



Pacific Climate Impacts Consortium

Strategy and Plan (2007-2011)

Themes and Products

**Harry S. Swain, Executive Director
Trevor Q. Murdock, Associate Director
Dave R. Rodenhuis, Senior Scientist
3 August 2007**

Table of Contents

Preface	iii
Pacific Climate Impacts Consortium: Themes and Products	TP-1
Vision	TP-2
Focus	TP-3
Objectives	TP-7
Paradigms for Collaboration	TP-8
Themes	TP-9
Products and Outreach	TP-10
Pacific Climate Impacts Consortium: Strategy and Plan	1
Introduction	1
Program	2
Target accomplishments	3
Partners	3
Collaborators	4
Pacific Climate Impacts Consortium: Strategic Choices	5
Organizational structure	5
Simplified structure	6
Program resources	6
Core competencies of the Consortium	6
Current staff	7
Current resources	7
Futures under alternative funding scenarios	7
Status Quo: \$500,000 per year	7
Jump Start: \$1,500,000 per year	8
Sustained effort: \$2,500,000 per year	8
PCIC and the “Arrhenius Institute”	9
Hiring priorities	9
Visitor program	9
Computing facilities	10
Space	10
GIS, website, graphics and publishing	10
Conclusion	10

Preface

The Pacific Climate Impacts Consortium was initiated at a meeting of experts in May 2005. Since that time we have attempted to define a regional program in Pacific North America that would focus on BC, and include the opportunity for collaboration across international boundaries and with Canadian institutions. At the same time we have been pushed, if not overtaken by a public awakening to the threat of global climate change. It has proved to be unusually difficult to define our consortium, in spite the volume of new research results and potential climate impacts. Our problem was to find the right focus, and to set aside many worthy topics that could not be addressed within the expected resources and resident expertise of the consortium.

About 2 years after initiating the consortium, a staff retreat was convened at Dunsmuir Lodge (April 2007) in the presence of several external advisors. At this meeting our concepts were reviewed, and we were encouraged to proceed with 3 major themes, and several others that would require further development. These materials are summarized and used to introduce the *Strategy and Plan*.

Although this plan defines a vision, focus, objectives and themes for our work, it also raises some questions on scope and organization that can only be answered in practice. It is our hope and expectation that the members of the consortium will continue to support and encourage collaboration in the gap between disciplines, and between research and applications—all within the context of uncertain climate variability and change, including extreme weather events.

I have been especially influenced by conversations with climatologist Rick Lee, and with faculty of the University of Victoria, especially: Prof Andrew Weaver, School of Ocean and Atmospheric Sciences (SEOS), and Dr. Terry Prowse, Water-Climate Impacts Research Centre (W-CIRC). Several faculty of the University of Washington, Center for Science in the Earth System (CSES) have also contributed their experience, especially: Prof. Ed Miles and Prof. Phil Mote.

This plan was authored by Dr. Harry Swain during his term as Executive Director of the Consortium. Contributions came from all the staff members and from the Management Committee, chaired by Ben Kangasniemi, who oversees the work of the consortium. . The authorizing Board and Chairman, Dr. Gordon Smith approved the plan (June 14, 2007).

We are grateful for the advice and critique, and now it's up to us—members, affiliates and staff of the Pacific Climate Impacts Consortium.

Dave Rodenhuis
Acting Director and Senior Scientist
August 2007



Pacific Climate Impacts Consortium Themes and Products

23 April 2007

TP-1

Vision*

A vision for a consortium emerged ... to stimulate the collaboration of government, academe and industry to reduce vulnerability to extreme weather events, climate variability and the threat of global change. The consortium for climate impacts will bridge the gaps between climate research and climate applications, and will make practical information available to government, industry, and the public.

* - Organizational Workshop (May, 2005)

TP-2

Focus (1) – Reduce vulnerability to...

- Global climate change
- Regional climate variability
- Local extreme weather events

TP-3

Focus (2): ... in Pacific North America



TP-4

Focus (3) – Bridge the Gap between...

