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Evaluating Sentinel-1 DEMs for Geospatial Applications: A Benchmark Study

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INTRODUCTION & AIM

- The objective of this study is to generate a local Sentinel-1 DEM and assess its accuracy vs global and LiDAR datasets.
- DEMs are fundamental for hydrologic, geomorphic, and environmental analysis.
- Common datasets: SRTM (~30 m), Copernicus GLO-30 (~30 m), Sentinel-1 InSAR (custom).

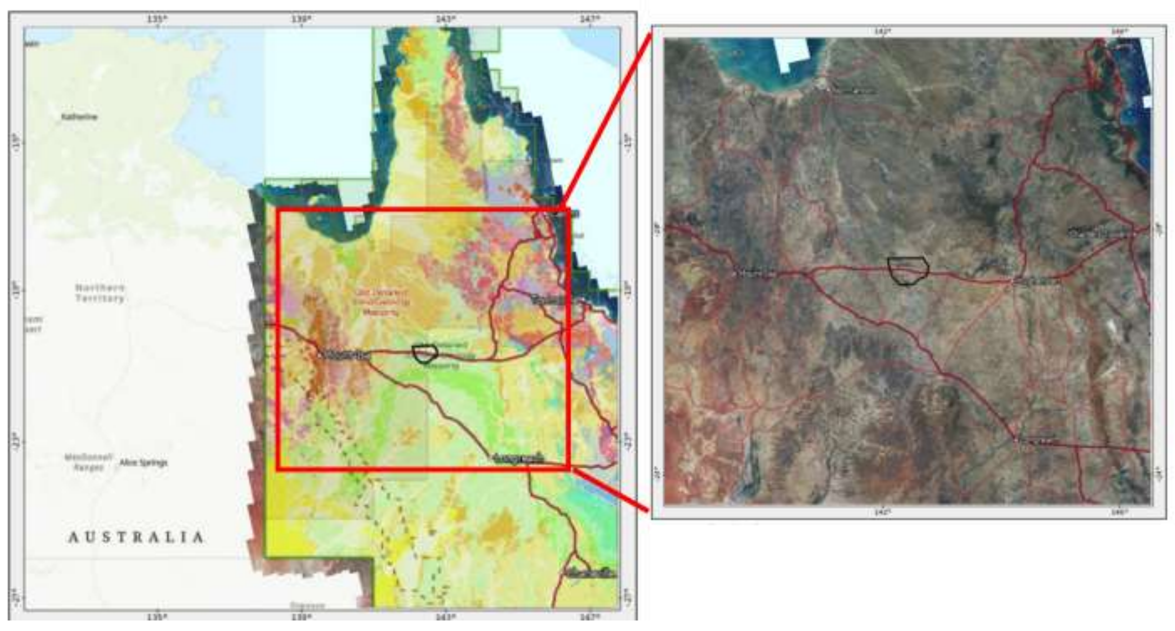

Figure 1 :Study Area, Maxwelton, Queenslans, Australia

METHOD

- Sentinel-1 SAR pairs images processed in SNAP for interferometric DEM generation.
- Copernicus GLO-30 and SRTM DEMs were downloaded from DLR and USGS websites.
- LiDAR DEM used for accuracy assessment.
- Accuracy metrics: RMSE, MAE, R^2 correlation.
- Qualitative checks: visual comparison of elevation profiles.

