Impacts of terracing on hydrological processes: a case study in Wangmaogou watershed of the Loess Plateau

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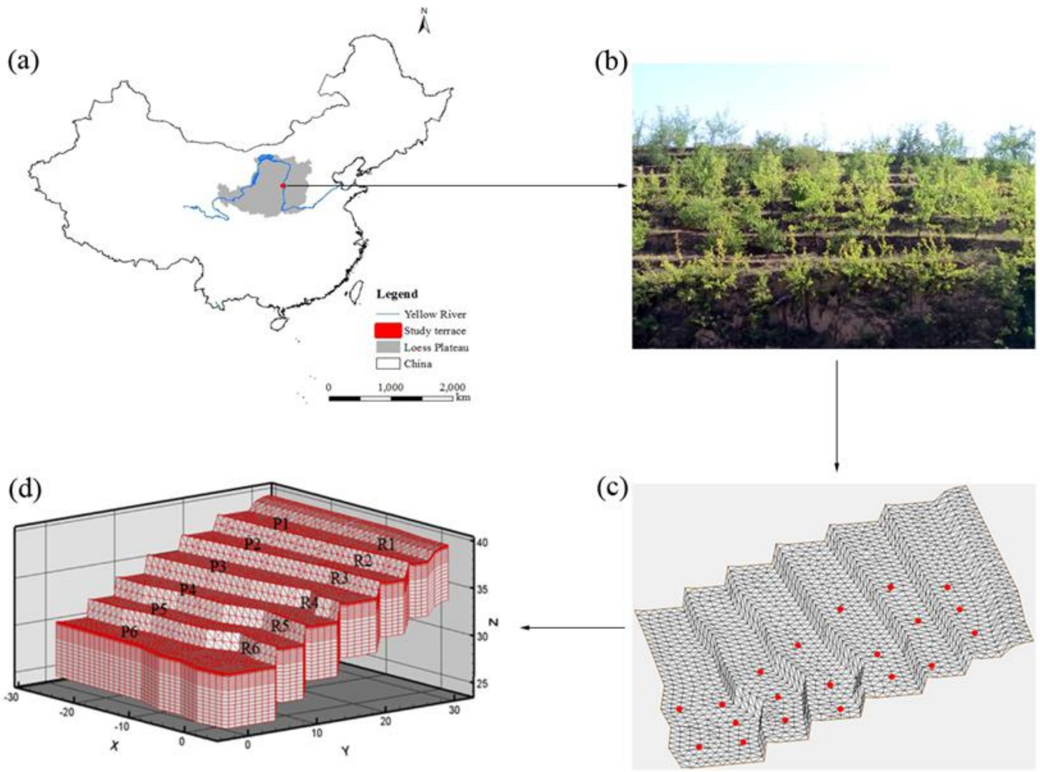
Contents

1. Background

- field experiments → numerical simulation (InHM)
- the effects of terracing practices on runoff and erosion → the redistribution of rainfall by terrace in the Loess Plateau of China (runoff + evapotranspiration + water storage)

2. Materials and methods



Study area:

a terrace in Wangmaogou (1327.95 m^2)

Avaliable data:

