Answer to the Referee 1

After reading the comments, we list them as following.

1. There is error in Equation 4 of Tong et al. (2010).

Reply: Thanks for your careful calculation. We have omitted the -1 in the equation, so the correct equation is

$$C_w(t)=C_w(t_p)\cdot\left[\frac{\alpha\cdot(p-i_{1p})\cdot(t-t_p)+h_{mix}\cdot\theta_s}{h_{mix}\cdot\theta_s}\right]^{\frac{-\gamma\cdot i_{1p}}{\alpha(p-i_{1p})}-1}=C_w(t_p)\cdot\left[\frac{\alpha\cdot(p-i_{1p})\cdot(t-t_p)+h_{mix}\cdot\theta_s}{h_{mix}\cdot\theta_s}\right]^{\frac{-\gamma\cdot i_{1p}-\alpha(p-i_{1p})}{\alpha(p-i_{1p})}}$$

, not the

$$C_w(t)=C_w(t_p)\cdot\left[\frac{\alpha\cdot(p-i_{1p})\cdot(t-t_p)+h_{mix}\cdot\theta_s}{h_{mix}\cdot\theta_s}\right]^{\frac{-\gamma\cdot i_{1p}}{\alpha(p-i_{1p})}}$$

in Tong et al. (2010). However, as the reviewer said, we recalculate and re-identify two incomplete parameters α and γ, the results are almost the same since we have the observation after the surface runoff. This error only influences the value γ before the surface runoff since this equation is the solution for the process before the surface runoff. So we do not present the recalculated results in the paper except Figures 8(b), 11(b) , 12(b) and prediction figures 3-12(c).

2. Why during three phases of infiltration/runoff processes the water fluxes i (infiltration) and q (runoff) are constant?

Reply: In our experiments, we get the average infiltration and runoff fluxes by the balance equation after the surface runoff since the sum of them is the constant rainfall intensity. They are the average values, so they are constant.

3. With two unknown parameters α and γ, the linear equation will be successfully fit the data.

Reply: Yes, with two unknown parameters, the prediction data fit the observed data successfully. However, the main objective of this paper is to identify and analyze the incomplete mixing parameters for the two-layer model. And we just find one way to identify the incomplete mixing parameters for the model, and explore how the parameters vary with different conditions, which will give guide for us to make more accurate prediction in future. And we also add some sentences in the end of this paper on this issue.

4. Consider the derivative for parameters α and γ.

Reply: In this paper, we try to get the parameter γ with convection-diffusion equation model based on its physical meaning, and then to consider the derivative for parameters α. However, we still find there some problems to get parameters α. Please see the details, take the first observation for example:
According to the governing equation

$$\frac{d\left(C_w\left[\alpha h_p + h_{mix}\cdot\theta_s\right]\right)}{dt} = -\gamma\cdot i\cdot C_w(t) - \alpha\cdot q\cdot C_w(t)$$

$$\left[\alpha h_p + h_{mix}\cdot\theta_s\right]\frac{dC_w}{dt} + C_w h_p\frac{d\alpha}{dt} = -\gamma\cdot i_r\cdot C_w(t) - \alpha\cdot(p - i_r)\cdot C_w(t)$$

$$\left[\alpha h_p + h_{mix}\cdot\theta_s\right]\left.\frac{dC_w}{dt}\right|_{t=t_r} + C_w h_p\left.\frac{d\alpha}{dt}\right|_{t=t_r} = -\gamma\cdot i_r\cdot C_w(t)\big|_{t=t_r} - \alpha\cdot(p - i_r)\cdot C_w(t)\big|_{t=t_r}$$

Based on this equation, according to the convection-diffusion equation, we can always get the value of γ, and the terms in the right side are known.
If we know all the other terms in the left side except the term $\left.\frac{d\alpha}{dt}\right|_{t=t_r}$, then we can get the solution for this term, and get the value of α for the next time. But

$$\left.\frac{dC_w}{dt}\right|_{t=t_r} = \frac{C_w(t_r + t_1) - C_w(t_r)}{t_1}, \alpha_1 = \alpha\big|_{t=t_r} + t_1\left.\frac{d\alpha}{dt}\right|_{t=t_r}$$

