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Seasonal cycle of the mixed layer depth, of the seasonal thermocline and of the upper-ocean heat rate in the Mediterranean Sea: an observational approach

Loïc Houpert (1), Pierre Testor (1), Xavier Durrieu de Madron (2), Samuel Somot (3), Fabrizio D'Ortenzio (4), Claude Estournel (5), and Héloïse Lavigne (4)

(1) LOCEAN-IPSL, Université Pierre et Marie Curie, CNRS, IRD, MNHN, 75252 Paris, France (houpertloic@gmail.com), (2) CEFREM, CNRS, Université de Perpignan Via Domitia, 52 Avenue Paul Alduy, 66860 Perpignan Cedex, France, (3) CNRM-GAME, Météo France, CNRS, 42 avenue Coriolis, 31057 Toulouse, France, (4) LOV, CNRS, Université Pierre et Marie Curie, Observatoire océanographique, 06234 Villefranche sur mer, France, (5) LA, CNRS, Université de Toulouse, 14 avenue Edouard Belin, 31400 Toulouse, France

We present a relatively high resolution Mediterranean climatology (0.5°x0.5°x12 months) of the seasonal thermocline based on a comprehensive collection of temperature profiles of the last 44 years (1969-2012). The database includes more than 190,000 profiles, merging CTD, XBT, profiling floats, and gliders observations. This data set is first used to describe the seasonal cycle of the mixed layer depth and of the seasonal thermocline and on the whole Mediterranean on a monthly climatological basis. Our analysis discriminates several regions with coherent behaviors, in particular the deep water formation sites, characterized by significant differences in the winter mixing intensity.

Heat Storage Rate (HSR) is calculated as the time rate of change of the heat content due to variations in the temperature integrated from the surface down to the base of the seasonal thermocline. Heat Entrainment Rate (HER) is calculated as the time rate of change of the heat content due to the deepening of thermocline base. We propose a new independent estimate of the seasonal cycle of the Net surface Heat Flux, calculated on average over the Mediterranean Sea for the 1979-2011 period, based only on in-situ observations. We used our new climatologies of HSR and of HER, combined to existing climatology of the horizontal heat flux at Gibraltar Strait. Although there is a good agreement between our estimation of NHF, from observations, with modeled NHF, some differences may be noticed during specific periods. A part of these differences may be explained by the high temporal and spatial variability of the Mixed Layer Depth and of the seasonal thermocline, responsible for very localized heat transfer in the ocean.