Overview of Models

- CREAMS-WT
- GLEAMS
- Opus
- FHANTM
- ADAPT
- EAAMOD
- ACRU2000
- AGNPS
- ANSWERS2000
- SWAT2000
- WAM

Content of Overview

- Overview of each model will include:
  - Brief model history
  - Scope and objectives
  - Summary of process components

CREAMS-WT

- Developed by USDA-ARS for use by action agencies in 1980 and modified at UF for use in high-water-table regions
- Assembled from currently available information by a large research team
- General, flexible model to evaluate *relative* BMP effects on water quality
- Intended to be simple, yet remain physically descriptive

CREAMS-WT (cont.)

- Continuous, field scale, daily time step (original model can use either daily or sub-daily)
- Physically-based with some empirical relationships
- Daily, monthly and annual output summaries available
- Simulates runoff, ET, percolation, water-table depth, N, P, pesticide transport, and management practices

CREAMS-WT (cont.)

- UF modifications to original CREAMS
  - modified SCS CN procedure
  - ability to simulate water table in the root zone and below the root zone
  - modified P algorithms to better represent low buffering capacity of flatwoods soils

GLEAMS

- Developed by USDA-ARS beginning in mid-80s with enhancements to CREAMS to evaluate effects of management systems on agricultural chemical movement within and through the root zone
- Continuous, field scale, daily time step

GLEAMS (cont.)

- Modifications to CREAMS
  - vertical flux of pesticides
  - programs combined into one interactive program for hydrology, erosion and chemicals
  - sediment particle characteristic calculation is changed
  - improved nutrient cycling and transport

Opus

- Developed by USDA-ARS in late 1980s in an effort to improve CREAMS
- Borrows some components from CREAMS, EPIC, SWRRB, MUSLE and others
- Purpose is to study effects of weather and management inputs on water and pollutant movement in small watersheds

Opus (cont.)

- Continuous, field scale, daily time step with an option for detailed storm event simulation
- More detailed treatment of field topography and shape than GLEAMS
- Physically-based with some empirical relationships
- Event, daily, monthly and annual output summaries are available

Opus (cont.)

- Simulates weather, infiltration, runoff, ET, subsurface drainage, percolation, water-table depth, erosion, crop growth, agricultural management, nutrient cycling and transport, and pesticide fate

FHANTM

- Modification of DRAINMOD developed at UF in early 90s to include runoff routing and P movement
- DRAINMOD developed at N.C. State in mid 70s for design and analysis of water-table management systems in high water table soils

FHANTM (cont.)

- Continuous, field scale, simulates water balance on hourly basis from hourly rainfall
- Physically-based with simplifications
- Daily, monthly and annual outputs
- Simulates infiltration, runoff, ET, surface and subsurface drainage, subirrigation, water-table depth, plant water stress, and N & P movement

FHANTM (cont.)

- Modifications to DRAINMOD
  - N and P cycling routines from GLEAMS
  - subsurface nutrient routing
  - Surface runoff routing
  - Simulate other management practices related to pollutant loading

ADAPT

- Extension of GLEAMS developed at Ohio State in late 80s - early 90s using algorithms from DRAINMOD to simulate profile drainage and subirrigation
- Additional options were added for ET, infiltration, snowmelt, & macropore flow
- Current version includes nutrient cycling and transport based on GLEAMS

ADAPT (cont.)

- Includes simulation of processes below the root zone where fluctuating water tables, subsurface drainage, and deep seepage may occur
- Continuous, field scale, daily time step for most processes
- Daily, monthly and annual outputs are available

EAAMOD

- Developed at UF in mid 90s to simulate P loadings from the organic soils and underlying marl rock of the Everglades Agricultural Area
- Emphasizes the effects of management practices in reducing P losses from fields with layered soils and a shallow water table

