

## GIS for FORESTERS:

# Using Google Earth for Forest Management

By Yanli Zhang and Jeremy Stovall

Geographic information system (GIS) software, such as ArcGIS, is often used in spatial data collection, organization, and mapmaking. However, many users, such as consulting foresters, landowners, forest managers in developing countries, and students may not have access to relatively expensive GIS software. For these and other land managers, Google's freely available Google Earth software provides many functions that can be used as GIS tools to support natural-resources management activities. This article offers a forestry-oriented demonstration of data creation, processing, and mapmaking with Google Earth and a free service, the KML Tools Project at the University of New Hampshire.

Google Earth, which lets you view and work with satellite imagery, maps, aerial photos, and other imagery, is available in three versions: the free version, Google Earth Pro, and Google Earth Enterprise. For our demonstration, we used only the features available in the free version for desktop computers, which is available to download at [earth.google.com](http://earth.google.com). It runs on Windows (XP

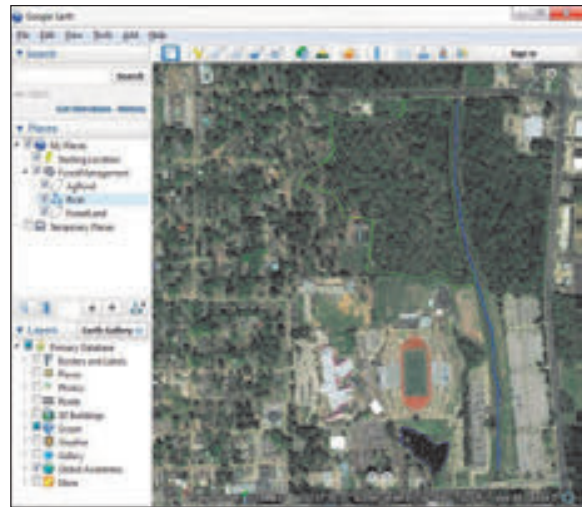


Figure 1. Google Earth's user interface, showing a portion of the Stephen F. Austin State University campus in Nacogdoches, Texas.

through version 8), Macintosh OS X 10.6.0 or later, and Linux LSB 4.0 libraries.

Google Earth Pro (\$399) includes the same features and imagery as the free version, but offers additional capabilities, such as access to data layers, and tools for measuring the area of polygons, making three-dimensional measurements, and making and printing high-resolution maps. You'll need the Pro edition if you use imagery from Google Earth in reports and presentations or otherwise create materials that will be displayed or distributed outside your organization. According to Google, the Enterprise edition lets companies or organizations store and process terabytes of imagery, terrain, and vector data on their servers, and publish maps that users can view using Google Earth desktop or mobile apps or custom apps developed using the Google Maps API. Pricing is based on the number of users and usage.

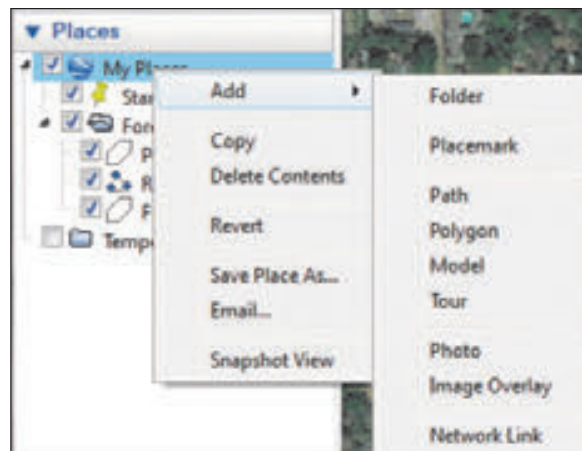


Figure 2. Adding a new project folder in Google Earth.

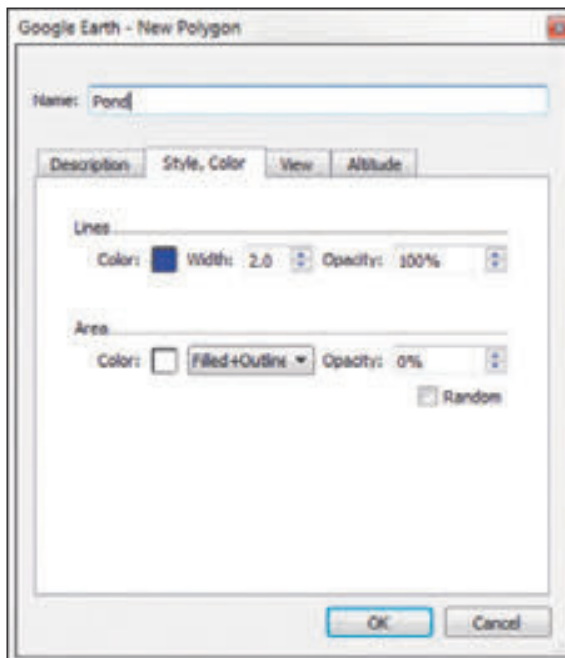


Figure 3. Google Earth's facility for adding a new polygon.

