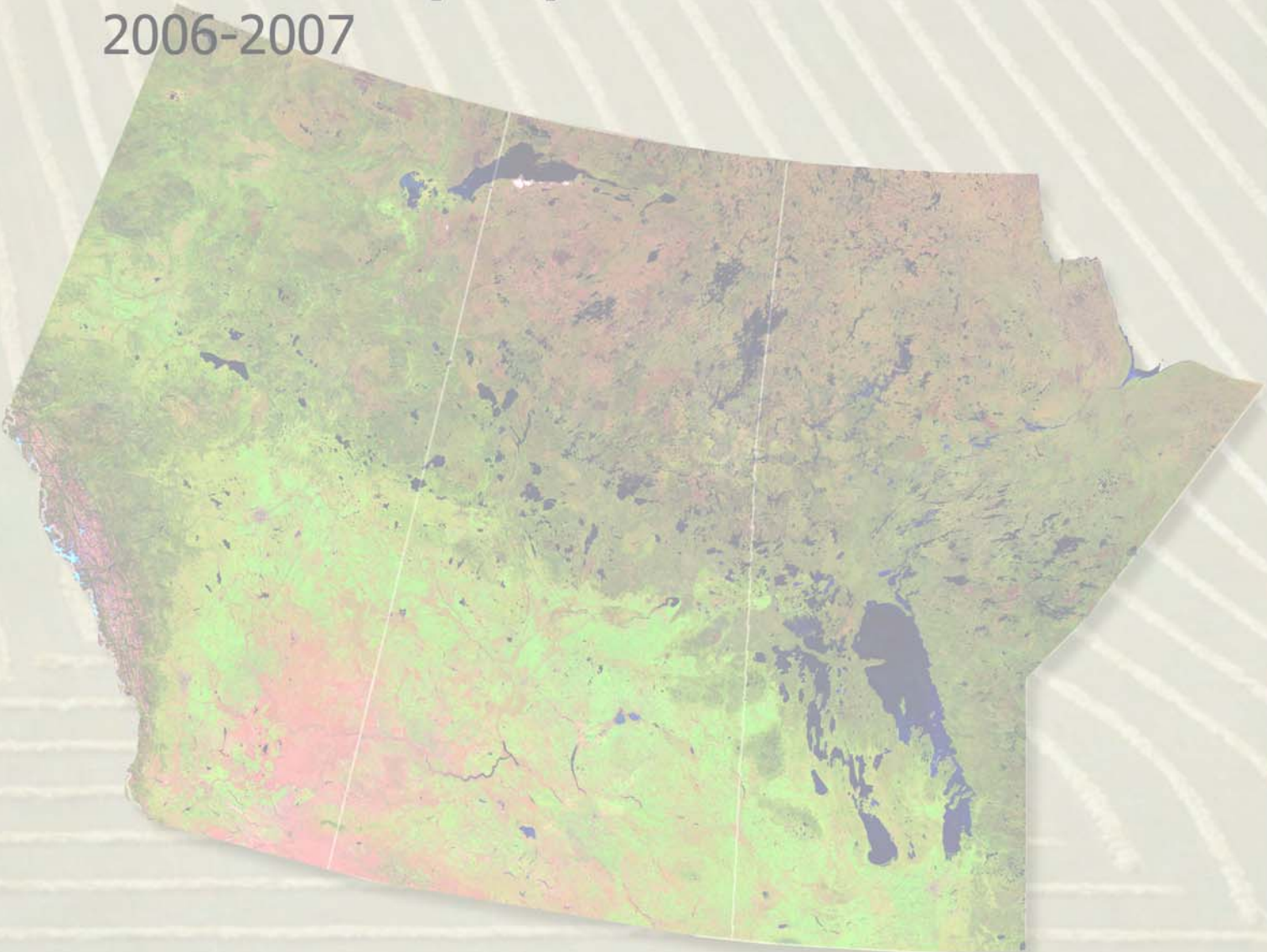




C-CIARN Prairies

State-of-Play Report

2006-2007



C-CIARN Prairies – State-of-Play Report

*The Status of Climate Change Impacts and Adaptation
from the Perspective of C-CIARN – Prairies*

