Education evenings 2018

Practical introduction to groundwater modelling

Computer exercises
03 02 Particle tracking

1

Purpose

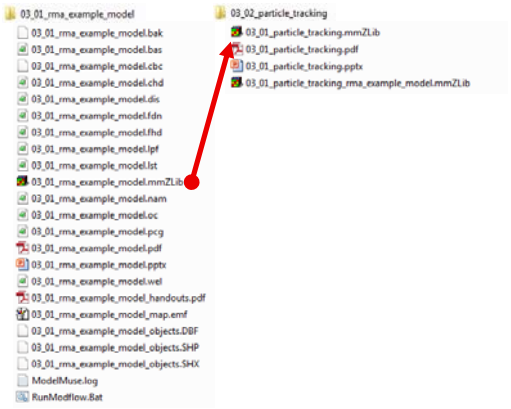
In this example, we will use the Rocky Mountain Arsenal model, one of the examples that come with ModelMuse, to set up

- ✓ forward particle tracking to visualize advective flow paths from a disposal pond, and
- ✓ backward particle tracking to map an (advective) well capture zone.

2

Copy example model

- ✓ Copy the model from the previous exercise "03-01_rma-example-model.mmZLib" to folder "/03-02_particle-tracking/",
- ✓ and rename the copied file to "03-02_particle-tracking.mmZLib".
- ✓ Another option is to copy file "03-01_rma-example-model.mmZLib" in folder "/06_solutions/".
- ✓ Double click the new file to open ModelMuse.

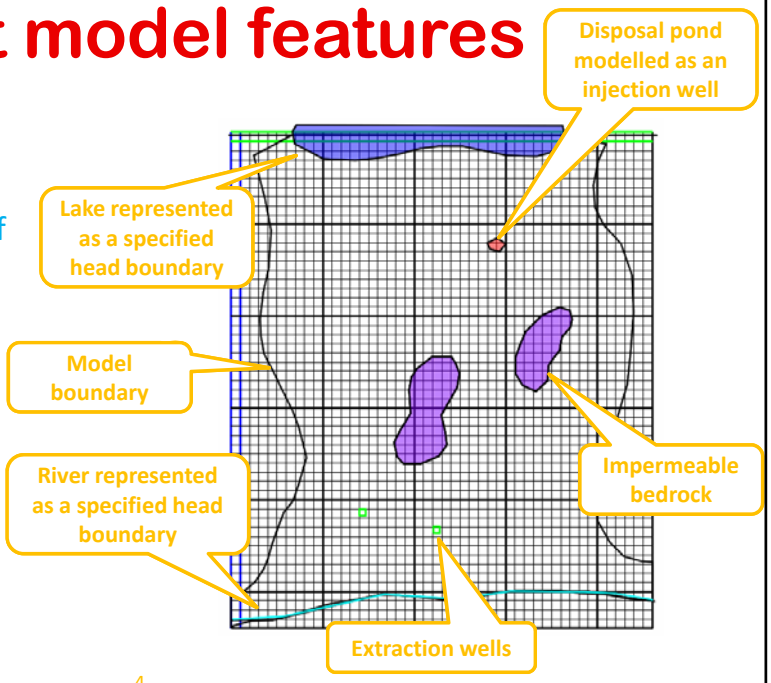


3

Inspect model features

Take some time to inspect the objects and learn what model features they define, if you did not just create them yourself in the last exercise.

