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An assessment of the Dead Sea level change using remotely sensed data

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Remote Sensing (RS) and Geographic Information System (GIS) instruments have spread rapidly in recent years to manage natural resources and monitor environmental changes. Remote sensing has a vast range of applications; one of them is lakes monitoring. The Dead Sea (DS) is subjected to very strong evaporation processes, leading to a remarkable shrinkage of its water level. The DS is being dried out due to a negative balance in its hydrological cycle during the last five decades. This research aims to study the spatial changes in the DS throughout the previous 48 years. Change detection technique has been performed to detect this change over the research period (1972-2020). 73 Landsat imageries have been used from four digital sensors; Landsat 1-5 MSS C1 Level-1, Landsat 4-5 TM C1 Level-1, Land sat 7 ETM+ C1 Level-1, and Landsat 8 OLI-TIRS C1 Level. After following certain selection criteria , the number of studied images decreased. Furthermore, the Digital Surface Model of the Space Shuttle Radar Topography Mission and a bathymetric map of the Dead Sea were used. The collected satellite imageries were pre-processed and normalized using ENVI 5.3 software by converting the Digital Number (DN) to spectral radiance, the spectral radiance was converted to apparent reflectance, atmospheric effects were removed, and finally, the black gaps were removed. It was important to distinguish between the DS lake and the surrounding area in order to have accurate results, this was done by performing classification techniques. The digital terrain model of the DS was used in ArcGIS (3D) to reconstruct the elevation of the shore lines. This model generated equations to detect the water level, surface area, and water volume of the DS. The results were compared to the bathymetric data as well. The research shows that the DS water level declined 65 m (1.35 m/a) in the studied period. The surface area and the water volume declined by 363.56 km^2 (7.57 km^2/a) and 53.56 km^3 (1.11 km^3/a), respectively. The research also concluded that due to the bathymetry of the DS, the direction of this shrinkage is from the south to the north. We hypothesize that anthropogenic effects have contributed in the shrinkage of the DS more than the climate. The use of the DS water by both Israel and Jordan for industrial purposes is the main factor impacting the DS, another factor is the diversion of the Jordan and Yarmouk rivers. Our results also allow to give a prediction for the near future of the DS: the water level is expected to reach –445 m in 2050, while the surface area and the water volume is expected to be 455 km^2 and 142 km^3, respectively.