

# NetCDF Tutorial



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# About the netCDF Tutorial

Network Common Data Form (netCDF) is a file format for storing multidimensional scientific data (variables) such as temperature, humidity, pressure, wind speed, and direction. You can use tools from the Multidimension Tools toolbox to create a raster layer, a feature layer, and a table view from a netCDF file. You can change the display by selecting a specific dimension value from the properties dialog box or by running the Select by Dimension geoprocessing tool. You can also perform analysis using a layer or table view created from a netCDF file.

## Tutorial scenario

The tutorial data, a netCDF file, contains derived data from an atmospheric model simulation. The three-dimensional variable tmin represents the annual minimum temperature for winter seasons. In addition to lon and lat dimensions, the variable tmin also has year, a third dimension to represent time steps.

This tutorial is divided into three exercises and is designed to allow you to explore the multidimension tools and the netCDF-related functionality in ArcGIS at your own pace.

- In exercise 1, you'll copy the tutorial data locally and create a raster layer from a netCDF file. You'll then change the display by selecting a different time step.
- In exercise 2, you'll create a temperature time series table for a specific location.
- In exercise 3, you'll create a model to find the temperature difference between two time steps.

You will need approximately 45 minutes of focused time to complete the tutorial. Alternatively, you can perform the exercises in sequence one at a time, saving your results along the way when recommended.

# Exercise 1: Displaying a raster layer from a netCDF file

You'll locate the [Make NetCDF Raster Layer](#) tool and create a raster layer using a variable from a netCDF file. You'll then change the display by selecting a different time step. This exercise will take approximately 15 minutes to complete.

**Complexity:**  
Beginner

**Data Requirement:**  
ArcGIS Tutorial Data Setup

**Data Path:**  
C:\arcgis\ArcTutor\NetCDF

**Goal:**  
Create a raster layer from a netCDF file.

## Copying tutorial data

Before working with multidimension tools, you'll organize your tutorial data.

Steps:


1. Open Windows Explorer. You can use the shortcut key combination Windows logo key+E to open it.
2. Navigate to the location where you installed the tutorial data; for example, if you installed ArcGIS on your C drive, navigate to C:\arcgis\ArcTutor.
3. Right-click the NetCDF folder and click **Copy**.
4. Right-click the C drive (or an alternative location) in Windows Explorer and click **Paste**.

## Making a netCDF raster layer

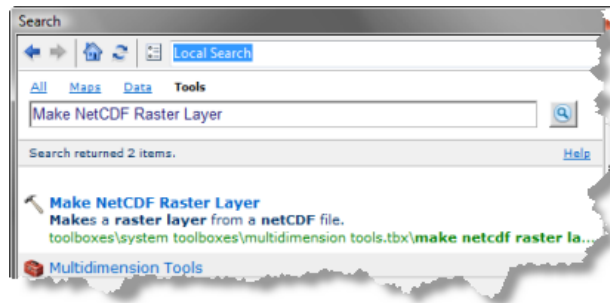
You'll run the [Make NetCDF Raster Layer](#) tool to create a raster layer using the tmin variable from the temperature.nc netCDF file.

Steps:

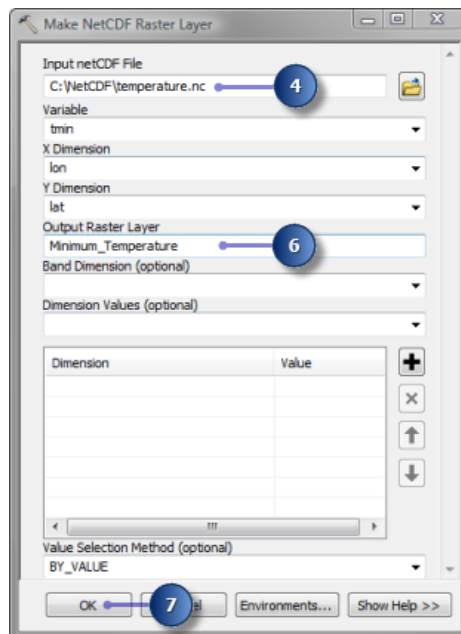
1. Start ArcMap by either double-clicking a shortcut installed on your desktop or using the All Programs list on the Start menu.
2. Click **OK** on the ArcMap startup dialog box.
3. Open the [Make NetCDF Raster Layer](#) tool.

