

# Monitoring Hydromorphological Changes in Meandering Rivers via Multi-Temporal UAV-Based Measurements

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## Abstract

Unmanned Aerial Vehicle (UAV) based Structure-from-Motion (SfM) techniques have renovated 3D topographic monitoring of earth surface, offering low-cost, rapid and reliable data acquisition and processing. Multi-temporal models of the river environment can be produced by autonomous operation in order to determine erosion, subsidence, landslide, soil transport and surface deformation in the riverbeds. Herein, the acquisition of repeated topographic surveys helps us to characterize the flow regime and to monitor the sediment dynamics. This study presents the hydromorphological changes of the meandering structures by using UAV-generated point clouds and Digital Surface Models (DSMs) produced by SfM at different times in the Büyük Menderes Basin located in the western part of Turkey. The processing of the data obtained with the flights were made in January and June 2018 at selected three meander locations with the highest visible changes according to the long-term satellite imageries. Especially, riverbank erosion along the river was determined by digitizing the edges and volumetric calculations of the eroded/deposited sediments derived from UAV-based measurements. In addition to the periodic volumetric differences of the meander structures, the differences in volumetric comparison methods for the same meander structures have been evaluated. Ultimately, the sediment profiles were extracted along the river banks at the selected part of the meanders and the amount of deposited sediments were determined to increase in a range between 1.5% and 3.3% of the total sediment. In conclusion, it is estimated that UAVs will be used instead of conventional photogrammetry aircraft in many future projects, considering the data production times and costs in large areas. Further, various digital cameras and sensors can be mounted on UAVs in order for examining the sediment effect on the health and productivity of plants in agricultural areas around the meanders.

# MONITORING HYDROMORPHOLOGICAL CHANGES IN MEANDERING RIVERS VIA MULTI-TEMPORAL UAV-BASED MEASUREMENTS

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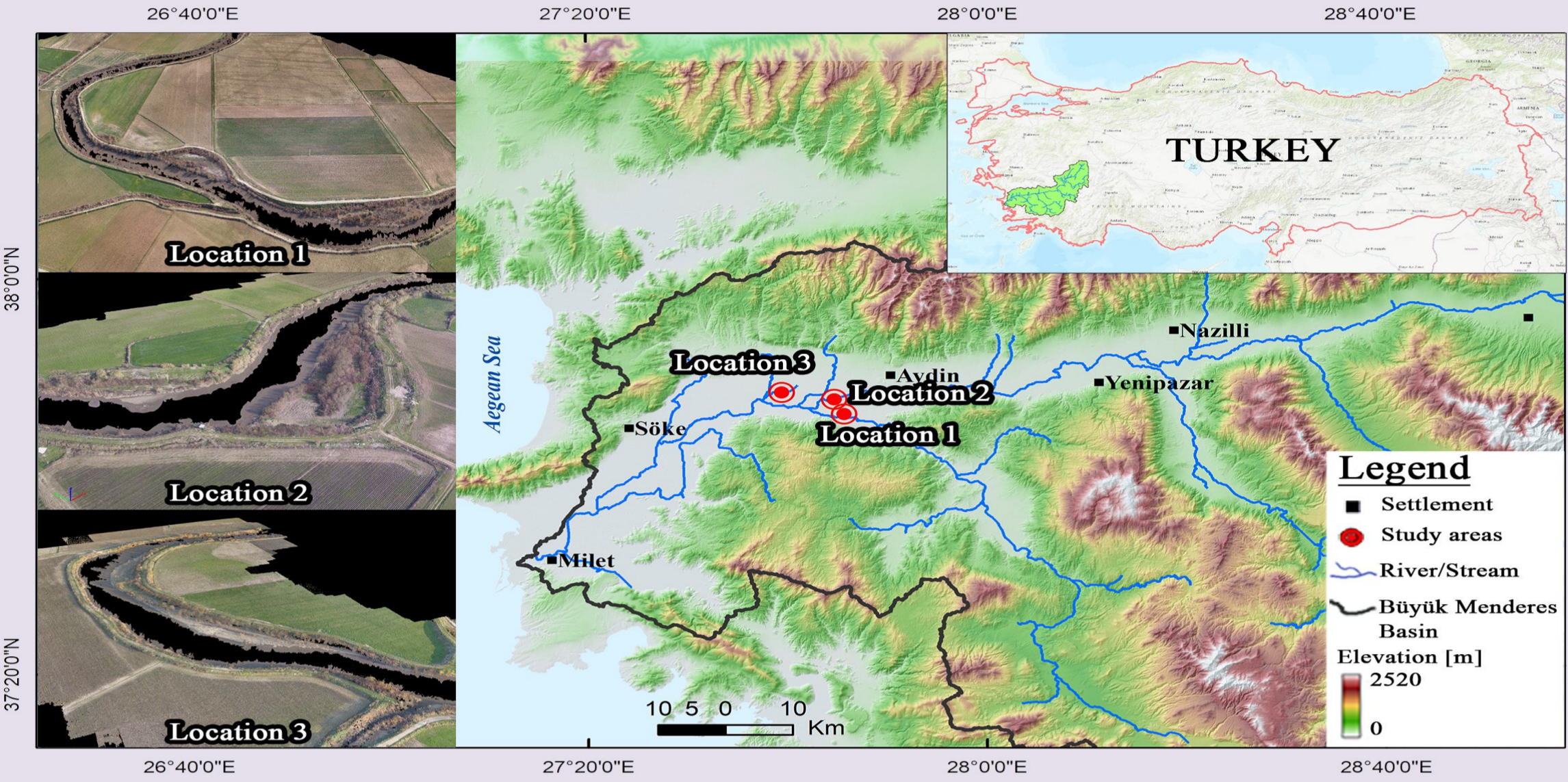
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## IMPORTANCE & AIM OF THE STUDY

