Response to HESS-2019-8-RC3

Anonymous Referee #3

Thanks for your suggestions. We appreciate for anonymous referee comments concerning our manuscript entitled "Dissolved Organic Carbon Driven by Rainfall Events from a Semi-arid Catchment during Concentrated Rainfall Season in the Loess Plateau, China". We have studied comments carefully and have made corrections. The main corrections in the manuscript according to the referee's comments are as follows:

Comment 1. The authors declared that there were no reports to the LPR, but I do not think that is the reason they conducted such a study.

Response: Thanks for your suggestions. The Line 72-79 has been revised and explained why we conducted this study.

Line 72-79: Therefore, the primary goal of this study is to investigate how variations of DOC concentration and flux response to a sequence of rainfall events from a restored catchment during concentrated rainfall season in the LPR. Specifically, the two objectives of this study were (1) to examine the dynamic changes in DOC concentration and flux and assess the difference in DOC export driven by various rainfall events, and (2) evaluate how rainfall, runoff, and antecedent factors affect DOC export from a catchment. To do so, we used high-frequency method to capturing the temporal changes in DOC export and hydrological process driven by rainfall event within an ecological restored watershed in LPR. These results will provide evidence of DOC export response to rainfall events, especially driven by extreme events, which may be important for evaluating carbon balance and modeling DOC export through runoff at ecological restored catchment in LPR.

Comment 2. They claimed that this study highlighted the interaction of rainfall and antecedent conditions for DOC exports in a catchment, but they did not say what interactions and what effects.

Response: Thanks for your suggestions. The Line 282-303 explained the antecedent condition for DOC exports.

Line 282-303: The infrequent and amount of violent rainfall events strongly influence the runoff discharges and soil moisture, which in turn impact on DOC during or later export from a catchment. In this study, temporal variations of rainfall, air temperature and soil moisture content were continuously monitored throughout the study period to provide detailed information describing the antecedent and current conditions. Positively correlation between Ra, R7 and C_f suggested that the combination of the current rainfall amount and the accumulated rainfall before a current rainfall event are important. R7 may reflect the antecedent hydrological condition and Ra represent the current rainfall input into the catchment, resulting in well hydrological connectivity, and more DOC source may contribute to runoff.

Therefore, C_f can by strongly influenced by Ra and R7 due to the hydrological properties of the catchment. Apart from the hydrological changes, the antecedent soil moisture also played an important role in C_f and showed a extreme significantly and negatively correlated with SMC7 and SMC14 (Table 2). The soil moisture content was continuously dried and then effectively rewetted under a specific rainfall amount, as supported by the soil moisture variations shown in Figure 2-c. These results were also consistent with Yang et al. (2018), who found that the threshold of rainfall effectively recharged into soil was 20-26 mm for grassland and forestland in LPR. Therefore, the pattern of soil moisture dry-wet cycle may affect event-driven DOC concentration, and this highlights the importance of soil moisture condition in DOC export (Figure 7). The higher DOC concentrations from June to middle July coincided with light rainfall, and thus rainfall recharge into soil moisture. This is probably attributed to inactive microbial activity, caused by the relatively lower soil moisture (Jager et al., 2009). The DOC concentration decreased with increased soil moisture content, particularly in July-18 with a total rainfall amount of 56.4 mm. On one hand, violent rainfall events may induce a higher discharge, causing a dilution effects on DOC concentration. On the other hand, the rainfall water may effectively replenish soil moisture content, and thus stimulate a higher decomposition of soil carbon under wet and higher temperature condition. Then, the relative decreased DOC concentrations were observed in a drying soil moisture condition for the next rainfall events, which may attribute to an exhaustion of DOC (Laudon et al., 2004). These findings were similar to previous studies by Tunaley et al. (2017), who reported a strong influence of dry antecedent conditions on DOC export response to rainfall event.

Comment 3. The introduction is very difficult to follow, they presented a numerous report (for example, L40-L64), I think they need to summary these studies and then the potential readers can know why they design this study.

