Geophysical Research Abstracts
Vol. 12, EGU2010-5638, 2010
EGU General Assembly 2010

Differences and Sensitivities in Potential Hydrologic Impact of Climate Change to Regional-Scale Athabasca and Fraser River Basins of the Leeward and Windward Sides of the Canadian Rocky Mountains Respectively

Thian Yew Gan (2) and Ernst Kerkhoven (1)

(2) Dept of Civil & Environmental Engineering, University of Alberta, Edmonton, AB T6G 2W2, (1) Alberta Environment and Protection

Sensitivities to the potential impact of Climate Change on the water resources of the Athabasca River Basin (ARB) and Fraser River Basin (FRB) were investigated. The Special Report on Emissions Scenarios (SRES) of IPCC projected by 7 general circulation models (GCM), namely, Japan's CCSRNIES, Canada's CGCM2, Australia's CSIROMk2b, Germany's ECHAM4, the USA's GFDLR30, the UK's HadCM3, and the USA's NCARPCM, driven under four SRES climate scenarios (A1FI, A2, B1, and B2) over three 30-year time periods (2010-2039, 2040-2069, 2070-2100) were used in these studies. The change fields over these three 30-year time periods are assessed with respect to the 1961-1990, 30-year climate normal and based on the 1961-1990 European Community Mid-Weather Forecast (ECMWF) re-analysis data (ERA-40), which were adjusted with respect to the higher resolution GEM forecast archive of Environment Canada, and used to drive the Modified ISBA (MISBA) of Kerkhoven and Gan (2006). In the ARB, the shortened snowfall season and increased sublimation together lead to a decline in the spring snowpack, and mean annual flows are expected to decline with the runoff coefficient dropping by about 8% per oC rise in temperature. Although the wettest scenarios predict mild increases in annual runoff in the first half of the century, all GCM and emission combinations predict large declines by the end of the 21st century with an average change in the annual runoff, mean maximum annual flow and mean minimum annual flow of –21%, –4.4%, and –41%, respectively. The climate scenarios in the FRB present a less clear picture of streamflows in the 21st century. All 18 GCM projections suggest mean annual flows in the FRB should change by $\pm$10% with 8 projections suggesting increases and 10 projecting decreases in the mean annual flow. This stark contrast with the ARB results is due to the FRB's much milder climate. Therefore under SRES scenarios, much of the FRB is projected to become warmer than 0oC for most of the calendar year, resulting in a decline in FRB's characteristic snow fed annual hydrograph response, which also results in a large decline in the average maximum flow rate. Generalized equations relating mean annual runoff, mean annual minimum flows, and mean annual maximum flows to changes in rainfall, snowfall, winter temperature, and summer temperature show that flow rates in both basins are more sensitive to changes in winter than summer temperature.