A) **Material and Methods**

1) Equation (9) and (11)of the standard deviation are wrong, and the denominator of the two equation should be "n" or "n+1", and please check other equations(Referee#1).

Response: Yes, the equation (9) and (11) in the manuscript are wrong, and we checked other equations and concluded the corrigendum as follows:

Former equations in manuscript	Revised equations in revision
Eq(9) $\varsigma\left(\bar{\delta}_{CP(j)}\right)=\sqrt{\sum_{j=1}^{n}\frac{\left(\delta_{CP(i,j)}-\bar{\delta}_{CP(j)}\right)^2}{6}}$	$\varsigma\left(\bar{\delta}_{CP(i\cdot j)_n}\right)=\sqrt{\sum_{j=1}^{n}\frac{\left(\delta_{CP(i,j)}-\bar{\delta}_{CP(i\cdot j)_n}\right)^2}{n}}\quad \begin{matrix} for\ n=1\sim 2 & DTW \\ for\ n=3\sim 7 & WTD \end{matrix}$ $\bar{\delta}_{CP(i,j)_n}$ is the mean relative difference of TSSM on CP of the *i* th microplot (*i*=1~16) at *j* th observation time (if *j*=*n*=1~2, then represented the DTW process; if *j*=*n*=3~7, then represented the WTD process) dimensionless, abbreviation of TSSM-MRD
Eq(11) $\varsigma\left(\bar{\delta}_{AP(j)}\right)=\sqrt{\sum_{j=1}^{n}\frac{\left(\delta_{AP(i,j)}-\bar{\delta}_{AP(j)}\right)^2}{6}}$	$\varsigma\left(\bar{\delta}_{AP(i\cdot j)_n}\right)=\sqrt{\sum_{j=1}^{n}\frac{\left(\delta_{AP(i,j)}-\bar{\delta}_{AP(i\cdot j)_n}\right)^2}{n}}\quad \begin{matrix} for\ n=1\sim 2 & DTW \\ for\ n=3\sim 7 & WTD \end{matrix}$ $\bar{\delta}_{AP(i,j)_n}$ is the mean relative difference of TSSM on AP of the *i* th microplot (*i*=1~16) at *j* th observation time (if *j*=*n*=1~2, then represented the DTW process; if *j*=*n*=3~7, then represented the WTD process) dimensionless, abbreviation of TSSM-MRD
Eq(8) $\bar{\delta}_{CP(j)}=(1/n)\sum_{j=1}^{n}\left(\frac{16\theta_{CP(i,j)}-\sum_{i=1}^{16}\theta_{CP(i,j)}}{\sum_{i=1}^{16}\theta_{CP(i,j)}}\right)$	$\bar{\delta}_{CP(i,j)_n}=\frac{\sum_{j=1}^{n}\left(\frac{16\theta_{CP(i,j)}-\sum_{i=1}^{16}\theta_{CP(i,j)}}{\sum_{i=1}^{16}\theta_{CP(i,j)}}\right)}{n}\quad \begin{matrix} for & n=1\sim 2 & DTW \\ for & n=3\sim 7 & WTD \end{matrix}$ $\varsigma\left(\bar{\delta}_{CP(i,j)_n}\right)$is the standard derivation of mean relative difference of TSSM on CP of the *i* th microplot (*i*=1~16) at *j* th observation time (if *j*=*n*=1~2, then represented the DTW process; if *j*=*n*=3~7, then represented the WTD process) dimensionless abbreviation of TSSM-STD
Eq(10) $\bar{\delta}_{AP(j)}=(1/n)\sum_{j=1}^{n}\left(\frac{16\sum_{p=1}^{4}\theta_{AP(i,j,p)}-\sum_{i=1}^{16}\sum_{p=1}^{4}\theta_{AP(i,j,p)}}{\sum_{i=1}^{16}\sum_{p=1}^{4}\theta_{AP(i,j,p)}}\right)$	$\bar{\delta}_{AP(i,j)_n}=\frac{\sum_{j=1}^{n}\left(\frac{16\sum_{p=1}^{4}\theta_{AP(i,j,p)}-\sum_{i=1}^{16}\sum_{p=1}^{4}\theta_{AP(i,j,p)}}{\sum_{i=1}^{16}\sum_{p=1}^{4}\theta_{AP(i,j,p)}}\right)}{n}\quad \begin{matrix} for & n=1\sim 2 & DTW \\ for & n=3\sim 7 & WTD \end{matrix}$ $\varsigma\left(\bar{\delta}_{AP(i,j)_n}\right)$is the standard derivation of mean relative difference of TSSM on AP of the *i* th microplot (*i*=1~16) at *j* th observation time (if *j*=*n*=1~2, then represented the DTW process; if *j*=*n*=3~7, then represented the WTD process) dimensionless, abbreviation of TSSM-STD

