Review

Kelleway et al. 2017, Sediment and carbon accumulation vary among vegetation assemblages in a coastal saltmarsh

Kelleway et al. present a study on the effect of different vegetation species on the trapping of mineral and organic deposits on a tidal marsh in southeast Australia. They use three different methods to assess deposition rates at the short (days) and medium term (months). Their study provides insights in the processes controlling both mineral sediment deposition and deposition of organic matter on a tidal marsh platform. Although their results make a substantial contribution to our knowledge of processes controlling tidal marsh growth and organic carbon dynamics in these environments, some issues need to be resolved before publication of the manuscript is possible, as I point out in my comments below.

<u>*General comments*</u>

One of my main concerns is that the authors use short-term (days) deposition data measured only in December and January to draw conclusion on longer term carbon and sediment dynamics, since they express the accumulation rates on a per-year basis. I think the authors should limit the conclusions they draw based on these data to short-term deposition rates, instead of C sequestration.

Another concern is that the authors calculate the annual sediment deposition rates using a linear regression line which does not pass through the origin to: this results in an overestimation which has to be corrected.

Furthermore, the authors compare the results of measurements at different timescales (days – months) to draw conclusions about the processes controlling accretion rates in different vegetation assemblages. However, they do not address the issues this poses, e.g. the short-term methods were only employed in December and January, so no information from the rest of the year is collected using these methods. This will have an effect on the results, and should be thoroughly addressed.

Also, as one of the aims of this paper is to compare different methods, I would like a discussion about the effect of the results obtained by these different methods on the conclusions they draw. The filter and vial methods result in C deposition rates that differ up to an order of magnitude: this is now not discussed in the manuscript and is a major shortcoming, and necessary if the authors want to use these results in order to draw conclusion based on these data.

The authors should re-consider the title they use for this manuscript, e.g. based on the work they present, the word 'deposition' could replace the word 'accumulation'.

<u>*Specific comments*</u>

P1 L24: you report the C deposition rates on a yr^{-1} basis, while you only measured during 2 cycles of spring and neap tide, which is misleading for the reader. I address this issue further in my comments.

P1 L33: By stating in the abstract that you have gained novel insights into processes responsible for regional differences, you suggest that you explicitly addressed these issues at a broader regional scale, which is not the case. Furthermore, by saying '…processes *responsible* for regional differences…', you suggest that you have conclusive evidence that these processes are the most important one, which is also not the case (e.g. you didn't took belowground biomass production or

soil compaction into account). Therefore, I would change this sentence so that you make it clear you only performed these analyses for a single tidal marsh.

P1 L34-36: I would formulate this more careful, as now you imply that it is possible that belowground processes are of minor importance. This contradicts with the finding of e.g Saintilan et al. (2013) that root OC is an important component of the total OC pool in SE Australian saltmarshes, and P2 L34 of this ms.

P4 L22: I recommend to change this title to e.g. 'Surface elevation measurements'

P4 section 2.2: This method is of course characterised by substantial uncertainty. Are there e.g. no measurements of daily tidal height in the surroundings of the study area? That way you could calculate the difference between measured and predicted tidal height and use this to correct your measurements?

P5 L4: I propose you change this title to 'Sediment traps'

P5 L5-6: Here you state that the purpose is to quantify short-term deposition, while you report the measurement on a yr^{-1} basis. This should be addressed (see below).

P5 L14: please explain what you mean by 'resolution'

P6 L2: The term 'residual sediment' is confusing, as this term is used to denote both residual sediments and organic matter, I propose to change this to e.g.; 'residual deposits'.

P6 L6: Jaschinski et al. (2008) is not included in the reference list

P6 L11: It's very confusing that you say here that you used MIR spectroscopy to assess the *composition* of the listed materials, as this is not done in this ms. In some cases, MIR spectroscopy is used to assess characteristics of the analysed material (e.g. C content), based on a calibration dataset, but this is not done here. I think this sentence is confusing to the reader, as you use the MIR spectroscopy results only to perform a PCA to discriminate between different types of deposits. Therefore, I would limit the materials section about MIR spectroscopy to this aspect.

P6 L14: if these procedures are important for the reader to replicate your measurements, please mention them.

P6 L15: the mid-infrared range of the electromagnetic spectrum is between $4000 – 400$ cm^{-1}, so why did you measure between $8000 – 400$ cm^{-1}? Please clarify.

P6 L15: Please clarify why the spectral range was adjusted to $6000 – 600$ cm^{-1}?

P6 L35-36: You say you test main and interactive effects of vegetation assemblages: please provide the effect *on what exactly*?

