WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: HI2141

Title: An Accurate Evaluation of Water Balance to Predict Surface Runoff and Percolation

Focus Categories: Water Quality, Groundwater

Keywords: models, runoff, best management practices, vadose zone, ground water, infiltration, recharge

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Abstract

Water management strategies are closely related to the management of water resources and water pollution. Water resources and pollution problems that affect all areas of the world are ground water recharge and the corresponding surface runoff from storm events. An accurate quantification of surface runoff and recharge is essential for water resources development, development and implementation of best management practices (BMPs) for ground and surface water pollution prevention such as a reduction of pesticide use rate and the resulting impact to ground water, and other engineered technologies such as low-cost capping technologies for the closure of landfills to reduce percolation, hence the generation of leachate.

In Hawaii and other areas of the world, where ground water is the major source of drinking water, prevention of pollution originating through recharge water and protection of source water areas are two main concerns. Quantifications of recharge and surface runoff using calibrated models are cost effective compared to direct measurement at every site for each storm event. A calibrated model should have the ability to account for land use changes for predictive simulations without significant additional experimental efforts.

Past and ongoing studies in Hawaii indicate that daily averaging of rainfall can cause serious discrepancy between model predictions and actual measurements of evapotranspiration and soil moisture. This can also provide inaccurate prediction of amount of recharge and contaminant transport in subsurface. In order to quantify the amount of error in modeling, an instrumented field site that monitors surface runoff, percolation, soil moisture, and climatic data is necessary. One such site recently became available to the PI from the U.S. Navy. The site has six test plots and each is equipped with necessary instrumentation to measure soil moisture, percolation, and runoff on an hourly basis. In addition, climatic data is monitored at the site and can be recorded at the same time intervals. All data will be downloaded from the dataloggers at the site through a modem and a cellular phone once daily.

In the first year of this research, a surface runoff and a percolation producing model will be calibrate at the site and they will be tested for their prediction for other storm events. Differences in measured and predicted values will be the basis for model sensitivity analyses and for identifying the parameters for

which field measurements would be critical. One critical question that needs to be answered is how erroneous it is to average actual precipitation over 24 hours. This is an essential part of management where rainfall is only recorded on a daily basis. Further, the effect of macropore flow on improved model calibration will be examined. The first year effort will provide us insight into management practices needed to deal with pesticide transport in percolating water, based upon the field data. The phase-2 effort (year 2) will focus on the validation of a regulatory model that is commonly used for the closure of landfill caps. Further, the 2nd year data will also help in the recalibration of the surface runoff and percolate production models and studying the transport of a chemical through the soils.

The greatest asset of this effort is the availability of an intensely instrumented site (rare to find in Hawaii and U.S. mainland) for the calibration of two appropriate computer models that have the potential to predict recharge water quality and surface runoff in response to storm events. Without significant new capital investment, many questions on model calibration for surface runoff and percolate production and their impacts on BMPs can be answered from this study.