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Study 213 (SWP04): Correlation Analysis of Surface Water Concentration with Pesticide Use and Precipitation for Sacramento and San Joaquin Watersheds

Background

Pesticide contamination has been routinely detected in California's rivers and tributaries. These toxic chemicals contribute to the toxicity to aquatic species, and threaten the well being of riverine ecosystems.

Pesticides were transported from the field to the surface water by the process of runoff. Although numerous factors affect runoff and therefore surface water concentration, many of these factors such as soil properties, stream reach network distribution, land use, and landscape remain virtually unchanged over time and thus reduce basically to constants for a given watershed. In this case, the temporal and spatial changes of the surface water concentration of a pesticide would only be dependent on two major explanatory variables, both very well documented: precipitation and pesticide use; precipitation determines the total amount of runoff water and pesticide use represents the source of contamination.

We propose to explore the dependence of pesticide concentration in Sacramento and San Joaquin rivers on precipitation and pesticide use by regression analysis. A correlation equation will be developed, based on historic records of SURF (a surface water monitoring database), PUR (Pesticide Use Report), and CIMIS (California Irrigation Management Information System) weather stations, relating pesticide concentration in the rivers directly to the amount of pesticide use and rainfall in the respective watersheds. We believe that such a relation fundamentally characterizes the vulnerability of a watershed to pesticide contamination, and is the ultimate measure for evaluating success of mitigation measures in reducing pesticide runoff into surface water at the watershed scale.

Objectives

The purpose of this project is to develop a correlation equation, for each significant contaminant detected in Sacramento and San Joaquin rivers, between the surface water concentration and two predictor variables, the precipitation and use. This information, integrating all critical watershed attributes affecting transport, will provide us a predictive tool for future concentrations in the rivers or, should such a relationship change over

time, a baseline for evaluating impacts of new agricultural management practices on surface water quality in the watersheds.

Method

This study will utilize two databases, SURF and PUR, established by DPR. SURF is a surface water monitoring database which contains sampling results of over thirty surface water monitoring studies conducted in California by federal, state, and local agencies, private industry, and environmental groups since 1990. Data contained in the database include sampling dates, locations, and chemical concentrations. PUR or Pesticide Use Report is a database documenting pesticide use in agricultural and commercial applications. It includes information on application date, amount, and location accurate to the scale of a section (one square mile).

At least ten years worth of data are available in SURF at two stream locations for Sacramento and San Joaquin rivers: Sacramento river at the I street and San Joaquin River at Vernalis (Spurlock, 2002). These locations capture nearly all the runoff from agricultural lands in the watersheds.

Query of the two databases of SURF, PUR, and the CIMIS station records will be conducted to extract data of pesticide concentration, pesticide use, and precipitation. Results will be grouped by an array of temporal (weekly, biweekly, monthly, and seasonal) and spatial (section, subwatershed, and watershed) scales. Statistics will be derived for each scale to characterize means, sums, and/or distribution such as 95^{th} percentile, 75^{th} percentile, 50^{th} percentile, etc.

The regression analysis will be conducted systematically between the statistics of pesticide detections and the use and precipitation at every level or scale both temporally or spatially. This type of analysis, involving a matrix of regression of one dependent variable at every scale with two predictor variables at every scale, requires massive amount of computation, but is necessary on the physical premise that the response time of a river in concentration would be dependent upon the travel time specific to the watershed and chemical decay rates. In the case that the linear regression fails to resolve correlation, log transformation of the original concentrations will then be tried, and analysis of data proceed in the same manner. The ultimate purpose of this regression is to find a relationship of surface water concentration with its two major predictor variables so that a correlation equation with predictive power can be derived.

Although monitoring data at the two sampling locations are available throughout the years, this analysis will only focus on data collected during the winter months when the winter storms were the primary driving force for pesticide transport. Transport in other months, especially in summer, is driven by irrigation drainage, which will not be considered in this study. Regression analysis with irrigation is difficult since information on irrigation is difficult to obtain.

Personnel

The following personnel will be responsible for the project:

Lei Guo will be the principal investigator of this project. She will be responsible for database query, programming, statistical analysis, data interpretation, and preparation of draft and final project reports.

LinYing Li will be the co-principal investigator and will offer assistance in GIS related data query and programming.

Bruce Johnson will be the senior scientist. He will oversight the project design and data analysis strategies, and review deliverable products.

Time Table

A draft report is expected in February 2003.