agronomy and agricultural engineering

sustainable sugarcane production

SWAT model as a decision support tool for water management on sugarcane fields

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Background

Hawaiian Commercial & Sugarcane Company (HC&S) consumes 270 million gallons of water every day on its 14,100-hectare plantation, with 71 % of irrigation water originating from rainforests via 76 miles of ditches and tunnels while the remaining 29 % is supplemental ground water.

It has been recognized that the availability of water is the most critical variable that affects sustainability of Maui's sugar production.

Objectives

The overall objective is to develop a decision support system to determine the feasibility of biofuel production and environmental sustainability on the HC&S sugarcane lands in Maui, Hawaii.

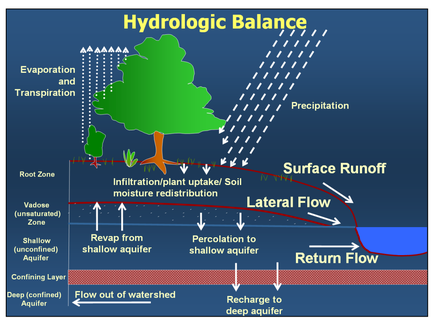
The specific goals of this project at this phase are :

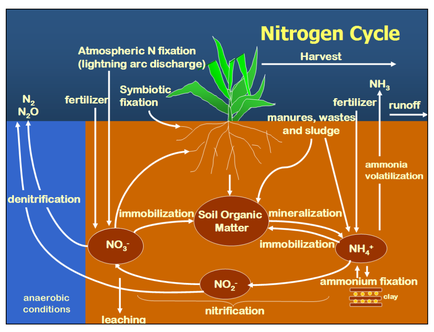
1) to develop a decision support tool that provides irrigation managers with process based real-time information of the sugarcane fields by adapting the Soil Water Assessment Tool (SWAT);
2) to modify SWAT to a semi-real time water balance simulation model for day-to-day continuous forecasts of water balance in sugarcane fields;
3) to develop a Windows interface for querying a SQL server for daily input, for running SWAT , and for visualizing field scale output through a web-based graphical interface or the traditional texts.

SWAT model

The Soil & Water Assessment Tool (SWAT) is a physically-based and continuous (daily time step) simulation model for watershed processes developed by U.S. Department of Agriculture.

SWAT has modeling components that comprehensively iterates inter-processes between water, soil, and management operations.