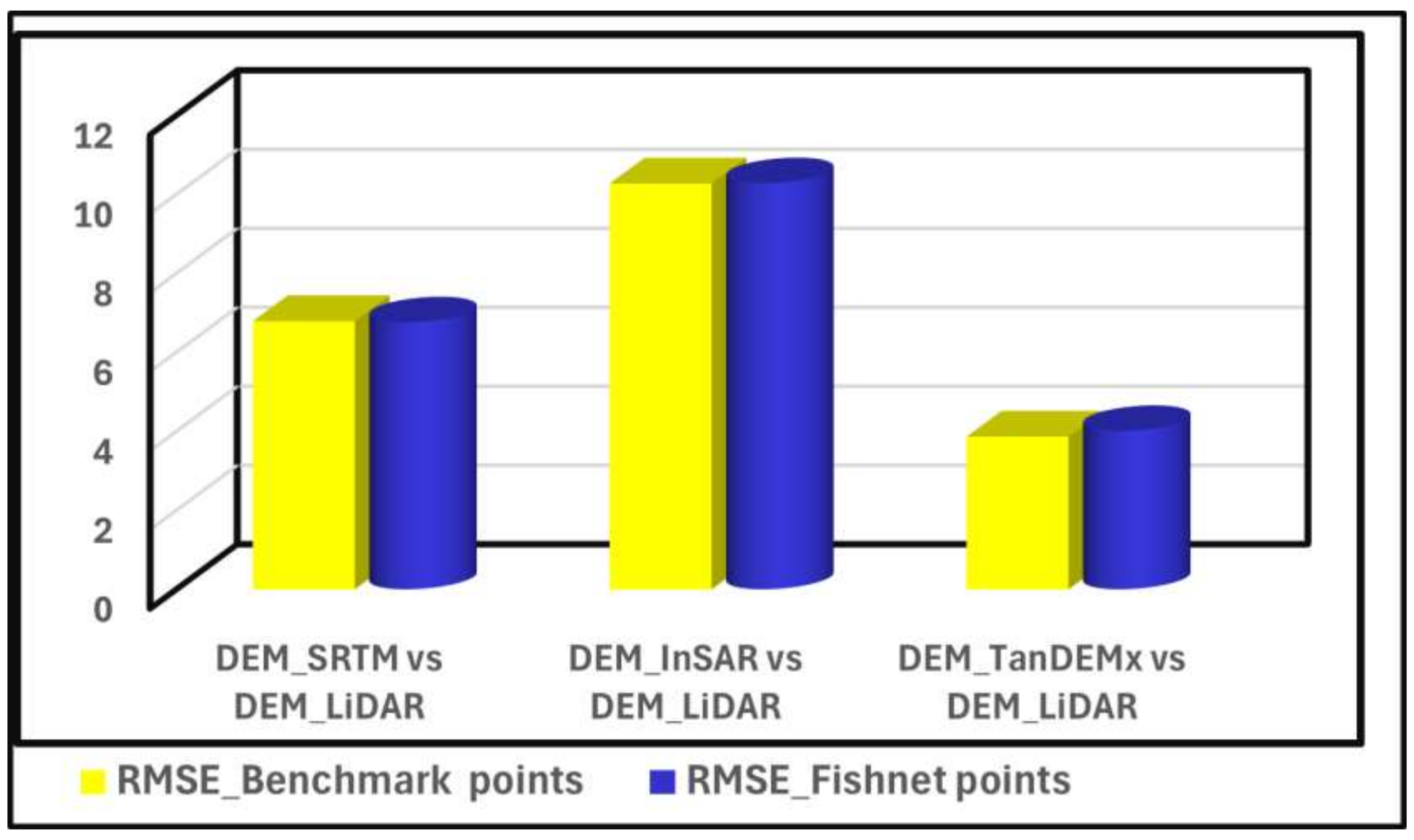

Figure 6.Comparison of DEM accuracy (RMSE) against LiDAR reference benchmark and Fisher-based points sampling. DEM_TanDEM-X showed the highest accuracy (RMSE ≈ 4 m) and strong agreement with DEM_LiDAR, while DEM_SRTM and DEM_InSAR had much larger errors (≈ 6–11 m). RMSE consistency across datasets confirms the reliability of the results.

