Sustainability of Oklahoma Groundwater Systems? Climate versus Human Impact

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Abstract:
Modern water plans have re-established priorities and are working toward achieving sustainable water resources. The planning process involves anticipating variability in supply and demand, whether they are naturally driven supply issues (e.g., drought) or human induced demand issues (e.g., increased groundwater withdrawals). When a groundwater system is perturbed it will adjust to a new equilibrium. The time scale required for groundwater equilibration, or response time, may range from minutes to millions of years, depending on the spatial scale of the groundwater system, material properties, which component of the water balance changed, and the magnitude of the perturbation. The effects of natural climatic cycles versus water use patterns are seldom described and related to water availability, particularly groundwater availability. Because the effects of climate and groundwater withdrawals are superimposed on one another in groundwater level measurements, it is difficult to separate these effects into their component parts. The objective of this study is to separate the effects of climatic variability from human impacts to groundwater storage in Oklahoma aquifers. This is accomplished by synthesizing groundwater monitoring data, precipitation records, and groundwater withdrawals onto the same time-scale. Large-scale climatic cycles, such as the Pacific Decadal Oscillation (PDO) and the El Niño Southern Oscillation (ENSO), are filtered out using long-term regional precipitation records. Dynamics of groundwater systems must be well understood to effectively manage the resources, and adaptive management strategies may vary substantially depending on geologic nature and climatic region of each aquifer. Groundwater management could be handled quite differently based on these results, with tighter controls on groundwater withdrawals in those aquifers that are more critically affected by water use patterns.