Response to Reviewer #1

General comments

The manuscript aims to add measurements and calculations of energy transported by tidal water movements to the energy balance of a mangrove forest. I believe that this is one of the first attempts in this task, of clear interest to the readers of Biogeosciences. The manuscript is generally well written, focused and easy to follow. My main concerns are related to the extent of the study and to the lack of clarity in some parts of the methodology. The study is restricted to a very short time (10 days), which raise concerns about the generality of the author's findings in the specific site itself. Moreover, this time limitation has not been discussed by the authors. The calculations of the cross-sectional area and width of the tidal creek are not clearly explained and a bit obscure, despite their importance in determining the tidal import and export of energy. Besides, the fact that the authors reveal the application of non-referenced "user specified information of the channel geometry" does not add to clarity.
I believe that the time lag between ΔH and the heat fluxes is crucial and should be central in the discussion of this experiment, even to highlight the study limitations, but the authors seem to simply solve the issue presenting a figure with cumulative fluxes (Fig. 10). Some more discussion about this issue would add to the message of the paper.

We thank the reviewer for a thorough evaluation of the manuscript and for sharing excellent comments for improving the quality and content of the paper.

Specific comments

Pag 11742 Line 8: what about the winter? If the study is limited to the summertime, change the manuscript title accordingly.

Line 1 - The title was changed to "Summertime influences of tidal energy advection on the surface energy balance in a mangrove forest".

Pag 11743 Line 20: 10 days is a very short time to perform such experiment: please highlight the limitations due to this extent of time.

The site description was augmented to state the limitations of the short 10-day study period. The modified text (lines 110-113) now reads, "The field study was carried out during August 6-16, 2005 in the middle of the Everglades' wet season. The 10-day study period was representative of summer months characterized by seasonally maximal upstream water levels and daytime air temperatures that exceed water temperatures within the estuary."

Pag 11744 Did you perform any rotation in the flux data processing?

Yes. This step is now stated in the text (line 125). Flux data processing includes, "a two-dimensional coordinate rotation of the wind field…." Also, the reader is referred to Barr et al. (2010) for a more complete description of flux processing.

Pag 11744 line 27: Was only the estuary to be out of the footprint? How many and which of the instrumented locations were inside the footprint? What implication does this have on your results?

Text was added to address the separation of Shark River and the surrounding estuary from the observed fluxes as follows. "Flux data were discarded when the flux footprint extended beyond the forest fetch (Barr et al., 2010). However, the Shark River can contribute weakly to observed fluxes when winds originate from the NE to NW." (lines 145-147). Also, the text (lines 174-175) now specifies that the instrumented sites are "…located wholly within the flux footprint of the tower."

Pag 11745 Line 12: why did you divide the study site into 4 sectors if there are only 3 instrumented locations?

This choice was a matter of convenience. Site 2 represents the dividing line between sectors B and C (Fig. 3). Sectors A and B and sectors C and D represent a mixture of properties of sites 1-2 and sites 2-3, respectively. If we had divided the space into 3 sectors, then the middle sector would have included properties from all 3 instrumented sites.

Pag 11746 Line 3: did you correct G for heat storage in the 10 cm above the instrument?

No. The text (lines 180-181) now states that soil heat flux "…did not include the change in heat storage in the top 10 cm of sediment since the thermistors were not deployed in the peat at the 3 sites."

Explain better how you estimated the cross-sectional area, A, and of the creek width, w, which is crucial for a correct estimate of ΔH at Pag 11746 Line 13 and Pag 11747 Line 7, respectively.

Regarding the cross-sectional area of the creek, the text has been modified. To compute the cross sectional area of the tidal creek, A, required inputs of both "Water level, measured by the flow meter's pressure transducer, along with user specified channel widths measured at height increments of 5 to 10 cm was used to compute instantaneous wetted wall cross-sectional area, A (in m^2), in 1 s intervals" (lines 191-193). Software running on flow meter then sums the areas of the trapezoids up to the water depth height. Regarding the width, *w*, of each sector defining the drainage area of the creek, a new equation 6 has been added along with modified text (lines 211-215) describing the calculation of *w* from least squares regression.

Pag 11748 Line 11: I'm a bit puzzled by this last sentence. If "recharge was not used in determining import and export of enthalpy since the analysis required mass balance closure", how did u estimate ΔH for flood tides?