 **Note:** Use the Search window to locate the [Make NetCDF Raster Layer](#) tool.

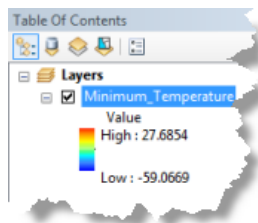
- a. Click **Search**
- b. Choose **Tools**.
- c. Type `Make NetCDF Raster Layer`.
- d. Click the magnifying glass icon.
- e. Click the Make NetCDF Raster Layer tool in the list.



4. For the **Input netCDF File** value, type or browse to C:\NetCDF\temperature.nc.
5. Accept default values for **Variable** (tmin), **X Dimension** (lon), and **Y Dimension** (lat) parameters.
6. Type Minimum\_Temperature in the **Output Raster Layer** text box.
7. Click **OK** to run the tool.



The Minimum\_Temperature raster layer is added to ArcMap. It displays the winter minimum temperature of the year 1875, which is the default (first) time step. Note that the maximum and minimum and temperature values in the table of contents are 27.6854 and -59.0669, respectively.

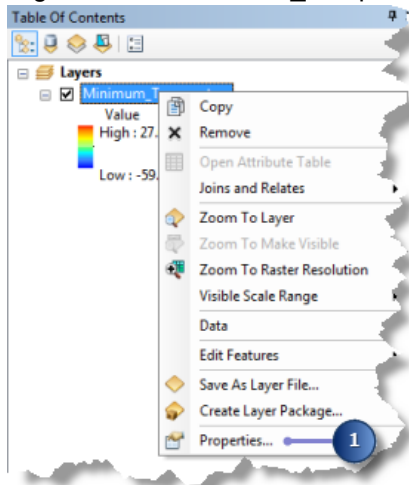


## Displaying a specific time step

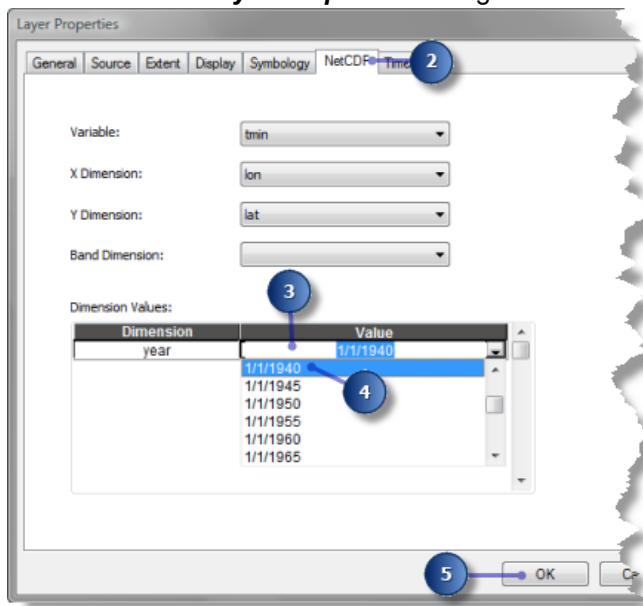
The raster layer is displayed using the default time step, which is 1/1/1875. You'll change the display to show the minimum winter temperature of the year 1940 by changing the time step on the Layer Properties dialog box.

Steps:

1. Right-click the Minimum\_Temperature layer in the table of contents and click **Properties**.



2. Click the **NetCDF** tab.
3. Click the cell next to Year under the **Value** column. An arrow appears.
4. Click the arrow and choose 1/1/1940.
5. Click **OK** on the **Layer Properties** dialog box.



