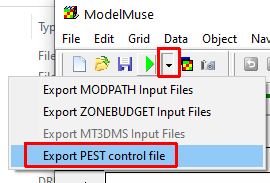
ModelMuse with Support for PEST – Beta 6

# Summary

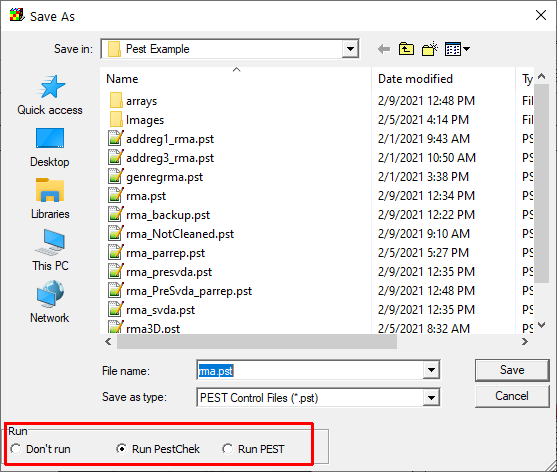
* The command to export the PEST control file has been renamed and the functionality is a little different.
* Prior information equations are automatically added to the PEST control file.
* The PEST Regularization mode is now supported.
* Both Singular Value Decomposition and Tikhonov regularization are supported.
* Some PEST utilities can be called from within ModelMuse.
* A regularization example is described in this document.
* The example shows how to display the model input after PEST has calibrated the model.

# Running PEST

The command for generating the PEST Control File has been renamed. It is now accessed by selecting “File|Export|PEST|Export PEST control file”. The command can also be accessed through the “down” arrow next to the “Run model” button.



In the dialog box for running PEST, you now have a choice between not running PEST, running PESTCHEK, or running PEST. By default, it will run PESTCHEK as illustrated below.

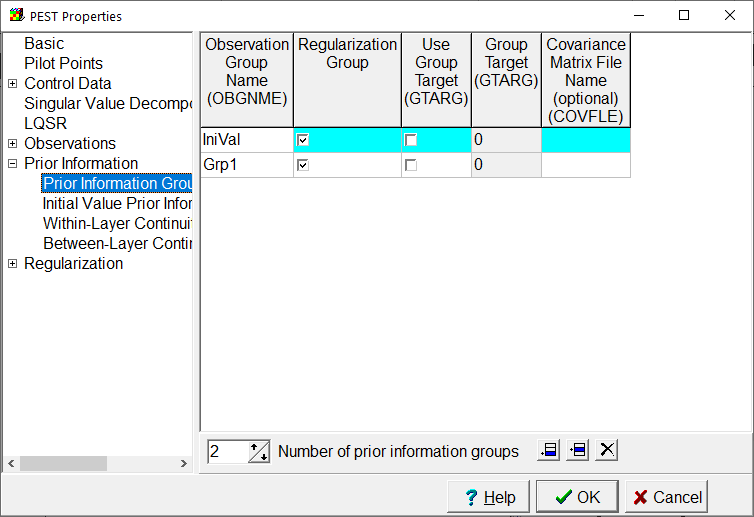


# Prior Information

There are three types of prior information that are included by default in the PEST control file: initial value prior information, within-layer continuity, and between-layer continuity. The user must also define observation groups for prior information. The prior information is defined in the “Model|PEST Properties” dialog box. The prior information equations added by ModelMuse are modeled after those that can be added using the PEST Utility program ADDREG1 and the PEST Groundwater Utility program GENREG.

## Observation Groups for Prior Information

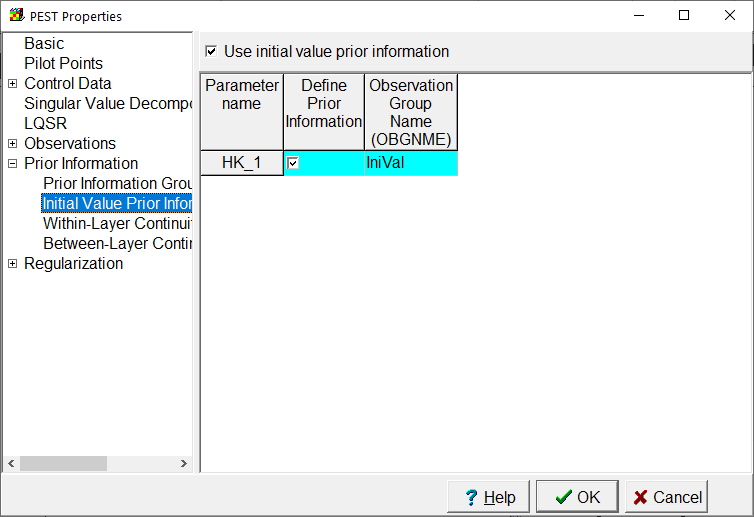
Observation groups for prior information are defined on the “Prior Information Groups” pane. The information required for these groups is the same as for observations groups for observations.



