University of Cincinnati

GEOL 6024: GroundWater Modeling

Github Example

Project Report

Submitted By

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Github Example

Link: `https://github.com/modflowpy/flopy`

Introduction

This model is very basic model on a simple grid to show what flopy can do, and be familiar with the functions and classes in flopy.

Code

First Let's load libraries, flopy is the flopy library and matplotlib is for plotting the plots, flopy also uses this internally for the plots.

—— code: python ——
```python
import flopy
import matplotlib.pyplot as plt
```

We also need to define the working directories flopy will save the modflow model in that directory with given name. Here we also give the exe_{name} which is the modflow executable to be called for simulation.

—— code: python ——
```python
ws = './models/01_github_example/'
name = '01_git_ex'
sim = flopy.mf6.MFSimulation(sim_name=name, sim_ws=ws,
  exe_name='modflow-mf6')
```

After we have a simulation object, we can add more packages. Here tdis package is for time descretization we're using the default values as we don't have timesteps.

I don't know what ims package does.

gwf is groundwaterflow package.

—— code: python ——
```python
tdis = flopy.mf6.ModflowTdis(sim)
ims = flopy.mf6.ModflowIms(sim)
gwf = flopy.mf6.ModflowGwf(sim, modelname=name, save_flows=True)
```

Here we define descretization package which will take number of rows and columns and make a grid internally. We're using 10x10 grids.

—— code: python ——
```python
dis = flopy.mf6.ModflowGwfdis(gwf, nrow=10, ncol=10)
ic = flopy.mf6.ModflowGwfic(gwf)
npf = flopy.mf6.ModflowGwfnpf(gwf, save_specific_discharge=True)
```

Now we can use chd package which is used for constant head conditions, we have assigned two points with heads 1 and zero we we can see the flow from higher head to lower.

```python
chd = flopy.mf6.ModflowGwfchd(gwf, stress_period_data=[[(0, 0, 0),
↪    1.],
                                                       [(0, 9, 9),
                                                        ↪   0.]])
```

Now the oc package will be used to give the filenames for where the results will be saved. We can load these files directly and use the data next time if running model everytime is troublesome.

```python
budget_file = name + '.bud'
head_file = name + '.hds'
oc = flopy.mf6.ModflowGwfoc(gwf,
                            budget_filerecord=budget_file,
                            head_filerecord=head_file,
                            saverecord=[('HEAD', 'ALL'),
                            ↪   ('BUDGET', 'ALL')])
```

After we have all the packages we use `write_simulation()` function to write the files for the simulation that will be used my modflow when we use `run_simulation()`.

```python
sim.write_simulation()
sim.run_simulation()
```

```
| True | nil |
```

The output of `run_simultion()` is `True`, hence the model run was successful.

We can extract the values from the model. We can also extract them using the output files we saved using oc package.

```python
head = gwf.output.head().get_data()
bud = gwf.output.budget()
```

The output files for head and bud are binary files and are quite hard to read (even more so because 3D data are compressed to 1D), so we're going to use postprocessing tools to get the data we want. Let's get the specific discharge values so we can use them to plot arrows in the plan to show the direction of flow.

```python
spdis = bud.get_data(text='DATA-SPDIS')[0]
qx, qy, qz =
↪   flopy.utils.postprocessing.get_specific_discharge(spdis, gwf)
```

Now we can use model structure and the output to make plots.

```python
pmv = flopy.plot.PlotMapView(gwf)
pmv.plot_array(head)
pmv.plot_grid(colors='white')
pmv.contour_array(head, levels=[.2, .4, .6, .8], linewidths=3.)
pmv.plot_vector(qx, qy, normalize=True, color="white")
```

If you want to save the figure use this. You can save png or pdf. You can use `plt.show()` to view it.

```python
plt.savefig("./images/1_results_plan.pdf")
plt.show()
```
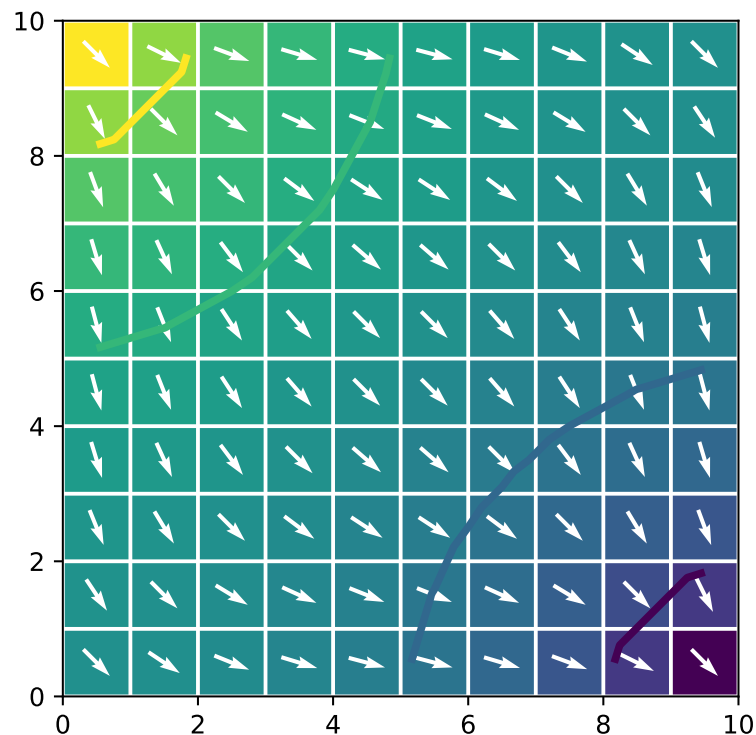

We got the result which is same as that in the example. So it was a success.