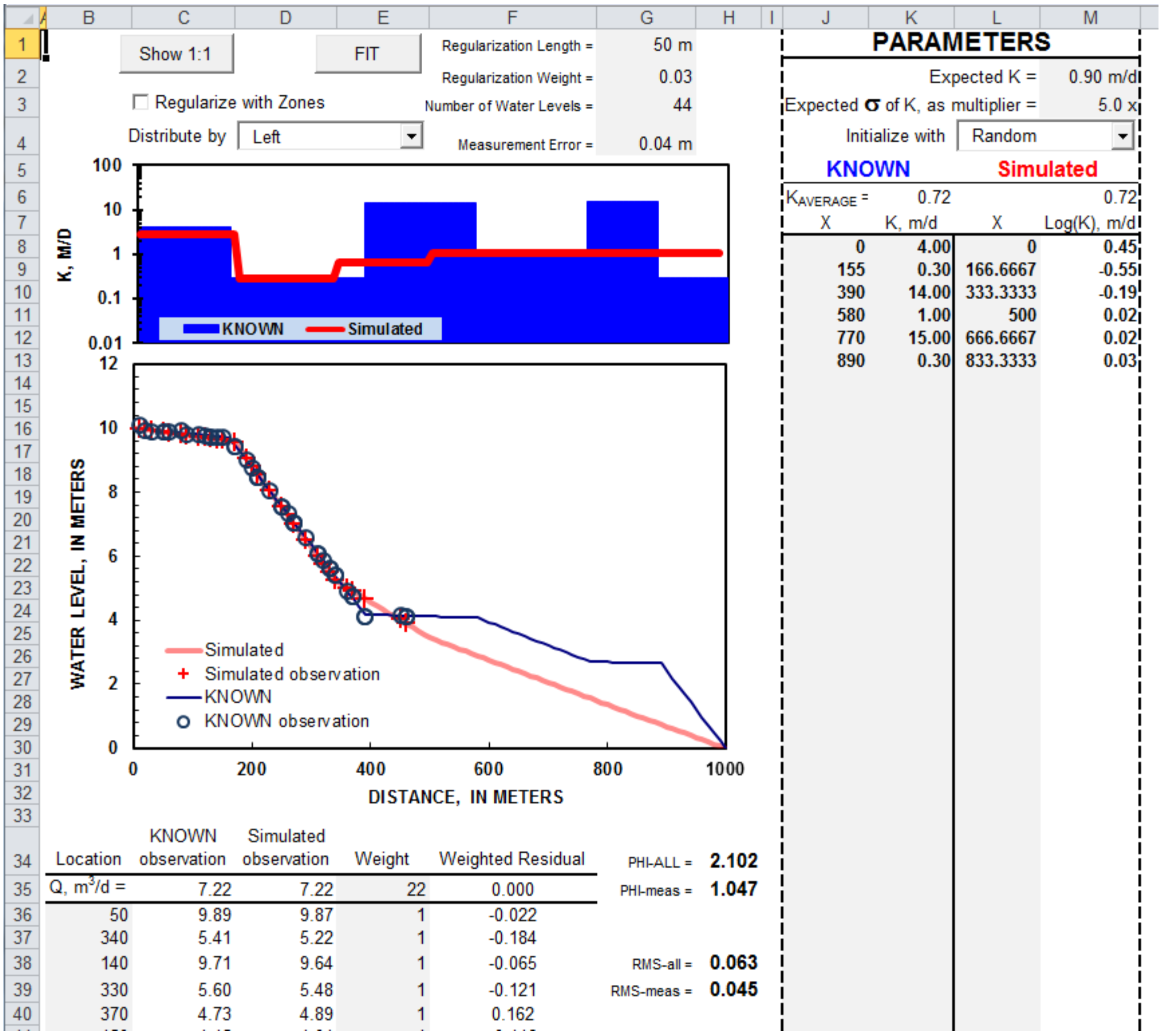
The RegularizeParameters-Compare.xlsm workbook demonstrates advantages & disadvantages of "a few zones without Tikhonov regularization" and "a bunch of zones with Tikhonov regularization."



