Dear Thom Bogaard and the two anonymous reviewers

Thanks for your comments, help and insightful suggestion for improving the quality of the manuscript HESS-2024-268, titled “Understanding soil loss in two permanent gully head cuts in the mollisol region of Northeast China”.

After the first reviews process, we continuously revise the manuscript according to requirements of Hydrology and earth system science and previous comments from the editor and the reviewers. In previous submission, both the editor and reviewers pointed us that some important information are missing and we need a thorough revision. Then, we revised and submitted manuscript again.

We already have made a point-to-point revision according to the two anonymous reviewers’ comments and replied to them, which can be seen in the replies to RC 1 to 5. Except some great revisions for the title, abstract and the discussion (see following point-to-point revisions), some figures are also improved.

Following aspects show the important revisions:

Comment 1: The title or the abstract should highlight the important finding of this work. The methods in "3.4 Soil water storage and drainage" and the figure 11 sufficiently illustrate that the soil loss prediction cannot be from the event rainfall, but from the antecedent precipitation. It is rational and logistical to consider antecedent precipitation in predicting soil loss because the soil water status greatly influent the time, intensity of runoff and the stability of soil on the steep slope. Therefore, I suggest the authors should extend the finding in the discussion part.

Revisions:

We revised the previous title “Understanding soil loss in two permanent gully head cuts in the mollisol region of Northeast China”, into “**Understanding soil loss in mollisol permanent gully head cuts by hydrological and hydromechanical response**”. The revised title would be better than the previous one as it highlights the ideology used in this work.

We revised the previous Abstract into “**During permanent gully development, soil losses on steep slopes and in channel beds are typically driven by the hydromechanical response and water storage within the soil mass; however, this knowledge has been largely neglected in previous studies of gully erosion in the mollisol region of Northeast China. In this study, erosion intensities during the 111 d of the rainy season and 97 d of the snow-melting season were analyzed with respect to soil water storage, drainage capacity, and soil**

suction stress, supported by monitoring results of soil moisture, temperature, and precipitation, as well as experimental analysis of soil hydromechanical properties. Under the same confining stress, the mollisols in the interrupted head cut of Gully No. II increased more rapidly and dissipated pore water pressure more effectively than those at the uninterrupted head cut of Gully No. I. The combination of the soil water characteristic curve and the hydraulic conductivity function indicated that the mollisols of Gully No. II had a lower air-entry pressure and higher saturated hydraulic conductivity during the wetting and drying cycles than Gully No. I. The head cut area of Gully No. II exhibited rapid water infiltration and drainage response and high soil water storage capacity. The absolute suction stresses within the mollisols of Gully No. II was lower than that in Gully No. I, which could lead to high erosion per unit of steep slope area. Importantly, gravitational mass wasting on steep slopes was closely related to soil suction stress, and we observed a correlation between erosion per unit in the gully bed area and soil water storage. Therefore, it is more important to predict the soil loss in the permanent gully from soil water storage and the hydromechanical response of soil mass, other than sole rainfall amount. In other words, the required water storage capacity to yield runoff intensity and low suction stress would predict soil loss in the permanent gully head cut more accurately.".

In the last two paragraphs in the Discussion part, we extended our finding, e.g., the figure 11. The last two paragraphs were revised into "**Commonly, the gully bed erosion rates mainly depend on runoff intensity, and some studies reported that the runoff hydraulics in the rainy season were significantly higher than the snow-melting runoff. However, additional studies proved that gully heads may retreat faster in the snow-melting season than in the summer (Wu et al., 2008; Hu et al., 2009). The accumulated snowfall depth during the monitoring duration in this study was high, up to 49.6 mm, which was far more than the average snow depth of 30 mm. Besides, the snowfall melted from 3 to 10 May 2023 (Figs. 7a and 7b). Therefore, heavy snowfall during the winter of 2022 and early spring of 2023 and the intensive melting may result in high soil moisture and intensive runoff, ultimately causing substantial bed erosion. Long-term saturation during the snowmelt season provides sufficient water infiltration and low suction stress. Therefore, the highest erosion per unit area occurred in the snowmelt season but not in the rainy season.**"

Dong et al. (2011) revealed that a critical mass water content for gravitational mass wasting ranged from 31.0% to 33.8%, corresponding to a volumetric water content of 39.0% to 48.0% for the soil mass and a suction stress of 11.0 kPa. This showed that the direct-shear apparatus limited the ability to differentiate between the effective cohesion and suction stress contributions to total cohesion. As shown in Fig. 10b and

supported by Xu et al. (2020), the high soil water storage during the snow-melting season in Gully No. II (Fig. 9a) and long-term water infiltration can lower suction stress and higher erosion per unit area. This suggests a potentially reciprocal relationship between the absolute suction stress and erosion per unit area. The result shown in Figs. 11c and 11d are key findings and main contributions in the study domain of gully erosion, as they clarify the role of suction stress of storied water on soil loss from steep slopes and gully beds, respectively. Our results also imply that the soil water storage may not equal the amount of rainfall from the event, but instead partially derives from the initial soil water. Figure 11 illustrates that antecedent soil moisture or precipitation substantially influences surface runoff depth and soil loss during the permanent gully expansion in MEC, while this critical aspect has been neglected in previous study. In other words, the effect of antecedent precipitation should be assessed in predicting soil loss as it closely relates to the soil water and indirectly influences the runoff generation and intensity (Sachs and Sarah, 2017; Wei et al., 2017; Schoener and Stone, 2019; Wang et al., 2019). Notably, the theoretical framework underlying this work is that the soil loss at steep slopes occurs through the mechanism of bank slope stability, and the loss in gully beds occurs due to the balance between the shear force from runoff water and soil erodibility. Therefore, it is preferrable to predict soil loss in the permanent gullies from soil water storage and the hydromechanical response of soil mass, rather than solely from rainfall amount.”

