

ODM Tools Python: Open Source Software for Managing Hydrologic and Water Quality Time Series Data

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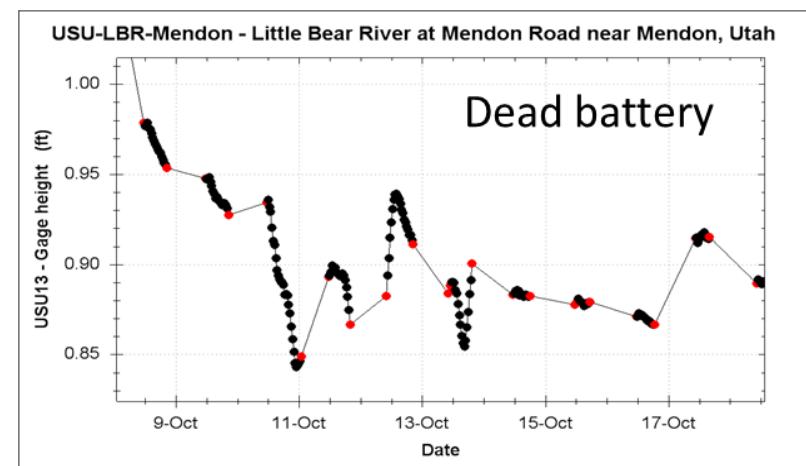
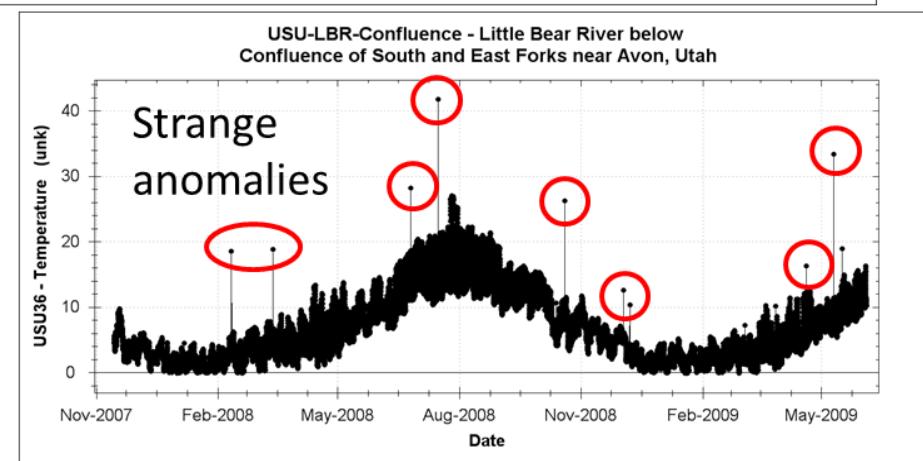
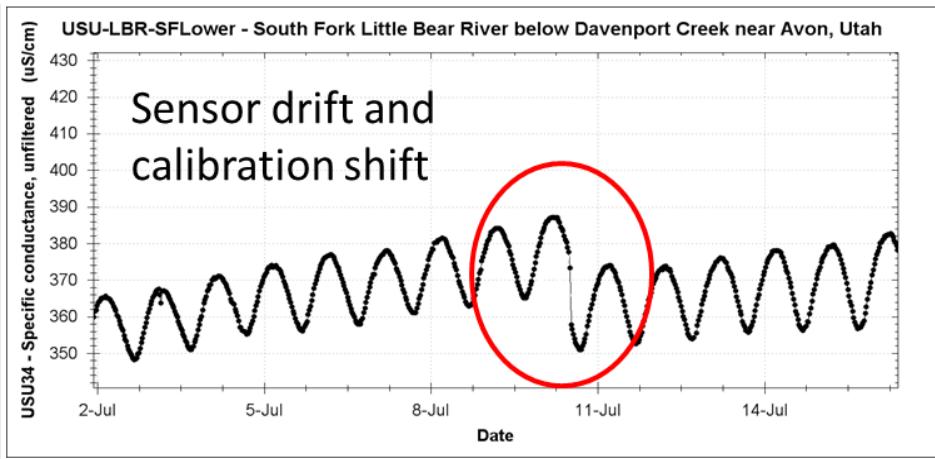
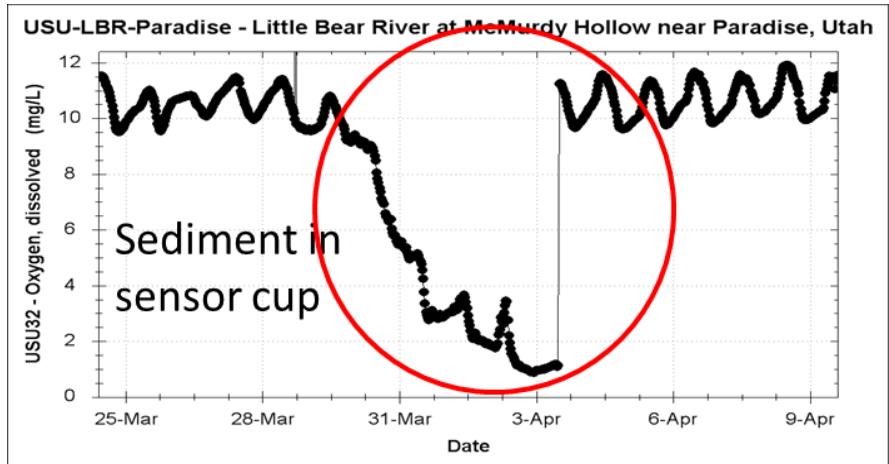
Amber Spackman-Jones