Response: Thanks for your suggestions. The introduction part has been rewritten and the details show in Line 25-79 of this manuscript:

Line 28-79: Dissolved organic carbon (DOC), often defined as the solute filtered through <0.45μm pore size, is regarded as one of the active constituents and provides a biologically available carbon source for organisms (Raymond and Saiers, 2010). The estimated DOC flux of terrestrial organic carbon through major worldwide rivers to ocean is from 0.45 to 0.78 Pg C y^{-1}(Drake et al., 2018; Hedge et al., 1997; Ran et al., 2018). The substantial magnitude of flux suggests that the DOC export on a global scale acts as one of the crucial processes of linking between terrestrial and aquatic ecosystem (Battin et al., 2008; Raymond et al., 2013; Raymond and Saiers, 2010). For instance, high DOC concentrations can lead to water pollution and eutrophication, and thus have dramatic consequences on aquatic ecosystem services (Evans et al., 2005; Hu et al., 2016). In addition to ecological impacts, DOC in runoff also play an important role in social well-beings. High DOC concentrations will aggravate the complexation and adsorption of pesticides and heavy metals in hydrological process. Therefore, the quality of domestic water could be damaged and it might potentially lead to adverse impacts on human health, such as increased risk of cancer, diabetes, or other diseases (Bennett et al., 2009; Ritson et al., 2014). Therefore, it is urgent to improve the associated knowledge on DOC export variability and develop a mechanistic understanding of DOC export from catchments.

DOC exported from catchments has attracted great attention in the last two decades due to global concerns about potential influences on the global carbon cycle and climate change (Laudon et al., 2004; Raymond et al., 2013). The transport of terrestrial DOC to runoff is strongly influenced by hydrological process, soil carbon cycle and climatological factors. Hydrological process driven by rainfall event plays an important role in controlling terrestrial DOC from soil pool to runoff. Previous studies have shown that the release of DOC concentrations ranged from 0.5 to 50 mg L^{-1} for global catchments (Mulholland, 2003). For instance, Clark et al. (2007) found that DOC concentration ranged between 5-35 mg L-1 with a highly variable in rainfall events from a peatland catchment, and a study by Blaen et al. (2017) showed that the DOC concentration ranged from 5.4 to 18.9 mg L-1. Similar results were reported by Ran et al. (2018), who found that DOC concentration ranged from 1.4 to 9.5 mg L-1 in the Wuding River in the LPR. Such studies highlighted that the importance of hydrological process on DOC transport (Billett et al., 2006; Dawson et al., 2002; Inamdar et al., 2006). Different rainfall events may alter hydrological connectivity or the flow path, which in turn lead to a varied hydrological connectivity and DOC source contributing to runoff. Moreover, the intensity and frequency of rainfall event not only influenced the current hydrological and DOC loading processes, but also changed the soil moisture conditions. The latter point may be particularly important in soil biogeochemical cycle. For example, DOC concentration may increase due to accumulated soil organic carbon after a dry period (Jager et al., 2009). In addition, variations in the magnitude and frequency of precipitation are one of manifestations of climate change, and thus, changes in hydrological process induced by climate change are also impact on the transport of terrestrial DOC. Therefore, understanding the dynamic and magnitude of DOC export from catchment is an important component of prediction DOC flux under the circumstance of future climate change.

The LPR, which has an area of 6.4×10^5 km^2, is situated in the middle reaches of the Yellow River, China, and approximately 90% of the river loading sediment is derived from this region (Tang, 2004). With regard to this fragile environment, the Chinese government has launched some ecological restoration projects since the beginning of this century, such as the 'Grain-for-Green' and 'Natural Forest Protection Project'. With the implementation of these projects, large areas of steep-sloping (higher than 20°) agricultural land was converted to forest, shrub, or grassland, and engineering measures were also applied to control erosion (Fu et al., 2017). For instance, check dams can retain sediment and also offer flat and fertile land behind the dam (Wang et al., 2011a). These measures have caused the Loess Plateau to experience a substantial change in land use, vegetation cover, soil properties, and catchment hydrology (Chen et al., 2007; Wang et al., 2011b; Wei et al., 2014). Consequently, the hydrological and carbon biogeochemical processes, which operate and interact with each other, were dramatically altered (Liang et al., 2015a; Liang et al., 2015b). These changes in hydrology and soil carbon cycle induced by land use and vegetation change may particularly important in the dynamics of DOC concentration and flux in an ecological restored catchment. Moreover, the majority of annual rainfall is concentrated between July and September in LPR. Less information is available on DOC export driven by rainfall event, which DOC flux is an important component in overall carbon balance for ecological restored catchment.

Therefore, the primary goal of this study is to investigate how variations of DOC concentration and flux response to a sequence of rainfall events from a restored catchment during concentrated rainfall season in the LPR. Specifically, the two objectives of this study were (1) to examine the dynamic changes in DOC concentration and flux and assess the difference in DOC export driven by various rainfall events, and (2) evaluate how rainfall, runoff, and antecedent factors affect DOC export from a catchment. To do so, we used high-frequency method to capture the temporal changes in DOC export and hydrological process driven by rainfall event within an ecological restored watershed in LPR. These results will provide evidence of DOC export response to rainfall events, especially driven by extreme events, which may be important for evaluating carbon balance and modeling DOC export through runoff at ecological restored catchment in LPR.