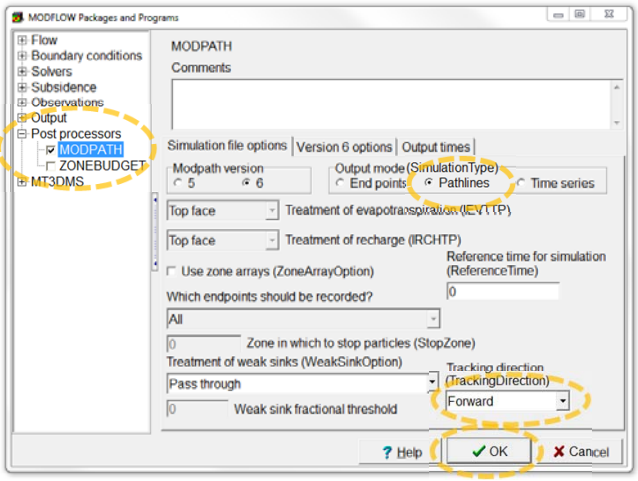
- ✓ What is the lake head?
- ✓ How is the river head specified?
- ✓ How is the impermeable bedrock simulated?
- ✓ How much does the extraction well pump?
- ✓ How much does the disposal pump leak?



4

Enable MODPATH

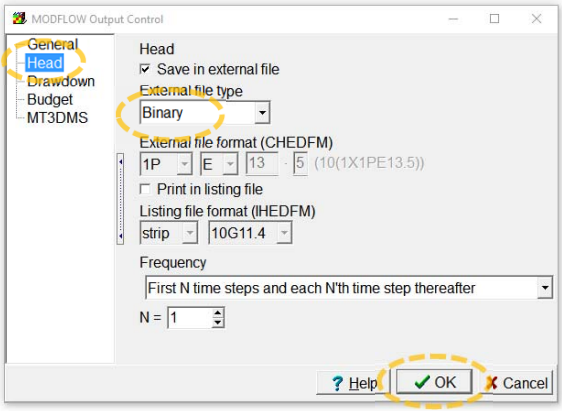
- ✓ Select **Model | MODFLOW Packages and Programs…**,
- ✓ expand **Post processors**, and
- ✓ check the check box for **MODPATH**.
- ✓ Change the Output mode to **Pathlines**, and note we will be doing **Forward** tracking,
- ✓ and press **OK**.



5

Change head output file type

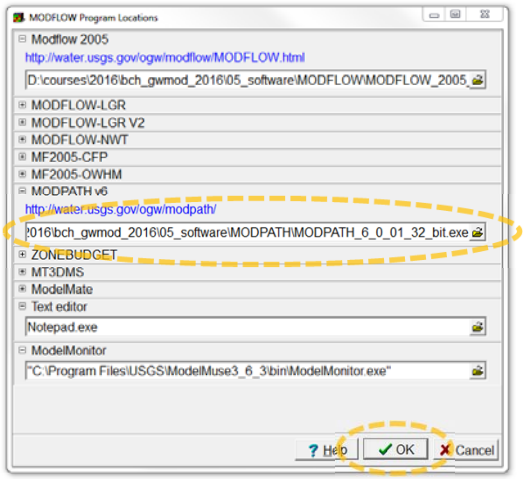
- ✓ Note you get a warning concerning the head output file type.
- ✓ Select **Model | MODFLOW Output Control…**,
- ✓ Choose **Head**, and set the **External file type** to **Binary**.
- ✓ Click **OK**.



6

Set the MODPATH program location

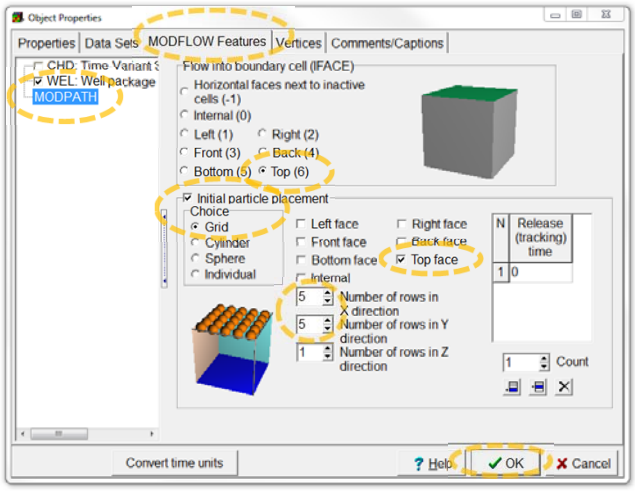
- ✓ Select **Model | MODFLOW Program Locations**, and
- ✓ fill in the path to the MODPATH executable for your machine architecture in folder "/05_software/modpath/".
- ✓ Then press **OK**.