Table of Contents

Preface	1
1. Introduction	3
2. Key Climate Change Impacts on the Prairies	4
3. Key Stakeholders	5
4. Strategies for Stakeholder Engagement	7
5. Engaged Stakeholders	8
6. Unengaged Stakeholders	11
7. Unanswered Research Questions	12
8. Advancing The Impacts And Adaptation Issue	13
9. Other Questions	14

Preface

In the last year of C-CIARN's mandate (July 2006-June 2007), each C-CIARN office was asked to write a report summarizing their perspectives on the state of climate change impacts and adaptation within their region or sector.

The resulting State-of-Play reports identify, from the point-of-view of C-CIARN, the key climate change impacts, as well as the key stakeholders and adaptation decision-makers (including how these stakeholders/decision-makers were most successfully engaged) of each representative region and sector of Canada. The reports also include a description of the important research questions which, from the perspective of C-CIARN, need to be answered, as well as the steps that need to be taken to both increase the level of engagement on the issue and to facilitate the decision-making that is needed to reduce vulnerability, across Canada, to the impacts of climate change.

It is anticipated that the State-of-Play reports will serve as a valuable point of reference for climate change impacts and adaptation initiatives carried out across Canada, post-C-CIARN.

1. Introduction

C-CIARN Prairies is co-managed and co-funded with PARC (Prairie Adaptation Research Collaborative). Our mission is to “provide knowledge and tools to inform and encourage adaptation decision making”. We have the following goals related to adaptation to climate change impacts:

- raise awareness and understanding
- conduct, support, facilitate, and cooperate in research
- develop present and future research capacity
- transfer and disseminate knowledge and share research results
- assist the application of research and evaluate its effectiveness
- Database Development for Climate Change Research in the SSRB (PFRA)

Some key achievements over the past five years include:

The hosting of many major research projects, including:

- South Saskatchewan River Basin (SSRB) Project
- Impact of Climate Variability on Hydroelectric Generation (Manitoba Hydro)
- Impacts and Severity of Prairie Drought (NSERC)
- Testing of GCM scenarios using paleoclimatic data (CFCAS)
- Climate Change Impacts on Regional Water Supply (Canadian Water Network NCE)

- Serving the PPWB Water Demand Database (Prairie Provinces Water Board) Institutional Adaptive Capacity (SSHRC)
- Vulnerability to Climate Change in the Grassland – Forest Transition (CCIAD)
- Island Forests Study (provincial environment departments)
- Creation and continued teaching of an internet course on adaptation to climate change. The course was delivered for the first time during January to April, 2004. To our knowledge, this is the first Internet-based course on this subject. We place an emphasis on Canada and the Prairies. The course is offered to university students throughout the world, fulfilling PARC’s mandate to attract a new generation of natural and social scientists to the field of climate change impacts and adaptation.
- Graduated and trained summer students, PARC interns, Masters, and PhD students.
- Good profile and respect by all Prairie Provinces governments.
- The creation and expansion of the PARC graduate student scholarship and internship program. We support students based at Prairie Provinces universities and beyond.
- Key participation in both the Alberta Vulnerability Assessment and the National Climate Change Impacts and Adaptation Assessment.
- Creation and expansion of the popular Summary Documents series.

- Many responses to media, stakeholders, and governments for impacts and adaptation information and advice.

