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Climate of the Past Discussions

Interactive comment on "Variability in terrigenous sediment supply offshore of the Rio de la Plata (Uruguay) recording the continental climatic history over the past 1200 years" *by* L. Perez et al.

Anonymous Referee #2

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In this review of the manuscript entitled "Variability in terrigenous sediment supply offshore of the Rio de la Plata (Uruguay) recording the continental climatic history over the past 1200 years" by Perez et al. I will first make some general comments and then show a list of specific comments/technical corrections.

General comments

The extremely high-temporal resolution records of the Río de la Plata discharge presented by Perez et al. are impressive and could constitute a major step towards a more comprehensive understanding of the environmental changes that happened in the Río de la Plata drainage basin and the siliciclastic sedimentary input to the SE

South American continental margin during ca. the last millennium. Still, at its present stage, a number of issues need to be addressed in order for the manuscript to reach its full potential, as listed below. Many of these issues are major issues with possible implications to the conclusions of the manuscript.

1. The authors claim that during the Little Ice Age, El Niño-like conditions may have helped to bring the Río de la Plata plume further north. However, Piola et al. (2005. Geophysical Research Letters) and Piola et al. (2008. Continental Shelf Research) showed that despite the increased precipitation over SE South America, during El Niño conditions the Río de la Plata plume is directed offshore. Under El Niño conditions, anomalously strong NE winds prevent an along-shore northeastward spreading of the Río de la Plata plume and force the high-nutrient fluvial waters offshore. This has not only been characterized for the instrumental record, but also for the paleo record (Voigt et al., 2013. Marine Geology). It is noteworthy that both manuscripts (i.e., Voigt et al. (2013. Marine Geology) and Perez et al. (under review for Climate of the Past)) have a common author but the mechanisms used to explain the dispersal of the Río de la Plata plume are significantly different. An in-depth re-evaluation of the behavior of the Río de la Plata plume under El Niño conditions is necessary, and bears possible major implications for the conclusions of this manuscript.

2. The disagreement between element ratios and diatom groups described for the Current Warm Period (e.g., increase in Ti/Ca and Fe/K, and decrease in freshwater diatom group) deserve significant more attention from the authors. A single short paragraph (i.e., page 13, lines 1-15) is dedicated to the topic. The authors claim that industrial activities have increased the content of some heavy metals but it is not clear in the text if this is also the reason for the increase in the elemental ratios. Moreover, the high natural Fe content of the sediments delivered by the Río de la Plata (Burone et al., 2013. Continental Shelf Research; Razik et al., 2015. Marine Geology) raises the question to what extent industrial activities could affect the used element ratios. Also, the authors claim that other anthropic activities (e.g., river damming, deforestation) modified

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the Río de la Plata drainage basin, but it remains elusive if, how much, and to what direction those changes affected sediment and water discharge of the Río de la Plata. Note that processes like river damming and deforestation may have opposite effects on the total suspended sediment load of a certain river (e.g., Syvitski and Milliman, 2007. The Journal of Geology). Additionally, another key element has to be taken into consideration in this discussion, namely the marked increase in precipitation over SE South America during most of the last century (e.g., Liebmann et al., 2004. Journal of Climate; Barros et al. 2008. Theoretetical and Applied Climatology). I would urge to authors to perform an in-depth re-evaluation of their data, the possible mechanisms that explain the data, and the conclusions that can be drawn out of them.

3. Throughout the manuscript, the Intertropical Convergence Zone is inappropriately mentioned as directly related to the Río de la Plata plume (both for water discharge/precipitation, and transport of the plume) (e.g., page 2, lines 21-27; page 3, lines 16-26; page 11, lines 12-19; page 12, lines 11-16; page 13, lines 19-25). The wind patterns that control the northward/southward penetration of the Río de la Plata plume are only indirectly related to the Intertropical Convergence Zone. Note that none of the references cited by the authors in page 3, lines 16-26, for instance (i.e., Guerrero et al., 1997. Continental Shelf Research; Camilloni, 2005. In: El Cambio Climático en el Río de la Plata; Möller et al., 2008. Continental Shelf Research; Piola et al., 2008. Continental Shelf Research) even mention the Intertropical Convergence Zone as an element controlling the freshwater plume. Also, precipitation over the Río de la Plata drainage basin (and the integrated basin discharge) is only indirectly related to the Intertropical Convergence Zone, whereas the South Atlantic Convergence Zone plays a direct influence (e.g., Carvalho et al., 2004. Journal of Climate). Still, the South Atlantic Convergence Zone is not mentioned throughout the text, and should be discussed. Note that this may affect the conclusions of the authors. I would urge the authors to consider the role of the South Atlantic Convergence Zone and other southern hemisphere atmospheric elements.

