

## ***Interactive comment on “Does temperature affect the accuracy of vented pressure transducer in fine-scale water level measurement?” by Z. Liu and C. W. Higgins***

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### 1. Reviewer's Comment:

I can see the need for a paper such as this if there has not been significant work done on the influence of temperature on pressure measurements. I find the methodology somewhat confused as I would have relied more on laboratory work to ensure that all of the variables are correctly isolated and that it becomes possible to isolate the causes of temperature variability in pressure readings especially as the found changes differ from sensor to sensor.

C264

The way this paper has been set out there are just too many variables all interacting to come up with an outcome apart from yes temperature does an effect, if you want to know how you remove this then I don't see how you can do this given that you have density changes in the water itself, thermal impacts of venting, thermal impacts of strain gauges, snow and icing, evaporation, atmospheric pressure and so on all interacting at the same time. Some of these can be controlled in the laboratory to just isolate the components of the sensor design that contribute to sensor based inaccuracies due to temperature so I would have focused on this first and then backed this up with field work. The field environment is too complex unless you try and model each component which would be worthwhile and then have an actual versus temperature corrected pressure reading given all of the know variables.

So my issue is that the work doesn't lead to a useful outcome, that is either a better design or a way of correcting for temperature in pressure sensors. The work may also only apply to the brand of sensors tested and so the issue of other sensors remains. It is useful to look at temperature related issues with pressure sensors but I would have liked it to be more strongly linked to an outcome. So if you just wanted to answer the question does temperature impact vented pressure transducers then simple lab experiments would have better demonstrated this and this was done to a point in theory but not really in practice. If you want to ask how can you correct for temperature effects either by design or correction then this paper doesn't help much.

There are some English issues that also need to be addressed, for example line 27 on page 546 and others.

### 2. Authors' response

First of all I would like to take this opportunity to thank the reviewer for providing us with these comments. The idea to develop this paper came from our experiments to monitor surface runoff at field scale. During the experiment I noticed that the ambient temperature has a strong impact on the accuracy of the pressure transducers which

C265

were used to measure the water level change in fine scale. As I looked deeper into the previous publications and studies related to this issue, especially in hydrological research, I found previous report may not necessarily be true. So a laboratory examination was conducted and field observation was discussed in this paper to provide more information and insights.

I agree with the reviewer that there are many factors affecting the performance of the pressure transducer, especially in field deployment. A well controlled laboratory test for each of these factors will certainly be the best way to characterize this problem. This is a very good suggestion and will be my next effort as a continuation to this paper.

I used an off-the-rack water level sensor where the pressure transducer is fixed in a casing and the venting tube with fixed length is attached. Without disassembling it, I can only use the measured water temperature as a surrogate for the actual temperature of the strain gauge itself. For a better calibration, using strain gauge temperature instead of water temperature will be more accurate. Under field conditions, I consider the thermal effect on the strain gauge from all the environmental factors to be a "comprehensive effect" which is reflected in the water temperature. But since this is a submersible type sensor and the strain gauge is directly contacted with water, the water temperature should be a reasonable approximation.

As for the reviewers' comment about whether this paper leads to an useful outcome or not, the authors think there are useful information can be drawn from this study. We provided a way to look at the error induced by the thermal gradient and this can be used to correct the pressure transducer reading if the water temperature is also measured. There are many brands for water level sensors in the market and the sellers likely purchase their strain gauges from multiple source. The point is that if the thermal compensation is done poorly at step one, then the final measurement accuracy will be compromised. We agree with the reviewer that this work may only apply to the brand tested here but the idea and the mathematical deduction performed can be easily adopted for the testing of other brands. Also the problems we reported in the cold

C266

weather field experiment can be avoided in other future studied.

We revised the text where the reviewer indicated. In line 27 at page 546, we deleted "Extra attention needs to be paid to the performance of the transducer as well as the its safety." due to its redundancy.

Please also note the supplement to this comment:

<http://www.geosci-instrum-method-data-syst-discuss.net/4/C264/2015/gid-4-C264-2015-supplement.pdf>

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Interactive comment on Geosci. Instrum. Method. Data Syst. Discuss., 4, 533, 2014.

C267