Comment 4. The three objectives of this study were not well described in the introduction section.

Response: Thanks for your suggestions. The objectives have been reorganized.

Line 73-76: Specifically, the two objectives of this study were (1) to examine the dynamic changes in DOC concentration and flux and assess the difference in DOC export driven by various rainfall events, and (2) evaluate how rainfall, runoff, and antecedent factors affect DOC export from a catchment. To do so, we used high-frequency method to capture the temporal changes in DOC export and hydrological process driven by rainfall event within an ecological restored watershed in LPR.

Comment 5. The result section is too long, making it difficult to read.

Response: Thanks for your suggestions. The result section has been reorganized in Line 152-222 as following:

Line 152-222: 3.1 Rainfall and Discharge in the Study Catchment

Rainfall is the main driving force of hydrological process in a catchment. Event-based rainfall amount varied from 62.6 mm (18 July) to 0.60 mm (17 August) from the June to September, 2016 (Figure 2-a). Over this period, the total rainfall amount was 372.1 mm, with approximately 70 % of the annual rainfall amount. All the rainfall events in between June to September were grouped into four grades: <5 mm (Light rainfall), 5-10 mm (Moderate rainfall), 10-20 mm (Heavy rainfall), and >20 mm (Violent rainfall) according to rainfall amount classification (Yang et al., 2018). Figure 3-a showed that the total rainfall amount was 41.1, 44.8, 99.6, and 186.6 mm for each grade, respectively. The occurrence frequency of rainfall in each grade was 52.4% (<5 mm), 17.1% (5-10 mm), 16.7% (10-20 mm), and 14.3% (>20 mm) (Figure 3-b). These results indicated that the light and moderate rainfall occurs frequently with a less total rainfall amount, whereas the majority of rainfall amount occurs with a less chance in violent rainfall.

In general, flow discharge tended to follow the pattern of rainfall amount in the study catchment. The mean flow rate at the outlet of the catchment was 0.46 L s^{-1}, but it was also more variable and ranged from 0 to 4.5 L s^{-1} during June to September, 2016. In particular, there was no runoff in the catchment, due to the higher temperature, evapotranspiration and lower rainfall amount in early July. The higher flow rate is caused by continuous heavy rainfall. For instance, the cumulative rainfall amount was 91.8 mm and the mean flow rate was 4.05 L s^{-1} from 18-19 July. Therefore, the flow rate increased rapidly with short duration and violent rainfall. In addition, Figure 4-a showed the relationship between flow rate and rainfall amount during June to September. This indicated that event-driven flow rate varied with rainfall amount, and thus suggested that runoff discharges are highly sensitive to larger rainfall amount with greater than 20 mm in this area.

3.2 DOC Concentrations in Runoff Discharges

3.2.1 Event-based DOC Concentrations during Concentrated Rainfall Season

In general, the monthly mean DOC concentration tended to decrease from 11.52 mg L^{-1} in June to 6.81 mg L^{-1} in August, and then slightly increased to 7.49 mg L^{-1} in September. There were less variations in the mean DOC concentration among monitoring months. For the event-driven DOC concentration, the flow-weight mean DOC concentration (C_f) ranged from 4.08 to 15.66 mg L^{-1} for all sampled rainfall events during June to September. The relationship between flow rate and C_f for sampled rainfall events was shown in Figure 4-b. The C_f exhibited a poor relationship with flow rate, and the C_f was a more variable at low flow rate period compared to the high flow rate period, which is typically observed during consecutive rainfall events with high rainfall amount. In addition, Table 2 showed the correlation between C_f and a set of factors in all sampled rainfall events during the study period. On one hand, the C_f was positively correlated with rainfall amount (Ra) and R7. On the other hand, the C_f was extreme significantly and negatively correlated with SMC7 and SMC14. These results showed that different rainfall and soil moisture condition may affect DOC concentration for a rainfall event.

