



## **Untangling groundwater head series using time series analysis and Pastas**

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Heads vary as a result of a variety of stresses on the aquifer, including rainfall, evaporation, pumping, and variations in surface water levels. One of the common objectives of groundwater models is to untangle measured groundwater head variations into contributions of these different stresses, for example to determine if lower heads are caused by a reduction in rainfall, an increase in pumping, or the construction of a new drainage system. Time series analysis with response functions is a relatively new groundwater modeling technique to model groundwater dynamics at observation wells. The method is fully data-driven. It requires measured time series of the head in an observation well and of the stresses on the aquifer. No other knowledge, including knowledge of aquifer parameters, is required. Two of the main difficulties in application of this method are the choice of the response function and the approach to simulate the movement of recharge through the unsaturated zone. Response functions are often based on analytic solutions to simple groundwater flow problems. Movement of recharge through the unsaturated zone is modeled numerically with a reservoir-type model. In this presentation, examples will be given of untangling head responses using the newly developed Pastas software. Pastas is free and open-source software, and is available from <https://github.com/pastas/pastas>.