HydroServer Workshop Agenda

CUAHSI Conference on Hydrologic Data and Information Systems
Logan, UT

June 23, 2011

1. Presentation – Brief introduction to HydroServer, how it fits into the CUAHSI HIS, and what you can do with it.
2. Demo – Capabilities of HydroServer
3. Exercise – Organizing, Loading and Publishing data Using HydroServer
4. Demo – The HydroServer collaborative CodePlex website and tour of HydroServer Resources

Additional Materials if People are Interested

1. Presentation - Setting Up a HydroServer
2. Demo - Closing the loop; registering your web service at HIS central and tagging data series

Exercise: Organizing, Loading, and Publishing Point Observations Using HydroServer

Objectives

In this exercise you will learn how to organize and load data into an ODM database using the ODM Data Loaders. You will also learn how to interact with your ODM Database using ODM Tools.

Prerequisites

The HydroServer that we will be using in today's exercise was set up ahead of time for the workshop. The following software was loaded onto or configured on that machine:

- Microsoft Windows Server 2008 R2
- Microsoft Internet Information Services (IIS) (comes with Windows)
- Microsoft .Net Framework 3.5 (comes with Windows)
- Microsoft SQL Server 2008 R2

We will not be covering publication of geospatial datasets in today's workshop, so the HydroServer does not include ArcGIS Server.

Several HydroServer software applications have been installed on the workshop computers to enable you to interact with the training HydroServer. These include:

- ODM Data Loader
- ODM Streaming Data Loader
- ODM Tools

Creating an ODM Database

NOTE: A blank ODM database has already been created for you on the HydroServer. In the following sections, you will be loading data into this database. The details for your ODM database are given below:

Server Address: hydroserver.uwrl.usu.edu
Database Name: ODMX – where X is your user number (e.g., "ODM1" if you are user number 1)
Server User ID: HydroServer
Server Password: HydroServer123!

If you did need to set up an ODM database within Microsoft SQL Server on a new HydroServer, the steps below provide an overview of the process. For more specific instructions, refer to the ODM page of the CUAHSI HIS website (http://his.cuahsi.org/odmdatabases.html).

1. Download the zip file containing the blank ODM 1.1 database schema from the CUAHIS HIS website.

2. Unzip the blank ODM database to the SQL Server data folder.
3. Open SQL Server Management Studio.
4. Attach the blank ODM database to SQL Server.
5. Create appropriate SQL Server users within the database for the HydroServer software tools and for any users that will be connecting to the database.

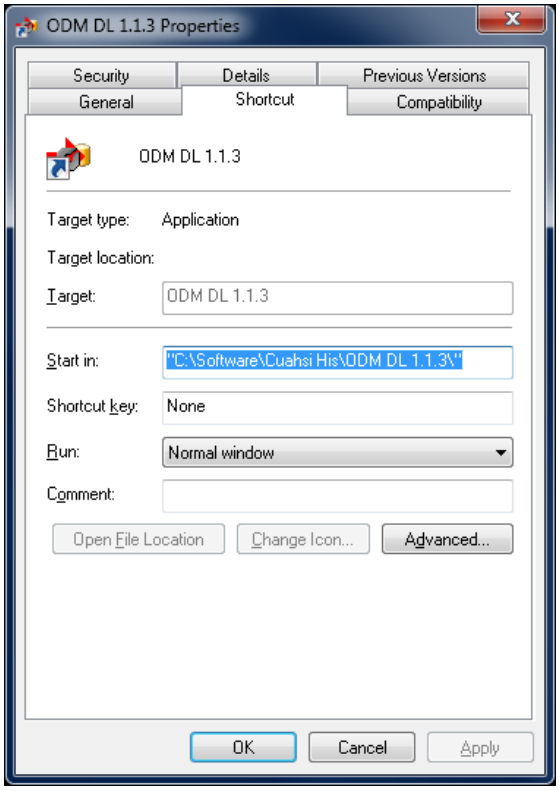
Load Table Based Data into the ODM Database Using the ODM Data Loader

To demonstrate the capabilities of the ODM Data Loader, we will begin to populate your ODM database with information about the sites at which we have collected data, the variables that we have measured, the methods that we have used, etc. The ODM Data Loader was designed to load tables of data into an ODM database. Data tables to be loaded must conform to a set of acceptable templates that are documented in the ODM Data Loader software manual, which is available on the CUAHSI HIS Website (http://his.cuahsi.org/odmdataloader.html).

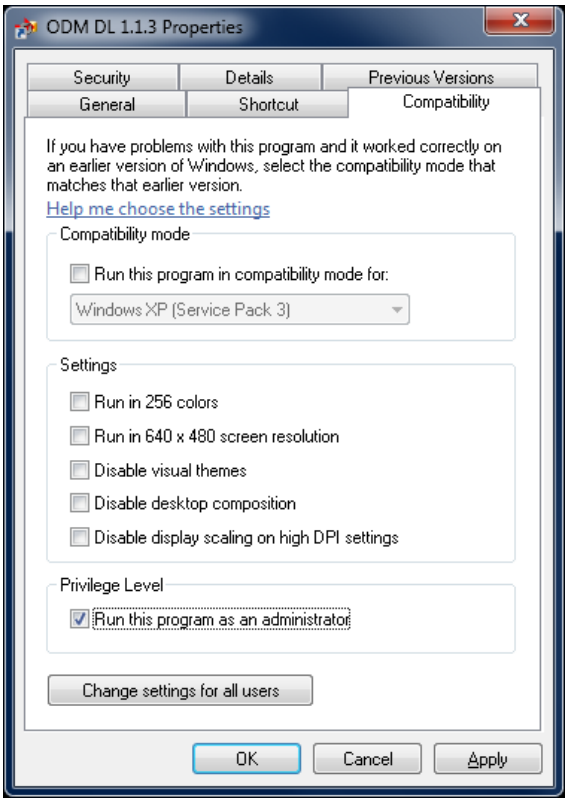
NOTE: Organizing your data so that it can be loaded into an ODM database is one of the most difficult steps in publishing your data using HydroServer. This process involves assembling all of the necessary information to populate the metadata within an ODM database and then formatting it into a set of files that can be loaded into the database. For the purposes of this exercise, we have done much of this work for you. You can look at the contents of the files that we have created to get an idea of the formats that the Data Loader can use.

For this exercise, a set of data files containing data for the Little Bear River Experimental Watershed has been prepared for you. Use the following steps to begin loading data into your ODM database:

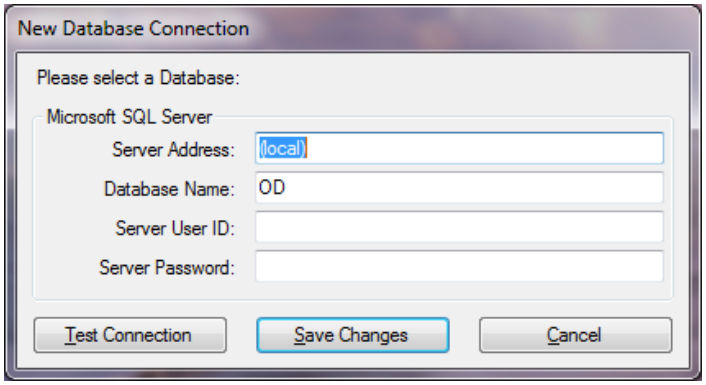
1. Download the zip file containing the data files from the following URL and save it to the desktop of your computer: http://colossus.uwrl.usu.edu/downloads/jeff/2011HydroServerWorkshop.zip.
2. Create a new folder on your desktop and unzip the contents of the zip file to that folder.
3. We need to set up the ODM Data Loader to run with administrative permissions. We will do this by setting the properties of the ODM Data Loader shortcut in the Windows Start Menu. Click Start → All Programs → Engineering Tools → CUAHSI HIS and then right click on the shortcut called "ODMDL 1.1.3" and click "Properties" in the context menu. The following window will open:



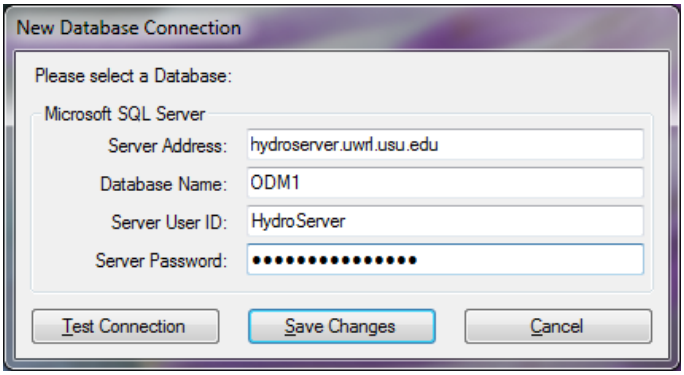
4. Click on the “Compatibility” tab and then check the box next to “Run this program as an administrator” near the bottom of the form. Then click the “OK” button.