3.2.2 Dynamic Changes of DOC Concentrations in a Rainfall Event

Four rainfall events of total sampled events were chosen for detailed examine the relationship between DOC concentration (C_i) and flow rate in the hydrological process. These selected rainfall events represented 83% of the occurrence frequency of rainfall amount and the collected samples with high-frequency cover a complete of hydrological process during the monitoring period. Figure 5 shows the dynamic changes in DOC concentration and flow rate via the hydrograph over an event-driven hydrological process. In general, C_i varied between the runoff discharge process induced by different rainfall amount. The C_i increased quickly in the rising limb of the hydrograph and the maximum concentration occurred behind the peak of the hydrograph on 7-June (Figure 5-a) and 2-August (Figure 5-c), a period with less rainfall and of a long duration. Then, the C_i then decreased from 1.35 to 0.41 mg L^{-1} at the falling limb on 2-August, while the C_i remained relatively high values at 1.41-1.50 mg L^{-1} in the falling limb on 7-June. In rainfall events on 13-July (Figure 5-b) and 10-September (Figure 5-d), the discharge hydrograph exhibited a higher fluctuation due to the high rainfall amount and short rainfall duration. The C_i was kept relatively stable despite the facts that it increased from 1.05 to 1.30 mg L^{-1} at the rising limb on 13-July. However, the C_i sharply increased from 0.61 to 1.24 mg L^{-1} and the maximum C_i was observed before the peak of the hydrograph. The C_i then declined and remained stable ranging from 0.61 to 0.75 mg L^{-1} at the falling limb on 10-September. Overall, the dynamic changes in C_i in the hydrograph show that the DOC export process varied with different rainfall and runoff condition.

3.3 Hysteresis of event-driven DOC Concentrations

The above results showed a nonlinear correlation with flow rate and DOC concentrations (C_i) over a rainfall event. Therefore, A hysteresis analysis was used to examine the dynamic changes of the C_i response to a hydrological process, which has been applied to investigate the temporal variation in solute concentration with flow rate (Blaen et al., 2017; Lloyd et al., 2016a; Lloyd et al., 2016b; Tunaley et al., 2017). Figure 7 shows that the C_i varied in the rising and falling hydrograph during four selected rainfall events. Three hysteresis patterns were observed, including clockwise (13-July and 10-September), anti-clockwise (7-June) and figure-of-eight (2-August). As shown in Figure 6-a, the C_i was higher during the falling limb than during the rising limb of the hydrograph, thus resulting in an anti-clockwise pattern. A figure-of-eight pattern and indicated that C_i generally varied in pace with runoff discharge on 2-August, 2016 (Figure 6-c). The difference of C_i between rising and falling limb at a given flow rate was small, as supported by the results shown in Figure 5-c. On 13-July (Figure 6-b) and 10-September (Figure 6-d), the C_i exhibited a clockwise pattern, which implied that the C_i was higher in the rising limb than in the falling limb. The relationships between concentration and flow rate highlighted that the DOC export behavior was different in a complete hydrological process driven by a single rainfall event.

3.4 DOC Fluxes from Catchment

A rainfall event-based monitoring method is helpful to better understand the hydrological, DOC concentration and flux process. The rainfall event-based DOC flux ranged from 0.08 to 2.81 kg km^{-2} with a mean DOC flux of 0.43 kg km^{-2} for all sampled rainfall events from June to September, 2016. The relationship between event-based DOC flux and runoff discharge amount is shown in Figure 4-c. The DOC flux showed a positive linear relationship with the runoff discharge amount, especially for violent rainfall events. The DOC flux was more variable in lower runoff discharge conditions. In general, event-based DOC flux was significantly and positively correlated with Q, Ra, R1 and R, as showed in Table 2. For the monthly DOC flux, the total DOC loading from the catchment ranged from 94.73 kg km^{-2} in August to 110.17 kg km^{-2} in September (Table 1). Although the total runoff discharge was lowest in June in these four months, the DOC monthly flux was 102.39 kg km^{-2} and had a higher flow-weighted DOC concentration (11.52 mg L^{-1}). However, the DOC flux was higher in September, with an increased runoff discharge and a lower flow-weighted DOC concentration. The larger runoff discharge amount may offset the effects of lower DOC concentration.

Comment 6. The authors need to redo the tables and figures. I do not understand Figure 2a. It is also difficult to understand Fig. 8. The authors also need to explain the abbreviations for R1, R2 in table 2 so the readers need not to find them in the text.

