

## Practical 2 – Making a Natural Heritage/Renewables Map of Orkney

### 1 Working with raster data

#### 1.1 Data Download

Our map as it lies is looking a little plain, so we need to get some extra contextual data. So, if signed up now go to the EDINA download service at <http://digimap.edina.ac.uk/>. Sign in and go to **Ordnance Survey > Digimap** **Ordnance Survey > Download OS mapping data for use in GIS/CAD > Data download**. You may have to accept the individual OS Digimap licence agreement.

This will take you to the download screen, which is a map of Britain. Various options are listed down the left hand side. Expand the **Land and Height Data** tab and select the **PANORAMA DTM** data layer. Zoom into the map until Orkney is fairly obviously visible. Select the **Draw Rectangle** tool and draw a box round Orkney (you should be able to fit this into the tile limit easily). Next, click on the basket icon which will bring up a review of your order.



Give the order a name. However, **before confirming it, change the data type to .TIFF**. This will save us some headaches later. Retrieve the data from the e-mail address to which you had them delivered. **NB** You must **unzip** them before ArcMap will work with them. When you have unzipped the data files, add them to the map (you will notice there are a lot of files to add – you can use shift and/or control to select multiple files in one go).

**NB** To work with raster data in ArcMap we must make use of its Spatial Analyst extension. To enable this go to **Customize > Extensions**, then tick beside **Spatial Analyst** and click **Close**.

## 1.2 Data Processing

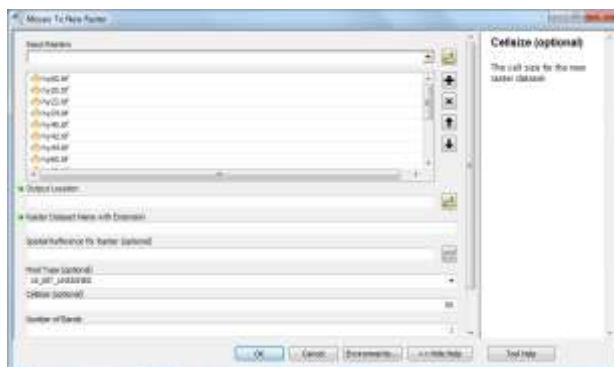
You will notice that the files you have added to the map also appear as individual map *tiles*, which can be merged into one easy-to-work-with layer using the **Mosaic** tool in ArcMap. You can go to **GeoProcessing > ArcToolbox** then within the **ArcToolbox** window which appears go to **Data Management Tools > Raster > Raster Dataset > Mosaic to New Raster**. (Alternatively you can look for the tool via the **Search** window that should be somewhere in your display – usually as a tab to the **right-hand** side of the ArcMap window.)

Highlight (**click** on) the rasters to be merged (should be all at this stage – use **shift** and/or **control** to select multiple rasters, or you can **right-click** on the Data Frame name – **Layers** then use **Select All Layers**) then **click and hold** the mouse on any one raster and drag across to the **input layers** box to populate this with all raster layers.

You should ensure the output is saved to the folder in which you have already been working. To do this, click the **folder** button next to the **Output Location** text box, browse to the folder *in which your working folder lies* (i.e. the folder or drive *above!*), **single-click** (i.e. **once**) on the folder name to select it, then click the **Add** button. (Most of ArcGIS is relatively intuitive except for specifying output locations which is strangely cumbersome.) Give the output the filename **Orkneydtm**.

### An important note about ESRI GRIDS

GRIDs are the default raster type for ESRI files. A particular aspect of their nature means that filenames for them cannot be longer than 13 characters. Do remember this when naming your files or you'll find yourself bashing your head into the keyboard for no reason.



Set the **Pixel Type** as **16 Bit Unsigned**, the **Cellsize** as **50** and the **Number of Bands** as **1**. Additionally, set the mosaic method as **Blend** – this will take an average of values at the edges of the rasters being mosaicked. Click **OK** and wait for a while as ArcMap carries out the operation.

Now we should have one raster, in this case a **Digital Terrain Model** or **DTM** of Orkney. **NB** This is often alternatively called a **Digital Elevation Model (DEM)**.

### 1.3 Exploring our Raster Surface

Use the **Identify** tool to find out what the values for this raster layer are on land and at sea. Do the same for the **uk\_dcw** layer.

a) What answers do you get? Are they different? If they are, can you explain why they are?

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### 1.4 Layer Properties

All aspects of a layer are controlled through the Layer Properties window, which can be accessed by double-clicking the layer name in the TOC. This allows you to define how the layer is displayed, the data source on which it is based and labelling etc.