Motivation

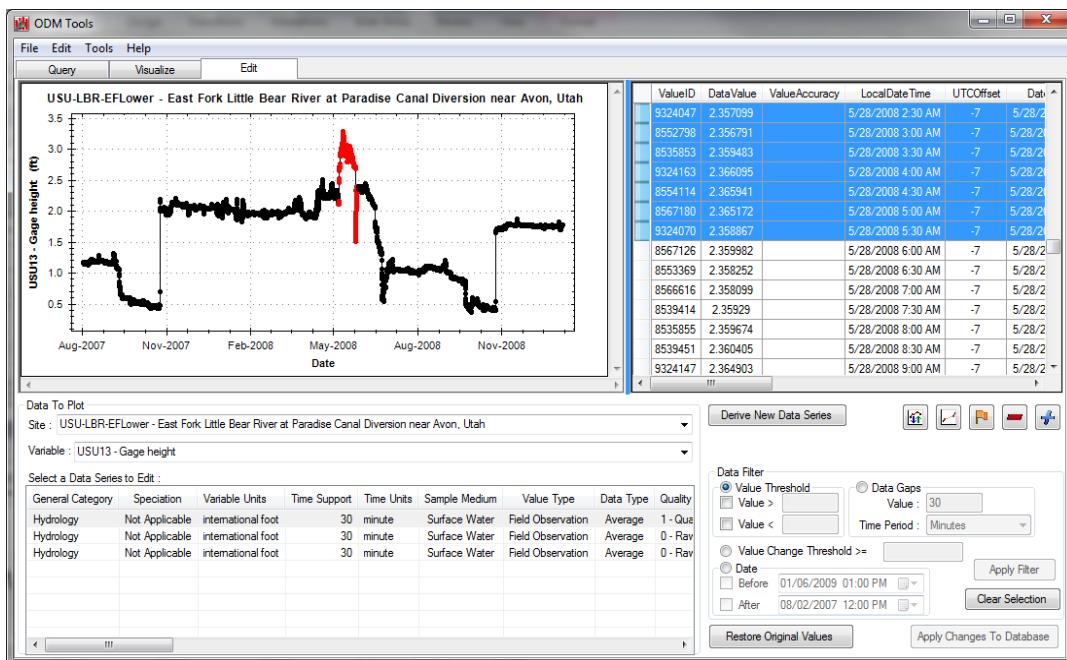


Motivation

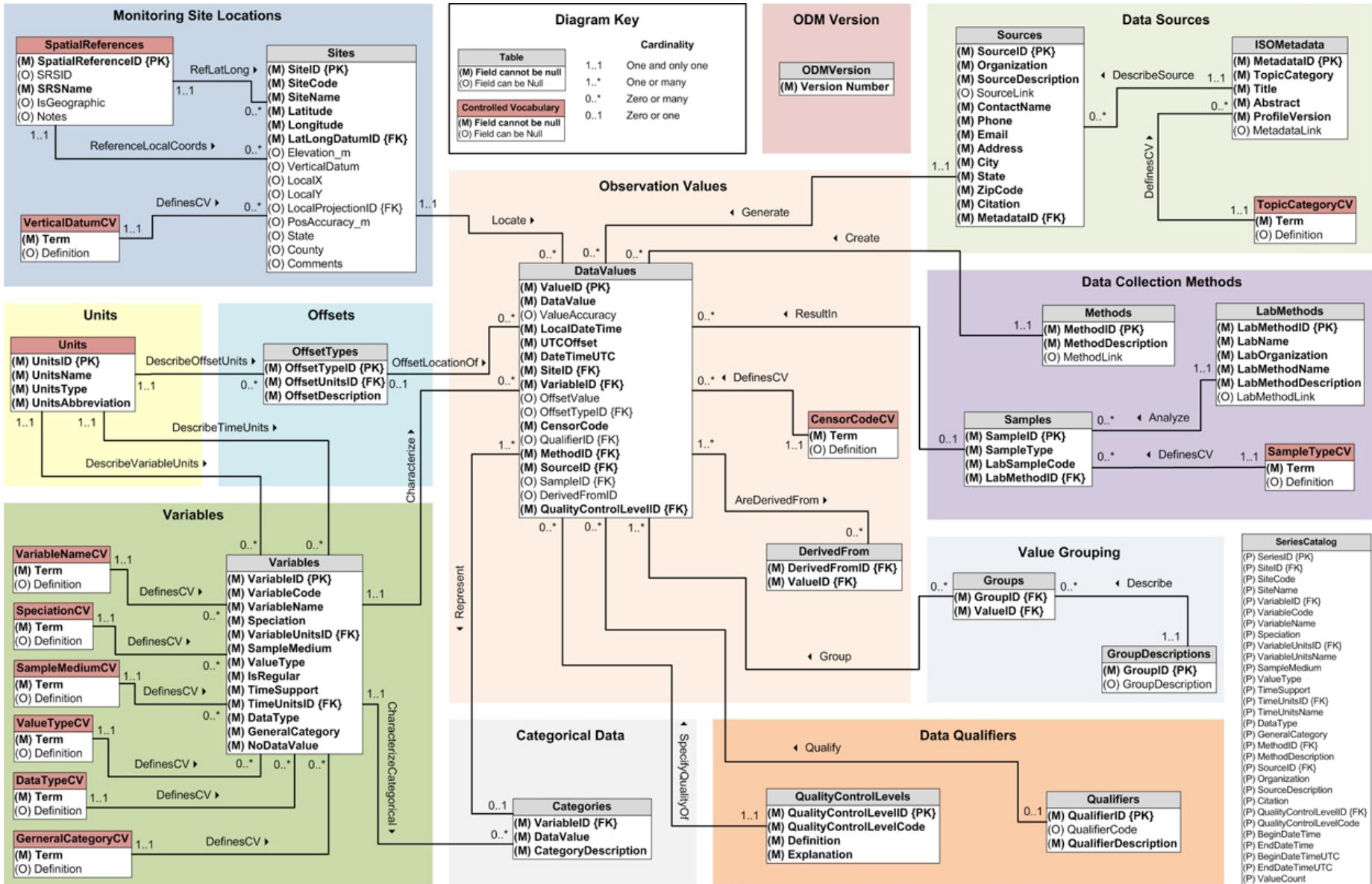


Some History

- ODM Tools originally developed as part of the CUAHSI Hydrologic Information System
- Developed in Microsoft Visual Studio .Net
- Limited to Windows Machines
- Only worked with Microsoft SQL Server databases
- Provided editing tools, but did not preserve the history of edits



