

Article

# Modeling Surface Water–Groundwater Interactions: Evidence from Borkena Catchment, Awash River Basin, Ethiopia

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## Supplementary Information

Table S1. Groundwater elevation of existing boreholes and Surface elevation of the nearby river cell for each borehole and their differences to indicate if the river is gaining, loosing and either gaining or loosing river

Well_ID	X	Y	SWL (mbgl)	GW_Elevation (masl)	Riv_Elevation (masl)	Difference	River_Type
Kutaber	561487	244816	3.2	2666.8	2680.2	-13.4	gaining
Boru Sillasse Kb02	569164	1239609	41.5	2568	2602.6	-34.6	gaining
Wollo University	568373	1238516	42.7	2561.3	2603.6	-42.3	gaining
GBH	569589	1232065	18.87	2472.1	2487.8	-15.7	gaining
DDBH	569138	1232098	26.1	2470.9	2489.6	-18.7	gaining
PW3	579565	1226611	0	1848	1833.6	14.4	loosing
KCVTW- 02-19	578915	1226614	0	1839.8	1841	-1.2	gaining
KCPW-2	579066	1226301	6.96	1831	1833.4	-2.4	gaining
Well One	579376	1226205	1.66	1832.9	1831.4	1.5	loosing
BH-1	579647	1226175	0	1832.7	1831.4	1.3	loosing
BGI-3	579337	1224720	0	1827	1826.2	0.8	loosing
HrW4	584466	1208649	0	1485.8	1485.8	0	either gaining or loosing
HrBH-3	584806	1208276	0	1485	1481.5	3.5	loosing
HCKTW1	582859	1207575	5	1499.4	1495	4.4	loosing
Harbu Kut	583712	1206639	0	1475	1470	5	loosing
HrBH2	585040	1206425	6	1469	1469	0	either gaining or loosing
HrBH3	586180	1205450	0	1471	1464	7	loosing

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HCKTW#5	585874	1203916	0	1459	1459	0	either gaining or loosing
TUCHE	585983	1192236	0	1460	1458	2	loosing
Girma's bh	589091	1194110	0	1436	1435	1	loosing
Dewacheffa Shekla	590348	1193360	5.4	1440	1440	0	either gaining or loosing
KCVTW- 03-19	586891	1189916	0	1444	1444	0	either gaining or loosing
KCPW-1	588411	1189219	4.7	1423.3	1430	-6.7	gaining
CKBH1	586795	1186734	14.5	1442.5	1447.4	-4.9	gaining
HCKPW07	590430	1186027	0	1422.7	1422.9	-0.2	gaining
HCKPW- 14	590446	1185131	0	1428	1420	8	loosing
HCKTW2	587545	1182629	8.3	1438.7	1436.9	1.8	loosing
Bilacha	595434	1187099	4.1	1477.9	1473	4.9	loosing
KW-4	595464	1186863	5.8	1470.2	1470.2	0	either gaining or loosing
KW-3	595586	1186261	5.97	1470.16	1471	-0.84	gaining
KW-1	595093	1185847	11.13	1437	1447	-10	gaining
KW5	597030	1184798	9.3	1447	1456	-9	gaining
Chereti bh	600932	1172716	6	1415.6	1416	-0.4	gaining
H/Mesno bh	593218	1172644	0	1423	1420	3	loosing

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Table S2. Assigned River cells in to SWAT-MODFLOW interface

Layer	Row	Column	River Stage	River Conductance	River Elevation	Layer	Row	Column	River Stage	River Conductance	River Elevation
1	12	13	1825.703	60000	1825.6	1	27	9	1441.238	135000	1441.4
1	13	13	1800.413	60000	1800	1	28	9	1440.818	140000	1440.7
1	14	13	1776.773	70000	1776.6	1	28	8	1436.908	145000	1436.8
1	14	12	1759.223	70000	1759	1	29	8	1435.321	155000	1435.2
1	15	12	1730.358	80000	1730.2	1	29	7	1431.606	155000	1431.5
1	16	12	1703.918	80000	1703.7	1	30	7	1430.908	155000	1430.8
1	17	12	1675.774	90000	1675.6	1	30	8	1430.816	167000	1430.7
1	18	12	1658.238	90000	1657.9	1	31	8	1426.646	167000	1426.5
1	18	11	1623.308	80000	1623.1	1	32	8	1423.186	167000	1423
1	19	11	1556.166	85000	1550.9	1	32	7	1422.708	171000	1422
1	20	11	1498.866	66667	1498.7	1	33	7	1419.958	171000	1419.8
1	21	11	1487.626	66667	1487.3	1	34	7	1416.346	171000	1416.2
1	21	10	1482.738	77778	1482.3	1	34	6	1415.096	171000	1414.9
1	22	10	1473.258	78000	1472.9	1	35	6	1412.996	178000	1412.9
1	22	11	1469.728	88000	1469.7	1	34	6	1412.508	178000	1412.4
1	23	11	1459.906	98700	1459.8	1	34	5	1412.408	178000	1412.3
1	23	10	1459.786	100000	1459.6	1	35	5	1412.377	183000	1412.2