2. Key Climate Change Impacts on the Prairies

Experienced and forecasted climate change on the Prairie Provinces presents the following risks and opportunities:

1. Changes in the availability of water resources represent the most serious climate risk. Recent trends and future projections include lower summer stream flows, falling lake levels, retreating glaciers, and increasing soil and surface water deficits as more water is lost by evaporation and transpired from plants. A trend of increased aridity most likely will be realized by droughts of longer duration and greater frequency. Water management and conservation have been and will continue to be important mechanisms of adaptation to climate change and variability. This includes adaptive technologies for improved water use efficiency and water pricing regimes to more accurately reflect the real costs of water treatment and supply and to ensure that an increasingly scarce resource is properly allocated. Higher forest, grassland and crop productivity from increased heat and CO₂ could ultimately be limited by available soil moisture. Dry soil is more susceptible to degradation. Water scarcity is a constraint on all sectors and communities. For example, it could constrain the rapid economic and population growth in Alberta (e.g. the projected investment of \$87 billion in oil sands projects by 2010).
2. Shifts in climate and the distribution of ecosystems will result in new ecosystems (e.g. shortgrass prairie), changed disturbance regimes (insects and fire), stressed aquatic habitats, fewer native species, and the introduction of previously non-native plants and animals. Impacts will be most visible at strong ecological gradients: mountain ecosystems, isolated forests and forest fringe areas. There are major implications for livelihoods (e.g. aboriginal) and economies (e.g. agriculture, forestry) most dependent on ecological services. Adjustments to ecosystem management are required to enable or prevent change.
3. The prairies are losing the advantages of a cold winter. There will be less frozen ground to support winter transportation and resource extraction; and new pests and disease vectors likely will survive warmer winters. Most importantly, however, more precipitation will fall as rain, a less reliable and predictable source of water than snow and ice. Water supplies are generated in upland watersheds, primarily in the eastern slopes of the Rocky Mountains, the water tower of the prairies. Growth of prairie communities and economies during the 20th century (and especially since the 1930s) occurred while mountain glaciers were rapidly melting

and droughts were of relatively short duration. Resulting perceptions of abundant and consistent water supplies have influenced water use, policy and management. Paradigms and practices must be adjusted to manage a hydrological cycle that may be increasingly sensitive to the timing and frequency of rainfall events with less of a buffer from glacier ice and late lying snow at high elevations.

4. Resources and communities are sensitive to climate variability. The prairies have one of the world's most variable climates. This variability has been both costly (e.g. a circa \$3.6 billion drop in agricultural production during the drought of 2001-02) and the stimulus for most of the adaptations. The impacts of climate change on resource sectors are necessarily adverse because resource management practices have assumed a stationary climatic and hydrological regime. Sensitivity to drought suggests that our communities and institutions are not adequately adapted to climate variability even in the absence of climate change that could produce shifts in the amplitude and frequency of departures from an average climate. Records of past climate and models of future climate both show climate extremes (*i.e.* prolonged droughts) that were lacking in the 20th century. An expanded range of year-to-year departures from climate norms may represent a greater risk to the prairie economy than simply a shift in mean conditions. Climatic extremes, especially droughts, can limit opportunities provided by a warmer

climate and require adaptation strategies that are different than those that address the impacts of climate change.

5. Levels of vulnerability are uneven geographically (e.g. rural communities generally have less resources and emergency response capacity) and among populations; elderly, aboriginal and ethnic populations are the fastest growing and most vulnerable to health impacts. Climate change could encourage further migration from rural to urban communities and to regions with the most resources (e.g. Alberta cities). The adaptive capacity will be challenged by a projected increase in climatic variability (e.g. drought) and frequency of extreme events.

3. Key Stakeholders

Key stakeholders include governments at federal, provincial and municipal levels, as well as First Nations. Governments at all levels are critical, as they set the nations' laws and regulations, are expected to provide leadership and research, and have collective spending power of approximately 40% of GDP. They are also often the owners or operators of threatened resources or systems, such as forest ecosystems or hydropower.

The various users of PARC research are also important stakeholders. These include academics and public and private sector policy makers. These stakeholders are a very broad and diffuse group, engaged by

workshops, personal contact, or via website access.