RESULTS & DISCUSSION

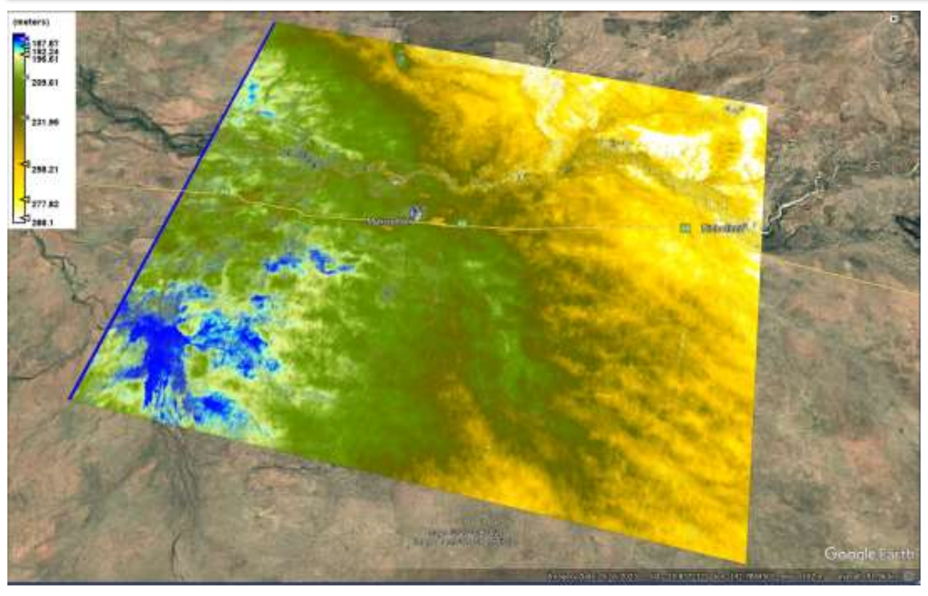

Figure 2. Sentinel-1 InSAR DEM

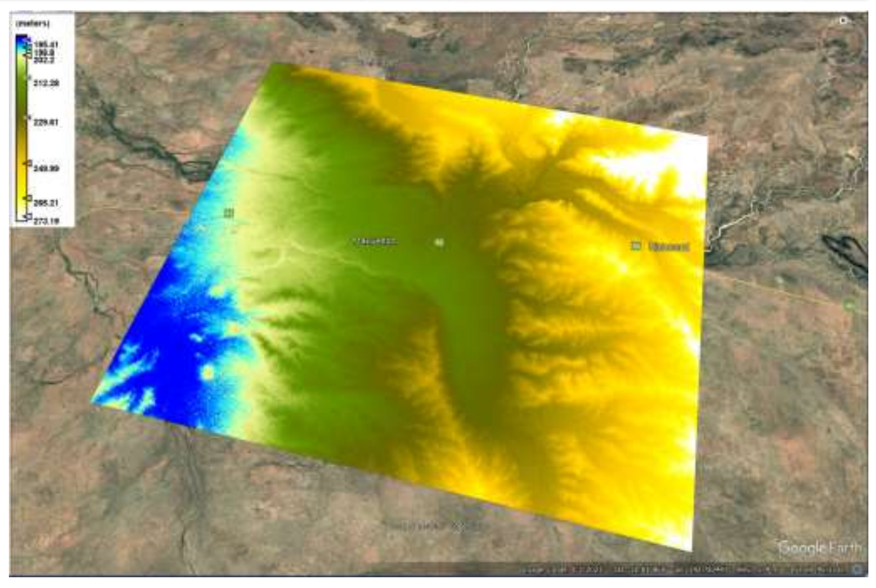

Figure 3. SRTM DEM

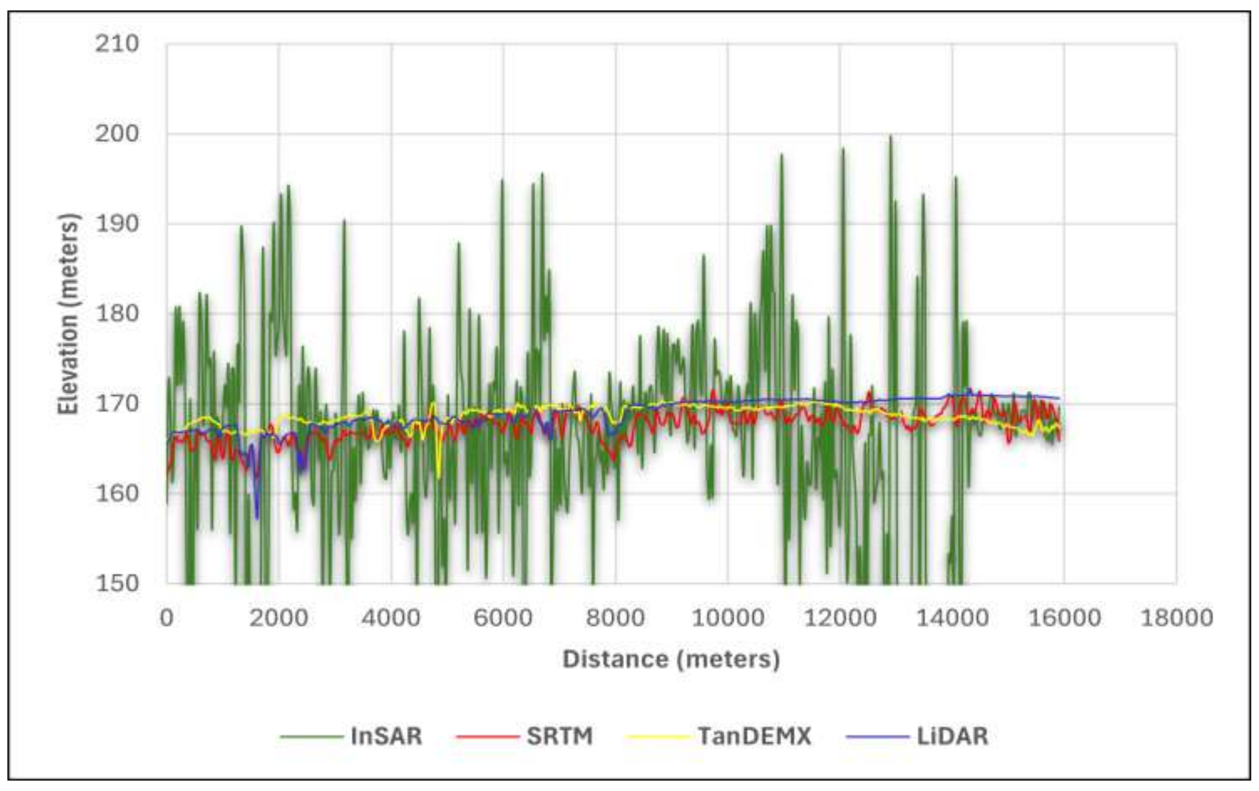

Figure 4.Elevation cross-section comparison of LiDAR, TanDEM-X, SRTM, and Sentinel-1 InSAR DEMs along Profile 1.