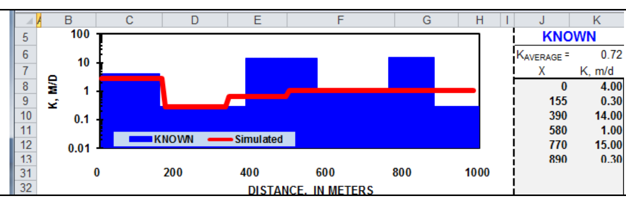
Location	KNOWN observation	Simulated observation	Weight	Weighted Residual
Q, m³/d =	7.22	7.22	22	0.000
50	9.89	9.87	1	-0.022
340	5.41	5.22	1	-0.184
140	9.71	9.64	1	-0.065
330	5.60	5.48	1	-0.121
370	4.73	4.89	1	0.162

KAVERAGE =	0.72		0.72
X	K, m/d	X	Log(K), m/d
0	4.00	0	0.45
155	0.30	166.6667	-0.55
390	14.00	333.3333	-0.19
580	1.00	500	0.02
770	15.00	666.6667	0.02
890	0.30	833.3333	0.03

Geologic and hydrologic model

The model is a 1-D flow tube where the true K is defined by zones in columns J & K

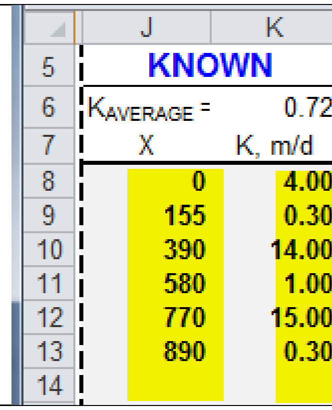
The 1-D model is assumed to have a homogeneous K from the geologic framework.



Known K is defined from X in a row to X in the next row or until the end of the model.

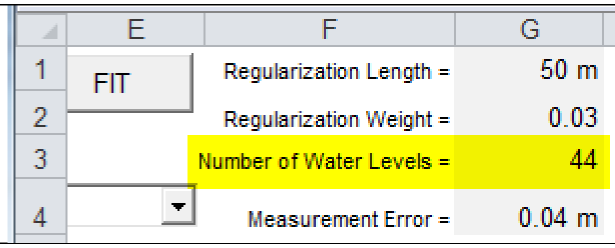
For example,
K = 4m/d for X between 0 and 155 m or
K = 0.3 m/d for X between 890 and 1,000 m, which is the end of the model.

The known distribution can be defined with a single value or as many as 100.

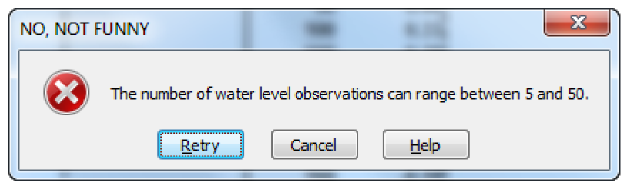


Define measured observations

Specify number of water-level observations, cell G3.

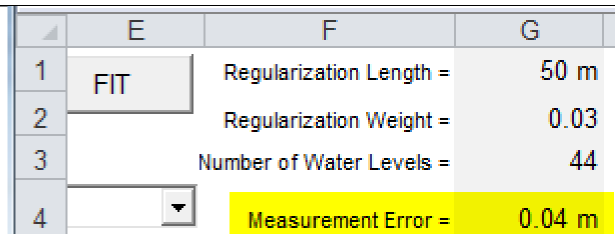


Number of water-level observations must range between 5 and 50.



