Virtual Beach 3.0.6 – Data Preparation for MLR model

In this module you will learn how to:

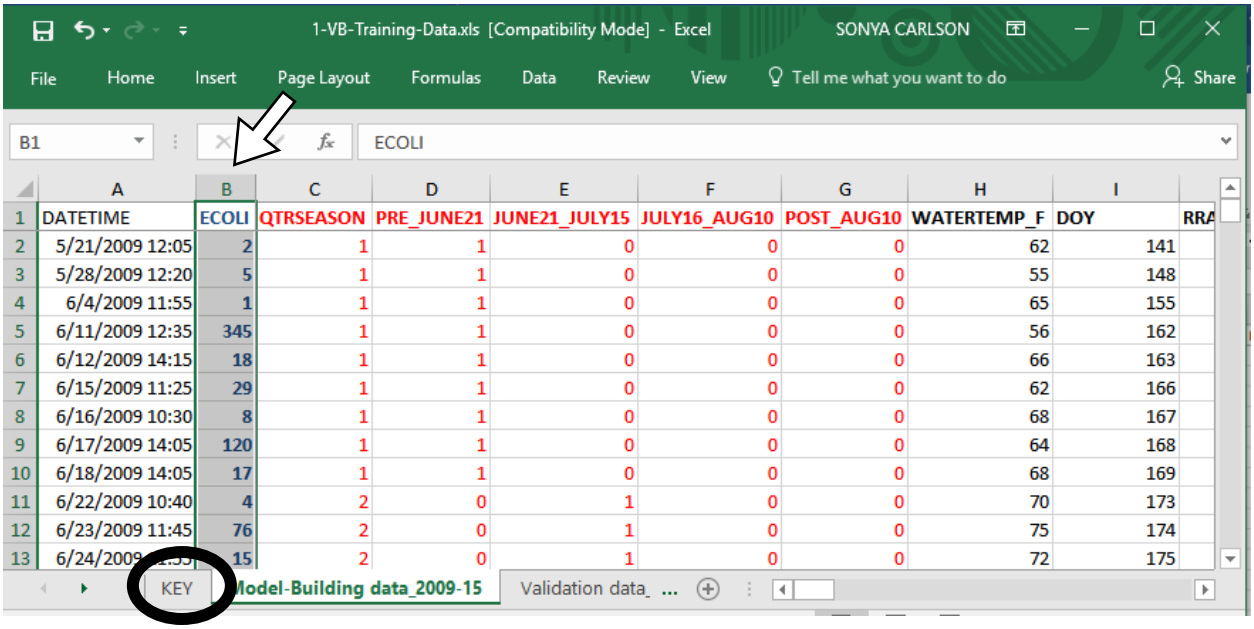
A. Import and clean-up model-building data for your beach
B. Process directional data (wind, currents, waves)
C. Combine two or more predictive variables
D. Transform variables and explore potential relationships

A. Import and clean-up model-building data for your beach

A.1. Open **Microsoft Excel** to preview the data you will be importing into **Virtual Beach 3**. Open the file "VB_Training_Data_MLR.xls".

☛ Be sure to save your data as "*.xls" files. A plugin for **Virtual Beach** 3 is available for importing "*.xlsx" files, but there are still bugs to be worked out.

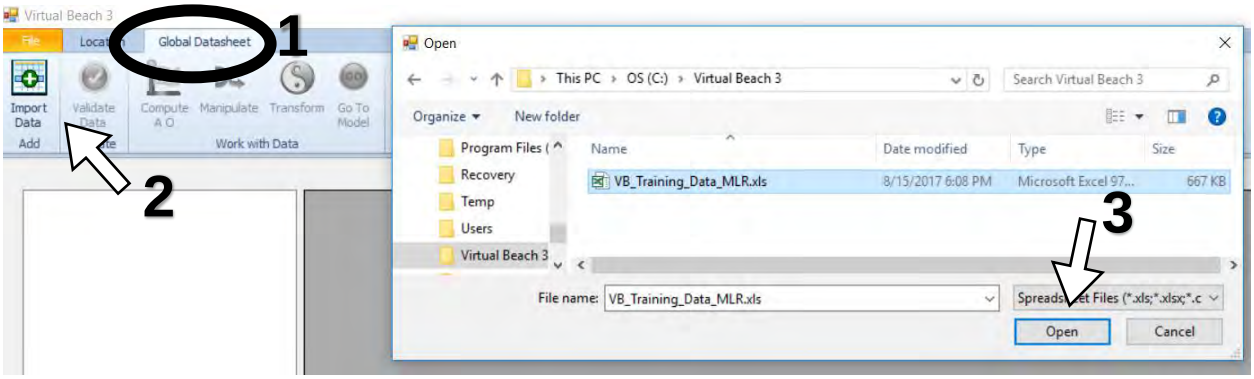
Column **B** is always the *response* variable, "ECOLI" in this example. All data to the right are potential *explanatory* variable. See the **KEY** tab of the **Excel** file for descriptions of variables used in this module. Close the **Excel** file before returning to **Virtual Beach 3**. Data cannot be imported from an open Excel file.



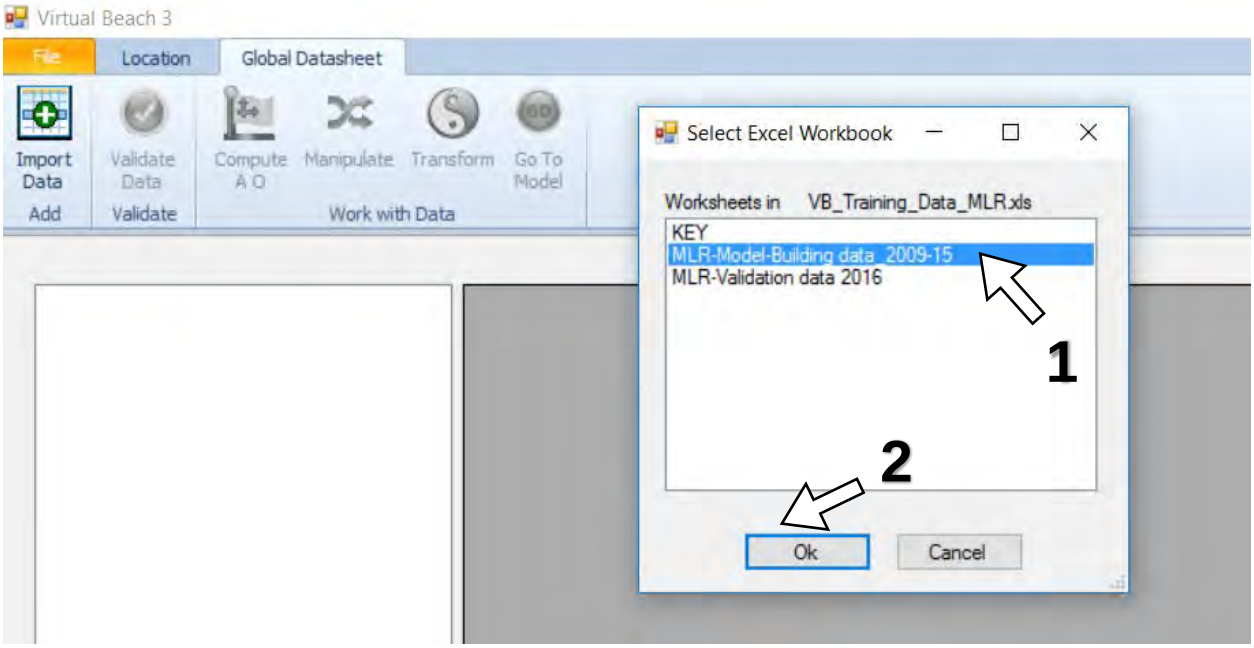
	A	B	C	D	E	F	G	H	I
1	DATETIME	ECOLI	QTRSEASON	PRE_JUNE21	JUNE21_JULY15	JULY16_AUG10	POST_AUG10	WATERTEMP_F	DOY
2	5/21/2009 12:05	2	1	1	0	0	0	62	141
3	5/28/2009 12:20	5	1	1	0	0	0	55	148
4	6/4/2009 11:55	1	1	1	0	0	0	65	155
5	6/11/2009 12:35	345	1	1	0	0	0	56	162
6	6/12/2009 14:15	18	1	1	0	0	0	66	163
7	6/15/2009 11:25	29	1	1	0	0	0	62	166
8	6/16/2009 10:30	8	1	1	0	0	0	68	167
9	6/17/2009 14:05	120	1	1	0	0	0	64	168
10	6/18/2009 14:05	17	1	1	0	0	0	68	169
11	6/22/2009 10:40	4	2	0	1	0	0	70	173
12	6/23/2009 11:45	76	2	0	1	0	0	75	174
13	6/24/2009 [illegible]	15	2	0	1	0	0	72	175