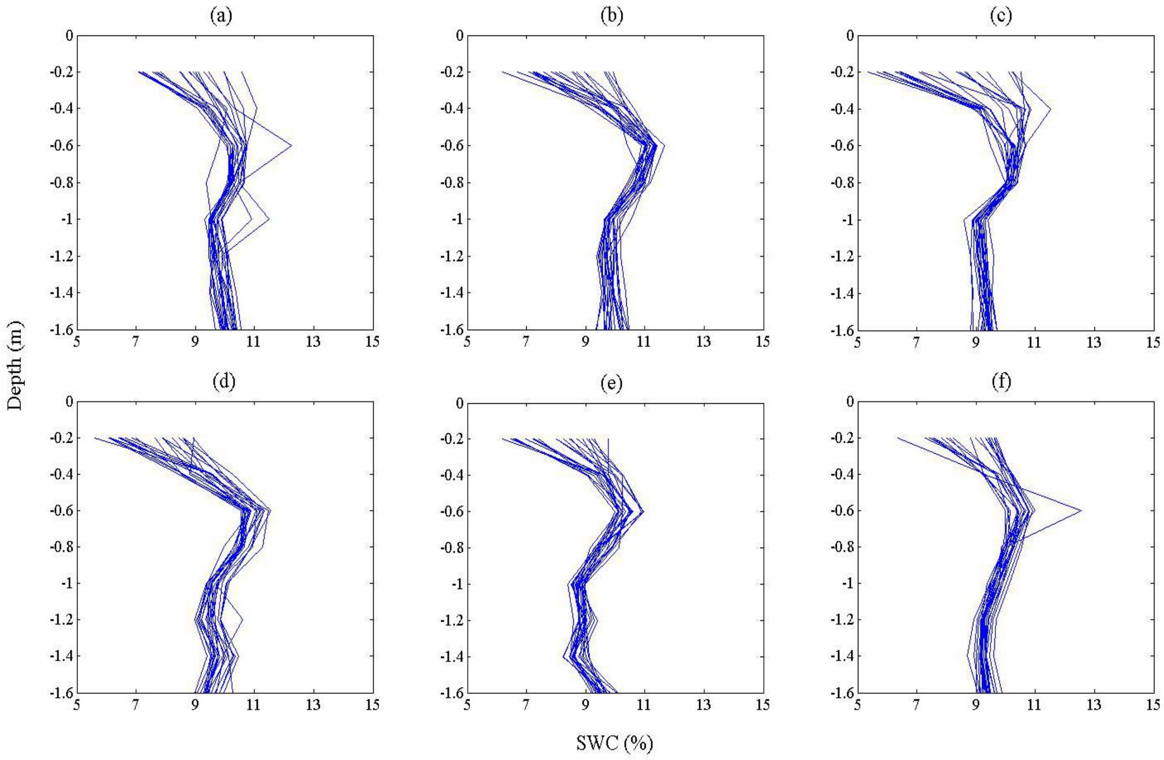
1. soil properties

2. soil water content (SWC):
   2015.08.01-2015.08.31, 21 nodes
   down to -1.6m
   (at 0.2m intervals, L1-L8)

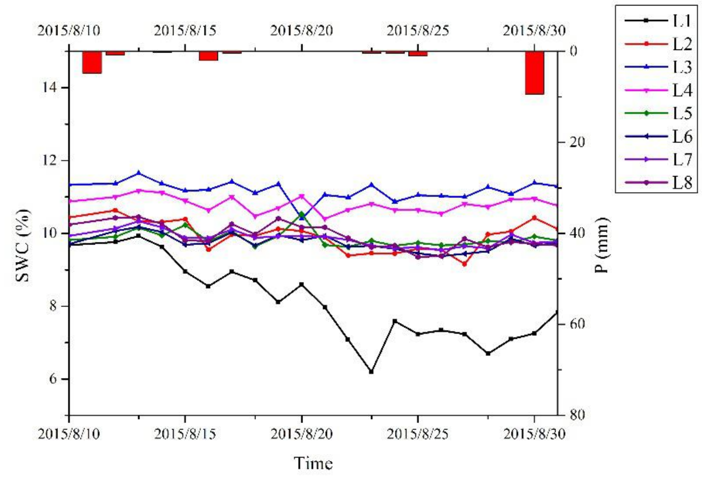
3. rainfall data:
   2015.08.10-2015.08.31
   (every 5 minutes)

4. parameters for reference evapotranspiration calculating:
   FAO56 Penman-Monteith formula

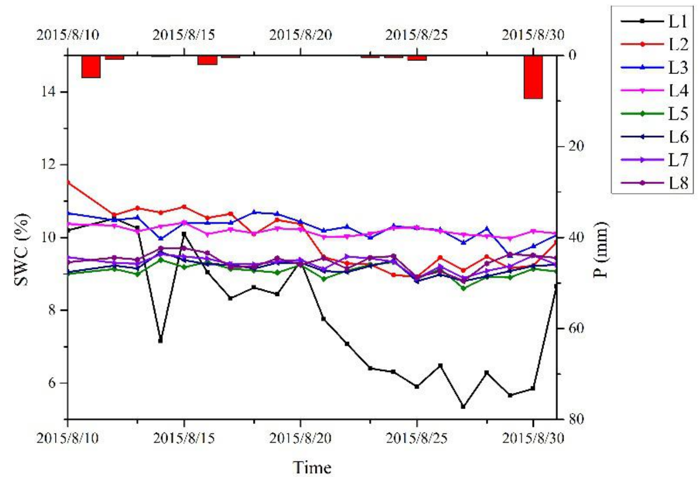
3.1 Measured SWC distribution characteristics



Measured SWC distribution from 10th August to 31st August 2015, (a) to (f) represent 6 platforms from bottom to top separately



