# COURSE: GROUNDWATER MODELLING USING MODFLOW

## Session 5: Description MODFLOW Package and Programs, Parameters, Name File and Observation File

### Objective:

The objective of this session is learning about the package and programs, define parameter, name file and observation file.
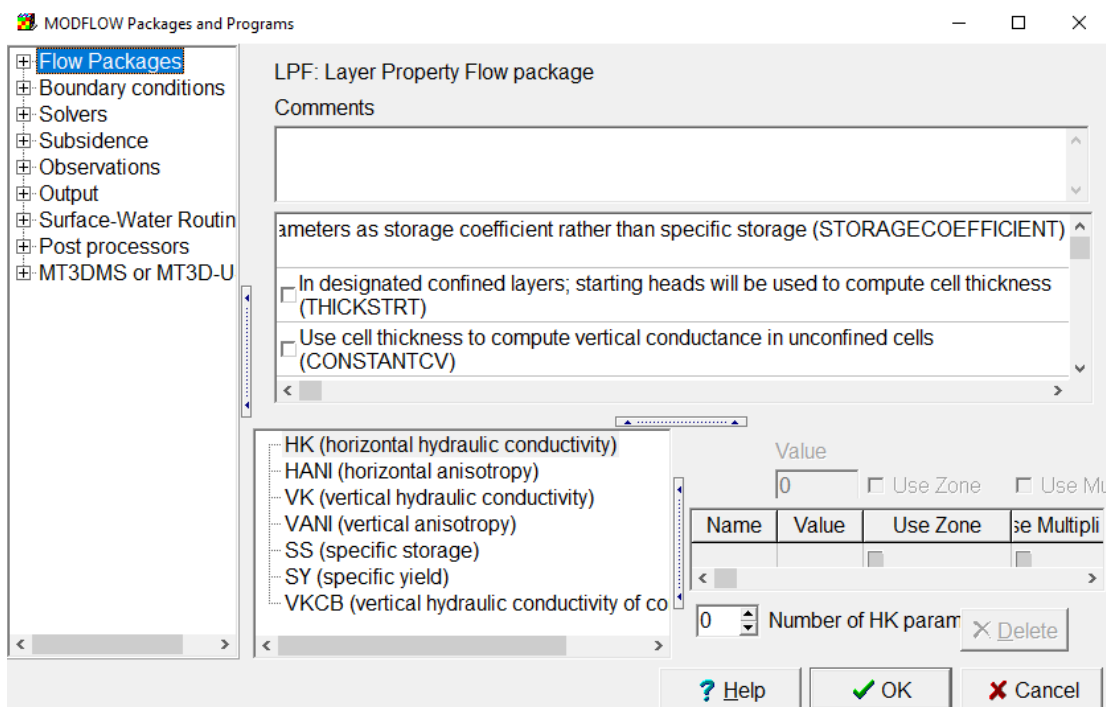
### Package and programs

MODFLOW displays a dialog box where non-space data required for the different MODFLOW and MODPATH packages is entered.
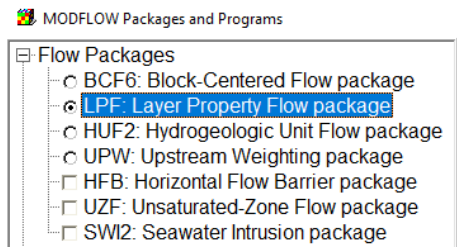
In this exercise, open **Model1.gpt** located in the folder:

**Course_GroundwaterModellingMODFLOW\Week_5\Practice\Models**

The next step is select **Model/MODFLOW Packages and Programs.** The packages will be described below:

The **Flow Package** has different packages for example:



In this case will be explained about:

**BCF (Block-Centered Flow):** This package simulates the internal flow in MODFLOW, specifying the properties that control water flow (conductivity) in the center of each cell.

