Displaying RAPID outputs in ArcGIS

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Goal

Learn how to display a map of flow rates and a hydrograph from flow rate computations available in a netCDF file produced by RAPID using ArcGIS.

Requirements

The ArcGIS software, and basic knowledge on how to use it.

A shapefile of the rivers used in RAPID and the corresponding netCDF outputs from RAPID. Examples of these files are available at http://rapid-hub.org/.

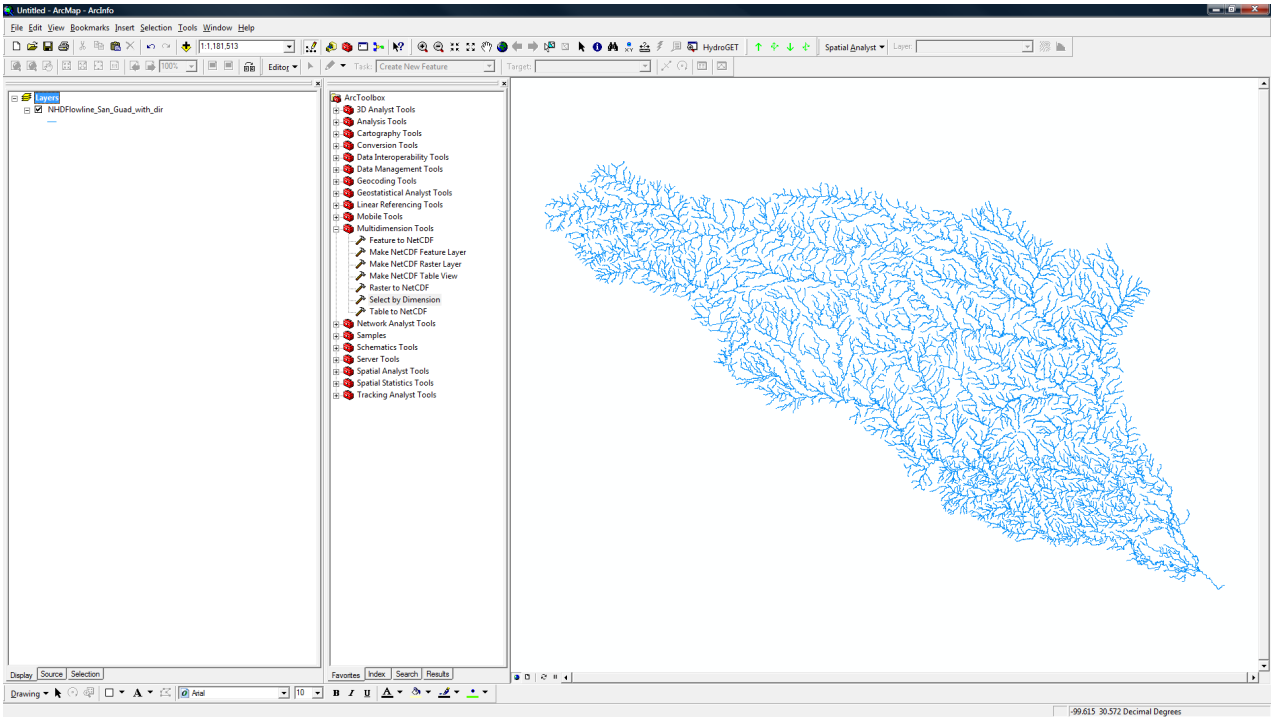
Introduction

RAPID provides flow rate computations in m^3/s for each one of the many thousands river reaches in a large river network, and at every time step. All these values of flow rate are stored in a netCDF file with two dimensions: River ID, and Time. The River ID is an integer that uniquely defines each river reach of the river network. The example demonstrated here uses a river network extracted from the NHDPlus dataset. In the NHDPlus dataset, an integer called COMID uniquely defines each river reach, and serves here as the River ID. More information on netCDF can be found on the netCDF website: http://www.unidata.ucar.edu/software/netcdf/, although a perfect understanding of netCDF files is not required for this tutorial.

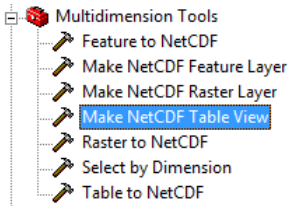
In this tutorial, the shapefile containing the river network is called "NHDFlowline_San_Guad_withdir.shp" and contains 5,175 river reaches. The netCDF file containing RAPID flow rate computations for the corresponding river network is called "Qout_San_Guad_1460days_p3_dtR=900s_n1_comid.nc" and contains one value for each of the 5,175 river reaches every 3 hours between 01/01/2004 and 12/30/2007 (a total of 11,680 time steps).

