FORECASTING COQUITLAM RIVER BASIN, BRITISH COLUMBIA

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ABSTRACT

Rain-on-snow events during warm periods with high precipitation amounts can produce high floods. Due to the complexity of the process, predicting run-off during these events is difficult and current conceptual hydrologic models are believed to simulate rain-on-snow events only very poorly. The inability of conceptual hydrologic models to simulate rain-on-snow events correctly may eventually translate into a greater risk adopted into BC Hydro's operations. For this purpose, hydrologic simulations and forecasts of several rain-on-snow events for the coastal Coquitlam watershed, British Columbia, Canada, were selected for analysis. In the first part of this study, the ability of the UBC Watershed Model to simulate Coquitlam Reservoir inflows during rain-on-snow events using observed precipitation and temperature data as model input was investigated using various performance measures. In the second part of this study, performance measures for hydrologic forecasts for the selected rain-on-snow events were calculated and the forecast skill determined. The result of this study shed more light on hydrologic simulations and forecasts of rain-on-snow events in a coastal Pacific Northwest watershed.

INTRODUCTION

To verify the performance of the UBC Watershed model during rain-on-snow events, high flows were chosen for the period 2003-2007. Due to the limitation of forecast data (mostly available during weekdays), day 0 forecast data were used for events that occurred on weekdays and day 1, day 2 forecast data for events that occurred during weekends and holidays.

In this analysis, only the event peak values were picked. For the long term simulation, 2002-2007 record was chosen to simulate the Coquitlam reservoir inflows. The observed precipitation and temperature values used were the UBC Watershed Model index values for Coquitlam reservoir (average of the data from COQ (Coquitlam Lake Forebay) and CQM (Coquitlam R. above the Lake). A long term simulation was done using the UBC Watershed model. (Unadjusted observed precipitation and temperature were used). Events were picked from the graph of the daily flows for the period 2003-2007. Values of the simulated and forecast flows are plotted in Figure 1.

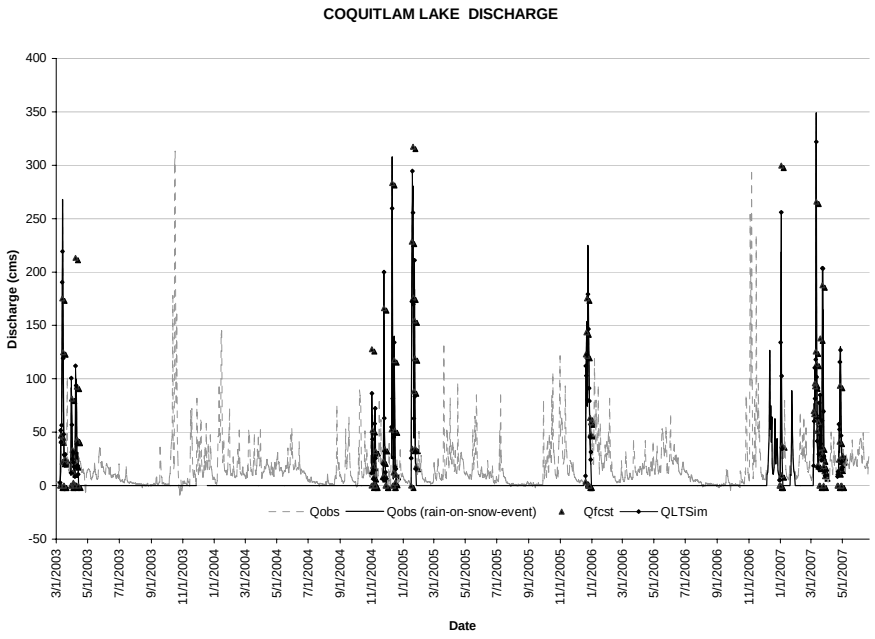

Figure 1. Simulated and forecasted lake discharge, 2003-2007

Paper presented Western Snow Conference 2008

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To determine the rain-on-snow events, events where precipitation > 20mm (Fig 2) and snowmelt > 1 mm (Figure 4), and were picked.

