

Metadata Report

Project Name

Landscape Evolution of the Melamchi Valley, Nepal (2014-2024)

Personnel

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Summary

Earthquakes, landsliding and flooding are common natural hazards threatening the livelihood and economic progress of Nepal. The Melamchi Valley of Central Nepal has been particularly devastated by multiple disasters in recent years including the 2015 Mw7.8 Gorkha earthquake and a large sediment-laden flood in 2021. Multiple hazards and evolving ground conditions require immediate attention for assessment of future threat and mitigation strategies.

Twelve 1 m resolution digital surface models (DSMs) were produced by photogrammetry of 0.5 m resolution Pleiades stereo satellite images (Table 1) to document the topographic changes in the Melamchi Valley (Fig. 1). These DSMs show and quantify significant impacts of the 2021 flood, including intense headwater erosion and downstream sediment aggradation. Detailed data interpretation refers to Chen et al. (2024) “Erosion Cascade during the 2021 Melamchi Flood” in *Nature Geoscience*. These high-resolution DSM data enable researchers to trace how this earthquake- and hazard-prone region evolve in the future to understand surface processes shaping rapidly eroding mountain belts. This research is funded by an NSF Frontier Research in Earth Sciences Program awarded to A. Joshua West.

Methods and Products

DSMs were constructed through the NASA Ames Stereo Pipeline (ASP) software version 3.3.0. Stereo satellite images were first bundle adjusted and map-projected with an external reference digital terrain model (ALOS World 3D - 30m Ellipsoidal) before the *parallel_stereo* process. Details of stereo parameterizations are listed in Table 2. Point clouds were transformed into 1 m resolution DSMs with outlier filters (*--remove-outliers-params* and *--max-valid-triangulation-error*). The copies of DSM stored in Open Topography are compressed with the “deflate” algorithm. The Coordinate Reference System is EPSG:32645 - WGS 84 / UTM zone 45N. DSMs were aligned with a rigid method Point-to-Plane ICP (iterative closest point) algorithm with ten iterations to mitigate global misregistration errors (i.e., translation, rotation) and produce the best fitted terrain models. The alignment was based on stable areas only; we selected these areas by excluding any active erosion and deposition visible on satellite imagery, as well as clouds, shadows, ice, and distorted slopes known to deteriorate local DSM quality. Shapefiles of mapped landslides, river channels, clouds, and shadows is available in Hydroshare (<https://www.hydroshare.org/resource/b6da096000284d5882d13b085b7669ac/>).

