

General Comments:

1. Does the paper address relevant scientific questions within the scope of HESS?  
Yes, the paper presents information that falls within the scope of HESS.
2. Does the paper present novel concepts, ideas, tools, or data?  
Yes, the paper provides new insights into using UAV technology to detect SGD sources and therefore contributes to the scientific body of knowledge.
3. Are substantial conclusions reached?  
The new insights for using UAV technology are an important component of the paper, but many of the conclusions are presented in previously published papers.
4. Are the scientific methods and assumptions valid and clearly outlined?  
The scientific methods are not currently described clearly enough for reproducibility by other scientists in the field. Critical information regarding software packages and even references to portions of the method are missing.
5. Are the results sufficient to support the interpretations and conclusions?  
The results in general support the interpretations and conclusions presented; however, I'm not convinced about the explanation provided for the effects of the area's geology on the observed groundwater discharge patterns.
6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)?  
Absolutely not. I would love to do some of this, but there is not enough detail provided in the text to get me started let alone finish the task. I'm looking forward to seeing the revised and more detailed version of this paper!
7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution?  
The authors have given proper credit to previously published papers. Yechieli et al. 1995 is referenced on page 3, but the citation is missing from the references cited.
8. Does the title clearly reflect the contents of the paper?  
Admittedly, I was confused by the title after reading through the abstract, and I'm still confused by the title after reading through the paper. Do the three minutes of thermal imagery really constitute a continuous temporal scale? Does an image of one beach really constitute a continuous spatial scale?
9. Does the abstract provide a concise and complete summary?  
Yes, the abstract nicely summarizes the material presented in the paper.
10. Is the overall presentation well structured and clear?  
No, there are some structural problems with one sentence paragraphs, mislabeled results, the methods and results were not written in past tense, and several figures were incorrectly referenced.
11. Is the language fluent and precise?  
No, there are numerous language issues. Furthermore, the authors commonly use vague antecedents, (e.g. it, its, ones, this, these), which makes some parts of the paper challenging to read and understand.
12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used?  
E.g is probably overused. Some acronyms, even though common (LWIR) are not defined before their first use.
13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated?

Figure 2 is not necessary and the results can be more succinctly stated. The authors also refer to focused and diffuse SGD spots. It would be really helpful to know where those focused and diffuse SGD spots are located on Figure 1. Furthermore, the authors present spring names, on Figure 1. Do any of the focused SGD spots correspond to these spring names? If so, why not call the spots by their name instead of spot 1, for example. The authors present some water chemistry data, but it seems like the water chemistry is not used as fully as it could be in the manuscript.

14. Are the number and quality of references appropriate?

Yes.

15. Is the amount and quality of supplementary material appropriate?

Yes.

Even though the paper needs major improvements with the written language and would definitely benefit from more detail in the methods section, the paper presents information that very useful.

#### Specific Comments:

##### Abstract:

The use of in-situ in the abstract made me think that you were making in-situ measurements, but such measurements are not adequately presented and used in the paper

Page 1 Line 2 – "...measurements may provide" - not all in situ measurements are made to determine continuous temporal changes as implied by the sentence

##### Introduction:

Page 2 Line 21 – can reference Tamborski papers and Kelly papers

##### Materials and Methods:

Why is there no materials and methods text below the 2 heading on page 3 and then a duplicate heading of 2 Material and Methods on page 7 with lots of text below it that looks more like results? Also, I think Tamborski should be referenced within the section 2 text starting on page 7. In general, the methods section could benefit from more references and better explanation of software packages and processes used.

Section 2.1 is a one sentence paragraph that was lacking in critical information about the study area. At the very least, please add information about the number of known springs in the study area and perhaps the volume of water they discharge. Is there seasonality to the discharge volumes?

Section 2.1.1 the last sentence proposes a connection between groundwater discharge and the maturity of the karst system. It seems like this is the hypothesis that is set out to be tested in the paper, but the authors never come back to this thought in the discussion or conclusion sections.

Section 2.1.2 I don't consider diffuse flow to be onshore springs, but the title of the section says that there are onshore springs. What and were are the onshore springs that are meant to be described in this section? This becomes very important for understand the information presented in section 2.5.

Section 2.1.3 What about ambient warming of shallow areas compared to deeper areas? How do you address this issue? It seems like your data may have been collected at night. If so, say so.

Section 2.2 should be written in past tense

Page 5 Line 1 With data acquisition between what times? Your UAV was airborne between 12:43 and 12:50 AM, but when were the data actually collected. You present fewer minutes of data than advertised here.

Section 2.3 should be written in past tense

Figure 2 is not necessary because the text adequately describes what the authors did

What program did you use to co-register your images?

Section 2.4 should be written in past tense

What software did you use to calculate thermal variance per pixel of the entire frame set?

Why did you choose 150 pixels? I have seen very small-sized focused SGD flows (much smaller than 150 pixels) and very large focused SGD flows.

Page 6 Lines 18-19 I'm confused about using frame 210, which you say is not shown, and then reference the first image in Figure 3 later on in the same sentence. I don't understand what is happening here.

What software did you use to do the morphological closing to clean extracted pattern objects?

Section 2.5 should be written in past tense. What software did you use to do the inverse modelling?

Page 6 Line 26 – you say single SGDs, are these point source or diffuse or both?

What software did you use to do the 9<sup>th</sup> order median filter?

The last sentence of the paragraph is mostly already said and is not necessary.

Section 2 (with text) Does the last sentence of the last paragraph of the section refer to known spring locations? Can these be provided in one of the figures or referenced in the sentence?

Section 3.1 What assumptions did you make to arrive at the statement "we expect here the most pristine patterns representative for each spot"?

