

Supplementary file for

Automatic Mapping of Thermokarst Landforms from Remote Sensing Images using Deep Learning: A Case Study in the Northeastern Tibetan Plateau

Authors: Lingcao Huang, Lin Liu, Liming Jiang, and Tingjun Zhang

Correspondence: huanglingcao@link.cuhk.edu.hk (Lingcao Huang)

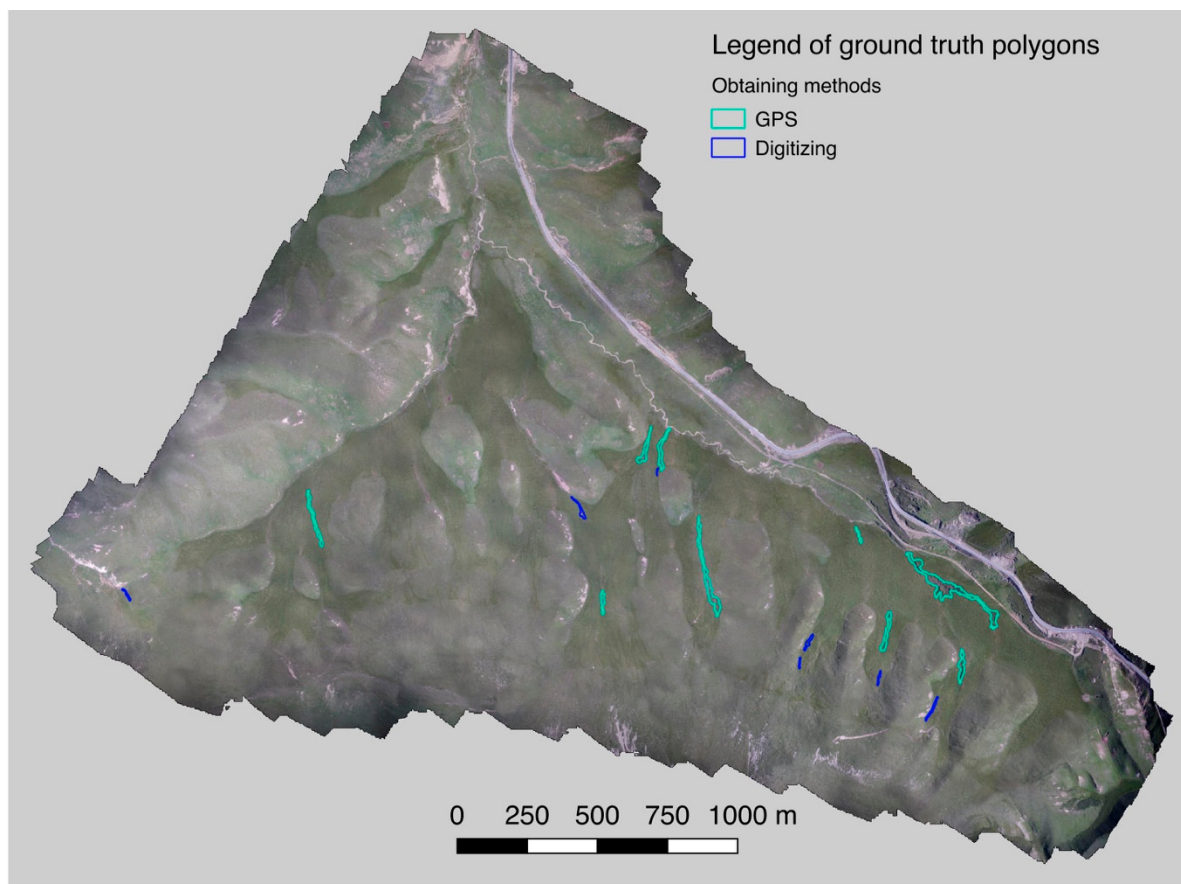


Figure S1. Map of the ground truth polygons and their obtaining methods. Nine of them were collected in the field using GPS Real-Time Kinematic. Seven of them were manually delineated (digitizing) on the DOM.