Response: Thanks for your suggestions. We redo the Table 1, 2 and Figure 2 a as following:

Table 1

Date	Ra(mm)	Flow rate ($L\ s^{-1}$)	C_f ($mg\ L^{-1}$)	*Flux* ($kg\ km^{-2}$)	Date	Ra(mm)	Flow rate ($L\ s^{-1}$)	C_f ($mg\ L^{-1}$)	*Flux* ($kg\ km^{-2}$)
1-Jun.	1.0	0.56	10.87	0.52	1-Aug.	0.8	0.54	5.14	0.24
2-Jun.	7.0	0.59	9.97	0.51	2-Aug.	4.2	0.63	9.72	0.53
3-Jun.	3.0	0.53	10.53	0.48	6-Aug.	0.8	0.47	7.95	0.32
5-Jun.	3.2	0.53	11.59	0.53	12-Aug.	0.8	0.40	5.30	0.18
7-Jun.	13.8	0.65	12.96	0.73	13-Aug.	1.2	0.35	5.93	0.18
Jun.	82.9	0.35	11.52	102.39	16-Aug.	18.8	0.96	6.46	0.54
11-Jul.	24.6	0.44	11.92	0.45	17-Aug.	0.6	0.55	9.69	0.46
13-Jul.	19.8	1.28	11.84	1.31	18-Aug.	1.2	0.57	7.44	0.37
14-Jul.	11.0	0.46	13.00	0.52	Aug.	53.8	0.53	6.81	94.73
18-Jul.	62.6	1.46	11.64	1.47	9-Sept.	6.8	0.44	13.14	0.50
19-Jul.	29.2	4.05	8.12	2.84	10-Sept.	21.8	1.24	7.21	0.77
31-Jul.	2.2	0.54	6.70	0.31	17-Sept.	6.2	0.48	9.10	0.38
Jul.	184.2	0.41	8.95	96.57	Sept.	51.2	0.57	7.49	110.17

Table 2

	Flux	Q	Ra	R1	R7	R14	REI	T_{air}-7	T_{air}-14	SMC-7	SMC-14
C_f	0.30	-0.01	0.30	-0.01	0.23	-0.05	-0.32*	-0.25	-0.24	-0.44**	-0.65**
Flux		0.94**	0.69**	0.76**	0.57**	0.29	-0.14	-0.07	-0.04	0.06	-0.24
Q			0.60**	0.85**	0.53**	0.33*	-0.07	-0.02	0.01	0.19	-0.03
Ra				0.38*	0.39*	0.14	-0.06	0.02	0.07	-0.05	-0.30
R1					0.58**	0.42**	-0.27	0.11	0.10	0.12	-0.01
R7						0.69**	-0.28	0.24	0.23	0.40**	0.02
R14							-0.20	0.19	0.13	0.56**	.420**
REI								-0.02	0.03	0.26	0.25
T_{air}-7									0.96**	0.09	0.20
T_{air}-14										0.09	0.17
SMC-7											0.79**

Note: ** (P<0.01), * (P<0.05).

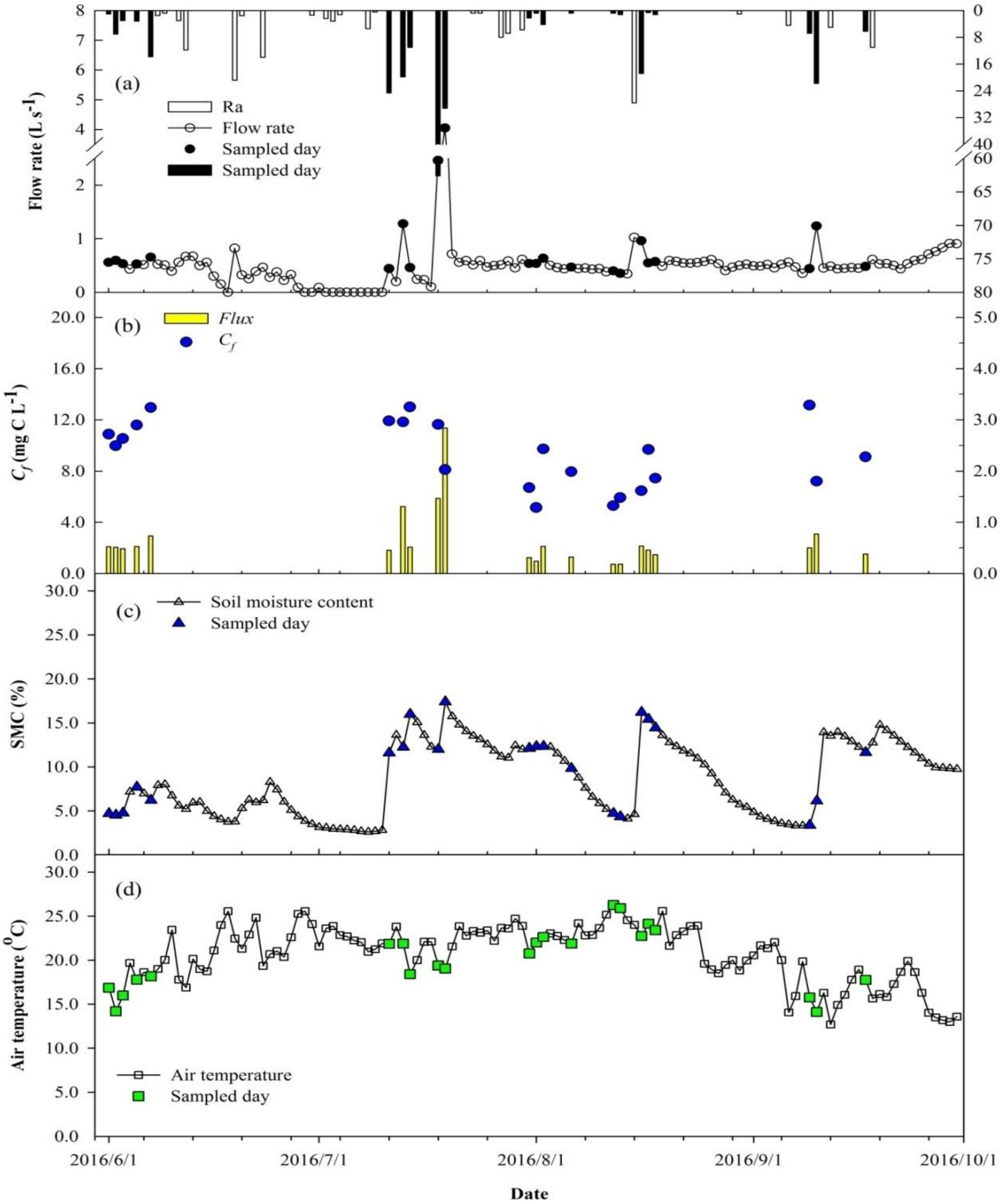
C_f: Flow-weighted mean concentration driven by an event, Flux: Event-driven DOC quantity,