- science and applications
- disciplines
- physical sciences, economics, social relevance
- researchers and users
- climate centers in Pacific North America

TP-5

Focus (4) – ... produce practical Information

- assessment reports
- downscaling results
- near-real-time climate monitoring
- seasonal climate forecasts for PNA
- web information services

TP-6

Objectives*

- to foster collaborative and interdisciplinary approaches to research on meteorology, atmospheric science, climate variability, climate change, (social sciences) and economics
- to channel and strengthen the capacity to address regional climate change and variability, including extreme weather events.
- to focus research on public and private sector needs in order to provide the scientific basis to develop policy options

* - Organizational Workshop (May, 2005)

TP-7

Paradigms for Collaboration

With researchers.....

- *Embed PCIC staff*
- *Extension of the research lab to user-stakeholders*
- *Joint proposals for directed research*
- *Technology transfer to applications*

With stakeholders and end users

- *Consultations*
- *Presentations*
- *Information workshops*
- *Directed research (contracts)*
- *Climate Assessment Reports*

TP-8

I. Themes
for a
Pacific Climate Impacts Consortium (2006-07)

Applied Science and Regional Climate Impacts

1. Global climate variability and change: Regional interpretation of global scenarios
2. Water resources: Hydrological modelling and impacts
3. Storm surge, sea-level-rise, and extreme weather events
4. Economic impacts of climate variability and change (TBD)
5. Historical data, analysis and climate assessment (TBD)
6. Seasonal climate prediction (TBD)

TP-9

II. Products and Outreach:
for a
Pacific Climate Impacts Consortium (2006-07)

Climate Applications and Outreach to Inform Adaptation by Users and Stakeholders

- Consultation
- Assessment Reports
- Website and Information Services
- Presentations – on climate variability and change, and extreme weather events
- Near-real-time climate monitoring and analysis (TBD)
- Joint proposals (TBD)

TP-10

Pacific Climate Impacts Consortium Strategy and Plan

Introduction

Humans are changing the climate of the earth. Ecosystems and biophysical regimes on which human industry and society depends are at risk. Regardless of actions that may be taken to limit greenhouse gas emissions, large changes are now inevitable, and attention must focus on adaptation.

This assessment and the science that supports it is global in scale, but adaptation to climate change, climate variability and extreme weather events must be carried out regionally and locally. The voluminous scientific work must therefore be made relevant in scale, time, and language to the needs of specific social and economic actors and made accessible to institutions that manage resources and develop policy. The research community is committed to advancing the scientific enterprise, but has little time and attention available for technology transfer in terms and formats that are useful for adaptation.

Water is the leading edge of climate change. Its several forms, and their changing distribution in time and space, are primary drivers of ecosystem change in the Pacific Northwest. Understanding these distributions is a critical first step in assessing impacts on human and natural systems and assisting sectoral experts in planning to lower societal risk. We propose a multi-year program of research to elucidate changes in hydrology, such as streamflow, snowpack, glaciers, onset of freshet, groundwater, and soil moisture, together with an understanding of the changing probability of extreme events. The likely evolution of sea levels is also an important topic for coastal communities. This program is to be undertaken in close consultation with user communities in order to maintain a continuing relevance. The mechanism for doing this is the Pacific Climate Impacts Consortium (PCIC).

PCIC was born at a workshop of producers and users of climate information in May 2005. A vision for a consortium emerged:

...to stimulate the collaboration of government, academe and industry to reduce vulnerability to extreme weather events, climate variability and the threat of global change. The consortium for climate impacts will bridge the gaps between climate research and climate applications, and will make practical information available to government, industry, and the public.

There was great enthusiasm for connecting a scarce supply of researchers and research users on a regional basis to increase efficiency and relevance. Since then, the Canadian Institute for Climate Studies, a non-profit corporation at the University of Victoria, has served as the secretariat and legal agent of the still-informal Consortium. With support from several Consortium members, notably the BC Ministry of the Environment and BC Hydro, a proposal for future work has been formulated and is the subject of this note.

