Estimation of rainfall over the Canadian Rockies by approximating the water balance component

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Using observed discharge together with re-analysis rainfall data have resulted in unrealistically high calculated yearly runoff ratios for a number of basins located in the Canadian Rockies. High runoff ratio for a semi-arid region covered partially with forests that actively transpire during summer are hard to explain. Moreover, in some basins, the estimated runoff ratio is more than one, which can have different possible explanations. Among them can be systematic error in discharge measurement, systematic error and uncertainty in rainfall and snow measurement due to spatial variation of precipitation and limited rain gauges, possible glacier retrieve, and etc.

General water balance components for the basins of interest can be written considering precipitation, evaporation and discharge.

$$dS/dt = P - Q - E_a$$

To have a better estimate of precipitation and to reduce our uncertainty regarding the precipitation value, we need to better study the other two fluxes, discharge and evaporation. The storage in the catchment should also be estimated in order to pin the precipitation value as narrow as possible. For estimation of storage, satellite data such as GRACE, observation on glacier retrieval, observation on lake levels can be used. For estimation of evaporation and snow sublimation, remotely sensed evaporation products can be used as well.

A final possible outcome of this study can be a correlation between the inferred precipitation from closing the water balance and the measured precipitation at the rain gauges. This will additionally help the rainfall re-analysis products to follow a similar correlation.