Evaluate GSFLOW Water Budgets with the Microsoft Excel SeriesSEE Add-In 'GSFLOW_WBAnalysis_SeriesSEE' (October 1, 2016)

An update to the 'gsflowAnalysis.xls' Excel workbook that was distributed with previous versions of GSFLOW has been done beginning with the release of GSFLOW version 1.2.1 on October 1, 2016. This was done to better evaluate model results with the data-viewing and data-manipulation capabilities provided by the SeriesSEE Excel Add-In. As part of the update, the definitions of the various GSFLOW water-budget output variables have been revised. The revised water-budget components are illustrated in the 'Budget_Diagrams.pdf' and the updated variable names are defined in 'Definitions of Budget Variables.pdf.' Users are encouraged to review the Budget Diagrams, which provide convenient depictions of the inflows, outflows, and storage processes of the major water-budget compartments simulated by GSFLOW.

Please note that the current version of the GSFLOW_WBAnalysis workbook will only work with SeriesSEE.V1.20 released July, 2016, which is available for downloading at http://pubs.usgs.gov/tm/tm4-F4/

SeriesSEE Installation

Before using the water-budget utility, the user must install the current version of SeriesSEE. To install SeriesSEE, go to http://pubs.usgs.gov/tm/tm4-F4/and download AppendixA_SeriesSEE.v.1.20. Then:

1. Unzip the folder.
2. Follow instructions in the 'SeriesSEE.V1.20_INSTALL.pdf' documentation. The first step is to copy the 'AppendixA_SeriesSEE.v.1.20' directory to your local drive. The typical location in which to put MS Excel add-ins is: C:\Users\USERNAME\AppData\Roaming\Microsoft\AddIns.
3. In some cases, it may be necessary to remove the 'txt' file extensions from the following files, which are located in subdirectory 'AddIN' within the 'AppendixA_SeriesSEE.v.1.20' directory:
   SShelp.chm.txt => SShelp.chm
   WLM_NoComment.exe.txt => WLM_NoComment.exe
   WLM_pest.exe.txt => WLM_pest.exe
   WLM_wlmodel.exe.txt =. WLM_wlmodel.exe
4. SeriesSEE works correctly in Excel 2010 or greater. It will also work in Excel 2007, but performance will lag. SeriesSEE will not work in Excel 2003 or earlier versions. For best performance, use Excel 2016.

Once installed, the SeriesSEE add-in will appear as an additional tab on the Excel Ribbon (fig. 1).

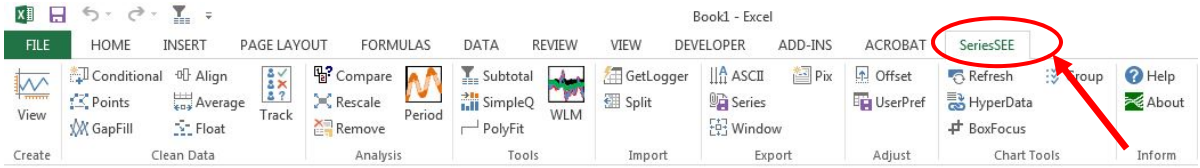


Figure 1.—SeriesSEE tab that appears in the ribbon after successful installation in Excel 2013.

GSFLOW_WBAnalysis_SeriesSEE.xlsm

Double-click on the GSFLOW_WBAnalysis_SeriesSEE.xlsm workbook, which includes several worksheets (be sure to 'Enable Content' if you receive a Security Warning on opening the

workbook). The workbook should open on the 'data' worksheet. The "data" worksheet includes three buttons (fig. 2) for loading data from the GSFLOW Comma-Separated-Values (csv) output file. An example GSFLOW csv output file ('gsflow.csv') is included in the 'water-budget utility' directory with the GSFLOW distribution; users of the utility can replace that file with their own 'gsflow.csv' files.

