

Interactive comment on “Interrelationships between MODIS/Terra remotely sensed snow cover and the hydrometeorology of the Quesnel River Basin, British Columbia, Canada” by J. Tong et al.

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p. 3690 How representative is the Quesnel River Basin when compared with other river basins in the region and elsewhere?

Response: The Quesnel River Basin (QRB) is one of the 13 sub-basins in the Fraser River Basin (FRB), BC. The land cover distribution (forests, agriculture, surface water, alpine tundra and glaciers), for the QRB is highly representative of the other sub-basins

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of the FRB landcovers. In fact, the hypsometry of the QRB nearly matches that of central BC. Note that details on the characteristics of the QRB have been presented by Burford et al. (2009).

p. 3692 MOD10A2 non-snow values are not classified as “one type of land use”. Rather, they are classified as non-snow. Other values are possible (see the documentation at http://www.nsidc.colorado.edu/data/docs/daac/modis_v5/mod10a2_modis_terra_snow_8-day_global_500m_grid.gd.html) but land use is not considered in this product.

Response: See the revised text at lines 144-145: “If a pixel has experienced no snow throughout all 8 days, it is then classified as no snow in MOD10A2.”

p. 3700 How does groundwater storage modulate streamflow in the basin? In some regions with highly permeable aquifers this can be a significant influence on runoff. The simplistic discussion of the relationship between snow cover and streamflow mistakenly leads the reader to infer that snowmelt occurs and directly translates into runoff. In fact, the landscape acts as a filter through which snowmelt is transmitted into soils (some of which is then used by vegetation), into shallow groundwater systems (with relatively short residence times), and into deep groundwater systems (which may have residence times on the order of years).

Response: Please see the revised text at lines 476-485: The hydrological cycle is complex, involving processes such as precipitation, surface water runoff, surface infiltration and groundwater storage, and evaporation. Although the terrain of the QRB is not highly permeable, groundwater may have an impact on streamflow of the Quesnel River, particularly during the low flow season (winter). However, the majority of the annual discharge occurs during the spring freshet when the groundwater has much less impacts on discharge (Burford et al., 2009). This paper focuses only on the relationships between surface water storage such as snow and streamflow. Therefore, it is beyond the scope of this study to truly evaluate the groundwater contribution to the

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overall streamflow.”

p. 3702 The regression relationship between temperature and SCF_50% is useful for understanding present-day relationships. However, caution should be used when attempting to use this relationship in a predictive sense for future climate scenarios. For instance, the IPCC AR4 scenarios project an increase in winter precipitation and an increase in winter temperature for this region. As the authors show, the QRB snow cover is highly sensitive to temperature. But this would not necessarily mean a decline in streamflow since with higher amounts of winter precipitation, the high elevations would see an increase in snow water equivalent. Given this same scenario, the lower elevations would likely see a decline in snow water equivalent but an increase in winter rainfall. The hydrograph would then look quite different from what would be predicted. Snow cover extent would change (less at low elevations) but the total snow water equivalent might remain the same or even increase (but it would be because of more snow at higher elevations). Also, a simple 1degC increase in temperature does not account for other meteorological and biological effects that relate to temperature such as higher relative humidity and rates of evaporation/sublimation, earlier onset of photosynthesis (and thus higher spring water use by vegetation), etc. The authors should add some strong and clearly worded caveats to this section of the paper to prevent these results from being misconstrued.

Response: See the revised text at lines 488-493: “In general, climate change will have multiple, nonlinear impacts on snow accumulation and snowmelt runoff. Since the QRB is located in the sub-boreal forest where snowmelt forms the majority of spring runoff, its timing is highly sensitive to air temperature. However, the results should be combined with other climate change scenarios for precipitation, evaporation, and earlier onset of photosynthesis in other areas.”

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 6, 3687, 2009.

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