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Using gravity measurements to infer large scale hydraulic properties

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Soil hydraulic models are being used in many large-scale applications including basin scale hydrological analysis and land use planning. These models require estimations of soil hydraulic properties that are appropriate at large scales. However, most of our measurement methods have support volumes that are too small to provide representative measurements to constrain these parameter estimates. We have investigated the potential of ground-based gravity measurements for hydraulic property estimation. Specifically, we have examined time-lapse gravity measurements made during infiltration and redistribution beneath a large-scale infiltration feature, such as an artificial recharge facility or an ephemeral stream. We used the Shuffled Complex Evolution Metropolis inverse model to evaluate which hydraulic parameters can be identified using gravity measurements. We also developed a recursive scheme to identify the most valuable data for parameter estimation resulting in the most cost-effective sampling strategy. Results show that parameter estimations based on ground based gravity measurements were accurate and had low uncertainty for thick unsaturated zones that experience large changes in vadose zone storage. The recursive scheme greatly reduced the cost of monitoring by limiting the number of person-days required in the field.