Supplementary information

A novel analytical approach for the simultaneous measurement of nitrate and DOC in soil water

Elad Yeshno[1], Ofer Dahan[1], Shoshana Bernstain[1], Shlomi Arnon[2]

[1]Department of Hydrology & Microbiology, Zuckerberg Institute for Water Research, Blaustein Institutes for Desert Research, Ben-Gurion University of the Negev, Israel
[2]Electrical and Computer Engineering Department, Ben-Gurion University of the Negev, Israel

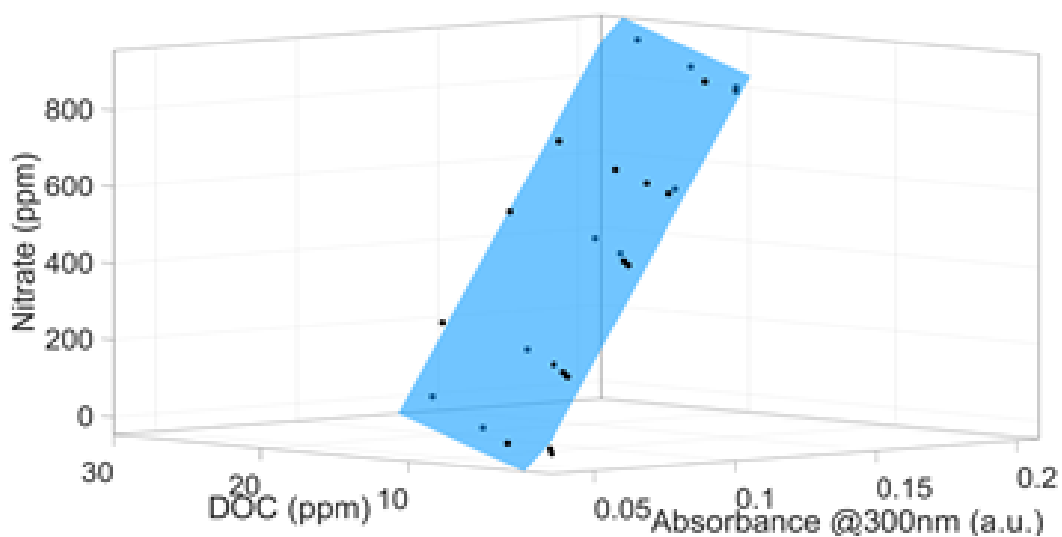
Correspondence to: Elad Yeshno (Eladyes@post.bgu.ac.il)

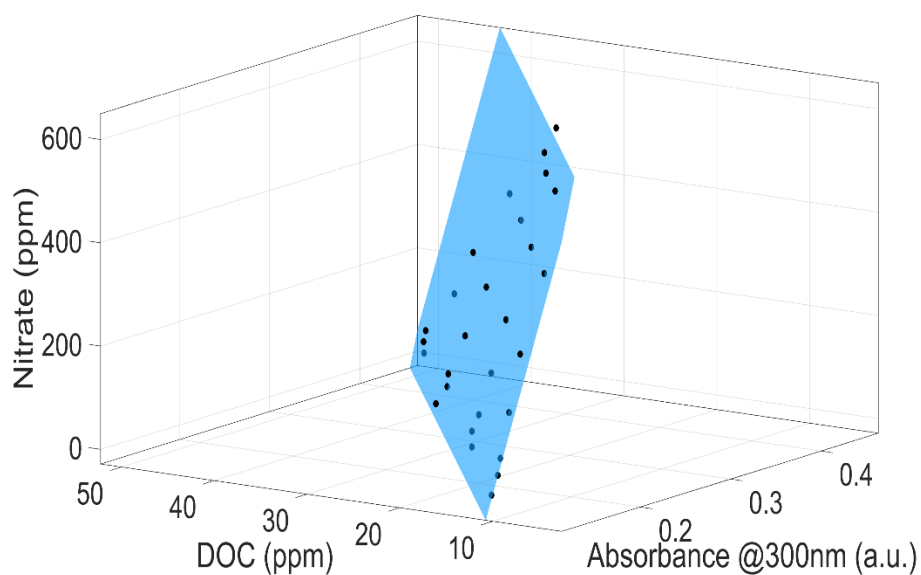
Section S1: Selected agricultural sites

The open crop field and citrus orchard sites are located next to the village of Nir Galim in Israel (34°41`13`` E long; 31°49`42`` N Lat). Over the past 10 years, the crop field has been used for rainfed winter cereal and summer watermelon cultivation, fertilized mainly with dairy slurry manure. In 2015, the field was converted to irrigated jojoba cultivation. The citrus orchard is irrigated during the summer, in addition to the rainfall during the winter. Further information on these sites may be found at Turkeltaub et al., (2014). The additional study sites were two greenhouses used for rotating vegetable crops. One site practiced an organic regime that is based on the application of organic compost as the main fertilizer, while the other applied conventional fertigation methods. A detailed description of the VMS at each site was previously presented in Dahan et al., (2014); Turkeltaub et al., (2014, 2015a, 2016). Additional samples were taken from an open field located next to Kibbutz Afek (32°50'14.7"N 35°07'28.6"E).