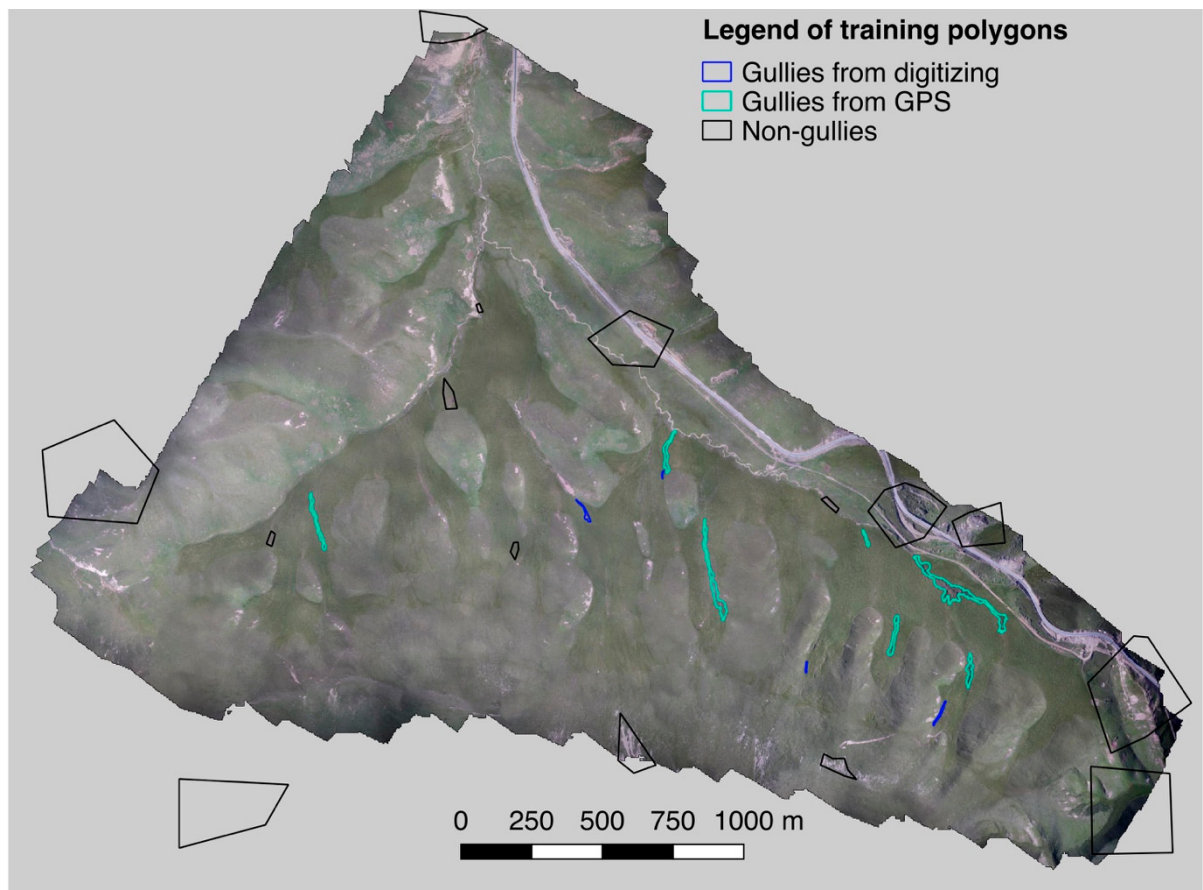


Figure S2. Distribution of the training polygons: 15 of them are non-gullies; seven were collected from field GPS measurements; and four were from manual delineation (digitizing).