☛ This file can be used as a template for formatting beach-specific data.

A.2. Return to **Virtual Beach 3** project file created in the “Beach Orientation” module. **1.** Click the **Global Datasheet** tab. **2.** Click the **Import Data** icon and select the Excel file “VB_Training_Data_MLR.xls”. **3.** Click **Open**.

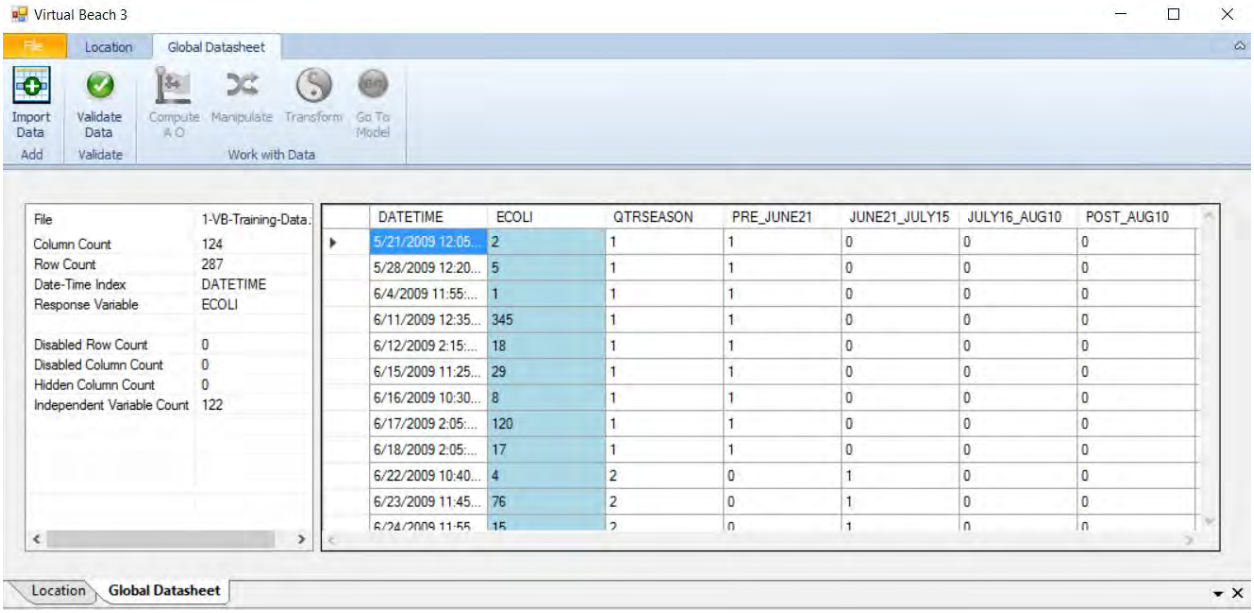


A.3. In this example there is more than one worksheet in the Excel file, so you must choose which one to import. **1.** Select the worksheet **MLR-Model-Building data_2009-15**. **2.** Click **OK**.

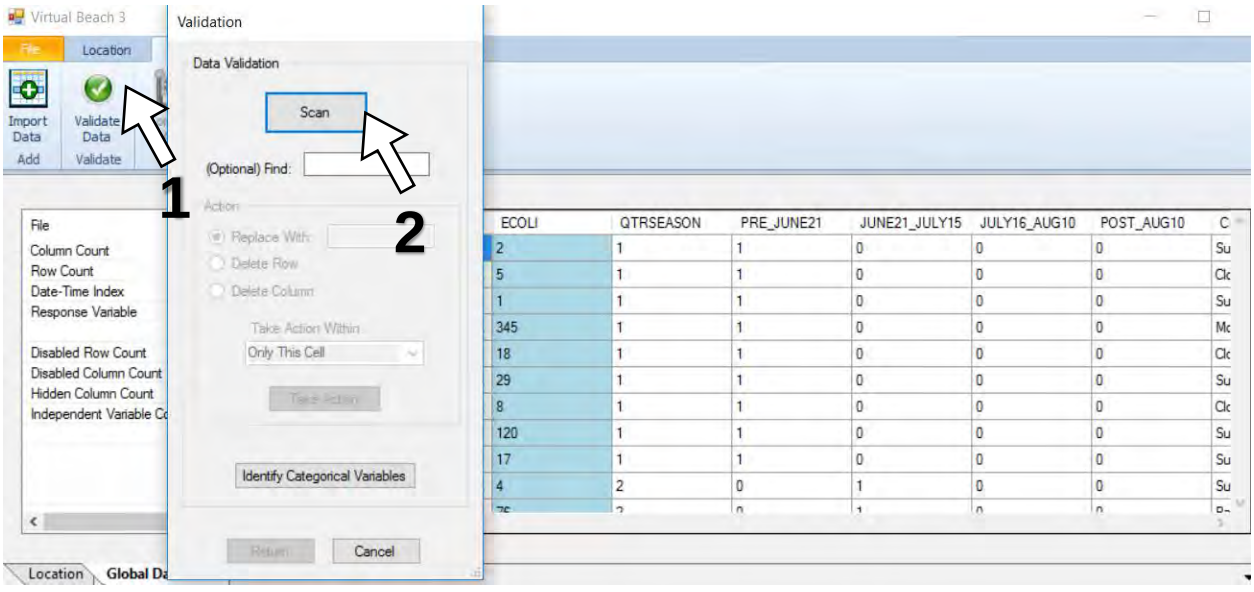


A.4. The data table will open in **Virtual Beach 3**.

