RC2

This paper presents a new coupling of two existing models, SWAT+ (watershed hydrology) and MODFLOW-NWT (groundwater flow). The coupled model is more hydrologically complete than either of the models on their own, and would be a useful tool for many regional hydrological studies. The paper falls within the scope of GMD, and I believe that it will be fit for publication after minor revisions have been completed. I think that this paper and the tool it describes are useful, but certain explanations need to be clarified and figures in particular need some work to aid the reader's understanding.
Response: Thank you for providing the review and for the positive response. We have addressed all comments and suggestions.

This paper provides an updated coupling after a 2020 paper (referenced Bailey et al., 2020a in the paper) already linked SWAT+ and MODFLOW. The motivation given for the new paper is that SWAT+ has been modified extensively over the past 5 years. One question that I have is whether the new linkage will be able to absorb future improvements to SWAT+, or will brand new couplings be required every few years as modifications continue?
Response: This is a great point. The new linkage will be able to include future improvements to SWAT+. I am in constant communication with the SWAT+ development team, as new routines are included in SWAT+, necessitating a new merge of the code. So, no new couplings (the basic coupling code is set), but we will need to include SWAT+ modifications as they come.

The paper links to a tutorial document, executable file, and sample input data to attempt reconstructions of the simulations presented. I appreciate this effort and the inclusion of the sample data. However, as a Linux user, I was unable to run the .exe file. Source code is provided; it would be extremely helpful to include compilation instructions.
Response: Thank you, this is an excellent point. We have now included a document that outlines the procedure for compiling SWAT+ in Intel Visual Studio. I am not familiar with Linux, and therefore do not have instructions on compiling using a different Fortran compiler.

Line 90: The paragraph starting at this line seems repetitive and unnecessary. Can it be integrated into the above paragraph?
Response: Thank you. We deleted the first sentence, and integrated the second sentence into the above paragraph.

Figure 1: This figure needs some work, e.g. both the Arkansas River and the San Joaquin River have the same symbology, so maybe it would work better to use the same symbol and then just specify on which panel does it refer to which river. What are the small black dots on panel B? Why does panel C have the additional aquifer information while panel A does not?
Response: Thank you. We have attempted to be consistent between the maps. The small black dots in B are irrigation pumping wells. We neglected to include this in Figure 1B, but have now corrected this. Panel C has additional information because of the existing MODFLOW model (CVHM2) which is providing many of the aquifer property values for the smaller model used in this study.

Line 163 states that for the JMR, the aquifer boundary is the same as the watershed boundary (Fig 1B), but Fig 1B does not actually show this – it would be clearer if explicitly shown or mentioned in the caption.
Response: Thank you; we have now included this in the caption to Figure 1.

Are aquifer boundaries shown in this figure and mentioned in the text from an external dataset?
Response: For the John Martin Reservoir watershed, the aquifer boundary is set to the same boundary as the watershed, with geologic units (see Figure 2B) obtained from a national dataset, as specified in Table 2 ("geologic units"). For the San Joaquin – Lower Chowchilla Watershed, the boundary is obtained from the CVHM2 model.

Table 2 includes aquifer thickness but it is not clear if this dataset also defines the boundaries.
Response: the datasets of aquifer thickness and geologic units do not provide the boundaries; the boundaries are explained now in the caption to Figure 1 (for the JMR model). The aquifer extent for the MSJ-LC model is provided in **lines 166-167**: *"For the MSJ-LC, only the 33,012 cells within the delineation of the Central Valley aquifer (see Fig. 1C for the aquifer boundary) are active."*

Line 173 begins a description of population grid cell properties for the MSJ-LC model. Why are these needed for only this model, and not for JMR? Conversely, why is JMR MODFLOW data included in Table 2, but not MSJ-LC MODFLOW data?
Response: Properties for the MSJ-LC model are provided by the regional MODFLOW model CVHM2, a model previously developed by the USGS. Conversely, there is no existing MODFLOW model for the JMR, and therefore datasets are required to populate aquifer properties and geologic unit boundaries.