**The windows for raster and vector are similar, but not identical.**

### 1.5 Changing the display of raster data

#### Stretched

The way raster data are displayed is changed through the **Symbology** tab of the **Layer Properties** window. Open this tab of **Orkneydtm** and experiment with different colour ramps. Using more colours can bring out greater differences in height, particularly with the minimum-maximum stretch applied.

#### Classified

Stretched classifications are probably the most aesthetically pleasing way to display a raster, but interpretation is aided by classifying into bands with a legend.

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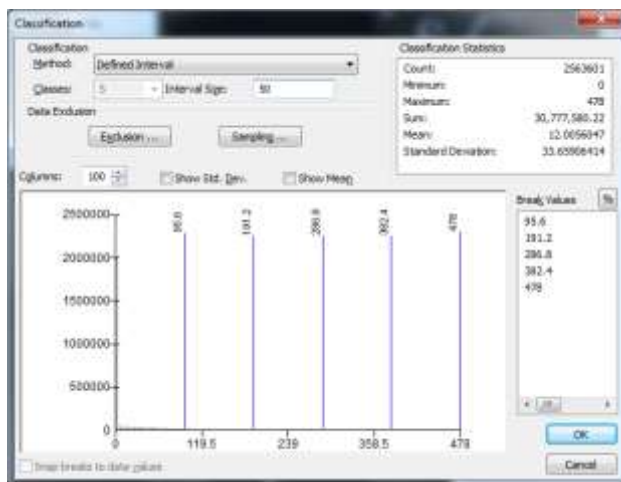
a) Yes the answers should be different since these are different types of data model with different (data) structures.

The vector layer when clicked will return attributes relating to the particular polygon (individual closed shape) clicked upon. Clickin outwith any polygon (i.e. on the 'sea' area in this case) will produce nothing as there is nothing there to report! Vector objects exist as discrete or distinct entities located at points within space.

The raster layer however models space as a continuous field. Therefore clicking on a raster cell will return data values (and perhaps also stretched values – these are the values of colour or shade in the colour palette used and governed by the image histogram which relates the scaling between true data value and the display value or colour/shade). Clicking on a coloured raster cell will return data however since the model is of a continuous field all cells between those shown hold a special NoData value. If you also click outwith the landmass (this raster is a model of elevation about sea level = 0) you will see NoData values so long as you click within the specified geographical extent of this raster layer. Clicking outwith the extent however will reveal nothing at all – not even NoData!

Let's display the Orkney DEM in 50-metre bands.

- On the left-hand side of the **Symbology** tab, select **Classified**
- **If asked to calculate histograms, click yes.**
- Then press **Classify**
- Set the **Method** to **Defined Interval** and set the interval size to 50.
- Click **OK** in both windows.



This may make it easier for you to approximate elevations without using the identify tool. Experiment with different ways of classifying, different numbers or colours used.

### 1.6 Raster Resolution

b) Look at the **Properties** window for the Orkney DEM again. The raster has a **resolution** or **cell size**. What is it?

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c) This is a pretty good cell size for what we're doing (basic visualisation). However, it can restrict the capabilities of analysis which we will be doing later. Think why this might be. Return to the Edina site and have a look at the other height data available. What are the differences? Why might you choose one over the other?

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#### Commented [OM2]:

b) The resolution (cell size) for PANORAMA data should be 50m. That is each square grid cell is of side length 50m thus each square covers an area of 2.5 sq km.

#### Commented [OM3]:

c) For now while PANORAMA (and its recent updated versions OSTerrain50) are available as OS OpenData to all (i.e. those outside of Higher Education and the Digimap Agreement) the OS Profile dataset at 10m resolution is a must for any real analysis work and should probably be considered the minimum standard desirable (unless perhaps looking at huge areas where data volumes and processing times are a concern).

Due to sampling theory the DEM resolution must be at least half of the smallest feature to be measured i.e. the DEM must have a height (or elevation) measure twice as frequently as the rate at which the smallest feature changes. Like a spatial Nyquist frequency.

