The authors wish to extend their appreciation for the thorough review undertaken that we believe has strengthened the paper. Individual items have been addressed below. Unfortunately the Pages and Lines referred to by the reviewer are not the same as those on the HESSD manuscript but in all cases the location within the document was successfully identified.

1. There is merit in an open review comment by an unnamed critic that the description of the SR method is inadequate. If the reader is not well versed with the SR technique, then the general description of the theory in the paper does not give the reader sufficient information without expecting them to consult the references. In particular, the theory and methods required to solve for the amplitude and ramping period using the temperature structure function needs to be included/expanded. The dependence of the weighting factor on measurement height is included in Equation 2 but there is no indication of how it is dependent on the canopy architecture and thermocouple size and how these are included in the calibration process.

The surface renewal technique is a complex, but well-recognised technique, covered in numerous technique based papers. This paper is aimed at wetland ecologists and hydrologist and therefore the inclusion of detailed surface renewal theory is arguable. However, we suggest that the following theoretical explanation could be included to address the points raised above:

Page 1749 Line 3 - The SR technique is based on the principle that an air parcel near the surface is renewed by an air parcel from above (Paw U et al., 1995). This process involves ramp like structures (rapid increase and decrease of a scalar, such as air temperature in this study), which are the result of turbulent coherent structures that are known to exhibit ejections and sweeps under shear conditions (Gao et al., 1989; Raupach et al., 1996; Paw U et al., 1992). The theory of heat exchange between a surface and the atmosphere using the SR method is described in detail by Paw U et al. (1995), Snyder et al., (1996), Paw U et al. (2005) and Mengistu and Savage (2010). The exchange of sensible heat energy between a surface and the atmosphere is expressed as:

$$H = \alpha \rho_a c_p z \frac{a}{\tau} \qquad \textbf{(1)}$$

where, α is a weighting factor, ρ_a is the density of air, c_p is the specific heat capacity of air, z is the measurement height, a is amplitude of the air temperature ramps and τ is the total ramping period.

The amplitude and the ramping period were deduced using analytical solutions of Van Atta (1977) for air temperature structure function (Sn(r)). This is calculated for each averaging period (30 min) from high frequency (10 Hz) air-temperature measurements using:

$$S^n(r) = \frac{1}{m-j} \sum_{i=1+j}^{m} \left(T_i - T_{i-j}\right)^n \qquad \textbf{(2)}$$

where, n is the power of the function, m is the number of data points in the time interval measured at frequency f (Hz), and j is the sample lag between data points corresponding to a time lag $r = j/f$, T_i is the i^{th} temperature sample. The Van Atta (1977) method then involves

estimating, for time lags of 0.4 and 0.8 s (Mengistu and Savage, 2010), the mean value for amplitude *a* during the time interval, by solving the following equation for the second, third and fifth order roots:

$$a^3 + pa + q = 0 \qquad \textbf{(3)}$$

where:

$$p = 10S^2(r) - \frac{S^5(r)}{S^3(r)} \qquad \textbf{(4)}$$

and

$$q = 10S^3(r) \qquad \textbf{(5)}$$

The ramp period τ is then finally calculated using:

$$\tau = -\frac{a^3 r}{S^3(r)} \qquad \textbf{(6)}$$

The weighting factor *α* is required to determine the final *H* using the surface renewal technique (Eq. 2). It depends on the measurement height (Eq.1), canopy architecture (due to changes in heat exchange between the plant canopy and air parcels) and thermocouple size (due to changes in sensor response time). Once determined by calibration, it is fairly stable and does not change regardless of weather conditions unless the surface roughness changes (Snyder et al., 1996; Spano et al., 2000; Paw U et al., 2005). An extended Campbell Scientific Open Path Eddy Covariance system (Campbell Scientific Inc., Logan, Utah, USA) was therefore deployed at the Mfabeni Mire to determine the weighting factor *α* during two window periods of measurement in November 2009 and March 2010. A "Sx" style Applied Technologies, Inc. sonic anemometer (Longmont, Colorado, USA) was used at the Embomveni Dune site during the same window periods. The sensors were mounted on 3 m lattice towers at a height of 2.5 to 3.0 m above the ground level or 2.0 to 2.5 m above the vegetation cover. They were orientated into the direction of the mean wind on the upwind side of the tower to minimize flow distortion effects. At both sites, water vapour corrections as proposed by Webb et al. (1980) and coordinate rotation following Kaimal and Finnigan (1994) and Tanner and Thurtell (1969) were performed using EdiRe software (R. Clement, University of Edinburgh, UK) to determine the eddy covariance derived *H*. The weighting factor α (Eq. 1) was finally obtained from the slope of the least-squares regression (forced through the origin) of the eddy covariance *H* versus the uncalibrated surface renewal *H* (Paw u et al., 1995). At the Mfabeni Mire and Embomveni Dunes, an *α* of 0.8 and 1.0 respectively were determined (at a measurement height of 1.0 m above ground surface).

2. I do not think the term “residual” is the correct terminology for the determination of ETSR as a component of Eq.1. It would also help to elaborate on how EL is “converted” to ETSR (Page 7 line 17)

‘residual’ is commonly used in this context (See amongst other Mengistu and Savage, 2010) but could be replaced with ‘unknown’. Also on Pg 1750 Line 18: Finally, ET using the SR techniques (ER_{SR}) was determined every 30 min (Eq. 1).

…….which was then converted into ET using the specific heat capacity of water (Savage et al., 2004).

3. It also would help to elaborate on the difference between the two methods of soil heat flux measurement between the two sites as it may have a bearing on some of the interpretations.

The soil heat flux was calculated in exactly the same way at both sites using the method by Tanner. See Page 1748 Line 22.

4. The authors claim that “at night the ETSR was negligible during the calibration period” Page 9 line 20). However, it was significant during the night of the 20 at both sites (up to approx 50W/m) according to Figure 5 and this appears to be a significant proportion of the rate during the previous day? Does this influence the interpretations of the results when the ET from this site is influenced by the energy constraints.

In most studies ET is ignored at night (unless there is significant advection or the oasis effect in an arid area) where the energy balance is used because the driving energy (Rn) for ET becomes negative. The night-time values are therefore not considered in any of the energy balance discussions or calculations of ET.

A more appropriate sentence could read ‘During stable night-time conditions, the analysis failed to resolve the ramp characteristic and therefore while Rn < 0, ET_{SR} was reduced to zero (Monteith, 1957; Baldocchi, 1994).

5. The paper claims that “most of the rainfall occurred during summer”. It is difficult to judge from Fig 2 but it seems that rainfall occurs consistently throughout the year although there are generally smaller magnitude events in winter due to the nature of the rainfall. The larger events are known to recharge the groundwater but it is expected that the smaller events would influence the soil moisture regime and hence the ET rate. I don't know if this would affect the interpretation of the resulting difference between the two sites but it may warrant a mention.

These smaller events would absolutely influence the soil moisture regime and the ET rate at the Embomveni Dune site and this could be mentioned here under the weather conditions, however, it is discussed in some detail on Page 1753 Line 28 to Page 1754 Line 5.

6. The reference to the drought needs to be interpreted carefully. The only physical parameter it could affect in this study is the depth of the unsaturated zone. It would influence a comparison of the results with other areas and periods but the comparison between methods would not be affected.

Agreed. For this reason the drought conditions were not emphasised, however, because soil water availability was a limiting factor at the Embomveni Dune site and a wetter year may result in higher ET at this site – Page 1763 Line 17.

7. The range in head at the Mfabeni Mire (-0.3 to + 0.3) is about 400mm between a wet and dry season if we assume a porosity of about 0.3. If we neglect the runoff from the Nkazana stream (which is about 3mm or 0.2% MAP from Grundling et al 2012) then the ET would be about 800mm (1200-400). Is this significantly different to the 900mm average ET measured by the authors for a dry season? i.e. would the ET and/or the stream likely to change in a wet season?

