

# Presentation 12

## Evaluating Output from SEAWAT Version 4

### Model Results of Interest

- Listing Files
  - Flow budget
  - Solute mass budget
- Heads
- Flows
- Concentrations
  - Unformatted concentration file
  - Concentration observations
- Solute mass budget

## Listing Files

- Output from both MODFLOW and MT3D are written to either:
  - Global Listing File (of FTYPE GLOBAL)
  - Forward run listing file (of FTYPE LIST)
- Output file contains
  - Runtime information
  - Flow budgets
  - Solute budgets

## Flow Budget

mod - WordPad

File Edit View Insert Format Help

MASS BUDGET FOR ENTIRE MODEL AT END OF TIME STEP 10 IN STRESS PERIOD 4

CUMULATIVE MASS		RATES FOR THIS TIME STEP	
	M		M/T
-----			
IN:		IN:	
-----			
STORAGE =	618989.6988	STORAGE =	139.2432
CONSTANT HEAD =	1078242399.5443	CONSTANT HEAD =	25875399.0454
WELLS =	7300000000.0000	WELLS =	0.0000
PCDT =	35591415.4881	PCDT =	4820.0528
TOTAL IN = 38134484598.7312		TOTAL IN = 25880258.3415	
-----			
OUT:		OUT:	
-----			
STORAGE =	3273206.9498	STORAGE =	136.5419
CONSTANT HEAD =	36317342309.9046	CONSTANT HEAD =	15840535.8578
WELLS =	1803918003.5461	WELLS =	10024529.4836
PCDT =	12188109.4458	PCDT =	15289.3897
TOTAL OUT = 38134938630.2463		TOTAL OUT = 25880491.2871	
IN - OUT = -2454031.5152		IN - OUT = -232.9256	
PERCENT DISCREPANCY = -0.01		PERCENT DISCREPANCY = 0.00	

0

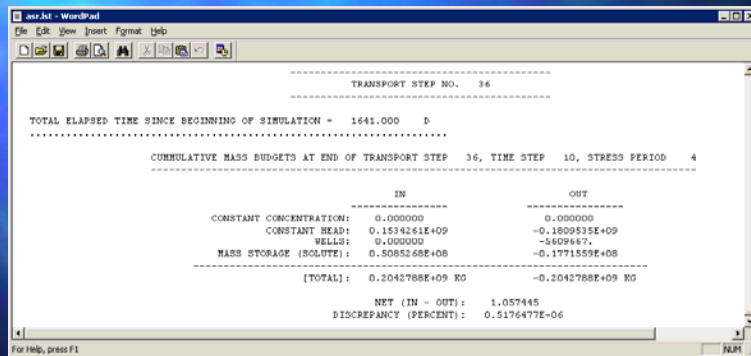
TIME SUMMARY AT END OF TRANSPORT STEP 36 IN TIME STEP 10 IN STRESS PERIOD 4

	SECONDS	MINUTES	HOURS	DAYS	YEARS
TRANS STEP LENGTH	67255.	1120.9	18.482	0.77841	2.13118E-03
TIME STEP LENGTH	3.09115E+06	51521.	858.68	35.778	9.79560E-02
STRESS PERIOD TIME	1.55522E+07	2.59000E+05	4320.0	180.00	0.49031
TOTAL TIME	1.41782E+08	2.34304E+06	39384.	1641.0	4.4928

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## Solute Budget



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=====
TRANSPORT STEP NO.  36
=====
TOTAL ELAPSED TIME SINCE BEGINNING OF SIMULATION = 1641.000  D
=====
CUMULATIVE MASS BUDGETS AT END OF TRANSPORT STEP  36, TIME STEP 10, STRESS PERIOD  4
=====

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	IN	OUT
CONSTANT CONCENTRATION:	0.000000	0.000000
CONSTANT HEAD:	0.1534261E+09	-0.1809535E+09
WELLS:	0.000000	-5609667.
MASS STORAGE (SOLUTE):	0.5085268E+08	-0.1771559E+08
[TOTAL]:	0.2042788E+09 KG	-0.2042788E+09 KG
NET (IN - OUT):	1.057445	
DISCREPANCY (PERCENT):	0.5176477E-06	

For Help, press F1

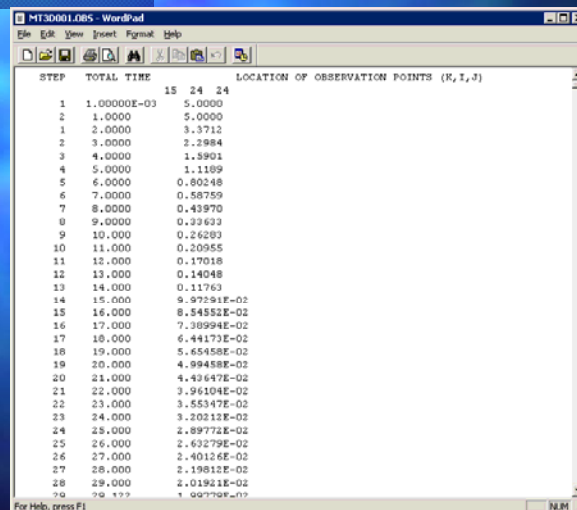
## Heads

- Binary head file is “true binary”
- Heads (not equivalent freshwater heads)
- Used to make water-table and potentiometric surface maps

