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Assessment of wastewater impact on dissolved oxygen around southern California's submerged ocean outfalls

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ABSTRACT

Ocean wastewater dischargers in southern California maintain extensive water quality monitoring programs to assess their effects on coastal receiving waters, but there is no shared protocol to analyze these measurements for compliance with California Ocean Plan standards. Here we present an assessment methodology that we apply regionally to determine discharge effects on dissolved oxygen (DO). The methodology was developed using an optimization algorithm to determine the following: (1) the most appropriate number of reference sites to capture natural variability among sites without moving so far from the potentially affected site to confound the comparison with natural latitudinal and offshore gradients; (2) the thickness of depth slices for comparing profiles between reference and potentially affected sites that minimizes false positives from natural vertical variability while not being so large as to average out plume-caused deviations; and (3) an allowable difference from the reference mean associated with variability among reference profiles. The algorithm was based on maximizing the chance of detecting DO outranges in the effluent plume, while simultaneously minimizing the chance to falsely identify outranges at reference sites outside of the plume zone. The assessment methodology also differentiates DO outranges resulting from physical upward entrainment of deep, low-oxygen water by rising of lower density plume water, as opposed to outranges resulting from low-oxygen relationships as a tracer of water masses. When the algorithm was applied to a ten year monitoring record from four discharge monitoring programs along the southern California coast, 11% of effluent sites were found to contain DO outranges, with about half of them resulting from deep water entrainment.