We would like to thank you for the careful review and the expert comments. Hereinafter we present our point-to-point reply.

- This paper presents a simulation study on the effect of groundwater table depth on soil surface temperature. The simulation study shows convincingly that shallow groundwater does indeed affect surface temperatures so that the groundwater depth may be inferred from remote sensing of soil surface temperature. In the study, it is brought forward that soil moisture is a key variable for interpreting soil surface temperature. The effect of the groundwater table on soil surface temperature is therefore an indirect effect since the groundwater table depth has an influence on the soil moisture content at the soil surface. Besides groundwater table depth, there are also other parameters and variables that influence soil moisture and its spatial pattern. For instance, soil texture and soil hydraulic properties, lateral runoff, but also soil management. Especially soil management may play an important role since soil tillage may have an important impact on the capillary connectivity of the land surface with the subsoil. When this connectivity is broken, the soil surface layer acts as a capillary barrier that blocks capillary rise. This implies that the influence of these other parameters on soil moisture must first be filtered out before the signature of the groundwater table becomes visible. How important the impact of other factors and their spatial distribution are and how well these patterns can be filtered out, will be crucial for using soil surface temperatures to estimate groundwater table depths. I think that the paper can be improved largely if these aspects were considered. The authors could for instance illustrate the effect of soil texture on soil surface temperature and the effect of a tilled soil surface layer on soil surface temperature.
- This is true, soil texture and soil hydraulic properties are very important within the course of thermal detection of shallow groundwater depth. Although we briefly discussed this in the manuscript, we will conduct and discuss three more numerical experiments to explore the critical depth of detection for three types of soil (i.e. clay, loam and sand). The importance of the tillage practice emanates from its effect on the soil porosity and consequently on its hydraulic properties. Nevertheless, its effect on infiltration and percolation (water driven by gravity forces) would be more pronounced: the porosity of subsurface soil can be reduced by compaction and tillage practices that may disorder and destroy pore spaces resulting in a zone of low permeability at the bottom of the tilled layer. We will discuss these issues more in the manuscript.

- p3 ln 15: 'Furthermore, **<u>Quiel's</u>** study considered only the penetration of the daily temperature variation and totally neglected the yearly temperature oscillation.' From reading the paper further, it did not become clear to me how the authors would propose using yearly temperature oscillations to assess groundwater table depths or what would be the advantage of using yearly oscillation.

- The work of Quiel (1975) aimed at supporting the remote sensing studies for detecting shallow groundwater effect on surface temperature. In our analysis we illustrated that the effect of shallow groundwater on surface temperature is variant in pattern and magnitude throughout the year (Figures 3-6). This illustrates that conducting the measurement only in a single day (as Quiel, 1975 did) is not enough to adequately realize and portray the significance of groundwater effect.

- p4 ln 11 and following: Therefore, these studies did not provide a complete prospective of shallow groundwater effect. The temporal patterns of that effect on surface temperature, net radiation, and surface heat fluxes (latent, sensible and ground heat fluxes) were not portrayed. In the work of Kollet and Maxwell, exactly these aspects were considered. Kollet, S.J., and R.M. Maxwell. 2008.
- Kollet and Maxwell (2008) addressed the influence of groundwater only on the yearly averaged surface energy fluxes in their figures 8 and 9. However I did not cite this paper as I have some reservations regarding its methodology, tools and results. I think that explaining the reasons behind these reservations are beyond the scope of this discussion, however I will be happy to discuss them further with you if you wish to.

- p 6 ln26-27: Lout was not defined and Eq. 2 represents the relation between albedo and soil moisture.
- This is true. Lout is embedded in (Eq. 2) as the last term on the right hand side. We will clarify this in the script. The albedo-soil moisture relationship is described in (Eq.2a). In order to treat this confusing numbering we will renumber (Eq.2a) as (Eq.3) and adjust the rest of equations' numbers accordingly.

- p 8 ln 15-16: How are the roughness lengths for momentum, zm, and heat, zH, transfer defined?
- According to the model documentation, the surface roughness parameter for momentum transfer, z_m, is an input parameter to SHAW and estimated by the user. (Typical value is 0.1 cm for a very smooth surface to 10 cm for a very rough surface). The surface roughness parameter for the temperature profile, z_H is assumed to be 0.2 z_m. We will furnish this information in the manuscript.

- p 9 Eq. 12: The formulation of the soil thermal conductivity seems different from what is normally considered in text books of soil physics. The hydraulic conductivity depends in a non-linear way on the volumetric soil water content whereas in Eq. 12, a linear relation is proposed (unless the weighting factors are a function of the soil water content).

