Quantification of Carbon Sequestration in Urban Forests

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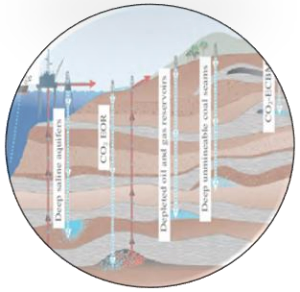
Great challenge: real time monitoring of CO_2 emission and offset

Current business approach: offset emission by purchasing carbon credits

CO_2 Emission

CO_2 sequestration

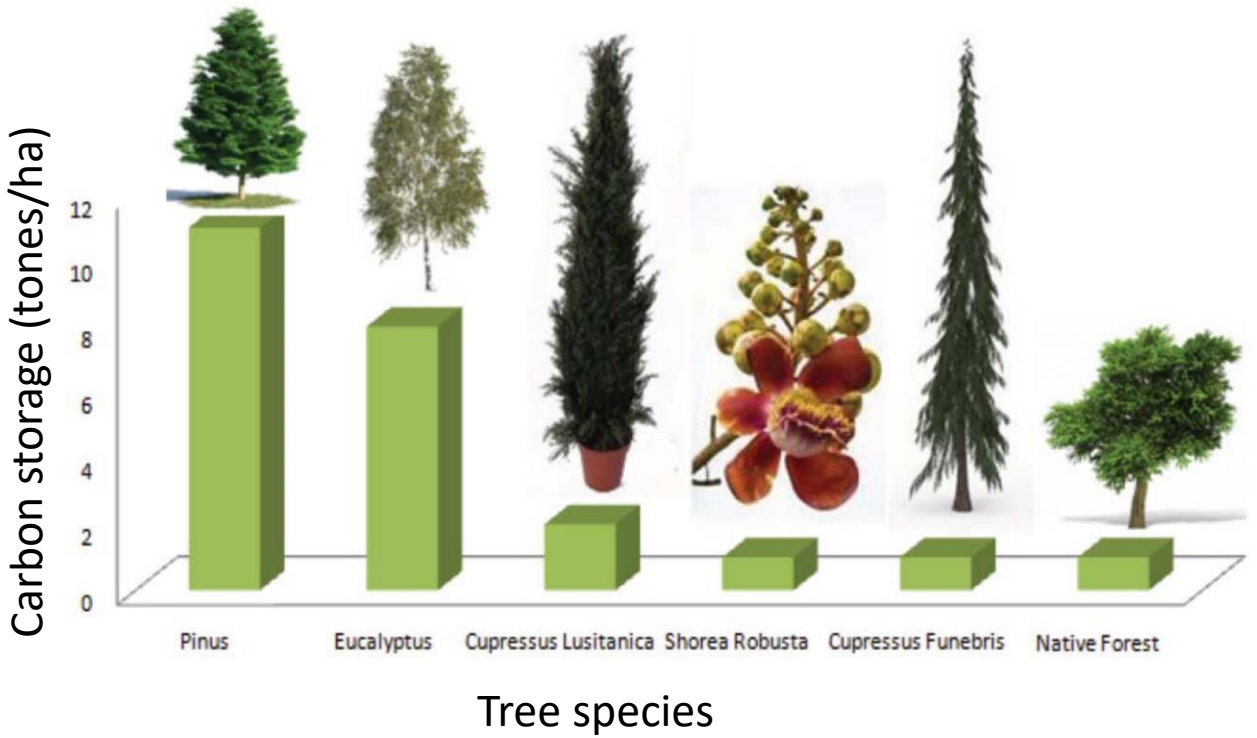
Air Scrubbing



Underground storage

Net Zero CO_2 in atmosphere

Tree species dependent carbon storage



*C. Silveira "Which species perform best in carbon sequestration and storage in planted forests? A review of the potential of Pinus and Eucalyptus." *International Forestry Review* 22.4 (2020):

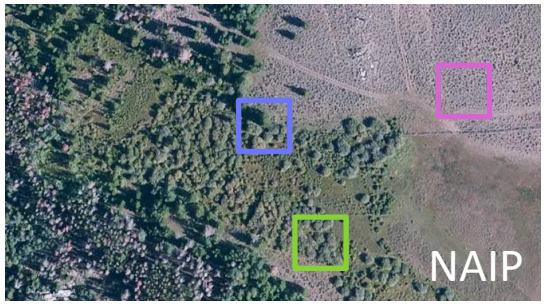
Conventional approaches to monitor tree species

