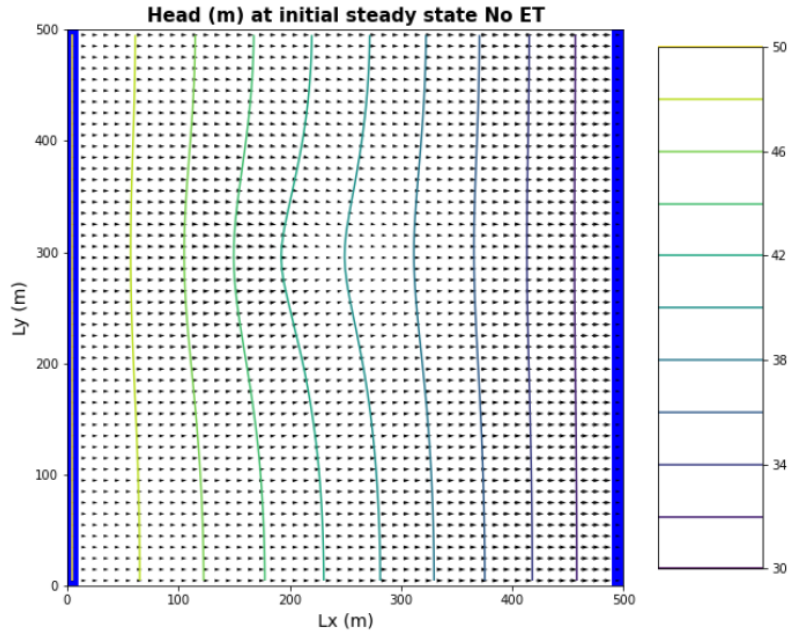


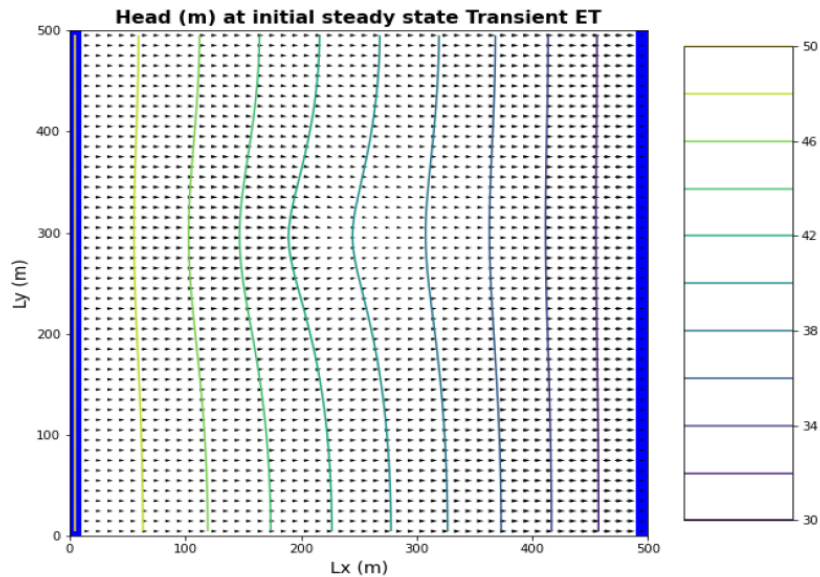
Discussion Questions

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

Fig. 1 Head contours for period with no ET



Left Flux = 793.723 Right_flux= 836.1856 Difference = 42.462585

Fig. 2 Head contours for period with transient ET

As seen in the first plot, the case with no ET demonstrates a larger amount of water that made it through the domain due to the ongoing recharge which can be observed in the water balance difference. As for the second plot where there is a transient ET occurring, there is a smaller difference in the water balance which indicates that less water made it through the domain due to being captured from the ET sink.

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.*

Left Flux = 788.2183 Right_flux= 842.1594 Difference = 53.9411

The most important graphic that demonstrates the effect (or lack thereof) caused by the constrained ET is the above water balance. Comparing this value to the initial steady state with no ET, the water balance difference with constrained ET is only 0.00293 less which suggests the ET has very little effect because the well drawdown is so significant. The two drawdown plots below further demonstrate this minor effect because they look almost identical.

