ForestCast: Developing a Novel Convolutional Neural Network to Enhance Prevention of Fragmentation in the United States

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The United States lost 4.22 million acres of forest in 2021 - equivalent to 775 million tons of carbon dioxide emissions. Remote sensing is the most common model used to monitor deforestation. However, typical remote sensing models only achieve 66% accuracy, resulting in insufficient data for policy making regarding deforestation, specifically forest fragmentation. Fragmentation urgently needs proper management which requires higher accuracy, higher precision, and faster computation than remote sensing. This research aimed to develop ForestCast - the first computational program to enhance visualization of forest fragmentation data by i) masking clouds to create a dataset for training, ii) innovating a novel convolutional neural network (CNN) that visualizes fragmentation, and iii) comparing the results to remote sensing. Using Google Earth Engine (GEE), the clouds in the satellite imagery were masked, increasing visualization by 92% ($p<0.001$). The CNN was developed and trained to identify fragmentation using the dataset obtained from GEE, achieving 90.5% accuracy. ForestCast illustrated the strong relationship between urbanization and fragmentation in the US ($p<0.005$). In a case study comparison, it was discovered ForestCast had 24.5% higher accuracy and was almost 7 times faster than the average remote sensing model. In conclusion, ForestCast is a new model with higher accuracy and efficiency than remote sensing. These findings allow ForestCast to undergo refinement in future investigations for other common deforestation pressures like wildfires and agricultural expansion. Thus ForestCast has the potential to become an important cornerstone of national forest-monitoring programs.

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