

Interactive comment on “Spatio-temporal variations of lateral and atmospheric carbon fluxes from the Danube Delta” by Marie-Sophie Maier et al.

Anonymous Referee #1

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Review bg-2020-197

The MS by Maier et al. presents some extensive and original data of C concentrations and CO₂ and CH₄ fluxes in the Danube delta. This is a well-designed study. The methods are appropriate, the results are well presented and the interpretations are sound. I recommend the publication of this paper. However, I found few weak points that can easily be improve before publication, based on a more detailed analysis of the data and reading of the literature :

In general, the text is insisting more on spatial variations, rather than temporal variations. Most of the calculated flux numbers are annual averages for the two years

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of the study. It would be interesting to interpret more precisely these data in relation with seasonal flooding of the wetland (how do flooded areas change seasonally?), the spring/summer primary production in the wetland, eventually the winter C recycling in the wetland. . . potentially changing the CO₂, O₂ and CH₄ concentrations and air-water fluxes particularly in the channels.

The results of BOD appear in the discussion but not in the result section. A special paragraph in the result section to describe the discrepancies and concordance between in stream respiration and CO₂ outgassing would be useful.

It should be made very clear in the discussion that wetland C metabolic and burial fluxes shown in the last figure are from the literature, not necessarily valid for same study period, and that they do not consider seasonal variations.

Line by line comments:

Abstract : I miss some information about seasonal variations please provide standard deviations on flux numbers L21 & 22 L25, explicit what form of C is exported from the delta: is it OC or DIC ?

L43 : the fact that carbon inputs from terrestrial ecosystems degas as CO₂ and CH₄ along the way to the ocean is known for a long time, and not only from recent estimates In the introduction, it is important to cite pioneer papers and not refer all the time to very recent work that only confirmed the previous study, and do not provide any new information about the mentioned statement.

L59 : The statement "riparian wetlands in the Amazon basin have been identified as significant sources for the outgassing of terrestrial carbon in the form of CO₂" Cite also Abril et al. 2014 here.

L62: "While wetlands are estimated to contribute 1.1 PgC yr⁻¹ (Aufdenkampe et al., 2011) to the global carbon emissions, Amazonian wetland emission alone could contribute another 0.2 PgC yr⁻¹ (Abril et al., 2014). Specifically, riparian systems in the low-

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lands could provide significant lateral carbon inputs (Sawakuchi et al., 2017).” These references to the literature are partially inappropriate. There is a confusion here between CO₂ outgassing from waters and CO₂ emissions from wetland ecosystem. Abril et al. proposed that central amazon wetland + river channel could be at equilibrium (zero flux), the flooded forest and marophytes being a sink and the open waters a source. Also, no need to be so precise on Amazon numbers in an introduction of a MS on the Danube delta.

L68, mention that flooding has been recently described an important transport mechanism of terrestrial C to aquatic system, additional to drainage and surface runoff.

L162: “As tests showed that there was no significant difference between the lab- and field-based methods, we pooled the data in our analysis.” I suggest you provide the result of these tests as a figure as supplementary material

L184: “In the high-resolution LGR time series, the influence of gas bubbles could easily be identified.” The method is described graphically in Grasset et al. *Freshwater Biology*. doi:10.1111/fwb.12780.

L242 In section “2.6 Import by Danube River and Export to Black Sea”, please provide here or maybe in the results section, more precise verbal information (equation is ok) on how you calculate C lateral fluxes before and after the wetland in the delta and how you deal with the problem that these two fluxes might be too close to each other to allow a precise calculation of the net lateral export from the wetland in the delta as a small differences between two large numbers that contain some uncertainty. What are the representativity of stations and data, with respect to observed spatial and temporal differences in the C forms and discharge data between sampling points.

L290: figure 3 and next ones would be easier to read if simultaneous discharge could be shown

L350 and k values. Lake are more exposed to wind indeed, however rivers and chan-

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nels are exposed to current which may also contribute to k600

L380 you are repeating what has been said in Mat and met about CH4

L394. The calculation of lateral flux is indeed poorly constrained and it would be interesting to see the data that support the statements “POC import from the catchment exceeds the export to the Black Sea in February and March, while DOC import exceeds export only during August (data not shown).”

L400-410, please simplify the story about statistics.

442: what about summer stratification in lakes?

L445: the study of CH4 emissions from various plant types by Grasset et al 2016 might be helpful here

L584 drylands are not defined as the contrary of wetlands. The difference here is between floodable land and non-floodable land

L594 “Assuming a carbon content of 0.42 gC gBiomass⁻¹ determined by Greenway and Woolley (1999) for *Phragmites australis*, between 1000 and 1210 GgC yr⁻¹ are bound in the form of macrophyte biomass in the reed area of the Danube Delta”. Not clear the meaning of “bound” here. A great portion of the macrophyte biomass is supposed to be recycled. “The wetlands thus hold 12 to 17 times the total input of organic C to the delta from the catchment” do you mean the total ANNUAL input?

L595 “Nevertheless, wetlands are considered to be net C sinks and Zhou et al. (2009) estimate the sink capacity of a *Phragmites australis* dominated wetland to -62 gC m⁻² yr⁻¹ considering CO₂ and CH₄ release from the wetland itself.” You must be more precise here in the vocabulary used. CO₂ sink might be different from C sink. Please specify that C sink is OC burial in sediments and not the atmospheric CO₂ sink. Same in the following sentences.

L600 “Assuming that carbon emitted from the channels originated only from the wet-

land source, this would suggest that up to 20 % of the potential wetland sink might be exported laterally, eventually finding its way to the atmosphere.” Please explain more clearly

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