# Spatial modelling of insect pests under climate change

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## Background

- Climate plays a decisive role in the proliferation and spread of pests and pathogens.
- Abundance and generation time of insects depend primarily on ambient temperature. Pests increasingly spread through global trade and establish themselves due to more suitable climate in new regions.
- Pressure from pests is expected to increase with climate change, thus requiring adaptation of crop protection measures
- Quantitative information on potential future distribution of many insect pests is still lacking.
- We aim to investigate under which circumstances pest species may enter Switzerland in the near future



Figure 1: Apple maggot (Rhagoletis pomonella) as example of a harmful insect pest species with the potential of invading European countries. Image source: wikimedia commons.

0.0



Current

Figure 2: Example of a species distribution model output: projected habitat suitability of Rhagoletis pomonella under current climate conditions (left) and projected to Europe using climate scenarios for 2040 (right). Blue crosses show occurrence records we used as model input.

#### Methods

- We consider insect pest species from EPPO (European Plant Protection Organisation) lists which do not occur in Switzerland so far.
- Presence records are gathered from published literature and open databases for 94 species.
- We use current crop distribution derived from EarthStat dataset (Monfreda et al. 2008).
- Climate data are obtained from CHELSA dataset in a 5 x 5 km resolution (www.chelsa-climate.org).
- We establish species distribution models (SDMs) for all pest species and their host crops using an ensemble of four common modelling techniques (GLM, GAM, GBM and randomForest) and seven ecologically relevant bioclimatic variables.

# Prospects

- Combining climate data with physiological data to model the climatic conditions restricting the distribution of the insect pest species.
- Quantify precisely when pest species will have suitable conditions for population development.
- Forecast how the number of generations for different pest species changes under future climate scenarios.
- Comparison between insect pests and other stress factors of relevant crops in Europe (e.g. drought stress, heat stress).

## Aims

Establish SDMs for all selected species and investigate habitat suitability in Europe under future climate conditions.

2040

- Identify which pests are expected to invade Europe in the near future
- Model the distribution of host crops.
- Evaluate the development of pest host relationships within Europe.



Figure 3: Example of how pest – host relationships might change in Switzerland. Future climate change is expected to affect pest species composition and the distribution of host crops.



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