

Reviewer manuscript #hess-2022-49 titled “Intertidal spring discharge to a coastal ecosystem and impacts of climate change on future groundwater temperature: A multi-method investigation” by KarisAllen et al.

### **General Comments :**

This manuscript describes the thermal effects of intertidal springs on coastal waters and the thermal sensitivity of these springs to climate change. Methods that used including hydrologic and thermal monitoring, groundwater tracers (temperature and radon), and numerical simulation methods. It includes an intensive work. The paper is logically clear, and the results are well discussed and explained. I have the following comments that needed to be further addressed.

1. The application of thermal information to indicate groundwater discharge has been investigated for several years. A combination of Radon, thermal images and models are not creative, therefore, it is very important to state out what are the new findings of this work?

The same, as you are combing several methods, it is better to present a more clear graph abstract or figure to show the function of each method in your study. What are their contributions in this work. The figure 2 in the current version is not that straightforward and kind of confusing.

2. Based on your data, the influence on coastal waters in the study area should be discussed in details as this is your main research goal.

3. Thermal sensitivity analysis is your another proposed research goal. As to sensitivity, you have to first clarify what this term represent in your study case? what is the difference from your model “sensitivity”? What do you mean by using this term? A factor analysis by indicating which factor is the most important to impact the thermal variation? Or is it a case to study the response of thermal change to the climate change? I am a little confused from your analysis. By the way, the data you proposed is within a short period, how this validate a long term prediction in many years?

4. A model calibration figure should be better added to show the model accuracy with continuous time series data for the main variables.

5. Some of the cited papers are not well formatted, please check them carefully.

6. In line 141, why the spring discharge is assumed to vary linearly with the piezometer water table? Whether there is any basis to confirm the rationality of the hypothesis. If yes, please add the corresponding description.

7. How to use thermal image to determine spring discharge is always a challenge as the pictures are two dimensional and your discharge is a three dimensional volume. Meanwhile, they are varied with time in every minute, and make it hard to say what you photoed can indicate more information in different hydrological period, like in the wet or dry season.

1) Please add your flying area of the drone into your location map. It can help you to show whether they are consistent with the Radon data and you know the drone has a limitation to cover large area within a short time period.

2) In lines 275-280, three springs were selected to determine the power function relationship between spring discharge and thermal plume area for the lagoon. There are about 40 springs in this area. Are the three springs representative? In addition, are the three data points too little to yield the mathematical relationship between the two?

3) In line 281, the area of the spring is evaluated based on the irregular clipping of the spring location on the thermal image. What is the standard of graphic clipping? What principles need to be followed?

8. In line 253, the 1-D subsurface heat and water transport model established in the study area includes a saturated area of 3-93m. Do you have a temperature distribution along the perpendicular cross section to show the area that is effected by the spring plume. This is important to support that why the authors only select the temperature data at the depths of 1m, 3m, 5m, 10.28m, and 15.24m in the numerical modeling approach in response to the surface forcing (Fig. 10)?

9. In line 823, please change "Bottom row [(c) and (c)]" to " Bottom row [(c) and (d)]".

10. In Fig. 4(a)-4(b), please add the corresponding scale bar or pixel size of the image.

11. In Fig 10(a), the precipitation data over the years is unclear and lacks units. Please modify it.

12. The work is comprehensive, it would be a good work if the main research goal and methods, especially their connections, can be stated very clear through the paper.