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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Experimental and numerical study on the design of a deposition basin outlet structure at a mountain debris cone" *by* B. Gems et al.

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The present authors' comment, referring to the discussion paper titled "Experimental and numerical study on the design of a deposition basin outlet structure at a mountain debris cone", is aimed at comment of the anonymous referee #2, published on 21 October 2013.

Undoubtedly, specific torrent defence measures can be established not only at the fan apex but also in the upper catchment parts. The authors fully agree with this note, accordingly, the relevant part of the abstract is reformulated in the revised version of

the manuscript.

In general, the mentioned catchment characteristics and the characteristics of bed-load transport under flood discharge conditions result from a topography analysis, from a detailed field survey and an expert judgement done by the Austrian Service for Torrent and Avalanche Control. In the course of this, the expected amount of sediment during a 150 yr flood event is roughly estimated to 100000 m^3. Regarding the transport capacities upstream of the deposition basin on the fan apex, high transport rates or rather supply limited conditions dominate in the canyon reach, whereas further upstream the bed-load transport conditions are more likely transport limited. In chapter 2.1 of the manuscript, the latter is signified with the mentioned channel gradients. Still, it will be more clearly pointed out in the revised manuscript. The maximum capacity of the deposition basin is 18000 m^3 (actual condition) as stated in chapter 2.2.

With regard to the comment on the grain sizes considered within experimental modelling, the minimum grain size in the model was chosen to be 0.5 mm. The limit of 0.5 mm or rather 1.5 cm in prototype scale was set in a manner, that all the sediment smaller than this value is added to the next larger bed-load fraction (0.5 mm – 1.0 mm or rather 1.5 cm – 3.0 cm in prototype scale). With this procedure, any influential scale effects are precluded. Further, with regard to the transport capacities in the experimental model, the model set up can be considered to be on the safe side, as the finest sediment fraction is modelled marginally larger than in prototype conditions.

Concerning the fraction of bed-load under design flood conditions, a constant value of 10 % is estimated for the Larsennbach torrent by the Austrian Service for Torrent and Avalanche Control. This means that, looking for example at the peak of the 150 yr flood event, 55 m^3/s is the total discharge, where the sediment fraction is already included (this is mentioned in chapter 2.1). Accordingly, the peak of the clear water hydrograph, which is illustrated in Fig. 2b as the input hydrograph of the physical scale model, amounts to 49.8 m^3/s. As the numerical model does not consider sediment transport processes, the bed-load fraction is considered as an admission flow to the hydrograph shown in Fig. 2b and, thus, simulations with Q = 55 m^3/s are accomplished. The latter is mentioned in chapter 3.3 of the manuscript.

In chapter 4.1 it is mentioned that the sediment input rates within experimental modelling amount to approximately 5 % of the clear water discharge. Indeed, this differs from the above mentioned conditions with a constant sediment fraction of 10 %. This has a purely practical reason within experimental modelling: The input of material in the physical scale model was done manually. Thereby, 5 % was the maximum fraction, where the allocation and the constant input into the model over the duration of 70 minutes could be reasonably managed. Qualitative tests with higher input rates delivered that at higher rates the additional material was deposited directly at the input location in the upper part of the basin and did not affect the situation at the deposition basin's outlet. This is not yet mentioned in the manuscript, but will be added in the revised manuscript.

Due to Fehr's procedure (1987) allowing for the transfer and conversion from surface characteristics to the characteristics of the bed layer, and due to the uniformity of the sediment inventory in the Larsennbach catchment, surface sampling is expected to be an adaequate and precise analysis method.

The significance of a holistic planning process, fully considering the morphodynamic effects of the torrent defence measures in the downstream reach, is already discussed in connection with the referee comment of Bruno Mazzorana. The authors fully agree that the analysis of the confluence zone is highly important in order to quantify also the effects of the tested design layouts in the receiving water course. Due to the large extent of the lined trench a physical scale model covering both, the deposition basin and the confluence zone, is hardly practicable and the 3-D-hydrodynamic model is not an adaequate tool for simulating the morphodynamic processes in the confluence zone. Within the discussion with Bruno Mazzorana, the authors suggest the application of a 2-D-morphodynamic model (e.g. BASEMENT, HYDRO-GS_2D), covering the lined trench of the Larsennbach torrent and the relevant reach of the Inn River. In addition

to the planned torrent defence works at the Larsennbach torrent, also measures at the Inn River in the confluence zone are intended by the Austrian Service for Torrent and Avalanche Control. They contain a bank revetment resulting in an increased transportation of sediments in the confluence zone. These measures are not mentioned in the manuscript as they were not subject of investigation within experimental modelling, which is legally required only for the optimization of the deposition basin's outlet structure. However, it has to be noted that in order to provide a fully functioning transport within the entire lined trench a further transport of the sediments at the confluence into the river Inn is obligatory. In chapter 5.2 of the revised manuscript, a remark addressing the transport capacities of the Inn River in the confluence zone is added within the context of sediment continuity.

In accordance with the comment on the figures of the manuscript, the figures 2 – 4, 7 and 8 are slightly modified in the revised manuscript. Amongst others, the figures are enlarged and as far as possible oriented in the same perspective view. However, the latter is not useful for the figures 4 and 7, as the design layouts and the results from experimental modelling are in these cases not discernible from the same perspective view. For better orientation, the flow directions are marked in the figures 4 and 7.

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