SCCWRP #1467

Urban eutrophication enhances domoic acid production by *Pseudo-nitzschia* in the Southern California Bight

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ABSTRACT

The diatom genus *Pseudo-nitzschia* and its neurotoxin domoic acid (DA) are major contributors to harmful algal blooms (HABs) along the U.S. West Coast, affecting marine ecosystems and human health. Observations implicate anthropogenic nutrient inputs, upwelling, and climate variability, but their relative importance remains unclear. We couple a mechanistic DA-production model, constrained by culture experiments, to a three-dimensional ocean biogeochemical model to simulate the DA cycle in the Southern California Bight, an urbanized region with a population of 23 million. Using 1-km resolution simulations for 2006–2017 we compare two cases: (i) an anthropogenic scenario (ANTH), in which rivers and wastewater outfalls supply freshwater and enhanced nutrient loads, and (ii) a control (CTRL) with freshwater-only fluxes, and nutrient loads set to zero. Skill assessments show that ANTH captures observed seasonal patterns, vertical distributions, and horizontal gradients of particulate DA. Performance is highest in the San Pedro and Santa Barbara Channels, but lower elsewhere, indicating need for refinements to capture local HAB dynamics. Comparison of the two simulations shows that terrestrial nitrogen inputs enhance coastal diatom production and shift nutrient limitation from nitrogen to silica, amplifying DA production. Surface particulate DA along the coast increases on average by ~25% with anthropogenic inputs, suggesting a substantial enhancement of the region's natural susceptibility to DA events. This study advances our ability to disentangle natural versus human drivers of *Pseudo-nitzschia* HABs, quantifying the role of anthropogenic inputs among the drivers of DA production in the Bight.