Bredehoeft Steady State Seepage Calculator

Bredehoeft, J.D. and Papadopulos, I.S., 1965. Rates of vertical groundwater movement estimated from the Earth's thermal profile. Water Resour. Res., 1(2): 325-328

This notebook utilizes steady-state sediment temperature profile to estimate groundwater seepage flux. Users are encouraged to familiarize with the theory beforehand. The only assumed parameters in the steady-state models are volumetric heat capacity of water (ρfcf) and thermal conductivity (k) of the saturated porous media. Please look up the worksheet - "Parameter Metadata" for applicable parameter values.

In [ ]:
```
from numpy import exp
from scipy.optimize import fsolve

conductivity = 1.56
heat_capacity = 4190000
sed_temp_shallow = 19.87
sed_temp_mid = 17.53
sed_temp_deep = 16.21
shallow_mid_dist = 0.3
mid_deep_dist = 0.7

expected = 0.0807

estimate = 1
```

In [ ]:
```
func = lambda x: ((sed_temp_mid - sed_temp_shallow) / (sed_temp_deep - sed_temp_shallow) - (
                  (exp(x * (shallow_mid_dist / mid_deep_dist)) - 1) / (exp(x) - 1)))
```

In [ ]:
```
solve_solution = fsolve(func, estimate)
```

In [ ]:
```
print(len(solve_solution))
if len(solve_solution) == 1:
    C27 = solve_solution[0]
    qz = (-1 * conductivity * C27 * 86400) / (heat_capacity * mid_deep_dist)
    print(f"Expected: {expected}")
    print(f"Actual:   {qz}")
```

In [ ]: