BRITISH COLUMBIA River Forecast Centre

An Improved Temperature-index Snowmelt Model on a Watershed Scale Using an Hourly Time Step for Real-time Flood Forecasting in British Columbia, Canada

Western Snow Conference 2021

April 14 Poster Presentation Room 6

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Model Area: 700,401 (km^2, 74% of BC)

Model stations: 311

Resources: 1 Desktop +2 laptops

Time: 90 mins (9:30am to 11:00am)

We must be very time efficient!

Area (km^2):

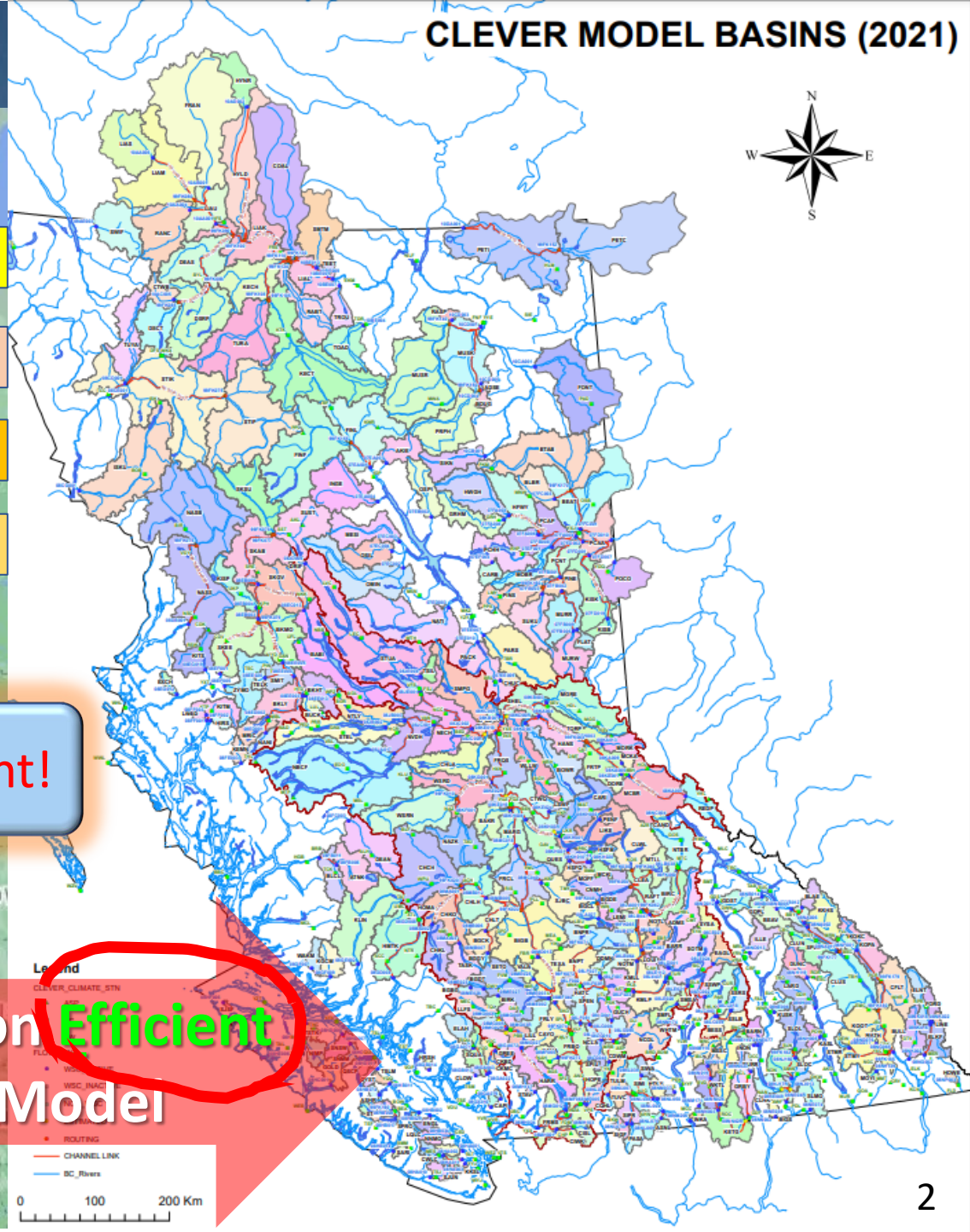
British Columbia: 947,900

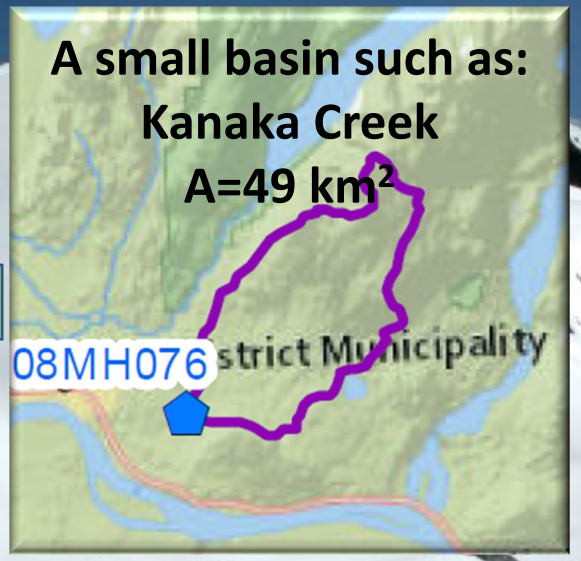
=91% of the following states:

Washington:	184,827
Oregon:	254,806
Idaho:	216,443
Montana:	380,800

Total:	1,036,876

Channel Links Evolution Efficient Routing (CLEVER) Model





Temperature-index method:

$$M = M_f(T_i - T_b)$$

M: snowmelt

M_f: melt factor

T_i: air temperature

T_b: base temperature snow starts to melt

$x=y$

Simple

Time Efficiency

Large portion of radiation absorbed by vegetation for photosynthesis

Hourly time step shorter than time needs for snow to melt as estimated

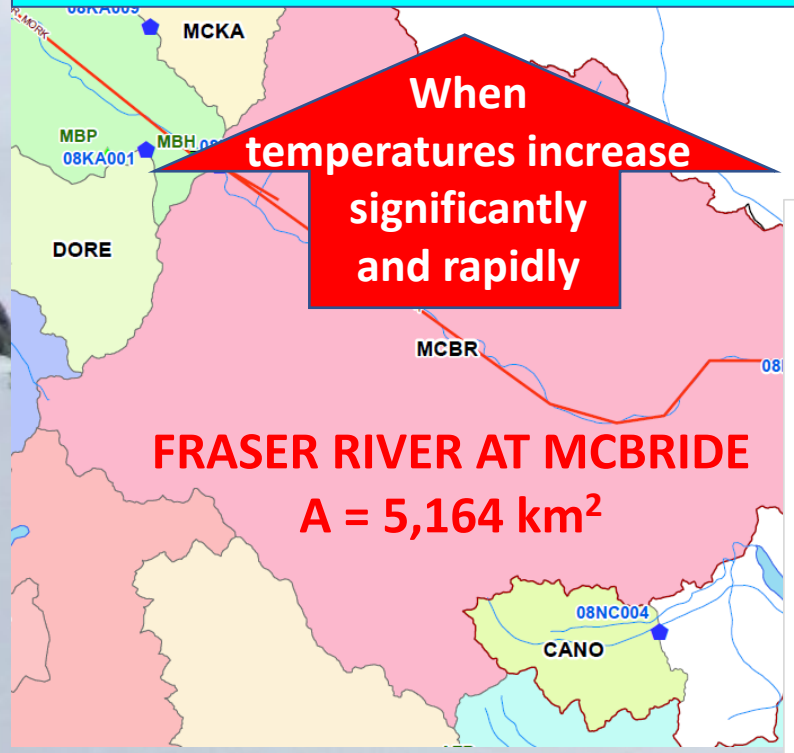
T usually lags and attenuate in daytime

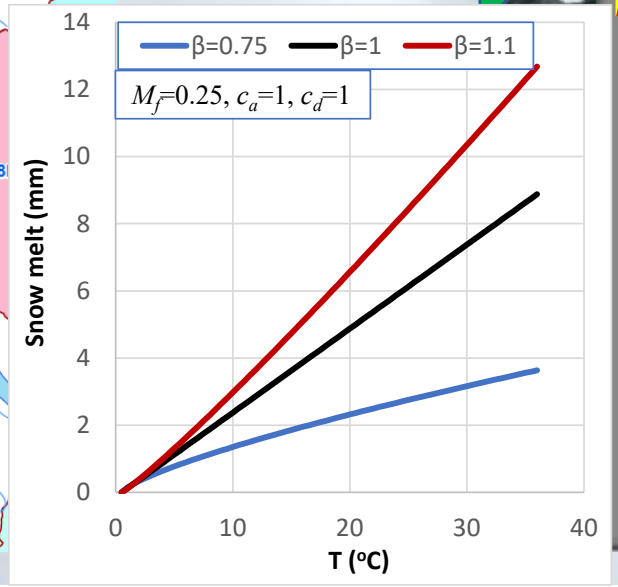
Energy for melt is nonlinear to *T*

