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Centennial and seasonal climate variability during the last 4000 years in the Gulf of Taranto, Southern Italy

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Holocene, millennial-scale climate oscillations as the medieval warm period (MWP) and the little ice age (LIA) have been related to changes in the North Atlantic oscillation (NAO) during the winter season. Differences in trends and patterns during these worldwide events in the northern hemispere have been explained by the seesaw in atmospheric masses which forms the basis of the NAO-index. During periods with a dominant positive NAO state, the westerlies will bring relatively more moisture and warm air to northern Europe, while southern Europe stays relatively dry. Although knowledge of millennial scale climate oscillations is increasing, comprehensive studies on climate behaviour for centennial time scales are still relatively scarce. Hence, a high resolution multi-proxy approach in a climate sensitive area, as the Mediterranean (influenced by both high and low latitude climate systems) will permit to unravel patterns in seasonality and short time scale climate variability. Here we use such a multi proxy approach on a high resolution record ($\sim$12 yr/cm) of the last 4000 years from the Gulf of Taranto, Southern Italy. The record covers i.e. the Bronze Age (a cold period in the Mediterranean), the Roman warm period, the MWP and the LIA. Previous provenance studies in the area have shown that sediments originating from southern and northern Italy can be distinguished using geochemical parameters, thus permitting us to study changes in the NAO seesaw. Besides grain size and bulk geochemistry analysis of the sediments, temperature and salinity are reconstructed by using δ18O, δ13C, Mg/Ca and the novel proxy Na/Ca of both the planktonic foraminifera Globigerinoides ruber and the benthic specie Hyalinea balthica. The latter has a test rich in Mg/Ca and has been proven to be extremely sensitive to small temperature changes, making it an excellent recorder of small variability in temperature as observed during the Holocene (Rosenthal et al,,2011). Furthermore, from selected samples single specs of G.ruber are analysed to unravel seasonality during these periods. In contrast to signals from G. ruber which are believed to be mainly dominated by summer conditions, variability in the geochemistry of the test of H. balthica can be related to variability in the winter/autumn season. Centennial scale climate variability comparable to frequencies found in total solar irradiation ($\sim$350 yr cycles) can be found in all proxies. It appears that variability on millennial time scales are controlled by different climate phenomena (e.g. NAO, Bora and ITCZ) than the centennial scale variability. Furthermore, these centennial scale climate oscillations are less expressed during the earlier part of our record, possibly related to dominant processes on a millennial time scale. In addition changes in river run-off can be related to times of political turmoil in Italy and the eastern Mediterranean area.