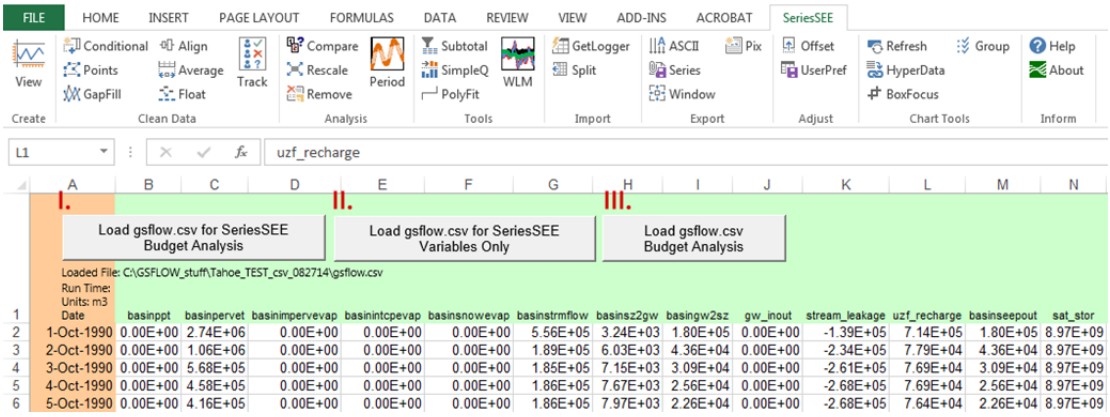


Figure 2.—Data-processing buttons in the "data" worksheet of GSFLOW_WBAnalysis_SeriesSEE.xlsm.

Data processing with the MS Excel SeriesSEE Add-In

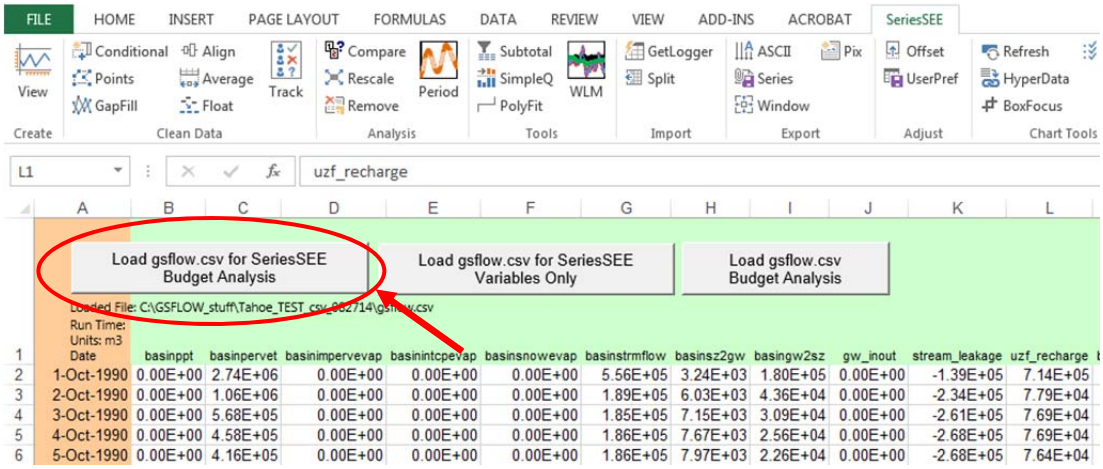
Details of the functions for each button are described in sections I–III below:

I. **Load gsflow.csv for SeriesSEE Budget Analysis**—evaluate water budgets with the SeriesSEE 'Group' tool
II. **Load gsflow.csv for SeriesSEE Variables Only**—evaluate individual GSFLOW output variables with SeriesSEE (no budgets)
III. **Load gsflow.csv Budget Analysis**—evaluate water budgets with Excel alone (no SeriesSEE)

