Major Program Components

Program Kineros2

Description

The main program unit.

Structure

Open input/output files and get duration, time step and run-time options (Prompt).

Get parameter multipliers (Mult).

Read global parameter block (Reader).

For sediment routing, get global sediment parameters and define global sediment variables (Sed00).

Define output units and copy global data to Writer's local variables (Wrt00).

Initialize dynamic storage for element outflows (Clerk).

Read all rainfall data (Rain).

Loop to successively read element parameter blocks from parameter file (Reader), branch to appropriate subroutines (Plane, Channel, Pond, Pipe, Inject, Urban) and write element output (Writer).

Write event summary (Event).

Subroutine Clerk

Description

Provides dynamic storage for element outputs such as discharge, sediment concentration, etc. These values are then available as input to downstream elements, output, etc.

Entry point New: Allocates a new block of storage for element output.

Entry point Old: Returns the index to an existing block of storage.

Entry point Store: Stores a value in the specified block.

Entry point Get: Retrieves a value from the specified block.

Entry point Stora: Stores the contributing area of a particular element.

Entry point Geta: Retrieves the contributing area of a particular element.

Entry point Orphan: Checks for unprocessed blocks at the end of a run.

Subroutine Reader

Description

Reads a block of labeled data from a text file, passing the data to calling routines when requested.

Entry point Getr4: Returns a real*4 value.

Entry point Getr8: Returns a double precision value.

Entry point Geti4: Returns an integer*4 value.

Entry point Getstr: Returns a character string and its length.

Subroutine Writer

Description

Writes information to the output file for each element according to the print option specified.

Entry point Qwrt: Copies element volume balance data to Writer's local variables.

Entry point Swrt: Copies element sediment balance data to Writer's local variables.

Entry point Event: Writes the end-of-event volume and sediment yield summary.

Entry point Wrt00: Defines output units and copies global data to Writer's local variables.

Subroutine Rain

Description

Reads time-depth/intensity pairs for all rain gages.

Entry point Interp: Returns a set of time-depth pairs and the initial soil saturation (if specified in the rainfall file) based on interpolation from rain gage sites surrounding the element's coordinates.

Subroutine Plane

Description

Simulates overland flow using a four point implicit finite-difference approximation to the kinematic wave equation written for one-dimensional unsteady flow on a sloping plane.

Structure

Get geometric and hydraulic parameters (Geti4, Getr4, Getstr).

Get the index to the storage location for upstream inflow (Old).

Allocate storage for outflow and rainfall (New).

Update contributing area (Geta, Stora).

Interpolate rainfall intensities (Interp) and adjust for interception.

Update total rain rate over contributing area for each user-defined time step.

Get infiltration parameters and initialize infiltration variables (Infil0).

For sediment routing, get sediment parameters and initialize sediment variables (Sed0).

Compute geometric variables related to micro topography.

Initialize local variables.

A. Loop over the user-specified time steps.

B. Loop over rainfall breakpoints within the current user time step.

C. Loop over smaller steps if necessary to satisfy the Courant condition.

Get average infiltration rate (Infilt).

Interpolate upstream inflow and compute the upstream boundary depth.

Zone A solution?

Yes: Compute zone A solution.

No: Loop over spatial nodes to compute finite-difference solution (Iter).

Check Courant condition - reduce time step and restart loop C if necessary.

Compute sediment concentration at each node (Kinsed).

End loop C.

End loop B.

Save the discharge rate from the end of the plane (Store).

End loop A.

Finish sediment computations (Sedfin).

Pass volume balance data to Writer (Qwrt).

Subroutine Channel

Description

Simulates open channel flow using a four-point implicit finite-difference approximation to the kinematic wave equation written for one-dimensional unsteady flow in a compound trapezoidal channel, where the cross section may include an "overbank" section which floods when the main channel is overtopped.

Structure

Get lateral and upstream contributing element identifiers, channel length, Woolhiser coefficient, baseflow, and channel type (Geti4, Getr4, Getstr).

Loop to get upstream and downstream geometric and hydraulic parameters (Getr4).

Initialize local variables.

Loop to interpolate hydraulic parameters at each spatial node.

Compound channel -

Loop to get upstream and downstream geometric and hydraulic parameters.

Loop to interpolate hydraulic parameters at each spatial node.

Get the indices to the storage locations for upstream and lateral inflow (Old).

Allocate storage for outflow and rainfall (New).

Update contributing area (Geta, Stora).

If **rw**idth is specified, interpolate rainfall intensities (Interp).

Update total rain rate over contributing area for each user-defined time step.

Get infiltration parameters and initialize infiltration variables (Infil0).

For sediment routing, get sediment parameters and initialize sediment variables (Sed0).

If **qb**f is specified, compute the baseflow contribution to lateral inflow and determine the initial depth profile due to baseflow. For sediment routing, compute the initial sediment concentration due to baseflow (Sedbf).

A. Loop over the user-specified time steps.

If **rw**idth is specified, compute average rain rate over the current time interval.

B. Loop over smaller steps if necessary to satisfy the Courant condition.

Get average infiltration rate (Infilt).

Interpolate lateral and upstream inflow and compute upstream boundary depth.

Zone A solution?

Yes: Compute zone A solution.

No: Loop over spatial nodes to compute finite-difference solution (Iter).

Check Courant condition - reduce time step and restart loop B if necessary.

Compute sediment concentration at each node (Kinsed).

End loop B.

Save the discharge rate at the outlet of the channel (Store).

End loop A.

Finish sediment computations (Sedfin).

Pass volume balance data to Writer (Qwrt).

Subroutine Infilt

Description

Computes an average infiltration rate over the current time step for each spatial node of a plane or channel element.

Entry point Infil0: Gets infiltration parameters and initializes infiltration variables.

Subroutine Kinsed

Description

A four-point explicit finite-difference solution of the equation of supply and conservation of a transported material. The solution is explicit because discharge and depth are known from the kinematic solution obtained in plane or channel for the same time step.

Entry point Sed0: Gets sediment parameters and initializes sediment variables.

Entry point Sed00: Gets global sediment parameters and defines global sediment variables.

Entry point Sedbf: Computes initial concentration in a baseflow profile based on transport capacity.

Entry point Sedfin: Finishes sediment balance computations.

Subroutine Pond

Description

Computes the volume and associated outflow of a detention pond with a given volume-discharge relation in tabular form.

Structure

Initialize local variables.

Get lateral and upstream contributing element identifiers, rating table, infiltration rate and initial storage volume (Geti4, Getr4, Getstr).

Get indices to storage locations for rainfall, inflow and outflow (New, Old).

Update contributing area (Geta, Stora).

Interpolate rainfall intensities (Interp).

Update total rain rate over contributing area for each user-defined time step.

A. Loop over the user-specified time steps.

B. Loop over rainfall breakpoints within the current user time step.

Solve for pond volume and discharge based on continuity and interpolation of the rating table (Iter)

For sediment routing, compute the sediment balance.

End loop B.

Save the discharge rate at the outlet of the pond (Store).

For sediment routing, save the sediment concentration (Store).

End loop A.

Pass volume balance data to Writer (Qwrt).

For sediment routing, pass sediment balance data to Writer (Swrt).

Subroutine Urban

Description

Represents a composite urban element consisting of up to six overland flow subareas representing various combinations of pervious and impervious surfaces contributing to a paved, crowned street.

Structure

Get input parameters (Geti4, Getr4).

Get the index to the storage location for upstream inflow (Old).

Allocate storage for rainfall (New).

Update contributing area (Geta, Stora).

Interpolate rainfall intensities (Interp).

Update total rain rate over contributing area for each user-defined time step.

Allocate temporary storage for total lateral flow into the street (New).

A. Loop over the six possible overland flow subareas.

If the area fraction is nonzero, then:

If the subarea is contributing flow to another subarea, allocate temporary storage for its outflow (New).

Initialize local variables.

Get infiltration parameters and initialize infiltration variables (Infil0).

If the subarea is receiving inflow from another subarea upstream, get the index to the temporary storage location (Old).

B. Loop over the user-specified time steps.

C. Loop over rainfall breakpoints within the current user time step.

D. Loop over smaller steps if necessary to satisfy the Courant condition.

Get average infiltration rate (Infilt).

Interpolate upstream inflow and compute the upstream boundary depth.

Zone A solution?

Yes: Compute zone A solution.

No: Loop over spatial nodes to compute finite-difference solution (Iter).

Check Courant condition - reduce time step and restart loop D if necessary.

End loop D.

End loop C.

End loop B.

If the subarea is contributing flow to another subarea, save the discharge rate from the subarea (Store), otherwise add the discharge rate to the total flowing into the street (Old, Store).

End loop A.

Allocate storage for final outflow from street (New).

Re-initialize local variables.

E. Loop over the user-specified time steps.

F. Loop over smaller steps if necessary to satisfy the Courant condition.

Interpolate lateral and upstream inflow and compute upstream boundary depth.

Zone A solution?

Yes: Compute zone A solution.

No: Loop over spatial nodes to compute finite-difference solution (Iter).

Check Courant condition - reduce time step and restart loop B if necessary.

End loop F.

Save the discharge rate at the end of the street (Store).

End loop E.

Pass volume balance data to Writer (Qwrt).

Subroutine Inject

Description

Reads a file with time and inflow data pairs, interpolates values at the user-specified time steps, and stores them. If sediment routing has been requested, it will also attempt to read sediment concentration, and if that fails, will assume the incoming water carries no sediment, i.e., zero concentration for all particle classes.

Kineros2 Main Program Structure