Example flow map for the San Antonio and Guadalupe Basins in Texas

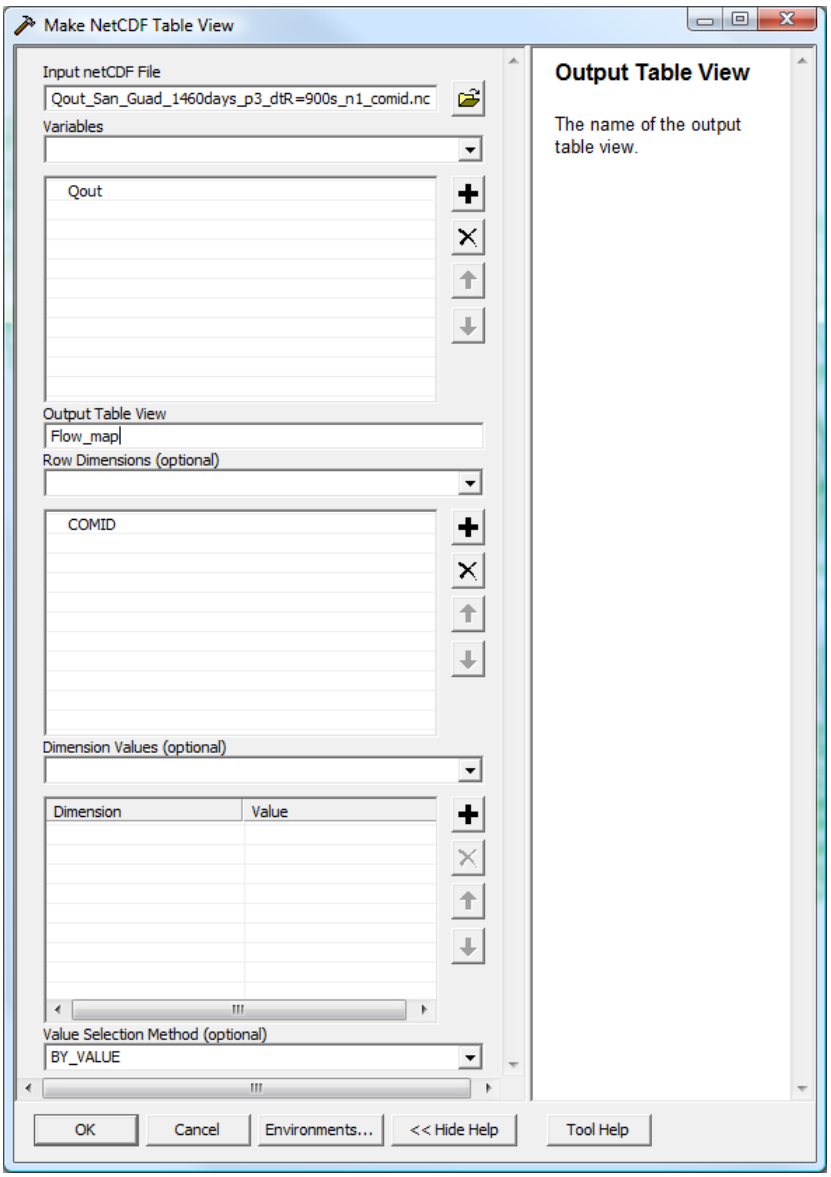
Open “NHDFlowline_San_Guad_withdir.shp” in ArcGIS. It should look like this:



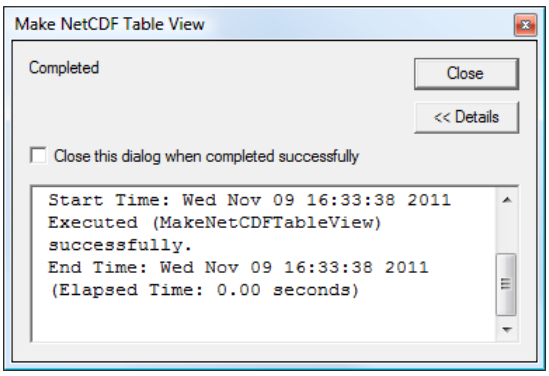
Use the “Make netCDF Table View” tool available in the “Multidimension Tools” toolbox.



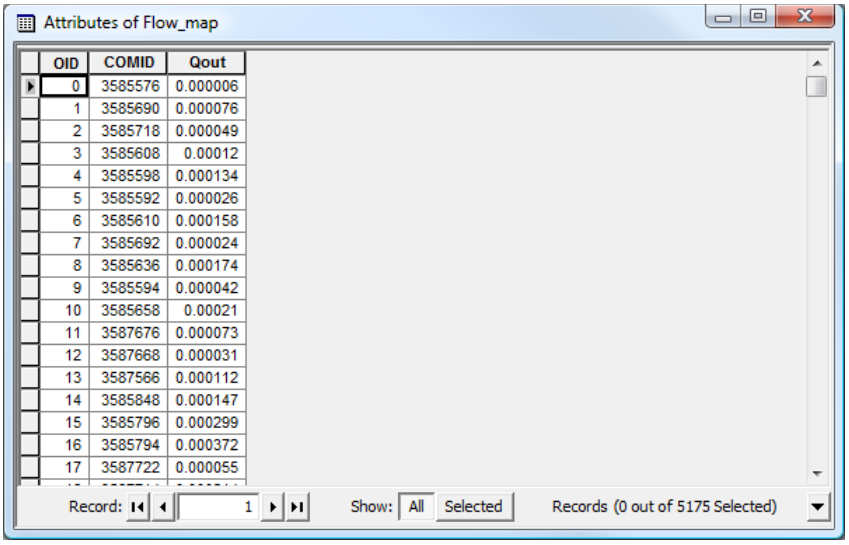
The “input netCDF file” is the netCDF file with RAPID outputs “Qout_San_Guad_1460days_p3_dtR=900s_n1_comid.nc”. Variables is “Qout”. Row Dimensions is “COMID”. Name the Output Table View as “Flow_map”.



