

Report #2**Submitted on 06 Jan 2025****Anonymous referee #2**

Suggestions for revision or reasons for rejection

(visible to the public if the article is accepted and published)

General Comment

The Author only partly addressed my previous major comments, concerning in particular model evaluation and quality of the presentation.

Major Comments

(1) Model evaluation: the Author added, in the Appendix, an evaluation of the model in offline mode (i.e., directly forced by observations). However, the comparison is too short to obtain reliable information on the model performance. Moreover, as specified by the Author “A numerical scheme needs a warm-up period in order to reach numerical equilibrium after initialisation. Unfortunately, it has not been possible to find a continuous observation period of sufficient length in order for the simulated parameters to reach a balanced state” and “Probably, there are some measurement inaccuracies”. So, it seems that the dataset used to force and verify the model is not suitable for this scope. It is then strongly recommended to use a more suitable dataset for this scope, evaluating model results for a longer time period, similarly to the online evaluation presented in Section 7.

(2) I have been performed another verification study. The study is based on the continued simulation of 912 days (2,5 years) with the column version of the “Pochva” scheme. The observed data on the radiation budget and precipitation flux at the surface, the computed data on sensible heat and latent heat fluxes, as well as the evaporation flux in the air surface layer have been used as atmospheric forcing parameters in the simulation. The computation of the fluxes in the surface layer has been performed using the observed data on wind, pressure, temperature and humidity at the surface and at 40 m above the surface. The bottom conditions for the soil temperature and the soil water content have been defined using the observed values at the deepest levels available. The initial conditions for indicated prognostic variables have been defined using the measured values at the various soil levels. The simulation was successful and provided good results. The simulated values of the soil prognostic variables have been compared with the observed values. The results of the performed verification are presented in the Appendix of the manuscript.

(3) The obtained results of the new verification studies are presented in the lines 897-900, 964-1000 in the corrected manuscript.

- (1) Quality of the presentation: The quality of the presentation is still not satisfying. Actually, little has changed with respect to the previous version of the manuscript.
- (2) I am sorry that the English language style of the manuscript is not literary and expressive enough. I have re-checked everything thoroughly again and have corrected the manuscript in many places. I hope that the text clearly expresses the intended meaning.
- (3) Many corrections of the text have been made throughout the whole paper.

Minor and technical comments

- (1) The reference style is still wrong throughout the manuscript.
- (2) The reference style of the manuscript has been adapted to the requirements of the journal.
- (3) References in the manuscript.

- (1) Line 21: “current model” or “current models”?
- (2) Yes
- (3) Correction made, line 21 in the corrected manuscript.

- (1) Line 58: delete comma.
- (2) No, this comma is important for the following scheme presentation.
- (3) No modification.

- (1) Lines 64-65: the meaning of this sentence is not clear.
- (2) The sentence has been rewritten.
- (3) Correction made, lines 64-66 in the corrected manuscript.

- (1) Line 97: “is determined by THE RATIO BETWEEN THE water mass deposited on the leaf surface and THE maximum value of this mass, which is also EVALUATED using A dataset.”
- (2) The sentence has been rewritten.
- (3) Correction made, lines 97-98 in the corrected manuscript.

- (1) Line 115: what is q_{vatm1} ?

(2) The definition has been corrected.

(3) Correction made, line 116 in the corrected manuscript.

(1) Line 116: (kg kg^{-1}), superscripts in units should be used (throughout the manuscript).

(2) Yes.

(3) Correction made, line 116 in the corrected manuscript.

(1) Line 121: α_{soil} , “soil” should be a subscript.

(2) Yes.

(3) Correction made, line 121 in the corrected manuscript.

(1) Line 136: “temperature at 2 m...”

(2) Yes.

(3) Correction made, line 136 in the corrected manuscript.

(1) Lines 154-155: please reformulate this sentence.

(2) The sentence has been rewritten.

(3) Correction made, lines 155-156 in the corrected manuscript.

(1) Line 180: “root zone depth is defined using a suitable vegetation dataset” should be in a separate sentence.

(2) Yes.

(3) Correction made, line 181 in the corrected manuscript.

(1) Equations 11-13 are not introduced in the text.

(2) Yes.

(3) Correction made, lines 153-154 in the corrected manuscript.

(1) Equation 16: can the snow surface temperature exceed 0 °C?

(2) No, it is physically impossible, but it is possible in a numerical algorithm.

(3) No modification.

(1) Equation 35: what is $\Phi_{v\ surf}^{\{turb\}}$?

(2) The equation has been corrected, thank you.

(3) Correction of the equation (35) made.

(1) Line 372: “is THE pressure gradient...”

(2) Yes.

