

The main areas for consideration as identified by the reviewer were:

- 1) The diagram of the study area (Figure 1) needs additional information of sites mentioned in the text such as place names (Mission Rocks, Fannies Island, Charters Creek- all mentioned on Page 12613 lines 19; Embomveni Dunes). – Agreed, these locations have now been included in Fig.1.
- 2) The reference list is incomplete and there are examples of references that are not included in the text. These have been highlighted in the accompanying file. – Thank you for the highlighting the references in the document, they have been corrected.
- 3) The use of abbreviation for all the evaporation (ET_x) and some meteorological (R_n and I_r) terms does become confusing in the text. This is particularly problematic in the discussion where there are references to evaporation (ET) components that are referred to as observed, estimated, predicted, modeled, often using similar abbreviations (ET). – Agreed. We have clarified the difference between R_n (net solar irradiance) and I_s (solar irradiance) and standardised on the types of ET we referred to throughout the manuscript. Predicted ET was removed in all cases and referred to as ET_m (modelled).
- 4) It is not usual to mention specific company products in scientific papers as it can be considered as promoting the products. – Noted. Without wanting to promote any company products we felt it necessary to list the model and manufacturer for each variable measured as this provides an indication of the expected accuracy and quality assurance of the data. If confirmed necessary, we are happy to remove all references to the manufacturers.

Two papers from an international journal where measurement was a key component of the paper and where equipment manufacturer details were included:

Twine, T. E., Kustas, W. P., Norman, J. M., Cook, D. R., Houser, P. R., Meyers, T. P., Prueger, J. H., Starks, P. J., and Wesely, M. L.: Correcting eddy-covariance flux underestimates over a grassland, *Agricultural and Forest Meteorology*, 103, 279-300, 2000.

Welp, L. R., Randerson, J. T., and Liu, H. P.: The sensitivity of carbon fluxes to spring warming and summer drought depends on plant functional type in boreal forest ecosystems, *Agricultural and Forest Meteorology*, 147, 172-185, 2007.

- 5) There is some confusion with the paragraph on page 13625 starting line 12. The radiation values do not compare with those in Table 1-3. –The radiation values quoted in this paragraph are net radiant densities (R_n) with reference to Fig. 5. Tables 1 to 3 show radiant densities (I_s) which are described and referred to on Pg 13624 Line 3.
- 6) I think the line fit to the graphs in Figure 9b and 10b are more likely to be linear than concave. It would help to quote the R² for the linear fit. – Agreed, we propose including the R² for linear and concave fits in the text. R² was optimised by fitting the concave curve.

Detailed corrections applied, based on the comments above and the areas highlighted in the text, are documented below:

Pg 13608 line 2:

Remove (ET)

Pg 13608 line 5:

Total evaporation (ET) was...

Pg 13608 line 10:

Additional text has been inserted and grammar has been altered to emphasise the two components of the relationship ie ET and sapflow.

Previous: An empirical model was derived, describing the relationship between the observed ET of the Nkazana PSF measured during two of the window periods ($R^2 = 0.92$ and 0.90) which, overlapped with sapflow measurements, thereby providing hourly estimates of predicted ET of the Nkazana PSF for a year, totalling 1125mm (while rainfall was 650 mm)

Corrected: An empirical model was derived, describing the relationship between the observed ET (ET_{ec}) of the Nkazana PSF and sapflow measurements, which overlapped during two of the window periods ($R^2 = 0.92$ and 0.90), providing hourly estimates of modelled ET (ET_m) of the Nkazana PSF for a year, totalling 1125mm (while rainfall was 650 mm).

Pg 13608 line 16:

‘Observed ET’ should be ‘ ET_{ec} ’

Pg 13608 line 17:

RMSE = 0.08 mm h^{-1})

Pg 13608 line 23:

Clarification was added.

Corrected: From the empirical model of ET_m (derived in this study from sapflow) and the FAO56 Penman–Monteith equation, a monthly crop factor (K_c) was derived for the Nkazana PSF providing a method of estimating long-term swamp forest ET_m from meteorological data.

