Trees Over Module

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Updates Since Running 14 Priority Counties

- After buffers workflow, forest from all environments is dissolved together to run Rules 1-3
    - Agricultural forest patches (psegs pre-dissolve) who are sharing their border with at least 85% forest are considered windbreaks and are not dissolved with any other forest
- Rules 1-3 are run once per tile
    - 14 county version ran once per environment, enforcing harsh parcel boundaries between forest of different environment types; **over-estimated Trees over classes.**
- Trees in Agriculture class now encompasses all patches of forest that are less than an acre in area and width that are not sharing at least half of their border with buildings, other impervious surfaces and turf grass; small patches that are Tree Canopy over Turf Grass are now only if they are sharing over half of their border with turf grass, buildings and other impervious surfaces.; **over-estimated TCT**
- Updated width function to determine spacing based on forest segment shape
    - Uses proportion of polygon area to bbox area to determine how compact the polygon is; more compact can use larger spacing/less points, less compact needs smaller spacing/more points.
    - This is a little slower since it is generating more points per poly – but this function no longer throws an error
- Width function had a logic error with the width threshold that is now fixed
    - Was calculating distance from "center" point to edge (radius) and comparing to width threshold of 72 meters (diameter) – **over-estimated Trees over classes.**
- Automated the number of processers to be pulled by each tile
- Automated the deletion of the temp_qgis folder – leaving only the final output gpkg and log

Overview

The Trees Over module creates the Trees over Turf Grass and Trees in Agriculture classes. They are produced in a geopackage named *trees_over.gpkg* with 3 layers:

1. toa – Tree Canopy in Agriculture
2. tct – Tree Canopy over Turf Grass
3. tct_bufs – Buffers to overlay with Tree Canopy class to create remaining TCT

Each county will be split into four environment types: dense, less dense, forested, and agricultural. The county will be run through the module by environment type. Results from each environment type will be stored together in the same layer in the trees_over.gpkg.

A log file named *etime_treesover_log.txt* will be produced and stored in the county folder.

There are two trees over calculations, called buffer workflow and rules 1 – 3.

Buffer Workflow:

1. Buffer buildings, turf grass and other impervious that are touching a structure by
    a. 20m for dense parcel
    b. 10m for all other environments
2. Find intersection of buffers and forest to create Tree Canopy over Turf

Rules 1 – 3:

1. Forest patches < 1 acre sharing over half of their border with development classes are Tree Canopy over Turf Grass
2. Forest patches < 1 acre sharing less than half of their border with development classes are Trees in Agriculture
3. Forest patches > 1 acre and < 72m wide
    a. Sharing over half of their border with development - Tree Canopy over Turf Grass
    b. Sharing less than half of their border with development - Tree Canopy in Agriculture

Burn in Logic

The 3 layers should be burned in in the following order using lu_code field:

1. toa (lu_code 3200) directly into lu raster
2. tct (lu_code 2240) directly into lu raster
3. tct_bufs (lu_code 2240) where lu raster sis still Tree Canopy (do not burn in over toa)

Required Inputs

1. Geopackage of county psegs - B:/priority/{cf}/output/data.gpkg
2. Geodatabase of county parcels - B:/priority/{cf}/temp/temp_dataprep.gdb
3. Urban Census Area Shapefile - B:/ancillary/census/urban_area_albers.shp
4. Count Tiles Shapefile - B:/priority/{cf}/input/tc_tile_buff.shp

Environment

The required environment will be provided in a YAML file (located on lu1 B Drive). Dependencies also listed below.

- python=3.7
- curl
- fiona
- gdal
- geopandas
- geos
- geotiff
- hdf4
- hdf5
- matplotlib
- numpy
- pandas
- rasterio
- requests
- rtree
- scipy
- shapely
- qgis

Scripts

There are 3 scripts needed to run the Trees Over module (located on lu1 B:\landuse_dev):

1. TC_Submodule_v1.py – main Trees Over Module script (standalone script)
2. TC_LU_Submodule_v1.py – main Trees Over Module script (callable script)
3. dense_mp_14_cnty.py – script that contains functions to classify psegs environment type
4. QGIS_geoprocessing.py – helper functions that contains QGIS functions Dissolve, Intersection and Difference

These scripts must be saved in the same folder.