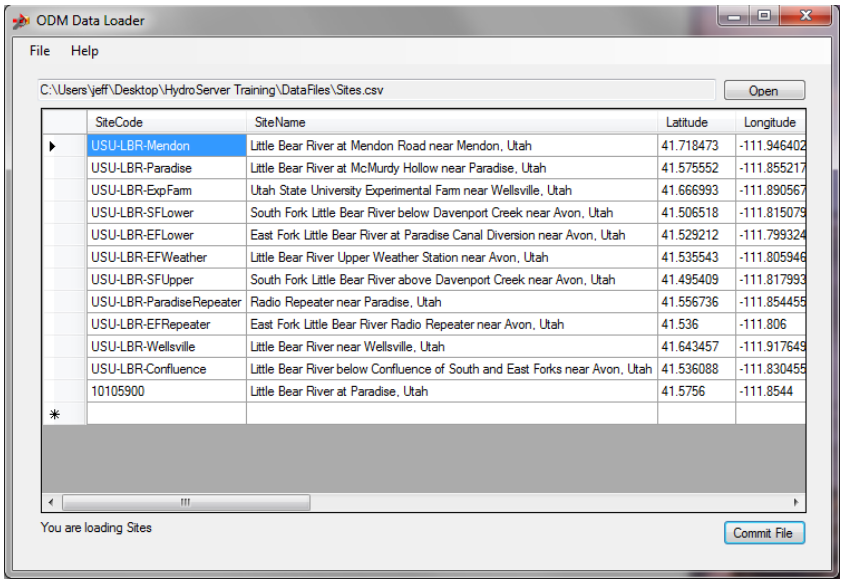
5. Open the ODM Data Loader by clicking Start → All Programs → Engineering Tools → CUAHSI HIS → ODMDL 1.1.3. The following window will appear:



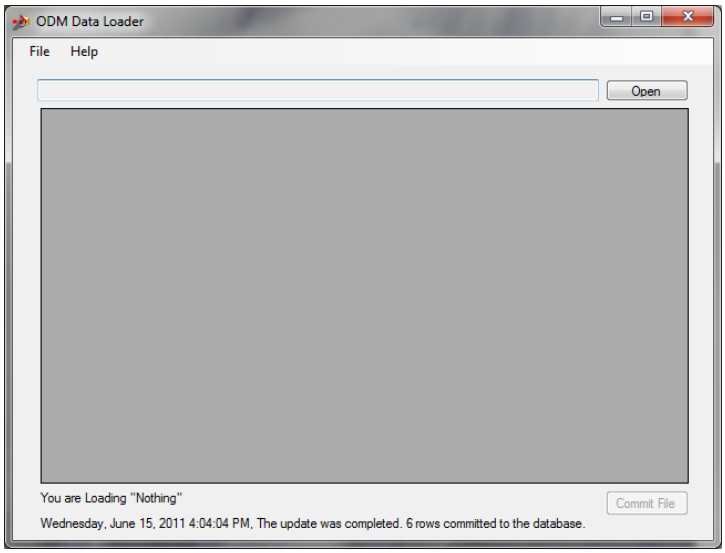
6. Create a connection to your ODM database by supplying the information given at the beginning of the previous section on the form. Make sure you use your user number with your database name! When your form looks something like the following, click the "Save Changes" button.



7. In the form that opens, click the "Open" button to open a file dialog. Navigate to the folder on your desktop into which you unzipped the data files. Select the file called "Sites.csv" and then click "Open." You will now see the file in the ODM Data Loader window.



8. You will see at the bottom left of the form that the ODM Data Loader has figured out from the contents of the file that we are loading Sites into our ODM database. Click the "Commit File" button to load the sites into the ODM database. Your window will now look like the following, and there will be a note at the bottom of the form telling you how many records were added to the database:



9. Follow the steps above to load the "Methods.csv" table, the "Sources.csv" table, and the "Variables.csv" table.

NOTE: Although we have only loaded sites, variables, methods, and sources, you can load data into any of the tables in your ODM database using the ODM Data Loader, including DataValues.

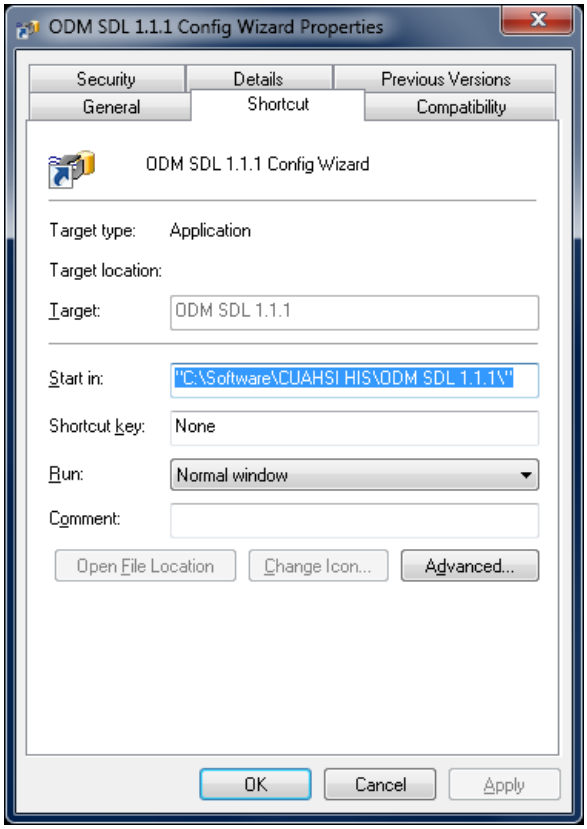
Load Data into the ODM Database Using the ODM Streaming Data Loader (SDL)

In this section, we will load some in situ sensor data collected in the Little Bear River into the ODM database using the ODM SDL. The SDL was specifically designed for loading data files that have one date/time column and multiple columns of data values, as is usually the case with datalogger files. This process will be simplified given that we have already loaded our sites, variables, methods, etc. into our database.

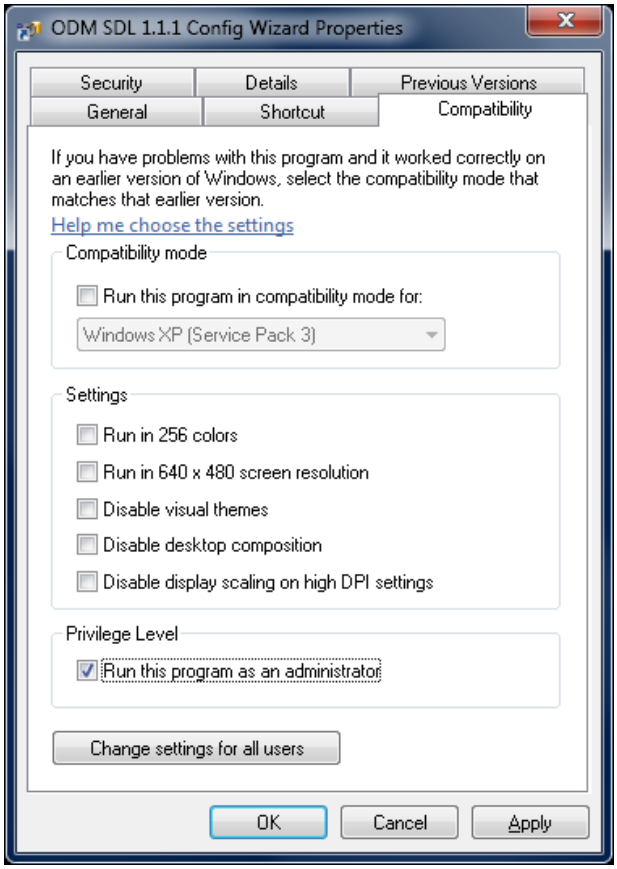
The file that you will be loading contains continuous water quality data from one of the monitoring sites in the Little Bear River. It is a datalogger file created by a Campbell Scientific CR200 datalogger and contains 30 minute observations of battery voltage, water level, water temperature, dissolved oxygen concentration, specific conductance, pH, and turbidity.

