

## ***Interactive comment on “Controls of Caribbean surface hydrology during the mid- to late Holocene: insights from monthly resolved coral records” by C. Giry et al.***

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Comment by Anonymous Referee #1 is generally very positive. Referee #1 pointed to some relevant aspects that further need to be addressed in order to improve the quality of the paper. We address here all comments and the revised version of the manuscript will be adapted accordingly.

Referee #1 is mainly concerned by the fact that the upwelling occurring on the northern coast of South America may have impacted our coral data. As suggested, it would benefit the manuscript if we would express our thought on that topic. For working on Bonaire, an island located hundreds kilometres away from the Cariaco Basin, we

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are for several years now highly concerned by this upwelling issue. However, the coral data did not support that upwelling is important at Bonaire. Actually, it would have shortened the manuscript if we would have found an influence of the upwelling on the coral data.

The strong Ekman transport induced by easterly trade winds causes upwelling along the southern margin of the Caribbean Sea. The source of the upwelled water is the Subtropical Underwater that is characterised by more saline and colder water (Wüst et al., 1964; Giry C., 2011 PhD Thesis). Consequently, if upwelling would be the prevailing factor, we would expect that colder conditions are accompanied by more saline conditions. But, as presented in section 4.5 (cf. Figure 9), the coral data show inverted relationship (colder-less saline). Moreover, as indicated line 19-21, Page 3914, “Results show that different calibration values do not affect the sign of the correlation between Sr/Ca-derived SST and Dd18O-related salinity”. Consequently, this result is independent of the selected proxy-SST calibration. This is true for interannual to multidecadal timescales. On seasonal timescale, upwelled deep waters have a higher Sr/Ca value than shallow water. This leads to apparent cooler conditions in the aragonite secreted in the upwelling season. This might increase Sr/Ca value in wintertime, thus leading to a steeper Sr/Ca-SST regression slope. However, as shown in a recent paper (Giry et al., 2012) the regression slope from modern Bonaire coral is comparable to other published coral data from a site not influenced by upwelling (Hetzinger et al., 2006). Therefore, for seasonal timescales, there is no direct evidence for the influence of local upwelling on coral Sr/Ca data.

But why is there no direct influence of the upwelling on Bonaire coral data? From December through May, the northern coast of south America is prone to seasonal upwelling. Such upwelling is well-known from the semi-enclosed basin of Cariaco in the southeastern Caribbean (Taylor et al., 2012). However, Bonaire is an open-ocean island located off the northern coast of Venezuela and hundreds kilometres away from the Cariaco Basin. Consequently, the near-shore Ekman transport of nutrient-rich sub-

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surface waters occurs hundreds kilometres to the south east and must be transported long enough to influence directly sea surface hydrology at Bonaire as recorded in the coral records. Although there is evidence for short-lived upwelling events (filaments) that would bring cold and salty water to Bonaire at timescale of a day up to a week (cf. Andrade et al., 2005), these synoptic events are not lasting long enough to be recorded in the coral data using our microsampling strategy (monthly resolution targeted). Moreover, upwelled waters in Cariaco should be transported westward to reach Bonaire. However, there is evidence for an eastward flow between Bonaire and northern coast of Venezuela (cf. Figure 5a from Andrade et al., 2003) whereas a westward flow typical of the Caribbean Current occurs north of the island. Consequently, while there might be a synoptic influence of the upwelling filaments at Bonaire, the dominant oceanographic features at this open-ocean location, is a constant westward flow north of Bonaire and an eastward flow south of Bonaire that disable upwelled waters from Cariaco to be transported directly to Bonaire.

Below are our comments to specific issues raised by referee #1:

1. Regarding the much smaller  $\delta^{18}\text{O}$ -SST regression slope found compared to Hetzinger et al., 2006 the referee would like to see some more proof on that before believing that this coral is recording the local climate and thus that fossil corals have a good likelihood of representing local climate. We definitely agree with this comment. In order to circumvent uncertainties associated with calibrating proxy data, the reconstructed  $\delta^{18}\text{O}_{\text{sw}}$  was derived from a range of proxy-SST calibrations rather than from fixed calibration values. To address this comment in details, an entire paper needs to be written, not only by focussing on the distinct hydrology and temperature cycle between Bonaire and Guadeloupe, but by using other monthly resolved coral data from regions influenced or not by well-marked oceanographic parameters.

2. With regards to specific issue 2), referee#1 proposed to look at other source of salinity data. Such as the local salinity data kept by IRD and the group led by Thierry Delcroix. As suggested by referee #1 we extracted the volunteer observing ship salinity

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data and will include them in the revised version of figure 10. These new data support the idea that no consensus exist on the real annual salinity cycle at Bonaire (cf. section 5.2, line 1-3, page 3916). It might not be so relevant here to look at salinity data from Cariaco Basin because this is a fairly remote location that is affected by very local effects such as the upwelling that appears synoptic for the open-ocean island of Bonaire (see above). So we decide not to include any salinity data from Cariaco in the manuscript.

3. Referee #1 is right saying that Subtropical Underwater is often high salinity with different  $\delta^{18}\text{O}$  value (relatively higher) and a  $\delta^{18}\text{O}$  -SSS relationship that is more indicative of the sub-tropics (steeper slope). However, as we argued above, such high  $\delta^{18}\text{O}$  water is brought during synoptic events. So, it is not recorded in the monthly-resolved coral records.

5. Page 3923, lines 17-18: it was meant that the atmosphere plays an important role and is not the only factor influencing inter- to multidecadal variability. So the sentence will be changed accordingly.

6. Really minor typos will be corrected in the revised version.

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