Students, both graduate and undergraduate, benefit from our training. Students, and also interns, are supported by our scholarship and internship program. There is a shortage of climate change knowledgeable professionals and part of PARC's mandate speaks specifically to helping to address this gap. Since its inception PARC has contributed to developing needed research capacity by: providing financial support for supplementary multidisciplinary training to scholars who have received NSERC scholarships for their graduate research; by giving undergraduates and research assistants an opportunity to participate in research projects; and by a successful program of graduate scholarships and internships.

The general public, and in particular the media, are also important consumers of our research and information. There is a large demand for reliable scientific assessment of climate change impacts. PARC responds to numerous general information requests.

While climate change affects everyone in some way, in the Prairies we have identified water supply issues and forestry issues as particularly important. This means that private stakeholders such as Domtar/Weyerhaeuser and Louisiana Pacific, or crown entities such as Manitoba Hydro, are particularly important. Governments are typically either owners or regulators of these resources.

Farmers and agricultural landholders are often seen to be critical stakeholders, and there is no doubt climate change is impacting

agriculture. However, many other factors, from world commodity prices to government support programs, change fairly frequently, and farmers are well used to adapting to an annually changing political-economic environment. As annual decision makers, they are relatively well placed to react to and anticipate climate change. However, given the sheer number of individual landholders on the Prairies, it will remain a constant challenge to provide a flow of useful, concise and reliable climate information to this large group.

At the individual person level (as opposed to institutions or sectors) one could identify ministers as key decision makers, and in a sense this is true. However, ministers find it hard to lead on a complex issue like climate change without significant outside support. In the case of Alberta, for example, it may be that the provincial government will find it much easier to move on climate and water shortage issues after major industrial players take it on as a serious issue. To a degree, for example, the government of Manitoba takes climate change impacts seriously because a major local industry (Manitoba Hydro) does.

4. Strategies for Stakeholder Engagement

If we have learned one thing, it is that there is no single best method for engaging stakeholders, and rather that the methods of engagement and communication must be tailored to the particular audience, and also that often several forms of engagement must be used simultaneously or consecutively, and often repeatedly.

We have engaged media by responding to interview requests by print, radio or television media, and by supplying relevant documentation. On occasion it has been useful to issue a press release.

To engage students, and sometimes the general public, an effective website is clearly essential. Students are now almost excessively driven by web content (perhaps because of its convenience). Therefore attractive up-to-date content is essential.

Engaging researchers is complex. It may require the use of list serve systems, of dedicated or pass coded webpages, or targeted workshops. Personal contact is also often very useful. In recent years at PARC we have deliberately tried to engage in smaller, more focussed, climate change impacts and adaptation workshops on topics of special interest to groups in a particular research field (such as introducing new tree species into the western boreal, for example). At the same time, the grand questions, such as watershed management across the Prairies, still require the organisation and engagement of large numbers of people and specialisms. All of

PARC's sponsored research is available from our website, and we also make it a condition of our funding support that deliverables be in the public domain.

At the highest end of decision maker, there is no substitute for personal contact and trust building over time. Government ministers, for example, or CEOs and VPs at institutions like Manitoba Hydro, need to be spoken with formally, or informally, on a frequent basis, if at all possible. Good presentations can be helpful, but are not enough. Without frequent contact, climate change tends to get lost in the shuffle of many other issues, many of which appear more pressing to top executives.

PARC's "Summary Document" series has been particularly useful for engaging stakeholders. These documents summarise the essence of completed research projects in a comprehensible way for as wide an audience as possible, and are available both online and in hardcopy. Many people, particularly higher level stakeholders and decision makers, still react best to hardcopy information.

PARC's general brochure is useful at general conference events for people with no previous knowledge of our existence.

