



Introduction

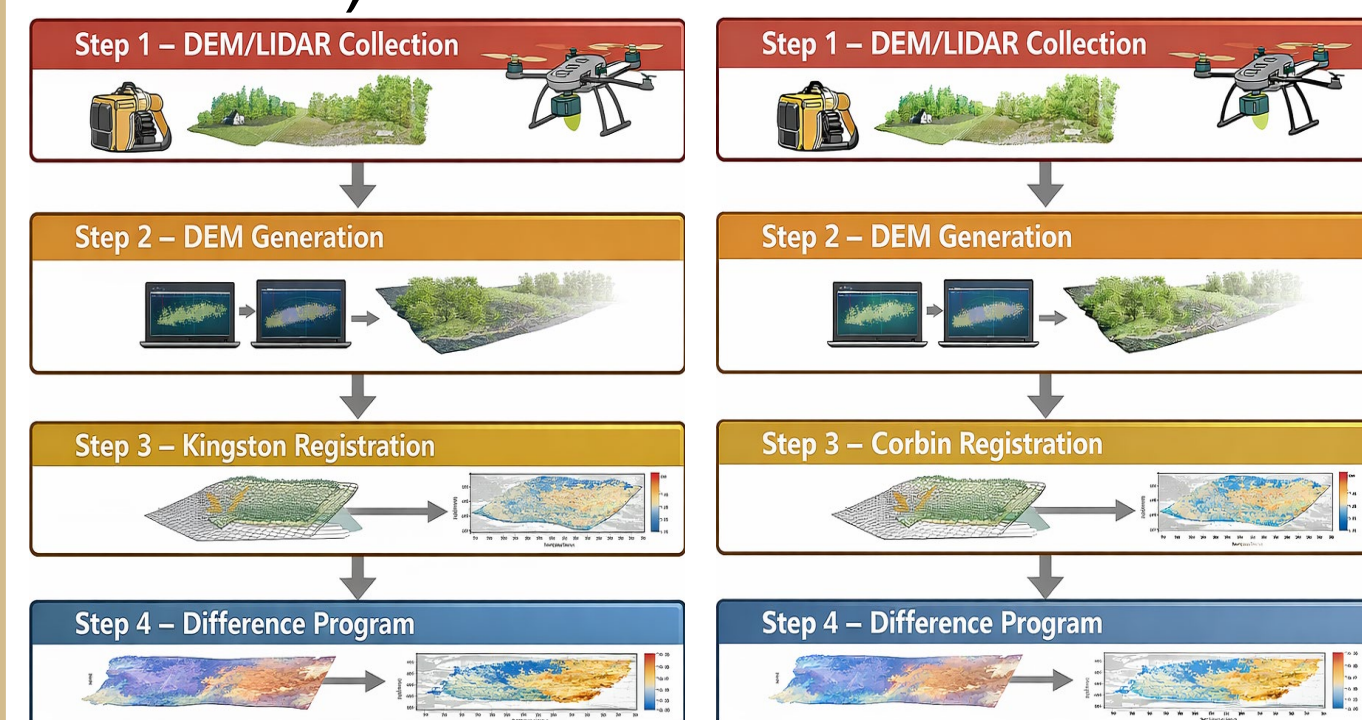
Handheld SLAM LiDAR enables organic terrain collection in GPS-denied environments. This study compares SLAM-derived DEMs against UAS airborne ground truth at two sites to evaluate accuracy and assess whether the magnitude of the error is acceptable for vehicle trafficability planning.

Objectives

1. Evaluate the vertical accuracy of backpack SLAM LiDAR for representing under-canopy bare-earth topography.
2. Assess how SLAM loop closure success or failure affects DEM accuracy across geographically distinct sites.
3. Determine whether SLAM-derived DEMs meet the Buckeye 30cm RMSE standard for military vehicle trafficability planning.