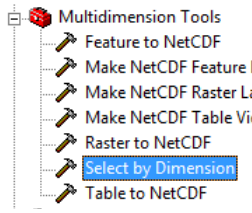
If all goes well, the following should appear:



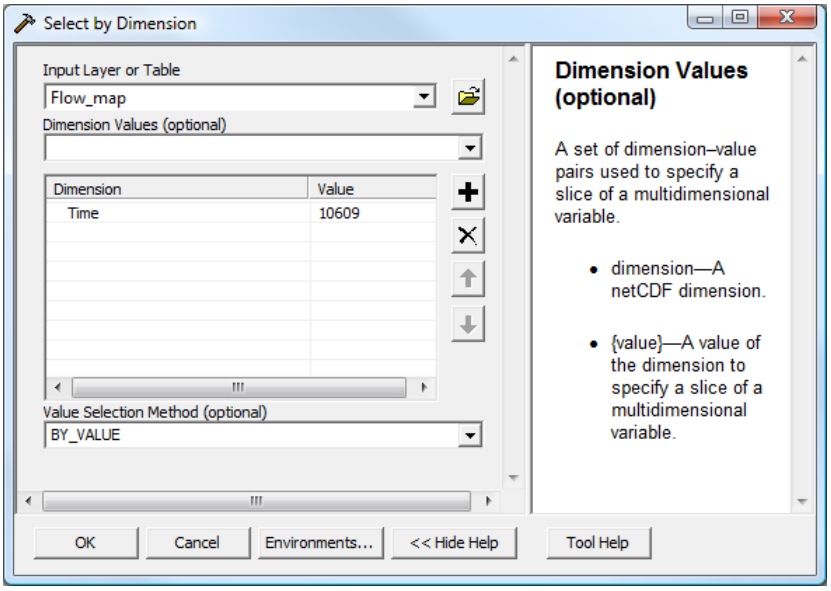
This makes a table in which a value of flow rate ("Qout") is given for each of the 5,175 river reaches based on the unique identifier of NHDPlus rivers called "COMID". By default, ArcGIS picks the first time step of the netCDF file. Opening the table should look like the following:



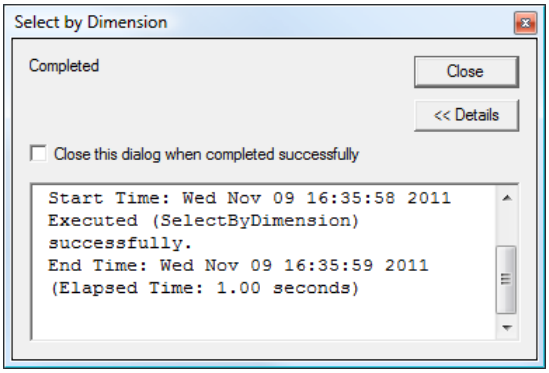
Now use the "Select by Dimension" tool available in the "Multidimension Tools" toolbox.



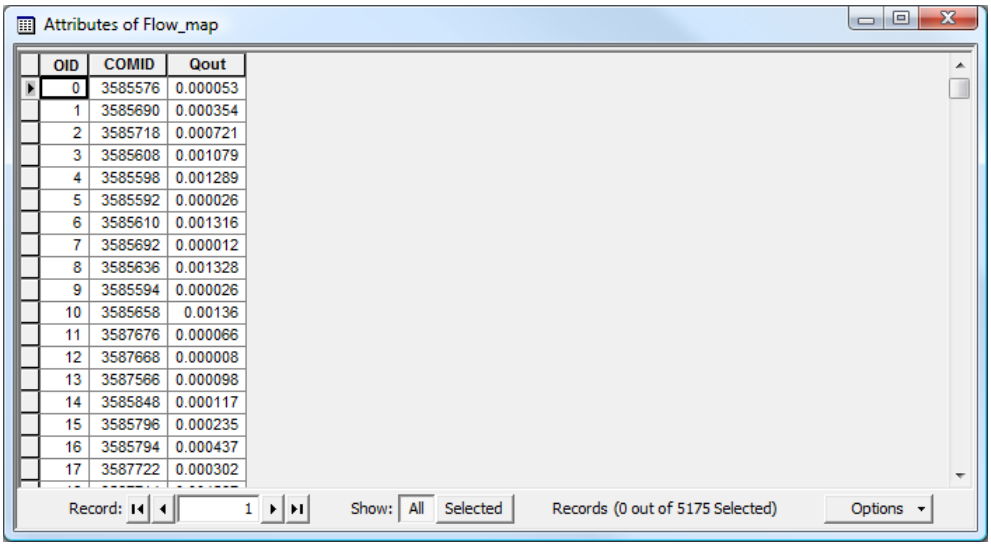
Select the table that was just created as the "Input Layer or Table" and select "Time" as the "Dimension Values". Pick time step number 10,609 which corresponds to 08/19/2007 between 00:00 and 03:00.