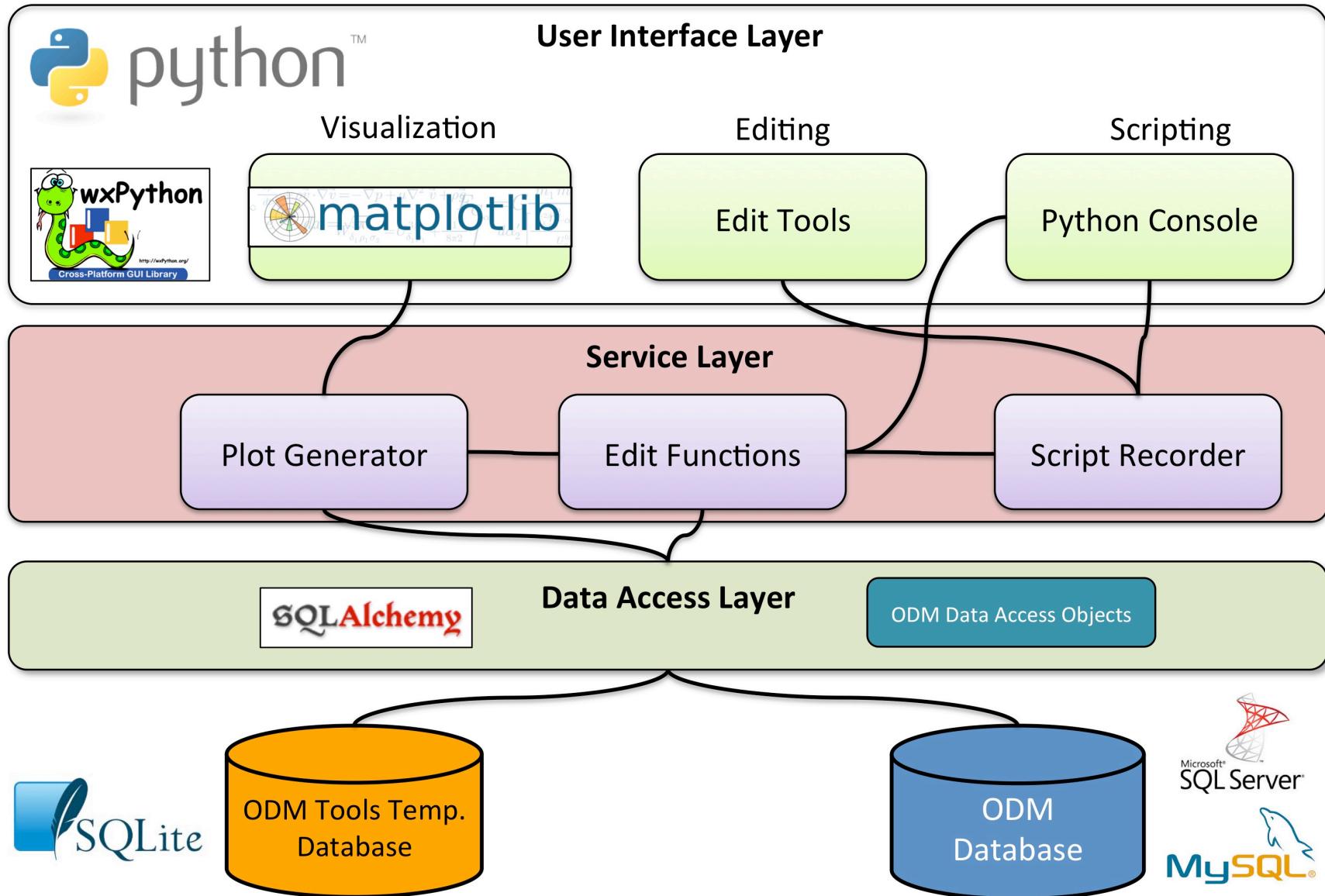
Observations Data Model



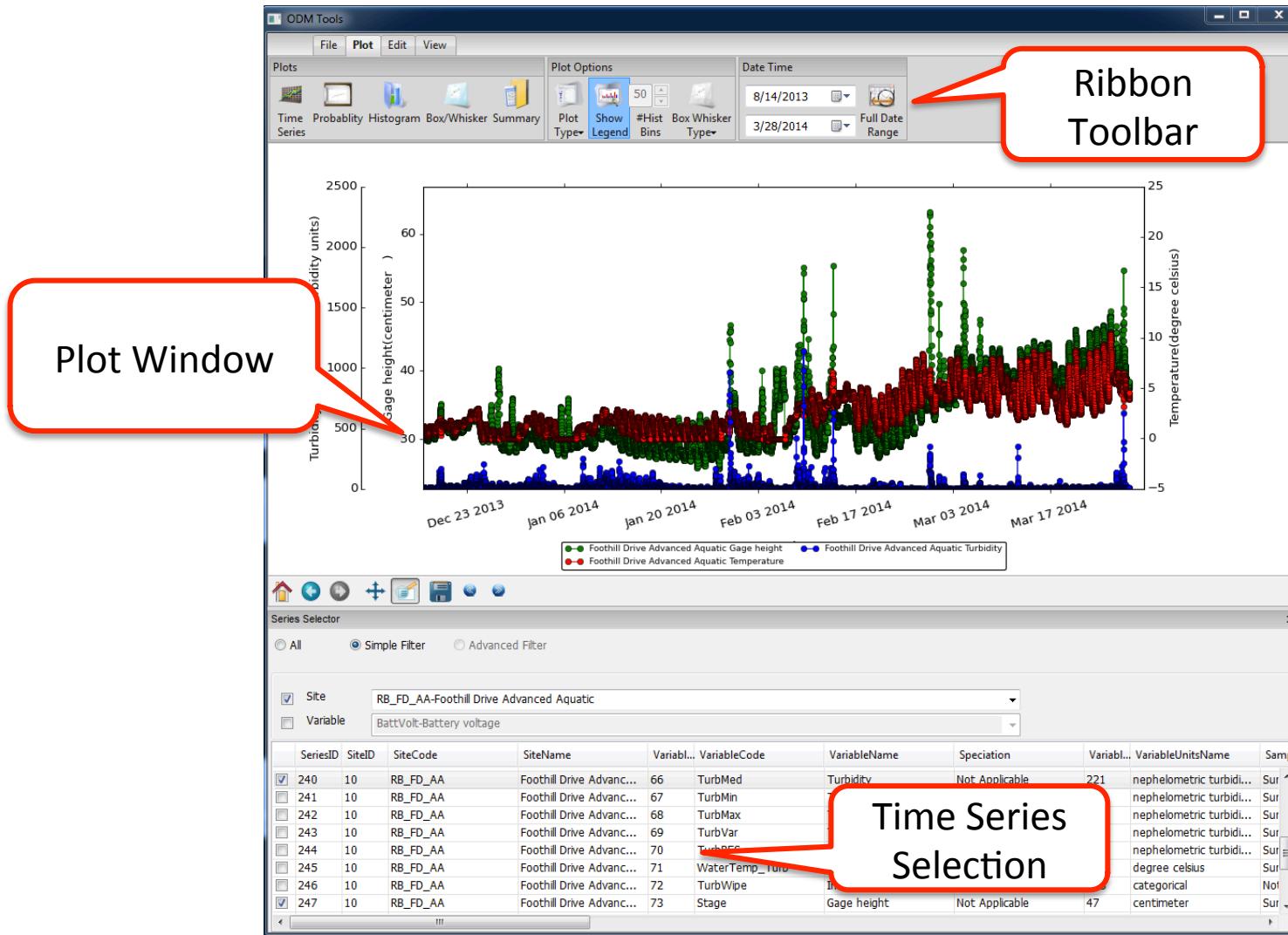
ODM Tools Python: Design Goals

- Multi-platform support (Windows, Linux, Mac)
- Multi-database support (Microsoft SQL Server and MySQL)
- Implement a scripting interface to save the provenance of data edits in QC process
- Modernize the Graphical User Interface (GUI)

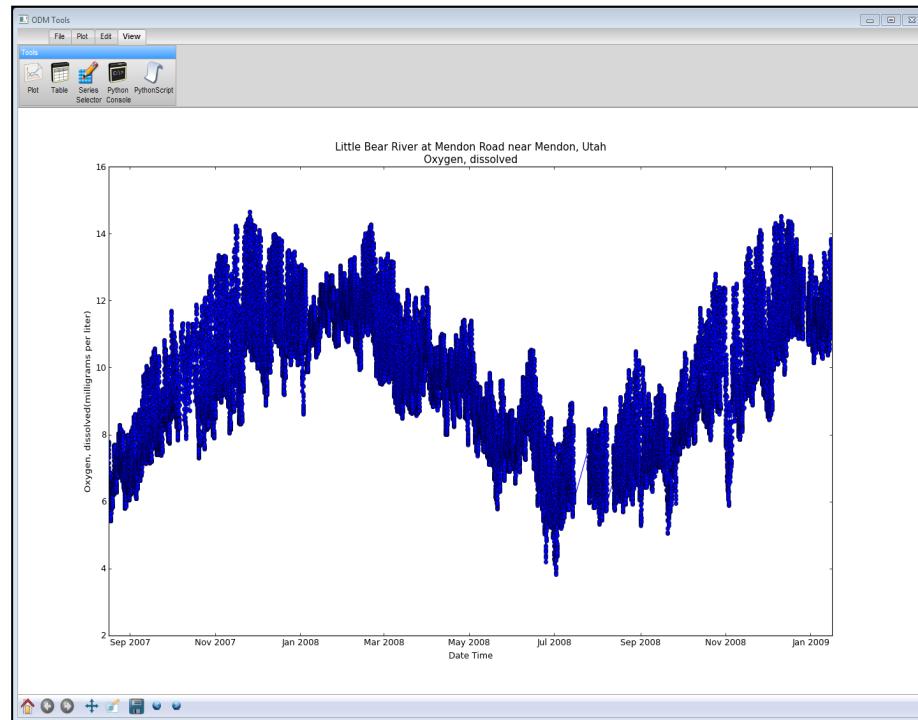
Architecture



Graphical User Interface



Dockable Windows



ValueID	DataValue	Val...	LocalDateTime	UT...	DateUTC	Sit...	Va...	Of...	O
8607706	4.00045970149		2008-07-02 07:30:00	-7.0	2008-07-02 14:30:00	1	32		
8615287	4.25681459701		2008-07-01 07:30:00	-7.0	2008-07-01 14:30:00	1	32		
8616334	4.23571177612		2008-07-02 05:30:00	-7.0	2008-07-02 12:30:00	1	32		
8619129	4.33288192537		2008-07-02 01:30:00	-7.0	2008-07-02 08:30:00	1	32		
8619782	4.4006091194		2008-07-02 03:00:00	-7.0	2008-07-02 10:00:00	1	32		
8619818	4.4100449403		2008-07-01 05:00:00	-7.0	2008-07-01 12:00:00	1	32		
8620012	4.36762985075		2008-07-02 03:30:00	-7.0	2008-07-02 10:30:00	1	32		
8620220	3.83081343284		2008-07-02 08:00:00	-7.0	2008-07-02 15:00:00	1	32		
8622377	3.89308523881		2008-07-02 06:30:00	-7.0	2008-07-02 13:30:00	1	32		
8622441	4.49635820896		2008-07-01 04:30:00	-7.0	2008-07-01 11:30:00	1	32		
8625349	4.58550746269		2008-07-02 00:30:00	-7.0	2008-07-02 07:30:00	1	32		
8625395	4.59515373134		2008-07-02 00:00:00	-7.0	2008-07-02 07:00:00	1	32		
8625705	4.2038311791		2008-06-25 06:30:00	-7.0	2008-06-25 13:30:00	1	32		
8626475	4.62864941791		2008-07-03 04:30:00	-7.0	2008-07-03 11:30:00	1	32		
8627214	4.66996268657		2008-07-03 04:00:00	-7.0	2008-07-03 11:00:00	1	32		
8627341	4.66188076119		2008-07-03 02:00:00	-7.0	2008-07-03 09:00:00	1	32		
8628198	4.28373167164		2008-07-01 05:30:00	-7.0	2008-07-01 12:30:00	1	32		
8630093	4.78889435821		2008-07-02 10:00:00	-7.0	2008-07-02 17:00:00	1	32		
8630222	4.37667031343		2008-07-02 04:30:00	-7.0	2008-07-02 11:30:00	1	32		
8634141	4.93983449254		2008-06-30 07:30:00	-7.0	2008-06-30 14:30:00	1	32		
8634276	4.48706534328		2008-06-25 05:00:00	-7.0	2008-06-25 12:00:00	1	32		

Series Selector

All Simple Filter Advanced Filter

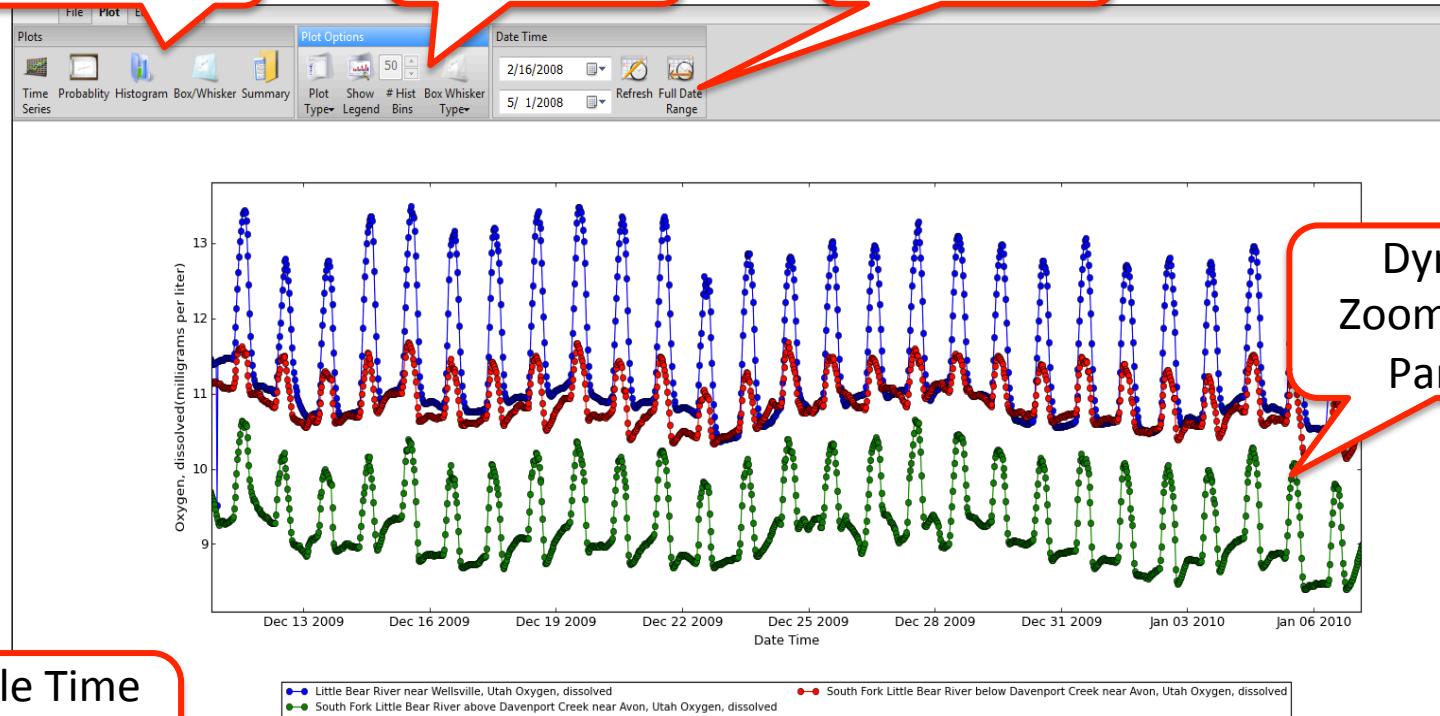
SeriesID	SiteID	SiteCode	SiteName	VariableID	VariableCode	VariableName	Speciation	VariableType
12	1	USU-LBR-Mendon	Little Bear River at Me...	13	USU13	Gage height	Not Applicable	48
13	1	USU-LBR-Mendon	Little Bear River at Me...	13	USU13	Gage height	Not Applicable	48
14	1	USU-LBR-Mendon	Little Bear River at Me...	13	USU13	Gage height	Not Applicable	48
15	1	USU-LBR-Mendon	Little Bear River at Me...	32	USU32	Oxygen, dissolved	Not Applicable	19
16	1	USU-LBR-Mendon	Little Bear River at Me...	32	USU32	Oxygen, dissolved	Not Applicable	19
17	1	USU-LBR-Mendon	Little Bear River at Me...	33	USU33	Oxygen, dissolved per...	Not Applicable	1
18	1	USU-LBR-Mendon	Little Bear River at Me...	34	USU34	Specific conductance	Not Applicable	19

Data Visualization

Multiple Plot Types

Plot Display Options

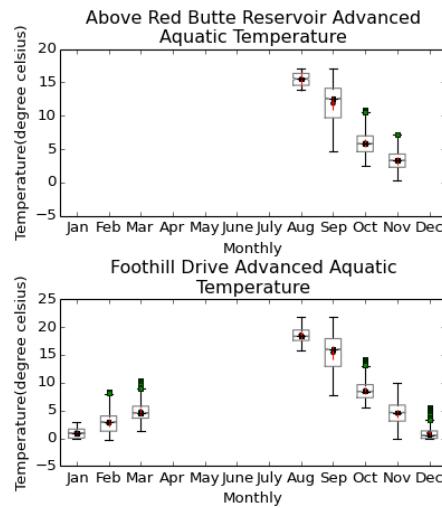
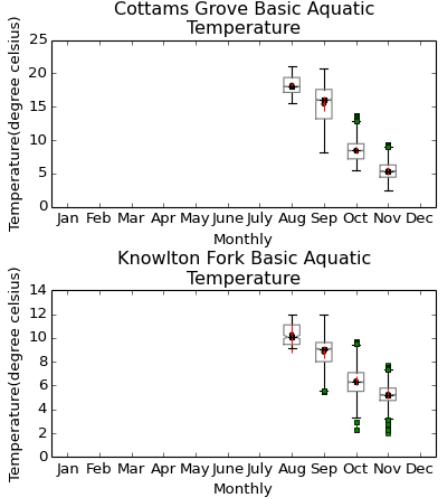
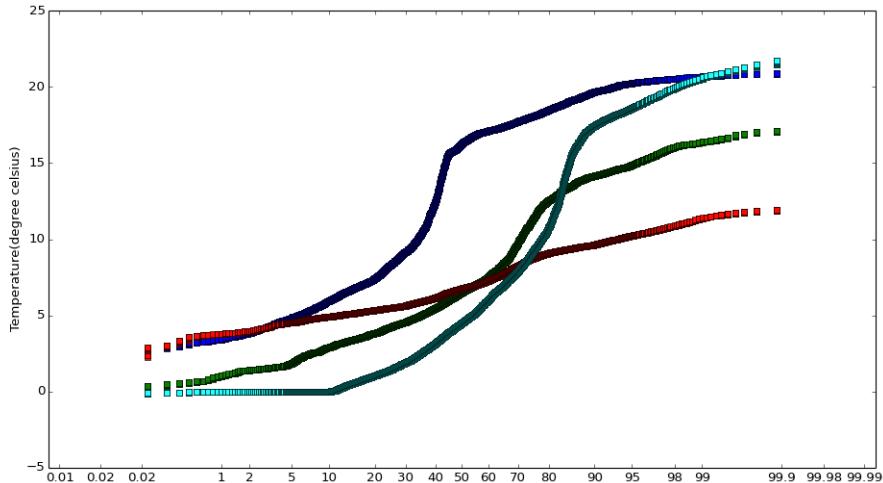
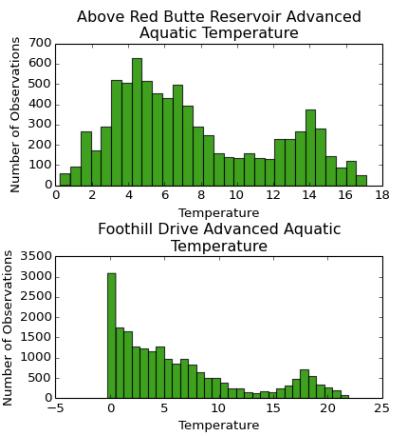
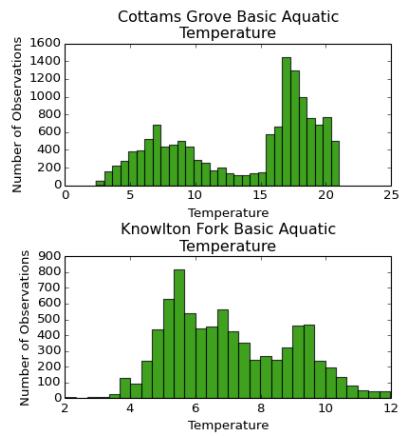
Date Range Restrictions