Because we get the observed solute concentration in the surface runoff water, then

$C_w(t_r + t_1) = C_w(t_r + t_1)_o / \alpha_1$

where $C_w(t_r + t_1)_o$ is the observed solute concentration in the surface runoff water at time $t_r + t_1$.
So at this time there are two unknown terms in the left side $\left.\frac{dC_w}{dt}\right|_{t=t_r}, \left.\frac{d\alpha}{dt}\right|_{t=t_r}$.
Therefore, it is still very difficult to get two incomplete parameters according to the derivative for parameters α.
Moreover, parameters α also affects the solute transfer into the surface runoff, so it also affects the convection-diffusion equation model, which will influence the value of parameter γ.

5. What has been gained by the work?
Reply: The main objective of this paper is try to find a way to identify and analyze the incomplete mixing parameters for the two-layer model with different conditions, and to give us more accurate predictions in future. And this is what we have gained in this study, while we analyze the results and get conclusions in the end of the paper. We have also added some sentences in the introduction and conclusion part to indicate this.

6. Provide a basis for us to understand how is it possible to predict these parameters or how they change with time (why they are constant for some cases and they vary with time for some cases). What use are they? Are they very specific to the particular experiments?

Reply: This paper is based on the analytical solution for the two-layer model in Tong et al. (2010), where the model is described in detail and the incomplete mixing parameters are assumed to be constant. While in this paper, we want to try to find a way to identify and analyze the incomplete mixing parameters for the two-layer model with different conditions, and to give us more accurate predictions in future. Section 2.2 described how to identify the parameters, where the incomplete parameters γ and α are assumed to become variable at the sampling time after surface runoff. Equations (8-10) showed details. To fit the observed data, the constant values can be constant for some conditions while they are variable for other conditions after the surface runoff. They are used to give us more accurate predictions. We get general conclusions with different condition, for example, the α will increase with many orders of magnitudes for different conditions without any infiltration with this model

7. Given the equations were derived assuming the parameters were constant in time, how should we interpret temporal changes in the variables from the same equations?

Reply: According to Equations (8-10), we can see that the parameters are constant during the sampling time gap from $t_r+t_1+t_2+\cdots+t_{m-1}$ to $t_r+t_1+t_2+\cdots+t_{m-1}+t_m$, while they are variable at the sampling time. However, we plot the identified values at the sampling time in this paper, so they change temporally based on the assumption that the parameters were constant in time.

8. Why experiments were conducted in a particular way? What is a coherent scientific objective? The conclusion seems to for the individual experiments not generalized.

Reply: We have described the experiments in detail in Tong et al. (2010). We have done different experiments with different conditions and compare the results for them. The coherent scientific objective is to find the identified parameters to fit the observed data and get general conclusion for us, which give us more accurate prediction and guide in future. We have modified the conclusion to make it generalized.

9. Good fit of the model to the data is doubtful.
Reply: The main objective of this paper is try to find a way to identify and analyze the incomplete mixing parameters for the two-layer model with different conditions, and to give us more accurate predictions in future. We get the two identified parameters to fit the observed data, and they are variable (see reply to comment 3 above), so they can have good fit.

10. There are numerous gaps in the description of the methodology including: measurement of concentrations; optimization procedure used in the calibration; measurement of soil properties such as hydraulic conductivity and porosity. Describe particular cases in the paper not just refer to the table and figure.
Reply: Because this paper is based on the results of Tong et al. (2010), and the experiments details are described there, so we do not give description for the measurement of concentrations. In the model, we only need the infiltration data, and we obtained it by the water balance for different experiments, so we give the description for the measurement of soil properties such as hydraulic conductivity and porosity in the paper. Optmization procedure used in the calibration is the shown in equations (8-10) in detail. We have added some sentences to describe particular cases in the paper now.

11. There are also numerous grammatical errors present.
Reply: We have read the paper carefully and modified it.