ASSESSING AQUIFER DEPLETION AND AGRICULTURAL WATER WITHDRAWAL WITH REMOTELY SENSED AIRBORNE AND SATELLITE EARTH OBSERVATIONS

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Remotely sensed Earth observations from National Aeronautics and Space Administration (NASA) satellites and unmanned aircraft systems (UAS) can provide timely information to enhance security and sustainability of water, energy, and food supplies. Scientific and resource-management applications involving remote-sensing technology can 1) define aquifer depletion caused by drought and over-pumping; 2) assess patterns and amounts of basin-wide agricultural water withdrawal during the growing season; and, 3) direct precision-irrigation techniques to conserve water and energy, increase agricultural production, and improve farming economy. Observations of Earth's gravitational field measured by NASA's Gravity Recovery and Climate Experiment (GRACE) satellite can detect regional anomalies resulting from variations in water stored as soil moisture and in water-table and shallow-confined aquifers. Commensurate with GRACE gravity observations, NASA's soil moisture active passive (SMAP) satellite can detect soil-moisture variations, allowing quantification of the groundwater-level-change component of GRACE gravity anomalies to combine with geohydrology data for calculating aquifer depletion. Multiple-level Earth observations from high-altitude long-endurance (HALE) aircraft or pseudo-satellites (HAPS) and low altitude UAS platforms can identify near real-term irrigation patterns during the growing season that are crucial to 1) assess and manage agricultural water withdrawal, and 2) direct precision irrigation to enhance agricultural production and the Nation's food supply. Solar-powered HALE aircraft or HAPS, flying above the troposphere at altitudes of 60,000 feet, can linger from weeks to months collecting and transmitting thermal and hyperspectral imagery daily over areas of interest, such as agricultural regions of Georgia. Together with contemporaneous irrigation-meter data, irrigated acres identified using HALE imagery constitute critical components for assessing basin-wide agricultural water withdrawal. Complementary imagery acquired from UAS flights over specific agricultural fields can downscale HALE imagery to identify over- or under-irrigated cropland—soil-moisture conditions detrimental to agricultural production—and can direct precision- irrigation techniques to inform water and energy management at the farm scale.

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