Responses to Editor:

Thank you for your constructive suggestions. Our responses to each comment (*italics)* are given below .

1) *Please follow the reviewer's advice to motivate your study better in the introduction. I do not think the research question is essential, as it is a model description paper, but nonetheless the purpose of your improved model has to be really clear.*

Response: We have added additional text. The rationale for this study is to extend the applicability of OHM in modelling storage heat flux ΔQ_S for areas (land uses and land covers) where measurements are not available and to cover a wider range of seasonal/meteorological conditions. We have elaborated on this in the manuscript:

a. The importance of ΔQ_S: page 2 lines 5–17.
b. The advantages and limitations of OHM: page 3 lines 1–16.
c. The lack in the physical interpretations of OHM coefficients: page 3 lines 16–18.

2) *I would like you to take into account the suggestions of the reviewer concerning the equations. Please make clear where equations are taken from textbooks and where they are your own work.*

Response: We have added additional references to make this clear. Notably, references (Gao et al., 2003; 2010) for the solution (eqns 4 and 5) have been added in the revised manuscript.

3) *The reviewer's comments on the outgoing longwave radiation require some additional work, please provide physical justification for ignoring the term.*

Response: First of all, we acknowledge that inclusion of the "re-emitted downwelling longwave radiation" improves the physical rigour of the parameterisation of outgoing longwave radiation $L_{\uparrow}$. We now include this as part 2 in eqn 10 of the revised manuscript. However, as the omission of this term is well accepted in modelling the outgoing longwave radiation (Bateni and Entekhabi, 2012; Lee et al., 2011; Stensrud, 2007), and its omission greatly enhances the simplicity of the AnOHM formulations, the simplified form of $L_{\uparrow}$ (i.e., $\varepsilon_s \sigma T_s^4$) is still used in this study. The rationale for using the simplified form is presented in Appendix A.

We do not, though, agree with the following comment by the reviewer that *"the longwave radiation is not reflected (solely possible for shortwave radiation), but re-emitted."*

We recognise that the concept of reflectivity is only valid for the case of a single wavelength; however, in practise it is referred to in this way for fairly wide wavebands (e.g., such integral reflectivity is referred to as *albedo* for shortwave radiation). However, longwave radiation can be reflected given we are not concerned with ideal blackbody surfaces. The related physics is discussed in section 3 of chapter 1 by Oke (1987).

4) *It would also be great if you can explain in your introduction in a single sentence what exactly an OHM is and on which physical principles it is based.*

Response: This explanation has been provided on page 2 lines 29–30 of the introduction: OHM is a model to estimate the storage heat flux ΔQ_S based on a hysteresis relation between ΔQ_S and net radiation Q^*.

5) *It would be useful to have again a native speaker check your paper.*

Response: This has been done.

References:

Bateni, S. M. and Entekhabi, D.: Relative efficiency of land surface energy balance components, Water Resour. Res., 48(4), W04510, doi:10.1029/2011WR011357, 2012.

Gao, Z., Fan, X. G. and Bian, L. G.: An analytical solution to one-dimensional thermal conduction-convection in soil, Soil Science, 168(2), 99–107, doi:10.1097/01.ss.0000055305.23789.be, 2003.

Gao, Z., Horton, R. and Liu, H. P.: Impact of wave phase difference between soil surface heat flux and soil surface temperature on soil surface energy balance closure, J. Geophys. Res., 115(D16), D16112, doi:10.1029/2009JD013278, 2010.

Lee, X., Goulden, M. L., Hollinger, D. Y., Barr, A., Black, T. A., Bohrer, G., Bracho, R., Drake, B., Goldstein, A., Gu, L., Katul, G. G., Kolb, T., Law, B. E., Margolis, H., Meyers, T., Monson, R., Munger, W., Oren, R., U, K. T. P., Richardson, A. D., Schmid, H. P., Staebler, R., Wofsy, S. and Zhao, L.: Observed increase in local cooling effect of deforestation at higher latitudes, Nature, 479(7373), 384–387, doi:10.1038/nature10588, 2011.

Oke, T. R.: Boundary Layer Climates, Taylor & Francis, Abingdon, UK. 1987.

Stensrud, D. J.: Parameterization schemes: keys to understanding numerical weather prediction models, Cambridge University Press, Cambridge. 2007.

Responses to Reviewer 2:

We appreciate the comments and constructive suggestions from the reviewer. Our detailed responses are given after each comment (*italics)* below.

