Abigail Kahler, HW 3

**Discussion**

**1** Does the equipotential distribution depend on the absolute or relative K values for the background and the inclusion?

The relative K values are more broadly representative of the system’s overall hydraulic conductivity, so they have more effect on the equipotential head distribution. The arithmetic mean has the greatest discrepancy between the harmonic and equivalent hydraulic conductivities, which is exacerbated at very high and very low inclusion K values. We could test this by calculating and plotting the contour array for each calculation of K at each inclusion value.

**2** 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?

Steady state dictates no change in storage; flux in equals flux out. So, with q = -K dh/dl, setting q\_in and q\_out equal will affect the system in the same way as keeping dh constant. In real applications, one property may be more readily measured than another and being able to model a system with equivalent type of boundary can support the properties that are known.

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

Confined aquifers have a different pressure relationship with total hydraulic head than unconfined. With h = z + ψ, a transient system releases more volume per drawdown in an unconfined aquifer. Comparing the two types of aquifers in a steady state system, I think there would be a greater change in dh/dl. But I’m having trouble reconciling steady state conditions between the aquifers because my understanding of confined and unconfined is based on their respective changes in storage.

**Glossary**

**1** Flopy is a Python application that uses an executable file generated by MODFLOW to run and process a model. It is more easily alterable than working directly with MODFLOW’s .list and .bcf files (for example), but can have a prohibitive learning curve for people who are not familiar with Python.

**2** A single K value per grid cell means the modeler must choose a balance between accuracy and model run time. Shrinking the cells so that a single K value is not spanning too much of the area dramatically increases the computational draw. Because of the difficulty (time, expense) of taking extensive K measurements to cover the entire area, the K values input into the model are generalizations taken to be representative of the system.

**3** 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?

According to some documentation I found, confining a groundwater model affects where the head is calculated. Or, it’s an assessment of the usual heads that are calculated or defined at each node. “A layer is considered confined when the head in the cell is above the top of the cell" could mean that the model is reading the head from the next cell outside of the boundary. Although, confined is in the z direction, not within the layer that we’ve been discussing. https://www.aquaveo.com/blog/2019/02/06/creating-confined-aquifer#:~:text=In%20MODFLOW%2C%20a%20layer%20is,the%20top%20of%20the%20cell.&text=The%20layers%20in%20your%20GMS,%2C%20HUF%2C%20and%20UPW%20packages.

We use the LPF package do define the hydrologic properties of a layer (porosity, specific storage, etc.). The function/variable uncf takes an input of 0 (confined) or greater than 0 (unconfined). We are not currently using LPF, but the same variables are defined in the BCF package. However, uncf is not called while making the BCF object.

The m.writeinput() function might be applying uncf behind the scenes, but the comment says that cell is calling objects and we did not apply uncf when creating any objects.