7

Define initial particle placement

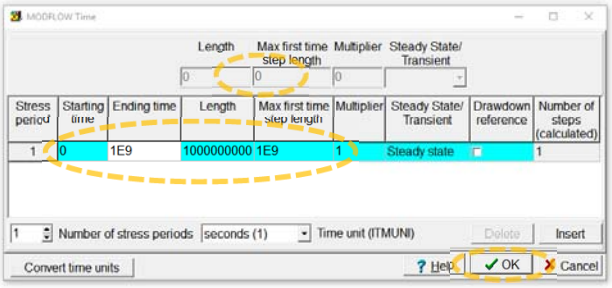
- ✓ Double click on the disposal pond object,
- ✓ and in the **Object Properties** dialog box, select **MODFLOW Features**, and click on **MODPATH**.
- ✓ Set the flow into the cell at the **Top** face, and
- ✓ put 5 by 5 particles at the **Top face** in the **Grid**.
- ✓ Then press **OK**.



8

Chance stress period duration

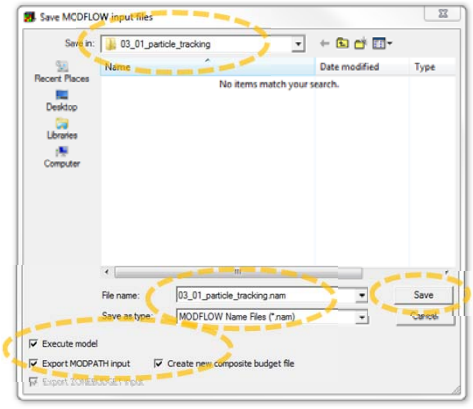
- ✓ Select **Model | MODFLOW Time…** and
- ✓ Set **Starting time** to 0,
- ✓ **Ending time**, **Length** and **Max first time step length** to 1E9.
- ✓ Then press **OK**.



9

Run model (1/2)

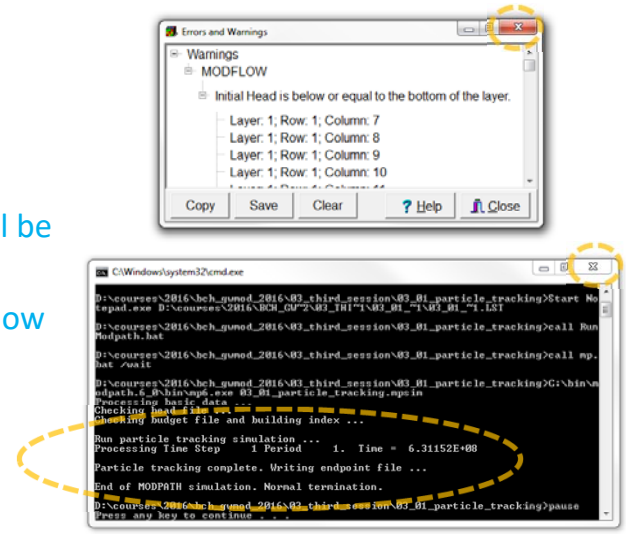
- ✓ Run MODFLOW by saving the MODFLOW input files.
- ✓ Note that the **Export MODPATH input** checkbox is selected as well, and
- ✓ check the **Create new composite budget file** checkbox.
- ✓ Press **Save** to save and run the model.



