Author’s response to reviews

Title: Projected local rain events due to climate change and the impacts on waterborne diseases in Vancouver, British Columbia, Canada

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Projected local climate change and its impacts on waterborne diseases in Vancouver, British Columbia, Canada, in the next century [NOTE NEW TITLE BELOW]

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Response to Reviewer:
Thank you for the constructive comments below. We agree in each instance and have made the appropriate changes.

Reviewer #1: This paper estimates changes in risk of cryptosporidium and giardia resulting from changing rainfall patterns due to climate change. The authors find that rainfall patterns are likely to become more extreme over the next century and that this change may lead to increased giardia and cryptosporidium diarrhea. The methodology used to conduct the study appears to be sound and the paper provides a good theoretical framework for investigating similar questions in other contexts. My main comment is that I would like the authors to connect their results to the new filter technology introduced in Vancouver in 2010-2015. Do the authors expect that giardia and cryptosporidium risk will not increase because of this new intervention? Or do they expect the same trends with smaller effect sizes (for example, because the technology was only used in two of the three surface water sources or because the efficacy is suboptimal)? Such information could improve the impact and interest of the paper by helping to clarify how much standard water quality interventions might offset increased risk due to climate change.

In the Discussion at line 240 we have added:
Since 2009 the DWS for Metro Vancouver has had staged increases in the proportion of filtered finished water beginning with the Seymour Reservoir, followed by the connection of the Capilano Reservoir water to Seymour Capiliano filtration plant in 2014. The Coquitlam Reservoir, the third source for system, is unfiltered relying upon ozonation as pre-treatment, UV (added in 2014 to enhance treatment), chlorine and pH control for treatment. Though it varies, usually about half of Metro Vancouver's finished water is filtered (46). We would expect these interventions have reduced the effect size seen between 1997-2009, but because turbidity remains a feature of source water from surface sources, we would expect the relationship between extreme rain events and waterborne disease risk to remain.

I also think that the title should be changed to clarify that the authors are focusing on rainfall changes since they do not consider any other climate covariate and to clarify the focus on cryptosporidium and giardia--the effects on other pathogens might be quite different.

We have changed the title to Projected local rain events due to climate change and the impacts on waterborne diseases in Vancouver, British Columbia, Canada

Apart from that, I have only minor comments:
In general, while the expected increase in cases is not very large, the baseline risk is low. The percent increase (up to about 20%) is in fact quite high. The authors might wish to point out that extreme rain events may cause a more substantial increase in burden in populations where the baseline risk of giardia and cryptosporidium is higher.

In Discussion at line 285 we added: We expect that in areas with higher baseline prevalence of disease the increase burden of disease due to extreme rain events would be further increased.

All minor comments are addressed in the revisions to manuscript and supplement.
Line 75: add a comma after levels
Line 88: add a comma after sediments and another comma after indirectly
Line 100-102: The authors state that the new filter protects against 'turbidity-causing events'---does this
include both the indirect and direct mechanisms by which rain might impact risk described in lines 85-89?

Line 115: 'are' should be 'were'
Line 124: the equation is not easily legible. Please make it bigger.
Line 133: remove 'or'
Line 181: 'The' should not be capitalized
Lines 211-212: The authors may wish to comment that their findings are likely a lower bound since sensitivity<specificity (i.e., if extreme rain events generally increase risk, detecting too few of them would underestimate the impact of climate change on diarrhea)

In Discussion line 287 we added: Additionally, for the precipitation estimates sensitivity is less than specificity, so our disease estimates likely represent a lower-bound of the risk because we are necessarily conservative in the estimate of extreme rain events.
Line 273: remove the comma

Figure S2: please define the abbreviations in the caption

Note that RCP stands for Representative Concentration Pathway.