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Interactive comment on "Topography significantly influencing low flows in snow-dominated watersheds" *by* Qiang Li et al.

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In this paper, Li et al. present evidence that certain topographic indices are useful to describe the variability in low flows between watersheds with snow-dominated hydrological regimes in the Southern Interior of British Columbia, Canada. The authors arrive at this conclusion by analyzing 22 different topographic indices and comparing them to flow statistics in the different watersheds. Using factor analysis, half of the original number of topographic indices was found to be non-redundant and together describe more than 90% of the variance in the watersheds. By building multiple regression models of these indices to explain the variability in flow statistics, the authors identified a set of five indices which were especially useful to compare watersheds when low flow assessments are conducted. These topographic indices were perimeter, surface area, openness, terrain characterization index, and slope length factor.

The topic of this study has actually been discussed during recent years of drought where I work in Sweden. Different authorities have been looking for ways to map streams with high risk of drying out during prolonged periods of dry weather. The results of this study add nicely to the already existing knowledge on the subject, i.e., the risk of a stream drying out increases with decreasing catchment area, decreasing winter precipitation, increasing ratio between evapotranspiration and precipitation, absence of lakes and wetlands, and decreasing soil depth. Not all of Sweden has snowmelt-dominated hydrology, so the findings would have to be verified across a wider spectrum of landscapes and climatology, but this would be interesting to pursue in the near future.

The general conclusion that "topographic ruggedness/roughness acts to sustain low flows" warrants further investigation to become practically useful. Earlier studies have indicated that riparian areas play a central role in streamflow generation, and it is difficult to relate this finding directly to the work done in this study. There has also been evidence that, during dry periods, topographic controls on drainage may be surpassed by local (evaporative) controls, making much of the watershed "disconnected" from the hydrologic network. Nevertheless, the study by Li et al. brings up interesting linkages between topography and hydrology not previously explored.

General comments

1. The ratio of annual PET/P (Figure S4 in the supplement) is useful in a broad sense, but the effect of evapotranspiration on the water balance varies greatly between winter and summer. This causes summer precipitation to be "less valuable" to water storage in the catchment compared to winter precipitation. In able to distinguish this, i.e., identifying years with more/less effective precipitation, I recommend that PET/P is analyzed monthly instead of annually.

2. The results of this study are somewhat difficult to translate to practical meaning

as many of the topographic indices can be quite abstract to many readers. In the discussion part of the paper, the authors should consider to supplement the reasoning around the different indices with examples that illustrate what the indices measure in reality, e.g., examples of landscapes with low vs. high index values. This is not absolutely necessary but would stimulate discussions about the findings of the study.

Specific comments

1. Lines 121-122. Each annual flow variable was standardized with annual (P), but flows may be more related to (P-ET) which better describes the effective precipitation.

2. Lines 217-218. Please rephrase "[. . .] are mainly driven by small return periods of precipitation events of relatively short durations".

3. Supplement Table S7-S8. In extreme years (1994 dry, 1996 wet) hardly any of the TIs are significantly correlated to Q90, but almost all are correlated to Q100. Why?

4. Supplement Table S8. Consider changing Q100 to Qmin to avoid confusion with the main text.

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