10

Run model (2/2)

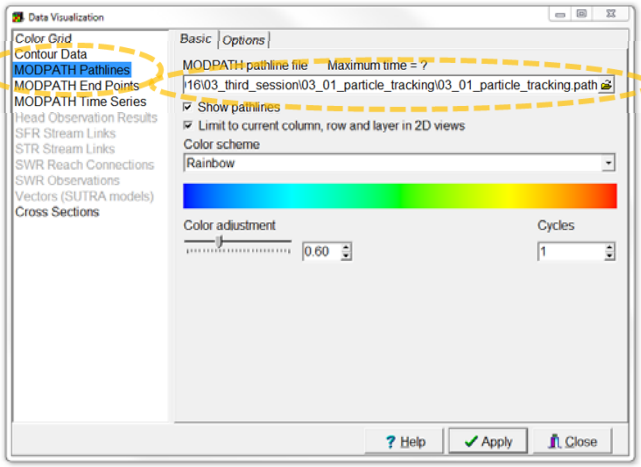
- ✓ You can neglect the warnings and close the **Errors and Warnings** window.
- ✓ Note that when you close ModelMonitor, MODPATH will be launched as well.
- ✓ Close the command line window after it has finished.



11

Visualize pathlines (1/2)

- ✓ Select **Data | Data Visualization…** or use the corresponding button,
- ✓ and choose **MODPATH Pathlines**.
- ✓ Select the MODPATH pathline file "03-01_particle-tracking.path".



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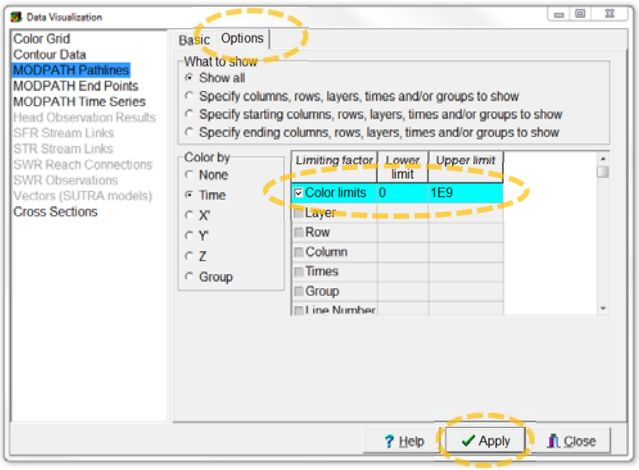
Visualize pathlines (2/2)

- ✓ Switch to the **Options** tab, and
- ✓ set the **Color limits** to 0 and 1E9.
- ✓ Then press **Apply**.



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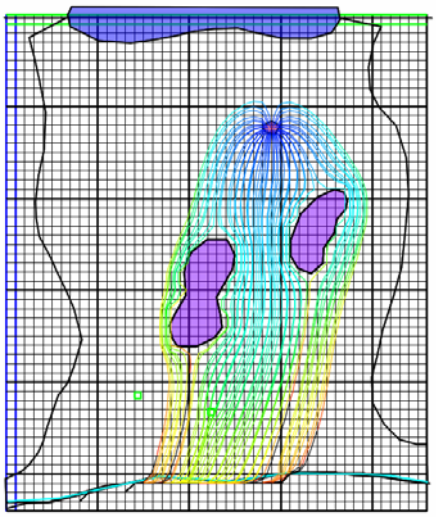
This is what you should get



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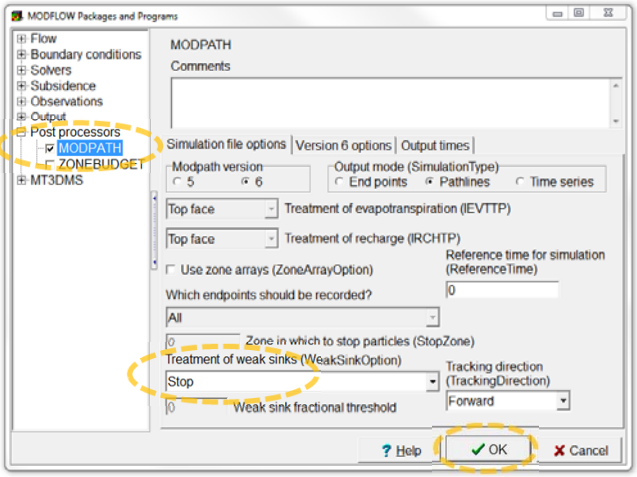
Rerun MODPATH without weak sinks (1/3)

- ✓ Select **Model | MODFLOW Packages and Programs…**,
- ✓ go to **MODPATH**,
- ✓ and set the **Treatment of weak sinks** to **Stop**.
- ✓ Then press **OK**.



