Climate Change Overview and Projections

Q&A

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Steven Pueppke (Michigan State University): All of the discussions spoke, to one degree or another, about climate change and farmers, and I was wondering if anyone has talked to farmers and to gauge their opinions on climate change—whether they believe it is occurring, whether they’re prepared to respond to it—issues of that sort. I realize that probably doesn’t fall within the direct expertise of any of the speakers, but I’m curious about where the rubber meets the road part of it, which is with the agricultural practitioners.

Raymond Desjardins: I can start answering it. We have a good program. We have developed a greenhouse-gas calculator and the Saskatchewan Soil Association has put a lot of money into training farmers in its use. So, they are interacting with the producers quite a bit in this format. We are at least familiarizing them with the climate-change issue and this calculator allows them to say, “If I do this or that, what will happen to the greenhouse-gas emission on my farm?” After they put in the information for their farms they will know a lot more about climate change and the impact of what they do on greenhouse-gas emissions.

Linda Mearns: In the United States there is a lot of work with stakeholders and in particular there are grants funded by NOAA\(^1\) that are geared towards working with stakeholders. In the one for the southeast, they have worked extensively with farmers, talking to them about adaptation, how they see climate change and what adaptations they envision.

Francis Zwiers: My interaction with the agro-industry community hasn’t been with respect to climate change, but earlier in my career I dealt with seasonal forecasting issues. From time to time we held meetings in western Canada to bring people from Environment Canada, who had knowledge of seasonal forecasting, together with producers to learn from producers what types of information they would like to receive from us and

\(^1\)National Oceanic and Atmospheric Administration.
to understand their concerns. My impression from those meetings was that the kinds of questions that producers had for their own farms were often quite different from the kinds of things that we imagined that we could produce that might be useful to them. Maybe there wasn’t an adequate conversation between the two communities. Typically, somebody would get up at a microphone and say that what they would really like to know was the likelihood of a damaging thunderstorm or other extreme weather event during harvest time. Of course we were not in a position to make that kind of forecast 3 months in advance, and we would try to respond and say that we were in the business of trying to forecast average conditions a season in advance and do that on a global scale, and since they were selling into a global market wouldn’t it be useful for them to know something in hedging their bets here in this country and wouldn’t it be useful for them to know something about growing conditions elsewhere. But the people we were talking to at the time weren’t thinking in that particular way, and I think that was largely because we weren’t effectively explaining our products and their utility.

Desjardins: One more point—my colleague and I have just published a book, *Better Farming Better Air*. I will put a copy on the desk and anyone interested can get a copy by writing to me. It deals with the impact of climate change on farming practices.

George Khachatourians (University of Saskatchewan): Data were presented that the animal production industry is responsible for 61% of the GHGs in Canada. You listed the species of animals. What would be the contribution of aquaculture should we substitute one with the other?

Desjardins: It was 61% of greenhouse gas emission from agriculture, of which agriculture contributed only 8.5%. So it’s 61% of 8.5, or about 5% of the emissions in Canada. Aquaculture: I don’t know much about it. I suspect there would be a bit of methane emitted, but I would think it would be quite low. We have counted the greenhouse-gas emissions for practically everything, but we didn’t estimate it for fish yet, because you have to count the crop complex that you use to feed the fish; we have done that for poultry, beef and pork, but I suspect that the emission from aquaculture would be low by comparison.

Scoles: Do you have another question?

Khachatourians: The other question is related to adaptation. The adaptation phenomenon follows initiation; people in the next wave follow and then, of course, the system either collapses or continues. My feeling is that another phenomenon is occurring vis-à-vis farmers. The current generation is technologically, and even informationally, so knowledgeable that they don’t necessarily have to absorb the diffusion of adaptation. They might just simply abandon, and choose other professions and other things. So, we have a dilemma. On one hand we have the most educated, most informed population that should embrace adaptation, yet on the other hand they have “other options.” What would your comments be on this one?
Mearns: That’s an interesting point and I think it illustrates several things that are beginning to happen in, let’s say, the study of impacts and adaptation, and that includes things like migration and change in job category. The younger, more technologically agile farmers may be able to make the best go of farming because they would be among the early adopters; hence, it’s not clear to me. It would be interesting to study whether or not it would result in more abandonment of farming or injection of new life into farming.

Tom Wilson (Pennsylvania State University): Dr. Desjardins, you mentioned that carbon sequestration was a reversible process but sensitive to changes in climate and the uncertainties surrounding that. Can you talk a little bit about that and the dynamics?

Desjardins: When you change from intensive tillage to no-till, you will sequester carbon. But if you cultivate the land again, it won’t take long to lose the carbon that you sequestered. With the increase in temperature, we expect that there will be more decomposition of the soil organic matter with loss of carbon as carbon dioxide. That’s why we say it is reversible.

Wilson: So the loss of organic matter is large enough to shift that balance?

Desjardins: Yes.

Audience member: I want to comment on disseminating information to farmers. We scientists are not trained to disseminate information. I think the experts are being neglected: the agricultural extension agents. Those are the ones who can really talk to the farmers. As students, we are being taught to do research, to find out, not to disseminate information. Extension agents know how to pass information across to farmers.