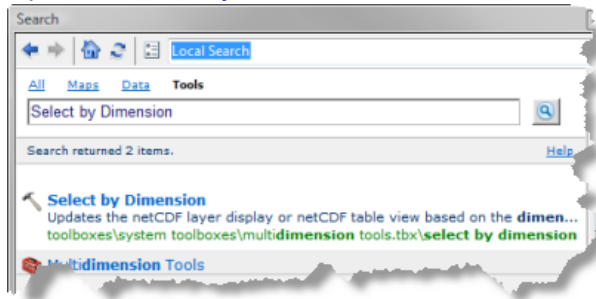
The Minimum\_Temperature layer now displays the winter minimum temperature of 1940. Note that the maximum and minimum temperatures have changed to 28.153 and -60.2398, respectively.

## Returning to the default time step

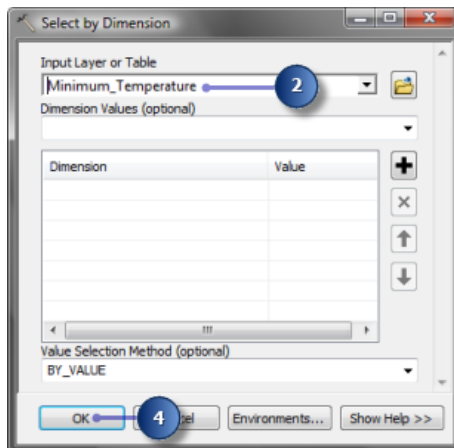
You can return to the default (the first) time step by changing the time dimension value on the Layer Properties dialog box, or you can run the [Select by Dimension](#) tool.

Steps:

1. Open the [Select by Dimension](#) tool.



2. For the **Input Layer or Table** value, choose `Minimum_Temperature` from the drop-down list.
3. Accept default values for all other parameters.
4. Click **OK** to run the tool.



The display of the `Minimum_Temperature` layer is back to the default time step (in other words, the winter minimum temperature of 1875). Note that the maximum and minimum temperatures are now back to 27.6854 and -59.0669, respectively.

## Exercise 2: Creating a temperature table at a specific location

You'll locate the Make NetCDF Table View tool and create a table view using a variable from a netCDF file. You'll then create a temperature profile from the table. This exercise will take approximately 10 minutes to complete.

### Making a netCDF table view

Run the Make NetCDF Table View tool to create a temperature time series table at a specific location using the `tmin` variable from the `temperature.nc` netCDF file.

**Complexity:**  
Beginner

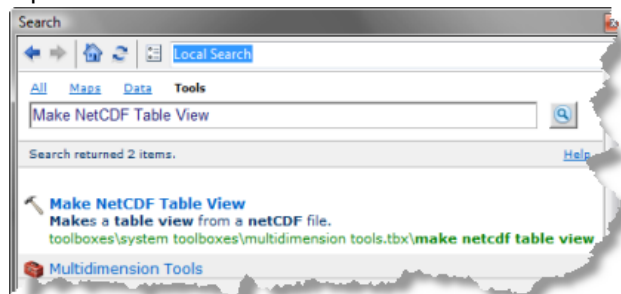
**Data Requirement:**  
ArcGIS Tutorial Data Setup