Overestimate slope of rise (steeper)

Underestimate slope of rise (flatter)

Improved





Temperature-index on watershed-scale using hourly time step:

$$M = c_a c_d M_f (T_i - T_b)^{\beta}$$

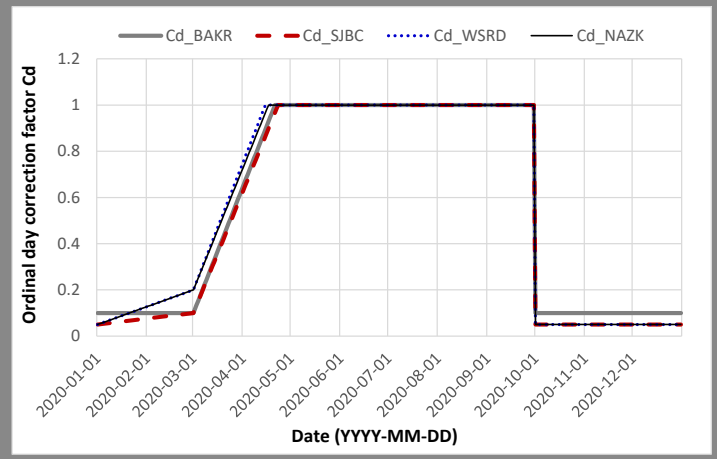
c_a: snow covering correction factor during the snowpack receding period (<=1):

$$c_a = \left(\frac{SWE_i}{SWE_{max}}\right)^{\alpha}$$

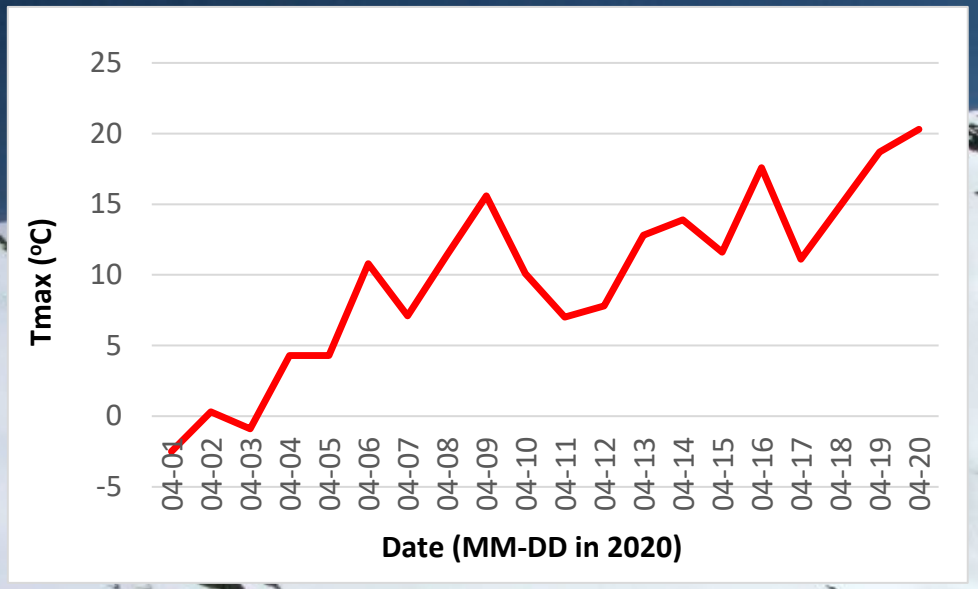
c_d: Ordinal day correction factor (<=1)