This statement was unclear and has been deleted. The following text (lines 235-237) has been added. "To ensure mass balance closure, the rate of recharge was determined from the volumetric change across the drainage area of the creek, A_{tot}, in place of direct measurements of flow in the tidal creek."

Pag 11748 Estimate an error to the calculation of ΔH.

A sentence was added (lines 238-240) to provide an uncertainty estimate of ΔH_{adv}.

Paragraph 4.1 has hardly any discussion in it. Moreover the discussion chapter considers very few published papers, so it is hard to place this paper in the context of the broader literature.

Additional discussion was added to Section 4.1 (lines 256-259 and lines 266-271) citing three energy budget studies in coastal ecosystems. To the best of our knowledge, this study is the first to report on energy exchange between a mangrove forest and the surrounding atmosphere and estuary.

Pag 11749 Line 26: the fact that "discharge of water exiting the creek during ebb tides was substantially dampened and in some cases not observed" raises concerns on the calculation of the ebb tides ΔH. Please explain.

Text was added in Section 4.2 (lines286-288) to clarify this statement. The reader is referred to Eq. 8, which specifies the difference in the calculation of H_{in} at the end of ebb tide compared to that during other periods (Eq. 7).

Pag 11750 Line 28: please discuss the reasons for this afternoon shift from sink to source

The following text was added to explain this shift (lines 316-318). "This change in ΔH_{adv} from a sink to a source of energy was the result of air temperatures dropping below those of flood waters driving heat transfer from the surface to the atmosphere." This explanation is further supported by the results in Fig. 8, which shows that ΔH_{adv} was controlled by air-water temperature gradients.

Pag 11751 Line 26: Discuss the lag time between ΔH and the other fluxes of energy and what it means for your measurements.
Several sentences were modified (lines 341-346) to address the potential for temporal lags among the fluxes, including ΔH_{adv}.

Technical corrections
Pag 11740 Line 9: add "10-day" after "intensive"
Done.

Pag 11740 Line 11: here and later in the manuscript, add USA when appropriate.
Changed throughout.

Pag 11740 Line 18: add a comma in the sentence starting with "Including"
The sentence was changed.

Pag 11741 Line 14: explain why it's possible to neglect energy stored in the biomass
Text was added (lines 52-55) to clarify this point as follows. "The available energy (R_{net} – G) is then partitioned into fluxes of sensible (H) and latent heating (*LE*) in the vertical direction and heat energy storage in the biomass and atmosphere below the height where H and *LE* are measured. Typically, storage amounts are small (~5% of R_{net}) over short (30-min to hour) time intervals and are neglected."

Pag 11741 Line 15: Maybe "fluxes of sensible and latent heat" is better
Done.

Pag 11741 Line 25: "dryland" is a somewhat ambiguous term
The term, "dryland" has been changed to "terrestrial" (line 64).

Pag 11742 Line 10: add reference here
The text (lines 74-75) was modified to read, "…flood waters entering from Shark River are generally observed to be cooler than the overlying air in the afternoon…." Air-water temperature gradients at our study site have not yet been reported in the literature.

Pag 11742 Line 10: replace "cool" with "cooler"
Done.

Pag 11742 Line 14: are you using soil and sediments as synonymous? Please clarify
Yes. The following text was added (lines 80-81) to avoid any confusion. "Throughout the text, the terms soils and sediments are used synonymously and interchangeably."

Pag 11743 Line 11: or Laguncularia racemosa?
Spelling was corrected (line 103).

Pag 11743 Line 18: please specify if the peat is buried by the 1 m sediments
The text (lines 108-109) has been modified to indicate that the 1 m thick sediments represent the top section of the 6 m thick peat.

Pag 11744 Line 4: RS-50 or R3-50?
Model number changed to R3-50 (line 120).

Pag 11744 Line 13: please specify the thermistor-hygristor probe manufacturer
The manufacturer was added (lines 129-130).

Pag 11744 Line 14: the producing factory is in the Netherlands
The change was made to "Delft, Netherlands" (line 130).

Pag 11744 Line 15: HFT 3.1 or HFT 3-L?
The change was made to “HFT 3-L” (line 131).

Pag 11744 Line 20: add reference
A reference was added (line 136).