It is unlikely that the ET from the Mfabeni Mire would be much higher in a wet year. In a wet year, there would be standing water on the surface during summer but in winter the water level is below the peat surface whether in a wet or a dry period. But, while the groundwater level is below the peat, the surface of the peat is still wet. It therefore becomes a question of the unsaturated hydraulic conductivity of the peat and whether this limits soil evaporation from the peat surface. We feel that during summer the ET is dominated by transpiration and that soil water evaporation or open water evaporation is low due to low surface roughness and saturation within the plant canopy. Whether there is open water or wet peat would therefore not make a difference to the seasonal ET.

8. It would be informative if the early morning prevalence to cloud affecting the solar radiation was also noticeable in the rainfall.

This was investigated and there is no noticeable rainfall in the mornings associated with the morning cloud.

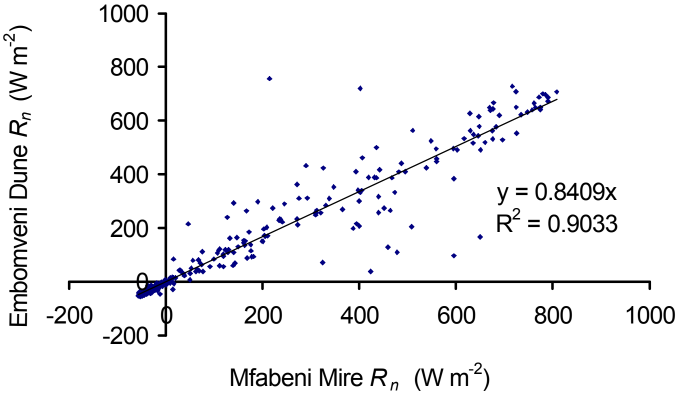
9. The occurrence of minimum daily temperature below zero is not well document for this region, which is dominated by the moderating influence of the Indian Ocean. However, it does not appear to be a rare instance because there are two other periods when the temperature dropped close to 0C according to Fig 2. It would have been interesting to see if this was the case at the other site where the environmental conditions were different.

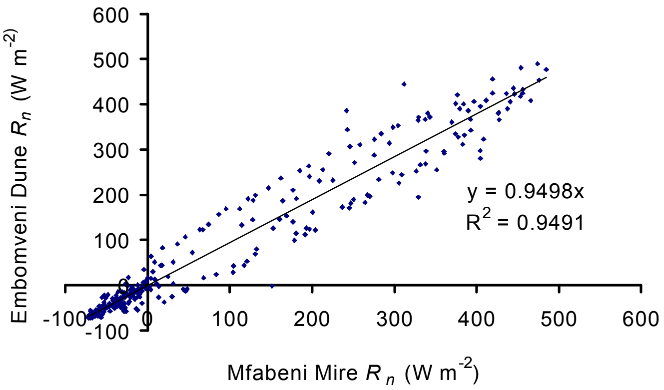
The fine wire thermocouple data show that the minimum temperatures at the Embomveni Dunes were the same as the Mfabeni Mire but this was not specifically mentioned as this is a night-time condition unrelated to the day-time fluxes of importance.

10. Page 11 line 23 : "The burn however, provided an opportunity to investigate the ET directly after a fire followed by natural re-growth". The magnitude of the increase in albedo followed by an equal decline later in the season may be more of a natural process than one that could be attributed solely to the fire.

Agreed. The reference is to 'ET directly after the fire' and in the manuscript on-line, 'natural spring re-growth' is referred to. This emphasises that the influence of the fire is primarily in the period immediately after the fire.

11. Page 12 line 14 "Plant senescence in winter reduced the difference in the reflected irradiance between the sites (Figs. 5b and 5d)". It is difficult to make a value judgement between these two series in Figure 5 so it would be more informative to plot them against one another.





