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Unexpected pronounced heating in the uppermost layer of the Dead Sea after a sharp drop in noon surface solar radiation

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A passage of frontal cloudiness accompanied by dust pollution over the Judean Mountains and the Dead Sea valley, which occurred on March 22, 2013, led to a sharp drop in noon solar radiation under weak winds (from 860 W m-2 to 50 W m-2). Solar radiation measurements showed that the transition from clear-sky to overcast conditions was sharper over the Dead Sea than over the Israel Mediterranean coast. The maximal rate of decrease in noon solar radiation at the Dead Sea almost doubled that near the Mediterranean coast (17 W m-2 min-1 vs. 10 W m-2 min-1). The temperature stratification was observed in the uppermost layer of the Dead Sea before the aforementioned drop in noon solar radiation. This temperature stratification was evidence that the weak winds were incapable of producing significant mixing in the Dead Sea. Buoy measurements showed that, unexpectedly, a sharp decrease in noon solar radiation caused pronounced heating in the uppermost layer of the Dead Sea. Evaporation from the Dead Sea surface leads to an increase in salinity in the surface layer. In the presence of significant solar radiation, this increased salinity in the surface layer did not lead to an increase in water density. The gravitational stability and temperature stratification in the uppermost layer were observed. By contrast, after the drop in solar radiation, the increased salinity in the surface layer led to an increase in water density and, consequently, to gravitational instability, because of higher density of surface seawater compared to the density in the layers below. The gravitational instability switched on a pronounced heating process in the 2-m uppermost layer of the Dead Sea. This temperature increase took place under weak winds, which were incapable of creating significant mechanical mixing in the Dead Sea. The heating of seawater in the 2-m uppermost layer was switched off later by the sharp influx of hot foehn winds up to 20 m/s from the lee side of the Judean Mts. into the Dead Sea. These winds led to significant mixing of the Dead Sea water to a depth of 14 m. The heat transfer to deeper layers down to 14 m occurred with a delay in time in each following layer: the time delay in the maximum temperature with increasing depth is clearly seen in the buoy data.