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Characterizing the Effects of Two Storms on the Coastal Waters of O'ahu, Hawai'i, Using Data from the Pacific Islands Ocean Observing System

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Abstract

Pathogens (and other contaminants) associated with urban storm water runoff plumes have long been recognized as adversely affecting the water quality of the coastal ocean. An understanding of the temporal and spatial characteristics of stormwater plumes is a critical first step in protecting the health of people who recreate in coastal waters. Until recently, characterization of stormwater plumes was limited to expensive vessel-based sampling and satellites, which cannot always provide imagery of the nearshore areas, particularly during storms. With the advent of coastal ocean observing systems with their fixed sensor platforms and autonomous underwater vehicles, we have begun to better understand the temporal and spatial characteristics of stormwater plumes in the coastal ocean. The Pacific Islands Ocean Observing System (PacIOOS) provides continuous environmental monitoring of island coastal waters throughout the Pacific Ocean. This network of new ocean-based monitoring stations enabled the authors to study the effects of two storms on coastal water quality. We find that storm runoff from even a relatively small, partially urbanized watershed can profoundly affect the surface waters of the coastal ocean for days to weeks, both inshore and up to hundreds of meters offshore. Even in these coastal waters exposed to the open ocean, the lower salinities and higher turbidity values indicative of stormwater plumes lingered for nearly two days along the southern coast of O'ahu, Hawai'i.

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References

- Battista, T.A., B.M. Costa, and S.M. Anderson. 2007. *Atlas of the Shallow-Water Benthic Habitats of the Main Hawaiian Islands*. NOAA Technical Memorandum NOS NCCOS 61. NCCOS Biogeography Branch, Silver Spring, MD, 331 pp.
- Bay, S., B.H. Jones, K. Schiff, and L. Washburn. 2003. Water quality impacts of stormwater discharges to Santa Monica Bay. *Marine Environmental Research* 56:205–223. [[CrossRef](#)]
- Boehm, A.B. 2007. *Enterococci* concentrations in diverse coastal environments exhibit extreme variability. *Environmental Science and Technology* 41(24):8,227–8,232. [[CrossRef](#)]
- Byappanahalli, M., and R.S. Fujioka. 2004. Indigenous soil bacteria and low moisture may limit but allow faecal bacteria to multiply and become a minor population in tropical soils. *Water Science and Technology* 50:27–32.
- Corcoran, A.A., K.M. Reifel, B.H. Jones, and R.F. Shipe. 2010. Spatiotemporal development of physical, chemical, and biological characteristics of stormwater plumes in Santa Monica Bay, California (USA). *Journal of Sea Research* 63 (2010):129–142. [[CrossRef](#)]
- Cuffney, T.F., and R.A. Brightbill. 2008. *Methods for Processing and Summarizing Time-Series Temperature Data Collected as Part of the National Water-Quality Assessment Program Studies on the Effects of Urbanization on Stream Ecosystems*. USGS Data Series 330, US Geological Survey, Reston, VA, 23 pp.
- Davies, C.M., J.A. Long, M. Donald, and N.J. Ashbolt. 1995. Survival of fecal micro-organisms in marine and freshwater sediments. *Applied and Environmental Microbiology* 61:1,888–1,896.
- De Carlo, E.H., V.L. Beltran, and M.S. Tomlinson. 2004. Composition of water and suspended sediment in streams of urbanized subtropical watersheds in Hawai'i. *Applied Geochemistry* 19:1,011–1,037.
- De Carlo, E.H., D.J. Hoover, C.W. Young, R.S. Hoover, and F.T. Mackenzie. 2007. Impact of storm runoff from tropical watersheds on coastal water quality and productivity. *Applied Geochemistry* 22:1,777–1,797. [[CrossRef](#)]
- Drupp, P., E.H. De Carlo, F.T. Mackenzie, P. Bienfang, and C.L. Sabine. 2011. Nutrient inputs, phytoplankton response, and CO₂ variations in a semi-enclosed subtropical embayment, Kaneohe Bay, Hawaii. *Aquatic Geochemistry*. [[CrossRef](#)]
- Desmarais, T.R., H.M. Solo-Gabriele, and C.J. Palmer. 2002. Influence of soil on fecal indicator organisms in a tidally influenced subtropical environment. *Applied and Environmental Microbiology* 68:1,165–1,172. [[CrossRef](#)]
- Eich, M.L., M.A., Merrifield, and M.H. Alford. 2004. Structure and variability of semidiurnal internal tides in Māmalā Bay, Hawai'i. *Journal of Geophysical Research* C109. [[CrossRef](#)]
- Fenton, J.D., and W.D. McKee. 1990. On calculating the lengths of water waves. *Coastal Engineering* 14:499–513. [[CrossRef](#)]
- Fryer, P. 1995. The 1991–1992 NSF Young Scholars Program at the University of Hawaii: Science and engineering studies of the Ala Wai Canal, an urban estuary. *Pacific Science* 49(4):319–331.
- Fujioka, R.S., and L.K. Shizumura. 1985. *Clostridium perfringens*, a reliable indicator of stream water quality. *Journal Water Pollution Control Federation* 57:986–992.
- Giambelluca, T., and M. Sanderson. 1993. The water balance and climatic classification. Pp. 56–72 in *Prevailing Trade Winds: Climate and Weather in Hawai'i*. M. Sanderson, ed., University of Hawai'i Press, Honolulu, HI.
- Giambelluca, T.W., L.S. Lau, Y.S. Fok, and T.A. Schroeder. 1984. *Rainfall Frequency Study for O'ahu, State of Hawai'i*. Report R-73. State of Hawai'i, Department of Land and Natural Resources, Division of Water and Land Development, Honolulu, HI, 232 pp.
- Giambelluca, T.W., M.A. Nullet, and T.A. Schroeder. 1986. *Rainfall Atlas of Hawai'i*. Report R76, State of Hawai'i, Department of Land and Natural Resources, Division of Water and Land Development, Honolulu, HI, 267 pp.
- Gordon, L.I., J.C. Jennings Jr., A.A. Ross, and J.M. Krest. 1994. A suggested protocol for continuous flow analysis of seawater nutrients (phosphate, nitrate, nitrite, and silicic acid) in the WOCE Hydrographic Program and the Joint Global