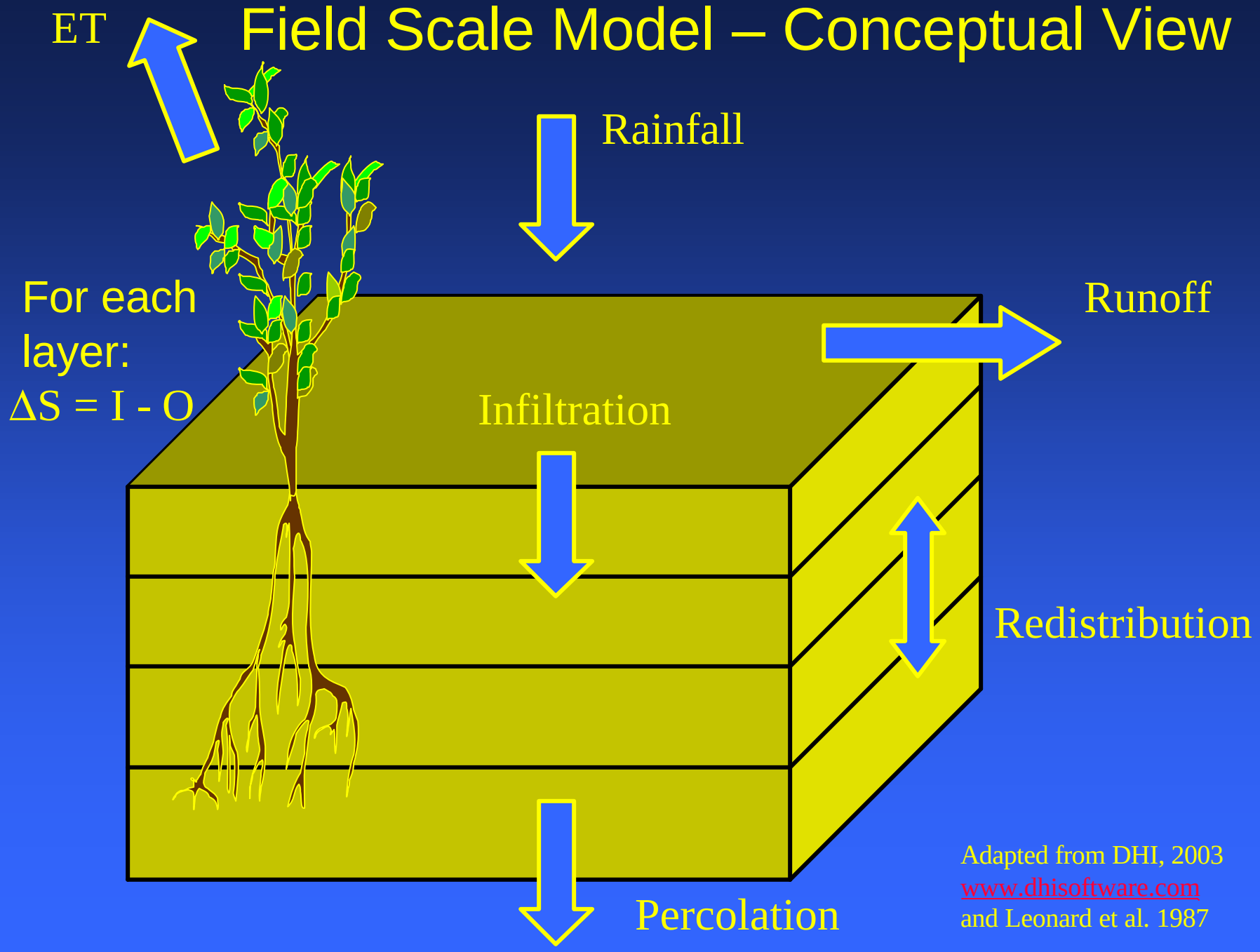
EAAMOD (cont.)

- Continuous, field scale (also a “farm” version available), variable time step
- Uses grid cells with a finite difference numerical solution technique using a maximum one hour time step
- Simulates hydraulics of water flow, water table depth, vertical and lateral seepage, and P cycling and transport

EAAMOD (cont.)

