

[back](#)

GETTING ADDITIONAL INFORMATION

Linda Mortsch

Environmental Adaptation Research Group, Environment Canada

I want to take one step back and just reiterate what we mean by "climate impact assessment." Some of the questions that we are asking ourselves when we do an impact assessment is: How does current climate affect natural and human activities? How do climate change scenarios impact human and natural systems? What are the linkages between climate and the activity of the area of the person or the water resources? What are the sensitivities? What are the vulnerabilities? Are there any thresholds that are important? Then, how do you adapt to the current funding? The current funding including means? And also very importantly, the variability and extremes, and how might you adapt or respond to a future climate change. The issue that we're dealing with is exceedingly complex. It's pretty darn messy. There are so many things that we need information on -- many, many things. In our group we focused on terms of impacts -- direct impacts on a particular region, a particular activity, and also considering indirect impacts -- impacts from elsewhere or impacts that have to travel through something else to affect our region or our activity. Consider not only identifying problems and impacts but looking at what we can do about it. Because I think we have to spend a lot of intellectual energy not only identifying the problem but working to solve it.

Today 1.27 CO₂ -- why all the interest in studying that? Impacts and extreme events -- cost of the normal climate in adapting to our infrastructure -- water resources management and planning, adaptation to current climate and also looking at things that make us more vulnerable to climate. Now applications. One example used by one of our researchers at Canterbury Smith is looking at how crop insurance often may impede adapting to climate. The impact of two times CO₂ scenario. The cost of the future climate, and how do we adapt? What is the process of adaptation and what are the costs? Also, since we're having problems getting our emissions reduced and the concentrations are still going up -- people are now looking at saying "we're going to be a two times CO₂; we better start accepting the impacts and the consequences of moving on to three and four times CO₂," so that's on the agenda at this time.

In the Great Lakes, I just want to put up some temperature and precipitation graphs. I just wanted to give you a sense of one general circulation model -- the Canadian one, that we use in the Great Lakes. None of these have the aerosol influence in them, and that's extremely important as well. People who are talking now about the increase globally, is not as important. But it is important for he

Great Lakes Basin for two considerations: It's due to sulfate aerosols and it is a regional impact short-term and it's masking the warming within our region. So that doesn't mean that the warming's not happening -- it's just being masked for now. But the climate will still change and be affected by two times CO₂ and with our other policies of reducing emissions. Just think about this for a minute. We use these scenarios, plausible futures, and "what if" conditions, and we do not talk about credentials. Bad mistake. Because we don't have that certainty. We are trying to provide information to the Basin that gives people some boundaries for planning and accepting the influence -- not predictions -- we're not there yet. But what if temperature within this region increased four to nine degrees in the winter. What if in the summer it went up four to six degrees. The precipitation -- went down by 10 percent or up by 20 percent in the winter; down by 30, or up by 30 percent in August. Temperature indicates an increase throughout the Basin. Precipitation is much more variable throughout the Basin in terms of what is going to be estimated from these scenarios. In the Great Lakes St. Lawrence Basin project, we used a matrix to try to help us guide our research in the selection of projects that we were working on and trying to integrate to get a sense of where we were and of what we had to do. And we chose four theme areas -- climate sensitive theme areas to work on -- Water Use and Management, Ecosystem Health, Human Health, and Land Use and Management. And then we also felt that to do a good job we should be addressing within those studies -- integrated within those studies -- end-to-end -- climate and biophysical systems or impacts, socio-economic impacts, adaptation, and also communication and education. And the color graph shown here allows you to achieve that within our various theme areas. Water use and land use and management have a long history of addressing climate or being sensitive -- vulnerable to climate, and they already have a fair bit of information in that particular area, but ecosystem health is next, and then human health is an area that virtually -- we had three studies and it's just in its infancy. One of the other key things that we found out is that we don't really have a good handle on urban impacts or effects. We didn't really address that particularly well in our study. What were we trying to get out of our assessment? We wanted to get a sense of no regrets out of it. I guess it's in a sense hedging the uncertainty with respect to predictions or the scenarios for future climate. What things make sense now in terms of addressing climate variability and change and also address other known problems that make sense irrespective of how much the climate changes. We wanted to express the impacts simply so that we could work with decision-makers and policy-makers, and we wanted to highlight social, economic, and political impacts -- try to give some vulnerability indices -- we didn't do that very well -- and also provide some information on the divergence of information. Great Lakes lake levels are at an all-time high -- well, are at high levels, and our scenarios suggest water level drops from 20 centimeters to 2-1/2 liters. What's going on? So now I took some of the working group sections or categories and tried to identify some areas that needed some work or that had proven fruitful. Scenarios, historical analogues looking at past extreme events. such as the 1988

