Ag-Analytics

ELEVATION INDEX

API Documentation 2021
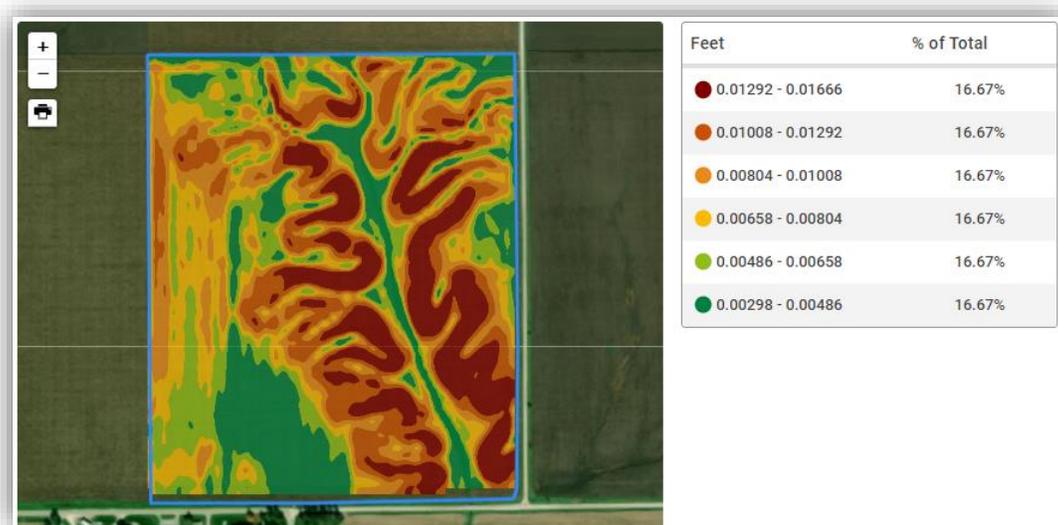
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Service Overview

The Elevation Index API offers a means of computing four elevation indices for an elevation raster that is passed to the service. The four indices are relative elevation, slope, topographic position index (TPI), and terrain ruggedness index (TRI). When using the API, the client can specify the indices that should be calculated for the elevation raster and there are options for a few tuning parameters relating to TPI and TRI.

The intent behind the service is to provide farmers and producers with the ability to extract more information about the elevation of their field and the relationship with parameters such as wetness and yield. The correlation between these indices and yield is most often due to the way water is transported across sections of a farm field (i.e., correlation with chronically dry and wet areas).

Along with our Elevation Index API, we also offer the Digital Elevation Model API, which clips boundaries to the 10-meter USGS DEM map of the United States.

Feet	% of Total
0.01292 - 0.01666	16.67%
0.01008 - 0.01292	16.67%
0.00804 - 0.01008	16.67%
0.00658 - 0.00804	16.67%
0.00486 - 0.00658	16.67%
0.00298 - 0.00486	16.67%

Elevation Index (Slope) in DataLayers

POST Request

POST Request Example – application/json - The service requires a raster file be passed as a template for computing indices.

```
{
"Shape":"{\"type\":\"Feature\",\"geometry\":{\"type\":\"Polygon\",\"coordinates\":
[[[-76.5907145, 42.443918], [-76.5898132, 42.4224745], [-76.5699863, 42.4230447],
[-76.5710592, 42.4443296], [-76.5907145,
42.443918]]]},\"properties\":{\"OBJECTID\":4944402,\"CALCACRES\":46.15999985,\"CAL
CACRES2\":null},\"id\":4944402}",
'index_list':"['Slope, TRI, TPI, Relative_Elevation']",
'Outside_Radius' :'5',
'Inside_Radius':'3',
'Search_Radius' :'7',
'Legend_Range': '10'
}
```

Header Parameters

content-type:"application/json"

