Analyzing The Accuracy of SWOT's Data at Mono Lake

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I. Mission

SWOT Mission:
Water in our world is a vital resource that has not been measured adequately. The SWOT (Surface Water and Ocean Topography) mission launched by NASA has been in orbit since December of 2022 to map the entire world's water resources through elevation and area. SWOT data is used to map the water cycle over time on land to provide critical information on water inventory.

Question: Does the SWOT data locate the water's edge and give an accurate depiction of the area of Mono Lake?

Our Mission: As an endorheic basin, Mono Lake has no outflow of water. It is sourced from the groundwater that runs from the Eastern Sierra Mountains. After significant depletion in the 1990's, measuring the area and resource of water is an important factor to track the ecosystem. It also provided our group with questions about its water resources and how it has evolved over the last decade through water crisis and climate change. With the large area of water within marshes surrounding the lake, it was unknown whether or not it could be traced with SWOT data. Our group took data on the area surrounding the lake to measure the perimeter.

II. Our Methods

1. Tracked on Strava app and walked clockwise directly over waterline. Walked 0.20 km, recording any points where necessary to step deeper into water to avoid obstacles. Walked same path in the other direction back to starting point.
2. Repeated these steps counterclockwise first, then back to starting point.
3. Deleted any outlier lines to improve accuracy of lines' average. Sorted tracks into folders based on position on Mono Lake and ran an open source R script on folders to generate centerline for each group of tracks.
4. Used QGIS to find difference in meter distance between SWOT's shape files and the pixel files from our averaged lines.
5. Performed these steps for Navy Beach and Boat Launch locations.

Locations

III. Results

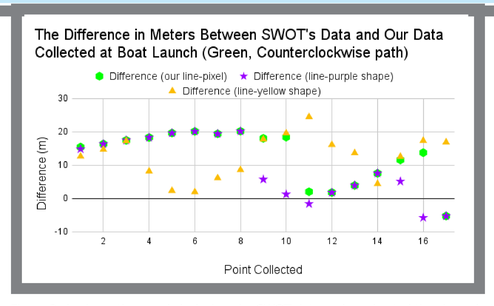


Figure 3. As the path moved clockwise, the SWOT data underestimated the shore, but not by very much for yellow or purple. The pixel file had the greatest discrepancies. As more distance was walked, yellow experienced a series of huge difference between our averaged path. The data recorded for this path was probably the most inconsistent despite still skewing heavily to underestimating. SWOT may have difficulties reading the shore as it curves downward.

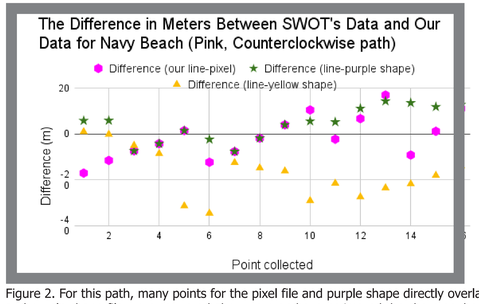
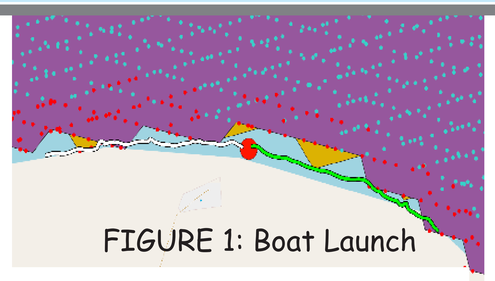
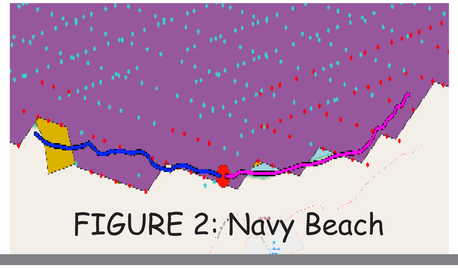


Figure 2. For this path, many points for the pixel file and purple shape directly overlap. The pixel file and purple shape file were scattered about zero and overestimated the shore as the path got farther clockwise. In comparison, the yellow shape file consistently underestimated the shore.



Purple	SWOT's Shapefile data
Blue dots	Pixel Cloud data representing water
Red Dots	Pixel Cloud data representing land near water
Blue Line	Navy Beach clockwise track
Pink Line	Navy Beach counterclockwise track
White Line	Boat Launch clockwise track
Green Line	Boat Launch counterclockwise track



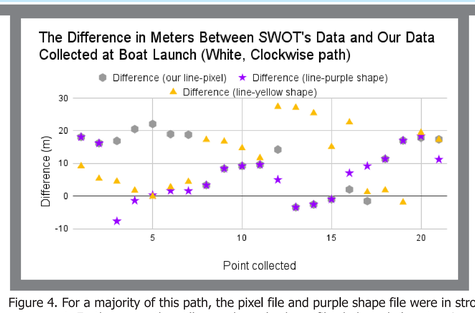


Figure 4. For a majority of this path, the pixel file and purple shape file were in strong agreement. Furthermore, the yellow and purple shape files behaved almost as inverses of one another. Still, SWOT consistantly underestimated where the shore was.

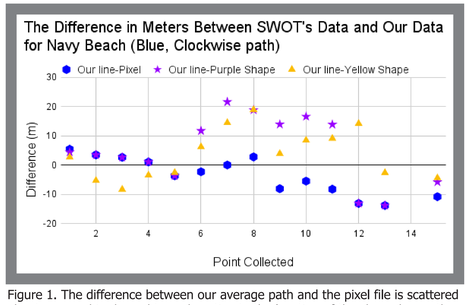


Figure 1. The difference between our average path and the pixel file is scattered about zero and is skewed to underestimate the location of the shore, hence the negative values as we move clockwise. The yellow shape file had fewer and less severe discrepancies to our average path than the purple file. The purple and yellow files tended to overestimate the shore. The pixel file and shape files overlap at times, because the shape files are generated from the pixel files.

IV. Discussion & Conclusions

SWOT's data is in agreement with ours and sufficently locates the water of Mono Lake

- The SWOT data aligned with our ground data from Strava the majority of the time, as seen in Figures 1 and 2. There are multiple factors that could have decreased the accuracy of the data:
  - Some areas of Mono Lake's edge were marshy and may not have been clear enough for SWOT to capture an accurate reading.
  - The Boat Launch location included many tufas that needed to be avoided, which could have affected the accuracy of our average line.
  - At Navy Beach, the yellow shape file overestimates where the shore is as it slopes Southwest, but as it slopes Northeast it underestimates where the shore is. This could be a legitimate issue SWOT has with capturing data near curved shores, and for future research adjustments to the algorithm that forms the shape files are needed to make these files more comparable with the pixel file data.
  - SWOT captured the shoreline with a level of precision satisfactory for NASA's JPL

V. Citations & Acknowledgments

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