To increase engagement, more trained people and resources could obviously help, but key to deepening and expanding engagement is greater profiling by governments and / or industry. When a major government (which could be the federal government, or a major city administration, for example) makes adaptation a publicly

acknowledged priority, then engagement will greatly increase amongst many sectors and individuals. Something similar will occur if, for example, the oil industry, or agricultural groups, began to talk about climate change impacts and adaptation as a major concern for them.

Sadly, we will also get increased engagement via natural disasters, such as severe forest fire seasons, drought in agricultural regions, or the mountain pine beetle devastation in British Columbia. This latter event has already galvanised the BC government to some degree.

As a network and as researchers we already have many of the tools and knowledge in hand to expand engagement now. But there is always room for improvement and innovation. At PARC we are working with the Saskatchewan provincial government on the possible development of a new web-based tool based on the successful experience in the UK of the UKCIP's (the UK Climate Impacts Programme's) "Wizard", a relatively simple to use web tool that enables users from many economic and social sectors to include forecasted climate change impacts in their decision making processes. We are also working with CCRI (Climate Change Research Initiative), an Alberta-based group, to increase our contacts with Alberta industry.

A key to engaging governments and industry successfully is to not just present them with threats or problems, but instead to offer them realistic (and hopefully positive-looking) actions that they can actually take in response. Governments and ministers are flooded with problems and issues daily - what

they really appreciate is someone presenting them with well thought out solutions. Such solutions could be technology, a research plan, a communications plan, a negotiating plan, whatever, depending on the particular issue. But simply bringing problems to their attention is not enough, and often will not be welcomed. Offering positive options helps us enter into the decision space of busy and conflicted government and industry executives.

5. Engaged Stakeholders

Manitoba Hydro has become deeply engaged in climate change research and adaptation, partly through developing awareness on their own parts, and partly through individual engagement between ourselves and key counterparts within Manitoba Hydro, including presentations to the research board. Manitoba Hydro has experience of high variability of water flows through their structures and generation turbines, which in turn impacts directly (at a level of 100s of millions of dollars) on the value of their electrical generation. They were therefore perhaps naturally predisposed to be concerned about the possible impacts of climate change, especially in the question of the investment in major new infrastructure that would have an operational lifetime of many decades. Climate change is now integrated into their planning process, such that future infrastructure questions are not based purely on past flow records, but also on climate change modelled future flow projections. They have been a generous research funder to PARC, and are likely to remain heavily engaged with us in future.

The government of Saskatchewan has become increasingly engaged in recent years, partly through good relations with ourselves, and partly as a result of a policy decision by the governing party to make “greenness” in general a central part of their agenda. We successfully engage with bureaucrats on a day to day basis in the development of funding and project ideas, but have also met with ministers on occasion, and with caucus members of both government and opposition parties. As noted above, the key to success here is to present government with positive actions it can take (for example, in dealing with forest fire risk and forest decline, or in dealing with increasing water shortages), rather than just presenting them with problems and gloomy prognoses.

The government of Alberta is perhaps ahead of all other provinces with its three-stage Alberta Vulnerability Assessment. PARC has a long history of engagement with the Alberta Environment Department on impacts and adaptation, and have taken a lead role in the Vulnerability Assessment. The first stage (climate scenarios for Alberta) is complete, and the second stage (biophysical impacts assessment) is nearly so. The third stage (economic and social impacts and adaptation options) is just getting underway. Key to working with Alberta on these and previous projects has been personal contact with government personnel and the maintenance of a network of researchers who are able to contribute to the multidisciplinary demands of these broad studies.

It is noteworthy that some municipalities have become quite engaged. PARC has co-funded

research with the City of Regina, for example. When direct impacts on the practical water supply needs or infrastructure of a city can be demonstrated, and adaptation options can be offered, they are more than willing to be engaged. One promising future avenue of engagement with municipalities centres around the need to reduce water consumption and rethink parks and landscaping design and operations to adapt to a warmer and drier future. Given that much of the required adaptation could save money, there is plenty of potential here.