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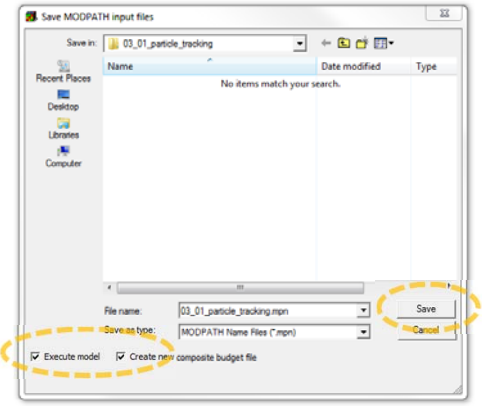
Rerun MODPATH without weak sinks (2/3)

- ✓ Select **File | Export | MODPATH Input Files**,
- ✓ check the **Execute model** and **Create new composite budget file** checkboxes, and
- ✓ press **Save**.



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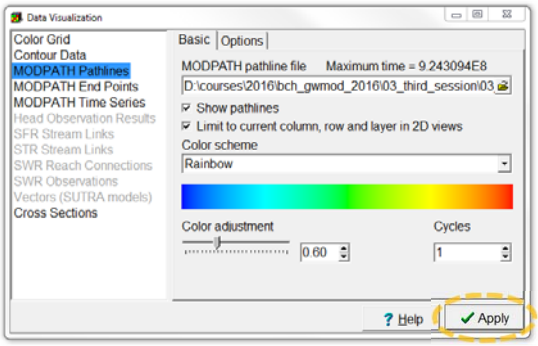
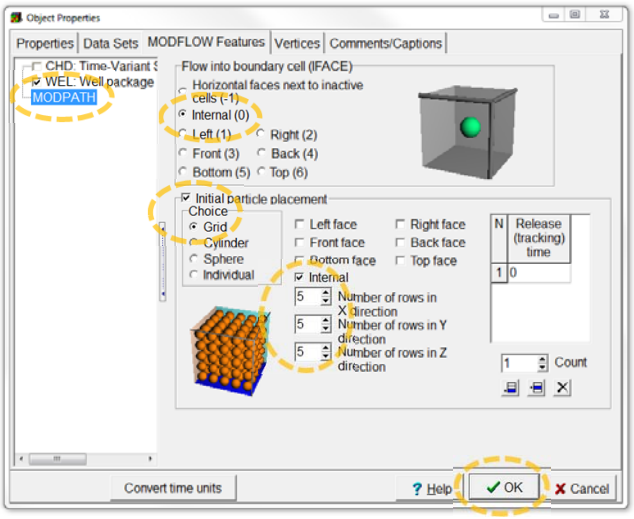
Rerun MODPATH without weak sinks (3/3)

- ✓ Now update the visualization in the **Data Visualization** dialog box, by pressing **Apply**,
- ✓ and click **Yes** to import the new file.
- ✓ Can you see what has changed by stopping the particles at weak sinks?



