

Interactive comment on “Invited Perspective: What Lies Beneath a Changing Arctic?” by Jeffrey M. McKenzie et al.

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The article by McKenzie and co-authors provides philosophical view on the main impacts of groundwater in changing climate in three research areas, namely contaminant transport, modification to water resources, and infrastructure in permafrost conditions. The authors perform "screening" of the effects of groundwater on mentioned above research areas and point out the main consequences. The authors point out the factor of groundwater is overlooked in the analysis of those research areas, and conclude that this needs to be taken into account when setting the research agenda. I agree with the authors.

I may suggest to mention the cascading effects of new knowledge which the authors

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suggest to develop (in contaminant transport, modification to water resources, and infrastructure) on sustainable development of societies in the Arctic. Obviously, the new knowledge build on better consideration of groundwater will help to mitigate the climate change impacts, and will make the Arctic societies more resilient. This would be useful to highlight, especially seeing that this article is aiming not only to scientists, but also to the authorities setting the scientific/research agenda.

The comments I provided are aiming to strengthen the article. I did not find critical point in the article, which I would not accept. Please find my comments in attached PDF.

General scientific comment/wish: Line 26 or 35: I am lacking a sentence or paragraph explaining in more details the reasons behind appearance/activation of the phenomena of groundwater for permafrost. I.e., a link which connects groundwater to the atmospheric processes of higher hierarchy – warming of air temperatures, increase of precipitation, changes in snow patterns (more snow > warmer permafrost) and the permafrost thaw.

Specific scientific comment (see comments to #2.3 in PDF). I have got an impression, that thoughts the authors provide in #2.3 present the impacts of groundwater on infrastructure as something, in a way, new and unexpected/overlooked. It is not always the case. Issues with drainage, needs to reroute excess water, flow of groundwater beneath the structures, eventual floorings along the roads, issue with icings – all such issues usually arise from errors in the initial site investigations/design/constriction/maintenance. These issues may be amplified by the climate change, but the design approaches are normally conservative and able to handle the impact of climate change. These points are reflected in my comments.

In lines 83-85 authors point out that "infrastructure designs that typically rely on historical climate information to engineer necessary risk averting measures are becoming increasingly insufficient to keep pace with rapidly changing groundwater conditions". Would it be the case for the methods utilizing downscaled GCM (see for instance,

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(Instanes 2016; Incorporating climate warming scenarios in coastal permafrost engineering design – Case studies from Svalbard and northwest Russia)?

I fully recommend this article to be published in The Cryosphere. Hope my comments will be useful for strengthening the article.

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Please also note the supplement to this comment:

<https://tc.copernicus.org/preprints/tc-2020-132/tc-2020-132-RC2-supplement.pdf>

Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2020-132>, 2020.

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