Actions taken to address the concerns of Anonymous Referee #1.

Referee #1.

Mazarrasa et al. compiled a large data-set of particulate inorganic carbon (PIC) in seagrass meadows and discuss the potential significance of this reservoir globally. The figures are of high-quality, text is well written.

My major concern is to determine if seagrass meadows develop in areas with hydrodynamic conditions that are favorable for sediment deposition, and that these areas are naturally favorable for shell debris deposition. If this was correct, then these areas would anyway have sediments enriched in PIC even in the absence of seagrasses. In this case seagrasses would not be an additional and so far not accounted reservoir of PIC, and in fact this was already accounted in the budgets of PIC for coastal/continental shelf sediments by Milliman et al. (1993) and others. Figure 6A strongly suggests that this is the case since there is no significant difference in the PIC content between the seagrass sediments and adjacent unvegetated sediments.

Response:

Seagrass meadows occur in a wide range of depositional environments (from estuarine to exposed coastal areas; Carruthers et al. 2007) and the dataset explored in this study compiles all or most habitat types (from highly depositional to erosional environments). It is true that in areas where carbonate precipitation is favoured, such as tropical areas of high temperature and salinity, $CaCO_3$ precipitation and accumulation occurs independent to the presence of seagrass meadows. However, much higher cycling in both $CaCO_3$ precipitation and dissolution has been described in seagrass patches compared to adjacent bare-sands (Barrón et al. 2006; Morse et al. 1987; Burdige and Zimmerman, 2002). In addition, seagrass meadows are likely to enhance $CaCO_3$ sediment accumulation rates by sustaining a large biodiversity including calcifying organisms (Jeudy de Grissac and Boudouresque, 1985), favouring the accumulation of carbonate epiphyte load (Frankovich and Zieman, 1994; Perry and Beavington-Penny, 2005), favouring particle trapping (Gacia et al. 2003) and/or preventing sediment resuspension (Gambi et al. 1990; Terrados and Duarte, 2000; Gacia et al. 1999). Canals and Ballesteros (1997) compared the production of carbonate particles within different benthic communities in the Mediterranean Sea, including seagrass meadows and sandy bottom communities and found that *Posidonia oceanica* meadows have more than 100-fold higher carbonate production rates than sandy bottoms (60-70 g m^{-2} yr^{-1} and 0.5 g m^{-2} yr^{-1} respectively). Unfortunately we don't have estimates on the sediment accumulation rates for the vegetated and adjacent un-vegetated patches included in this study. Therefore, figure 6a only shows PIC concentrations, and not accumulation rates, that would have probably been higher in the vegetated patches compared to the un-vegetated.

The message that we aimed to transmit with this figure (6a and 6b) is that, if considering the ratio POC:PIC in the sediment as a way of assessing the role that seagrass play as carbon sinks or sources, we find that seagrass patches, thanks to the POC accumulation, show higher POC:PIC ratios, compensating somehow the CO_2 emissions derived from the $CaCO_3$ precipitation and accumulation.

Action:

In the final version we will clarify in the text that figure 6a shows PIC concentrations and not accumulation rates, that would have probably been higher in the seagrass patches compared to the un-vegetated sites.

The text will read (4121-L26/29, 4122-L1/13):

Understanding the balance between CO_2 emissions from carbonate deposition and CO_2 sequestration from organic carbon storage in seagrass sediments should not only focus on the POC:PIC ratio, but also on resolving how seagrass affect the POC:PIC ratio compared to adjacent un-vegetated sediments. When comparing the carbon content (%DW) between vegetated and adjacent un-vegetated patches, there was no difference in PIC whereas the POC content was about two-fold larger in vegetated sediments compared to adjacent un-vegetated sediments as previously observed (Duarte et al., 2010, Kennedy et al., 2010). As a consequence, the POC: PIC ratio of seagrass sediments (mean ± SE, 0.28 ± 0.06) exceeded that of adjacent un-vegetated *sediments (mean ± SE, 0.19 ± 0.040) in 73% of the meadows examined. Hence, the organic carbon stock present in seagrass sediments would be expected to be reduced to half if seagrass cover was lost while the inorganic stock will be comparable, thereby confirming the role of seagrass meadows as intense CO_2 sinks. It is important to point out that the rational above relates to the content (%DW) of both PIC and POC and not to the rate of accumulation, which may be significantly higher in seagrass compared to adjacent sand patches due to autotrophic production and sediment trapping.*

Minor Comments.

Referee #1.

4117 – L15/23: Please also compare the deposition fluxes per surface area (g PIC/m2/yr) in addition to the integrated fluxes.

Response: We agree.

Action: We will include in the final version the deposition fluxes per surface area estimated for different habitats (pelagic system, coral reefs and *Halimeda bioherms*) based on the global accumulation rates and the surface area occupied by each system reported in the literature (Milliman and Droxler, 1996; Catubig et al. 1998).