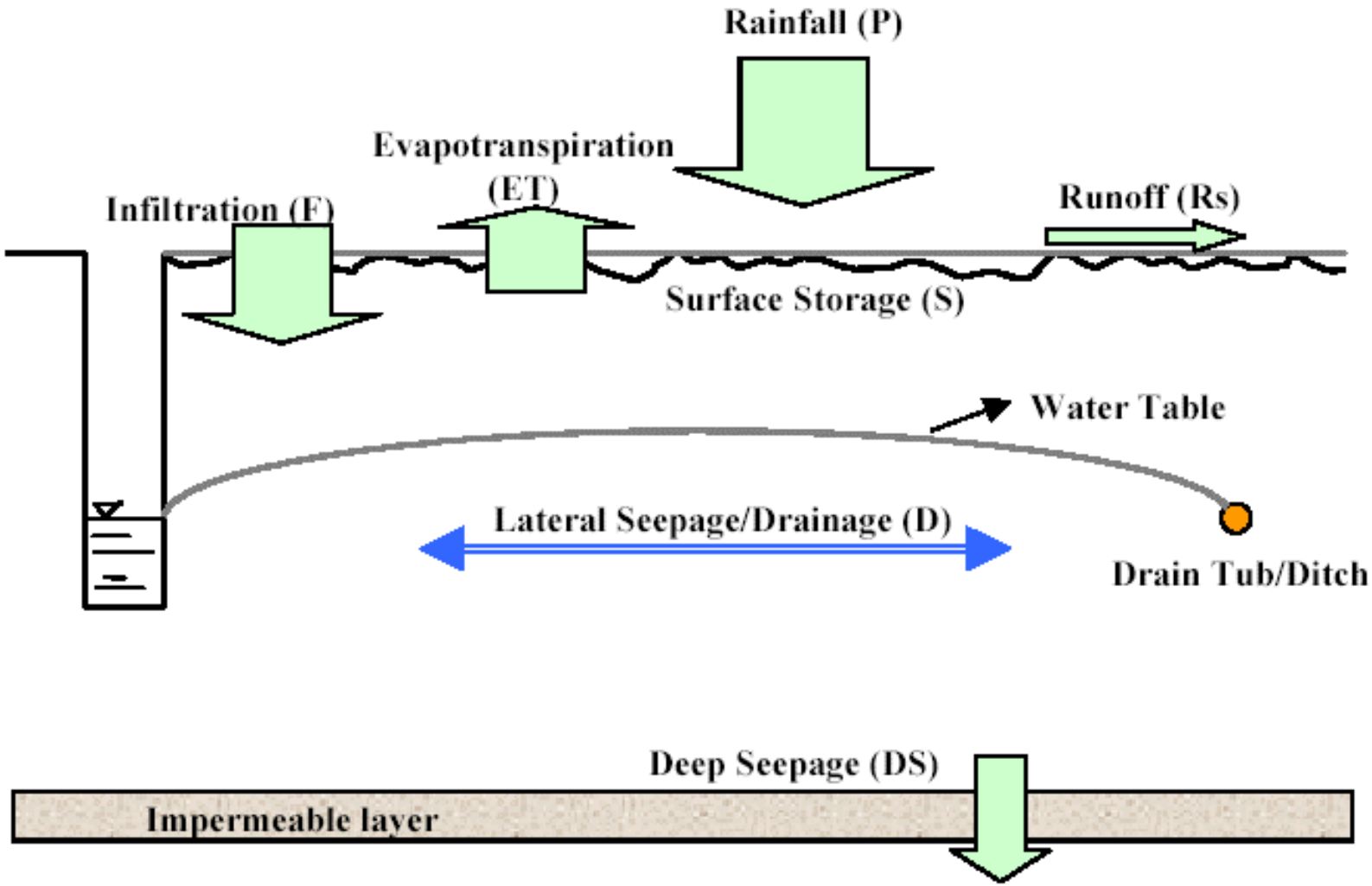
- Uses a Windows-based user input interface
- Detailed time series, daily summary, and full simulation period outputs are available in both tables and graphs

Field Scale Model – Conceptual View

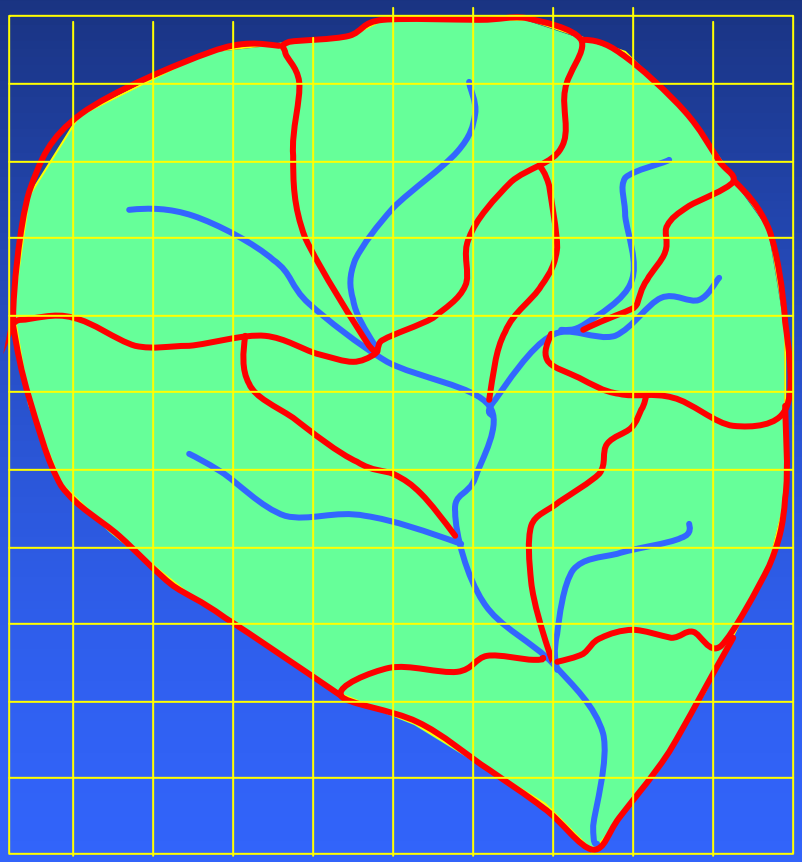


Adapted from DHI, 2003
www.dhisoftware.com
and Leonard et al. 1987

Field Scale Model for Subsurface Drainage Model – Conceptual View



Watershed Scale Model – Conceptual View



ACRU2000

- Developed in South Africa in the early 80s for hydrologic studies of water availability
- Components have been added to represent the complete hydrologic cycle
- Code recently completely rewritten in object-oriented Java

ACRU2000 (cont.)

