Evaluating long-term land subsidence sustainability goals set by SGMA in the Central Valley, California, USA (2020-2070)

Logan Platt and Matthew Weingarten

Questions/Data inquiry: lplatt@sdsu.edu

In 2014, California lawmakers passed the Sustainable Groundwater Management Act (SGMA). Our focus is on the critically overdrafted basins in the California’s southern Central Valley (denoted in orange below). By 2020, each basin was required to form a groundwater sustainability agency (GSA) and draft a groundwater sustainability plan (GSP). These GSPs were designed to achieve sustainability by 2040 and maintained through 2070.

Study Goals:
1. Compile and evaluate database of SGMA sustainability indicators wells and subsidence rates across the southern Central Valley for its spatial coverage and completeness.
2. Model future scenarios of groundwater pumping that are reflective of both wet and dry conditions.
3. Use the modelled scenarios to determine where future groundwater depletion and subsidence may be most severe in the Central Valley.

Central Valley Hydrologic Model 2 (CVHM2)

Simulating monthly water budgets between 1961 and 2020.

Six sets of data constrain model parameters:
- Hydrologic
- Lithologic
- Water consumption
- Land use (farm & urban)
- Surface water inflows

Farm Process Package (MODELW)

Uses acreage and crop type in agricultural areas as a proxy for groundwater pumping.

Each crop is assigned a “crop coefficient”. This coefficient reflects that crop’s water demand on a per acre basis.

CVHM2: Simulating Future Pumping

Future climate is modelled by using historical water year data to simulate future climate from 2021 - 2070 (Baseline Scenario).

Follows the approach of Kern County GSP (Todd, 2020).

Modelled Future Scenarios:
(1) Baseline Pumping
(2) 25% pumping increase
(3) 50% pumping increase

SGMA Indicator Wells:
1. Synthesize GSP plans for each basin (Madera example)
2. Each monitoring well site has 2040 measurable objective & 2040 minimum threshold water levels and subsidence goals
3. CASGEM database of state well numbers to locate monitoring well and determine if well depth information exists

- Ground water level targets vary widely within and between GSAs (e.g. Kaweah)
- Key areas of future depletion and subsidence include Westside, Kaweah, Tulare Lake, Tule and Kern GSAs.
- Transboundary groundwater depletion and subsidence between GSAs is evident in both 2040 and 2070.
- SGMA indicator wells and subsidence monitoring stations fail to meet sustainability criteria in baseline and reduced pumping scenarios.

SGMA Measurable Objective Well

- Measurable Objectives: Unconfined
- Measurable Objectives: Confined

Baseline Model Unconfined
Baseline Model Confined

Subsidence Failure

- Measurable Objective Failure
- Minimum Threshold Failure

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