Unmanned Aerial Vehicle (UAV) based Structure-from-Motion (SfM) techniques have renovated 3D topographic monitoring of earth surface, offering low-cost, rapid and reliable data acquisition and processing.

Herein, the acquisition of repeated topographic surveys helps us to characterize the flow regime and to monitor the sediment dynamics.

This study presents the hydromorphological changes of the meandering structures by using UAV-generated point clouds and Digital Surface Models (DSMs) produced by SfM at different times in the Büyük Menderes Basin located in the western part of Turkey.

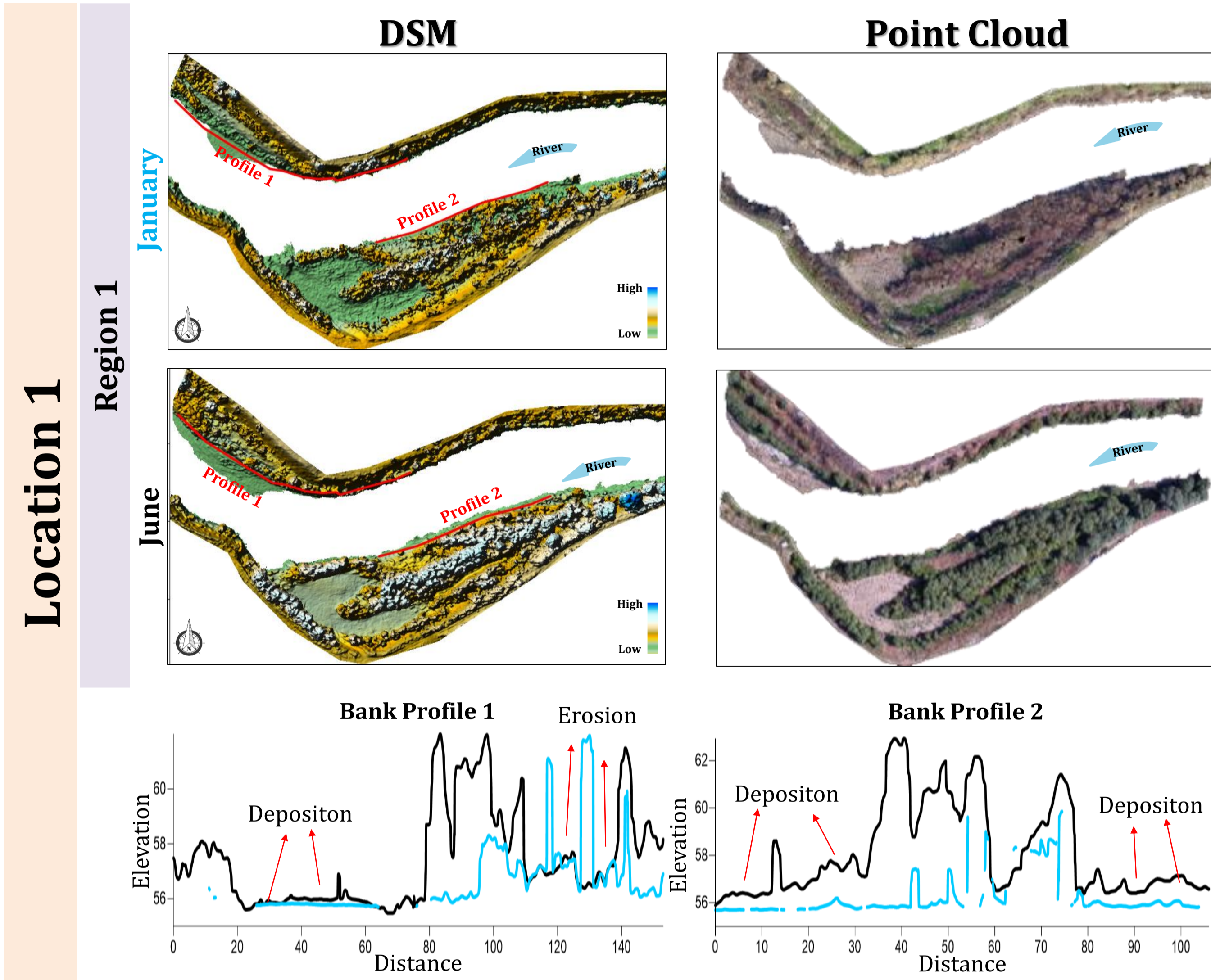
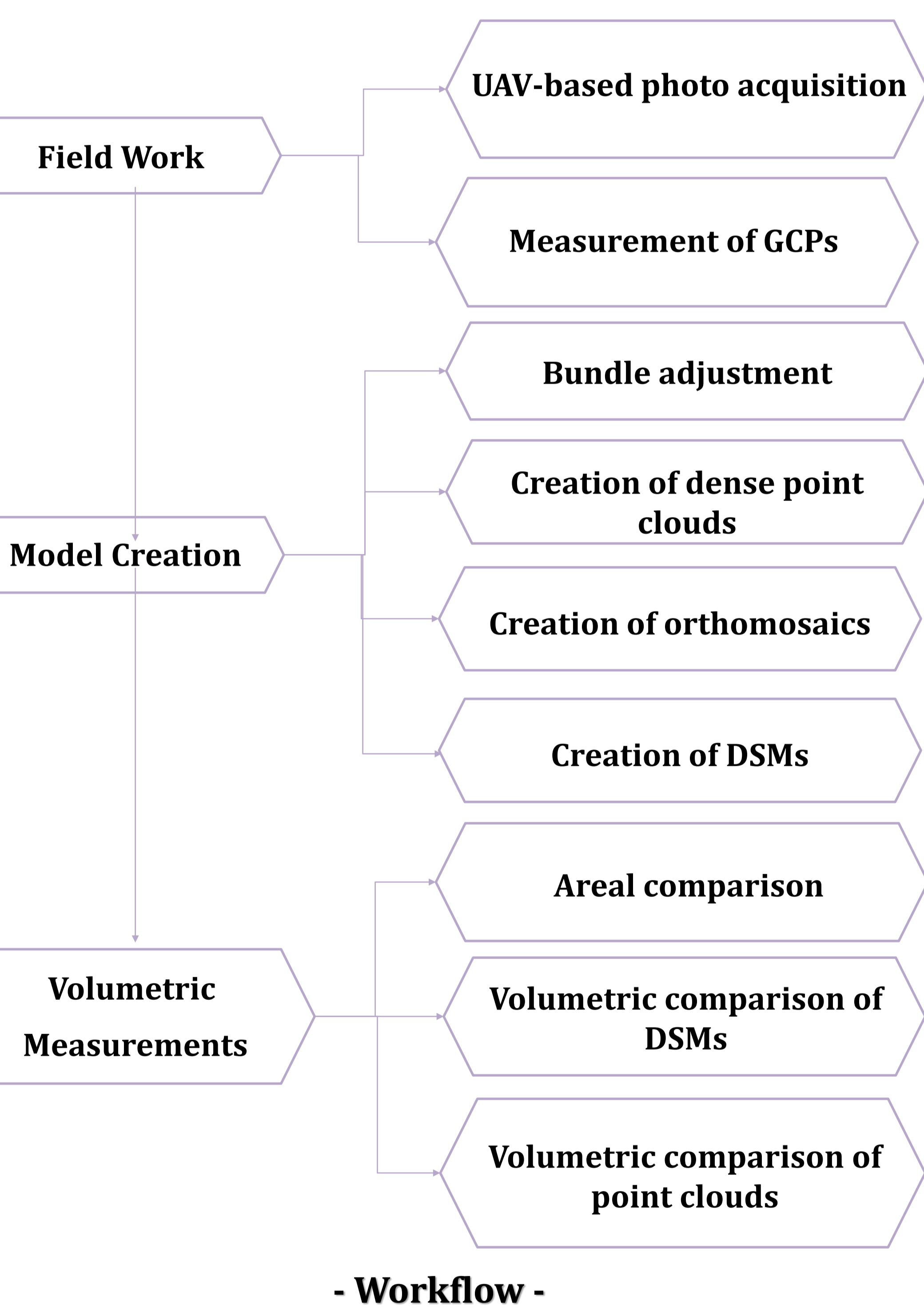


