# Transient Groundwater Flow

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# Objectives of the course

* The students will become familiar with the basic 1D and axially symmetric transient groundwater solutions that can readily be applied in practical situations when a computer models is not readily available, where a fast idea of the effect of groundwater impacts is required, where a model is to be verified and so on.
* Students will learn how to deal with and apply superposition, which is perhaps the most important tool to handle more complex systems with analytically.
* Students will obtain insight in the transient behavior of groundwater systems, and learn to reason based on their characteristics such as halftime and the relations between parameters and the way parameters workout in the effect on the system.
* Students will learn to simplify analytical solutions to extract behavior characteristics that are easy to understand and apply for under specified conditions.
* Closed analytical solutions for transient groundwater flow are only available for linear systems, i.e. systems with a constant transmissivity and storativity. Students will learn how to deal in an approximate way with situations where transmissivity will vary due to extractions or injections of water.
* Students will gain insight in the behavior of real-world groundwater systems and learn how to read their reaction.
* Students will also learn what physics cause a given behavior of groundwater systems. Storage characteristics and barometric and tidal reactions will be dealt with.
* Students will learn and exercise how to implement transient analytical solutions in Python and visualize their results.
* Students will learn how to analyze basic pumping tests to obtain the parameter values of a groundwater system.
* Depending on the group, students will learn how to handle complicated time varying systems by means of convolution.
* Students will carry out an assignment in which they apply the various aspects they've learned.