Forestry companies are seriously engaged in impacts and adaptation thinking, as they can see their resource base directly impacted by a changing climate. Over the long term, this leads to questions about the right species for post-harvest replanting in a warming and drying environment, but most concern is more immediately directed at the increased risk and prevalence of forest fires, and the increased risk of forest decline from drought or pathogen attack.

We have engaged forest companies individually by co-funding research with them (most notably with Louisiana Pacific in Manitoba), but also collectively, via our memorandum of understanding with the Saskatchewan Forest Centre, a public-private research entity with whom we have co-funded forestry adaptation research. We have also worked collaboratively with the Canadian Forest Service on research projects. One-to-one contact has been our prime mode of engagement with the forestry sector.

Engaging with the water sector has been exceedingly complex because of its inter-

jurisdictional nature (major Prairies rivers flow across provincial boundaries) and because of the many stakeholders involved in a given drainage basin. Because of the complexity of these situations it has been necessary to engage in comprehensive interdisciplinary studies, such as the South Saskatchewan River Basin study, which we organised and hosted over several years. In this case there is no substitute for frequent conferences, workshops, and extensive communications between many different researchers and policy people. The challenge is now to see that the outcomes of research are translated into policy changes at the political level. This will occur, but is likely to be slow and bumpy, owing to the politically charged and emotive nature of water politics, and to the many interest groups involved. We need to continue engagement on water issues, but with awareness of how time and resource consuming this area of engagement will always be.

At the training and education level, we find many undergraduate and graduate students wish to be involved in climate change issues. We meet that need by providing graduate scholarships and internships (for recent graduates) across the Prairie Provinces, and by the introduction of a web-based climate change impacts and adaptation course open to users anywhere, at both the undergraduate and graduate level. There is a great demand for climate related training that could usefully be met given more resources. We also try and encourage students to attend impacts and adaptation related conferences or workshops, helping with travel or registration costs where appropriate.

5.1 Outstanding Needs of Engaged Stakeholders

Engaged stakeholders generally accept that climate change is occurring, but typically they still face many barriers to action:

- Climate change is slow moving, and perceived as a distant, future problem. This means that impacts and adaptation lose out in comparison with immediate, pressing issues, of which there are always many.
- The uncertainties around future climate scenarios are a huge source of difficulty for the typical user. While good adaptation science demands the use of a range of scenarios and scenario output for a given subject area, the typical end user instead demands to see “the answer”, i.e. a single scenario of the future. This demand by users is perfectly understandable – after all the weather office does not issue three or four different forecasts of tomorrow’s weather and tell the listener that they are all equally probable, and prepare to cope with any of them. Most listeners would find this useless and annoying. Even the weather office’s way of dealing with uncertainty (attaching a probability of rain to a single forecast, for example) is too complex for many users. So there is a huge demand for scenarios certainty that cannot, in a scientifically honest sense, ever be met. When we asked the then Manitoba minister responsible for the environment what specific climate futures information he would find most useful, he replied that he most needed

certainty as to future precipitation levels. Of course, we can only deliver a range of possibility around such questions, which for him is too vague to be useful. The whole range approach also strikes many users as dubious, as they wonder how a whole range of scenarios can be described as “equally probable”.

- Even given certainty around a climate scenario, there is still much interpretation and hypothesis around the impacts that will result, and this added source of uncertainty creates further difficulties. It is early days for impacts science, and it is quite possible we will get better at impacts scenarios, which will help somewhat. However, again, it is the nature of impacts scenarios that there will always be significant uncertainty attached to them.

6. Unengaged Stakeholders

By contrast with Manitoba Hydro, SaskPower and the Alberta electrical utilities have been less interested in impacts and adaptation. The difference is instructive. These latter utilities are largely coal-based, and this generation mode is not directly threatened by climate change impacts. These utilities do, however, see the emissions and mitigation side of climate change as a major concern for them, and have therefore focussed their energies on questions like offsets or “clean coal” power generation.