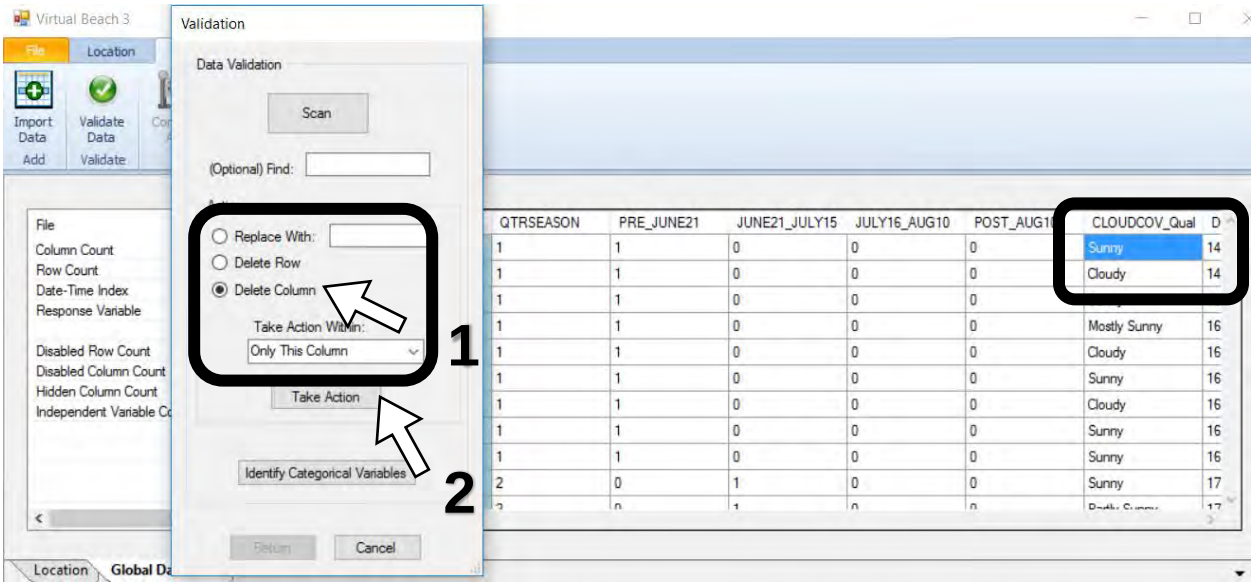
Virtual Beach 3 automatically highlights the second column of the datasheet as the *response* variable, “ECOLI”, in this example. The “Response Variable” is indicated in the left-hand panel, along with “Column Count”, “Row Count” and other descriptions of the data.



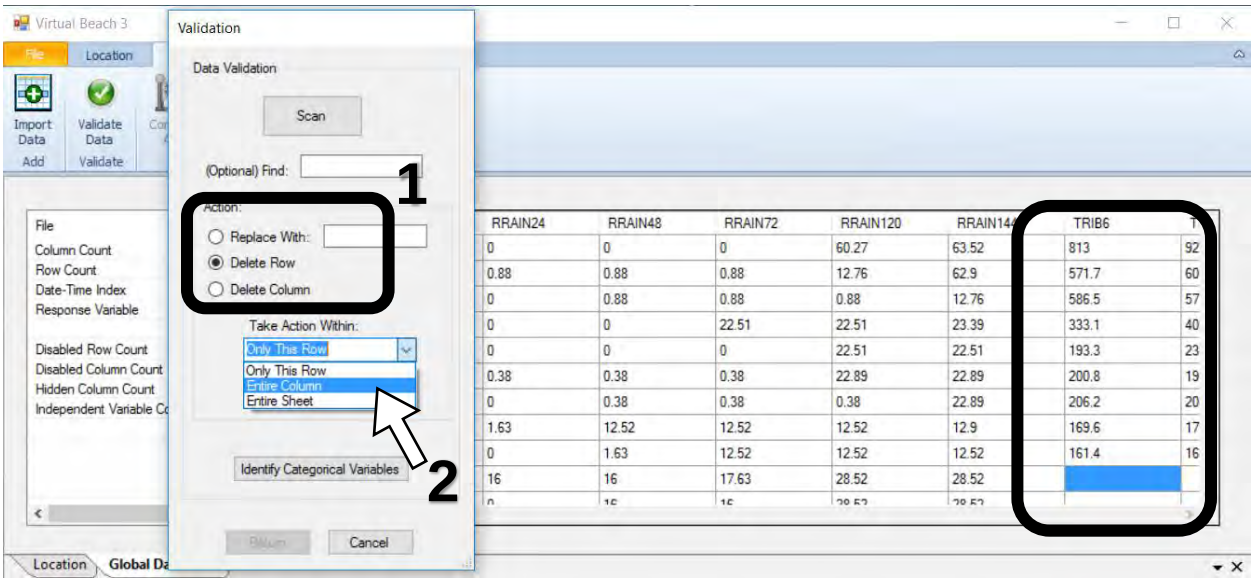
A.5. **Virtual Beach 3** will NOT build a model if any cells have null (missing), or non-numeric (text) values. **1.** Click the **Validate Data** icon to check your dataset. **2.** In the pop-up window, click **Scan**.



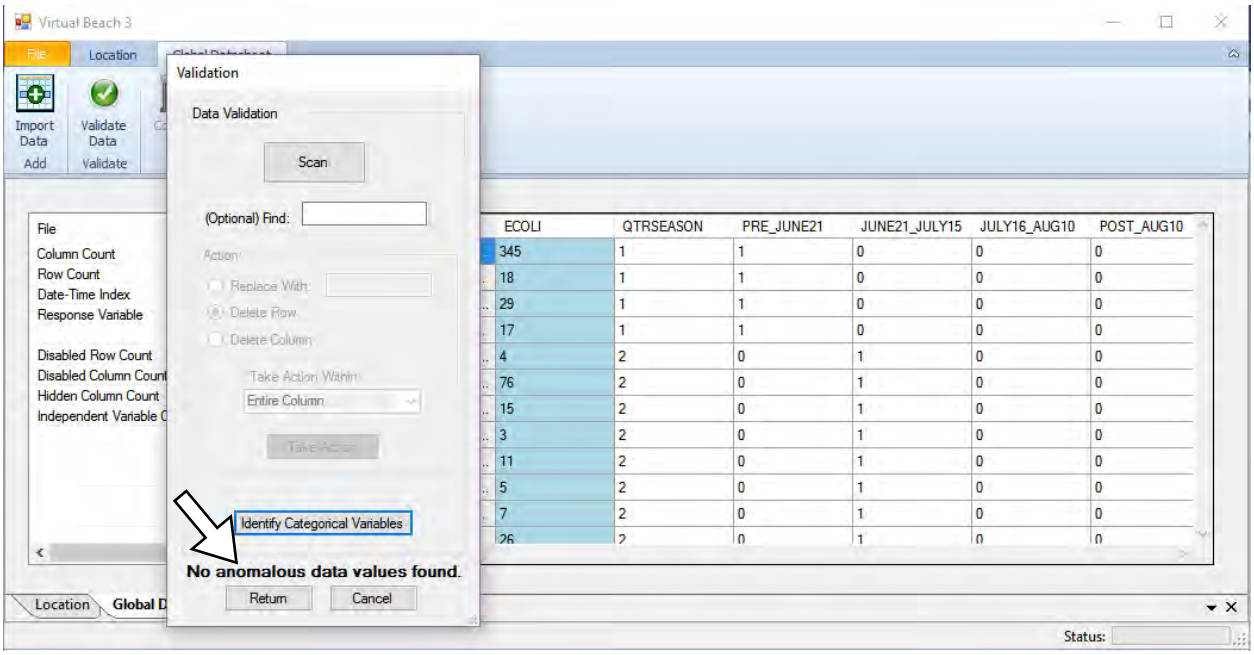
A.6. In this example, the “CLOUDCOV_qual” column is flagged because the values are text, or non-numeric. **1.** Click the radio button next to **Delete Column**. Under **Take Action Within** make sure **Only This Column** is selected. **2.** Click **Take Action**.



A.7. Repeat step A.6 until you come to the “TRIB6” column. The variable is numeric, but some cells are empty. Do not remove the entire column. **1.** Click the radio button for **Delete Row**. **2.** Select **Entire Column** and click **Take Action**.

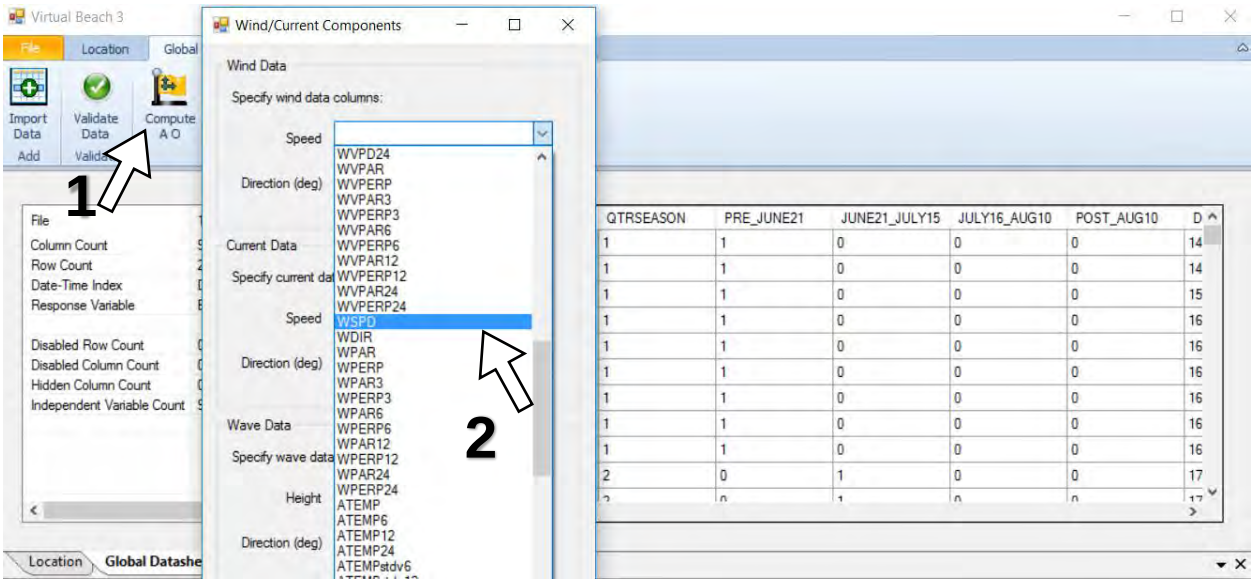


A.8. Repeat Step A.7 until a notice appears at the bottom of the pop-up window stating **No anomalous data values found**. Then click the **Return** button.

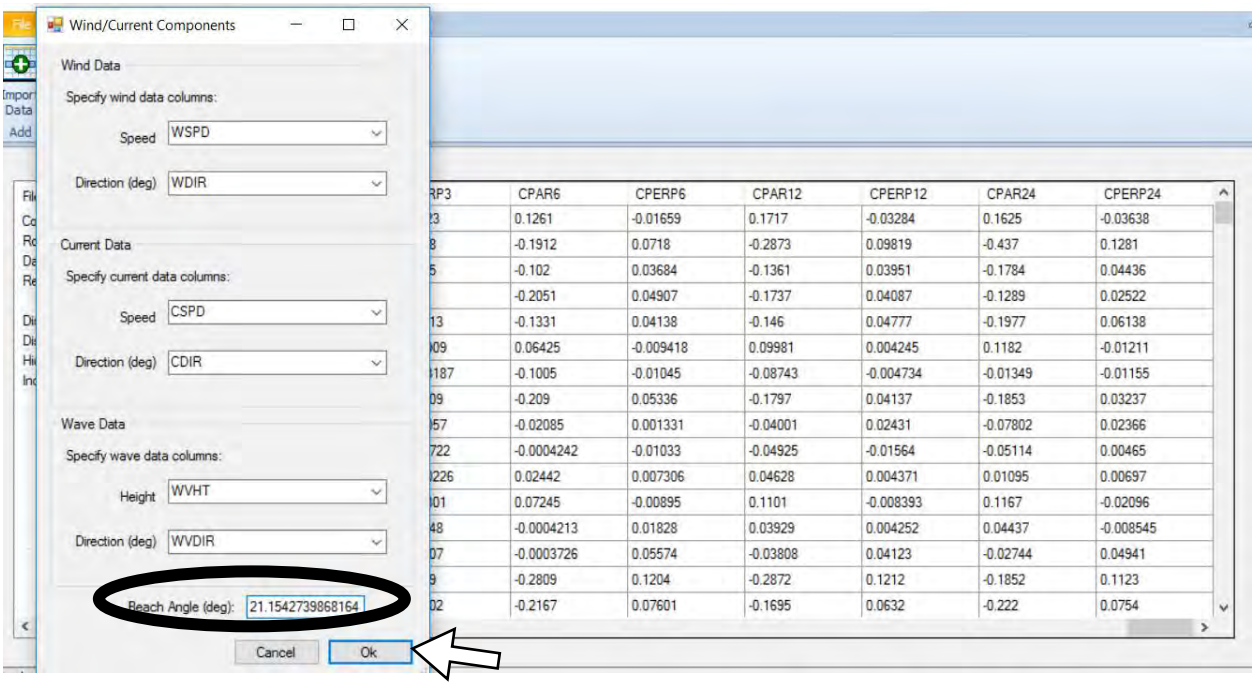


B. Process wind and current data

B.1. **1.** Click the **Compute A O** icon. **2.** In the pop-up window, under **Wind Data**, click the pull down arrow next to **Speed** and select WSPD. For **Direction**, select WDIR.

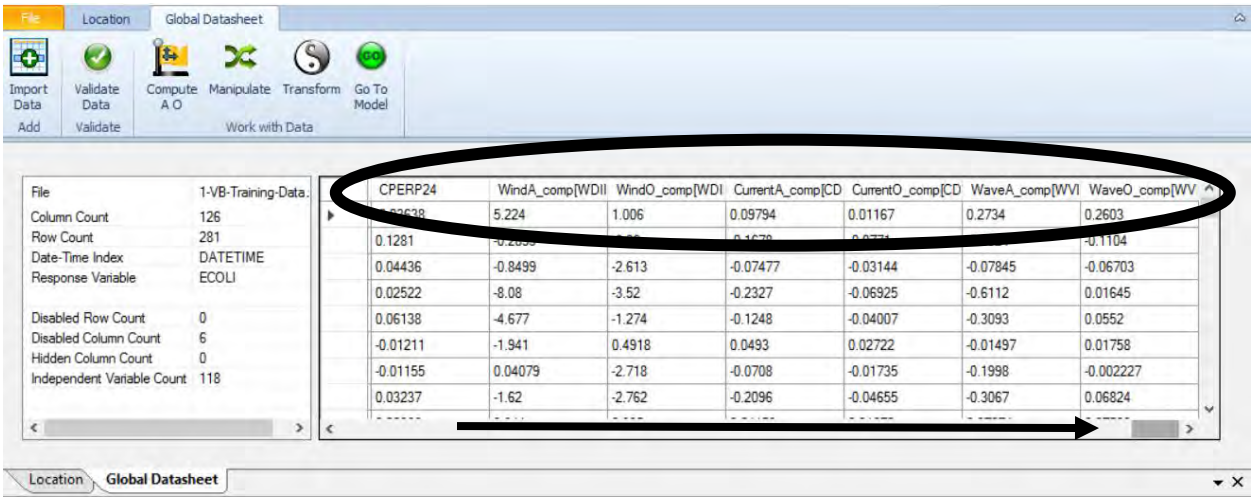


B.2. Repeat for **Current Data**, selecting CSPD and CDIR. Repeat for **Wave Data** selecting WVHT and WVDIR. The Beach Angle is automatically included. Click **OK**.