drought, to find out what the impacts were and how people responded helped to give me that kind of information. Transient scenarios are starting to get their front general circulation models where you do time slices and have climate elements and find its parameters at different time slices -- 1.3 CO₂, 1.5, etc., to give you the path to two times or three times CO₂ are very important, and considering beyond two times CO₂ to three times CO₂ and four times CO₂, a lot of people are talking about regional climate models and getting finer scale resolution and processing and balancing conditions set by general circulation models. It's an up and coming area of research but it's not moving ahead as quickly as the impacts people want their information. There's still a lot of fundamental science and work we have to do on that. So they're not going to be available -- not for two years at least in Canada. One of the things that came out in most of our impact discussions in the last little while was "what are the impacts of extreme events?" We need some way of developing scenarios to address that particular problem. Precipitation changes, storms and heat waves, and their intensity, duration, and frequency. In the Canada country study and also in the Great Lakes project, some of the issues with respect to water resources that are important to know -- at least that came out in our report -- groundwater -- bottom line -- you don't know very much about it. First of all, we don't have an inventory of the Great Lakes Basin -- on the Ontario side I know for sure of what's there. So therefore it's extremely difficult to assess the impacts. I know of one study in the Great Lakes Region on ground water impact and climate change scenarios, and that was in the Grand River Basin in Ontario. There is a new study trying to do a regional characterization of the ground water hydrology for Ontario to assess the impacts. I think that will be extremely interesting. One of the calls of the 1997 workshop was integration within the water resources sector, so, for example, integrating water quantity studies with water quality studies, and integrating them into policies such as the Great Lakes Water Quality Agreement. Other questions are things such as adaptation -- how do we respond? How do we do better conservation of water? How do we cost water more appropriately?

Land and Water Ecology -- a big topic. I've only got about a couple of snippets here which doesn't do the topic justice, but just to spark some discussion, some ideas. Ecosystem characteristics and function -- how might those change in terms of habitat? About acidification here just to sort of keep the discussion with respect to other issues -- climate change and acidification. There's one study that shows that pH levels in small lakes in the Dorset area, which is north of Toronto, were starting to go back up again because of reductions in sulfur dioxide and then all of a sudden certain have remained constant -- that's tied into drought effects and acidification. So there's combinations of other air issues -- there's also the issue of UV -- ultraviolet radiation penetration in water relating to climate change. The whole issue of exotics and their introduction and the effects. Other issues within our Great Lakes Basin of protection, remediation, and restoration. And the case, for example, that I am familiar with are wetlands. We want to protect existing wetlands, we want to remediate some of them and restore some

of them, and we also want to get more wetlands, but what are the impacts of climate change, in terms of changes in hydrology, water level changes, precipitation changes to that remediation. Forestry -- Boreal Forests decline in certain areas. Why? How? What are the impacts of droughts and fires? Extremely important. I think Mike Berkles said that he wrote the agriculture chapter -- just for some ideas-- he did a historical review of the work that was done with respect to climate change in the Great Lakes -- pardon me -- (they said the first folder) Agro-climatic Properties -- number of freeze-free days, growing degree days -- we've done a fair bit of assessment on that, and we know that fairly well in terms of what climate change means to those agro-climatic properties in many cases. We've also looked at changes in certain regions of Canada -- for example, Ontario which is close to but not in the Great Lakes Basin. on productivity changes, in terms of individual crops, and also land productivity changes. But it does say that grain crops are much more -- such as corn and wheat -- are addressed, but other crops such as potatoes and specialty crops do not have a good understanding. There's an issue of what climate change means to agricultural economics at the farm level, the individual farm level decision making, and what that means to the farmers' bottom line, and then also within the region, and also within the country. He talks about a real need for agriculture studies in terms of international agricultural economics -- those indirect effects in terms of Russia's production of grain increasing other areas' experience in changing patterns of migration and demands for food. How does that affect international economics and the competitive advantage or disadvantage to a particular region by experience? And then he also talks about adaptation preventing climate change and so your cropping and tillage practices to enhance CO2 uptake. And then on the other side the coping mechanisms with the impacts of climate change.