**Data Path:**  
C:\arcgis\ArcTutor\NetCDF

**Goal:**  
Create a table from a netCDF file.

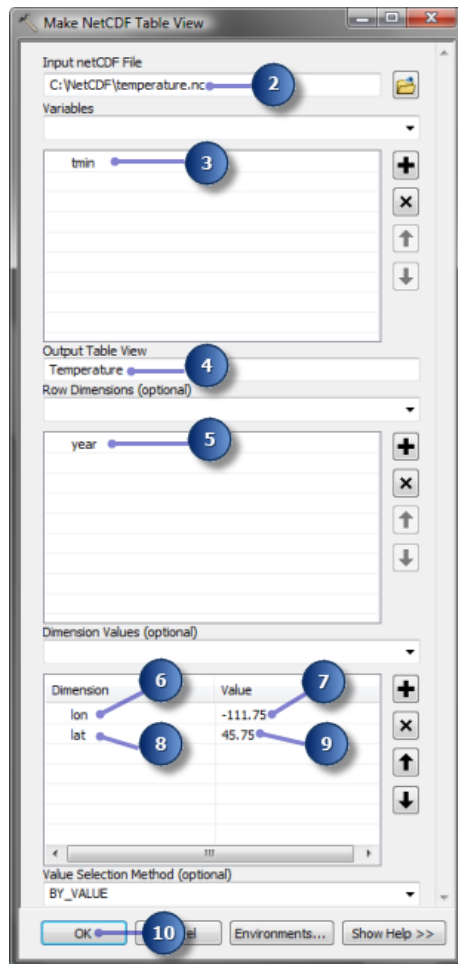
Steps:

1. Open the [Make NetCDF Table View](#) tool.

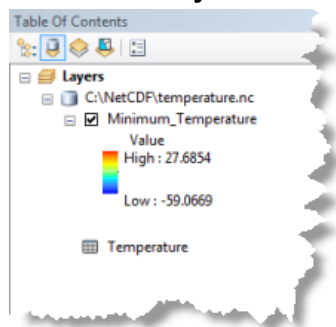


2. For the **Input netCDF File** value, type or browse to `C:\NetCDF\temperature.nc`.
3. Click the **Variables** arrow and choose the `tmin` variable.
4. Type `Temperature` for **Output Table View**.
5. Click the **Row Dimensions** arrow and choose the `year` dimension.
6. Click the **Dimension Values** arrow and choose the `lon` dimension.
7. Click the cell next to `lon` in the **Value** column and type `-111.75`.
8. Click the **Dimension Values** arrow again and choose the `lat` dimension.
9. Click the cell next to `lat` in the **Value** column and type `45.75`.
10. Click **OK** to run the tool.

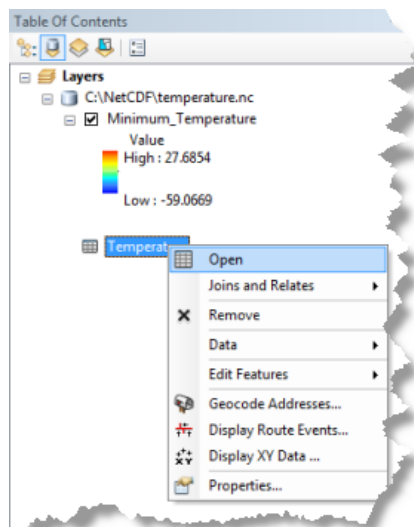




11. Click the **List By Source** button in the table of contents to see the Temperature table.



12. Right-click Temperature table in the table of contents and click **Open**.



13. Examine fields and values in the Temperature table and close it.

OID	year	tmin
0	1/1/1875	-3.89956
1	1/1/1880	-4.197895
2	1/1/1885	-5.583697
3	1/1/1890	-3.631523
4	1/1/1895	-4.16319
5	1/1/1900	-3.276012
6	1/1/1905	-4.90945
7	1/1/1910	-4.568613
8	1/1/1915	-3.715039
9	1/1/1920	-4.005638
10	1/1/1925	-4.278658
11	1/1/1930	-4.10734
12	1/1/1935	-4.335642
13	1/1/1940	1.435794
14	1/1/1945	1.500879
15	1/1/1950	0.87678
16	1/1/1955	1.589518
17	1/1/1960	1.045807
18	1/1/1965	1.211914
19	1/1/1970	1.46302
20	1/1/1975	2.244391

14. Click the **List By Drawing Order** button in the table of contents.

You can create a temperature profile from this table. See [A quick tour of creating graphs](#) and [The steps to create a graph](#) for more information.

