SWAT modeling of
Arroyo Colorado watershed

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Need for the project

Arroyo Colorado failed to meet Texas water quality standards

- Low dissolved oxygen and high levels of bacteria - Fish kills
  
  • nutrient loading from agricultural fields
  • wastewater and storm water from urban areas
  • failing septic systems, untreated/poorly treated wastewater

Goal: Identify BMPs control poor water quality

Previous modeling effort:

Modeling of Arroyo Colorado watershed using HSPF model
Modeling period: 1988-1999

Recommendations: 90% reduction in Sediment, nitrogen and phosphorus reducing substances for 90% of times between March and October

TCEQ recommendations (2003): Reassessment of watershed using more data, recent data, sophisticated analysis
Soil and Water Assessment Tool (SWAT)

- developed by Dr. Jeff Arnold, Research Leader-USDA-ARS at Temple, TX

**Model details**
Physically based, Continuous simulation, Daily time step
Watershed and very large scale assessments, presently used in > 90 countries

**Components**
Flow, soil erosion, transport of sediment, nutrients, pesticides and bacteria

**Processes**
Crop growth, Evaporation, infiltration, runoff, soil water routing

**Management operations**
Crop rotation, Tillage, application of fertilizer, pesticides, irrigation water

**Some unique features** : auto-fertilizer application, auto-irrigation, auto-calibration

**User Interfaces:** AVSWAT, ArcSWAT (GIS interface) Windows
Data Sources

Elevation: United States Geological Survey (USGS) 30 m DEM

Soil map: USDA-NRCS

Land use: Spatial Sciences Lab, Texas A&M, College Station

Weather data: State Climatologist Office, Texas A&M

Flow: International Boundary and Water commission (IBWC)

Point Sources / Outfall: Texas Commission on Environmental Quality (TCEQ)

Water Quality data: TCEQ

Other data sources:

- Local offices in the valley
- Information from previous HSPF modeling effort
Model inputs for watershed delineation

Watershed boundary: Previous HSPF modeling work
Elevation information: 30 m USGS DEM

Digitized stream network
Watershed boundary and stream network

SWAT model set up—watershed boundary
Watershed area: 1692 km² (653 sq miles)

Comparison with previous HSPF watershed boundary

watershed boundary—HSPF
Sub-watersheds

SWAT model set up of Arroyo Colorado
Total number of sub-watersheds: 17

Comparison with previous HSPF sub watersheds
Land use map

Reclassified for SWAT model

Dominant land use classes

- Cultivated land 54%
- Brush-Range grasses 18.5%
- Urban 12.5%
- Water bodies 6%
- Sugarcane 4%

AGRL and AGRR: Agricultural land
FRST: Trees/Forest
WATR: Water body
ORCD: Orchard/Citrus
RNGB: Range grasses and brush
SUGC: Sugarcane
UCOM, UIDU, UINS, URHD, URLD, URML, UTRN: Urban
WETF, WETN: Wetland

crop rotation for 2004-2007 (Farm Service Agency-USDA)
- Dates of planting
- Irrigation
- Field/farm basis
Soil map – previous HSPF modeling work
Based on county soil survey USDA-SCS

Soil map – present SWAT model setup
SSURGO data : USDA-NRCS

Moderate permeability
Low permeability
Discretization of Arroyo Colorado into HRUs

Cultivated land in sub basin 6

Soil TX21519-1 in sub basin 6

HRU - Hydrologic Response Unit

Unique combination of land use and soil type

475 HRUs in SWAT model set up

Average: 28 HRUs per sub basin

Cultivated land with Soil TX21519-1
Crop rotation information

- **678 ac** Sorghum-sorghum-sorghum-sorghum-sorghum
- **420 ac** Grass-grass-grass-grass-grass
- **262 ac** Cotton-sorghum-fallow-fallow-fallow

Model simulates crop growth

**Tillage:** mainly cultivator, deep chiseling after sugarcane harvest

**Fertilizer application:** auto-fertilizer application option used

**Irrigation:** auto-irrigation application used
List of management operations

Management Data:
Generic HRU

General Parameters:
- Initial Land Cover Status: No land cover growing

BIOMUX: 0.20
USLE_P: 1.00
BIO_MIN: 0.00
FILTERW: 0.000
CN2: 89.00

Operations:
- Schedule by Date
- Schedule by Heat Units

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<th>Operation</th>
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<th>Month</th>
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Buttons:
- Load Scenario
- Save Scenario
- Urban
- Irrigation
- TileDrain
- Add Year
- Delete Year
- Add Operation
- Delete Operation
- Edit Operation
- Help
- Cancel
- OK
Location of rain and flow measurement gauges

- Mc Allen
- Mercedes
- Harlingen

△ Rain gauge  ● flow gauge

Location of temperature gauges

- Mc Allen
- Harlingen

Modeling period: 2000-2006
Preliminary results for flow at Mercedes
Future tasks:

- Flow calibration
- Calibration for sediment, nutrients, water temperature, and dissolved oxygen
- Scenario trials to control water quality impairment
Data requirements

- Fertilizer application
  - rates and tentative dates for different crops

- Irrigation
  - timing, number of irrigations, water applied

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