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Predicting Flows in Semi-Arid Watersheds Using GIS Technologies

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Background

The Tijuana River Watershed drains 1,750 square miles of highly varied habitat straddling both sides of the U.S.-Mexico border. The complex network of seasonal creeks that feed this watershed is prone to destructive flash flooding and is known to contribute significantly to chronic beach pollution. As the populations of Tijuana and San Diego continue to grow, it is expected that water quality will continue to decline and flood damage increase unless action is taken.

Although streams are usually either unmonitored or inadequately monitored, reliable estimates of stream flows are needed for developing flood-warning systems and for cost-effectively addressing ways to reduce ocean pollution.

The Project

The goal of this project was to use geographic information system (GIS) technologies to develop a simple stream-discharge model for predicting flows through the Tijuana River Watershed. The project is linked to an ongoing project to create a GIS-database for the San Diego–Tijuana area, funded by the National Oceanographic and Atmospheric Administration, the Environmental Protection Agency, and the Southwest Center for Environmental Research and Policy.

The first phase of the Sea Grant project involved integrating all the different data sets needed to accurately model river flows—data on elevation, precipitation, temperature, soil type, soil porosity and vegetation, combined with information on the locations of roads, sewers and utility lines.

Because most hydrologic models have been designed for temperate climates, Dr. Wright and colleagues developed a Physical Hydrology Simulator for modeling monthly river flows in the semiarid, chaparral-dominated coastal watersheds of California.

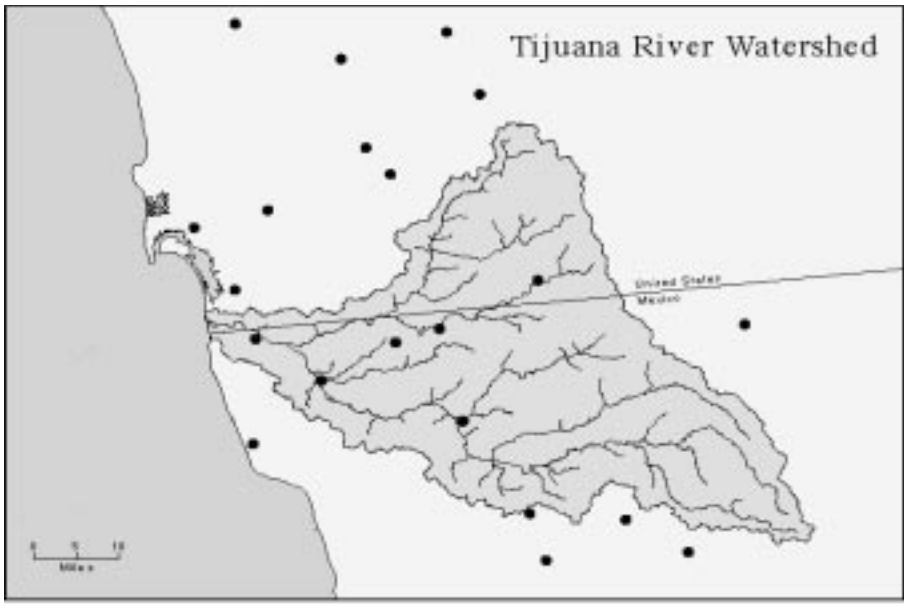
To test and fine tune the Hydrology Simulator, they compared predicted monthly river flows to real data for the Campo Creek watershed, a subbasin of the Tijuana River Watershed.

The scientists found that calibrating their models was difficult because of the complex nature of hydrologic processes in semiarid watersheds and because of an absence of high-quality data on stream flows and rainfall. Uncertainties in the model were greatest for low flows.

Researchers at the Department of Geography at San Diego State University are now evaluating the predictive capability of more complex river flow models in semiarid watersheds of California.

Applications

The model developed for this project, in conjunction with comprehensive rain gauge and stream-flow data, will enable scientists to calculate the magnitude of 25-, 50- and 100-year floods. From this, it will be possible to develop a binational flood-warning system for the entire watershed. Dr. Wright is currently working with the County of San Diego, the City of Tijuana, and the National Weather Service to develop a flood-warning system for the Cottonwood Creek–Rio Alamar portion of the Tijuana River drainage area. Flood waters along the Rio Alamar not only cause loss of life and property but contribute to coastal water pollution and burden



The above map shows the locations of rain gauges of relevance to this study.
Credit: Richard Wright, San Diego State University.

the Tijuana Estuary with sediments and contaminants from streets, lawns and storm drains.

Cooperating Organizations

City of San Diego Water Utilities Department
International Boundary and Water Commission
San Diego Association of Governments
San Diego County Department of Public Works
United States Geological Survey

Presentations

Five papers and four posters were presented at professional scientific conferences.

Awards

California Geographic Information Association Award for Outstanding Contributions to Geographic Education and Partnerships
Phi Kappa Phi National Honor Society, 1998

Trainees and Theses

Two doctoral students and seven master's students, all in the geography department at San Diego State University, received support through this grant.

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