Specifically, the different ranges of the value of *n* evaluated by *j* represent the different hydrological processes, which was beneficial to determining the calculation methods of TSSM-MRD and TSSM-STD over WTD and DTW processes. Moreover, we further interpreted the meaning of TSSM-MRD and TSSM-STD both of which composed a part of TSSM indices and represented different characteristics of TSSM in finer spatiotemporal scales.

First of all, the distribution of soil water in 16 microplots varies with the different observational periods, which formed the various spatial patterns of soil moisture over the whole hydrological processes (from DTW to WTD), if we regarded the average soil moisture over the change processes occurred in the spatial patterns of soil moisture as one of indicator to evaluate the characteristic of TSSM, then the TSSM-MRD indicates the fluctuation of every measuring point compared with the average value over a different hydrological processes (DTW or WTD) at distinct positions (CP or APs). Furthermore, the more closely the absolute value of TSSM-MRD in some microplot approaches to zero over specific hydrological process, the more likely the corresponding soil moisture represented the average soil moisture of all mcrioplots distributing on the whole spatial patterns over the corresponding interval, which could reflect one of characteristics in TSSM.

And as the standard derivation of TSSM-MRD, TSSM-STD reflects the fluctuation of TSSM-MRD in a specific microplot over specific interval, which represents the fluctuant degree of given specific soil moisture to the average soil moisture derived from the spatial change processes of soil moisture in all microplots during the corresponding hydrological process. If the absolute value of TSSM-STD in a given microplot approaches zero more closely, then it is considered to be better representing the lower fluctuant of TSSM-MRD, and higher stability process over which the corresponding soil moisture gradually closed to the whole-spatial-pattern average soil moisture. Therefore TSSM-STD also reflects one of features in TSSM. And some of related interpretations and equation revisions were rewrote in *2.2.2 Quantification of TSSM* of revised manuscript.

2) It is not clear to me why the different parameters WP_n,WD_n,…..are defined and what they represent, a clear definition of these parameters and why the authors intend to use these specific values to characterize the soil moisture dynamics is missing (Referee#1).

Response: According to the suggestion of referee #1, we tried to interpret two questions:

(1) What is the definition of derivate parameters of ET-TSSM model?

Evapotranspiration process indicates the dynamic change of soil moisture in WTD processes, and TSSM reflects the temporal stability of soil moisture in different spatial patterns. The combination of evapotranspiration application and the TSSM concept composed the framework of ET-TSSM model in terms of bringing the TSSM parameter (θ_S) into evapotranspiration curves (ET curves). Therefore, the processes of deducing these seven derivate parameters was divided into seven steps: a) the selection of TSSM parameter (θ_S) from three TSSM indices; b) the construction of evapotranspiration curve (ET curve) of different land uses/covers over WTD process; c) the deduction of $t_{s(m)}$ from ET curve and θ_S; d) the deduction of WP_m by integral of curve, t_0 and θ_S; e) the deduction of WD_m by integral of curve, t_e and θ_S; f) the deduction of $\Delta\theta_m$ by subtraction between WP_m and WD_m; g) the deduction of $t_{c(m)}$ and $\theta_{c(m)}$ by ET curve and $\Delta\theta_m = 0$ condition. And the physical significance of each parameter showed in a table as follow:

Parameters	Deduction components	Physical significance
θ_S	TSSM-MRD TSSM-STD TSSM-CumuP	This parameter represents the soil moisture of a specific microplot over a specific hydrological process based on the four selection principles[a] which indicated the physical significance of this parameter. It means that the corresponding soil moisture not only has the same rank order distribution of all microplot over different hydrological processes, but also likely has least fluctuation from the average soil moisture of all mcrioplots distributing on the whole spatial patterns over the WTD and DTW hydrological processes. This parameter, in this paper, connected the TSSM concept with distinct hydrological functions owned by different land uses/cover microplots, which was the first step to evaluate the temporal characteristics of soil moisture under finer spatiotemporal scale in terms of ET-TSSM model.
$t_{s(m)}$	θ_S ET Curve	$t_{s(m)}$ represents how quickly the soil moisture of the four different land uses/cover reached the TSSM condition which indicated the soil moisture was most close to the average soil moisture of all mcrioplots distributing on the whole spatial patterns over the WTD processes with lowest temporal fluctuant. It also could be regarded as the threshold of soil moisture coming from temporal stability condition to fluctuant conditions.
WP_m	θ_S $t_{s(m)}$ t_0 ET Curve	WP_m represents the cumulative effect of the soil moisture in different land uses/cover on the observational time when the soil water contents decreased from the relative saturation conditions ($\theta_m(t_0)$) to the same TSSM condition (θ_S). Compared with the average amount of soil moisture of all mcrioplots distributing on the whole spatial patterns over the WTD processes, WP_m could reflect the possibility that the soil water storage of a specific land uses/cover is under the “water profit” condition before the soil water reached the threshold of the temporal stability condition $t_{s(m)}$

WD_m	θ_S $t_{s(m)}$ t_e ET Curve	WD_m represents cumulative effect of the soil moisture from TSSM condition (θ_S) to the end of WTD process $\theta_m(t_e)$, Compared with the average amount of soil moisture of in whole spatial pattern, WD_m reflects the possibility of the soil water storage of a given land uses/cover being under the "water deficit" condition with the continuous decrease of soil moisture.
$\Delta\theta_m$	WP_m WD_m	$\Delta\theta_m$ was defined as the different extents of the soil moisture transforming "water profit" condition to "water deficit" condition in four types of land uses/cover microplots during the WTD process.
$t_{c(m)}$	$\Delta\theta_m$ ET Curve	$t_{c(m)}$ represent that how quickly the soil moisture condition of the four different land uses/cover transformed the "water profit" into "water deficit" and finally reaching into the "profit-deficit offset" condition ($\Delta\theta_m = 0$) during the WTD process. The parameter also could be regarded as the temporal thresholds of the soil water storage balance owned by different land uses/cover, which was used to evaluate the different abilities to soil water conservation of these land uses/cover based on the application of TSSM concept to the specific evapotranspiration process.
$\theta_{c(m)}$	$\Delta\theta_m$ ET Curve	$\theta_{c(m)}$ was defined as the corresponding soil moisture of the specific microplot whose soil water water content transformed the "water profit" into "water deficit" and finally reaching into the "profit-deficit offset" condition ($\Delta\theta_m = 0$) in the WTD process.

[a]: Four principles include 1) The absolute value of TSSM-MRD in the selected microplot should be lowest than others; 2) The absolute value of TSSM-STD should also be lowest; 3) The difference between the TSSM-CumP values of the soil moisture in the selected microplot should be less than 0.1; 4) Based on Principle 3), the TSSM-CumP value in the selected microplot should be close to 0.5.

And the related interpretations were revised in *2.2.3 Evapotranspiration-TSSM model (ET-TSSM)* of revised manuscript.

(2) Why did we use these parameters to characterize the soil moisture dynamics?

The purpose of using these parameters to characterize the soil moisture dynamics was exploring an approach to introduce the TSSM concept into the specific hydrological processes under finer spatiotemporal scale. ET curve indicates the dynamic change of soil moisture in WTD processes, and TSSM parameter reflects the temporal stability of soil moisture in different spatial patterns, both of which deduced the seven parameters by means of the ET-TSSM model. This combination at least has two advantages on characterizing the soil moisture dynamics. Firstly, from the view of TSSM, ET-TSSM model actually enriched the implication of TSSM concept through expanding this concept on specific evapotranspiration processes of different vegetation-land uses, and quantificationally evaluated the temporal characteristics of soil moisture dynamic in these vegetation land in terms of some values of these ET-TSSM model parameters; Secondly, from the view of evapotranspiration or WTD process, ET-TSSM model further particularized the time variable of ET functions formed by different land uses/cover, which was the result of the determination of ET-TSSM parameters including $t_{s(m)}$ and $t_{c(m)}$. Specifically, based on the ET-TSSM model, the TSSM-trait evapotranspiration processes finally characterized that the soil moisture of the four different land uses/cover transformed the temporal fluctuant condition into TSSM condition and at last reaching into the fluctuant condition again, which was probably a new aspect to understand the hydrological processes.