## Concentrations

- Unformatted concentration file (mt3d001.ucn; true binary)
  - Perhaps most important output from SEAWAT
  - Animate with Modelviewer
- MT3DMS Observations (mt3d001.obs)
  - Import into Excel and prepare plots of concentration versus time for one or many cells
  - Saving interval is specified as a multiple of transport timesteps

## Observation File



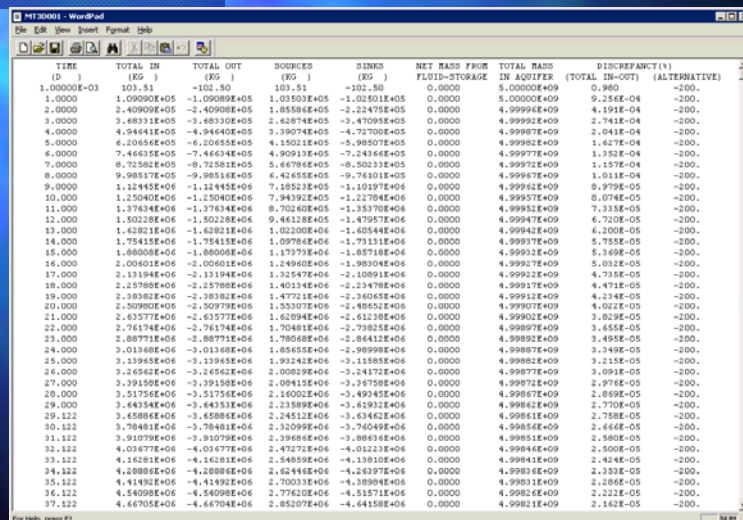
STEP	TOTAL TIME	LOCATION OF OBSERVATION POINTS (R, I, J)
1	1.00000E-03	15 24 24
2	1.0000	5.0000
1	2.0000	3.3712
2	3.0000	2.2984
3	4.0000	1.3901
4	5.0000	1.1109
5	6.0000	0.80248
6	7.0000	0.58759
7	8.0000	0.43970
8	9.0000	0.32633
9	10.000	0.26283
10	11.000	0.20955
11	12.000	0.17018
12	13.000	0.14048
13	14.000	0.11763
14	15.000	9.97291E-02
15	16.000	8.54552E-02
16	17.000	7.39994E-02
17	18.000	6.44173E-02
18	19.000	5.65458E-02
19	20.000	4.99458E-02
20	21.000	4.43647E-02
21	22.000	3.96104E-02
22	23.000	3.55347E-02
23	24.000	3.20313E-02
24	25.000	2.89772E-02
25	26.000	2.63279E-02
26	27.000	2.40126E-02
27	28.000	2.19812E-02
28	29.000	2.01921E-02



# Solute Mass Budget

- Mass budget information written to:
  - Listing file
  - Mt3d001.mas
    - Written as cumulative mass
    - Useful to plot cumulative mass in model domain as a function of time—indicates when steady state is achieved