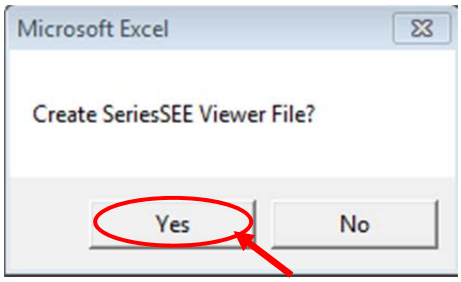
I. **Load gsflow.csv for SeriesSEE Budget Analysis**—evaluate water budgets with the SeriesSEE 'Group' tool

In 'data' worksheet in GSFLOW_WBAnalysis_SeriesSEE.xlsm, the button **"Load gsflow.csv for SeriesSEE Budget Analysis"** pulls data from gsflow.csv and creates a separate Excel Viewer File with water budgets for each water-budget compartment (for example, for the HRUs, soil zone, unsaturated zone, saturated zone, entire basin, and for evapotranspiration). The appropriate variables are grouped and the error term in the continuity equation is calculated for each budget. With SeriesSEE, users can quickly zoom into periods of interest, turn individual variables on and off, and toggle between water budgets. The following steps outline the creation of a SeriesSEE Viewer File to evaluate budgets:

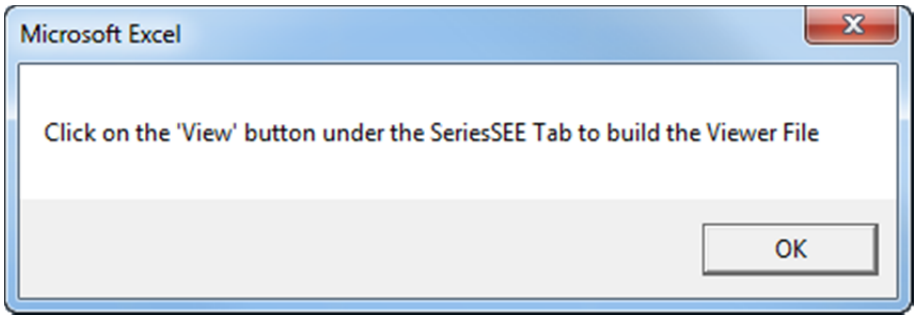
1. To create the SeriesSEE Viewer File, click “Load gsflow.csv for SeriesSEE Budget Analysis”



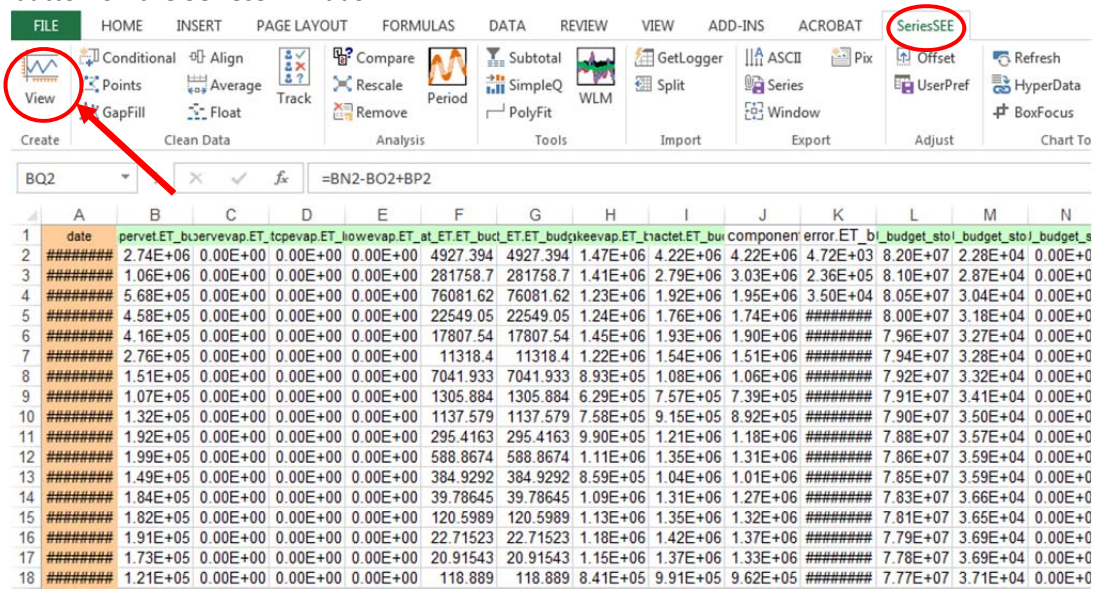
2. The associated macro will populate the “To_SeriesSEE” worksheet with the grouped variables and error calculations for each water budget. Click “Yes” to create the Viewer File.