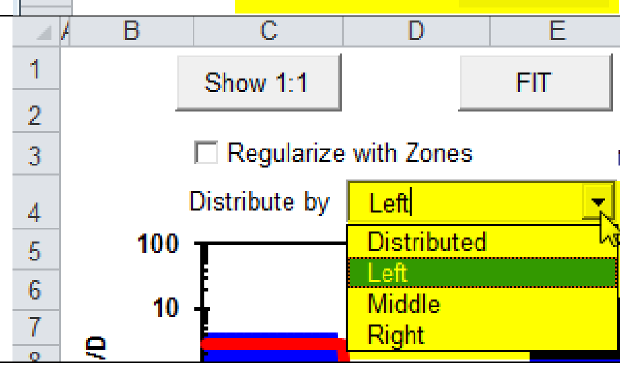
Random, normally distributed error that is added to “measurements” from the known model are specified in cell G4.

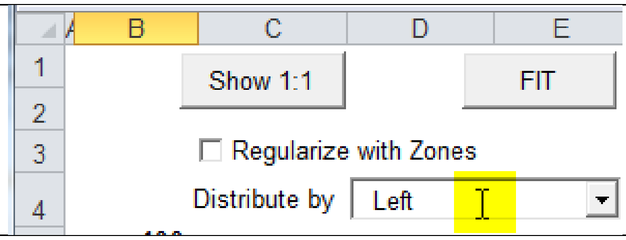
The specified value is the standard deviation.



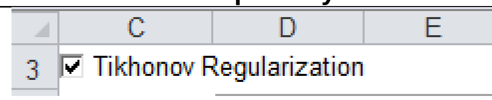
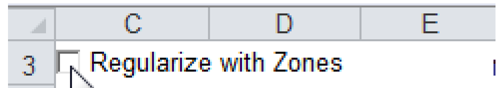
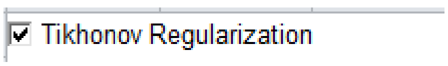
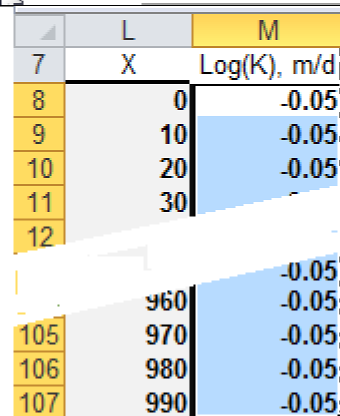
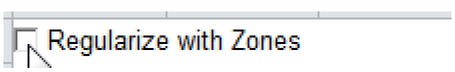
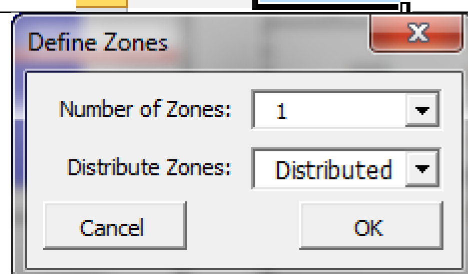
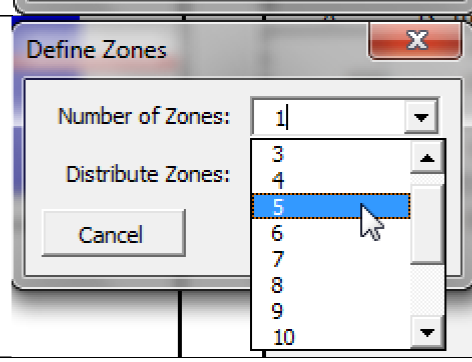
Known water levels are calculated and distributed with the combo box in cell D4.

