

**Studio della conoide alluvionale del Fiume Taro per la  
realizzazione di un modello idrogeologico per la gestione  
sostenibile delle risorse idriche**

# **IL MODELLO MATEMATICO DEL FLUSSO IDRICO NEGLI ACQUIFERI**

**7 – Il Bilancio del Bacino Idrogeologico**

## Fluid flux mass balance histories for time period: 38626.000000 – 38991.000000 [d]

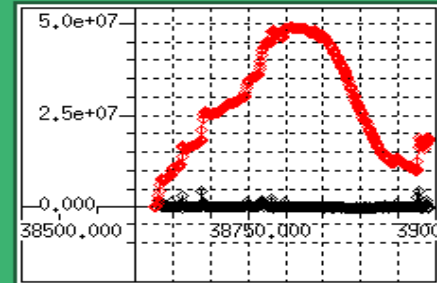
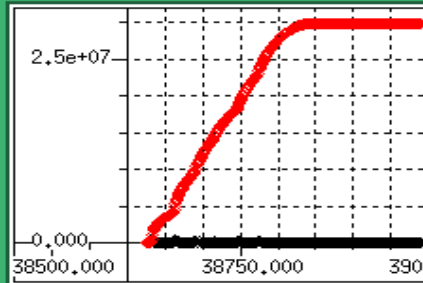
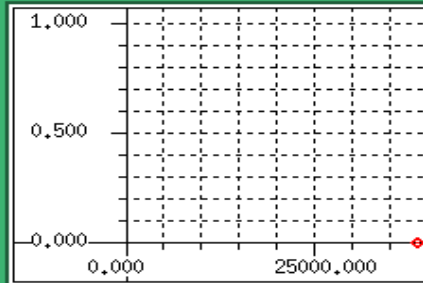
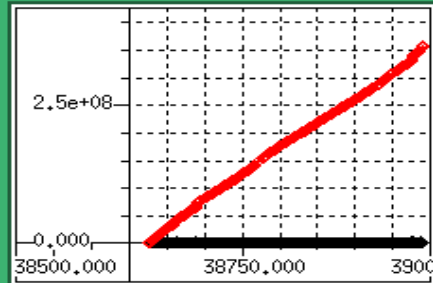
Fluxes through  
outer and inner  
boundaries

Injections and  
withdrawals  
through single  
wells

Areal fluxes  
due to infiltra-  
tion, recharge,  
etc.

Imbalance:  
Gain(+)/Loss(-)

**FLUX IN (+) : Flux Q [m3/d] / Accumulated mass M [m3]**



135: 9.056e+C  
136: 8.754e+C  
137: 1.065e+C  
138: 1.550e+C  
139: 1.656e+C  
140: 1.295e+C

36: 3.519e+08  
37: 3.543e+08  
38: 3.557e+08  
39: 3.567e+08  
40: 3.577e+08

135: 0.00000C  
136: 0.00000C  
137: 0.00000C  
138: 0.00000C  
139: 0.00000C  
140: 0.00000C

496: 0.000000  
497: 0.000000  
498: 0.000000  
499: 0.000000  
500: 0.000000

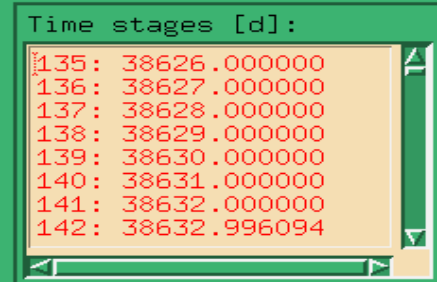
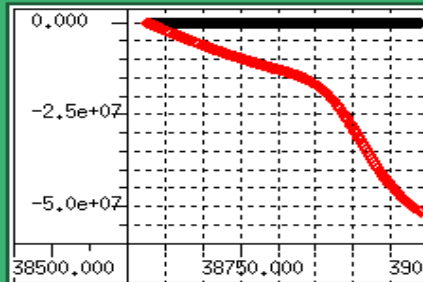
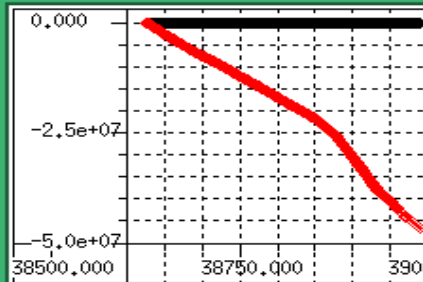
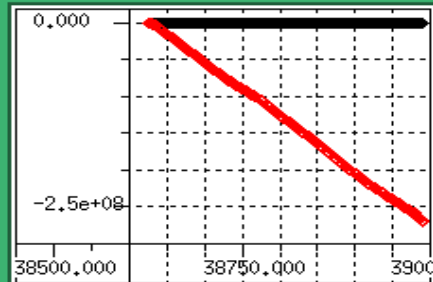
135: 16.32074  
136: 31.33731  
137: 9588.07E  
138: 50092.57  
139: 92900.57  
140: 1.311e+C

