Using time-lapse gravity for groundwater model calibration: An application to alluvial aquifer storage

The estimation of hydrological model parameters by calibration to field data is a critical step in the modeling process. However, calibration often fails because of parameter correlation. Here it is shown that time-lapse gravity data can be combined with hydraulic head data in a coupled hydrogeophysical inversion to decrease parameter correlation in groundwater models. This is demonstrated for a model of riverbank infiltration where combined inversion successfully constrains hydraulic conductivity and specific yield in both an analytical and a numerical groundwater model. A sensitivity study shows that time-lapse gravity data are especially useful to constrain specific yield. Furthermore, we demonstrate that evapotranspiration, and riverbed conductance are better constrained by coupled inversion to gravity and head data than to head data alone. When estimating the four parameters simultaneously, the six correlation coefficients were reduced from unity when only head data were employed to significantly lower values when gravity and head data were combined. Our analysis reveals that the estimated parameter values are not very sensitive to the choice of weighting between head and gravity data over a large interval of relative weights. Copyright 2011 by the American Geophysical Union.

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