Pg 13609 line 7:

‘ET’ should be ‘ ET_m ’

Pg 13609 line 8:

‘the contrast in ET and rainfall emphasises’ should be ‘the contrast in ET_m and rainfall emphasised’

Pg 13609 line 22:

The reviewer is correct that Allen et al., (2006) is the latest reference however in the study being described in the text by Dye et al., (2008) they used Allen et al., (1998) – this is missing from the references and should be added.

Allen, R. G., Pereira, L. S., Raes, D., and Smith, M.: Crop evapotranspiration: Guidelines for computing crop water requirements, FAO Irrigation and Drainage Paper 56, Food and Agriculture Organization of the United Nations, Rome, Italy, 1998.

Pg 13610 line 25:

Estimated not predicted

Pg 13611 line 18:

Reference Farge et al. (2000) was incorrect and should be Falge et al. (2001) and added to the references as:

Falge, E., Baldocchi, D., Olson, R., Anthoni, P., Aubinet, M., Bernhofer, C., Burba, G., Ceulemans, R., Clement, R., Dolman, H., Granier, A., Gross, P., Grünwald, T., Hollinger, D., Jensen, N.-O., Katul, G.,

Keronen, P., Kowalski, A., Lai, C. T., Law, B. E., Meyers, T., Moncrieff, J., Moors, E., Munger, J. W., Pilegaard, K., Rannik, Ü., Rebmann, C., Suyker, A., Tenhunen, J., Tu, K., Verma, S., Vesala, T., Wilson, K., and Wofsy, S.: Gap filling strategies for defensible annual sums of net ecosystem exchange, *Agricultural and Forest Meteorology*, 107, 43-69, 2001.

Pg 13611 line 27:

, above all at temporary sites - removed

Pg 13612 line 4:

ET_{ec} defined:

Wilson et al. (2001) applied EC and sapflow techniques in a deciduous forest of the south-eastern United States, and found that there was a qualitative similarity between ET derived using the EC techniques (ET_{ec}) and tree transpiration.

Pg 13612 line 12:

To be added to the references:

Wullschleger, S. D., Hanson, P. J., and Todd, D. E.: Transpiration from a multi-species deciduous forest as estimated by xylem sap flow techniques, *For. Ecol. Manage.*, 143, 205-213, 2001.

Pg 13612 line 14:

Citation should be corrected to:
Čermák and Nadezhdina (1998)

Pg 13612 line 27:

Previous: Two of these window periods overlapped in time and space with long-term sapflow measurements, and a nearby weather station provided measurements during the full period.

Corrected: Two of these window periods overlapped with long-term sapflow measurements, and a nearby weather station provided climatic data during the full period.

Pg 13614 line 3:

Embomveni Dunes now labelled in Figure 1b and additional locations such as Fannies Island, Mission Rocks, Charters Creek included as recommended in the reviewer comments.

Pg 13617 line 21:

The word 'the' should be removed in: site in ~~the~~ a predominantly downwind direction.

Pg 13618 line 13:

for a specified time period (Bowen, 1926).

Pg 13619 line 5:

'Bar' should be 'Barr'

Pg 13619 line 7:

'corrected or adjusted' should be replace by 'corrected'

Pg 13620 line 17:

2.5 ~~Predicting~~ Modelling annual total evaporation from sapflow

Pg 13620 line 22:

‘Predicting ET’ should be ‘modelling total evaporation (ET_m)’

Pg 13620 line 23:

Previous: The hourly data was checked for homoscedasticity and square root transformed where necessary. The model derived was applied over a full year of sapflow data (October 2009 to September 2010) to obtain an annual predicted ET.

Corrected: The hourly data was checked for homoscedasticity and required a square root transformation to correct the variance distribution.

Homoscedasticity means that the property of having a homogenous variance distribution across the dataset which is a requirement for many statistical tests. It is the assumption that the statistical properties of any one part of the overall dataset are the same as any other part. The relationship between larger sapflows and ET tended to have larger variances, hence the square root transformation. Square root and log transformations are standard approaches to dealing with non-heterogeneity of variances.

Pg 13620 line 25:

.....to obtain an annual ET_m.