α: snowpack covering area receding power

β: temperature power, which could be >,=,<1

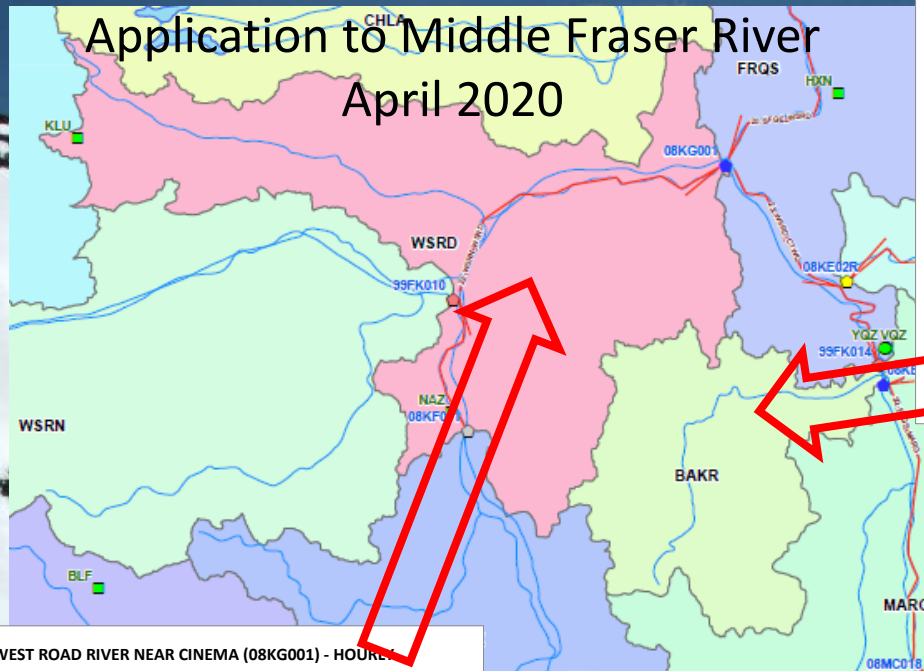


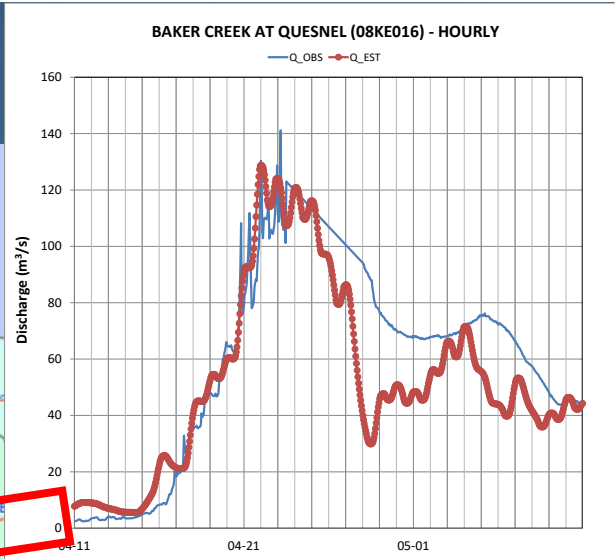
Application to Middle Fraser River
April 2020