## Exercise 3: Finding temperature difference between two time steps

In this exercise, you'll create a model to find the temperature difference between two time steps. This exercise will take approximately 20 minutes to complete.

**Complexity:**  
Beginner

**Data Requirement:**  
ArcGIS Tutorial Data Setup


**Data Path:**  
C:\arcgis\ArcTutor\NetCDF

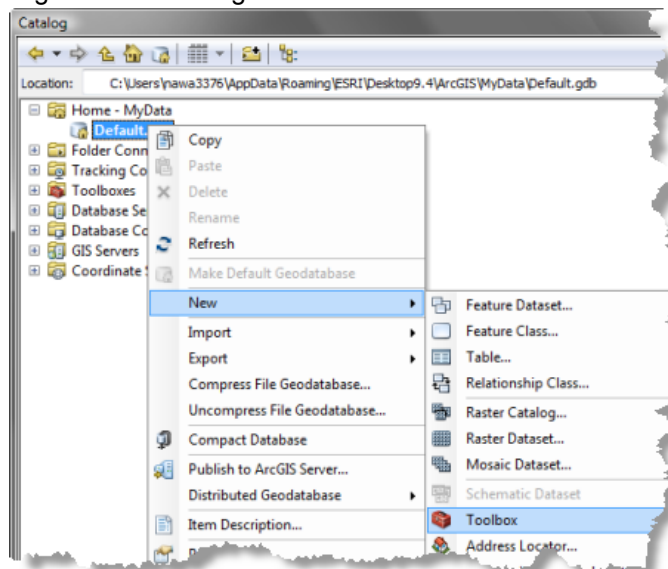
**Goal:**  
Perform analysis using a netCDF file.

### Creating a new toolbox

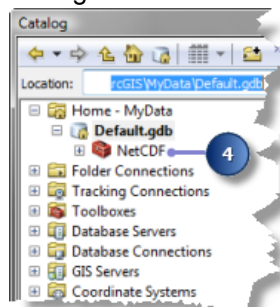
You'll first create a new toolbox to store the model you will create in this exercise.

Steps:

1. Click the **Catalog Window** button  on the **Standard** toolbar to open the **Catalog** window.
2. Click the **Default Geodatabase** button on the Catalog.
3. Right-click Default.gdb and click **New > Toolbox**.



4. Change the name of the toolbox you just created from Toolbox to NetCDF.

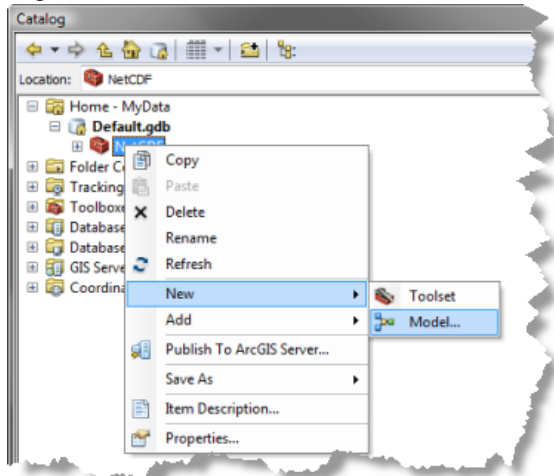


## Creating a new model

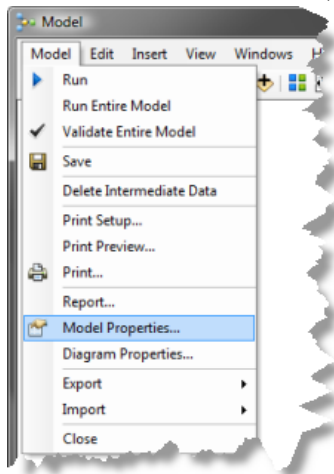
You'll create a new model and name it TemperatureDifference.