Pg 13621 line 1:

applicability of ~~estimating~~ modelling ET_m

Pg 13621 line 4:

was applied to the long-term ET_m discussed above

Pg 13621 line 16:

To be added to reference list:

Mao, L. M., Bergman, M. J., and Tai, C.C.: Evapotranspiration measurement and estimation of three wetland environments in the upper St. Johns River Basin, Florida, J. Am. Water Res. Ass., 38, 1271–1285, 2002.

Pg 13621 line 26:

To be added to the reference list:

Allen, R. G., Pereira, L. S., Raes, D., and Smith, M.: Crop evapotranspiration: Guidelines for computing crop water requirements, FAO Irrigation and Drainage Paper 56, Food and Agriculture Organization of the United Nations, Rome, Italy, 1998.

Pg 13621 line 20:

reference evapotranspiration (ET_r) should read reference evaporation (ET_r)

Pg 13622 line 10:

Previously: By rearranging Eq. (5) to make K_c the subject of the equation, and using the long-term predicted ET as a surrogate for ET_c , K_c was calculated for the Nkazana PSF at an hourly interval (while $R_n > 0$ and $ET_{ec} > 0.1 \text{ mm h}^{-1}$) and summed to daily totals as recommended by Irmak et al. (2005).

The reviewer is quite correct and some simplification and further explanation has been provided as well as substitution of the word ‘estimated’ for ‘predicted’:

By modelling ET_r using the FAO56 Penman-Monteith model, estimating long-term ET (from sapflow) as a surrogate for ET_c , K_c was calculated for the Nkazana PSF at an hourly interval (while $R_n > 0$ and $ET_{ec} > 0.1 \text{ mm h}^{-1}$) and summed to daily totals as recommended by Irmak et al. (2005).

Pg 13623 line 2:

To be added to reference list:

Price, J. S.: Blanket bog in Newfoundland: Part 2. Hydrological processes, *J. Hydrol.*, 135, 103-119, 1992.

Souch, C., Wolfe, C. P., and Grimmtind, C. S. B.: Wetland evaporation and energy partitioning: Indiana Dunes National Lakeshore, *J. Hydrol.*, 184, 189-208, 1996.

Mao, L. M., Bergman, M. J., and Tai, C.C.: Evapotranspiration measurement and estimation of three wetland environments in the upper St. Johns River Basin, Florida, *J. Am. Water Res. Ass.*, 38, 1271–1285, 2002.

Pg 13623 line 5:

To be added to reference list:

Sumner, D. M., and Jacobs, J. M.: Utility of Penman–Monteith, Priestley–Taylor, reference evapotranspiration, and pan evaporation methods to estimate pasture evapotranspiration, *Journal of Hydrology*, 308, 81-104, 2005.

Pg 13623 line 14:

The I_s (solar irradiance) is different to R_n (net radiation). Solar irradiance (I_s) was specifically used as this is routinely available at automatic weather stations whereas R_n is not.

Pg 13623 line 18:

A sentence noted as requiring clarity:

Previous: The variability in sapflow increased as the magnitude of the predictor variables increased.

Corrected: The log of the sapflow measurements was modelled, as the variance of the measurements themselves was not homoscedastic and therefore required a variance stabilizing transformation.

This transformation is performed in a similar way and for the same reasons as the square root transformation on pg 13620 line 23.

Pg 13624 line 3:

Response to the reviewer comment – agreed. The sapflow systems were unfortunately not fully functional in August 2009.

Pg 13625 line 2:

Author correction: In November the dip occurred.....

Pg 13625 line 9:

The soil heat flux was lower during November when R_n was higher due to the specific placement of the sensors in the Swamp Forest between field campaigns. The canopy structure is variable allowing dominantly shaded and sunnier areas. This is explained further in a paragraph in the Discussion section on pg 13633 line 8. It can be concluded that a larger number of sensors should be used to get a better spatial distribution of soil heat flux below such forest canopies. This should be added as seen below in the conclusion section - thanks.

Pg 13626 line 6 and 7:

ET should be ET_{ec}

Pg 13626 line 9:

The standard deviation (SD) for.....

Pg 13626 line 24:

Author addition as a final sentence to the paragraph: It is recommended that G be measured at numerous positions under swamp forest canopies in order to capture the variability in G and a representative average.

