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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Geophysical methods to support correct water sampling locations for salt dilution gauging" *by* C. Comina et al.

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Following the reviewer requests the paper has been further modified. We attach a marked reviewed paper in order to allow for a direct verification of the implemented comments and an unmarked version for an easier reading. We hope to had satisfied most of the reviewer observations which allowed to improve, in our opinion, the overall quality of the paper.

R: A while back I reviewed a version of this manuscript and thought the science was novel, but the presentation, consistency of terms, accuracy of statements, and attention to detail were lacking.

This revised version is much improved; however, there are still issues.

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Interactive Discussion
Discussion Paper

A point brought up last time was the authors, in the opinion of this reviewer, should show how this technique is used to actually estimate discharge. If this paper is only about presenting a qualitative technique, why imply that this paper is all about better discharge measurements? I still think there needs to be at least some range in possible discharge estimates made with the FERT imaging to better justify use of this method for other researchers or water managers.

A: As stated in several part of the paper we do not think that the technique in his present development could completely substitute local sampling and that there are still some limitations in quantitative estimation. Nevertheless to accomplish the reviewer observation, also expressed in other part of the review, an attempt of a quantitative estimation has been performed and added to the discussion section together with some detailed comments. Hope the reviewer will be satisfied with that.

R: While the imaging is very interesting, I do not see a reason to go through all this trouble if the same qualitative conclusion about mixing can be achieved by simultaneously injecting a dye. Why go through the effort of building this apparatus and make sampling and calculations more complicated if a significant gain in accuracy is not achieved? I think the argument for "sample optimization" is not altogether clear or justified. This seems to be a fancy way to say trail-and-error should be used to select appropriate sampling locations with increased effort and time investment. Although there is a need for improving sampling techniques, dilution gauging is widely used because of its simplicity and efficiency.

A: We do not think that injecting a dye will give the same imaging result and the same imaging quality. A dye can only roughly represent the passage of the plume and is only seen from the water surface. Potentially FERT could provide a more accurate reconstruction. We indeed also made use of a fluorescine tracer but the plume observed from it was not able to evidence the different concentrations along the sampling section except from the left banck area (as discussed in the paper). We do agree that using FERT will involve some more work and that probably the technique is not directly appli-

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cable as is in most of situations, even if building the tomographic section is not such a big effort (almost one hour work). However we see strong potentialities in the method we are proposing and we think that this paper could be an example starting point for a wider use of the technique. We have tried to limit the strength of some phrases ("sampling optimization") to accomplish the reviewer observation. The whole paper is not only based on a trial and error procedure: the FERT imaging in the particular example proposed can suggest the importance of covering the whole section with distributed sampling points in order to obtain a more reliable discharge estimate. The point is indeed not only chose the appropriate section but also place correctly sampling points within it. FERT images can give a clear indication in this respect.

R: Another point I harped on in the last review was that the authors consistently say, “NaCl was used as a tracer.” I pointed out that either Na- or Cl- ions are used as the tracer. It is appropriate to present findings in terms of NaCl concentration, but the authors ignored this subtle, but important detail in this version. If the authors consider this unimportant, please let me know why. Maybe all that is needed is say “NaCl (in ionic form)”.

A: We have consistently changed through the whole paper the notation proposed by the reviewer: “NaCl (in ionic form)” or "ionic NaCl concentration".

R: I had a difficult time getting through the introduction. I feel that there are still too many details provided, which hinders the flow and readability and leaves the reader wondering what the contribution and point of the paper is. For example, there are four large paragraphs in the Introduction dedicated to summarizing dilution gauging. This could easily (and, in my opinion, should be) be reduced into one concise paragraph. The authors reference a series of Moore (2004;2005) papers that summarize methods of dilution gauging, but this does not seem to be the main focus of this paper. Simply summarizing the method with a few sentences and then providing references would suffice.

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A: The introduction section has been strongly modified and shortened following all of the reviewer suggestions.

R: I felt the discussion was rather weak. It is currently a summary of what was done and does little to show how this paper fits into other works or makes a significant contribution. There should be a least a few citations in the discussion.