B.3. Scroll to the far-right end of the table. Six new columns have been added to the end of the global data sheet and that the unprocessed wind, current, and wave data columns are now inactive (red text):

Wind A_comp: along-shore wind speed
Wind O_comp: toward shore wind speed
Current A_comp: along-shore current speed
Current O_comp: toward shore current speed
Wave_A_comp: along-shore wave height
Wave_A_comp: on-shore wave height



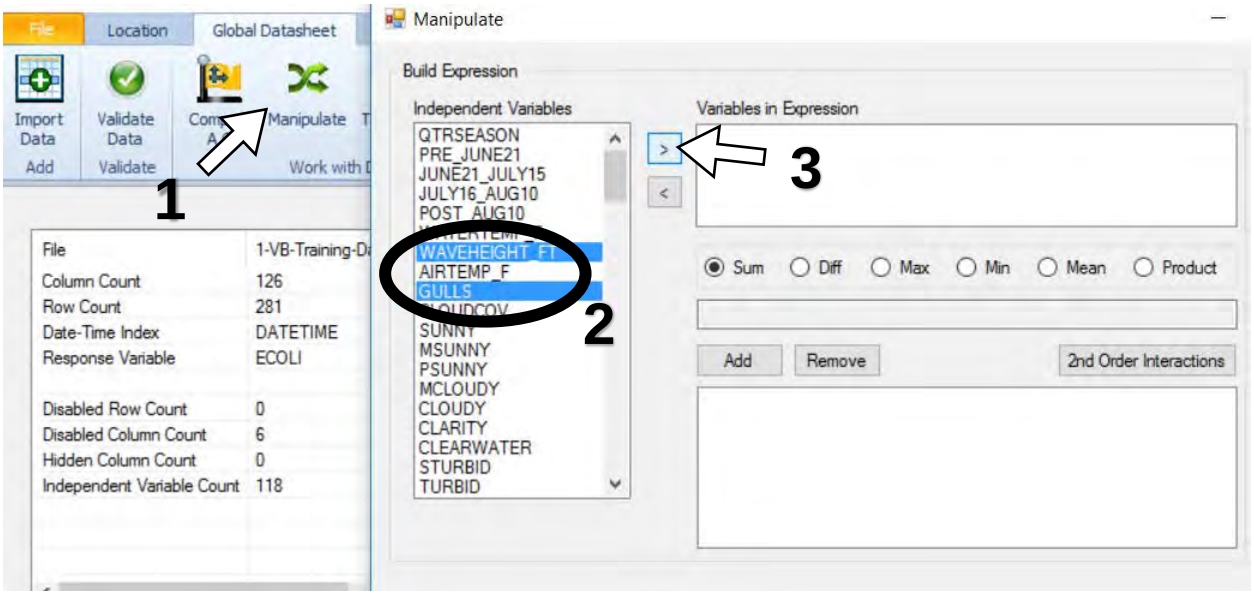
C. Combine two or more predictive variables

Interaction Terms: In situations where two predictive variables are themselves correlated, meaning they interact with one another in terms of how they influence water quality, it may be beneficial to combine them into a single interaction term by **multiplying** them together. Combined the two variables may be better predictors of water quality than if included individually.

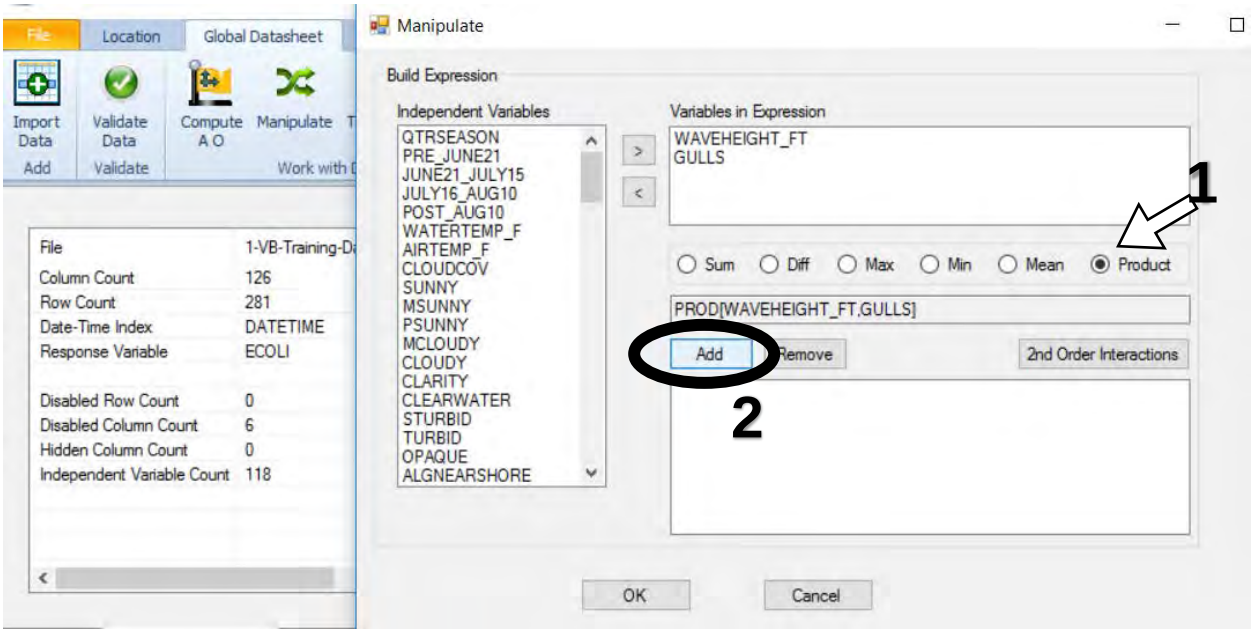
Combined Categories: Some variables are either yes or no. The 0 is "no" and the 1 is "yes". In situations where binary variables represent successive categories of some qualitative variable, like visually-observed water clarity, it may be useful to combine them into a single binary variable by **summing** them. The resulting variable will have a value of 1 when *either* of the two conditions is present. This can be especially helpful when there is little functional distinction between the categories or few cases in which one of the conditions is ever observed. In this example, the difference between TURBID and OPAQUE water is not very distinct; if the water is turbid, it was probably also opaque.

Change-in-Flow Variables. In situations where continuous stream flow data are pre-processed over different timeframes, **subtracting** one temporal snapshot from another can create proxy variables for *changes* in flow. The difference between 24-hour maximum and minimum flow rates indicates whether recent tributary discharge has been consistent or very different after a flash flood event.

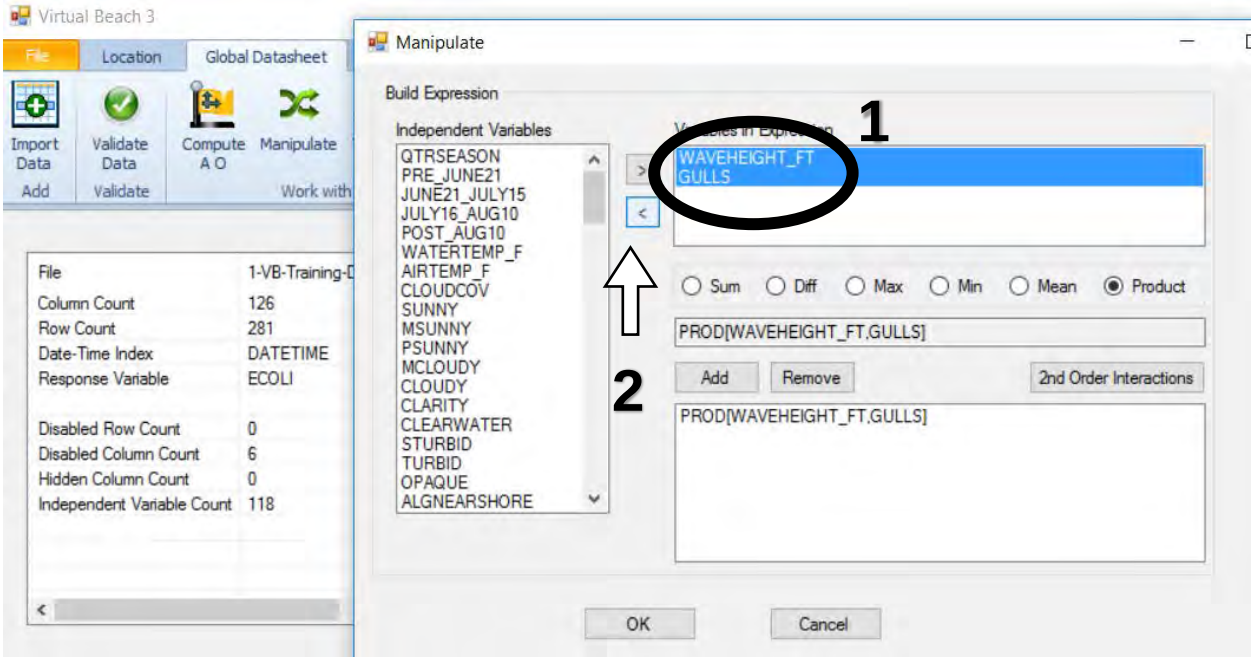
C.1. First create an interaction term by multiplying two variables together. **1.** Click the **Manipulate** icon. **2.** In the pop-up window, ctrl-select WAVEHEIGHT_FT and GULLS. **3.** Click the right-arrow "›" button.