Measured SWC distribution in P2



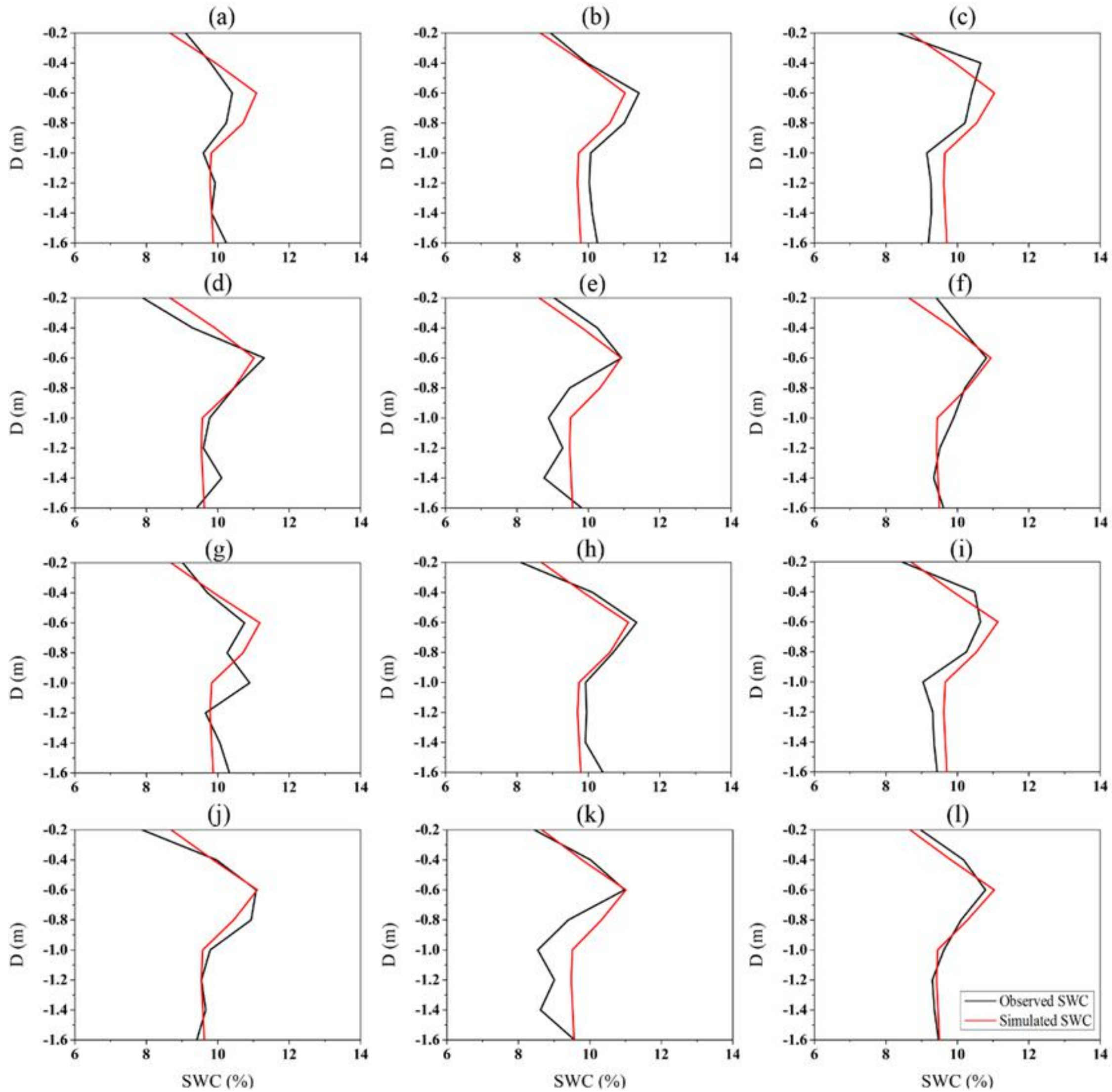
Measured SWC distribution in P3

3.2 Calibration and validation

Table 1: Parameters for the initial condition and calibrated results: soil depth (D), saturated hydraulic conductivity (Ks), soil porosity (∅), parameter needed in soil moisture characteristic curve (α), parameter needed in soil moisture characteristic curve (n), and residual water content (θ_r).

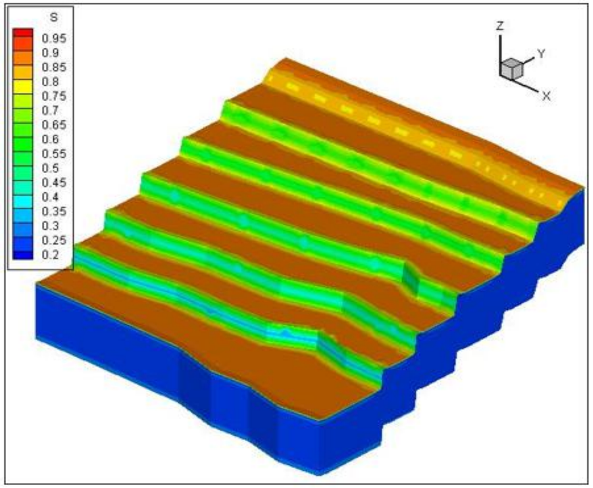
Zone	Initial condition			Calibrated result		
	1	2	3	1	2	3
D (m)	0 - 0.2	0.2 - 0.4	> 0.4	0 - 0.2	0.2 - 0.4	> 0.4
K_s (m/s)	4.44×10^{-6}	5.46×10^{-6}	1.61×10^{-6}	4.44×10^{-6}	2.73×10^{-6}	1.61×10^{-6}
∅ (m^3/m^3)	0.44	0.40	0.44	0.44	0.40	0.44
α (m^{-1})	1.91	1.40	1.40	1.91	1.40	1.40
n (-)	1.72	1.71	1.66	1.72	1.71	1.66
θ_r (m^3/m^3)	0.08	0.08	0.10	0.05	0.07	0.09