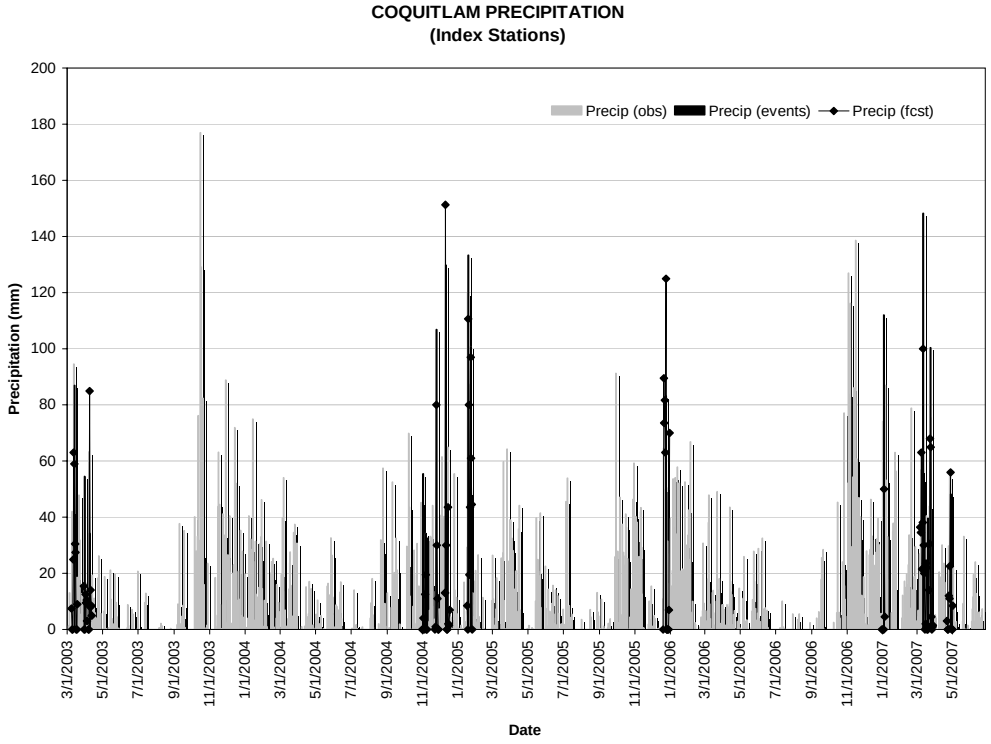

Figure 2. Precipitation at Coquitlam Reservoir

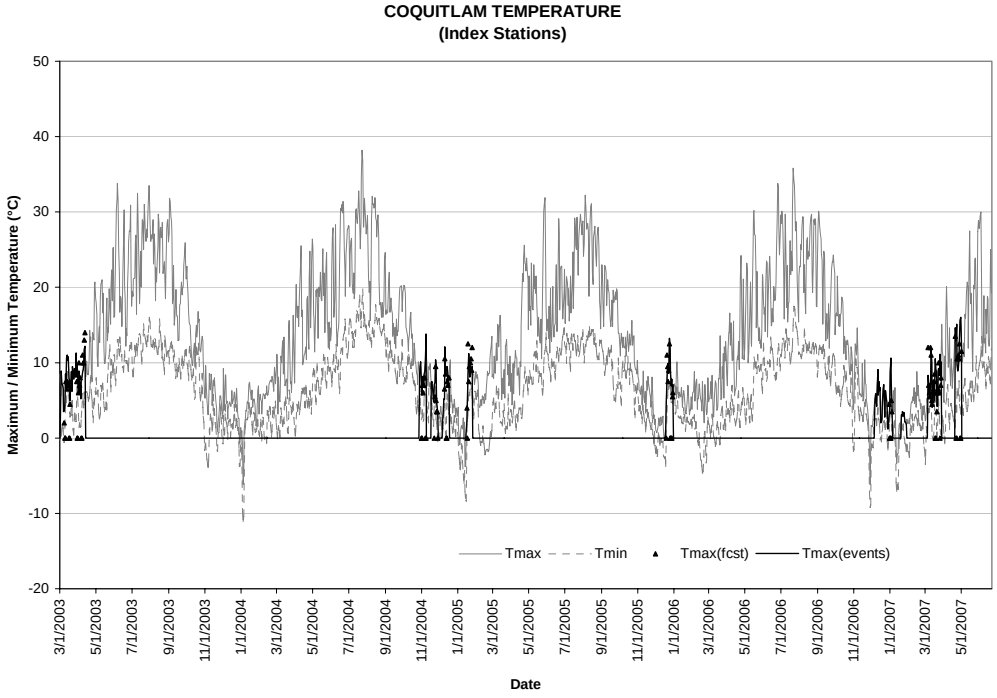

Figure 3. Temperature at Coquitlam Reservoir

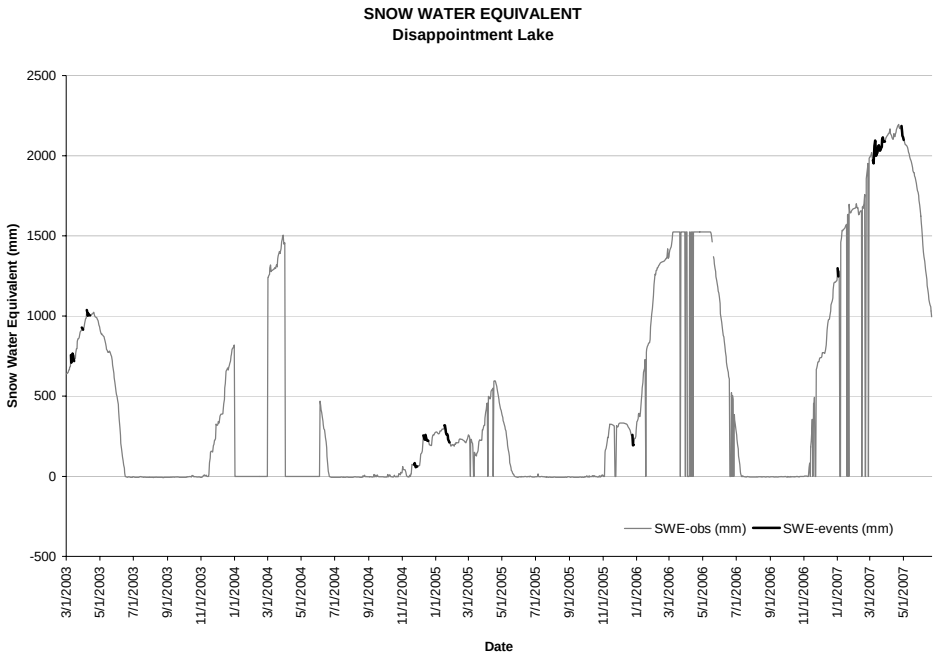

Figure 4. Variations in modeled snow water equivalent at Disappointment Lake

The simulated, forecast and observed values during the peak of the events were used to correlate with the observed peak values. Daily snowmelt was calculated by subtracting the daily observed snow water equivalent value of day 2 from day 1. A negative difference indicates snowmelt while the positive difference indicates snow accumulation.

Table 1

	Q (LTsim)	Q (fcst)	P (fcst)	Tmax (fcst)	Tmin (fcst)
Bias	-4.5	-9.4	-3.8	-0.7	-0.8
Relative Bias	-0.03	-0.06	-0.05	-0.08	-0.12
Mean Squared Error	668.9	1922.6	597.8	4.8	6.3
