SWAT

Soil and Water Assessment Tool

Background

SWAT is a river basin, or watershed, scale model developed to quantify and predict the impacts of land management practices on water, sediment, and agricultural chemical yields in large complex watersheds with varying soils, land use, and management conditions over long periods of time. Users of this model include, but are not limited to, Natural Resources Conservation Service, Environmental Protection Agency, Texas River Authority, National Oceanic and Atmospheric Administration, Bureau of Indian Affairs, United States Department of Agriculture, and universities.

Capabilities

Basins of several thousand square miles can be studied, but must be divided to account for difference in soils, land use, crops, topography, weather, etc. SWAT accepts outputs from APEX (Agricultural Policy/Environmental eXtender) as well as measured data and point sources. Watersheds with no monitoring data can be modeled and impacts of changes in management and climate can be generated.

SWAT Components

Weather Inputs

- precipitation, solar radiation, temperature, relative humidity, and wind speed
- can be measured or generated

Hydrology

- simulates canopy interception of precipitation, partitioning of precipitation, and snowmelt water
- simulates partitioning water between surface runoff and infiltration, redistribution of water within the soil profile, evapotranspiration, lateral subsurface flow from the soil profile, return flow from shallow aquifers, and deep aquifer recharge

Plant Growth

- inputs: soil properties, management operations, and weather variables
- estimates crop yields and biomass output for a wide range of crop rotations, grassland/pasture systems, and trees
- simulates forest growth from seedling to mature stand
- simulates planting, harvesting, tillage passes, nutrient applications, and pesticide applications for each cropping system with specific dates or with a heat unit scheduling approach

Bacteria and Pathogens

- simulates bacteria and pathogen loads through surface runoff in both the solution and eroded phases

Nutrient and Pesticide Simulations

- residue and biological mixing in response to each tillage operation
- nitrogen and phosphorous applications in the form of inorganic fertilizer and/or manure inputs
- biomass removal and manure deposition for grazing operations
- continuous manure application for confined feeding operations
- type, rate, timing, application efficiency, and percentage of application to foliage versus soil pesticide applications
- accounts for pesticide fate and transport by degradation/losses by volatilization and leaching
- routes sediment, nutrient, pesticide, and bacteria loadings/concentrations through channels, ponds, wetlands, digressional areas, and/or reservoirs to the watershed outlet

Land Management Simulations

- conservation practices such as terraces, strip cropping, contouring, grassed waterways, filter strips, and conservation tillage
- irrigation water on cropland from sources such as stream reach, reservoir, shallow aquifer, or a water body source external to the watershed

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SWAT Interfaces and Tools:

Several interfaces and other tools have been developed to support SWAT applications since the first versions of the model were released:

ArcView SWAT (AVSWAT)

- Provides a complete set of tools for watershed scale assessment and control of the agricultural and urban sources of water pollution (supports SWAT2001).

ArcGIS SWAT Extension (ArcSWAT)

- An ArcGIS extension and graphical user input interface for current SWAT model (ver. 2012).

MapWindow-SWAT (MWSWAT)

- Open source interface to SWAT using GIS system MapWindow.

SWAT-CUP

- A computer program for the calibration of SWAT models.

VIZSWAT

- Visualization and analysis tool that animates times series and spatial data over GIS maps with impressive display speed.

SWAT Check

•Helps to identify potential model problems.

Conversion Program

•Reformats ASCII input files created for SWAT99.2 into the format used in SWAT2000.

SWAT Input Checker Program

•Assists the user in identifying input data that may be causing SWAT to give unreasonable results.

Potential Heat Unit Program

•Estimates the number of heat units required to bring a plant to maturity.

Baseflow Filter Program

•Estimates the fraction of base flow and surface runoff from stream flow records.

SWAT + Modular 3-Dimentional Groundwater Flow Model (SWATMOD)

Various SWAT Scenario Applications:

Examples of SWAT applications include assessments of:

- the effectiveness of conservation practices within the USDA Conservation Effects Assessment Program (CEAP) initiative
- the impacts of climate change on:
    - plant development and transpiration from increased atmospheric carbon dioxide concentrations
    - plant growth, stream flow, and other responses from changes in climatic input shifts
- the impacts of historical climate trends versus future climate change projections on hydrology, erosion, and pollutant loss
- the effects of land use and land management on recharge estimates at the watershed scale
- the impact of changes in land use on hydro-sedimentologic characteristics of rivers
- the economic and environmental benefits of conservation practices
- watershed-scale bacteria fate and transport
- hydrological modeling of watersheds
- flow and chemistry variables for development of ecological indicators in stream ecosystems
- soil and water patterns in small watersheds
- cumulative winter stream flow and spring base flow estimates
- conversions to wetlands
- sediment load predictions at different watershed scales
- pesticide and nutrient movement predictions
- alternative land use, best management practices, and other factors on removing pollutants
- stream flow impacts in response to historical land use shifts versus hypothetical land use change

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