

## ***Interactive comment on “Rapid Phase Transfer of DOC and DIC Transport in a Subtropical Small Mountainous River” by Yu-Ting Shih et al.***

**Anonymous Referee #2**

Received and published: 23 May 2018

### General Comments

This research makes a useful contribution to the understanding of the hydrologic controls on DOC and DIC streamwater export in a humid tropical region, and by quantifying the annual fluxes and DIC/DOC ratios, define these systems as end-members or ‘hot spots’ within the context of global measurements. While there has been evidence that sub-tropical regions were important with respect to both DOC and DIC fluxes due to high productivity and rainfall, the detailed long-term measurements of concentrations and evaluation of relationships with flow had not been previously studied in any detail. By consistently sampling during a range of flow conditions (including frequently during typhoons) over a relatively long period (2 1/2 years) and using the data in conjunction with measurements of flow, flow simulation and end-member mixing analysis,

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they are able to evaluate the relationship between concentration and flow, estimate the relative contribution of different hydrologic flow paths to the DOC and DIC fluxes and quantify the importance of the typhoon events relative to non-event flow conditions. The research presented in this paper addresses a topic that is of interest to the carbon cycling and hydrologic community and while the presentation of concentrations, relationships to discharge and calculations of fluxes for flow components are useful and important, the description of methods needs considerably more clarity and completeness and the writing could be significantly improved in order to make this a more valuable contribution to the literature.

### Specific Comments

**Methods** The description of the calculation of DIC is confusing and the citations do not appear to be correct, I did not see an ion balance calculation method in either Lyons et al., 1992 or Zhong et al., 2017. DIC is/can be defined as  $\text{CO}_2 + \text{H}_2\text{CO}_3 + \text{HCO}_3^- + \text{CO}_3^{2-}$ . Are you estimating DIC as  $\text{HCO}_3^-$  which you are calculating by ion balance difference? Please clarify how you define and calculate DIC. With respect to the LOADEST and HBV, the models were run at a daily time-step, yet measurements during the typhoons were taken more frequently (3-hr interval). Indicate how the hourly data was incorporated into the flux and HBV models or did those models not use the hourly data? In reference to streamflow 'composition' (l 161), do you mean physical or chemical composition? I assume physical, meaning the model derives the relative flow in the 3 components of the total stream flow (rapid surface, subsurface and deep groundwater). Please clarify in the text as 'composition' is typically used to discuss chemical constituents. If correct, this would be the appropriate time to identify the names used to describe the 3 flow components. At the end of the streamflow simulation method description, it is stated that the streamflow composition was affirmed through 3-end member mixing using 3 different ions and electrical conductivity (l. 167-169), but that requires knowledge of the end-member concentration of those analytes, not just streamwater concentrations? Did you measure or have estimates of surface,

sub-surface and ground water concentrations for each of those analytes or am I not understanding how EMMA was used? Please explain how the EMMA analysis was conducted to verify the streamflow simulation. The description of the EMMA analysis (l. 171-184) to describe the three sources of DOC and DIC is unclear as written, specifically, 3 equations are referenced, only two are presented and 'i' is never defined. Is EMMA being used to calculate the concentration of DOC and DIC in each of the three flow components by using the calculated fractions of those flow components and the streamwater concentration of DOC and DIC for each timestep, 'i'. I believe this is what was done but it should be more clearly stated. Is time invariance of the sources a valid assumption? I would think DOC would be variable in time, please provide a citation indicating that is a reasonable assumption. Results/Discussion Are reported concentrations flow-weighted? Since parameters are correlated with discharge, a flow-weighted estimate would be a more accurate representation of the data for comparisons to other systems (assuming those are also flow-weighted).

Technical corrections

In the title, does 'phase' refer to the transport of terrestrial carbon to the aqueous system? The word is never used within the paper. Change wording to illustrate the paper is focused on evaluating dynamics in relation to changing hydrology and flow paths.

(l. 31) Pluralize 'model'

(l. 41) Does 'SMR' refer to sub-tropical mountain rivers or small mountain rivers. Please define and clarify in the abstract, figures and tables.

(l. 54) Extra period after (POM, DOM)

(l. 59-61) Check grammar, mismatch in 'quantity' and 'they'

(l. 62/63) A citation is needed for the global river DOC and DIC statistics.

(l. 68) As stated 'an understanding of riverine C response in different regions is

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needed', but in response to what? Changing climate? Hydrology? Land use?

(l. 78) The term 'regular flow periods' is used to describe the biweekly sampling, but I believe either regularly sampled base flow or non-event flow would be more appropriate terms unless the biweekly sampling captured events. This is a term used throughout the paper.

(l. 110) It would be more useful to state the drainage area upstream of the sampling points, rather than the entire river watershed.

(l. 146) The phrase 'then over the average' should be replaced by 'divided by' or use a written equation.

(l. 165-166) Delete either the word 'using' or 'with'. Were the climate variables much different between T1, T2 and M3, they appear relatively close in proximity?

(l. 191) Incomplete sentence, add 'were observed' after 'rapid increases'

(l. 229) Unsure of what is meant by 'companying'. Also, the three end-member mixing model doesn't note Chloride which was cited in the methods (l. 169).

(l. 243) Change 'extreme' to 'extremely'.

(l. 244) Sentence incomplete, 'RSR is a predominant factor for transporting DOC due to the large amount', I assume large amount of flow transported relative to the annual total.

(l. 264-265) 'the abundant discharge has been well recognized' is incomplete/unclear. Are you referring to the positive relationship between DOC and discharge being strong, or that there is a lot of rainfall and/or runoff per unit area relative to other locations?

(l. 273) 'Incessant' is not the best word choice, perhaps consistent or invariable.

(l. 300) Correct punctuation, extra period and capitalization

(l. 301) 'subtle area' is not correct, perhaps minimal or small relative to global land

mass?

(l. 305) Correct capitalization

(l. 335) How would isotope techniques be used to clarify the importance of riparian and hillslope zones, please elaborate.

(l. 338/339) Incomplete sentence. “Not only the change of DOC concentration but also DOC composition.” Composition was never mentioned in the paper until this point and I don’t think it is useful to include it in a single sentence unless the authors want to discuss the impact variability in DOC quality could have on their conclusions; how important may it be relative to quantity?

(l. 343) Add ‘per year’ to the number of typhoons making landfall.

(l. 350/352) Elaborate on how changes in the DIC/DOC ratio would alter biogeochemical C processing in aquatic ecosystems.

Table 1. ‘Performance metrics’ would be a better term to use in the title. Define and/or describe NSE.

Table 2. Define dates for wet and dry season, respectively.

Table 4. Is Meybeck and Vorosmarty, 1999 the correct reference for the global data? There is one table in that publication which only has flux in units of g C yr<sup>-1</sup>, there is no concentration data, perhaps it was another related reference, or state how calculations were made if it was derived from that citation. Should concentration be per liter? Are concentrations flow-weighted? Letters in footnotes are not consecutive.

Figure 1. Would be useful to outline the catchments defined by the 3 different sampling locations.

Figure 3-6. Nice job representing the data with different metrics that are uniquely useful.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2018-126>, 2018.

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