2009-2010

PCIC Corporate Report

PACIFIC CLIMATE IMPACTS CONSORTIUM

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Dave Spittlehouse, *PhD,* BC Ministry of Forests and Range
Paul Whitfield, *MSc,* Meteorological Service of Canada

PCIC Staff (March 2010)

Dave Rodenhuis, *President and CEO/Director*
Andrew Weaver, *Senior Scientist*
Katrina E. Bennett, *Hydrologist*
Anne Berland, *Research Assistant*
David Bronaugh, *Programmer/Analyst*
Gerd Bürger, *Empirical Downscaling Analyst*
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Andres Soux, *Climatologist*
Derek van der Kamp, *Research Assistant*
Arelia T. Werner, *Hydrologist*

PACIFIC CLIMATE IMPACTS CONSORTIUM

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Vision

The Vision of the Pacific Climate Impacts Consortium is to stimulate collaboration among 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 gap between climate research and climate applications and will make practical information available to government, industry and the public.

Mission

The Mission of the Pacific Climate Impacts Consortium is to quantify the impacts of climate change and variability on the physical environment in Pacific North America.

Scope

The Scope of the Pacific Climate Impacts Consortium is the physical sciences that describe climate, its variability and change, including extreme events, in Pacific North America.

Focus

The Focus of the Pacific Climate Impacts Consortium is on climate stakeholders in industry, government, commerce and communities that require climate information for adaptation to future climate conditions.

Products

The Products of the Pacific Climate Impacts Consortium are analyses of climate and historical trends as well as estimates of future environmental design conditions for the 21st century.

Year in Review 2009

Strategic Plan

The *Strategic Plan 2009-2013* was approved by the PCIC Board of Directors in April 2009. It outlines the vision, scope and structure for future growth and development and builds on the consortium's success over the previous four years. One year into the Strategic Plan, PCIC continues to gather momentum for its Regional Climate Impacts, Hydrologic Impacts, and Climate Analysis and Monitoring themes. Also consistent with the Strategic Plan, PCIC has fostered a number of formal and informal collaborative agreements with several groups. The PCIC Strategic Plan will continue to guide the consortium's targeted research program into the future.

Photo: BC Climate Action Secretariat

BC Minister of State for Climate Action John Yap (left) with PCIC Director/CEO Dr. Dave Rodenhuis (right)

Completion of the Forest Pests and Tree Suitability Project

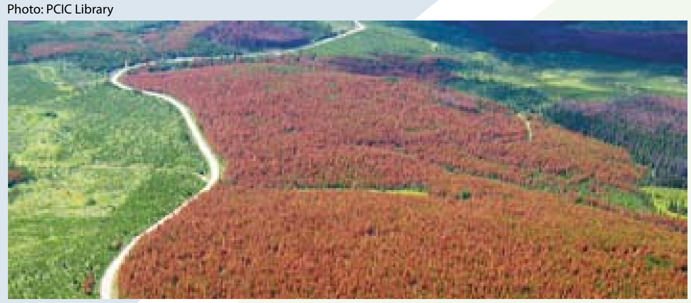
PCIC successfully completed a major three-year project funded by the BC Ministry of Forests and Range's Forest Science Program. This targeted research project studied the impacts of climate change on spruce and Douglas fir forests in British Columbia. The project included three major components: (1) Understanding climate suitability of spruce and Douglas fir forests; (2) Evaluating the risk of forest pest outbreaks; and, (3) Assessing economic costs associated with climate change impacts on forest health.

VIP Visitors

John Yap, Minister of State for Climate Action, visited PCIC in December 2009 and met with staff in their offices after listening to a presentation on PCIC capabilities. Several consortium representatives attended the meeting, including PCIC Board Chair Dr. Howard Brunt and Ben Kangasniemi, Chair of the Program Advisory Committee.

Bev Van Ruyven, Acting President and CEO of BC Hydro, visited PCIC in March 2010 and met with staff who presented an overview of the consortium's Hydrologic Impacts Theme, updating her on the status of the current project with BC Hydro: Hydrologic Modelling – Peace, Campbell and Columbia River Basins.

Photo: PCIC Library



A section of BC forest devastated by the mountain pine beetle

Senior Scientist

Andrew Weaver (PhD), Canadian Research Chair and Professor at the University of Victoria's School of Earth and Ocean Sciences (SEOS), was appointed PCIC Senior Scientist in August 2009. He provides scientific guidance to PCIC research efforts, ensures quality control, and offers constructive solutions to potential research barriers. Prof. Weaver is a leading international climate scientist as well as a lead author with the UN Intergovernmental Panel on Climate Change (IPCC) which received the 2007 Nobel Peace Prize. His research interest is the dynamics of the climate system with a special emphasis on three-dimensional climate modelling.

Photo: Courtesy Andrew Weaver

Professor Andrew Weaver

Photo: Courtesy Shawn Marshall

Dr. Shawn Marshall

Visiting Scientists

Dr. Daniel Caya, Director of Climate Science at Ouranos, joined PCIC for six months to provide advice on its programs and initiate the project in Climate Diagnostics using Regional Climate Models (RCMs). He has since returned to Ouranos, but continues to maintain close ties with the PCIC Climate Diagnostics project.

Dr. Shawn Marshall, Associate Professor and Canada Research Chair in Climate Change at the University of Calgary's Department of Geography, visited PCIC for four months in the fall 2009. During his visit, Dr. Marshall wrote a textbook titled *The Cryosphere* for the upcoming Princeton University Press series "Primers in Climate Science" and worked on evaluating the impact of climate change on BC glaciers.

Hydrologic Impacts

The hydrologic impacts group successfully completed its work quantifying the impact of mountain pine beetles on the water resources of the Fraser River basin. PCIC's ongoing project with BC Hydro concerning climate change impacts on the hydrologic regimes of the Columbia, Peace and Campbell River basins passed an important milestone with the completion of Variable Infiltration Capacity (VIC) model runs on the Peace and Campbell Rivers. The hydrologic impacts group is now preparing for its final year of the first phase of this project with BC Hydro.

Photo: iStock Photo

The Fraser River Delta, BC

Message from the Chair, Board of Directors

Photo: University of Victoria

This has been another highly productive year for PCIC and, on behalf of the Board of Directors, I would like to congratulate Dave Rodenhuis and his team for their accomplishments. I would also like to recognize the significant support provided to PCIC by its Program Advisory Committee (PAC). At the heart of PCIC's success is the active engagement of our stakeholders on both the Board and the PAC. PCIC strives to conduct targeted research that is relevant to the needs of decision makers in government, industry, and NGOs. The secret of our success is that these groups are intimately involved in helping set the research agenda.

The focus at PCIC is on applied and targeted research that can be used in long-term planning for adaptation to climate change impacts. One of the highlights of the year was the recent presentation to some 70 employees and executives from BC Hydro on the hydrological impacts of climate on the Campbell, Peace, and upper Columbia River watersheds. The work that was presented has direct relevance for meeting the hydro-electric needs of the province over the next few decades. It was very well received.

While this corporate report provides an accurate account of the activities of PCIC over the past year, it cannot adequately capture the dedication of our employees and affiliated researchers from various universities and institutes who passionately believe in the value of their work. No one has been more dedicated or passionate than our Director, Dr. Dave Rodenhuis. Dave will be stepping down from his directorship later in the summer but, thankfully, he has agreed to continue to work on a few critical projects. On behalf of all of us at PCIC and our stakeholders, I want to thank him for all he has done to establish a firm foundation from which we can grow.

Howard Brunt
Chair, PCIC Board of Directors
Vice President of Research, University of Victoria

Photo: University of Victoria

PCIC Board of Directors 2009-2010 (left to right): Lynn Bailey, Asit Mazumder, Tom Pedersen, Howard Brunt, Renata Kurschner, Don Barnhardt, James Mack, Peter Keller, Gayle Gorrill, Dave Rodenhuis (Director/CEO), Cassbreea Dewis (Treasurer), and Sally Eshuys (Secretary)

Message from the Chair, Program Advisory Committee

The past year has seen significant growth in capacity at the Pacific Climate Impacts Consortium (PCIC). This increased capacity is now recognized by stakeholders and other organizations in BC and beyond. PCIC is now able to provide leading edge climate science services and information to an increasing number of BC stakeholders. To a large extent, this growth is attributable to the exemplary personal and professional commitment of PCIC Director Dave Rodenhuis who has attracted expert staff, built partnerships and developed policies to guide this young organization. On behalf of the Program Advisory Committee (PAC), I welcome Dave's continued involvement with PCIC after he steps down as Director this summer.

The government of British Columbia released "Preparing for Climate Change: British Columbia's Adaptation Strategy" in February 2010. This strategy builds on the provincial government's commitment to reduce greenhouse gas emissions and includes a commitment to provide communities, businesses and government agencies with the practical information they need to adapt to the unavoidable impacts of climate change. By drawing on its in-house expertise and the expertise of its partners, PCIC will play a leading role in meeting these adaptation objectives. This focus on the impacts of climate change is complementary to the activities of PCIC's sister organization, the Pacific Institute for Climate Solutions, which is tackling broader policy-related issues pertaining to reducing greenhouse gas emissions.

PCIC's strategic direction is maintained through guidance provided by its Board of Directors and the PAC. PAC members include representatives from stakeholder agencies as well as research organizations which provide advice to the Director and the Board on numerous strategic, program and operational matters. I wish to acknowledge some important changes in PAC membership over the past year. In particular, Dirk Nyland, Chief Engineer for the Ministry of Transportation and Infrastructure, and Dave Spittlehouse from the Ministry of Forest and Range recently became members. Representatives from BC Hydro have changed. Doug McCollor, who was critically important in advising PCIC regarding hydrological projects now nearing completion, will be replaced by Stephanie Smith. Also, long time PAC member Terry Prowse of Environment Canada has left the PAC to accept a position on the Board of Directors.

Photo: Courtesy Ben Kangasniemi

Looking ahead, I anticipate a continued increase in demand for high-resolution climate change projections from several government agencies, communities and businesses. PCIC can meet this challenge by maintaining its strategic focus, leveraging its capacity through institutional partnerships, enhancing engagement with academic researchers and, where possible, training consultants and others to apply the methods it is developing.

