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Manuel Vargas-Yáñez, Francina Moya, **Rosa Balbín**, **Rocio Santiago**, Enrique Ballesteros,
Ricardo F. Sánchez-Leal, Patricia Romero, Ma Carmen García-Martínez, 2022.

**Seasonal and Long-Term Variability of the Mixed Layer Depth and its Influence on
Ocean Productivity in the Spanish Gulf of Cádiz and Mediterranean Sea.**

Front. Mar. Sci., 10 June 2022.Sec. Marine Fisheries, Aquaculture and Living
Resources.Volume 9 . <https://doi.org/10.3389/fmars.2022.901893>

Abstract:The warming of the surface ocean is expected to increase the stratification of the upper water column. This would decrease the efficiency of the wind-induced mixing, reducing the nutrient supply to the euphotic layer and the productivity of the oceans. Climatic projections show that the Mediterranean Sea will experience a strong warming and salting along the twenty first century. Nevertheless, very few works have found and quantified changes in the water column stratification of the Western Mediterranean. In this work, we obtain time series of Mixed Layer Depth (MLD) along the Spanish Mediterranean waters and the Gulf of Cádiz, using periodic CTD profiles collected under the umbrella of the Ocean Observing system of the Instituto Español de Oceanografía (IEO-CSIC). The length of the time series analyzed is variable, depending on the geographical area, but in some cases these time series extend from the beginning of the 1990s decade. Our results show that at present, no statistically significant changes can be detected. These results are confirmed by the analysis of MLD time series obtained from Argo profilers. Some of the meteorological factors that could affect the water column stratification (wind intensity and precipitation rates) did not experience significant changes for the 1990-2021 period, neither were observed long-term changes in the chlorophyll concentration. The hypothesis proposed to explain this lack of trends, is that the salinity increase of the surface waters has compensated for the warming, and consequently, the density of the upper layer of the Western Mediterranean (WMED) has remained constant. As the wind intensity has not experienced significant trends, the stratification of the Spanish Mediterranean waters and those of the Gulf of Cádiz would have not been affected. Nevertheless, we do not discard that our results are a consequence of the short length of the available time series and the large variance of the variables analyzed, evidencing the importance of the maintenance of the ocean monitoring programs.

Keywords:mixed layer depth,Western Mediterranean,climate change,ocean productivity,ocean

observing system.