3) Difficult to understand the figure 2 and its equation and symbols(Referee#1)

Response: We revised in figure 2 in manuscript more understandable and changed the symbols, moreover we supplemented new figure in revised manuscript to describe the relationship between TSSM indices—including TSSM-MRD, TSSM-STD and TSSM-CumP—and the derivate parameters of ET-TSSM model, which could probably sketch the general formational process of ET-TSSM.

4) Thirdly, the sentence "some evapotranspiration curves are fitted to the data," but which curves are employed? Which type (linear, polynomial power)? Which are the parameters of these curves? I strongly suggest describing the main rationale behind the proposed ET-TSSM model at the beginning of this section.(Referee#1)

Response: With respect to the evapotranspiration curves fitting, we mainly fitted the ET curve by using composite function way $(f \circ g)(t) = f(g(t))$ to describe the relationship between soil water content and time. Specifically, $\theta_m(t)$ was the composite function of time which was composed of exponential function ($g(t) = a^t$) and linear functions ($f(t) = bt \pm c$), and the parameters *a*,*b* and *c* are all constants. Compared with other function fitting patterns such as linear, polynomial power, logarithmic and exponential types, composite function could have higher degree of the explanation of the variables (higher value of R) and lower value of P. In the revised manuscript, we supplemented the value of *P* and *m* in the table 4, and according to referee #1's suggestion, we also briefly interpreted the fitting type of ET curves in *2.2.3 Evapotranspiration-TSSM model (ET-TSSM)* of revised manuscript.

5) Rewritten all the equation in a general form(Referee#1)

Response: We rewrote all the equation in a general form in revised manuscript.

B) **Results**

6) Another important drawback of this study is that a single DTW (and WTD) period is analyzed. This is not sufficient to understand the real soil moisture dynamics as the recession of soil moisture varies a lot during different WTD periods as a function of climate forcing (e.g. higher/lower evapotranspiration). The analysis of a single WTD period can only characterize a single recession period and it can be hardly generalized to understand the overall soil moisture behavior. This issue should be underlined in the paper and, possibly, different WTD periods should be analyzed in previous studies *Wang et al. (2012, 2013)*, the same authors analyzed continuous soil moisture time series obtained from fixed probes in the same study area. This data could be used to better generalize (if possible) the soil moisture behavior through the ET-TSSM model (Referee#1)

Response: We admitted that a single WTD and DTW process may not be enough, and agreed it was the limitation of the study, which, as the referee #1's mention, could hardly generalized to understand the overall soil moisture behavior. However, we had to interpret the reason for analyzing only a single WTD and DTW process, due to some of reasons been caused by some uncontrollable natural factors. There actually existed at least two limitations to our determining more DTW and WTD processes in this paper.

The first limitation is the field experimental condition. The precipitation mainly occurs between June and September which is the rainy season of the study region. The difference distribution of inter-monthly precipitation, to some extent, was difficult for us to acquire a whole DTW/WTD processes by using TDR to measure the soil moisture. As to all of different land uses/cover microplots, we expected to select a series of soil moisture whose hydrological response on precipitation and radiation could form obvious response pulses during an ideal DTW/WTD processes, however, in reality, this expectation was difficult to come true in both WTD and DTW processes. Specifically, on the one hand, due to being lack of enough precipitation or rainfall duration, the hydrological response of soil moisture on precipitation was not obvious during the DTW process; On the other hand, because of being short of enough radiation duration after heavy precipitation or long rainfall duration, the hydrological response of soil moisture on radiation was not obvious over the WTD period. Therefore, the probability to find out a whole and ideal DTW/WTD processes became smaller under the actual field experimental condition.

