Dynamics of the Deep Chlorophyll Maximum in the Black Sea as depicted by BGC-Argo floats

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The deep chlorophyll maximum (DCM) is a well known feature of the global ocean. However, its description and the study of its formation are a challenge, especially in the peculiar environment that is the Black Sea. The retrieval of chlorophyll a (Chla) from fluorescence (Fluo) profiles recorded by biogeochemical-Argo (BGC-Argo) floats is not trivial in the Black Sea, due to the very high content of colored dissolved organic matter (CDOM) which contributes to the fluorescence signal and produces an apparent increase of the Chla concentration with depth.

Here, we revised Fluo correction protocols for the Black Sea context using co-located in-situ high-performance liquid chromatography (HPLC) and BGC-Argo measurements. The processed set of Chla data (2014–2019) is then used to provide a systematic description of the seasonal DCM dynamics in the Black Sea and to explore different hypotheses concerning the mechanisms underlying its development.

Our results show that the corrections applied to the Chla profiles are consistent with HPLC data. In the Black Sea, the DCM begins to form in March, throughout the basin, at a density level set by the previous winter mixed layer. During a first phase (April-May), the DCM remains attached to this particular layer. The spatial homogeneity of this feature suggests a hysteresis mechanism, i.e., that the DCM structure locally influences environmental conditions rather than adapting instantaneously to external factors.

In a second phase (July-September), the DCM migrates upward, where there is higher irradiance, which suggests the interplay of biotic factors. Overall, the DCM concentrates around 45 to 65% of the total chlorophyll content within a 10 m layer centered around a depth of 30 to 40 m, which stresses the importance of considering DCM dynamics when evaluating phytoplankton productivity at basin scale.