3.2 Calibration and validation

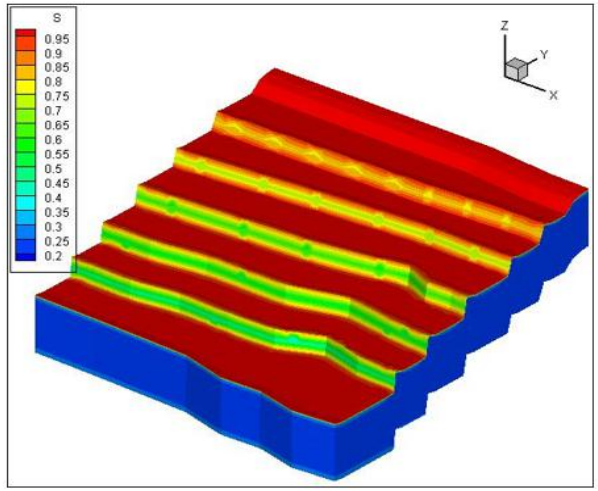


Example of the comparison between observed and simulated vertical distribution of SWC at six platforms from P1 to P6 on 17th August (calibration) (a - f); and on 19th August (validation) (g - l).

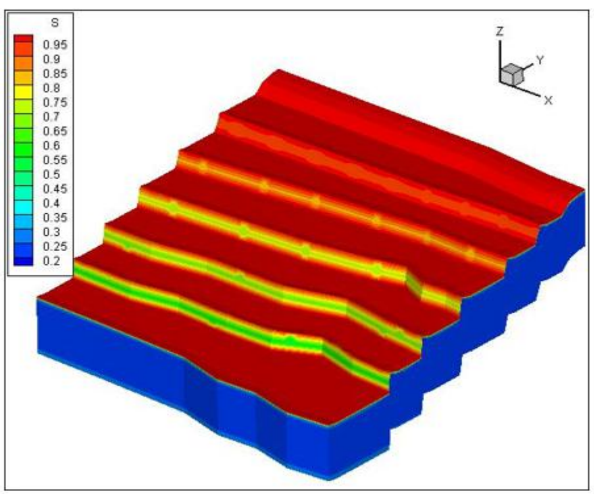
3.3 Sensitivity analysis



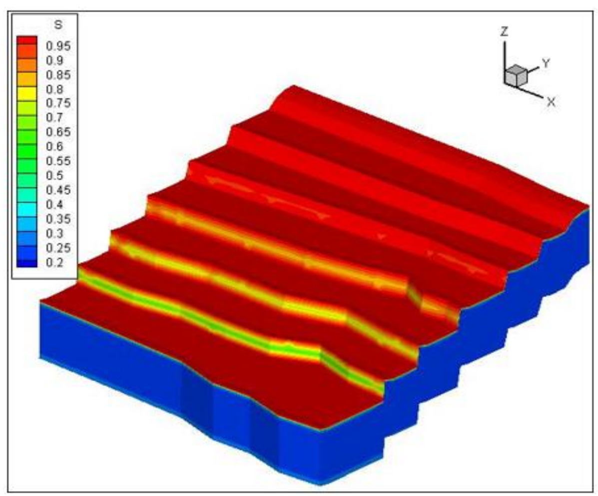
30 mm/h (a)



60 mm/h (b)