Use the following steps to add the sensor data to your ODM database:

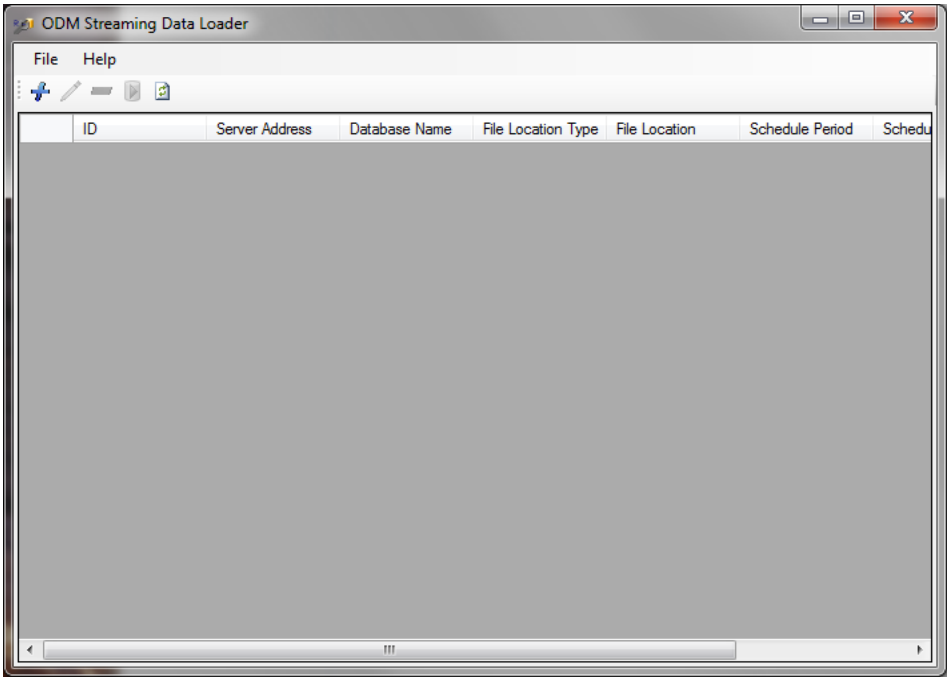
1. Like the ODM Data Loader, we need to configure the ODM Streaming Data Loader to run with administrative permissions. We will do this by setting the properties of the ODM Data Loader shortcut in the Windows Start Menu. Click Start → All Programs → Engineering Tools → CUAHSI HIS and then right click on the shortcut called "ODM SDL 1.1.1 Config Wizard" and click "Properties" in the context menu. The following window will open:



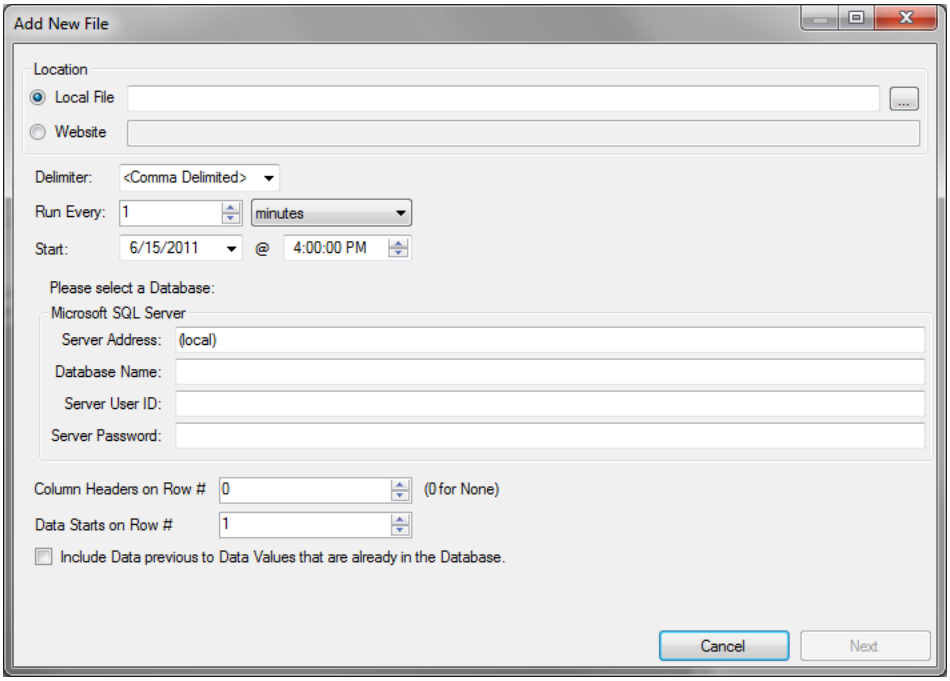
2. Click on the "Compatibility" tab and then check the box next to "Run this program as an administrator" near the bottom of the form. Then click the "OK" button.



3. Open the ODM SDL by clicking Start → All Programs → Engineering Tools → CUAHSI HIS → ODM SDL 1.1.1 Config Wizard. The following window will appear:



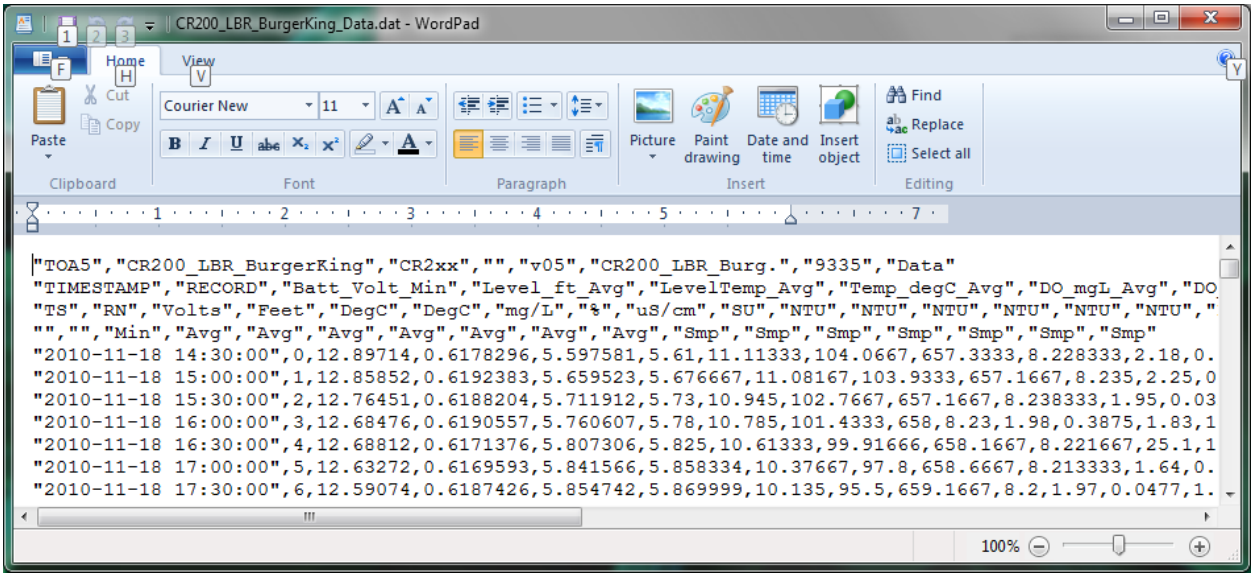
4. Click on the “Add” button (the blue plus sign icon at the top left of the form) to open the “Add New File” form. On this form, you will tell the SDL where the file is that will be loaded, which ODM database it will be loaded into, and some other information about the data file.