Ben Kangasniemi
Chair, PCIC Program Advisory Committee
Climate Action Secretariat
BC Ministry of Environment

Photo: University of Victoria

PCIC Program Advisory Committee (left to right): Dave Rodenhuis (Director/CEO), Paul Whitfield, Dirk Nyland, Dave Spittlehouse, Stephanie Smith, Andrew Weaver (Senior Scientist), Ben Kangasniemi, and Greg Flato

Message from the PCIC Director

I think the staff photo is a tangible statement of the growth in size and capability that has occurred over the past year at PCIC. The Hydrologic Impacts group has achieved recognition for its hydrologic modelling of several BC watersheds. The Regional Climate Impacts group has defined a research plan and is downscaling future climate conditions from the global to the regional scale. Our computational support group has grown in size and responsibility for PCIC products and services. The Climate Analysis and Monitoring program has been initiated and is working to develop a much-needed, province-wide climate dataset. Supporting the entire effort is our administrative group which prepares and tracks the budget, implements all personnel activities and facilitates the oversight meetings of the Program Advisory Committee (PAC) and the PCIC Board of Directors.

But not all of what PCIC does is so obvious or visible. Throughout this report our commitment to collaboration with extramural researchers, and with users and stakeholders of climate information, is implicit. Interactions have also grown with other climate centres in Pacific North America such as Oregon State University and the University of Washington.

In the next few years we can expect the demand for climate information to increase substantially. The BC government has a Climate Action Plan and a new Adaptation Strategy (2010). Motivated by a new appreciation of the importance of clean water resources, the province is considering amendments that will modernize the BC Water Act. At the federal level, Natural Resources Canada has launched a Regional Adaptation Collaborative (RAC) to stimulate preparations for climate change in western Canada. BC Hydro is preparing for future hydroelectric power generation. In every sector and every organization there is new awareness of climate change and the uncertain impacts on community infrastructure, ecosystems, and water resources that this entails.

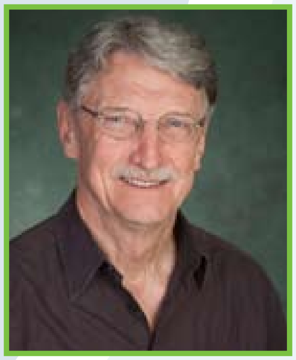


Photo: University of Victoria

PCIC must prepare to meet the growing challenge of climate change and variability in British Columbia and Pacific North America. We have launched several new initiatives in high-resolution regional climate modelling, water resources, hydrology and community impacts assessment, as well as climate monitoring. Along with our sister organization, the Pacific Institute for Climate Solutions (PICS), and with affiliated centres in Canada and the US, we are committed to bringing research results forward in support of climate change adaptation and policy development. We can continue to do this with the support of consortium members, the strengthening of in-house technical staff, and through sustained and active collaboration with researchers and stakeholders. This is our strategic plan.

Dave Rodenhuis
President & CEO/Director
Pacific Climate Impacts Consortium

Photo: University of Victoria

PCIC Staff June 2010 (left to right): David Bronaugh, Dave Rodenhuis, Markus Schnorbus, Andres Soux, Hailey Eckstrand, Paul Nienaber, Arelia Werner, James Hiebert, Katrina Bennett, Gerd Bürger, Anne Berland, Cassbreea Dewis, Trevor Murdock, Greg Maruszeczka, and Leslie Gallacher

Regional Climate Impacts— Projects 2009-2010

SELECTED PROJECTS:

Forest Pests and Tree Species Suitability in Future Climates

Climate Change Adaptation for Local Communities Based on Past Trends and Future Projections

Statistical Downscaling of Surface Winds in British Columbia

Improving Access to High Spatial Resolution Climate Data

Climate Change Adaptation for Engineering Applications

SELECTED STAKEHOLDERS:

Natural Resources Canada, Pacific Forestry Centre

Local Communities

University of Victoria

BC Ministry of Forests and Range

BC Ministry of Transportation and Infrastructure

Forest Pests and Tree Species Suitability in Future Climates

Team: Trevor Murdock (PCIC)
Aquila Flower (PCIC)
David Bronaugh (PCIC)
Alvaro Montenegro (University of Victoria)
Alan Mehlenbacher (University of Victoria)
Kirsten Campbell (TerraTree Forestry)

Project Overview

Choosing the tree species best suited to future climate conditions is a significant challenge for forestry managers planning to adapt to climate change. Shifts in regional climate may alter the composition of ecosystems, potentially increasing the populations of organisms that feed on particular tree species. This project investigated two pest/host systems for tree species suitability in British Columbia: western spruce budworm which affects Douglas fir, and spruce bark beetle which affects spruce.

The objective of this project was twofold: (1) to develop standard spatial climate datasets for forest health impacts research; and (2) to use these datasets to determine if projections of tree species suitability, pest outbreak risk, and economic impacts could be generated to guide operational forest management.

Methods

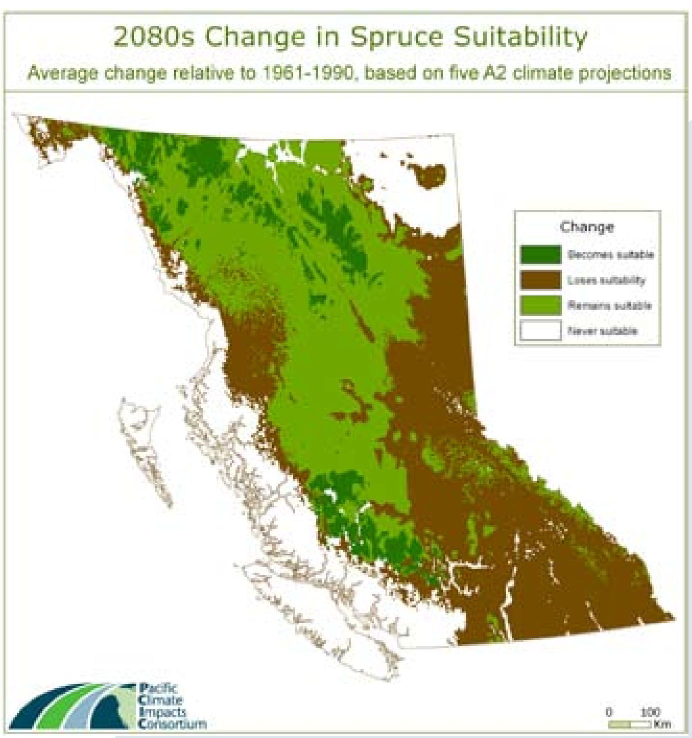
The resolution of Global Climate Model (GCM) projections is too coarse (approx. 350 km x 350 km) for assessing impacts in British Columbia due to the presence of large climatic gradients over short distances. Therefore, empirical downscaling to higher resolution (approx. 4 km x 4 km) was performed by applying projected climate change from GCMs to high-resolution historical climatology. Tree species suitability was approximated using climate envelope techniques.

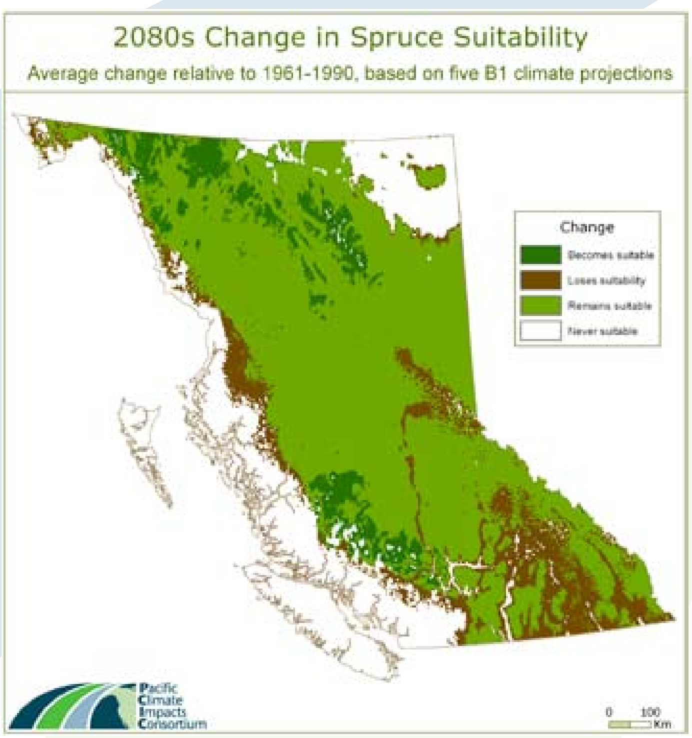
Results

Projected tree suitability by the 2080s depends on future greenhouse gas emissions. With higher emissions (SRES A2 scenario), much of the current spruce distribution becomes unsuitable (Figure 1, far left) but lower emissions (SRES B1 scenario) results in little change (Figure 1, centre).

Because future emissions are uncertain, results from both A2 and B1 scenarios are relevant. Additional uncertainty arises from differences in GCMs. Using a set of five different GCMs, the annual temperature over British Columbia increases between 1.8-2.6°C for A2 emissions scenarios and 1.7-1.9°C for B1 emissions scenarios. For precipitation, the increase varies between 2-11% for A2 emissions and 6-8% for B1 emissions.

Impacts projections may inform policies for adaptation if uncertainty can be quantified by agreement between different models. For example, the percentage of projections that indicate





spruce suitability in the future is shown in Figure 1 (far right). This illustrates the level of agreement among the different GCMs and emissions scenarios. Dark brown areas of the map are projected to become unsuitable for spruce in most or all cases, implying that an appropriate adaptation strategy might be to consider species other than spruce for those areas. Where there is low agreement among the GCM-scenario combinations (represented in the figure by the light coloured areas), other local factors may be more important for informing planning decisions.

Additional Information

Murdock, T. Q. and Aquila Flower, 2009. “Development and Analysis of Forest Health Databases, Models and Economic Impacts for BC: Spruce Bark Beetle and Spruce; Western Spruce Budworm and Douglas Fir”. Final Technical Report: Forest Science Program Project #Y093061. Pacific Climate Impacts Consortium, Victoria, BC.

Natural Resources Canada | Ressources naturelles Canada

Pacific Forestry Centre

The Pacific Forestry Centre (PFC) is one of five Canadian Forest Service research and development centres at Natural Resources Canada committed to the sustainable development and competitiveness of the country’s forestry sector.