Q: Total discharge volume, Ra: Total rainfall amount,

R1: Total rainfall amount in the 1 day before the current rainfall event,

R7: Total rainfall amount in the 7 days before the current rainfall event,
R14: Total rainfall amount in the 14 days before the current rainfall event,
SMC-7 and SMC-14: Soil moisture content in the 7 and 14 days before the current rainfall event,
T_{air}-7 and T_{air}-14: Mean air temperature in the 7and 14 days before the current rainfall event,
REI: Interval days between the current and last rainfall event.

Figure 2

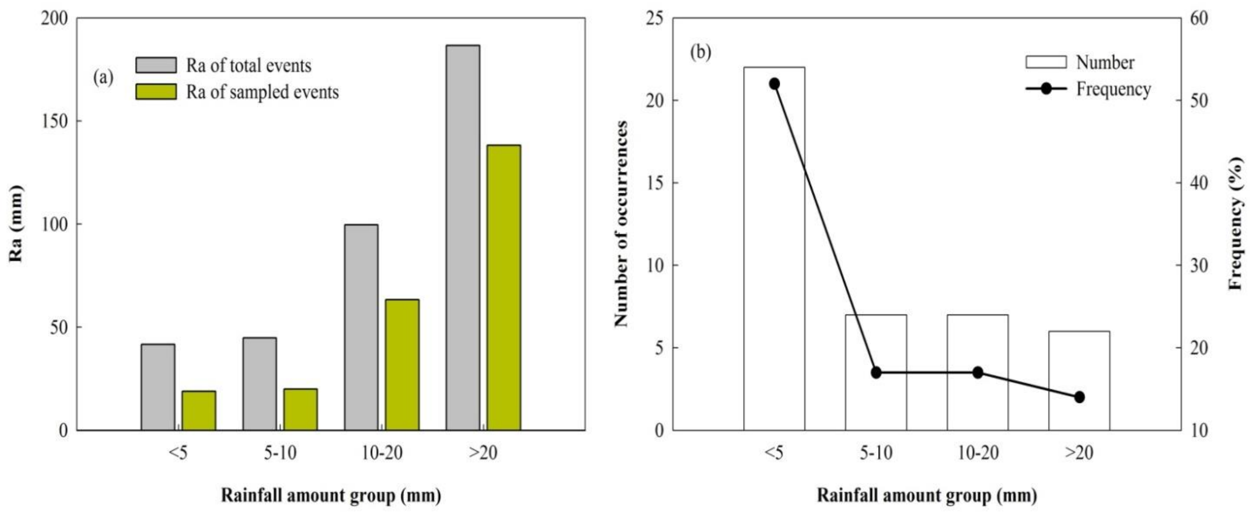


Comment 6. The authors should clarify the rainfall amount and rainfall intensity, which is important to class the rainfall events.

