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# Land Surface Subsidence and Aquifer Compaction: A Comparison of Surficial and Deep-Monument GPS Data, Northwest Harris County, Texas

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Land surface subsidence occurs in urban areas worldwide, often in locations where inhabitants or businesses extract fluids from subsurface aquifers. Subsidence may also result from sediment compaction and/or surface faulting. In this study, groundwater withdrawal has been identified as the primary mechanism for the recent and rapid subsidence observed near the Addicks Reservoir, northwest of the Houston metropolitan area. Not only does Texas have one of the highest rates of groundwater withdrawal in the United States, but the other mechanisms listed above are slow: occurring over geologic time.

This study is centered on the use of a deep-monument, permanent GPS station in northwest Harris County, which began collecting data in 1996. A co-located extensometer has monitored compaction at the site since 1975. Furthermore, a surface-based, portable GPS station is located 50 meters from the deep-monument site. The proximity of these devices allows for the crucial comparison of regional vertical displacement with local compaction taking place within the aquifers. The deep-monument GPS station records vertical positions at a depth of 600 m, which is below the aquifers in this area. Thus, the positions are largely unaffected by groundwater withdrawal, and have observed only two centimeters of subsidence since measurements began. Conversely, vertical displacement at the surface records both the regional displacement as well as the local aquifer-driven displacement. This surface-based station observed subsidence of 25 centimeters during its first decade of operation (1996-2006) which reveals that nearly all the subsidence at this site is a result of aquifer compaction rather than regional processes.

This study incorporates data collected from a borehole extensometer and several GPS stations in order to constrain both past and current subsidence rates. The findings are compared with geologic, groundwater, and precipitation data to further the understanding of subsurface fluid behavior as well as the effects of groundwater withdrawal on aquifer compaction and rebound across Harris County, Texas, USA. ■