Blueberry Mountain Trail, Nova Scotia – 3D GIS

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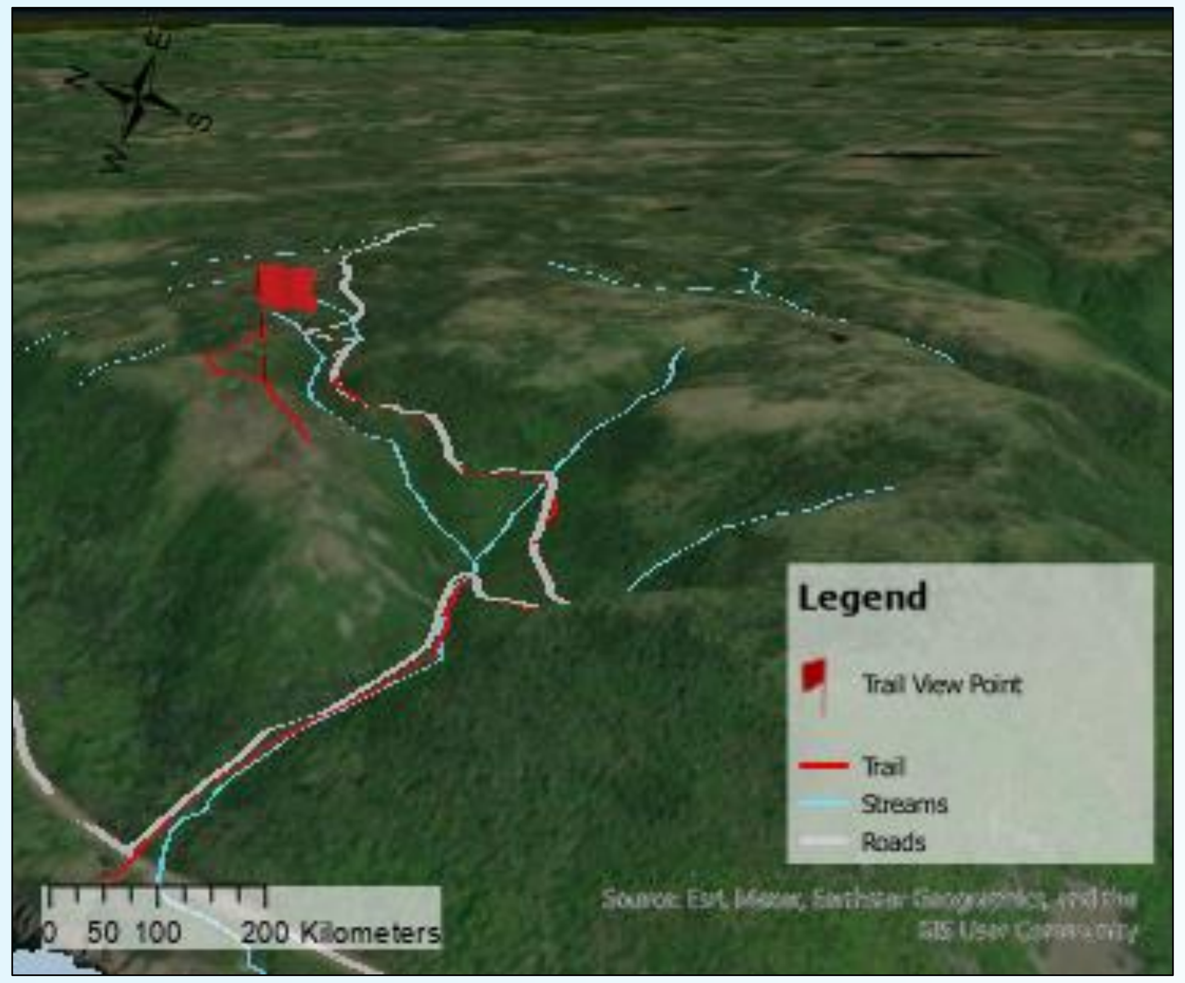

