

A GRIM SCRIPT

Analysing Groyne Impacts on Morphology Script

A Grim Script (Analysing Groyne Impacts on Morphology Script) is a freely available Python plugin for the open source GIS program QGIS, which provides a set of tools for quickly and easily examining the impacts of groynes on beach morphology and sediment transport.

This document describes some of the technical details behind the plugin.

Script Format

Grim is implemented as a Python QGIS plugin. It adds a button to the QGIS interface that can be clicked to bring up a series of screens, that guide the user through the analysis process. This format was chosen as it is more user friendly than a simple PYQGIS script, and the complexity of a standalone application was not required.

Installation

To install the script, copy the folder “Grim” to your QGIS plugins folder. This will look similar to “C:\Users\Thomas\.qgis2\python\plugins”.

Using the Plugin

After installation, the icon for the Grim plugin will appear on your QGIS toolbar. Click it to begin the program.

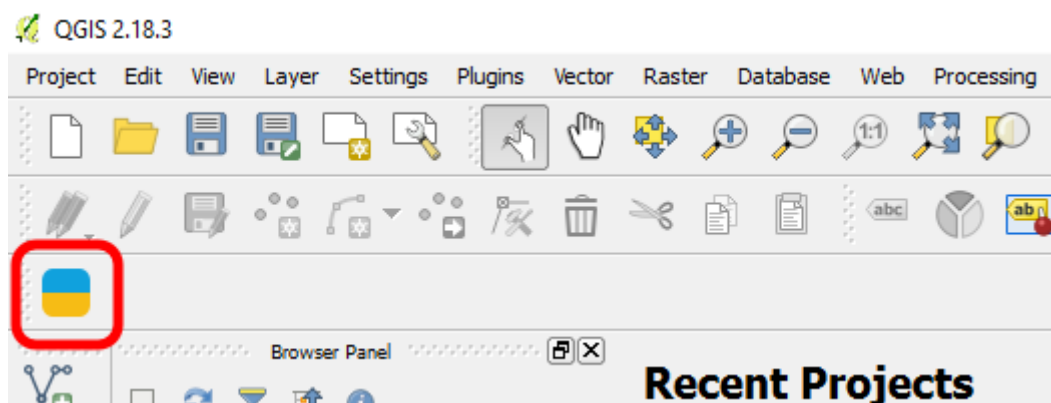


Figure 1: The Grim icon on the QGIS toolbar.

Alternatively, you may start the plugin by navigating to the *Plugin* menu, then the *Grim* submenu, and clicking the *Grim* menu item.

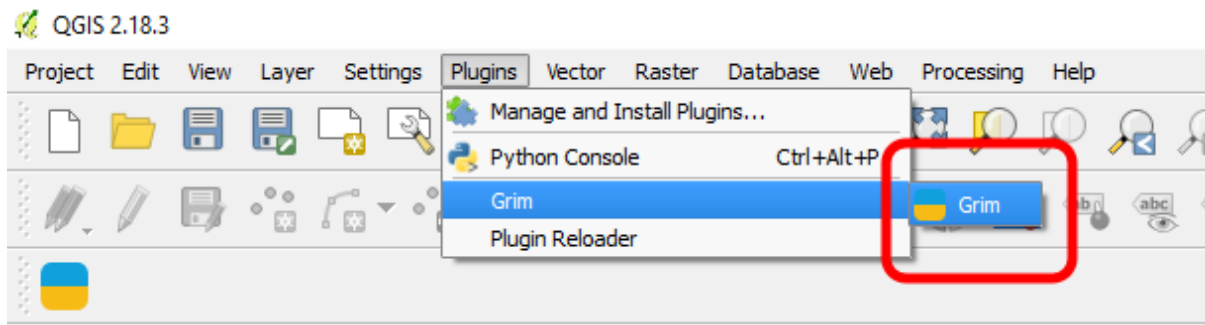


Figure 2: The Grim menu item within the Plugins menu.

Once opened, the first screen displayed is the welcome screen.

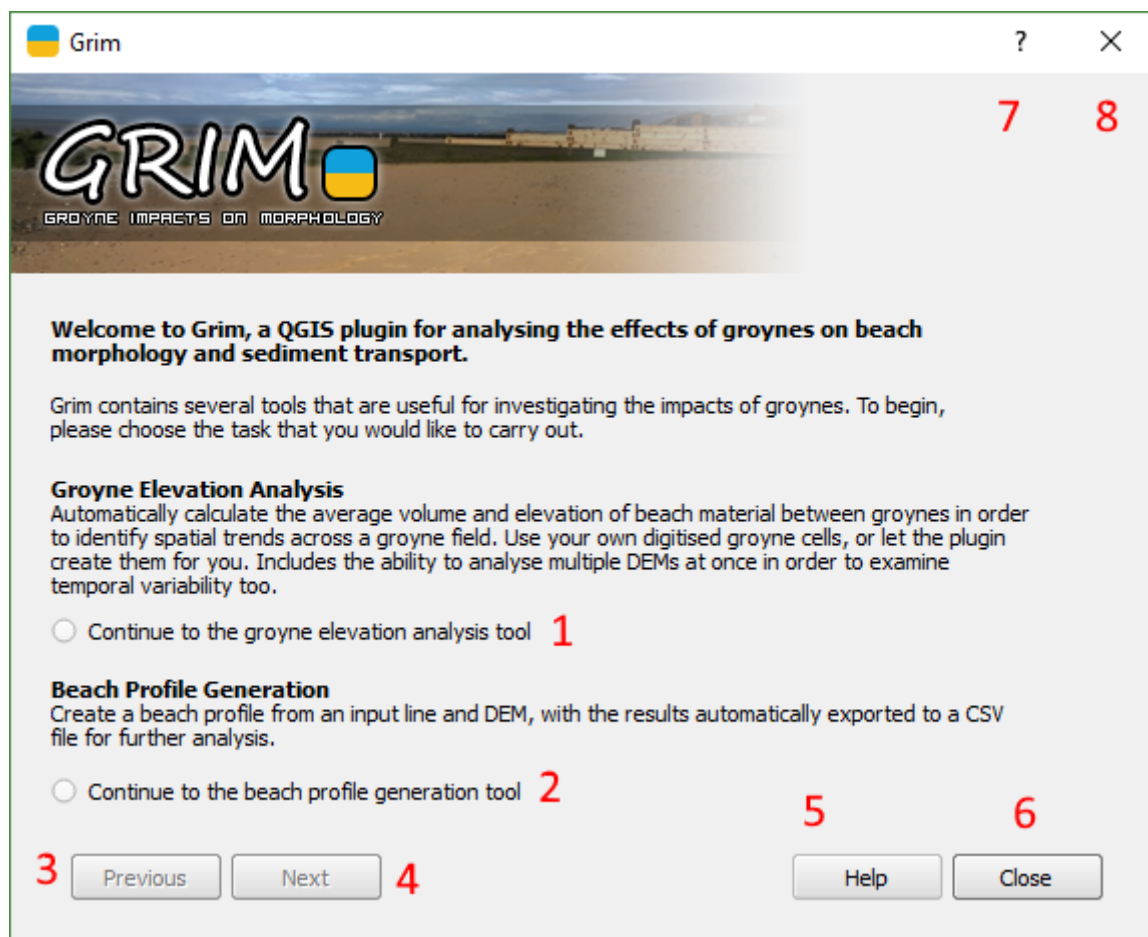


Figure 3: The welcome screen, the first screen to be displayed.

Grim includes several tool that are designed to simplify the process of analysing the impacts of groynes on beach morphology and sediment transport. This screen allows you to choose which tool you would like to use.

1. *Groyne Elevation Analysis*: This tool takes one or more elevation rasters covering the same area (normally created from LiDAR data, but DEMs from any source can be used), showing

an area of beach at different times, along with the locations of groynes. It then calculates the area of each groyne cell, and the average elevation and volume of beach material within it. This can provide an indicator of the effects of a groyne field on beach morphology, showing spatial, and if multiple rasters are used, temporal variations. For more information, see the section **Groyne Elevation Analysis**.

2. *Beach Profile Generation*: This tool takes one or more elevation rasters covering the same area, and one or more lines along which elevation profiles are created and stored as both a shapefile and CSV spreadsheet file. For more information, view the **Beach Profile Generation Section**.

To select a tool, click the appropriate radio button (circle). To navigate between pages in the plugin, use the

3. *Previous Button*: Click this to go to the previous page. In this case, as we are on the first page already, the button has been disabled.
4. *Next Button*: Click this to go to the next page. In this case, as no tool has been selected, the button has been disabled.

In certain situations such as this, the next button is disabled until an appropriate choice has been made. Along the bottom of the screen, there are two more buttons:

5. *Help Button*: This can be clicked at any time to open this help file. The file is opened in a new window, and your progress will not be lost.
6. *Close Button*: Click this to close the window. Please note that all progress will be lost if you do this.

The plugin also contains the standard interface elements common to most Windows applications.

7. *What is this? Button*: Click this, and then hover over items in the window. If the cursor icon changes from a red circle with a line through it to a pointer with a question mark, the item can be clicked to find out more information, an example can be seen in Figure 4.
8. *Exit Button*: As with the *Close Button*, this can be clicked to exit the dialogue, but be aware that if you do so all changes will be lost.

Now that you have a basic understanding of how to navigate around the plugin, select the tool that you would like to use. Notice that the *Next Button* becomes enabled. Click it to proceed to the next screen.

Groyne Elevation Analysis Tool

This section is concerned with the Groyne Elevation Analysis Tool. For details on the Beach Profile Generation Tool, please see the next section.

Results Directory Selection

The next screen you will be presented with is the *Results Directory Selection Screen*. Grim produces several outputs, including a CSV file with the results in a numeric format, and a shapefile representing groyne cells, with things such as area and volume stored as attributes. This screen allows you to select where Grim places these outputs. **It is highly recommended that you choose an empty directory**, to avoid the chance of any existing files being overwritten. To select a directory, first click the “...” button, and a directory selection window will appear. Select the appropriate

directory, and then click “Select Folder” at the bottom right of the screen. The path to this directory will then be displayed in the box.



Figure 4: The results directory selection screen.

Notice the red text beneath the directory selection widgets highlighting that a directory has not yet been selected. While you can move to subsequent pages without selecting some inputs, you will not be able to carry out the analysis until all required inputs have been selected. Click the *Next Button* to continue.