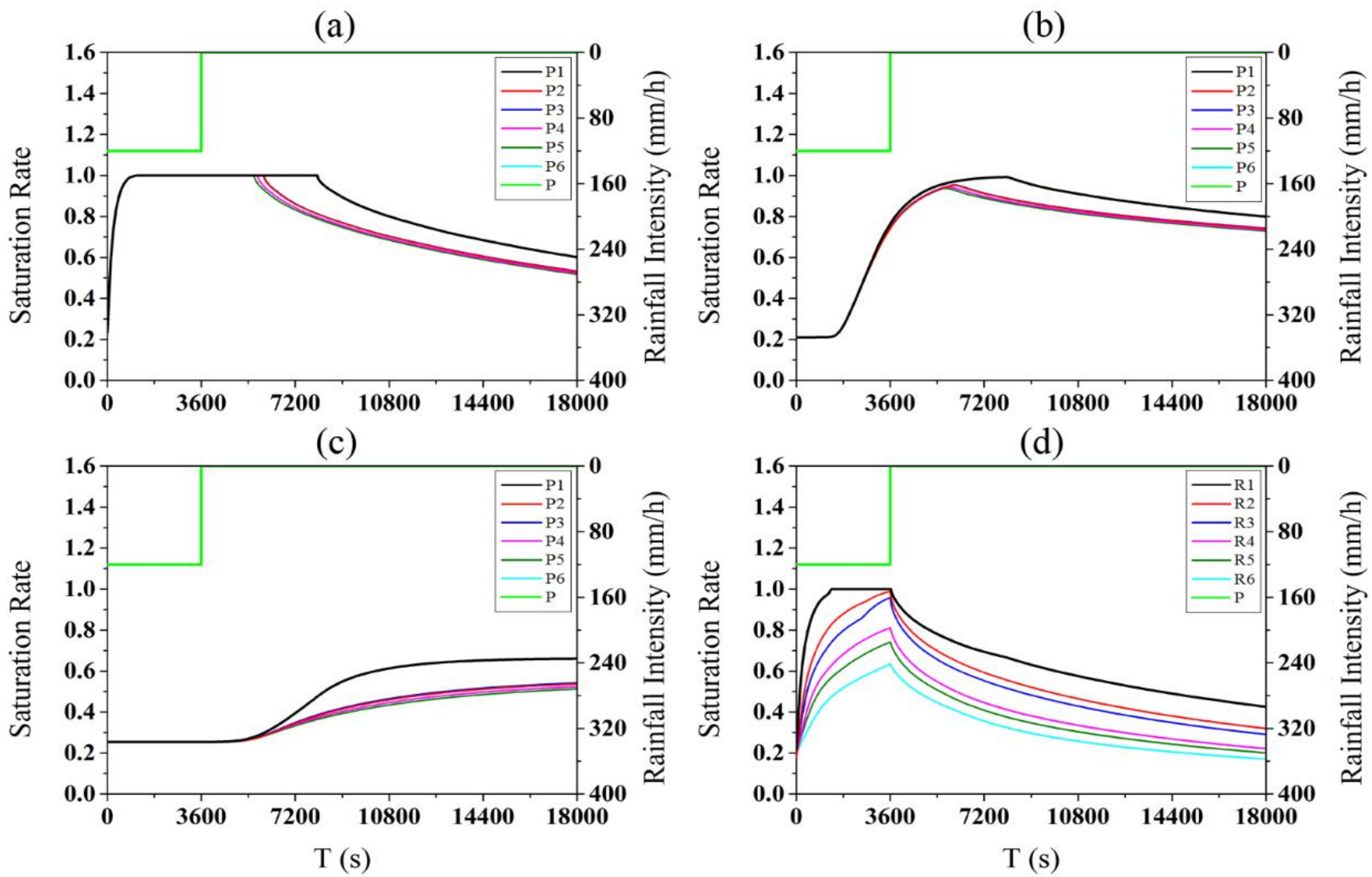
90 mm/h (c)



120 mm/h (d)

Simulated SWC distribution characteristics after different rainfall lasted for 1h

3.3 Sensitivity analysis

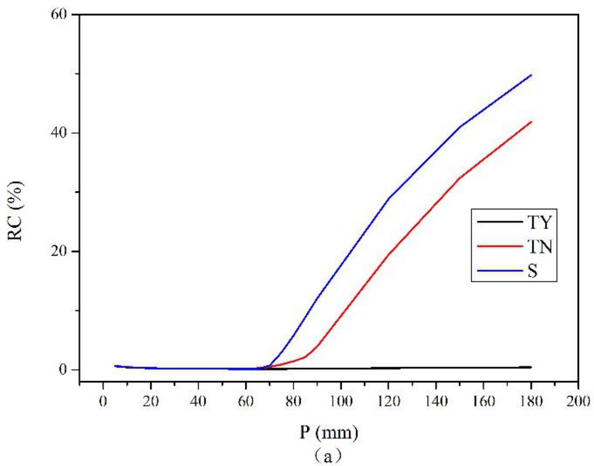


Simulated soil saturation at different depth of platforms or risers under the rainfall event with largest intensity (120 mm/h): : (a) surface (0 m) of platforms, (b) D1 (0.2 m below surface) of platforms, (c) D2 (0.4 m below surface) of platforms; and (d) surface of risers.