Researchers from PFC collaborated with PCIC to submit a joint proposal under the Forest Sciences Program (FSP) for expanding the scope of the tree species and pest suitability project from one pest/host system to two. PFC researchers have also provided in-kind access to forest health datasets and advised PCIC on matters of entomology, tree species suitability and wildfire. In exchange, PFC researchers have benefited from PCIC expertise in the use of downscaling techniques and climate projections.

Acknowledgements

BC Ministry of Forests and Range, Forest Sciences Project
Dave Spittlehouse (BC Ministry of Forests and Range)
Steve Taylor (Natural Resources Canada)
Richard Hebda (University of Victoria)
Tongli Wang (University of British Columbia).

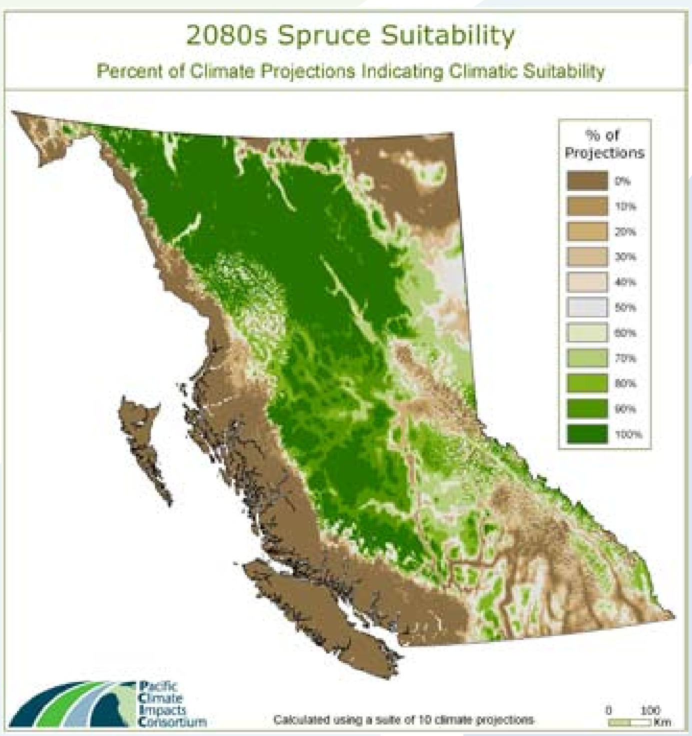


Figure 1 – Maps showing projected spruce suitability for the 2080s period in British Columbia. (Far left) A map showing spruce suitability for high emissions (A2) scenarios from five GCMs. Light green areas were suitable in both 1961-1990 and in the 2080s. Dark green areas become suitable and dark brown areas become unsuitable by the 2080s. (Centre) Same as above except this time considering lower emissions scenarios (B1). (Far right) A map showing the percentage of projections in agreement on future climate from among a set of ten GCMs following A2, B1 and A1B emissions scenarios. Dark green indicates high agreement between the models that climate will be suitable in these areas. Dark brown indicates high agreement between the models that climate will be unsuitable in these areas. Light coloured areas indicate low agreement between the models.

Climate Change Adaptation for Local Communities Based on Past Trends and Future Projections

Team: Trevor Murdock (PCIC)
Arelia Werner (PCIC)
Hailey Eckstrand (PCIC)
Ian Picketts (City of Prince George)

Project Overview

The objective of this series of projects is to identify the potential impacts of climate change on local/regional communities in Pacific North America and assess adaptation strategies based on community needs.

The Pacific Climate Impacts Consortium (PCIC) has undertaken a series of regional assessments in collaboration with local communities in Pacific North America. These assessments on historical and future hydro-climatology are a product of PCIC's Regional Climate Impacts Theme, one of four major themes comprising the PCIC program. In 2009 PCIC collaborated with the City of Prince George, BC to develop a regional assessment. Similar projects have been completed or are currently underway in Dawson City (Yukon) and the Atlin Taku (BC), Columbia Basin (BC) and Cariboo-Chilcotin (BC) regions.

Prince George is a city built on a flood plain at the confluence of the Nechako and upper Fraser rivers. During the winter of 2007-2008, Prince George experienced severe ice-related flooding along the lower Nechako River that caused extensive damage. The watersheds surrounding Prince George encompass the headwaters of the largest river in BC (the Fraser River), where vegetation has been heavily damaged by the mountain pine beetle. These factors make this community particularly susceptible to climate change impacts. Thus, maintaining regional water security is a concern to both the residents of Prince George and the provincial government. Many organizations and user groups, such as Rio Tinto Alcan (who regulates flow on the Nechako River), also have a stake in water resource management in this north-central region of the province.

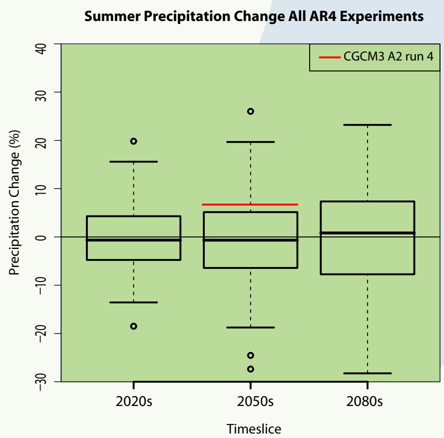
Methods

In anticipation of climate change, the community of Prince George has taken steps towards adaptation of its community infrastructure. To assist them, an introductory summary of impacts on temperature, precipitation and streamflow was prepared by PCIC and presented at several workshops. Through these workshops the implications of climate change were identified. Feedback from senior city staff and planners was solicited and the results documented in a summary report "Climate Change in Prince George: Summary of Past Trends and Future Projections".

An integral part of this process involves the identification of a local "champion" who leads the effort to assess community needs and ensures that the resulting regional assessment report addresses these needs. Such collaboration results in two-way knowledge transfer between the local champion who learns about climate change impacts, and PCIC staff members who acquire specific knowledge on the adaptation needs of a particular community. For Prince George, the local champion was Ian Picketts, a graduate student and Pacific Institute for Climate Solutions (PICS) scholar at the University of Northern British Columbia.

Results

Over the last century, Prince George experienced an average warming trend of 1.3°C. In recent decades, warmer winters resulted in a greater percentage of precipitation falling as rain rather than snow, leading to increased surface runoff. Future climate projections were used with an evaluation of uncertainty to allow



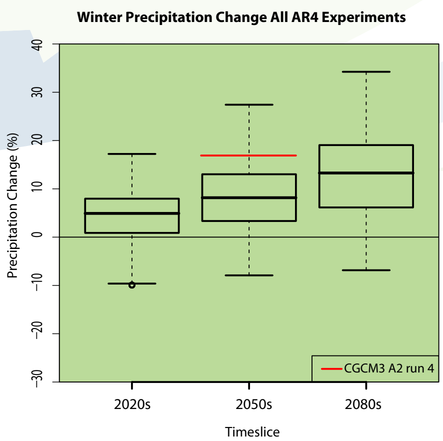


Figure 2 – Boxplots showing the range of seasonal (summer/winter) projected changes in precipitation for three time horizons (2020s, 2050s, and 2080s) in Prince George, BC. The inner boxes illustrate projected precipitation changes (per cent change) for roughly half of the model projections used.

planners, managers and engineers to make informed decisions in preparation for climate change. Annual temperatures in the region are projected to increase by an average of 1.6-2.5°C over the next 50 years. Precipitation during this time is projected to increase by 3-10%, with increases occurring primarily in winter and decreases occurring in summer (Figure 2). These precipitation and temperature changes will result in alterations to streamflow timing and volume, depending on watershed location and type.

Additional Information

Werner, A. T. and T. Q. Murdock, 2009. "Climate Change in Prince George – Summary of Past Trends and Future Projections". Pacific Climate Impacts Consortium, Victoria, BC.

Acknowledgements

City of Prince George and other communities/regions: Integrated Land Management Bureau, Canadian Parks and Wilderness Society-BC, Columbia Basin Trust.

Photo: iStock Photo

A Coastal community on Vancouver Island, BC. Many local/regional communities have begun to consider climate change considerations alongside other factors affecting long-term planning and decision-making

Local Communities

While all levels of government have a role to play in the development of climate change adaptation and mitigation strategies, potential impacts tend to be most immediate and direct for local and regional governments entrusted with maintaining community-level infrastructure. Many local and regional governments have begun to include climate change considerations in the development of community planning processes. At the same time, few local communities have the scientific and technical resources to address this challenge alone and can benefit from collaborative relationships fostered by PCIC.

PCIC has worked with several regions and communities in BC and the Yukon Territory. In 2009 PCIC entered into a partnership with the City of Prince George and the University of Northern British Columbia to provide a summary of past trends and future climate projections for the Prince George area. This foundational work is providing the basis for a broader adaptation strategy for informing the city's community planning processes. At the same time, PCIC has gained valuable additional experience in community needs assessment.

Statistical Downscaling of Surface Winds in British Columbia

Team: Derek van der Kamp (PCIC)
Charles Curry (Environment Canada)
Adam Monahan (University of Victoria)

Project Overview

The objective of this project is to identify appropriate methods for downscaling wind statistics that could be used to assess possible changes in these characteristics under future climate conditions in British Columbia.

Surface winds have obvious effects on society and its environs, including the prospect of property damage and ecosystem disruption, as well as impacts on wind energy production. Therefore, it is important to assess the likelihood and amplitude of changes in surface wind attributes under possible future climate conditions. For instance, will extreme wind events, such as the storm which caused severe damage to Vancouver's Stanley Park in December 2006 (Figure 3), increase or decrease in frequency and severity as the climate changes?

It is difficult to interpret surface winds using raw output from large-scale Global Climate Models (GCMs), as they do not resolve the local-scale topography and boundary-layer dynamics which are often dominant drivers of surface wind statistics. This is especially the case within the complicated and varied landscapes of British Columbia. Consequently, numerous attempts at statistical downscaling of surface winds have been presented in the literature in recent years. Although details vary, these projects depend on a transfer function connecting applicable large-scale atmospheric variables provided by GCMs, such as mean sea-level pressure and winds in the mid-troposphere, to the statistics of surface winds derived from long-term observations. Examples of transfer functions include non-linear neural network models, spline functions, or multivariate linear regressions.

Figure 3 – A large tree uprooted during a December 2006 winter storm in Vancouver's Stanley Park, BC.

Photo: Wikipedia

Methods

This project involves the assessment of various statistical downscaling techniques and their suitability for application to BC surface winds. As a first step, surface wind measurements from a variety of long-term climate monitoring sites maintained by Environment Canada throughout BC were acquired along with data from a number of models, including historical and future scenario runs using the Canadian Regional Climate Model (CRCM).

