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Biogeosciences Discussions



# *Interactive comment on* "Sensible and latent heat flux from radiometric surface temperatures at the regional scale: methodology and validation" *by* F. Miglietta et al.

**F. Miglietta et al.**

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Anonymous Referee 2

This paper describes the results of a comparison between estimates of sensible and latent heat flux from a combined satellite and ground based method with aircraft measurements, for different land cover types. Such a validation of energy flux estimates is very useful, because validation dataset of spatial estimates of heat fluxes are scarce. The paper is well written, the methodology is described in a clear manner, and the results are encouraging. I recommend publication after a minor revision (see the numbered comments below).

1. There is a mistake in equation 6, the last part needs to be: /(Rn-G)

Reply: Equation 6 corrected

2. The psychrometer constant has a tilde only in Eq 6

Reply: tilde removed in Equation 6

3. Page 1948, line 17: generation of aircraft -> aircrafts

Reply: unchanged, aircraft is also plural

4. Page 1952, line 20. Repeating twice, does it mean the measurements were carried out two times or three times?

Reply: text changed in flying twice, means two measurements

5. Page 1953, line 18. The equation only considers incoming and reflected long wave and shortwave radiation. Long wave radiation emitted by the surface is not included here (but Rn in Fig 3b seems ok).

Reply: This comment highlighted that Equation 3 was incorrect. The computation scheme however was correct (why Fig 3b is ok), including emitted longwave contribution, that was derived from LST (satellite land surface temperature) using the same literature surface emissivity values as used in the non satellite version of the method. Some more detail about this calculations have been added in the revised text above Equation 3, and the potential use of satellite derived emissivity has been cited in the conclusions.

6. Page 1959, line 15, a space is missing between fraction and of;

Reply: corrected

7 - In addition, I would like to comment on two conclusions of the paper (the authors may or may not want to address these comments in this paper: they are not essential for the understanding of the paper, but they are relevant for people who want to use the methodology in the future). I was interested in the applicability of the method in



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areas where no aircraft and fewer ground data are available. The authors say that the method can even be applied if no tower or aircraft measurements are available: On page 1962, lines 11-14, the authors conclude that results for H are similar when aircraft surface temperature is replaced by satellite surface temperature. On page 1962, line 25 to page 1963, line 2, the authors state that the method can be applied even when no tower data are available, by using models or measurements of stomatal resistance. Looking at the methodology, if I substitute (the corrected) Eq 6 back into Eq 4, I find the following expression for H: H = rho*cp*(Ts-Ta)/((Ts-Ta) + (es-ea)/psyc)) * (Rn-G) In this expression, es is a function of Ts and rc/ra. The energy balance is closed (forced), and thus the distribution of available energy over H and lE is a function of Ts, aerodynamic and stomatal resistances. If we want to apply the method in the absence of tower and aircraft measurements, then the sensitivity of H to Ts, ra and rs is relevant. In the above equation, Ts appears both in the numerator and in the denominator. How sensitive is H to Ts, compared to the sensitivity to the resistances ra and rc?

Reply: The referee correctly points out that a sensitivity of the method to the input quantities is needed, in order to assess relative importance of Ts and resistances (rc) in driving the method. To assess this, we performed a sensitivity analysis of the method to Ts and rc. Such analysis was based on average values for all variables during the observation period, perturbing alternatively Ts and rc. The sensitivity was studied for 3 different values of the delta DT = Ts 8211; Ta, equal respectively to 3, 4, and 5°C (representing different conditions in the surface energy balance). Ts was perturbed on +- 1C° and +- 2°C, while rc was perturbated +-25

8 - Is the fact that aircraft surface temperature can be replaced by satellite surface temperature caused by (1) the good match between aircraft and satellite Ts (Fig 3a) or (2) a relative insensitivity of the model to Ts?

Reply: The model is sensitive to Ts, as confirmed by the sensitivity analysis that was done. Our point is that using aircraft observations of radiometric temperature and net radiation, and using satellite observations of the same quantities, lead to similar results



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in terms of model performance. This means either that uncertanties associated to these observations are similar for the two methods, and/or that uncertanties associated to other variables are dominating the total uncertainty of the model. Based on the sensitivity of the model to Ts, we can rule out this latter hypothesis supporting the first.

9 - In this study rc was calibrated from flux measurements of the tower, and thus, the raeestimates of lE are dependent on the flux tower measurements. The authors say that literature values for rc can be used as well. I wonder whether the authors tested the sensitivity of H to the ratio of rc/ra, since ra and rc may play a key role (Eqs 7 and 8).

Reply: this point was also raised by Referee 3 (last point). Based on these comments of both reviewers, and on sensitivity analysis that was done showing dependancy of the method to rc values, the conclusion on the applicability of this method when no tower rc estimates are available has been revised to a more cautious version (see revised text).

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Interactive comment on Biogeosciences Discuss., 6, 1945, 2009.