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Interactive comment on "Coral records of reef-water pH across the central Great Barrier Reef, Australia: assessing the influence of river runoff on inshore reefs" *by* J. P. D'Olivo et al.

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We are thankful with the anonymous referee whose helpful and thoughtful comments have greatly improved the manuscript. We have spent a substantial period of time rewriting parts of the manuscript; particular emphasis was placed in dealing with the variability to the aragonite saturation state and seawater pH. We have now included modeled data for the aragonite saturation state and made changes to the text accordingly. As a result the discussion was greatly improved as the reduction to the aragonite saturation during flood events perfectly fitted with observations of reduced coral growth. The amount of text dedicated to the variability of the river waters between flood events

has also been shortened. We believe that the changes done to the manuscript will make it easier for readers to follow. Below, we respond to specific comments from the referee and describe how we have revised the manuscript.

Anonymous Referee #1 - I felt that the authors attempted to do a thorough interpretation of the data but I am concerned that they under emphasized a very important factor. The paper reads as if the authors are trying to directly link seawater pH with aragonite saturation state, however the saturation of aragonite is a function of both the Ca concentration and the carbonate ion concentration. The carbonate ion concentration can be influenced by pH, but it is also impacted by total dissolved inorganic carbon (DIC). River inputs to the reef can impact both Ca ion concentration, DIC and pH, but the text seems to ignore all but pH. The authors seem to be good geochemists, so I think this may just be an oversight in the communication of the work, but it should be explicitly and prominently addressed. If there is no data that can be brought to bear on this topic, the many sections of the text that refer to saturation state and pH should be carefully re-written to account for the fact that pH is not the only driver of saturation state and that other variables are likely important in this system.

Response: - We agree that the description of changes to the aragonite saturation state during flood events was under emphasized in the original version of the manuscript. The discussion in the manuscript has been modified to include results for the aragonite saturation from the modelled data. The model itself has also been revised and refined by incorporating natural seasonal variations in pCO2 and CO2 uptake by phytoplankton during flood events based on the input of nutrients (DIN and DIP). The results confirm that nutrient enhanced productivity results in increase in pH but indicate a reduction in aragonite saturation state during flood events. The change to the saturation state has helped us reconcile the results from the coral growth and coral δ11B. Consequently we have modified the discussions and conclusions to indicate that the lower growth rates observed during flood events observed in the inshore region could be the result of decreased water quality and aragonite saturation state.

Anonymous Referee #1 - The analytical work for this data was not trivial and the authors generally did a good job of concisely explaining the work. The only thing I was left wondering was what their recoveries were from the ion exchange resins and how do they know that there is no fractionation if they do not have complete recovery.

Response: - As indicated by the reviewer it is very important to collect all the B during the purification process to avoid possible fractionation. The elution procedure and sample recovery is discussed in detail in the methods specific paper recently published by McCulloch et al 2014 referenced in the text. “In both methods the boron is collected in relatively large fractions ensuring 100% collection efficiency.” was added to the methods section.

Anonymous Referee #1 - An important detail in this section and throughout the paper was a lack of consistency with significant figures. For example the δ11B value of the JCP carbonate standard (is that Jcp-1 or Jcp-2?) measured by MC-ICP-MS was 24.3$\pm$0.34‰ŹIt should be reported by the correct 24.3$\pm$0.3‰ or by 24.30$\pm$0.34‰ with the extra sig-fig that many geochemists conventionally use.

Response: - It is now indicated that the standard correspond to Jcp-1 and we have made changes throughout the manuscript to add the extra significant figure when applicable.

Anonymous Referee #1 - My impression was that the style of the writing lacked a cohesive narrative that led to a perceived lack of scientific gravitas, though I think hidden in the text are some valid interpretations and some interesting scientific findings. The discussion section explored different aspects of the data, but the important points seemed to me to be lost in the details. For example after reading section 4.1, I was left wondering what the point was except for the basic facts of the mean pH from both rivers and the fact that there was no regular seasonal cycle of pH in the river data. Both facts seem more at home in a Results section. The choice of the Elbe estuary as a comparison seemed random. The reader was left wondering what are the primary differences

between the Elbe River and the Burdekin River watersheds and hydrology. To remedy the perceived lack of focus and narrative in the writing, I suggest that the authors focus the text on making arguments for the points made in the Summary and Conclusion section and limit the amount of text dedicated to digressions/explorations of the data that don’t pan out. I do think it is important to include negative and inconclusive findings, but it is important to keep them from disrupting the narrative of the primary conclusive findings. It is very valid to explore multiple working hypotheses and eliminate some of them in the discussion, but this needs to be done explicitly so that the reader can follow the thought-process of the authors.

Response: - The comparison with the Elbe River was included in the original version of the manuscript to provide background information for the discussion on the variability of the plume waters between different flood events. The study on Elbe River was chosen because it is the only study in the literature, to our knowledge, where the δ11B composition of floodwaters has been characterized between flood events of different magnitude. However, in an effort to improve the focus in the narrative this comparison was removed from the manuscript and the discussion regarding the river and plume water characteristics has been condensed. As a result we feel that by taking the Elbe discussion out has certainly helped get the ’narrative’ to thread together. Figures 2 and 4 were also moved to the SOM. We have also rewrote large sections of the discussion to make it easier to follow.

Anonymous Referee #1 - I read this paper more for large-scale issues rather than small-scale ones, but I did notice two things: 1) the text describing Figure 6 indicates the units are z-scores, but the units on the graphs are the units of the individual parameters, 2) Table 2, the numbers are described as “Mean annual values” but my understanding is that this is reporting average values from 1973-2000 using annual data. The way it is currently written can be misinterpreted that the data represent the average of a single year.

Response: - 1)The text in manuscript has been re-written to better describe how the

composite records were obtained. This section now reads: " The data from each core was first normalized according to the following equation:

zt = xt - (xc) (3) where xt is a δ11Bcarb value at certain point of time, (xc) is the mean δ11Bcarb value for a given coral. The composite records were then obtained by calculating the average from the normalized data at certain point in time. To preserve the units the composite records were 're-scaled' according to the equation:

rt =(Zt) + (xR) (4) where (Zt) is a composite δ11Bcarb value at certain point in time, (xR) is the average mean value for all the cores from a specific region."

2) The description in table 2 has been modified to avoid misinterpretations to: "Table 2. Average values and variability (2 SD) for δ11Bcarb, pHcf, and coral reconstructed pHsw calculated over the common period of 1973-2002. The reconstructed pHsw values were estimated using Eq. (2) to correct for the pH offset at the site of calcification. The slope is was obtained from the linear regression of the full length of each core (see Table 1) and is used to indicate the annual rate of change for the reconstructed pHsw time series."

Interactive comment on Biogeosciences Discuss., 11, 11443, 2014.