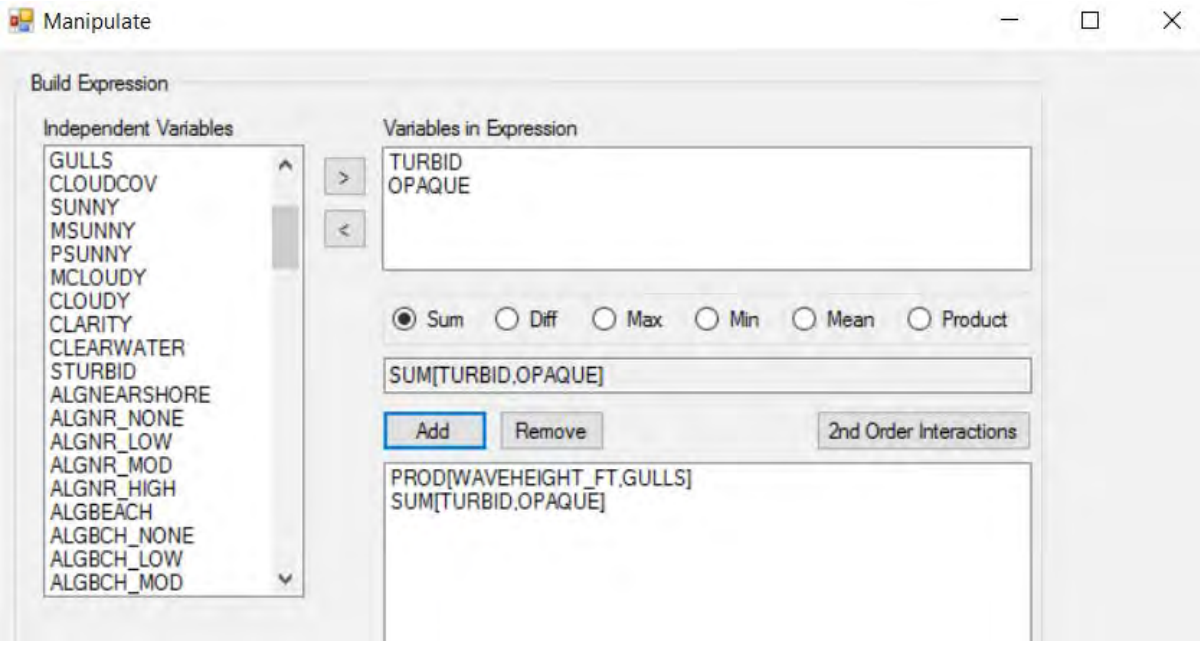
C.2. **1.** Click the radio button next to **Product**. **2.** Click the **Add** button.



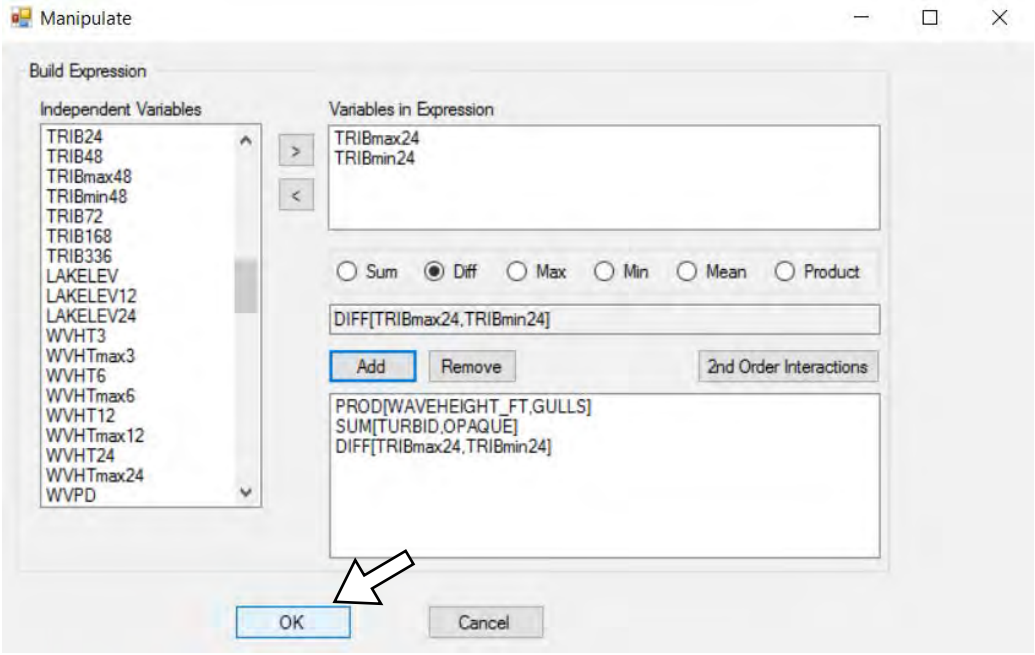
C.3. This creates an interaction term that may describe more accurately how wave height influences the number of gulls on the beach. **1.** Shift-select WAVEHEIGHT_FT and GULLS. **2.** Click the left-arrow "‹" button to move them back to the main list.



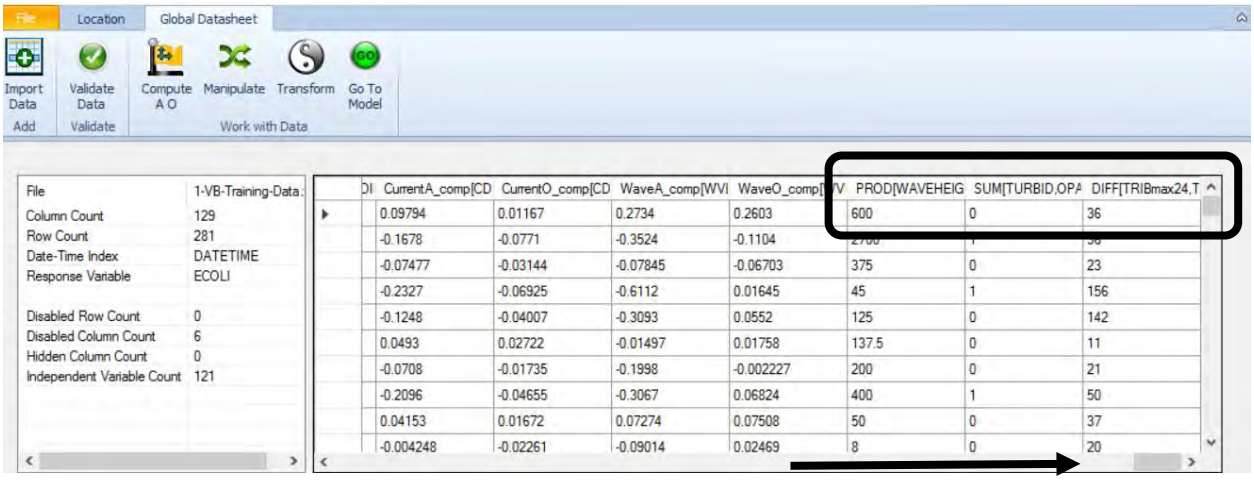
C.4. Repeat the steps in C.2 and C.3 to create the expression of combined categories TURBID and OPAQUE using the **Sum** radio-button. This combined expression creates a variable where a visual observation of either TURBID or OPAQUE water receives a value of 1.



