

# 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.

## *Rhagoletis pomonella* projected habitat suitability

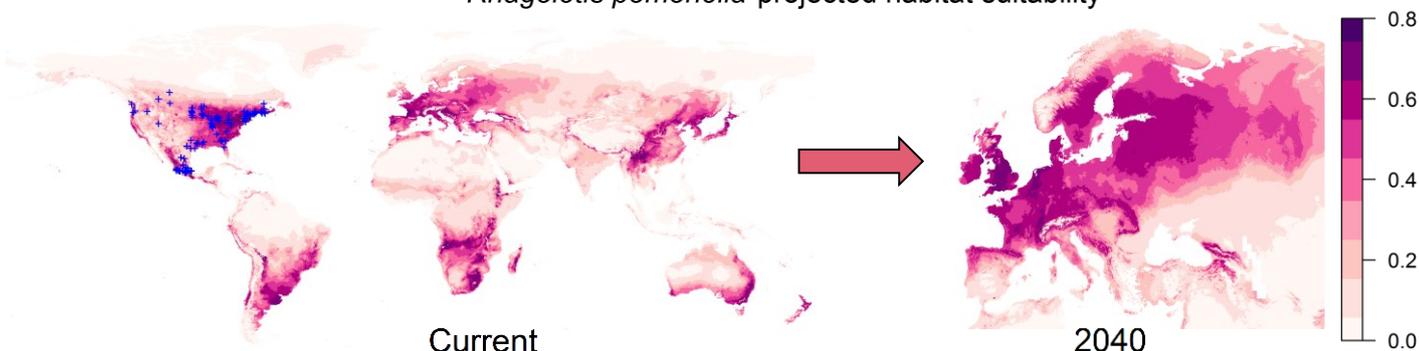


Figure 2: Example of a species distribution model output: projected habitat suitability of *Rhagoletis pomonella* under current climate conditions (left) and projected to Europe using climate scenarios for 2040 (right). Blue crosses show occurrence records we used as model input.

## 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](http://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.
- 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.

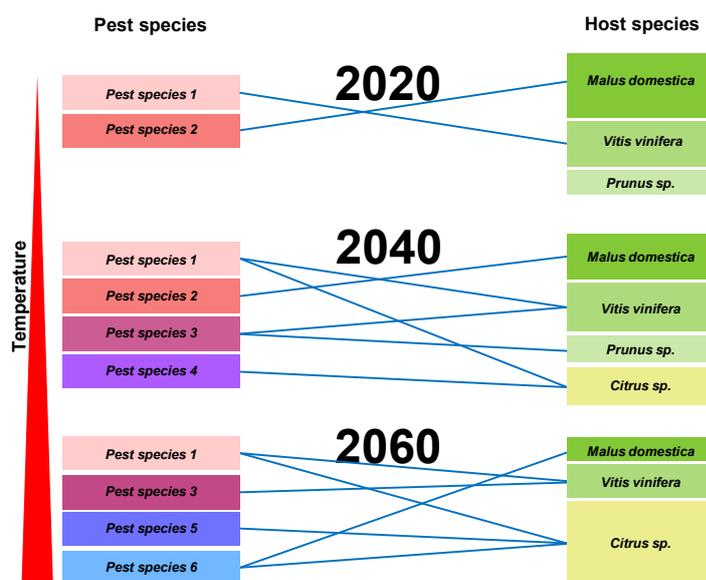


Figure 3: Example of how pest – host relationships might change in Switzerland. Future climate change is expected to affect pest species composition and the distribution of host crops.