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Early to Late Pliocene climate change in the mid-latitude North Atlantic

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The early Pliocene, with atmospheric CO_2 concentrations at levels similar to today, is seen as a case study for Earth's future climate evolution. During this period the progressive closing of the Central American Seaway led to increased poleward heat and salt transport within the Atlantic with North Atlantic Deep Water (NADW) becoming warmer and saltier and resulting in an enhanced Atlantic Meridional Overturning Circulation (AMOC). In order to evaluate how stable the Pliocene AMOC really was, we are producing surface and deep-water records for IODP Site U1313 (41°N, 33°W, 3412m) for the interval from 3.3 to 4.1 Ma. This site is ideally located to monitor past AMOC changes with North Atlantic Drift waters at the surface and NADW, exported by the deep western boundary current, in the deep. Surface water conditions are reconstructed based on the stable isotope data of planktonic foraminifer species *Globigerinoides ruber* (white) or *Globigerinoides extremus* with centennial-scale resolution and on sea-surface temperatures ($U^k_{37'}$ alkenone thermometer) with an average 4 ky resolution. Stable isotope records of the benthic foraminifer genus *Cibicidoides* reveal changes in the deep water.

Besides the interglacial/glacial cycles, higher frequency oscillations are recorded in both the planktonic and benthic foraminifer stable isotope records. Varying surface water conditions, especially during Late Pliocene interglacial periods, are reflected in the *Globigerinoides* isotope data and appear to be linked to salinity changes since they are not recorded in the sea-surface temperature data. The high-frequency oscillations in the planktonic isotope records are related to precession (insolation) forcing, especially its harmonics in the 5.5 ky and 11 ky ranges. The benthic $\delta^{13}C$ values indicate nearly continuous NADW presence and confirm a strong AMOC throughout the studied interval, also during most of the glacial periods. Excluding the pronounced M2 glacial, glacial stage Gi 6 had a stronger impact on the AMOC, as revealed by cooler, less ventilated surface waters and a less ventilated NADW, than Gi 2 and Gi 4. Overall, the AMOC was strong

throughout, but experienced high frequency oscillations at a level similar to the middle Pleistocene interglacial periods.