Results

Initial results suggest that the choice of downscaling techniques must be made with care in order to correctly model the unique surface wind characteristics of a given site. Results which seem statistically significant may not carry any applicable information for future surface wind projections due to the lack of any event-based forecasting ability.

Selected Recommendations

Results are limited by the absence of observational data for many areas of the province. In addition, the availability of station meta-data, including station location and history, could be significantly improved. Therefore, a homogeneous climate monitoring database is needed, such as the one being developed by PCIC's Climate Analysis and Monitoring Theme in collaboration with the BC Ministry of Environment.

University of Victoria

Consortium Member Since: 2006

PCIC Board Members: Dr. Howard Brunt, Vice President of Research; Don Barnhardt, General Counsel; Claire Cupples, Dean of Science; Asit Mazumder, Professor; Gayle Gorrill, Vice President of Finance and Operations; Tom Pedersen, PICS Director; Terry Prowse, W-CIRC

The University of Victoria is home to several premier Canadian climate centres, including the Water & Climate Impacts Research Centre (Environment Canada), the Canadian Centre for Climate Modelling and Analysis (Environment Canada) and the Pacific Institute for Climate Solutions. Each of these centres has a representative on either the PCIC Program Advisory Committee or the PCIC Board of Directors.

The Water & Climate Impacts Research Centre (W-CIRC) specializes in the hydrologic and ecological impacts of atmospheric change and variability. In 2009 PCIC funded a post-doc to work with W-CIRC on a project analyzing Variable Infiltration Capacity (VIC) model parameter sensitivity in the upper Peace River basin.

The Canadian Centre for Climate Modelling and Analysis (CCCma) and PCIC collaborated on a project with the School of Earth and Ocean Sciences to identify methods for downscaling wind statistics in BC. CCCma is also a resource for climate modelling expertise.

The Pacific Institute for Climate Solutions (PICS) was formed in 2008 to translate existing knowledge on climate change into policy solutions. The institute is the sister centre for PCIC and works collaboratively with it on various projects; for example, the joint PCIC-PICS Pacific Climate Seminar Series. PCIC targeted research results also inform the institute's policy work. PICS recently contributed to the Climate Analysis and Monitoring Program initiated by the BC Ministry of Environment.

Improving Access to High Spatial Resolution Climate Data

Team: David Bronaugh (PCIC)
Paul Nienaber (PCIC)
Trevor Murdock (PCIC)

Project Overview

The objective of this project was to generate high spatial resolution climate projections and make these products available to a wide range of user stakeholders in British Columbia. To make this information more accessible, the project extended the current capabilities of PCIC's online Regional Analysis Tool (RAT) while also developing a separate, and simpler, web-based interface tool designed for users outside the climate modelling community.

Methods

This project utilized climate data results obtained from stand-alone software tools such as ClimateBC, ClimatePP and ClimateWNA. New capabilities were also added to PCIC's Regional Analysis Tool in order to create better quality and higher resolution future projections.

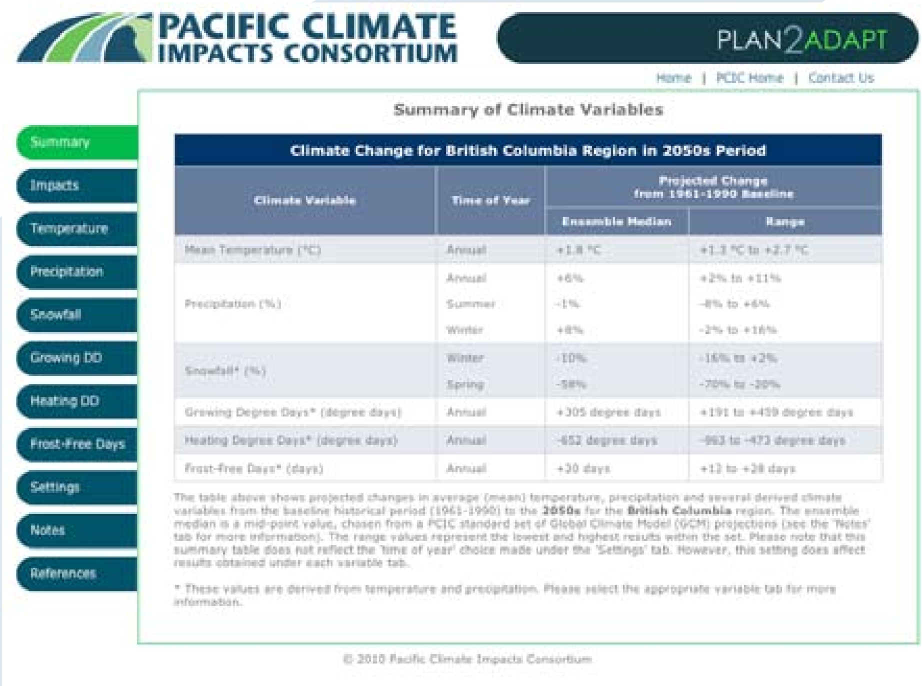
Results

The performance of PCIC's Regional Analysis Tool has been improved, allowing for quick and responsive analysis of high-resolution climate data for use by scientific and technical professionals already versed in climate modelling. In addition:

- A 'zoom' feature was added which allows users to focus in on their region of interest and see climate data within the context of ground-level geophysical attributes like coastlines, rivers and lakes;
- Online computations were implemented of several derived climate variables, such as 'growing degree days'.

To make future projections more accessible to those outside the climate impacts community, PCIC developed another web-based user interface called Plan2Adapt. This tool uses the same data as the RAT but provides a simpler interface aimed at the needs of engineers, community planners,

Screenshot showing the summary information table for PCIC's Plan2Adapt online tool. The table provides projected changes in temperature, precipitation and other climate variables by region in British Columbia, based on user selection

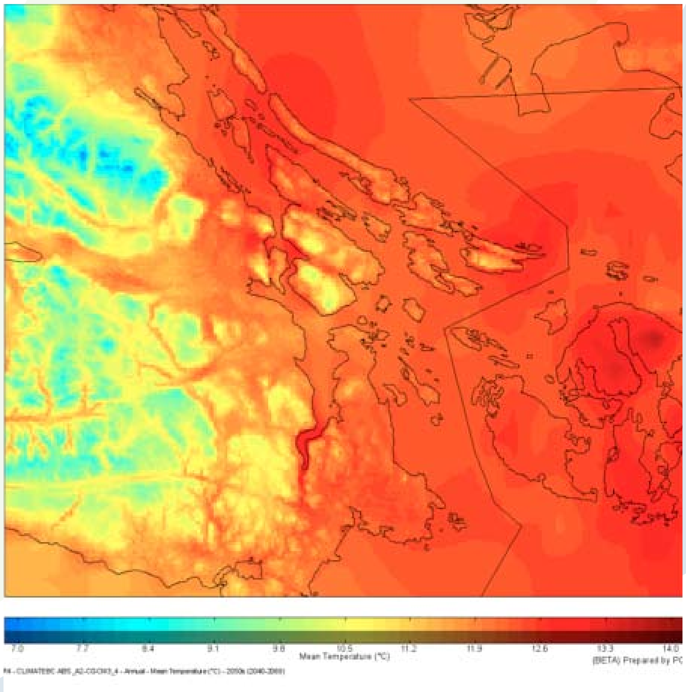


Summary of Climate Variables

Climate Change for British Columbia Region in 2050s Period			
Climate Variable	Time of Year	Projected Change from 1961-1990 Baseline: Ensemble Median	Range
Mean Temperature (°C)	Annual	+1.8 °C	+1.3 °C to +2.7 °C
Precipitation (%)	Annual	+6%	+2% to +11%
	Summer	-1%	-8% to +6%
	Winter	+8%	-2% to +16%
Snowfall* (%)	Winter	-10%	-16% to +2%
	Spring	-58%	-70% to -20%
Growing Degree Days* (degree days)	Annual	+305 degree days	+191 to +459 degree days
Heating Degree Days* (degree days)	Annual	-652 degree days	-963 to -473 degree days
Frost-Free Days* (days)	Annual	+20 days	+12 to +28 days

The table above shows projected changes in average (mean) temperature, precipitation and several derived climate variables from the baseline historical period (1961-1990) to the **2050s** for the **British Columbia** region. The ensemble median is a mid-point value, chosen from a PCIC standard set of Global Climate Model (GCM) projections (see the 'Notes' tab for more information). The range values represent the lowest and highest results within the set. Please note that this summary table does not reflect the 'time of year' choice made under the 'Settings' tab. However, this setting does affect results obtained under each variable tab.

* These values are derived from temperature and precipitation. Please select the appropriate variable tab for more information.



Screenshot showing the Regional Analysis Tool's new small window option. Figure shows projected mean annual temperature change for Southern Vancouver Island and the Gulf Islands in the 2050s according to CGCM3 A2 run 4

municipal government officials and others with an interest in climate change adaptation in BC. Along with the improvements to the RAT, the creation and launch of Plan2Adapt was an important project result that broadens the audience for PCIC-supplied climate change projections.

Acknowledgements

BC Ministry of Forests and Range, Forest Sciences Project

David Spittlehouse, BC Ministry of Forests and Range

Tongli Wang, Centre for Forest Conservation Genetics

BC Regional Adaptation Collaborative, Natural Resources Canada

Photo: iStock Photo

More frequent forest fires are a dramatic example of the potential impacts of climate change. Decision-makers may need to consider the likelihood of such impacts during community and land use planning processes.

Ministry of Forests and Range

Consortium Member Since: 2009

PAC Members: Dave Spittlehouse, Senior Research Climatologist

The BC Ministry of Forests and Range established the Future Forest and Ecosystems Scientific Council (FFESC) in 2008 to guide research under the Future Forest Ecosystem Initiative. This initiative aims to influence BC's forest and range management to enhance the resilience and productivity of ecosystems that will be affected by global climate change.

In 2009 PCIC received an FFESC grant for a collaborative project with PAC member Dave Spittlehouse and research scientists at the BC Ministry of Forests and Range. The purpose of this two-year project is to increase the capabilities of the ClimateWNA tool and PCIC's Regional Analysis Tool (RAT). These software products greatly improve the delivery of climate-related data for a wide range of users and applications, including other FFESC research projects, the wider scientific community, resource managers, community planners, and others seeking to understand the impact of climate change on ecosystems and society.