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4. This manuscript is based on element ratios and diatom groups analyzed in a well dated high temporal resolution marine sediment core. The diatom data (and most probably the age model) has apparently been published previously (page 5, line 24) (Perez et al., in press. In: Applications of Paleoenvironmental Techniques in Estuarine Studies). However, the similarity of that previous publication to the present one is impossible to evaluate since Perez et al. (in press. In: Applications of Paleoenvironmental Techniques in Estuarine Studies) is not yet available. From section 5.2, it seems that there is at least some degree of overlapping between both manuscripts. This is a critical issue that needs to be addressed by the authors. The novel aspects of both contributions should be clearly stated and able to be evaluated by the reviewers. So far, this seems not to be the case.

5. In section 3.2.1 Runoff-indicative element ratios, the authors mention that Fe/K and Ti/Al area are proxies for fluvial vs, eolian input. However, in a site strongly affected by fluvial discharge of the second largest drainage basin in South America (e.g., Lantzsch et al., 2014. Quaternary Research) and relatively far from the area affected by the major South American dust plume (e.g., Mahowald et al., 2006. Journal of Geophysical Research) this interpretation is doubtful. Instead, relatively small changes in source region within the Río de la Plata may have produced similar features. I would urge the authors to consider how changes in sediment source within the Río de la Plata basin would affect their proxy. In section 5.2 Paleo-environmental proxy records, the authors claim that Ti/Al in their study is a proxy for grain-size distribution. Still, no grains-size data is presented.

6. 210Pb analyses on the uppermost section of the marine sediment core analyzed here would be necessary if the authors want to make any inference on the Current Warm Period. As the age model stands now, there is no age constrain for the Current Warm Period. The closest age constrain is a 14C age of 1688 yr AD. This is not appropriate for the evaluation of the Current Warm Period. I suggest to either provide a more accurate age constrain for that portion of the record, if the discussion and

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conclusions are to include the Current Warm Period.

Specific comments / Technical corrections

Page 2, line 10: “m” should not be italicized. Page 2, lines 14-15: “terrigenous water” reads awkward, please rephrase. Page 2, line 15: The terms “and sediment discharge” may have to be deleted if the “freshwater” diatoms developed in situ. See my comment above. Page 2, line 18-19: Delete “such regional and global climatic episodes as”. Page 2, lines 21-27: There is confusion on the role of the Intertropical Convergence Zone and the South Atlantic Convergence Zone on controlling rainfall over the Río de la Plata drainage basin (the transport of the Río de la Plata plume). It is rather the South Atlantic Convergence Zone that exerts a great influence on precipitation over the Río de la Plata drainage basin (e.g., Carvalho et al., 2004. Journal of Climate) (and regional winds that exert a great influence on the transport of the Río de la Plata plume (e.g., Möller et al., 2008. Continental Shelf Research)). Yet, the South Atlantic Convergence Zone (regional winds) is not cited in the text. Please, review the text accordingly. Page 2, line 22: Be more precise. Only Fe/Ca and Ti/CA are “indicative of a lower terrigenous input”. Page 2, line 25: Delete “state”. Page 2, lines 24-27: The relationship between El Niño events and the behavior of the Río de la Plata plume needs in-depth re-evaluation. See my comment above. Page 3, lines 1-4: Be more specific. Neither here nor in page 13, lines 1-15, the disagreement between the element ratios and diatom groups is appropriately assessed. See my comment above. Page 3, lines 16-26: As mentioned above, the wind patterns that control the northward/southward penetration of the Río de la Plata plume are only indirectly related to the Intertropical Convergence Zone. Note that none of the references cited by the authors (i.e., Guerrero et al., 1997. Continental Shelf Research; Camilloni, 2005. In: El Cambio Climático en el Río de la Plata; Möller et al., 2008. Continental Shelf Research; Piola et al., 2008. Continental Shelf Research) even mention the Intertropical Convergence Zone as an element controlling the freshwater plume. Also, precipitation over the Río de la Plata drainage basin is only indirectly related to the Intertropical Con-