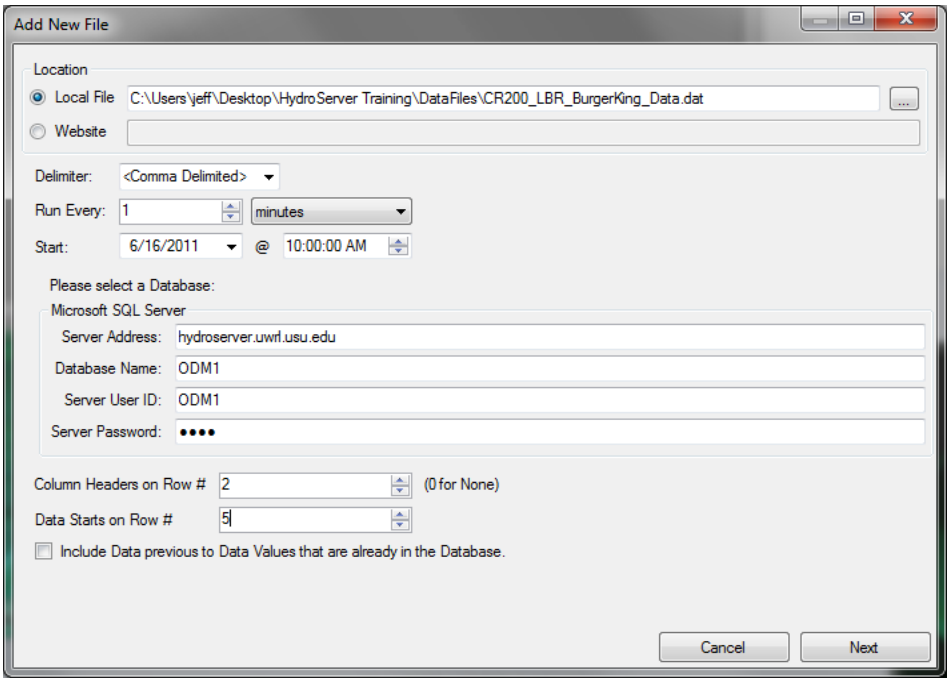
5. Click the button to the right of the “Local File” text input box to open a file browser. Navigate to the location on your desktop where you unzipped your data files and select “CR200_LBR_BurgerKing_Data.dat.” Click the “Open” button. You will notice that the path to your datalogger file is now shown on the form.

NOTE: The ODM Streaming Data Loader can load data from files stored locally on disk, from files available over a network share, or from a web or FTP site.

6. The file that you are loading data from is a .dat file from a Campbell Scientific CR200 datalogger. It is comma delimited and has a header at the top with information about the data. In the “Delimiter” drop down list, make sure the “Comma Delimited” is selected.
7. Next you will tell ODM SDL how often you want it to run. For this workshop, we will not be scheduling SDL to run automatically, but you can do that in the case where you are streaming new data into a datalogger file and want to load it periodically from the file to the ODM database. We will tell ODM SDL to run every 1 hour. Leave the starting date as it is.
8. Now we need to tell ODM SDL how to connect to your ODM database. Use the database connection information in the section above to create a connection to your ODM database. Make sure to use your user number in the database name!.
9. ODM SDL also needs some information about the header of the file. The figure below shows the first few lines of the file that you are loading. The column headers are on row number 2, and the data start on row number 5. Set these values in the appropriate text boxes in the SDL window.

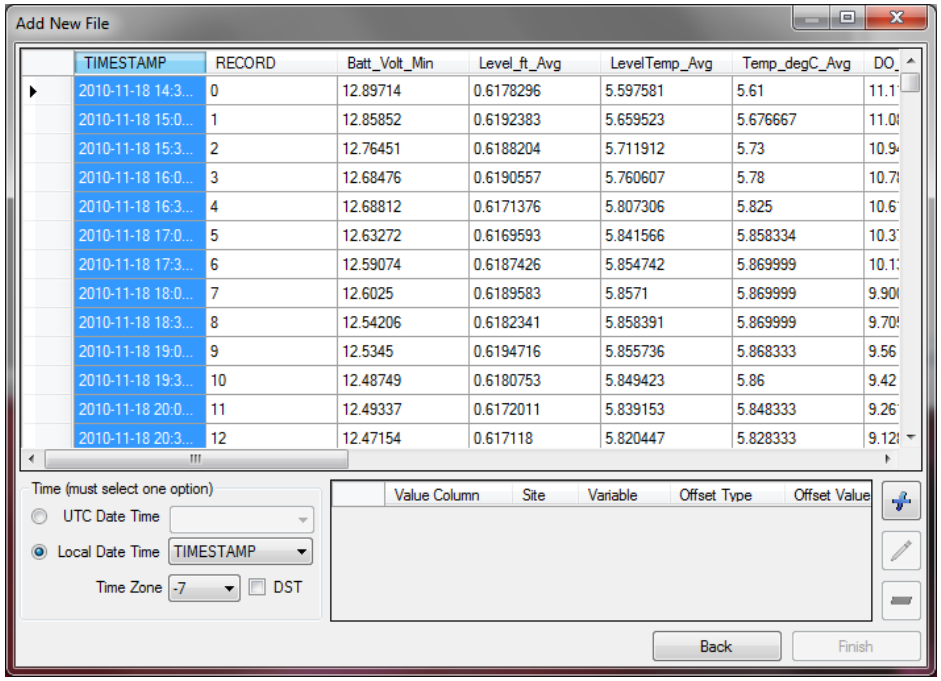


10. The last option on this form is to tell SDL whether it should look for data in your data file that predate any data you have in the ODM database. Since we are starting with a blank database, we will leave this option unchecked. Your form should now look like the below. Click the "Next" button to continue.

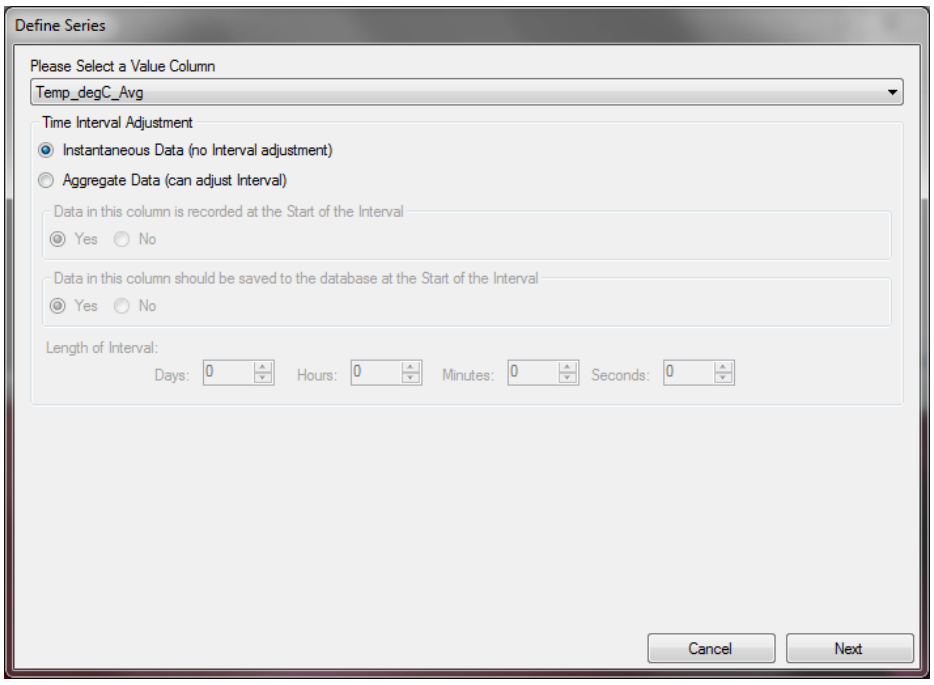


11. You will now notice that the SDL has loaded the data file into a table on the form. The next step is to tell SDL which column contains the time stamp. Click the radio button next to "Local Date Time" at the bottom left corner of the form and then make sure that "TIMESTAMP" is selected in the drop down list. This is the name of the column containing the time stamp for the data values.

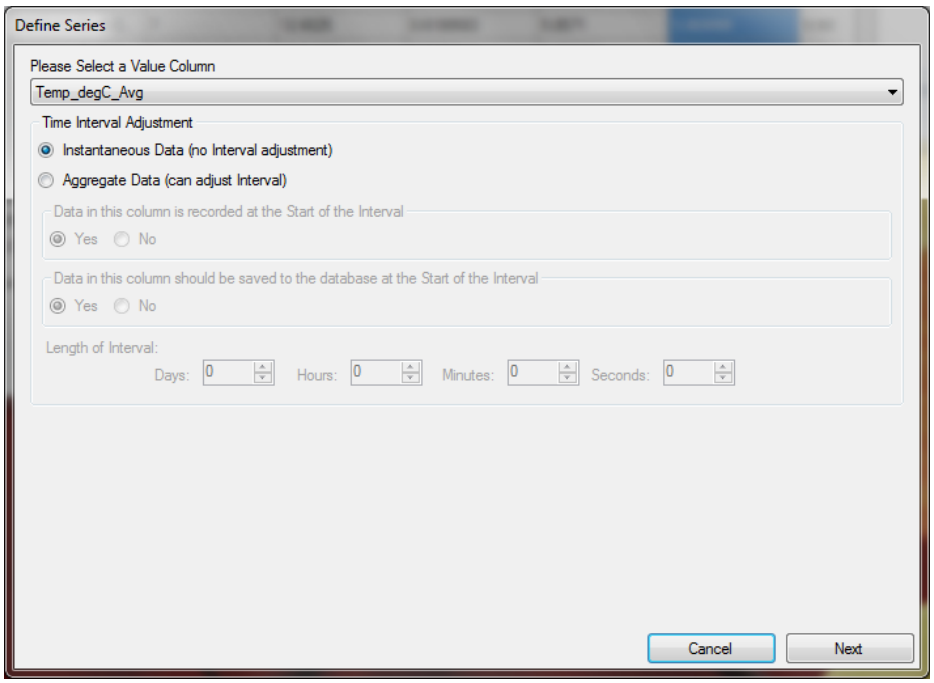
12. In the “Time Zone” drop down list, select “-7.” This datalogger is programmed to run on U.S. Mountain Standard time and does not change for Daylight Saving Time. Your window should now look like the following:



