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Hydrology and Earth System Sciences Discussions

Interactive comment on "Dissolved inorganic carbon export from carbonate and silicate catchments estimated from carbonate chemistry and $\delta^{13}C_{DIC}$" *by* W. J. Shin et al.

W. J. Shin et al.

kslee@kbsi.re.kr

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In this study, the authors tried to quantify, with many assumptions, DIC efflux from the groundwater and rivers and its possible variations with catchment lithology. The importance of carbon exchange processes in headwater regions is increasingly gaining attention, as the authors pointed out and therefore, this study may provide useful data and interpretation that have implications on related studies on this subject. However, a few uncertainties need to be clarified as presented below.

Comment: p.9 line 22_line 28: Do you assume that the relationship between d13C changes and log unit change of excess pCO2 can be applied to any conditions of degassing? Is there any established isotopic fractionation mechanism for this seemingly systematic change in d13C? Also, does this quantification of the effect of degassing exclude the possibility of incorporation of C4-derived organic material?

Reply: The relationship between ln(ePCO2) vs. d13C was derived empirically from river system where its pCO2 was in disequilibrium with the atmosphere and degassing(evasion) was assumed to be prevalent (Doctor et al., 2007). pH, water chemistry and micro-meteorological factors are assumed to play to determine the relationship. It is premature to conclude the relation as a solid, quantitative expression describing the effect of degassing. However, the relation provides a useful baseline on which more quantitative studies should be conducted to understand carbon isotope fractionation associated with kinetically driven CO2 degassing. The effect of C4 crops (e.g., Corn) cannot be estimated clearly due the lack of distribution data, d13C measurement of soil organic material, and uncertainties associated with specific agricultural practices. Therefore, we take this as a part of uncertainties in our interpretation.

Comment: p.10 line 14_line25: Is there possibility that photosynthesis and degassing affect d13C of DIC at different degrees with seasons? For example, photosynthesis could have been major during summer while degassing was more intense during winter.

Reply: It is assumed to be unlikely, since the correlation between O2 saturation and d13C during summer was not clear. Likewise, ice covering in the stream waters during winter precludes the possibility of CO2 degassing as the major cause of d13C changes in the season.

Comment: p.12 line 1_7: Why not discuss the EC data of the silicate catchment?

Reply: The EC data are not available for the silicate spring.

Comment: p.14: The monsoon climate in East Asia significantly affects the hydrological condition and resultantly carbon exchanges as well. While the authors mainly interpreted the data assuming baseflow condition, can there be any notable change in carbon export during monsoon season with stormflow generation? Could this condition be additional uncertainty of the budget estimate in this report?

Reply: A relevant study in a mountainous Korean forest catchment indicated that the carbon export during summer monsoon period was significantly changed due to heavy rainfall and associated rapid overland flow (Kim et al., 2010, Organic carbon efflux from a deciduous forest catchment in Korea. Biogeosciences, 7, 1323–1334). The effect was more pronounced in DOC/POC export but less significant in DIC export. As the reviewer indicated, this can be one of the main uncertainties in our DIC budget estimates and should be one of the major research directions in the future. We will add discussion on this regard in the section 4.4.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 1799, 2011.