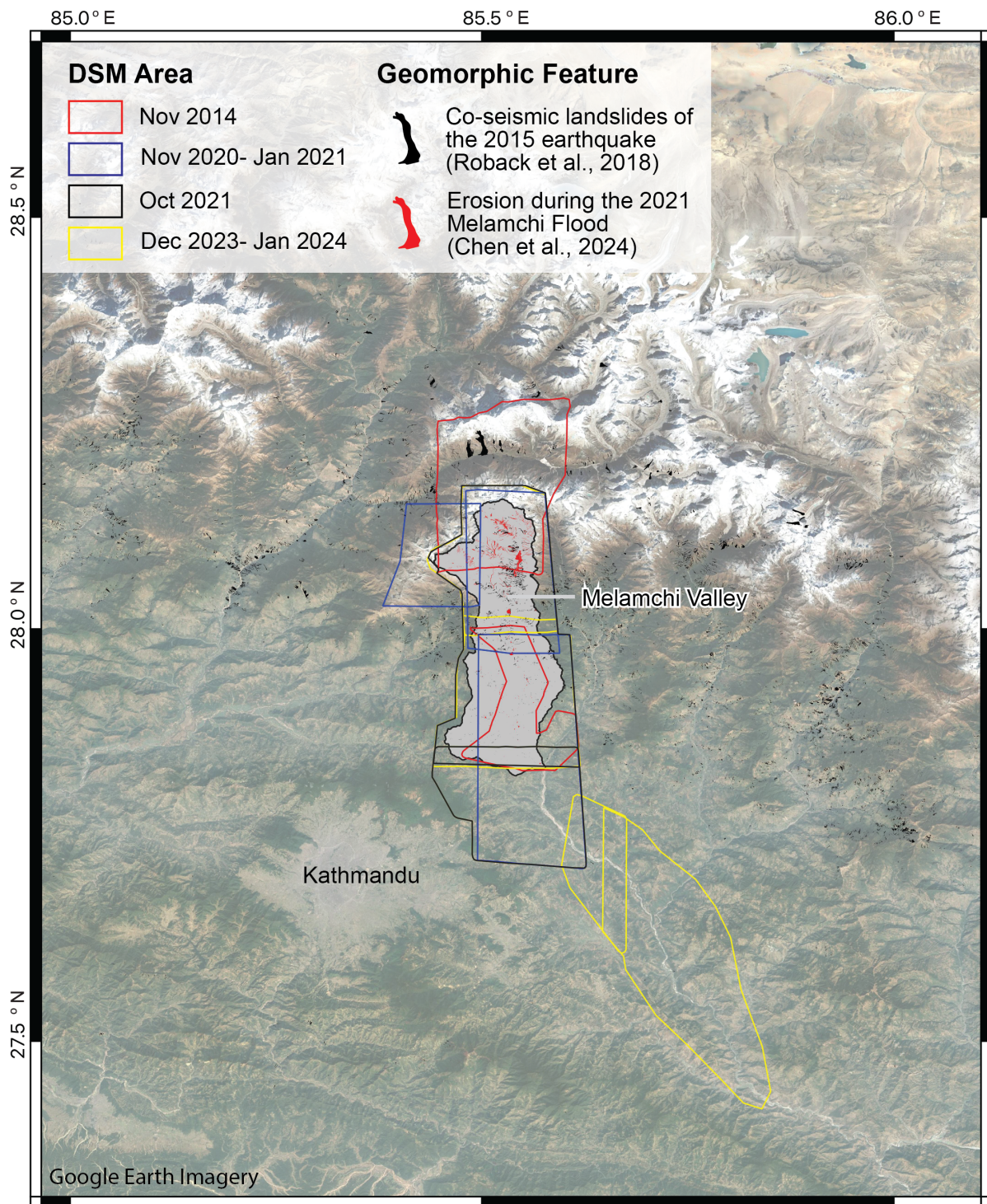


Table 1. Stereo satellite imagery used for DSM production.

Pair	Spatial extent	Satellite	File name	Acquisition time (mm/dd/yy)	Cloud cover
1	N028°03'32" - N028°16'51", E085°26'44" - E085°36'27"	Pléiades 1A	5906795101	11/9/14 5:03	0%
		Pléiades 1B	5906796101	11/1/14 5:15	3.35%
2	N027°49'36" - N028°00'15", E085°28'32" - E085°37'05"	Pléiades 1A	5906797101	12/5/14 5:04	0.39%
		Pléiades 1B	5906798101	11/29/14 5:00	0.25%
3	N027°58'10" - N028°10'11", E085°28'35" - E085°35'39"	Pléiades 1A	5906792101	11/13/20 5:11	0%
		Pléiades 1B	5906791101	11/19/20 5:15	0%
4	N028°01'17" - N028°09'29", E085°22'50" - E085°30'00"	Pléiades 1A	5906794101	11/13/20 5:11	0%
		Pléiades 1B	5906793101	11/19/20 5:15	0%
5	N027°42'33" - N027°59'37", E085°29'40" - E085°37'40"	Pléiades 1A	5906800101	1/11/21 5:07	0%
		Pléiades 1A	5906799101	1/18/21 5:04	1.31%
6	N027°42'23" - N027°51'37", E085°26'21" - E085°37'34"	Pléiades 1B	6004961101	10/11/21 5:08	4.55%
		Pléiades 1B	6004962101	10/11/21 5:08	5.44%
7	N027°49'54" - N028°10'52", E085°25'37" - E085°37'31"	Pléiades 1A	6005840101	10/12/21 5:00	1.26%
		Pléiades 1A	6005841101	10/12/21 5:01	1.85%
8	N027°59'12" - N028°10'23", E085°26'08" - E085°35'26"	Pléiades 1B	6890961101	12/19/23 5:11	0%
		Pléiades 1B	6890962101	12/19/23 5:11	0%
9	N027°36'24" - N027°48'00", E085°35'47" - E085°40'31"	Pléiades 1B	6893039101	12/26/23 5:07	0%
		Pléiades 1B	6893040101	12/26/23 5:08	0%
10	N027°25'02" - N027°47'05", E085°38'47" - E085°51'05"	Pléiades 1B	6893041101	12/26/23 5:07	0.27%
		Pléiades 1B	6893042101	12/26/23 5:08	0.19%
11	N027°42'32" - N027°51'29", E085°26'21" - E085°37'36"	Pléiades 1B	6893043101	12/26/23 5:07	0%
		Pléiades 1B	6893044101	12/26/23 5:07	0%
12	N027°49'24" - N028°01'26", E085°26'26" - E085°37'18"	Pléiades 1B	6902874101	1/9/24 4:59	2.04%
		Pléiades 1B	6902875101	1/9/24 5:00	2.63%

Table 2. Parameters invoked in the NASA Ames Stereo Pipeline algorithm for DSM production.

Tool	Parameter	Value
bundle_adjust	--ip-per-image	10000
	--tri-weight	0.1
	--tri-robust-threshold	0.1
	--camera-weight	0
parallel_stereo	--stereo-algorithm	asp_final_mgm
	--cost-mode	3
	--xcorr-threshold	-1
	--min-xcorr-level	1
	--subpixel-mode	12
	--corr-kernel	9 9
	--corr-tile-size	2048
	--sgm-collar-size	512
	--corr-memory-limit-mb	4096
	--filter mode	2
	--rm-threshold	3.5
	--rm-min-matches	50
	--rm-half-kernel	9 9
	--rm-cleanup-passes	1
	--max-disp-spread	100
	--ip-per-image	10000
	--num-matches-from-disparity	90000
point2dem	--median-filter-params	9 9
	--remove-outliers-params	95 3
	--max-valid-triangulation-error	2
	--erode-length	0
pc_align	--alignment-method	Point-to-Plane ICP
	--max-displacement	50
	--num-iterations	10
	--highest-accuracy	