Climate Change Adaptation for Engineering Applications

Ministry of Transportation and Infrastructure

Consortium Member Since: 2009

PAC Member: Dirk Nyland, Chief Engineer

The integrity of long-term public infrastructure like roads and bridges may be sensitive to the impacts of climate change and extreme weather events. In recognition of this fact the BC Ministry of Transportation and Infrastructure (MoTI) has made climate change adaptation a priority. Civil engineers traditionally rely on historical data to guide the design of safe, durable structures. Now they need to consider a changing climate with more extreme weather events in their design approaches and practices.

Concerns over the effects and uncertainties surrounding climate change on public infrastructure prompted the BC MoTI to partner with PCIC in 2009 on a pilot project for establishing the application of climate change parameters to infrastructure planning. BC MoTI and PCIC continue to develop methodologies for providing probability estimates of the impacts of extreme weather events on public infrastructure along with uncertainties.

Team: Gerd Bürger (PCIC)
Trevor Murdock (PCIC)
James Hiebert (PCIC)
Hailey Eckstrand (PCIC)

Project Overview

Increasing frequency and intensity of extreme weather events and natural hazards will impact British Columbia's critical infrastructure. The province's transportation network, port facilities, electricity and communications distribution systems are major investments where replacements or upgrades also present opportunities for climate change adaptation. The objective of this project was to provide present and future values of climate parameters in the vicinity of British Columbia's Coquihalla Highway.

Methods

Using station observations and future conditions from Regional Climate Models (RCMs), probability increases were derived: 1%, 5%, 50%, 95%, and 99% quantiles of daily, and where available, 3-hourly values of temperature and precipitation. This information was the basis for deriving many subsequent climate parameters. Additionally, probability estimates for present and future conditions were computed for some of the most important extreme events (e.g., heavy rainfall). This was achieved by mapping local event thresholds to the corresponding thresholds for future conditions with identical probability. Future probabilities were determined directly from the RCM scenarios and assigned to the corresponding future local events.

Results

Estimates of present and future values of climate parameters for the Coquihalla Highway study area were produced. The parameters are probability measures of extreme weather events based on historical records and future projections of temperature and precipitation. For example, future projections using three RCMs indicated that temperature extremes that might occur every two years in the past may occur up to three times every two years by the 2050s.

It must be noted that the approach used in this project involved uncertainties that have not been thoroughly assessed. A more in-depth analysis of these uncertainties, especially with regard to extreme events, is being applied for similar projects currently underway in other locations (e.g., Castlegar, Rossland and Vanderhoof).

Photo: BC Ministry of Transportation and Infrastructure

Extreme weather events can negatively impact community infrastructure such as transportation networks, causing disruption to the flow of people and goods. Understanding how climate change affects the frequency and intensity of extreme events can help community decision-makers better adapt to these changes.

Hydrologic Impacts—Projects 2009-2010

SELECTED PROJECTS:

Hydrologic Modelling — Peace, Campbell and Columbia River Basins

Hydrologic Modelling — Fraser River Basin

Climate Model Diagnostics

SELECTED STAKEHOLDERS:

BC Hydro

BC Ministry of Environment

Ouranos

Hydrologic Modelling — Peace, Campbell and Columbia River Basins

Team: Katrina Bennett (PCIC)
Markus Schnorbus (PCIC)
Arelia Werner (PCIC)

Project Overview

The objective of this project is to quantify the hydrologic impacts of climate change for selected watersheds in British Columbia. Specifically, it concerns future projections for the 2050s period (2041-2070) on the hydrology and monthly streamflow of three key watersheds:

- The Campbell River basin, a 1,200 km^2 coastal watershed on Vancouver Island with a hybrid rain and snow runoff regime;
- The Peace River basin, a 100,000 km^2 continental snow-dominated watershed located in the northern interior of British Columbia at the headwaters of the Mackenzie River system;
- The Canadian portion of the Columbia River system, a 104,000 km^2 watershed dominated by the upper Columbia and Kootenay River systems with a snow-dominated runoff regime.

All three basins were selected for their importance in the generation of hydroelectric power in the province.

Methods

Hydrologic projections were produced by using the Variable Infiltration Capacity (VIC) model at a resolution of 1/16-degrees (approximately 25-32 km^2). Climate change impacts used statistically downscaled climate change projections from a selection of Global Climate Model (GCM)-SRES scenario combinations. A total of 23 GCM-scenario combinations were selected based on GCMs that most accurately replicate historical climate over North America and western Canada. Hydrologic simulation with the VIC model was driven by daily transient runs for each GCM-scenario combination from 1915 to 2100. Baseline conditions (e.g., streamflow, snow accumulation) for the 1961-1990 historical period were compared to the 2041-2070 period (the 2050s) in order to estimate hydrological changes due to projected future climate conditions.

Results

Hydrologic projections have been completed on the Peace and Campbell River watersheds for the 2050s. Such projections (Figures 3 and 4) show changes in monthly streamflow for the Peace River (at Taylor) and Campbell River (Strathcona reservoir inflow) basins, respectively. Results for the Peace River in the 2050s indicate an increase in surface runoff during

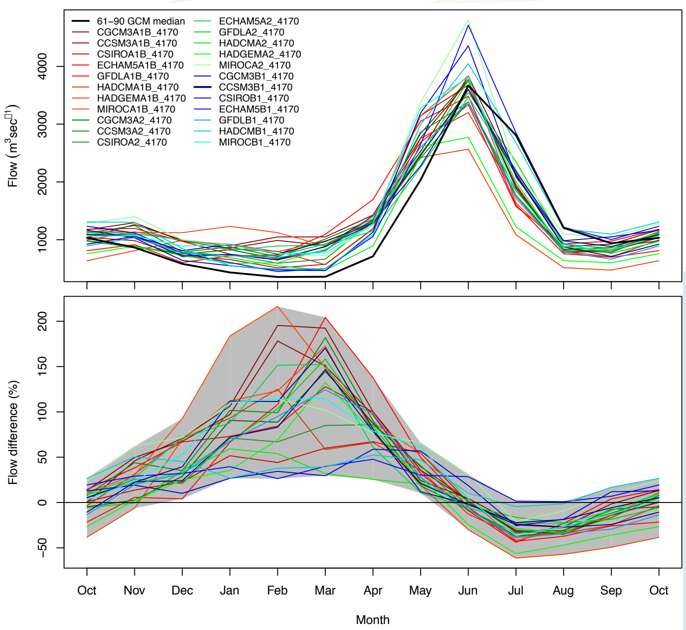


Figure 3 – Projected monthly median streamflow for the 2050s for each individual GCM-scenario combination compared to the simulated median historical streamflow (grand median for all GCMs and scenarios for the 1960-1990 period) for the Peace River at Taylor, BC. Top panel shows median hydrographs while the bottom panel shows relative anomaly from the historical grand median.

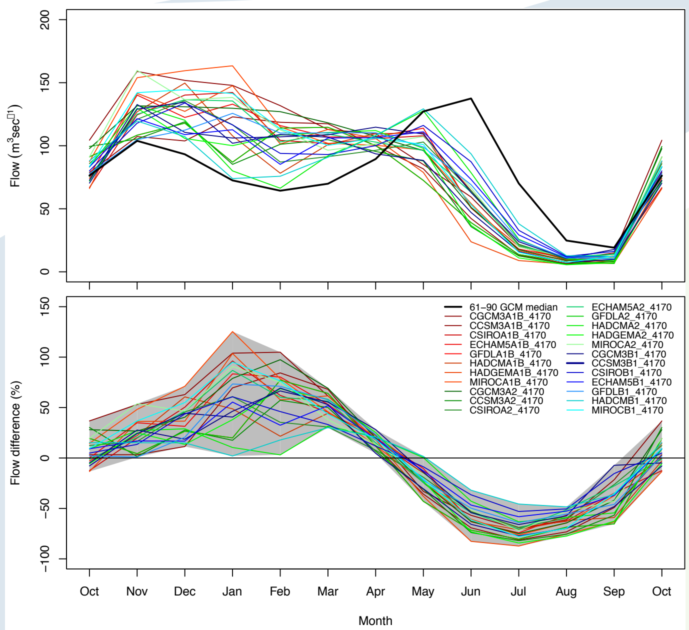


Figure 4 – Projected monthly median streamflow for the 2050s for each individual GCM-scenario combination compared to the simulated median historical streamflow (all GCMs and scenarios for 1960-1990) for the Campbell River (Strathcona Reservoir inflow). Top panel shows median hydrographs while the bottom panel shows relative anomaly from the historical grand median.

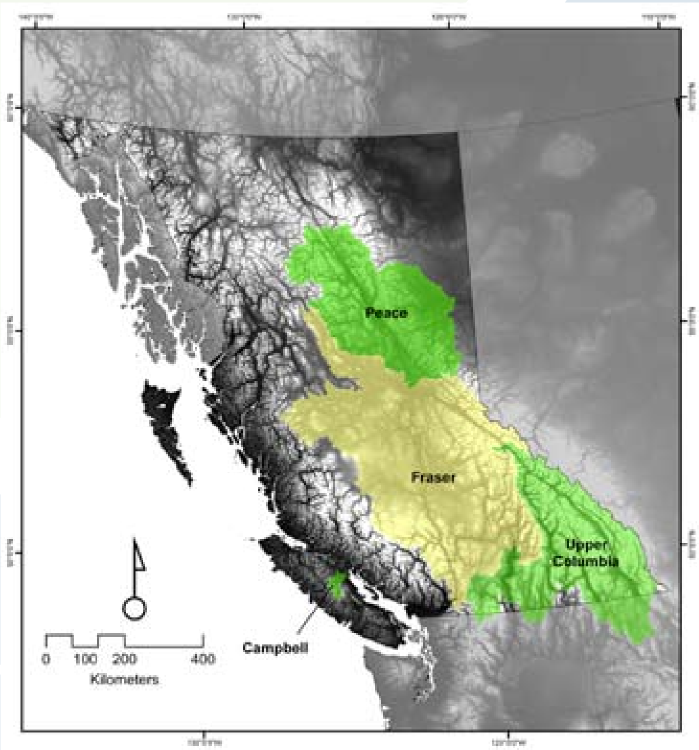


Figure 5 – Map showing current study areas for PCIC's Hydrologic Impacts Theme. Watersheds of the Peace River, Campbell River and the Canadian portion of the Columbia River are being studied as part of the Hydrologic Modelling project.

the winter months due to a greater proportion of precipitation falling as rain, an earlier rise and peak in the spring thaw event (freshet) due to warmer temperatures, and lower snow packs as well as drier conditions in the summer. Projections in the 2050s for the Campbell River basin indicate a change from a mixed rain and snow regime to one that is almost entirely rainfall dominated, with the highest flows of the year switching from freshet runoff in May/June to rainfall runoff during November, December and January. In the future, the Peace and Campbell Rivers will experience higher runoff in the winter and early spring, and reduced surface runoff in the summer. Despite considerable variability between the different GCM-scenario projections with respect to the magnitude of change, overall trends are consistent for all projections.