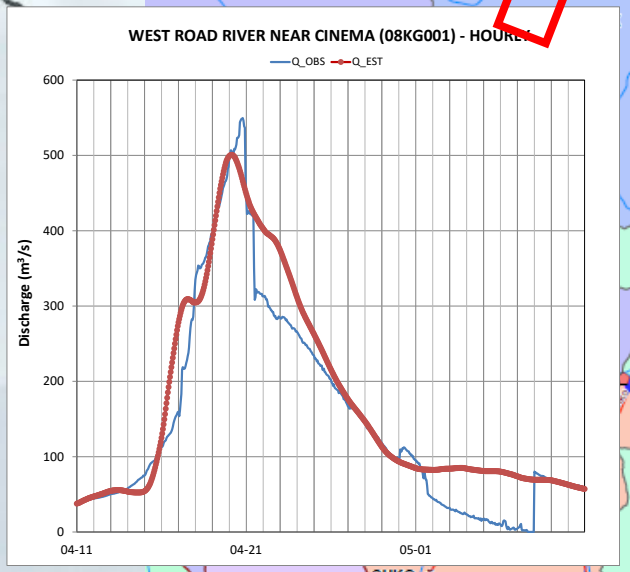


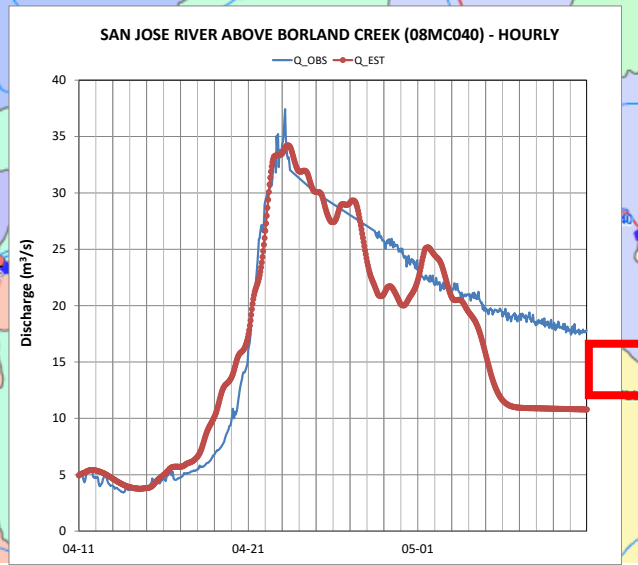
Basin	A (km²)	M_f	α	β
BAKR	1,567	0.33	0.30	0.90
SJBC	2,180	0.10	0.30	1.10
WSRD	12,432	0.35	0.50	0.75