36: 2.994e+07  
37: 2.994e+07  
38: 2.994e+07  
39: 2.994e+07  
40: 2.994e+07

135: 1.442e+C  
136: 1.016e+C  
137: 3.902e+C  
138: 9.620e+C  
139: 1.162e+C  
140: 7.802e+C

36: 1.729e+07  
37: 1.876e+07  
38: 1.891e+07  
39: 1.842e+07  
40: 1.819e+07

**FLUX OUT (-) : Flux Q [m3/d] / Accumulated mass M [m3]**



Time stages [d]:

135: 38626.000000  
136: 38627.000000  
137: 38628.000000  
138: 38629.000000  
139: 38630.000000  
140: 38631.000000  
141: 38632.000000  
142: 38632.996094

135: -5.477e+C  
136: -5.729e+C  
137: -4.838e+C  
138: -4.378e+C  
139: -3.868e+C  
140: -4.458e+C

36: -2.672e+08  
37: -2.679e+08  
38: -2.689e+08  
39: -2.701e+08  
40: -2.712e+08

135: -1.227e+C  
136: -1.101e+C  
137: -1.101e+C  
138: -1.101e+C  
139: -1.101e+C  
140: -1.101e+C

36: -4.620e+07  
37: -4.634e+07  
38: -4.648e+07  
39: -4.662e+07  
40: -4.674e+07

135: -91003.0E  
136: -90810.1E  
137: -90616.11  
138: -90422.0E  
139: -90227.0E  
140: -90031.8E

36: -5.108e+07  
37: -5.120e+07  
38: -5.132e+07  
39: -5.143e+07  
40: -5.154e+07

## Fluid flux mass balance histories for time period: 38626.000000 – 38991.000000 [d]

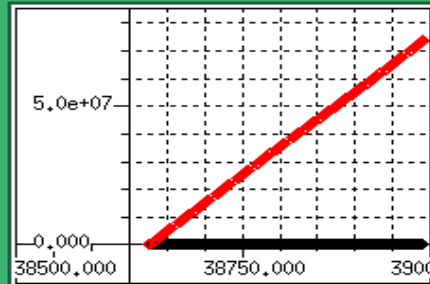
Fluxes through  
Dirichlet bound-  
aries (1st kind)

Fluxes through  
Neumann bounda-  
ries (2nd kind)

Fluxes through  
Cauchy bounda-  
ries (3rd kind)

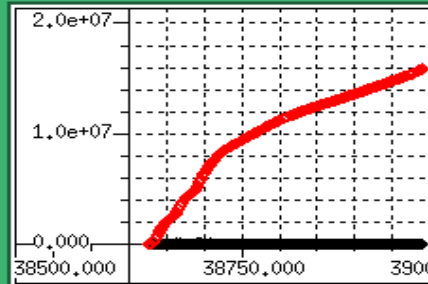
Fluxes through  
well boundaries  
(4th kind)

FLUX IN (+) : Flux Q [m3/d] / Accumulated mass M [m3]



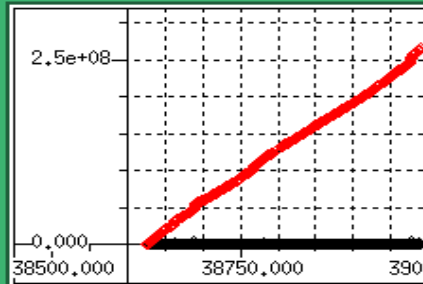
135: 2.005e+C  
136: 2.007e+C  
137: 2.034e+C  
138: 2.148e+C  
139: 2.213e+C  
140: 2.167e+C

