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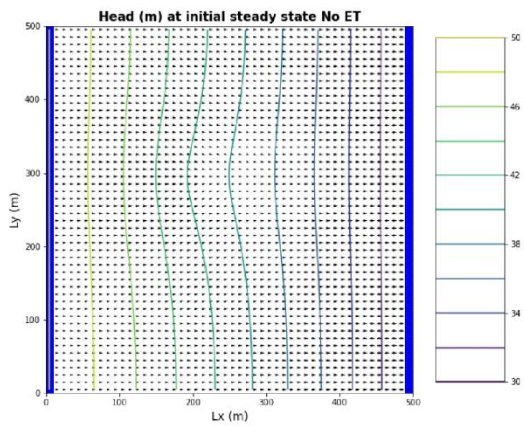
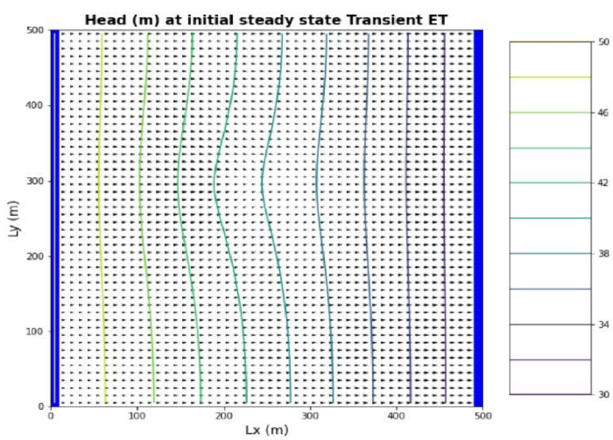
HW 9 Challenge

1.Compare your results for the case with no ET to the modified ET case and explain how your results differ. To do this I'm expecting you will create some plots as well as looking at the water balance



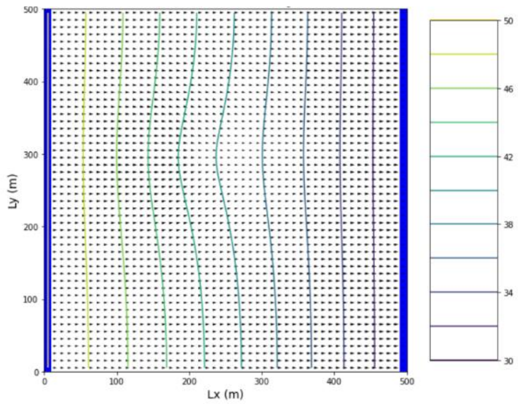

```
Left Flux = 788.2169   Right_flux= 842.16095   Difference = 53.94403
```




```
Left Flux = 793.723   Right_flux= 836.1856   Difference = 42.462585
```

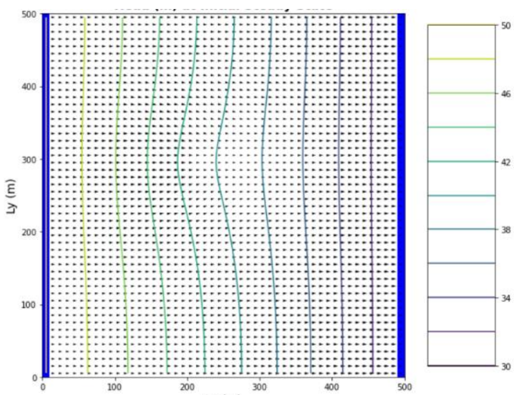
From our plots we do not see a significant difference from the head values and flow patterns at the end of the simulation (10 years) when we add the transient ET vs when there is no ET change. However, when we do a flux calculation, we can see that the values are different coming in and going out. For our left flux, the value we get for no ET is 788 and when we do have ET it is 793, the flux on the left side increased. For our right flux, the value we get for no Et is 842 and when we do have ET it is 836, the flux on the right side decreased. The reason this could happen is that there is some water loss due to the ET values and we get a loss of water in the right boundary, and we get an increase of water in the left due to the well on this location, and the recharge occurring here (it was there initially, over the entire domain).

2.Modify the model so that the ET only occurs in a square area around the well that is 200m by 200m. Discuss how this changes your results using plots and water balance calculations.




```
total ET -3734.696488616988
total recharge 3600.000321865082
Left Flux = 848.62897   Right_flux= 781.91724
```

Head and flow patterns with the total ET, Recharge, and flux values for recharge happening in the entire domain.




```
total ET -705.0454015806317
total recharge 3600.000321865082
Left Flux = 844.5629   Right_flux= 786.3513
```

Head and flow patterns with the total ET, Recharge, and flux values for recharge happening in a box near the well.

As we can see, with the ET happening in the entire domain and in just a box around the well. The figures do not change, however if we take the total ET, Recharge, and the fluxes, there is change. As we would expect there is more total ET when recharge is happening in the entire domain than in just a box. Our recharge values are the same. It seems that the left flux has been reduced when there is only ET in a box near the well. This is because water is being lost to the atmosphere near the well on and off where there is no ET in the rest of the domain allowing for more flux in the right.

3.Modify the recharge in the model so that it is also transient. It's up to you how you want to modify it. Provide and explanation for the scenario you ran and explain how it impacts your results.

It seems that our starter code already had a transient recharge. The figures from above are with a transient recharge over the entire domain. Therefore, I could not think of another way our figures would change, as well as our water balance values. I could have changed the system to where there was no recharge the entire time. I could also decide to put recharge only in the area near the well as we did for ET.

Glossary questions

1.What are initial conditions? Describe various approaches to determining initial conditions for a groundwater model.

Initial conditions are what your system parameters are before you start recording data. Initial conditions for ground water models are the steady state condition. We compare this to our model over time, to see what differences our tuning made to our system.

2.What does it mean for a groundwater model to be 'spun up'? How can we go about achieving this and how would we know if we are done? What can happen if you run transient models on a groundwater model that is not spun up?

When I think of it, spun up would mean that the model was played around with a lot. Meaning that several different "knobs" were turned, and different scenarios were considered. I also think of it meaning that the model overestimates or underestimates, that we set our model either overestimating or underestimating. I will assume that if we run a transient model on a model that is not spun up would give you an invalid answer.

3. Groundwater is generally the slowest moving component of the hydrologic cycle. Describe (1) the speeds at which groundwater flows compared to surface water (2) the time scales over which water tables and groundwater heads respond to changes in pumping vs recharge in both confined and unconfined systems? What are the implications of these timescales for how we model groundwater systems?

Ground water flows are much slower than surface water flows. It could take a few minutes for surface water to reach a point further away, where it takes groundwater more times as it must maneuver subsurface obstacles, such as soil and other particles. Sometimes water is unable to move in the subsurface and it takes longer (years) for it to move outside of that confinement. Recharge can happen over days as we can see with the recharge projects in Tucson area, and it could also take longer depending on the properties of the subsurface. The effects of pumping depend on the rate at which you pump and the amount of water available. The timescales at which these effects work need to be considered, as we can sometimes see little or more change depending on what time we use and what we are using the model for.