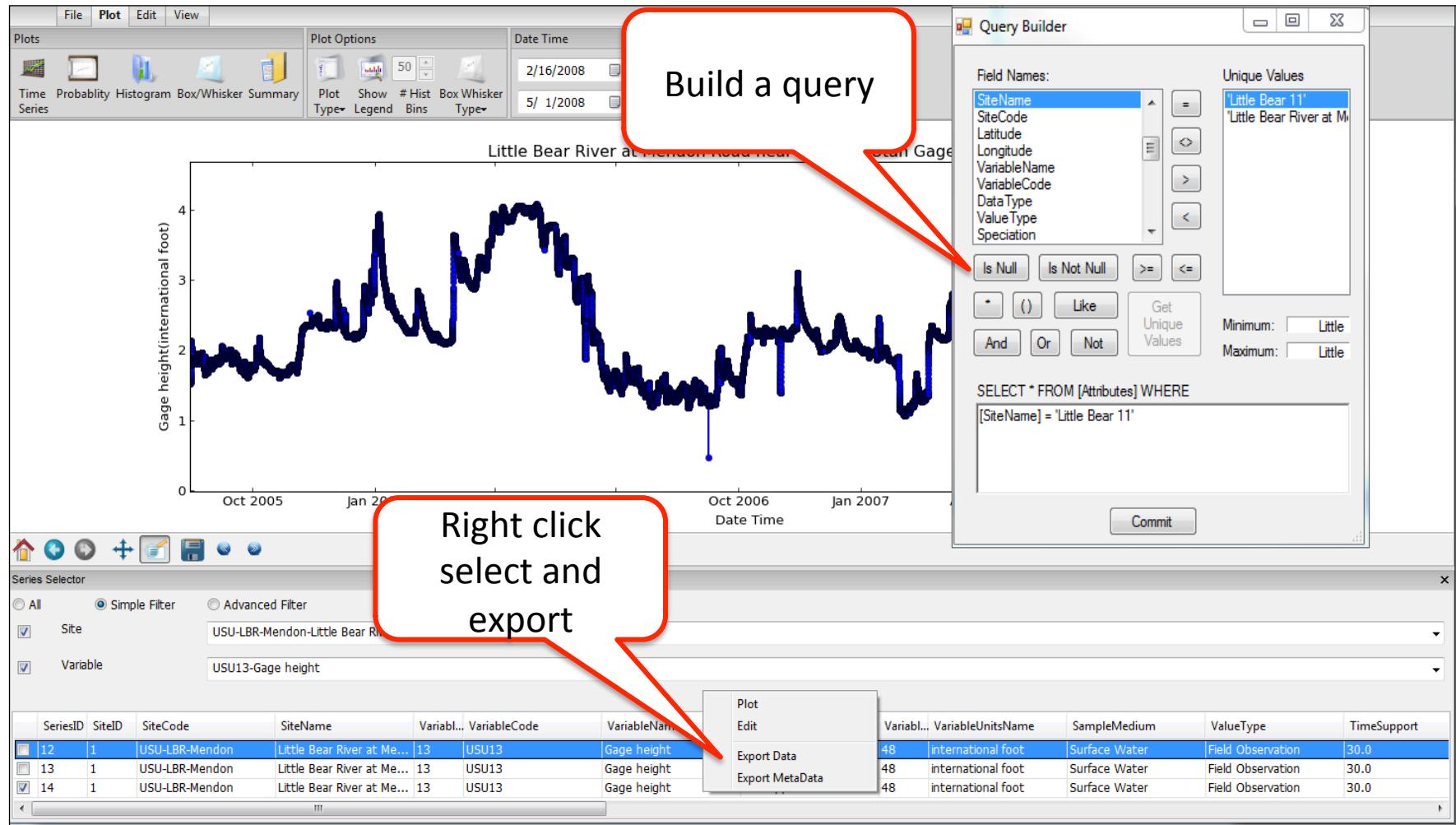
Multiple Time Series Selection

SeriesID	SiteID	SiteCode	SiteName	Variable	VariableCode	VariableName	Speciation	VariableUnitsName	SampleMedium	ValueType	TimeSupport	Time
331	10	USU-LBR-Wells	Little Bear River near ...	32	USU32	Oxygen, dissolved	Not Applicable	199	milligrams per liter	Surface Water	Field Observation	30.0