P6 Section 2.8: please mention that you report the confidence on the mean of replicate measurements as standard error (as I assume this is what you mean with SE). Also state how this was done an why you didn't use standard deviation to report on the spread among different replicate measurements.

P6 Section 2.8 + P7 L24-29 + section 4.1: You use a simple linear regression, which you fit through the data points representing sedimentation rates above the MH's, to obtain annual rates of sediment deposition: this technique leads to an overestimation of sediment deposition rates! As you show in figure 2: the regression lines do no pass through the origin of the graph, which implies that

after an infinitesimal timestep you have e.g. already 0.5mm accretion at the Sporobulus site. Likewise, when you use this regression line to calculate the amount of material that has been deposited after 12 months, you will overestimate this amount. This should be corrected: make sure you force your regression line to pass through the origin and calculate the deposition rates again.

P7 L9: Please explain what you mean by 'organic residue': are these the deposited macrolitter? Or all deposited materials combined? Or…?

P7 L18-19: please explain what you mean with 'composition'? It's confusing that you state that you will identify differences in composition, while you will only use PCA to plot the data on two PC's. Please better explain here how you used the PCA based on MIR spectra as an added value to standard lab analyses.

P7 L24: I don't agree that 'consistent' accretion was measured for the Juncus plots, as e.g. replica 2 remains relatively stable after 11 months and replica 1 and 3 show negative erosion rates towards the end of the measurement period. I would formulate this more careful.

P8 L12: $F_{2,45.8}$: how can the degrees of freedom of variance within groups be 45.8?

P8 L24-25: please perform a statistic to show whether the differences between sporobolus and the other vegetation types is significant.

P8 L 31: indicate if the 66% and 78% are mass percentages or some other measure?

P8 L32-37: Sarcocornia and Sporobolus plots were located on the low marsh, which are generally subject to higher water flow velocities compared to the high Juncus marsh. This can partly contribute to the lower amount of litter retained at the low marsh. Please discuss this briefly.

P10 L9: Indicate that you analysed the types of materials deposited for the short term

P10 L22: how about the effect of sediment removal through erosion?

Section 4.1: here you discuss that sedimentation rates are higher for the high marsh compared to the low marsh, which is the opposite of what is normally observed. Discuss this briefly, or refer to where you discuss this (section 4.2.2)

P10 L29: Section 4.2 has a confusing structure: in sections 4.2, 4.2.2 and 4.2.3 you describe the results from the short-term methods, while in section 4.2.1 you describe results from the long-term methods. Please indicate this e.g. in the titles of the different subsections, as this in very confusing for the reader.

P11 L6: you state here that during the January neap there was no inundation of the Sporobolus plots for the vials, but in table 2 you report deposition rates for JN in vials for Sporobolus plots. Please explain.

P11 L8-10: please better explain which 'scale differences' you mean and shorten this sentence (or split into two sentences).

P11 L11: please use a more specific title, so the reader know what this section is about

P11 L14: please better specify that with 'direct organic sedimentation' you mean contributions of litter fall to increases in marsh elevation. The fact that local vegetation has a high biomass production does not necessarily mean that this litter will contribute to long-term accretion rates, so this should be nuanced.

P11 section 4.2.1 In my opinion, the conclusions drawn in this section are too much based on speculations. The only evidence you present that vegetation has an effect on sedimentation rates is that Juncus has a higher standing biomass (while no measures of biomass have been carried out on the studied marsh), without putting forward evidence that e.g. indeed more autochthonous plant material is being retained on the longer term. Moreover, if measurements would have been carried out over e.g. 11 months, the conclusions would have been different and the Sporobolus plots would have collected most sediment. Therefore, I would like the authors to formulate these conclusion more careful and include some discussion about the effect of the duration on their measurements on their results.

P11 L30: please use a more specific title, so the reader knows what this section is about

P11 L34-36: You can add '3) flooding frequency is higher at lower elevations' to this list.

P12 L28 – P13 L5: Here you compare the results from the short-term methods with the long-term methods in order to draw conclusion about the redistribution of surface materials. However, the data obtained with the short-term methods has only been collected in December and January, neglecting potential intra-annual variability in the composition of deposits. This is a major concern of mine, as I don't agree the results obtained in these two months can be directly compared to the results obtained over a 19 months period without addressing this issue thoroughly: please do this.

P13 L28: How about the effect of kinetic fractionation of stable carbon isotopes on the results of your analysis.

P13 L38: In my opinion, I don't agree that the evidence presented allows to draw definite conclusions about the mobilisation of litter on the tidal marsh. Therefore I propose that these results are formulated in terms of hypothesis instead of conclusions.

P13 L40 – P14 L1: 'Autochthonous sedimentation' is a strange term, as sedimentation refers to sediment deposition. This could be changed with 'autochthonous litter'

P14 L5: Please change to e.g. 'Implications for wetland functioning'

P14 L10: Since you didn't measure long-term C sequestration, remove 'sequestration' from the title of this section

P14 L12-14: Since C deposition was only measured 4 events in December and January, I don't agree to calculate annual C deposition rates based on this data, as this way 1) you ignore intra-annual variations in C deposition and 2) the reader might think that you measured C deposition over a whole year. Also, you don't discuss the effectiveness of the method you use to calculate these number (filters) in trapping deposits. I suggest the annual C deposition rates are removed, or a detailed discussion on the effect of intra-annual C deposition dynamics on the calculations is included.

Moreover, you use the results from the filters to calculate these annual C deposition rates, while the amount of deposits measured with the filters (fig. S2) are an order of magnitude smaller compared to the amount of deposits measured with the vials (fig. S3). Please explain why you used the filter results to make these calculations, and not the vial results?

As one of the goals of your study is to compare both the filter and vial method, please provide a more in-depth discussion of the effect of the order of magnitude difference between the results from both methods on the calculations you make and the conclusion you draw based on this data.

P14 L26: By using the title 'Decomposition of organic matter…' you suggest that you have effectively measured OM decomposition, which is not the case. Please change the title so that this is more clear. E.g. 'Chemical structure of deposits varies among…'

P14 L28-31: Please reformulate this sentence: by saying '… these analyses have revealed insights in to fate of aboveground OM and the likelihood of their contribution to…' you suggest that you have done measurements that directly allow you to say something about the different contributions of OM in these different vegetation assemblages to long-term C sequestration. This is however not the case, as you use chemical measurements to make suggestions about these processes.

P15 L8: Based on which data do you calculate the 'retention of plant-derived C'? Please explain.

P15 L17: 'The selective sorption of N by a plant…': how does this explain that Juncus litter is enriched in N compared to the original biomass?

P15 L23: How does table 2 show that the bacterial biomass increases for Sacocornia and Sporobolus?

P15 L24-27: This seems highly speculative and you don't use any data or references to prove this: I suggest you remove this.

P15 L30-31: you only measured C deposition on a very short timescale (averaged over 2 months), so I would refrain from any suggestions or conclusion of your observations for long-term C sequestration.

Technical corrections

P1 L15: remove 'surface'

P1 L21: Replace 'Accretion was…' by 'Accretions rates were…'

P1 L23: change '(6d)' to '(6 days)'

P1 L28: change 'mid infrared' to 'mid-infrared' (also in the rest of the ms)

P2 L5: change 'broad' to 'general'

P2 L8: change 'exceptional productivity' to 'exceptionally high productivity'

P2 L12: Change 'Surface elevation and sedimentation dynamics are central…' to 'Sedimentation dynamics partially determine the survival of coastal wetlands under rising…'

P2 L14-16: This is a strange sentence: first you define minerogenic as 'dominated by mineral inputs', by which you imply that there is also other (organic) material present. Next you say that most saltmarsh sediments contain both organic and mineral fractions, repeating what you first said. You can simply only say that most saltmarsh sediments are a mixture of organic and mineral materials, to avoid confusion.

P2 L18: change 'sediment' to 'sediments'

P2 L19-20: change '…); as well as the tidal range of a site and position…' to '…), the tidal range of a site and the position…'

P2 L25: change 'Broadly' to 'Generally'

P2 L26: change 'helping to trap mineral sediments' into 'facilitating sediment tapping'

P2 L27-30: Change to: 'Findings of comparative studies of the effect of vegetation composition on sediment deposition rates, however, vary from no difference among different vegetation species () to substantial differences among…'

P2 L32: I would change this sentence to: 'Average global rates of carbon accumulation in saltmarshes are extremely high, relative to…'

P2 L33: state that SE is the standard error

P2 L39: change 'their' to 'its'

P3 L1: change 'soil pools' to 'soils'

P3 L9: You can change this sentence to 'Because methods vary…, a combination of …'

P3 L15: change 'presented' to 'presents'

P3 L15-16: I would reformulate this sentence and state that another aim of your study was to compare different methods that are used to measure sedimentation rates on tidal marshes (otherwise it is not clear to the reader whether or not you made the comparison).

P3 L24-25: put '(Fig. 1)' at the end of the sentence

P3 L 25-26: 'mangrove species Avicennia…'

P3 L27: 'the upslope limit of saltmarshes…'

P3 L28: 'but for the most part saltmarshes are bordered…'

P3 L29-30: '… with ranges in elevation and tidal extent.'

P3 L31: 'Salmarshes within this site comprise…'

P3 L31: '… communities. The lower and middle marsh is characterized by an association of … pathway). The upper marsh …'

P3 L36: 'Fifteen plots were selected on the basis…'

P4 L5: is this g dry weight per m^{-2}? If so, mention this, also in the next sentence.

P4 L6: '… 350 g m^{-2}). Moreover, there do not'

P4 L12-15: Move these sentence to the beginning of the study area section: they provide general information about SE Australian saltmarshes.

P5 L5: Change 'sedimentation traps' to 'sediment traps'

P5 L35: Change to '… the supernatant decanted and the vial was placed…'

P7 L14-16: Please explain the symbols more clearly: e.g. 'where $\delta^{13}C$ denotes the isotopic signal of different sources of OC: $C_{residue}$ (…), C_{C4} (…) and C_{C3} (…).

P8 L16: please mention the units of '100 ± 32.73'

P8 L19: better to give the range in R^2 instead of saying '$R^2 > 0.35$); I wouldn't call these relationships significant as long as you didn't test them statistically.

P10 L 15-16: change to '… and deposition measured with short-term sediment traps…'

Section 4.1: use the re-calculated accretion rates (see my comments above)

P11 L14: change 'massive' to 'large'

P12 L7: '<u>the</u> physical position'

P14 L6: This sentence is not correct: change to e.g. '… surface dynamic is critical to <u>predict</u> the survival…'

P14 L11: Please rephrase 'organogenic and minerogenic assemblages' to e.g. 'organogenic and minerogenic deposits'

P14 L28: Replace 'MIR' by 'MIR spectroscopy'

P15 L38: remove 'then'

Figures

Figure 1

- Heading: change '…location of nearest…' in '…location of *the* nearest …'

Figure 2

- Heading: is 'SE' the standard error? Is this the same as standard deviation? Please clarify.
- Change the axes so that the 0 marker of the y-axis is at the same height of the x-axis (since you don't plot negative accretion)
- You should make it more clear that what you show is the height of deposited sediments above the marker horizon. Now the reader can interpret it as accretion rates measured at different time periods. I would change the y axis label to something like 'Height of deposited sediments (mm)'

Figure 3

- Heading: write '6d' as '6 days'
- As you have standard deviations on this data the quality of the figure would improve if the differences between the different vegetation species are significantly different, e.g. with letters above the bars.

Figure 4

- The letters written within the symbols of A) are very difficult to read: place them next to the symbols
- Also the letters next to the symbols in A) are difficult to read: enlarge them and increase the space between the symbol and the letters

Figure S1

- Heading: replace 'scatterplots' with 'plots'; explain what 'AHD' is; put 'regression line' in plural; explain that DW (on the y-axis) means dry weight; explain what 'bulk material' is.
- Y-axis: change units to 'g DW m^{-2}'
- Plot D should be January 'spring' instead of 'neap'?

Figure S2

- Heading: same remarks as for fig. S1
- Replace the y-axis label as for fig. S1
- Remove 'no linear fits' from the legend: this is already explained in the heading
- Plot D should be January 'spring' instead of 'neap'?

Tables

Table 1

- Heading: change 'Summary of sediment measure techniques...' to 'Summary of sedimentation measurement techniques'; Change 'C' to 'OC', since you measure only organic carbon
- Under Parameter, change 'Measure' into 'Measurement'
- Under 'Filter + isotopic analyses': clarify what 'sediment residue' is. This should be clear to the reader without reading the whole manuscript.
- Under 'Filter + MIR & ^{13}C NMR': change 'Character of ...' to 'Characteristics of ...'
- In the 'Filter + elemental analysis' section: C deposition rate is expressed in 'yr^{-1}' while you only measured for a short period in summer. This should be changed (see my previous comments)
- In the notes ([a]): change '%C' to '%OC', since you measured organic carbon
- For the filter method – 'Filter + isotopic analysis': it should be clear what 'sediment residue' is, please clarify in the heading.

Table 2

- Heading: change 'assemblage' to plural; change '... plant assemblages, plus other...' to 'plant assemblages and other potential sources'; change '... for each of biomass...' to '...for each of *the* biomass...'
- Explain what 'n/a' stands for in the heading

Table S1

- Place 'Number of tides exceeding mean plot elevation' above the names of the neap and spring events to increase readability

Table S2

- Are these values based on 1 measurement or are these average values from multiple replicates? If so, provide the standard deviation.