Response to Anonymous Referee #2

This technical not describes the opportunities, methodological considerations and challenges of applying thermal infrared imagery to map surface saturation. This technique shows great promise to understand the spatiotemporal dynamics of surface saturation and the hydrological processes that induce or are a result of these dynamics. Overall the manuscript is well written and articulates the challenges and opportunities well and is appropriate as a technical note for HESS. I would recommend publication with minor revisions with the main comments and technical edits provided below.

We wish to thank the reviewer for the assessment of the manuscript and for the valuable comments and suggested edits.

Main comments:

1. Overall the manuscript conveys a lot of information, but I struggle with the overall organization. Technical notes obviously are not full research articles, but I would still expect a similar format. Intro/Methodology/Results/Discussion/Conclusions. In this work the methodology, results, and discussion seem to overlap in some cases. There is no specific results section, so the findings are not clear before a discussion section begins rather abruptly. I would suggest the following organization:

1. Introduction 2. Methodology
-in fundamental principles it would be good to see the full equation for how to relate what is seen with TIR to absolute temperature. Will help in the communication of the challenges of this method and why for example emissivity and environmental conditions are important.
-in image acquisition if the various challenges could have their own headings. Ie.Weather conditions, view obstruction, view angle… etc..
-"4. Building saturation maps" is still a lot of methodology. Could it be incorporated in this section?

3. Results/Application examples

4. Discussion

5. Conclusions

As is the combination of methodology, results and discussion throughout makes the article feel muddled and at time repetitive even though the information is all very relevant.

We thank the reviewer for the suggestions on the structure, this is an important point.
The current manuscript combines both review and own experimental work on how to use the TIR methodology (see objectives in the introduction). Thus we think that the organization in the 'classical' way is not the best option.
However, we agree that especially section 4 can be clearly improved in terms of structure and can be disentangled. We will carefully recheck the manuscript for overlaps of methodologies, results, and discussion within the different sections and we will revise the structure of the manuscript to some extent. Mainly, we will integrate section 3 'Application examples' into section 2. Section 4 will be subdivided, but be a stand-alone section. We decided to do this since we have one method review and methodological approach for section 2-3 and section 4 each. In other words, the two parts evaluate and review different aspects of the technology. We hope that our planned restructuring will make this clearer.

2. Generalize. Portions of the article are very specific to the software and camera that were selected for this study. To make this more relevant to a wider audience certain sections could be removed or be made to be more generalized. Ie(Page 5 line33-34, Page 6 line 15-24, and page 7 line 10-19).

We agree that some parts are very specific and we will generalize them in the revised manuscript (see also our reply to the comment of Reviewer #3 on P6, L 13-20). Yet, we think that not all parts can be completely generalized (i.e. P5, L33-34), but that these parts are nonetheless interesting for several camera types / software and thus might be useful for a wider audience.

3. The influence of difference of surface emissivity's were only very briefly mentioned. In TIR, depending on what is in the scene, the differences in emissivity's can be important to the reported temperatures- will have implications for absolute temperature values and gradients across the image. I would expect more of a discussion at least so, even if this article doesn't do it, others can incorporate these important corrections in their own work. An example for this in another paper can be found in: Aubryâ˘A˘RWake,Caroline, et al. "Measuring glacier surface temperatures with groundâ˘AR˘ based thermalinfrared imaging." Geophysical Research Letters 42.20 (2015): 8489-8497.

We will give it more emphasis in a revised form of the manuscript.

Specific comments:

We thank the reviewer for the technical comments and suggestions, we will consider them in a revised form of the manuscript.

Throughout: please use an oxford comma
Page 2. Line 6-10. Unclear sentence structure
Page 2 Line 16. "up to now" -> to date
Page 2 Line 28-35. Paragraph is muddled. Please improve structure
Page 3 Line 1-2: sentence is awkward
Page 3 Line 13: "Yet," remove
Page 3 Line 18: "allow to obtain an areal picture"- please rewrite as this is awkward
Page 3 Line 29-30: please define surface saturation more clearly on its own as this is critical to the entire paper.
Page 4 Line 3-6. Long complex sentence. Breakup. "or" -> "of"
Page 4 Line 7: "as expressed from" -> relative to
Page 5 Line 14: clarify how one can still observe ground temperatures even if there is vegetation.
Page 6 Line 5. Define what image vignetting is in this situation and why it is a challenge
Page 6 Line 29-34: discussion of consistent temperature scale is redundant

Page 7 Line 21-25. Georectification of terrestrial photos has also been extensively worked on by Corrpio and Harer and should be cited here as well as examples:

Härer, S., M. Bernhardt, J. G. Corripio, and K. Schulz. 2013. "PRACTISE – Photo Rectification And ClassificaTIon SoftwarE (V.1.0)." Geoscientific Model Development 6 (3): 837–848. doi:10.5194/gmd-6-837-2013.

Corripio, J. G. 2004. "Snow Surface Albedo Estimation Using Terrestrial Photography."International Journal of Remote Sensing 25 (24): 5705–5729.doi:10.1080/01431160410001709002.

Page 8 Line 2-4. Can the usability of an image be related to any metrics that would be helpful for fieldwork planning? This would be very useful information from a practical fieldwork perspective- help improve fieldwork efficiency.

Sadly we cannot relate this to any metric. The usability depends on the combination of various conditions affecting the image quality as mentioned and explained in section 2.2. In addition, it depends on the intended purpose up to which point an image is useable.
Fieldwork efficiency can be improved by avoiding such unfavourable conditions, but it is unfortunately not possible to predict with certainty if the temperature contrast will be good enough. Thus, in our case it was still a third of images that was not useable.

Page 9 Line 28-29: please clarify as I'm unclear what the 90% means.
Page 12 Line 21. What does the "(non)-" add to this statement. Confusing as is.
Figure 4. The b scene with snow makes me wonder about how much the snow on the ground combined with the low camera angle is obscuring saturated area. Perhaps discuss this as a challenge in the article.

Snow can indeed obscure the saturated area. We mentioned snow as a possible view obstruction (P5, L12), but we will add one or two sentences to further discuss the effect of snow. If the amount of snow is low, the saturated areas mainly stay uncovered (due to a warmer temperature of the water

and thus a fast melting). This is the case for Figure 4b. If the snow cover is thicker, saturated areas will be covered and the snow surface has to be interpreted as the new ground surface.

Figure 7. Please use upper case on first characters of axis labels and put percentage into a unit. “percentage of saturated pixel” is unclear to me. Is this some sort of a cumulative distribution?