Preliminary hydrology and streamflow projections for the Mica sub-basin are complete and work on the calibration and validation of the entire Columbia River study area is continuing.

Additional information

Bennett, K. E., A. T. Werner, M. Schnorbus and A. J. R. Berland, 2009. "Status Report: VIC Hydrologic Modelling Project, January 2009-June 2009". Pacific Climate Impacts Consortium, Victoria, BC.

Schnorbus, M. A., K. E. Bennett, A. T. Werner and D. R. Rodenhuis, 2010. "Status Report: VIC Hydrologic Modelling and Regional Climate Modelling Diagnostics, July 2009-March 2010". Pacific Climate Impacts Consortium, Victoria, BC.

Acknowledgements

The Hydrologic Modelling project has been partially funded by a grant contribution from BC Hydro (Grant Contribution Agreement, March 3, 2008).

BC hydro

FOR GENERATIONS

Consortium Member Since: 2006

PCIC Board Member: Renata Kurshner, Director of Generation Resource Management

PAC Member: Stephanie Smith, Manager, Hydrology and Technical Services, Generation Resource Management

Since helping to establish PCIC in 2006, BC Hydro recognized that the collaborative nature of the consortium would lead to an enhanced provincial capacity for responding to climate change. As an active member of PCIC's Program Advisory Committee (PAC), BC Hydro has been instrumental in guiding the direction of the consortium's program development over the last four years. The company benefits from the results of PCIC calculations of future hydrological conditions in British Columbia, including streamflow projections for the 2050s period.

PCIC and BC Hydro are currently in their final year of the project's first phase. Important milestones have been reached, such as the publication of a provincial climate overview, the establishment of a Technical Advisory Committee, and hydrological modelling and analysis for the Peace, Campbell and upper Columbia Rivers. Preliminary results were presented during a joint workshop in April 2010.

Hydrologic Modelling — Fraser River Basin

Team: Markus Schnorbus (PCIC)
Katrina Bennett (PCIC)
Arelia Werner (PCIC)

Project Overview

The objective of this project was to quantify the impacts of the mountain pine beetle and salvage harvesting on the peak flow regime and surface runoff of various sub-basins within the Fraser River watershed upstream of Hope, BC.

The study area was composed of the Fraser River watershed upstream of Hope, BC which has a drainage area of 217,000 km^2 (Figure 5). Surface runoff within the Fraser River watershed is dominated by snowmelt and the basin has complex climatological and physiographical features that result in tremendous spatial variation in streamflow.

In addition to providing a quantitative analysis of the impacts of beetle kill and salvage harvesting on water resources in the basin, this study also served as the prototype setup and application for the use of the Variable Infiltration Capacity (VIC) model for all of British Columbia.

Methods

Hydrologic impacts for the Fraser River basin were assessed by using the VIC model at a resolution of 1/16-degrees (approximately 25-32 km^2). This model was forced with spatially distributed observational data spanning the historical period 1915-2006 for several forest cover scenarios representing baseline conditions (circa. 1995), current conditions (circa. 2007), and various hypothetical disturbance scenarios. Streamflow for each scenario was compared to simulated baseline conditions at 62 locations within the basin to assess the effects of forest disturbance. This assessment not only provided an overall quantification of hydrological sensitivity to forest cover change, but also identified those regions of the Fraser River watershed most vulnerable to hydrological impacts.

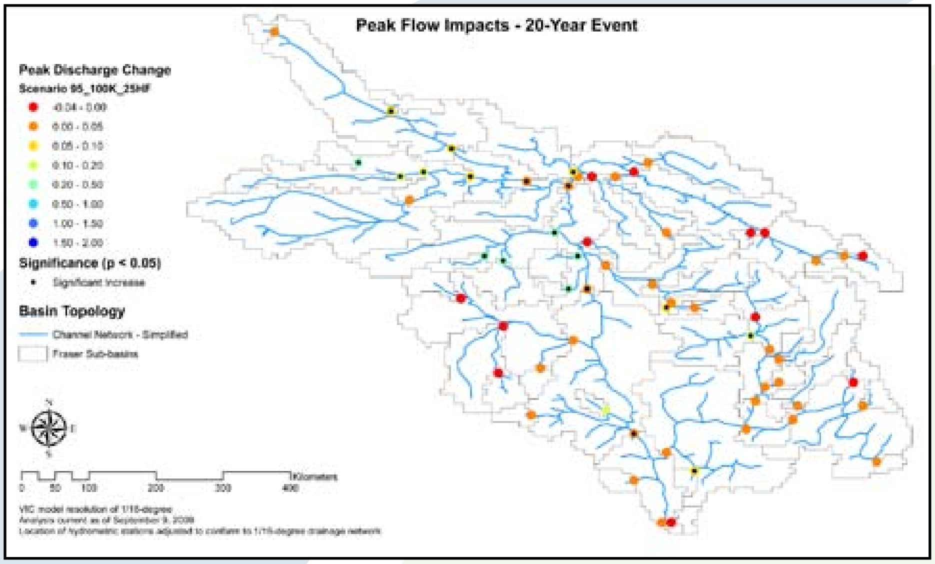


Figure 6 – Map showing the relative change (from baseline) in the 1 in 20-year peak flow event for individual hydrometric locations from a scenario of 100% beetle kill of mature pine plus 25% harvest by area. The black dots indicate locations of statistically significant (p < 0.05) increase.

Results

The sensitivity of the peak flow regime to forest disturbance varies widely between the 62 sub-basins. For instance, relative changes (from baseline) in the magnitude of the 20-year peak flow event varied over the studied basins from 'no change' to the following:

- 8% for current forest cover,
- 8% for 100% beetle-kill (0% harvesting),
- 46% for 100% kill plus 25% harvesting,
- 91% for 100% kill plus 50% harvesting,
- 130% for 100% kill plus 75% harvesting,
- 172% for 100% kill plus 100% harvesting of dead pine.

Figure 6 illustrates the spatial variation of relative change in the 1-in-20-year event for a disturbance of 100% kill of all mature pine in the basin plus 25% harvest by area of dead pine. Small basins located on the Fraser Plateau (i.e., with no significant alpine/sub-alpine snow contribution) and with large proportions of susceptible pine (i.e., large disturbance areas) are most sensitive to forest cover changes.

Additional information

Schnorbus, M., K. Bennett and A. Werner, 2010. "Quantifying the Water Resource Impacts of Mountain Pine Beetle and Associated Salvage Harvest Operations Across a Range of Watershed Scales: Hydrologic Modelling of the Fraser River Basin". Information Report: BC-X-423, Natural Resources Canada, Canadian Forestry Service, Pacific Forestry Centre, Victoria, BC, 64 pp.

Ministry of Environment

Consortium Member Since: 2006

PCIC Board Members: Lynn Bailey, Assistant Deputy Minister; James Mack, A/Head Climate Action Secretariat

PAC Member: Ben Kangasniemi, A/Manager of Science and Adaptation, Climate Action Secretariat

The BC Ministry of Environment (BC MoE) has developed a strategy for incorporating climate change adaptation in the day-to-day business of the BC government, particularly in key climate-sensitive sectors such as forestry and agriculture. As part of the BC Climate Action Plan, this adaptation strategy envisions a future where the province is prepared for, and resilient to, the impacts of climate change. To this end, the BC MoE has provided base funding to PCIC through an endowment established specifically to support climate change research in the province.

Over the years, PCIC has developed a strong collaborative relationship with the River Forecast Centre (RFC) within the BC Ministry of Environment. In 2009 the RFC provided in-kind support for an analysis of the impacts of mountain pine beetle analysis on the Fraser River.

Acknowledgements

This project was supported by an in-kind agreement with the River Forecast Centre (BC Ministry of Environment) via funding from the Government of Canada through the Mountain Pine Beetle Program, administered by the Canadian Forest Service at Natural Resources Canada.

Climate Model Diagnostics

Team: Daniel Caya (Ouranos)
Biljana Music (Ouranos)
Marco Braun (UQAM)
Dave Rodenhuis (PCIC)

Project Overview

The objective of this project is to simulate future impacts of climate change on surface hydrological components, including the annual cycle of runoff, on selected watersheds in British Columbia.

This is a collaborative project between Ouranos, the Université du Québec à Montréal (UQAM) and PCIC. Ouranos and UQAM built the diagnostic tools, developed the experimental design, and supplied the model output for analysis. PCIC identified the watersheds and developed the research plan. The investigation focused on: (1) the ability of current regional climate models to adequately simulate water cycle components at the watershed scale; (2) the uncertainty of climate forcing as determined from global climate models; and (3) the interpretation of future trends in climate impacts. The ultimate objective is to obtain reliable estimates of surface runoff in the 2050s period, including changes to the annual cycle and estimates of uncertainty. This kind of information is vital for planning future water use and hydroelectric power generation.

Methods

The traditional method for evaluating hydrological components involves the use of a detailed water balance model on a designated watershed. To obtain estimates of future hydrological conditions, results from a Global Climate Model (GCM) can be statistically downscaled to the site of the watershed. A promising alternative method is to use a regional climate model (RCM), in this case the Canadian Regional Climate Model (CRCM), to dynamically downscale the GCM simulation to higher resolution and to diagnose the water components at the watershed level directly from the land-surface model that is embedded in the CRCM. In contrast to the traditional method, the RCM method can be applied over any region of the globe without the need for parameter calibration. Another important advantage of using RCMs is the fact that these models are based on energy and water balance that maintains an internal consistency of simulated hydrological cycle components. Runoff projections from the CRCM are expected to be comparable to what is obtained using the traditional method, since they both depend on climate change signals coming from the GCMs.

