THE PACIFIC CLIMATE IMPACTS CONSORTIUM - HYDROLOGIC MODELLING PROJECT

Recent accomplishments, challenges, and future directions

Katrina E. Bennett
Markus Schnorbus
Daniel Caya
David R. Rodenhuis

IP3-WC2N, Lake Louise
18 October, 2009
What is PCIC?

- Vision: 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: to **quantify the impacts of climate change and variability on the physical environment in Pacific North America**.
PCIC Hydrology Theme

- BC Hydro driven
- Four projects
  - Climate Overview
  - Hydrologic Modelling
  - Regional Climate Modelling
  - Synthesis
- Study of three major watersheds in British Columbia using the VIC hydrologic model
- 2007 - 2010
CLIMATE OVERVIEW

Winter Precipitation

Winter Mean Temperature (1900-2007) Trend

Winter Precipitation (1900-2007) Trend

Winter Mean Temperature (1951-2007) Trend

Winter Precipitation (1951-2007) Trend

Winter Mean Temperature (1971-2007) Trend

Winter Precipitation (1971-2007) Trend
Hydrologic Modelling - Recent Progress

- Peace River Basin
  - Model calibration and validation
    - Sensitivity analysis
    - Uncertainty analysis
- Campbell River Basin – calibrated/validated
- BC Hydro’s Technical advisory committee for the project
- Columbia River Basin – working on next
Updated Calibration

Initial Calibration

MOBER (MOBER/2009–06–29–1732/10336) net monthly mean inflow (KAF): OBS, OPTI,

MOBER (MOBER/2009–09–17–1021/00699) net monthly mean inflow (KAF): OBS, OPTI,
**Model Validation**

- **Inputs**
  - Forcings
  - Downscaling approach

- **Output**
  - Runoff
  - Snowpack
  - Evapo-transpiration?
  - Soil moisture?
  - Glaciers?
Uncertainty Analysis

Map of the Ingenika River Basin with the Peace at Taylor location highlighted.

Box plot showing runoff data for DJF (December, January, February) with five scenarios: cgA1B, cgA2, cgB1, ecA1B, gfA2, haA1B.
<table>
<thead>
<tr>
<th>Modeling Laboratory (GCM name-version)</th>
<th>Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max Planck Institute for Meteorology (mpi_echam5)</td>
<td>A1B, A2</td>
</tr>
<tr>
<td>Canadian Centre for Climate Modelling and Analysis (cccma_cgcm3)</td>
<td>B1, A1B, A2</td>
</tr>
<tr>
<td>Hadley / United Kingdom Meteorological Office (ukmo_hadcm3)</td>
<td>A1B, A2</td>
</tr>
<tr>
<td>Geophysical Fluid Dynamics Laboratory (gfdl_cm20)</td>
<td>A2, B1</td>
</tr>
<tr>
<td>Commonwealth Scientific and Industrial Research Organization (csiro_3_5_20c)</td>
<td>B1</td>
</tr>
</tbody>
</table>

**Winter (DJF)**

<table>
<thead>
<tr>
<th>Temperature (deg C)</th>
<th>Precipitation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1.5</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>2.5</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>3.5</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>4.5</td>
<td>0</td>
</tr>
</tbody>
</table>

**Summer (JJA)**

<table>
<thead>
<tr>
<th>Temperature Change (deg C)</th>
<th>Precipitation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1.5</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>2.5</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>3.5</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>4.5</td>
<td>0</td>
</tr>
</tbody>
</table>
REGIONAL CLIMATE MODELLING

- Dynamical downscaling
- Running RCM at 15 km
- Zhang (PCIC) + Caya Music, Braun (Ouranos)
DIRECTIONS FOR PCIC

- Hydrologic impacts of changing glacier mass balance
- Improved validation of snow process modelling at regional scales
- Challenges of downscaling to high elevation, poorly monitored watersheds in BC
- April workshop
Additional Materials
**Variable Infiltration Capacity (VIC) Hydrologic Model**

- Macro-scale hydrologic model
- Model runs for 1 grid cell, calculates fluxes
- No horizontal transfer of flow
- Model resolves fluxes at a daily or sub-daily time step
Peace RB (at Taylor)

PEACE AT TAYLOR: 2041-2070, relative to 1961-1990

EVAP

RUNOFF

PRECIPE

SWF