Interactive comment on "A Salinity Module for SWAT to Simulate Salt Ion Fate and Transport at the Watershed Scale" by Ryan T. Bailey et al.

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L: 217: Generally, the cation exchange capacity is pH-dependent. Is this taken into account by the model? If not, what are the reasons?

Response: pH was not simulated in the model. The salinity module used in SWAT-Salt is based on Tavakoli-Kivi et al. (2019: "A salinity reactive transport and equilibrium chemistry model for regional-scale agricultural groundwater systems. Journal of Hydrology 572, 274-293"), which does not account for pH. The module was not changed in this sense for imbedding within SWAT. In addition, the precipitation-dissolution reactions dwarf the cation exchange process in terms of governing salt ion concentration, and hence we believe that the exclusion of pH dependency is not critical for this study

region. It will be re-visited for future studies and model applications.

L: 293 - 295: You mention that only minimal manual calibration was applied. However, changing the solubility product by almost a one order of magnitude seems more than minimal. Can you provide reasons why it may be necessary to modify a solubility product?

Response: The word "minimal" in the text refers to the low number (2) of parameters modified during manual calibration. This has been changed in the text:

Lines 325-327: "Manual calibration was applied to the model to yield correct magnitudes of salt ion concentration in soil water, groundwater, and stream water. Due to the predominance of SO4 and Ca among salt ions in the regional system, targeted parameters were the solubility product of CaSO4 precipitation-dissolution and the soil fraction of CaSO4."

Similar to groundwater salinity models that employ equilibrium chemistry, simulations indicate that model results are strongly dependent on the solubility product of the salt minerals. These solubility products are governed principally by temperature and pH. As temperature in the soil profile and aquifer differ, and also vary seasonally, and since pH is not modeled in the current model version, the solubility product of CaSO4 was modified during the calibration process since the true solubility product value is not known with certainty. However, the same value was used for both the soil profile and aquifer, with the value held constant for all HRUs.

L: 334: What's a stochastic river mass balance?

Response: This refers to a salinity mass balance of the Arkansas River system, . For clarity, we have changed the text to the following:

Lines 381-384: "Mass balance plot values are the mean of an ensemble of a stochastic river mass balance calculation of surface water salinity loadings along the length of the Arkansas River within the model domain, using a method similar to Mueller-Price and

Gates (2008), with values indicating the mass of salt not accounted for by surface water loadings.

Fig. 4A: In this figure one cannot distinguish the different ions. Please modify.

Response: This figure was changed to show average daily salt ion loading, for each year (1999-2009). The values for each salt ion can now be seen more clearly.

We thank the Editor for the helpful suggestions and comments.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2018-614, 2019.
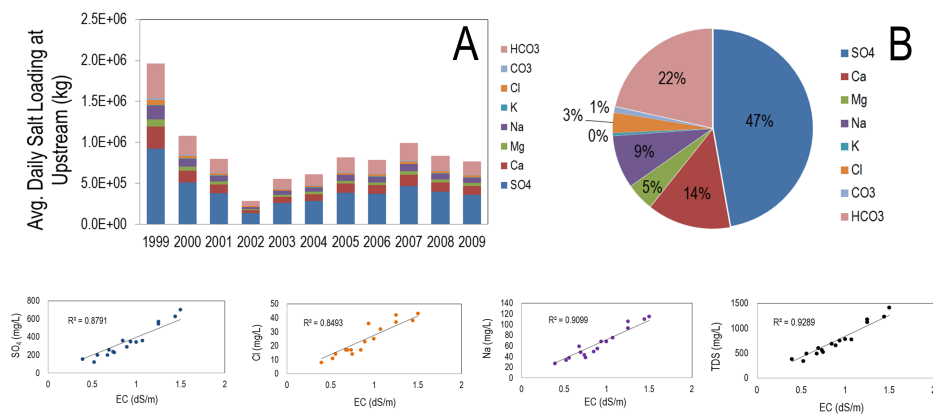
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Fig. 1. Figure 4

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