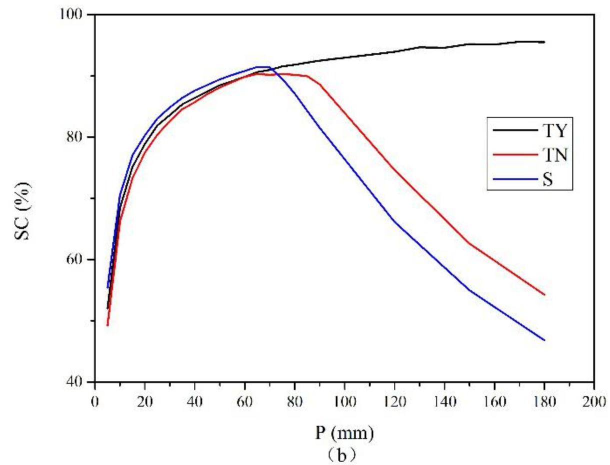
3.4 Redistribution of rainfall by terrace on event time scale

➢ 21 different rainfall intensity from 5 mm/h to 180 mm/h
(5, 10, 15, …, 85, 90, 120, 150, 180 mm/h)

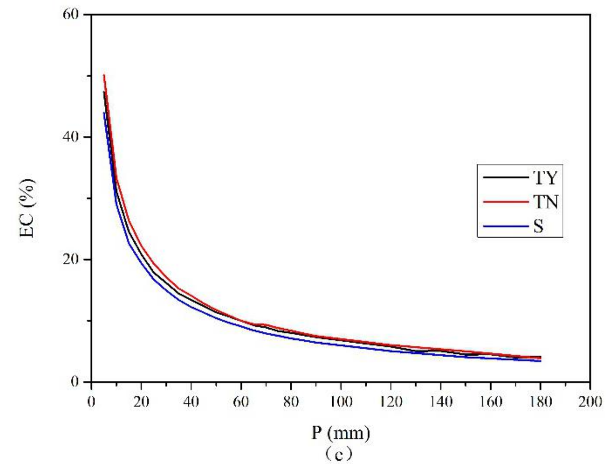
