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Air-Sea seasonal CO2 fluxes in a fast warming oligotrophic region – the Eastern Mediterranean case study

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In a recent study, it was suggested based on the apparent correlation between multi-annual measurements of summertime maxima and wintertime minima temperature and calculated pCO_2 in the most eastern region of the Mediterranean Sea surface waters that they are a net source of atmospheric CO_2. Furthermore, it was predicted that the magnitude of this source would increase substantially in this region and that adjacent regions in the Eastern Mediterranean as well would turn into net sources of atmospheric CO_2 due to the fast warming of these waters. In order to confirm the underlying assumption that seasonal variations in pCO_2 in Eastern Mediterranean surface waters are primarily a strong function of seasonal variations in temperature, water samples were collected for the analysis of total alkalinity and pH during 12 monthly cruises from February 2018 to January 2019 at the shallow (THEMO1) and the deep (THEMO2) open water stations that are ca.10 and 20 NM off the Mediterranean coast of Israel. The data from all the cruises show that surface (< 30m depth) seawater pCO_2 has a strong positive linear relationship with temperature in both stations (n=56, r^2=0.94, p<0.001). The calculated annual net flux of CO_2 from the surface to the atmosphere based on these measurements is ca.1.13 Tg C y^{-1}, which is ca.15% higher than the previously estimated flux, but within its range of uncertainty (± 30%). These results clearly demonstrate that surface water pCO_2 levels are indeed a strong positive function of the seasonal variations in sea-surface temperature and that the open water of the most eastern Mediterranean Sea is a net source of atmospheric CO_2. These results are also in agreement with the conclusions of observational and modelling studies of air-sea CO_2 fluxes in the centers of subtropical gyres and therefore globally relevant.