Droughts and tropical-induced rainfall in the East Mediterranean during warm periods

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Interglacials are characterized by relatively high temperatures, sea levels and greenhouse gases. In the East Mediterranean, these intervals were marked by dry conditions. However, changes in the spatial and temporal distribution of rainfall also occur. These are evident in the past, observed in the present and predicted for the future. The present climate in the East Mediterranean is highly variable and occasionally suffers from droughts. There is a strong meridional gradient in precipitation and evaporation and influence of both tropical and north hemisphere climates. The Dead Sea Deep Drilling Project (DSDDP) cores allow for the first time to reconstruct past climate during the warmest and driest periods in this region. We focus here on both the Holocene and Marine Isotope Stage (MIS) 5e intervals. These intervals are characterized by thick layers of halite, reflecting the driest periods over the past 200 ky. The fast sedimentation rate (several mm to several cm) allows identification of the climatic changes in high resolution along various orbital forcings. Based on the amount of salt and major elements in pore waters and fluid inclusions, the average runoff was 30-50% of the present runoff (pre-1964, before the diversion of the Jordan River) reaching 20% during the most arid intervals over decades to centuries. $^{234}U/^{238}U$ activity ratios, $^{87}Sr/^{86}Sr$ ratios and Pb isotopes in the primary minerals indicate drastic shifts in the lake's hydrology during the driest times. These changes (e.g., $^{234}U/^{238}U$ activity ratios decrease from ~1.5 to ~1.1) point to a shift toward tropical influence rather than the typical Mediterranean–North Atlantic influence. The U isotope budget, together with the calculated runoff, shows that at MIS 5e peak ~50% of the runoff came from the arid south, reaching three times the present amount. At the end of the extremely arid MIS 5e, 90% of the runoff was from the south. Combining the DSDDP record with CCSM3 climate model runs provides information on the temporal distribution of rainfall. The increase in precipitation in the south at 125 ky, is attributed to summer precipitation, while the extremely dry period at 120 ky is attributed to drying during winters, with an increase in precipitation in the south during the fall season.