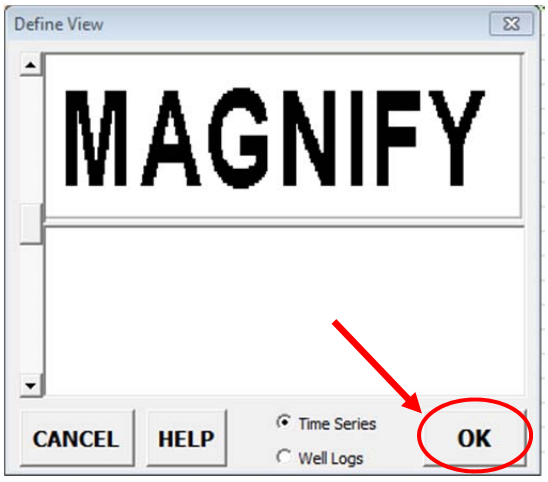
Doing this leads to the following dialog box, which can be closed by selecting the “OK” button:



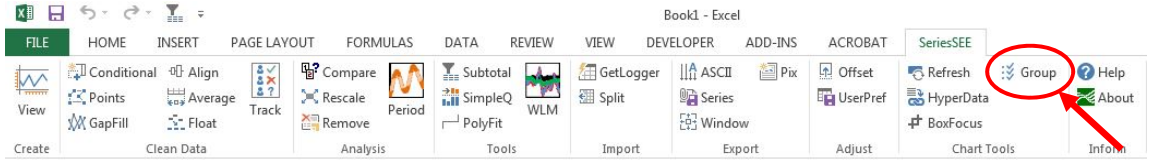
3. The macro will open the “To_SeriesSEE” worksheet and prompt the user to click the “View” button on the SeriesSEE ribbon.



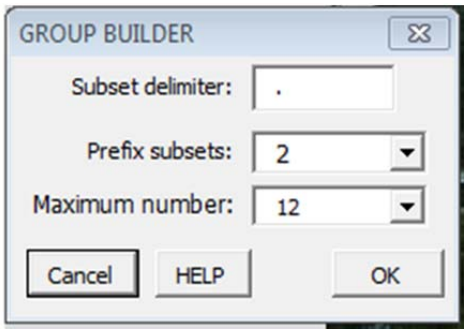
4. Click “OK” on the “Define View” prompt. The default settings are fine.



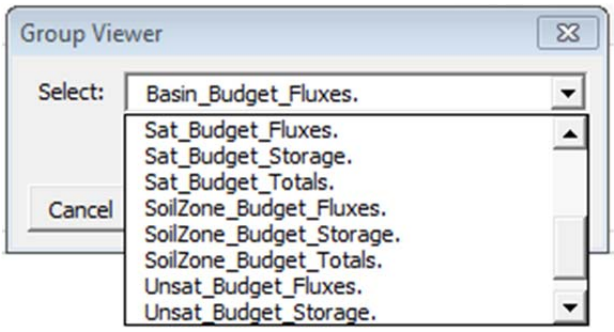
5. SeriesSEE will build and open the Viewer File and prompt the user to save it. The viewer file is a separate Excel workbook in which the budgets can be viewed. Once saved, the Viewer File will open. In this new workbook, click the “Group” button in the SeriesSEE Ribbon to organize the water-budget data.