36: 7.308e+07  
37: 7.333e+07  
38: 7.356e+07  
39: 7.376e+07  
40: 7.395e+07



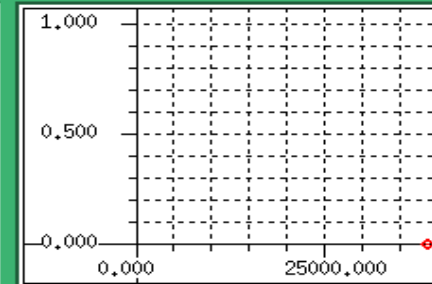
135: 22555.73  
136: 22563.48  
137: 22572.02  
138: 22583.04  
139: 22589.20  
140: 23040.87

36: 1.580e+07  
37: 1.583e+07  
38: 1.586e+07  
39: 1.588e+07  
40: 1.591e+07



135: 6.825e+C  
136: 6.522e+C  
137: 8.391e+C  
138: 1.313e+C  
139: 1.412e+C  
140: 1.055e+C

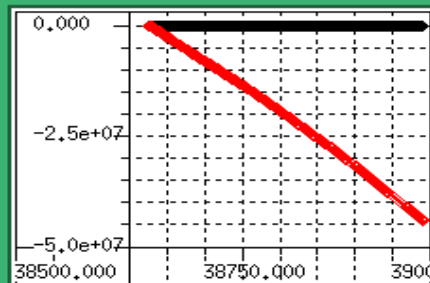
36: 2.630e+08  
37: 2.651e+08  
38: 2.663e+08  
39: 2.670e+08  
40: 2.678e+08



135: 0.000000  
136: 0.000000  
137: 0.000000  
138: 0.000000  
139: 0.000000  
140: 0.000000

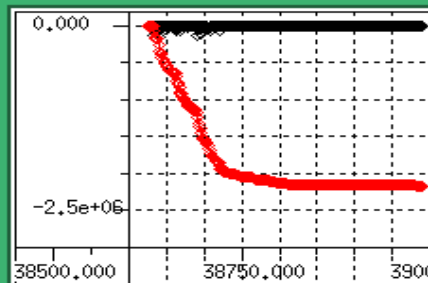
496: 0.000000  
497: 0.000000  
498: 0.000000  
499: 0.000000  
500: 0.000000

FLUX OUT (-) : Flux Q [m3/d] / Accumulated mass M [m3]



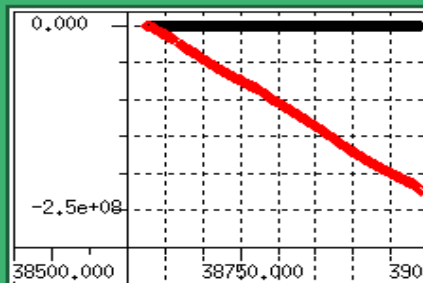
135: -1.106e+C  
136: -1.109e+C  
137: -1.098e+C  
138: -1.064e+C  
139: -1.056e+C  
140: -1.047e+C

36: -4.362e+07  
37: -4.376e+07  
38: -4.389e+07  
39: -4.404e+07  
40: -4.419e+07



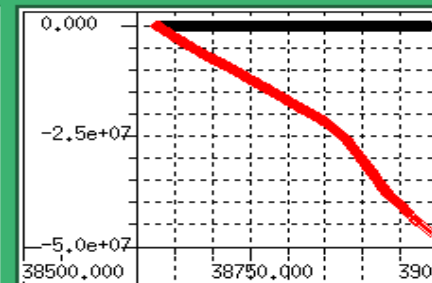
135: -0.128071  
136: -0.413268  
137: -0.602263  
138: -0.341602  
139: -0.379950  
140: -0.012578

36: -2.182e+06  
37: -2.183e+06  
38: -2.184e+06  
39: -2.184e+06  
40: -2.185e+06



135: -4.371e+C  
136: -4.620e+C  
137: -3.740e+C  
138: -3.314e+C  
139: -2.812e+C  
140: -3.412e+C

36: -2.214e+08  
37: -2.220e+08  
38: -2.228e+08  
39: -2.239e+08  
40: -2.248e+08



135: -1.227e+C  
136: -1.101e+C  
137: -1.101e+C  
138: -1.101e+C  
139: -1.101e+C  
140: -1.101e+C

36: -4.620e+07  
37: -4.634e+07  
38: -4.648e+07  
39: -4.662e+07  
40: -4.674e+07

Alveo Taro in zona di Apice

Fluid flux mass balance histories  
for time period: 38626.000000 – 38991.000000 [d]

