Using NetCDF data within ArcGIS

Objective:

This practical introduces the importing and use of Network Common Data Form (netCDF) data within ArcGIS. The NetCDF format is commonly used in climatology as a means of handling spatio-temporal data sets, particularly those in raster format.

Important note: The ability to work with NetCDF data was only introduced in ArcGIS v9.2. If you are working with an older version of ArcGIS, you will not be able to complete this exercise.

Data:

To access the data for this exercise, go to the University of East Anglia Climate Research Unit's web site at:
http://www.cru.uea.ac.uk/cru/data/temperature/

We will download a simple data set here that contains global average monthly temperatures for the period 1961-1990, measured in degrees centigrade. The data are labelled as 'absolute' in the file. There are thus 12 time periods and the data are for grid squares that are 5 degrees of latitude by 5 degrees of longitude.

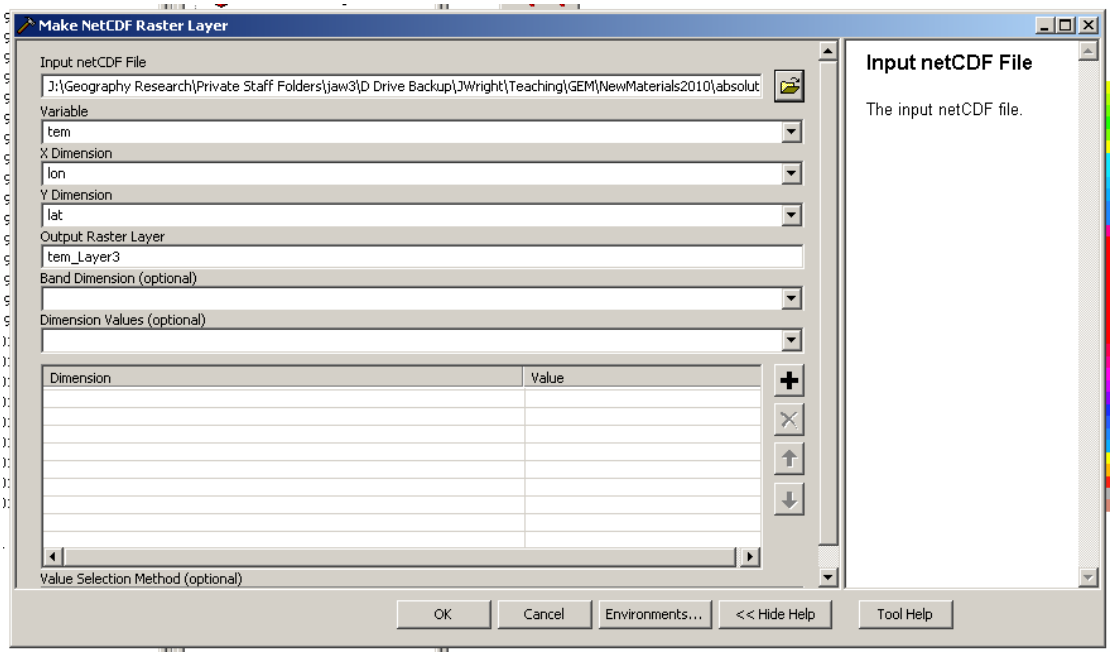
To access the data, under 'data for downloading' on this page, scroll down to the 'absolute' data set and choose the NetCDF format. Save the file to your computer.

Data for Downloading

Dataset	Full grid		End month Updated	Hemispheric means			Hadley Centre
CRUTEM3	Zipped ASCII 2 MB	NetCDF 19 MB	2010-09 2010-10-15	NH	SH	GL	HADLEY CENTRE
CRUTEM3v	Zipped ASCII 3 MB	NetCDF 19 MB	2010-09 2010-10-15	NH	SH	GL	
HadCRUT3	Zipped ASCII 7 MB	NetCDF 19 MB	2010-09 2010-10-14	NH	SH	GL	HADLEY CENTRE
HadCRUT3v	Zipped ASCII 7 MB	NetCDF 19 MB	2010-09 2010-10-14	NH	SH	GL	
HadSST2	Zipped ASCII 3 MB	NetCDF 38 MB	2010-09 2010-10-05	NH	SH	GL	HADLEY CENTRE
Absolute	Zipped ASCII 3 MB	NetCDF 63 KB					

