EUPORIAS MASTERCLASS 2015
A PROTOTYPE FOR THE AGRICULTURAL SECTOR

Young scientists involved:

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- *Yann Chavaillaz, LSCE-IPSL, Gif-sur-Yvette, France*
- *Amélie Rajaud, LSCE-IPSL, Gif-sur-Yvette, France*
- *Lorenzo Sangelantoni, UNIVPM, Ancona, Italy*

Call for climate services:
Bernd Panassiti, Laimburg Research Centre for Agriculture and Forestry, Ora, Italy

During this Masterclass, young scientists were split in three different groups with the aim of building a prototype for a climate service in the context of three different sectors: energy, tourism and agriculture. The agriculture-related issue was faced and described by an ecological scientist from the nearby Laimburg Institute, Bernd Panassiti. Bernd is working on the spreading of a fungal disease in apple trees, vectored by an insect, in the province of Bolzano (and Trentino, to a lesser extent). He uses two ecological models. A static model enables to simulate the spread of the disease on a yearly basis. A dynamical model simulates the insect dynamics and the disease cycles on a weekly basis. The spread and the cycles of the disease depend on many factors. Most of them are already taken into account in the models developed by Bernd's team. The factor that has not been studied yet is the influence of climate change. In order to address this issue, climate data is needed to force them for the present time, for near-future prediction, and for long-term projections. The end-users of this service are apple trees farmers in the study area, in order to prepare themselves to future occurrences of the disease.

RESHAPING THE ISSUE

Bernd is not a climate scientist, but surely knows that climate change has, or at least will have a strong influence on the study. The fact that the ecological issues he was dealing with was indeed very complex and difficult to grasp for non-specialists, combined with the imprecise use of scientific terms and notions of climate sciences, made his request at first unclear for us. This is the reason why we had first to engage into an interactive process with him, in order to clarify the main objectives, notions, possibilities and limits of both parties. In a first phase, we decided to communicate through e-mails, as Bernd was not supposed to attend the whole of the Masterclass. After a few exchanges, we came to the conclusion that we strongly needed to talk to Bernd in person. And thus, we invited him for lunch the following day. Many hours were consequently devoted to e-mail exchanges and to a lunch that ended up turning into an intense collective working session. At the end of this session, we, the project-holder and the young scientists, had agreed on re-focusing the issue on a problem that was possible to handle, and reached a co-designed path for a solution.

DESCRIPTION OF THE RESHAPED ISSUE

Disease cycles and the spread of insects are strongly linked to the evolution of surface air temperature, precipitation, wind intensity, and wind speed. The Bolzano province is located in the middle of the Alps, and thus exhibits a very complex topography. Climate and weather conditions can be quite different within this region. Altitude, sun exposure and lower-tropospheric streams are decisive. Spatial resolution of climate information must be quite high to properly address the current issue.

The dynamical model has a time resolution of a week. Climate projections with such a precise timescale are consensually considered irrelevant for far time horizons. Precipitation and wind are two

climate variables more difficult to predict and to project by climate models. Therefore, we commonly agreed to stick to the static model and to the evolution of temperature as a first step. Even with this restriction, Bernd felt that relevant and useful information could already be delivered to the farmers.

AVAILABLE CLIMATE DATA

EURO-CORDEX is a scientific program led by the World Climate Research Program to organize an internationally coordinated framework to produce regional climate change projections of high resolution for the European region. The CORDEX-outputs aim to serve as an input for impact and adaptation studies. Simulations are performed by several regional climate models (RCM) depending on different climate institutes. Data access is free of charge for most of these institutes. Projections are saved in the spatial resolution of 0.11 degree, and are computed for the entire twenty-first century. 3 model meshes cover the Bolzano province.

CO-DESGINED SOLUTIONS

After all our discussions and interactions, a major point was emerged: Bernd is already able to find solutions without our help. Work has thus to be collaborative, and includes several distinctive steps.

a. Sensitivity and cluster analysis

Different responses to an increase in mean temperature are possible. Each tree can be influenced in its own way depending on its specific situation (altitude, exposition, etc.). Bernd's scientific team is planning to initiate a sensitivity analysis to temperature for each orchard of trees in the focused region. Several weather stations are operational within the region. In order to conduct the sensitivity analysis successfully, each orchard has to be associated with a weather station. A cluster analysis is therefore mandatory in this situation.

b. Empirical forcing of the model

The amplitude of temperature change strongly relies on which pathway will be followed in the future regarding greenhouse gases and aerosols emissions. A range of worth considering conditions should be simulated to get a collection of effects on the spread of the disease under different climate conditions. Simulations from +1°C to +5°C will be performed.

c. Access to multi-RCM projections

EURO-CORDEX projections are available for different Representative Concentration Pathways over the entire twenty-first century. Outputs of several models can be delivered for the Bolzano province in order to get a mean response of the climate system. In a first phase, 3 EURO-CORDEX RCMs will be selected. With the aim of informing farmers of possible future conditions of their trees, empirical simulations of +1°C to +5°C will be associated to a specific year/period relative to the scenario of emissions that will be followed in the future. Farmers may have information about the schedule of impacts, which they have to be prepared for.

d. Statistical bias-correction for each weather station

Despite the high resolution of RCMs, 3 grid cells only represent the Bolzano province. This does not account for different conditions depending on the topography. In order to get station wise future conditions, statistical bias-correction depending on the bias between simulated and observed mean temperature value and variability should be conducted. This post-process attempts to find a correction function that maps a modelled variable such that its new statistical distribution is equal to the distribution of the observed variable.

These four steps allow linking each orchard with possible future temperature conditions and their influence on the disease.

WORK IN PROGRESS

Since the project-holder and young scientists are strongly motivated by this climate service prototype, collaboration has arisen from this exercise. Also living in Northern Italy, Johannes and Lorenzo are the main contributors on the project. The sensitivity and cluster analysis is currently under consideration by Bernd's team with the help of Johannes. Bernd also envisages empirical forcing of the static model. Lorenzo conducts the gathering of multi-RCM projections. When the first three phases will be completed, Lorenzo also foresees to start with the statistical bias-correction analysis.