Use Case: Evaluating Impacts and Adaption Options to Climate Change

Bas van Ruijven and Brian O'Neill

National Center for Atmospheric Research

Pablo's Story

This use case describes the hypothetical example of a researcher who evaluates impacts and adaption options of climate change. The economist Pablo works at the Inter-American Development Bank (IDB). His task is to compile a report on climate change in Latin America. This report should provide a broad overview that includes the impacts of climate change at different atmospheric stabilization levels, the possibilities for adaptation and the consequences of emission mitigation policies for Latin America. His institute runs its own macro-economic model for the Latin American region, and publishes economic projections for the individual countries. Their macro-economic model has a strong focus on the role of the agriculture sector, and therefore, Pablo is able to run his own agricultural impact scenarios if he is able to obtain information on changes in precipitation, temperature and other growing-season variables.

The starting point for his analysis is the IIASA database on the Representative Concentration Pathways (RCP) and Shared Socio-Economic Pathways (SSP). This database provides information on socio-economic conditions such as population, per capita income, and energy use in scenarios that are consistent with the RCPs. The scenario assumptions and results from different global Integrated Assessment Models are downloadable from this database in several different formats. Pablo aims to combine these data with climate-data that are also consistent with the RCPs, which are available in the EarthCube system, and then do his own model runs to produce information for the report.

For analyzing the impacts of climate change on Latin America, he obtains the results from climate model runs for the RCP's. These could be the results of global circulation models, or the regionalized detailed results of regional climate models. Currently, Pablo would have to find out on the internet whether these data are available, but in this idealized use case, he simply logs on to EarthCube to find all the available model results for his geographical region. The information that he uses from these climate model runs includes changes in surface temperature, land cover, hydrology, sea level and growing-season. From these parameters, Pablo is able to estimate the impact of climate change on agricultural productivity.

Using the EarthCube system, he also can build upon the climate change impact work of colleagues that work in biodiversity and ecology. The results (and data) of these studies related to the impacts of climate change on different species are uploaded to the EarthCube system and tagged with their geographical area. So, if Pablo wants to write short literature assessments on potential climate change impacts on the Amazon, the Andes or the Pampas, he just selects the relevant geographical area to find all studies that have been done on that specific topic.

Using the outputs of the climate models, Pablo runs his own model with these projected climate variables as inputs, also using projected socio-economic conditions based on the SSP's as input as well. In this way, he is able to calculate the impacts of climate change on the agricultural sector and the consequences of those impacts for the rest of the economy.

To investigate the possibilities for adaptation, Pablo uses again his own macro-economic model for Latin-America. This time, he formulates a number of measures that would help the agriculture sector to adapt to the new climate conditions. These include for instance switching to crops more suited to the new climate conditions as expected in the earth system model results, or investing in irrigation systems or additional fertilizers.

Finally, Pablo analyses the consequences of emission mitigation in two steps. First, he analyses the macro-economic impact of mitigating emission within Latin-America, so that emissions from this region are consistent with global reductions needed to achieve the radiative forcing assumed in the RCPs. For this, he uses the information on future socioeconomic conditions from the SSP's and his own model (which includes an energy sector description). In this way, Pablo is able to develop a number of scenarios on different mitigation levels and he can derive the macro economic impacts of emissions reductions consistent with the RCPs.

The second part of his mitigation analysis focuses on the implications of bioenergy production and has implications for his assessment of impacts on the agriculture sector. From the RCP and SSP database, Pablo tracks the amount of bioenergy expected to be exported from Latin America as part of the results of several global integrated assessment models analyzing these scenarios. He uses these flows as input for his own regional model and determines how much land, and its spatial distribution, would be required for bio-energy plantations in Latin America. He includes this land constraint in his assessment of how the agriculture industry would be affected by climate change, and derives the net macro-economic consequences for the agriculture sector and the economy as a whole considering mitigation, impacts, and adaptation jointly.

After finishing his report, Pablo uploads his own model results to the IIASA database on the SSP's so that others can download his data, compare it with their own results and use it in other studies. He also tags his report to the category of studies on climate change impacts in Latin America in EarthCube. In this way, other authors can easily find it and use the report, for instance as context for an impact report for individual counties or in a global assessment of climate change impacts in different regions.