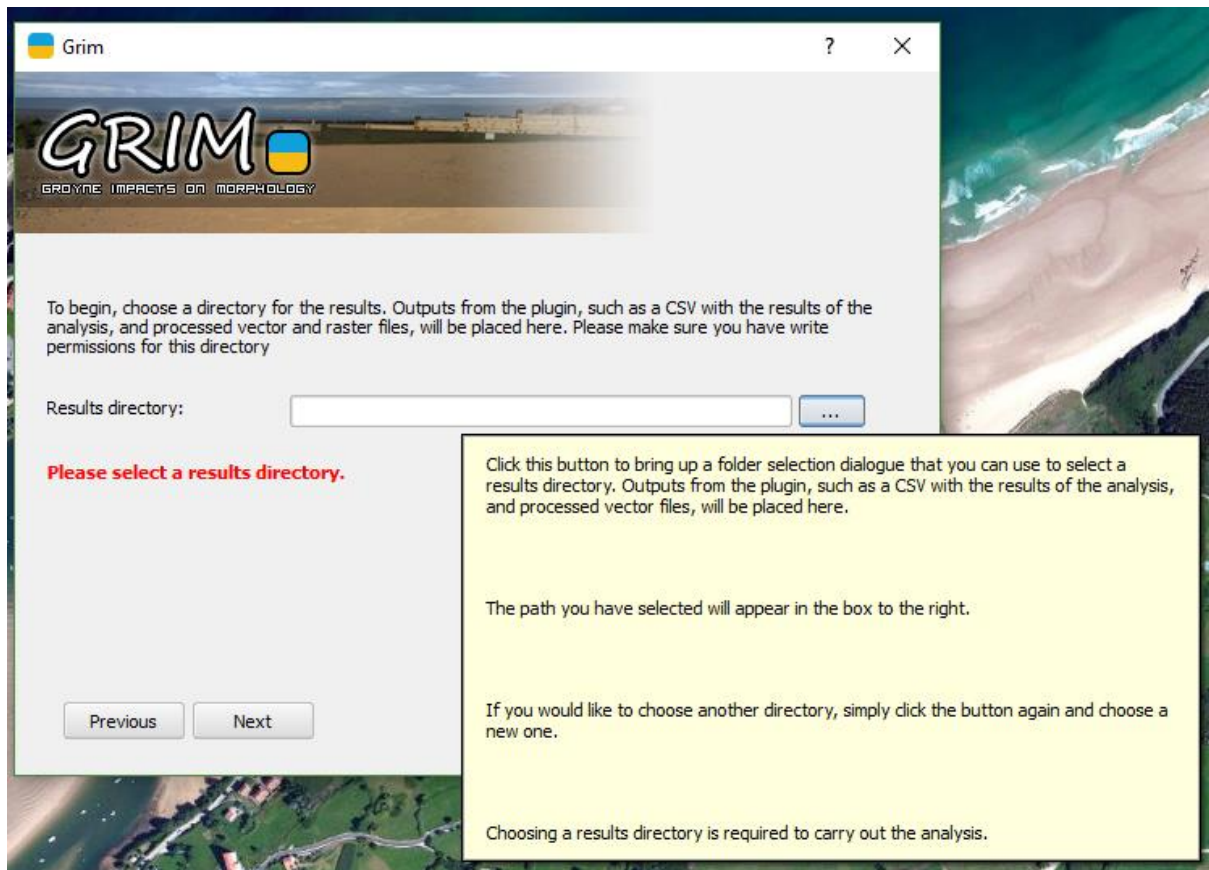


Figure 5: An example of a "What is this?" dialogue.

Elevation Raster Selection

Next is the elevation raster selection screen. Grim analyses elevation data in the form of a raster digital elevation model. Although these are normally produced using LiDAR, DEMs produced by any means may be used. For Grim to work, the rasters must at least cover the area covered by the groyne cells. If the rasters are to be compared with each other, it is also recommended that they have the same resolution and height units.