Human Health -- as I said before within our project anyway was very limited in scope. We looked at malaria for Toronto and incidence of heat stress for Toronto -- not very much. But I think this is an extremely important area because people from the Lakes to their human health -- it makes it real to them. They may buy on to some of the important changes that have to be made if they know they are protecting their human health. But other issues that should be addressed are smog and other air pollution and how that affects human health and all climate change -- changes in storm tracks, changes in introducing more smog or increasing smog up in Windsor or other areas. One idea or research need that came out quite frequently was the impacts of and trends in extreme events and how that -- how frequently they may or may not be happening, but that human health impacts on those as well. Things such as heat waves, storms, and floods. Another area that should receive attention is what are the risks of infectious diseases from a particular region. Does it necessarily mean that it will happen? For example, risk of malaria because of temperature conditions improves for the Toronto region. You can actually have malaria occurring in Toronto. Whether it happens or not is still a stress on the health care system, and we need to think of

ways to respond to that risk. It also came out of our discussions is that we need some case studies, looking at the human health -- the physical and also the psychological health of people in response to heat waves or floods, etc. -- their health and well being.

Not really knowing exactly what was meant by economy and commerce, I put up some ideas, and I hope they don't throw things off, but when I was thinking about economy and commerce in terms of the work that we've done and the discussions that we've had I came up with: What are the costs of the impacts? What's the cost of the adaptation? Because everybody says for example in agriculture, farmers can adapt, but we need to address what it costs in terms of money, technology, intellectual brain power, and the timing of that -- so what are those costs compared to the advantage from one region to another for products, opportunities for things that we may lose because of climate change. And in one study that we did an impact assessment of two climate change scenarios, represented by changes in agriculture, forestry, fishery, and hydronavigation, representing about ten percent of the employment in the economy by employment. And I tried to get a sense of using the putout model what the impact on the economy would be, and came up with a number -- net impact. I feel very, very, very uncomfortable using that. One scenario said a positive gain -- very small -- another one said a negative impact on the economy. And when you do that net income, you throw everything up into one number, and what you're failing to present to the policy decision-makers are the regions in Ontario that will have gains, regions that will be affected, and then how will that play out in the policy in the decision-making for Ontario? The other area that needs serious consideration are the things -- what economic instruments can we use to promote -- responding to impacts of climate change -- promote conservation of water or energy -- economic tools. We seem to be working on that in some areas.

Governance. I think if we can just pick one area such as water resources, which is more familiar than some others. There are some significant governance issues here. For example, water apportionment, the Niagara River Treaty setting out water for hydra, recreational Niagara Falls. That's coming up for negotiation in the next little while. How are we going to apportion the water for that? How do we regulate our Great Lakes -- Lake Superior and Ontario. For example, Lake Ontario regulated to maintain water levels within the Great Lakes -- within Lake Ontario -- for shoreline, for navigation, for recreation, and hydrogeneration. Downstream in the Province of Ontario where does one get off? We have upstream and downstream conflicts. If you have lower water levels in Lake Ontario, are they going to hold back water to maintain levels within Lake Ontario, and only let out enough to meet hydrogenerating needs? What happens to the Port of Montreal when twenty to forty percent of the flow to the St. Lawrence River could be gone. Really sinful. There is the Great Lakes Water Quality Agreement that's identified 42 areas of concern within the Great Lakes -- areas that need remediation to enhance -- to bring back the beneficial uses. Not one of

them -- 42 of them -- not one of them other than the one that we're working on right down in the day of printing has even considered climate variability, first-off, or potential climate change. They're also doing Great Lakes Management Plans -- they are starting to consider climate change, which is of great interest, and I'm glad of that. The Great Lakes Charter Gentlemen's Agreement for not diverting out of the Great Lakes, and I always thought as I was -- this is my bias -- and it would be the U.S. that would be pushing for this, and Lake Superior one hundred sixty million gallons of water they wanted to take out of Lake Superior, and thankfully, that's not an issue any more. One of the things that came out of our symposium was are there any adaptations that could be harmonized on a bilateral basis or a strategy of integrated adaptation?

Communication. One of the areas that's come up over and over and over again is the whole issue of communication. When I started my career in the early 80's communication and climate change was not an issue and it barely was on the table, and now it is very, very important because we are starting to realize that we need to building stakeholder participation and public awareness, understanding and hopefully action. Other things that we need to communicate more effectively are our probabilistic data. The general public and a lot of stake-holders don't understand our science in terms of probabilities and it's apt to confuse them. Another thing that comes out is people want information on what is known, what is certain about climate change. Can't you give us something, scientists, on what you do know? You always talk about uncertainties. Could you tell us something about what you do know? We need that information. But also we do need to know what we don't know. Barry Schmidt also raised a really good question is "we scientists talk in terms of mean climate change and temperature da da da da" They said perhaps some of the problem in communication is that we're not using the right words to talk to our stakeholders, i.e., the wine industry in southern Ontario say, "oh, the mean temperature in winter" well, go on -- what we really should say to them is, "you know, your ice wine industry -- the one that you rely on freezing temperatures, and actually, no other conditions in the world are quite as good as your ice wines." Well that could be it right there. Then you've got their attention because you're talking about something they can relate to. It is encouraging that we're starting to have the agenda driven in partnership with stakeholders, and helping them set the research agenda. One of the things that we're starting to find successful are having local stakeholder forums within, say, watersheds. One of the studies in the Great Lakes Basin went to farmers groups in Quebec and actually held forums and outreach with the farmers to actually get feedback and provide information to them.