As suggested, the graphs attached describe the summer and winter comparisons of net radiation (Rn) and will be added to the text. The upper graph is the summer and the lower graph the winter comparison. These clearly support the statements made in the text and show that there was a bigger difference between the Rn at the two sites in summer (y=0.8409 x) where as in winter (y=0.9498x) the difference was reduced. In addition, the lower co-efficient of determination during summer, supports the cloudiness noted in the paper which, despite a close proximity (6 km) resulted in different half hourly solar radiation results. These graphs will be a useful addition to the paper.

12. The difference between sites in ETSR was claimed to be due to availability of water. The exclusion of a difference due to vegetation type needs to be explained.

The different vegetation type will be included in the explanation and we suggest the following rewording:

Despite the close proximity of the two sites (6 km), ET_{SR} at the Mfabeni Mire (900mm) was almost double the ET_{SR} at the Embomveni Dune site (478mm). This difference was due to the freely available water at the Mfabeni Mire and the different vegetation types found between the sites. The dominant limitations to transpiration and surface evaporation at the Mfabeni Mire were likely to have been available energy, low atmospheric demand (noted above) and some stomatal control (mainly of the grasses) due to plant senescence in winter. The ET_{SR} at the Embomveni Dunes was limited by soil water content and the low water-use requirements of the dune vegetation, an adaptation to survive prolonged dry conditions. Even for brief periods after rainfall when soil water was not limiting, the daily ET_{SR} was still lower than the Mfabeni Mire. However, soil water

availability was generally low with volumetric water content of ~6% and frequently below −800 kPa at a depth of 0.075m (measured continuously but not shown).

And therefore also changes to ……

Page 1763 Line 16.

The Embomveni Dune (dry grassland) measurements of ET_{SR} provided a useful contrast to the Mfabeni Mire (wetland). The ET_{SR} was seasonal at both sites yet only 478 mm over 12 months. Even for brief periods after rainfall when the soil water was not limited, the ET_{SR} was lower at the Embomveni Dune site. The vegetation is therefore adapted to dry conditions and has a low water-use requirement even with higher soil water availability. However, for the majority of the measurement period, the ET_{SR} was limited by soil water availability. The drought conditions (650mm of rainfall versus a mean annual precipitation of 1200mmyr^{-1}) therefore contributed to the low summer ET_{SR} at the Embomveni Dunes which are expected to be higher in a normal to high rainfall year.

13. I assume the ETEQ at the Mfabeni site is directly related to LE(P-T). This needs to be specified.

With the first reviewers proposed removal of the well-known Priestley Taylor methodology, the reference to LE(P-T) does not appear in the paper anymore.

14. The paper uses ET to symbolise total evaporation (page 3:line 8). It then states that it is calculated from LE (Page 7: Line17). The paper then goes on to describes three ET estimates based on SR, ES and Penman-Monteith (ETr). In several instances I was unsure of which one was being described when ET was used with no subscript. An example is equation 8 where I have assumed ET represents ETSR. If this is not the case then I have the wrong interpretation of the calculated Kc

As above, the specific equation and section referring to the equation has been removed. A reference to a generic ET is necessary and there are a number of different ET's in the document that need to be clearly specified as a reader can be easily confused. The authors have checked that all references to ET without a subscript are correct and clearly a reference to a generic ET.

15. Application of ETEQ to the Dune site. This methods assumes (page 16 line 2) that "ET would eventually reach a rate of equilibrium when the air is saturated and the actual rate of ET would be equal to the Penman rate of potential evapotranspiration.". Is this a reasonable assumption for the dune site?

This is not the case at the Embomveni Dunes and therefore it is interesting that an acceptable linear regression of ET_{SR} on ET_{EQ} was found at this site. We considered leaving this result out but it does provide someone wanting to estimate Embomveni Dune grassland ET with some guidelines in terms of a suitable α and level of confidence. In addition it is a useful contrast to the Mfabeni Mire and for this reason we support its inclusion in the paper. It would be appropriate on Page 1759 Line 23, to highlight that the Dune site is not a suitable site for application of the Priestley-Taylor method as some of the assumptions of the methodology are violated.

