

Tracking stormwater discharge plumes and water quality of the Tijuana River with multispectral aerial imagery

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ABSTRACT

Spatial-temporal characteristics and environmental factors regulating the behavior of stormwater runoff from the Tijuana River in southern California were analyzed utilizing very high resolution aerial imagery, and time-coincident environmental and bacterial sampling data. Thirty nine multispectral aerial images with 2.1-m spatial resolution were collected after major rainstorms during 2003–2008. Utilizing differences in color reflectance characteristics, the ocean surface was classified into non-plume waters and three components of the runoff plume reflecting differences in age and suspended sediment concentrations. Tijuana River discharge rate was the primary factor regulating the size of the freshest plume component and its shorelong extensions to the north and south. Wave direction was found to affect the shorelong distribution of the shoreline-connected fresh plume components much more strongly than wind direction. Wave-driven sediment resuspension also significantly contributed to the size of the oldest plume component. Surf zone bacterial samples collected near the time of each image acquisition were used to evaluate the contamination characteristics of each plume component. The bacterial contamination of the freshest plume waters was very high (100% of surfzone samples exceeded California standards), but the oldest plume areas were heterogeneous, including both polluted and clean waters. The aerial imagery archive allowed study of river runoff characteristics on a plume component level, not previously done with coarser satellite images. Our findings suggest that high resolution imaging can quickly identify the spatial extents of the most polluted runoff but cannot be relied upon to always identify the entire polluted area. Our results also indicate that wave-driven transport is important in distributing the most contaminated plume areas along the shoreline.

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