A: The discussion section has been modified and several comments have been added following also the previous reviewer observation in respect to the lack of quantitative estimations with FERT. No citations have been however added, we would prefer to focus on the observed result from the paper rather than performing a general discussion.

âĂČ Answer to all specific comments are delineated in the folowing:

37: improper sentence structure and use of commas. Discharge measurements are not a traditional technique. Suggest “Salt dilution gauging is a traditional technique.”

The sentence has been modified.

38-39: complete mixing of dissolved salt, delete “is required for reliable measurements”, not necessary and misleading because you don’t actually show how they are reliable.

The sentence has been modified.

43: suggest “With this imaging, complete mixing can be verified.” Instead of “In this way, . . .”

The sentence has been modified.

45-48: awkward sentence.

The sentence has been modified.

49-50: this sentence is not necessary. Suggest delete and just state that this method provides a three-dimensional image of a dissolve salt plume to better estimate dis-

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charge.

The sentence has been modified.

58-67: I think this paragraph should be reduced into one sentence that is specifically related to your study or deleted. Defining discharge is not necessary as it is obvious to the reader. Also, you refer to discharge as an “environmental variable” and a “useful parameter”. Which one is it? There is a difference between the two mathematically. By being inconsistent with descriptions and making blanketed statementsâĂŤespecially in the opening paragraphâĂŤit is difficult to understand what the paper is about and even cause you to be misleading. I also think the Moore reference is inappropriate here as their study had nothing to do with habitat diversity and rates of nutrient export. Although a table is presented in this reference that shows some ecological considerations, this is a summary of many works.

The whole paragraph has been shortened in few introductory sentences. Moore reference and the questioned definition of discharge have been deleted.

72: Why do you use the Moore (2004) reference here? Dilution gauging was not developed by Moore as this reference is a summary of decades of work. For a more thoughtful reference, I think you should use Rantz (1982) here.

The reference has been changed.

73-74: here you say “ion concentration”âĂŤwhich is correctâĂŤbut then say NaCl is used as a tracer throughout. Plus, EC is not the only surrogate used. Others have used fluorescent dye to perform dilution gauging. Maybe say “for example” EC is used.

The sentence has been modified.

75: “average” do you mean aggregated over distance? Averaged over time?

The sentence has been modified.

76: Why in some places do you say “the dilution gauging” and “dilution gauging” in

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others? Suggest “dilution gauging” throughout and drop the article.

The term has been uniformed through the whole paper.

80: Again, NaCl itself is not used as a tracer. Either Na+ or Cl- is.

The use of NaCl (in ionic form) has been uniformed through the whole paper.

86: I thought Gooseff and McGlynn (2005) did not use NaCl as a tracer. They used Br- as a tracer and measured background Cl- (natural). Please revise.

The reference has been removed.

89: especially and almost exclusively used for low flows.

The sentence has been modified.

90-91: Based on other references, I’m not sure if this is true. If transient storage residence times are larger than the tracer window of detection (the elasped time from tracer first arrival to last detection), then transient storage can have significant effects on a solute breakthrough curve because some tracer mass will not be detected. See Harvey JW, Wagner BJ, Bencala KE. 1996. Evaluating the reliability of the stream tracer approach to characterize stream-subsurface water exchange. Water Resources Research 32(8): 2441–2451. Schmadel NM, Neilson BT, Kasahara, T. 2014. Deducing the spatial variability of exchange within a longitudinal channel water balance. Hydrological Processes 28: 3088-3103. Wondzell SM. 2006. Effect of morphology and discharge on hyporheic exchange flows in two small streams in the Cascade Mountains of Oregon, USA. Hydrological Processes 20: 267–287.

The sentence has been deleted.

106: Great. This is the crux of the problem that you are testing.

Thank you.

107-108: is another assumption that there is not significant inflow or gains (e.g.,

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groundwater discharge)?

Yes, the sentence has been modified

128: in what "respect". Suggest "...be applied be applied to test mixing." This is specific.

The sentence has been modified.

137: is this detail necessary to support your study. I find that the amount of details used are creating tangents and causing the point of this paper to be lost.

