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Estimating the hydrogeological parameters for unconfined aquifers with the time-lapse resistivity imaging method during the pumping tests

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We have conducted the time-lapse monitoring study during two single-well pumping tests at the Pengtsuo site in Pingtung and the Dajou site in Ilan in Taiwan. Water level gauges were installed in the pumping the nearby observation wells with different screen depths for the observation. We designed the pumping tests to be executed in three phases, including the background, the stepwise pumping, and the continuous pumping phases. The survey line is crossing all wells in order to compare the resistivity measurements with the water level records. Although the inverted resistivity images the vertical resistivity structures also reveal that the influences from the steel well casing at the well positions, the resistivity differences to the pre-pumping background show that the electrical resistivity imaging is able to resolve the change due to the dewatering from the pumping activity. We have found that the maximum resistivity increase took place at the locations in the vadose zone instead of the groundwater surface in the time-lapse images. The variation of the maximum resistivity differences in the vadose zone is consistent to the change of the groundwater level during the pumping test. We tried to use the drawdown from the time-lapse resistivity differences and the Theis equation for estimating the hydraulic transmissivities and the specific yields at both sites. The estimated transmissivity and the specific yield are 1.01 m^2/min and 0.11, respectively at the Pengtsao site, and 0.39 m^2/min and 0.12 at the Dajou site. These values are close to those calculated from the measured groundwater level variations in the multiple wells. Therefore we concluded that the time-lapse resistivity imaging methods is able to help estimating and verify the transmissivity and the specific yield for the pumping test in the unconfined aquifer.