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Detecting plane trees in the city using open access remote sensing data: chances and challenges.

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Plane trees (Platanus sp.) are common ornamental city trees in Poland, planted often along roads, avenues and in parks. Their number has been increasing in recent years, however they produce large amount of wind-transported pollen, which can induce allergy symptoms. It is very likely that plane tree allergy will be more frequent in near future, especially in urban societies. Allergy sufferers can partially limit the contact with plane pollen by avoiding places with high concentrations during pollen season. It is possible thanks to pollen concentration forecasting, based mostly on source location data. Unfortunately available street greenery inventories are lacking for most of cities while acquisition and maintenance are expensive and time consuming. Growing accessibility of remote sensing technology, for instance consumer grade drones, makes opportunity to efficiently detect location of specific plants. Nevertheless for large areas it is still often beyond possibilities of local authorities and data acquired this way can be quickly outdated. Therefore this study explores potential of using access free, remote sensing data to detect plane trees in highly urbanized environment of Poznań.
Airborne laser scanning point cloud was used to derive location of treetops above 6 meters tall. Then small part of them (n = 912) from city center was manually marked to one of four classes: young plane tree, mature plane tree, other species or artifacts. Three aerial photo orthomosaics in CIR and RGB composition, as well as point cloud were used to extract variables values. Circular buffers (r = 1 m) around treetops were used to avoid shadowing effect, overlapping crowns influence and other obstacles. Random Forest machine learning classifier was applied to assess variables importance and tag treetops in 2 km radius around standard, Hirst-type volumetric pollen trap. The model performed well during 10-fold cross validation on training set (OA ≈ 86%, $\kappa \approx 80\%$), however when implemented on broader area, significant overestimations in number of plane trees are observed. Pollen concentration data and wind direction was also compared with predicted number of plane trees in eight main directions from pollen monitoring station. Result showed that using open access remote sensing data to detect trees producing allergenic pollen is promising alternative method, although it has many limitations, as these products were not planned for plant research. One of the most serious issue in this method seems to be "radial shift" effect. Real position misalignment of objects above ground surface, compared to pixels representing them on basic orthophotomap, is causing noises in spectral characteristic, making detection challenging. To summarize, better accuracy is possible to achieve through well suited data acquisition. However using free of charge public administration data to scientific purposes can be beneficial to our knowledge about pollen sources.

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