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Abrupt drying events in the Caribbean related to large Laurentide meltwater pulses during the glacial-to-Holocene transition

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At the end of the last deglaciation North Atlantic meltwater pulses from the retreating Laurentide ice sheet triggered a chain of oceanic and atmospheric responses including temporary slow-down of the thermohaline circulation and hemispheric-scale alterations of the atmospheric circulation. The 8.2 ka event (occurring about 8.2 ka BP) is the most pronounced meltwater pulse during the Holocene and serves as an analogue to understand how North Atlantic fresh water influxes can affect the ocean-atmosphere coupled system on a basin, hemispheric or global scale. This event left strong regional climate imprints, such as abrupt cooling reconstructed over the North Atlantic and Europe lasting 100 to 150 years and drying in the northern hemispheric tropics. However, there is a lack of high resolution proxies to learn about the event's temporal structure especially in the tropics.

We present geochemical evidence from a stalagmite indicating sudden climate fluctuations towards drier conditions in the northeastern Caribbean possibly related to rapid cooling in the high northern latitudes and a southward shift of the Inter-Tropical Convergence Zone (ITCZ). Stalagmite PR-PA-1 was collected in Palco cave, Puerto Rico, and it is a remarkable record of the 8.2 ka event because 15 MC-ICPMS ^{230}Th/U-dates produce a precise chronology of its Holocene period growing solely between 9.0 ka BP to 7.5 ka BP. Based on 240 trace element and stable isotope ratio measurement we reconstructed hydrological changes with sub-decadal resolution. Our proxy data show large and rapid climate variations before 8.0 ka. Pronounced peaks in the Mg/Ca and δ^{13}C records indicate three major events of abrupt drying. These fluctuations towards drier conditions took place in less than 10 years and the climate remained drier than the natural range for 10 to 20 years, before it returned to pre-fluctuation conditions again. Our observations confirm previous studies suggesting that repeated meltwater pulses affected the thermohaline circulation leading to the temporal and spatial extension of the 8.2 ka event. Moreover, based on our results we hypothesize that three large meltwater pulses decreased the thermohaline circulation, cooled the North Atlantic region and pushed the region of ITCZ influence further southward leading to decreased rainfall in the northeastern Caribbean.