



### Introduction

What comes to mind when you think about drones (or UAV's)? Photographers in the park? The nosy kids next door? Or, perhap something more serious, such as the US military? Whichever application they are being used for, drones are amazingly versatile tools that are changing the way many businesses and technologies function. But did you know drones are also used for science? Using UAV's and Structure from Motion, the scientists at UNAVCO study the changes on the Earth's surface. Recently, we used these methods to create 3D maps and measure the rate of change of the Slumgullion Slide.

### Survey

The first step in a survey is planning the survey itself. Before even setting foot in the field, we used an iOS app called Map Pilot to plan the size, shape, and elevation of the survey. The plan is then uploaded to the drone, enabling it to perform the survey autonomously.



The flight plan we used to survey the geomorphology of the **Slumgullion Slide.** 

### Results

After flying a survey, photographs are uploaded from the drone into software such as Agisoft Photoscan Pro, where the photos are turned into point clouds using photgrammetric processing. A point cloud is set of point in a threedimensional coordinate system used to represent the external surface of an object. Two point clouds are then compared with one another in order to map goespatial change.



**Acknowledgements:** This material is based upon work supported by the National Science Foundation under Grant No. 1540524. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation

# The Slumgullion Slide: Using Drones (UAV's) for Structure from Motion (SfM) Summer 2017 By Brandon Lucas, Elizabeth Schaeffer, and Dave Mencin



The Slumgullion Slide is an earthflow located in the San Juan Mountains, southeast of Lake City, CO. According to the United States Geologic Survey (USGS) the earthflow began around 300 years ago and is still active today, moving as much as 7 meters (23 ft) per year! Slumgullion is about 4 miles long and covers over 1000 acres.





**Above:** Printed targets are used as a geospatial reference to improve survey accuracy

After uploading a survey plan to the UAV, all you have to do is press go, and the drone simply takes off and performs the survey completely on its own, though the completion time varies greatly, depending on its size and shape. Surveys performed at a higher elevation will finish faster with a lower accuracy (>1cm), while surveys performed at a lower elevation will be slower with a higher accuracy (often <1 cm). We experienced the best results when we performed multiple surveys at different elevations for the same data set.



**Dense Point Cloud from the edge of the slide** 

Right: GPS can be placed on top of or near printed targets to help georeference the point cloud.

![](_page_0_Picture_23.jpeg)

![](_page_0_Picture_25.jpeg)

**3D Map showing rate of change in the Slumgullion Slide** 

![](_page_0_Picture_28.jpeg)

### **Structure from Motion**

Structure from Motion, (or SfM) is a photogrammetric range imaging technique used for estimating three-dimensional structures from two-dimensional images, or, to put it simply, SfM is a technique used to make 3D models from 2D pictures. The technique stems from the ancient concept of using multiple perspectives to better describe a single object.

![](_page_0_Picture_32.jpeg)

The foundation for the concept of Structure from Motion. People discovered they could get a more detailed description of an object by observing it from different viewpoints.

# The Mavic Pro

We used the DJI Mavic Pro, a powerful and small UAV, to conduct our geospatial surveys.

![](_page_0_Picture_36.jpeg)

## Looking Forward

Over the summer we were able to get better and better at our processes. In the future we plan to return to Slumgullion several times, under different conditions, to find possible correlations between the speed of movement and weather events. We would also like to see if we can confirm the USGS findings in previous reports that show the slide slowing down over time.

![](_page_0_Picture_39.jpeg)

![](_page_0_Picture_40.jpeg)

![](_page_0_Picture_41.jpeg)