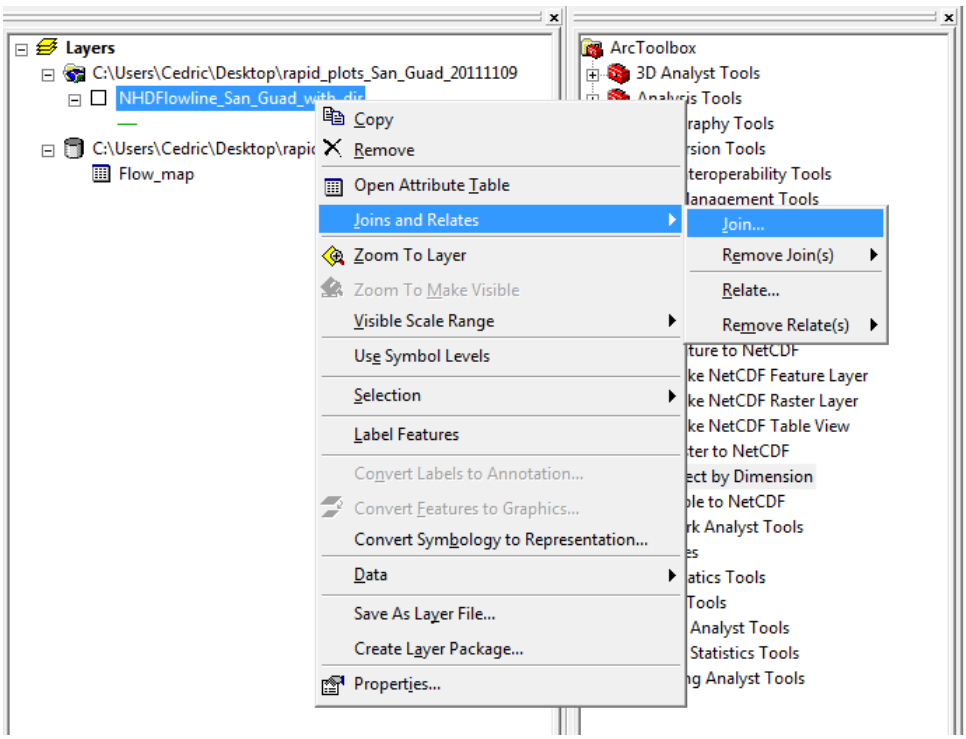
If all goes well, the following should appear:

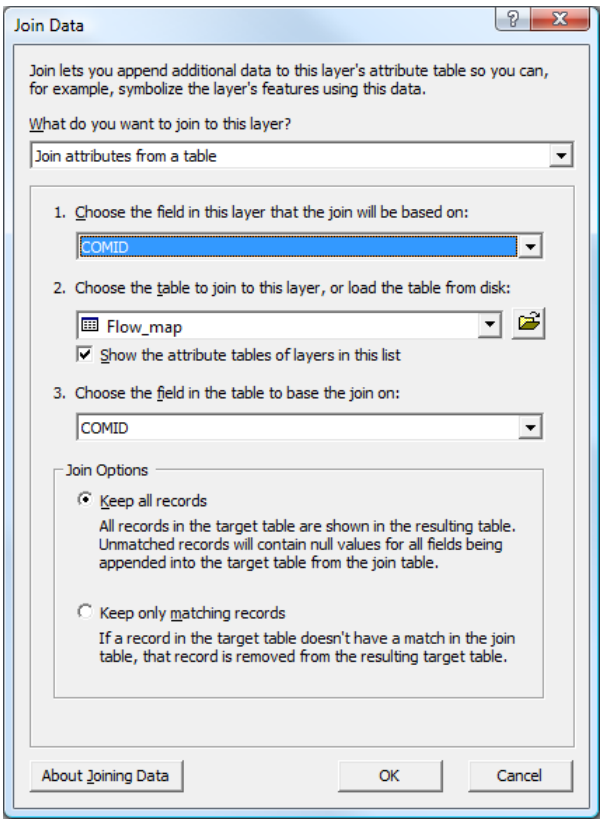


The table has now been updated with new values, opening it shows:

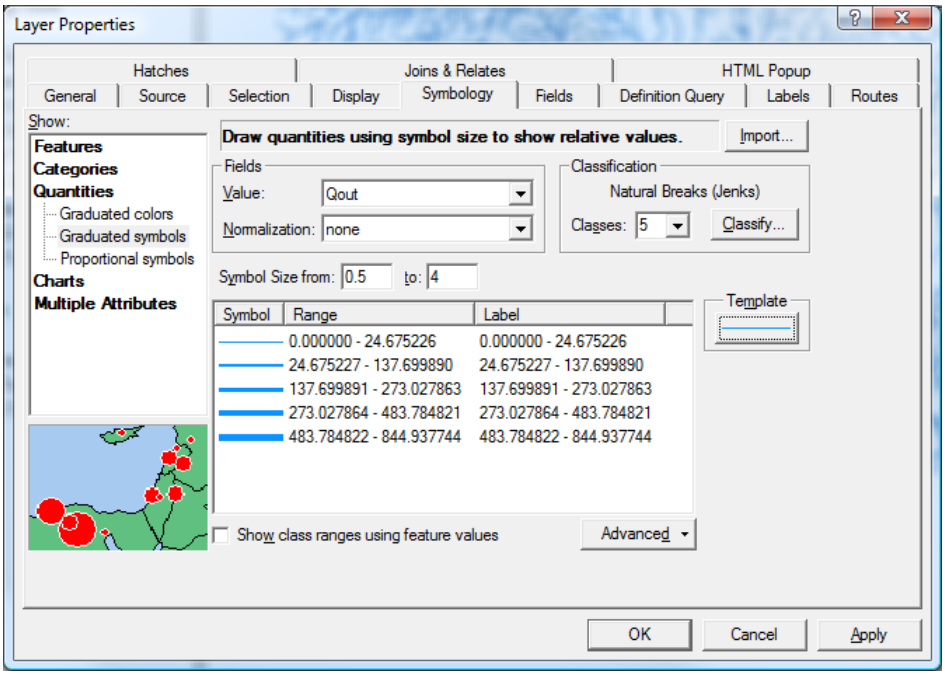


Now let's use these values to plot a map of river flow. In order to do that, join the shapefile with the above table using COMID to base the join on:

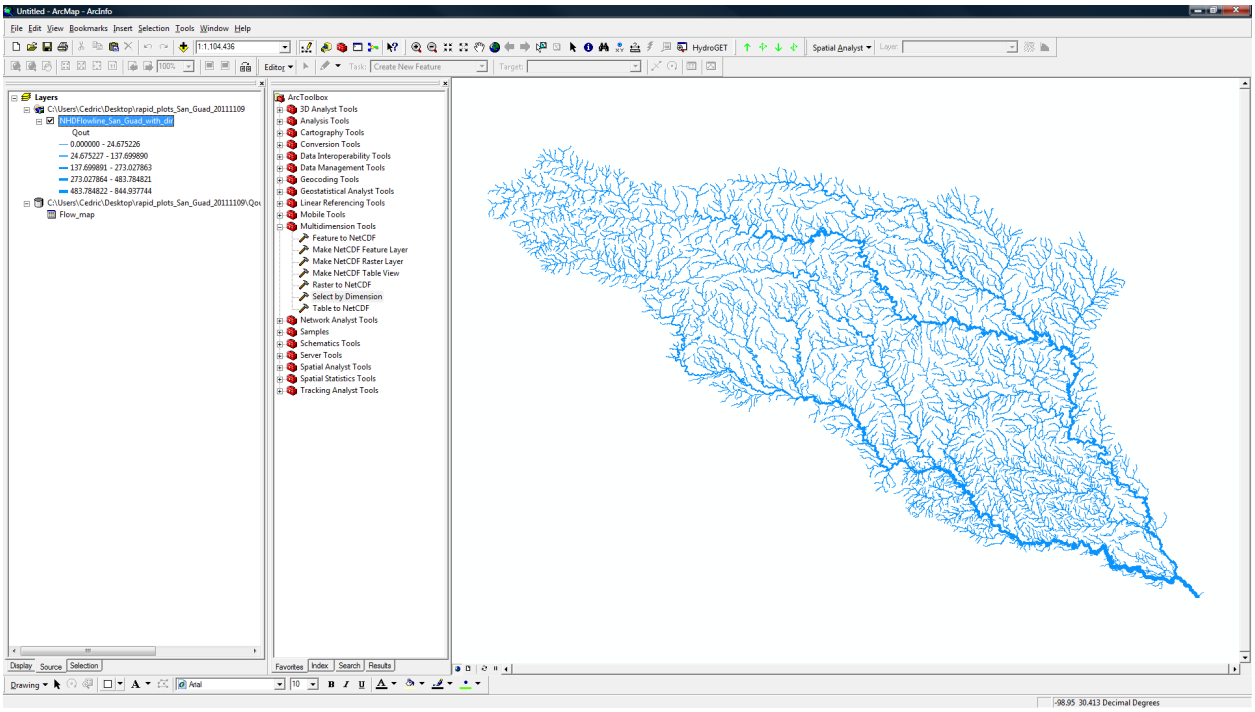




Change the layer properties of “NHDFlowline_San_Guad_withdir.shp” by displaying the symbology with graduated symbols based on “Qout”.

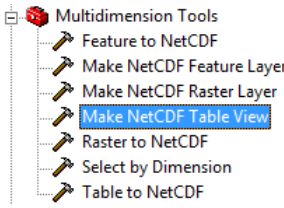


That’s it! The following map should display:

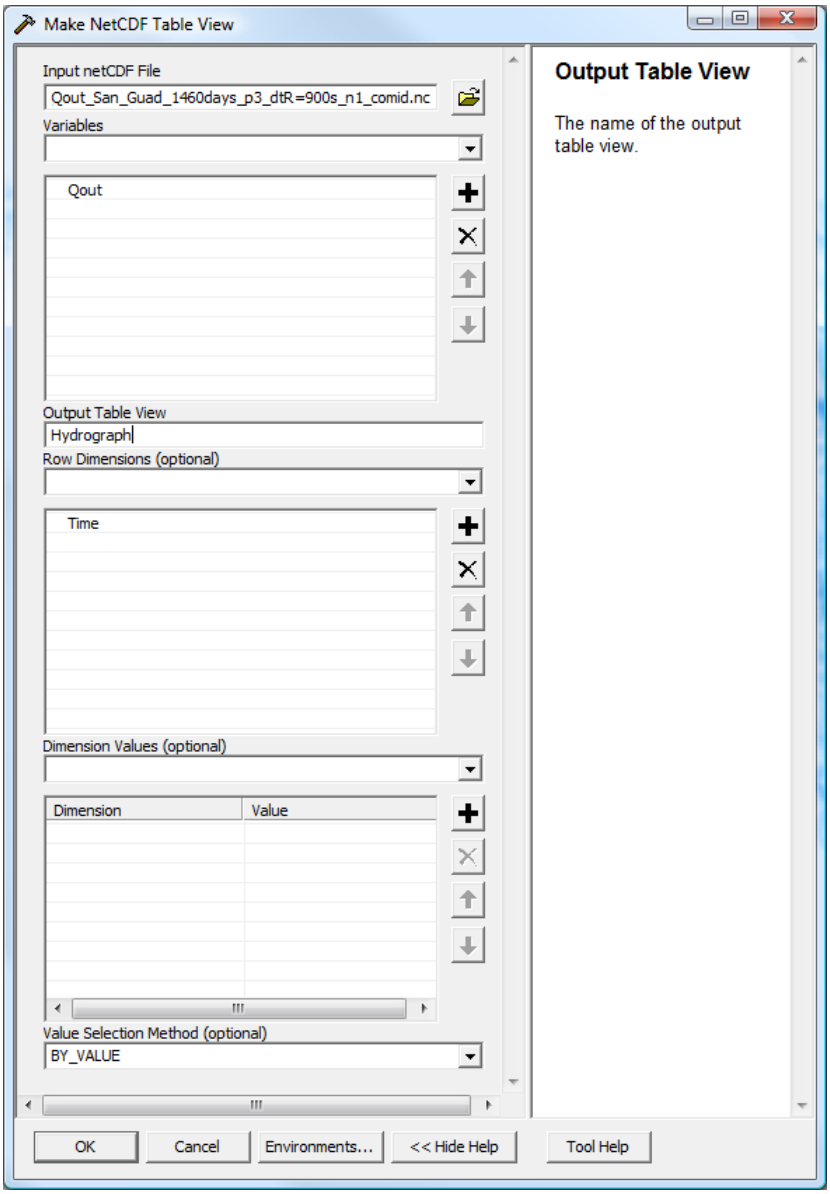


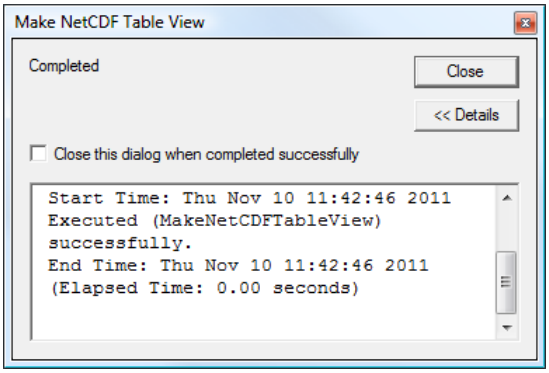
Example hydrograph for the San Antonio and Guadalupe Basins in Texas

Use the “Make netCDF Table View” tool available in the “Multidimension Tools” toolbox.

