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Eastern Mediterranean climate reconstruction over the last 12,000 yrs based on a non-continuous varve sediment record from Vouliagmeni lake, Gulf of Corinth (Greece)

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Understanding the mechanisms that formed past climatic and environmental changes is essential in order to produce models of future climatic trends. Climatically highly sensitive areas like the Eastern Mediterranean are characterized as key sites for those studies and can imprint regional and large-scale atmospheric patterns as well as the impact of those changes into early human societies. Still, the distinction between regional and global climatic signals is challenging, due to variations between chronological control and environmental factors occurring in each study site. Annually laminated sediments assist to that problem since they can provide information on temperature fluctuations, precipitation, volcanism, solar activity etc, up to seasonal scale through coherent varve chronology. In this study, we present a multi-proxy climate reconstruction of eastern Mediterranean over the last 12000 years, based on a non-continuous varved sediment core from Vouliagmeni lake, located in the eastern part of Gulf of Corinth, Greece. The compiled dataset consists of: (a) grain size analysis and magnetic susceptibility measurements, (b) high-resolution X-ray fluorescence data, (c) mineralogical analysis, (d) Computed Tomography (CT) and μCT analysis (e) AMS radiocarbon dating correlated with varve counting, (f) isotopic composition ($\delta^{18}O$, $\delta^{13}C$) on selected samples and (g) diatom analysis. For the determination of lamination boundaries and thickness, standard Computed Tomography was conducted with the highest possible resolution (0.3 mm) and combined with μCT results from selected sections from the core. Sedimentological changes were also documented through the 2D Haunsfield model that was constructed for the core and further correlated with the other studied proxies. The chronological framework of the core was established at 12,500 cal BP through a combination of Bayesian age-depth modelling and varve counting. Accumulation rates change drastically at around 3000 cal BP at the approximate time of extensive urban growth in the study area, as indicated from historical reports. Different precipitation/temperature and runoff patterns for the catchment area were recognized, through the different proxies examined, providing signals of long scale and regional climatic anomalies. The covariation of $\delta^{13}C_{carb}$ and $\delta^{18}O$ characterizes the lake system as evaporatively dominant, whereas elemental ratios and isotopic data determine wet (1200-1800 cal BP, 2200-300 cal BP, 4500-4800 cal BP, 5800-6600 cal BP, 9500-10500 cal BP) and arid phases

(3000-3200 cal BP, 3800 cal BP, 7100 cal BP) that correspond also to changes in water level, stratification and the formation of laminations. Addressing the fact that laminated sediments in Eastern Mediterranean that extend in 12 ka years are scarce, Vouliagmeni lake seems to present a very promising geoarchive.