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Automated Satellite Detection of Tornado Forest Damage in Canada

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The Northern Tornadoes Project (NTP), a division of the Canadian Severe Storms Laboratory (CSSL), has the goal of detecting every tornado that occurs in Canada. However, due to Canada's vast area, often the only significant damage caused by a tornado occurs in remote forested regions that may go unreported. In order to detect these remote, unreported tornadoes, researchers at the NTP perform an end-of-season systematic sweep of Canada using satellite imagery. By comparing satellite imagery between different dates, large swaths of damaged trees can be detected and classified as tornado damage, among other severe storms (including downbursts).

Performing systematic sweeps of satellite imagery for all forested regions of Canada (over 4 million km²) is time-consuming, currently taking a team of researchers multiple months to complete. In order to speed up this process, an automated computer vision model is utilized. However, due to the rarity and diversity of tornado tracks, existing computer vision instance segmentation architectures may fail to achieve a high enough accuracy to detect every tornado in the vast search area. Instead of directly predicting tornadoes, this study develops a forest damage detection model that utilizes a convolutional neural network to automatically compare small sections of satellite imagery between different dates and identify regions that contain significant changes to the forest. Resultingly, only areas with detected forest damage need to be manually searched for tornado tracks, substantially speeding up the required search time, while being reliable enough to ensure no tornado is misclassified. Future work will aim to utilize this model outside of Canada in the similar forested regions of Northern and Eastern Europe.