Pg 13626 line 26:

(RMSE = 0.05 mm h⁻¹)

Pg 13625 line 12:

Reviewer comment on the difference between the radiation values discussed in the paragraph and those of Tables 1-3: The paragraph describes the energy balance (hence referring to Fig. 5) and therefore daily net radiant density, whereas the Tables 1-3 show climatic data, which includes daily radiant density (without the net). Essentially the difference is between R_n and I_s .

Pg 13627 line 1:

(RMSE = 0.06 mm h⁻¹)

Pg 13627 line 2:

As correctly suggested by the reviewer the following amendment is proposed to support the concave and convex trendlines of Figs 9a and 9b which were based on optimising the coefficient of determination:

The polynomial regression was convex ($R^2=0.89$) rather than linear ($R^2=0.87$) in the case of the emergent tree (Fig. 9a) and concave ($R^2=0.92$) rather than linear ($R^2=0.90$) in the case of the understory tree (Fig. 9b). The increase in the rate of sapflow of the emergent tree was exponential for lower values of ET_{ec} (morning and evening) but the rate of sapflow versus ET_{ec} for higher values of ET_{ec} slowed down as the tree reached its peak transpiration rate. In contrast the understory sapflow rate increased gradually per unit increase in ET_{ec} at lower values but at higher values of ET_{ec} the increase in sapflow was exponential. In March 2010 the results were similar with RMSE's of 0.07 and 0.08 mm for the emergent and understory trees, respectively. Convex and concave trendlines again fitted the data best (Fig. 10a and b). Lagging the sapflow by one hour as suggested by Granier et al. (2000) did not improve the regression of sapflow on ET_{ec} .

Pg 13627 line 8:

RMSEs of 0.07 and 0.08 mm h⁻¹

Pg 13627 line 23:

The SDs and RMSEs of.....

Pg 13628 line 14:

Change 'predicted' to 'modelled' for consistency. In the case below the wording of the sentence required slight change.

3.6 Modelling long-term total evaporation and monthly crop factors

The long-term ET (October 2009 to September 2010) was modelled (ET_m) through the relationship between the observed ET_{ec} and observed sapflow over the November 2009 and March 2010 field campaigns.

Pg 13628 line 19:

(R² = 0.92 and 0.89; RMSE = 0.05 mm h⁻¹ and 0.06 mm h⁻¹)

Pg 13628 line 21:

RMSE = 0.07 mm h⁻¹

Pg 13628 line 25:

RMSE = 0.08 mm h⁻¹

Pg 13628 line 27:

0.08 mm h⁻¹).

Pg 13629 line 5:

Change ET to ET_m to indicate more clearly that it is modelled.

$$ET_m = (0.16341 \cdot T_r + 0.06)^2 \quad (1)$$

where, ET_m is the estimated total evaporation (mm hr⁻¹) and T_r the emergent tree sapflow (L hr⁻¹).

The ~~estimated total~~ annual ET_m (October 2009 to September 2010) from the Nkazana PSF was 1125

Pg 13629 line 9:

(well below the long-term average of between 844 and 1200 mm yr⁻¹ for the area)

Pg 13629 line 11:

Substituting the ET_m in place of 'modelled ET' brings consistency with terminology used above and should clarify the sentence.

Finally, K_c was calculated at a daily interval from the ET_m and ET_r (Eq. 5) and averaged for each month of the year (Fig. 11).

Pg 13629 line 24:

Replace 'from the ET modelled from sapflow of the emergent tree and' with 'ET_m'

Pg 13630 line 2:

Thank you. Clarification added through consistent terminology.

~~The equation developed between sapflow and total observed ET~~ Equation 8 allowed us to predict ~~ET_{ec}~~ derive ET_m over the period during which we had sapflow measurements (October 2009 to September 2010).

Pg 13630 line 5:

The purpose for this was to better understand the relationship between important climatic variables and ET ~~in order to understand the climate risks over a long term period~~. Three statistical approaches were used to determine these relationships with sapflow, which were directly related to ET and the climatic variables. We considered the simple linear regressions of daily sapflow with radiant flux density and VPD and found that these were poor, with coefficients of determination of only 0.51 and 0.52 respectively (not shown). Clearly the relationship between climatic conditions and sapflow is more complex.