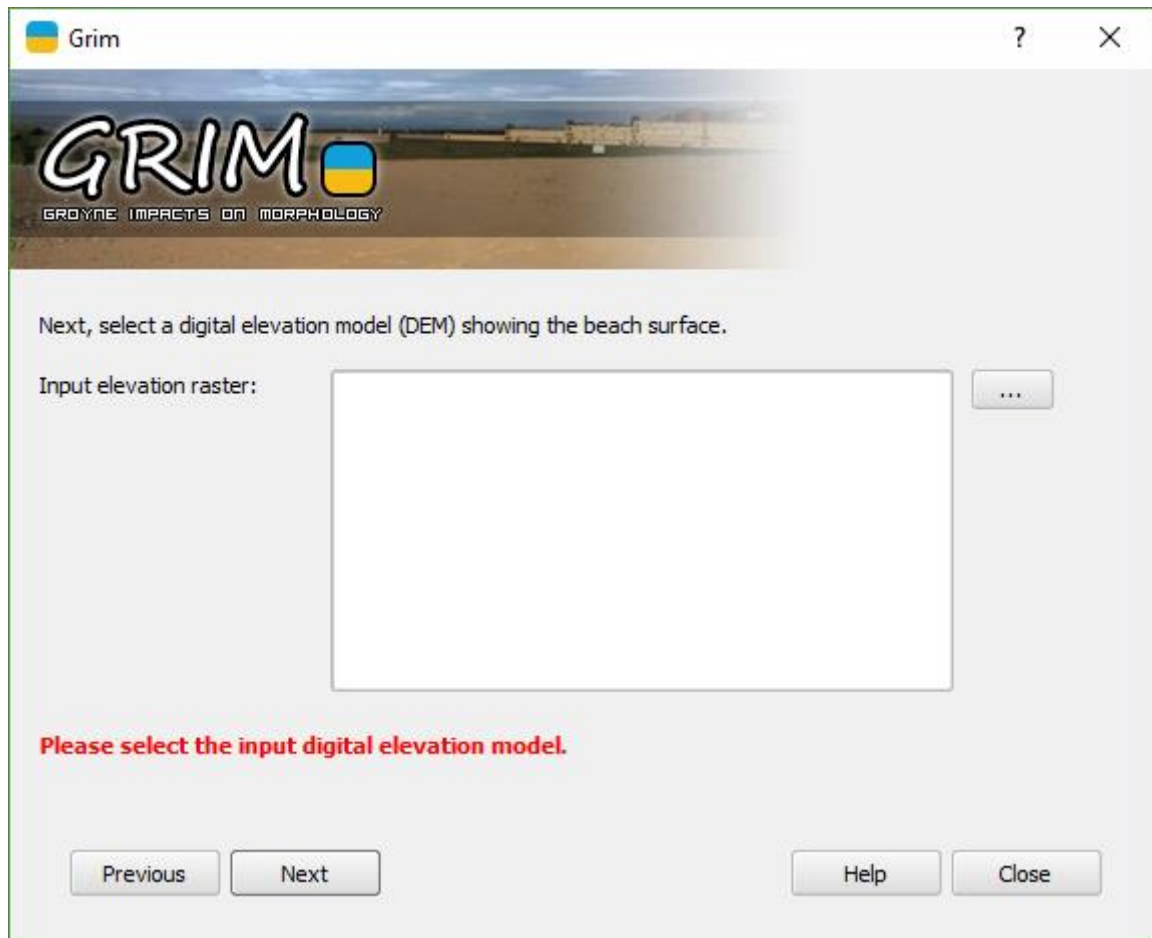


Figure 6: The Elevation Raster Selection Screen.

To select one or more rasters, click the “...” button to open the file selection dialogue. To select a single raster, click it and select *Open* at the bottom right of the screen. To select more than one raster, press control while clicking each raster in turn. Alternatively, click and drag your mouse to produce a box highlighting the files you would like to select.

Paths to your selected files will appear in the box. Selected rasters that are valid will appear green, while invalid layers will appear red. You cannot complete the analysis unless all selected files are valid. Once again, hit the *Next Button* to continue.

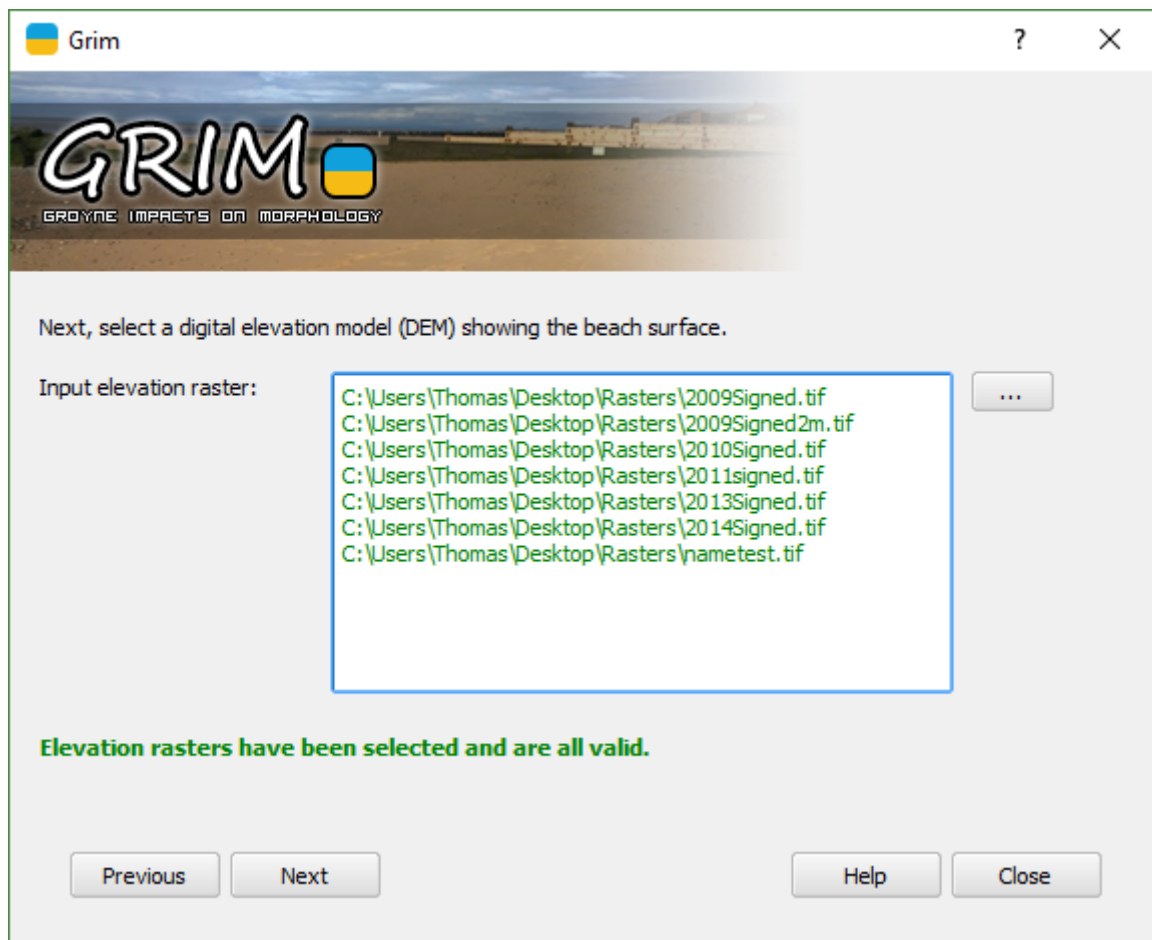


Figure 7: The Elevation Raster Selection Screen, with all selected layers found to be valid.