1	24	10	1457.326	100000	1457	1	34	5	1411.996	183000	1411.9
1	24	9	1453.228	120000	1453	1	34	4	1410.678	183000	1410.5
1	25	9	1449.956	120000	1449.9	1	35	4	1410.407	185000	1410.2
1	25	10	1447.746	130000	1447.6	1	36	4	1409.887	185000	1409.7
1	26	10	1447.446	133000	1447.3						
1	27	10	1443.566	133000	1443.2						

Table S3. Assigned observation wells in to SWAT-MODFLOW interface

No	Obs_well	Row	Colum	layer of cell
1	Kutaber Well	3	2	1
2	Borusillase	5	6	1
3	Wollouniversity	6	5	1
4	KCVTW-02-19	12	11	1
5	BGI New-2	13	11	1
6	HCKTW1	21	13	1
7	Harbu	22	13	1
8	KCVTW-03-19	30	15	1
9	Bilacha Keb	32	19	1
10	KW-2	32	19	1
11	HCKTW2	34	15	1
12	H/mesno bh	39	18	1
13	Chereti bh	39	22	1
14	Tuche	29	14	1
15	KCPW#5	23	14	1
16	HCKTW3	32	16	1

Table S4. Default values/outputs/ of Groundwater-Surface water interaction in m<sup>3</sup>/d after SWAT-MODFLOW simulation

Cell No	Exchange Values							
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-16838.10
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	3096.11	3096.11	3096.11	3096.11	3096.11	3096.11	3096.11	3096.11
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	1189.56	1189.56	1189.56	1189.56	1189.56	1189.56	1189.56	1189.56
8	-251672.00	-242128.00	-259402.00	-264391.00	-267444.00	-281259.00	-277611.00	-291506.00
9	-374321.00	-368751.00	-377817.00	-382794.00	-388018.00	-398920.00	-398370.00	-402206.00
10	-187227.00	-195562.00	-207724.00	-215549.00	-222721.00	-232816.00	-236576.00	-241351.00
11	-336034.00	-329516.00	-337116.00	-338222.00	-341320.00	-350209.00	-349816.00	-353444.00
12	-462105.00	-456901.00	-466528.00	-470942.00	-476583.00	-487857.00	-487548.00	-491557.00
13	-312306.00	-306213.00	-316024.00	-319978.00	-325891.00	-337573.00	-337606.00	-342219.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	-380055.00	-374428.00	-387370.00	-391428.00	-397702.00	-410589.00	-410295.00	-416267.00

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19	870.05	3474.89	1305.07	1305.07	2175.12	2175.12	3909.92	2610.15
20	-264722.00	-258140.00	-266412.00	-267660.00	-271286.00	-280882.00	-280013.00	-283568.00
21	-390223.00	-383672.00	-391762.00	-394740.00	-398963.00	-408793.00	-407237.00	-409931.00
22	-214171.00	-212872.00	-224249.00	-229888.00	-234928.00	-245504.00	-244897.00	-249021.00
23	652.44	2605.77	978.65	978.65	1631.09	1631.09	2931.99	1957.31
24	1957.51	7818.10	2936.27	2936.27	4893.77	4893.77	8796.86	5872.53
25	2972.30	11871.08	4458.45	4458.45	7430.75	7430.75	9440.22	-17471.00
26	3842.35	15345.97	5763.52	5763.52	9605.87	9605.87	17267.14	11527.05
27	3697.41	14767.08	5546.11	5546.11	9243.52	9243.52	16615.79	11092.22
28	6307.15	25190.15	9460.73	9460.73	15767.88	15767.88	28343.73	18921.46
29	-87164.60	-94766.60	-102881.00	-110281.00	-117201.00	-124183.00	-130476.00	-136921.00
30	4712.40	18820.86	7068.60	7068.60	11780.99	11780.99	21177.05	14137.19
31	2319.86	9265.31	-14683.30	-33718.00	-48395.20	-86773.00	-117257.00	-141692.00
32	7244.42	35921.48	14338.53	14338.53	-11278.30	-40403.70	-48062.00	-85932.90
33	5437.31	-14772.70	-61886.00	-86766.80	-101224.00	-116029.00	-136770.00	-161532.00
34	3096.11	-487857.00	3096.11	3096.11	586.14	3096.11	3096.11	3661.07

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