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Discussions

Interactive comment on "Sustaining the Ogallala Aquifer: From the Wells to People, A Holistic CNH Model" *by* Joseph A. Aistrup et al.

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The general comments 1, 2, 3, 4, and 5 deal with the model set up, depiction, calibration, communication of outcomes, and developing a sustainable policy option.

First, in our revision, we are more than happy to provide a diagram (GC5) depicting the data exchanges and feedback loop. This diagram should also help to better explain the model setup (GC2) and facilitate a discussion of the limitations of this 100-year predictive model, the accuracy of which decreases overtime.

Second, each separate component of the coupled model is calibrated independently prior to being linked to the other components. Citations are provided in the text and will not be repeated in this response. However, AR1 indicates that we did not provide

an evaluation of the coupled model's performance (GC1). At one level, we disagree with this assessment because we calibrated each individual disciplinary model prior to linking it to the next. We nonetheless recognize the burden of proof is on us to demonstrate that once the model is coupled, the coupled model produces outcomes that are consistent with existing data. In the revision, we plan to show predicted outcomes for the period between 2000 and 2014 and a comparison of the model's outcomes with the published data in a supplementary section for the paper. Communicating the model's outcomes (GC3) to stakeholders and policy makers will be partially accomplished by this peer reviewed publication process. After our peers have evaluated this model and found it acceptable, additional steps are planned to communicate the model's outcome to other policy-makers and stakeholders in the Groundwater Management District 3 study region.

The coupled-model is robust enough to develop a sustainable outcome for the aquifer (GC4), which we define as halting the current trajectory toward depletion. However, this policy option is not evaluated, since it is not under consideration at this time within the study region. This study advances the societal need to understand the ramifications of coupled natural/human systems, while contributing towards a more sustainable dialog grounded in real-world possibilities.

GC6: Groundwater pumping is based upon an annual decision for when to start pumping and when to stop, where the well is traditionally left on throughout the growing season. Thus, the dynamics are drawdown throughout a growing season and recovery before the next pumping cycle, where large drawdowns may occur when the wells actively pump (Mullican,2012), and a new elevation becomes established during a recovery period (Duganet al., 1994, p. 23). Thus, the groundwater model exchanges data at the same annual frequency as the economic crop choice model that dictates the annual water requirements.

GC7: The baseline model predictions accurately reproduced the groundwater data throughout the historical period. Model results were compared to the future predictions of a higher-resolution fishnet model of Seward County from Steward et. al (2009). Groundwater levels were consistent between studies. Similarly, the results from the model resolution of this study, when aggregated to the region, reproduce longer term regional projections (Steward et al. 2013).

GC8: The recharge component was kept consistent throughout this study. Given the relatively thick soil units throughout much of the region (Gutentag et al. 1984B), recharge rates are low and may take decades or longer to reach saturated groundwater (McMahon et al. 2007). This is consistent with Sophocleous [2005] who noted that "Groundwater pumping usually has little impact on the recharge".

McMahon PB, Dennehey KF, Bruce BW, Gurdak JJ, Qi SL (2007) Water-Quality Assessment of the High Plains Aquifer, 1999 – 2004 (US Geological Survey, Reston, VA), Professional Paper 174.

GC9: AR1 wants some details added to section 2.5 on what the resulting dryer-year resampling of years looked like statistically. We will compare the statistics of the original 27 years of weather data and compare them to a set where the dryer years are 25% more likely.

GC10: We will add standard deviations to table 1.

AR1 also made a number of useful "specific comment" (SC). We agree with SC 1 through 10, 13, and 15. We will make the suggested revisions.

SC 11 and 12 ask questions regarding the crop production model. The crop choice model is not calibrated to a specific year, rather to the mean outcomes during the base period. Calibrating to a specific year will "overfit" the model so that it replicates that year exactly but likely at the cost of very poor prediction accuracy for other years. The mean approach doesn't predict any single year exactly, but makes the model provide a better match with the range of observations during the base period.

SC 14 notes a poor choice of wording on our part. We will revise our text to reflect

that we ran all of the scenario simulations 100 times, where each policy scenario simulated a period of 100 years, and that the parameter we modified was the weather-year resampling.

SC 16 and 17 draws attention to the conclusion where we use the term "policy issues" and "meaningful policies." We use the term policy to refer to a course or principle of action adopted or proposed by a government/regulatory agency. We will delete the words "issues" and "meaningful".

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