- The de Vries's Model which is adopted in SHAW for calculating soil thermal conductivity may not be the best available model (please see Markle et al., 2006). However it is well-known and widely used (for examples, please refer to Ochsner et al., 2001; Lu et al., 2007, etc.). Since SHAW was originally developed to simulate soil freezing and thawing, it adopted this formulation as it can include the influence of ice. The relationship expressed in Eq.12 seems linear but it is not. Actually, the weighting factor of a soil constituent is a function of the size and the shape of its granules, etc. however it depends also on the ratio of the thermal conductivity of the constituent to that of water.

- p 10 Eq. 17: I propose including Kelvin's equation linking air humidity to water pressure head.
- OK.

- p11 ln 17: Could a reference to GEM be given?
- We will add some references (for example, Johnson et al., 1996; 2000).

- p11 Soil profile information: Could the spatial discretization that was used to simulate the profile be given?
- Vertical node spacing starts as fine as 5 cm for the first 40 cm and increased downward smoothly to become 1m at deep depths. We will provide this information in the manuscript.

- p12 ln 9: Is there a rationale behind choosing the upper 2.5 cm of the soil profile to represent the surface conditions? Why isn't simply the surface temperature that represents the skin temperature used?
- With the second soil node in the model at 5 cm, the surface soil layer in the model is 2.5 cm thick. The model does not compute a skin temperature, but uses temperature and moisture conditions of the surface layer for energy transfer at the surface.

- p 13 table 2 and discussion on the ground heat flux. On the long term, shouldn't the net ground heat flux be equal to zero for both the GWP and NOGWP? I think that the authors need to discuss why this net ground flux isn't equal to zero in this case. Is this caused by the fact that the weather generator did not produce years with a yearly average temperature that is exactly equal to the long term yearly average? The fact that the obtained yearly averaged ground flux is positive, is that not just by coincidence? If another series of 4 years would have been generated, couldn't it be then that a negative average ground flux was observed. Therefore, I have questions also about the statement in the conclusions section at p 17 ln 22-23: Nevertheless, the milder surface temperatures of such areas make the upshot of ground heat flux smaller in the long run, i.e. the yearly average.

- This comment is very sharp and correct. We realized that the discussion we present regarding the annual values of ground heat flux in both profiles is not completely precise. In reality, deep soil temperatures will eventually come into equilibrium with surface and climate conditions; the deep temperatures will eventually be very close to the average annual temperature of the soil surface. Therefore, the deep soil temperature should be slightly higher under the NoGWP profile than the GWP profile so that the average annual soil flux for both profiles should be very close to zero. Changing weather and surface conditions from year to year and spatial variability of groundwater will complicate this, but under homogeneous conditions, this would be the case. The weather generator does not necessarily provide a yearly average temperature that is exactly equal to the long term annual average. It produces time series which is statistically representative of the weather that can be expected at a certain location over a period of time. For example, Johnson et al. (1996) illustrated that data generated by GEM closely imitates the actual climate in a specific site. In our case, I believe that the annual G was positive due to the fact this year was a bit warm year and the subsurface gains heat. In a cold year however the subsurface looses heat and the yearly G upshot will be negative. We will amend this in the MS.

- p 14 ln 30-31: I do not observe in Figure 5c that the net radiation for the GWP is lower than that of NOGWP during night. During night, both are negative but net radiation from NOGWP is more negative than net radiation from GWP.
- There is no contradiction between your statement and ours. Actually the absolute value of the heat flux refers to its magnitude while the algebraic sign designates its direction. For clarifying this statement we may rephrase it to be "the absolute value of the net radiation for GWP was higher during daytime, but a little lower in nighttime".

References

Johnson, G. L., C. Daly, G. H. Taylor and C. L. Hanson (2000), Spatial variability and interpolation of stochastic weather simulation model parameters. J. Appl. Meteor., 39, 778-796.

Johnson, G.L., C.L. Hanson, S.P. Hardegree and E.B. Ballard (1996), Stochastic weather simulation: Overview and analysis of two commonly used models. J. Appl. Meteor., 35, 1878-1896.

Lu, S., T. Ren, Y. Gong, and R. Horton (2007), An improved model for predicting soil thermal conductivity from water content at room temperature, Soil Science Society of America, 71, 8-14, doi:10.2136/sssaj2006.0041.

Markle, J. M., R. A. Schincariol, J. H. Sass, and J. W. Molson (2006), Characterizing the two-dimensional thermal conductivity distribution in a sand

and gravel aquifer. Soil Science Society of America, 70, 1281-1294, doi:10.2136/sssaj2005.0293.
Ochsner, T. E., R. Horton, and T. Ren (2001), A new perspective on soil thermal properties, Soil Science Society of America, 65, 1641–1647.