Closing a scale-gap in Earth observation using regional-scale airborne geophysics in the lower Mississippi Valley

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Critical groundwater resources and hidden seismic hazards underly much of the Mississippi Alluvial Plain. Spanning nearly 100,000 square kilometers across seven states, this region hosts one of the most prolific shallow aquifer systems in the United States that supports a $12 billion agricultural economy amidst chronic groundwater decline. Further, underlying fault structures of the Reelfoot Rift and New Madrid Seismic Zone represent an important and poorly understood hazard with a complex pattern of historical impacts. Despite its societal and economic importance, mapping of shallow subsurface architecture with spatial resolution needed for effective management is insufficient. Here, we report the results of 40,000 flight-line-kilometers of electromagnetic, magnetic, and radiometric data collectively providing a system-scale snapshot of an entire aquifer system, the first such effort in the United States. This survey enables new understanding of the regional hydrogeology while also revealing previously unseen large vertical displacements (exceeding 50 m) in the uppermost Tertiary units within the New Madrid Seismic Zone.