"Thermal damping and retardation in karst conduits" by A. J. Luhmann et al., Hydrol. Earth Syst. Sci. Discuss., 11, 9589-9642

The authors present a novel methodology to characterize karst conduit systems. Based on analytical and numerical models they investigate the effect of various system properties on transmission and retardation of heat signals. Finally, the analytical solution allows to characterize the conduits hydraulic diameter based on measured transmission and retardation of heat signals. A conducted field experiment is used to demonstrate the approach. The paper is well structured and written, extensive, and comprehensible.

What I missed was a proper explanation of the underlying conceptual model. After the introduction, the paper starts immediately with a description of the mathematical model. I'd suggest to add some description of the conceptual model prior to the mathematical model, i.e. which processes are considered and which are neglected (maybe Fig. 1 can be modified). In doing so, the authors could help readers to understand some of the limitations of the approach (which are, however, well explained in the latter part of the manuscript, p 9617, line 17ff).

One significant conceptual limitation is the missing consideration of variable conduit hydraulics that interact with the matrix. From my understanding, the models assume constant (steady-state) hydraulics for most of the setups (except what is described in section 6.3.2) and there is no interaction between conduit and matrix hydraulics (hydraulically isolated conduit). In consequence, the models cannot consider processes related to varying hydraulics like storage, or water transfer with the surrounding matrix. I assume that for some real situations these processes can be significant: for example an event induced increase of discharge will result in an increase of conduit hydraulic heads; subsequently, this head change potentially affects water transfer with the matrix continuum (matrix storage) or with other fractures or cavities (conduit storage). The authors touch this topic (discussion of water addition along the conduit; p9619, line 19ff). I suggest to discuss this limitation more in detail (in section 8.2 and / or related to the conceptual model). Maybe the paper from Birk et al. (2006) is helpful because the numerical model used there overcome some of the limitations.

Specific comments:

- The authors use two different model setups with a cylindrical conduit and a fracture (see Fig. 1). For me the reason in doing so is not always comprehensible. The fracture model setup is introduced at page 9594 line 20. Maybe the authors can add some explanation why this setup is considered (I found something on p9611 line 11).
- Can Equation 13 be moved to section 3.1 (similar to Equation 24, which is in 3.2)?
- Can Equation 12 be generalized (for planar and cylindrical case)?
- Some numerical models have different conduit lengths but the discretization remains at 1000 discretized elements (page 9602, line 10 ff). Why is the discretization along x not kept constant (i.e. same element size)?
- At p9619, line 19ff water addition along the conduit is discussed. What about losing water (flow from conduit to matrix or to some other storage)?
- In Figure 2 the numerical models for small transmission differ from analytical results (first elements along the x-axis until F ~ 0.05). Is there an explanation why corresponding numerical results seems to be zero?

- Some further data for the field experiment would be helpful to understand the situation without reading Luhmann et al. 2012 (e.g. distance between sinkhole and spring, some information about the sinkhole like distance to the conduit). What about heat recovery?
- If possible, please discuss the results of the field study (D_H) little more. The obtained hydraulic diameter D_H seems very small. Luhmann et al. (2012) helps to understand these results but some short interpretation can be given here too.

Suggested technical corrections

- Equation 15: explanation for X, Y (and R in equation 25)
- Page 9611 line 9: add “m” behind DH = 1
- Table 3, first data line: delete comma at L/V value