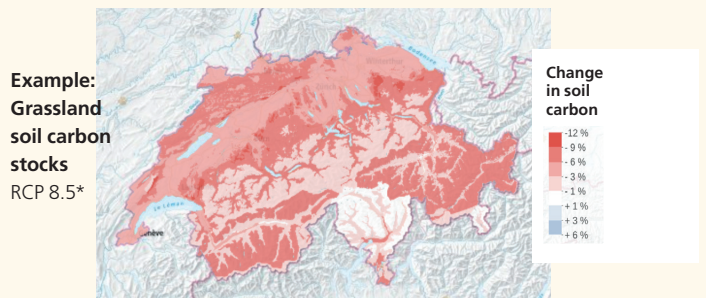
In addition to the average yield of grassland and arable crops, the app also provides information about future variability of annual yields. These variations are a key indicator of food production stability. Such fluctuations are caused by factors including extreme weather conditions. The greater the fluctuations, the lower the reliability of agricultural production. Information on the extent of yield fluctuations helps producers and insurance companies to assess risk.



Soil carbon stock

Indicator for the ecosystem service of carbon storage

The app shows the future development of soil carbon stocks in the top 30 cm of grassland and arable land soils. A decrease in soil carbon leads to CO₂ emissions. At the same time, soil fertility is related to the carbon stored in the soil. With the help of the app, regions can be identified where soil fertility could decline in the future.



Pollination potential

Indicator for the ecosystem service of pollination

Pollination is a basic prerequisite for yield and the yield quality of many agricultural crops. Depending on the pollination requirements of the plant species in question, the degree of pollination can have a more or less pronounced impact on yield. Pollination potential in spring and summer was calculated for the pollination-dependent crops apple, cherry, and rapeseed. Producers can use this information to develop location-specific and seasonal habitat management for wild bees with suitable habitats for food and nesting, thus ensuring pollination performance under future climate conditions. This also includes selecting crops whose flowering time is favorable for pollination.



i WHAT ARE ECOSYSTEM SERVICES?

Ecosystem services are benefits that humans derive from natural processes, such as the pollination of plants. These services ensure food, health, climate, and quality of life—often unnoticed, but indispensable. The [cross-sector 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 provides a unique overview for the whole of Switzerland.

Scientific basis of the app

CLIMAGS shows model-based developments of the effects of climate change on various ecosystem services, still using the older generation of climate scenarios ([CH2018 climate scenarios](#)). The new [CH2025 climate scenarios](#) are now available. However, the main statements for the two sets of scenarios remain qualitatively unchanged. In order to take into account the heterogeneity of agricultural production areas in Switzerland, an agroclimatic stratification proposed by Wüst-Galley et al. (2020) and Dos Reis Martins et al. (2024) was used. Pollination potential was calculated using data on relative wild bee abundance from species-specific distribution models (Adde et al. 2021), scaled land use and land cover maps (Giuliani et al. 2022), and species-specific characteristics (Westrich et al. 2019; Pollimetry model according to Kendall et al. 2024). The technical report discusses the scientific findings in detail.

[Technical report](#)

[CH2018 Climate scenarios for Switzerland](#)

[Adde et al. \(2021\), Ecography](#)

[Broennimann et al. \(2024\), Earth System Science Data](#)

[Dos Reis Martins et al. \(2024\), Agroscope Science](#)

[Giuliani et al. \(2022\), Land](#)

[Kendall \(2024\), R package "pollimetry"](#)

[Westrich et al. \(2019\), Eugen Ulmer Publishing](#)

[Wüst-Galley C. et al. \(2020\), Agroscope Science](#)

INVEST ® [Standard](#) / [Modified version 3.14.2](#)

Further information

[Agripedia](#)

A compilation of measures and projects by the federal government and cantons, as well as practical offers and tools.

[Agridea](#)

The Climate Change dossier lists ongoing and completed projects by Agridea and partner organizations. It also contains data sheets and other publications, as well as links to relevant courses and other content.

[Agroscope](#)

A compilation of frequently asked questions and answers on the topic of climate change with references to relevant work at Agroscope.

[Wild bees / bees](#)

Information about habitats, nesting habits, flower relationships, and visual aids for identifying bees.

[Bee Center Canton of Zurich](#)

The Bee Center provides information on measures that can be taken to promote bees in different habitats.

[Federal Office for Agriculture FOAG](#)

The FOAG promotes sustainable, competitive, and environmentally friendly agriculture as well as food security in Switzerland.

[Federal Office for the Environment FOEN](#)

The FOEN protects the environment and promotes the sustainable use of natural resources so that people, nature, and the economy in Switzerland can live in harmony.

[ValPar](#)

Comprehensive analyses of the ecological, social, and economic values of nature. The results are available in various formats, e.g., in the form of interactive maps or in a synthesis report.

[ESS tools](#)

Compilation of numerous tools on the topic of ecosystem services.

Contains both decision-making tools and tools for knowledge acquisition and research.

Imprint

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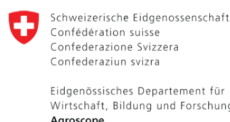
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More information
about the programme

[NCCS-Impacts programme](#)

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