(3) Correction made, line 374 in the corrected manuscript.

(1) Line 427: S_{soil}

(2) Yes.

(3) Correction made, line 429 in the corrected manuscript.

(1) Lines 463-464: refer to the relevant equation.

(2) The sentence has been rewritten.

(3) Correction made, lines 465-467 in the corrected manuscript.

(1) Lines 535-536: this sentence is not clear: it seems that variations of the solid component take place only in the presence of solid precipitation or sublimation/deposition of water vapour. However, variations of the solid component can also occur due to melting in any snow layer.

(2) Yes, this sentence was confusing, it has been rewritten.

(3) Correction made, lines 539-540 in the corrected manuscript.

(1) Lines 541-546: I still do not understand this hypothesis. Why cannot the water drain through more than one layer in one time step?

(2) Since an exact representation of the vertical drainage speed is not crucial for a correct simulation of the dynamics of the snow layer, for simplicity in numerical solution it has been decided to let the water flow through exactly one layer during one time step.

(3) No modification.

(1) Line 550: $\Phi_{m\,kh}$

(2) Yes

(3) Correction made, line 552 in the corrected manuscript.

(1) Lines 580-581: $\rho_{\text{snow}}^{\text{fresh}}$ and $\rho_{\text{snow}}^{\text{old}}$

(2) Yes

(3) Correction made, line 584 in the corrected manuscript.

(1) Line 597: “respectively” is repeated.

(2) Yes, the text has been corrected.

(3) Correction made, line 600 in the corrected manuscript.

(1) Line 599: “The values of the physical parameters at half levels ARE computed”.

(2) Yes.

(3) Correction made, line 602 in the corrected manuscript.

(1) Line 602: “taking INTO account”.

(2) Yes.

(3) Correction made, line 605 in the corrected manuscript.

(1) Line 608: k should not be superscript.

(2) Yes, it has been corrected.

(3) Correction made, line 611 in the corrected manuscript.

(1) Line 612: “below or equal to 0 °C”.

(2) Yes.

(3) Correction made, line 615 in the corrected manuscript.

(1) Line 662: “experiences bias values between”

(2) Yes.

(3) Correction made, line 665 in the corrected manuscript.

(1) Line 705: “moreover the points...”, start a new sentence.

(2) Yes.

(3) Correction made, line 708 in the corrected manuscript.

(1) Line 716: “it is lower...”, start a new sentence.

(2) Yes.

(3) Correction made, line 718 in the corrected manuscript.

(1) Line 718: “by a similar COLD climate”.

(2) Yes.

(3) Correction made, line 721 in the corrected manuscript.

(1) Line 766: “it is positive during daytime and negative in the evening and morning hours”, looking at fig. 9 the behavior seems different.

(2) Yes, the analysis has been corrected, thank you.

(3) Correction made, lines 768-772 in the corrected manuscript.

(1) Line 773: “for 2-m temperature”.

(2) Yes.

(3) Correction made, line 775 in the corrected manuscript.

(1) Line 774: “The overall errors are not high”, “high” is very qualitative if not compared with typical errors found in other similar studies.

(2) The comment has been clarified.

(3) Correction made, lines 776-777 in the corrected manuscript.

(1) Line 778: full stop is missing.

(2) Yes.

(3) Correction made, line 780 in the corrected manuscript.

(1) Line 784: “while THE worst scores”

(2) Yes.

(3) Correction made, line 786 in the corrected manuscript.

(1) Line 788: “occurs AT daytime”

(2) Yes.

(3) Correction made, line 790 in the corrected manuscript.

(1) Line 796: full stop is missing.

(2) Yes.

(3) Correction made, line 798 in the corrected manuscript.

(1) Lines 813-814: The Author has still not demonstrated that Pochva works better than other models over snow cover or with a stable surface layer.

(2) The verification results presented in the manuscript have shown good scores for air temperature and humidity in the surface layer in the Cold Steep, Subarctic and Mountains climatic zones.

(3) No modification.

(1) Line 866: “for soil water exchange processes...”, start a new sentence.

(2) The text has been rewritten

(3) Lines 866-872 in the corrected manuscript.

(1) Figures A1 and A4: what is net? (red line).

(2) The comment has been clarified “global radiation budget”.

(3) Figures A1, A4, A7 in the manuscript.

(1) Line 906: “characteristics: a light...”

(2) Yes.

(3) Correction made, line 927 in the corrected manuscript.

(1) Lin 942: “observed values of soil physical parameters, of forcing scheme parameters”

(2) Yes.

(3) Correction made, line 962 in the corrected manuscript.

(1) All Figures: use always the correct unit symbols.

(2) Yes.

(3) All figures and these captions have been controlled and corrected.