➢ Rainfall duration: 1h



runoff



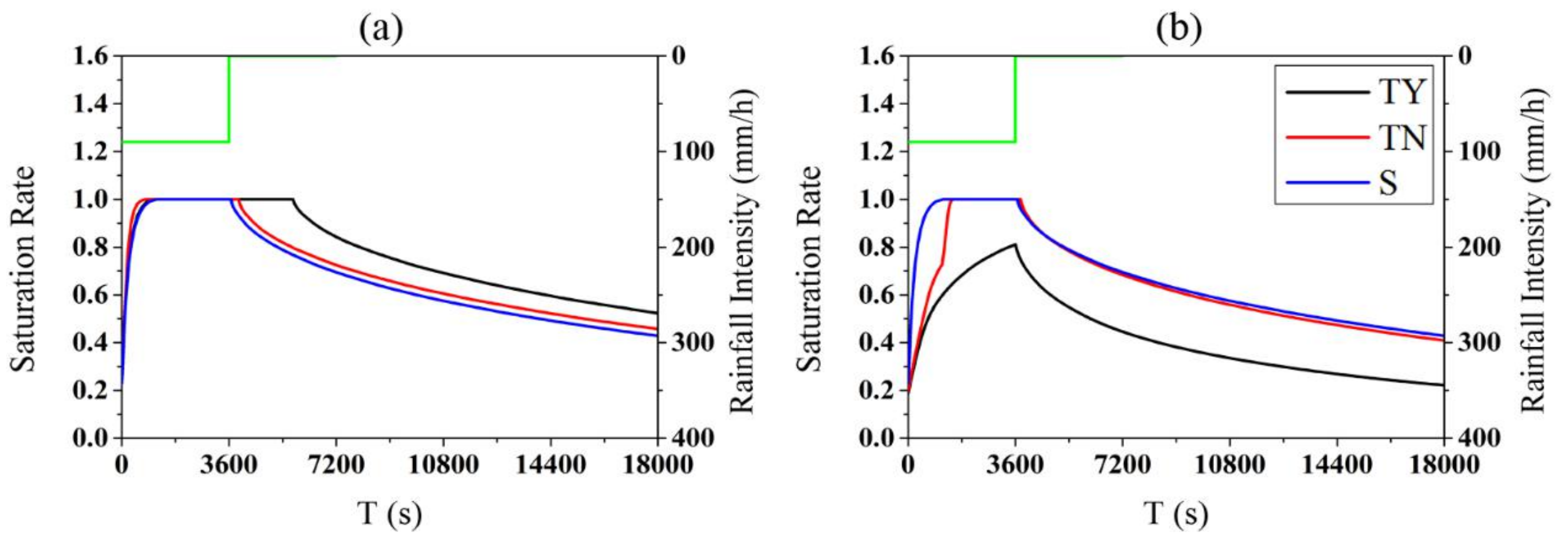
water storage



evapotranspiration

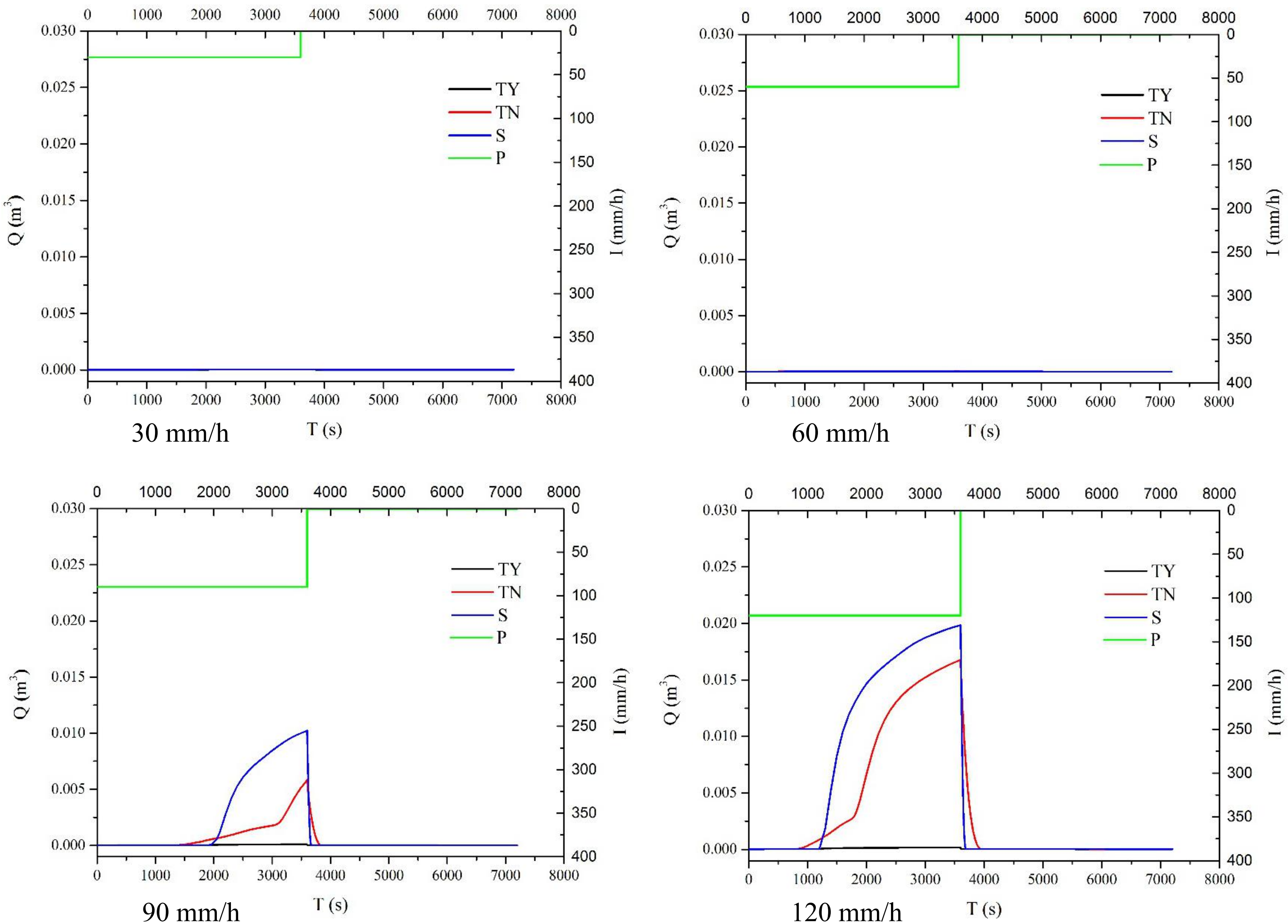
TY: terrace with embankments   TN: terrace without embankments   S: slope