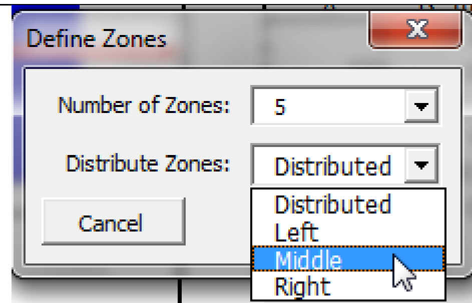
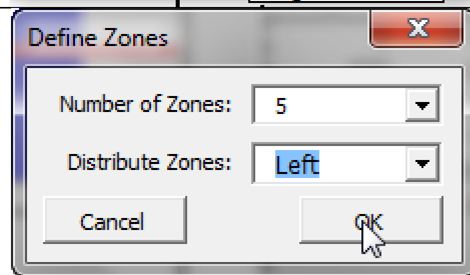
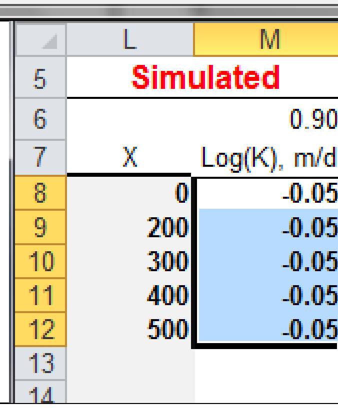
Measurements can be bunched on the left, in the middle, or on the right.   Measurements also can be distributed uniformly across the model.



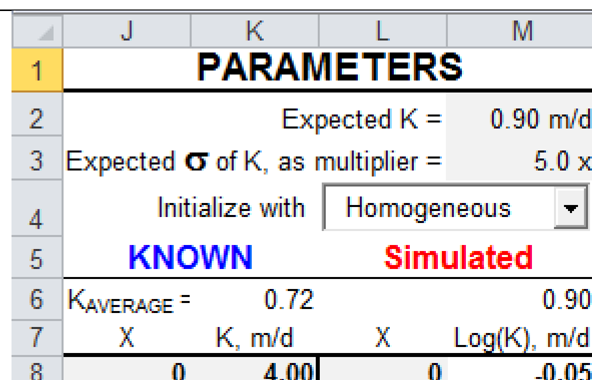
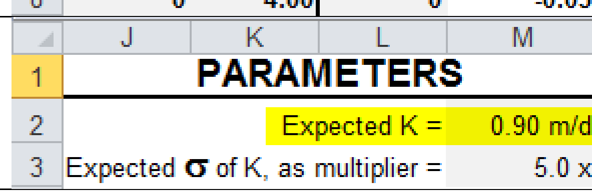
Double-clicking combo box in cell D4 will create a new realization of the measurements with the specified distribution.	

Specify regularization approach and distribute K in model of "Known" aquifer system

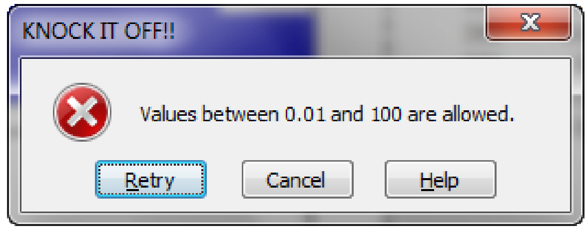
Specify regularization approach with checkbox in cell C3. Regularization approach controls method for distributing K.	 OR 
Select,  , and you are done. 100 independent 10-m wide zones will be created, where local variation of log(K) is constrained with Tikhonov regularization.	
Select,  And a form will appear so zones can be defined.	
Select the number of zones with the pull down in the upper combo box.	

Distribute zones with the pull down in the lower combo box. Zones can be bunched on the left, in the middle, or on the right. Zones also can be distributed uniformly across the model.	
Select OK to create new zones of K.	
Zones of K can be defined manually	

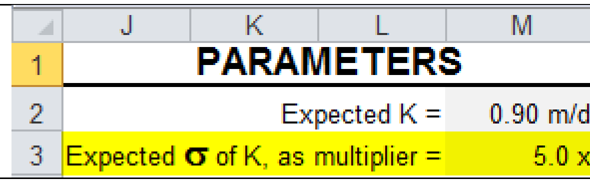
Initialize estimates of K in simulated model

Initial estimates of K in simulated model are defined in cells M2, M3, and L4:M4.	
Mean initial K is specified in cell M3.	