- Multi-purpose physical model with some empirical relationships
- Continuous, watershed scale, daily time step, homogeneous cells of any shape
- Simulates surface runoff, ET, irrigation demand, percolation, crop yield, sediment, and N and P cycling and transport

ACRU2000 (cont.)

- Channel related processes include: stream water routing, baseflow, riparian zone effects, irrigation water extractions and return flows, and in-stream dams
- Recent UF additions
  - Simulate shallow water table and upflux
  - Modified P adsorption and moisture response functions for nutrient transformations
  - Multi-directional surface and subsurface flow

AGNPS

- Developed jointly by USDA-ARS, MPCA, USDA-SCS and Minnesota SWCB in mid 80s to address quality of runoff from agricultural watersheds
- Goal was flexible, easy-to-use model with primary emphasis on sediment and nutrients
- Modified in late 90s by NRCS and ARS team to include continuous simulation

AGNPS (cont.)

- Continuous, watershed scale, daily time step, homogeneous cells of any shape
- Simulates surface runoff, ET, percolation, lateral groundwater movement, sediment, N, P, organic carbon, and pesticide transport on daily basis
- Evaluates feedlots & other point sources, non-point BMPs, & resulting runoff quality

AGNPS (cont.)

- Simulates flow through drainage channel network and can output at node points within the watershed network
- Simulates stream channel hydraulics, basic nutrient and pesticide transport, sediment transport, channel erosion and in-stream impoundments

AGNPS (cont.)

- Uses Windows-based input interface and provides easy-reading, interactively-generated, output tables
- Newest version has an ArcView interface
- Event-based and source accounting outputs over the simulation period

ANSWERS2000

- Original version developed at Purdue University in early 80s for planning and evaluating strategies for controlling erosion and sediment movement in agricultural watersheds
- Modified for continuous simulation with N and P cycling and transport at Virginia Tech in early 90s

ANSWERS2000 (cont.)

- Distributed parameter, continuous, watershed scale, grid-cell based
  - cells 0.4-1 ha, up to 3,000 ha watershed
  - daily time step (30 seconds during events)
- Simulates infiltration, runoff, percolation, crop growth, ET, sediment detachment and transport, and N and P cycling and transport

ANSWERS2000 (cont.)

- Uses an ArcView-based user interface called Questions for inputs and graphical output
- Physically-based, simulates flow through some structural BMPs and the drainage channel network and can output at cells within the watershed
- Developed as a planning tool for use on ungaged watersheds

SWAT2000

- Developed by the USDA-ARS in the early 90s as a merging of the SWRRB and ROTO models
- Borrows components from CREAMS, GLEAMS, EPIC, MUSLE, QUAL2E, and SWMM models

SWAT2000 (cont.)

- Developed to predict the impact of land management practices on water, sediment, and agricultural chemicals in large, complex watersheds
- Has been integrated into the US EPA's BASINS modeling framework
- Can use an ArcView-based user interface called AVSWAT for inputs and output

SWAT2000 (cont.)

- Continuous, watershed scale, daily or sub-daily time step, sub-basin cells of any shape that can be composed of multiple HRUs
- Simulates surface runoff, ET, percolation, lateral groundwater movement, plant growth, sediment, N, P, and pesticide cycling and transport

SWAT2000 (cont.)

- Simulates chlorophyll *a*, CBOD, and DO contributions to streams by surface runoff, build-up and wash-off from urban areas
- In-stream processes include: hydraulic routing, nutrient cycling and transport, pesticide and sediment transport, algal growth and CBOD/DO/algal interaction

WAM

- A GIS based tool for determining the spatial influence of landuse and soil on hydrology and water quality at a watershed scale
- Initially called WAM (Watershed Assessment Model) when it utilized ARC/INFO grid coverages
- Sometimes called WAM*View* as it uses ArcView shapefiles and grids

WAM (cont.)

- Utilizes embedded models such as GLEAMS, EAAMOD, urban and wetland submodels
- Capable of assessing the use of
  - Stormwater Treatment Areas (STAs)
  - Reservoir-assisted STAs
  - Stormwater management BMPs
  - Non-structural BMPs

WAM (cont.)

- Simulates particulate and soluble P and N, suspended solids, BOD, and is also capable of simulating culvert and weir crest elevation as a function of time
- Has been extensively used by water management agencies (e.g. SFWMD)