Capillary effect on the tidal response of buried aquifers – an interaction between shallow and deep groundwater systems

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The interaction between the shallow and deep groundwater systems is important for a number of issues on water resources and the environment but is difficult to evaluate directly. Here we use two-dimensional numerical simulations to show that the tidal response of deep aquifers may be significantly affected by capillary force on the water table. We propose a criterion to evaluate the capillary effect and apply the model to interpret the tidal response of the Arbuckle aquifer in a USGS deep monitoring well in Oklahoma. Our study suggests that the shallow and deep groundwater systems may interact across thick layers of intervening aquitards and that the analysis of the tidal response of deep aquifers may be an effective means to evaluate such interaction.