Groyne Input Method Selection

Grim calculates the average elevation and volume of material within **groyne cells**. This is the name given to the area between two or more groynes. You can either use groyne cells you have created yourself, or upload the locations of the groynes themselves and Grim will delineate the groyne cells for you.

On the *Groyne Input Method Selection Screen*, you can select how you would like to input the locations of groyne cells or groynes.

- Single polygon shapefile, with each groyne cell as a separate feature
- Multiple polygon shapefiles, with a single groyne cell in each
- Single line shapefile, with each groyne as a separate feature
- Multiple line shapefiles, with a single groyne in each
- Multiple multipoint shapefiles, with a single groyne in each

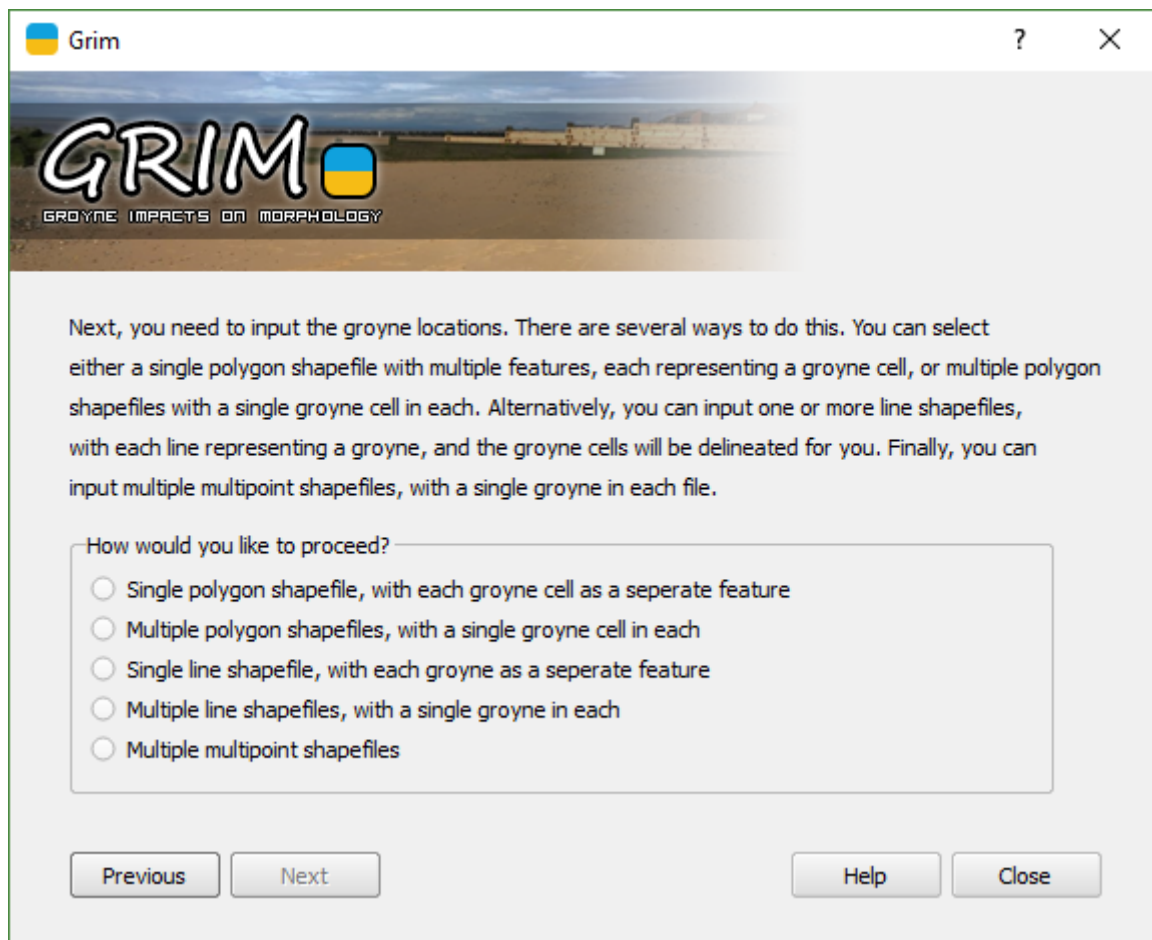


Figure 8: The Groyne Input Method selection screen, with no option selected.

Select which method you would like to use, and hit *Next*. More information about each method can be found in the following sections.

Single polygon shapefile, with each groyne cell as a separate feature

This input takes a single polygon shapefile. It should contain one or more features, with each feature containing a single polygon representing a groyne cell.

