SPATIAL RESOLUTION IMPACTS ON REMOTELY SENSED PRODUCT UNCERTAINTY AND REPRESENTATIVENESS

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Satellite remote sensing, while providing broad geographic coverage, faces limitations in spatial resolution for detailed benthic mapping, especially in coastal regions like Puerto Rico. Small unmanned aerial vehicles (drones) offer a promising solution due to their ability to capture high-resolution imagery with flexibility. This study evaluates how spatial resolution and classifier training strategies affect the accuracy and consistency of benthic habitat classifications derived from drone-based imagery. Using high-resolution RGB orthomosaics (0.036 m/pixel) collected via UAS and upscaled to coarser resolutions (0.5 m to 10 m), we assessed classification performance for coral, sand, seagrass, and substrate using Support Vector Machine (SVM) classifiers under four case-study scenarios. Spatial metrics (total area, patch count) and accuracy assessment indicators (self-transition and Critical Success Index) were applied to quantify classification degradation across scales and scenes. Results show that fine-scale features, especially coral and seagrass, rapidly degrade beyond 1 m, while more homogeneous classes like sand and substrate remain relatively stable. High classification reliability was observed at sub-meter resolutions (<0.5m) when site-specific training was used, though operational constraints often limit their feasibility in routine surveys. A resolution range of 1–3 m emerged as a practical compromise for a real-world mapping mission carried out on a manned aircraft, offering a balance between ecological accuracy and platform constraints. Additionally, no universal CSI threshold was found to define classification reliability, as acceptable values depend on the habitat class and prevailing water conditions. These findings provide a framework for selecting optimal spatial resolution and training strategies to support scalable, ecologically meaningful benthic mapping using drones.