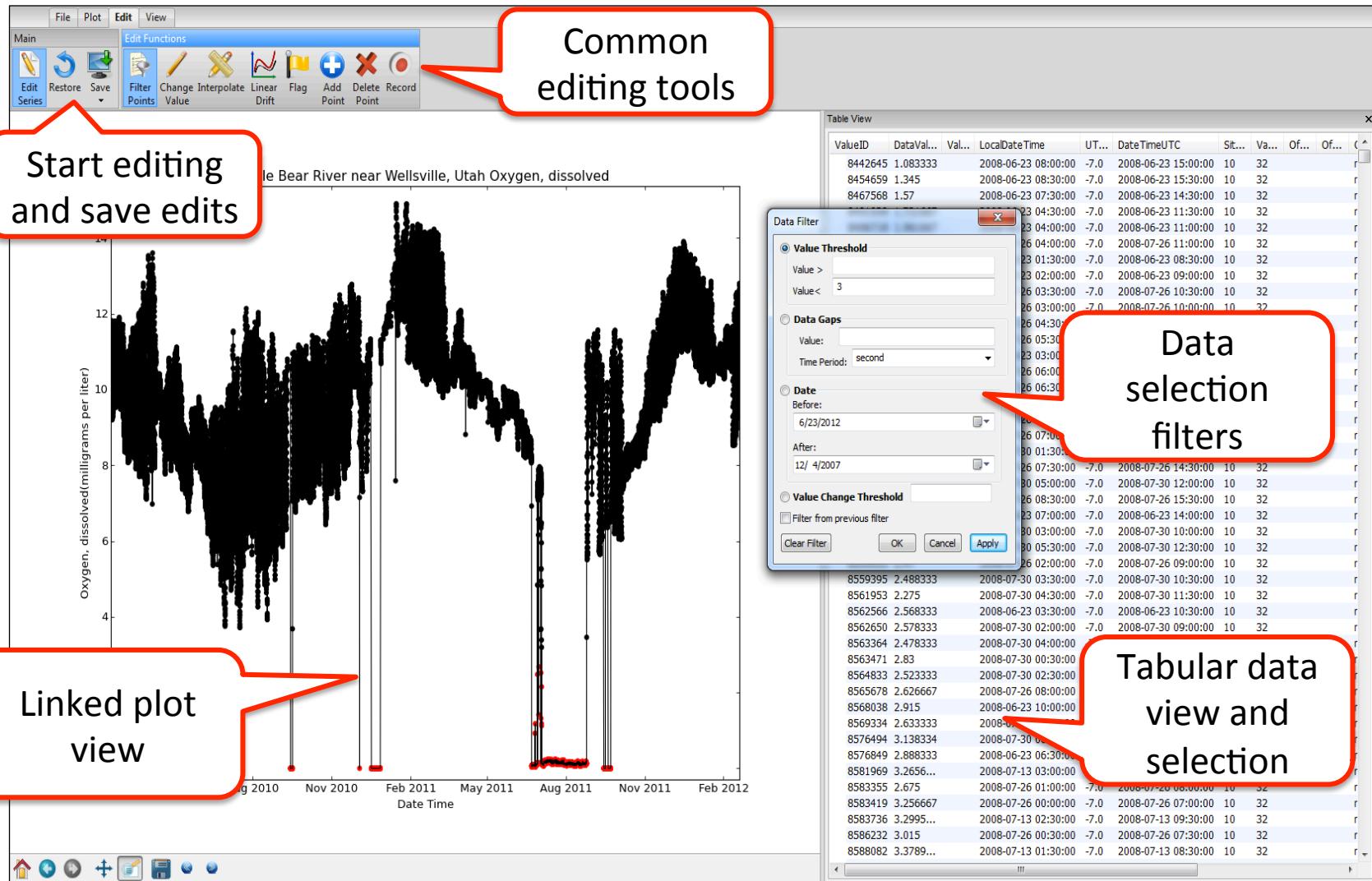
Data Visualization: Plot Types



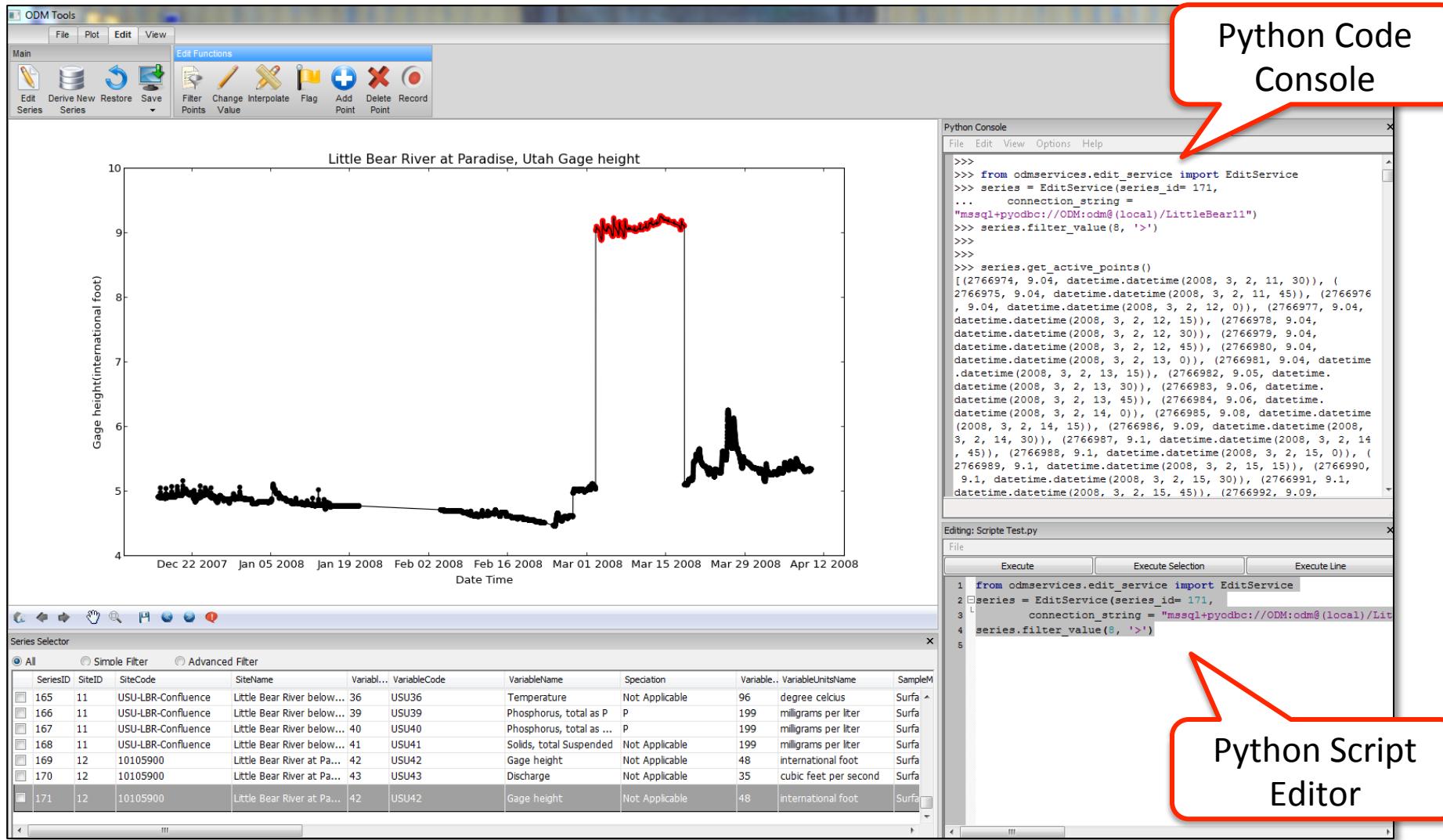
Query and Export



Data Editing for Quality Control

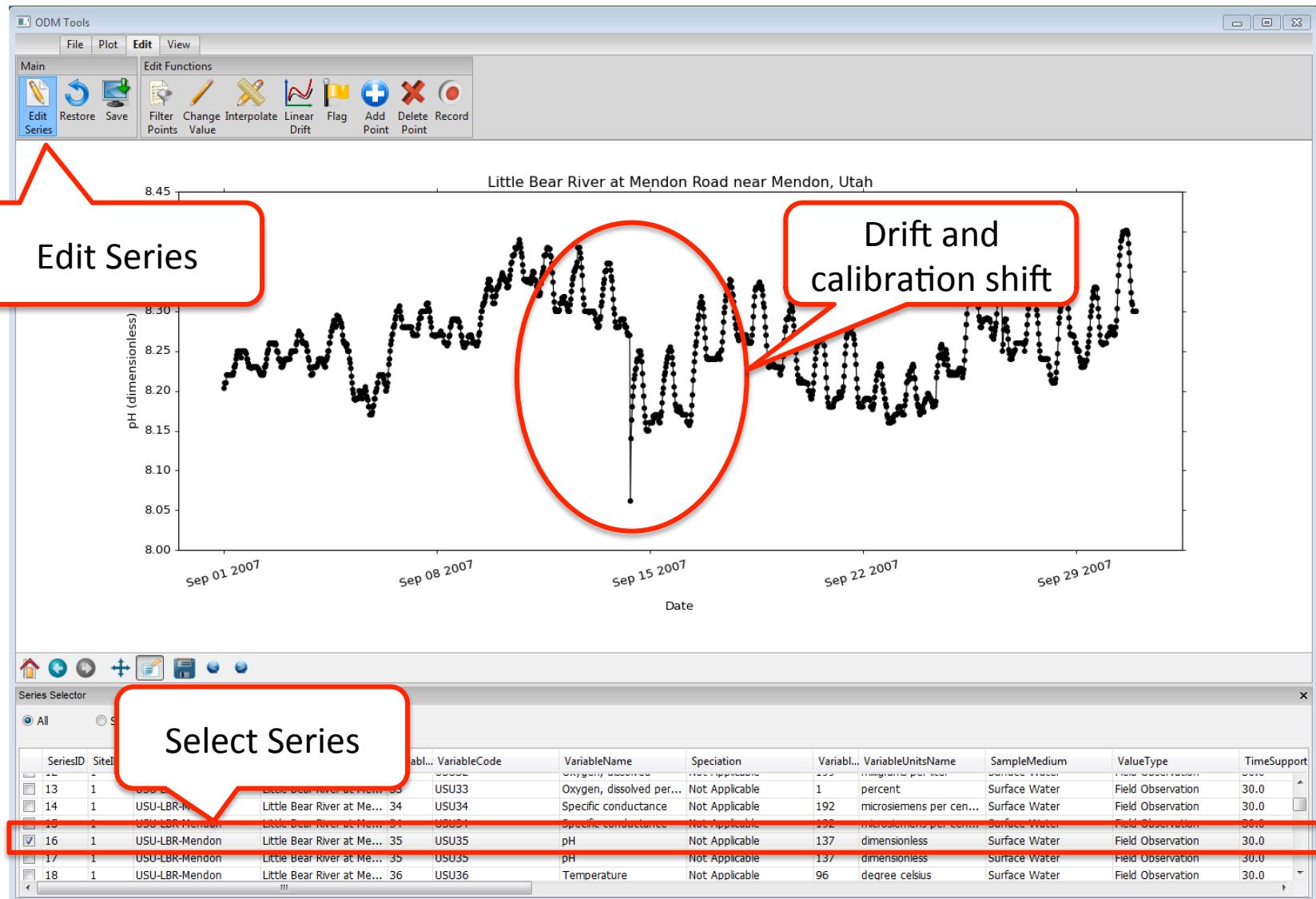


Data Editing for Quality Control

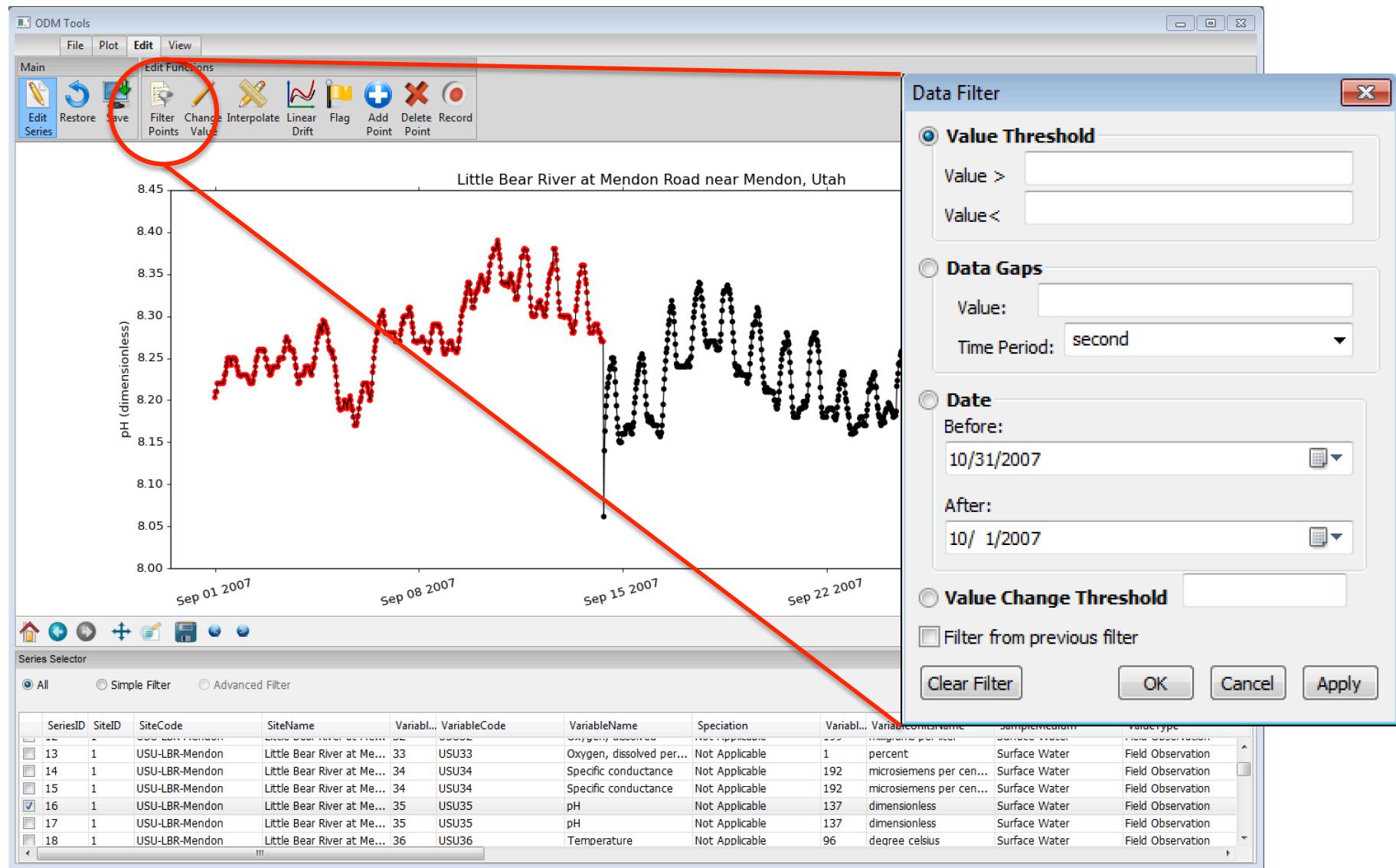


How does it work?

