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How will climate change affect mercury biogeochemistry in the ocean? Projected changes for the Mediterranean Sea under RCP4.5 and RCP8.5 emission scenarios.

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Disentangling the mechanisms of methylmercury (MeHg) production and bioaccumulation at the base of marine food webs is crucial for understanding the pathways of ecosystems and human exposure, and the potential impacts associated with environmental changes. Previous research pointed out that the Mediterranean Sea has a high methylation potential and high levels of bioaccumulation and biomagnification driven by its peculiar physical, biogeochemical, and ecological features.

Numerical models are essential tools for integrating and interpreting interdisciplinary data and foreseeing possible outcomes of environmental changes, also taking into account the different sources of uncertainties.

A 3D coupled transport-biogeochemical-bioaccumulation model (OGSTM-BFM-Hg model) was recently developed and used to investigate spatial-temporal variability of MeHg concentrations in the water column and plankton food web of the Mediterranean Sea (Rosati et al., 2022) in the present climate (2004-2017). The horizontal model resolution is about 6 km with 70 uneven vertical levels, allowing to resolve mesoscale processes, such as eddies, that affect the biogeochemical dynamics of various areas of the basin.

The evaluation of model performances in the present climate showed that the model reproduced well the observed zonal gradients of MeHg concentrations related to spatial patterns of primary production, as well as vertical distributions. However, MeHg concentrations are underestimated where the highest values are observed (i.e., the intermediate waters of the most productive subbasins). The analysis of the MeHg seasonal cycle in different subbasins showed that summer stratification plays an important role for the buildup of the MeHg sub-surficial maximum, which is then disrupted by open ocean convection in winter.

This has suggested that the increasing stratification of the water column, driven by the overall warming of the Mediterranean Sea during the 21st century, may lead to an increase in MeHg concentrations in the intermediate waters (200-400m), possibly enhancing bioaccumulation. Here, the OGSTM-BFM-Hg model is used to run long-term simulations for the 21st century under the climate change emission scenarios RCP 4.5 and 8.5 to explore the magnitude of these cascading effects.