Methods

Sites: Corbin, VA (Successful Loop Closure) & Kingston, PA (Failed Loop Closure)



Research Question

How well does backpack-mounted LiDAR represent under-canopy topography, and does it meet the requirements for trafficability analysis?

Results

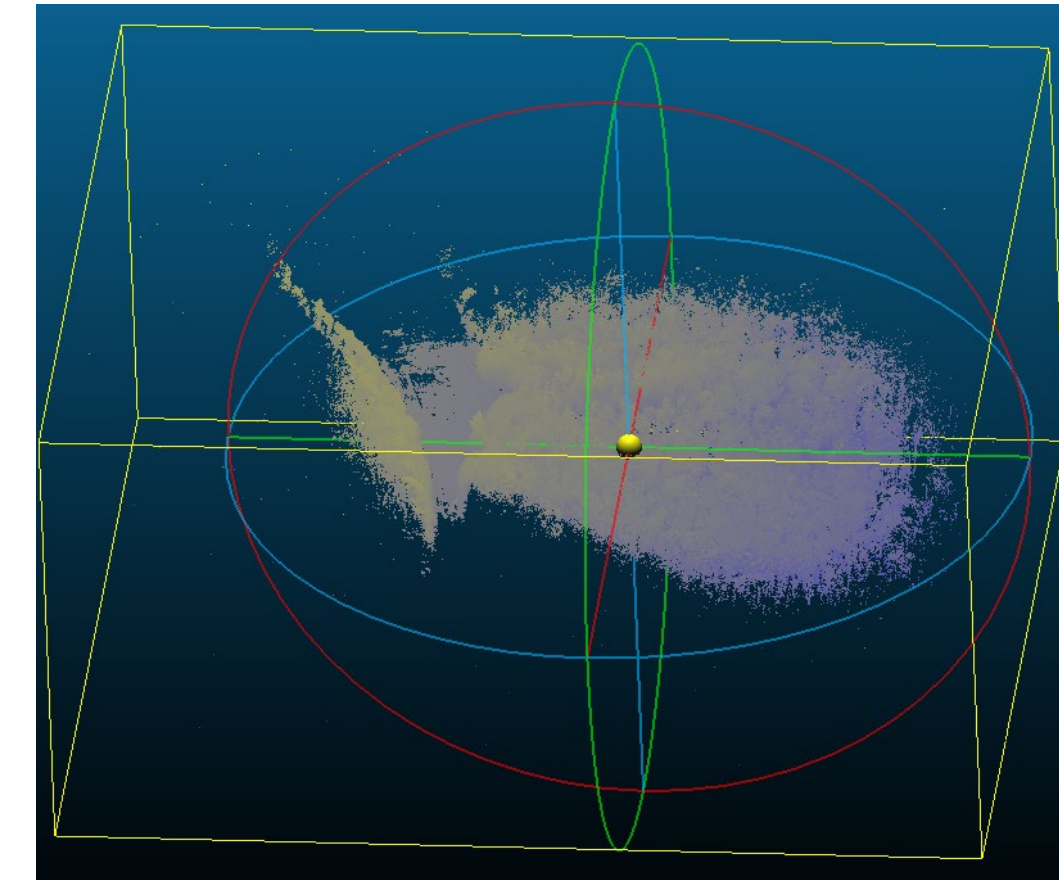


Figure 1. Original SLAM Corbin Data in Cloud Compare

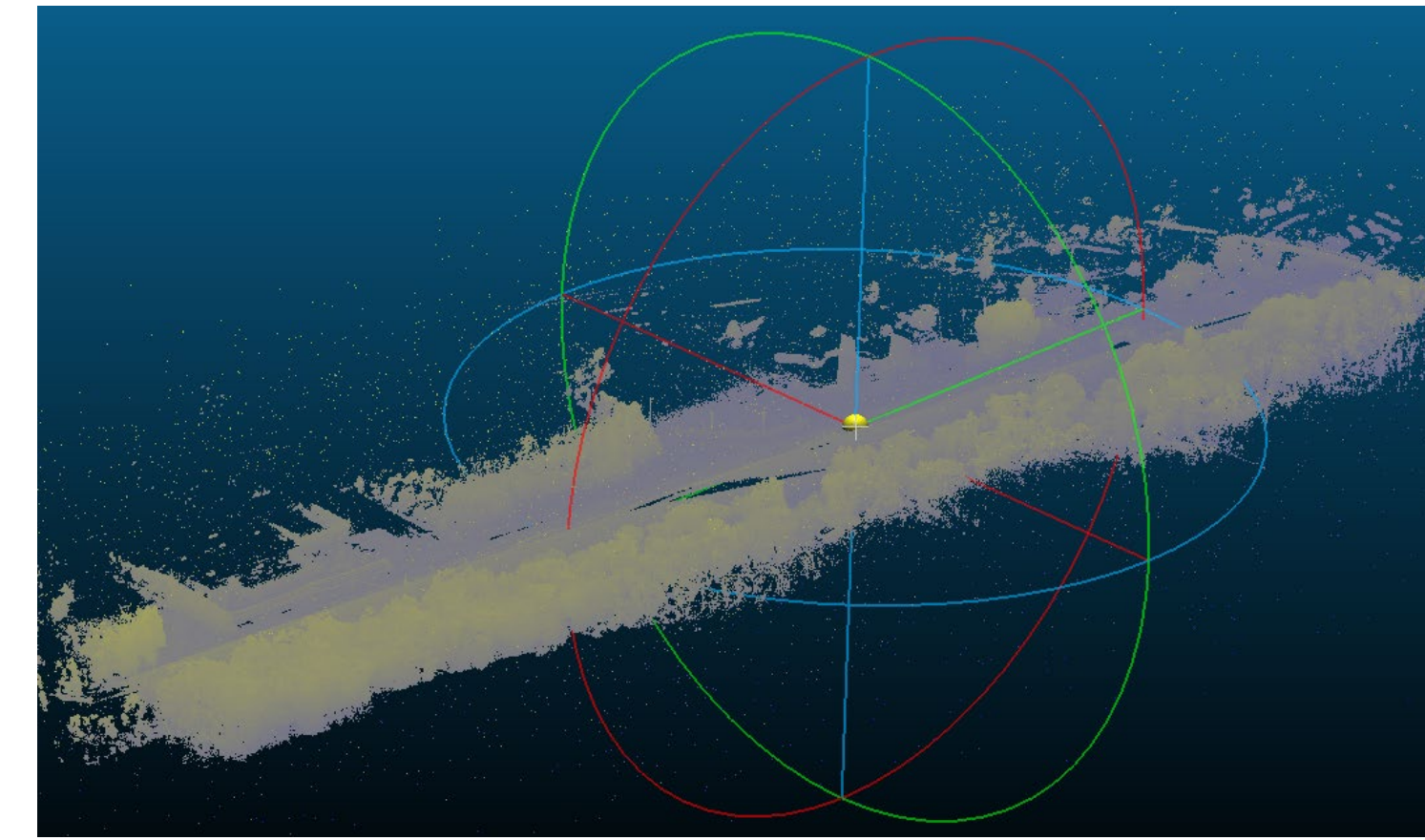


Figure 2. Original SLAM Kingston Data in Cloud Compare



Figure 3. Corbin Airborne Data in Cloud Compare

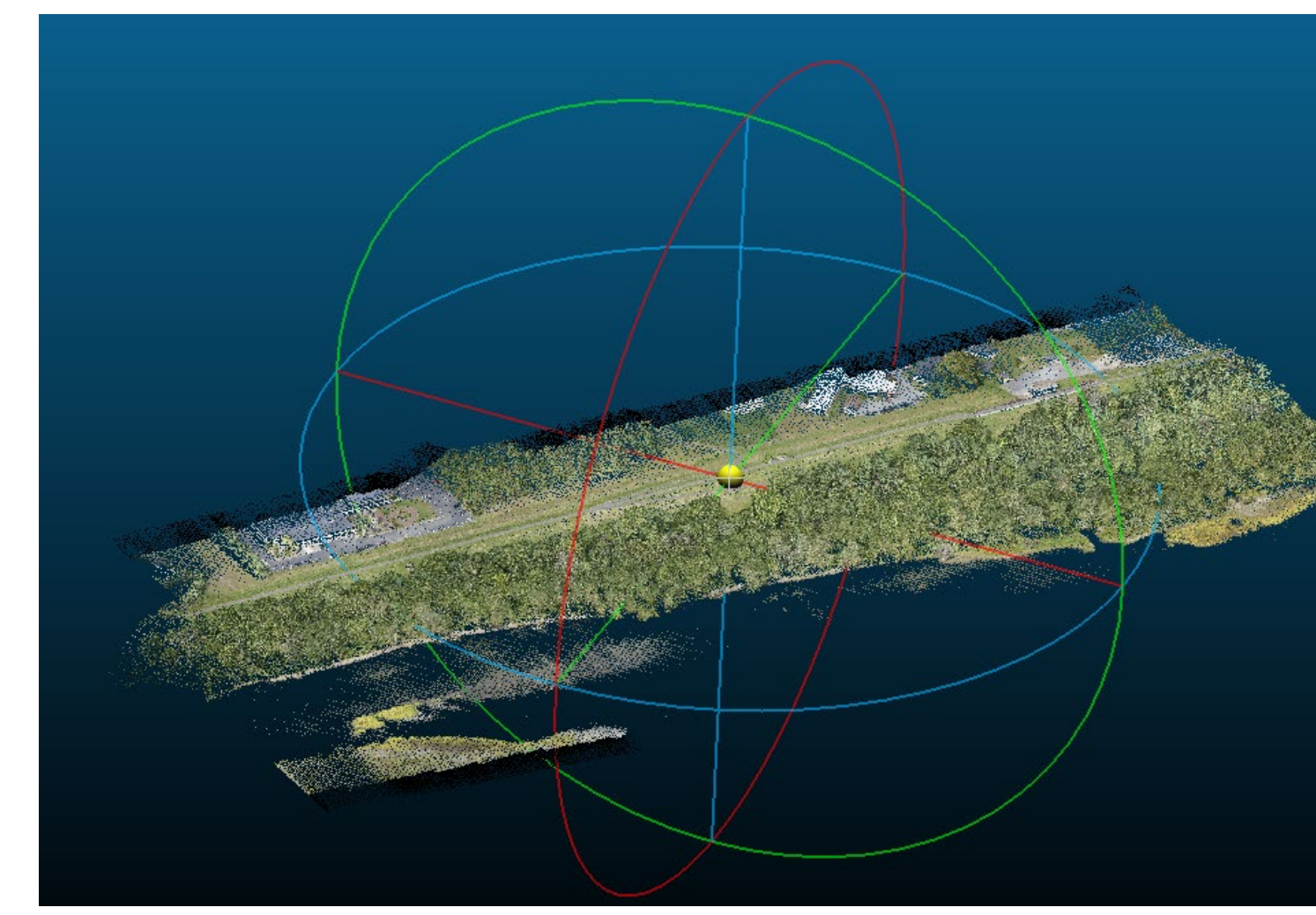


Figure 4. Kingston Airborne Data in Cloud Compare

