Agricultural futures

Cynthia Rosenzweig heads the Climate Impacts Group at the NASA Goddard Institute for Space Studies in New York. Recently she has taken on another role co-leading the Agricultural Model Intercomparison and Improvement Project. She explains that task to *Nature Climate Change*.

Why does the world need the Agricultural Model Intercomparison and Improvement Project (AgMIP)?

AgMIP started a couple of years ago. For a good while before that the agricultural modelling community realized that disparate groups needed to work more closely together to bring about a leap forward. And when the 2008 spikes in world food prices happened, our motivation grew substantially. The models projecting what will happen with agriculture in the future were created in the context of the steadily decreasing food prices that had been the norm since the end of the Second World War. And suddenly everyone realized, "Oh no! That assumption doesn't hold any more." Throw climate change into the mix and it was obvious that we have a lot to do to improve the scientific rigour of predicting how much the world will have to eat and how much food will cost.

The goal is to significantly improve projections of how climate change will impact food security on both regional and global scales. The results will help to identify and prioritize adaptation strategies. Regions need to know how other agricultural areas, as well as their own, may fare, as this affects prices, trade and land use.

How is the organization set up?

There are four main teams of workers: the crop modellers, the climate scientists, the economists and the information technology team. Before AgMIP brought them together, these groups tended to act more like separate tribes. They would come across one another at conferences, but there was wariness about collaborating. Of course, it's important that they do because of the tendency in the field of agricultural impacts for uncertainty to stack up: the agricultural economists depend on the work of the crop modellers, whose output, in turn, relies on scenarios that come from climate modellers. One idea of our annual meetings is to give specialists a good grounding in the key assumptions of researchers in other fields. We also work in regions with teams of local experts.

What has AgMIP done so far?

During our first phase, we're running protocol exercises for several crops, starting with

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wheat, maize and rice pilot studies. There are four sites with top-quality data on wheat growth — in Argentina, Australia, India and the Netherlands — and we have 27 groups each testing different wheat models against their data. The participants initially get a series of data sets to run and then give us results from their partially calibrated models. Next we provide them with more information and see how the fully calibrated models perform. Then we further test the sensitivity of the models by making them deal with variation in carbon dioxide level, water availability, temperature and fertilizer application. AgMIP analyses how accurate the models are next to real data and how differently they perform. We're going to run these kinds of exercise for millet, sugar cane, sorghum, soybean and livestock as well.

What are the priority areas in improving models that predict the agricultural impacts of climate change?

The exact biophysical effects of high temperature and carbon dioxide levels on crops are issues that come up time and time again. Part of the disagreement in representing the carbon dioxide data in models stems from differences in the methods of studies that grow crops in experimental chambers compared with those where the crops are grown in open settings. We are holding a special meeting in September to encourage experimentalists and modellers in this field to get into the nitty gritty of these difficulties. It is virtually the first time they'll have ever done that together. Otherwise the priorities include modelling how crops respond to variation in extreme events and how to aggregate crop data in the face of heterogeneity of soil types, farm types and weather patterns.

What are representative agricultural pathways?

AgMIP is also coordinating the agricultural crop and economic modelling for the Inter-Sectoral Impact Model Intercomparison Project (ISI-MIP). The climate modelling community has come up with representative concentration pathways (RCPs), a set of four trajectories for how changes in greenhouse-gas concentrations that are used to drive climate model projections up to 2100. Similarly, social scientists have developed shared socioeconomic pathways (SSPs), which project forward a series of socioeconomic shifts. So, following that lead, AgMIP's economists are working on four representative agricultural pathways (RAPs) to provide a standard and detailed time series of agricultural developments up to 2100 that would also be consistent with the SSP trajectories.

A common axiom with models is that the output quality depends on the input quality. Is AgMIP doing anything to improve the quality of crop data?

We've come up with a grading system for field sites. I think of it as a good housekeeping guide to running crop experiments. We give out silver, gold or platinum stamps of approval according to how comprehensive and consistent the data from sentinel sites are. For the wheat pilot studies, for example, we're just using platinum sites. Hopefully, this system will provide crop modellers with better guidance in site selection and inspire those designing field tests to measure more key parameters in a rigorous fashion. Our information technology team puts the sentinel site data onto the web, so anyone can access them and use them in modelling. I'm also conscious that hardworking data gatherers have received little recognition in the past, with the modellers taking the limelight. We are going to change that.

INTERVIEW BY ANNA PETHERICK