

Interactive comment on “Measuring methods for groundwater, surface water and their interactions: a review” by E. Kalbus et al.

Anonymous Referee #1

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General comments

This paper reviews methods to measure interactions of ground and surface waters in the transition zone between these two hydrological bodies. The main emphasis is on methods applicable in the hyporheic zone of streams and rivers, that are hot spots of ground and surface water interactions. The significance of this transition zone in stream and river ecology as well as in water quality is at present clearly recognized. Numerous investigators have recently presented research in this field and it will surely continue to be a field of active investigation. Hence, a review and critical discussion on the methods applicable in this zone is highly important and clearly in the scope of HESS. However, the objective to cover 'in general' the interactions between ground and surface water including hydraulic processes and the contaminant concentration is

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very ambitious for a single paper. The successive listing of methods for groundwater, surface water and transition zone is reason for redundancy and makes it difficult for the readers to find the logical thread of flow. The manuscript addresses many methods and most of them are presented (to) briefly. Some of the methods, in particular the methods applied in ground water, are subject of standard textbooks or existing reviews and will be familiar to most of the readers of HESS. I see the authors point to give a comprehensive but nevertheless clear classification of the multitude of methods available. However, I suggest to condense this, may be in form of a table. These would provide space for 1., detailed descriptions of selected methods that are more specific to the hydraulic exchange in the transition zone and 2., enable expansion of the interesting comparison and discussion of the methods that are 'state of the art'. Further possibility to enhance conciseness and readability of the paper might be to drop the 'grouping of methods with respect to the hydrologic zone' (page 1812, line 26) and restructure the paper (may be along the 2 approaches given in page 1813, lines 1 to 5). Restriction of the focus to hydraulic processes and dropping of the aspects of contaminant concentration may also enhance clarity and readability of the paper.

Specific comments

I suggest to make the title more specific according to the content of the revised manuscript.

Page 1811, second paragraph. The strict separation of gaining reaches and reaches with down-welling of water does not reveal the small scaled spatial heterogeneity of the mixing. I suggest to change 'or' in line 12, page 1811 in 'and'.

The mechanisms that cause mixing of stream and ground water are much more complex than emphasized in paragraph 2 of page 1811 (pumping, sediment mobility, etc.).

Although I agree with the initial statement of paragraph 2, page 1813 'When studying the interactions between groundwater and surface water, the first step is the analysis of regional groundwater flow in relation to topographical characteristics and surface water

bodies', I am uncertain if the very basic hydrological methods must be described here. This should be background of the HESS readers.

Paragraph: 3 Methods applied to the surface water. This is a nice section. May by the authors could specify the title, since 'surface water' covers more than streams and rivers.

Paragraph: 4 Methods applied in the transition zone. This section is most relevant compared to Methods applied in ground and surface water.

Page 1826, line 5. Sentence is redundant I suggest dropping 'If the water level in the piezometer is higher than that of the stream, this indicates groundwater flow into the stream, and vice versa.'

Page 1826, line 8. Find better expression for 'the thickness of the sediment layer where the piezometer is installed'.

Many very short paragraphs - e.g. 4.2.1; 4.3.1. -, could you combine them into larger units.

Paragraphs 4.2.3. and 4.2.4. are partly redundant; page 1827, line 23 to 25, this statement is also valid for slug and bail tests.

Page 1829, first paragraph. This method is limited to fine sediments. I recommend to add this information.

I suggest further elaboration of paragraph 4.4

Page 1831, line 5-7. The seepage meter themselves are also obstacles to flow and hence might induce pumping. I would briefly add this information to the text.

I suggest to drop paragraph 4.6.

Page 1832, first paragraph. I am not sure if this is in the scope of the paper.

Figure 1 is nice. May be other aspects of the many methods could also be condensed

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and presented in similar form.

The discussion seems to start with comparison of the spatial scale of the various methods. I suggest to explicitly point out this in the beginning of the section to clarify the structure of the discussion. If so, I also suggest to move the consideration on the heterogeneity in page 1833, line 20 to page 1834, line 16 to this section of the manuscript.

Page 1833, lines 16 to 19. 'For instance, pressure transducer may.' this is state of the art. I suggest to drop the sentence.

Page 1834, line 18 to 24. This section could complete the part of the introduction that sketches the processes driving forces of surface and ground water mixing at page 1811.

Transient storage, that is despite its problems one of the most applied techniques for hyporheic exchange flows at present, should be mentioned earlier in the paper.

Paragraph 5.3. I assume this the most interesting part of the paper to most readers. Hence, I recommend to elaborate this section.

Figure 2. I assume the dashed line shall symbolize the subsurface transfer of stream water due to the riffle pool morphology of the channel. If so, the arrow should point out of the stream bed at the base of the riffle not in the center of the pool.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 3, 1809, 2006.

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