**LPF Package (Layer Property Flow):** This is a package that simulates the flow in the saturated zone.

The options of this LPF package will be described:
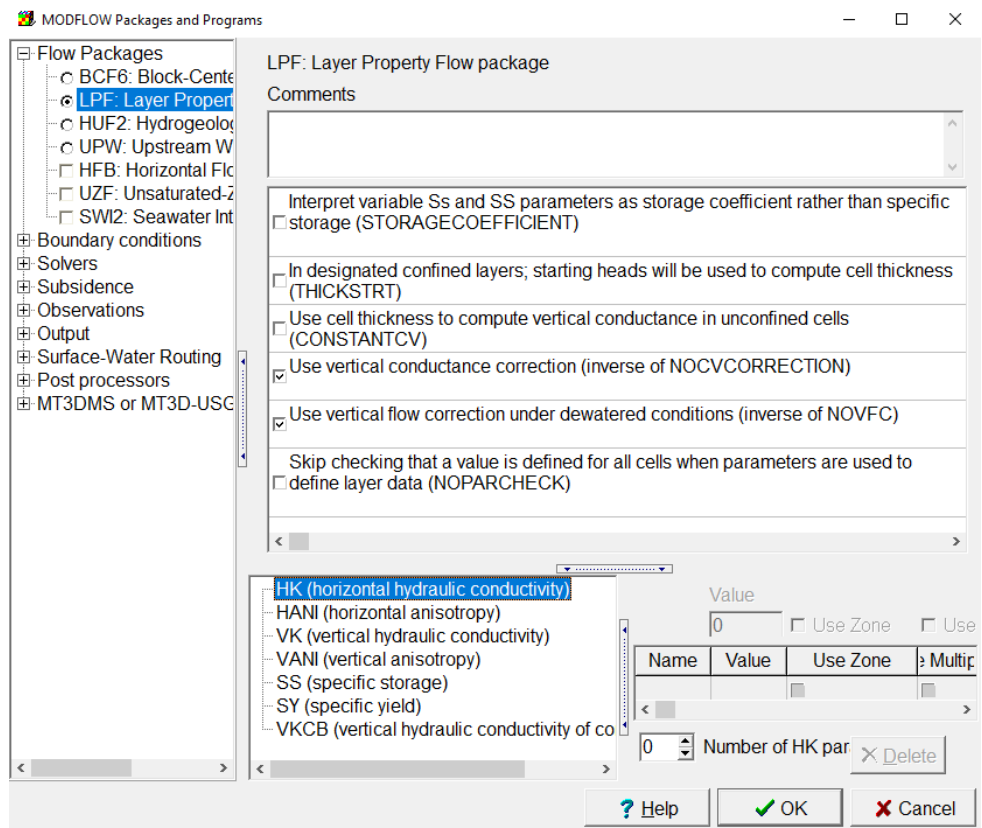


The first 2 options are used to treat an unconfined layer as confined, helping to achieve convergence more easily.

- The specific storage is treated as if it were specific yield.
- Indicates that in some user-designated confined layers, the thickness of their cells will be [starting head - cell bottom] instead of [cell top - cell bottom].

The following options are used to promote model convergence by disabling or simplifying some calculations about vertical flow.

Then select **Boundary Condition**, that allow represent locations in the model where water flows into or out of the model region due to external factors. Lakes, streams, recharge, evapotranspiration and wells.

There a three types of boundary conditions in MODFLOW: **Specified heads, Specified fluxes**, and **head dependent fluxes.**
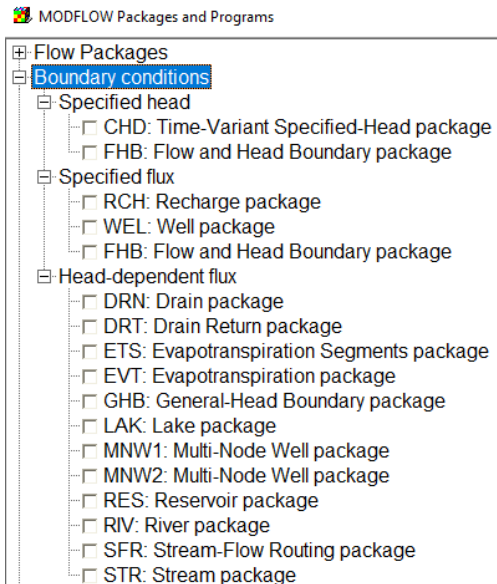


- Time-Variant Specified-Head package (CHD): This package allows the user to specify the head in the model cells.
- Recharge Package Panel (RCH) This package allows us to specify the rate of recharge over a certain area.
- Well Package Panel (WELL): This package allows us to specify the rate of volume injected or extracted.
- Drain Package Panel (DRN): This package causes water to drain out of the system when the head in a cell exceeds the elevation of the drain condition.
- Evapotranspiration Package(EVT): This package causes the water to leave the system at a rate that depends on the head in the cell with this condition.
- River Package (RIV): This package is used to enter or withdraw flow from the aquifer, depending on the hydraulic head.

Then select **Solvers**, each model needs to include one Solver package. Each solver package defines a different algorithm used to solve the model equations.

For example **The Preconditioned Conjugate Gradient (PCG)** package is the most commonly used solver package because it is fast and does not require excessive memory.
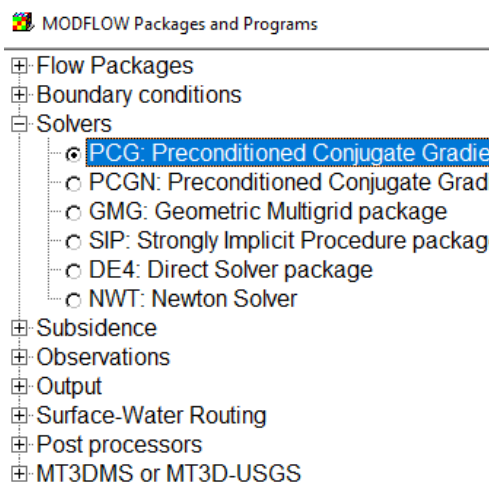