$$M = c_a c_d M_f (T_i - T_b)^{\beta}$$









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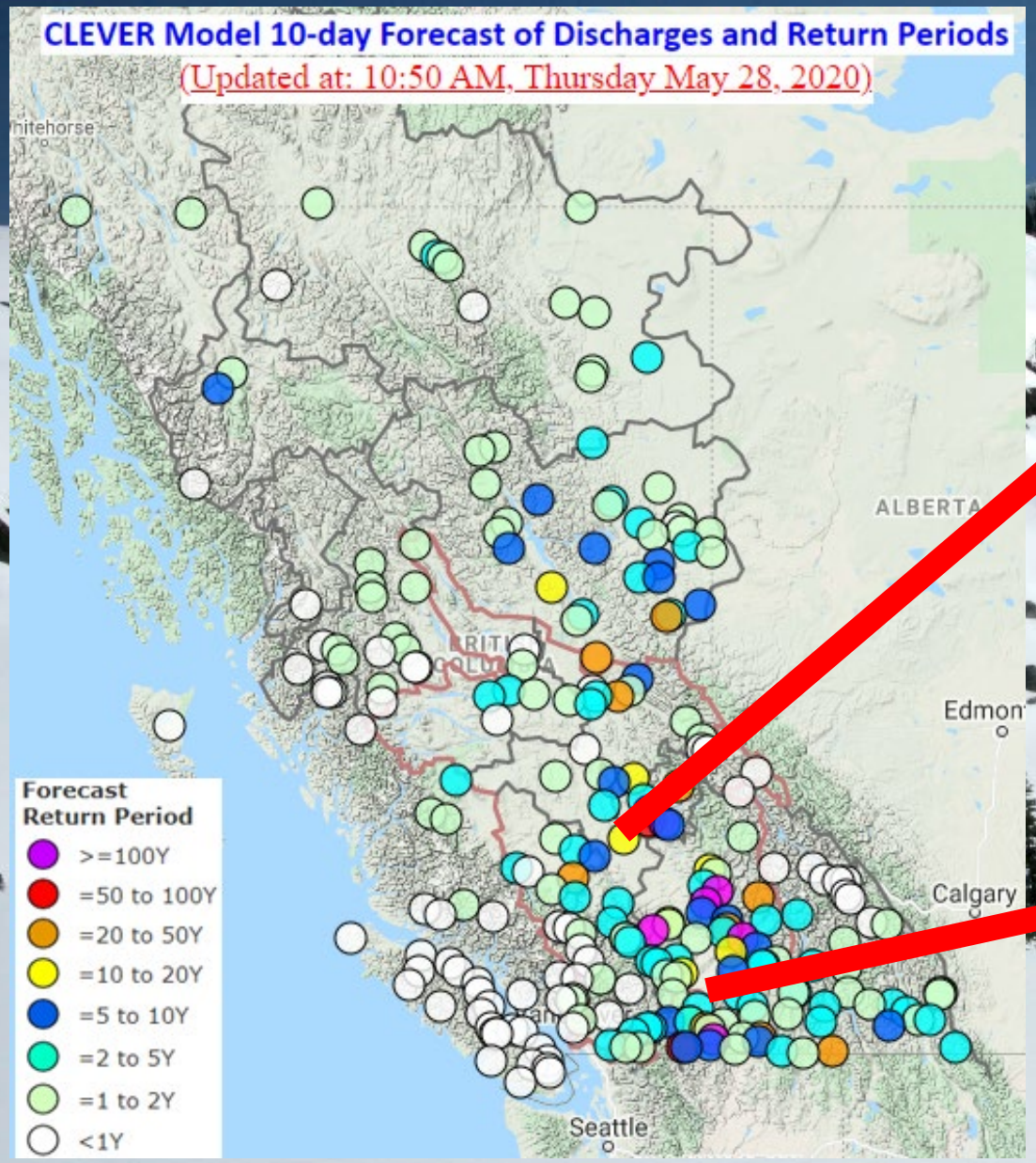

