

# ***Interactive comment on “The Interactions between Soil-Biosphere-Atmosphere (ISBA) land surface model Multi-Energy Balance (MEB) option in SURFEX – Part 1: Model description” by Aaron Boone et al.***

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REF: Geosci. Model Dev. Discuss., doi:10.5194/gmd-2016-269, 2016. Title: “The Interactions between Soil-Biosphere-Atmosphere (ISBA) land surface model Multi Energy Balance (MEB) option in SURFEX – Part 1: Model description” Authors: A. Boone, P. Samuelsson, S. Gollvik, A. Napoly, L. Jarlan, E. Brun and B. Decharme

Corresponding Author response to Anonymous Referee #1

Comment: I propose a small change in title “The Interactions between Soil-Biosphere-Atmosphere land surface model with Multi-Energy Balance option (ISBA-MEB) in SUR-

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FEX”

Response: In accordance with this reviewers suggestion, we have modified the title to:

“The Interactions between Soil-Biosphere-Atmosphere land surface model with a Multi-Energy Balance (ISBA-MEB) option in SURFEX - Part 1: Model description”

Please note that we retained the text - “Part 1: Model description” – since it is the first of a 2 part series. But, we will leave the decision on whether or retain or not this last phrase up to the editor.

Comment: P3. L. 63-69: Re-phrase the paragraph describing the different application of ISBA. Possibly break the sentence to multiple sentences each describing one of the ISBA application. For example “ISBA has been used in operational high resolution short term numerical weather prediction . . . .... It also has been employed in climate research studies . . . .”

Response:

Comment: P3. L75: Remove this phrase “by improved realism with respect to for example” then rephrase to “The force-Restore approach of ISBA has been replaced in recent years by multi layer explicit . . . .”

Response: Done

Comment: 3. L90: The last sentence is unfinished!

Response: It has been rewritten (and completed) as:

in order to distinguish the soil, snow and vegetation surface temperatures since they can have very different amplitudes and phases in terms of the diurnal cycle. Accounting for this distinction facilitates (at least conceptually) incorporating remote-sensing data, such as satellite-based thermal infrared temperatures (Anderson\_ea\_97), into such models.

Comment: P4. L93: change “lessening” to reducing or minimizing.

Response: Done

Comment: P5. L.130-135: Needs some correction in the text. For example: put parenthesis around “Smith et al. (2011)” and “Zhang et al. (2014)”. “over Europe by Wramneby. ...”

Response: Done

Comment: P6. L.171: by DIF do you mean ISBA-DF in Boone et al. 2000? what ES stands for? Line 4: is it 12 soil layers? what is the total depth of the soil?

Response: We have now defined the acronyms DF (DiFfusion equation) and ES (Explicit Snow process) in the text, and the default number of layers (14 and 12, respectively, for each).

Comment: P6. L.188: Define  $V_a$

Response:  $V_a$ =the wind speed at the atmospheric forcing level (represented by the subscript “a”): this is now defined in the text.

Comment: P6. L. 189-191: Re-phrase “ equations for the evolutions o the bulk vegetation canopy temperature,  $T_v$ , the snow-free ground surface (soil-litter) temperature,  $T_g$ , . . . . .”

Response: Done: reworded as: “The surface energy budgets are formulated in terms of prognostic equations governing the evolutions of the bulk vegetation canopy. . . . .”

Comment: P6. L. 192: change to “equivalent water content of ice” or “ice water equivalent (IWE)”

Response: Done: we have used the former choice of wording

Comment: Fig 1: the colors in the picture is not as indicated in the text.

Response: We have corrected this: we verified the caption (it is OK) and have edited

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the text in the body of the paper (near the beginning of Section 2 where the Fig. 1 is referred to) to be consistent with both the caption and Fig. 1.

Comment: P8. L 233: should be Eq. 5

Response: In fact, this should be Eq. 6. (although indeed it is also applicable to Eq. 5). But we can see this has led to some confusion: Although  $p_{ng}$  cancels in Eq. 6, it has been used here simply because by multiplying by  $p_{ng}$ , energy conservation can be obtained by summing Eq. 4-6. But indeed we have realized that this is a bit awkward, thus we have dropped  $p_{ng}$  in Eq. 6 (essentially it cancels out since it appears on both the RHS and LHS of Eq. 6, so in fact this represents no change to the math). The same is true for the discretized forms of the snow heat and mass prognostic equations...i.e. Eq. G2 and G11 (so for consistency, we have also canceled out  $p_{ng}$  from both sides of those equations). We now emphasize later in the paper that when combining Eq. 4-6 (to solve them simultaneously and for mass/energy conservation of the entire patch or grid cell), we must multiply Eq. 6 by  $p_{ng}$  (specifically, we emphasize this now in the Appendices, notably G, just after Eq. G3 and G14, and I, after Eq. I3). Note that dropping  $p_{ng}$  from Eq. 6, G2 and G11 does not cause any of the other derivations/equations to change. Finally, we edited the text to reflect the reviewers' main comment: that indeed the text can apply to Eq. 5.

Comment: P8. L225-227: Define other parameters in Eqs 4-6 (e.g. H, LE, Rn, G, SW) with their units.

Response: The terms were defined in successive parts of the text when the corresponding mathematical definitions are given: but indeed defining them upon first appearance is a good suggestion (improving readability and more standard) so we have done as the reviewer requests: we have moved the definitions and adjusted the text accordingly.

Comment: P 11. L354. Shouldn't be  $q_{sat}$  based on eqs 19, 20?

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Response: Yes: but in fact a naming convention is defined in the text just after this equation so we didn't define it explicitly: but we realize based on this reviewers comment that it is not explained well enough so we have added the text giving the explicit definition:

The same convention holds for saturation over ice, so that  $q_{\text{satin}}$  represents the value over the snowpack.

Comment: P16. L490. Are emissivities defined based on the vegetation classes?

Response: Yes: emissivities depend mainly upon vegetation class. But some dependence on climate (location) exists, but indeed they depend primarily on vegetation class: the text has been modified to add this information.

Comment: P20 L. 637: Correction "soil liquid water content and water content equivalent of frozen water"

Response: Correction done.

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