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In landscapes worldwide, agricultural trees provide valuable ecosystem services. These trees store a significant amount of carbon and could mitigate global climate change[1]. Agricultural trees also have tremendous value for biodiversity, providing refuges and stepping-stones for forest-dwelling animals in fragmented habitat. The ecosystem services can improve human livelihoods, for example, adding a few trees and shrubs to otherwise bare cattle pasture can increase milk and meat production[2]. Due to their ecological and economic value, agricultural trees play an increasingly important role in land management plans, such as forest landscape restoration. A first step towards implementing these plans is measuring the amount of tree cover in agricultural landscapes.
Measurements of agricultural tree cover could enable land managers to identify gaps in tree cover, monitor tree cover change, and ultimately, design spatially-targeted interventions for more effective restoration. However, measuring fine-scale patterns of tree cover over large areas is not straightforward. These patterns of tree cover include live fences, riparian corridors, and isolated pasture trees. These tree cover types vary over fine spatial scales—often at the scale of an individual tree crown. Consequently, satellite-borne data sources that are commonly used to measure global forest cover (e.g. Landsat and MODIS), have resolutions that are too coarse to measure agricultural tree cover. A GISCorps volunteer, Paul Russell, in collaboration with researchers at University of Florida, and the Azuero Earth Project in Panama has devised a solution.
The team has developed a technique to measure tree cover using freely-available imagery from Google Earth in combination with open source software. Google Earth presents a repository of high resolution images that display variation in tree cover across landscapes. However, this imagery does not include quantitative data on tree cover, such as the area covered by trees that is essential for landscape planning. To produce these quantitative data, the team used an open source software package, Orfeo, originally developed by the French Space Agency (CNES), in combination with QGIS software. Altogether, the software automatically digitizes tree cover from the Google Earth imagery, transforming an image into a shapefile that can be used for area calculations, identifying gaps in tree cover, and more. These software packages are freely-available with underlying code that can be inspected and modified by any user. The practical implication is that anyone from private individuals, to NGOs, to scientists, can use the newly-developed method for measuring tree cover without paying expensive license fees. To ensure that the team's work is accessible to everyone, the team has produced a step-by-step guide to enable users with a minimum amount of GIS training to quantify tree cover at landscape scales.
Currently, the team is applying the new method to measure tree cover in riparian corridors in Southwestern Panama, in collaboration with the Azuero Earth Project, as well as tree cover in private land in Rio de Janeiro State, Brazil. Both projects will provide critical details to land managers. In Southwestern Panama, riparian corridors are invaluable habitat for endangered animals, such as the Azuero Spider Monkey. Across this hilly landscape, where many cattle pastures are remote and inaccessible, tree-planting is expensive and time-consuming. The newly mapped tree cover will enable land managers to pinpoint areas where planting a single tree could have a big ecological impact. In Rio Claro Province, Brazil, a law incentivizes protection for tree cover on private land. Mapping tree cover will enable better compliance with these laws and help maintain tree cover in vulnerable areas. The GISCorps program has again provided expertise that will contribute to spatial planning for a more sustainable world.
Click here to see the animated change detection tool.
An agricultural landscape in Rio Claro Province, Brazil, with fine scale patterns of tree cover. The image on the right is the original Google Earth image (©2015 Google), while the image on the left displays the mapped boundaries of agricultural tree cover, automatically classified using the new method

Complete workflow of the process is found in here.

[1] http://www.nature.com/articles/srep29987
[2] http://www.sciencedirect.com/science/article/pii/S0378112710005591