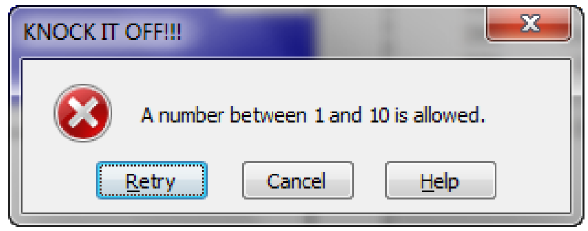
Mean initial K must range between 0.01 and 100 m/d.



Multiple of initial K that equal a standard deviation of log(K) is specified in cell M3. Random and bimodal distributions are created with this value.

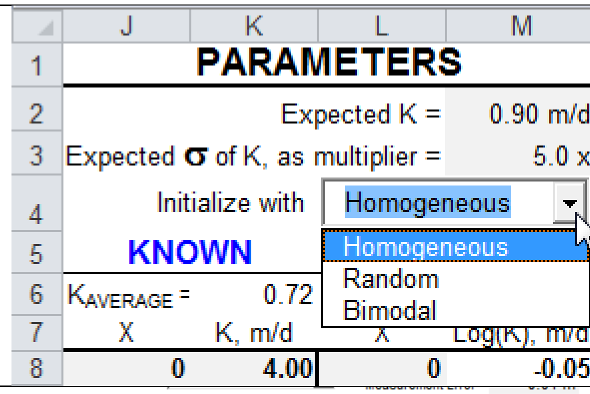


Multiple of initial K that equal a standard deviation of log(K) must range between 1 and 10.

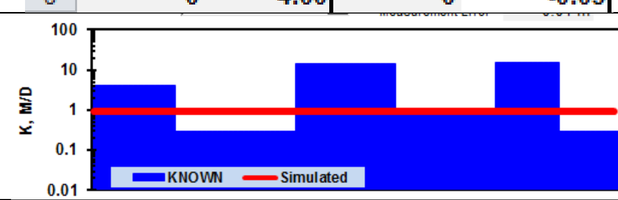


An initial K for each zone is calculated with the combo box in cell L4.

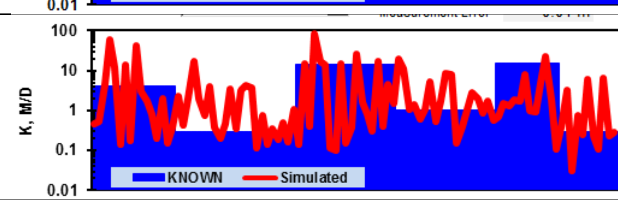
The distribution of initial K estimates can be homogeneous, random, or bimodal.



