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Increased frequency of debris flows during a regional late Holocene drought inferred from a Dead Sea sediment record

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Conclusive understanding of the relationship between extreme-flow-producing torrential rainstorms and the long-term climate trend is crucial for developing future scenarios and assessing of impacts of global and regional climate change. Here we present a unique record of late Holocene torrential rainstorms, which accumulate during a multi-century regional drought in the Eastern Mediterranean, providing evidence for changes in the synoptic atmospheric circulation pattern.
Shallow water sediment core DSEn from the Dead Sea provides a late Holocene record of debris flows, which are preserved in the shape of discrete graded layers in regularly laminated sediments. Present-day observations show that debris flows are induced by torrential rainstorms over the nearby steep western escarpments when precipitation exceeds 30 mm h-1 for the duration of one hour. Such rainstorms are associated with the Active Red Sea Trough synoptic atmospheric circulation pattern. We established a time series of torrential rainstorms for the time interval between 3.3 and 1.8 cal ka BP from core DSEn. Microfacies analysis revealed twenty-three discrete graded layers, which accumulate during a multi-century regional drought (3.0-2.4 cal ka BP). A higher frequency of debris flows and associated rainstorms during this drought indicates a shift in the synoptic atmospheric circulation pattern during the investigated period. We suggest that fewer passages of eastern Mediterranean cyclones caused the regional drought and thereby favored an increased frequency of the Active Red Sea Troughs in the Dead Sea basin resulting in more rainstorms during this drought. These inferences are confirmed by modern meteorological data from nearby gauging stations, which show an increased frequency of torrential rainstorms in drier climate regions. Considering the ongoing decrease in annual rainfall in the eastern Mediterranean our results offer valuable insights in linking torrential rainstorms and long-term climate trend and might serve as analogue for future scenarios.