

## ***Interactive comment on “Development of fragility curves for railway ballast and embankment scour due to overtopping flood flow” by R. Tsubaki et al.***

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We'd like to express our sincere thanks to the referee for carefully reading the manuscript and for being interested in the topic. Comments and suggestions from referee #1 regarding the readability of the manuscript were quite helpful to us when revising the manuscript.

Explanations in the manuscript relating to the geotechnical property and how the overtopping water depth was estimated were short in the original version and will be revised. Here, we'd like to explain why these two points are not critical for this study and why we originally chose to provide limited explanations.

The materials and construction of railway embankments are regulated by construction standards, so the range of geotechnical properties for railways is limited by the stan-

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dards. The presence of upper structures, consisting of a ballast layer and rails and sleepers, on top of an embankment are unique for railway embankments as compared to other earthen embankments. Upper structures remain after a railway embankment has been severely damaged by flooding flows. Ballasts are regularly maintained by railway operator management. In the manuscript, we focused on two, single-track, non-electrified railway embankments with upper structures, and these two could be assumed to be practically uniform. Since this point was not well documented in the original version of the manuscript, and we'd like to add explanation in the revised version.

Overtopping water depth was an input parameter for development of our fragility curves. Understanding the uncertainty of the overtopping water depth was more essential for our work than the method used for its estimation. Therefore, in the original manuscript (lines 263-279) we focused on a quantitative discussion regarding the uncertainty surrounding water level estimates. Based on your comment, we now recognize that our original explanation for the method employed for estimating water depth was too short and will added a description of the method in the revised version.

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[Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., doi:10.5194/nhess-2016-167, 2016.](#)

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