3.4 Redistribution of rainfall by terrace on event time scale



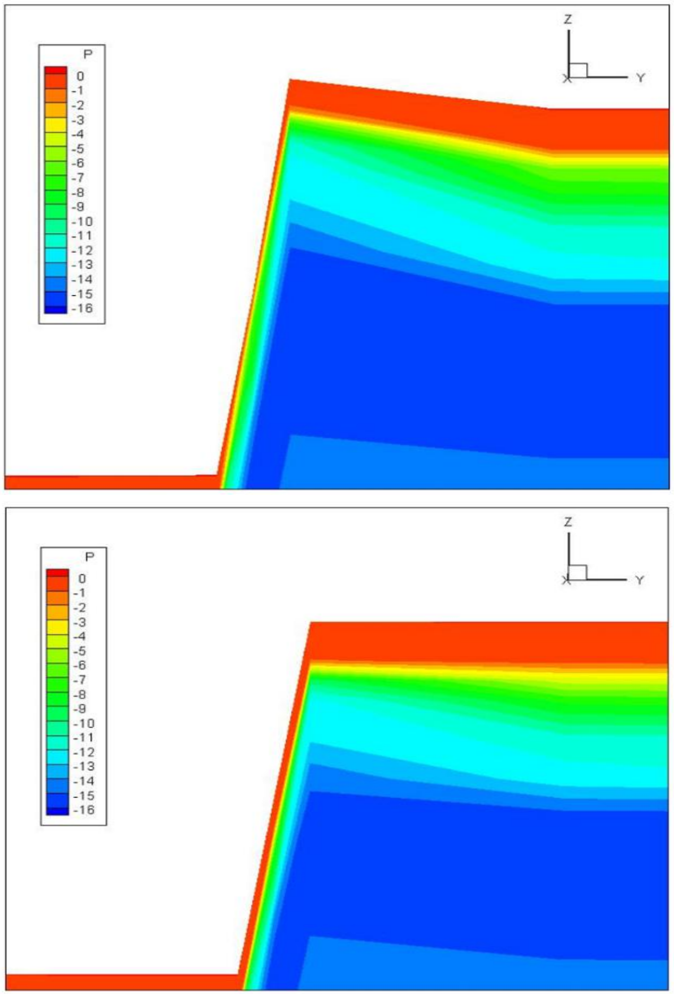
Simulated surface saturation level of the three topographic organizations at (a) platform (P4), and (b) riser (R4).

3.4 Redistribution of rainfall by terrace on event time scale

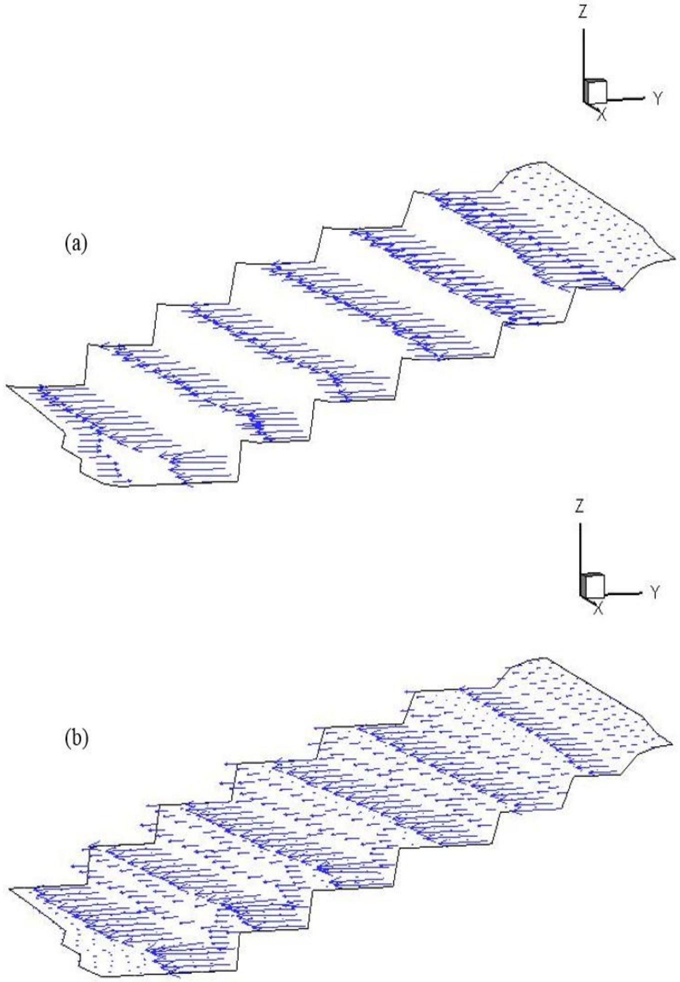


The runoff process of three scenarios at different rainfall conditions

3.5 Embankments' influence on flow direction



pressure head distribution after 90 mm rainfall



surface flow after 90 mm rainfall

4. Conclusion

1. Terracing can substantially reduce runoff, especially with ridges;

2. By changing the flow direction, ridges prevent overflow along platforms

3. Evaporation is not negligible even during the rainfall events.

Thank you！

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