Figure 1: World Imagery Scene

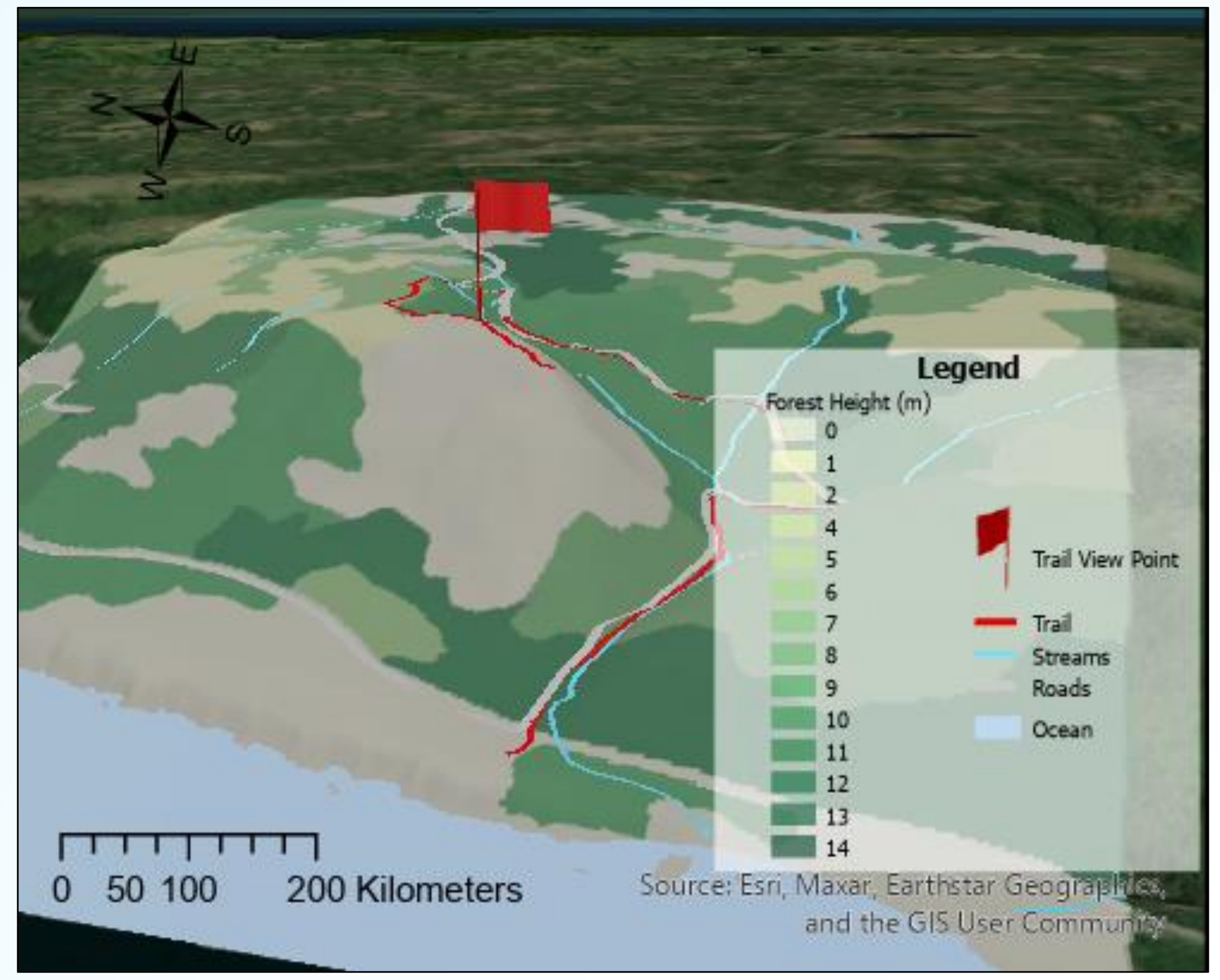

Figure 2: Forest Height Scene, view on AGOL: https://arcg.is/0vizuz

A natural resource layer that provided information on forest polygons in Nova Scotia was used to drape over the TIN layer (Figure 2). First, the polygon layer was clipped to the study area and was symbolized by unique values of the height field, representing the height of a forest stand. The polygon layer was then converted to a raster using the Polygon to Raster (Conversion) tool. The resulting raster shows areas of taller forest stands represented in dark green, with the maximum height being 14 meters, and shorter stands represented by lighter greens, with white corresponding to a height of zero and therefore, non-forested areas. Draping this raster over a 3-D scene, makes it easier to visualize the relationship between elevation and forest height. For example, some areas of higher elevation correspond to lower forest heights. It is also helpful to show forest heights along the trail to determine how much how much coverage you will have along the trail, in terms of sun exposure, and in terms of viewing areas. Spots along the trail with high forest stands, are less likely to allow for clear views. Conversely, areas with shorter stands will provide better opportunities for sight seeing. Additionally, in Figure 1, the World Imagery layer provided by Esri was draped over the surface to give a realistic representation of the terrain.