## Mt3d001.mas



TIME (D)	TOTAL IN (KG)	TOTAL OUT (KG)	SOURCES (KG)	SINKS (KG)	NET RASO FROM FLUID-STORAGE	TOTAL RASO IN AQUIFER	DISCREPANCY (%) (TOTAL IN-OUT) (ALTERNATIVE)
1.00000E+03	103.51	-102.50	103.51	-102.50	0.0000	5.00000E+09	0.980
1.0000	1.00000E+05	-1.00000E+05	1.03503E+05	-1.02501E+05	0.0000	5.00000E+09	9.255E-04
2.0000	2.40900E+05	-2.40900E+05	1.85588E+05	-2.22475E+05	0.0000	4.99992E+09	4.191E-04
3.0000	3.68332E+05	-3.68332E+05	2.62874E+05	-3.47095E+05	0.0000	4.99992E+09	2.741E-04
4.0000	4.94641E+05	-4.94640E+05	3.39074E+05	-4.72700E+05	0.0000	4.99997E+09	2.041E-04
5.0000	6.20451E+05	-6.20451E+05	4.15021E+05	-5.98507E+05	0.0000	4.99992E+09	1.617E-04
6.0000	7.46635E+05	-7.46634E+05	4.90913E+05	-7.24366E+05	0.0000	4.99977E+09	1.352E-04
7.0000	8.72582E+05	-8.72581E+05	5.64786E+05	-8.50233E+05	0.0000	4.99972E+09	1.157E-04
8.0000	9.98517E+05	-9.98516E+05	6.42455E+05	-9.76101E+05	0.0000	4.99967E+09	1.011E-04
9.0000	1.12445E+06	-1.12445E+06	7.18523E+05	-1.10197E+06	0.0000	4.99962E+09	8.979E-05
10.0000	1.25040E+06	-1.25040E+06	7.94392E+05	-1.22704E+06	0.0000	4.99957E+09	8.074E-05
11.0000	1.37634E+06	-1.37634E+06	8.70246E+05	-1.35370E+06	0.0000	4.99952E+09	7.331E-05
12.0000	1.50228E+06	-1.50228E+06	9.46128E+05	-1.47957E+06	0.0000	4.99947E+09	6.720E-05
13.0000	1.62821E+06	-1.62821E+06	1.02200E+06	-1.60544E+06	0.0000	4.99942E+09	6.200E-05
14.0000	1.75415E+06	-1.75415E+06	1.09786E+06	-1.73131E+06	0.0000	4.99937E+09	5.755E-05
15.0000	1.88008E+06	-1.88008E+06	1.17373E+06	-1.85718E+06	0.0000	4.99932E+09	5.369E-05
16.0000	2.00601E+06	-2.00601E+06	1.24960E+06	-1.98304E+06	0.0000	4.99927E+09	5.032E-05
17.0000	2.13194E+06	-2.13194E+06	1.32547E+06	-2.10891E+06	0.0000	4.99922E+09	4.735E-05
18.0000	2.25788E+06	-2.25788E+06	1.40134E+06	-2.23478E+06	0.0000	4.99917E+09	4.471E-05
19.0000	2.38382E+06	-2.38382E+06	1.47721E+06	-2.36065E+06	0.0000	4.99912E+09	4.234E-05
20.0000	2.50976E+06	-2.50976E+06	1.55307E+06	-2.48652E+06	0.0000	4.99907E+09	4.012E-05
21.0000	2.63570E+06	-2.63570E+06	1.62894E+06	-2.61238E+06	0.0000	4.99902E+09	3.809E-05
22.0000	2.76174E+06	-2.76174E+06	1.70481E+06	-2.73825E+06	0.0000	4.99897E+09	3.655E-05
23.0000	2.88771E+06	-2.88771E+06	1.78068E+06	-2.86412E+06	0.0000	4.99892E+09	3.485E-05
24.0000	3.01368E+06	-3.01368E+06	1.85655E+06	-2.98998E+06	0.0000	4.99887E+09	3.349E-05
25.0000	3.13965E+06	-3.13965E+06	1.93242E+06	-3.11585E+06	0.0000	4.99882E+09	3.215E-05
26.0000	3.26562E+06	-3.26562E+06	2.00829E+06	-3.24172E+06	0.0000	4.99877E+09	3.091E-05
27.0000	3.39159E+06	-3.39159E+06	2.08416E+06	-3.35758E+06	0.0000	4.99872E+09	2.976E-05
28.0000	3.51756E+06	-3.51756E+06	2.16002E+06	-3.49345E+06	0.0000	4.99867E+09	2.869E-05
29.0000	3.64354E+06	-3.64354E+06	2.23589E+06	-3.61932E+06	0.0000	4.99862E+09	2.770E-05
29.122	3.65884E+06	-3.65884E+06	2.24511E+06	-3.63462E+06	0.0000	4.99861E+09	2.758E-05
30.122	3.78481E+06	-3.78481E+06	2.32099E+06	-3.76049E+06	0.0000	4.99856E+09	2.666E-05
31.122	3.91079E+06	-3.91079E+06	2.39686E+06	-3.88636E+06	0.0000	4.99851E+09	2.580E-05
32.122	4.03677E+06	-4.03677E+06	2.47272E+06	-4.01223E+06	0.0000	4.99846E+09	2.500E-05
33.122	4.16281E+06	-4.16281E+06	2.54859E+06	-4.13810E+06	0.0000	4.99841E+09	2.424E-05
34.122	4.28886E+06	-4.28886E+06	2.62446E+06	-4.26397E+06	0.0000	4.99836E+09	2.353E-05
35.122	4.41492E+06	-4.41492E+06	2.70033E+06	-4.33984E+06	0.0000	4.99831E+09	2.286E-05
36.122	4.54098E+06	-4.54098E+06	2.77620E+06	-4.51571E+06	0.0000	4.99826E+09	2.222E-05
37.122	4.66705E+06	-4.66705E+06	2.85207E+06	-4.64158E+06	0.0000	4.99821E+09	2.162E-05

## Mass Budget Errors

### ■ Mass balance error computation

- Source – Sink =  $\Delta(\text{Storage})$
- Source – Sink =  $\Delta(C+) - \Delta(C-)$
- Source +  $\Delta(C-)$  = Sink +  $\Delta(C+)$
- Total in = Source +  $\Delta(C-)$
- Total out = Sink +  $\Delta(C+)$

$$\text{error}(\%) = \frac{\text{TotalIN} - \text{TotalOUT}}{0.5(\text{TotalIN} + \text{TotalOUT})} \times 100$$

## Mass Budget Errors (cont.)

### ■ Alternative error computation

- Source +  $M^0$  = Sink +  $M^t$
- $M^0$ : initial mass in aquifer
- $M^t$ : current mass in aquifer
- Total in = Source +  $M^0$
- Total out = Sink +  $M^t$

$$\text{error2}(\%) = \frac{\text{TotalIN} - \text{TotalOUT}}{0.5(\text{TotalIN} + \text{TotalOUT})} \times 100$$