Mearns: I agree. Interestingly enough, in the area of climate change, at least in the United States, the agriculture extension service is considered a good model for what we would need for climate change in general. In other words, we kind of need an extension service on climate-change information. And something like that may develop in the United States, where we are rapidly gearing up for the development of climate-services programs. It will require working actively with farmers to come up with what information is really useful to them and some scientists are interested in doing that, like those at the University of Florida. On the other hand, some scientists are much more theoretical and not interested in communicating to general stakeholders. It’s partially a matter of personal preference, but we need everybody who is interested in communicating to participate.

Desjardins: I might add that, regarding the course I mentioned, the trainees who, in turn, are training farmers to use the calculator have a set of questions they are going to ask the producers and then they will come back to us and hopefully we will be able to improve the calculators so they will be more useful for the farmers.
Mark McLellan (University of Florida): I come from a very interesting state. Florida is a peninsula with a large population and a large agribased business. I have extraordinary confidence in the ability of farmers to adapt. What drives fear into our farmers are catastrophic events. Florida deals with catastrophic events regularly: hurricanes. When we talk about massive rainfall and extraordinary drought, these are things that drive fear right to the core. One of the options is to sell the land, and we worry about harvesting fire hydrants instead of harvesting citrus. It’s a real concern. My question is, “Are we moving into a realm of more-dramatic and more-extensive catastrophic climatic events?”

Zwiers: Linda and I were both involved in another one of those US climate-change science plan assessment products on extremes, which can be found on the US global climate-change program website. Look for SAP 3.3. One of the things that this report focuses on is hurricanes, on what we know and don’t know about them, and one of the things that I learned in the process was that if you have three people who study hurricanes in the room then you have a hurricane. We understand some aspects of what controls the development of these storms and the conditions under which they will form, but we don’t have complete process understanding. It’s not a phenomenon that is represented directly in global climate models; you have to go to the high end of regional climate model resolutions—at the 15-, 10- or 5-km scale—in order to simulate these things well. Depending upon how you look at the data and what data you look at, you might convince yourself that there has been a large change in the frequency or intensity of hurricanes in the North Atlantic, or you might convince yourself that the frequency is not all that large and the change in intensity is not all that large. Depending upon who looks at this, you might come to the conclusion that future storms are going to be much more intense than at present or moderately more intense than at present. We are not able to give a clear picture. And the observational evidence from one basin in which tropical cyclones are found is not so consistent with the data from other basins in which tropical cyclones are found. We are still in the process of trying to understand why that is the case and we are understanding for example that hurricane formation in the North Atlantic has a lot to do with large-scale global variations and circulation, such as the state of the North Atlantic oscillation. So, lots of things make this particular picture hazy. There will be another opportunity for the global community to make an assessment on extremes, and I think we will come closer to your particular question, which has to do with whether climate change is causing more frequent disasters and is it affecting our ability to manage those disasters and are we managing disasters effectively at the moment. The IPCC recently made a decision to produce a special report on extremes and managing the effects of extremes. We just had a scoping meeting on that and it will deal with what we understand about how extremes have been changing in the physical climate system and how they will continue to change in the future.

Mearns: Francis addressed one of the more complex extremes. There are other extremes that could have catastrophic effects that we are more certain about, for example, heat waves, however you want to define them. We know that very high heat in certain phenological
stages in crops can be disastrous. In 1983 in the US corn belt, there was tremendous loss in yield not because of drought but just because of a series of days above 95°F around fertilization. Those are absolutely inevitable, I would say. The other is, of course, more extreme precipitation, so more flooding devastation is possible, like we had in spring on the Mississippi River. Also, clearly, is the problem of heavy precipitation causing soil erosion. A lot of thought is being given to weather extremes and more attention will be placed on it such as through IPCC special reports.

*Myles Frost (Agricultural Institute of Canada):* My question has to do with adaptation and communication—the reference to farmers being aware of this sort of analysis and what steps they can take. My sense is that, in the schools of agriculture and bioresources, or by whatever name, some percentage of undergraduates are being exposed to IPCC-type analysis such as the work coming out of Agriculture and Agrifood Canada on climate change and adaptation. So my first question is, “What percentage of undergraduates at schools of agriculture are being brought up understanding this ethic and this certain information?” And the second is, “How do you personally rely on your views getting across to non-ag, non-environmental senior public servants and their bosses, so that when decisions are made around cabinet tables as to regulatory matters, funding, etc., they can make informed choices?”

*Desjardins:* I’ll try to answer the second question.

*Mearns:* Can’t you answer the first?

*Desjardins:* I can’t. I’m not a teacher.

*Zwiers:* I can’t.

*Mearns:* We can’t answer the first question. None of us.

*Desjardins:* In response to the second questions, we work closely with policymakers. We prepare treasury-board submission. Like in Ag-Agfood Canada, I am fortunate that policymakers interact with our research group and we get our message to the policymakers about our needs in research. And we have been team-working on preparing treasury-board submissions, so this works quite well as far as I’m concerned, in some departments. In other departments it doesn’t work quite as well.