## Initial Value Prior Information

Initial value prior information is specified on the “Initial Value Prior Information” pane as illustrated below. All parameters that are not fixed or tied are listed on this pane. This type of prior information will be included if the checkbox at the top of the pane is checked. If it is checked, prior information equation will be included in the PEST control file for all the parameters in which “Define Prior Information” check box is checked. If the parameter uses pilot points, equations for the pilot points associated with the parameter will also be defined. All the prior information equations will specify that the parameter values are unchanged from their initial values. These equations are similar to the ones that would be added with the ADDREG1 PEST Utility program.

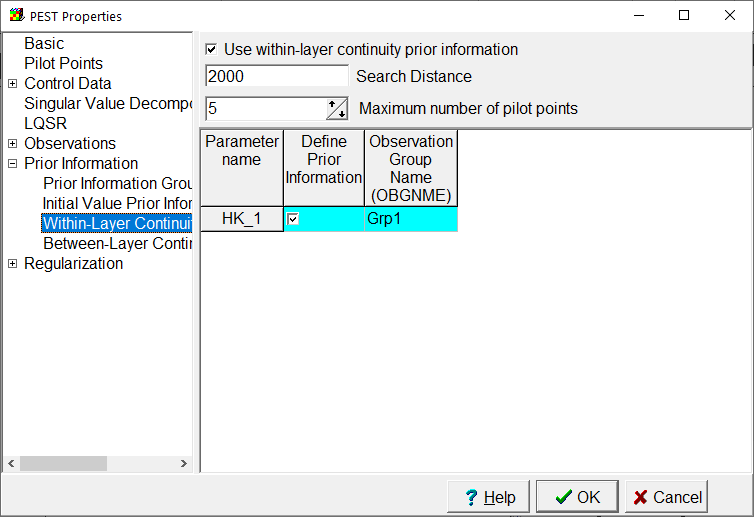
You should also select an Observation Group for each parameter for which prior information will be used. (If you don’t select one, one will be created for it when the PEST Control File is exported.)



## Within-Layer Continuity Prior Information

The “Within-Layer Continuity Prior Information” is used to define prior information equations between neighboring pilot points that are all related to a single parameter of a single layer of the same data set. There is a checkbox at the top of the pane that determines whether this sort of prior information will be included in the PEST control file. The table includes parameters that are used with pilot points and are not fixed or tied. In addition, there are two additional controls: “Search Distance” and “Maximum number of pilot points”. For each related pilot point, ModelMuse will search for other pilot points that are no more than the search distance away from it. Prior information equations will be generated between the closest points within the search distance until the Maximum number of pilot points has been equaled or exceeded. The Maximum number of pilot points is not a strict limit because multiple pilot points at equal distances will all be included. For example, suppose the pilot points were arranged in a regular square grid pattern and the maximum number of pilot points was 5. For a pilot point in the center of such a grid, there would be four pilot points that were closest to it. Prior information equations would be written for all of them. Further out there would be four more pilot points that were all an equal distance from it. Rather than choosing one of these points arbitrarily, prior information equations would be written for all of them.

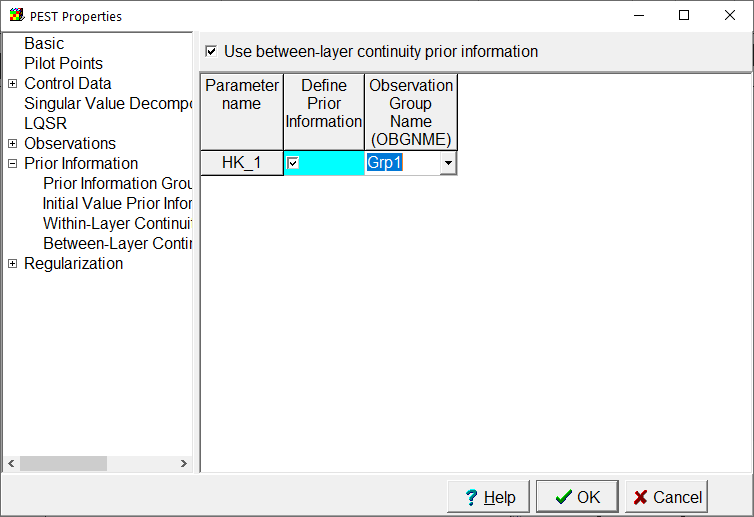
The equations described above would be similar to one way that the PEST groundwater utility program GENREG can create prior information equations. However, GENREG has additional options beyond what ModelMuse provides. To use those options, the user should deactivate within-layer continuity prior information for one or all of the parameters and instead use GENREG.