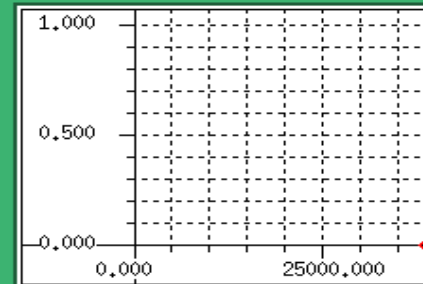
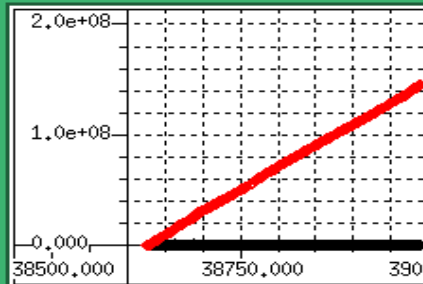
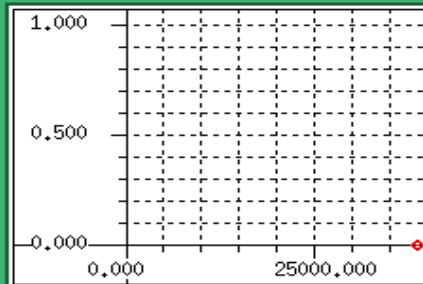
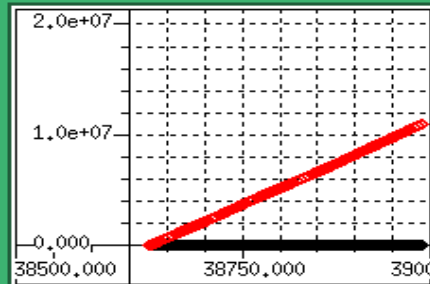
Fluxes through Dirichlet boundaries (1st kind)

Fluxes through Neumann boundaries (2nd kind)

Fluxes through Cauchy boundaries (3rd kind)

Fluxes through well boundaries (4th kind)

FLUX IN (+) : Flux Q [m3/d] / Accumulated mass M [m3]



135: 30970,0E  
136: 31019,64  
137: 30996,6E  
138: 30794,42  
139: 30391,6E  
140: 29946,4E

36: 1.094e+07  
37: 1.097e+07  
38: 1.100e+07  
39: 1.102e+07  
40: 1.105e+07

135: 0,000000  
136: 0,000000  
137: 0,000000  
138: 0,000000  
139: 0,000000  
140: 0,000000

135: 0,000000  
136: 0,000000  
137: 0,000000  
138: 0,000000  
139: 0,000000  
140: 0,000000

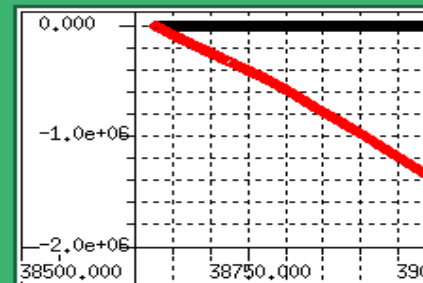
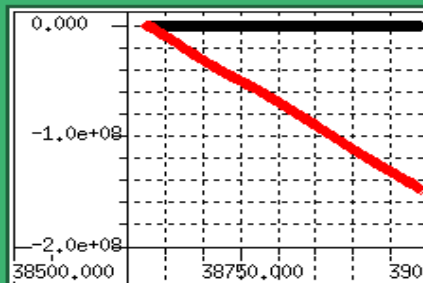
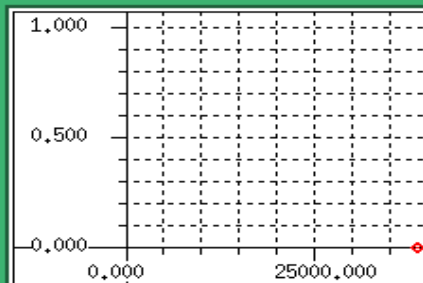
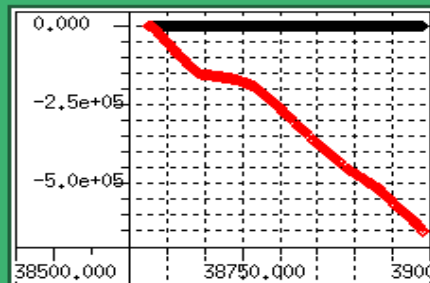
135: 3,836e+C  
136: 3,511e+C  
137: 4,366e+C  
138: 4,935e+C  
139: 5,578e+C  
140: 3,436e+C

