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Comment on hess-2021-82

Anonymous Referee #2

Referee comment on "Small-scale topography explains patterns and dynamics of dissolved organic carbon exports from the riparian zone of a temperate, forested catchment" by Benedikt J. Werner et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2021-82-RC2>, 2021

Werner et al. examines export patterns and dynamics of dissolved organic carbon from the riparian zone in a temperate, forested catchment. The paper used an array of different approaches to relate DOC source zones within the RZ to their dominant DOC export mechanisms. Stream DOC samples from different hydrological conditions were compared to riparian DOC groundwater and surface water chemistry. They also characterized DOC chemically (via Fourier-transform ion cyclotron resonance mass spectrometry) and used topographic analysis (at a resolution of 1m). Water fluxes were simulated using the code HydroGeoSphere. The paper concluded that surface runoff from zones of high TWIHR values, which occupied about 15% of the total area, exported about 1.5 times the load of DOC from the remaining 85 % of the area, and that "this study highlights that surface DOC export from the riparian zone plays an important role for lateral DOC export from hydromorphic soils with overall low topographic relief."

The work is interesting and collated an array of approaches from chemical analysis to modeling at high spatial resolution. The current manuscript is phrased from the angle of horizontal heterogeneity / landscape topography, which I think is actually already well studied [*Herndon et al.*, 2015; *Jencso et al.*, 2009; *Ledesma et al.*, 2018; *McGuire and McDonnell*, 2010; *Pacific et al.*, 2010]. But I find the conclusion is not particularly surprising. On the other hand, It seems to me that this work presents a rare opportunity to dig deeper to think about the relative influence of vertical versus horizontal heterogeneity. the relative importance of vertical versus horizontal heterogeneity in doc export is poorly understood. In particular, there has been quite some interests in understanding the solute export from different subsurface depths, for example, [*Seibert et al.*, 2009; *Zhi and Li*, 2020; *Zhi et al.*, 2019]

The data from this work have depth profile (top 100 cm) of doc, and flow calcination from different depths. These two can be combined to calculate at what depth most doc was exported, and how the export varied with depth in high flow events. At a minimum, it

would be nice to see some discussion along this line of vertical heterogeneity.

I also find "Surface export" is a confusing term. Is this really surface runoff, or does the water mostly flow through top soil? Unless in extremely large events, most forests do not see significant amount of surface runoff. In many places, stream water comes from "old" water from the subsurface, not surface runoff "new" water [Klaus and McDonnell, 2013].

Line 52-54, "a strong focus on vertical heterogeneity". Interesting thoughts but maybe not accurate. My impression is that existing literature has focused much more on landscape hillslope - riparian heterogeneity. As I mentioned earlier, papers in hydrology and ecology have emphasized a lot on hydrological connectivity from hill to streams. In fact, the management practices related to riparian zones originated from our understanding of differences between hill and riparian and their connectivity.

Figure 3: also draw doc in this figure to help viewing when doc coming out most?

Figure 4: this figure is busy. What is ns, hc, oc, ... please explain in caption or provide legend.

Why not show doc vs depth data. It would be cool to see that data. We rarely have subsurface solute depth profile. Also, these depth data, together with the modeling work for subsurface flow, provide rare opportunity to assess the relative importance of vertical heterogeneity vs horizontal landscape heterogeneity, as I mentioned earlier

Figure 7: can the discharge data be added here? Would it be easier to understand the time series of doc export?

Line 525-530: it seems that there is some mis-understanding about "lateral export". Lateral export means doc export via surface water (streams and rivers). Stream water can come from the surface runoff and subsurface (soil + gw). In fact, in many places, stream water comes from "old" water from the subsurface, not surface runoff "new" water (Klaus+McDonnell 2013). While I agree that surface runoff can be important during events, it may be misleading to present these numbers without mentioning the temporal scale (event scale). At the annual scale, these numbers might be quite different.

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