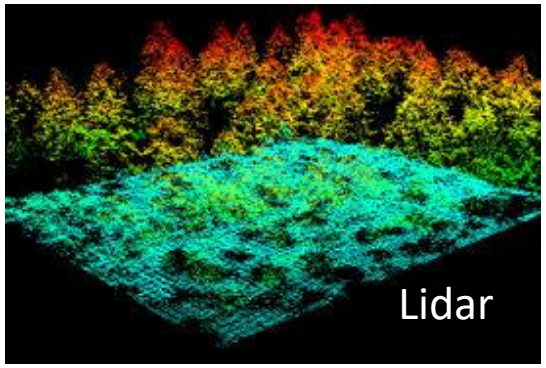
1) Crowdsource effort to identify species based on volunteer's visual observation
2) Manually document tree types/sizes/status for trees on streets but not between buildings, private properties, parks …
3) Repeat survey every 5 years or so

Our approach: classify tree species with DL

Data

- NAIP data from PAIRS
- Lidar data for calibration





Label

NYC Urban tree survey-2015

https://www.nycgovparks.org/trees/treescount

DL Model

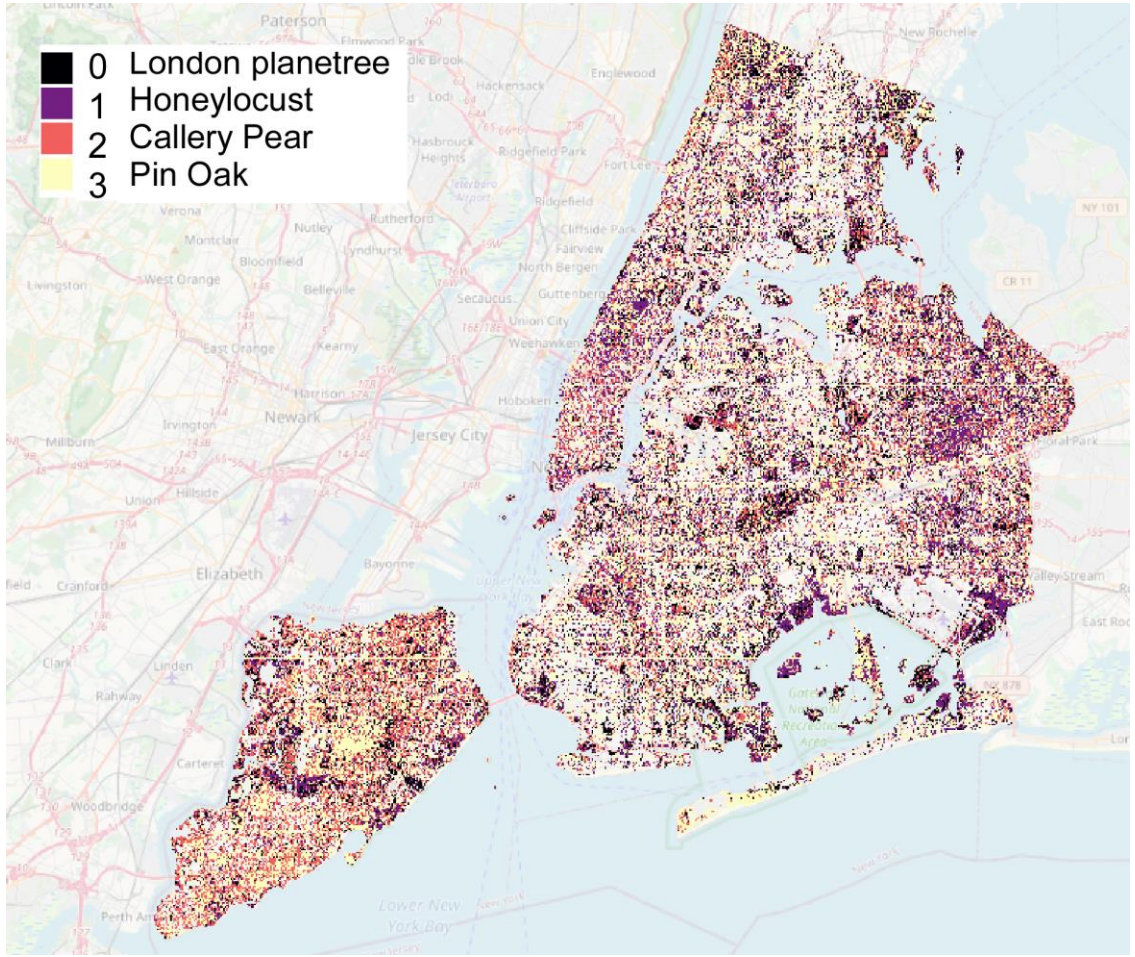
- Modified ResNet34
- 32 x 32 x 4 image tiles
- Data cleaning
- Data from 2015-2020
- Four classes
- **80%** accuracy on test

