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| **Integrating UAV Lidar and Multispectral Data for Mapping Disturbance Severity in West African Relict Forests** |
| **Introduction/Aim:**  Forests are essential ecosystems that provide a wide range of services, such as carbon sequestration, habitat for biodiversity, and water regulation. However, they are increasingly threatened by human activities, leading to degradation and fragmentation. In West Africa, relict forests represent critical biodiversity hotspots but face significant anthropogenic pressures. Assessing their status and disturbance severity is crucial for guiding conservation and restoration efforts in these valuable ecosystems. This study aimed to explore the integration of unoccupied aerial vehicle (UAV) lidar and multispectral data to evaluate forest status and map disturbance severity across Ewe-Adakplame, a 560-ha relict forest in Benin, West Africa.  **Methods:**  We collected UAV lidar and multispectral data over the Ewe-Adakplame Forest using a fixed-wing UAV equipped with a lidar sensor and a multispectral camera. The lidar data was processed to generate a canopy height model (CHM), from which structural metrics describing canopy height, cover, gaps, and surface complexity were extracted. The multispectral data was processed to derive five key vegetation indices related to moisture availability, productivity, and foliar health: Green Normalized Difference Vegetation Index (GNDVI), Enhanced Vegetation Index (EVI), Soil Adjusted Vegetation Index (SAVI), Normalized Difference Red Edge (NDRE), and Leaf Chlorophyll Index (LCI).  To develop an Integrated Disturbance Index (IDI), we first analyzed the correlations between the lidar-derived structural metrics and the multispectral vegetation indices. Significant positive correlations were observed between canopy height and spectral indices, such as NDRE (r=0.709) and LCI (r=0.693), indicating joint disturbance effects on forest structure and function. We then condensed the correlated height and spectral indices via Principal Components Analysis (PCA) to create the IDI, which was used for categorical mapping of low, medium, and high disturbance severities.  **Results:**  The IDI revealed that 25.8% of the Ewe-Adakplame Forest experienced low disturbance, while 45.7% and 29.5% of the forest underwent medium and high disturbance severities, respectively. Accuracy assessment using independent field measurements showed that the fused index (overall accuracy=88%) outperformed the individual datasets (lidar: 80%, multispectral: 78%) for disturbance detection. Integrating lidar and multispectral data provided a comprehensive understanding of forest status and disturbance severity, enabling more targeted conservation and restoration efforts.  **Conclusion:**  With three-quarters of the Ewe-Adakplame Forest undergoing medium to high disturbances, urgent interventions are imperative to strengthen resilience and prevent further declines. Protecting intact (low disturbance) zones through conservation enforcement and active restoration can help check further declines. The fusion method demonstrated in this study can be widely applied across West Africa to support effective conservation and restoration efforts. By integrating UAV lidar and multispectral data, we can better understand the complex interactions between forest structure and function, ultimately guiding more informed decision-making for forest management and conservation. This approach has the potential to significantly improve the assessment and monitoring of forest ecosystems, ensuring their long-term sustainability and the preservation of the vital services they provide. |

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