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Interactive comment on "3D-hydrodynamic modelling of flood impacts on a building and indoor flooding processes" *by* B. Gems et al.

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The present authors' comment, referring to the discussion paper titled "3D-hydrodynamic modelling of flood impacts on a building and indoor flooding processes", is aimed at the comment of anonymous referee #1, published on 19 Feb 2016.

The authors of the manuscript would like to thank the reviewer for the valuable comment. It is addressed, as reported below, to the issues (1) to (4), which are commented by the authors as follows:

(1) No assessment and consideration of on-site measurements or past damages in the case study area and with it no adequate model calibration validation has been accomplished

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According to what is known, no previously occurred flood event at the Rio Vallarsa caused relevant damages in the case study area and on the building which was selected for computational modelling. As stated in section 2.2 of the manuscript, a flood event occurred in November 2012 and the Department of Hydraulic Engineering (Autonomous Province of Bolzano) assume that channel geometry can cope with discharges in the range 30-40 m^3/s before overbank flooding occurs. The data and information from the 2012-event led to an adaptation of the HQ100- and HQ300-discharge design hydrographs and this was also considered in the present work (section 2.2), which is primarily addressed on this design flood (HQ300) conditions (section 2.3, first paragraph). With the available information the computational model was accurately calibrated by adjusting the surface roughness parameters in the channel. As stated in section 2.3 (first paragraph) of the manuscript and already discussed in the work of Hofer (2014), discharges higher than 30 m^3/s exceed the channel capacity in the model which fits well with the available information and expert assessment. In summary, the roughness coefficients are well calibrated in the torrent channel and – since any observation data is not available – set to characteristic values found in literature for the floodplain and the building structure.

Since the aspect of model calibration is also mentioned in the comment of anonymous referee #2, the sections 2.2 and 2.3 of the manuscript will be revised accordingly within the further revision process.

(2) No consideration of uplift processes that potentially (also) damage the considered building

Based on the physics-based vulnerability assessment scheme for buildings exposed to torrential hazards (Figure 2 and introduction-section, both referring to the work of Mazzorana et al. (2014)), the present work means a first step towards this integral assessment concept. It is explicitly addressed on hydrodynamic modelling of building intrusion processes and thereby mainly addressed to analyse the general need and the added value of complex three-dimensional computations compared to con-

ventional two-dimensional flood plain mapping. Any structures in the model (terrain, building walls, etc.) are assumed to be rigid obstacles with a certain surface characteristics. The focus was set primarily mainly on three research questions in the manuscript (section 1, last paragraph): (i) relevance of dynamic clear-water impacts on the building, (ii) delivery of beneficial information for the design of local structural protection measures and (iii) computational possibilities and limits (from a practical rather than a purely scientific perspective) of complex three-dimensional modelling with regard to its application on larger areas (floodplains) with at least a couple of buildings. The authors conclude in the manuscript that an adequate modelling of indoor flooding processes has a rather small influence on the adjacent flow field. Consequently, inundation mapping does not necessarily require a three-dimensional modelling approach. However, for the analysis of local structural protection measures at the building, this modelling approach delivers very valuable information, e.g. (i) points in time and locations of initial indoor flooding, (ii) critical loading conditions, (iii) determination of critical and safe locations inside the building, (iv) information for evacuation planning or (v) efficiency analysis of various options of protection measures. By reflecting the simplifying assumptions of the modelling concept (compared the figure 2 and the contents of the introduction-section) the mentioned modelling benefits and computational effort are discussed in the sections 3.3 and 4.

(3) Missing consequences / benefit for the planning of new buildings

The authors fully agree with the reviewer's note that consequences and benefits for planning new buildings, potentially resulting from the case study analysis at the Rio Vallarsa torrent, are not clearly stated in the conclusions. With regard to the computed impacts and wetting durations on the considered building, it seems not reasonable to transfer computed specific impact loads under design flood conditions to any further objects. The modelling results showed that the computed impacts and the flooding inside the building are significantly influenced by the design flood characteristics (hydrology and if relevant sediment transport processes), the capacity of the torrent channel and

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also by the topography of the adjacent floodplain. As stated already for issue (1), the general knowledge of a reasonable application of three-dimensional models for simulation of indoor flooding processes and, further, its computational limits represent the actual added value of the present case study analysis.

Within the further revision process this aspect is discussed in more detail.

(4) Manuscript language and style

The manuscript is found to be of appropriate language quality, even though no detailed English proofreading has been performed by the reviewer. In this regard the manuscript is again carefully checked within the further revision process.

References

Hofer, T.: 3D-numerische Modellierung der Durch- und Umströmung von Infrastrukturobjekten (Gebäuden). Master thesis, Unit of Hydraulic Engineering, University of Innsbruck, 2014 (in German).

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