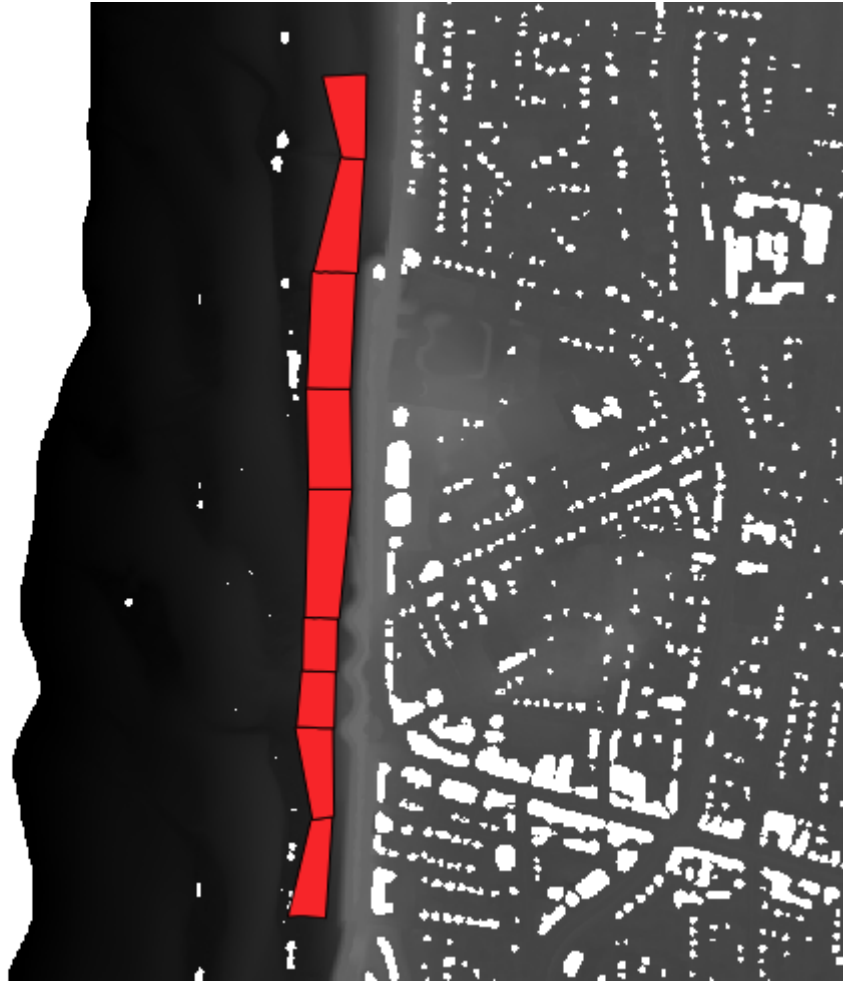


Figure 9: An example of a single shapefile containing multiple features, each representing a groyne cell, overlain over a raster digital elevation model (DEM).

To select the shapefile, click the “...” button, navigate to the appropriate file and then click “Open” at the bottom right of the screen. Hit the “Next” button to continue.

Multiple polygon shapefiles, with a single groyne cell in each

This input takes multiple polygon shapefiles. Each shapefile is expected to contain a single feature, which is a polygon representing a single groyne cell. To select the shapefiles, click the “...” button and navigate to the appropriate files. To select more than one file, hold control while clicking, or click and drag your mouse to create a rectangle, overlapping with the files you wish to select. It is important to note that Grim processes the files in the order you input them. You can see this order in the box along the bottom of the files selection screen. For example in Figure 10, it can be seen that the files are ordered from *mypoly1.shp* to *mypoly4.shp*. Files are ordered in the order they are shown in the file selection screen. To change this order, *right click* in the file selection screen and select *Sort by*. Available options include *Name* and *Date Modified*.

File name: "mypoly1.shp" "mypoly2.shp" "mypoly3.shp" "mypoly4.shp" ▼

Figure 10: The box at the bottom of the screen will show the order that the shapefiles have been input.

There is currently no facility to sort input files within Grim. If you would like to change the order, a simple method is naming the files in the correct order and selecting the *Sort by* option. Once you have selected your polygons, hit the *Next Button* to continue.

Single line shapefile, with each groyne as a separate feature

This input takes a single line shapefile. It should contain one or more features, with each feature containing a single line representing a single groyne. To select the shapefile, click the “...” *button*, navigate to the appropriate file and then click “*Open*” at the bottom right of the screen. Hit the “*Next*” button to continue.