The second limitation is the CP/APs sampling strategy. We employed the FieldScout TDR 300 Soil Moisture Meter owning two 10cm length probes to insert into the CP or APs in every measuring time. Although we took some ways—designating the CP/APs circle areas, removing and recovering the litter layer condition as well as mending the disturbing holes—at different stages of measuring processes, the inevitable disturbance of the soil surface layer could be intensified if we increased the frequency of soil moisture measuring during other DTW/WTD processes, and finally lead to the increase of the system error. That is the why we reduced the measuring time after a whole and ideal DTW/WTD processes (from 2012/7/8 to 2012/8/20) of soil moisture data logging. Consequently, reducing the frequency of soil layer disturbance was an anther important limitation factor.

Essentially, the determination of WTD and DTW processes represented the downscaling the temporal scale, and the designing of CP/APs sampling was aim to downscale the spatial scale, both of which composed a fine spatiotemporal scale of TSSM study. Due to the scale and content of this study being different from former TSSM studies, especially when we integrated the TSSM concept with WTD/DTW process to analyze the hydrological characteristics of different land uses/cover depended on the construction of ET-TSSM model, this study was probably seemed to have more exploratory characteristics rather than being merely an experiment-driven paper. Therefore, although the one typical WTD/DTW processes could hardly generalize overall soil moisture behavior and supplied limited data with the ET-TSSM model, the seven deduced parameters by means of the ET-TSSM model enriched the implication of TSSM concept and further particularized the time variable of ET functions, which could be regarded as the first step to understand the hydrological processes affected by different land uses/cover from a new aspect. However, we definitely accepted referee #1's suggestion, and in the "*limitation and uncertainties*" of the discussion section of revised manuscript, we mentioned the limitation of one WTD/DTW processes, and point out that increasing the soil moisture data to the application of ET-TSSM model was one of direction of future TSSM-study.

In addition, referee #1 also mentioned the previous study of soil moisture in the Yangjuangou Catchment (*Wang et al. (2012, 2013)*), we also listed the similarities and differences of Wang's study and ours in a table to discuss with referee #1.

difference	Wang et al.,(2012) in HESS	Zhou et al.,(2013) in HESSD
research contents	systematically described the evapotranspiration processes curves of different land uses and soil moisture pulses curves over multiply WTD and DTW processes, analyzed the relationship between other soil information (such as temperature) and soil moisture as well.	analyzed the probable influencing factors of the TSSM under the finer spatiotemporal condition, and further combined the TSSM characteristics with one WTD and DTW processes in terms of model construction,
research methods	applied HOBO automatic soil moisture-temperature logger system to monitor the soil moisture and temperature on different soil layers at programmable interval, which could collect huge number of soil moisture and temperature data under unmanned condition.	applied TDR apparatus to collect the soil moisture data on fine spatiotemporal scale in terms of the CP/APs sampling (fine spatial scale) designing and a WTD/DTW processes (fine temporal scale) partition, which limited by the field experimental condition
similarity	Based on the different land uses/cover condition, both of them focused on the hydrological response of soil moisture on the precipitation and radiation, and describe the soil moisture pulses over the WTD and DTW processes.	

Therefore, compared with the systematically description of the response characteristics of soil moisture in Wang's research, in this study, we paid more attention to quantificationally particularize these hydrological response characteristics through introducing the TSSM concept into specific DTW/WTD processes, and to emphasize the soil moisture pulses of different land uses/cover influenced by the evapotranspiration process by enriching the TSSM concept as well as detailing the time variable of ET function. Theoretically, in Wang's study, the huge number of soil moisture collected by automatic soil moisture-temperature logger could be supplied with the ET-TSSM model of this study, but these data should be collected in some ideal DTW/WTD period over which the soil moisture have obvious hydrological responses on the precipitation and radiation. And actually, not all of the soil moisture collected by automatic satisfied with the condition, therefore, further selection of these soil moisture data was required before applying them on ET-TSSM model, which was also the next study of TSSM. And the related indication of the limitation was added in the 4.4 *Limitation and uncertainties* of the revised manuscript.