Then select **Subsidence**, MODFLOW has several packages that can be used to simulate subsidence due to groundwater withdrawal. The ones supported in ModelMuse are the **SUB** and **SWT** packages. These programs simulate groundwater storage changes and compaction
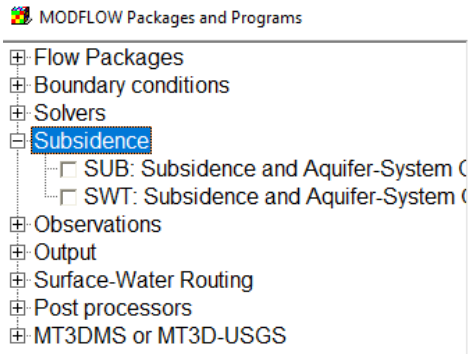
Then select **Observations** packages are used to compare observed data with data simulated by the program. These comparisons are very important in model calibration.

**Head Observation Package (HOB)** The observed data enter as points in the plant view of the model. The simulated head is interpolated from the center of the nearest cell to the observed head position for the comparison.
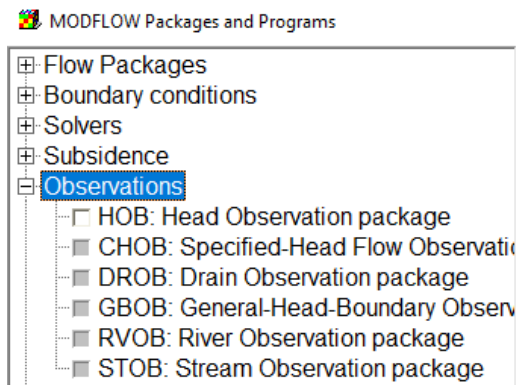


Then select **Output**, only one package related to output can be selected the **HYDMOD** package is used to record time-series data for selected data types.
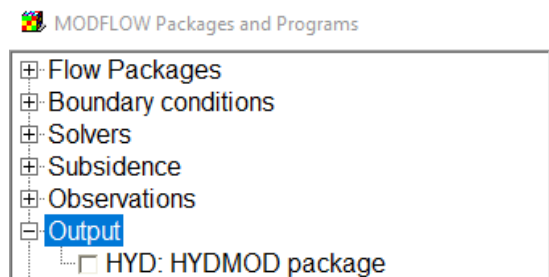
Then select **Surface-Water Routing Process,** is used to simulate complex surface-water flow conditions. For example, it can simulate backwater effects due to flooding and can simulate structures, such as dams, that control the flow.
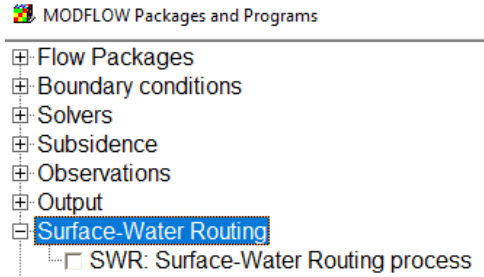


Then select **Post Processors**, ModelMuse supports two post processors: **MODPATH** and **ZONEBUDGET.**

- **MODPATH** is used for particle tracking. The user assigns starting locations for particles and MODPATH will track the advective transport of those particles either forward or backwards.

- **ZONEBUDGET** is used for constructing subregional water budgets. The user assigns cells to zones and ZONEBUDGET constructs a water budget for all the cells in each zone.
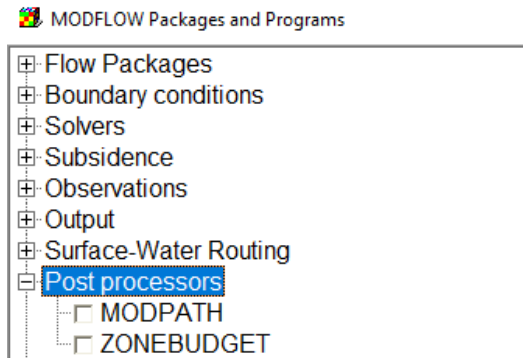


Then select **MT3DMS or MT3D-USGS**, various MT3DMS and MT3D-USGS packages can be selected on the can be selected in the MODFLOW Packages and Programs dialog box.

MODFLOW Packages and Programs

- ⊞ Flow Packages
- ⊞ Boundary conditions
- ⊞ Solvers
- ⊞ Subsidence
- ⊞ Observations
- ⊞ Output
- ⊞ Surface-Water Routing
- ⊞ Post processors
- ⊟ MT3DMS or MT3D-USGS
  - ☐ BTN: Basic Transport package
  - ▢ ADV: Advection package
  - ▢ DSP: Dispersion package
  - ▢ SSM: Sink and Source Mixing package
  - ▢ RCT: Chemical Reactions package
  - ▢ GCG: Generalized Conjugate Gradient S
  - ▢ TOB: Transport Observation package
  - ▢ CTS: Contaminant Treatment System P₂
  - ▢ LKT: Lake Transport Package
  - ▢ SFT: Stream Flow Transport Package
  - ▢ UZT: Unsaturated-Zone Transport packa