# Beach Profile Mapping from Unmanned Aerial Vehicle Imagery

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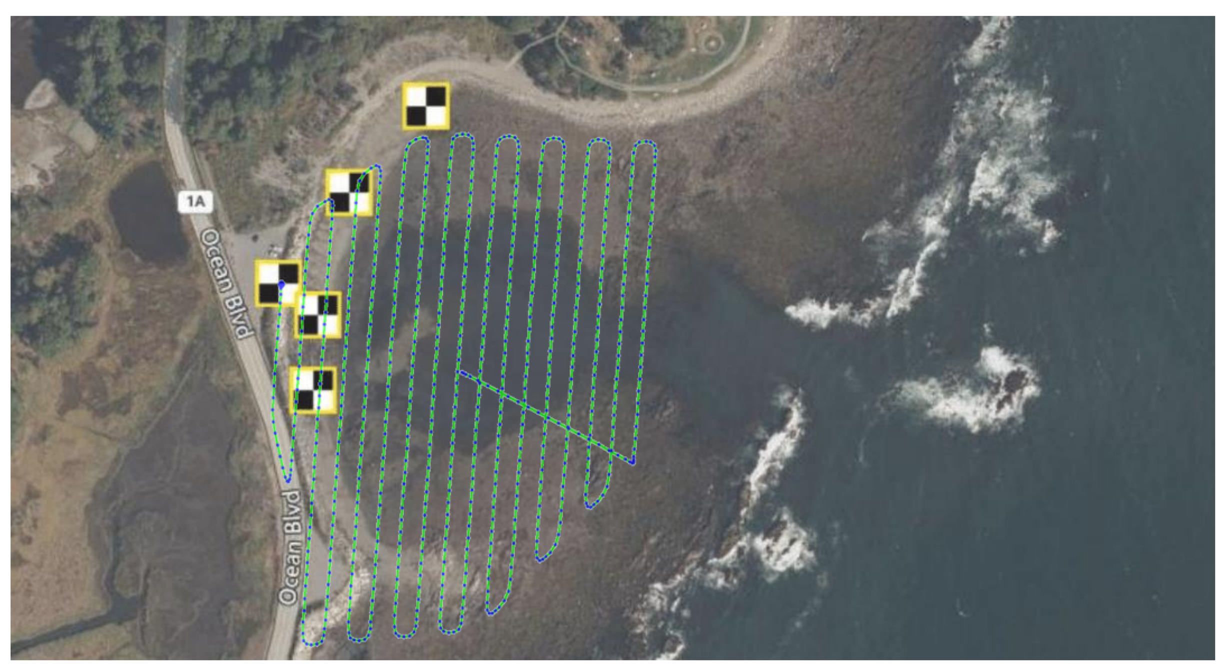
## Introduction

- Beach profiling is an important tool to measure shoreline elevations.
- As climate change increases global temperatures, beach profiling has become more valuable in analyzing the acceleration of coastal erosion.
- Coastal erosion predictions can serve as preventative measures against further harm when planning and constructing infrastructure.
- Unmanned Aerial Vehicles (UAVs) could be far more efficient for surveying, but their effectiveness is widely unproven.
- Research goal is to assess if UAVs are accurate and efficient for surveying.

## Flight Setup



Ground Control Points (GCPs) are compared against Propeller AeroPoint's database to ensure accurate locations.

## Methodology

- *Assessed the accuracy and efficacy of using aerial imagery to map coastal regions.*

- Data Collection:
  - Determined best weather to fly UAV considering tides, sunlight, and wind.
  - Created flight plan for drone using DJI controller.
  - Placed GCPs on beach.
  - Both flights were 10 minutes and covered 26.6 acres.

- Data Processing:
  - Used Pix4D's structure from motion software to create an orthomosaic model.
  - Postprocessed elevation data by comparing ariel images against GCP.
  - Created a digital elevation model (DEM) stored as raster file using photogrammetry to combine orthomosaic and elevation data.

- *Concluded flying at an altitude of 180 feet in combination with elevation data is accurate within 1 inch.*

## References

[1] Ballard, M. Curley, R. Murray, A. 2024. *Change in New Hampshire Coastlines Over Time* [Poster]. University of New Hampshire Undergraduate Research Conference. 24 April, the University of New Hampshire Whittemore Center.

## Odiorne State Park Orthomosiac and Contours

Map shows orthomosiac and 1-foot increment contours overlaying Google satellite imagery.

## Pro and Con Assessment

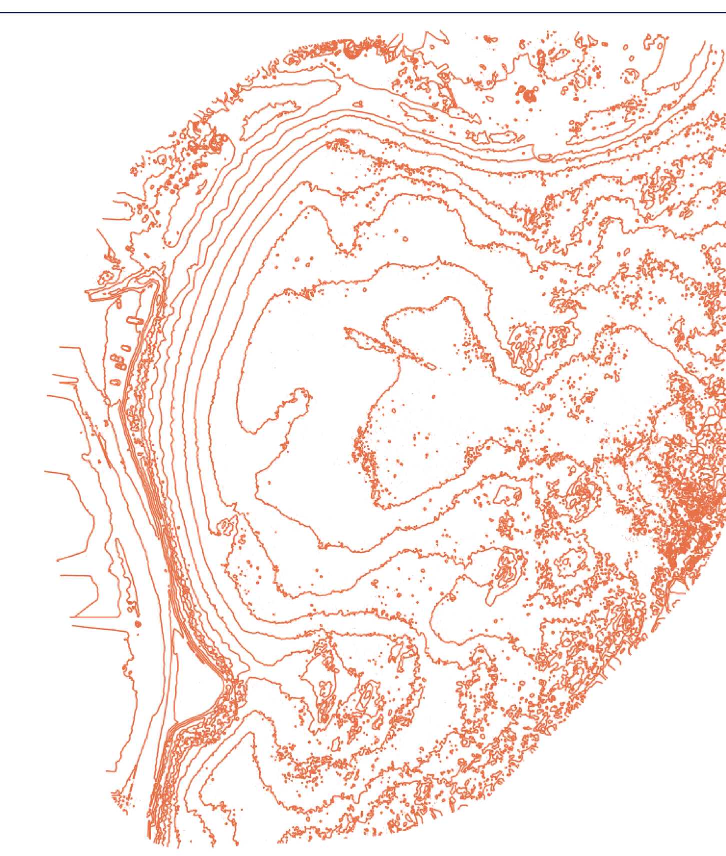
Pros:

- 10-20 minute flight opposed to 3+ hours [1] with traditional surveying methods.
- Every photo has data including latitude, longitude, altitude, and time.
- Software allows users to select a point, see its location data and how many pictures overlap it.
- Software such as Pix4D and QGIS offer useful tools including volume calculations and contour representation.

Cons:

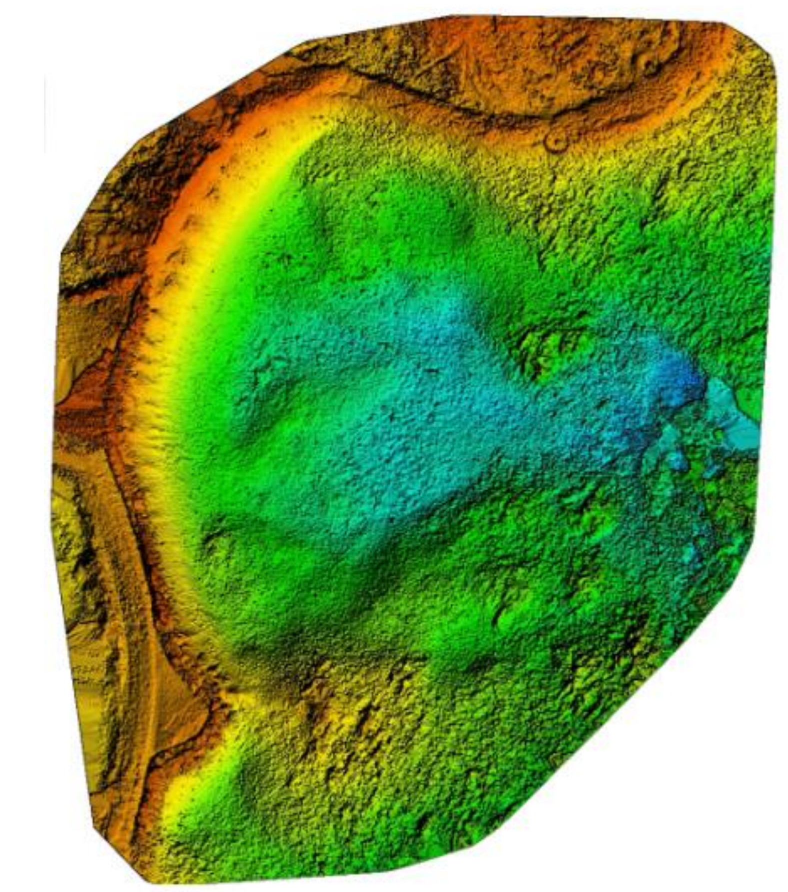
- Photogrammetry requires large static points to draw accurate data.
- Any motion will cause fuzziness in imagery, can create issues with water.
- Difficult to analyze sand or snow, algorithm needs specific objects to locate.
- Larger areas generate larger error.
- Drones can cost upwards of $2,000, $4,000 for GCPs, and additional fees for software.

## Contour Map



Contour map generated in QGIS.

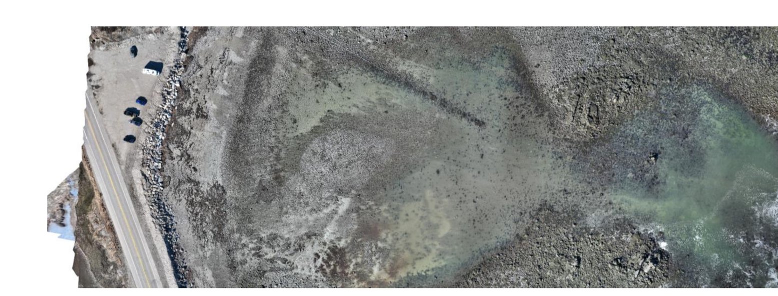
## Digital Surface Model

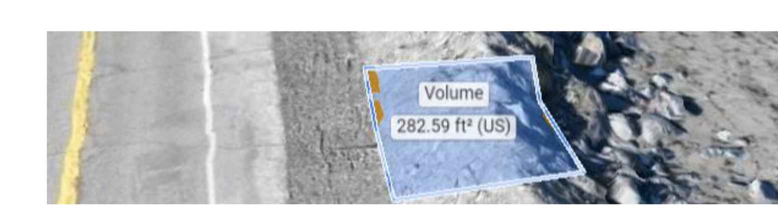


The Digital Surface Model (DSM) represents the shoreline topography and can be viewed as a 3D model in Pix4D.

## Application: Shoreline Flooding

- Prevention: Determine areas that were most susceptible to flooding
- Response: Evaluate which areas require the most urgent attention
- Restoration: Calculate sediment volume replacements





## Conclusion

- Flight survey covered 2.67 acres per minute.
- Shorter survey time with a greater number of points (greater efficiency and greater accuracy).
- Data assessment can contribute to coastal erosion databases and be used in short-term emergencies and long-term climate assessment.
- However, cost and conditions limitations are important considerations.

## Acknowledgements

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