C.5. Repeat the steps in C.2 and C.3 to create the change in flow variable with TRIBmax24 and TRIBmin24 using the **Diff** radio-button. This approximates whether and to what extent the previous 24 hours of tributary discharge has been constant or varied a lot. Other manipulations can be added as needed. Click “OK” when complete.



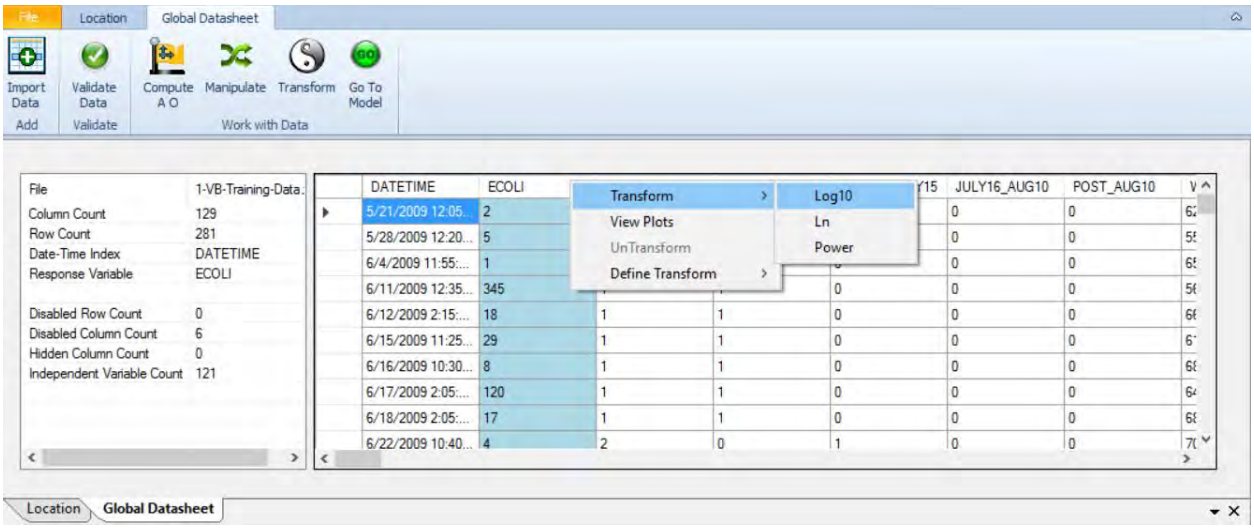
C.6. Scroll to the far-right end of the table to see any new columns added through this process.



D. Transform variables

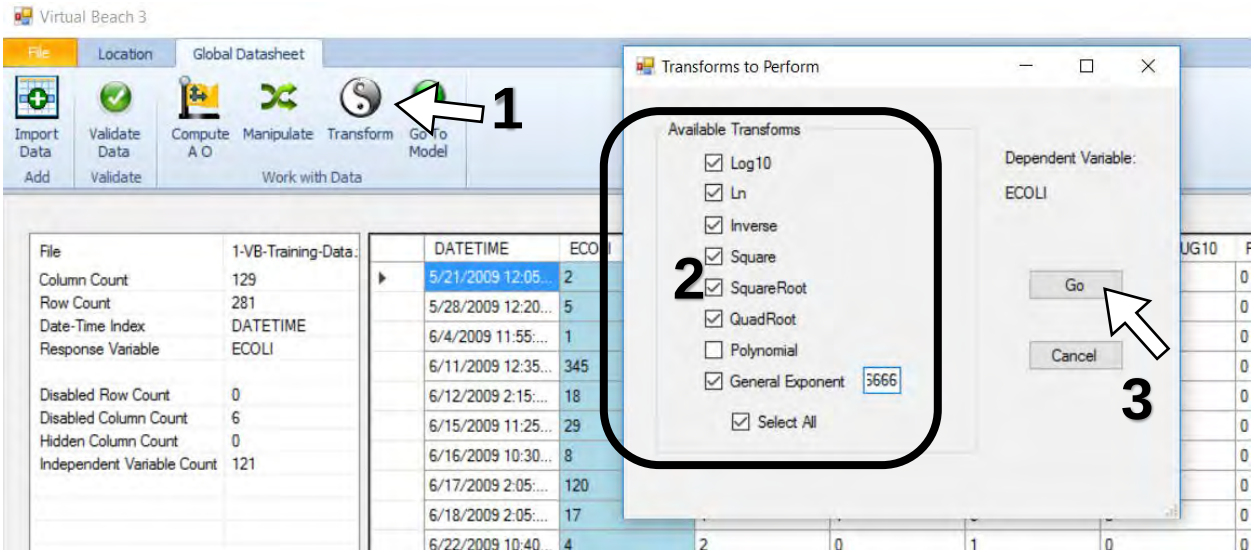
D.1. Right-click on the “ECOLI” column header and select Transform > Log10.

To build a usable nowcast model, bacteria counts **must** be transformed. Log10 is a common transformation for microbial concentrations.

