**Alpine Fault Seismometer Location Finder documentation**

Rating Mapper

How it works:

Each of the following steps is timed and that time is sent to the arcmessage output

Step 1

Information from the tool input parameters is gathered and stored in an info object. Information on these inputs including their types can be seen in the tool metadata

Step 2

Buffers for the whole and right-hand side of the fault are made using the buffer tool and the fault feature class from the info object made in step one

Step 3

The road data gathered in step 1 is clipped to the size of the fault buffer made in step 2

Step output roads

A copy of the clipped roads is made and dissolved into a single feature and added to the output

Step 4

The clipped road data from step 3 is buffered

Step 5

The DOC land data gathered in step 1 is clipped to the fault buffer made in step 2

Step 6

The doc land data is made up of many different polygons that are separated based on irrelevant parameters and so these polygons are dissolved into a single feature

Step 7

The Geo map data gathered in step 1 is clipped to the fault buffer made in step 2

Step rate

A rating field is assigned to each feature class that will be merged into the output these classes are as follows:

* The buffered fault from step 2
* The buffered right-hand side of the fault from step 2
* The clipped and dissolved doc land from step 6
* The buffered roads from step 4
* The clipped geo map from step 7

Step 8

Each feature class listed in step 7 is given a rating (for feature classes with multiple polygons the rating is given to each polygon). The rating is based on its suitability as a location for a seismometer

Step output geo

An output geo map from step 8 is made by dissolving the rated geo map into rock group and rating

Step 9

Each feature class listed in step 7 is merged together using union. This creates separate polygons in the unioned feature class that represent unique combinations of the feature classes that make up the union

Step 10

The geo map is dissolved into hard and soft rocks

Step union

The polygons from step 9 in the unioned feature class are given total ratings calculated from the sum of the ratings of the feature classes that make them up.

Step add fields

Adds two fields to the unioned feature class. One that says whether the feature is on doc land and one that says whether it is on the hanging wall side of the fault

Step 11

ArcGIS pro writes the outputs to the map. The outputs are the listed feature classes from step 7, the unioned feature class from step 9 after step 10 and step *add fields* has been applied and the dissolved roads and geo map.

Locations

How it works:

Step 1

The input parameters are obtained from the mapping program

Step 2

Fields are added (or reset) to the theoretical point and polygon classes that were input in step 1

Step 3

A search cursor iterates through each polygon from the rated polygon feature class from step 1.

*The following steps are for each polygon from the iteration above*

Step 3.1

The near tool is applied to the current polygon and the idealised points from step 1. This adds an x and y coordinate to each point that are the closest coordinates on the given polygon to each point. It also adds the distance between each point and the given polygon to a field in each point

Step 3.2

An update cursor iterates over each point in the point feature class obtained in step 1

*The following steps are for each point from the iteration above as well as the iteration for each polygon from step 3*

Step 3.2.1

A rating is given to the current polygon. This is calculated with the following formula

* Where T is the total rating and is stored in the polygon for the duration of one iteration from step 3.2
* D is the distance between the polygon and the point obtained in step 3.2
* S is the static rating of the polygon. This is a field from the polygon feature class from step 1
* A is the average distance between a set of points evenly distributed along the fault
* F is the distance scale factor obtained in step 1 and determines how important the spacing is to where the seismometer should be placed
* Step 3.2.2

If the best x coordinate field has not been initialised, the values from the nearest x and nearest y fields are put into the best x and best y fields of the current point. Also, the best rating field is assigned the total rating calculated in step 3.2.1. Attributes are also transferred to the point from the polygon determining the nature of the polygon. E.g. is it on soft rock

3.2.3

If the rating assigned to the polygon in step 3.2.1 is greater than the best rating currently stored in the point, the values from the nearest x and nearest y fields are put into the best x and best y fields of the current point. Also, the best rating field is assigned the total rating of the current polygon. Attributes are also transferred to the point from the polygon determining the nature of the polygon. E.g. is it on soft rock

Step 4

The points are then iterated through again and a new point is made from the best\_x and best\_y fields

Step 5

The collection of points in step 4 are then made into a feature class

Step 6

If the program is not in iteration mode, the points from step 5 are output as the best locations for seismometers

*Only executed if the program is in iteration mode*

Step 6.1

If the program is in iteration mode, the points halfway between the ith and i+2nd point are calculated and this becomes the new set of theoretical points for the next program iteration. The end points remain the same over the iterations.

Step 6.2

The iteration ends when the end value of the program is less than the end value input in step 1. The program end value is calculated by the following:

* The distance between each point in the ith iteration and its i-1 counterpart is calculated.
* The change in each of these distances over two iterations is calculated for each distance and the sum of these distances are taken
* The value is this sum

Step 7

The distance from ach final point to the nearest road and the distance between the point and the nearest point on the fault is calculated and added to each point

Step 8

The distances between each final point along the fault is calculated and output in a histogram. The number of bins for this histogram can be specified in the input parameters.