C) **Discussion**

7) Related to the above issue, the generalization described in Figures 10, 11 and 12 is not clear. Many information are provided in these figures and probably it is not sufficient a paper for describing them. The description of the hydrological processes provided in these figures and in the corresponding text is too general and is not really related to the results reported in the study. In my opinion, this part should be removed or strongly smoothed(Referee#1)

Response: Firstly, in order to help readers to understand the difference between the former TSSM studies and TSSM studies processes in this study more clearly, we readjusted the figure 10 in manuscript to the introduction section in revised manuscript, which could assist word description to illuminate the framework of finer spatiotemporal scale of TSSM research. Secondly, according the referee #1's suggestion, we smoothed the figure 11 and 12, only retained the description of WTD/DTW processes, and deleted some vague expressions such as "water input pattern", "direct response" and "indirect response" in figure 11 and 12. We changed them into "upon the ground", "on the surface" and "under the ground" correspondingly, which could correspond to the content of new table (as follow)—Table *Main influencing factors of WTD/DTW processes*—added in the discussion section. Meanwhile, we combined the table with "*Table2 main characteristics of TSSM parameters in hydrological processes*" "*Table4 characteristics of parameters derived from ET-TSSM model*", figure 11 and figure 12 in manuscript to analyze the effects of these influencing factors on the WTD/DTW processes, all of which could be beneficial to explaining the effect of hydrological processes on CP/AP sampling-trait TSSM under different land uses/cover condition.

D) **Others:** Language problem and grammatical flaws (#1#2#MA)

Response: We will carefully exam the grammatical flaws and try to make correct and clear expression in this paper.

Main influencing factors of WTD/DTW processes										
DTW		Plot1		Plot2		Plot3		Plot4	
	Partitions	HE	HB	HE	HB	HE	HB	HE	HB
CP	UPG	×	×	CS	Int(-)	CS	Int/Thf (-/+)	CS	Int/Stf/Thf(-/+/+)
	OSF	SS	RF/Inf (-/+)	CS/SS	Inf(+)	SS/TNLL/MRS	Inf/Cons (+/-)	SS/TKLL/MRS	Inf/Cons(+/-)
	UDG	SubS	Inf(+)	SRSD/SubS	Inf(+)	DRSD/SubS	Inf(+)	DRSD/SubS	Inf(+)
AP	UPG	×	×	CS	Int(-)	CS	Int/Thf(-/+)	CS	Int/Stf/Thf(-/+/+)
	OSF	SS	RF/Inf(-/+)	CS/SS	Inf(+)	SS/TNLL	Inf/Cons(+/-)	SS/TKLL	Inf/Cons(+/-)
	UDG	SubS	Inf(+)	SRSD/SubS	Inf(+)	DRSD/SubS	Inf(+)	DRSD/SubS	Inf(+)
WTD									
CP	UPG	×	×	CS	TR(-)	CS	TR(-)	CS	TR(-)
	OSF	SS	EV(-)	CS/SS	EV(-)	SS/TNLL/MRS	EV/Cons(-/+)	SS/TKLL/MRS	EV/Cons(-/+)
	UDG	SubS	×	SRSD/SubS	Asm/HL(-/?)	DRSD/SubS	Asm/HL(-/?)	DRSD/SubS	Asm/HL(-/?)
AP	UPG	×	×	CS	TR(-)	CS	TR(-)	CS	TR(-)
	OSF	SS	EV(-)	CS/SS	EV(-)	SS/TNLL	EV/Cons(-/+)	SS/TKLL	EV/Cons(-/+)
	UDG	SubS	×	SRSD/SubS	Asm/HL(-/?)	DRSD/SubS	Asm/HL(-/?)	DRSD/SubS	Asm/HL(-/?)

HE: Hydrological Environment; HB: Hydrological Behavior; UG: Upon the Ground; OSF: On the Surface; UDG: Under the Ground

SS: Surface Soil; SubS: Subsurface Soil; CS: Canopy Structure; SRSD: Shallow Root System Distribution; DRSD: Deep Root System Distribution; TNLL: Thin Litter Layer; TKLL: Thick Litter Layer; MRS: Main Root System

RF: Runoff; Inf: Infiltration; Int: Interception; Thf: Thoughfall; Stf: Stemflow; Cons: Conservation by Litter layer ; EV: Evaporation; TR: Transpiration; Asm: Absorption of soil moisture by root system distribution; HL: Hydrological Lift

+: Positive effect on the increment of soil water by different hydrological behaviors; -: Negative effect on the increment of soil water by corresponding hydrological behaviors;

?: Unknown effect on the increment of soil water by hydrological lift