## CONCLUSIONS

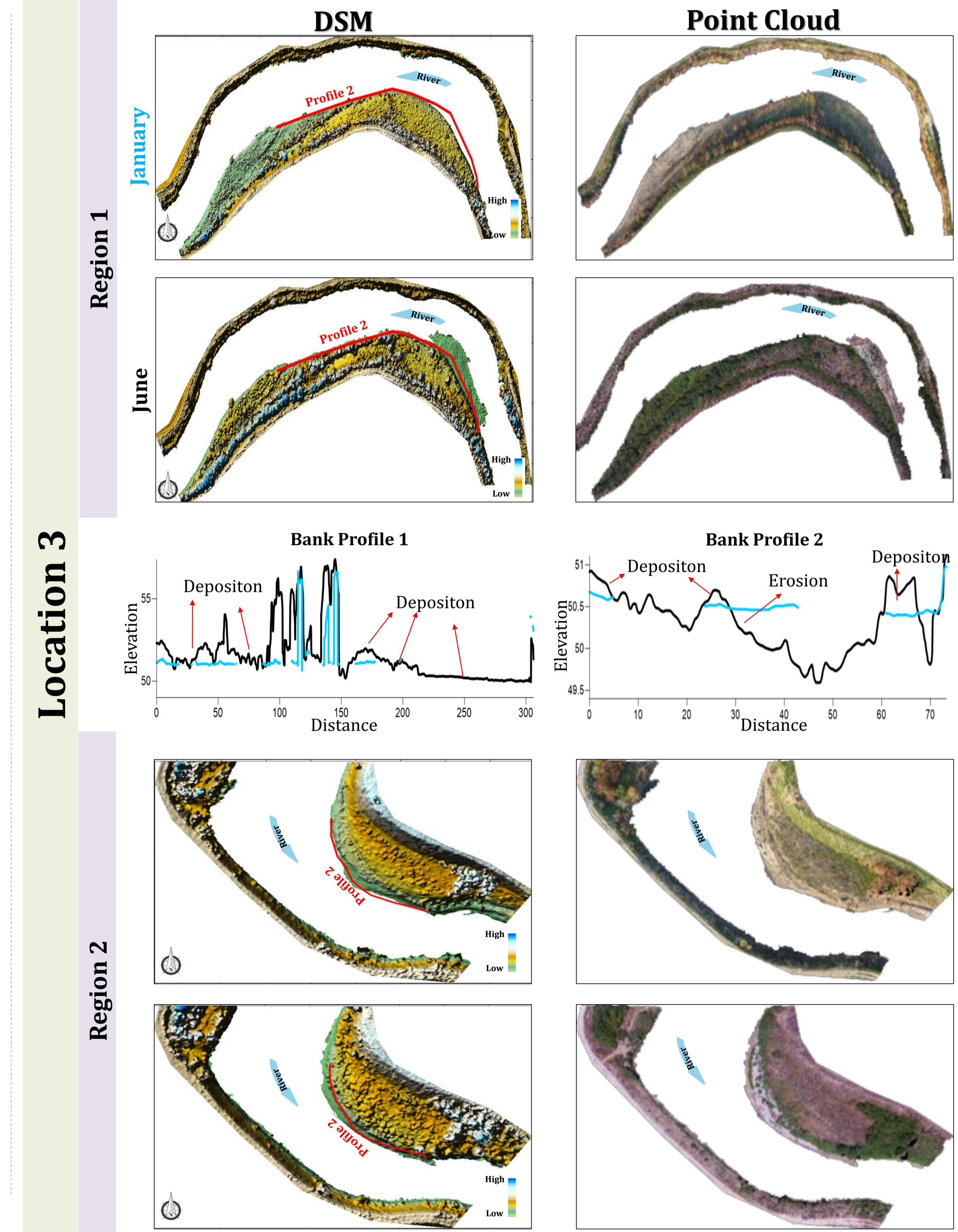
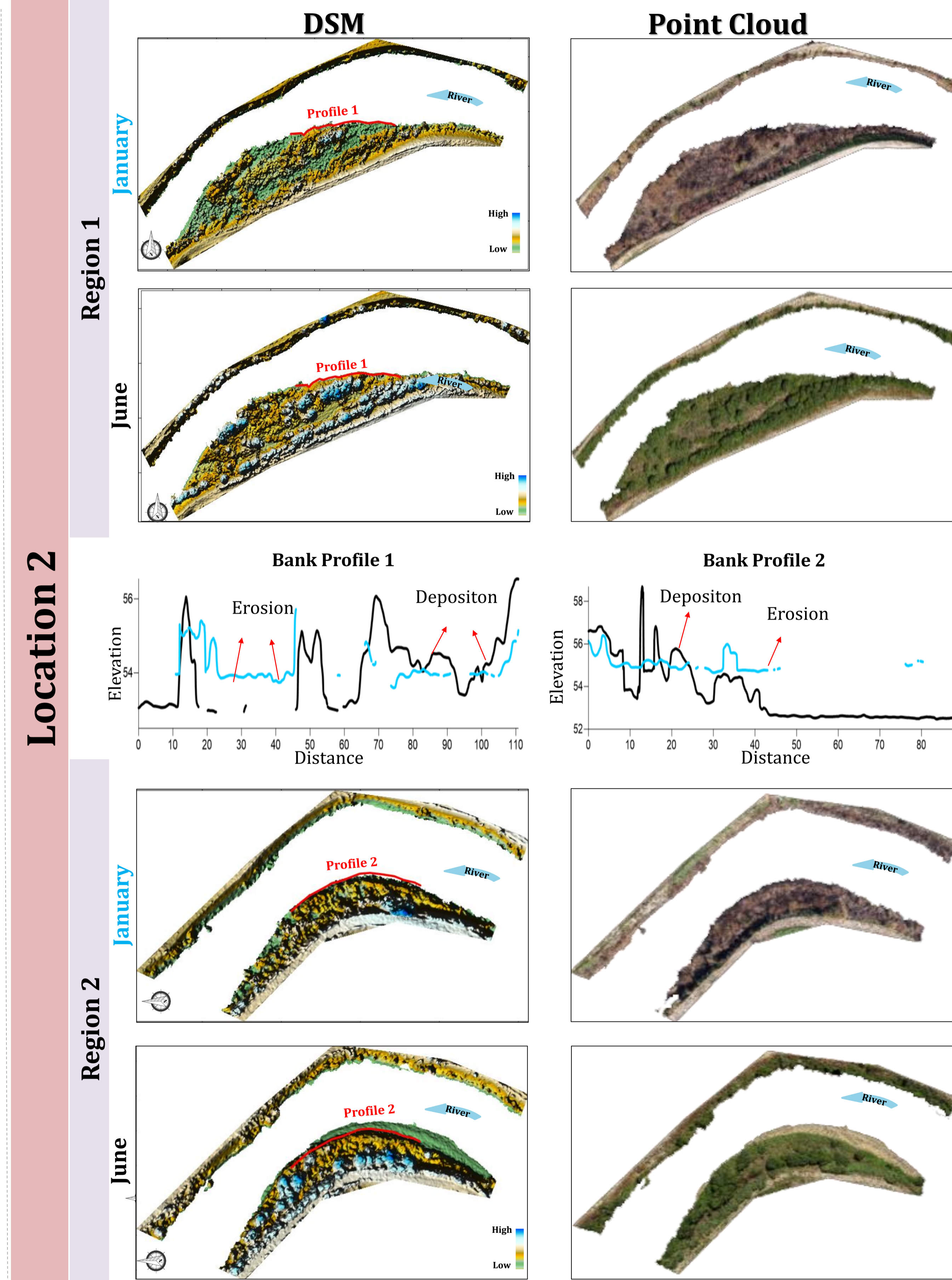
Multi-temporal models of the river environment can be produced by autonomous operation in order to determine erosion, subsidence, landslide, soil transport and surface deformation in the riverbeds.