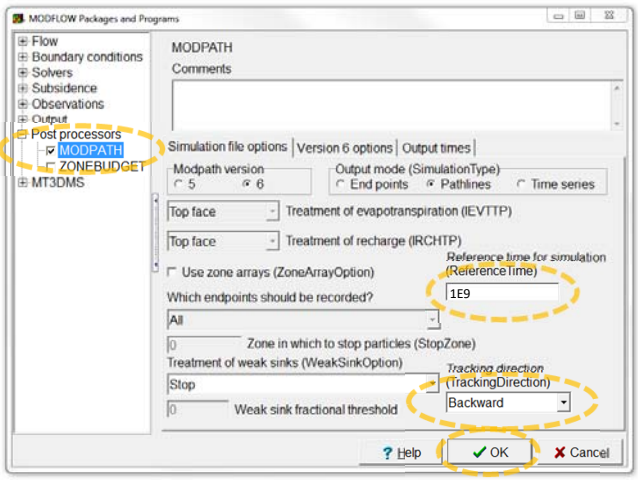
Define particles at well cells

- ✓ Double click on each of the extraction well objects,
- ✓ go to the **MODFLOW Features** tab in the **Object Properties** dialog box, and
- ✓ set **IFACE** to **Internal**,
- ✓ the **Initial particle placement** to **Grid** and **Internal**, and
- ✓ use 5 by 5 by 5 rows.
- ✓ Then press **OK**.



Rerun MODPATH with backward tracking (1/3)

- ✓ Select **Model | MODFLOW Packages and Programs…**,
- ✓ go to **MODPATH**,
- ✓ set the **Reference time for simulation** to 1E9,
- ✓ and set the **Tracking direction** to **Backward**.
- ✓ Then press **OK**.



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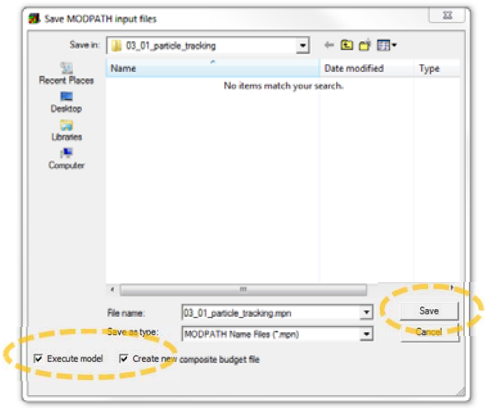
Rerun MODPATH with backward tracking (2/3)

- ✓ Select **File | Export | MODPATH Input Files**,
- ✓ check the **Execute model** and **Create new composite budget file** checkboxes, and
- ✓ press **Save**.



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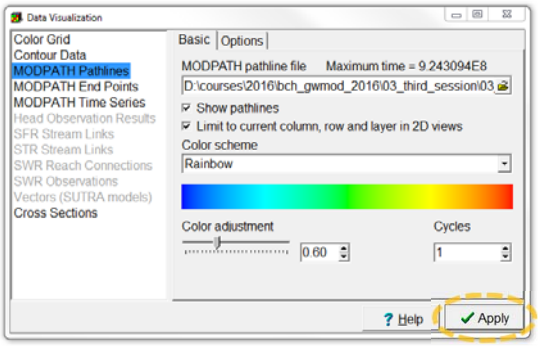
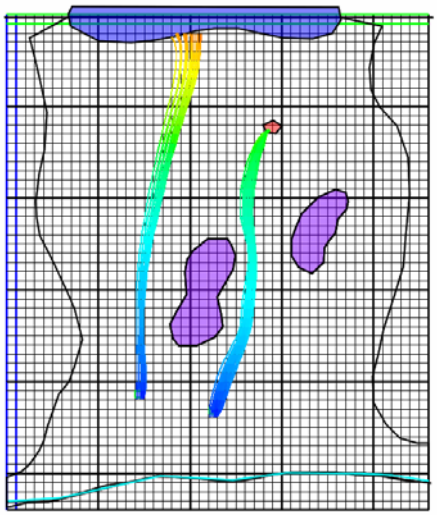
Rerun MODPATH with backward tracking (3/3)

- ✓ Now update the visualization in the **Data Visualization** dialog box, by pressing **Apply**,
- ✓ and click **Yes** to import the new file.



21

This is what you should get



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Questions? Found an error?
Please contact B. Rogiers at brogiers@sckcen.be.

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