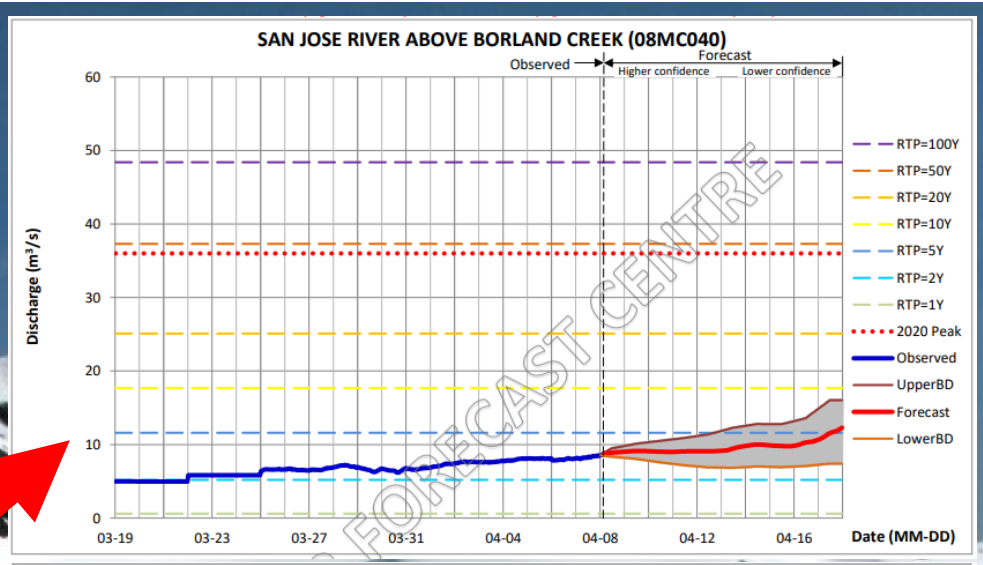

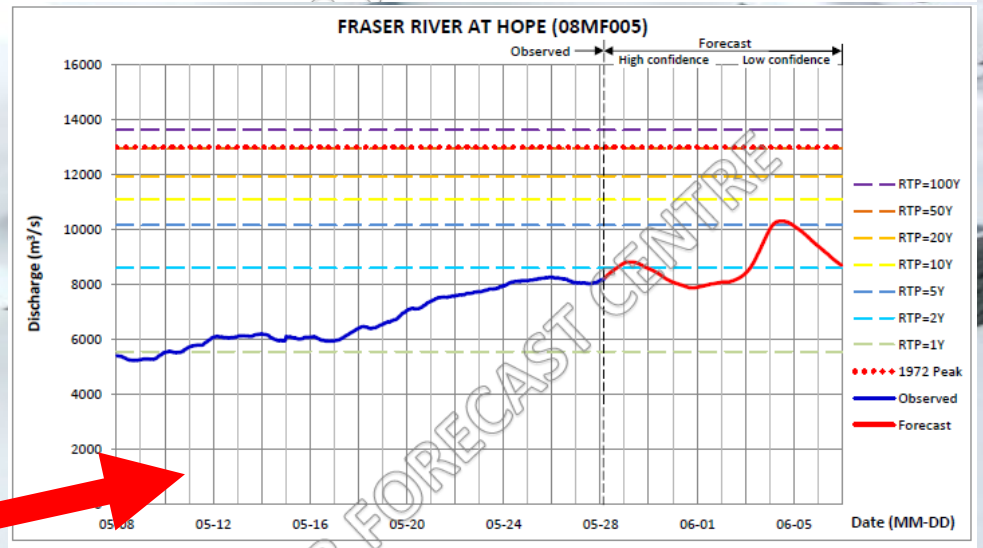

Reading at 05 AM (m^3/s)	Forecast Daily Discharge (m^3/s): MAX / AVERAGE / MIN									
Thu	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat
2020-05-28	2020-05-28	2020-05-29	2020-05-30	2020-05-31	2020-06-01	2020-06-02	2020-06-03	2020-06-04	2020-06-05	2020-06-06
	8783.6	8825.9	8578.0	8085.5	8083.9	8395.4	9960.8	10310.8	10130.7	9394.3
8260.0	**8552.3**	**8753.4**	**8342.3**	**7957.7**	**7999.4**	**8182.6**	**9125.3**	**10241.8**	**9791.9**	**9039.0**
	8289.9	8594.4	8100.1	7882.6	7904.3	8090.7	8430.2	10028.1	9423.7	8706.6

Color Scheme for Return Periods:	RTP=1Y	RTP=2Y	RTP=5Y	RTP=10Y	RTP=20Y	RTP=50Y	RTP=100Y	1972 Peak
	5572.8	8605.7	10163.7	11102.7	11939.8	12938.0	13627.7	13000.0 (m^3/s)

Download CSV file of 10-day hourly forecast for this station.

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CLEVER Model 10-day Forecast of Discharges and Return Periods:
http://bcrfc.env.gov.bc.ca/freshet/map_clever.html