Hydroclimatic variations and human-ecosystem interactions in northwestern Iranian highlands during the Holocene (double paper)

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Northwestern Iran is a very heterogeneous geographic realm at the interface of several climatic and biogeographical zones. Such a heterogeneity and the consequent diversity of climates and ecosystems have definitely impacted the spatio-temporal patterns of human settlements and anthropogenic activities in this area and in the neighboring Caucasus and Eastern Anatolia. Here, we present high-resolution multi-proxy palaeoenvironmental records from three different geographical settings in northwestern Iran: 1) Lake Urmia (~1260 m), a large hypersaline lake with a huge catchment basin which can reflect hydrological and vegetation change in a regional scale. Lake Neor, a high altitude (~2500 m) freshwater hydrosystem with a moderate-sized catchment basin to show both local agro-sylvo-pastoral practices and local to regional hydroclimatic variations. And finally, Almalou lake, a high altitude (~2400 m) seasonally changing lake system with a very small catchment basin to reconstruct local agro-pastoral activities but regional hydroclimatic variations. Our records comprise both geochemical proxies (organic and inorganic) and biological indicators (pollen and insects). The cross-correlation of all proxy datasets indicate that: (i) not all the so-called socio-cultural crises of the Holocene are clearly reflected in the three records, (ii) not all proxies have the same sensitivity to the Holocene high-frequency climatic events (due to differential resolution, time-lag in response, etc.) and (iii) some rapid climatic events seem to be well recorded in palaeoclimatic records but not in the archaeological record. Proxy records from Neor and Urmia lakes both demonstrate all six major Holocene rapid climate change periods (HRCC), including 8.2 and 4.2 events. However, proxy records from Almalou only show two of the HRCC periods at 1200-1000 and 600-150 years B.P. More high-resolution records with the addition of new proxies and more specific question-based palaeoenvironmental records are needed to address some site-specific archaeological questions.