General Comments:
The manuscript addresses the important problem of estimating the CO2 exchange at the air-water interface across the land-ocean boundary, from streams to the coast and shelf region, ranging from Cape Hatteras to the Scotian Shelf. The methodology is sound and the results provide useful insights into the processes that control the CO2 budget. I believe that the manuscript should be published with some minor changes, primarily to provide more details of the methodology and expanding the discussion of results.

We thank the reviewer for his positive comments and answered his remarks, point by point, to the best of our abilities. Some of the reviewer's requests regarding the clarification of some methodological aspects of our study were also formulated by reviewer #2 and we occasionally refer to those answers in our replies.

Specific Comments:
Page 11989, sentence starting on line 9, "The riverine data…". Here the authors should be more specific on how the data, riverine pH and alkalinity and shelf SOCAT pCO2 are used to derive the air-water CO2 exchange. Specifically, details on how was the pCO2 derived from pH and alkalinity.

The riverine pCO_2 values were calculated from pH, alkalinity, water temperature, and, where available, major ion concentrations, using the hydrochemical modelling software PhreeqC v2 (Parkhurst & Appelo, 1999). This information has been added in the methods section of the manuscript.

"Lauerwald et al. (2013) calculated pCO_{2river} values from pH, alkalinity, water temperature, and, where available, major ion concentrations, using the hydrochemical modelling software PhreeqC v2 (Parkhurst & Appelo, 1999)."

Equation (1), the procedure to derive k should be more detailed as it requires an approach quite distinct from the gas transfer coefficient evaluation in the open ocean.

We agree with the reviewer and elaborated on our methodological approach. See our response to Reviewer #2 on the same query.

The discussion of methods for rivers, estuaries and continental shelves is a bit out of balance, with much longer description for rivers than for estuaries and shelves.

We agree with the reviewer's comment that the description for the rivers is significantly longer than for estuaries and the shelves. In answers to some of reviewer's 2 suggestions, additional information was provided to describe the calculations for the estuaries and the shelf but, overall, their descriptions remain shorter than that of the rivers. We carefully looked into this and we actually believe that this imbalance reflects the required amount of information that is needed to properly describe each method, which are quite distinct. Stated differently, the imbalance does not result from ignoring details in the estuary and shelf description, but rather because the river FCO_2 estimates require specific predictors for, e.g., surface area (and thus stream width), channel slope and current velocity (for the exchange coefficient k).
Also, the manuscript could improve with the use of a table summarizing the data sources used for each of the three regions.

The table requested by the reviewer has been added to the manuscript (as new table 1) and is also provided below.

Page 11993, the "Results and discussion" session has rivers, estuaries and continental shelf results blended together. It makes the interpretation somewhat difficult, especially taking in consideration that in the methods section they were treated separately.

We understand the reviewer's concern regarding the readability of the results and discussion section but we believe that our integrated vision of the LOAC should be reflected in the way the results and discussion is structured, with the simultaneous analysis of all connected compartments to provide an overall understanding of the regional biogeochemical dynamics. We thus feel that dissociating each compartment in the discussion would weaken the message we are trying to convey. However, to ease the interpretation of our ms. the "Results and discussion" section was restructured in such a way that long paragraphs now appear as smaller sections, dedicated specifically to the rivers or the continental shelf. We hope this improves the readability of our ms. while preserving the integrated view.

Nine lines of conclusions seem a bit short.

We agree that our conclusion was particularly synthetic. We re-wrote the section to include the temporal dynamics of the CO_2 exchange with the atmosphere and to better explain to role of estuaries in the overall carbon balance.

"Our data driven spatially and seasonally resolved budget analysis captures the main characteristics of the air-water CO_2 exchange along the LOAC of COSCAT 827. It evidences the contrasting dynamics of the North and South section of the study area and an overall gradual shift from a strong source in small streams oversaturated in CO_2 towards a net sink in continental shelf waters. Our study reveals that ice and snow cover are important controlling factors of the seasonal dynamics of CO_2 outgassing in streams and rivers and account for a large part of the difference between the North and South section. The close simultaneity of the snow melts on land and of the phytoplankton bloom on the continental shelf leads to opposite temporal dynamics in FCO_2 in these two compartments of the LOAC. In addition, our results reveal that estuaries filter significant amounts of terrestrial carbon inputs, thereby influencing the continental shelf carbon uptake. Although this process likely operates in conjunction with other regional physical processes, it is proposed that the much stronger estuarine carbon filter in the South section contributes to a strengthening of the CO_2 sink in the adjacent continental shelf waters."

Technical Corrections:
Page 11988, line 24, change region to regions.

Done

Page 11990, equation (1), give units of all variables used, for instance, units for FCO2 and k are not given.

Ok

Page 11992, “uncertainty of the yearly FCO2s”? “yearly estimates of FCO2” reads better.

Agreed, the text was modified accordingly.

Page 11993, line 17, change “Scotian shelves” to “Scotian Shelf”. Check other occurrences in the text as well

Done (3 occurrences)

Table 1: Summary of the data used for the FCO_2 calculations in compartment of the LOAC.

Compartment	Parameter	Description	Source	Reference
Rivers	*pCO2*	CO_2 partial pressure	GLORICH	Hartmann et al., 2014; Lauerwald et al., 2013
	-	River network, digital elevation model (DEM)	Hydrosheds 15s	Lehner et al., 2008
	-	Runoff	UNH/GRDC	Fekete et al., 2002
	T	Air-temperature	-	Hijmans et al., 2005
		Lake surface area	Global Lake and Wetland Database	Lehner and Döll, 2004
Estuaries	*As*	Surface Area	SRTM water body data set	NASA/NGA, 2003
	-	CO_2 exchange rate	Average of local estimates	Raymond et al., 1997; Raymond et al., 2000; Raymond and Hopkinson, 2003; Hunt et al., 2010
Shelves	*As*	Surface area	COSCAT/MARCATS Segmentation	Laruelle et al., 2013
	ΔpCO_2	pCO_2 gradient at the air-water interface	SOCAT database	Bakker et al., 2014
	k	calculated using wind Speed	CCMP database	Altas et al., 2011
	K'_0	Solubility, calculated using salinity, water temperature	SOCAT database	Bakker et al., 2014