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Comment

Interactive comment on “Carbon exchange between the atmosphere and subtropical forested cypress and pine wetlands” by W. B. Shoemaker et al.

Anonymous Referee #1

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This article reports on the dynamics of Net Ecosystem Exchange of CO₂ (NEE) and energy fluxes (sensible and latent heat, H and LE respectively) using one year of data from three distinct ecosystem types in or near the Florida everglades (a cypress swamp, a dwarf cypress wetland, and a pine upland forest). In one site (the dwarf cypress), methane flux is also measured. The dynamics were primarily linked to seasonal variation in meteorological drivers and the enhanced vegetation index (EVI).

The data from the cypress sites have the potential to improve our understanding of ecosystem carbon cycling in warm subtropical wetlands, which are certainly underrepresented in the current network of flux monitoring sites. The upland pine site is not a wetland site; nonetheless, it represents a historic ecosystem type (i.e. open pine

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savannah experiencing frequent fire) that is the focus of many restoration efforts in the region. Thus, studies that help us to understand patterns and drivers of carbon and water cycling in such a forest should be viewed as valuable contributions to the literature. Finally, these studies are located in an important conservation area (i.e. the Florida everglades) renowned for its biodiversity and subject to much regional and national attention from the environmental community.

Thus, while the significance of these results is potentially large, the current study suffers from a number of shortcomings, many of them methodological, which reduce the strength of the conclusions and the relevance of these results for predicting long-term patterns of carbon and water cycling in these sites.

First, the authors present only one year of flux data from each of the three sites. Interannual variability in NEE can be quite large, and a snapshot based on just one year of data can provide a biased view of the carbon uptake capacity. Undoubtedly, the manuscript would be strengthened with the inclusion of an additional year of data. The study period for these results is December 2012 – November 2013. If the towers are still running, then an additional year of data should exist at this point.

Next, the authors take an unorthodox approach to filtering, gapfilling, and partitioning the NEE fluxes, which leads me to view the reported annual values with some skepticism, especially since they are among the highest values ever reported in the literature (see Baldocchi et al. 2008, Australian Journal of Botany for reference). First, while they apply a u^* threshold to remove data collected under insufficiently turbulent conditions, this threshold is extremely low (< 0.05 m/s). If nocturnal data are retained that are collected under stable conditions, then vertical and horizontal advection fluxes may be important missing components of the flux balance, which could suppress inferred respiration model and thus lead to very high $|NEE|$. Second, daytime NEE data were gapfilled using a relationship between NEE and LE, which in my view is not appropriate as LE can represent a significant contribution from evaporation, which is not mechanistically coupled to carbon assimilation or respiration. This is particularly true

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in sites that support standing water! While I do not believe that all flux data must use a uniform set of gapfilling & partitioning approaches, some justification for novel approaches should be provided, and evidence should be given that these approaches are more site-appropriate than the well-established procedures that are widely used by the community (see, for example, Reichstein et al. 2005 or Lasslop et al. 2010). In the case of this particular study, I believe the results would be much stronger if the site-specific fluxes were presented alongside flux estimates derived from standardized approaches. Towards that end, the authors may find this Online Flux Partitioning and Gapfilling tool helpful: <http://www.bgc-jena.mpg.de/~MDIwork/eddyproc/>. The Reichstein et al. (2005) and Lasslop et al. (2010) approaches are discussed thoroughly on that website.

Third, as the authors acknowledge, export of carbon through surface water flow can be an important component of the carbon balance in wetland ecosystems. Unfortunately this was not measured in these sites; this is okay, but the authors should do a better job of discussing the relevance of this missing term, and also make its absence clear in the abstract.

Finally, the discussion of the drivers of these ecosystem fluxes is largely focused on seasonal patterns in meteorological conditions and EVI (or leaf area). Their principle conclusions seem to be: a) NEE and LE will be more decoupled in sites with open water, and b) replacing green leaf area with open water will decrease the magnitude of carbon uptake. Neither of these are particularly surprising and both could have been predicted a priori. I wish the authors had focused more closely on the unique physical and physiological features of the site (i.e. variation in water table depth, the effect of burning in the pine upland site, the exceptionally warm and mesic climate, etc), as in doing so their results may have represented a more novel and meaningful contribution to our understanding of carbon and water cycling in these ecosystems, and the sensitivity of these fluxes to ongoing changes in climate and management regime.

Some minor comments follow:

Section 2.1: Can the authors report on leaf area index for the study sites, rather than using a qualitative approach to describing canopy cover (i.e. open vs dense?).

Section 2.3, page 15760, lines 1 - 10: These threshold filters seem to be too limiting. How were they chosen, and what is the effect of using thresholds that have a higher absolute magnitude?

Section 2.3, page 15760, lines 12-17: A very large amount of data from the pine upland (60%) is removed in an effort to avoid contamination from fossil fuel burning occurring to the east of the tower. More details need to be provided about when the data originates from the east (for example, is it principally at night or during the day)? Also, it is possible a footprint model could be used to more carefully exclude questionable data, and thereby improve data availability?

Section 2.3, page 15761, lines 1-10: The authors correct the energy balance fluxes in order to force energy balance closure. This is not an approach that I recommend, as there are many reasons why energy balance closure may be low at any given site, and the synthesis of Foken (2008) and Stoy (2013) suggest that macro-scale heterogeneities will likely affect the observation of sensible heat for than latent heat flux, which invalidates the assumption of accurate measurement of the Bowen Ratio. If the authors insist on this approach, at some point the pre-corrected energy balance closure should be reported. It would also be helpful to report the estimates of annual sensible and latent heat flux before and after the correction.

Section 2.3, page 15762, Lines 11-22: Was the methane data missing evenly over the course of the year, and over the course of a representative day?

Section 3.3., page 15766, lines 24 - 26: Can these correlations between NEE & LE be placed into context by including previously reported values at other sites.

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