Quantifying climate induced changes in dissolved organic matter and nutrients on methylmercury bioaccumulation

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Methylmercury (MeHg) is a potent neurotoxin that is associated with adverse health effects in many populations. Here we present a modeling analysis of the impacts of changing dissolved organic matter (DOM) and nutrient inputs on MeHg production and food web bioaccumulation in the Northwest Atlantic coastal margin region where riverine DOM inputs have increased by 30% over the last 80 years. Results are constrained based on extensive measurements at 5 trophic levels from this ecosystem. Experimental data indicate uptake of MeHg into cells is affected by DOM concentration and quality. Our work considers the sensitivity of microbial MeHg production in seawater to physical and chemical conditions such as temperature, nutrients and the presence and composition of DOM. We also quantify the influence of changing phytoplankton biomass and community composition on uptake at the base of the food web. Climate-driven changes are expected to significantly alter DOM quality and inputs into marine environments, and phytoplankton concentrations and size distribution. We use recently measured ecological shifts in our study ecosystem to quantify impacts on MeHg bioaccumulation and gain insight into future changes. We discuss the relative importance of changing DOM concentrations and composition, and nutrient concentrations on phytoplankton growth for MeHg bioaccumulation in the food web. We use this analysis to bound the potential effects of future changes on marine MeHg bioaccumulation and MeHg exposure through fish consumption.