Pg 13630 line 12:

Correction to include the soil water content measurement methodology and θ symbol definition.

The following should be added to Pg 13620 Line 11:

Air temperature and relative humidity (HMP45C, Vaisala Inc., Helsinki, Finland) within the canopy, at a height of 2 m above the ground, and soil volumetric water content (θ) at the *Syzigium cordatum* tree (where the roots were most dense at a depth of 0.075 m), were also measured. These were recorded hourly to coincide with the sapflow measurements.

Pg 13630 line 13:

In this analysis, the purpose of log transforming the sap flow data was to correctly allocate the influence of each observation, and to avoid allocating too much influence to the larger values. The plot in Figure 7 provides a diurnal time course of the sap flow measurements for only a few days, and does not represent the full range of the sap flow measurements that were under consideration in the sapflow versus climatic variables section (20 months of hourly data). The statement regarding Figure 7 was that the sap flow measurements diurnal time course was relatively smooth compared to diurnal time course of the ET measurements. The sap flow measurements were log transformed in the sapflow versus climatic variables section because the variability of these measurements increased as the sap flow measurements increased. Log transforming data where the variability increases with increasing data has the effect of allocating the same amount of influence to all observations and prevents the larger values from dominating the analysis.

Pg 13630 line 17:

Author correction - comma added:

Solar irradiance was clearly a key variable to include and the first split observed, essentially separates day and night-time data.

Pg 13630 line 20:

The next important splits ~~are~~ were for RH above and below 93.2% for the night time data (essentially when there was dew or rain and when there was not) and an additional split.....

Pg 13631 line 3:

'ET' should be 'ET_{ec}'

Pg 13631 line 25:

Harding et al., ~~1994~~ 1992

Pg 13632 line 4:

Additional references required for the sentence:

aerodynamic resistance (Jacobs and De Bruin, 1992; Hall, 2002), shading of lower leaves (Cienciala et al., 2000) and wind stress (Kim et al., 2014).

Add to references:

Cienciala, E., Kučera, J., and Malmer, A.: Tree sap flow and stand transpiration of two *Acacia mangium* plantations in Sabah, Borneo, *Journal of Hydrology*, 236, 109-120, 2000.

Jacobs, C. M. J. and De Bruin, H. A. R.: The sensitivity of regional transpiration to land-surface characteristics: significance of feedback, *J. Climate*, 5, 683–698, 1992.

Kim, D., Oren, R., Oishi, A. C., Hsieh, C.-I., Phillips, N., Novick, K. A., and Stoy, P. C.: Sensitivity of stand transpiration to wind velocity in a mixed broadleaved deciduous forest, *Agricultural and Forest Meteorology*, 187, 62-71, 2014.

Hall, R. L.: Aerodynamic resistance of coppiced poplar, *Agricultural and Forest Meteorology*, 114, 83-102, 2002.

Pg 13632 line 8:

(Zweifel et al., ~~2002~~ 2005).

Pg 13632 line 23:

ET should be replaced with ET_{ec}

Pg 13632 line 28:

ET should be replaced with ET_{ec}

And,

‘opportunity to model the annual ET’ should be ‘opportunity to derive ET_m ’

Pg 13633 line 1:

‘ET’ should be replaced with ‘ ET_{ec} ’ in two cases.

Pg 13633 line 25:

‘ET’ should be replaced with ‘ ET_{ec} ’

Pg 13633 line 27:

Change ‘indicate’ to ‘may indicate’

Pg 13634 line 1:

‘ET’ should be ‘ ET_m ’

Pg 13635 line 14:

Argument for fitting exponential trends explained by optimised coefficient of determination (Pg 13627 line 2)

Pg 13635 line 19:

‘ET’ should be ‘ET_m’

Pg 13636 line 23:

‘ET’ should be ‘ET_{ec}’

Pg 13636 line 25:

The ~~empirical~~ model used to derive the annual ET_m from sapflow (Eq. 8), and then monthly crop factors, was verified.....