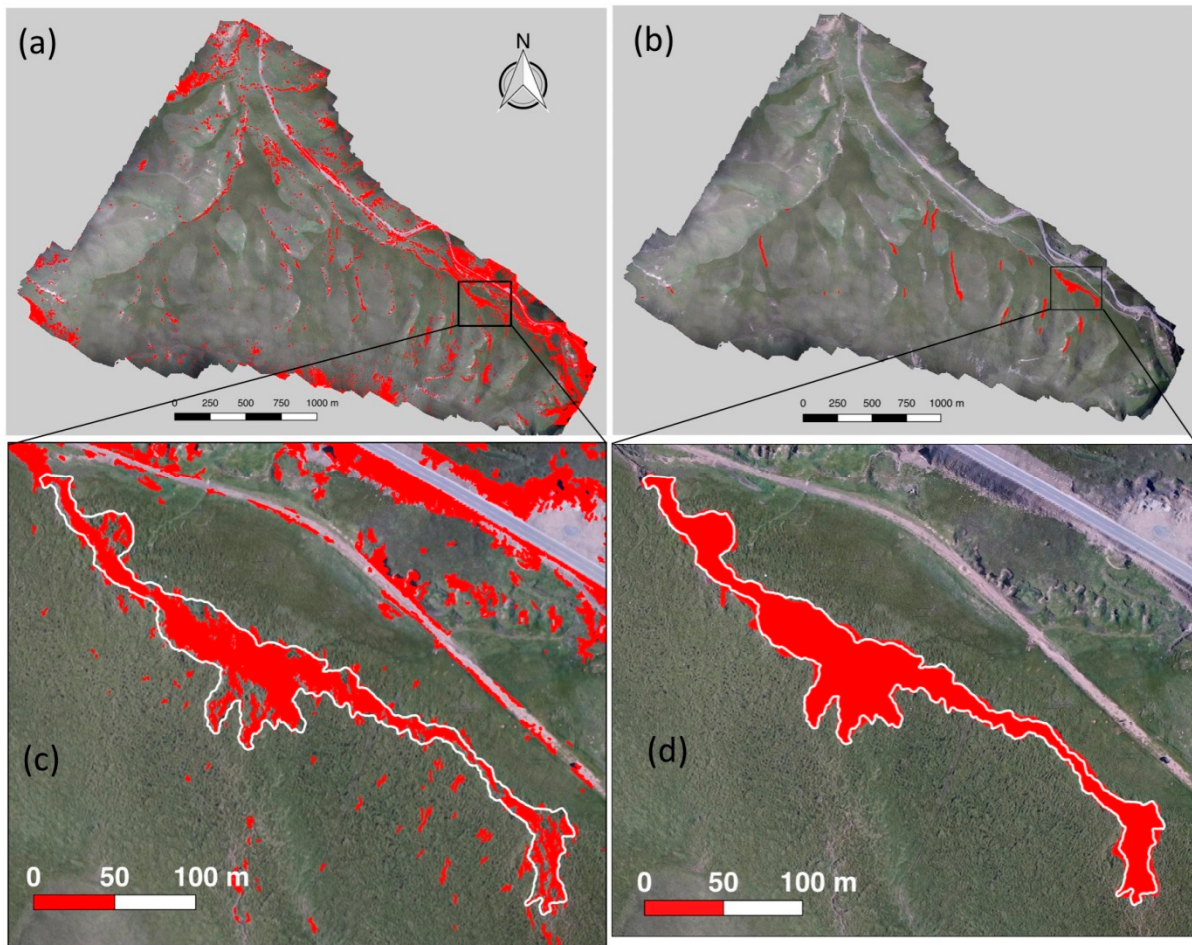


Figure S3. Comparison between the DeepLab-based results and those obtained from a supervised classification using support vector machine (SVM). The mapped gullies are marked by filled red polygons on all sub-figures. (a) and (c) are the results of SVM, which contain numerous false positives. (b) and (d) are the results of DeepLab, which only contain a few false positives. The white boundary in (c) and (d) is a ground truth polygon.

