# Practical exercises:

**Exercise**

To conduct solute transport simulations, you first need a steady state groundwater flow model. You can use the homogeneous steady-state hydraulic model we have been using in the last couple weeks. However, I recommend increasing the hydraulic gradient to 10 m to obtain higher flow velocities. Simulate the transport of an initial tracer concentration of 50 kg/m³ on the left side of your domain (e.g., column=5 & row=25) for 100 days (8640000 s). Assume negligible retardation (Rd = 1.0), a diffusivity of 0.00001 m²/s and a dispersivity length of 0.1 m. When conducting the simulation, make sure to tick the CFL criteria flag to ensure a small time step. Note, that you need to provide a raster map for groundwater sources/sinks (q) due to a bug in the current Grass GIS version. However, this map can be zeros.

# Theoretical exercises:

**Exercise**

Explain the difference between RAM and SDD for data storage.

**Exercise**

Name three computer components which are critical for conducting advanced groundwater simulations and explain the role of each of those components on the performance of the simulation.

**Exercise**

Explain the difference between serial and parallel computing with respect to a groundwater flow model.

**Exercise**

Explain the differences between parallelization techniques of shared and distributed memory.

**Exercise**

Explain the term computational cost.

**Exercise**

Explain the difference between integer and floating-point arithmetic.

**Exercise**

Name the relationship between bit and byte.

**Exercise**

Calculate the memory demand of a 200 x 100 raster map of integers and of a similar sized raster map storing double precision float.

**Exercise**

Specify the number of arithmetic calculations necessary to solve the following equation: Tnew = Told + dt* k/eta * (a – 2.0 b + c) / dx^2

**Exercise**

Reduce the number of arithmetic calculations necessary to obtain the result of the following equation: 3.2 * 7.6 + 3.5 * 3.2