13. Now we need to map each of the columns of data to the appropriate site, variables, methods, etc. in the ODM database. To do this, we will select each column and map them individually. In the interest of time, we will skip to a couple of the water quality variables that might be interesting. Select the “Temp_degC_Avg” column by clicking on its header at the top of the window. Then click the “Add” button (the blue plus sign near the bottom right of the form). The following window will open:

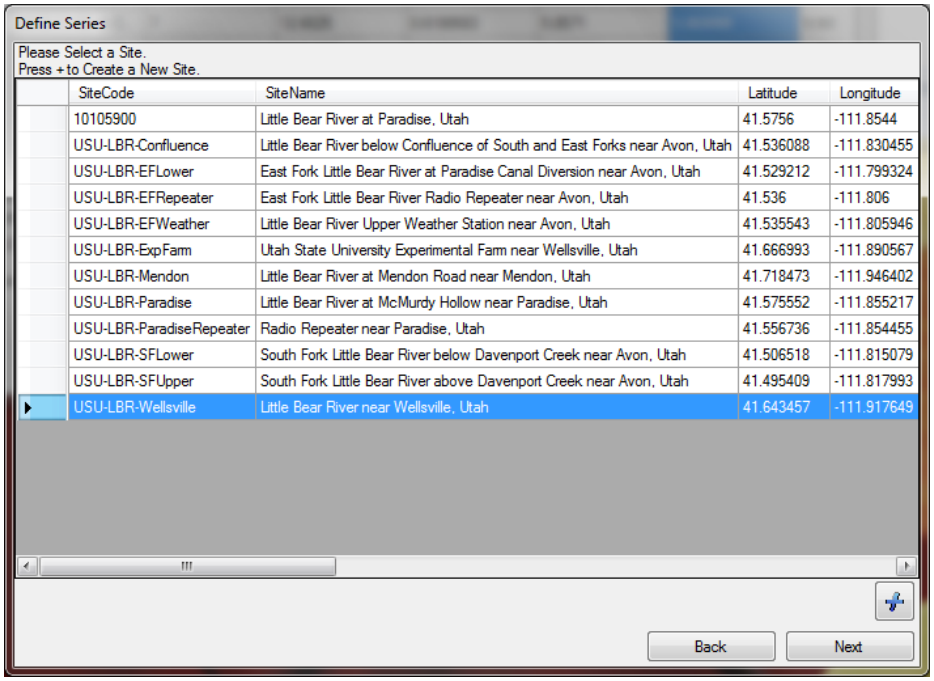


14. The options on this window will allow you to change the way the time stamps of your data are recorded in the database. For example, if your datalogger records data at the end of each time interval, but you want to record the data in the database at the beginning of the interval, you can set that up here. For this exercise, we will accept the default of no interval adjustment. Click the "Next" button to continue to the next window.

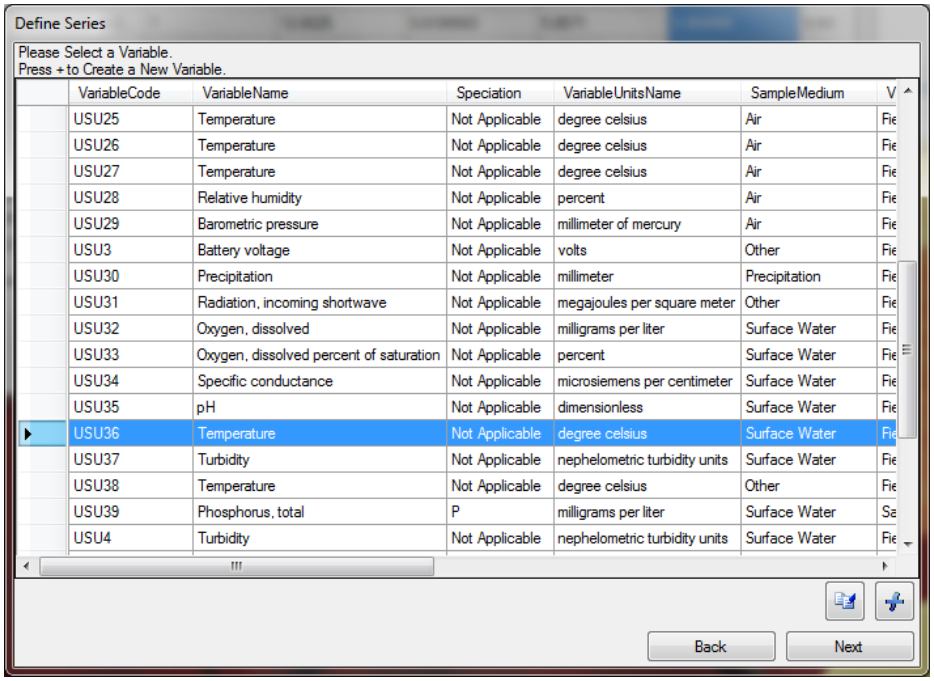


15. These data were collected at the site having the site code "USU-LBR-Wellsville." Since we loaded our sites previously, we can select it from the list. If the site were not already in the

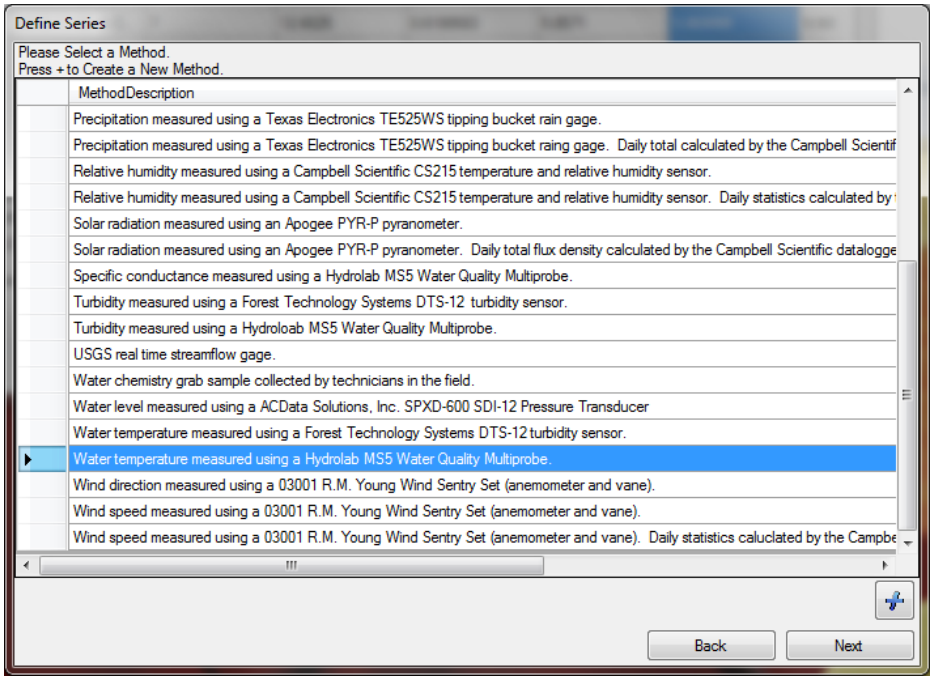
database, we could create it on the fly by clicking the “Add” button at the bottom right of the form. Select the “USU-LBR-Wellsville” site by clicking on its row in the table and then click the “Next” button.