Steps:

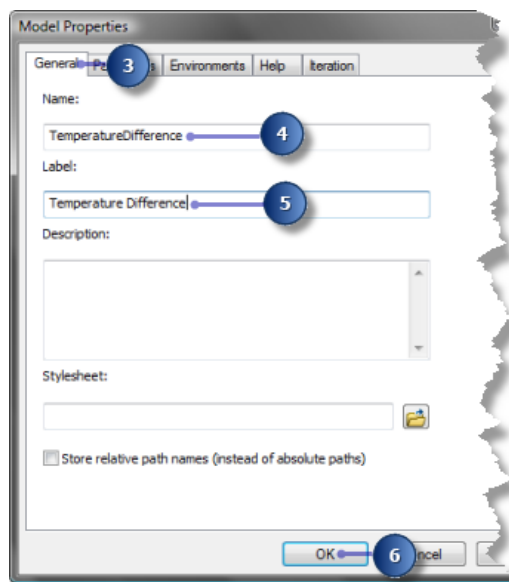
1. Right-click the NetCDF toolbox and click **New > Model**.



2. On the model's Main menu, click **Model > Model Properties**.



3. Click the **General** tab.
4. Type TemperatureDifference in the **Name** text box.
5. Type Temperature Difference in the **Label** text box.
6. Click **OK** to close the dialog box.

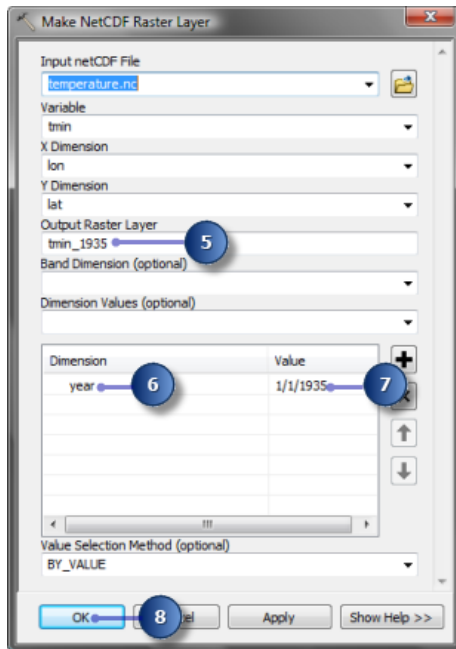


## Building the Temperature Difference model

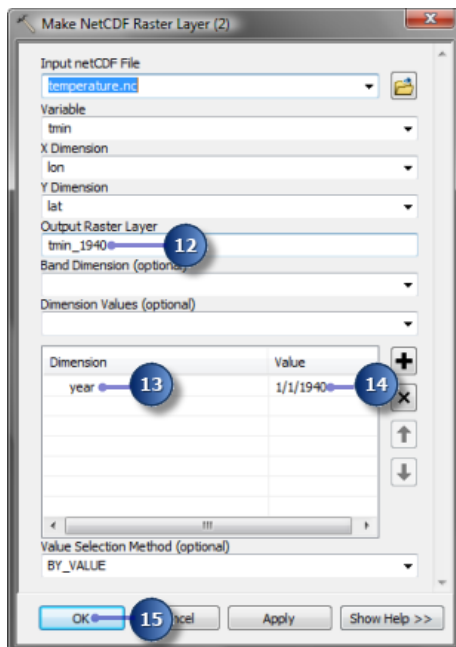
You'll add the netCDF file and Make NetCDF Raster Layer tool in your model to create two raster layers for the years 1935 and 1940.

### Steps:

1. From your NetCDF folder in Windows Explorer, drag the temperature.nc file onto your model.
2. Locate the [Make NetCDF Raster Layer](#) tool and drag it onto your model.
3. Connect the temperature.nc variable to the [Make NetCDF Raster Layer](#) tool.
4. Double-click the [Make NetCDF Raster Layer](#) tool.
5. Type `tmin_1935` in the **Output Raster Layer** text box.
6. Click the **Dimension Values** arrow and choose the `year` dimension.
7. Click the cell next to year in the **Value** column, click the arrow, then choose 1/1/1935.
8. Click **OK** on the [Make NetCDF Raster Layer](#) dialog box.