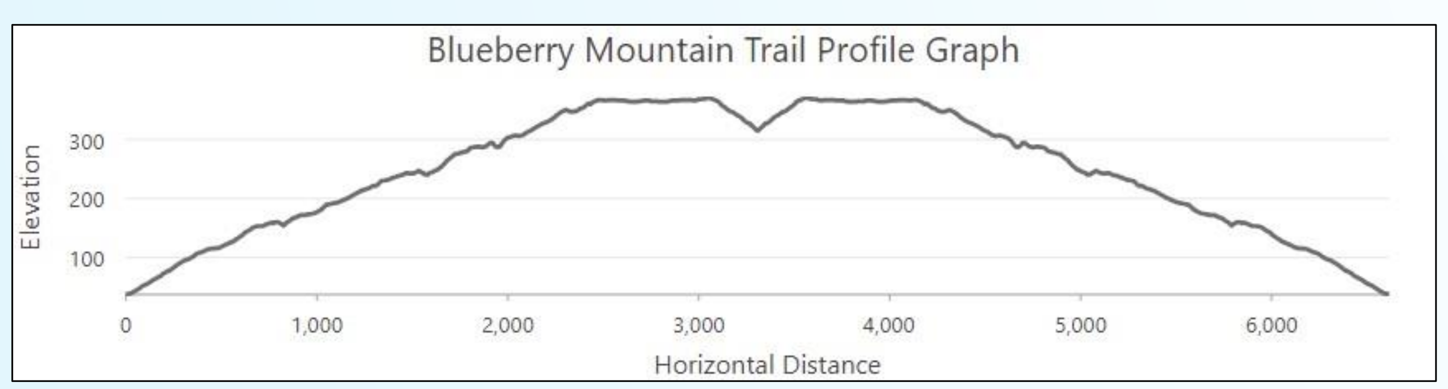

Figure 3: Profile Graph

Figure 4: Trail View Scene

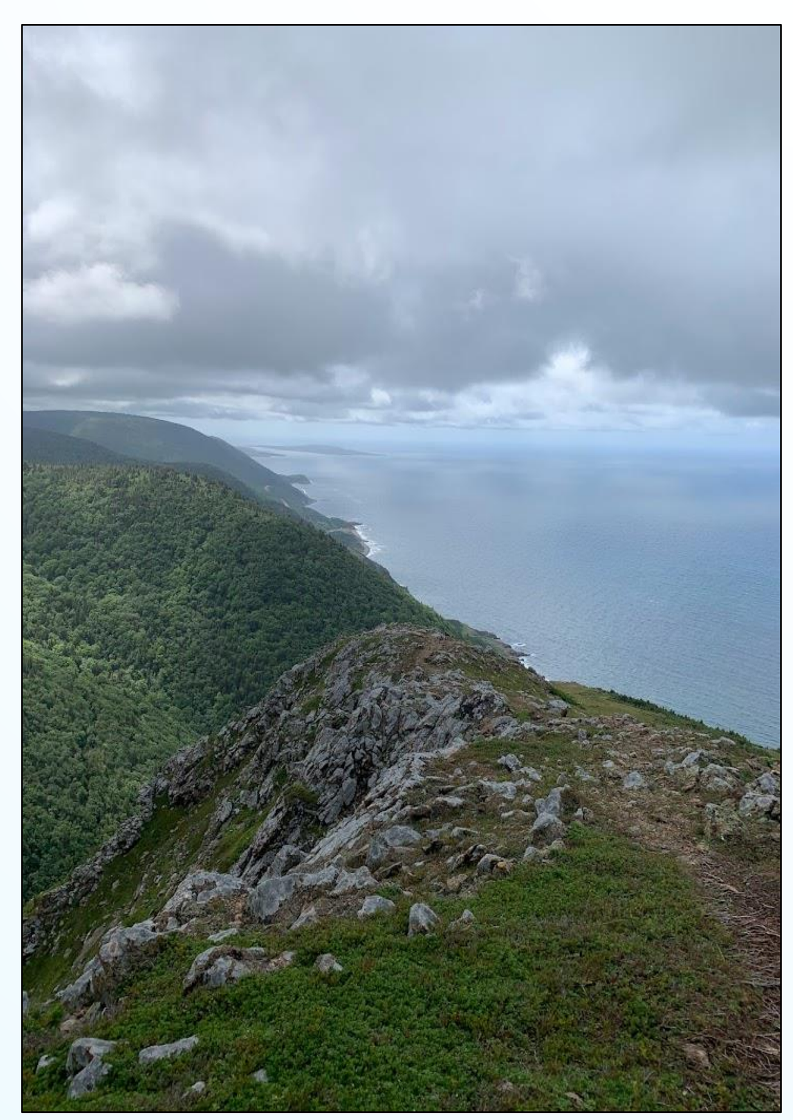

Figure 5: Trail View Photo

The profile map (Figure 3) was created, using the create graph button on the visualize group in the data tab and using the trail line feature as input. This graph shows the elevation change along the route, as well as the horizontal distance with each associated elevation.

The image (Figure 5) was captured from the top of the Blueberry trail. The view in the 3D scene (Figure 4) from the Trail View Point, corresponds to the same view in the photo. To do this, the coordinates of the picture location was provided from Google Photos. Then, a new point feature class was created, and an edit session was started. Using the 'go to XY' option, a new point was created using the photo coordinates. The scene was then adjusted to match the direction the photo was taken in.

Data Prep

The trail line feature was sourced from AllTrails and downloaded as a KML file. After importing the KML to ArcGIS Pro, it was converted to a featured class using the KML to Layer (Conversion) tool and projected to match the other map features. To prepare the layers to create the TIN, the study area was first defined. After creating a new polygon feature class in the geodatabase, an edit session was started, and a new polygon feature was created of the area surrounding the Blueberry trail representing my study area. The Nova Scotia Roads, Nova Scotia Streams, and Nova Scotia Contours layer were then imported to the map. The ocean layer was created by clipping the Nova Scotia Coast layer to the study area, then using the Erase (Analysis) tool, inputting the study area polygon and using the coast layer as the erase feature, resulting in a feature containing everything outside of the coast (the ocean). In addition, I used the Clip (Analysis) tool to clip the streams, roads, and contours layer to the study area. With all the layers prepped for input, the TIN could now be created.