The primary watersheds of interest were the Campbell, Peace, Columbia and Fraser River basins. First, the effects of structural differences among the various models were examined. Next, the natural variability of the climate model was analyzed and the effects on the hydrological components estimated. Finally, the annual cycle of water components at the surface were estimated and compared. Long-term trends in streamflow were also examined.

Results

By the 2050s the mean annual surface temperature in the vicinity of the targeted watersheds is expected to increase by approximately 2.5°C. In addition to increased evaporation, precipitation and runoff are expected to increase by more than 15% in the Peace River watershed (above Taylor). Similar results are expected for the upper Fraser River basin. However, in the Columbia and Campbell River watersheds, the increase in precipitation and runoff is estimated to be about half as much as the Peace and upper Fraser River basins with a large decrease in snow accumulation (Figure 7).

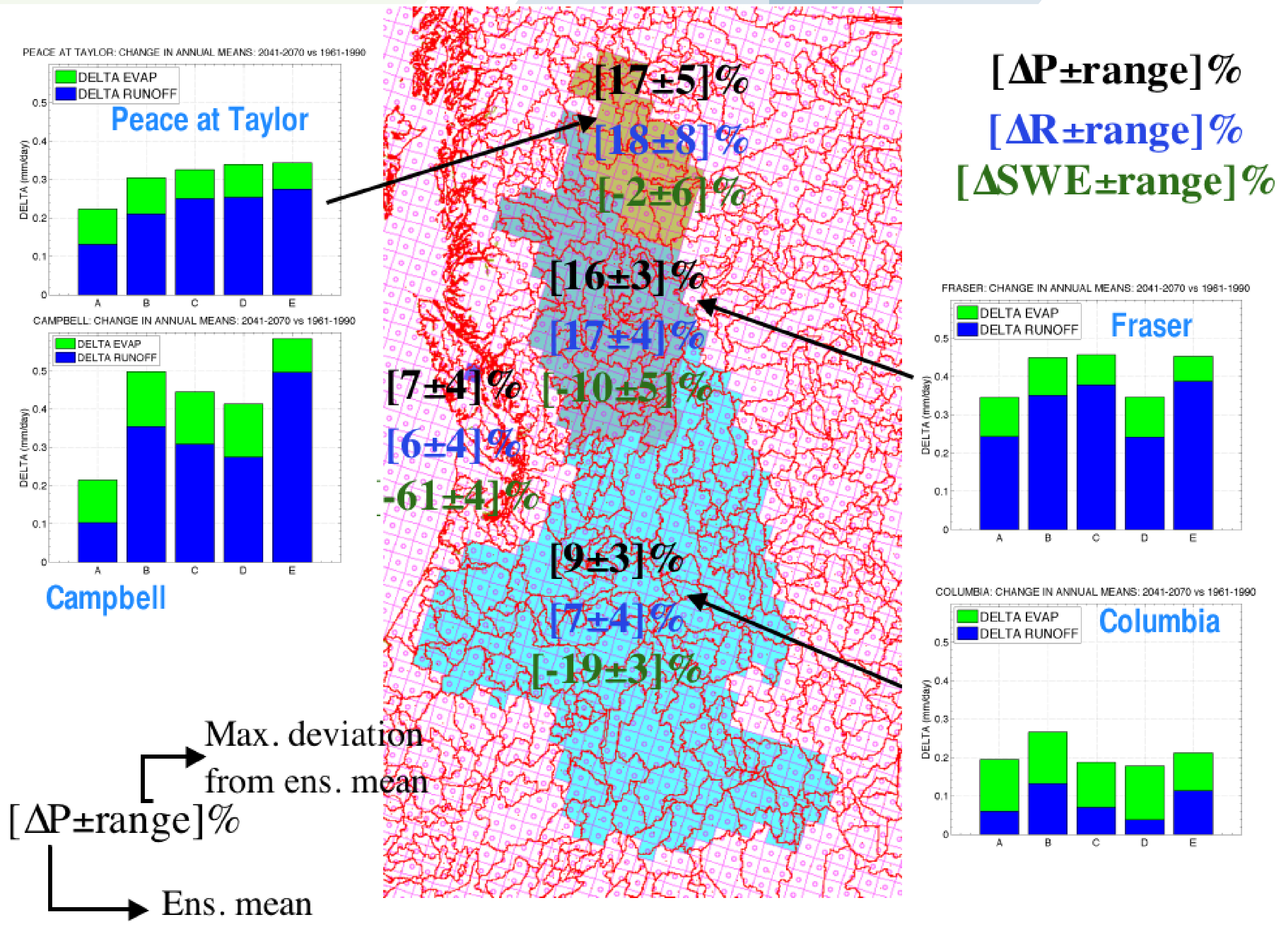


Figure 7 – Map showing CRCM projected changes and associated uncertainties in water budget components from historical period (1961-1990) to the 2050s (2041-2070) over the Upper Peace, Fraser, Campbell and Columbia River watersheds using A2 emissions scenarios. (B. Music, Ouranos)

Detailed estimates of snow accumulation and runoff were made month-by-month over a typical year in the 2050s period. The slight increase in estimated precipitation for the upper Columbia River occurs as rain instead of snowfall. This is expected to result in increases in surface runoff in the spring and a deficit in the fall and early winter. The northern portion of the Peace River watershed is expected to receive more precipitation as snow accumulation with the runoff maintained throughout the year.

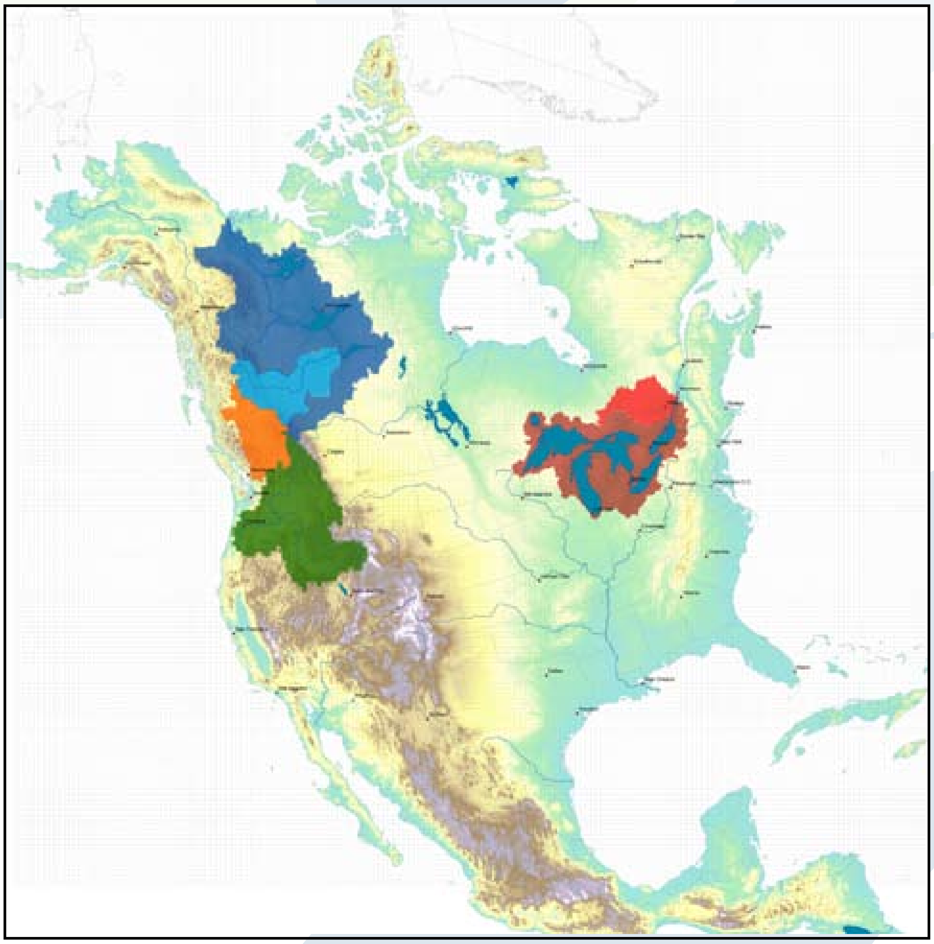
Analysis has shown that the CRCM with advanced physics is capable of diagnosing the impacts of climate change on large watersheds of British Columbia. More importantly, consistent results have been obtained on the Canadian portion of the upper Columbia River as well as a section of the Peace River watershed (above Taylor). Results were also obtained for the small watershed of the Campbell River on Vancouver Island. However, results for this watershed were somewhat uncertain due to the small sample size of grid points available at the current resolution of the CRCM.

Selected Recommendations

A higher resolution model of regional climate is needed and a new 15 km *Pacific Grid* has been defined for performing additional computations. Finally, the results of this project on Climate Model Diagnostics will be compared to the traditional methods of hydrologic modelling, culminating in a synthesis report to be published later in 2010.

Acknowledgements

Dr. Daniel Caya contributed to the design of this project and Dr. Biljana Music of Ouranos and Dr. Marco Braun, UQAM, analyzed the model output. Arelia Werner and Katrina Bennett of PCIC's Hydrologic Impacts group provided advice and defined the target watersheds examined in the project.



In Pacific North America, several major watersheds have their source in the mountains of British Columbia and cross provincial and international boundaries. For comparison, the watershed of the Great Lakes Basin is also shown.

OURANOS

Consortium Member Since: 2006

PAC Member: Daniel Caya, Director of Climate Science

The Montréal-based Ouranos Consortium was created in 2001 as a joint initiative between the Québec government, Hydro-Québec and Environment Canada. It brings together 250 scientists and researchers for the purpose of developing climate change knowledge and providing simulation data and climate scenarios required for impact and adaptation studies. Ouranos processes and validates results obtained through hydro-climatic analyses, including model output in support of hydroelectric power generation in Canada.

Ouranos is a valuable source of scientific expertise for PCIC as well as a supplier of regional climate model projections. PCIC offers helpful feedback on the quality of this output as a user of Ouranos products. In recognition of the mutual benefits of this partnership, PCIC and Ouranos renewed their collaborative agreement in 2008, extending it to 2014. The purpose of this agreement is to apply Ouranos expertise in regional climate modelling to British Columbia and Pacific North America.