Ocean Flux Study. Pp. 1–55 in *WOCE Operations Manual*. WHP Office Report 91-1, Revision 1, November 1994, Woods Hole, MA. This material is also available at: http://cchdo.ucsd.edu/manuals/pdf/91_1/gordnut.pdf (accessed January 7, 2011).

Hamilton, P., J. Singer, and E. Waddell. 1995. Ocean current measurements (with final report addendum). In *Māmalā Bay Study Final Report*. Māmalā Bay Study Commission, Honolulu, HI.

Hardina, C.M., and R.S. Fujioka. 1991. Soil: The environmental source of *Escherichia coli* and *Enterococci* in Hawaii's streams. *Environmental Toxicology and Water Quality* 6:185–195. [[CrossRef](#)]

Hoover, D.J., and F.T. Mackenzie. 2009. Fluvial fluxes of water, suspended particulate matter, and nutrients and potential impacts on tropical coastal water biogeochemistry: O'ahu, Hawai'i. *Aquatic Geochemistry* 15:547–570. [[CrossRef](#)]

Hoover, R.S., D. Hoover, M. Miller, M.R. Landry, E.H. De Carlo, and F.T. Mackenzie. 2006. Zooplankton response to storm runoff in a tropical estuary: Bottom-up and top-down controls. *Marine Ecology Progress Series* 318:187–201. [[CrossRef](#)]

Jiang, S., R. Noble, and W. Chu. 2001. Human adenoviruses and coliphages in urban runoff-impacted coastal waters of southern California. *Applied and Environmental Microbiology* 67(2001):179–184. [[CrossRef](#)]

Laws, E.A., D. Ziemann, and D. Schulman. 1999. Coastal water quality in Hawaii: The importance of buffer zones and dilution. *Marine Environmental Research* 48:1–21. [[CrossRef](#)]

Macdonald, G.A., A.T. Abbott, and F.L. Peterson. 1983. *Volcanoes in the Sea: The Geology of Hawai'i, 2nd ed.* University of Hawai'i Press, Honolulu, HI, 517 pp.

National Research Council. 1993. *Managing Wastewater in Coastal Urban Areas*. National Academy Press, Washington, DC, 477 pp.

Nezlin, N.P., and P.M. DiGiacomo. 2005. Satellite ocean color observations of stormwater runoff plumes along the San Pedro Shelf (southern California) during 1997–2003. *Continental Shelf Research* 25(2005):1,692–1,711. [[CrossRef](#)]

Nezlin, N.P., P.M. DiGiacomo, E.D. Stein, and D. Ackerman. 2005. Stormwater runoff plumes observed by SeaWiFS radiometer in the Southern California Bight. *Remote Sensing of Environment* 98(2005):494–510. [[CrossRef](#)]

Nezlin, N.P., S.B. Weisberg, and D.W. Diehl. 2007. Relative availability of satellite imagery and ship-based sampling for assessment of stormwater runoff plumes in coastal southern California. *Estuarine, Coastal and Shelf Science* 71 (2007):250–258. [[CrossRef](#)]

Ocean.US. 2002. *Building Consensus: Toward an Integrated and Sustained Ocean Observing System (IOOS)*. Ocean.US, Arlington, VA, 175 pp.