Practical instructions

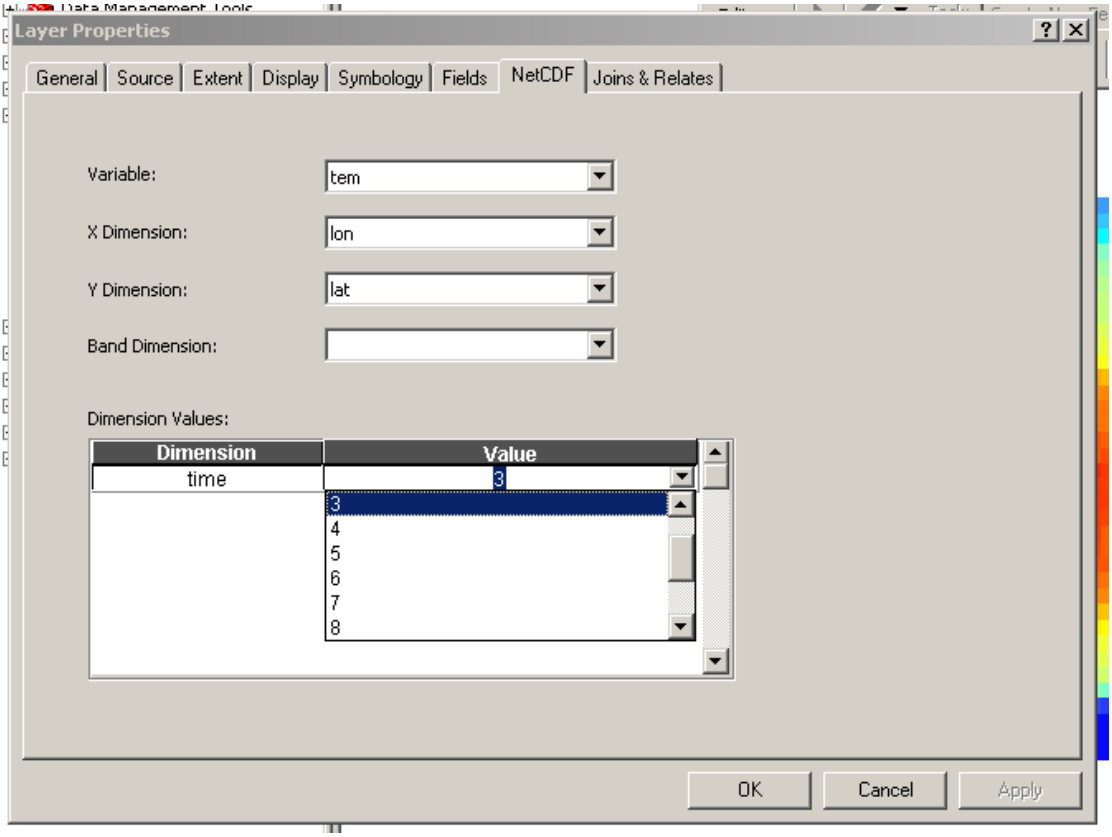
Start up ArcMap and head for the ArcToolBox, selecting 'multidimension tools' then 'Make NetCDF raster layer'.



Select the file that you just downloaded. Note that ArcGIS will automatically choose **tem** (temperature) as the variable to be contained in this data set, **lon** (longitude) as the X dimension, and **Lat** (latitude) as the Y dimension. Under 'dimension values', select **time** to have time (month of the year) loaded as the third dimension for this data set. Note that in the grid at the foot of this dialog box, you can optionally select a value between 1 and 12 (i.e. January through December) to indicate the month's temperature data that will be displayed by default in map format within ArcGIS. If you leave this blank, by default January's data will be displayed as the first in the series. You can also enter in the name of an *output raster layer* to contain the output. Press OK, and ArcGIS will generate a multi-dimensional raster based on the HDF data.

