
Subsidence-Groundwater Interaction in the Houston Metropolitan Area (2005–2014)

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ABSTRACT

Houston, Texas is one of the earliest places that employed high-accuracy global positioning satellite (GPS) technology for land subsidence monitoring. There are over 170 publicly-available permanent GPS stations located in the Houston metropolitan region. The U.S. Geological Survey operates 11 borehole extensometers and 175 wells screened in the Chicot Aquifer and 330 wells screened in the Evangeline Aquifer. This study summarizes all available ground subsidence measurements from GPS and extensometer stations and groundwater measurements from wells. Subsidence and groundwater level changes during the past 10 years (2005–2014) have been investigated. Long-term observations suggest that the overall subsidence rate in the Houston area has been decreasing since 2005. This decrease is a result of groundwater withdrawal regulations. Currently, subsidence in downtown Houston and in the southeastern region of Houston has nearly ceased (<3 mm/yr). Slight land rebound has been observed at stations along the Houston Ship Channel area since 2005. However, subsidence is occurring at a rate of 2 cm/yr in the western and northern regions of Houston. A comparison of current land subsidence, groundwater level altitudes, and their changes indicate a close correlation between groundwater-level altitude and aquifer compaction (subsidence). The preconsolidation heads of the Chicot and Evangeline were approximately 30–40 m below the surface. The water level of the Chicot is close to the preconsolidation head throughout most of Houston. The Evangeline water level is approximately 70 m below the preconsolidation head in the northern region and 50 m below the preconsolidation head in the western region. The subsidence rate is decreasing where the water level is rising, but still below the preconsolidation head. The rate of land subsidence is steady in the areas that groundwater head is declining and below the preconsolidation head.