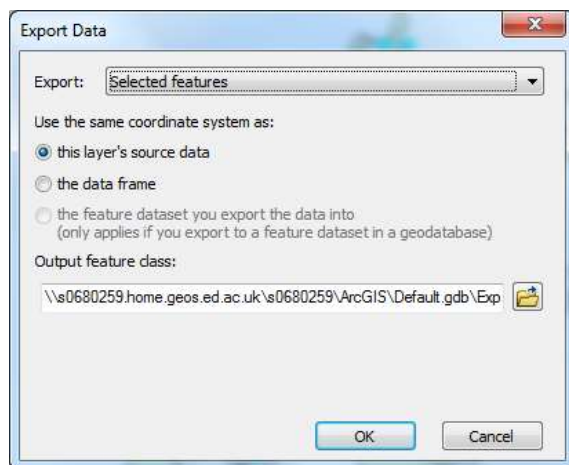
## 2 Preparing our map

Imagine the following scenario. You have been tasked by SNH with creating a map to appear in a new consultancy report on conservation and renewable energy activity in Orkney. The map is to show sites or areas of interest on top of natural features and perhaps also access to the sites. You have been provided with a small amount of data on the GeoSciences web server (see under **Other features** later). Before we get started, there is some preparation involved.

### 2.1 The SNH data

First, we must select only the sites from Orkney (no point including those off the islands). Using the **Select** button, draw a rectangle around the sites from Orkney. They will be highlighted blue. For each layer in turn (or at least a few of them), right-click the **relevant** layer name and go to **Data > Export Data**. You will be shown a window as below.

(If you prefer, rather than selecting an area each time with each layer you can use the **OrkneyDTM** as a mask – try reclassifying this to a single value and then converting to a polygon which you can then use to clip all layers.)



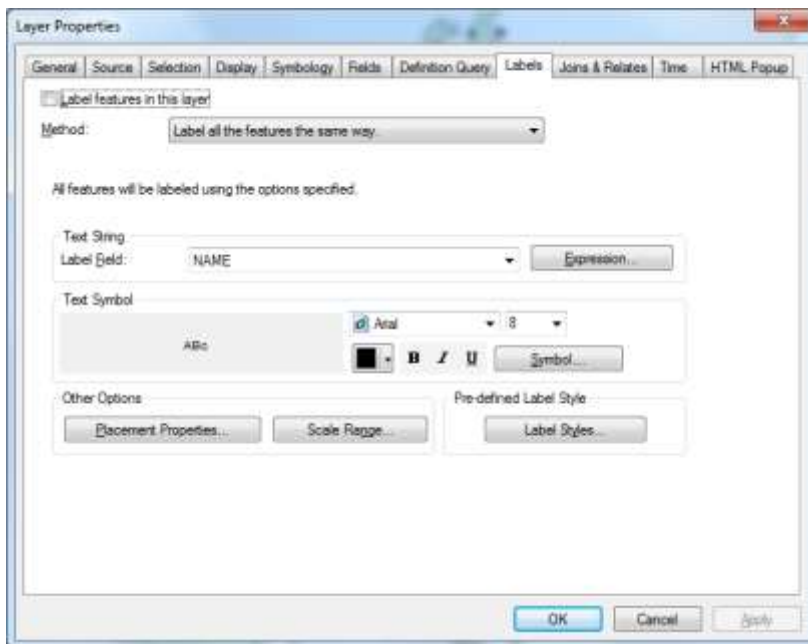
Save to an appropriate location once again, ensuring that you **Save** them as **type: Shapefile** and not geodatabase files. (Geodatabases have lots to recommend them on paper but for our purposes offer little benefit although little extra complexity.) When asked if you want to add the data as a new layer, click yes. Now uncheck the original layer, and perhaps remove it from the map.

If you feel you wish to remove any records from a layer you can either apply a Definition Query using Structured Query Language (SQL) but if new to this you may find it easier to use the Editor to remove certain records. **Right-click** on the taskbar at the top and click on **Editor**. This will add a new toolbar. Click on **Editor > Start Editing** and then select the relevant layer. This will allow you to delete any sites which don't fit the bill for our map. **Open the Attribute Table** for the layer and highlight any you want to delete. When you have finished, right click on the grey box along the left-hand side of the table and click **Delete Selected**. Once finished, go to the Editor toolbar, Save your edits, and Stop editing (you'll be prompted to save if you try to Stop Editing first).

## 2.2 Labelling

We'll now want to **label** the sites and areas, otherwise people aren't going to be able to see which is which. You can use any suitable attribute field but it might sometimes be best to make your own. If so, you can Open the **attribute table** for your layer once again. Click on the **Table Options** button on the attribute table taskbar and click **Add Field**. Call it '**Label**' and make sure you select **Text** as the type. Populate this with the names of sites as you might want them labelled.