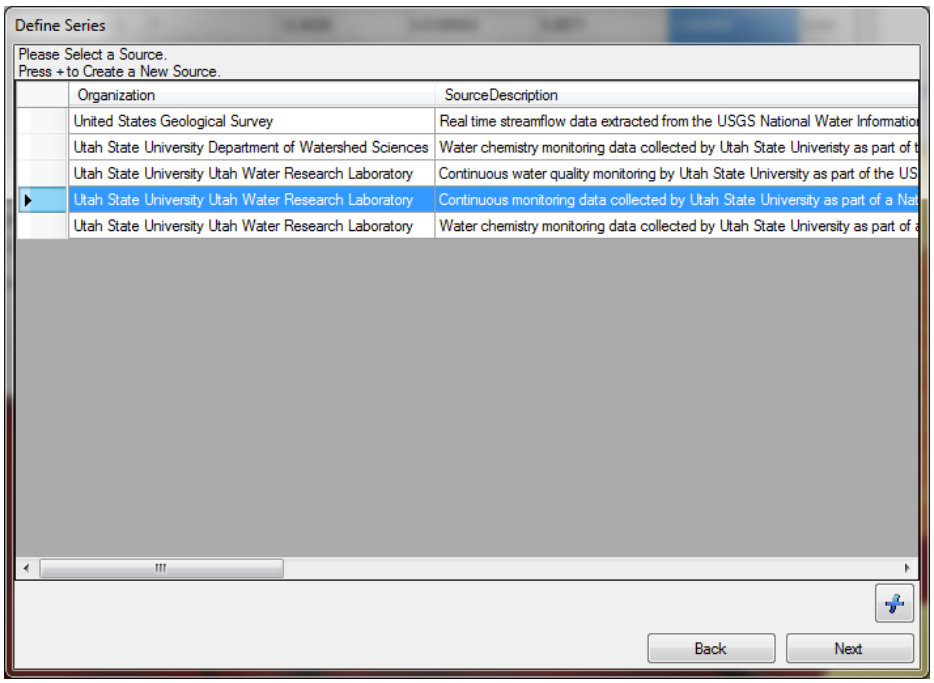
16. This particular column in the datalogger file contains 30 minute average water temperature values. Again, we already loaded our variables, so we need to find the right one in the list. Scroll down and select the variable with VariableCode “USU36” by clicking on its row in the table. You will notice if you look at the attributes of this variable that it represents field observations of temperature, in degrees Celsius, measured in surface water, with a time support of 30 minutes, and that the values are averaged over the time support. Again, if we hadn’t already loaded our variables, we could create a new variable on the fly here by clicking the “Add” button. Click the “Next” button to continue to the next window.



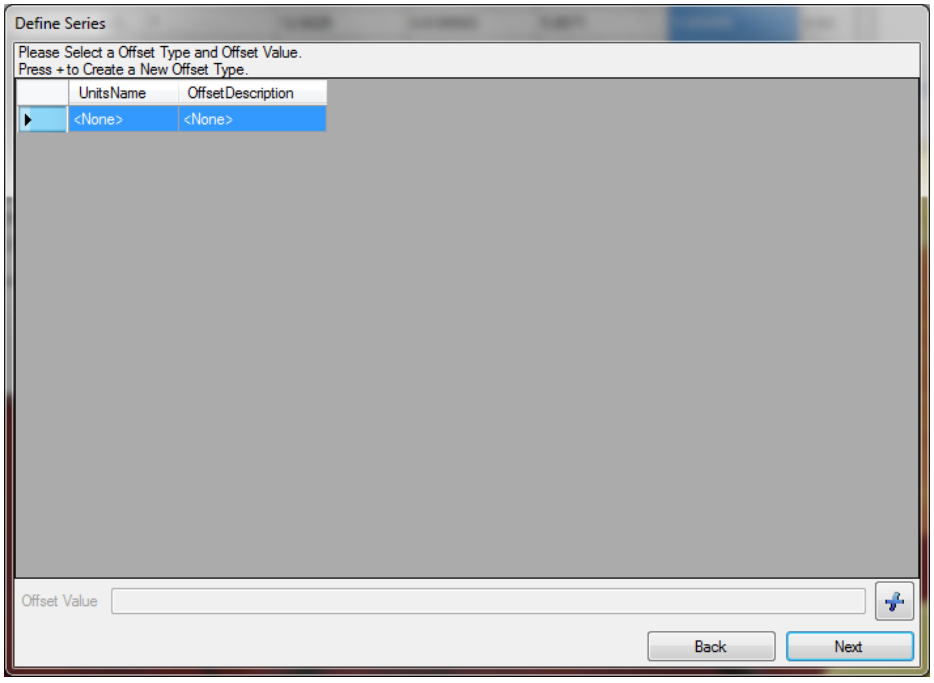
17. The temperature values were measured using a HydroLab MS5 Water Quality Multiprobe. Find and select the appropriate method in the list of methods (it's near the bottom of the list). Click the "Next" button to continue to the next window.



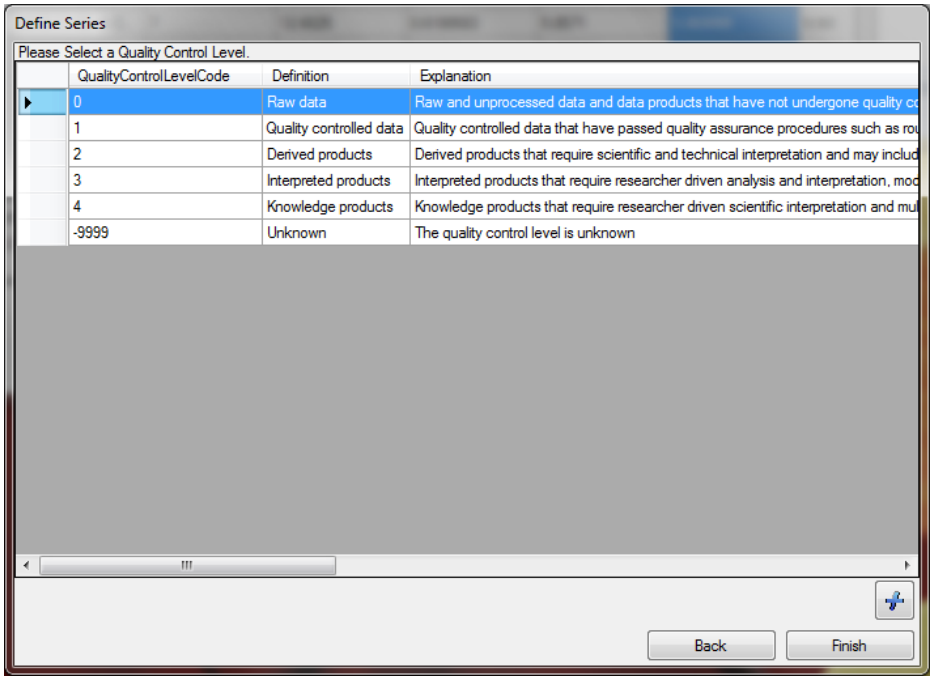
18. Now we need to select the source of the data from the list of sources in the database. These data were collected by Utah State University as part of an NSF-funded project, which corresponds to the fourth item in the list of sources. Select the appropriate source from the list and click the "Next" button to continue to the next window.



19. On the offsets form, you can define an offset for your data in the case where it was collected with a constant offset – e.g., an air temperature sensor at a fixed location above the ground, or a soil moisture sensor at a fixed location below the surface of the soil. The offset is not really relevant for the water temperature data, so we will accept the default of "None" and click next to move to the next window.



20. On the final screen of the Wizard, you will need to select a QualityControlLevel for your data. These are raw sensor data streaming in from the datalogger in the field, so we will select a QualityControlLevel of 0 (Raw Data) for these data. Select the appropriate record in the table and then click the "Finish" button.



21. Congratulations! You have now fully mapped one of the data columns in your file to be loaded into ODM. You will notice that a new record has been added to the table at the bottom right of the SDL window for the column that you just mapped.

NOTE: This process can be a bit laborious for large data files with many columns. However, it only has to be done once, and once a file is mapped, the SDL can load new data from that file to your ODM database on demand or on a schedule that you set.