Section 3.1.1 does the 1<sup>st</sup> focused SGD spot correspond to one of the springs labeled in Figure 1? If so, please say so in the sentence. Same thing for the 2<sup>nd</sup> and 3<sup>rd</sup> focused SGD spots.

Section 3.1.2 Where are the diffuse SGD spots relative to Figure 1? I don't typically think of diffuse SGD as being a "spot-like" and circular feature; rather, diffuse SGD is typically patchy and spread out over fairly large areas that do not have to be circular features. Perhaps diffuse SGD locations may be better than diffuse SGD spots?

Section 3.2 What does temporally mostly pristine mean? What software was used for the temporal autocorrelation analysis?

Section 3.2.2 Why reference Figure 4 in line 18? Also what does "ones" refer to in line 20 and in line 24?

Section 4.1 Line 15 the 3<sup>rd</sup> SGD spot refers to focused, SGD, correct? If so, why does the very next sentence starting with "This" refer to diffuse SGD? What is "This" referring to? There is an awkward transition here. Also, why reference Figure 4 in a sentence that talks about diffuse SGD?

Section 4.2 would benefit from referencing a figure: The variance image (Figure ?) provides... I'm also not convinced that the higher discharge rates reveal karst conduits (if higher discharge rates is what "it" refers to) close to the shoreline. We know that faults, fractures, paleochannels, and animal burrows can also be conduits of groundwater flow. Just because the area has karst, doesn't mean that karst is the only explanation for the flow patterns. Please justify your assumption of karst conduits more fully. Are you relying on your insitu data? If so, cite it as support in this section.

Section 4.3 Why keep referencing figure 4 throughout this section?

Figure 3 The red writing on the figure is very hard to see and read

Figure 4 If these spots correspond to spring numbers in Figure 1, please add spring numbers here. It seems like you should be able to do a very rough calculation of the volume of water coming from the springs since you know the water column depth and the size of the surface expression of the thermal plume. Do you have estimates for the volume of water issuing from these springs and how does that volume compare to a rough calculation?

Figure 5 should add NTR to middle column so reader is reminded of acronym in text. The read writing in the first column is very hard to read. The caption says red boxes in figure 4, but there are no red boxes in figure 4.

Figure 6 should add NTR to middle column so reader is reminded of acronym in text. What is the third transect pixel? Is that pixel 3 of the transect, closest to shore?

Table 1 are the peak values statistically different than the non-peak values. It would be very beneficial to do a simple statistical analysis to demonstrate significance.

Table 2 is illegible.

#### Technical Corrections:

\*Here is an incomplete list of technical corrections related to the paper.

Page 1 Line 8 – “thus accounts for” is not necessary

Line 9 – “it can provide a continuous spatial reference”

Line 11 – “location while continuously recording thermal”

Line 12 – suggest rearrange sentence to start with “we” part of sentence and end with flight altitude information

Line 19 – “SGD, which”

Lines 25 and 26 – mayor = major

Line 28 – multilevel piezometers

Page 2 Line 7 – “utilized, platforms”

Lines 11-13 – sentence structure issue – I don’t understand what you want to convey

Line 20 – what is “it”?

Line 29 – Awkward to start a paragraph with “However,” just delete “however”

Line 30 – Consequentially = Consequently

Page 3 Line 15 – graben is not capitalized

Page 4 Line 10 – “causing a circular”

Line 20 – SGD, water

Page 5 Line 5 – define LWIR acronym

Line 24 – What is “it”?

Page 6 Lines 3-4 – The last sentence is already stated above and is not necessary

Line 11 – artefacts = artifacts and 150 pixel = 150 pixels

Line 22 pixel = pixels

Line 24 – you say temporal analysis and then spatiotemporal analysis, which is it?

Page 7 Line 6 – delete “in order” – sentence reads fine without in order

Line 11 – applying the Phreeqc...

Line 11 – please provide web address for where the P&P database can be accessed

Line 15 – base = basis

Line 17 – SGD can influence (heavily recirculated seawater does not necessarily influence SGD temperature)

Line 20 – that are clearly

Page 8 Line 4 – it wasn't obvious that 11/120 for example were referencing spring numbers, please call the reader's attention to Figure 1.

Line 14 – I think the reference for Figure 3 is actually a reference for Figure 4

Line 20 – Insert 3. Results from former 2. Material and Methods section

Line 21 – What are “these?”

Page 9 Line 8 – pixels and shows instead of pixel and show

Line 25 – sentence beginning with All is not a sentence

Lines 25-30 – Sentences can be condensed and in all instances pixel = pixels

Page 10 Line 3 – forcing = force

Line 4 – In order can be deleted and what is “its” referring to?

Line 14 – reflecting = reflect and indication can be deleted

Line 24 – frequent = frequency?

Page 11 Line 4 – superscript 3 on cubic centimeters

Line 18 – delete “, and” and replace with .

Line 26 area = areas

Line 29 and thus is awkward in the sentence – suggest rephrase

Page 12 Lines 1-2 – the sentence at the top of this page and the end of the previous page is clunky and should be rephrased and perhaps divided into two sentences

Line 7 along with the location

Line 11 with the lowest variance

Line 13 from the south

Lines 21-23 - clunky sentence, please rephrase

Line 24 - focused SGD, the

Lines 29-30 – what does that in the following refer to?

Page 13 what does “it” refer to in lines 13, 16, 18, and 20? Autocorrelation? Periodicity? Something else?

Line 21 as the underlying

Line 24 – new paragraphs should have a thesis sentence and should never begin with the word “Plus”

Line 33 similar = similarly

Page 14 line 5 – you have combining continuous spatial with continuous spatial scales