Program¹

Beginning with the original vision, *PCIC will have four foci:*

- (1) Reduce vulnerability to
 - Global climate change
 - Regional climate variability
 - Local extreme weather events
- (2) In Pacific North America (PNA):
 - BC and its neighbouring provinces, states and territories, or
 - Cordilleran North America
- (3) Bridge the gaps between:
 - Science and applications
 - Disciplines
 - Physical sciences, economics, and social relevance
 - Researchers and users
 - Climate centers in Pacific North America, and
- (4) Produce practical information:
 - Assessment reports
 - Downscaling results
 - Near-real-time climate monitoring
 - Seasonal climate forecasts for PNA
 - Web information services

These are the ways we propose to fulfil the objectives set in the May 2005 workshop, which were:

- *To foster collaborative and interdisciplinary approaches to research on meteorology, atmospheric science, climate variability, climate change, (social sciences) and economics*
- *To channel and strengthen the capacity to address regional climate change and variability, including extreme weather events, and*
- *To focus research on public and private sector needs in order to provide the scientific basis to develop policy options.*

¹ The program and associated proposals were discussed at a Management Committee meeting on 11 July 2007 and a staff retreat on 23 April 2007. Invited guests at the retreat included Prof. Andrew Weaver (Victoria), Dr. Phil Mote (Washington State Climatologist), Dr. Tom Pedersen (Victoria), and Daniel Caya (Ouranos).

Target accomplishments for the period 2007-2011 follow:

- (1) Build up resident expertise in the following areas
 - Hydrological modelling, principally with VIC
 - Dynamic downscaling, from regional climate models; developing finer granularity in regional climate models
 - Storm surge, sea-level rise, and extreme weather events
 - Model diagnostics (GCM, RCM); developing the ability to manipulate very large data sets and to portray research results graphically;
 - BC climatology, data, monitoring
 - Evaluation of economic impacts

- (2) Collaboration
 - Mobility: PCIC staff seconded elsewhere, visitors accommodated here, with credit widely shared
 - Directed research through joint projects with UVic, UBC, SFU, and federal research centers
 - A working relationship with users in every major economic sector
 - A member of a network of centers in Canada (PARC, Ouranos)
 - A member of a network of centers in the US Pacific Northwest (UW, RISAs)

- (3) Products and user engagement:
 - A recognized web resource for users of climate data, information and outlooks in PNA
 - Regular and routine reports on climate variability and change, and on extreme weather events, including seasonal forecasts
 - An essential source of technical information for governments, commerce, and NGOs

Partners

- (1) The BC Ministry of the Environment is a long-time supporter of PCIC. A principal funder, it is represented on both the Management Committee and the Board.

- (2) BC Hydro has made a long-term funding commitment and is represented on the Management Committee.

- (3) The Canadian Centre for Climate Modelling and Analysis (CCCMA) is a national treasure that is resident on the University of Victoria campus. Part of Environment Canada, its XX researchers and other staff are responsible for the continued development of one of the premier GCMs in the world, the first to couple air and ocean circulation.

- (4) The University of Victoria is an interested collaborator through the Centre for Global Studies and through the presence of its Dean of Science, Prof. Tom Pedersen, himself a paleoclimatologist, on the CICS board. UVic's proposal for a climate solutions institute builds on the PCIC program.
- (5) Environment Canada scientists are closely involved with the universities through cross-appointments, enhancing research performance and student training. Dr. Terry Prowse, EC and UVic Geography, and Paul Whitfield, EC Met Service, sit on the PCIC Management Committee.
- (6) Outside BC, partners include Consortium Ouranos Inc., the world's premier research institution in respect of regionally focussed but globally consistent climate modelling; PARC, the Prairie Adaptation Research Collaborative; and colleagues at the Universities of Washington (Climate Impacts Group) and Calgary. Dr. Daniel Caya of Ouranos sits on the PCIC Management Committee.

