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Climate of the Past Discussions

Interactive comment on "Madagascar corals reveal Pacific multidecadal modulation of rainfall since 1708" *by* C. A. Grove et al.

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Response to Reviewer 2

This is an encouraging review which raises some interesting and valid points that will be discussed further in a revised version of the paper. The reviewer states that the objectives of this paper are well warranted and that the question of Indian Ocean multidecadal variability is of great importance. However, the reviewer has some major concerns which we will address individually.

1) There is much variability between all PDO reconstructions, both in North American and in Asian records. This of course makes it difficult to verify any climate record potentially influenced by the PDO, especially pre-1900. However, the reviewer correctly

indicates that we should discuss and compare the coral runoff record with other available PDO reconstructions. This will be done in the revised version of the manuscript. Below is a short summary of what the comparisons with different PDO reconstructions show.

The Madagascar runoff record shows the strongest relationship with the eastern Asian based PDO reconstructions (D'Arrigo and Wilson, 2006; Shen et al., 2006). Nevertheless, there are also similarities observed with the Mann et al. (2009) SST reconstruction, and with the combined PDO reconstruction of Henley et al. (2011). When considering the North American based PDO reconstructions (Biondi et al., 2001; D'Arrigo et al., 2001; Gedalof and Smith, 2001; MacDonald and Case, 2005), specifically, the Madagascar runoff record generally lags the PDO reconstructions. This is highlighted particularly in the MacDonald and Case (2005) PDO reconstruction, yet is also obvious in the Biondi et al. (2001) record.

2) We will include a more detailed review of the relationship between the PDO and rainfall patterns in the introduction.

3) We will address the IPO in more detail in the introduction.

4) We will include a Table showing the shared interannual variance between coral records from Antongil bay and discuss the rainfall link in greater detail.

5) We will discuss the possible physical mechanisms that might explain why the Pacific Ocean drives Indian Ocean rainfall in the discussion section of the revised paper. However, a detailed explanation is beyond the scope of this manuscript.

6) This is an interesting point the reviewer raises. However, it remains difficult to identify the true trend due to inconsistencies between rainfall records for the region. Comparing three different rainfall records for a 23 year period (11 years pre 1998 and 11 years post 1998) indicates that only one record has a declining rainfall trend (Figure A). The other two records show no trend difference pre and post 1998 (Figure A).

As all the coral records have a post 1920 deforestation influence, we cannot properly assess the G/B trend for the same period.

7) As satellite data only starts in the late 1970's it is very difficult to assess rainfall variability over the oceans on multidecadal timescales. Although not clear (patchy correlations), there are some indications of a negative correlation of rainfall with the PDO over south-eastern Africa, as well as positive correlations over eastern Africa. We will include a new sub-figure next to Figure D1 (now a main figure in a revised version of the manuscript), which highlights the PDO correlation with rainfall over Africa. Significance levels are now at 5%.

We use the May-April period here as it captures the complete seasonal cycle of rainfall over NE Madagascar. We will change the spatial correlation map in Figure 2 so that it is consistent.

8) We will delete this comment.

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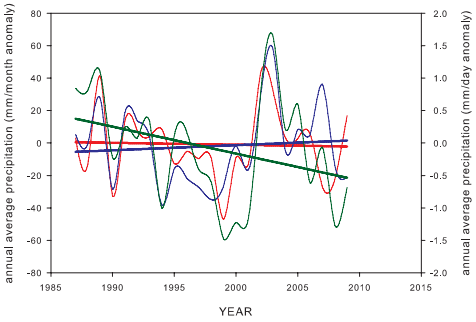

Figure A. Annual average time series of CRU (red; Mitchell and Jones, 2005), GPCC (blue; Adler et al., 2003) and CMAP rainfall data (green; Xie and Arkin, 1996) for the Antongil bay region (15S - 16S; 49E – 51E). The data start in 1987 and end in 2009, highlighting the difference in rainfall before and after the 1998 PDO-IPO switch.

Fig. 1.