The processing of the data obtained with the flights were made in January and June 2018 at selected three meander locations with the highest visible changes according to the long-term satellite imageries.

It is estimated that UAVs will be used instead of conventional photogrammetry aircraft in many future projects, considering the data production times and costs in large areas.



Study Area		Volumetric Calculations		Volumetric Diff. (%)
		DSM	Point Cloud	
LOC. 1	Reg. 1	121297.236 m <sup>3</sup>	119776.672 m <sup>3</sup>	1.25
	Reg. 2	79693.921 m <sup>3</sup>	76745.355 m <sup>3</sup>	3.70
LOC. 2	Reg. 1	57477.911 m <sup>3</sup>	55499.609 m <sup>3</sup>	3.44
	Reg. 2	164508.896 m <sup>3</sup>	163759.945 m <sup>3</sup>	0.45
LOC. 3	Reg. 1	26603.813 m <sup>3</sup>	25788.910 m <sup>3</sup>	3.06



## RESULTS

Riverbank erosion along the river was determined by digitizing the edges and volumetric calculations of the eroded/deposited sediments derived from UAV-based measurements. In addition to the periodic volumetric differences of the meander structures, the differences in volumetric comparison methods for the same meander structures have been evaluated.

Ultimately, the sediment profiles were extracted along the river banks at the selected part of the meanders and the amount of deposited sediments were determined to increase in a range between 1.5% and 3.3% of the total sediment.

Further, various digital cameras and sensors can be mounted on UAVs in order for examining the sediment effect on the health and productivity of plants in agricultural areas around the meanders.

Study Area		Areal Calculations		Area Change (%)
		January	June	
LOC. 1	Reg. 1	17425.70 m <sup>2</sup>	19022.90 m <sup>2</sup>	9.17 ↑
	Reg. 2	19090.50 m <sup>2</sup>	19966.70 m <sup>2</sup>	4.59 ↑
LOC. 2	Reg. 1	7257.72 m <sup>2</sup>	8410.55 m <sup>2</sup>	15.88 ↑
	Reg. 2	23839.10 m <sup>2</sup>	26703.70 m <sup>2</sup>	12.02 ↑
LOC. 3	Reg. 1	5977.63 m <sup>2</sup>	6466.16 m <sup>2</sup>	8.17 ↑