MODFLOW with Flopy (3)

modeling wells with well package

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CEE 696

Pumping well for optimization

Back to Example 1

A horizontal confined aquifer (1000 x 1000 x 50 m) with constant head on the western and eastern boundaries (h_{west} = 10 m, h_{east} = 0 m), no flow condition on northern and southern boundaries. Horizontal and vertical hydraulic conductivity are given by 10 m/d.

`https://github.com/modflowpy/flopy/blob/master/examples/Tutorials/Tutorial01/tutorial01.py`

my_first_flopy_scipt.py

1. Create a MODFLOW model object
2. Discretization package (DIS)
3. Basic package (BAS)
4. Layer Property Flow (LPF) package
5. Output Control (OC)
6. Linear System Solver (PCG)
7. Write MODFLOW inputs
8. Run MODFLOW
9. Post-processing

my_second_flopy_scipt.py (1)

1. Create a MODFLOW model object
2. Discretization package (DIS)
3. Basic package (BAS)
4. Layer Property Flow (LPF) package
5. Well package (WEL) - with a pumping well at the center
6. Output Control (OC)
7. Linear System Solver (PCG)
8. Write MODFLOW inputs
9. Run MODFLOW
10. Post-processing

my_second_flopy_scipt.py (2) - MODFLOW well package

```
# Add well package to the previous example
# Remember to use zero-based layer, row, column indices!
pumping_rate = -50.
wrow = ncol/2 - 1
wcol = nrow/2 - 1
wel_sp = [[0, wrow, wcol, pumping_rate]]
spd = {0: wel_sp}
wel = flopy.modflow.ModflowWel(model = mf,
       stress_period_data=spd)
```

---

model modflow object.

stress_period_data list of dictionaries

- Indices of the dictionary are the numbers of the stress period
- Each well is defined through definition of layer (int), row (int), column (int), flux (float)

my_second_flopy_scipt.py (3) - Post-processing

```
import matplotlib.pyplot as plt
import flopy.utils.binaryfile as bf


hds = bf.HeadFile(modelname+'.hds')
times = hds.get_times()
head = hds.get_data(totim=times[-1])

cbb = bf.CellBudgetFile(modelname+'.cbc')
frf = cbb.get_data(text='FLOW RIGHT FACE',
                   totim=times[-1])[0]
fff = cbb.get_data(text='FLOW FRONT FACE',
                   totim=times[-1])[0]

# extent = (delr/2.,Lx - delr/2.,delc/2.,Ly - delc/2.)
# Flopy coordinate origin at the upper left!
wpt = ((wcol+0.5)*delr, Lx - ((wrow + 0.5)*delr))
```

my_second_flopy_scipt.py (4) - Plotting

```
fig = plt.figure(figsize=(10,10))
ax = fig.add_subplot(1, 1, 1, aspect='equal')

modelmap = flopy.plot.ModelMap(model=mf, layer=0)

lc = modelmap.plot_grid()
cs = modelmap.contour_array(head,
                            levels=np.linspace(0, 10, 21))
plt.clabel(cs, inline=1, fontsize=10, fmt='%1.1f',
           zorder=11)
plt.plot(wpt[0],wpt[1],'ro')
plt.show()
```

Exercise

- Change pumping rates: Q = -100, -1000, 100, 1000
- Change grid size: ncol = 50, nrow = 50
- Change boundary conditions: left and constant heads = 0 (you need to change levels in clabel)