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Hydrology and Earth System Sciences
Discussions

Interactive comment on "The June 2013 flood in the Upper Danube basin, and comparisons with the 2002, 1954 and 1899 floods" *by* G. Blöschl et al.

Anonymous Referee #6

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The paper analyses the june flood 2013 from a hydro-meteorological perspective with a focus on causal factors including atmospheric situation, runoff generation, and flood wave propagation. The characteristics of the June flood 2013 are compared to other major flood events from the past namely the 2002, 1954 and 1899 Danube floods. Moreover, an attempt is made to lay out some lessons learnt and to state important implications for hydrological research, in particular design flood estimation, changes in regional floods and flood risk management.

The comprehensive analysis of the June flood 2013 considers atmospheric situations, spatial and temporal precipitation patterns including potential influence of snow

accumlation and snow melt, flood propagation along the Danube and superposition with its main tributaries. Further, statistical analyses of rainfall and runoff at selected sites/gauges are presented. Based on this analysis the main coclusions drawn by the authors are that 1) - on a local level - the 2013 was much less unusual than the 2002 flood, 2) the flood wave propagation along the upper Danube was comparably fast resulting in near peak superposition with the Inn flood wave which caused extreme inundation levels in Passau, 3) particular controls for the magnitude of the 2013 flood are a) relatively high antecedent soil moisture, b) little shift between the flood peaks at the confluence of the Bavarian Danube and the Inn, and c) rainfall blocks close together resulting in a single peak, large volume flood wave with relatively small peak attenuation, and 4) an even more extreme flood seems to be possible from a hydrological perspective if factors of different flood events are combined, e.g. 1899 precipitation with antecedend soil moisture of 2013.

The study is based on comprehensive meteorological and hydrological data which are analysed using methods of extreme value statistics as well as expertise about local conditions and knowledge available from previous research. Reading the paper is very rewarding as it offers intersting insight to both large scale characteristics of relevant factors for floods in this catchment and local particularities. The information, contents and findings from the analysis of the recent major flood are highly relevant and therefore I recommend the paper for publication. Overall, the paper is well structured. However, I think chapter 7 is not linked strong enough to the analysis of the flood events. This section contains rather general statements concerning important issues of current hydrological research and lists flood mitigation measures, their general effects as well as approaches towards flood risk management. Maybe it is suitable to focus on selected aspects (e.g. mitigation measures, operation of hydraulic control structures) and analyse and compare their performance in different flood events to achieve a closer link to the event analysis.

Beyond that I suggest the following minor revisions which could help to improve clarity

and rigour of the paper:

As a general remark, I think it is helpful to always provide the information of the time interval for preicpitation totals mentioned in the text, e.g. 100mm/48h. This makes the comparison of different numbers and between events easier.

Detailed remarks:

Section 3: page 9536, line 23: provide a reference to a detailed description of Rossby waves and its generating mechanisms, e.g. Holton, J.R. (2004) 'An introduction to Dynamic Meteorology, Elsevier, 4th Edition. page 9537, line 8: shortly explain the term 'Vb' and describve its 'way', or provide an appropriate reference.

Section 4: page 9539, line 1 ff.: Soil moisture is an important precursor for the June flood 2013. More details on the spatial extent of high soil moisture and the underlying data base cited are required. It is important to note that the data provided in BfG 2013 refer to a new maximum soil moisture on a specific day of the year (here 31. May) from the period 1962 to 2012. The formulation used in the paper 'for this time of the year' tends to blur this very specific definition. Furthermore, the 31. May is within the period of event precipitation used in the paper (starting on 29 May see line 9). Strictly speaking the information used to describe initial soil moisture is already affected by event precipitation.

page 9539, line 2 ff.: What is the data base for the statement that 'groundwater levels were particularly high'?

page 9539, line 15 ff.: The gauges Lofer, Kössen and Samerberg are located quite close together. To provide a more complete picture provide the amounts of several stations distributed throughout the area under investigation. For better orientation it would be useful to indicate the location of the gauges mentioned in Figure 4.

page 9539, line 22: Provide some information about the regional representativeness of the Weißbach catchment given as an example.

page 9540, line 17: Is it possible to provide quantitative information on snow accumulation and snow melt or to assess whether snow melt is a significant factor for the flood event or not?

page 9541, line 23: What is the reference period for the 'long term average'?

page 9541, line 25: What is the data base used to indicate low groundwater levels?

page 9541, line 28 ff.: The precipitation field shown for the 1899 event is based on manual interpolations. In comparison to the high spatial detail provided by RADAR for the recent flood events the statement concerning the 'spatial extend of precipitation above 200 mm over an area of 1000sqm' has to be evaluated carefully as it depends on the data base and interpolation technique applied.

Section 5: page 9542, line 14: The upper limit of the range of runoff coefficients for the 2013 event given in Table 1 is 0.58 not 0.56 as stated in the text.

page 9542, line 18: Provide the references for average runoff coefficients also in the text, not only in the table caption.

page 9542, line 118 ff.: The runoff coefficient for the 2013 event in St. Johann is 0.5 and for Staudach 0.58 (as given in Table 1), and hence larger than the average. According to this, only Weißbach is below the average, compare also page 9543, line 13 ff.

page 9543, line 13: For which proportion of the area investigated is Weißbach representative?

page 9544, line 4: What does the statement 'where rainfall was most severe' refer to?

page 9544, line 4 ff.: Why are the precipitation amounts for the 1954 and 1899 events not included in the statistical analysis?

It would be interesting to add an analysis and comparison of runoff generation as it is carried out for Weißbach also for a larger region, e.g. for Hofkirchen or Achleiten

catchments.

Section 6: page 9545, line 21: To which floods does 'previous floods' refer?

page 9545, line 24: indicate location of Vils, Naab and Regen in Figure 8 or Figure 1.

page 9546, line 6: Where is Rott? Maybe the sentence ' but a numer of small tributaries ...' can be omitted?

page 9546, line 26: What are the sources for the range of flood levels given? If possible provide references.

page 9547, line 18: 'more rain was available for runoff generation' Is this an absolute statement? Maybe it is more clearly to state that attentuation due to snow accumlation has been less in 2013 than in 1954?

page 9548, line 25: 'those tributaries' which ones are 'those'?

page 9549, line 8: Is it possible to indicate the order of magnitude of retention volume lost?

page 9549, line 10: Water depths in which reservoirs?

page 9549, line 13 ff.: Do the references cited provide any detail for the statements above? Is this sentence really necessary?

page 9549, line 24 ff.: From this sentence it is not clear which peak has been significantly lower at Korneuburg. Proposal: 'While at Kienstock the 2013 flood runoff peak was almost identical to that of 2002, at Korneuburg the 2002 peak was significantly lower.'

page 9550, line 15: What are the differences in the performance of the levees? what are the major differences in hydraulic structure operation? Further details on these issues could provide a basis to more closely linking the statements in Section 7 to the June flood 2013.

Figure 1: Include sub-catchment borders as mentioned in the text and elevation details as in Figure 8. This could improve the orientation for the reader and support the traceability of the system description in Section 2.

Figure 2: The labeling of isolines is hardly readable. Maybe a separate palette is more suitable.

Figure 3: Expand the display detail to provide information also for the atlantic ocean and eastern Europe as it is mentioned in the text.

Figure 7: Include data for 1954 and 1899 event for precipitation and runoff

Figure 8: Add a scale for elevations, indicate the name of the gauge for the different hydrographs and include the peak flow value

Table A1: Change order of gauges according to sequence in the river network

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