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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Estimating flood damage to railway infrastructure – the case study of the March River flood in 2006 at the Austrian Northern Railway" *by* P. Kellermann et al.

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Response letter to the comments of Anonymous Referee #1

Thank you very much for reviewing our article. Please find below our responses and revisions according to your comments.

Comment 1: Some more discussion is needed on how this method can be applied in larger areas (e.g. considering the whole national railway line).

Response 1: The RAIL model can be applied to estimate flood damage and related costs for larger areas (e.g. the entire railway network) provided the following conditions

are met: 1) the general construction characteristics of the infrastructure must be the same as (or very similar to) the characteristics of the Northern Railway. Accordingly, slab tracks (i.e. high-speed railway lines), for example, are not suitable to be investigated by RAIL since their construction design is significantly different from the design of the Northern railway line and, hence, the derived correlations of flood impact and resulting damage are no longer valid. Different empirical data would be needed to adapt the RAIL model to such types of tracks. 2) The RAIL model was derived from flood impacts caused by rather low flow velocities, i.e. river floods occurring in flat areas. However, around 65% of Austria is located in Alpine areas mainly characterized by high relief energy and steep slopes. In such topography, fluvial natural events often have hydraulic characteristics being significantly different to river flooding, e.g. regarding the flow velocity. Hence, since the RAIL model has not yet been tested for varying flood types, it is assumed that the RAIL model is in a first instance valid for lowland rivers.

The Austrian Federal Railways recently offered the possibility of acquiring a more comprehensive flood damage dataset for larger sections of the railway infrastructure network of Austria. It is planned to apply the RAIL model on the basis of this dataset in a follow-up study in order to estimate flood damage and loss for a larger area. This discussion on possible applications and limitations of the RAIL model will also be included in the revised version of our article.

Comment 2: Discussion should also be done about a possible methodology based on the interaction with the (flood hazard and risk) maps that have been produced in the framework of the implementation of the EU Floods Directive.

Response 2: The flood hazard maps developed in the framework of the EU Floods Directive are not suitable as input data for the RAIL model due to different reasons. First, the flood hazard maps are produced on a spatial scale of 1:25,000. This scale is seen as being not sufficient to provide detailed spatial information on linear structures such as railway lines. Next, the flood hazard maps feature a rather coarse resolution

of water depths, since this information is only provided on the basis of three categories of water depths, i.e. <0.6 m, 0.6 – 1.5 m, and >1.5 m. Using this classification for the flood impact parameter, it is not possible for the RAIL model to determine the resulting structural damage class at affected track segments unambiguously.

The data characteristics mentioned above are seen as arguments not only against the application of the flood hazard maps produced in the framework of the EU Floods Directive for the estimation of flood damages with the RAIL model, but also as arguments against their use for the derivation of a flood damage model for railway infrastructure according to the methodology presented in the study at hand.

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 3, 2629, 2015.