

Spatial scales and evolution of stormwater plumes in Santa Monica Bay

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INTRODUCTION

Rainfall during winter storms produces extensive turbid, freshwater plumes in the coastal waters of the Southern California Bight. When the plumes result from urban runoff they contain toxic pollutants along with pathogenic bacteria and viruses, often resulting in closure of public beaches. We examined the spatial structure and evolution of stormwater plumes in Santa Monica Bay in 1996. The plumes resulted from freshwater discharge from the Ballona Creek and Malibu Creek watersheds which supply ~60% of the freshwater runoff to Santa Monica Bay. The spatial scales of the plumes were determined using shipboard measurements of water properties obtained from towed transects and surface underway sampling. Salinity maps showed that the plumes typically extended 4–7 km offshore, consistent with scaling by the internal Rossby radius of deformation. Plumes extended alongshore 10 km or more. Generally the plumes occupied the upper 10 m of the water column. The persistence time of a plume offshore of Ballona Creek was about three days based on a sequence of surveys in March 1996 following rainfall of about 21 mm. Limited comparison of plumes from Ballona Creek, which drains a developed watershed, and Malibu Creek, which drains a rural watershed, suggested that Malibu Creek required greater rainfall to produce an offshore plume. A stormwater plume offshore of Malibu Creek was observed on both sides of the creek mouth, possibly due to freshwater discharge from smaller surrounding watersheds or advection of freshwater discharges from the east and south. Plumes offshore of Ballona Creek mainly resulted from the creek itself and usually extended northward from the creek mouth, consistent with the wind forcing and the Coriolis acceleration.

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