Creating the TIN

Within the Create TIN (3D Analyst) tool, the first input feature used was the clipped contour layer with the height field set to the elevation field with a hard line surface feature type. The second input feature was the clipped streams layer with a height field of <none> applied and surface type of hard line. The third layer inputted was the roads clipped layer using a height field of <none>, and a hard line surface type. Lastly, the ocean feature was inputted with the height set as the elevation field and a hard replace surface type. The Constrained Delaunay box was left unchecked. The resulting layer was the Triangulated Irregular Network, which served as the functional surface for the map. Elevation values can now be interpolated using the triangle vertices. Additionally, this TIN will be apart of the process of calculating the slope and aspect maps.

Before slope and aspect maps can be created, the TIN was converted to a raster using the TIN to Raster (3D Analyst) tool. Inputting the newly created TIN, setting the output data type to floating point, the interpolation method to linear, the sampling distance to a cell size, a sampling value of five, and the factor of one, the tool was ready to be run. Resulting in a raster version of the previously created TIN

Slope and Aspect Maps

The TIN raster surface can now be used as input to the Aspect (3D Analyst) tool using a planer calculation method. The result of this tool is a raster layer defining the compass direction that the downhill slope faces for every cell location. The compass direction is represented in degrees from 0 to 360 with zero corresponding to north and increasing in a clockwise direction. Cells with a zero slope and therefore flat surfaces are assigned an aspect of a negative one.