Collaborators

Besides those listed above who are financial contributors and colleagues with shared interests, there are a number of entities which might support the research plan on a long-term basis. These include:

- The four BC research universities house distinguished research professors and programs, and train an appreciable fraction of Canada's new young scientists in the relevant fields, and others (UNBC, UBCO for example) are active in specific fields.
- Fisheries and Oceans Canada: the fishery it manages, both oceanic and inland, will be strongly affected by climate change
- The Canadian Forest Service, which is concerned about the problem but would like to position itself in support of the BC Ministry of Forests and Range (MFR) and the industry
- MoFR, to whom an initial presentation has been made, and who now await a more detailed proposal from PCIC for one or two concrete projects. MoFR suggested that at some point an approach to the government of BC as a whole may be useful, since interest is so widespread.
- COFI: the forest industry, both corporate and labour, has historically not spent a great deal on research. Existential threats may change that view.
- UBCM: there are quite a number of BC towns and cities that depend on forests, fish, and water resources; some seem inevitably fated to suffer considerable economic losses. This heading should be read as including major Regional Districts, water authorities, and specific coastal and Interior towns.

- Environment Canada: the original founders of CICS may, once their managerial and political turmoil settles down a bit, wish to return to developing a better understanding of both mitigation and adaptation possibilities.
- Natural Resources Canada: they are already beginning to work with us, through the Institute of Ocean Sciences at Pat Bay, but there is scope for much broader collaboration.
- Agriculture Canada: a bit distant, but the research station at Summerland has been a leader in helping people in the Okanagan come to grips with the increasing pressure on fading water resources in that region.
- Individual business leaders: there are a few who not only understand the problem but want to see serious action underway.
- University of Washington: several excellent scientists who have led the way in the study of climate impacts and with whom we should broaden our contacts.
- The several parties interested in the renegotiation of the Columbia River Treaty, grouped together through the Columbia Basin Trust.

Pacific Climate Impacts Consortium: Strategic Choices

Organizational structure

PCIC is, so far, a loose association of people and institutions sharing an interest in the subject of climate change and what it means for the regional economy and society. Some individuals are spending all or most of their working hours within its ambit. Others are part-timers, and still others are, for the moment, passive but sympathetic observers. As noted, a pre-existing organization, the Canadian Institute for Climate Studies (CICS), serves as PCIC's secretariat and the legal entity for doing business. CICS, started in 1994, is a non-profit corporation which sits within the bosom of the University of Victoria. Through CICS, the University provides furnished space, computing facilities, liability insurance, library, accounting and banking services, and a framework for employment contracts which makes it easy for graduate students to work with PCIC and for PCIC staff to contribute to the wider university.

At present, the work of PCIC is directed by a Management Committee composed of the major funders and researchers. It is chaired by Ben Kangasniemi of the BC Ministry of the Environment (MOE), and includes representatives of Environment Canada, Ouranos, BC Hydro, and the University of Victoria. The Executive Director of PCIC, Harry Swain, is a member *ex officio*. Financial and contractual matters, including employment contracts, are handled on behalf of PCIC by CICS, whose members are all affiliated with the University of Victoria and who elect a Board of Directors, currently chaired by Gordon Smith, Director of the Center for Global Studies. The Board appoints the Executive Director on the recommendation of the Management Committee. Detailed terms of reference are available.

Simplified structure

It is getting increasingly difficult to explain our structure to others and even to our own staff. So far we have put off serious structural moves on the grounds that getting the substance of the program understood and accepted should come first. A question for the Management Committee and the Board is whether the present informal organization is well suited to carry the work forward. In particular, it has been proposed that CICS and PCIC be merged into one entity under the PCIC banner.

Under this proposal, the CICS name would disappear but the current two-level management structure would continue, with a Board of Trustees responsible for formal legal and financial matters, as well as matters affecting the reputation of the University, and a Management Committee that dealt with the substance of the work. As at present, one or two individuals might be members of both. The Board would meet twice yearly, as at present, with the centerpiece of the agenda being the approval of the budget for the coming year (spring) and examination of the audited statements for the previous year (fall). (Of course the Board would as now take a lively interest in the work and prospects of PCIC.) The Management Committee would meet every two months, summer excepted: five times a year, normally.

