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Increasing warming of steadily shrinking Dead Sea surface water

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The Dead Sea has been drying up over the last four decades: the water level has dropped at the rate of approximately 1 m per year. The Dead Sea drying up is due to the lack of water inflow from the Jordan River and increasing evaporation. A positive feedback loop between the steady shrinking of the Dead Sea and positive sea surface temperature (SST) trends takes place in the Dead Sea (Kishcha et al., 2018). This positive feedback loop together with atmospheric warming causes the following processes: increasing evaporation; an accelerating decrease in Dead Sea water levels; and increasing warming of steadily shrinking Dead Sea surface water. Using observations from Moderate Resolution Imaging Spectroradiometer (MODIS), positive trends were detected in both daytime and nighttime Dead Sea surface temperature (SST) over the period of 2000 – 2016. These positive SST trends were observed in the absence of positive trends in surface solar radiation, measured by the Dead Sea buoy pyranometer. We also show that long-term changes in water mixing in the uppermost layer of the Dead Sea under strong winds could not explain the observed SST trends. Satellite-based SST measurements showed that maximal SST trends of over 0.8 degrees per decade were observed over the north-west and southern sides of the Dead Sea, where shrinking of the Dead Sea water area was pronounced. No noticeable SST trends were observed over the eastern side of the lake, where shrinking of the Dead Sea water area was insignificant. This finding demonstrates correspondence between the positive SST trends and the shrinking of the Dead Sea, indicating a causal link between them. There are two opposite processes taking place in the Dead Sea: sea surface warming and cooling. On the one hand, the positive feedback loop (between the steady shrinking of the Dead Sea and SST trends) and atmospheric warming lead to sea surface warming every year accompanied by a long-term increase in SST. On the other hand, the measured acceleration of the Dead Sea water-level drop suggests a long-term increase in Dead Sea evaporation accompanied by a long-term decrease in SST. During the period under investigation, the total result of these two opposite processes is the statistically significant positive sea surface temperature trends in both daytime (0.6 degrees per decade) and nighttime (0.4 degrees per decade), observed by the MODIS instrument. Our findings of the existence of a positive feedback loop between the positive SST trends and the shrinking of the Dead Sea imply the following significant point: any meteorological, hydrological or geophysical process causing the steady shrinking of the Dead Sea will contribute to positive trends in SST. Our results shed light on continuing hazards to the Dead Sea.

Reference:
Kishcha P., Pinker R., Gertman I., Starobinets B., Alpert P. (2018). Observations of positive sea surface temperature trends in the steadily shrinking Dead Sea. Nat. Hazards Earth Syst. Sci., 18, 3007-3018, https://doi.org/10.5194/nhess-18-3007-2018.