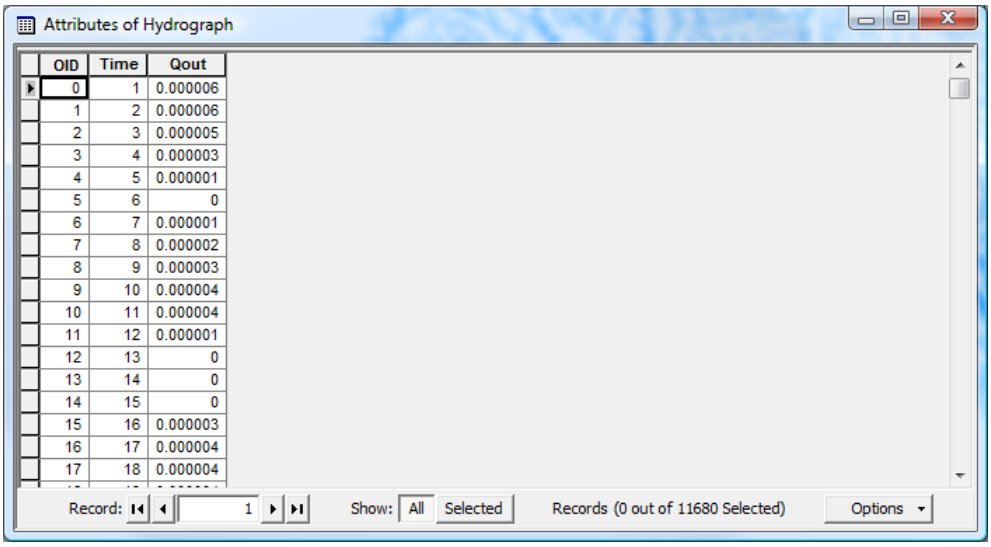


The “input netCDF file” is the netCDF file with RAPID outputs “Qout_San_Guad_1460days_p3_dtR=900s_n1_comid.nc”. Variables is “Qout”. This time, Row Dimensions is “Time”. Name the Output Table View as “Hydrograph”.



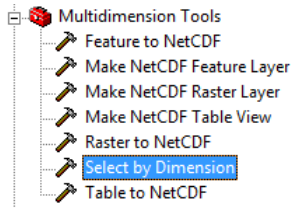


The table should look like this:

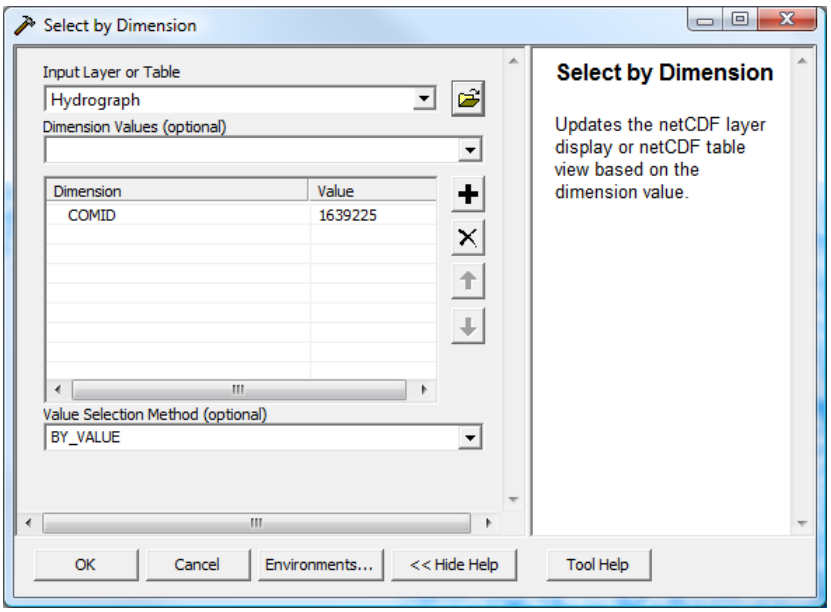


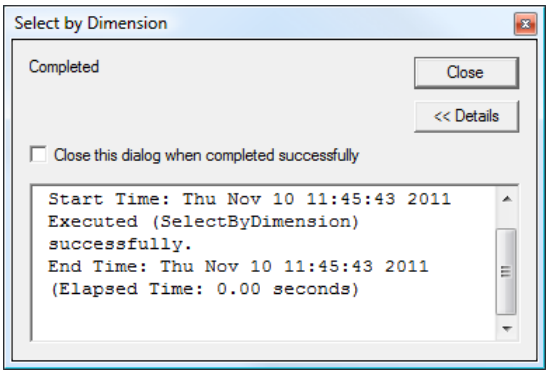
The number of records is now 11,680, i.e. the number of time steps in the RAPID output file.

Now use the “Select by Dimension” tool available in the “Multidimension Tools” toolbox.

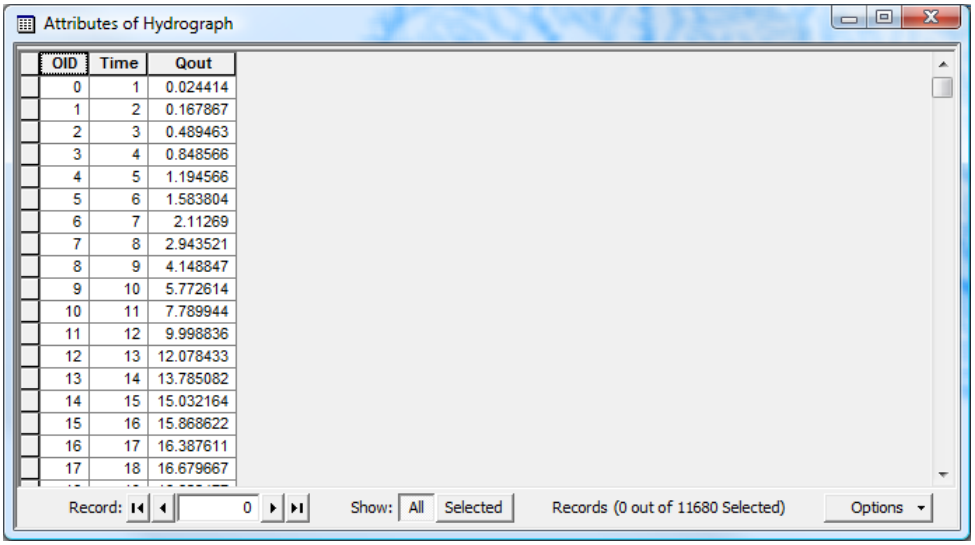


Select the table that was just created as the “Input Layer or Table” and select “COMID” as the “Dimension Values”. Pick a COMID value of 1639225 which is the COMID on which the USGS station called Guadalupe Rv at Victoria, TX is located.

