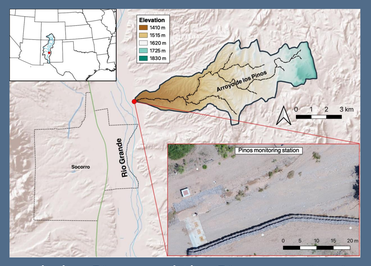
Monitoring Sediment Erosion and Deposition in the Arroyo de los Pinos Through Structure from Motion (SfM) Photogrammetry

Rebecca Moskal, Daniel Cadol
New Mexico Institute of Mining and Technology, Socorro, NM

Abstract

The Arroyo de los Pinos is a tributary of the Rio Grande that transports tons of relatively coarse sediment into the river annually through flash flood events. The focus of this research is to determine where sediment erodes and deposits in the arroyo reach leading into our monitoring station and to document how much enters the Rio Grande. To investigate this, we have started using Structure from Motion (SfM) photogrammetry from drone-based air photos that are then analyzed in a program called AGISOFT. This allows us to create digital elevation models (DEMs) that we can then use to create a digital elevation model of difference (DoD) which shows the difference between two DEMs and quantifies the deposition and erosion. Comparing DEMs and DoDs from previous years to our most recent DoD shows that the bed surface became flatter in the arroyo due to the flash flood events of this past monsoon season.



The Arroyo de los Pinos and the Pinos monitoring station

SfM Processing

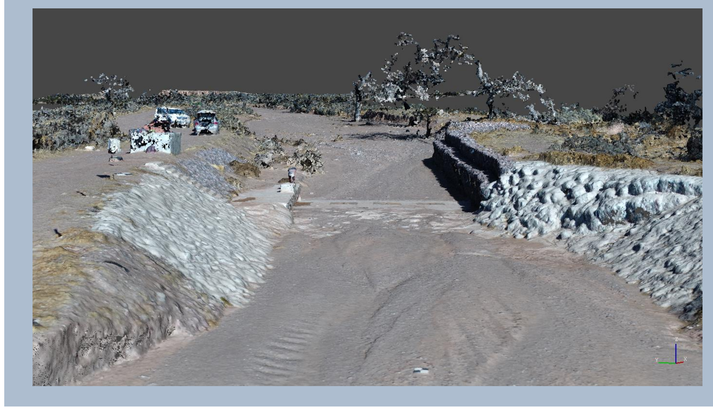
In order to create the DEMs for the DoDs these steps need to be followed:

- Field work consisting of flying a drone and surveying ground control points
- Running the program AGISOFT to assess the quality of the photos and do data post processing
- Create a sparse point cloud and add ground control points
- Create a dense point cloud
- Use the dense point cloud to create a DEM

DJI Phantom 4 drone

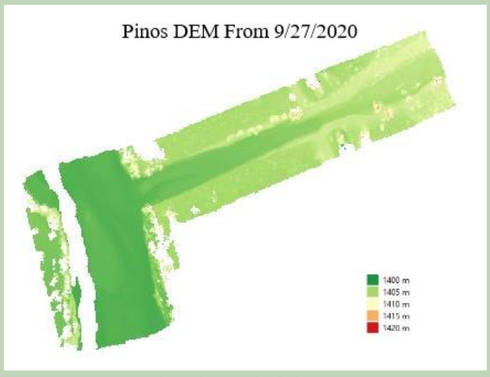
A target used as a ground control point

Dense Point Cloud

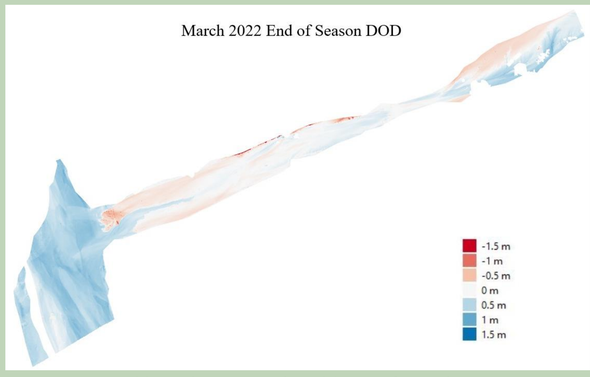


- This is a dense point cloud which is generated by running drone pictures through AGISOFT and creating a sparse point cloud.
- View of the Pinos monitoring station as a dense point cloud.

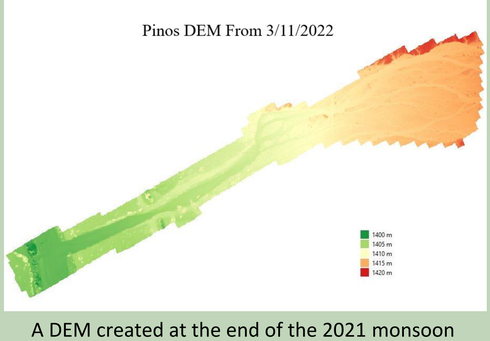
DEMs and DoDs



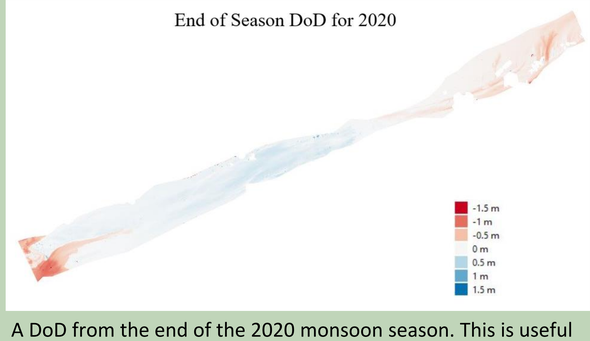
A DEM created at the end of the 2020 monsoon season by Sharllyn Pimentel.



A DoD created by subtracting the old DEM from the new DEM. This one is created by using the two DEMs on the left and is for the end of the 2021 monsoon season.



A DEM created at the end of the 2021 monsoon season by Rebecca Moskal.



A DoD from the end of the 2020 monsoon season. This is useful to compare to the 2021 end of season DoD above to understand how the channel changed over the span of the year.

Conclusions

The 2021 DoD shows that over the course of the 2021 monsoon season:

- Deposition of sediment has occurred in the thalweg of the channel
- Erosion in the channel occurred on the bars
- The general bed surface has become significantly more flat since the past year
- A significant amount of sediment has deposited at the mouth of the channel creating a fan

Future Work

- The next step is to use the programs BORAMEP and HEC-RAS to model different sediment transport equations to determine which best models sediment transport in ephemeral channels.

References

USGS National UAS Project Office. (2017). Unmanned Aircraft Systems Data Post- Processing Structure-from-Motion Photogrammetry. Retrieved from https://uas.usgs.gov/nupo/pdf/PhotoScanProcessingDSLRMar2017.pdf

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Contact Information

Rebecca Moskal: rebecca.moskal@student.nmt.edu