Line 181: What is meant by a 'geographic connection'? Was the data reprojected using GIS?
Response: The term "geographic connection" refers to the geographic intersection between the grid cells of the larger model (CVHM2) and the smaller model, using a shape file for both grids. Both grids used the same geographic projection. This has now been clarified in the text.

Line 187: How were the averages weighted? Based on layer thickness, or something else?
Response: Yes, by layer thickness. We have now clarified this in the text.

Figure 2: Why are we seeing geologic units for one aquifer, but hydraulic conductivity for the other? I'm wondering if the intention is to show two different types of setup/ simulation depending on your aims, but if so, that has not been made clear in the text.
Response: Yes, the intention is to show two different types of setup. Also, because the CVHM2 model has calibrated hydraulic conductivity values that we can map to the smaller grid, and the JMR model has uncalibrated values, and hence we show the geologic units that are used to define the boundaries of the hydraulic conductivity zones. This is now clarified in **lines 191-192**: *"Fig. 2D shows K values whereas Fig. 2B shows geologic unit boundaries, as the aquifer properties for the JMR model have not yet been calibrated."*

Figure 3: This figure is very blurry.

Response: This is likely because the high-resolution figure was not downloaded or included in the review version. The original figure is high-resolution and not blurry.

Line 233-235 and Figure 4: I am confused by the differentiation between options A and B. A makes sense since water will percolate downwards from the unsaturated soil profile; in B, why is exchange only possible from aquifer to soil profile? This implies that the water table can only rise in this case?
Response: Yes, in condition "B", groundwater is transferred to the soil profile, and for that time step percolation from the soil to the aquifer is not simulated. When the water table drops below the soil profile (e.g., on a subsequent day), then percolation from the soil to the aquifer can once again resume. We have modified Figure 4 to show the volume of groundwater transferred to the soil profile.

Lines 252-261 and Figure 5: On what scale are the HRUs constructed? Are they vectors? Is each agricultural field its own HRU? What else defines an HRU?
Response: HRUs are polygon. For these two models, each agricultural field has been designated as a unique HRU. There are other HRUs within the model boundary, based on intersections between soil type, topography, and land use.

Additionally, I thought that the cell size was 500 m (from line 162), but the quoted HRU sizes in this paragraph don't match with that.
Response: Yes, the size of the MODFLOW cells are 500 m. However, the HRU size depends on the agricultural field boundaries and the intersection polygons between soil type, topography, and land use.

Figure 8: This figure has helpful information, but I feel like I, as the reader, am having to do too much work. Having a reference for what all of these abbreviations mean closer to the image e.g. in the caption would help a lot.
Response: Yes, this is a great point. We have tried to provide meaningful information regarding the model input/output and code structure, but there are many abbreviations. We have included abbreviation references for MODFLOW and SWAT+ files and subroutines in the figure caption.

Lines 403-406: What is PEST++? Is it different from PEST? While references are provided, a very brief explanation would be helpful.
Response: PEST++ is a new version of PEST that allows for sensitivity analysis and uncertainty analysis. For this study, we have used PEST++ to include sensitivity analysis. We have included the correct reference (White et al., 2020), a short description of the Morris method, and a brief explanation of the extension from the original PEST.

Figure 10: What is recharge in all of the areas that are left white?
Response: These are areas of no recharge (0 flux). This is now clarified in the figure caption; also for irrigation pumping and canal seepage.

Figure 12: Is this the change from the model or from the well data? How do the two compare to one another?

Response: This is the change in the observed groundwater head. We have now clarified this in the figure caption. These changes should be compared to the average yearly change in head as simulated by the model, in Figure 11B. This is described in the text, **lines 466-468**.

We thank Reviewer #2 for the helpful comments and suggestions.