Variance	648.2	1834.9	583.6	4.3	5.7
Mean Absolute Error	20.0	36.5	21.1	1.7	2.1
Relative Mean Abs Err	0.12	0.23	0.31	0.18	0.35
Slope	0.88	0.91	0.97	0.31	0.23
Intercept	15.60	5.86	-1.41	5.93	3.99

RESULTS

A. Simulated flow vs. Observed Flow

$R^2 = 0.9121$ (Figure 5) shows that there is a high degree of association between the simulated and observed flows during the peak of rain-on-snow events, the simulated flows are under forecast, high values are slightly under simulated, and low values are slightly over simulated (Table 1).

B. Forecast Flow vs. Observed flow

$R^2 = 0.7861$ (Figure 6) shows a high correlation between the forecast and the observed flows. Rain-on-snow events peaks are under forecast with a very good estimate of the high values. Low values are slightly over forecast.

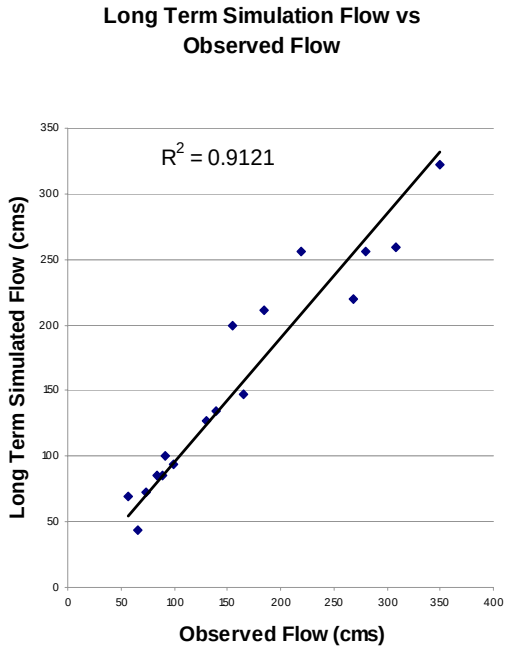

Figure 5.

