

American Water Resources Association
2009 SPRING SPECIALTY CONFERENCE
Managing Water Resources Development in a Changing Climate
May 4-6, 2009
Anchorage, AK

Wednesday, May 6

10:30 AM – 12:00 Noon

Session 30: Changing Streamflow and Water Availability

1. Projected River Ice Cover Changes By Mid-Century In Southern British Columbia - Paul Doyle,
Doyle Engineering, Oliver, BC, Canada (co-author: Jephtha Ball)

Global warming has caused winter temperatures in southern British Columbia to steadily rise since 1976. Resulting changes to the ice cover regimes will have an increasing impact on typical river ice behaviour in the region where sporadic significant problems have occurred during the past century. A variety of methods can be used to predict future changes in river ice cover regime. This paper applies one of these methods to predict future changes in several ice cover variables. Ice cover variables investigated include date of first ice, date of last ice, total number of ice cover days, longest duration of continuous ice cover, and a related important variable to the ice cover regime, streamflow. Average values of the 5 ice cover variables recorded at 22 streamgauging sites from the 5 warmest winters in the past 30 years are compared to the average of these same variables for the entire 30 year period. Using future temperature projections in the study region generated from climate modelling, and the measured average temperature differences between the warmest 5 winters in the last 30 years and all 30 winters, it is possible to predict what the average regional ice cover variables will be like in the future up to the range of the warmest winter temperature data measured to date allows. Ice cover data analyses show that in the study region, it is very likely that by mid-century, average values for ice cover variables compared to the averages calculated for the last 30 years will exhibit these changes: (1) the number of ice cover days will be reduced by about 35%, (2) the longest continuous ice cover duration will be reduced by about 40%, (3) the last day of ice cover will be about 3 weeks earlier, and (4) winter discharge will be about 10% larger. The fifth variable, date of initial ice cover, is, intuitively, not well correlated to average temperatures over the 5 winter months which mostly follow initial ice formation and that generally occurs early in winter. Thus, projections of future changes for this variable are done differently.

2. Risk Informed Planning - Hubbard Glacier Dam Induced Flood Near Yakutat Alaska - David Williams,
U.S. Army Corps of Engineers, Elmendorf AFB, AK (co-author: George A Kalli)

The Alaska District of the US Army Corps of Engineers is conducting an unusual planning study related to potential flooding damages that could result from the continued advancement of Hubbard Glacier near Yakutat, Alaska. Hubbard Glacier, the world's largest non-polar tidewater glacier, is threatening to form a glacial dam that would transform 56-kilometer long Russell Fiord into Russell Lake. If the glacial dam proved to be sufficiently stable, Russell Lake would eventually begin draining into the Situk River, dramatically altering its hydrology and negatively impacting its fishery resources which are the economic lifeline of Yakutat. Identification of suitable responses to this threat is complicated by the many uncertainties inherent to it. Uncertainties include long-term glacial advance rates, glacial dam stability, and flood flow quantities, locations, durations, and timing. A risk informed planning process was undertaken to design an effective approach to respond to this potential hazard. This process involved a critical assessment of the uncertainties and risks inherent to the problem and a prioritization of those to be managed. A deterministic scenario analysis approach was utilized to address the critical risks identified. This approach has been the basis of a collaborative decision-making effort to identify and promote adaptive management measures capable of reducing potential damages from this spectacular geological threat. We will present information regarding how risk informed planning was utilized to prioritize responses to this threat, summarize what we have learned to date, and provide status on ongoing efforts.

3. Estimates of mean annual freshwater discharge into the Gulf of Alaska (1960-1990) - Eran Hood,
University of Alaska Southeast, Juneau, AK (co-authors: K. M. Smikrud, E.G. Neal)

Freshwater discharge is a primary driving mechanism of coastal circulation throughout the northern Gulf of Alaska influencing both the chemistry and productivity of the coastal oceanographic environment. We estimate mean annual freshwater discharge into the Gulf of Alaska from Dixon Entrance at the southern end

of Alaska to the west end of the Alaska Peninsula using state-of-the-art maps of mean monthly precipitation for Alaska and adjacent areas of Canada (PRISM maps), produced by Oregon State University's Spatial Climate Analysis Service, USGS stream gage data, a GIS model of the entire GOA drainage basin, and estimates of ice-field volume changes for the period from 1960-1990. Discharge from the five largest contributing rivers was computed directly from stream gage data. The ratio of runoff to precipitation in the remainder of the basin was calibrated using additional stream gage data from smaller rivers in the study area and used to estimate the runoff from smaller ungaged basins. Preliminary estimates yield a mean annual freshwater discharge of 26,000 m³/s, which is a thirteen percent increase from previous estimates. Our results further suggest that while current precipitation maps may resolve some orographic effects on precipitation distribution they underestimate precipitation in the wetter and elevated regions of the study area as evidenced by runoff/precipitation ratios greater than one.

4. Statistical Implications of Global Warming for Water Yield – A Case Study - Qiang (Charles) Luo, University Of Guam, Mangilao, Guam

This study focuses on the statistical analysis of global warming impact on water yield for the Browns River watershed, Vancouver Island, BC, Canada. The global warming trend was obtained by analyzing the 62 years of climate data. Assuming that the trend would sustain at the current level in the coming 50 years, a watershed model was employed to simulate the streamflows for two scenarios, with and without global warming, using the 62-year data. A statistical analysis was conducted using the model output of the same length. Results show that a 4% decrease in annual precipitation and a 1.14 °C (2.04 °F) increase in temperature in the next 50 years may result in an average reduction of 6.6% in annual water yield, and the reduction in percentage increases with drought return period. For a 100-year drought, the annual water yield decreases by 80 mm (3.15 inches) or 8.3%, which is 88% of the annual water supply to the local communities