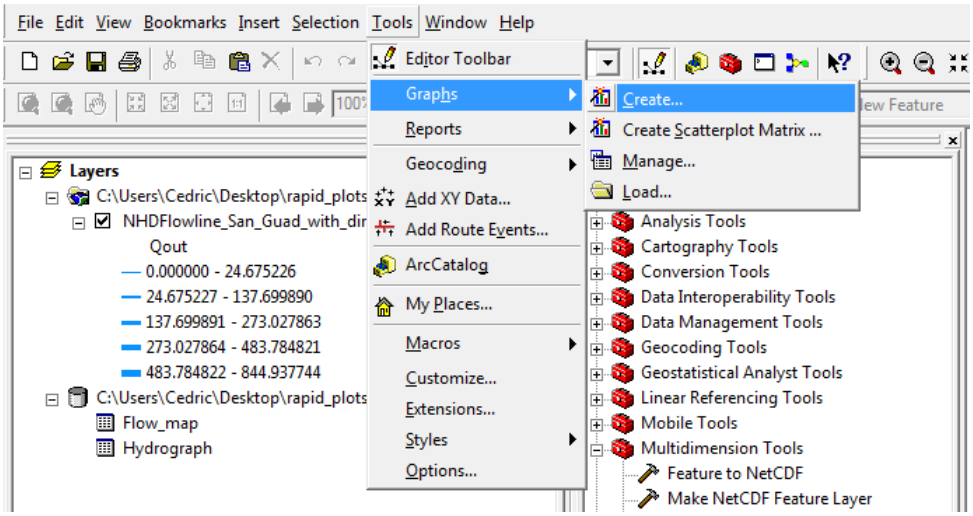




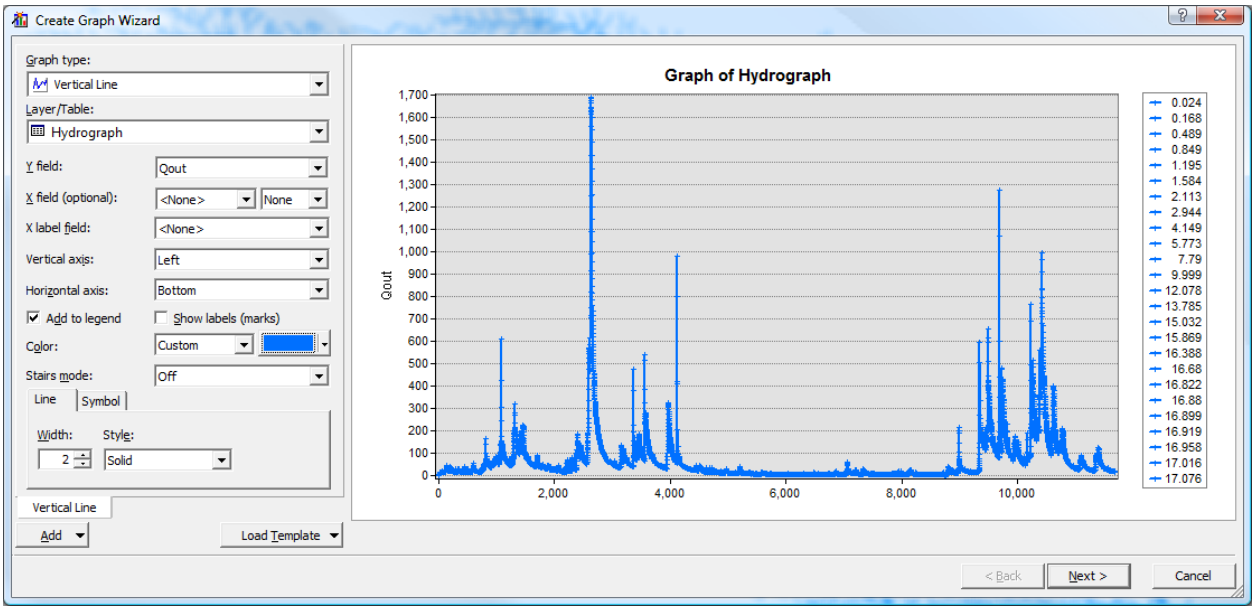
The table has now been updated:



Now let's plot the hydrograph using Tools/Graphs/Create.



Pick Vertical Line as the Graph type, Hydrograph as the Layer/table and Qout as the Y field. That's it!



Further information

RAPID website: http://rapid-hub.org/

RAPID source code: https://github.com/c-h-david/rapid/