

Estimating the Volume of Saline Valley Basin using ASTER -TIR and an ASTER Derived DEM

Executive Summary:

Imagery of Saline Valley, CA derived from the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) data was used for this theoretical analysis. The aim of this experiment was to calculate both the potential volume of water that the valley basin would hold, should it become filled, along with calculating the potential lake morphometry value.

Firstly, a region of interest (ROI) was created as a polygon over the basin area. This polygon included only the basin, not the flow channels. The pixel size was found to be 90 meters from the metadata. Length of the ROI was calculated using the measurement tool and found to be 599.9208 pixel. Its value became 53,992.872 when converted to meters. Area of the ROI was determined to be 489,127,000 m² or 489.127 km². The ROI was then loaded into the digital elevation model and a transect was drawn from one end to the other (fig.1). The minimum depth was determined to be 350 m, while the maximum height was 1500 m. Net height was calculated as 1150 m. For the sake of simplicity, the shape of the basin was simplified to be an inverted elliptic cone. The following equation was used to estimate volume:

$$V = \left(\frac{1}{3} \right) \pi abh$$

Where a is the major axis semidiameter, b is the minor axis semidiameter, and h is height. Both diameters were measured using the measurement tool. Additionally, the lake morphometry was calculated using the following equation:

$$D_s = \frac{s}{(2\sqrt{A\pi})}$$

Where s is the lake shoreline length and A is the area of the lake. D_s ranges between 1 and 2. This indicates the irregularity of the lakes shape, with 1 being a perfect circle. Simulated shoreline distance was estimated using both the ROI and the measurement tool.

The resulting volume after solving for V was 325 km³ of water. After comparing this value to other lakes with similar surface areas, it was determined to be a reasonable estimation. D_s was calculated as 1.54, which makes sense based on the lakes irregular shape.

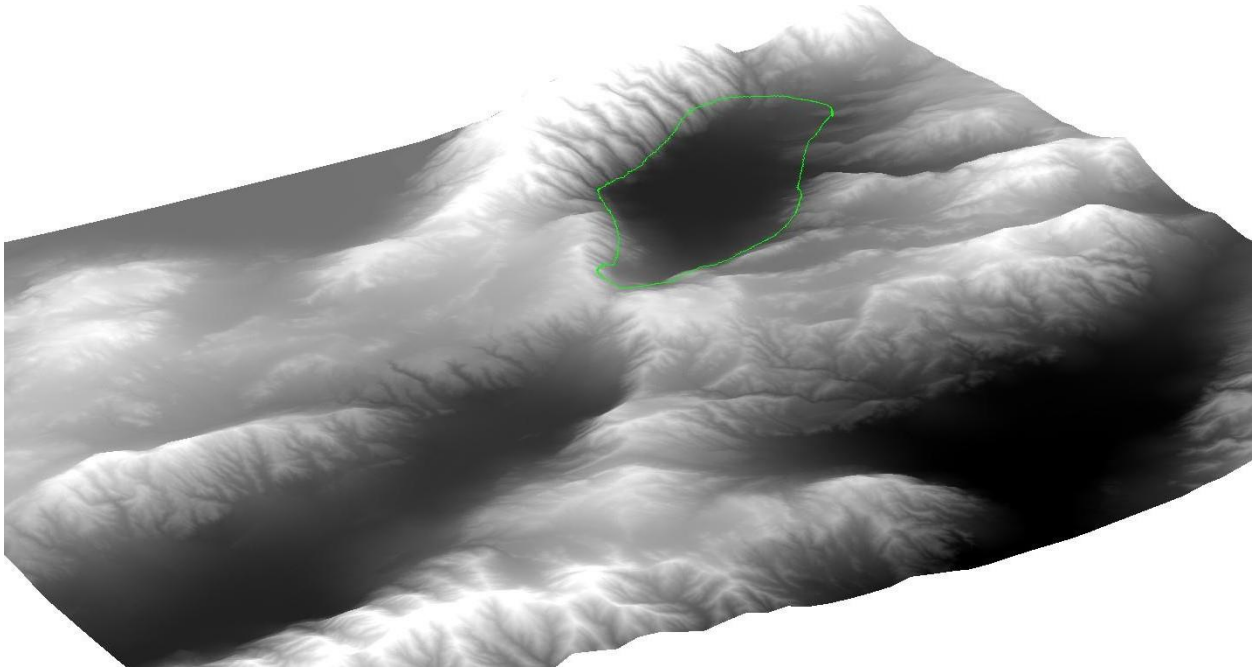


Fig.1 – DEM of saline valley basin from NASA (downloaded from Earthdata.nasa.gov) showing the ROI polygon, unfilled, in green.