Pg 13637 line 1:

Remove sentence:

The crop factors derived during these two field campaigns in 2008 (August and November) verified those derived from the empirical model calculations.

Pg 13637 line 3:

in 2008 ~~however~~ did not

Pg 13637 line 4:

‘ET’ should be ‘ET_m’

Pg 13637 line 16:

‘ET’ should be ‘ET_m’

Pg 13637 line 18:

even higher than the range (844 to 1200 mm yr⁻¹) of reported estimates of mean annual precipitation for the area (Lynch, 2004; Taylor et al., 2006; ARC-ISCW, 2011).

Pg 13637 line 19:

‘ET’ should be ‘ET_m’

Pg 13638 line 21:

Remove reference:

Aubinet, M., Grelle, A., Ibrom, A., Rannik, Ü., Moncrieff, J., Foken, T., Kowalski, A. S., Martin, P. H., Berbigier, P., Bernhofer, C., Clement, R., Elbers, J., Granier, A., Grünwald, T., Morgenstern, K., Pilegaard, K., Rebmann, C., Snijders, W., Valentini, R., and Vesala, T.: Estimates of the annual net carbon and water exchange of forests: the EUROFLUX methodology, *Adv. Ecol. Res.*, 30, 113-175, 1999.

Pg 13639 line 10:

Corrected in text

Pg 13639 line 13:

Corrected in text

Pg 13641 line 31:

Correction to reference:

Meiresonne, L., Nadezhdin, N., Čermák, J., Van Slycken, J., and Ceulemans, R.: Measured sap flow and simulated transpiration from a poplar stand in Flanders (Belgium), *Agricultural and Forest Meteorology*, 96, 165-179, 1999.

Pg 13644 line 9:

Remove reference:

Venter, C. E.: The vegetation ecology of Mfabeni peat swamp, St. Lucia, KwaZulu-Natal, Unpublished MSc. thesis, Faculty of Natural and Agricultural Science, University of Pretoria, Pretoria, South Africa, 140 pp., 2003.

Pg 13649:

Correction to table title:

Table 4. Summary of the hourly crop co-efficient K_c and advective term α with standard deviation (SD) and root mean square error (RMSE) for each of the three field campaigns.

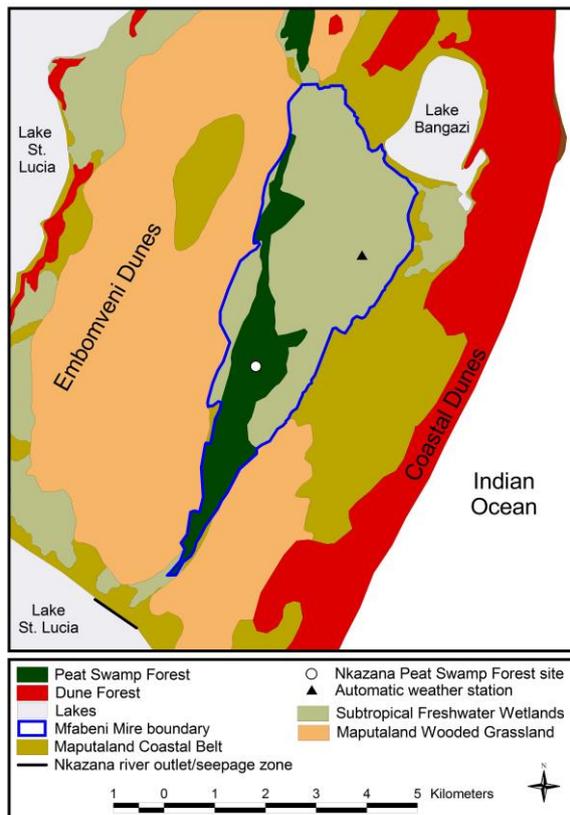
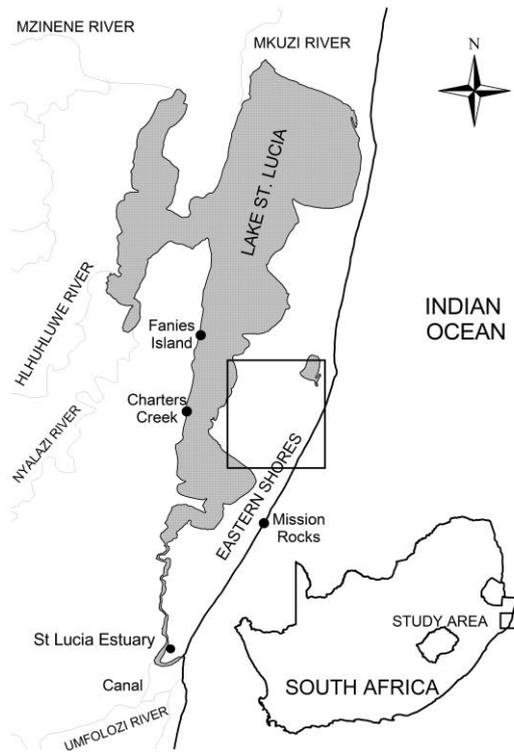