To a degree, agriculturalists also remain less engaged than was originally supposed they

would be. This is somewhat explicable. Farmers make many choices every year based on rapidly changing product and input prices and on changing government support programs. They also have long experience of a variable climate, so to tell them that the climate may become more variable in future, or is trending warmer and drier, does not necessarily suggest to them that immediate action is required. The price of wheat or canola is more likely to impact their decisions in the immediate term. Nonetheless, at the individual farmer, or at the level of water planners and engineers, it is evident that future climate scenarios suggest a need to begin to secure future water supplies now.

At the same time as some single resource-dependent communities may be quite threatened by climate change, these same smaller communities have markedly less capacity to understand, plan and deal with adaptation issues. The complexity and scope of the issues can seem overwhelming to them, and they may lack the resources to become engaged, or it may not be clear to them what pro-active measures are feasible. It is our responsibility here to present doable adaptation options within their existing resource constraints.

The general public remains somewhat disengaged from impacts and adaptation. This is partly because of the scientific complexity of the topic, partly because of the uncertainties surrounding scenarios, partly because impacts are thought to be a future problem, and partly because it is not clear what the general individual can or should do about impacts. One strategy to counter this and generate engagement is to emphasise

that impacts have already occurred, and that climate change is today's problem, not just an issue with impacts on the future.

There are some general challenges that make climate change impacts and adaptation a fairly intractable field for many people. They include:

- Climate change is an abstract impersonal phenomenon. There are no evil people or evil bacteria against which to focus anxiety and action. It is unclear who is to blame, and it is unclear whose responsibility it is to act (whether in the fields of mitigation or in adaptation).
- A warmer climate sounds like a good thing to many people, especially here on the Prairies.
- It seems a distant, future problem.
- Climate change is for most people imperceptibly slow in its development (disasters can help change this perception).
- The science is complicated and probabilistic.
- There are still vocal climate change sceptics, often given equal time in the press with the vastly larger body of convinced scientists.
- There are no obvious and easy answers about what to do, which discourages people from even trying. Change seems inevitable (and to a large degree this is

true), and it takes some thinking to realise that we can better adapt with careful planning and action.

7. Unanswered Research Questions

- While all GCM-derived scenarios indicate increasing heat and aridity across the Prairie Provinces, the speed and degree to which this will occur varies greatly between different models. It would be very useful to have more precision on this.
- Quantification of the changing, and likely increasing, risk of extreme events such as drought, or severe storm, or flood event, would be extremely useful. We ourselves would like to sponsor research in this very young field of study, and are discussing with Alberta this possibility.
- The future of the western boreal forest is in question. It remains very uncertain how best to deal with climate change impacts over this huge ecosystem. The stakes are very high – massive forest loss and conversion to scrub or grassland systems are possible outcomes. We urgently need research and options development on questions such as wildfire management, response to forest decline, major pathogen attacks, and the risks and potential benefits of alternative tree species.
- There is as yet no clear understanding of the potential for new institutional arrangements to adapt to climate change

impacts. Particularly amongst rural and small isolated communities we need to develop some kind of networking or institutional capacity to understand and cope with climate change impacts. Small rural communities on the Prairies often already have a sense of abandonment by governments and larger centres and may feel completely disenfranchised from a huge abstract issue such as climate change.

- We need to develop a new understanding of, and respect for, the use of water across the Prairies. New regulation and greater protection will need to be given to our water resources. In many cases users who have previously been allowed to consume water, or alter water quality, at no charge, will have to face the prospect of no longer being allowed to treat water as a free commodity. This is necessary, but politically very difficult.
- There will be major shifts in natural ecosystems, and the potential loss of isolated systems such as island forests, fescue uplands in the south, or some aquatic systems. There are major open questions, such as whether we should resist ecosystem changes and new invading species, or whether we should welcome and assist invasives as an ecosystem adaptation to a changing climate.
- Impacts on two important Prairies natural systems, natural grasslands and aquatic ecosystems, have been little studied and require attention, as both will be heavily impacted by climate change.