Climate Analysis and Monitoring—Projects 2009-2010

SELECTED PROJECTS:

Program Initiation — Climate Analysis and Monitoring (CAM)

SELECTED STAKEHOLDERS:

BC Ministry of Environment, Climate Related Monitoring Program

Program Initiation — Climate Analysis and Monitoring (CAM)

Team: Andres Soux (PCIC)
Ted Weick (BC Ministry of Environment)
Dave Rodenhuis (PCIC)

Project Overview

The objective of this project was to initiate the Climate Analysis and Monitoring (CAM) Theme at PCIC. Once established, the CAM theme will supply climate stakeholders with important historical and near real-time climate data products which can be used to monitor climate variability and change in British Columbia.

The monitoring of historical and current climate data is essential for the development of climate change adaptation and mitigation strategies. However, climate monitoring and analysis in BC are difficult due to the topographically complex terrain and relatively sparse network of observation sites. Accurately monitoring changes in BC climate requires data from Environment Canada and other available meteorological networks in the province. These include specialized operational meteorological data from government and commercial networks. All these data will be used to develop unified climatological datasets.

Results

While the development of the CAM Theme is still at an early stage, a foundation has been laid:

- A proposal for collecting and archiving climate data has been written which includes a plan for the long-term management of these data (both historical and near real-time);
- Historical climate data has already been collected from across the province and is expected to be complete in 2010.

Next Steps

The following tasks are underway or soon to be undertaken:

- Defining an efficient and common format for the disparate climate data already collected from across the province. In addition to deriving the usual benefits from standardization, this activity will aid in the development of Quality Assurance/Quality Control procedures;
- Creating and maintaining a high-resolution gridded climate dataset for all of BC using the Parameter-elevation Regressions on Independent Slopes Model (PRISM) mapping technique developed by researchers at Oregon State University. PRISM technology is ideal for accepting the sparse and irregular data encountered in BC;
- Preparing a Seasonal Climate Review. This review will document and highlight regional climate anomalies and extreme weather events in BC for the previous season. Commentary will place the seasonal climate anomalies in an appropriate context of ongoing climate change.

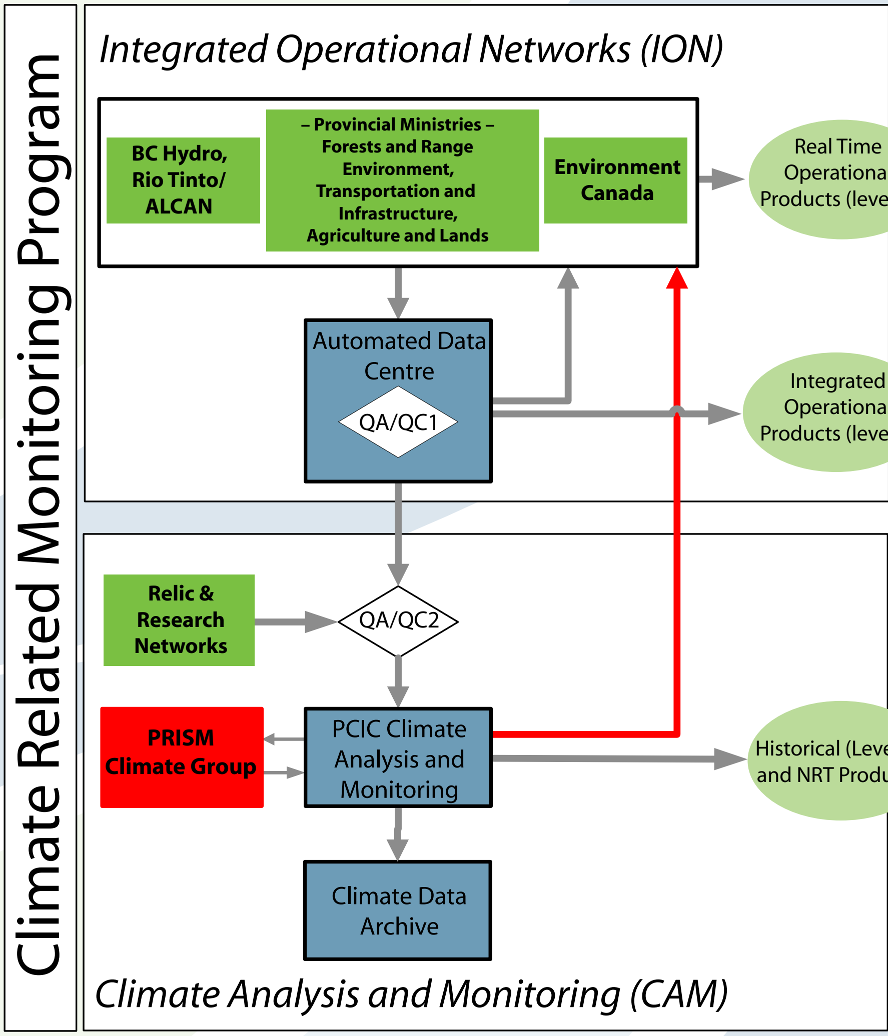


Figure 8 – Flowchart showing the structure and flow of data and information for the CRMP-PCIC collaboration. The CRMP is divided into two components: Integrated Operational Networks (ION) and Climate Analysis and Monitoring (CAM).

BRITISH COLUMBIA
The Best Place on Earth
Ministry of Environment

Climate Related Monitoring Program (CRMP)

The BC Ministry of Environment, along with the BC Ministry of Transportation and Infrastructure, BC Ministry of Forests and Range, and the BC Ministry of Agriculture and Lands are working together with BC Hydro and Rio Tinto Alcan to make long-term meteorological data available for professional users involved in climate change analysis and adaptation.

The BC Ministry of Environment created the Climate Related Monitoring Program (CRMP) in 2008 with a mandate to foster cooperation between operational networks in the province. The CRMP (Figure 8) is divided up into two components: Integrated Operational Networks (ION) and Climate Analysis and Monitoring (CAM). PCIC is responsible for developing CAM using data provided through ION in addition to historical meteorological data collected from various sites across the province. One of CAM's objectives is to archive climate-related data in BC and ensure that this information is made available to a wide range of users and stakeholders.

Treasurer's Report

Cassbreea Dewis, Treasurer

At the close of the 2009-2010 Fiscal Year PCIC was in a sound financial position according to our audited financial statements.

PCIC management committed a fraction of the revenues of the BC government endowment to base funding and organizational growth, investing in the further development of residential expertise through personnel and subprojects. In 2009-2010 PCIC invested 64% of its expenditures (Figure 9) on personnel, increasing the capacity of its computational support group, as well as hiring the first full-time employee for projects in the Climate Analysis and Monitoring Theme. Funding for collaborative research projects (subprojects on Figure 9) increased to 19% of total expenditures from 15% in the previous fiscal year. The operational expenses of the consortium through this fiscal year equaled approximately $1.5 million.

In addition to endowment funding, other major sources of revenue include ongoing support provided by BC Hydro (13% of gross revenue), the BC Ministry of Environment, and the BC Ministry of Forests and Range (Figure 10). Together, these two provincial ministries provide 17% of PCIC's total annual revenue. Total revenues recorded in the fiscal year balance the expenses at approximately $1.5 million.

Looking ahead, PCIC management was successful at strengthening relationships with BC Hydro and secured a commitment to initiate a new Grant Contribution Agreement to fund the second phase of the Hydrologic Impacts Theme. PCIC will also initiate an agreement with consortium partner Columbia Basin Trust (CBT) to strengthen this relationship into the 2010-2011 Fiscal Year.

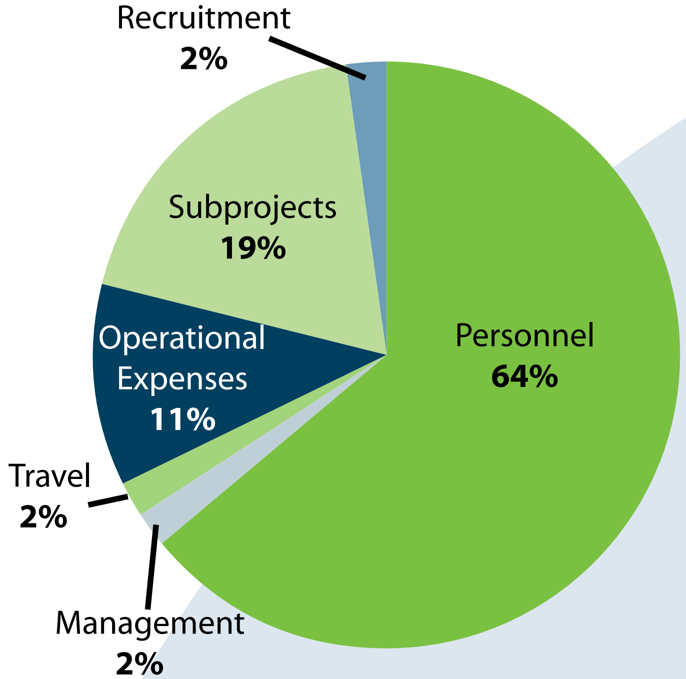


Figure 9 – PCIC expenditures 2009-2010

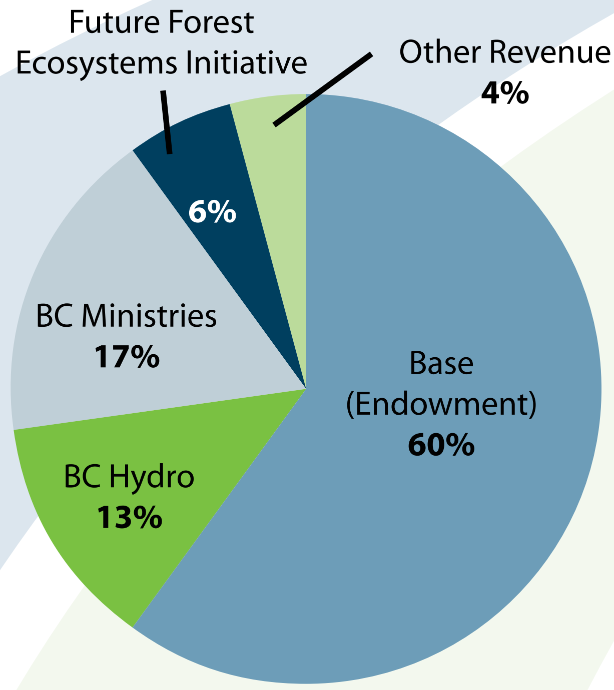


Figure 10 – PCIC revenue by source 2009-2010

PACIFIC CLIMATE IMPACTS CONSORTIUM

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