Program resources

Core competencies of the Consortium

The program rests on an understanding of how GCMs and RCMs are constructed and what they can do; of computation, big-file data handling, and GIS systems; and on the availability of computational and graphic resources. Secondly, since we intend to address future issues of water resources, an understanding of hydrological modelling is essential. One problem is that much of this has to be “constructed” before the above-water part of the iceberg is visible to clients. Convincing people to contribute to the core, as opposed to simply paying the marginal cost of a particular output, is sometimes difficult.

Carrying on downstream toward the particular requirements of a particular user requires further skills. Foresters interested in optimal replanting schemes, for example, need to know much more than seasonal temperatures and precipitation regimes. They need to know how individual species and systems of species will cope with these regimes, and what the boundary conditions are for plant health. They need to know which insect pathogens will thrive and which will not if they are to design workable control mechanisms, including the design of place-specific planting schemes. Fisheries people need to confront the predicted conditions with the sensitivities of specific species to water temperatures, ultraviolet, and dissolved oxygen levels. Ski operators need to convince their bankers that there is a reasonable probability that the season will last long enough to make the mortgage payment. Communities at risk need economists to assess threats and help decide among competing proposals for coping with them. Power generators need to know how to operate their reservoirs and how much back-up capacity they will need. And so on.

PCIC will concentrate on the climatic and biophysical parts of these problems, seeking to work with, and hand the work over to, specialists in these many different domains.

Current staff

The current professional staff of PCIC – not all of them full time – includes the following:

- Atmospheric research scientist (1)
- Climate scientist (1)
- Computer and GIS experts (2)
- Hydrologists (2)
- Economic geographer (1)
- Administrative personnel (2)

The latter three are part-time, with the geographer providing overall management. It goes without saying that while the current staff map well into the required core competencies, there are not nearly enough staff resources to undertake the work for which effective demand exists.

Current resources

PCIC had about \$350,000 for the fiscal year ending March 31 2007. The current burn rate is about \$30,000 a month. Most of this money comes from BC Hydro and the BC MOE, with smaller contributions coming from contracts with entities like the Greater Vancouver Regional District (GVRD) or the Columbia Basin Trust. BC Hydro has informally committed for a series of projects totalling about \$200,000 over the four-year period April 1 2006 to March 31 2010. MOE has provided \$312,000 in 2006-07, which will make the total currently available for 2007-08 about \$500,000.

The current situation is promising but unsustainable, and a serious effort to raise resources is necessary.

Futures under alternative funding scenarios

The question has arisen about what PCIC could do with a substantial increase in resources. Possible scenarios depend on a longer horizon than the balance of the fiscal year, however, as first-class people are unlikely to be available unless there is a prospect of a sufficient period of time to cycle through a publicly recognizable research program. That said, three scenarios at levels: status quo (\$0.5m/y), jump start (\$1.5m/y), or sustained effort (\$2.5m/yr) might be as follows:

Status Quo: \$500,000 per year

Continue development of the hydrological model VIC for several selected (heritage) watersheds in British Columbia Continue downscaling, in collaboration with W-CIRC. In collaboration with MOE and the Institute of Ocean Sciences at Pat Bay, we would prepare a preliminary view on probable sea level rise in the Gulf of Georgia/Puget Sound region, taking into account changing Pacific storm intensity and isostatic rebound as well as climate change. We would augment current capacity by recruiting a senior person in model diagnostics. Data, papers, and some limited visualizations would be posted on the

existing website. Outreach would be limited to the website and ~two regional visits a year. PCIC would employ about seven FTEs, including short-term and part-time appointments, as well as 2-4 students.

Jump Start: \$1,500,000 per year

In addition to the program above, we would:

- Commit to water resource assessment with the VIC hydrological model for BC and selected watersheds. In this connection, the hydrology of the Columbia and Peace watersheds with BC Hydro's engineering and planning needs would take precedence.
- Initiate work with MOE, Environment Canada and other networks on data collection, in part to get VIC up and running, and internationally with CIG (Washington); we would begin to extend the hydrological work in the main watersheds of interest to BC Hydro by incorporating the feedback effects of climate-induced changes in vegetation;
- Re-start the seasonal climate prediction work in collaboration with CCCma;
- Use the regional climate scenarios to prepare inputs for BC's Future Forests initiative, for infrastructure standards, and for fisheries planning;
- Expand the sea-level studies to cover tides, storm surges and the probability of other extreme events, and collaborate with NOAA's Climate Prediction Center on trends in Pacific storms; and we would
- Begin work on an assessment of different downscaling techniques for the particular topography of the Cordilleran west.

