In the manuscript, "Assessment of open thermodynamic system concepts for fluviokarst temperature calculations – an example, the Cent-Fonts resurgence," the authors construct a model to calculate heat transport within a karst aquifer. They use this model to attempt to assess the error resulting from an assumption that heat is a conservative tracer. In a number of ways, the presentation itself appears to be poorly, or perhaps hastily, constructed, for example: the English usage is sufficiently poor that in many cases it is not clear what the authors are trying to say, the figures are of sufficiently low resolution that some are barely legible, mathematical notation is often introduced with no definition or explanation (aside from the table at the end), and a bewildering number of non-standard abbreviations is introduced (i.e. CS, PFM, AW, CW). If the substance of the work was novel, useful, and largely correct, these shortcomings could be forgiven; however, in my judgment, the work also suffers from substantial theoretical errors or oversights. These errors are sufficient that I do not agree that the manuscript supports its primary conclusion concerning temperature as a conservative tracer. If the shortcomings of the theory were adequately addressed, the result, in my opinion, would be sufficiently different that it would be a different manuscript. I do not attempt to address the many minor concerns or edits that might be needed, but below I list my primary concerns with the manuscript.

Major concerns:

1. Steady-state assumption: The model presented relies on a steady state assumption concerning thermal energy within the aquifer. Nowhere within the manuscript is this assumption justified, and it is simply stated that aquifer recession periods are the time when this is mostly likely to be an appropriate assumption. I would argue that this assumption is the single biggest potential source of error when comparing the model to nature. Consequently, the comparison of adiabatic and conductive steady state simulations presented in the manuscript tells us little about the error associated with using temperature as a conservative tracer. It is straightforward to demonstrate from previous theory on heat transport in karst that temperature behaves conservatively within the steady state limit. Conduction of heat away from the conduit becomes gradually less effective with longer and longer temperature pulses (or longer periods of thermal input stability as modeled here). As the duration of a temperature pulse goes to infinity, which is effectively steady state as described in this manuscript, the heat exchange into the surrounding rock tends toward zero, and in this case temperature behaves conservatively. Therefore, the error incurred when considering temperature to be a conservative tracer is fundamentally tied to non-steady-state behavior. The error is a function of both the properties of the karst aquifer and of the time scale of variations in the temperature input.

It is also questionable whether the simulations presented in the manuscript actually reach a true steady state. The amount of time required for the system to reach this steady state is at least as great as the heat conduction time scale for the thickness of the aquifer, where this time scale can be calculated as $t_{cond} \sim Z^2/(4D_m)$, where Z is the vertical thickness of the aquifer. For 100 m of thickness, and an approximate thermal diffusivity of rock $D_m \sim 10^{-6}$ m^2/s this time scale is on the order of 100 years. This time scale is sufficiently long that it would be surprising if a natural system had stability over that period. For numerical reasons it also would be somewhat surprising if the simulations were run for that long. The fact that the displayed results show a fast drop of temperature near the conduit, and a large region that contains $T_{infinity}$ (Fig 2) is suggestive that the simulations have not truly reached steady state. Despite this, it is not surprising if temperature changes become extremely slow (the criteria for termination of the simulations presented) because the efficiency of heat conduction away from the conduit drops over a time scale much faster than the aquifer conduction time scale, which, judging by Eq 22 of Covington et al. [2012], must be on the order of $\sqrt{(t_{pulse}\pi/D_m)}(D_H/4)$, where t_{pulse} is the timescale of the input temperature pulse and D_H is the conduit hydraulic diameter. Note that, as discussed above, this thermal damping ability is fundamentally a function of both the conduit geometry and the time scale of the temperature variation. Therefore, it seems likely that the simulations are being halted and considered to have converged to steady state at some poorly defined time scale that is likely intermediate to these two. The physical meaning of this state where the simulations are halted is not clear.

2. Peclet Number(s): I think the analysis of the relevant dimensionless parameters is a reasonable approach. However, I am not convinced that the best approach for non-dimensionalization was taken. The Peclet number defined is related to the relative importance of advection and thermal conduction along the axis of the conduit. Here thermal conduction along the conduit axis should be completely irrelevant for natural systems, as advection is much more efficient. In equation 8, and others, it appears that thermal diffusivity has been substituted for the longitudinal dispersivity that is typically used in such advection-dispersion models (as in the cited models). In fact, it is not really clear to me that equation 8 follows from any of the previous heat transport models that are cited. I am not sure how the authors got this equation. There is also a Peclet number that compares the relative importance of conductive and advective heat transport within the matrix, but this is not explicitly considered. This Peclet number should certainly be important for the outcome, as it can control the temperature distribution within the rock.

3. Heat exchange in turbulent flow: If I understand the text correctly, the model presented here assumes laminar flow conditions within the conduit, at least when calculating heat exchange. This is done despite the fact that the other karst heat transport models that are cited consider the effect of turbulent flow and a thin conductive boundary layer near the wall using the Nusselt Number, an approach which is more physically realistic. The Reynolds numbers being considered here are certainly well into the turbulent flow regime. Why is the conduit flow considered laminar?

4. Field example: It is not clear why the field example is included and the field site discussed in so much detail. A few numbers are used to motivate a fiducial simulation case, but the vast majority of the information about the field site is not relevant. The connections between this field site and the model are weak and barely explored.

Concluding remarks

In conclusion, I cannot recommend publication of this work in HESS. The manuscript is not well written, and the model contains significant theoretical problems. The conclusion of the manuscript is misleading, as it appears to claim that temperature can be treated conservatively with little error. This is simply not the case, as is supported by a significant body of work on karst heat transport, much of which is cited in this manuscript. Temperature is typically one of the least conservative tracers that is used for interpretation of karst systems. Furthermore, theoretical work over the last few years provides a simpler means of answering the central question raised here concerning error introduced by assuming that temperature is conservative. While I cannot recommend publication of this manuscript, I will note that there is one particularly interesting aspect to the model presented. The model considers potential effects of heat conduction into the rock on emerging matrix water, and also of flow within the matrix on the matrix temperature distribution. To my knowledge, previous models have not considered these effects, and a more detailed and careful examination of them might lead to a useful contribution.