Tree type	Label	# points
London planetree	0	55,903
Honeylocust	1	43,974
Callery pear	2	42,384
Pin oak	3	30,575
Total		172,876

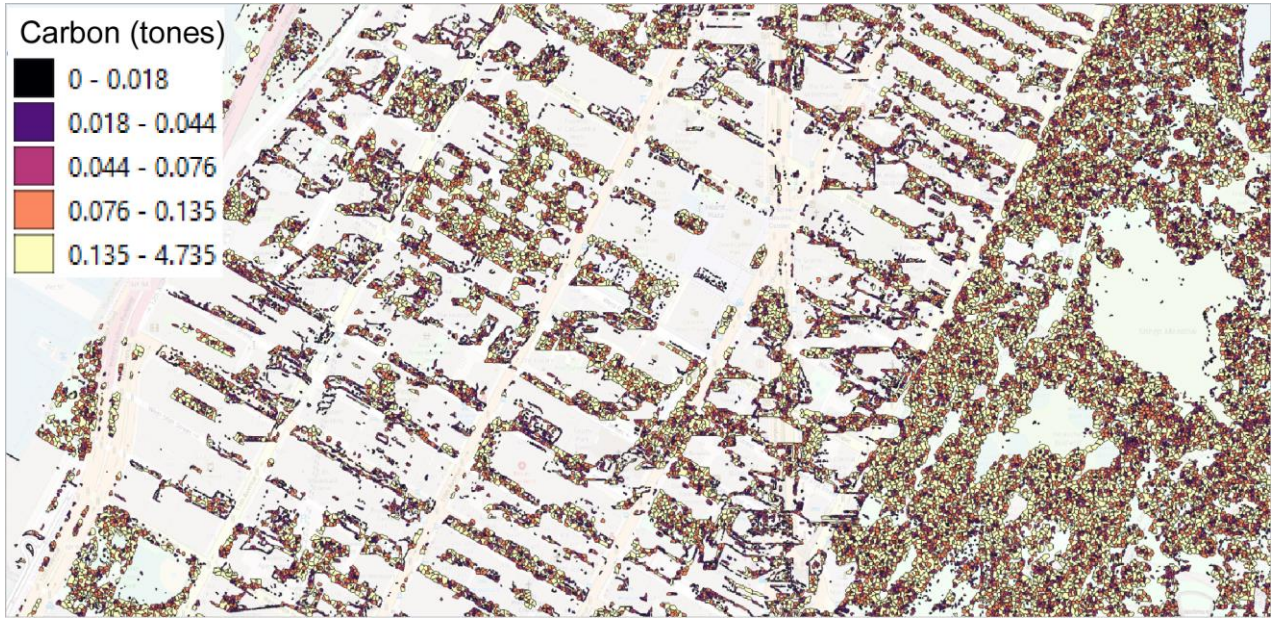
Carbon storage

- Identify all trees in NYC
- Delineate tree crowns
- Carbon storage for individual trees

Carbon storage- bottom-up summation



DL classification of all trees for NYC for the 4 tree species



Sum up carbon from all 300,000 trees in Manhattan, NYC

52,000 tones of Carbon

Ground truth is 43,500 tones of Carbon*

*Nowak, David J., et al. "The urban forest of New York City." *Resource Bulletin NRS-117. Newtown Square, PA: US Depart of Agriculture, Forest Service, Northern Research Station. 82 p* 117 (2018): 1-82

Conclusion

- A deep learning pipeline is proposed to identify and to classify urban trees based on their species and geometrical dimensions

- Tree location, tree type, and tree dimensions are calculated from open-source geospatial data and multi-year remote sensing data can verify the total carbon stored and sequestered in trees

- The tool can help carbon trading markets to verify the carbon stored in trees and validate carbon sequestration values used for offsetting CO_2 emission

Link to paper: https://arxiv.org/abs/2106.00182