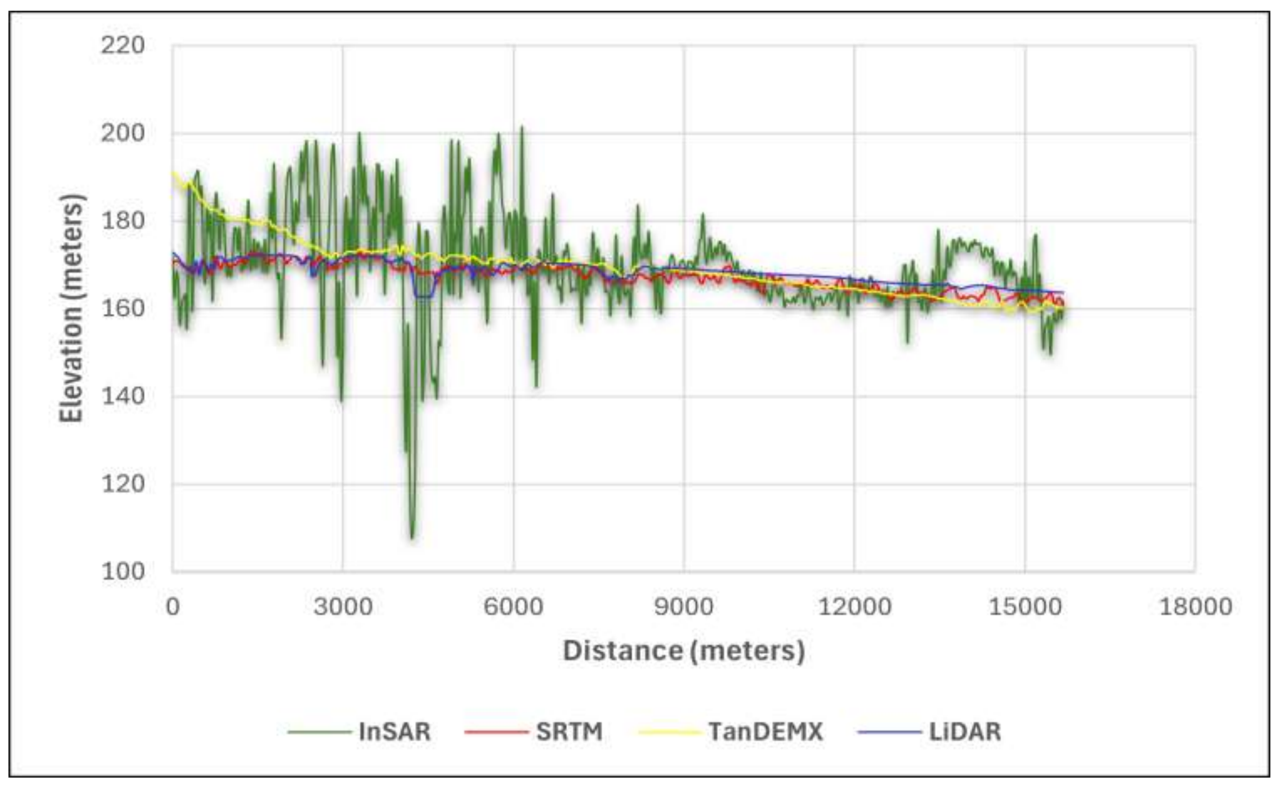

Figure 5. Elevation cross-section comparison of LiDAR, TanDEM-X, SRTM, and Sentinel-1 InSAR DEMs along Profile 2.

The LiDAR data show the most detailed and consistent elevation profiles. TanDEM-X and SRTM closely follow LiDAR but smooth out fine topographic features. InSAR shows the largest deviations, partly due to real post-2019 flood changes like sediment deposition or erosion. Overall patterns match the RMSE results, confirming higher errors for radar DEMs but also revealing the impact of acquisition timing.

CONCLUSION

All DEMs reproduce the overall longitudinal pattern well, but their precision differs. LiDAR remains the most accurate reference, with TanDEM-X and SRTM offering moderate, consistently smoothed representations. The larger fluctuations in the InSAR DEM align with its higher RMSE, but could partly result from actual post-flood topographic modifications and changes in vegetations. This suggests that dataset acquisition timing can meaningfully influence DEM–profile discrepancies.

FUTURE WORK / REFERENCES

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