Fig. 1. (a) Location of the Eastern Shores within South Africa, (b) the Nkazana Peat Swamp Forest site (where the EC and sapflow systems were located) and the automatic weather station within the Mfabeni Mire on the Eastern Shores (data from Mucina and Rutherford, 2006).

RMSE units should be mm h^{-1} , same as the y-axis of the graphs.

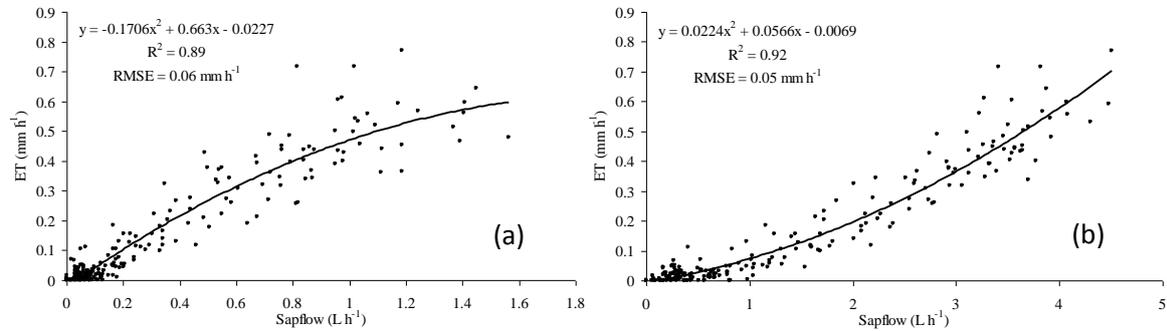


Fig. 9. Polynomial regressions of the total evaporation (ET) against the hourly sapflow for the (a) emergent tree and (b) understory tree in the Nkazana PSF during the November 2009 field campaign

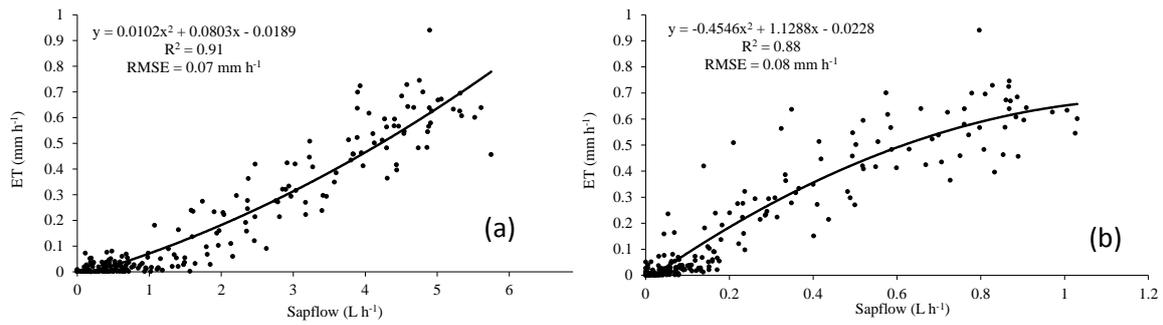


Fig. 10. Polynomial regressions of the total evaporation (ET) against the hourly sapflow for the (a) emergent tree and (b) understory tree in the Nkazana PSF during the March 2010 field campaign.