16. Page 17 line 9; ".... after rainfall, was ETSR similar to ETEQ as noted in Figs. 5c and 5d". There are no values for ETEQ in these Figures.

We suggest removing the reference to Fig 5c and 5d with the following re-wording: This indicates that a severe constraint was imposed by low soil water availability (measured but not shown). For example, on the days of the 21 and 22 August (following 12 mm of rain on 19 and 20 August) the near surface volumetric water content increased from 6.2 % to 8.7 % and the Priestley-Taylor α was 0.8 and 0.81 respectively. However by the 23 August the surface soil water was depleted to 7.0 % and the Priestley-Taylor α was restricted to 0.52 by the soil water limitation.

17. Page 17 line 10; Generally a plot of points with a regression with r =0.96 would show a similar plot to Figure 7 but it could be more intuitive to see the plot of the less correlated ETSR - vs - ETEQ for the dune site.

Our response follows from the comment in item no. 15 above. The Priestley-Taylor model is strictly speaking not suitable for application at the Dune site. It was however applied and a reasonable result found and therefore it was included but is not an emphasis of the paper. The Priestley-Taylor modelling for the Mfabeni Mire is however one of the main results and findings of the paper and therefore this regression is shown (R^2=0.96). We believe that the exclusion of the ET_{SR} on ET_{EQ} regression is therefore aligned to the main findings and results of the paper.

18. Page 18 line 15). "The high summer rates of the Drakensberg contrast with the Embomveni Dunes and were higher due to the high summer rainfall in the Drakensberg area which sustains an adequate soil water content for transpiration". Was a possible/probable difference in VPD considered as another important factor? A similar question relates to the last statement on page 18 line 22?

Page 1760 Line 19 - The high summer rates of the Drakensberg are likely to contrast with the Embomveni Dunes for a number of reasons. The high summer rainfall (long-term average = 1299 mm) of the Drakensberg area (compared to 650 mm measured in the Mfabeni Mire) sustained an adequate soil water content (generally > 43 % and < 80 kPa) in comparison to the rapidly draining drier soils of the Embomveni Dune site (generally < 7% and > 200 kPa) which limited ET. In addition, the summer VPD of the Drakensberg (Everson et al., in press) is higher (mostly between 1.5 and 2.5 kPa) than at the Embomveni Dunes (mostly between 0.5 to 1.5 kPa). The lower atmospheric demand together with the lower soil water content explains the lower summertime ET rates of the Embomveni Dunes and a comparison between these sites becomes questionable. The second ……..

19. Page 19 line 13. It would be useful to have a similar discussion of the applicability of the method to the Dune site where α was not equal to 1.020.Page 19 line 26: "An alternative to the Kc method is to estimate the ET using the Penman-Monteith method". This statement is confusing because I thought the Kc methods used the Penman-Monteith method.

Other specific issues in the text

Page 5: Line 29. The groundwater contribution to the water balance of Lake St Lucia is negligible except in extreme prolonged drought periods when the main rivers can cease to flow and groundwater and direct rainfall are the only source of freshwater for the lake.

Agreed

Page 5 Line 29 Reference (Rawlins and Kelbe, 1991, ..) not in the reference list and Rawlins incorrectly spelling)

Thank you

Some editorial correction

Page 16 line 26 maximum rates were higher (6.....) but more variable

Thank you

Page 17 line 19 end of line should be depended

Thank you

Page 19 line 11 close bracket on Moa reference

In the authors version the bracket is in place but this will be noted for final type setting

No reference in the text to Asner,et al, or Kotze et al;

Thank you – will be removed

Additional changes proposed by Authors

Page 1750 Line 17 - .....was determined during unstable conditions.

Page 1777 – August 2010.

New references to be added based on amendments suggested above

Baldocchi, D.:A comparative study of mass and energy exchange rates over a closed C3 (wheat) and an open C4 (corn) crop:
II. CO2 exchange and water use efficiency. Agric. For. Meteorol. 67:291–321, 1994.

Monteith, J.L.:Dew. Quart. J. Roy. Meteorol. Soc. 83:322–341, 1957.