Hydrol. Earth Syst. Sci. Discuss.,
doi:10.5194/hess-2017-181-RC3, 2017

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Nonparametric lower bounds to mean transit times" *by* Earl Bardsley

Anonymous Referee #3

Received and published: 18 May 2017

The technical mote provides tools to derive numerically lower bonds to mean transit times using tracer time series. I'm not in favor of publication of this note for the reasons discussed below.

1. relevance. As noted by other reviewers, the practical and/or theoretical relevance of this paper is unclear to me. Getting lower bonds for Mean Transit Times does not seem to be an obviously relevant scientific problem; therefore, the author should better discuss the important implications of this work for hydrology and interpretation of environmental time-series. Interestingly, the paper by Jim Kirchner who apparently inspired this work, suggested that the mean transit time is a poor representation of this type of systems (as noted by the author in the introduction). In fact, tracer dynamics are mostly driven by the fraction of young water, and its time-variability.

2. tools. there are several papers that have shown unambiguously why the lumped convolution approach is misleading. It is quite surprising to see that the lumped convo-

lution approach is still used (in this case in a discrete fashion). Therefore, in my view section 3 is completely useless - as that lumped formulation is not able to describe real-wold catchment dynamics. Note that Kirchner [2016a] used that approach only to explain the idea of aggregation bias in simple terms. Here the steady nature of TTDs (or MTTS) is a fundamental assumption (in fact, all the numerical examples shown in the paper refer to steady state TTDs).

3. tools. I have several problems also with the time varying version of the approach (section 4). first of all, the author apparently uses "forward distributions" and not "backword distributions" in equation (5). If this is correct, than the convolution in eq. (5) should refer to mass fluxes and not to concentrations, as in section 3 (see also the periodic nature of the input in Figure 2). Overall, the insisted use of the terminology "tracer time-series" is confusing. The meaning (and the nature) of the kernel linking input-output signals in environmental systems changes, depending on the quantity involved (concentrations, mass fluxes, water fluxes), as extensively discussed in the literature of the 70s by Niemi, Zuber and many others. Moreover, the constraint that the mean of the time-varying distributions is the same (Section 4) is untenable. There are tens of experimental and theoretical studies that show unambiguously how the mean travel time changes depending on hydrologic conditions (e.g. catchment wetness).

4. results. Based on my previous comment I find quite surprising that all the numerical examples refer to the steady state system.

5. as noted by other reviewers, the referencing is definitely inappropriate. I think the author is missing a huge number of papers about travel time formulation and application. As an example, the references to Kirchaner, Selle and Peralta-Tapia whan talking about TTD time-variance should be properly complemented by those works where the idea of time-variant TTDS has been proposed, proved theoretically and then applied. The relevant missing papers are too much to list them here.

Overall my impression is that this work is a nice mathematical exercise that unfortu-

nately disregards the physical processes involved in catchment transport processes, and (as such) it as a reduced potential for real world hydrological applications.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., doi:10.5194/hess-2017-181, 2017.