

Response to Remarks from the Preceding Review File Validation for the  
Manuscript gmd-2021-333

**“Optimization of Snow-Related Parameters in Noah Land Surface  
Model (v3.4.1) Using Micro-Genetic Algorithm (v1.7a)”**

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We appreciate your validation of our manuscript. We changed the colour scheme to allow readers with colour vision deficiencies to correctly interpret our findings in the manuscript (e.g., Figure 4(b), Figure 5, Figure 6 and Figure 7). Accordingly, the plot scripts also changed in the Zenodo code.

We also conducted minor corrections and they are summarized in below (red color represents the removed sentences while blue color represents the added sentences):

1. L54: Results, ~~discussion and conclusions~~ and ~~conclusions and outlook~~ are provided in sections 4 ~~and 5~~, ~~5 and 6~~, respectively.
2. L59: soil moisture and ~~soil~~ temperature
3. Figure 1(c) and its caption: We corrected the x-axis of Figure 1(c) and its caption as  $\alpha_{max,CofE}$ .
4. L119-120: SA shows similar sensitivities to both parameters within the same range but is a bit more sensitive  ~~$\alpha_{max,CofE}$~~  to  $C$ .
5. L129: where  $P_1 = 0.05 \text{ g cm}^{-3}$  and  $P_2 = 0.0017 \text{ g cm}^{-3} \text{ }^\circ\text{C}^{-1}$  are the default values of the coefficients.
6. L137: ~~individual~~  $\rightarrow$  individuals
7. L208: ~~depths~~  $\rightarrow$  thicknesses
8. L249-250: We moved the L245-246 in the original manuscript to L249-250 in the revised manuscript.  
 $\rightarrow$  The uniform crossover in which each gene is selected randomly from one of the parent chromosomes makes all populations perform a crossover at every generation to acquire the diversity (Lee et al., 2005).
9. Figure 4(b): We labeled the land cover types (LCT) in the each colored line.
10. Figure 5: We changed the colour scheme.
11. L305-306: We removed the '(Table 4)' at end of sentence.  
 $\rightarrow$  In the VRF\_5, new parameter values —  $P_s$ ,  $\alpha_{max,CofE}$ ,  $C$ ,  $P_1$ , and  $P_2$  — optimized by the micro-GA result in an improvement of RMSE for FSC, SA and SD, such as 0.7 %, 5.4 % and 13.7 %, respectively, ~~(Table 4~~

12. L312-313: We removed the '(Table 4)' at end of sentence.  
 → Next, SD shows the greatest RMSE improvement of 13.7 % (Table 4).
13. L325-330: To erase the statistics in OPT\_W for each LCT which can induce confusion, we revised the sentences like below:  
~~To supplement insufficient improvement in the FSC, we have additionally optimized the  $W_{max}$  in function of LCT (OPT\_W) based on the five parameters optimization results from OPT\_5. Here, we have only used the FSC to define the fitness function, they not considering SA and SD. Therefore, the fitness function is defined using Eq. (8) where the  $\vec{x}$  is only the FSC, so the normalized process with Eq. (9) is not needed. As a result, the OPT\_W further improves the RMSE of FSC compared to previous optimization results in the DBF, MF, WS, and UB by 4.6 %, 11.9 %, 7.7 %, and 5.5 %, respectively, while weakly decreases by 0.1 % in CL. To solve the under-estimated FSC that occurred at all stations in VRF\_5, we anticipate OPT\_W decreases the  $W_{max}$ , which leads to an increase of FSC. Consequently, the OPT\_W generates a decreased  $W_{max}$  in the MF and UB and other LCTs (e.g., DBF, WS and CL) generate increased  $W_{max}$ .~~  
 → To supplement insufficient improvement in the FSC, we have additionally optimized  $W_{max}$  in function of LCT (OPT\_W) using the optimized values of five parameters from OPT\_5. Here, we have only used the FSC to define the fitness function, not considering SA and SD; thus, the fitness function is defined using Eq. (8) where the FSC is the only element of  $\mathbf{x}$ , and the normalized process with Eq. (9) is not necessary. As a result, the OPT\_W further improves the RMSE of FSC in VRF\_6 compared to VRF\_5 in most stations: the significant decreases in  $W_{max}$  over MF and UB leads to an increase in the FSC, possibly alleviating the underestimation problem of FSC in VRF\_5.
14. L332-333: When the optimized five parameters are used except the  $W_{max}$  (VRF\_5), SA and SD are improved, and FSC shows a weakly improvement in RMSE performance (Table 4).
15. L334-338: As a result, an improvement of RMSE for the FSC, SA, and SD is 3.3, 6.2, and 17.0 %, respectively (Table 4). However, the MB for the FSC strengthens from 9.1 % to 11.9 % in VRF\_6 (Table 4 and Fig. 5(a)) due to larger negative bias especially in the DBF. On the other hand, SA and SD reduce the MB against the CNTL and enhance the improvement ratio from 26.9 % to 31.0 % and from 35.9 % to 44.2 %, respectively (Table 4 and Fig. 5(b)-(c)).
16. The title of first column in Table 4: ~~EXP~~ → Experiments
17. L358-359: ~~Figure 7 compares the time series of snow variables between the observations and the model simulations — CNTL and VRF\_6 — for DBF represented by UL.~~

- Figure 7 shows temporal changes in the snow variables after parameter optimization by comparing their time series of the observations and the model simulations (CNTL versus VRF6) for DBF represented by UL.
18. L361: The bias patterns in Fig. 7 are consistent with those in Fig.6(a)-(c).
  19. Figure 6: We changed the colour scheme and cation description.
    - Scatter plots of observations (OBS) and model results (LSM) for snow variables FSC (left panels), SA (middle panels), and SD (in cm; right panels) from the verification experiments — CNTL (~~red~~ black dots), VRF\_5 (blue dots), and VRF\_6 (~~green~~ orange dots), which are evaluated over different LCTs; (a-c) DBF represented by the station UL, (d-f) MF by GM, (g-i) WS by NG, (j-l) CL by BR, and (m-o) UB by SL.
  20. Figure 7: We changed the colour scheme and cation description.
    - Time series of the snow variables for DBF (e.g., UL) from May 2009 to April 2018: (a) FSC, (b) SA, and (c) SD (in cm). Observations are in ~~black~~ gray dots and model results are in ~~red~~ black dots for CNTL and in ~~green~~ orange dots for VRF\_6.
  21. L427-429 in Author contributions: Because Sujeong Lim and Seungyeon Lee use the same initial (e.g., SL), we distinguish the initials as follow: Sujeong is SuL. and Seungyeon Lee is SeL.
  22. L555-556: We removed the blank in the titles.
    - Saha, S. K., Sujith, K., Pokhrel, S., Chaudhari, H. S., and Hazra, A.: Effects of multilayer snow scheme on the simulation of snow: Offline Noah and coupled with NCEP CFS v2, J. Adv. Model. Earth Sy., 9, 271–290, 2017.