Reviewer 2:

This is a well written manuscript with the objective clearly stated, which is to describe the work extending SWAT to simulate pesticide plant uptake. This addition represents a major update to the SWAT model which has been widely used for water quality research and assessments throughout the world. Descriptions of the model implementation, calibration and evaluation are clear. It is publishable with minor technical corrections as suggested below.

A: Thank you for your positive feedback on our manuscript. We appreciate your recognition that this addition represents a major update to the SWAT model and that the descriptions of the model implementation, calibration, and evaluation are clear. We will address your specific technical corrections in our responses to your detailed comments below.

1. P7, ln205. The model without plant uptake looked under-estimating Catchment 2 data in 2013 onward (Fig 3). How would you justify the need for the plant uptake in this case? Over pre 2013, the model without plant uptake seemed performing generally well (albeit at some level of over-/under- predictions). Improvement wasn't obvious with the case of "with plant uptake" (i.e., comparing Fig 3 Plot b and c). Some more explanation should be useful than simply stating "not all sources of the metabolite were considered".

A: Thank you for this observation regarding the model performance in Catchment 2 (C2). You are correct that the model appears to underestimate metabolite concentrations during this period, and that the implementation of plant uptake does not improve the match with observations in this case.

The underestimation in C2 is due to the fact that, as briefly mentioned in the manuscript (line 185-188), not all sources of the metabolite were considered in our modeling approach. The metabolite we investigated can be formed from multiple parent compounds beyond the single pesticide we simulated. We deliberately chose to model only one parent compound (likely the most significant contributor) as pesticide application data for other parent compounds was not available. This limitation explains the systematic underestimation (bias ratio β of 0.66 without plant uptake and 0.61 with plant uptake) observed in C2.

The justification for including plant uptake is not based solely on improving model fit, but rather on incorporating a known and important physical process in pesticide fate modeling.

By implementing this process, we enhance the mechanistic representation of pesticide fate.

Revision planned:

In Section 3.2, we will expand our explanation of the C2 results to clarify why the model underestimates concentrations, provide a few more details about the multiple sources of the metabolite that weren't considered in our simulation, and better explain why plant uptake remains an important process to include despite not visibly improving the match with observations.

2. P7, ln210. Adding plant uptake to the model essentially includes another "sink" term in the mass balance system. There shouldn't be surprises to see reduced concentration predictions. For c2, such reduction seems not needed as comment above. Some data interpretation including potential impact of different factors between c1 and c2 should strengthen the statement in this paragraph. An open discussion otherwise is needed if this result does suggest plant uptake is a catchment- (or crop-) dependent process.

A: Thank you for this comment about the role of plant uptake as a sink term in the mass balance system and the differences observed between catchments C1 and C2.

You are correct that adding plant uptake as a sink term would naturally lead to reduced concentration predictions. Our goal was not to present this as a surprising finding, but rather to quantify the magnitude of this effect and demonstrate how it varies across different catchment conditions.

We further agree that the difference in impact between the two catchments is informative and that the manuscript would benefit from an expanded explanation. As you suggest, the impact of plant uptake on concentration reduction at the catchment scale appears to be influenced by several factors:

1. Land use composition: C1 has 73% agricultural land compared to 80% in C2, but the crop rotations and specific crop types differ between the catchments. C1 has more corn in the rotation, while C2 has more winter cereals. Spring and winter crops have different growing periods and biomass, which affect the water and chemical uptake of the plants.
2. Percent crop treated: The proportion of agricultural land actually treated with the pesticide forming the metabolite varies between catchments, affecting the spatial distribution and total mass of available metabolite for plant uptake.

3. Hydrologic regime: The catchments have different runoff ratios (28-36% in C1 vs. 38-48% in C2 as shown in Table 1). This suggests different partitioning of water between evapotranspiration (which drives plant uptake) and runoff/drainage pathways (which drives off-field transport of the parent compound before the metabolite can form).
4. Metabolite behavior: As noted in our response to your first comment, C2 has multiple sources of the metabolite beyond the simulated parent compound, which affects the relative importance of plant uptake as a sink term.
5. Different pesticide products are used across the catchments, with varying metabolite formation rates. Some products used in C2 may have reduced or no formation of the metabolite, further complicating the mass balance and the relative impact of plant uptake processes.

Revision planned:

In Section 3.2, we will expand our discussion of the factors contributing to different plant uptake impacts between C1 and C2. To this end, we will build upon the catchment-characteristics mentioned above.

3. P15-16, Figs.2 and 3 captions. There appeared to be duplicated "b" denoting Plots b and c.

A: Thank you for pointing out this error in the figure captions. The captions currently state:
"…metabolite concentration with plant uptake (b), metabolite concentration without plant uptake (b), and the difference between (c) and (b)"
This should be corrected to:
"…metabolite concentration with plant uptake (b), metabolite concentration without plant uptake (c), and the difference between (c) and (b)"

Revision planned:

We will correct the captions for Figures 2 and 3 as described above.