The text will read:

"Our review of the literature indicated that PIC accumulation in seagrass sediments is high and comparable to other carbonate producing ecosystems. Based on our identified mean PIC concentration of 62.5 ± 1.7 mg PIC cm^{-3} in the top 10 cm of seagrass sediments (n = 384) and a mean rate of sediment accretion in seagrass meadows of 0.2 ± 0.04 cm y^{-1} (Duarte et al., 2013) we estimate that the PIC accumulation rates per surface area in seagrass sediments would average 126.3 ± 0.7 g PIC m^{-2} y^{-1}. This rate is somewhat below the range of PIC sedimentation rates reported by Gacia et al. (2003) in seagrass meadows of SE Asia, based on direct measures of daily sediment deposition at 8 different sites (145–9443 g PIC m^{-2} y^{-1}) but higher than the average PIC accumulation rate in

sediments of Posidonia oceanica meadows (54.3 ± 1.9 g PIC m^{-2} y^{-1}) estimated from sediment stock assessment and sediment dating (Serrano et al., 2012). Extrapolation, assuming an estimated range of global area of seagrass meadows between 177000 and 600000 km^2 (Mcleod et al., 2011), suggests a total accumulation of PIC in seagrass sediments ranging between 22 and

76 Tg PIC y^{-1}.

The rates of PIC accumulation estimated in this study, both globally (22-76 Tg PIC y^{-1}) and per surface area (126.3 ± 0.7 g PIC m^{-2} y^{-1}), highlight the importance of seagrass meadows as major sites for $CaCO_3$ production and storage in the ocean. The global PIC accumulation rates are substantially lower than in deep oceans by pelagic communities (100–132 Tg PIC y^{-1}) but significantly higher when considering the contribution per surface area (0.34-0.45 g PIC m^{-2} y^{-1}). Seagrass PIC accumulation rates were comparable to those of coral reefs both globally (84 Tg PIC y^{-1}) and per surface area (140 g PIC m^{-2} y^{-1}) and larger than the global estimates for Halimeda bioherms (20 Tg PIC y^{-1}) but significantly lower when relative to their surface area (400 g PIC m^{-2} y^{-1}) (Milliman and Droxler, 1996; Catubig et al., 1998; Table 3).

In addition, we will modify Table 3 and include the estimated area occupied by each ecosystem and the correspondent PIC accumulation fluxes per surface are (g PIC m^{-2} y^{-1}).

The new table 3 will read:

Ecosystem	Area (10^{12} m^2)	Global (Tg PIC y^{-1})	Per surface area (g PIC m^{-2} y^{-1})	Reference
Planktonic communities	290	100-132	0.34-0.45	Catubig et al. (1998), Milliman and Droxler (1996)
Coral reefs	0.6	84	140	Milliman and Droxler, 1996
Halimeda bioherms	0.05	20	400	Milliman and Droxler, 1996
Bank/Bays	0.8	24	30	Milliman and Droxler, 1996
Seagrass meadows	0.6-0.177	22-76	126.3	Mcleod et al.2011; This study
Global		1,500		Lebrato et al. (2010)

The new Table 3 legend will read:

"Table 3: Estimated area, and PIC accumulation rates globally (Tg PIC y^{-1}) and per surface area (g PIC m^{-2} y^{-1}) for different carbonate producing ecosystems including the results found for seagrass in this study and a global estimation considering neritic, slopes, and pelagic areas along with organism-level data."

4121 – L14/15: The cited studies measured CO_2 fixation into organic carbon with chambers. However, these techniques under-estimate GPP because of photorespiration and also due to the discrete nature of measurements they miss "peak" production events (Champenois & Borges 2012). The biased GPP measurements by chambers could affect the estimates of the balance between organic and inorganic production.

Champenois W. & A.V. Borges (2012) Seasonal and inter-annual variations of community metabolism rates of a *Posidonia oceanica* seagrass meadow, Limnology and Oceanography, 57(1), 347–361

Response: We agree and are grateful for your comment. We considered the study by Barrón et al. (2006) to be especially relevant for the discussion as it is, to our best knowledge, the only study were both organic and inorganic metabolism were measured simultaneously during chamber incubations. By measuring changes in O_2, DIC and TAlk, they estimate the net fluxes of CO_2 due to both organic metabolism and to $CaCO_3$ precipitation and dissolution. They found that despite $CaCO_3$ precipitation was determinant in the CO_2 community balance, the *P. oceanica* meadow was still acting as a CO_2 sink in a yearly scale. As explained by Champenois and Borges (2012) photorespiration may be favoured in confined incubation chambers during the day time, leading to a release of CO_2, a consumption of O_2 and as a consequence, to an underestimation of Net Community Production rates (NCP). Considering the possible bias in the NCP add force to the consideration of the ecosystem studied as net autotrophic.

Action:

We will introduce in the text the possible underestimation of the NCP due to the constraints derived by the use of incubation chambers in the study by Barrón et al. (2006) and explain the implications in the estimated carbon balance.

The text will read:

"However, the carbonate precipitation in seagrass meadows is intimately regulated by the organic metabolic rates of the ecosystem (Smith and Atkinson, 1983; Barrón et al., 2006; Yates and Halley, 2006; Hendriks et al., 2014). Barrón et al. (2006) measured both in situ organic and inorganic metabolic rates simultaneously by using incubation chambers in a P.oceanica meadow, and found that the meadow studied was mainly a net CO_2 *sink system at a yearly scale (Barrón et al., 2006) even despite the underestimating Net Community Production (NCP) rates that may derive from the use of confined incubation chambers related to photoxidation processes and subsequent* CO_2 *increases and* O_2 *decreases during daytime (Champenois and Borges, 2012)."*

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