9. Locate the [Make NetCDF Raster Layer](#) tool again and drag it onto your model.
10. Connect the temperature.nc variable to the [Make NetCDF Raster Layer \(2\)](#) tool.
11. Double-click the [Make NetCDF Raster Layer \(2\)](#) tool.
12. Type tmin\_1940 in the **Output Raster Layer** text box.
13. Click the **Dimension Values** arrow and choose the `year` dimension.
14. Click the cell next to year in the **Value** column, click the arrow, then choose 1/1/1940.
15. Click **OK** on the [Make NetCDF Raster Layer \(2\)](#) dialog box.

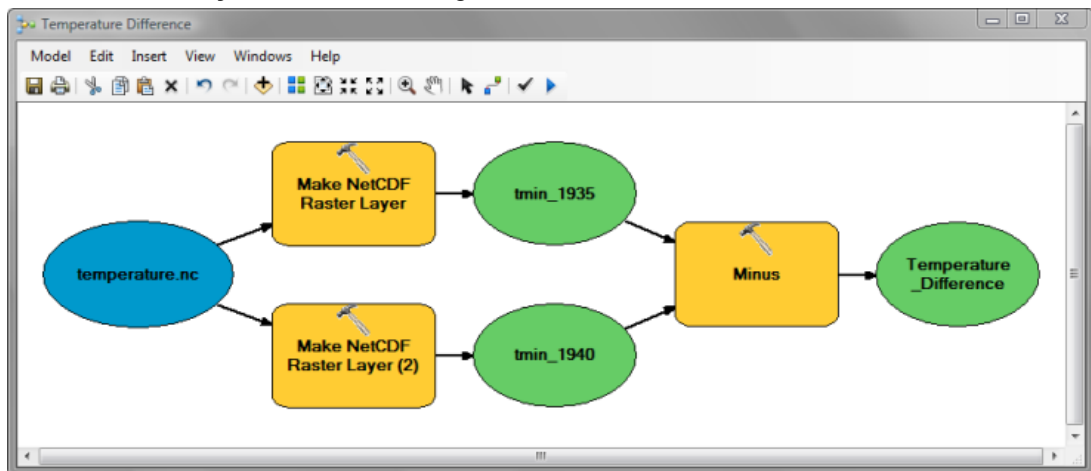



## Finding temperature difference

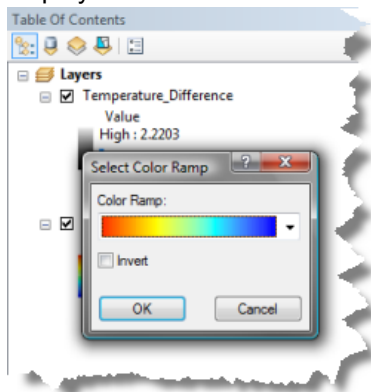
Now you'll finish up your model to find the minimum temperature difference between years 1935 and 1940 by subtracting two raster layers.

Steps:

1. Locate the **Minus** tool in Spatial Analyst or the 3D Analyst Tools toolbox and drag it onto your model.
2. Connect tmin\_1935 then tmin\_1940 to the **Minus** tool.
3. Right-click the output of the **Minus** tool and click **Rename**.
4. Type `Temperature_Difference` in the text box and click **OK**.
5. Right-click `Temperature_Difference` and click **Add To Display**.
6. Click the **Auto Layout** button to arrange the model elements.



7. Click the **Save** button  to save your model.
8. Click the **Run** button to run your model. The output raster layer is added to the table of contents.
9. Click the legend of the `Temperature_Difference` layer and choose a color ramp for better display.



## Saving the map document

You are done with the exercise. However, you may want to save the map document to explore other functionalities.

Steps:

1. On the main menu, click **File > Save**.