36: 1.443e+08  
37: 1.447e+08  
38: 1.451e+08  
39: 1.455e+08  
40: 1.460e+08

135: 0,000000  
136: 0,000000  
137: 0,000000  
138: 0,000000  
139: 0,000000  
140: 0,000000

135: 0,000000  
136: 0,000000  
137: 0,000000  
138: 0,000000  
139: 0,000000  
140: 0,000000

FLUX OUT (-) : Flux Q [m3/d] / Accumulated mass M [m3]



135: -950,2680  
136: -908,2483  
137: -932,8493  
138: -1336,06E  
139: -1767,772  
140: -1977,55E

36: -6,419e+05  
37: -6,445e+05  
38: -6,471e+05  
39: -6,497e+05  
40: -6,524e+05

135: -0,000000  
136: -0,000000  
137: -0,000000  
138: -0,000000  
139: -0,000000  
140: -0,000000

135: 0,000000  
136: 0,000000  
137: 0,000000  
138: 0,000000  
139: 0,000000  
140: 0,000000

135: -3,264e+C  
136: -3,327e+C  
137: -3,168e+C  
138: -3,020e+C  
139: -2,677e+C  
140: -3,070e+C

36: -1,468e+08  
37: -1,472e+08  
38: -1,477e+08  
39: -1,481e+08  
40: -1,485e+08

135: -3452,78E  
136: -3589,030  
137: -3589,030  
138: -3589,030  
139: -3589,030  
140: -3589,030

36: -1,347e+06  
37: -1,351e+06  
38: -1,355e+06  
39: -1,359e+06  
40: -1,363e+06

**Bilancio del Bacino Idrogeologico****Anno idrologico  
dal 1/10/05 al  
1/10/06**

<b><i>Volumi in Ingresso nel sottosuolo dell'area di studio (Mm<sup>3</sup>)</i></b>		<b><i>Volumi in Uscita dal sottosuolo dell'area di studio (Mm<sup>3</sup>)</i></b>	
Ricarica Zenitale	29.940	Perdite verso il fiume Po	-13.230
Ricarica dal Fiume Taro	26.850	Perdite verso il Gruppo Acquifero A padano	-1.980
Flusso subalveo entrante a Fornovo	13.130	Prelievi Areali Zootecnici, assimilati ai domestici e industriali minori di 10 m <sup>3</sup> /gg	-4.960
Ricarica dal Torrente Baganza e dal suo subalveo	11.580	Prelievi Areali Irrigui	-35.720
Flusso subalveo entrante dai corsi d'acqua minori sul Margine meridionale	13.910	Prelievi Irrigui Concentrati	-7.630
Flusso sotterraneo entrante dalle conoidi orientali (Parma- Baganza) nel Complesso A1	1.560	Prelievi Acquedottistici	-17.000
Ricarica dal Margine meridionale negli acquiferi dei Gruppi B e C	23.880	Prelievi Industriali maggiori di 10 m <sup>3</sup> /gg	-22.110
<b>TOTALE (Mm<sup>3</sup>)</b>	120.850	<b>TOTALE (Mm<sup>3</sup>)</b>	-102.630

**Volumi Accumulati nel sottosuolo (Mm<sup>3</sup>)**

18.220

<b><i>Bilancio del Fiume Taro nell'Area di Studio</i></b>	<b><i>Anno idrologico dal 1/10/05 al 1/10/06</i></b>
<b><i>Volumi in Ingresso in superficie (Mm<sup>3</sup>)</i></b>	
Flusso superficiale entrante a Fornovo	814.080
<b><i>Volumi scambiati con il subalveo e con la Conoide (Mm<sup>3</sup>)</i></b>	
Drenaggio dal subalveo del fiume Taro in apice Conoide (vale a dire tra Fornovo e Giarola)	5.400
Ricarica degli Acquiferi della Conoide a valle di Giarola	-32.250
<b><i>Volumi in Uscita in superficie (Mm<sup>3</sup>)</i></b>	
Prelievo da Canali Irrigui	-51.454
Flusso superficiale uscente in Po*	-735.776

\* a meno del contributo degli affluenti tra Fornovo e la foce in Po