At least one of the new senior appointments would be sponsored by the University of Victoria, thus extending our outreach and making the seasonal employment of co-op students, as well as the engagement of graduate and postdoctoral students, easier. New hires would include a webmaster, a visitor program coordinator, and up to five senior scientists in regional climatology and hydrological modelling. Total staff would be approximately 12-15. One of the senior scientists would become Director.

Sustained effort: \$2,500,000 per year

In addition to the above, and always working with collaborating institutions, PCIC would:

- develop near-real-time monitoring of critical climate parameters and support for the application of these data by the user communities;
- operate the hydrologic model with test scenarios on crucial watersheds, e.g., the Peace and Fraser River systems;
- extend the work on seasonal climate prediction and empirical data collection to allow the identification of truly robust downscaled model features;

- expand applications of the suite of tools being developed to a series of active projects in forest and range succession, climate-dependent regional economics, and other fields as users guide us;
- develop a capacity to forecast the frequency and magnitude of certain extreme weather events, and to contribute to standards development for civil society;
- build a deep and flexible capacity for interpreting the projections of climate models, at first on a regional scale, and subsequently over all relevant temporal and spatial scales; and would
- enable many more users to apply both data and intermediate results through expanded web services.
- Finally, at this level, we would have a capacity to model the economic consequences of specified climate scenarios.

PCIC and the “Arrhenius Institute”

The University of Victoria has made a proposal to the government of BC for the establishment of a “Canadian Institute for Climate Change Solutions.” If such an investment were approved, it would be akin to adding a third layer to an onion whose core would be CCCma and next layer PCIC. Together, the three layers would offer a capacity for the generation and assessment of scientifically-based policy options for dealing with both mitigation and adaptation.

Hiring priorities

The priorities for senior appointments are as follows:

- Model diagnostics
- Hydrological modeller
- Regional climatologist

Job descriptions are being prepared for each of these positions.

As circumstances allow, we would add a webmaster, a visitor program coordinator, and a person knowledgeable about the ocean impacts of climate change (acidification and its impacts on aquatic ecosystems), and we would strengthen our model diagnostics capability.

Visitor program

Central to the program at any funding level is the idea of a core permanent staff and a continual irrigation with visitors. PCIC would seek to invite researchers on both short- and long-term arrangements, graduate students and postdocs, and co-op students to work on the defined areas of PCIC interest. As the administrative time to arrange these visits and secondments is not trivial, a staff person will be added to manage the program.

Computing facilities

It is not yet clear to what degree we will be able to use UVic computer capacity and to what degree we may have to supplement it with specialized equipment. Moving from PC's to modern workstations with excellent graphic capabilities will be necessary, however.

Space

The University is pressed for space. PCIC can manage at the current \$500k level with the space it has in the Center for Global Studies (Sedgewick Building), but enlargement is probably best seen in the context of the possible Arrhenius Institute, for which an innovative proposal has been sketched. Besides office space, PCIC needs a small conference room and library.

GIS, website, graphics and publishing

Certain specific computer-based skills and facilities are needed. Some staff will need fluency in geographic information systems, and others in computer graphics. The basic method of publishing our results will be via an expanding web presence, but hard copies of formal papers will also be required. These will need to be done to professional graphic standards.

Conclusion

PCIC occupies a critical space between the world of climate science as represented in the world of GCMs and RCMs on the one hand, and the planners and decision makers in government, industry and civil society who must guide society through a period of unparalleled climate change and variability. Its task is to elucidate the regional biophysical meaning of climate science in ways useful to those coping with adaptive responses. Structure, funding, and an initial staff are in place, and first results are now publicly available. The principal issue going forward is funding at a level, and of sufficiently long term, that will allow us to recruit top-notch people.