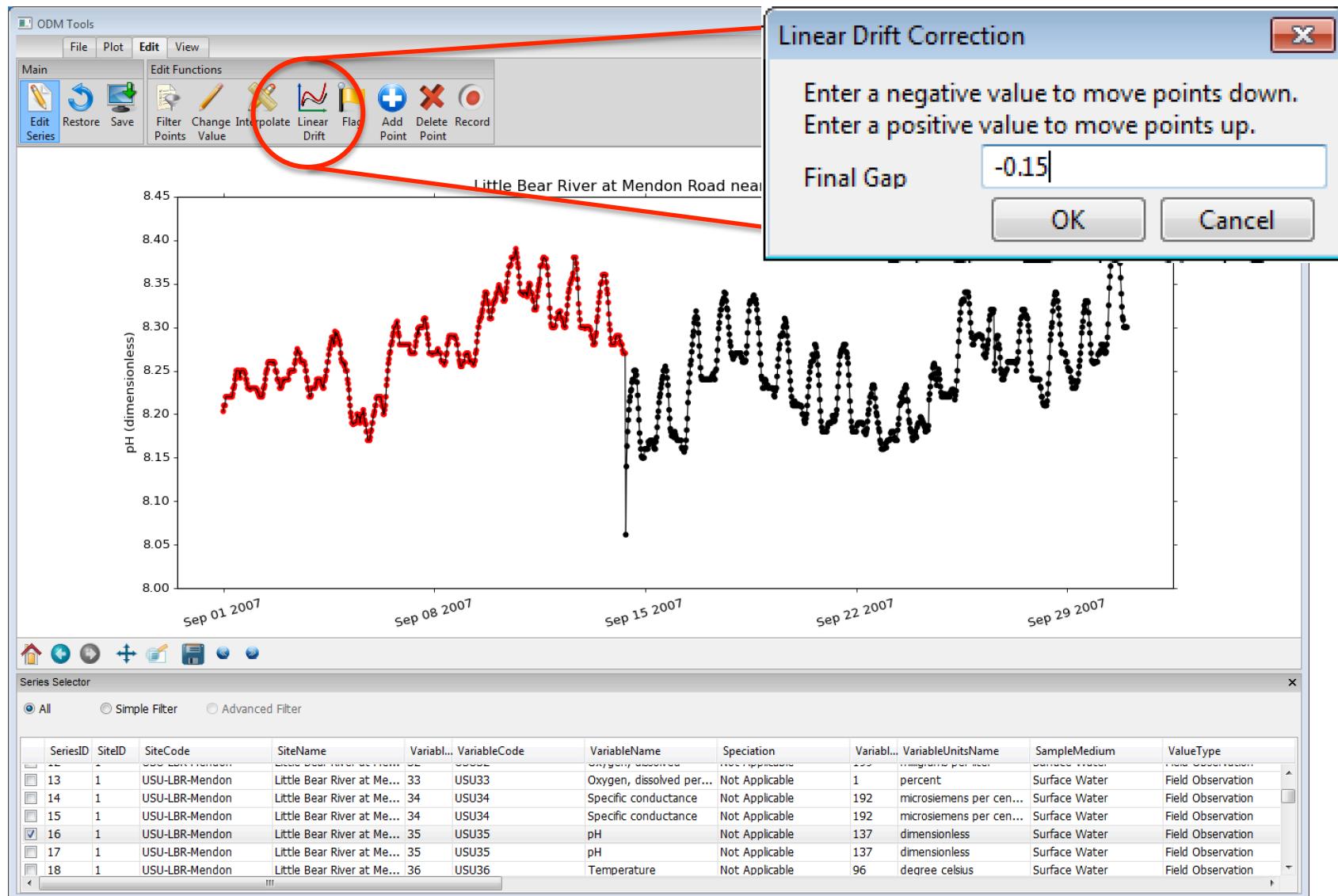
Step 1: Select a Time Series for Editing