## Between-Layer Continuity Prior Information

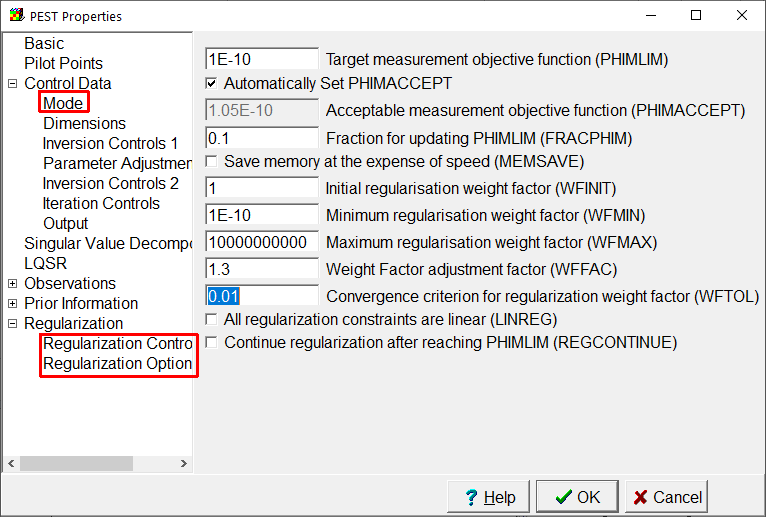
The “Between-Layer Continuity Prior Information” is used to define prior information equations between pilot points at the same location that are all related to a single parameter in adjacent layers of the same data set. The parameters included in the table for between-layer continuity prior information are those that use pilot points.

The equations described above would be similar to one way that the PEST groundwater utility program GENREG can create prior information equations. However, GENREG has additional options beyond what ModelMuse provides. To use those options, the user should deactivate between-layer continuity prior information for one or all of the parameters and instead use GENREG.



# Regularization

ModelMuse now supports using PEST in regularization mode. Values for the regularization section are specified in two panes in the “Model|Pest Properties” dialog box as illustrated below. The regularization mode is selected on the Mode pane.



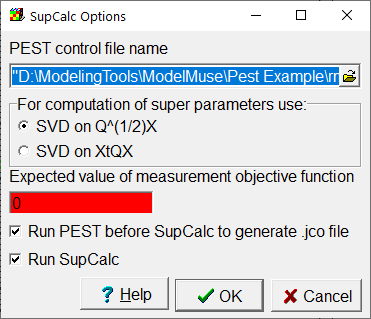
# Super Parameters

PEST allows the user to substitute “super parameters” for the user defined parameters through the use of the SVD-Assist methodology as detailed in chapter 10 of the PEST documentation. To do this, the user first must generate a .jco file that records parameter sensitivities. This is then used with the PEST utility program SUPCALC to estimate the number of super parameters that can be estimated. Next, the PEST control file is modified with the PEST utility program SVDAPREP and PEST is run with the modified PEST control file.

While these procedures can be done outside of ModelMuse, ModelMuse can help automate the process by generating the input for SUPCALC and SVDAPREP.

## Calculating the Number of Super Parameters

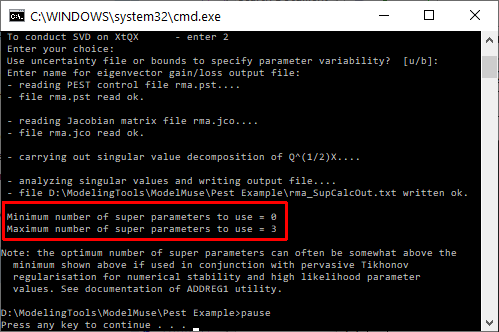
To determine the number of super parameters, select “File|Export|PEST|Calculate number of super parameters”. The SupCalc Options dialog box will appear.



In the dialog box, the user must select an existing PEST control file to modify and you must specify a value greater than zero for the expected value of the measurement objective function. ModelMuse will first back up the control file you specify and export a new one in which NOPTMAX is set to -2. This control file will be run by PEST to create the .jco file required by SUPCALC. After PEST has been run the backed up PEST control file will be restored. The other options in the SupCalc Options dialog box are the ones the user is most likely to wish to specify. For the remaining SUPCALC options, the input provided by ModelMuse directs SUPCALC to use its defaults. If the user wishes to change these other options, SUPCALC can be run from the command line manually instead of running it through ModelMuse.

When the user clicks OK, a batch file will be created that the runs SUPCALC. It will also

When SUPCALC has finished running, it will write to the screen the minimum and maximum number of super parameters to use. This can assist the user in running SVDAPREP.



## Running PEST with Super Parameters

After choosing the number of super parameters to use, SVDAPREP can be used to create a new PEST control file incorporating the super parameters. To run SVDAPREP, select “File|Export|PEST|Modify PEST control file with SVDAPREP”. The SVDAPREP Input dialog box will appear.