For our simple example, we'll use the campus of Stephen F. Austin State University in Nacogdoches, Texas. Suppose a forest management plan is needed for a woodlot on the campus. In Google Earth, we added a ForestManagement project folder to the Places panel and created three vector data layers (AgPond, River, and ForestLand) as shown in Figure 1. The AgPond located to the south of the woodlot was delineated to check the accuracy of Google Earth using more traditional GPS and GIS techniques.

To create a project folder, right-click on My Places in the Places panel and choose Add, and then Folder (Figure 2). You can re-name the new folder as needed.

The next step is creating spatial data with Google Earth. Similar to the previous step, right-click the project folder and then choose Placemark (point), Path (line), or Polygon. For the purposes of this demonstration, we discuss only the polygon option; however, the point and path features work similarly. The New Polygon user interface (Figure 3) is comparable to similar interfaces in professional GIS software. This is where you specify the polygon name, line style (color and width), and fill color. Then, with the New Polygon interface still open, you use the cursor to digitize the point, line, or polygon on the map. If modification is needed at a later stage, you can right-click on the layer name and choose Property, Edit Polygon. A window nearly identical to the New Polygon interface will open, letting you change style settings or alter the polygon itself. All the vertices of the polygon are high-

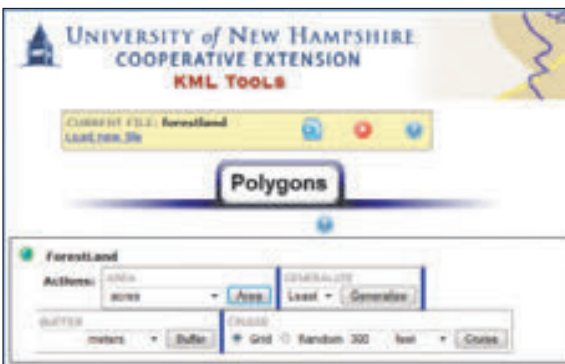


Figure 4. The University of New Hampshire's KML Tools Project website lets you add layers to Google Earth KML files, including cruise plot grids.

lighted, so you can add, move, or delete each vertex to re-define the shape of the polygon.

### The KML Tools Project

To assist in planning a timber cruise for this woodlot, we exported the ForestLand layer as a KML file by right-clicking on the layer and choosing Save Place As. KML files are a specific Google Earth spatial data format. (You can choose to save as either a KML or KMZ file, the latter being a compressed form of KML). We then

used the KML Tools Project website (<http://extension.unh.edu/kmlTools/>) to calculate the area of the ForestLand layer and to add plot locations within the woodlot. The KML Tools Project is a straightforward online application (Figure 4). It cannot import KMZ files.

After uploading the KML file, you can compute the area, generalize (smooth) the boundary of the polygon, add a buffer to the polygon, or generate cruise plots—common features found in GIS software that have not been freely or readily available to the public in the past. Once you've finished with any one of these operations, you can export a new KML file from the KML Tools Project website and then open it in Google Earth; for example, if you create a buffer and add a cruise grid, you'll need to export separate KML files for each of these operations.

Our grid of timber cruise plots for the woodlot, along with a 100-foot streamside management zone (SMZ, buffer) for the river to the east of the woodlot, is shown in Figure 5. The woodlot is 32 acres, while the pond is 1.76 acres. For the woodlot, this includes the area found within the SMZ (more on this later). Because three of the cruise plots were located within the defined riparian area, we manually removed them. This left 13 plots, each with longitude and latitude information that can be located with a GPS unit. To remove the acreage found in the SMZ, you can edit the ForestLand layer in Google Earth, save it as a KML, and then use the KML Tools website to determine the acreage of the edited polygon.



Figure 5. Timber cruise map and stream buffer for a 32-acre woodlot.

We did not do this in our example project.

We measured the pond with a Trimble Juno GPS unit and found its area to be 1.70 acres, only 3.4 percent smaller than the estimated 1.76 acres. We uploaded the GPS pond polygon to Google Earth and found that it matched well with the pond as digitized via Google Earth. In our experience, Google Earth usually produces accurate results in the United States, given the high-quality imagery available.

Other Google Earth features are useful to foresters. For example, on the Google Earth toolbar, selecting the Show Historical Imagery tool lets you check land-cover change within an area. For the demonstration site, Google has annual images from 1996 to 2013, all freely available. This could help a forester determine when past disturbances such as blow-downs occurred, when a plantation was established, or when a stand was last thinned.

Google Earth provides capabilities that traditionally could only be found in professional GIS software and provides greater access to mapmaking and data analysis tools for the general public and users who manage natural resources. Best of all, the Google Earth software and the KML Tools Project service are free.

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