Lastly, we really do have to think about how we are going to respond to cope with climate change. We need to define operationally what we mean by adaptation and also maladaptation. What is the process of adaptation? What do you have to do to adapt? What are the costs? Here is a schematic that Ann Burton has developed to identify some of the potential adaptation. Share the loss in terms of

insurance, bear the loss. If you build in a flood plain and it floods, you're on your own. Modify the events. Prevent the effects of things such as structural, technological innovation, legislative, regulatory, financial, institutional, administrative, market-based, on-site operations, changes in those activities.

Research -- consider education, promoting behavioral change, and then also avoid the impacts. Change your use or change your location -- what are some of the adaptations that you could consider. So why would you want to do that? Climate is not constant. It has a range of conditions and it creates uncertainty. So adaptation is a way of responding to the uncertainty in our information. And we have both opportunities and risks that we should consider. Think about how we might respond -- not necessarily have to be responding -- but at least think about it in a proactive manner. Many of our past experiences are based on past climate, and it may not be exactly -- it will not be the same as what we have used in the past. What do you need to do? Just some ideas. On the one side current studies and what we tried to do at least in terms of the Great Lakes project and some other work within Canada. A sectoral focus on water resources -- agriculture -- but already within this symposium we in agriculture should talk to the water resources people. so that's starting to make those linkages and starting to integrate a cross-sect, recognizing that you can't stay within your own sectoral box or your own regional box -- that you have to try -- even if you just acknowledge the facts -- a linkage -- but that you've at least considered it and put it aside for now is important. We've always used in most cases two times CO₂ equilibrium, so dump the carbon dioxide thing and this is the final. We need to address current variability and what it means to our system, and also we need to get a picture of the past two times CO₂ and beyond, and try and get a sense of what that means. And I know that Canadian Climate Center in the next little while will be having a post data available. And while I think of it, the Intergovernmental Panel on Climate Change has identified a number of general circulation models that will be available to impact researchers around the world for the next assessment. And there will be a number of web sites that will be available where you will be able to get a GCM model from Canada to the United States -- I think from Max Planck in Hamburg. So there'll be three or four available, so that there is at least some continuity in using same scenarios, but I'll also provide Peter with the web sites so that people can follow up on them. Two times CO₂-- we've focused on the two time CO₂, which is an artifact of the modeling exercise, and sincerely we do have to start assessing the impact of going beyond that mark to three and four. We really do because we're already saying in a way that people think it will just stop at that, and it will not.

Theory. Everything else remains equal -- social, economic, technology and climate change is imposed on a region, a sector, an activity, a person. We all know that those things will not stay the same, so how do we come up with social and economic scenarios that simply just acknowledge an increase in population in a region, increase in a demand for water, a change in technology. In the past

we've really focused on the biophysical impacts. We still do. That's the closest link, the most obvious and the most easiest link -- but we really do have to branch and continue down the analysis to the economic, social and policy analysis. We started to address adaptation. We also have to start thinking about maladaptation. I read a proposal for a study in the prairies of Canada, and they talked about adaptation, and it was only talking about technological adaptation and finding new supplies of water -- groundwater to augment irrigation for agriculture. We have to start thinking a little more broadly than that. In the past we've looked only at direct impacts -- an impact on a region, an activity -- we need to consider those indirect impacts from elsewhere in our equation, or at least acknowledge them. In the past we had -- it was a pretty closed shop. We didn't have too many stake-holders. In 1988 we didn't invite the Sierra Club or the Pollution _____ -- at least Canadian proponents to the discussion. They are there now and making valid contributions. In the past we've always focused on negative impacts and only the risks -- the bad things -- although in some instances, a study in the Arctic on increase loft of ice and increase in storm surge for the oil industry, and sometime stakeholders just only want to know the bad things. The oil industry said, "well, we don't want to hear about the good things. We want to hear about the bad things, so we can respond to those." So sometimes you lose on that. But I think we do have to acknowledge that there may be some benefits and opportunities and position ourselves to take advantage of those. In conclusion, I think part of the role in our impact work is to help decision-makers, policy-makers, general public also pay attention to the climate change issue and make our site solid but also help them plan for the future. Thanks.