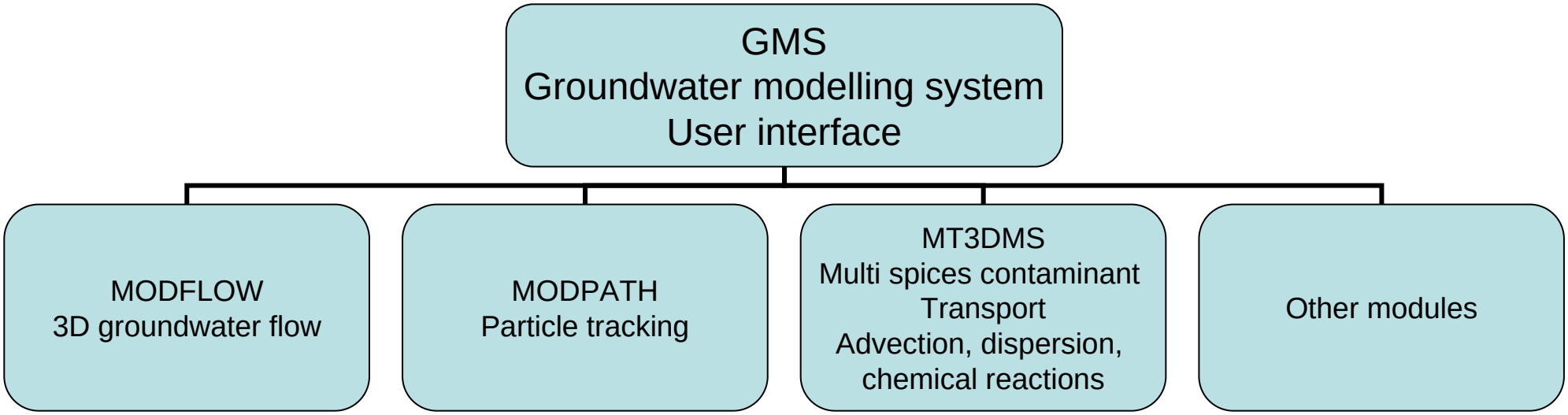
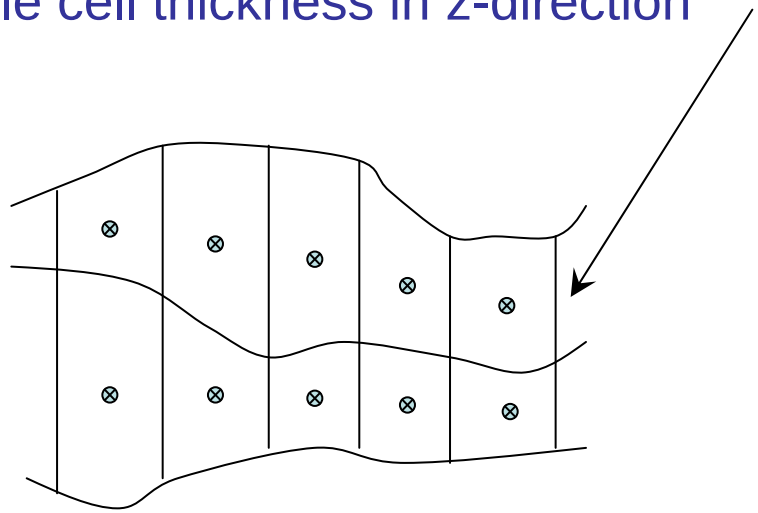
GMS


GMS
Groundwater modelling system
User interface
MODFLOW
3D groundwater flow
MODPATH
Particle tracking
MT3DMS
Multi spices contaminant
Transport
Advection, dispersion,
chemical reactions
Other modules

GMS – water flow

Engine:

- MODFLOW – free source code from the USGS
- World wide dominating groundwater model
- Finite difference approximation of governing equations
- Discretize into rectangular cells in x-y directions
- Variable cell thickness in z-direction

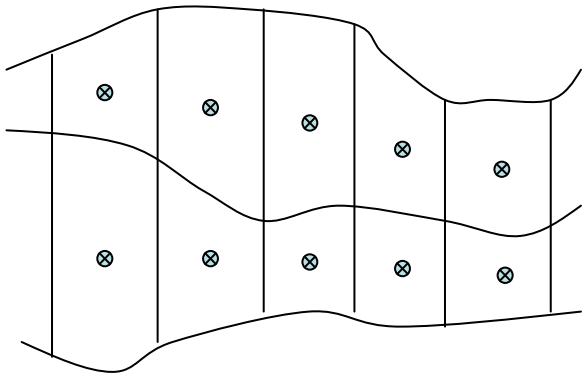


GMS – water flow

Input:

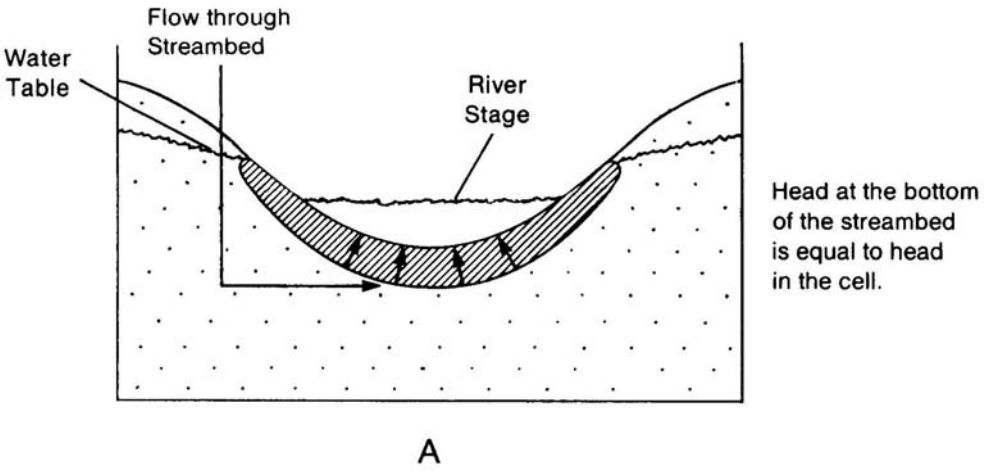
- Darcy parameters: hydraulic conductivity **K** - on cell basis
- Storage terms: Storage coefficient $\mathbf{S_s}$ and Specific yield $\mathbf{S_y}$ – on cell basis
- Sink/sources: precipitation, abstraction, exchange with rivers, drain **R**
- Initial conditions (head (h) in all cells.
- Boundary conditions – no flow or known head

$$K_x \frac{\partial^2 h}{\partial x^2} + K_y \frac{\partial^2 h}{\partial y^2} + K_z \frac{\partial^2 h}{\partial z^2} - R = S_S \frac{\partial h}{\partial t}$$

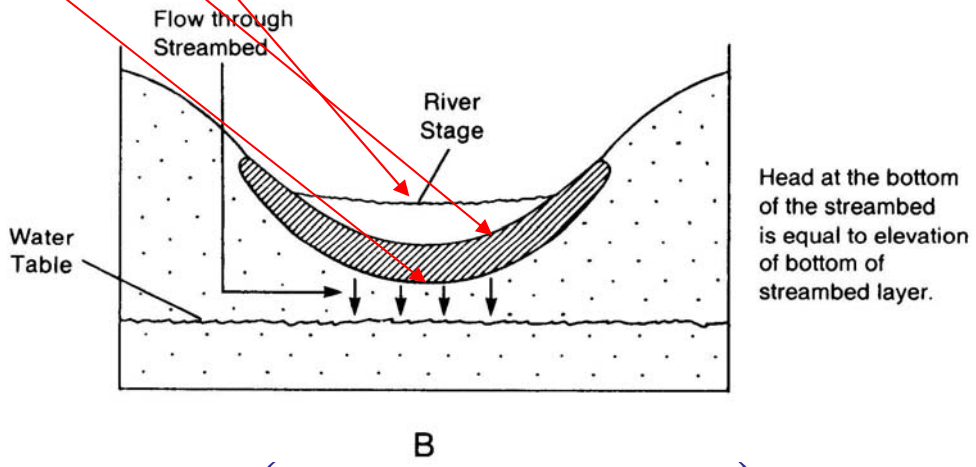


Sink/sources - Rivers

Stage, *H*: Head in river (water level)
Conductance, *C*: River bed conductance
Bed elevation, Z_{bed} : River bed elevation



