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Increase in flood frequency during extreme aridity in the Eastern Mediterranean at the last interglacial

Yael Kiro (1), Steven L Goldstein (1), Yochanan Kushnir (1), Boaz Lazr (2), and Mordechai Stein (3)

(1) Lamont-Doherty Earth Observatory, Columbia University, Palisades, United States (ykiro@ldeo.columbia.edu), (2) Institute of Earth Sciences, the Hebrew University, Givat Ram, Jerusalem, 91904, Israel, (3) Geological Survey of Israel, 30 Malkhe Israel Street, Jerusalem 95501, Israel

The Levant region of the Eastern Mediterranean is expected to suffer greatly from climate change. It is a drought-sensitive area, where warming climate may have already affected political stability in the region. Climate models and observations show a recent drying trend around the entire Mediterranean during winter, the wet season, that has been attributed to a combination of natural variability and increased greenhouse gas concentrations. Together with the drying trend, the region has also experienced more intense rainfall events.

Thick halite sequences revealed by the Dead Sea Deep Drilling project (DSDDP) cores show that extremely arid conditions prevailed in the Levant during Marine Isotope Stage (MIS) 5e. This time interval was relatively warm and characterized by an average precipitation rate of ∼50% compared to the present (based on water and salt budgets). It also exhibited strong fluctuations between wet periods similar to the present-day lasting a few thousands of years, and dry periods with precipitation as low as 20% of the present-day over intervals lasting a few hundreds of years. At the same time, the climate was characterized by scarce but intense rainfall events in the southern Levant and increased flash flood frequency. The increase in precipitation in the south is indicated by changes in 234U/238U activity ratios in authigenic minerals in the cores, which is a good proxy for identifying changes in water sources.

The synoptic configuration, of overall increased aridity together with an increase in southern precipitation and flash floods, is known from the present climate but is less dominant than the normal conditions whereby winter precipitation is fed by a Mediterranean moisture source. Climate models suggest that an increase in both summer and winter precipitation occurred during the peak insolation at 125 ka, with both the Mediterranean and the tropics as possible moisture sources. At 120 ka, climate model runs using the NCAR CCM3, show a decrease in precipitation, which coincides with the thick sequence of halite in the DSDDP core. Despite the decrease in total annual precipitation, the 120 ka simulation shows an increase in autumn precipitation that seems to be the result of intensification of the African Monsoon. This autumn intensification coincides with a drift in the positive summer insolation anomaly toward the fall season, and highlights the significance of the orbital forcing of mid-latitude climate. These results have a direct relationship to modern climate and possibly its expected future changes. Today, a manifestation of the African Monsoon in the Levant is the active Red Sea Trough (RST), which is responsible for major flooding in the Levant and the Middle East during the autumn. Modern observations show that the current increase in aridity is associated with a decrease in the major Mediterranean source (the Cyprus Low) contributor to Levant precipitation and an increase in RST frequency.