Dear associate Editor, Dear Editorial Team,

I am submitting a modified version of my paper about the soil heat fluxes measurement with the soil heat fluxes plates (SHFPs) and energies that should be included in the surface energies balance (SEB) equations. Since I can't change the fundamental law of energy conservation, I did not retrieve the concerned result: annual integration nullity of the surface energy exchange after geothermal flux subtraction. This point results from a very simple calculation of an inert body energy conservation. However, I did develop the corresponding calculation explanation in Appendix A to allow all readers to follow, step by step, this calculation. In another appendix, Appendix B, I am recalling the different components of the heat exchanges: conductive, radiative, and convective. Usually, the convective component is neglected in the soil and I am describing a simple case of advective heat flux into the air where the convective exchanges are predominant. In the soil, the convective part of the heat flux is not predominant but neither negligible.

Both appendixes are destinated to clarify the fact that there is always a difference between the reality governed by the physical laws and the measurement governed by the technical limitations. The energy conservation law is describing the real heat exchanges when the SHFPs are measuring only one heat fluxes exchanges component: conductive fluxes, therefore, limiting its real fluxes representation accuracy.

Honestly, I think that I have already answered my referee's questions and objections and developed these points in the first revised text. My feeling is that Dr. Montagnani dos not even read the revised text nor accords much attention to my answers but I would like to recall here why I am persuaded that there is a big misunderstanding and answer his last comments point-by-point.

After I queried clarifications of the reasons driving my first referee Dr. Montagnani, named hereafter RC1, to recommend the rejection of my paper, I obtained the following objections:

RC1: "Where for me the author makes a serious mistake is precisely when he claims that the balance is zero at the annual level. It contradicts centuries of experimental physics, and also world maps of geothermal energy fluxes."

Annual integration nullity of a geothermally corrected soil surface heat exchange is not a hypothesis that I make but a result of a simple calculation based on a fundamental physical law provided in Appendix A, already added to in the first revised version of my paper. Denying this result amounts to denying the fundamental law of energy conservation. RC1 is justifying the rejection of these results by the "contradiction with centuries of experimental physics". Besides that the soil heat exchange measurements are relatively recent; it seems difficult to sustain a fundamental physical law inexactitude due to a partial experimental measurements mismatch. The convective soil heat fluxes such as vegetation transpiration causing ground-water moves are real and not sensed by the SHFP nor any other known sensor. Corresponding energy losses are not negligible. Consequently, the annual integration of the SHFPs' measurements, after geothermal flux subtraction is not nil and the difference gives us the importance of the unmeasured heat fluxes. Concerning a "contradiction with world maps of geothermal energy fluxes", I am sorry, I do not understand what RC1 is talking about. The estimation of the geothermal energy at our station Fr-Lam (South-west of France) was taken from the studies of SIG BRGM realized in France in 1989 and widely used for geothermal fluxes estimation. Maybe the objection of CR1 is coming from the sign "-" that I attribute to this flux when

the dedicated measures are mainly talking about positive fluxes. The sign change is due to the convention adopted where an upgoing flux is given as negative.

CR1: ”Instead of excuting some heat flux plates and forcing the balance to zero, I would do an error analysis with Monte Carlo sampling and try to determine based on the error that is deemed acceptable how many heat flux plates to put in. That way you circumscribe the random error to a defined value.”

There is always this misunderstanding that is misleading RC1. I do not force anything. The balance of the real surface heat flux, after geothermal subtraction, is nil (this is according to the fundamental energy conservation law). The balance of the SHFPs' is not nil because it cannot be because the SHFP is not sensing all the fluxes. If I am proposing to exclude some plate's measurements it is not “to force the balance to zero”, no one plate's balance is zero, but I am proposing to exclude some plates measurements if their measurements are very different from the mean measurement, only to exclude the inhomogeneities perturbations (could be seen as random error) and to assess the unmeasured heat fluxes (could be seen as systematic error). I have already signaled the difficulties to use statistics on a very limited number of plates. We cannot ignore the feasibility of the plate's multiplication. All the corresponding explanations were already developed in the first revised version of my paper and the answers to the RC1's first rapport.

RC1: “Also, to reduce any bias from random placement, you could do a measurement period with many plates, then reduce them in number after stratifying them (stratified sampling). But always accepting the experimental results, only possibly removing outliers.
If, on the other hand, there is a systematic error, it should be pointed out and characterized as such. Systematic error is not reduced by increasing the sampling points.”

It is exactly what I am answering to the first RC1's comments and adding explicitly to the first revised version. There are two different sources of SHFP's measurements imbalance: spatially random perturbations caused by inhomogeneities and rather spatially homogeneous perturbations caused by convective fluxes. Forming a mean measured flux and then discarding the plates with measurements being far from the mean measured flux is to approach the systematic perturbation which is the convective unmeasured fluxes. Concerning the sentence: “but always accepting the experimental results, only possibly removing outliers” this is not at all the usual procedure when an overall representative measurement is sought after but a punctual perturbation is detected. For example, the eddy covariance measurements are often discarded not because they are outliers but just because we know that the conditions were not met for eddy covariance technique optimization such as too stable conditions, etc. Eddy covariance measurements are discarded to not bias the accumulated measurements. Disrupted measurements are then fulfilled by gap-filling methods where measurements are “recreated” from the previously acquired measurements. We are far, very far, from “always accepted measurements”. Also, I already mentioned, in the answers and the revised text, that in the case of an inhomogeneity boundary proximity, the soil heat flux is no more vertical or the SHFPs are always placed horizontally which means that they measure the vertical component of the heat flux. If the heat flux is not vertical SHFP's measurement is biased. Should we accept all the measurements even if we know that they are biased? An extensive discussion about the inhomogeneities and their boundaries influence is already in the answers to the RC1's first report and the first revised text.