A



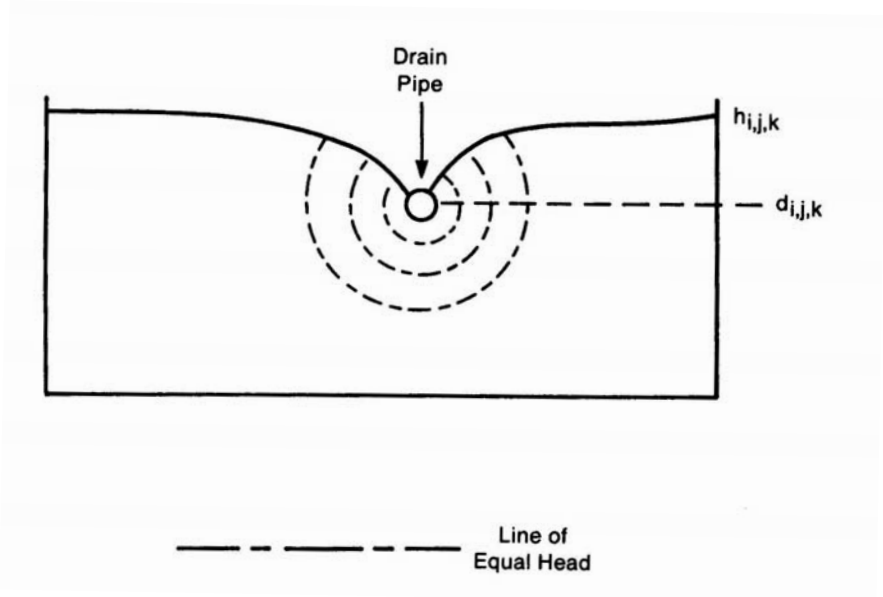
B

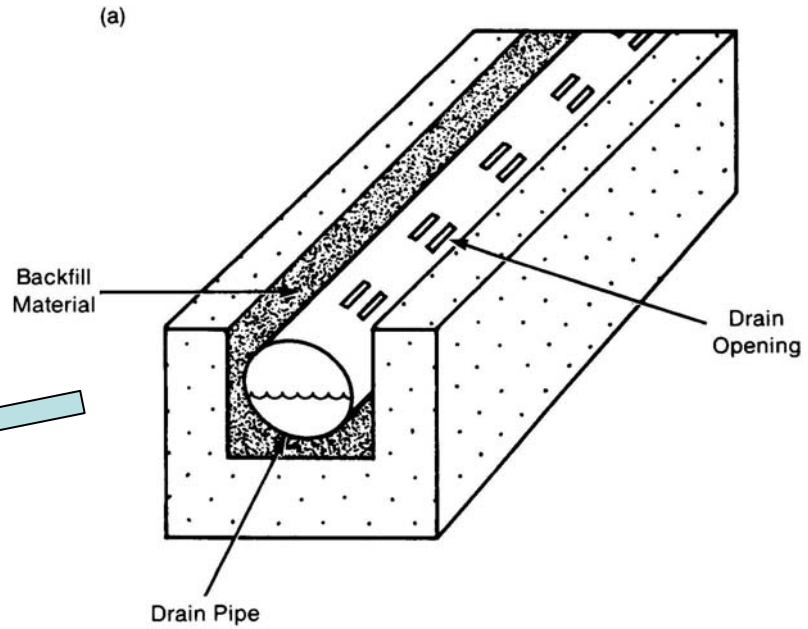
$$q_{i,j,k} = \left(H_{i,j,k}^{n+1} - h_{i,j,k}^{n+1}\right) C_{i,j,k}$$

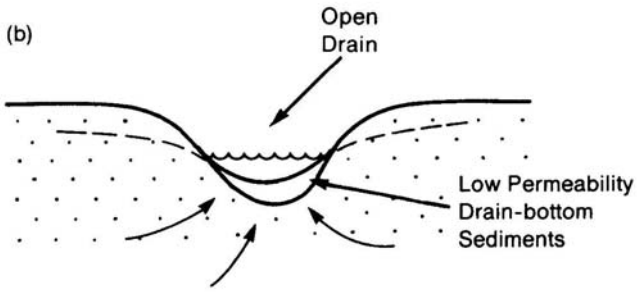
$$q_{i,j,k} = \left(H_{i,j,k} - z_{bed,i,j,k}\right) C_{i,j,k}$$

Drains - sink

Elevation, $d_{i,j,k}$: drain elevation
Conductance, $C_{i,j,k}$: drain conductance







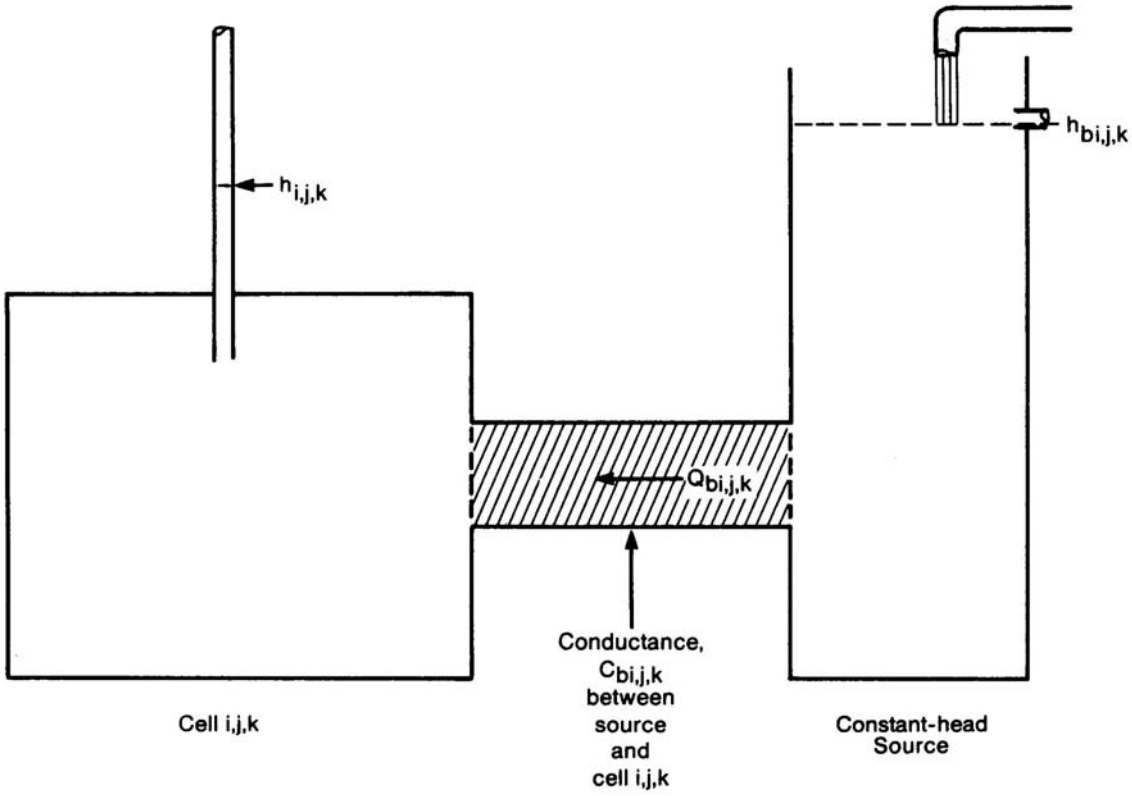
$$q_{i,j,k} = \left(h_{i,j,k}^{n+1} - d_{i,j,k}\right) C_{i,j,k} \quad \text{if} \quad h_{i,j,k}^{n+1} \geq d_{i,j,k}$$

$$q_{i,j,k} = 0 \quad \text{if} \quad h_{i,j,k}^{n+1} < d_{i,j,k}$$

General head – sink/source

Head, $h_{b,i,j,k}$: Constant head
Conductance, $C_{b,i,,j,k}$: Conductance

$$q_{i,j,k} = \left(h_{i,j,k}^{n+1} - h_{b,i,j,k}\right) C_{b,i,j,k}$$



MODFLOW documentation: modflow88I.pdf *and* mf2k_flowprocess.pdf

Use the documents!!!

GMS – a pre and post processor

How to enter data….

The **grid approach** or the **conceptual model approach**

The grid approach:

1. Define grid
2. Assign data directly to the grid

The Conceptual model approach

1. Assign data to GIS data types (line, point and polygons)
   - e.g. a river is a line coverage, a zone with constant conductivity is specified as a polygon coverage.
   - Data can be imported as ArcView GIS shapes or created within GMS
2. Define grid
3. Map data from the conceptual model into the grid.

Modules in GMS

GMS is organized into eleven modules. Each module is associated with a particular object type. Only one module is active at any given time. As you switch modules, the menus and the tools unique to the active module are displayed.

- TIN
  Used for surface modeling with Triangulated Irregular Networks (TINs).
- Borehole
  Used to display and edit borehole data
- Solid
  Used to view and assign properties to 3D models of stratigraphy using solid models.
- 2D Mesh
  Contains SEEP2D interface.
- 2D Grid
  Used for contouring and surface plotting.
- 2D Scatter Point
  Contains 2D geostatistics tools.
- 3D Mesh
  Contains FEMWATER interface.
- 3D Grid
  Contains MODFLOW, MODPATH, MT3DMS, RT3D, and SEAM3D interfaces. Also used to generate 3D iso-surface plots.
- 3D Scatter Point
  Contains 3D geostatistics tools.
- Map
  Used to build conceptual models using GIS objects.
- GIS
  Used to interact with shape files and can run ESRI from within GMS.

Module used in the grid approach …

A tour de GMS – Grid approach

GMS

AAU – site license to version 7.x

Tutorials will after installation be
located

Quick tour➔ help → GMS help → quick tour

Tutorial files:
The tutorial files that we will use during the course is located in C:\Documents and Settings\”user”\My Documents\GMS 7.1