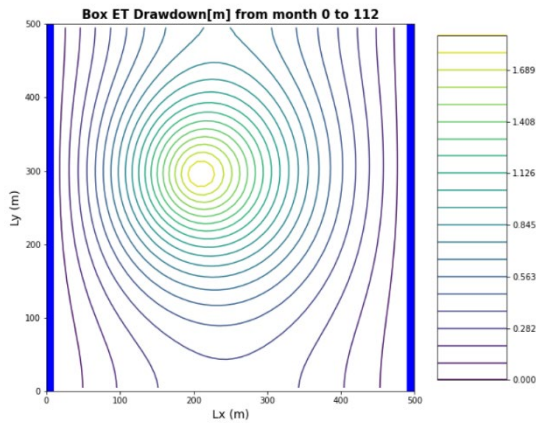


Fig. 11 Box ET

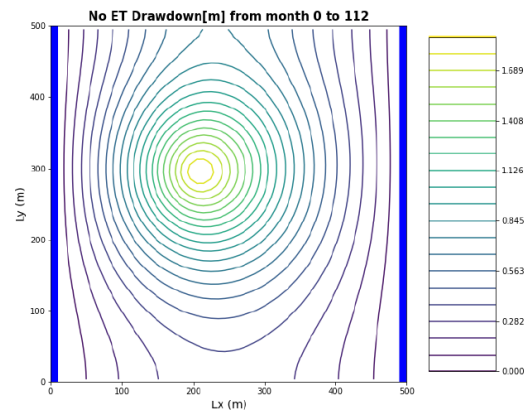
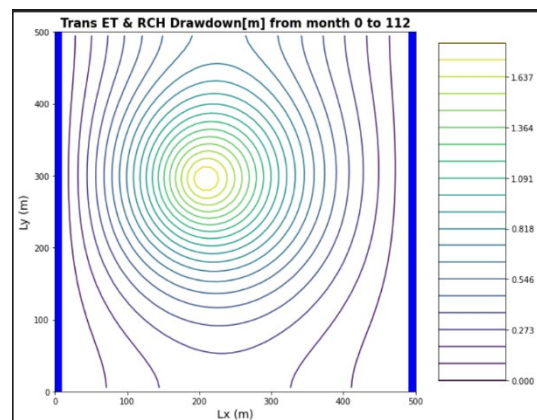


Fig. 5 Drawdown with no ET

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 an explanation for the scenario you ran and explain how it impacts your results.*

For this question, I saw an increase in the evapotranspiration which surprised me. I'm not sure why this would have occurred because I would have expected less ET would occur with non-constant recharge.

Left flux 844.5629
right flux 786.3513
ET -705.05
Recharge 3600.0



Glossary Questions

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

The initial conditions are parameter values set for the initial run of the model. Depending on the model's calculations, their value can have a significant impact or very little at all. Some approaches to determining the initial conditions of a groundwater model include obtaining field measurements of head values at observation wells, hydraulic conductivities from soil cores for a modeling area or referencing geologic maps. No matter the provenance, an important step in determining the initial conditions, the modeler must make assumptions about the temporal and spatial distributions for the initial conditions. The modeler then has the option to test parameter sensitivity to determine what the impact each parameter has on the model and also create an ensemble of models that reflect the initial conditions but yield various results.

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?*

A groundwater model is "spun up" when it has finally reached a dynamic equilibrium. Achieving equilibrium can be observed when the state of the model follows a cyclical pattern and runs through this cycle endlessly no matter how much extra time the model is allowed to go on for. Running groundwater models that are not spun up can result in conclusions that don't reflect the expected forecast. Models should result in spun up conditions so that the modeler can be sure their model is stable.

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?*

Groundwater flow often uses velocity units of m/day whereas surface water is measured in m/s due to the relatively high speeds of surface water. In all cases, confined aquifers transmit changes in groundwater heads at higher rates than unconfined aquifers of the same storage capacity and hydraulic conductivity because the higher-pressure gradients found in the confined aquifer allow these changes to propagate faster. Of course, the answer to this question also depends on the distance of observation from the location of pumping and recharge. In pumping, the effects of radial flow cause the pumping impacts to drastically reduce at distance because of the cross-sectional area that greatly increases for the cone of depression. The implications of these realities are that we as modelers need to build our models according to large timescales that incorporate decades if not quarter centuries.