*Scoles:* For question one, we have about ten graduate students in the room. How many of them are aware of IPCC? All of you.

*Joanne Puetz Anderson (South Dakota State University):* At South Dakota State University, a lot of ag students take meteorology and we deal with the feedback cycles—the carbon cycle and the water cycle, and we talk about climate change. We never say global warming, but we do say climate change.
Zwiers: If I can respond to the second question, I have a complicated answer and in three parts. I work two levels down from the assistant deputy ministry, and so we think a lot about how to feed our stuff up to policy people. I am part of the Atmospheric Science and Technology Directive of Environment Canada, and we have an air-quality group, a climate group, and a meteorological research group. The air-quality group has good interaction with policymakers because they are involved in science that is directed at regulation; the policymakers understand what they are doing. They are making rules on the kinds and quantities of materials that can be emitted into an airshed and what standards are appropriate for Canadian health, Canadian air quality, and so on; this is a direct working relationship between the policy types and the scientists. On the climate side, our science has largely been aimed at contributing to the IPCC process, so we have been studying global climate issues, and until recently have not been focused on regional aspects. Therefore, the pathway used for informing the policy committee has been mainly by contributing to the IPCC process and making sure that the IPCC report is a respected document for government use as a basis for negotiations internationally. We sometimes have to pass information up to our negotiators, but in Canada the negotiators tend to hold their cards close to their chests and we scientists find it hard to know what information they need. That communication doesn’t work as effectively, so we use the indirect IPCC route.

Abraham Blum (Plantstress.com): Farmer adaptation is outside the context of catastrophes. Farmers cannot adapt to crop-killing drought or crop-killing heat or flood. There is no way to adapt to those. A scientist at the International Rice Research Institute who has worked with farmers coping with drought in southeast Asia for 10 years reported that one of the ways a farmer in India copes with drought is to sell a child into forced labor. We don’t consider this adaptation. We cannot deal with catastrophes. My second comment is more technical. Dr. Mearns stated that increased CO₂ concentration in the atmosphere increases water-use efficiency and, therefore, increases yield. However, water-use sufficiency does not equate with higher yield. In rain-fed cropping systems, higher water-use efficiency is often achieved by reduced water use and not by increased yield. It’s a ratio, of which you have to consider both sides.

Scoles: Any comment? No?

Desjardins: I will just say that better-managed crops use water more efficiently.

Tajinder Grewal (Saskatchewan Research Council): It’s nice to hear that with global warming we will have new crops and more yield. What new crops are you expecting in the next 30 to 50 years, and what crops will not be grown after 30 to 50 years?

Mearns: That’s a very big question.

Scoles: Anybody want to take that on?
Desjardins: One of the things that I mentioned is that a highly reflective crop might help a little bit because it will increase the albedo. There have been several papers recently on that. There is talk about a C4 variety of rice which would be a major breakthrough, another Green Revolution. Any crop that avoids having to use nitrogen—a nitrogen-fixing crop would be a major breakthrough because whenever you apply nitrogen you produce 1 kg of carbon per kg of nitrogen fertilizer produced. That would be a major improvement.

Kelly Pitman (Texas A&M University): Dr. Mearns you mentioned that you use regional climate models in your research. I’m doing research on climate change effects on crops in South Texas, and we also have a lot of extreme events. For example, we are now in an exceptional drought, and last summer hurricanes flooded our fields. Can you suggest tools that I can use for crop modeling in our region? I’m having trouble finding something that I’m satisfied with.

Mearns: Do you mean climate-change scenarios that you could use?

Pitman: Well, more like a software program to assess climate change in my region.

Mearns: The slides that I had to skip would show that we can meet all your needs practically immediately. At the North American Regional Climate Change Assessment Program, we are using six regional climate models at a 50-km resolution and four different global models. Therefore, my first advice to you would be to look at our website. A users meeting will be convened in early September. Google “NARCCAP.”

Claire Sullivan (University of Saskatchewan): Dr. Desjardins, you talked about how we can adapt human behavior to affect climate change including change in diet. You suggested eating less, consuming less meat, and I am curious about the difference between us consuming less meat or producing meat more sustainably. In a previous NABC report, they spoke about using animal by-products as part of a biobased industry.

Desjardins: I think that consumers will probably want more meat in the future, so we’d better look for alternative production methods. I mentioned, for example, a farm where they have an adjacent ethanol plant. They feed cattle with byproducts from the ethanol-production process, using corn as the feedstock. The animals produce manure that is transferred to biodigester from which energy is produced. We might come to this type of farming system if we want to retain our lifestyle. Otherwise, we are faced with choices. For example, I read recently in the New Scientist where you eat some meat but in reduced amounts, and that can help considerably. Soy protein is an alternative, but I don’t think we will change consumers’ desire for meat. Meat may be produced from forages that have few other uses, and forage crops are excellent for sequestering carbon. We need to look at all options.