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TITLE: Global biogeochemical provinces of the mesopelagic zone

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ABSTRACT:

Abstract Aim Following the biogeographical approach implemented by Longhurst for the epipelagic layer, we propose here to identify a biogeochemical 3D partition for the mesopelagic layer. The resulting partition characterizes the main deep environmental biotopes and their vertical boundaries on a global scale, which can be used as a geographical and ecological framework for conservation biology, ecosystem-based management and for the design of oceanographic investigations. **Location** The global ocean. **Methods** Based on the most comprehensive environmental climatology available to date, which is both spatially and vertically resolved (seven environmental parameters), we applied a combination of clustering algorithms (c-means, k-means, partition around medoids and agglomerative with Ward's linkage) associated with a nonparametric environmental model to identify the vertical and spatial delineation of the mesopelagic layer. **Results** First, we show via numerical interpretation that the vertical division of the pelagic zone varies and, hence, is not constant throughout the global ocean. Indeed, a latitudinal gradient is found between the epipelagic-mesopelagic and mesopelagic-bathypelagic vertical limits. Second, the mesopelagic layer is shown here to be composed of 13 distinguishable Biogeochemical Provinces. Each province shows a distinct range of environmental conditions and characteristic 3D distributions. **Main conclusions** The historical definition of the mesopelagic zone is here revisited to define a 3D geographical framework and characterize all the deep environmental biotopes of the deep global ocean. According to the numerical interpretation of mesopelagic boundaries, we reveal that the vertical division of the zone is not constant over the global ocean (200-1,000 m) but varies between ocean basin and with latitude. We also provide evidence of biogeochemical division of the mesopelagic zone that is spatially structured in a similar way than the epipelagic in the shallow waters but varies in the deep owing to a change of the environmental driving factors.

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