Hydrol. Earth Syst. Sci. Discuss.,
doi:10.5194/hess-2016-270-RC2, 2016

Hydrology and Earth System Sciences
Discussions
Open Access
EGU

Interactive comment on "Advantages of Analytically Computing the Ground Heat Flux in Land Surface Models" *by* Valentijn R. N. Pauwels and Edoardo Daly

Anonymous Referee #2

Received and published: 10 July 2016

The authors present an analytical solution to the ground heat flux, that could eventually be used in models. I think there are several issues that need to be addressed, before this can be published.

General comments

I cannot check the math in detail and defer in this regard to the comments by the other reviewer. In my opinion this question needs to be settled before final publication. Additionally, I have a different question about eq. A1 (see specific comments).

The title of the paper "Advantages of Analytically Computing the Ground Heat Flux in Land Surface Models" does not seem to be delivered on. While the method the

Printer-friendly version

Discussion paper

authors proposed may very well be valid, I do not see from the results that the analytical solution is better, especially since there is no comparison of the numerical solution or a conventional model to the observed values. I would prefer a more neutral title as well as a figure comparing both the analytical and numerical fluxes to the observed data (both time-series and x-y plot).

Specific comments:

P4 18-21: "Of all the parameters affected by the resolution, the parameter that shows the largest variation in values is the thermal conductivity , with the value at Δz=0.1 m more than 4 times the value at Δz=0.01 m. No other parameter shows this variation." –> After reading the subsequent explanation. I can see, why for the purpose of this model this may be the case. However, I disagree with the statement that a physical interpretation of the soil heat conductivity is impossible. What would be the reason for the changes in the other values.?

P7: 12-15: "A pooled variance t-test with 95% confidence showed that all parameter values obtained with the analytical solution are not significantly different from the parameter values obtained with the numerical solution, with the exception of the objective function value and the heat capacity for all spatial resolutions, and the thermal conductivity for a spatial resolution of 0.01 and 0.1 m." –> Please reformulate this sentence. In my opinion this sentence obfuscates the fact that there are large differences in the parameters.

P8 6-7: "The solution derived in this paper does not allow for temporally varying soil thermal properties, ..." –> given the fact that soil thermal properties are highly dependent on water content, which varies in time. Does this not unduly limit the proposed method.

eq3 and others: consider z_t with $z_{u(pper)}$ in order to avoid confusion with t for time

Table 3: Depending on the resolution of the model, the parameters of the model seem

Printer-friendly version

Discussion paper

to change widely based on the optimization algorithm. It is my concern that results may be a bit arbitrary if very different combinations of the model parameters lead to virtually the same results. I am especially concerned that analytical solution and numerical solution at the same resolution have very different parameters. Assuming that these parameters have a real world manifestation , then they should be constant across runs.

Table 4: There appears to be a large difference in the observed and modeled G (4 vs. 0.35). Why is the modeled mean G off by so much. Also, while the RMSE values between the different model resolutions are similar to each other, at some instances larger resolutions have smaller RMSE. Could the authors comment on this.

Figure 2+5. I cannot distinguish the lines without zooming into the PDF. Since there is not charge for color figures. Please consider either using colered lines or at least to make lines for distinguishable. Figure 3. Assuming that the crosses and the line perfectly match (I cannot see the lines), please either use a grey/colored line on top of the crosses.

Figure 6 and associated text. Please specify, which analytical solution is being displayed. Why does the vertical resolution make a difference in the analytical solution?

eq A1: I am also confused with eq. A1. I understand that downward water movement constitutes a heat transfer. However eq. A1 does not contain the heat capacity of water but only the soil heat capacity. This confuses me. Please clarify.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., doi:10.5194/hess-2016-270, 2016.

Printer-friendly version

Discussion paper