Practical exercises:

Exercise

Take a look at the example given in the manual of r.gwflow. Make yourself familiar with the syntax of the commands used in the example, especially r.mapcalc and r.gwflow.

a) What does each of those two commands do?
b) What does each of the input parameters (phead, status, hc_x, hc_y, s, top, bottom, output, type, dtime) required for r.gwflow stands for?

Exercise

Find typical values for the hydraulic conductivity and the effective porosity for a sand. Generate rastermaps for those two values and set up top and bottom of an unconstrained aquifer with a thickness of 10 meters. What are typical values for groundwater recharge in Germany?

Theoretical exercises:

Exercise

a) Write down the equation for horizontal groundwater flow from the lecture slides. Name all occurring parameters and provide their units.
b) Write down the equation to describe the relationship between transmissivity and hydraulic conductivity. Also, express the relationship in your own words.
c) Write down the equation to describe the relationship between flow velocity, hydraulic conductivity and piezometric head. Name all occurring variables, parameters and provide their units. Also, express the meaning of the equation in your own words.
d) Provide typical value ranges for hydraulic conductivity and effective porosity for a sandy, silty and karstic aquifer.

Exercise

a) Read the manual of r.gwflow at https://grass.osgeo.org/grass79/manuals/r.gwflow.html
b) Locate the differential equation solved by r.gwflow and compare it to the mathematical groundwater flow equation known from the lecture. Spot differences and try to resolve and explain those.
c) Separate the list of input values of r.gwflow into three groups: Variables, Hydraulic Parameters and Numerical Model Parameters
d) From the list of required input parameters, explain how those are used to solve the differential equation for horizontal groundwater flow.

Exercise

a) Write down the equation for tracer transport known from the lecture. Name all occurring parameters and provide their units.
b) Explain the process of retardation of a tracer in a porous aquifer. How does that effect the measured tracer concentration in an observation well?

c) Explain the process of dispersion of a tracer in a porous aquifer. How does that effect the measured tracer concentration in an observation well?
d) Explain the difference between dispersion and diffusion of a tracer in a porous aquifer. What causes each process and what does both processes have in common (physically and mathematically)?
e) Mark the advective and diffusive/dispersive term in the transport equation.

Exercise

a) Read the manual of r.solute.transport at https://grass.osgeo.org/grass79/manuals/r.solute.transport.html
b) Locate the differential equation solved by r.solute.transport and compare it to the transport equation known from the lecture. Spot differences and try to resolve and explain those.
c) Separate the list of input values of into three groups: Variables, Hydraulic Parameters and Numerical Model Parameters
d) From the list of required input parameters, explain how those are used to solve the differential equation for horizontal groundwater flow.