6. Ensure that the *Subset delimiter* is a set as a period ("."), *Prefix subsets* = 2, and the *Maximum number* = 12 in the "GROUP BUILDER" prompt. Click "OK"

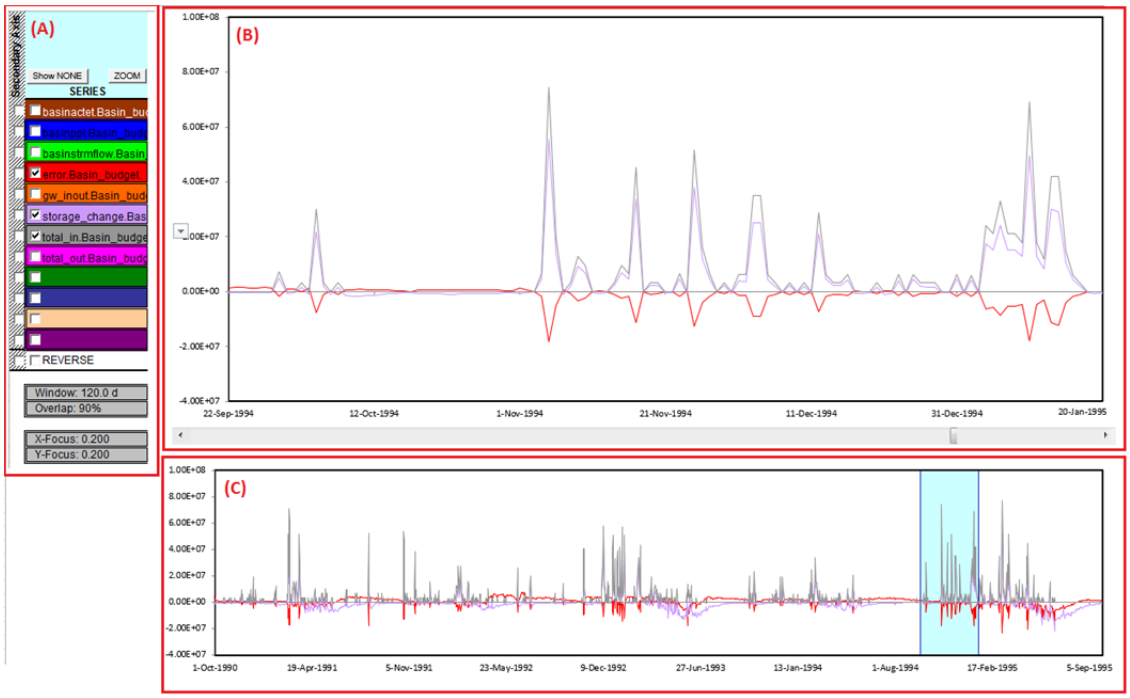


7. Select a budget of interest from the drop-down menu on the "Group Viewer" prompt. Once selected, the corresponding budget variables will be displayed in the "View" worksheet. Re-selecting a different budget from the drop-down will automatically repopulate the viewer file with the appropriate budget variables.



For each water–budget compartment, the user can display the corresponding fluxes, storage terms, and total mass balance.

8. Budget variables (A) are shown in cells B2:B13. Each variable can be switched on and off and plotted on either the primary or secondary axes. The upper plot (B) is a magnified region controlled by the slider along the bottom of the plot, and the amount of magnification is specified by the “Window” setting in cell B16. The entire period of record is shown in the lower plot (C), where the blue translucent area indicates the magnified period of record. Additional details are provided in the SeriesSEE.V1.20_Explain.pdf, which is included in AppendixA_SeriesSEE.v.1.20 in the SeriesSEE .zip file.