How to Run Standalone Script

This module will be run separately from the main land use model. To run this module, the user must update the following:

1. In the main function in the TC_Submodule_v1.py script, update cf_list to include all counties to be run (first 4 letters of county followed by an underscore and the county fips code)
    a. Save changes
2. Use the YAML environment file to create the required environment (named tct)
    a. Open anaconda prompt
    b. conda env create -f /path/tct_env.yml
3. Activate the new environment
    a. Conda activate tct
4. In the command prompt, type python /path_to/ TC_Submodule_v1.py
    a. Hit enter
5. When it is complete, the trees_over geopackage will be created

How to Run Callable Script from LU Model

1. In the import section of the main LU model, import the TC_LU_Submodule_v1 script
    a. import TC_LU_Submodule_v1 as TC_model
2. Call the run_trees_over_submodule function
    a. Accepts 2 arguments:
        i. NUM_CPUS – integer value of how many processors each tile should be given; 5 is recommended value
        ii. Cf – the county fips of the current county (first 4 letters of county name, underscore, 5 digit fips code)
    b. Returns flag
        i. 0 – submodule ran successfully
        ii. -1 – the submodule failed; check log for exception details
3. When it is complete and flag is 0, the trees_over geopackage will be created

Workflow

The trees over module is separated into 4 pieces and run on individual tiles:

1. Categorize psegs by environment type
    a. Use census urban area to categorize dense parcels
        i. Any parcels with Ag present will be reclassed to agricultural
    b. Agricultural parcels are parcels with any type of ag present (crop,pas,orchard, ag_gen)
    c. Forested parcels are any parcels that are not dense or agricultural with at least 25% forest coverage
    d. Less dense parcels are all remaining parcels
2. Prepare data by environment type
    a. For each environment type (excluding ag), create a geopackage of dissolved forest and a geodataframe of land uses that will be buffered in step 3 (buildings, turf, other imp)
    b. For agricultural parcels
        i. Run shared border analysis on forest to find forest segments who share at least 85% of their border with agriculture; Create an attribute to distinguish between these segments with those who do not meet this threshold.
            1. Those that meet this threshold are NOT dissolved with any other forest segments at any point in the workflow; they are windbreaks
        ii. Dissolve the segments that do not meet this threshold
        iii. Determine which patches do not touch any ag and create an attribute to distinguish between those that do and those that don't.
            1. Those that do not touch any ag must NOT be differenced with TCT bufs
3. Run Trees over Turf Grass Buffer Workflow (run by environment)
    a. Dissolve buildings, turf and other impervious psegs together based on PID
    b. Remove any that are not encapsulating a structure of the same PID
    c. Buffer results (20m for dense and 10m for all others)
    d. Difference buffers with roads (splits buffers by roads)
    e. Remove sections of buffers that cross the road
4. Run Rules 1 – 3
    a. Remove Tree Canopy over turf produced in step 3 from forest by environment
        i. Excluding ag environment forest where specified
    b. Dissolve all remaining forest
        i. Excluding agricultural wind breaks
    c. Calculate area of remaining patches and separate by < 1 acre and >= 1 acre
    d. For < 1 acre
        i. Calculate shared border to determine if majority of border is shared with development
        ii. Class patch as Trees over Turf or Trees in Agriculture accordingly
    e. For >= 1 acre
        i. Calculate shared border to determine if majority of border is shared with development
        ii. Separate data by majority developed border and majority non-developed border

iii. Calculate largest width for both sets of data
    1. If width < 72m wide, class accordingly

Future Updates/Things We May Need to Tweak

- Remove all qgis calls (dissolves) – will geopandas dissolve work on tiles?
- Play with threshold values
    - Width workflow proportion values and their relative spacing calculations
        - For first pass of width estimate, if proportion of polygons area to its bounding box area is _, then spacing between grid of points is _ meters per row and _ meters per column:
            - > 0.8, bbox width / 15, bbox height / 15
            - > 0.5, bbox width / 25, bbox height / 25
            - <= 0.5, bbox width / 50, bbox height / 50
        - Second (final) pass if width of first pass is < 72 (if it is already greater we don't need to test again) - spacing is calculated like so: bbox width / (25 / 1.4), bbox height / (25 / 1.4)
            - Bbox refers to first pass center point +- the max distance from first pass
    - % shared border with ag to determine windbreaks – currently 85%
        - This is likely less prevalent with switch to TCT being limited to sharing border with developments