Reviewer 2:

General comments:

The authors propose a novel application of an old method. Instead of applying the Bowen Ratio as a micrometeorological method used at the field-scale, they make use of satellite soundings to apply the Bowen Ratio method to large spatial scales. They test the method against flux tower measurements.

Specific

1. Given the rather large leap in spatial scale of the application of the Bowen Ratio, it might be informative to more systematically evaluate why the original assumptions (and typical assumptions of most subsequent uses) of the Bowen Ratio Energy Balance method remains valid or nearly valid in this modified use of the method. Typically, there are three basic assumptions layed out for the Bowen Ratio method to work: i. 1-D vertical transport, ii. homogeneous land surface, iii. steady-state conditions (Fritschen and Simpson, 1989, Journal of Applied Meteorology, 28: 680-689).

This is a very good point, and not something the original paper sets out explicitly. To this we could add similarity in the vertical transport mechanisms for heat and water vapour. We set our position on these assumptions in quite some detail (we hope) in our response to R1 so rather than repeat them here we direct the reader to that response. The revised manuscript will include a much more explicit handling of these core assumptions.

2. The dramatic difference in spatial scale between the flux tower footprint and this satellite based method would seem to inherently limit the ability of the flux towers to validate the method (a point made on Lines 350-355). Lack of energy balance closure at the flux tower sites is also an issue. Thus, it could be worthwhile to consider other methods to estimate actual ET that would be more consistent in terms of scale. Namely why not use an annual water balance method (P-Q=ET assuming minimal storage) for gaged watersheds at the approximately 1° scale? One would look at differences in ET across multiple years instead of monthly differences within the same year. Given the sometimes questionable relationship between this Bowen Ratio method and flux tower measurements at certain sites (Figure 3), this additional method of validation would provide a further check on the soundness of the method.

We have considered at length using the annual water balance method (and others) to validate the sounding approach. However, in our judgement the cumulative uncertainties associated with deriving annual budgets from uncertain and often biased precipitation and flow data we feel prevents this from being a robust test. We have however developed an additional test we believe is quite stern, namely exploiting radiosonde data in conjunction with tower fluxes (please see our response to R1). Again, we stress we envisage the need for significant further evaluation of the proposed methodology but believe enough is offered in the current manuscript to warrant publication at this stage.

3. On Lines 355 to 380, the manuscript reports RMS errors in latent heat fluxes from other studies. It suggests that errors observed in this study are comparable to those in other

studies. However, nearly all these other studies use daily fluxes or less. It would seem that the RMS errors for daily values represent something somewhat different, namely the ability to replicate daily variations in fluxes and maybe (but not necessarily) consistent bias in estimates. At a monthly scale, RMS error would seem to more strongly suggest bias since daily variations would cancel out over the longer averaging window. In essence, I might expect that a suitable RMS error for a monthly averaging window would be lower than that for a daily averaging window (much the same way it is often easier to model monthly streamflows relative to daily streamflows). Are there any additional studies that report RMS error for monthly fluxes?

In the present case, the reported RMS error is the RMS error of monthly averages of 13:30 hours ET. There are additional studies that reported RMS error of monthly fluxes (for example, Cleugh et al., 2007; Mu et al., 2011). In these studies daily ET was modeled using daily radiation and meteorological variables and monthly fluxes were generated from the daily averages. Cleugh et al. (2007) reported RMS error of 27 W m^{-2} over two contrasting sites in Australia using tower meteorology and MODIS vegetation index over the eddy covariance footprints. Mu et al. (2007, 2011) reported RMS error 8 – 180 W m^{-2} on eight-day average ET and 12 mm on monthly average ET. These will be cited in the revised version of the manuscript.

Minor Comments:

a. Lines 89 to 91 – Could this statement be explained in greater depth. Not enough context for most readers to understand the exact reasoning. May be a citation to something else?

We will expand the description as **'Sounders integrate signal horizontally over scales of thousands of square kilometres and hence benefit from strong spatial averaging characteristics in the measurement, despite suffering from ambiguities in the vertical integration of signal. However, this later drawback is aided by an effectively large sensor separation in the vertical.'** and a citation will also be included**.**

b. Eqn's 4a, 4b, 5 and adjoining text. Inconsistent notation in terms of T, P, and Z. Sometime capitalized, sometimes not.

Please see response to R1.

c. Line 224 – Make clear that the values in this expression came from the relationship shown in the caption of Figure 2. If one does not immediately look at the Figure 2 caption, it is confusing were this expression came from.

This will be made clear in the revised manuscript.

d. It would be helpful to repeat a full description of biome types in Figure 2. The abbreviations are not totally obvious and somewhat awkward to flip back to Table 2 depending how paper is layed out.

Sure.

e. What is N in Table 2? Is this the number of months of observation across all sites within each biome? Please clarify.

N is the number of datasets in Table 2. This will be clarified in the revised version.

References:

Cleugh, H. A., R. Leuning, Q. Mu, and S. W. Running (2007), Regional evaporation estimates from flux tower and MODIS satellite data, Remote Sens. Environ., 106, 285 – 304.

Mu, Q., F. A. Heinsch, M. Zhao and S. W. Running (2007), Development of a global evapotranspiration algorithm based on MODIS and global meteorology data, Remote Sens. Environ., 111, 519 – 536.

Mu, Q., M. Zhao and S. W. Running (2011), Improvements to a MODIS Global Terrestrial Evapotranspiration Algorithm, Remote Sens. Environ., 115, 1781 – 1800.