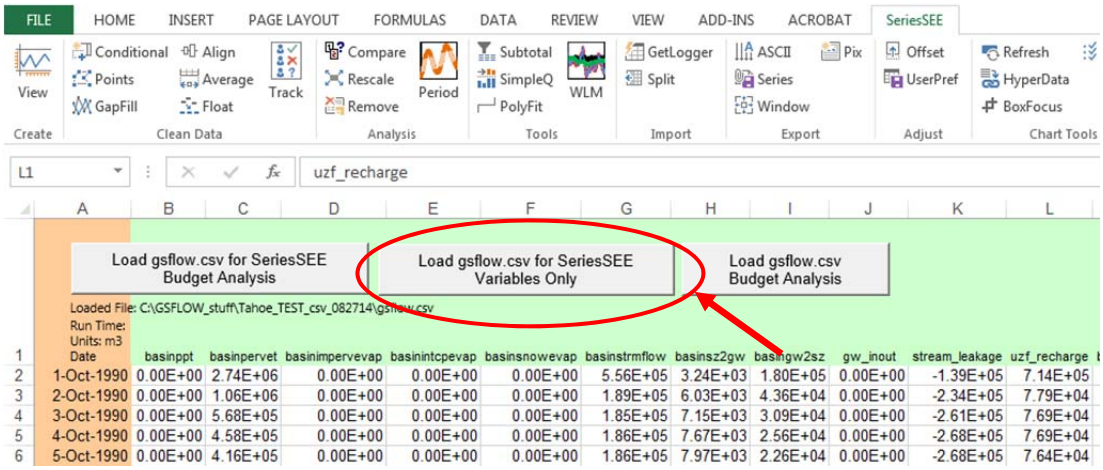


The user can quickly and easily generate and save separate Viewer Files for each model run, each time returning to the ‘data’ worksheet in GSFLOW_WBAnalysis_SeriesSEE.xlsm to read in new data and select the method for viewing.

II. **Load gsflow.csv for SeriesSEE**—evaluate individual budget variables with SeriesSEE

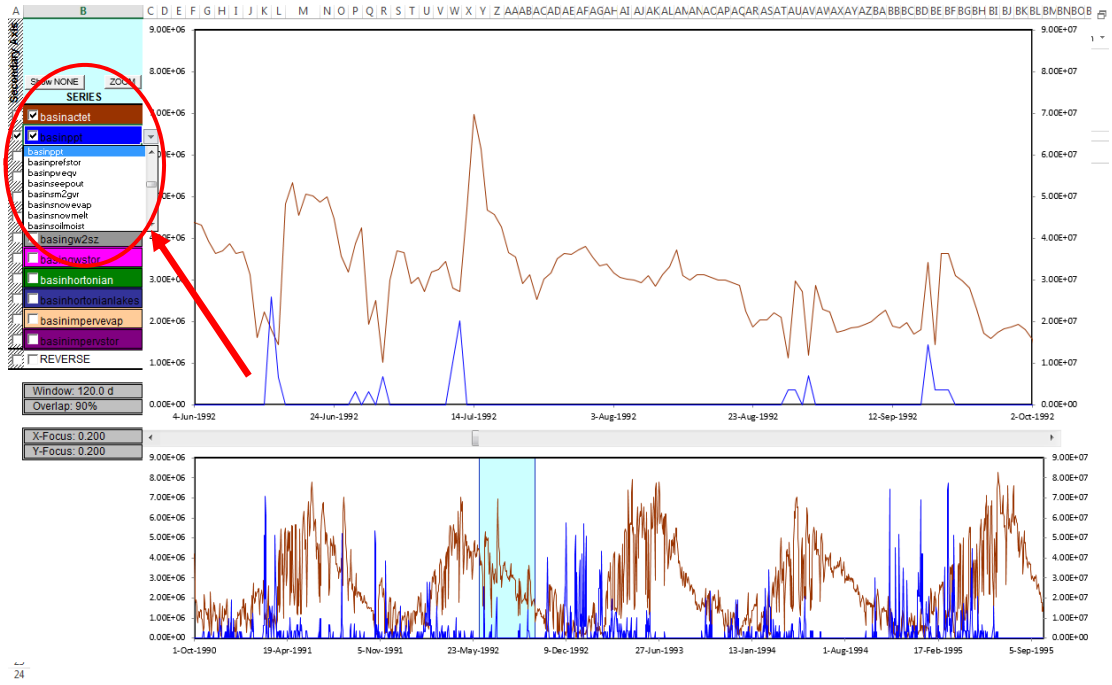
In 'data' worksheet in GSFLOW_WBAnalysis_SeriesSEE.xlsm, the button **"Load gsflow.csv for SeriesSEE"** pulls data from gsflow.csv and creates a separate Excel Viewer File where each variable can be viewed and manipulated with SeriesSEE. Instead of creating pre-packaged budgets, variables are left ungrouped to allow for greater user flexibility.

1. To initiate the SeriesSEE Viewer File, click "Load gsflow.csv for SeriesSEE Variables Only" and continue with steps 2–5 from the previous section to create a new viewer file.



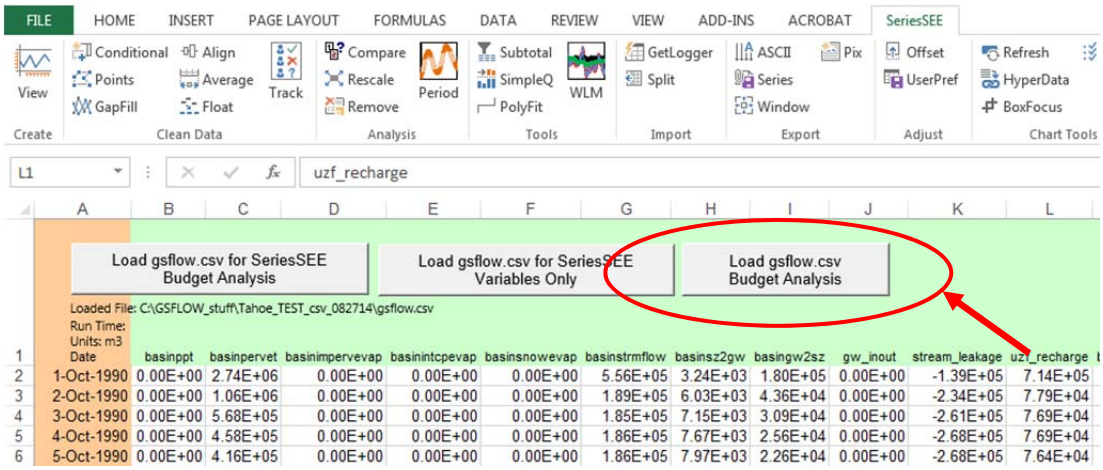
Date	basinppt	basinpervet	basinimpervevap	basinintcpevap	basinsnowevap	basinstrmflow	basinsz2gw	basingw2sz	gw_inout	stream_leakage	uzf_recharge
1-Oct-1990	0.00E+00	2.74E+06	0.00E+00	0.00E+00	0.00E+00	5.56E+05	3.24E+03	1.80E+05	0.00E+00	-1.39E+05	7.14E+05
2-Oct-1990	0.00E+00	1.06E+06	0.00E+00	0.00E+00	0.00E+00	1.89E+05	6.03E+03	4.36E+04	0.00E+00	-2.34E+05	7.79E+04
3-Oct-1990	0.00E+00	5.68E+05	0.00E+00	0.00E+00	0.00E+00	1.85E+05	7.15E+03	3.09E+04	0.00E+00	-2.61E+05	7.69E+04
4-Oct-1990	0.00E+00	4.58E+05	0.00E+00	0.00E+00	0.00E+00	1.86E+05	7.67E+03	2.56E+04	0.00E+00	-2.68E+05	7.69E+04
5-Oct-1990	0.00E+00	4.16E+05	0.00E+00	0.00E+00	0.00E+00	1.86E+05	7.97E+03	2.26E+04	0.00E+00	-2.68E+05	7.64E+04

2. Because there is no budget tag associated with each variable, the grouping tool will not work for this dataset. Each variable can be individually selected for display in the dropdown menus in cells B2:B13.



