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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Technical note: Mapping surface saturation dynamics with thermal infrared imagery" *by* Barbara Glaser et al.

Anonymous Referee #3

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HESS manuscript HESS-2018-334 presents a technical note describing the use of thermal infrared imagery to map surface hydrological saturation. While similar techniques have been previously applied in a limited sense for mapping surface saturation, the manuscript is novel in that it attempts to review and develop best-practice processes for TIR-based saturation mapping. The manuscript is general well-written and thorough and contains a range of good advice. It will therefore be of interest to a broad cross-section of HESS's readership. I have nonetheless included a range of relatively minor comments/suggestions that should be addressed or clarified. Provided the authors are able to make these revisions, I would support its publication in HESS.

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General comments

- Although the article is generally well written and flows very nicely, some sentences and uses of grammar might appear a bit 'clunky' to native English speakers. This is not to say that the quality of the English isn't already very good, but it might nonetheless be worth passing it to a native English speaker for a quick check.

- The 'Building saturation maps' section is quite long and brings up image processing techniques that are already well-established in the remote sensing literature. It can therefore be shortened. It would also benefit from more consistent referencing to existing image processing/ classification/segmentation literature.

- Although I appreciate that it was not the purpose of the MS, it would still be nice to see some validation of the saturation maps. Do you have any 'squishy boot' data that you can present to validate this data? Or soil moisture data or similar? If not, it would nonetheless be nice to add a section (maybe a paragraph of text) detailing a) the importance of thoroughly validating the TIR data and b) potential validation methods.

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Abstract

- Consider adding 1-2 sentences at the start of abstract explaining surface saturation dynamics and their importance

P1 L18: Unclear what you mean by 'intuitive character'. Can you rephrase?

P1 L19: No need for comma after 'methodological principles'.

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Intro

P2 L1: Change 'albeit' to 'despite'.

P2 L9: Change location of 'only': 'Hydrometric measurements ONLY have the potential to monitor. . .'

P2 L18-19: This sentence is factually incorrect - there are numerous examples of research using drones equipped with near infrared cameras to do things like NDVIs. Please delete/re-think this statement.

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Acquisition of TIR images for mapping surface saturation patterns

P4, L20-22: In my experience, it's less the similarity between air and water temperature that makes identification of waterbodies difficult to detect; it's more when the ground surface temperature and water surface temperature are the same. This means that the 'detectability' of surface water using TIR is often a function of time of day (ie. during summer, water will be cooler than land in the morning, but a similar temperature in the late afternoon/early evening). I know that you've alluded to this in lines 22-26, but it might be nice to clarify this point.

P4 L30: Is 'sun memory effects' an accepted term? Consider rephrasing.

P5 L2: Can you elaborate on why cloudy conditions are better? In my experience, TIR seems to produce better data when there are moderate amounts of cloud (not too clear, not too cloudy, eg. high level cirrus clouds), but persistent low level stratus-type cloud cover can cause reflections that are pernicious in TIR imagery.

P6 L1-3: I believe that the explanation for these false 'negative' values is that during clear sky conditions (if the water is sufficiently still), the water acts like a mirror and reflects the clear sky. However, because the emissivity value at the camera will be set to that of water (0.97) and not of air/sky, the resulting temperature value reported by the camera is incorrect. You get similar effects when filming very reflective surface such as aluminium using TIR cameras.

P6 L10: Change 'shades' to 'shadows'.

P6 L29 – P7 L9 and Figure 3, stage 1: I do not like the proposed technique for colour transformation prior to panorama creation. Personally, I feel that these 'colour transfor-

mation' type techniques are sub-optimal, and by converting the images to a simple 8 bit raster, you may lose contrast in the dataset that could be important.

A better way to do it would be to convert the radiometric TIR images to floating-point TIFF files (which preserve 'raw' temperature data), and then create the panorama using these files. This can be done with both of the cameras used in this study (FLIR b425 and T640). Furthermore, if working with videos, it is better to acquire them as .SEQ or .FCF files (essentially sequences of radiometric TIR images) rather than 'conventional' video formats (eg. MP4 files), as these a) preserve temperature data and b) are uncompressed. In my experience, the resulting panoramas are of better quality and have the added benefit of preserving 'real' temperature data.

I do not have a problem with the method you have used, per-se, for the purposes of this manuscript. However, you should not promote this method as the 'best practice' technique for converting TIR images. I would therefore simplify this section of text and Figure 3 to simply say something like 'convert TIR images to a file format that can be used by panorama software'.

P6 L13-20: Similar to the above, the findings here are specific to the panorama software used, and are not necessarily 'best practice'. I would therefore simplify this text, and just talk about the mosaicking process in general terms, rather than talking about the pros/cons of different software packages and using video vs. using still images.

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Application examples

P8 L15-16: How can you be sure that this is groundwater exfiltration? Could it not just be runoff occurring from a terrace above the stream?

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Building saturation maps

- This section is quite long, and a lot of the advantages/disadvantages of the image classification/segmentation approaches are common to all types of single-band imagery (not just TIR data). These approaches are thus well established in the remote sensing literature (see histogram thresholding, segmentation using k-means classification, etc etc), and you probably don't need to go into such detail. You could therefore probably shorten this section by around 50% and just preserve the key findings. It might also be nice to include more references to image processing/segmentation/ classification from the remote sensing literature.

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Discussion

- It would be nice to see some discussion of future work. For example, it would be fairly simple to combine TIR, VIS and NIR data to create multispectral images, thus allowing for advanced image classification procedures to better map connectivity patterns. This would help further improve the quality saturation maps by combining the advantages of these three approaches.

- Furthermore, you could also talk about using new computer vision techniques (eg. deep learning) to improve classification and thus generation of saturation maps from TIR imagery.

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Figures

Figure 3: See my comments about 'best practice' techniques for converting TIR images to formats that can be used with panorama software. Steps 1 and 2 should be revised to reflect these comments.

Figure 4(e): There is something interesting going on in this image, where the surface water temperature appears to change on the left hand side (ie. much warmer than on the right, as evidences by the light/white colour). Do you know what might be causing

this?

Figure 5. It would be nice to see the visible images that accompany these TIR photos to aid interpretation

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