Clim. Past Discuss., 9, C3001–C3004, 2013
www.clim-past-discuss.net/9/C3001/2013/

Interactive comment on "Terrigenous input off northern South America driven by changes in Amazonian climate and the North Brazil Current retroflection during the last 250 ka" *by* A. Govin et al.

P. Baker (Referee)

pbaker@duke.edu

Received and published: 29 December 2013

General comments

Using a three-core, south-to-north transect of marine sediments as their archive and a detailed analysis of XRF-derived elemental chemistry as their proxy, Govin et al. undertake an orbitally resolved ca. 250 kyr reconstruction of Andes/Amazon and Amazon/Orinoco sedimentary provenance. Theirs is an innovative approach, thoughtfully and carefully undertaken. How well they succeed is a matter of debate. So too is their

climatic and oceanographic interpretation of the reconstruction. In any case, the paper is a creative and useful approach that should help to refine the paleoclimate history of tropical South America (TSA).

The only archives of TSA paleoclimate that extend significantly beyond the last glacial are the lacustrine sedimentary record of Lake Titicaca (LT), the pollen records of Sabana de Bogota, and a few speleothem records from the western Amazon/tropical Andes. Baker et al (2001) contended from LT piston core records that both orbital (austral summer insolation) and millennial (north-south Atlantic SST gradient) forcing controlled precipitation variation in the south tropical Andes. LT drill core records (Fritz et al. 2007 and 2010) supported both inferences and extended the record back to nearly 400 Ka. The same inferences have also been largely supported by many well dated and wonderful speleothem records that followed. The LT drill core record also showed that the largest change in water balance (i.e. lake level) occurred on glacial-interglacial (ca. 100 kyr) timescales, thus demonstrating the likely role of global temperature in controlling local water balance.

Offshore, the marine sediment record (von Arz et al., 1998) was paramount in demonstrating the one-to-one correlation between Heinrich events and increased terrigenous input (likely due to increased precipitation) in the northeastern region of Brazil. Combined with LT, the clear implication is that millennial North Atlantic cold events brought about increased precipitation across the entire southern tropics of SA. Cruz et al (2009) on the basis of speleothem records from northeastern Brazil posited that precipitation in the eastern and western tropics of SA was anti-phased on precessional timescales. This was a fundamental and surprising observation and is clearly relevant to the interpretation of relative Andes vs. Amazon sediment provenance on orbital timescales.

Four of these five foundational references were not cited in the original version of the present article.

Innovative approaches to science often cause us to forget foundational approaches and papers (for sure, I am equally guilty of this). Speleologists often overlook prior work on lacustrine sediments and very often early papers on geomorphology or pollen are overlooked by those who follow.

Likewise it seems that seductive technological advances, such as scanning XRF, cause us to neglect more classical, tedious, yet powerful approaches. In the present case, mineralogical analysis by heavy mineral separation or powder X-ray diffractometry could have greatly advanced any conclusions regarding sediment provenance and paleoclimate based solely upon the bulk chemistry. Perhaps the authors will undertake such studies in the future to bolster their claims and to demonstrate the correlation between cation chemistry and mineralogy.

Specific comments

In every core analyzed, the variations that they reconstruct in end-member proportions (e.g., %Andes, %Amazon, %Orinoco, %marine; see Figure 5) are surprisingly small. Values of %Andes in their time series from 5N and 9N are always ca. 70+/-5%. If the Cruz et al (2009) antiphasing is present throughout the entire record, then I would expect that Andes/Amazon ratios should also change strongly with precessional pacing. However, the only proportion that changes more than a few percent is the marine sediment end member; this has much higher values during periods of high sea level, which also tend to be periods of much lower sedimentation rate (Figure 3). In fact, combining the variations of total sedimentation rates (Fig. 3) and %marine (Fig. 5), there appears to be about a 7X increase of Amazon-derived sediment flux during glacial versus interglacial periods in both cores. Why the variations of %Andes are so small despite the large change of Amazon sediment flux, is a big conundrum. Also, if these reconstructions are correct then time series from both cores (5N and 9N) should be identical, yet this is not the case (Figures 6C and 6D), a discrepancy that is not sufficiently explained.

In the tropical Andes (Lake Titicaca sediment record, e.g., Fritz et al., 2007), glacial-age sedimentation rates are many times higher than interglacial rates and sediment

compositions are also totally different. This is likely due to increased erosion rates by greatly expanded glaciers of the high Andes. I would expect to see a much higher ratio of Andes/Amazon sediment during glacial times, yet this is not reconstructed in the present study nor is the possibility discussed.

Two assumptions made in the end member analysis (p. 5863) deserve further consideration. Although calcite dissolution may not be an important factor, can the same be said for pteropod dissolution? Also, is it true that Si (diatom) productivity rates are “very small” despite large changes in Amazon sediment flux and the known influence of Amazon outflow on modern diatom productivity?

Interactive comment on Clim. Past Discuss., 9, 5855, 2013.