Request Parameters

Parameter	Data Type	Required?	Default	Options	Description
Shape	geojson	Yes	--	--	Geojson area of interest to return data for
index_list	List of indices as a string.	Yes	--	"Relative_Elevation" "Slope" "TPI" "TRI"	Indices that should be calculated for the input geojson.
Outside_Radius	Integer as string	No	3	0 < Outside_Radius < 20	Outer radius of window for computing TPI.
Inside_Radius	Integer as string	No	1	0 <= Inside_Radius < Outside_Radius	Inner radius of window for computing TPI.
Search_Radius	Integer as string	No	1	0 < Search_Radius	Radius of window for computing TRI.
Legend_Range	Integer as string	No	3	0 < Legend_Range	Number of ranges to display in png of output image.

POST Response

POST Response Example – application/json

```
{'Slope': 'raster_Slope_46283.tif',
'features': [[{
        'attributes':
        {'CellSize': [9.259259269220298e-05, -9.259259269220298e-05],
        'CoordinateSystem': 'GEOGCS["WGS 84",DATUM["WGS_1984",SPHEROID["WGS
        84",6378137,298.257223563,AUTHORITY["EPSG","7030"]],AUTHORITY["EPSG","632
        6"]],PRIMEM["Greenwich",0],UNIT["degree",0.0174532925199433],AUTHORITY["E
        PSG","4326"]]',
        'Extent': '-72.4693823, 42.85850073332885, -72.46327118888232,
        42.8626674',
        'Legend': [
            {'Area': '100.00 %',
            'Count': 460,
            'CountAllPixels': 1380,
            'Max': 0.03123498149216175,
            'Mean': 0.017523369751870632,
            'Min': 0.0038117580115795135,
            'color': '#4d76d5'}],
        'Matrix': [45, 66],
        'Max': 0.1261863261461258,
        'Mean': 0.04393044486641884,
        'Min': 0.0038117580115795135,
        'OID': 0,
        'Percentile5': 0.012359169591218234,
        'Percentile95': 0.07808069363236426,
        'Product': 'Slope',
        'Std': 0.021281977502967706,
        'Variety': 'NoVariety',
        'pngb64': 'data:image/png;base64,
        pdUqC3YqM4ayCaay7MpAU6aX/pDQ4JNAfidb8XKq4q9HgZrmI1VA='}}]]
}
```

Response Parameters

Parameter	Data Type	Description
Features	List	Container for all of the features of the raster.
Features.attributes (F.a)	Dictionary	Each feature in Features has an associated attributes dictionary.
F.a.CellSize	List	Resolution as x,y cell size. In units of projection.
F.a.CoordinateSystem	String	Projection in WKT
F.a.Extent	String	Extent of result geotiff.
F.a.Legend (F.a.L)	List	Each range in the output PNG is represented by a separate dictionary.
F.a.L.Area	String	Percent of total image that the particular range of values covers.
F.a.L.Count	Int	Number of pixels that a particular range takes up in the png.
F.a.L.CountAllPixels	Int	Total number of pixels in the png image.
F.a.L.Max	Float	Maximum value in the range.
F.a.L.Mean	Float	Mean value of the range.
F.a.L.Min	Float	Min value of the range.
F.a.L.color	String	Hex value that is used to display the png image.
F.a.Matrix	List	Dimensions of output image.
F.a.Max	Float	Maximum value of entire raster.
F.a.Mean	Float	Mean value of entire raster.
F.a.Min	Float	Min value of entire raster.
F.a.OID	Int	Deprecated
F.a.Percentile5	Float	5th percentile value.
F.a.Percentile95	Float	95th percentile value.
F.a.Std	Float	Standard deviation of raster values.
F.a.Variet	String	Either Variety or NoVariety. Flag for category or continuous data.
F.a.pngb64	String	The png image returned in base64 encoding.
FileName	String	Name of result raster that was generated in POST request. Used in GET request to retrieve GeoTiff file.
Index_Files	List	List of elevation index files that can be used in GET request to return the GeoTiffs.