We think these details are important since previous application of ERT in monitoring water flows has been performed, to our knowledge, under different boundary conditions in respect to the position of the electrodes of the one we use in our approach. Therefore underlining this difference is important: placing electrodes on one boundary only allow for a wider applicability of the technique at the expenses of model resolution which must be addressed.

149-151: you lost me here. Why is this an important statement? What does "quite large" and "quantitative evaluations" mean? Is there a simpler and more concise way to say this?

The sentence has been deleted since, indeed, in this position of the paper could be misunderstood. This specific observation is more detailed in the discussion section.

152: Why "therefore"? Please just state your objective. "Therefore" could refer back to many things previously covered.

Deleted.

156: delete "in this respect", not necessary and adds confusion.

Deleted.

158: in several places throughout the Intro, you say things like "in this case" and "in

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this respect" and it is not clear what "this (or these)" is referring to or what is meant by "respect".

Most of the terms "in this case" and "in this respect" have been detected through the intro.

173-178: "approximately" is used 4 times, which hinders the readability and flow.

Most of "approximately" have been deleted.

181: "can be", just say it is considered turbulent but placid

The sentence has been modified.

182: the Moore and Jaramillo references are redundant. Just say the estimated mixing length is 50 m.

Given the fact that very different estimated mixing length can be obtained depending on the adopted formulation (as suggested also by a previous reviewer of the paper) we think it is important to leave the references we made use of.

191: comma after "sections"...and why is this information important?

The sentence has been deleted.

193-201: Improper use of punctuation. For example, colons within colons and hyphens. I appreciate the conciseness, but I think it would be best to provide an enumerated list. I also think this should be part the of the study area section and not its own section.

All comments have been accomplished.

203: NaCl as the "tracer" is not physically correct. Maybe say in ionized form?

The use of NaCl (in ionic form) has been uniformed through the whole paper.

226: in what "way"?

We were referring to the previous phrase. The sentence has been modified.

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284: “clear water” quoted from where? Be specific and say the image without artificial tracer.

The sentence has been modified.

299: The data and not “interpreted”. Right? This suggests that these are based on your own interpretation. Concentration was estimated by relating to conductivity in Figure 3?

Yes. This is indeed only a transformation. The sentence has been modified.

300: 3D interpolation or averaging? Right?

The sentence has been modified.

323: suggest delete “As mentioned in the introduction,” from this sentence.

The sentence has been deleted.

328-352: improper punctuation. . .maybe instead of hyphens, enumerate this list. I think otherwise it is difficult to follow the main points you are trying to get across.

The list has been enumerated.

345” why is “sample” in quotations?

The term has been changed.

357 and Figure 11: I do not follow what “spilling points” means. These are the actual sampling tubes? If so, why not just state that?

Spilling tubes has been corrected in the text and in figure caption.

353-359: this discussion is weak. How do the methods quantitatively compare? You previously state that FERT is only good for qualitative testing, but some sort of quantitative comparison is needed. For me, this does not sell using this FERT method. Simply adding dye to the salt solution would give a similar qualitative conclusion. Right?

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A more quantitative discussion has been added in this section. Adding a dye to the salt will allow only for a qualitative visualization of the plume in its top part and it is not really the same of what we are trying to do with FERT.

Figure 3: I do not see why this is necessary. Plus, the significant figures on the y-axis are not consistent and there are too many significant figures in the intercept, slope, and R2.

Figure 3 has been removed and substituted with comments in the text.

Figures 7 and 8: These are for a snap shot in time, right? If so, it should be stated in the caption or say that these images represent the plume after x time from injection over 30-sec intervals.

The captions have been corrected and an indication of times has been included in the figures. We have also partially modified figure 6 and 10 to uniform the notation. The reference time has been taken arbitrarily and is not from the moment of the real injection.

Figure 10: why not try to estimate discharge from the FERT method? It seems that even though the error would be large, it would give a comparison to direct sampling and be appropriate here.

We have performed that in the new Figure 10.

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/11/C2571/2014/hessd-11-C2571-2014-supplement.zip

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