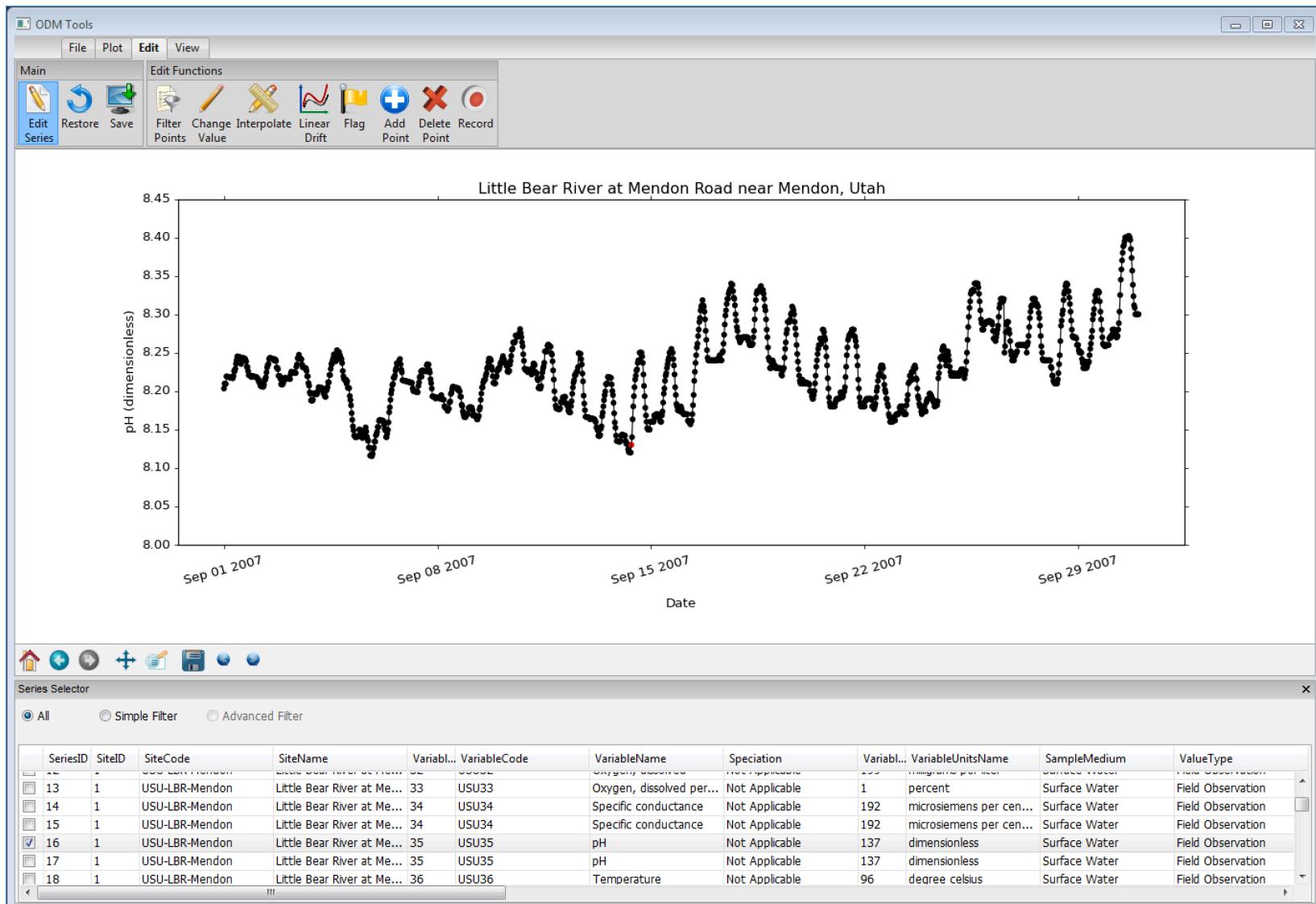
Step 2: Select Data to Edit



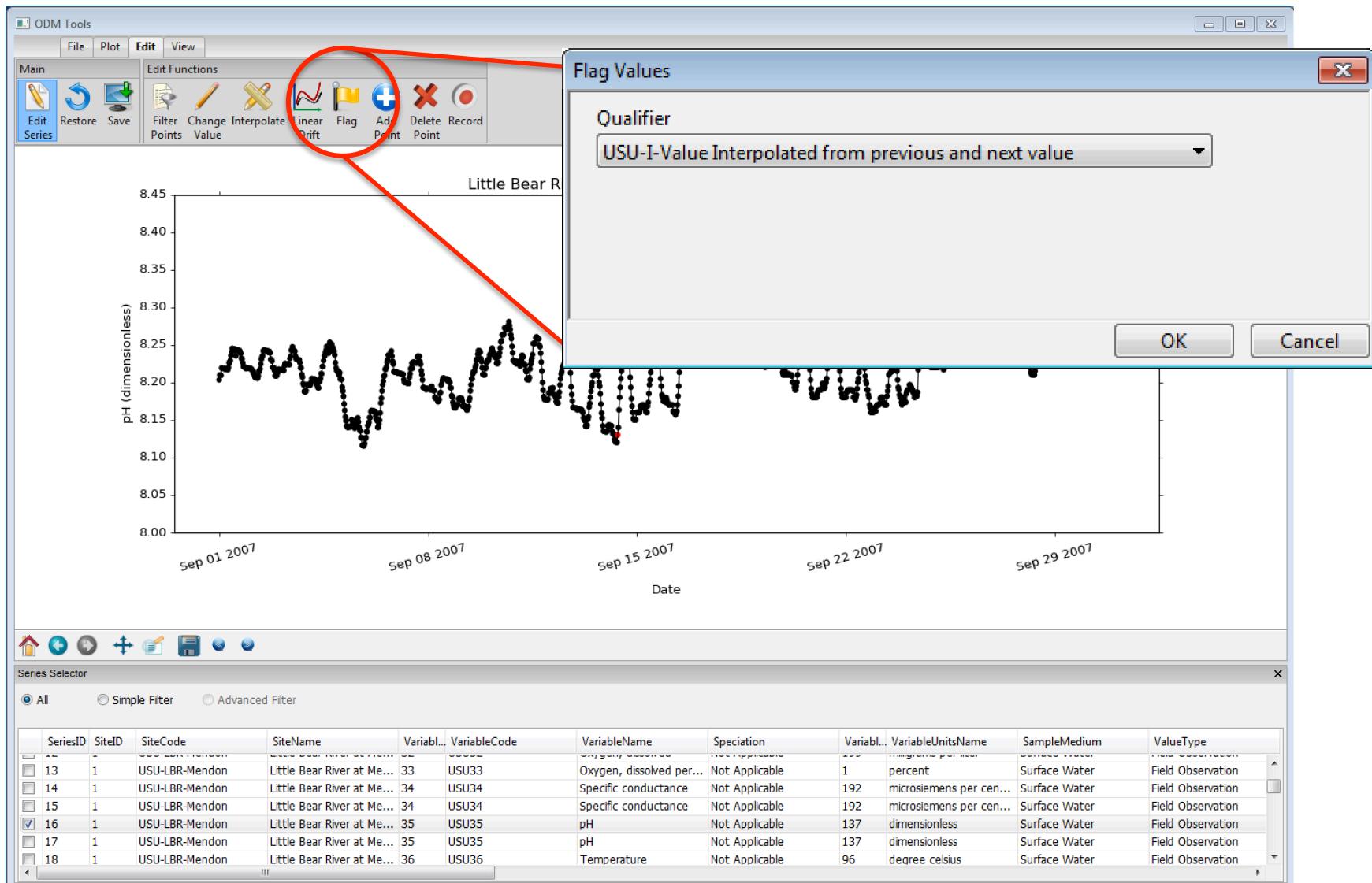
Step 3: Linear Drift Correction



Step 4: Interpolate



Step 5: Flag



Step 6: Save Modified Data Series

Save... Save... Save... Save... Save... Save... **Summary**

How would you like to save this data series?

Save as a new data series
 Save as an existing data series

Automatically generate a new code
 Select an existing Name

Description: Water temperature measured by a probe.

Turbidity measured by a probe.

Water level measured by a probe.

Battery voltage measured by a probe.

Air temperature measured by a probe.

Relative humidity measured by a probe.

Precipitation measured by a probe.

Create a new Method Description

Select an existing Variable

Code	Definition
-9999	Unknown
0	Raw Data
1	Quality
2	Derivative
3	Interpolated
4	Known

Create Quality Code:
Definition:
Explanation:

Use Current Variable

Select an existing Variable

Code	Name
USU3	Battery voltage
USU4	Turbidity
USU5	Turbidity
USU6	Turbidity
USU7	Turbidity
USU8	Turbidity

Create New Variable

Site: Code: USU-LBR-Mendon
Name: Little Bear River at Mendon Road near Mendon, Utah

Variable: Code: USU35
Name: pH
Units: dimensionless
Sample Medium: Surface Water
Value Type: Field Observation
Time Support: 30.0
Time Units: minute
Data Type: Average
General Category: Water Quality

Method: Description: Values derived from ODM Tools Python

Source: Organization: Utah State University Utah Water Research Laboratory
Description: Continuous water quality monitoring by Utah State University
Citation: Continuous water quality monitoring by Jeff Horshurah, David Ste

< Back **Finish** Cancel

Recording Edits

The screenshot illustrates the ODM Tools software interface, specifically the 'Edit' tab, showing a time-series plot of pH levels and a corresponding Python code editor.

Main Window: Displays a scatter plot titled "Little Bear River at Mendon Road near Mendon, Utah". The Y-axis is labeled "pH (dimensionless)" ranging from 8.00 to 8.45. The X-axis is labeled "Date" with ticks for Aug 30 2007, Sep 06 2007, Sep 13 2007, Sep 20 2007, and Sep 27 2007. A red circle highlights the "Record" button in the toolbar.

Edit Functions Toolbar: Shows various editing tools: Edit Series, Restore, Save, Filter Points, Change Value, Interpolate, Linear Drift, Flag, Add Point, Delete Point, and Record. The "Record" button is highlighted with a red circle.

Code Editor: Titled "Editing a new file", it contains the following Python code:

```
from odmservices import EditService
from odmservices import SeriesService
edit_service = EditService(series_id=16, connection_string='mssql+pyodbc://sa:nlcd34GI')
## To run commands from the python console uncomment and run the following command
#edit_service = Tools
edit_service.select_points([datetime.datetime(2007, 9, 1, 0, 0), datetime.datetime(2007, 9, 14, 8, 30)])
edit_service.draft_correction(-0.15)
edit_service.select_points([datetime.datetime(2007, 9, 14, 8, 30)])
edit_service.interpolate()
```

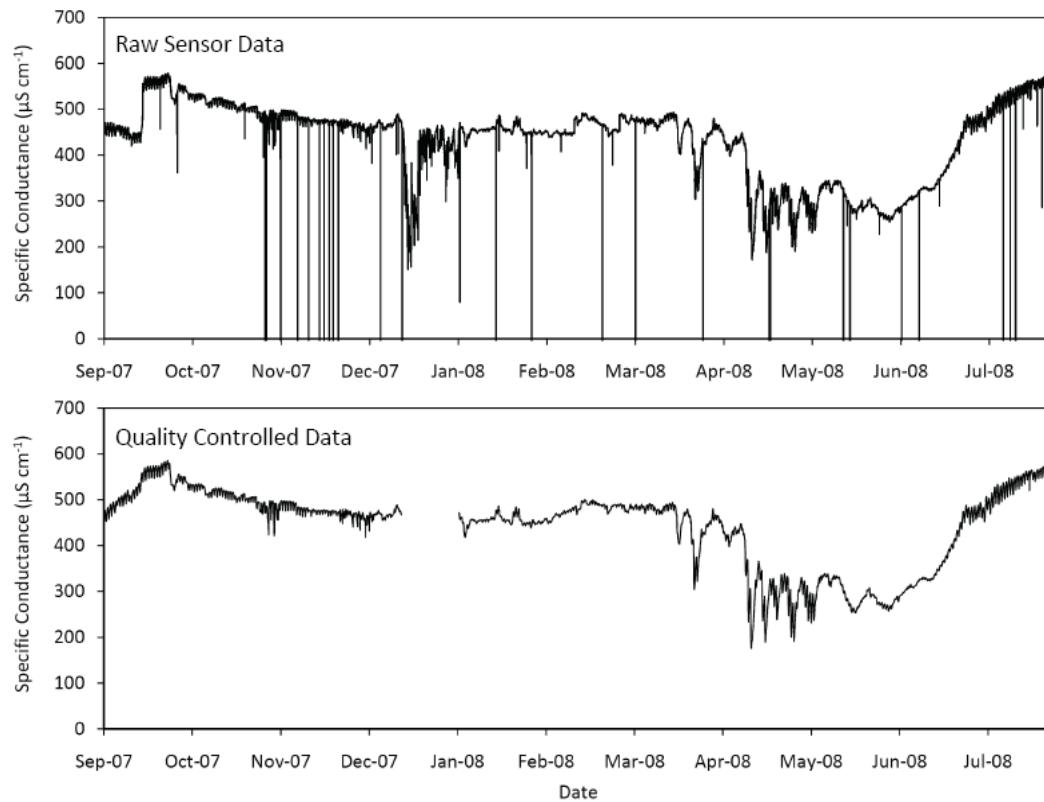
A red callout box points to the code editor with the text: "Automatically generated Python code with each editing step".

Series Selector: A table listing series details:

SeriesID	SiteID	SiteCode	SiteName	Variable	VariableCode	VariableName	Speciation	
14	1	USU-LBR-Mendon	Little Bear River at Me...	34	USU34	Specific conductance	Not Applicable	
15	1	USU-LBR-Mendon	Little Bear River at Me...	34	USU34	Specific conductance	Not Applicable	
<input checked="" type="checkbox"/>	16	1	USU-LBR-Mendon	Little Bear River at Me...	35	USU35	pH	Not Applicable
<input type="checkbox"/>	17	1	USU-LBR-Mendon	Little Bear River at Me...	35	USU35	pH	Not Applicable
<input type="checkbox"/>	18	1	USU-LBR-Mendon	Little Bear River at Me...	36	USU36	Temperature	Not Applicable
<input type="checkbox"/>	19	1	USU-LBR-Mendon	Little Bear River at Me...	36	USU36	Temperature	Not Applicable
<input type="checkbox"/>	20	1	USU-LBR-Mendon	Little Bear River at Me...	37	USU37	Turbidity	Not Applicable
<input type="checkbox"/>	21	1	USU-LBR-Mendon	Little Bear River at Me...	39	USU39	Phosphorus, total	P
<input type="checkbox"/>	22	1	USU-LBR-Mendon	Little Bear River at Me...	39	USU39	Chlorophyll-a, total	P

Ultimate Objective

- Transform raw sensor data to quality controlled data in a repeatable way



Summary

- ODM Tools Python is a cross platform (Windows, Mac) software for sensor data management
- Visualization capabilities are helpful in screening new data as they arrive
- ODM Tools provides GUI-based and scripting of data quality control edits



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Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Questions?

OPEN SOURCE CODE REPOSITORY:
ODM Tools Python is available in GitHub
<https://github.com/UCHIC/ODMToolsPython>

