Waelbroeck et al. have measured Ti/Ca and Pa/Th in a core taken on the margin of northern Brazil, which records rainfall on the nearby continental area and the strength of the Atlantic meridional overturning circulation at intermediate depths. Since the two measurements are done on the same core, they are able to determine the phase relationship between the two variables with minimum uncertainty, which gives them new insights into the response of the ITCZ to changes in the AMOC. They use wavelet analysis to determine phase lags at different frequencies and show that ITCZ movement lags changes in AMOC both at the D/O and HE frequency, but more so at the HE frequency. They attribute this difference to a positive feedback between the strength of the AMOC, seawater temperature and iceberg discharge, which they had first proposed in an earlier publication. The authors pay due attention to the possible impact of bioturbation on the phase relationship between Ti/Ca and Pa/Th, which they convincingly rule out, and to multiple caveats in the interpretation of Pa/Th in term of circulation changes. The paper is clearly written and provides important new findings. I recommend publication after considering the relatively minor comments below (note, however, that I am unable to provide knowledgeable comments on the technicalities of wavelet analysis).

While the authors have clearly established the lag between Ti/Ca and Pa/Th, their ultimate goal is to establish the lag in the response of the ITCZ to changes in AMOC. I think the authors should also discuss the extent to which there might be lags between processes and proxies. For instance, would a change in AMOC translate instantaneously into a change in Pa/Th in their core? I think this is unlikely. Pa/Th recorded in sediments is controlled by the ratio between lateral transport by circulation and vertical transport by scavenging of the Th and Pa produced in the water column. Even if seawater were flowing from the north Atlantic to the Brazilian margin through a pipe (i.e. changes in deep water formation would translate into an instantaneous change in lateral velocity in the pipe), there should still be a lag between sediment Pa/Th and changes in AMOC, depending on the response time of dissolved Th and Pa in the water column overlying the coring site. While the response time of Th is decadal, the full expression on circulation changes on Pa may take several centuries. In addition, the “pipe” is of course an unrealistic cartoon of the AMOC. In reality, I would expect an additional lag between lateral velocity at the coring site and changes in deep water formation, but at this point this is just intuitive and it is well beyond me to guess how long or how short this lag would be. Nonetheless, I think the authors could bring this up and indicate that the lag between Ti/Ca and Pa/Th should be taken as a minimum of the lag of the response of the ITCZ to changes in AMOC. There might also be a lag between Ti/Ca and the change in the seasonal latitudinal range of position of the ITCZ depending on the location of the region supplying lithogenics to the coring site. For instance, if the region is farther south from the southernmost zone of precipitation before the change in AMOC, it may take more time for the ITCZ to reach this region.

While the authors have taken into account how changes in scavenging could obscure the interpretation of Pa/Th in terms of circulation, I think it would also be worth mentioning that interpreting changes in circulation from a single core can also be problematic. While it is correct that higher rate of AMOC should result in a lower sediment Pa/Th when averaged over an entire ocean basin, that may not be correct for any core. Depending on the proximity of the coring location to the site of deep water formation, decreasing the AMOC may actually decrease sediment Pa/Th (e.g. Luo et al., 2010; Fig. 14). I

would suggest specifying that we would expect to see an increase in Pa/Th with decreasing rate of AMOC at the coring site of this study because it is sufficiently removed from the site of deep water formation.

Accordingly, I would change the wording on line 4-5 p5: "[*when average over an entire ocean basin*], high (low) flow rates therefore result in high (low) Pa export…"

Line 26, p7: shorter stadial may have lower increase in Pa/Th because they were too short to allow the full expression of the increase in Pa/Th (limited by the response time of Pa in the water column).

Line 10, p8: (including Pa/Th values susceptible to be partially impacted by large particles flux [*or boundary scavenging resulting from slower AMOC*])

Line 24, p12: Why not use Th-normalized Ti instead of Ti/Ca to totally eliminate the effect of changes in carbonate dissolution/production?

Line 8; p13: Briefly describe what the "independent approach" is.