Response: Thanks for your suggestions. Indeed, the rainfall events were grouped by rainfall amount and the Figure 3 has been changed. According to Yang's results, the threshold of rainfall amount mean rainwater can effectively recharge the soil water in LPR, which may affect soil moisture content. This is why we selected this classification. Thus, we choose the parameter of rainfall amount to analyze in this manuscript.

Line 156-158: All the rainfall events in between June to September were grouped into four grades: <5 mm (Light rainfall), 5-10 mm (Moderate rainfall), 10-20 mm (Heavy rainfall), and >20 mm (Violent rainfall) according to rainfall amount classification (Yang et al., 2018).

Figure 3:

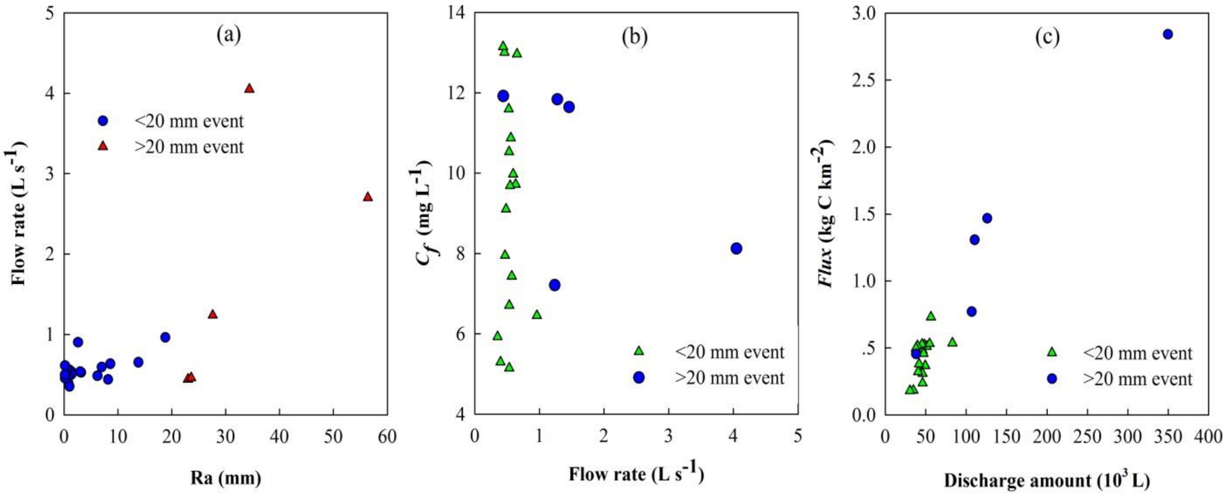


Comment 7. it is unclear about the time interval between these sampling times. If they want to conduct such analysis, they should check the original data to ensure the normal distribution.

Response: Thanks for your suggestions. details about sampling times showed in method part in Line 102-104. The regression was removed due to lack of data normal distribution and Figure 4 also has been changed accordingly.

Line 102-104: High-frequency monitoring was carried out in a rainfall event based hydrological process, thus the ISCO was set to acquire samples every 10 min from the first 12 runoff samples and another 12 were sampled every 30 min.

Figure 4



Comment 8. Conclusions. The findings of this study indicate that DOC concentrations were highly variable, particularly during low runoff discharge periods, granted, this belongs to the conclusion. The authors should think hard about the findings of this study and show that these findings are valuable.

Response: Thanks for your suggestions. The conclusion part has been rewritten and the details show in Line 327-342 of this manuscript.

Line 316-331: The DOC concentration and flux for individual rainfall events from a semi-arid catchment of the LPR was initially monitored during the concentrated rainfall season. DOC concentration showed a weak correlation with discharge, except in higher runoff discharge induced by extreme rainfall events. The findings of this study indicate that DOC concentrations were highly variable, particularly during low runoff discharge periods. Hysteresis analysis showed that the relationship between DOC concentration and runoff discharge for a rainfall event is nonlinear and varied with conditions in rainfall amount, discharge process. DOC flux increased with runoff discharge and showed a positive linear correlation with runoff discharge. These results showed that higher DOC flux with low DOC concentration related to higher discharge and its dilution effects in a hydrological process driven by larger rainfall amount. The diluted DOC concentration induced by increased discharges contributed slightly to difference in DOC flux, due to total runoff discharge is a major variable for flux. These results showed that the temporal variation magnitude of DOC is related to hydrological condition (Q and Ra) and antecedent condition (R1, R7 and SMC), and suggested that the event-driven DOC export is largely influenced by rainfall through direct effects on catchment hydrology and indirect effects on soil carbon cycles. Changes in catchment hydrology and soil carbon processes responded to climate change may play an important role in terrestrial carbon export, in particular for a restored catchment. Thus, further work should focus on carbon export response to various rainfall events at a larger spatiotemporal scale for better estimating future terrestrial carbon flux to aquatic ecosystem and evaluating carbon balance in ecological restored catchment in LPR. In addition, engineers and scientists can take advantage of the derived results to better develop advanced field monitoring work.

