Response to Interactive comments on "Comparison of six algorithms to determine the soil thermal diffusivity at a site in the Loess Plateau of China"

Dear Anonymous Referee #3

We greatly appreciate your efforts and your helpful comments in reviewing our article. We have considered all of your comments in the revised manuscript.

We respond below in blue to your comments item-by-item.

Comments on Comparison of 6 algorithms to determine the soil thermal diffusivity … Gao et al.
The paper aims at comparing different already existing algorithms to determine soil diffusivity. All these algorithms lies on the temperature variations at different depths. The comparison was done with a single experiment performed on the Tibet Plateau over 8 days period.

General comments
The main problem of this paper is the lack of reference measured values which would allow a hierarchy between the methods. In the paper we can just conclude that the methods led to different results, which is not really a new result. Moreover, harmonic methods are stressed out as being the best methods. Since these methods are more flexible, offering a higher degree of freedom, they are expected to reproduce the temperature more precisely. This not proves that HM offers better results to estimate the soil thermal diffusivity. Finally, there is no error assessment on the retrieved thermal diffusivity.
So in its present form, the paper is not conclusive enough to be published in HESSD. I recommend the author to resubmit a paper when the analysis includes reference values, measured using adequate sensors as thermal chamber or method based on artificial heating, or taken from literature. An error assessment on the thermal diffusivity should be added (temperature accuracy, exact location of temperature sensors …) .

The paper includes a comparison of available analytical models for estimating apparent soil thermal diffusivity for estimation of soil temperature. The results reported in the paper are new. There are no field-based reference measured values available. Soil heat transfer is complex and involves a large number of coupled heat and mass transfer mechanisms and properties. The focus of this paper is to use simple heat transfer models with an economy of properties for the purpose of estimating field soil temperature. It is beyond the scope of the paper to perform laboratory-based reference thermal property measurements

Specific comments
In page 2250 vapor convection should be added as a potential contribution to heat flows. Water vaporization is energy consuming

Yes, we agree.

P2251 : it is not clear what is expected to be found in supplement table 1.

Supplement Table 1 summarizes the methods included in the study.

Eq 3 is not consistant with 2 (remove Cg on Eq3 left term)

Thanks, we removed it.

-Cw/Cg Wtheta is not a clear notation for water flux

Gao et al (2003) is cited, and they provide the full description.

P2256 L 7 : I don't understand where the first term of W comes from

It comes from Eq. (20).

Soil granulometric fractions are missing.

We added these information into section 3 (Field Experiments)

For the need of the paper, the description of the site climate is not necessary for the paper understanding

We think it is important to provide some basic information about the measurement site.

P2257 L25 This not shown from Figures

We re-worded the sentence.

P2258 : the soil moisture diurnal patterns are not physically consistant, the soil moisture being the highest at noon. This is a typical illustration of the temperature influence on the dielectric constant.

We agree that diurnal temperature variation probably influenced the soil moisture sensors causing them to show diurnal variation in soil moisture. However, the diurnal variation shown in soil moisture does not remove the fact that soil moisture content decreased over time and that soil moisture increased with depth at any given time. Our statement on the reality of convective heat transfer stands.

P2261 take care : a good temperature representation does not necessarily show that the thermal diffusivity is better estimated

In this paper we estimate the apparent thermal diffusivity. The apparent thermal diffusivity is connected to temperature change. So, indeed a good estimation of temperature change does indicate a good estimate of apparent thermal diffusivity.

Axis labels and legends are too small

We improved them.

Best wishes.

Sincerely yours, Ling Wang, Robert Horton, and Zhiqiu Gao