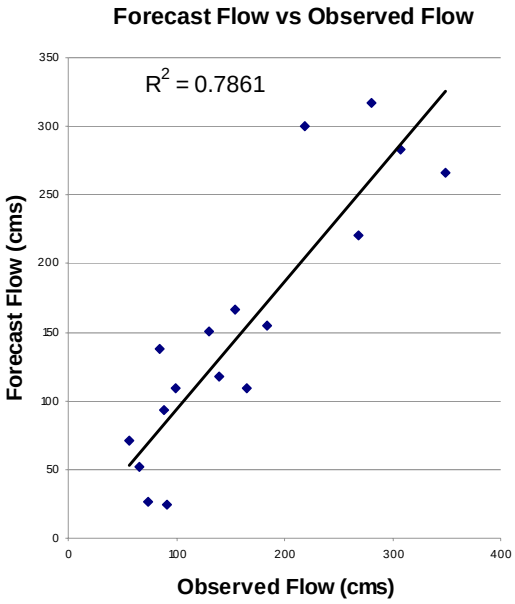

Figure 6.

C. Forecast Precipitation vs. Observed Precipitation:

$R^2 = 0.783$ (Figure 7) shows a good correlation between the forecast and the observed precipitation. Precipitation is under forecast, a good simulation of the high values, though, some values are under predicted at low magnitude.

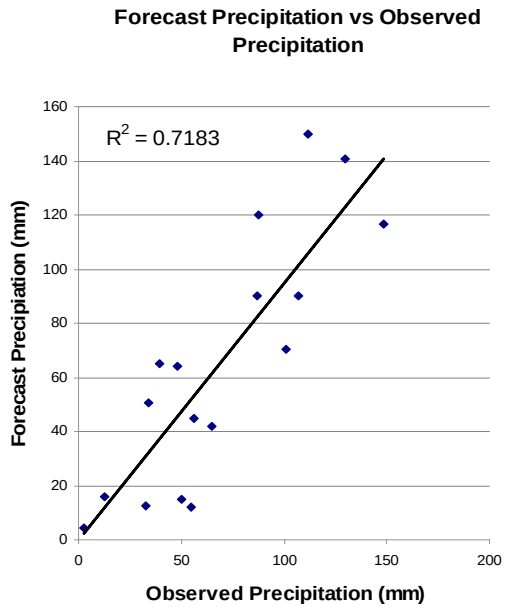

Figure 7.

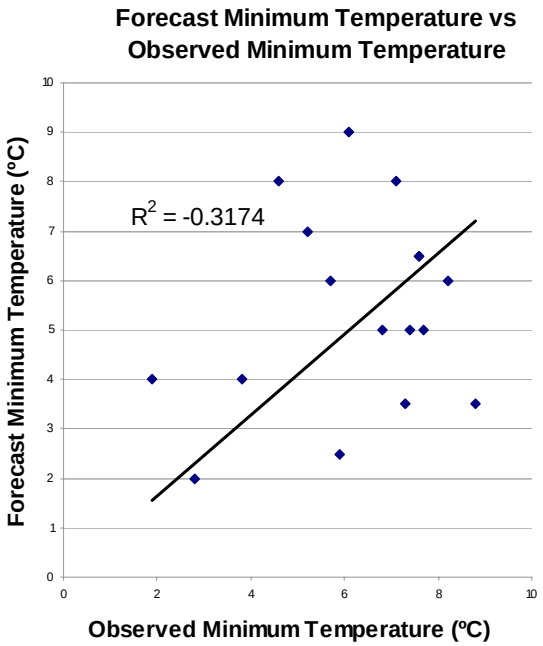

Figure 8.

D. Forecast Max/Min Temperature vs. Observed Max/Min Temperature

There is a poor correlation between the forecast and observed temperatures (Figures 8 and 9). High values are under simulated and low values are slightly over simulated.

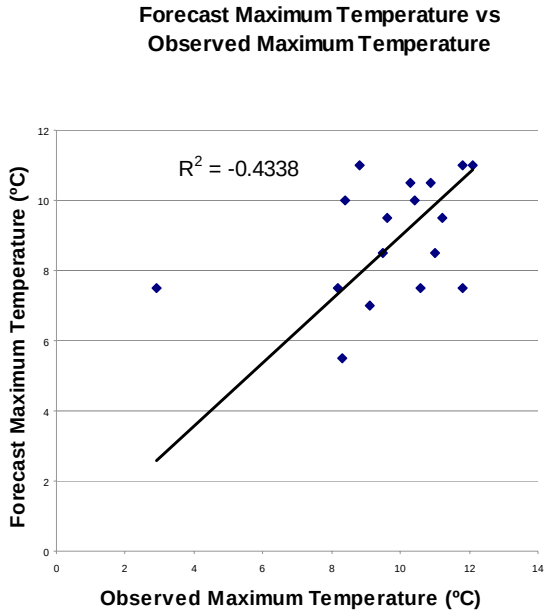

Figure 9.

CONCLUSIONS

The study shows that the forecast accuracy during rain-on-snow events is dependent on the accuracy of the forecast precipitation and temperature. Some adjustments on the input parameter may need to be done by the forecaster to improve the forecast values.

REFERENCES

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