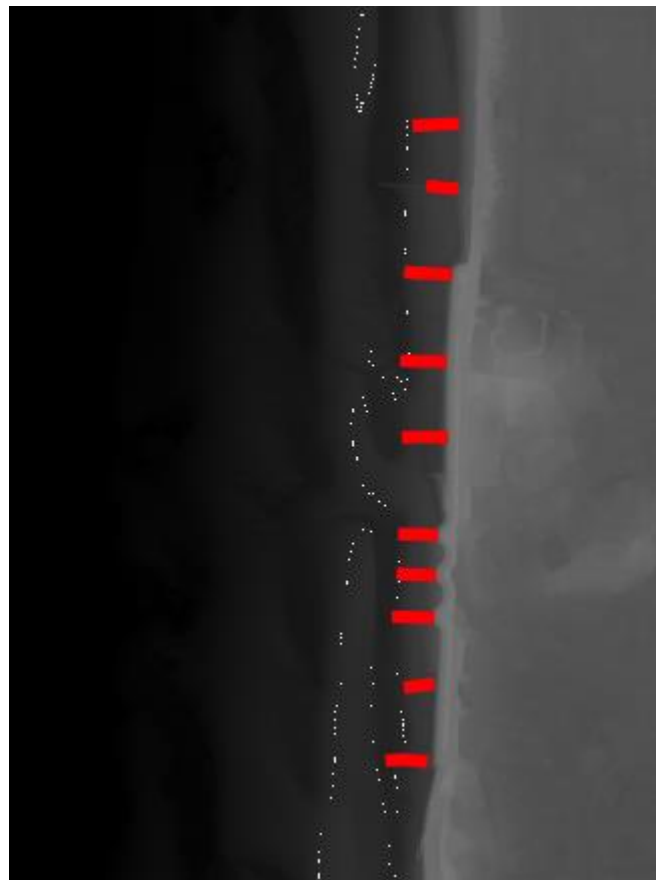


Figure 11: An example of a single line shapefile with multiple features, with each feature containing a single line representing a groyne.

For more details on how Grim creates groyne cells from input groynes, view the **How Grim Creates Groyne Cells** section.

Multiple line shapefiles, with a single groyne in each

This input takes multiple line shapefiles. Each shapefile is expected to contain a single feature, which is a line representing a single groyne. To select the shapefiles, click the “...” *button* and navigate to the appropriate files. To select more than one file, hold control while clicking, or click and drag your mouse to create a rectangle, overlapping with the files you wish to select. It is important to note that Grim processes the files in the order you input them. You can see this order in the box along the

bottom of the files selection screen. For example in Figure 11, it can be seen that the files are ordered from *LineGroyne1.shp* to *LineGroyne4.shp*. Files are ordered in the order they are shown in the file selection screen. To change this order, *right click* in the file selection screen and select *Sort by*. Available options include *Name* and *Date Modified*.

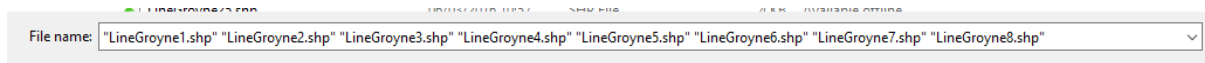
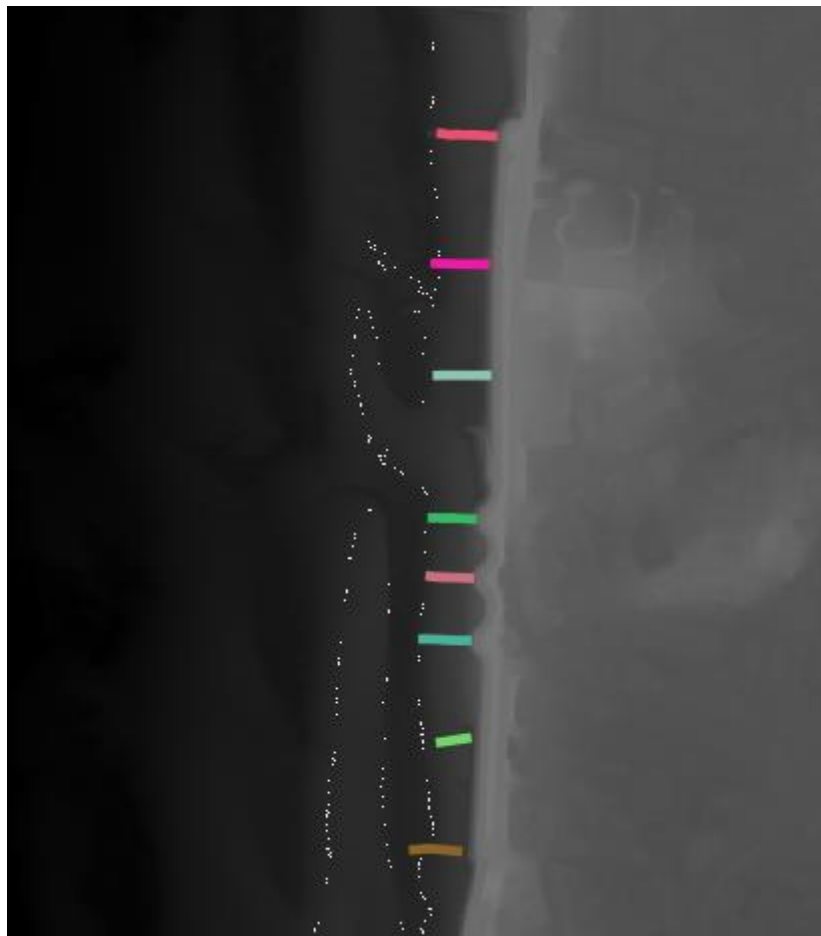


Figure 12: The box at the bottom of the screen will show the order that the shapefiles have been input.

There is currently no facility to sort input files within Grim. If you would like to change the order, a simple method is naming the files in the correct order and selecting the *Sort by* option. Once you have selected your polygons, hit the *Next Button* to continue.



For more details on how Grim creates groyne cells from input groynes, view the **How Grim Creates Groyne Cells** section.