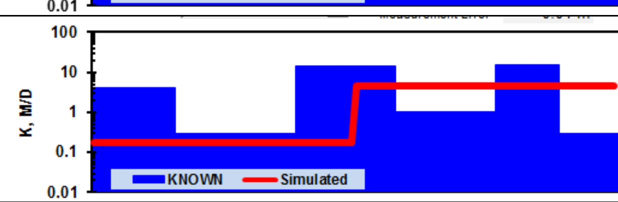
Homogeneous initial distribution of K



Random initial distribution of K

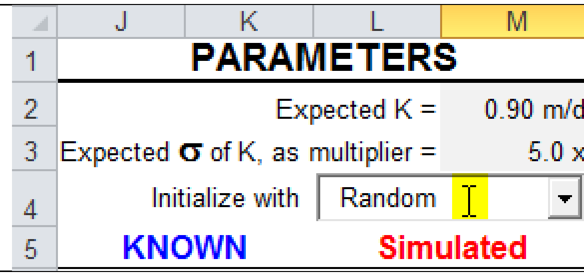


Bimodal initial distribution of K



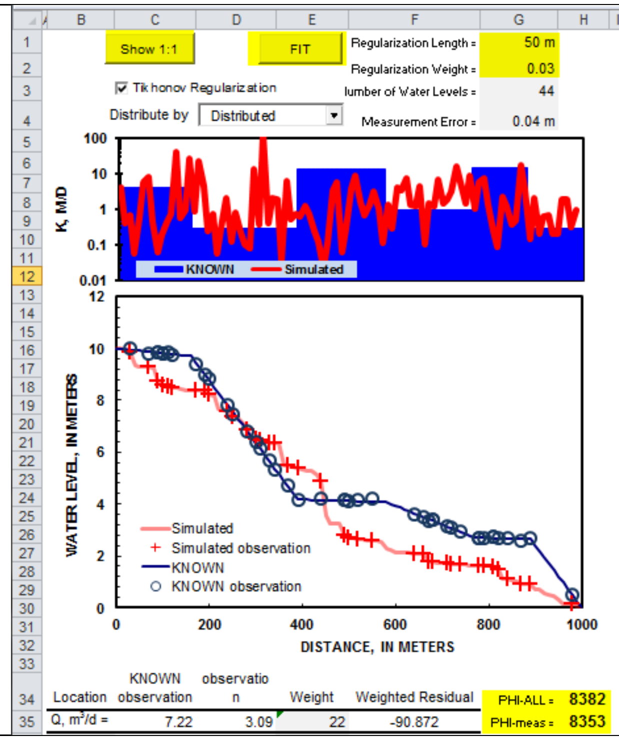
Double-clicking combo box in cell L4 will create a new realization of the initial log(K) estimates.

The zone distribution is NOT changed.



Estimate parameters

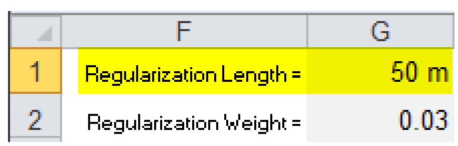
Controls for and cells for specifying regularization information.



Set regularization length in cell G1.

Length is distance where assumption of local homogeneity applied to estimates of log(K).

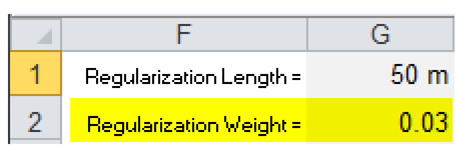
For example, estimates of log(K) at distances between 500 and 600 m will affect estimates of log(K) at 550 m with a regularization length of 50 m.

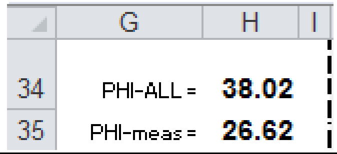
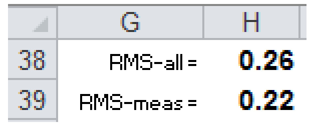
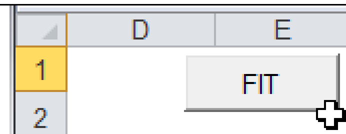
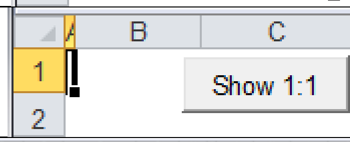


Set regularization weight in cell G2.

Bigger values reduce the variability of estimates of log(K).

No clever scheme exists to relate the assigned value to PHI-measured.



PHI-ALL is the sum-of-squares error with weighted regularization and measurement observations. PHI-meas is the sum-of-squares error with only weighted measurement observations.	
RMS-ALL is the root-mean- square error with weighted regularization and measurement observations. RMS -meas is the root-mean- square error with only weighted measurement observations.	
Press fit button at cell E1 to minimize differences between simulated and measured water levels and the total flow rate.	
Hold the “Show 1:1” button down to view 1:1 chart.	
1:1 chart is displayed to the right of K and head profiles while “Show 1:1” button is held down.