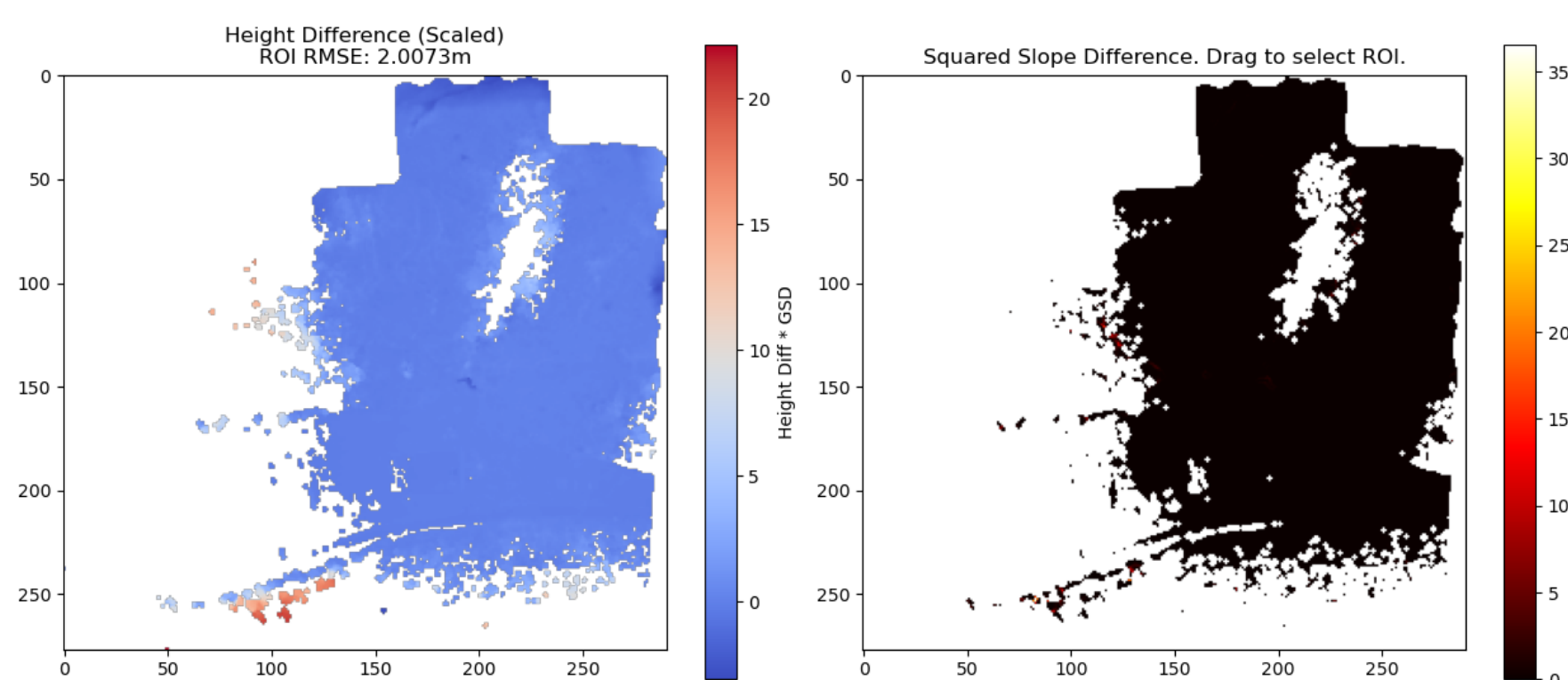


Figure 5. Colorized Height and Slope Scale of Corbin Data

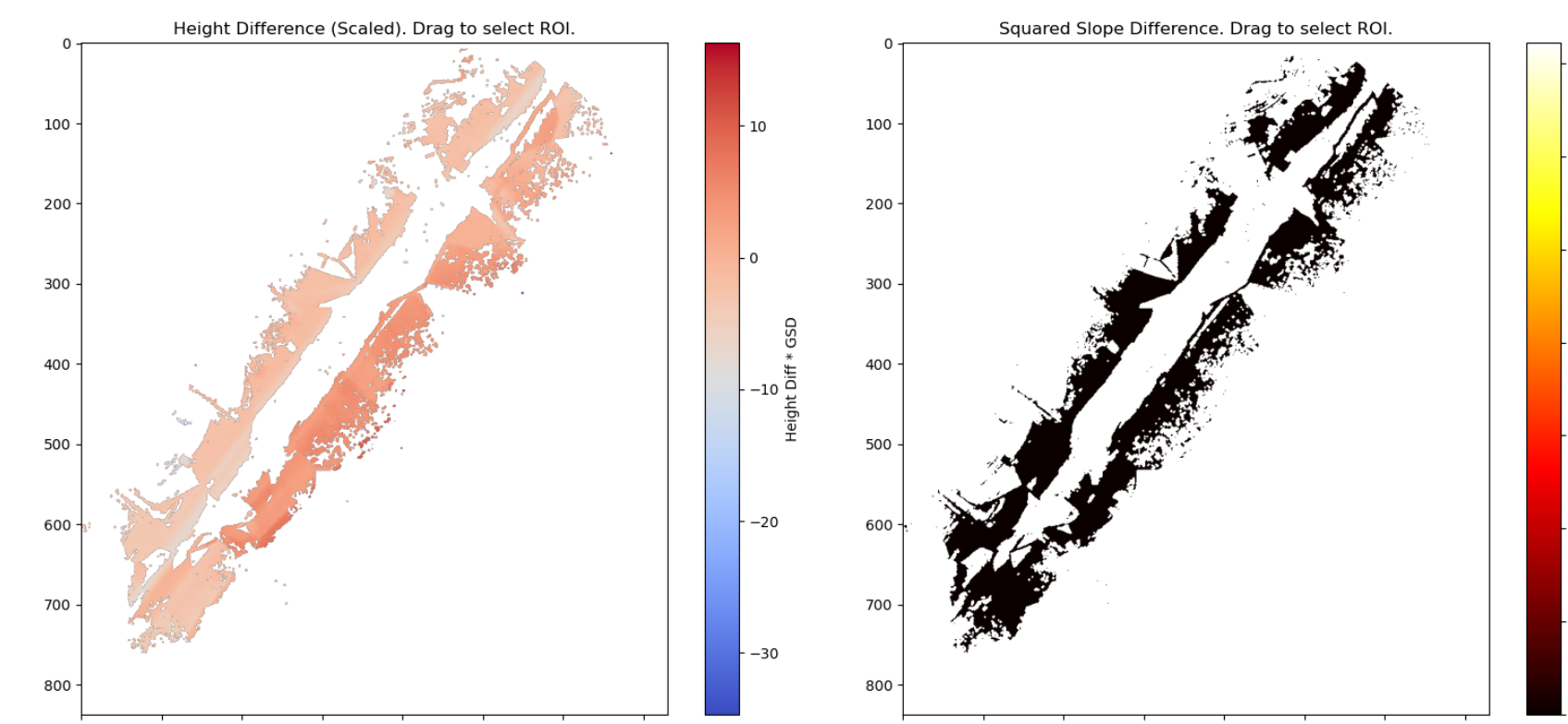
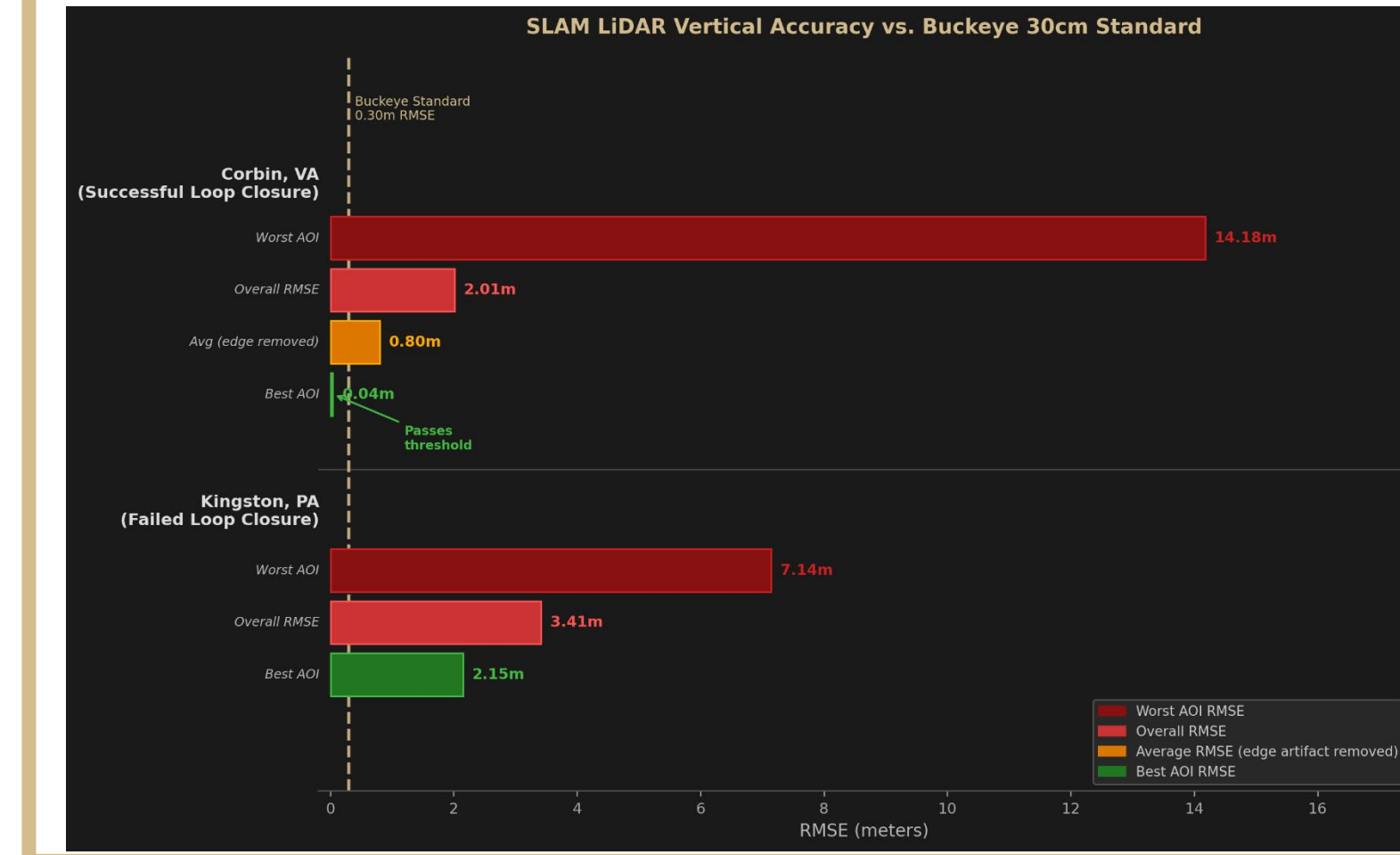


Figure 6. Colorized Height and Slope Scale of Kingston Data

Results



Discussion

Against the Buckeye 0.30m standard, Corbin's successful loop closure yielded a representative RMSE of 0.8m, with a best AOI of 0.04m when excluding a single edge artifact that inflated the overall average. Kingston's loop closure failure, driven by low terrain variation along the linear levee, left INS drift uncorrected and produced a 3.41m overall RMSE with no AOI approaching the threshold. Both sites fall short of the standard, but Corbin's interior accuracy suggests SLAM is conditionally viable when loop closure succeeds.

Conclusion

Loop closure success determines SLAM viability. Corbin's successful closure achieved 0.8m interior RMSE and 0.04m best-AOI, showing conditional promise. Kingston's closure failure, caused by insufficient terrain variation, rendered the data unusable. Neither site meets the Buckeye 0.30m standard, but results suggest SLAM is viable when site geometry supports loop closure.