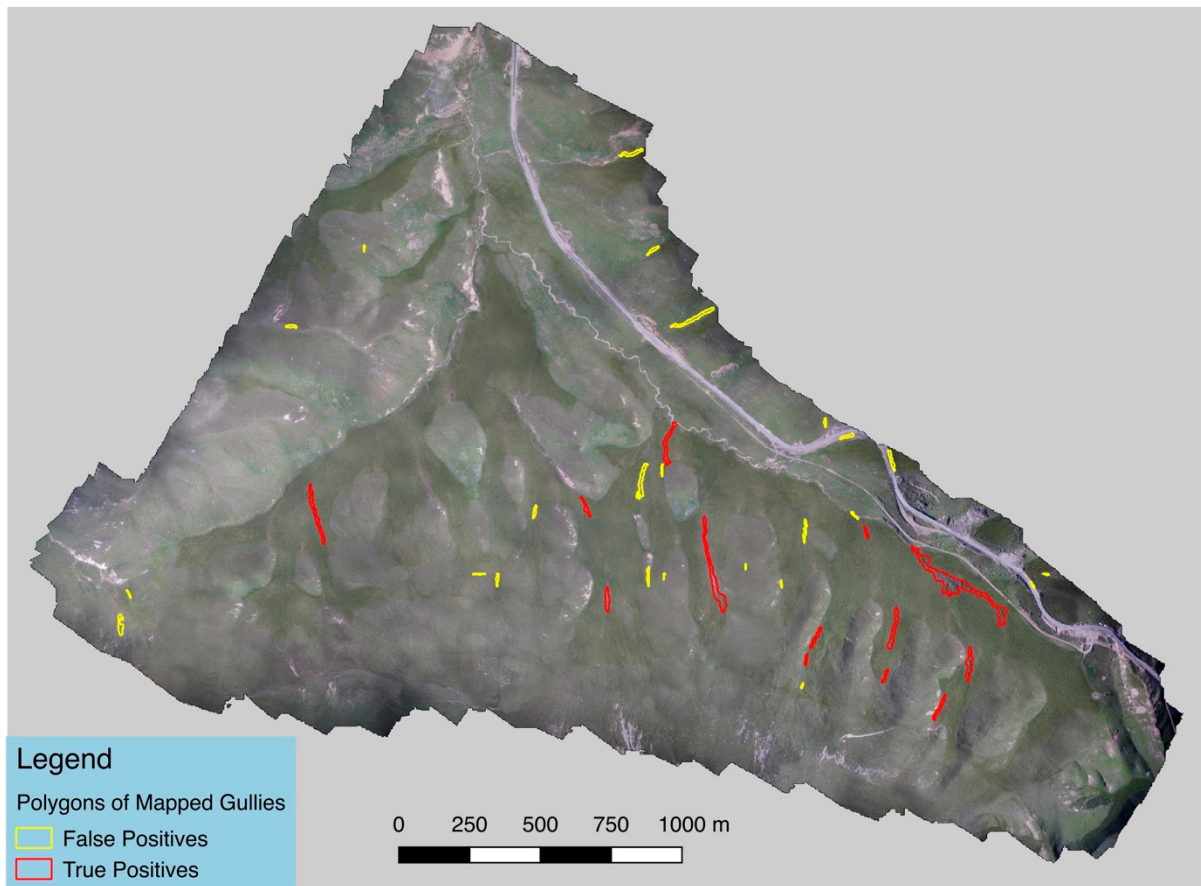


Figure S4. Distribution of mapped gully polygons (the red and yellow ones are true and false positives, respectively) solely using the UAV-based digital elevation model.

Table S1. Parameters and settings of the Trimble Inpho UASmaster software for producing the digital elevation model and digital orthophoto map

Steps	Parameter name	Value
Preparation	Projected Systems	WGS-84-99E
	Cameras/Sensors	UX5-5100
	Number of used images	280
	Number of strips	20
	Flying height (min / avg / max)	4018.4 / 4030.8 / 4045.4 [m]
	Terrain height (min / avg / max)	3443.3 / 3587.6 / 3832.6 [m]
	Average photo scale	1:24442
	Number of Ground Control Points	12
Camera Calibration	Sensor (width / height) [pixel]	6000 / 4000
	Distortion type	Polynomial
	Focal length [mm pixel]	15.5785 3974.0311
	Focal length (Fx / Fy) [pixel]	3973.9634 / 3974.0987
	Principal point (x / y) [mm pixel]	0.1388 / 0.0209 2964.0993 / 1994.1725
Block Adjustment	GNSS-Mode	On
	Earth Curvature Correction	On
	Refraction Correction	On
Georeferencing	Extraction With Adjustment	Full Resolution
	Exterior Orientation	extensive
Surface and Ortho Generation	Generate DSM	Very dense (slow)
	Pixel Size	0.15 m
	Output format	GeoTiff

Notes: Refer to the Userguide of Inpho UASmaster for the explanation of the settings and parameters.

Table S2. *Delineation* accuracies obtained with different IoU thresholds.

Threshold of IoU	0.4	0.45	0.5	0.55	0.6	0.65	0.7
Number of True Positives	16	15	14	14	13	12	11
Number of False Positives	11	12	13	13	14	15	16
Number of False Negatives	0	1	2	2	3	4	5
Precision	0.59	0.56	0.52	0.52	0.48	0.44	0.41
Recall	1.00	0.94	0.88	0.88	0.81	0.75	0.69
F1 score	0.74	0.70	0.65	0.65	0.60	0.56	0.51