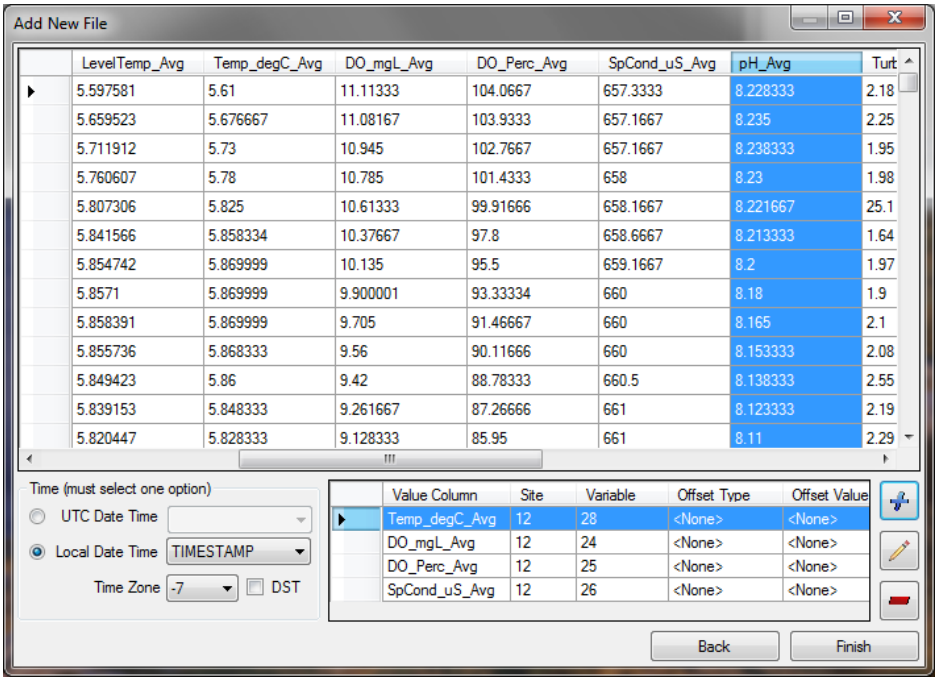
22. If you want to, you can map one or more additional columns of data from the file to be loaded into the database using the same process. The following are the details for a couple more columns that you can map. ***If you are short on time, you might want to skip mapping additional columns of the file.***

Data File Column Name: DO_mgL_Avg
SiteCode: USU-LBR-Wellsville
VariableCode: USU32
MethodDescription: Dissolved oxygen measured using a HydroLab MS5 Water Quality Multiprobe.
SourceDescription: Continuous monitoring data collected by Utah State University as part of a National Science Foundation funded test bed project.
Offset: None
QualityControlLevelCode: 0

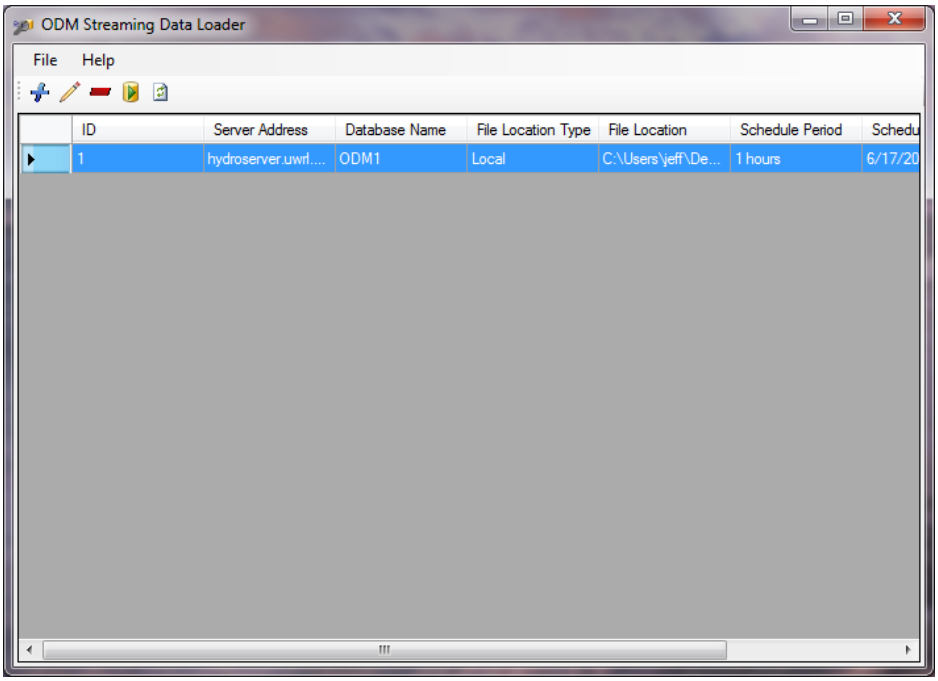
Data File Column Name: DO_Perc_Avg
SiteCode: USU-LBR-Wellsville
VariableCode: USU33
MethodDescription: Dissolved oxygen measured using a HydroLab MS5 Water Quality Multiprobe.
SourceDescription: Continuous monitoring data collected by Utah State University as part of a National Science Foundation funded test bed project.
Offset: None
QualityControlLevelCode: 0

Data File Column Name: SpCond_uS_Avg
SiteCode: USU-LBR-Wellsville
VariableCode: USU34
MethodDescription: Specific conductance measured using a HydroLab MS5 Water Quality Multiprobe.
SourceDescription: Continuous monitoring data collected by Utah State University as part of a National Science Foundation funded test bed project.
Offset: None
QualityControlLevelCode: 0

23. Now that you have mapped one or more columns in your data file to be loaded into your ODM database, your screen should look something like the following.



24. Click the “Finish” button on the “Add New File” Window to return to the main SDL window. It should now look something like the following. There will be a new record in the table for the file that you just configured.



25. You can now manually execute the SDL by making sure that the file that you just configured is selected in the table view and then clicking on the execute button on the toolbar  . This will load all of the data for the columns that you just mapped into your ODM database. While the SDL is running, you will notice a small database icon that pops up in your Windows task manager. 

. When the database icon disappears, SDL has finished loading your data.

NOTE: The mappings that you just input to the SDL are stored on your computer's hard drive in a configuration file. The SDL will open this configuration file each time you open the software. You can add new files or edit existing files at any time. You can also schedule the SDL to run automatically on a predefined schedule in the case that your data files are receiving new data from the field on a regular basis. Instructions on how to do this, as well as advanced functionality available in the ODM SDL are described in the SDL software manual, which is available on the CUAHSI HIS website (http://his.cuahsi.org/odmsdl.html).

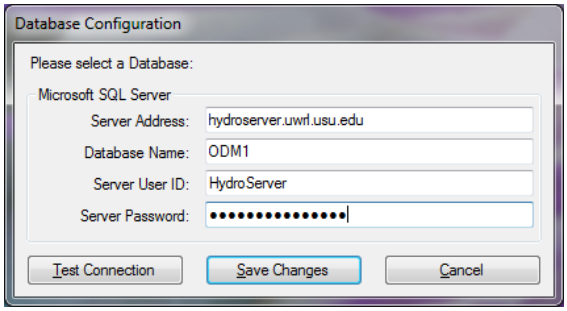
Visualize and Manage Data in the ODM Database Using ODM Tools

Now that you have loaded some data into your ODM database, you can use ODM Tools to do some quick visualizations and manage your data. In this part of the exercise we will use ODM Tools to examine the contents of your ODM database.

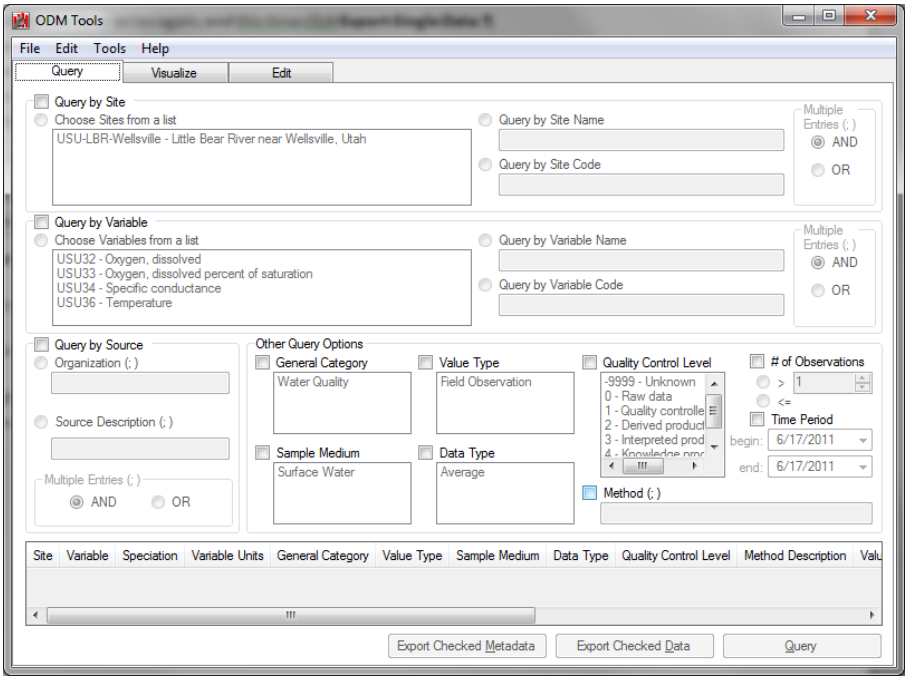
To examine the data you just loaded using ODM Tools:

1. Open ODM Tools by clicking Start → All Programs → Engineering Tools→ CUAHSI HIS → ODM Tools 1.1.1. The ODM Tools "Database Configuration window will open. Enter the connection

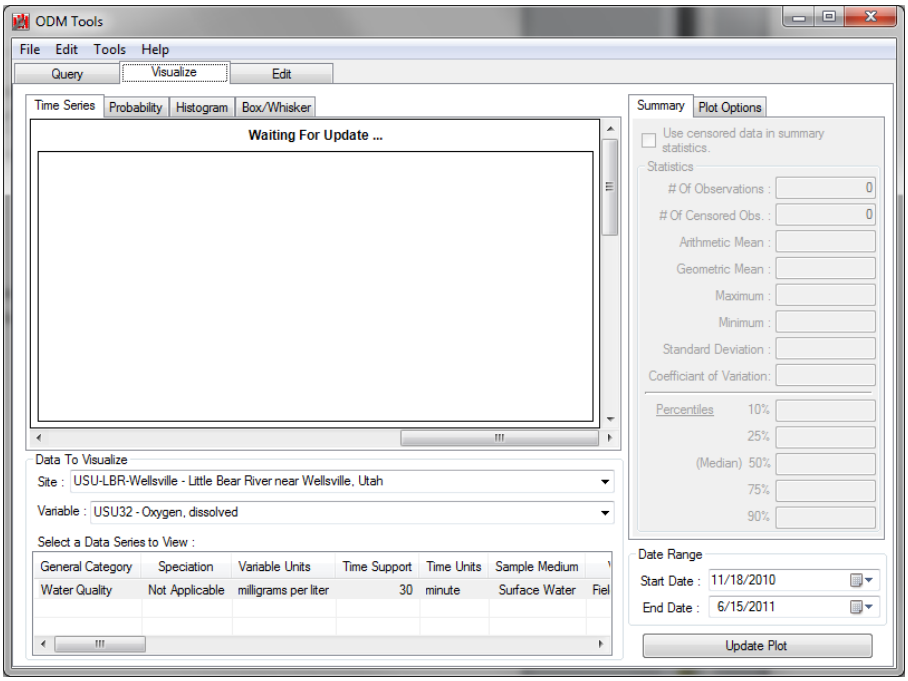
information for your ODM database (see above). When your window looks like the following, click the "Save Changes" button. Click "OK" on the Successful Connection window that pops up.



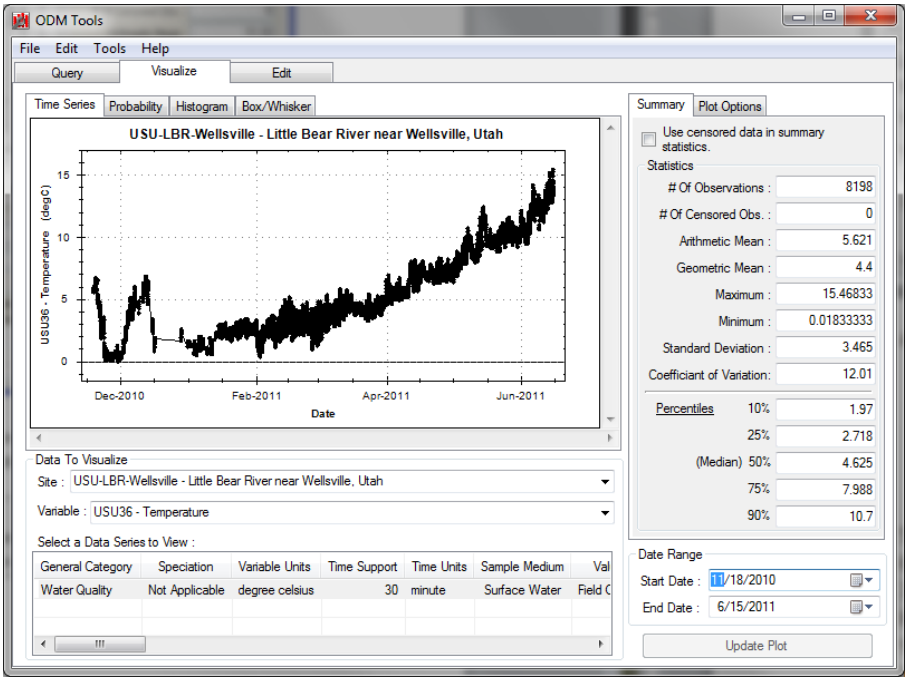
2. The ODM Tools application will now open with three tabs visible: Query, Visualize, and Edit. The Query tab is selected by default. On the Query tab you can specify various filters to search for time series in your ODM database. You can then select them for export to your local disk. This is handy when you have a large ODM database with many data series and you want to quickly export one for use in your favorite data analysis software like R or MATLAB.



3. Since your ODM database only has a small number of data series, the Query tab isn't that interesting, so we will skip to the Visualize tab. At the top of the ODM Tools window, click on the Visualize tab. Your window should now look like the following:



4. At the bottom of the window you can specify what you would like to be shown in the plot window. For now, we have only loaded data for one site and one or more variables at that site. Select one of the variables that you loaded in the "Variable" drop down list and click the "Update Plot" button. You should now see a time series plot of the selected variable.



5. On the right side of the form you will see a "Summary" tab that gives summary statistics for the data shown in the plot. At the bottom right of the window, you can set the "Date Range" for the

plot. Near the top of the Window, you will see several plot type tabs (Time Series, Probability, Histogram, and Box/Whisker. Click on any of these tabs to switch the plot type that is shown.

6. At the top right of the Window, you will also see a "Plot Options" tab. On this tab there are a few options for customizing the look and feel of the plots that are shown in the plot window. Click on the "Plot Options" tab and experiment with the options that are available there.
7. If you want a closer look at the data, you can click on the plot and drag a box to zoom in on the data. You can then use the scroll bars that appear on the plot to scroll through time to get a better feel for the data. To unzoom, right click on the plot and use the options on the context menu.
8. If you want to export the plot image, you can right click on the plot and select "Copy" to copy the image to the Clipboard or "Save Image As" to save the image to disk.

Congratulations! You have completed the main part of the exercise.

NOTE: You may have noticed as you were poking around in the data that there are some interesting artifacts in the data. These are raw data from the field and have not been subject to any QA/QC procedures. As an advanced step, we could explore using the data editing functionality of ODM Tools (the Edit tab at the top of the form) to clean these data up a little bit before we publish them. You are welcome to try out the data editing functionality if you still have time. Detailed documentation and instructions for editing data using ODM Tools are available in the software manual for ODM Tools on the CUAHSI HIS website (http://his.cuahsi.org/odmtools.html).

Publishing Your ODM Database as a Web Service

When you are finished loading the data into your ODM database, you are ready to publish the data using the WaterOneFlow web services. WaterOneFlow defines a standard set of queries (e.g., GetSites, GetSiteInfo, GetVariables, GetVariableInfo, GetValues) and a standard format for accessing your data over the Internet (i.e., WaterML). HydroServer includes a standard implementation of the WaterOneflow web services that you can install on your HydroServer and connect to your ODM database. We have created a WaterOneFlow web service for your ODM database on the training HydroServer. You can access this service using the following URL:

http://hydroserver.uwrl.usu.edu/ODMX/ - where the X is your user number.

The data that you just loaded into the ODM database is now accessible to HIS client software like HydroDesktop through your web service.

NOTE: Detailed instructions on how to install and configure the WaterOneFlow web services are available on the CUAHSI HIS website at (http://his.cuahsi.org/wofws.html). You can also find instructions for registering your WaterOneFlow web service with HIS Central so that your data can be discovered by searches in HydroDesktop.

Next Steps

Once you have completed the steps above, you may also be interested in implementing the rest of the HydroServer tools. These include:

1. **HydroServer Capabilities** – Publish the capabilities of your HydroServer.
2. **HydroServer Time Series Analyst** – implement a web based version of the data visualization capabilities of ODM Tools so that anyone with a web browser can quickly see and plot your data.
3. **Publish Geospatial Datasets** – use ArcGIS Server to publish geospatial datasets for your experimental site or watershed.
4. **HydroServer Map Application** – implement a web map application that combines your time series data from your ODM databases with the geospatial datasets you have published within a single map interface.
5. **HydroServer Website** – give your HydroServer a public website that summarizes the data resources that you have published.