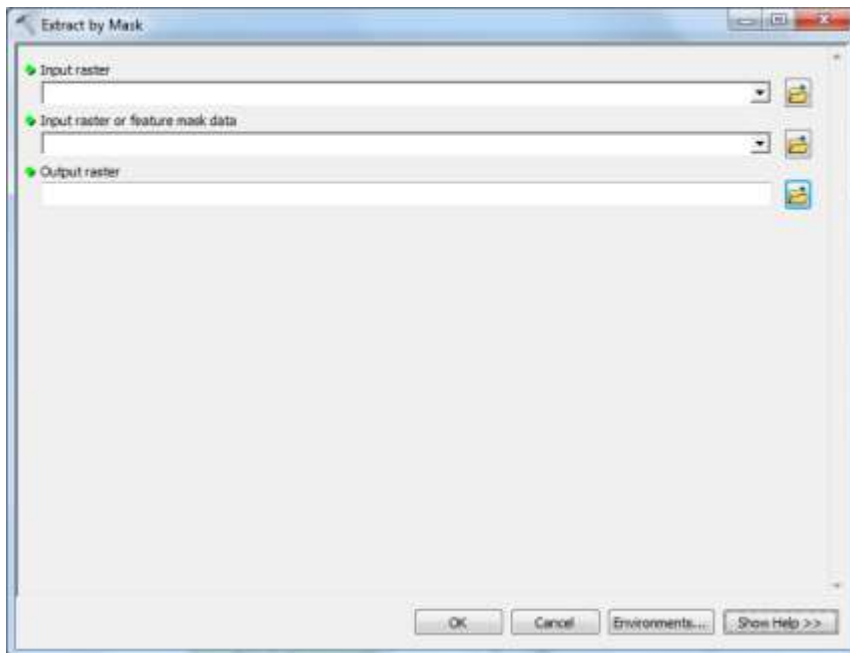
Now open the **Properties** menu and navigate to the **Labels** tab.



Check the box to label features and then select the appropriate field. You can change font and sizes here, as well as adding masks to ensure your sites' names show up accordingly. More refinements can be done when you've finished other aspects of the map. Of course, you don't have to label everything the same way, and you could give names as a list of sites elsewhere. You are not completely bound by the technology.

### 2.3 The Base Layer

Our **uk\_dcw** layer works fine as a guide on where the coast lies, but it's a little dull as the basis for a map. The following will make your map look lots better with not too much effort. First we need to trim that DEM! Search for the tool **Extract by Mask**. This tool covers the raster with a mask (in this case a polygon) and removes the cells which lie underneath it. This will leave us with a neater (though not necessarily more accurate) representation of Orkney's coastlines.



Enter the **Orkneydtm** layer as the input, and the **uk\_dcw** layer as the mask. Give the output an appropriate location and call it **OrkneyTrim**. Add these data to the map and turn off the **Orkneydtm** layer. Here's where it gets fancy.

Search for a tool called **Hillshade**. This takes a DEM and casts artificial light on it, illuminating it from a specified angle. You get a visualisation of what the landscape looks like, although from a 2D perspective. Obviously the quality of this will vary depending on the resolution of your DEM. Put the **OrkneyTrim** layer into this tool and execute it. Call the output **OrkneyTrimHS**.

Now, ensure that the hillshade is below the **uk\_dcw** layer in the TOC. Open the **Properties** of the **uk\_dcw** layer and go to the **Display** tab. Here you should see a **Transparency** option. Set this to 40% and click OK. Fancy, eh?

## 2.4 Other features

You have been provided with a whole host of other information for the map, available from [http://www.geos.ed.ac.uk/~gsiteac/ilw/data/common\\_files](http://www.geos.ed.ac.uk/~gsiteac/ilw/data/common_files). I've included roads of various types, settlements, rivers and lochs. Think about the purpose of the map and what you are trying to show with the layers. If you want to show access to the sites, you may wish to display the roads, and colour-code them depending on their size. If you just want to give an overall impression of distribution, perhaps only bigger roads are necessary but you might want to show lochs and rivers. Have a play around and see what you get.

You should have picked up enough in this practical to be getting on with this part. Think about selecting important towns to show, labelling features appropriately and generally making the map look decent.



### 3 Making the Map

Until this point we've just been working in the **Data View** part of ArcMap. Further refinement of the map is done in the **Layout View**. Switch to this through **View > Layout View**.

You should see your map represented on a page with a border. The layout toolbar will also appear, with tools very similar to those in data view. However they only affect the layout view, while the main toolbar affects both. Hover over them with your mouse to see what they do.

In most circumstances, all maps should show some basic information:

- Title (although this could be in a caption)
- Legend (key)
- North arrow
- Scale bar
- Relevant contextual information

The **Insert** menu in the **Layout View** allows you to add these features to your map. When you had added these and played around with your symbology to your heart's content, you can export the map as a JPEG (**File > Export Map**).

**Remember – when you change the size of a map this changes its scale as well, so it is best to specify the size of the image before exporting it.**