Ostrander, C.E. 2007. Physical factors controlling the temporal and spatial variability of freshwater plumes in Kāne'ohe Bay, Hawai'i. M.S. Thesis, University of Hawai'i at Mānoa, Honolulu, HI.

Ostrander, C.E., M.M. McManus, E.H. De Carlo, and F.T. Mackenzie. 2008. Temporal and spatial variability of freshwater plumes in a semi-enclosed estuarine bay system. *Estuaries and Coasts* 31:192–203. [[CrossRef](#)]

Pawlak, G., E. De Carlo, J. Fram, A. Hebert, C. Jones, B. McLaughlin, M. McManus, K. Millikan, F. Sansone, T. Stanton, and J. Wells. 2009. Development, deployment, and operation of Kilo Nalu nearshore cabled observatory. Paper presented at IEEE OCEANS 2009 Conference, Bremen.

Peterson, R.N., W.C. Burnett, C.R. Glenn, and A.G. Johnson. 2009. Quantification of point-source groundwater discharges to the ocean from the shoreline of the Big Island, Hawaii. *Limnology and Oceanography* 54:890–904. [[CrossRef](#)]

Reifel, K.M., S.C. Johnson, P.M. DiGiacomo, M.J. Mengel, N.P. Nezlin, J.A. Warrick, and B.H. Jones. 2009. Impacts of stormwater runoff in the Southern California Bight: Relationships among plume constituents. *Continental Shelf Research* 29:1,821–1,835. [[CrossRef](#)]

Tomlinson, M.S., and E.H. De Carlo. 2003. The need for high resolution time series data to characterize Hawaiian streams. *Journal of the American Water Resources Association* 39(1):113–123. [[CrossRef](#)]

US Department of Commerce Weather Bureau. 1962. *Rainfall-frequency Atlas of the Hawaiian Islands for Areas to 200 Square Miles, Durations to 24 Hours, and Return Periods from 1 to 100 Years*. Technical Paper 43, US Department of Commerce Weather Bureau, Washington, DC.

US Environmental Protection Agency and Hawai'i Department of Health. 2002. *Revisions to Total Maximum Daily Loads for the Ala Wai Canal—Island of Oahu, Hawai'i—Total Nitrogen and Total Phosphorus*. Hawai'i Department of Health, Honolulu, HI, 37 pp.

USEPA (US Environmental Protection Agency). 2006. *Implementing the BEACH Act of 2000: Report to Congress*. EPA-823-R-06-001, The US Environmental Protection Agency, Washington, DC, 108 pp.

USEPA (US Environmental Protection Agency). 2008. *National Coastal Condition Report III*. EPA/842-R-08-002, The US Environmental Protection Agency, Washington, DC, 300 pp.

Wahl, K.L., and T.L. Wahl. 1995. Determining the flow of Comal Springs at New Braunfels, Texas. Pp. 77–86 in *Proceedings of Texas Water '95, A Component Conference of the First International Conference on Water Resources Engineering*, August 16-17, 1995. American Society of Civil Engineers, San Antonio, TX.

Warrick, J.A., P.M. DiGiacomo, S.B. Weisberg, N.P. Nezlin, M. Mengel, B.H. Jones, J.C. Ohlmann, L. Washburn, E.J. Terrill, and K.L. Farnsworth. 2007. River plume patterns and dynamics within the Southern California Bight. *Continental Shelf Research* 27:2,427–2,448. [[CrossRef](#)]

Washburn, L., K.A. McClure, B.H. Jones, and S.M. Bay. 2003. Spatial scales and evolution of stormwater plumes in Santa Monica Bay. *Marine Environmental Research* 56(2003):103–125. [[CrossRef](#)]

Weisberg, S.B., T.L. Hayward, and M. Cole. 2000. Towards a US GOOS: A synthesis of lessons learned from previous coastal monitoring efforts. *Oceanography* 13(1):54–61. [[pdf](#)]

Wong, M.F. 1994. *Estimation of Magnitude and Frequency of Floods for Streams on the Island of O'ahu, Hawai'i*. USGS Water-Resources Investigations Report 94-4052, US Geological Survey, Reston, VA.

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