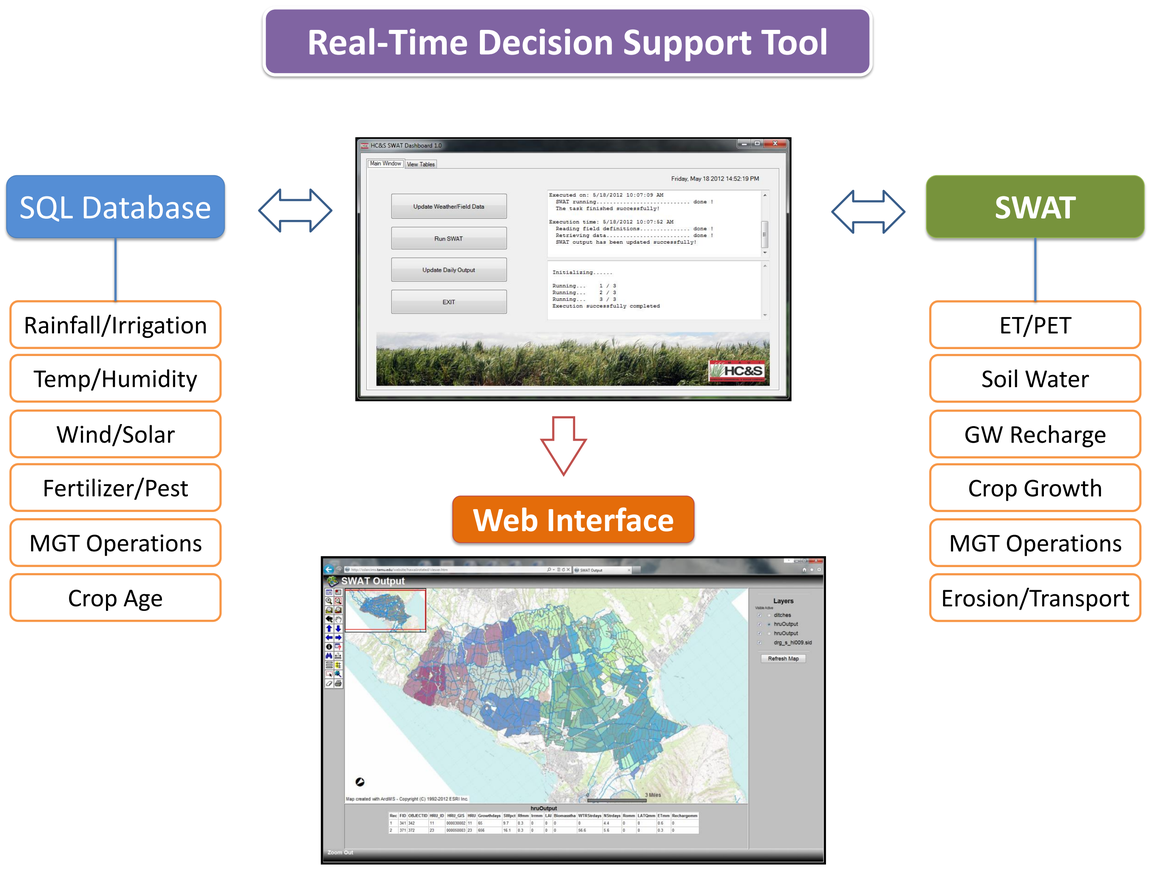


SWAT modeling components

- ❑ Hydrologic balance
- ❑ Nitrogen and phosphorus cycles
- ❑ Pesticide dynamics
- ❑ Plant growth
- ❑ Management operations
  - ❑ Tillage
  - ❑ Planting/Harvesting
  - ❑ Fertilization
  - ❑ Pesticide application
  - ❑ Grazing
- ❑ Carbon dynamics
- ❑ Pathogens
- ❑ Channel processes
- ❑ Ponds and reservoirs

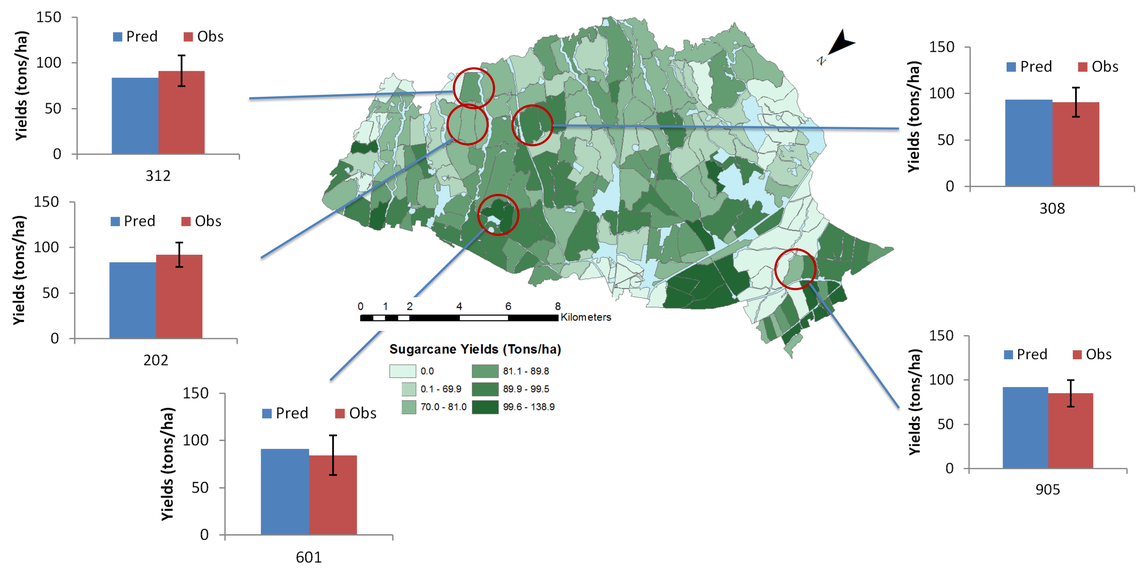
Methods

A Windows interface (VB.net) was developed to communicate with a SQL server for daily weather/management operations updates for SWAT (written in Fortran) simulation. The interface also runs SWAT and feeds a Web-visualization interface with daily outputs for various spatial management units.



Calibration: Sugar yields

Sugar yields for 6 harvest periods (~12 years) were calibrated with less than 10% errors at 5 selected fields.



Summary and Future Work

- ❑ SWAT was successfully calibrated for sugar yields at a heavily irrigated 2-year sugarcane plantation in sub-tropical climate.
- ❑ ET will be calibrated using field data collected from on-field Eddy Covariance Towers.

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