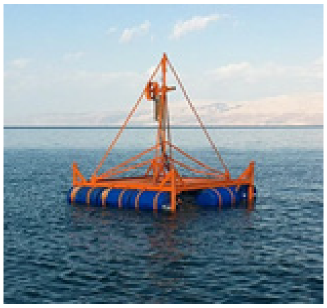
Geological Survey of Israel: EG-100 Dead Sea Buoy

MicroStrain sensor takes the wave action out of data.



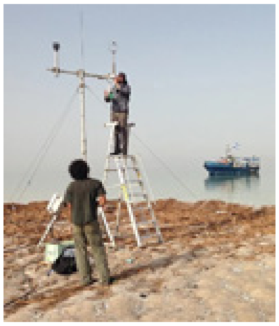
If you were a pilot preparing to land, you'd set your pressure altimeter to 31.45 inches of Mercury. That's 1065 millibars, and you would be 1412 feet (430.5 m) below global ocean levels, assuming you landed on the beach. The Dead Sea itself, with a depth of about 1,000 feet, is the deepest hypersaline lake in the world.

The Dead Sea Valley is not only the lowest elevation on land, it's a unique and very complex environment. The Jordan River is the only major water source for the Dead Sea, although there are some small perennial springs under and around it, forming pools and quicksand pits along the edges.   (watch where you land!)

In recent years, the level of the Dead Sea has been dropping, by about 1 meter per year.

Long favored as a health resort because of higher oxygen content in the atmosphere, and therapeutic powers of the waters, the receding lake level has resulted in sink holes around its banks. (To really be a 'sea', it would have to connect to the world's oceans. Despite its name, it doesn't; so it's a lake.)

The Geological Survey of Israel has been studying the Dead Sea since its founding in 1949. Nadav Lensky, its present director, observes that the valley of the Dead Sea is "a rare natural laboratory" for exploration by geologists and climatologists. The surrounding terrain can be quite rugged.



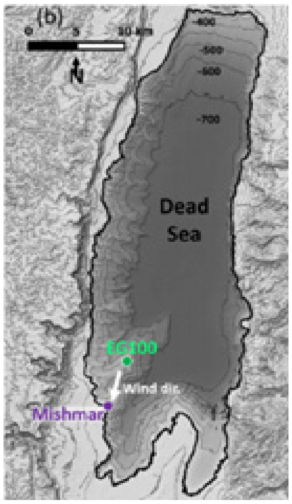
GSI, as it's known, has established two meteorological stations along the shores of the lake, along with one buoy mounted station, which is moored near the southern end, near Ein Gedi. Of particular interest to scientists is the rate of evaporation. This is studied using a technique called Eddy Covariance, which monitors the upward flow of air. Dr. Lensky points out, "eddy covariance is the most reliable technique for measuring evaporation over water bodies, and latent heat and momentum flux. In order to achieve a good measurement from offshore locations, buoys are the most practical means, but they rotate, oscillate, and translate, as they ride the waves. So the wind turbulence measurements are "contaminated" by platform motion. The MicroStrain instrument allows us to "decontaminate" the wind turbulance and calculate the eddy covariance fluxes of evaporation, sensible heat and momentum."

The challenge with measuring these vertical air movements on the EG-100 buoy lies with the 2-3' waves on the Dead Sea", Raanan Bodzin, GSI's lead technician, observed. "when your sensor is going up and down with the waves, the resulting air flows will be going up and down, as well. And that's where MicroStrain's 3DM-GX5-45 Inertial Navigation Sensor comes in. It allows us to remove the wave action."

The GX5-45 Sensor System includes GNSS satellite positioning, a magnetometer to identify North, a Gyroscope, an Accelerometer, and even an Altitude Pressure Sensor. Over a two-year period, this study has revealed an annual evaporation rate of over 1.1 meter per year.

MicroStrain Application note

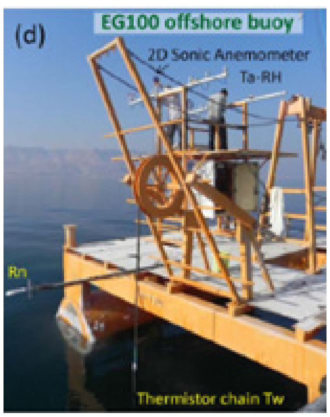
GSI is interested in the evaporation variations along the course of daily and seasonal cycles, as well as on spatial evaporation differences due to surface water salinity variations across the lake.



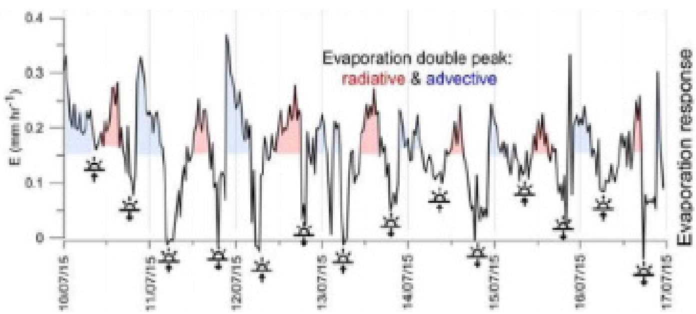
Evaporation is a major component of the water, heat, and salt budgets of lakes.

But it is the least known component, especially in hypersaline environments, and even more so in deep lakes. To directly measure evaporation and heat fluxes, GSI established two coastal stations and the offshore station on the buoy; all are equipped with eddy covariance towers and energy budget stations. The harsh environment of the Dead Sea required special adaptations of the instruments from the GSI team, such as development of automatic washing systems to keep lenses of the infrared gas analyzer clean in order to acquire long term, high quality data.

This state-of-the-art field observatory has not previously been applied to the Dead Sea.



Measurement data was correlated between the buoy and nearest land station, validating data from the Mishmar system. The data reflects a double-peak. The first peak occurs when surface water temperature peaks, around 3 hours after peak sun.



The second peak occurs at night, when the northerly wind is at its maximum velocity.

How salty IS the Dead Sea? Almost 10 times as salty as the oceans. Just look at this steel cable being pulled up for monthly salt deposition measurement. Imagine what that environment does to scientific instruments on the buoy!

MicroStrain thanks the Geological Survey of Israel, Dead Sea Observatory, Nadav Lensky (head), Raanan Bodzin, Ziv Mor and Roee Ezraty, for their assistance with this brief. More detail about GSI, and an extensive list of scientific publications can be found on their website.

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