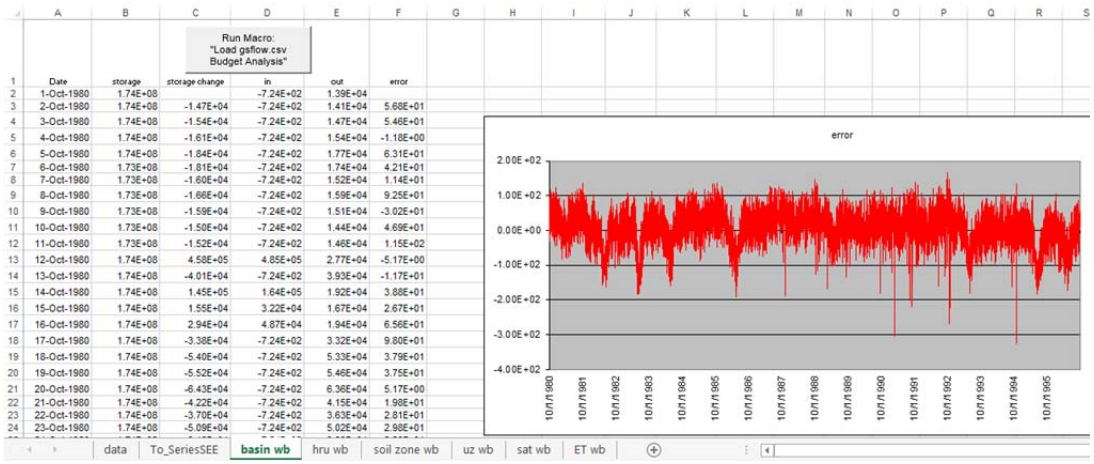
III. **Load gsflow.csv Budget Analysis**—evaluate budgets with Excel alone

In 'data' worksheet in GSFLOW_WBAnalysis_SeriesSEE.xlsm, the button **"Load gsflow.csv Budget Analysis"** pulls data from gsflow.csv into the "data" worksheet and populates each of the water-budget (wb) worksheets with the appropriate variables.



Date	basinppt	basinpervet	basinimpervevap	basinintcpevap	basinsnowevap	basinstrmflow	basinsz2gw	basingw2sz	gw_inout	stream_leakage	uzf_recharge
1-Oct-1990	0.00E+00	2.74E+06	0.00E+00	0.00E+00	0.00E+00	5.56E+05	3.24E+03	1.80E+05	0.00E+00	-1.39E+05	7.14E+05
2-Oct-1990	0.00E+00	1.06E+06	0.00E+00	0.00E+00	0.00E+00	1.89E+05	6.03E+03	4.36E+04	0.00E+00	-2.34E+05	7.79E+04
3-Oct-1990	0.00E+00	5.68E+05	0.00E+00	0.00E+00	0.00E+00	1.85E+05	7.15E+03	3.09E+04	0.00E+00	-2.61E+05	7.69E+04
4-Oct-1990	0.00E+00	4.58E+05	0.00E+00	0.00E+00	0.00E+00	1.86E+05	7.67E+03	2.56E+04	0.00E+00	-2.68E+05	7.69E+04
5-Oct-1990	0.00E+00	4.16E+05	0.00E+00	0.00E+00	0.00E+00	1.86E+05	7.97E+03	2.26E+04	0.00E+00	-2.68E+05	7.64E+04

For each budget, the appropriate variables are grouped and the error term in the continuity equation is calculated. Users can step through the various worksheets to evaluate model performance.



The macro allows the user to evaluate budgets without the SeriesSEE add-in; however, this approach lacks the data-investigation and data-manipulation functionality of SeriesSEE.