Major comment:

1) *The authors have revised the manuscript. However, I have the feeling the revised version still contains the main deficiencies that I have mentioned in my previous review. The justification for ignoring the re-emitted downwelling longwave radiation in the upwelling longwave radiation has been addressed, but still ignoring this term is physically wrong. In addition, the readability of the paper has not improved in my view; it is still a long list of equations that are sometimes poorly connected. For example section 3.1 could have literally been copied from a mathematics book, but the link with the AnOHM parameter estimation is missing. I suggest the authors improve the description of all steps that lead to the analytical solutions provided. Moreover the paper lacks a clear research question and some justification for the need to do this research, i.e. what can now be done with the AnOHM that was not possible before with the original OHM, and why an analytical approach is the most feasible to answer the research question.*

Response: We would like to thank the reviewer for his/her constructive comments and critique, which provides us another opportunity to elaborate our thinking.

The reviewer's comments can be summarised as:

1. Ignoring the re-emitted downwelling longwave radiation is physically wrong.
2. The readability of this manuscript needs to be improved.
3. The motivation of this study is unclear.

Our responses to these points are:

1. We recognise that inclusion of the "re-emitted downwelling longwave radiation" improves the physical rigour of the parameterisation of outgoing longwave radiation $L_{\uparrow}$. This now is included as part 2 in eqn 10 of the revised manuscript.
   However, as the omission of this term is very well accepted in modelling the outgoing longwave radiation (Bateni and Entekhabi, 2012; Lee et al., 2011; Stensrud, 2007), and its omission does greatly enhance the simplicity of AnOHM formulations, the simplified form of $L_{\uparrow}$ (i.e., $\varepsilon_s \sigma T_s^4$) is still used in this study. The rationale for using the simplified form is presented in Appendix A.
2. We have checked the steps thoroughly and added explanations where we believe they are necessary.
3. The rationale for this study is to extend the applicability of OHM in modelling storage heat flux ΔQ_S for land covers and time periods where measurements are not available. We have elaborated on this in the manuscript:
   a. The importance of ΔQ_S: page 2 lines 5–17.
   b. The advantages and limitations of OHM: page 3 lines 1–16.
   c. The lack in the physical interpretations of OHM coefficients: page 3 lines 16–18.

Other comments:

2) *Eq. 4 and 5 should be correctly referenced, since this is not a solution of your own course.*

Response: References (Gao et al., 2003; 2010) for the solution (eqns 4 and 5) have been added in the revised manuscript.

3) *P13, ln 3: the longwave radiation is not reflected (solely possible for shortwave radiation), but re-emitted.*

Response: we recognise that the concept of reflectivity is only valid for the case of a single wavelength; however, in practise it is often referred to in this way for fairly wide wavebands (e.g., such integral reflectivity is referred to as *albedo*). Longwave radiation can be reflected given we are not concerned with ideal blackbody surfaces. The related physics is discussed (for example) in section 3 of chapter 1 by Oke (1987).

References:

Bateni, S. M. and Entekhabi, D.: Relative efficiency of land surface energy balance components, Water Resour. Res., 48(4), W04510, doi:10.1029/2011WR011357, 2012.

Gao, Z., Fan, X. G. and Bian, L. G.: An analytical solution to one-dimensional thermal conduction-convection in soil, Soil Science, 168(2), 99–107, doi:10.1097/01.ss.0000055305.23789.be, 2003.

Gao, Z., Horton, R. and Liu, H. P.: Impact of wave phase difference between soil surface heat flux and soil surface temperature on soil surface energy balance closure, J. Geophys. Res., 115(D16), D16112, doi:10.1029/2009JD013278, 2010.

Lee, X., Goulden, M. L., Hollinger, D. Y., Barr, A., Black, T. A., Bohrer, G., Bracho, R., Drake, B., Goldstein, A., Gu, L., Katul, G. G., Kolb, T., Law, B. E., Margolis, H., Meyers, T., Monson, R., Munger, W., Oren, R., U, K. T. P., Richardson, A. D., Schmid, H. P., Staebler, R., Wofsy, S. and Zhao, L.: Observed increase in local cooling effect of deforestation at higher latitudes, Nature, 479(7373), 384–387, doi:10.1038/nature10588, 2011.

Oke, T. R.: Boundary Layer Climates, Taylor & Francis, Abingdon, UK. 1987.

Stensrud, D. J.: Parameterization schemes: keys to understanding numerical weather prediction models, Cambridge University Press, Cambridge. 2007.