GET Request

Request Example

The GET request to retrieve the image using the 'filenames' from the POST response.

```
https://ag-analytics.azure-api.net/elevation_index?filenames=raster_Slope_46283.tif
```

Request Parameters

Parameter	Data Type	Required?	Default	Options	Description
filenames	text	Yes	--	.tif file	file name returned by POST request

Response Parameters

| Parameter	Data Type	Description
file	.tif	Tiff file will be download to the computer of the caller with the name that was used to call the API.

Index

Relative Elevation

The relative elevation for a field is derived by calculating the z-score of every point in the field. This assigns a value to each point that says how far away from the mean it is. Unsurprisingly, this results in an identical image as the raw elevation data, however, the values are now relative to the rest of the field. Rather than using raw elevation data, which can be confounded by geospatial location (i.e., fields in Colorado are at a higher elevation than fields in Iowa) relative elevation is normalized by the mean elevation on the field.

Slope

The maximum slope of each point on the field is calculated by taking the gradient of the elevation for each point. This is accomplished with a central finite difference scheme to compute the x and y derivatives at every point.

By computing the maximum slope at every point, it is possible to tell whether a given point may be a place where water can pool or whether water will run off of it. One thing to note is that because the slope operation requires points beyond the point of interest, the raster was expanded by a single pixel that contained the same value as the edge pixels. These are called "ghost points" and ensure that the finite difference operation can be completed at every point in the raster. The method used here is edge replication, however, linear interpolation can also be used to generate ghost points.
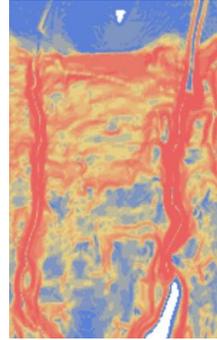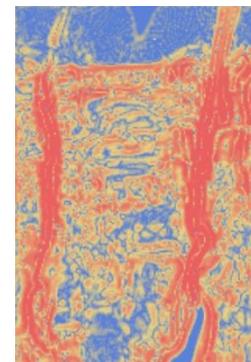
Topographic Position Index (TPI)

The topographic position index or TPI is a method of measuring the elevation of a given point with respect to a surrounding neighborhood of surrounding points. This index can be used to determine local extrema, or points of maximum and minimum elevation on a sub-field level. The index can be used to infer wet or dry areas of the field based on where water might pool or run off. The challenge with TPI is that the size of the search window or neighborhood is variable. The current implementation uses a ring search to calculate TPI, where the user can specify an outer bounding box and an inner bounding box between which the computation is done.
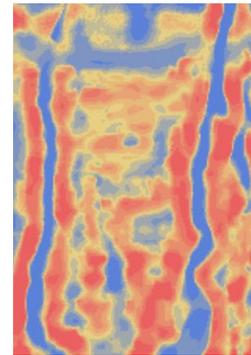
Terrain Ruggedness Index (TRI)

The TRI was developed by Riley et. al. in 1999 and is a means of calculating how rough a given area is in terms of local hilliness and steepness of gradients. This is done by constructing a window around each point in the raster and computing the mean of the squared differences of each window point and the central value. The TRI is then the square root of this mean value. The original paper specified a window of 8 pixels, however, the Elevation Index API leaves it up to the user.

Citations:

- Terrain Ruggedness Index: Riley, Shawn & Degloria, Stephen & Elliot, S.D.. (1999). A Terrain Ruggedness Index that Quantifies Topographic Heterogeneity. Internation Journal of Science. 5. 23-27.

- Topographic Position Index: Andrew D. Weiss, Topographic Position and Landforms Analysis, The Nature Conservancy

- Spatial Reference Information: World Geodetic System (WGS 84) - National Geospatial-Intelligence Agency – 1984

Please contact **support@analytics.ag** or **josh@ag-analytics.org** with any comments or questions.

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