INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: ***A Pipeline of Methods for Evaluating Carbon Sequestration Potential of Forest using LiDAR Data and Abiotic Factors***

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SHORT ABSTRACT

Forests act as vital carbon sinks, absorbing CO_2 from the atmosphere that is driven by both human and climate-induced shifts. However, recent studies reveal a decline in natural carbon sequestration. For instance, the atmospheric CO_2 increase has reached approximately 2.5 parts per million per year, a substantial portion of which is attributed to the decline in natural sequestration. Ecotone forests, often disturbed, exhibit reduced biodiversity and productivity, necessitating accurate assessments of their carbon pools in response to anthropogenic emissions, particularly greenhouse gases. The Acadian Forest in Canada, which serves as a Forest of national importance for both indigenous people and mammals, faces disturbances, including fire and climate variability, which impact its carbon dynamics. Remote sensing technologies, particularly LiDAR and to some extent, satellite data enable precise biomass estimations, which are critical for understanding forest carbon pools. This research introduces a modified method for crown structure modelling and branch detection using terrestrial LiDAR, achieving stem volume estimation errors between 0.03 and 0.87 m^3, and crown (branch) volumes with errors between 0.013 and 2.33 m^3 across a range of 22 trees in three tropical regions. Moreover, an approximate biomass estimation method is provided for the Acadian Forest using Airborne LiDAR data that considers species-specific canopy structures. For the same forest region, a parametric biomass model that integrates various satellite datasets is provided at 25m resolution, where LiDAR data is not available. At last, a carbon sequestration model is developed for the Acadian Forest that accounts for biomass and soil storage, along with essential abiotic factors. It predicts a significant carbon loss by 2048 due to changes in above-ground biomass and below-ground biomass, revealing oscillating carbon sequestration trends post-2029. The findings indicate a reduction of approximately 60,000 $kg.C$ in forest carbon storage by 2048, correlating to a 1.2% change in forest cover.