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| **The Impact of BRDF Correction on the Retrieval of Forest Leaf Area Index using Multi-Flightline Airborne Hyperspectral Imagery** |
| **Introduction/Aim:**  Airborne hyperspectral imagery provides detailed spatial and spectral insights, advantageous for retrieving forest biophysical and biochemical parameters. However, in practical forestry applications, large-scale multi-flightline airborne data is influence by Bidirectional Reflectance Distribution Function (BRDF) effects, limiting the accuracy of forest parameter models and introducing artifacts in forest parameter mapping.  **Methods:**  To evaluate the impact of BRDF correction on forest Leaf Area Index (LAI) retrieval and mapping, this study utilized hyperspectral imagery acquired by the Chinese Academy of Forestry's LiDAR, CCD, and Hyperspectral system (CAF-LiCHy) over the Mengjiagang Forest Farm (MFF, 193 km2) in northeastern China, covering common coniferous species in northern China's temperate-boreal ecozones. A kernel-driven BRDF correction model was applied to multi-flightline airborne hyperspectral imagery for the large temperate forests. Subsequently, an investigation was conducted into the influence of BRDF correction on potential optimal wavelength ranges, Vegetation Indices (VIs), and six commonly used estimation models (i.e., PLSR, RFR, XGBoost, GPR, SVR, and ANN) associated with LAI modeling.  **Results and Conclusion:**  Our analysis yields the following key findings:   1. BRDF correction notably enhances the accuracy of estimating large area forest LAI using multi-flightline airborne hyperspectral imagery, while also effectively mitigate artifacts in LAI mapping products. Specifically, after BRDF correction, the correlation with LAI showed a maximum improvement of ΔR² = 0.20 in the visible and near-infrared (VNIR) bands, while employing VIs resulted in a maximum improvement of ΔR² = 0.32. The estimation model exhibited a maximum increase of R²cv = 0.28, and a maximum decrease of ΔRMSEcv = 0.25. 2. Through repeated experiments in two study areas, it was found that regardless of whether BRDF correction is applied to airborne hyperspectral data, within the VNIR range, the optimal wavelength ranges for reflectance most correlated with LAI are within the NIR bands (780-990 nm), while the weakest correlations are observed in the green (540-600 nm) and red (690-720 nm) bands. Additionally, it was found that due to the complexity of real forest scenes, the absolute contribution ranking of VIs to LAI retrieval remains unstable even after BRDF correction, but some NIRrelated VIs perform relatively well. 3. Although the RFR exhibits the best performance in this study (MFF: R²cv = 0.77, RMSEcv = 0.55), we still recommended to use multiple estimation models for a comprehensive comparison to estimate practical forest biophysical and biochemical parameters. |