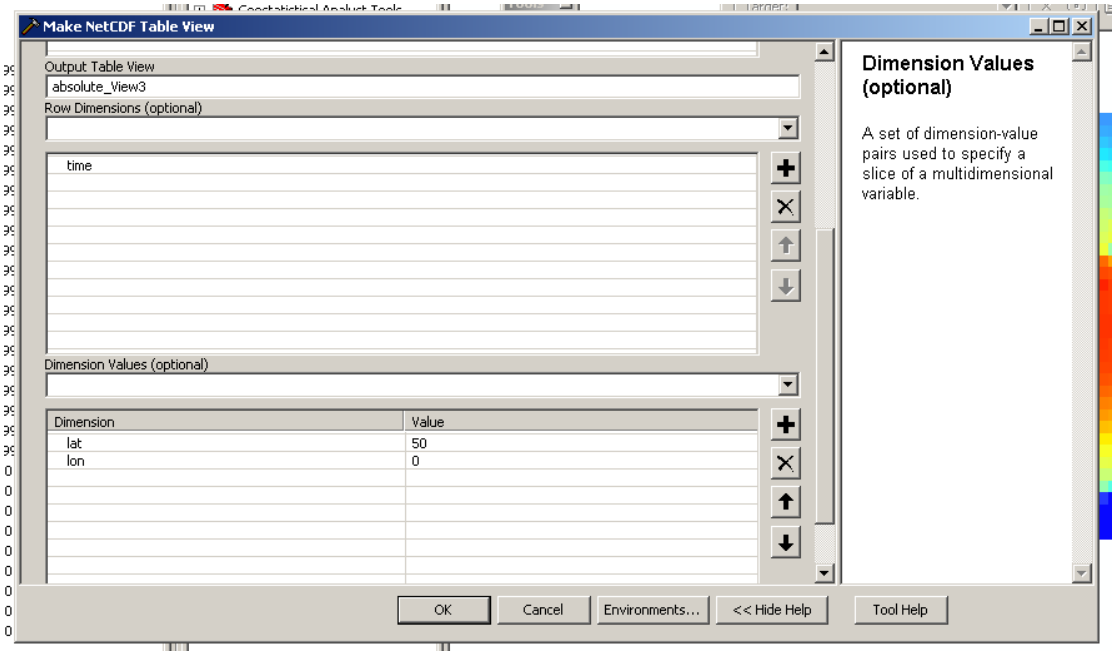
You can now display this 'cube' of spatio-temporal data in a variety of ways:

- right-click on the map layer in the left-hand table of contents panel and choose *properties*, then select the *netcdf* tab on the properties dialog box. In here, you can change the value of the dimension 'time' to be displayed on screen, selecting for example March [i.e. 3 as the 3rd month in the year rather than 1 for January]. Note: By using the 'symbology' tab, you may wish to set the means of displaying the raster to be 'classified' with a large number of classes [e.g. 30], in order to be able to see the effect of choosing to display different months.



- Using the 'select by dimension' tool in the ArcToolBox achieves the same effect as the above use of the NetCDF tab, enabling you to choose a particular time-slice of data to look at. For example, we could choose a different month and the time-slice shown in the ArcMap window would be updated accordingly.
- We can also use a feature known as 'table views' to extract particular values from our space-time grid in tabular format. What the table view provides is a 'slice' through our large array of temperature values in a tabular format that could be downloaded to a spreadsheet, for example. To do this:
    - In the ArcToolBox, select 'Make NetCDF Table View' and select your netCDF file that you downloaded under 'Input netCDF file'.
    - Under 'variables', select 'tem' (temperature).
    - Under 'row dimensions', select 'time'.
    - Under 'dimension values', select 'lat' (latitude) and 'lon' (longitude). In the grid beneath this option, you can pick out particular latitude and longitude values that you wish to look at in more detail (the screenshot below looks at latitude = 50, longitude = 0)
    - You can also choose a name for the 'output table view' that will be generated.
    - Click on OK and ArcGIS will generate a new table view which has data for temperature for your chosen location, with each row representing the temperature values for each time (in this case, months of the year).

- Note that in order to see the output, you may need in the bottom left of your screen (under the left-hand table of contents panel) to select the 'source' tab. If you then find your table view, you can right-click on it and choose open to view the result.



- Note also that once you see this tabular view of the data, you can click on the 'options' button beneath the table and choose 'export' to export your chosen 'slice' of the data to a spreadsheet package or elsewhere for further analysis. You can also graph the data that you have extracted from the netCDF file.
- If you close down this tabular view of the data, you can also right-click on the table view and choose *properties*, and thereby extract data for a different pair of co-ordinates within the data file.

Summary:

This practical has summarised some of the ways of manipulating data stored in NetCDF format, a format for handling spatio-temporal data. The tools enable us to view 'slices' of information from such files, either visually on-screen in the form of maps or in tabular format, and to extract subsets of the information within the file for further analysis. There are other tools available for analysing files, such as mechanisms for animating the data for different time periods.

In this case, the file is very small – the grid resolution is very coarse, there are few time periods, and there is only a single attribute. The power of this

format and the tools for slicing through it comes where the file has many attributes (e.g. abundance data for many different species, with each species held as a separate attribute), and finer spatial and temporal resolution.