Review of hess-2014-190
"Geophysical methods to support correct water sampling locations for salt dilution gauging" by C. Comina, M. Lasagna, D.A. De Luca, and L. Sambuelli

General comments:

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.

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. 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.

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)".

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.

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.

Specific comments:

The line numbers are the authors', not the ones automatically generated by hess.

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

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.

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

45-48: awkward sentence.

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 discharge.

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 statements—especially in the opening paragraph—it 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.

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.

73-74: here you say "ion concentration"—which is correct—but 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.

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

76: Why in some places do you say "the dilution gauging" and "dilution gauging" in others? Suggest "dilution gauging" throughout and drop the article.

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

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.

89: especially and almost exclusively used for low flows.

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.

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

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

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

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.

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?

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

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

158: in several places throughout the Intro, you say things like "in this case" and "in this respect" and it is not clear what "this (or these)" is referring to or what is meant by "respect".

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

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

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

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

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.

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

226: in what “way”?

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

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?

300: 3D interpolation or averaging? Right?

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

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.

345” why is “sample” in quotations?

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?

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?

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 R^2.

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.

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.