**Biogeosciences
Discussions**

Interactive comment on "Spatial linkages between coral proxies of terrestrial runoff across a large embayment in Madagascar" by C. A. Grove et al.

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Review of Grove et al. 'Spatial linkages between coral proxies of terrestrial runoff across a large embayment in Madagascar'.

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This manuscript presents a series of multi-proxy coral records that are influenced by three rivers that discharge to a single embayment in Madagascar. The strength of the paper is the critical examination of the different proxies used (luminescence, Ba/Ca, δ18O, δ13C) and their reproducibility across different sampling sites and with modelled river discharge. Another interesting aspect of the study is the comparison between the two most commonly used analytical methods for coral trace element geochemistry (LA-

ICPMS and Solution ICP-MS). I'm previously unaware of another published study that has examined the comparability between these different techniques. Overall, I think the authors have done a solid job at deciphering the often complicated signals that appear typical when examining multi-proxy records from different sites and their interpretations on the behaviour (i.e. conservative and non-conservative) of the different proxies. My main comments on the manuscript largely relate to providing some extra clarification on the methods and better stating the limitations of some of the proxy and modelled data. I think the paper is generally well-written and is a worthy contribution for Biogeosciences Discussions.

My specific comments include:

Abstract. Page 3101 Line 9: should be data were compared to. . .

Page 3101 Line 12: instead of 'we relate' suggest to replace with 'are likely to be linked'

Introduction. Page 3103 Line 8: 'Ba is dissolved in the river catchment area'. This needs to be a bit more specific – do you mean rainfall dissolves Ba associated with soils and rocks in the catchment area? I think there are probably two components that are going on – 1. There is dissolved Ba in the rivers which is probably sourced to 'free Ba' that can be immediately dissolved from sediments and 2. The Ba absorbed on clays that desorb at the river mouth.

Page 3105 Line 4: 'three coral cores' – I think readers could get confused between the total of four cores that we examined in the study across the three locations. Maybe remove the 'three'.

Page 3105 Line 12: be consistent with the spelling of 'modeled' throughout the manuscript (i.e. change to 'modelled').

Materials and Methods. Page 3106 Line 4-5: I see that in the discussion section it is revealed that MAS1 and MAS3 were taken from the reef slope and reef flat, respectively but it might be worthwhile to include this information in here as well. Also please state

the distance that these corals were collected apart from one another? Both corals are reported to be collected at 4 m depth but I wondered since MAS1 was collected on the reef slope it may be slightly deeper than MAS3? This may also influence the river signals as the buoyant freshwater plume may only sit in the top ∼2 -3 m of the water column.

Page 3107 Line 1: Can the authors provide some extra details on the nature of river discharge – do all three rivers have some flow throughout the year as the modelling data suggest in Figure 2 or are they ephemeral?

Page 3108 Lines 18-28: As previously stated I'm really interested in the comparisons between the LA-ICP-MS data and the solution ICP-MS data. This paragraph suggests that the LA-ICPMS data were only used to examine the Ba/Ca ratio, although we only get this information at the end of the paragraph. I suggest that an opening sentence be added to state this clearly. It would also be interesting to examine the Sr/Ca relationship between the two techniques if those data were available as well. Can the authors provide the RSD on the LA-ICPMS Ba/Ca data to compare with the Solution ICPMS?

Section 2.4: The authors need to be clear on the temporal resolution of their data in this section (or in section 2.2) – i.e. clearly state that the solution ICPMS trace element and stable isotope data are at monthly resolution and the LA-ICPMS data are at ∼weekly to fortnightly resolution. I realise that this information is provided in the discussion but I think it should also be stated in the methods.

Section 2.5: I would like to see a little more information on the model run and a general statement on its strengths and weaknesses. Specifically while Figure 2 shows that the model provides good information on seasonal river peaks and troughs over an 'average' year (in particular to match with the luminescence and Ba/Ca data), I would like to know how well the model can reconstruct river discharge over the entire 15 year record? If the latter is the case it would be good to see if the model and luminescence data match up for the inter-annual variability in river discharge. For example, it appears

from the G/B ratios that the largest flood in the 15 year record occurred c. 2000 (also in Ba/Ca ratios at the MAS site but not as evident in the δ18O record) – it would be great to see if this matches the model. Following on from this question – Table 4 appears to show the variability in the discharge over this period so it suggests there are annual discharge data available (or monthly data as appears to be suggested in this section). I recommend that the authors state the annual variability in river discharge over this 15 year period (in the results section). Moreover, the same comments on the discharge apply to the sediment export data (how does the 15 year record compare to the Ba/Ca data – does peak sediment export match peak Ba/Ca?).

Page 3110 Line 10: suggest changing the spelling of 'phosphorous' to 'phosphorus'

Section 2.6: I am wondering why coral Sr/Ca ratios were not used at least to help validate the chronology/seasonality of the coral? G/B ratios do provide an excellent indicator of seasonal cycles but the Ba/Ca ratios in some instances can also have peaks in the dry season.

Results. Page 3113 Line 4: should be 'Geochemical data were'

Sections 3.3.1 and 3.3.2. As stated earlier, it would be good to state the range of river discharge and sediment runoff/export over the 15 year period (in particular to examine if indeed the 2000 flood was the biggest over this 15 year record that the G/B and Ba/Ca ratios suggest).

Discussion.

Page 3117 Line 8: insert '(MAS1 and MAS3)' in between 'cores' and 'from'

Page 3118 Line 13: suggest to change 'a near significant' to something like 'show a considerable relationship'

Page 3118 Line 17: See earlier comments on the model data – I agree that the 'model data give a good indication of sediment yield and river discharge for the three watersheds' but on what temporal scale? The Figure 2 shows the model provides a good

indication of the average annual seasonal variability but can it distinguish between individual years (i.e. to say something like: discharge in the year 2000 was twice that of 1992). If the latter is not the case I suggest incorporating the words 'annual average seasonal variability' into this sentence.

Page 3123 Line 5: change to 'river systems' not rivers

Page 3123 Line 16: change from 'combing to 'combining'

Conclusions Page 3123 Lines 26 and 27: The size/discharge of the river is also important – maybe include?

Tables and Figures Table 4: I'd doubt given the uncertainty in the model ($\sim$ would have to be no better than $\pm$ 10%) that river discharge can be reported with two decimal places – suggest to just keep two significant figures for these numbers (e.g. 255.42 will become 260 and 6.76 will become 6.8)

Figure 2 : check the caption (no d)