Other Changes:

We have revised the abstract part in Line 11-26. We also added discussion information in Line 261-271 and Line 304-314. The details show in the following part:

In Abstract **Line 11-26:** Dissolved organic carbon (DOC) transported by runoff has been identified as an important role of the global carbon cycle. Despite there being many studies on DOC concentration and flux, but little information is available in semi-arid catchments of the Loess Plateau Region (LPR). The primary goal of this study was to quantify DOC exported driven by a sequence of rainfall events during the concentrated rainfall season. In addition, factors that affect DOC export from a small headwater catchment will be investigated accordingly. Runoff discharge and DOC concentration were monitored at the outlet of the Yangjuangou catchment in Yanan, Shaanxi Province, China. The results showed that DOC concentration was highly variable, with event-based DOC concentrations ranging from 4.08 to 15.66 mg L^{-1}. Hysteresis analysis showed a nonlinear relationship between DOC concentration and flow rate in the hydrological process. The monthly DOC flux loading from the catchment was 94.73-110.17 kg km^{-2} from June to September, while the event-based DOC flux ranged from 0.18 to 2.84 kg km^{-2}. Variations of event-driven DOC concentration contributed slightly to a difference in DOC flux, whereas intra-events of rainfall amount and runoff discharge led to evident difference in DOC export. In conclusion, our case results highlighted the advantages of high-frequency monitoring for DOC export and indicated that event-driven DOC export is largely influenced by the interaction of catchment hydrology and antecedent condition within a catchment. Engineering and scientists can take advantage of the derived results to better develop advanced field monitoring work. In addition, more studies are needed to investigate the magnitude of terrestrial DOC export in response to projected climate change at larger spatiotemporal scale, which may have implication for the carbon balance and carbon cycle model from an ecological restored catchment in LPR.

Line 261 -271: For event-driven flux, the DOC flux is a function of total runoff discharge and DOC concentration (C_f). DOC flux showed a positive linear relationship with runoff discharges, which is not surprising and parallel with studies reported by Clark et al. (2007) and Ma et al. (2018). In addition, it should be noted that the DOC flux induced by larger rainfall amount was higher than flux driven by light rainfall, whereas the C_f showed no evident difference for the selected rainfall events. Thus, the greater DOC flux clearly showed that the DOC export was close linked to hydrologic process induced by various amount of rainfall event in LPR. For an ecological restored catchment in LPR, the soil carbon driven by increased vegetation was significantly increased and acted as a positive pathway to sequestration soil carbon on terrestrial ecosystem (Wang et al., 2011b). Meanwhile, the reduced hydrology responded to an increased vegetation may diminish soil carbon transported by hydrological process in a catchment. The event-driven DOC transport is an important component for evaluating carbon balance of the ecological restored catchment in LPR. Hence, further study should be long-term undertaking to investigate the hydrological response and its impact on terrestrial carbon loss from a catchment in LPR.

Line 304-314: DOC flux was significantly and positively correlated with Q, Ra, R1 and R7. The Q and Ra reflect the direct effect of current rainfall and hydrological processes during a rainfall event, while R1 and R7 refer to the antecedent rainfall conditions and reflect indirect effects on DOC export. These results agreed with previous studies demonstrated by Blaen et al. (2017), who noted that antecedent conditions and rainfall were key drivers of DOC export during a rainfall event. Cooper et al. (2007) also concluded that DOC export is largely governed by interactions between hydrological and meteorological factors and carbon biogeochemical process. Overall, these results suggested that rainfall is a key factor influencing hydrological process, and thus DOC export from an ecological restored catchment in LPR. Apart from the increased soil carbon driven by increased vegetation (Wang et al., 2011b), the weaken hydrological process induced by increased vegetation may also cause a less terrestrial carbon export from a catchment. Therefore, our results highlight the need for research not only into the hydrological process and soil carbon cycle, but the integration of carbon export driven by a sequence of rainfall events across spatiotemporal scales to understand the carbon balance in a restored catchment in LPR.