Comment 2: Some references about the antecedent precipitation on the runoff or soil loss can be considered in citation. In fact, most of the soil loss prediction (such as USL equation) mainly base on the rainfall and runoff factor. The effect of antecedent precipitation has a great influence on the runoff factor.

Revisions: We cited four references in the last paragraph in the discussion part. The added sentences are: “**Figure 11 illustrates that antecedent soil moisture or precipitation substantially influences surface runoff depth and soil loss during the permanent gully expansion in MEC, while this critical aspect has been neglected in previous study. In other words, the effect of antecedent precipitation should be assessed in predicting soil loss as it closely relates to the soil water and indirectly influences the runoff generation and intensity (Sachs and Sarah, 2017; Wei et al., 2017; Schoener and Stone, 2019; Wang et al., 2019)**.”

The four references are:

Wei, L., Zhang, B., and Wang, M.: Effects of antecedent soil moisture on runoff and soil erosion in alley cropping systems, Agr Water Manage., 94, 54-62, https://

doi.org/10.1016/j.agwat.2007.08.007, 2007.

Schoener, G. and Stone, M. C.: Impact of antecedent soil moisture on runoff from a semiarid catchment, J Hydrol., 569, 627-636, https://doi.org/10.1016/j.jhydrol.2018.12.025, 2019.

Wang, F., Tian, P., Guo, W., Chen, L., Gong, Y., and Ping, Y.: Effects of rainfall patterns, vegetation cover types and antecedent soil moisture on run-off and soil loss of typical Luvisol in southern China, Earth Surf Process Landf., 49, 2998-3012, https://doi.org/10.1002/esp.5871, 2024.

Sachs, E. and Sarah, P.: Combined effect of rain temperature and antecedent soil moisture on runoff and erosion on Loess, Catena, 158, 213-218, https://doi.org/10.1016/j.catena.2017.07.007, 2017.

Some figure revisions:

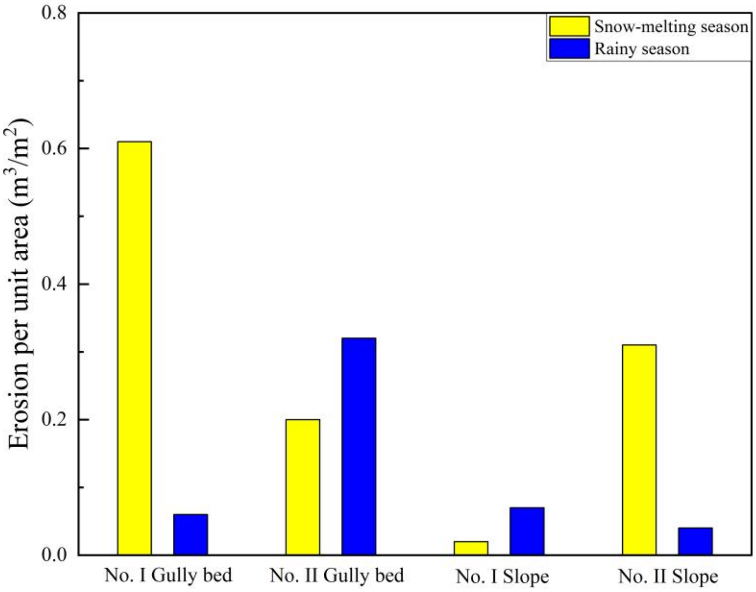

Fig. 4. Differences in the erosion per unit area for the gully bed and slope

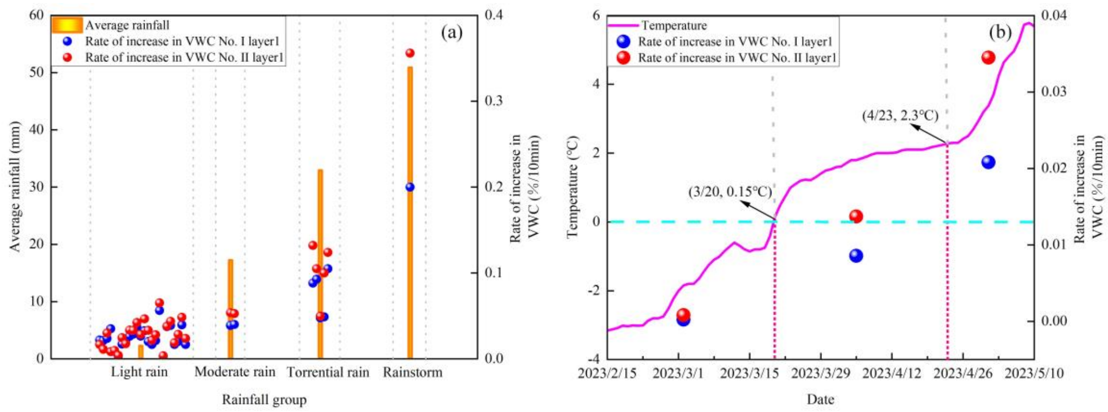

Fig. 8. Volumetric water content increasing ratio in snow-melting ratio and the rainy season. (**a**) Rate of increase in VWC at varied rain events. **(b)** Rate of increase in VWC at three stages of temperature increase.