Multiple point shapefiles, with a single groyne in each

This input takes multiple multipoint shapefiles. Each shapefile is expected to contain multiple features, with a single point in each feature. The points in each shapefile are expected to run along the length of a single groyne. To generate a groyne cell from these points, each shapefile requires an attribute to order the points by. For example, the point at one end of the groyne may have a value

on 1, the next point along 2 and so forth. These are used to create a line from the points. Alternatively, Grim will attempt to order the points using their field ID. This is normally the order in which the features were added to the shapefile. To select which field to order the points in the shapefiles by, use the drop down box. This box will only display attributes present in all uploaded shapefiles.

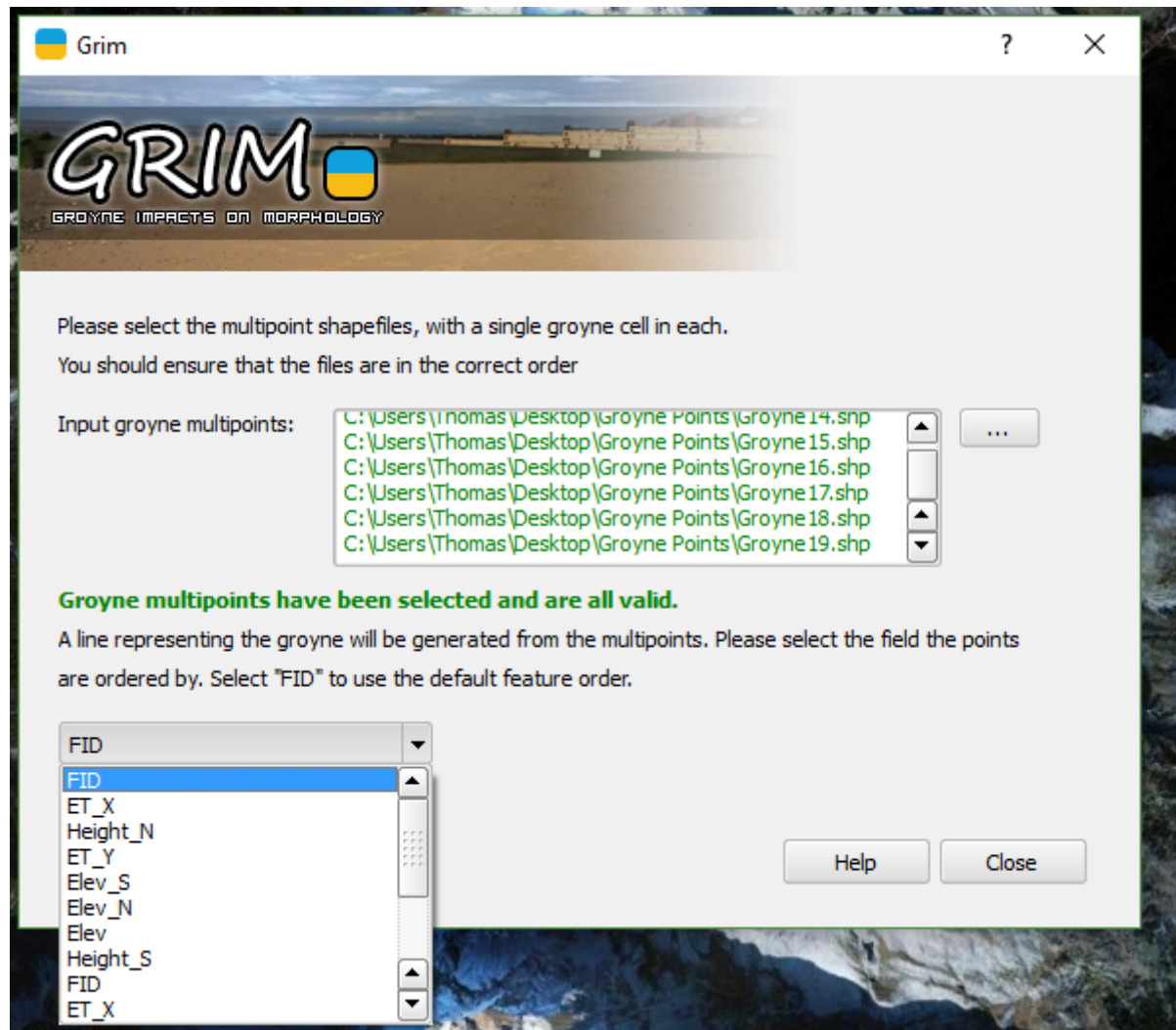


Figure 13: The drop down box you can use to select which field to order the points by. Alternatively, select FID to order the points by their feature ID.

To select the shapefiles, click the “...” button and navigate to the appropriate files. To select more than one file, hold control while clicking, or click and drag your mouse to create a rectangle, overlapping with the files you wish to select. It is important to note that Grim processes the files in the order you input them. You can see this order in the box along the bottom of the files selection screen. For example in Figure 11, it can be seen that the files are ordered from *LineGroyne1.shp* to *LineGroyne4.shp*. Files are ordered in the order they are shown in the file selection screen. To change this order, right click in the file selection screen and select *Sort by*. Available options include *Name* and *Date Modified*.

File name: "Groyne1.shp" "Groyne2.shp" "Groyne3.shp" "Groyne4.shp" "Groyne5.shp" "Groyne6.shp" "Groyne7.shp" "Groyne8.shp" "Groyne9.shp" ✓

Figure 14: The box at the bottom of the screen will show the order that the shapefiles have been input.

Advanced Settings

The next screen is **advanced settings**. Here, you can choose a value to adjust all heights by, and therefore all resulting volume calculations.



Click next, and then calculate, to complete the process.