One application of this aspect map (Figure 7) could be to plan sunset or sunrise hikes. Hikers can identify areas of the trail that face in an easterly direction for optimal sunrise viewing and alternatively finding areas of the trail that face the west for sunset viewing and plan accordingly.

The TIN raster surface can also be used as input into the Slope (3D Analyst) tool. The output measurement was set to degrees with a planar calculation method, and a factor of 1. The output results in a raster defining a slope value for each of its cells. The slope is the gradient or steepness of an area, resulting from a change in elevation. The slope tool can be used with either measurement units of degrees or percent. Since degrees were chosen for this iteration, the slope values range from 0 to 90. 90 representing the steepest slopes, and zero representing flat land.

The slope map (Figure 6) may be helpful to hikers for identifying stretches of the hike that are higher in difficulty i.e. those areas corresponding to a higher slope value and can adjust their route as needed.

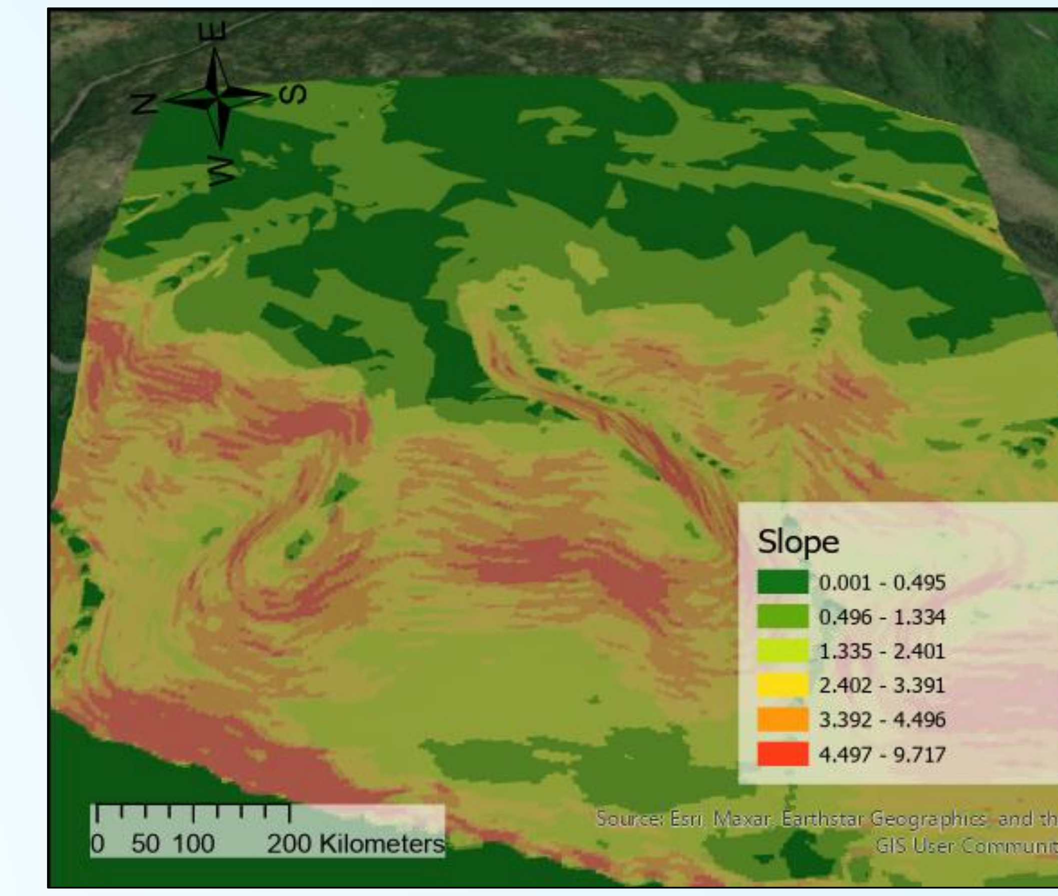

Figure 6: Slope Scene

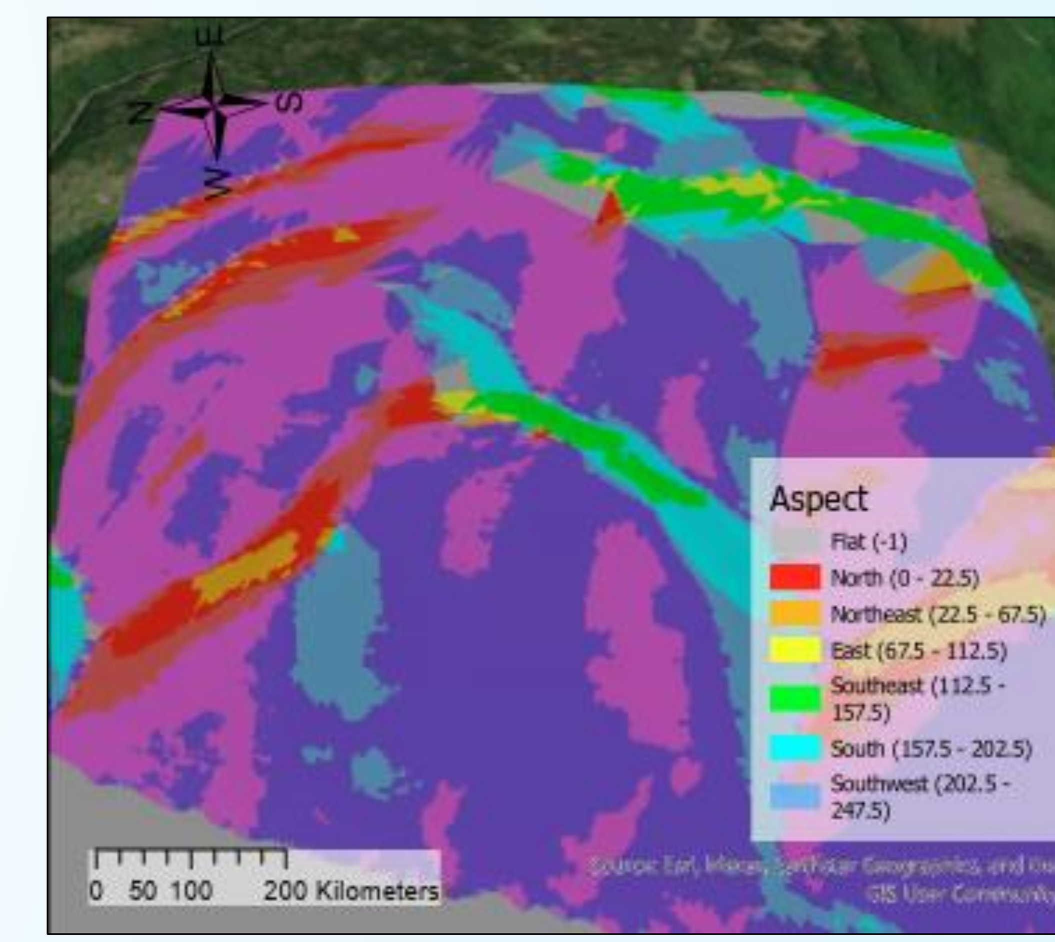

Figure 7: Aspect Scene

Credits

Clarke 1866 UTM Zone 20N, Transverse Mercator

Sources:
Trail Line Layer– AllTrails.com
Stream, Contours, Roads, Coast, and Forest Layers - Nova Scotia Department of Natural Resources, GeoNova
World Imagery Layer - Esri, Maxar, Earthstar Geographics, and the GIS User Community
Trail View Point Layer – coordinates provided by Google Photos

Poster produced as a portion of the requirements of the Geographic Information Systems Graduate Certificate Program at the Centre of Geographic Sciences, Nova Scotia Community College, Lawrencetown, Nova Scotia.

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