1. Explain the concept of stress periods in MODFLOW. How should you determine stress periods when setting up your model? How do they differ from timesteps?

A stress period in MODFLOW is a time period within the model where the model inputs are the same. For example, a model where you want to test two wells turning on and off would have two stress periods (one period for when the wells are on, one period for when the wells are off). Stress periods can be determined by analyzing your inputs for any parameters of interest that may change over the total time you will run the model. Conceptually, this can be thought of as looking for state changes within your input parameters. Depending on how many state changes you have in your input parameters, you may need to have more or less stress periods to account for those changes. Timesteps represent the time it takes for MODFLOW to solve the model over the total model timeframe. A stress period can contain multiple timesteps, and the timesteps it takes for MODFLOW to find a solution to the model can vary for each stress period (see Question 3).

1. What is the period length in MODFLOW? How does the meaning of the period length differ for a steady state vs non steady state solution?

Period length represents how long in time the total stress periods will take when the model is run in MODFLOW. A steady state stress period is not time dependent, so the lengths are essentially arbitrary and can be set to anything. In a non-steady state solution, the length of stress periods is dependent on the total time the model will be simulating. For example, if a model is set to run for 70 years then the model would have 70 instances of the stress periods (one set of stress periods per year). The stress periods themselves have their own individual lengths of time that must be set prior to creating the total period length variable.

1. What does the nstep variable signify in MODFLOW and how does it relate to the stress periods and period lengths? List the pros and cons of taking large timesteps vs. small timesteps. Is there any limit to how large a time step you can take and if so what determines this limit?

The nstep variable indicates how often MODFLOW will output solutions of the model. The nstep divides up the stress period lengths to solve the model incrementally over the whole model timeframe. The nstep can be thought of as similar to the timestep concept discussed in Question 1. The size of the nstep can affect how quickly the model will run as well as the resolution of the model’s results. See the chart below for pros and cons of using large and small timesteps:

|  |  |
| --- | --- |
| **Pros and Cons of Timestep Sizes** | |
| **Small Timesteps** | **Large Timesteps** |
| Pro: Greater temporal resolution, more likely to capture small changes in model outputs | Pro: Model runs quickly, can process lots of data in short amount of time |
| Con: Can slow down model depending on the length of the overall timeframe | Con: Reduction in resolution of model outputs |

In theory a timestep could be as large as the total timeframe being examined in the model, however this setup will not yield useful results. While the model would produce outputs quickly, the size of the timestep would be too large to examine any changes occurring throughout the model run.