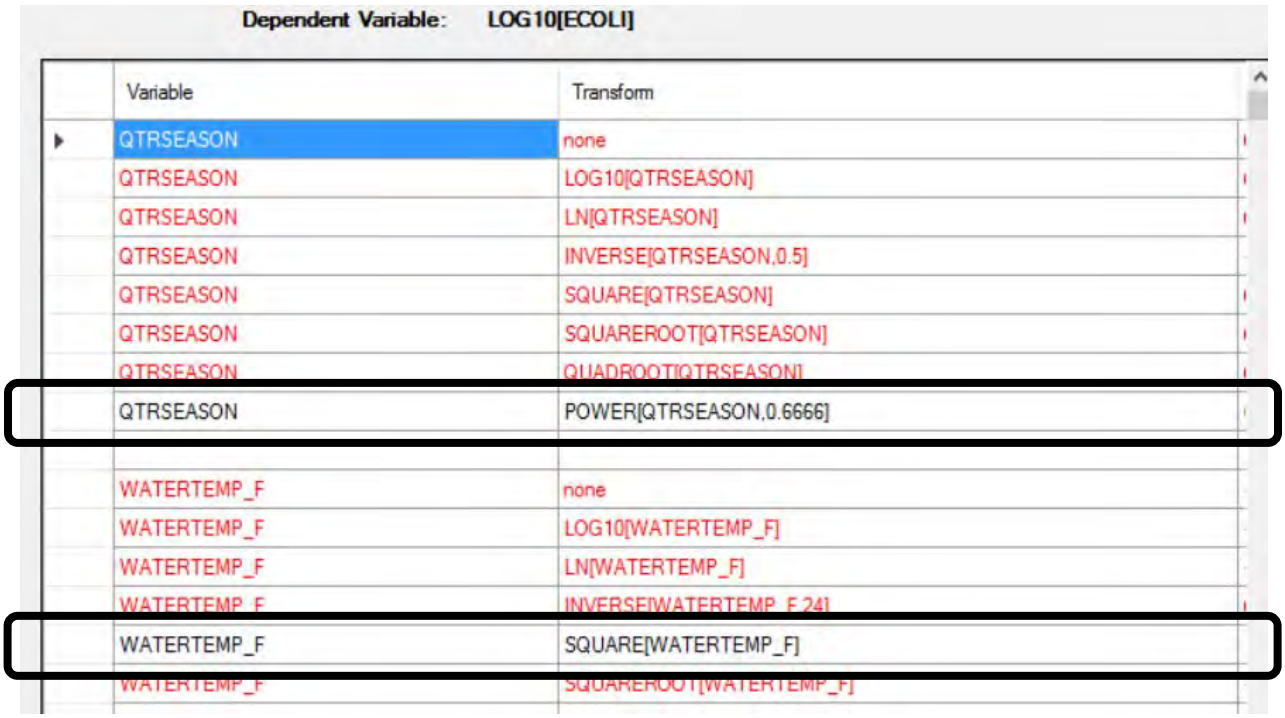


D.2. In addition to transforming the response variable, transforming explanatory variables can significantly improve model fit. **1.** Click the **Transform** icon. **2.** Check all options, EXCEPT Polynomial, and type 0.6666 next to **General Exponent**. **3.** Click **Go**.

As of July 2017, the polynomial transformation causes problems in the Virtual Beach program. Future updates will address this issue.

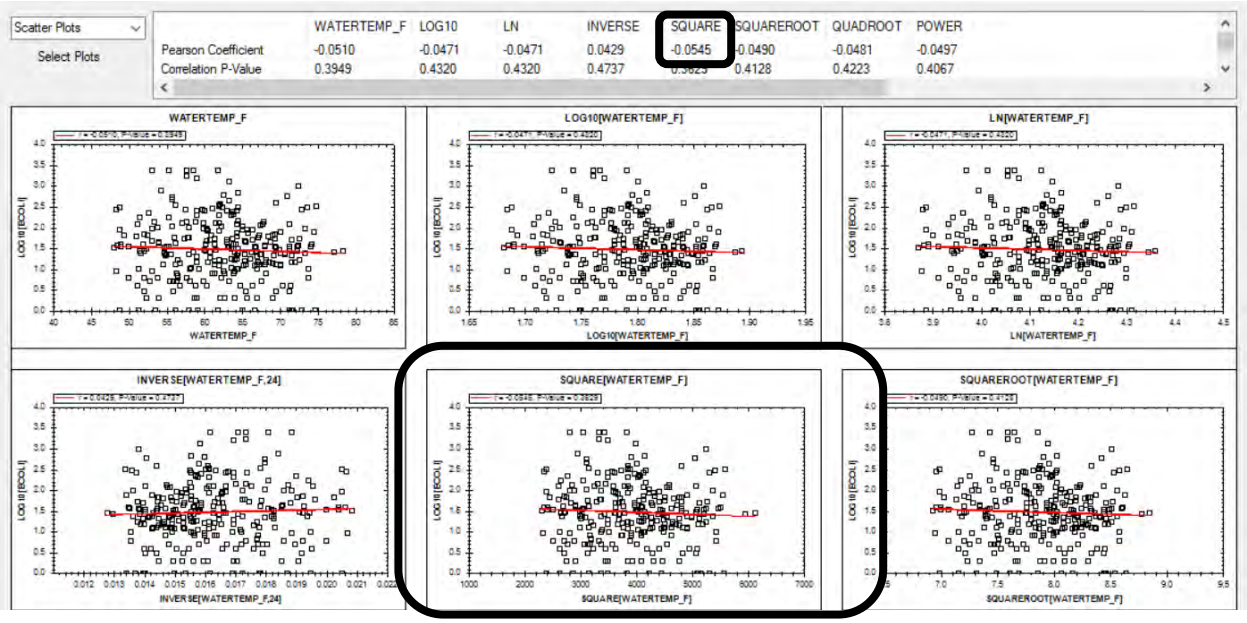


D.3. A pop-up will open listing all of the optional transformations for each explanatory variable. Those in black represent the transformation with the best correlation (Pearson's coefficient) with the response variable LOG(ECOLI).



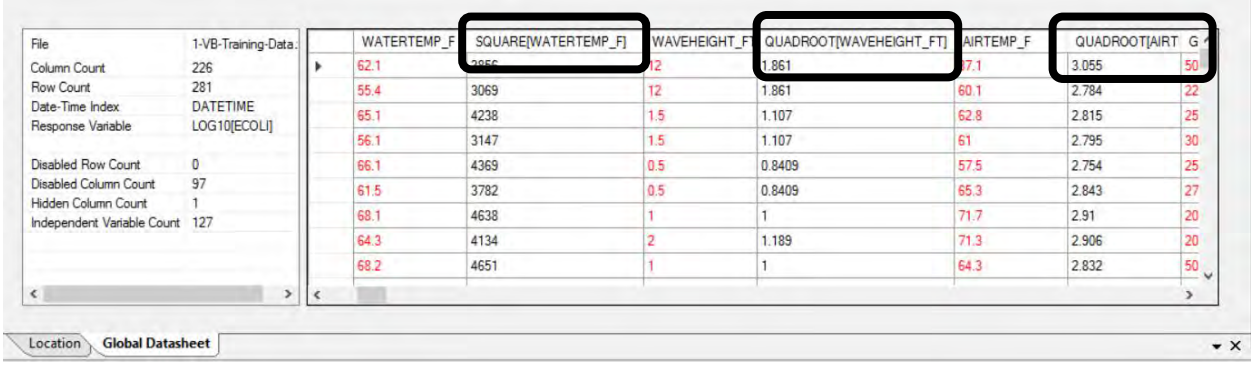
D.4. Right-clicking in any cell to the left of a variable will enable you to view scatter plots of all the transformations of that variable versus LOG(ECOLI). For example, right-click to the left of the variable WAVEHEIGHT_FT.

D.5. Note that in this case the best transformation, in terms of Person's r, is square transformation. The scatter plot confirms this selection. Close the window to return to the list of transformation options.



If you decide to select an alternative best transformation for a given variable, simply click on that row. When you are finished, click **OK**.

D.6. New columns are added if the newly-transformed variable had a better fit than untransformed original variable. The new columns here are SQUARE(WATERTEMP_F), QUADROOT(WAVEHEIGHT_FT), and QUADROOT(AIRTEMP_F). The original columns are now disabled as indicated by red text. Disabled columns will NOT be used in the model. Save your project file. You can now move onto the next module, “Building an MLR Model”.



File	1-VB-Training-Data..
Column Count	226
Row Count	281
Date-Time Index	DATETIME
Response Variable	LOG10[ECOLI]
Disabled Row Count	0
Disabled Column Count	97
Hidden Column Count	1
Independent Variable Count	127

	WATERTEMP_F	SQUARE[WATERTEMP_F]	WAVEHEIGHT_F	QUADROOT[WAVEHEIGHT_FT]	AIRTEMP_F	QUADROOT[AIRT	G
▶	62.1	3856	2	1.861	67.1	3.055	50
	55.4	3069	2	1.861	60.1	2.784	22
	65.1	4238	1.5	1.107	62.8	2.815	25
	56.1	3147	1.5	1.107	61	2.795	30
	66.1	4369	0.5	0.8409	57.5	2.754	25
	61.5	3782	0.5	0.8409	65.3	2.843	27
	68.1	4638	1	1	71.7	2.91	20
	64.3	4134	2	1.189	71.3	2.906	20
	68.2	4651	1	1	64.3	2.832	50

Location | Global Datasheet