Pag 11744 Line 25: what about amount of water moving in and out the system?
Yes. This is an important consideration. The following text (lines 140-142) addresses this concern. “The flow rate into (out of) the system during flood (ebb) tides indirectly controls ΔH_{adv} by altering the conditions and quantity of water transferring heat via the four direct mechanisms listed above.”

Pag 11744 Line 26: what about flood tides?
The following sentence was added to address flood tide periods (lines 142-143). “During flood tides, enthalpy enters the flux footprint and changes in heat storage are tracked while the sediment surface is flooded.”

Pag 11745 Line 7: but your analysis considers shorter time frames than a day or more. Please develop.
The text was modified (lines 155-157) to stress that, “This study did not include the necessary measurements for estimating S. Therefore, a simplified energy budget was used (Eq. 2) with the caveat that a portion the imbalance is likely attributed to positive S during the daytime.”

Pag 11745 Line 12: please justify why you forced the regression through the origin.
The following sentence was added (lines 161-163), “The slope provided an aggregated average estimate of energy closure during the 10-day study, which was invariant with amount of available energy.” Wohlfahrt et al. (2010) was cited (line 160) providing a precedence for forcing the regression through the origin.

Pag 11746 Line 13: “Point measurements of velocity were converted to depth- and width-averaged velocity”. How was this done?
The text (lines 188-190) was modified to list the procedure used to calibrate the vertical velocity profile in the tidal creek.

Pag 11746 Line 15: with which frequency did you compute A?
The frequency was 1 second, consistent with equation 3. The change was made (line 193).

Pag 11746 Line 15: Add “(discharge)” after “Recharge”
Done.

Pag 11747 Line 1: the unity of ΔH is Joule. Please verify and correct.
The units of ΔH_{stor} were changed to J m^{-2} (line 204). For consistency with eq. 4-8, ΔH_{stor} represents “the drainage area normalized difference in enthalpy storage….” (line 204)

Pag 11747 Line 4: the density of water is (rho) not p
Done.

Pag 11747 Line 4: add reference to equation 4, 5 and 6.
The change was made. Barr (2006) was referenced regarding current equations 5 and 7.

Pag 11747 Line 7: replace (C) with (^{o}C)
Done.

Pag 11748 Line 3: explain difference between eq 6 and 7
Equations 6 and 7 are now equations 7 and 8, respectively. Regarding the ebb tide calculation (eq. 8), the following text was added (lines 228-230). “During these periods, water outflows were assumed to exit

the system at the temperature of the overlying water, $\overline{T_j}$ (Eq. 8), when the temperature of water in the tidal creek, $\overline{T_{cr}}$ (Eq. 7), could not be measured due to minimal flow and channel depth."

Pag 11749 Line 4 and 6: why did you change the time periods in this comparison between fluxes?
A sentence was added as follows (lines 246-248) to provide some justification. "Five months of data during July to September 2004 and July and August 2005 provided a sufficiently long period for identifying such changes in energy partitioning and removed any effect of timing of tides in relation to time of day and magnitude of solar irradiance and R_{net}."

Pag 11750 Line 8: explain the high values of ΔH before 8:30.
The initial increase in ΔH_{adv} before 8:30 hours is now described in the text (lines 294-298).

Pag 11750 Line 11: it's not clear to which period you are referring to
The time period is 9:30 to 13:30 hours and this text was added (line 301).

Pag 11751 Line 12: since you did not perform measurements in October and November, replace "indicates" with "suggests" and "changed" with "would change".
The change was made (line 328).

Pag 11751 Line 30: discuss also the drop in r2.
Text was added and modified (lines 340-344) to discuss the decline in R^2 when including ΔH_{adv} as an energy output.

Pag 11752 Line 29: it's not clear what implications Gu et al. (2007) findings have for your paper.
This text was removed. The earlier reference to Gu et al. (2007) has been retained based on its relevance in improving energy closure (line 365).

Pag 11755 Line 6: check the journal name shortening.
The change was made to, "Global Biogeochem. Cycles" (line 436). Note that the Web of Science provides an incorrect abbreviation at:
http://images.webofknowledge.com/WOK46/help/WOS/G_abrvjt.html

Pag 11756: indicate in Fig. 1 where Florida Bay is.
"Florida Bay" was added to Fig. 1.