8. Advancing Impacts and Adaptation Issues

It would be extremely useful to further engage First Nations communities. PARC has begun to do this with its sponsoring of Elders' gatherings focussed on climate change impacts in their communities, and by the recent sponsoring of specific research projects. Because of their land bases and sometimes traditional resource use lifestyles, many First Nations people are directly affected by climate change impacts. As first tenants of the land they also have some moral authority when concerns are raised about rapid ecosystem change and about ground and water resource impacts.

It would in future be desirable to engage and emphasise the impacts and options for smaller communities. Adaptation capacity is often low in these communities, yet they are often quite vulnerable. At the local level of small communities people are often receptive to ideas to help their situation, and often motivated to act quickly. There is great potential in these small communities and we have not yet paid it much attention.

Communicating about uncertainty in our scenarios is a major challenge. The acknowledgement of uncertainty is good science, but is troubling to many decision makers not grounded in scientific methodology. Perhaps one aid to this problem is to note that we regularly make many important decisions based on probabilities, for example in agriculture, or in the insurance industry.

In a general sense impacts and adaptation science would get a better reception if we were careful to always put reasonable adaptation options on the table, rather than be seen as doomsday mongers. We should try and be seen as purveyors offering ideas with some hope, rather than as depressing people to talk to. People need options and solutions, not problems; they generally already have plenty of those.

9. Other Questions

The key present uncertainty is what kind of leadership role the federal government wishes to play in the impacts and adaptation field. It is possible that one kind of free-market philosophy might lead some people to the conclusion that there is no great role for governments to play in the general adaptation field, and instead that individual actors will all adapt to climate change impacts as they occur, without government research or direction, in the same way the government does not research, or tell people how to adapt, or provide general public scenarios, when the price of energy changes, or when phone technology evolves. The Bush Administration essentially said at one point, for example, that Americans are adaptable people, have successfully adapted to many challenges in the past, and can therefore be expected to successfully adapt to climate change impacts in the future. At PARC we envision a useful, and indeed necessary, role for governments, at the very least as the owners and stewards of many of our resources, and as regulators and lawmakers over much else, but it remains to be seen if that view carries.

While mitigation and emissions reductions are worldwide issues, impacts and adaptations concerns play out at local and regional levels. In Canada we are challenged by a huge range of geography, ecosystems, and economic and social systems, all facing different impacts and therefore different adaptation challenges and opportunities. An important issue in the Canadian context is therefore, constrained as we are by limited resources, how to organise ourselves. We need to avoid overlap and also to generate viable centres of research and communication excellence which are large enough to be efficient and reasonably stable. In view of these constraints it makes sense to us to organise impacts and adaptation science and communications on the basis of regions.

Since climate change affects everyone in some way, we need to be very focussed with our resources. This means agreeing on a reasonable number of key challenges, and focusing resources in these areas (while continually revisiting this selection to keep it valid and current).

It remains a constant challenge to gage the efficacy and efficiency of our work. Within a particular adaptation sector (such as water use, for example) it is possible to design a targets and measurement system that has some utility and credibility. It is a rough metric, but co-funding provides a guarantee that at least some other individuals or agencies value our work and output.

It would also be useful to build in some method of evaluating the effectiveness of completed research and the usefulness of its

application. One way to do this is to allocate funds at the front end of a research or communications project for this purpose. This does not usually happen for three reasons: a) a period of time is often required to measure effectiveness and utility; b) the validity of the conclusions may be called into question if the output is evaluated by the same funding source; c) due to the number of variables associated with the outcomes of a project, it is often difficult to measure the identifiable impacts that can be attributed to the research or communications exercise per se. Therefore in practice a second source of funding is often required to evaluate research or communications effectiveness.