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HWRS 482

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February 10, 2022

Challenge/Discussion/Glossary

Challenge

**For the initial values of background and inclusion K, plot the flow into the left and out of the right boundary. (The code, as provided, makes this plot for you.)**

**Explain why the values are not constant along the boundary (relate to the definition of a Type I boundary).**

A type 1 boundary is a constant head boundary. The flow in and out of the left and right boundaries aren't constant due to the change in head over the system. Q must be adjusted according to the K values in each cell and the head.

**Explain why the flow distributions are the same for the left and right boundaries.**

The flow distributions are the same for the left and right boundaries because it is a steady state system. What goes in comes out, or flow in equals flow out, and flux in equals flux out.

**Add a plot of the left-to-right flow along a line that passes through the center of the inclusion. What can you learn from comparing this distribution to that seen on the boundaries?**

What we can learn from comparing the flow along a line passing through the center of the inclusion is that there is very low flow through the inclusion, however what comes in initially goes out overall. When we compare them to the distribution that is seen on the boundaries, we can see that a single line through the inclusion has a different flow pattern. It also it shows more flow coming in and going out. This tells us that the water is having a hard time getting through the low K cells.

**Compare the Keq calculated based on the total flow into and out of the domain to the harmonic and arithmetic mean K values calculated based on the area occupied by each medium (rather than the length for a 1D system). Can you draw any general conclusions about the impact of high or low K heterogeneities on the equivalent K for the flow system examined?**

The arithmetic mean is higher than the harmonic and equivalent values.  A general conclusion that we can make from these values is that a higher K inclusion results in a higher K for the entire system. The system has a lower K overall value if the inclusion K is smaller than those of the rest of the grid cells.

Discussion Questions

**Does the equipotential distribution depend on the absolute or relative K values for the background and the inclusion? How would you use the model to test your answer?**

The equipotential distribution depends on the relative K values for the background and the inclusion. If I am understanding the question it is referring to the equipotential lines on a flow map (unless its

referring to a cell being isotropic). If you want to be precise you would have to use the relative values because not all cells have the same K value, and this affects the head gradients. The distribution and the shape of the lines would differ depending on where the water decided to go to around the lower K inclusion. To test this, you could compare outputs of the model for a heterogeneous (lower and higher K inclusions) and a homogeneous system.

**Discuss what it means to say that, for steady state flow, there are equivalent Type I and Type II boundary conditions. How might this be useful in practice?**

To say that steady state flow has equivalent Type 1 and Type II boundary conditions means that the system has a constant head boundaries and constant flux. This means that the system is steady state. What comes in goes out.

**What would you find if you altered your model to consider unconfined conditions??**

I think if we considered unconfined conditions the model wouldn't be as uniform. We would have differing flux values and head gradients. I am assuming that when we take a cross section the top would be a lot more jagged than what a confined system would look like.

Glossary questions:

**What is FloPy? How is it different from MODFLOW and how does it interact with MODFLOW? What are some advantages (easy) and disadvantages (harder) of using FloPy rather than building MODFLOW models manually?**

FloPy interprets MODLFLOW into something a user can understand. It allows MODFLOW to be automated rather than manual. You can input parameters into FloPy and get outputs from graphs and figures. With MODFLOW you would have to manually open and interpret files and create figures on your own. An advantage of FloPy is that it gives you the figures and moves files for you. A disadvantage for FloPy is that you need to able to read python code.

**Given that the distribution of K is always heterogeneous at the small scale, what does it mean to provide one K value per grid cell? What are the implications for the K values we use in models in general? How does this change if we are modeling with different spatial resolutions (i.e. grid cell sizes)?**

What it means to have a K value per grid cell means that the entire cell and the area in that cell a value of that K in all directions (this means the cell is homogeneous, or maybe I heard wrong). The implications for K values in our models is that no matter what section of that cell you choose, the K value will be the same and there is some error in the model when it assumes this. If we model in different special resolutions, it either reduces or increases that error (higher resolution = less error).

**What does it mean for a groundwater model to be confined? How does this simplify calculations of groundwater flux? How do we specify this with cell types in MODFLOW?**

For a ground water model to be confined means that there is no flow going beyond a point in your grid. It could mean that the K values along that boundary are very high, and we could see a flow of 0 around that area. This could simplify groundwater flux as there will be no change in the head and no flow in or out (no pumping). I assume you can specify this in MODFLOW by giving a grid cell a very high K value.