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Interactive comment on "Sediment CO_2 efflux from cleared and intact temperate mangroves and tidal flats" *by* R. H. Bulmer et al.

Anonymous Referee #1

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MS. BGD-12-3547-2015 titled "Sediment CO2 efflux from cleared and intact temperate mangroves and tidal flats" by Bulmer et al.

This manuscript investigates the spatial variability of CO2 fluxes from three different intertidal systems in New Zealand: a tidal flat, an Avicennia mangrove stand and a cleared mangrove stand. These mangroves are the southernmost ones in the IWP area and only Avicennia marina can grow in this temperate climate. Opposite to what is happening in the tropics, mangroves in New Zealand are expanding mainly because of increased sedimentation as a result of increased agricultural activities in water-

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Interactive Discussion
Discussion Paper

sheds. However, numerous clearings occurred recently notably in order to “recover recreational values of estuaries”. The main objectives of the authors were to understand the effect of mangrove clearance on sediment biogeochemistry and specifically on CO2 fluxes from mangrove soils. To reach their goals, they measured CO2 fluxes and collected 2-cm deep cores in numerous mangroves, cleared areas, and tidal flats at one season (late spring and summer). CO2 fluxes were determined on the field using dark incubation chambers connected to infra-red gas analyzer before and after having removed the biofilm from sediment surface. On sediment samples, grainsize, TOC, and Chla content were measured. In addition, forest biomass and macrofauna distribution were determined. Methods seem to have been conducted with care and references are up to date. The main results of the authors are: i) lower CO2 fluxes in cleared mangroves compared to Avicennia stand, ii) after clearance, a decrease in CO2 fluxes with time, iii) a strong effect of biofilm on CO2 fluxes, with increased values after biofilm removal. Mangrove forests are among the most productive terrestrial ecosystem, with high rates of carbon sequestration, both in their biomass and in their soil. Unfortunately and although there is an increasing number of studies working on it, there is still a need of data to constrain the becoming of mangrove primary productivity, notably carbon mineralization with the sedimentary column and the export of CO2 from mangrove sediments to the atmosphere, which are underestimated and understudied, even more in temperate mangroves (e.g. see papers of Leopold et al., 2013, 2015, Lovelock et al., 2014; Chen et al., 2012, 2014). The topic is thus relevant and the references are up to date; however the ms. is characterized by flaws that do not allow its publication in its present form. Usually, I find that ms. are too long for what the authors have to say, which is the opposite with the present ms. The authors did not present enough their data, and do not discuss them enough. As a result, I believe that this paper does not have the necessary breadth and depth in terms of providing fundamental new understanding in mangrove geochemistry and ecology for a publication in Biogeosciences.

Additionally, I have listed some points that have to be explained or modified in the ms.

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concerning the sampling strategy, the methods, and the presentation of their results in figures or tables.

- I'm not sure that it was relevant to study so many sites (40 mangrove clearance, 18 mangroves, 30 tidal flats). The authors should better describe the sites and their complementarity. With such a number of sites, the reader is expecting some figures or tables to present statistical analyses between sites, as well as for the relationships between CO2 fluxes and the parameters that can drive them. The authors may have chosen some specific areas, where they were able to have the 3 stands together (having the same sediment characteristics, hydrology, activities in watershed, etc), and to do more analyses on these specific sites. In the same way, the authors have a lot of data, including macrofauna characteristics, but since they are not well discussed, I would suggest the authors to focus, and deeply discussed the main parameters that can explain CO2 fluxes variability in their 3 strata. Another option would be to analyze the influence of mangrove clearings on sediment biogeochemistry and biology, not only focusing on CO2, and to present them in a more applied journal. For instance, the authors can discuss the evolution of grainsize, of the TOC content, of the macraofaune density, etc., before and after clearing.

- Do the authors think that cores of 2 cm are adequate for their topic? CO2 fluxes may be influenced by physico-chemical conditions (TOC, root respiration, redox, etc.) that are developing deeper than 2 cm. What was the limit between the saturated and the unsaturated zones at low tide during their measurements?

- Chla concentrations are usually highly variable at sediment surface in mangroves, thus I'm not sure that one measurement per site is enough.

- The authors did not measure CO2 fluxes at light, and mentioned that their measurements exclude the uptake of CO2 by photoautotrophic process. I agree, however they mentioned that Leopold et al did not observed any differences between light and dark measurement in Avicennia stand. I have read this paper again, and it seems that it is

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not directly linked to mangrove species, but rather to the position in the intertidal zone and canopy closure, that will lead to specific development of the biofilm. I do not know if the length of tidal immersion in New Zealand and canopy closure are the same that in New Caledonia for the Avicennia stands. In addition, Leopold et al. did not measure CO2 fluxes from tidal flats, but from salt flats (so not in front of mangroves, but in the back, at higher elevation, it means different conditions of sediment oxygenation).

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