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A new method for calibration of groundwater models in data-scarce areas, with an application to a semi-arid catchment in northwest Syria

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The calibration of numerical groundwater models is often constrained by a scarcity of water level data that predate the development of groundwater resources. This is especially a problem in the dry areas of the developing world where groundwater systems are frequently overexploited and information on pre-development groundwater levels is usually limited. Here we demonstrate a new and straightforward method to significantly reduce parameter uncertainty of numerical groundwater models related to scarce water level data. The method is based on the use of groundwater level data taken from wells that have been disturbed by pumping as an estimate of the lower bound of the pre-development, steady-state water level. During model calibration, these estimates are used as one-sided observations, e.g. observations that are only active in the calibration process when the simulated water level is lower than the observed water level. Thus, the method ensures that the calibrated steady-state water level exceeds the water level affected by pumping, which results in a model that is a much better approximation of the 'true' groundwater system. The method was applied to calibrate a groundwater model of an arid region in northwest Syria, where pre-development water level observations were limited to 6 wells. The inclusion of 170 recent, one-sided water level observations resulted in a reduction of the uncertainty range of the calibrated transmissivity parameters of 60%. The calibrated parameter sets were used to run model simulations of the long term impact of pumping on groundwater levels and flow.