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vergence Zone, whereas the South Atlantic Convergence Zone plays a direct influence (e.g., Carvalho et al., 2004. Journal of Climate). Still, the South Atlantic Convergence Zone is not mentioned in the text, and should be included. Page 4, lines 7-12: It is relevant to add that under El Niño conditions the Río de la Plata plume is directed rather offshore/southwards (Piola et al., 2005. Geophysical Research Letters; Piola et al., 2008. Continental Shelf Research). Page 4, lines 19-24: Discussing Vuille et al. (2012. Climate of the Past) here is of great relevance, since the authors provide well-dated, extremely high-temporal resolution data with a clear paleo-environmental significance. Moreover, the new record (i.e., Cristal cave) presented by Vuille et al. (2012. Climate of the Past) is virtually placed within the Río de la Plata drainage basin and shows increased precipitation during the Little Ice Age. A critical discussion of the results of del Puerto et al. (2013. Quaternary International) in face of Vuille et al. (2012. Climate of the Past) is necessary. Page 5, line 4: The characterization of the study area needs more information. By not addressing in this section the atmospheric circulation over the Río de la Plata drainage basin and the oceanic circulation offshore northern Argentina and Uruguay, the authors leave the reader with extremely few elements to contextualize their own study. In a journal like Climate of the Past, a more comprehensive characterization of the study area is possible. I would urge to authors to include a systematic and critically prepared overview of the main aspects controlling modern atmospheric and oceanic circulation in the study area. Page 5, line 24: The diatom data has apparently been published previously (Perez et al., in press. In: Applications of Paleoenvironmental Techniques in Estuarine Studies). The similarity of that previous publication to the present one is impossible to evaluate since Perez et al. (in press. In: Applications of Paleoenvironmental Techniques in Estuarine Studies) is not yet available. See my comment above. Page 6, line 2. Which species were used? Are they infaunal or epifaunal? If infaunal, please evaluate the need for applying a DR. Page 7, line 3: It has been shown (e.g., Weltje and Tjallingii, 2008. Earth and Planetary Science Letters) that the use of log ratios of element intensities are more appropriate that simple ratios. Please, use log ratios instead of normal ratios. Note that some

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features of the records may change significantly potentially affecting the conclusions of this manuscript. Page 6, lines 8-10: The authors mention that Fe/K and Ti/Al in their study area are proxies for fluvial vs, eolian input. Instead, relatively small changes in source region within the Río de la Plata may have produced similar features. I would urge the authors to consider how changes in sediment source within the Río de la Plata basin would affect their proxy. Moreover, the reference "Garvin et al. (2012)" is not listed in References. See my comment above. Page 8, lines 6-11: Has tis already been published in Perez et al. (in press. In: Applications of Paleoenvironmental Techniques in Estuarine Studies)? If this is the case, cite that reference clearly stating that this is not new data. Page 8, lines 18-20: Please provide a thorough time-series analyses if the aim is to explore any cyclical behavior of the records. From page 8, line 24 until page 9, line 1: Give age model uncertainties, it is not appropriate to address specific years. Page 9, lines 3-6: No grain-size data is presented in Krastel et al. (2012. Report and preliminary results of RV METEOR Cruise M78/3). Please delete this sentence and any related discussion/conclusion or show the grain-size data (e.g., page 12, lines 6-10). Page 9, line 17: Since most of my comments to this section are "General comments" please find them above. Page 10, lines 16-18: Why should there be "less energetic hydrodynamic conditions between the Medieval Climate Anomaly and the Little Ice Age"? Please provide thorough rationale. Page 11, lines 10-11: The northernmost record evaluated by Moy et al. (2009. Past Climate Variability in South America and Surrounding Regions) is located to the south of 40oS, and this citation is inappropriately placed here. Page 12, lines 16-23: The authors need to consider that a strengthening of the westerlies and stronger El Niño conditions would produce opposing effects over the transport of the Río de la Plata plume (e.g., Piola et al., 2005. Geophysical Research Letters; Piola et al., 2008. Continental Shelf Research). Please consider this opposing effects in the discussion. Page 13, lines 11-15: The "freshwater" diatoms found on core GeoB13813-4 developed in situ or were transported? The authors suggest in a rather indirect way that they are transported. This point needs further clarification since the interpretation of the record may change significantly in

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the occurrence of the one or the other phenomenon. Table 1: 210Pb analyses on the uppermost section of the marine sediment core analyzed here would be ideal given the high sedimentation rate of the core. Also, the discussion and conclusions from the Current Warm Period would have been significantly better constrained with an 210Pb-based age model for the uppermost section of the core. As the age model stands now, there is no age constrain for the Current Warm Period. The closest age constrain is a 14C age of 1688 yr AD. This is not appropriate for the evaluation of the Current Warm Period. See my comment above. Also, please state if this data has been previously published in Perez et al. (in press. In: Applications of Paleoenvironmental Techniques in Estuarine Studies). In Lantzsch et al. (2014. Quaternary Research) a 14C age of 1600 +/- 30 yr has been reported for a sample collected at 964 cm core depth (with lab identification of Poz-42431). The similarity to the deepest dated sample shown in the present manuscript, I wonder if they are the same sample. More on this would be enlightening. Figure 1: What does the stars at the right-hand margin of panel c means? Are they representing the 14C ages? If so, why the values do not agree with either the raw 14C ages nor the calibrated ages? Also, indicate this on the figure caption, as well as all other symbols used. Figure 3: Which reference was used to place the vertical grey bars? Cite Perez et al. (in press. In: Applications of Paleoenvironmental Techniques in Estuarine Studies) for the diatom groups. Figure 4: The 2 mm XRF data presented here is virtually not explored in the text. I would urge the authors to make full use of this precious dataset.

Interactive comment on Clim. Past Discuss., 11, 1343, 2015.