

Interactive comment on “Reply to D. L. Peters’ comment on “Streamflow input to Lake Athabasca, Canada” by Rasouli et al. (2013)” by K. Rasouli et al.

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‘Complexities in the Lake Athabasca watershed – extending the analyses’

Serving as the water supply for the controversial Athabasca oil-sands projects, the Athabasca River provides an international focus for environmental study. The river drains into Lake Athabasca and another large river, the Peace, also outflows into the extensive and biodiverse Peace-Athabasca Delta (PAD). The Bennett Dam on the Peace River provides a massive hydroelectric project and a third proposed project, the BC Hydro ‘Site C Dam’, has received partial government approval. There are thus scientific,

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conservation and water management interests in the Lake Athabasca system.

Subsequently, Rasouli et al. (2013) undertook analyses of historic river flows and Athabasca Lake levels over the half-century interval from 1960 to 2010. As they emphasize, the time series is complicated not only by the Bennett Dam, but also by other infrastructure intended to sustain the water regime of the PAD. Their analyses revealed progressive decline in river flows and these corresponded with declines in Athabasca Lake levels, an expected outcome.

Following from substantial experience with the Athabasca system, Peters' Comment (2013) recommends a broader perspective in both space and time. He recommends that the dynamic lake outflows should be considered, along with complexities from other lakes linked to the PAD and Lake Athabasca. He advises further consideration for the deliberate changes to the Bennett Dam operations over the study interval and on a longer, millennial time-scale, he recognizes the apparent fluctuation in Athabasca Lake levels evidenced by sediment cores. He thus encourages recognition of the complex nature of the system and advises caution in future projections.

In their Reply, Rasouli et al. (2014) appreciate Peters' Comment but emphasize that their analyses were deliberately limited in time-frame and scope. Following specific recommendations from Peters (2013) they undertook a few follow-up analyses and these largely confirm the patterns of their prior report. They also undertook some exploration to investigate prospective influence from some recent factors, and this did not disturb the primary conclusions. In closing their Reply, they provide a framework of further study that should address some of the unresolved complexities - this is a very worthwhile. The Reply extends the analysis and dialogue, and deserves publication.

Both Peters (2013) and Rasouli et al. (2014) suggest that further analyses could follow from regional hydroclimatic assessments after downscaling from global circulation models. However, this strategy is uncertain, partly since detailed mechanistic analyses are less advanced for boreal regions such as northcentral Canada. Conse-

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quently, for some time, analyses of historic hydroclimatic records will probably provide the most confident strategy for considering trends and near-future prospects for the Lake Athabasca watershed.

Another notable aspect of the Rasouli et al. (2013) analysis was not emphasized by Peters (2013) - the study interval. We know that there are climate alternations that influence precipitation and river flows, and for western North America the Pacific Decadal Oscillation is substantial (PDO, Mantua and Hare, 2002). The PDO signal is reflected in seasonal and annual Athabasca River flows (Rood et al. 2014) and Peters et al. (2013) have recognized this influence. A subsequent problem arises with shorter-term trend analyses since a PDO phase-transition occurred around 1970 and this may provide a stronger hydrologic impact than the gradual influence such as from climate change or due to water withdrawal for oil-sands developments. For Rasouli et al.'s (2013) investigation of the coordination between river flows and Lake Athabasca levels, this complexity is less serious. Conversely, as they and others seek to extend recent historic patterns into the future, the influence of the PDO and other climate patterns should be further explored. This provides another complexity, adding to those already recognized by Rasouli et al. (2013, 2014) and Peters (2014).

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