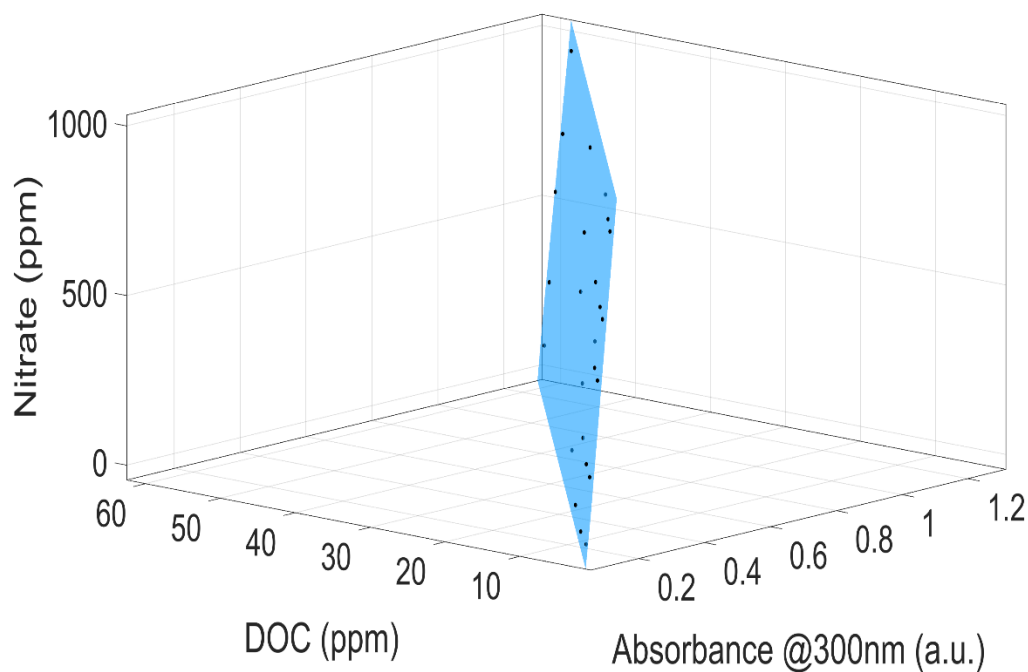
Section S2: Chemical and spectral analyses of porewater samples

Open field, inland: Database was obtained by analyzing water samples extracted from the soil, and was then used to form the nitrate calibration equation.

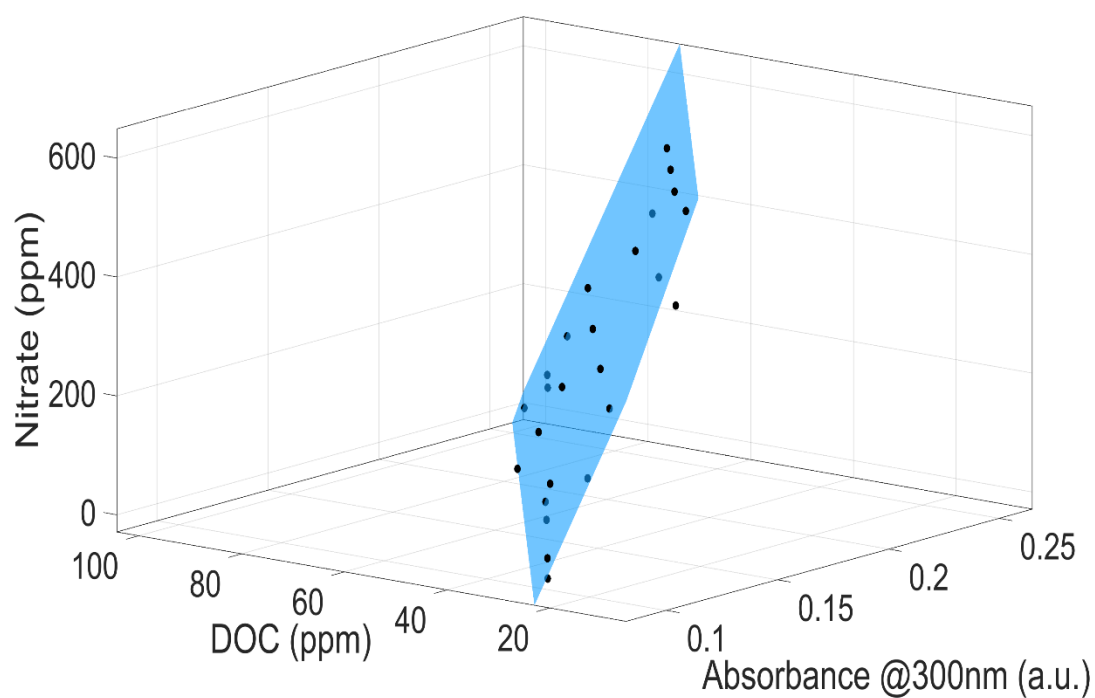
Concentration (ppm)		Absorption at 300 nm (a.u.)	Concentration (ppm)		Absorption at 300 nm (a.u.)
DOC	Nitrate		DOC	Nitrate	
28.65	0.1	0.1409	3.58	0.01	0.0515
28.09	196.18	0.1415	3.51	196.09	0.056
27.29	476.29	0.1614	3.41	476.2	0.0768
26.78	654.3	0.1763	3.35	654.22	0.0948
26.05	909.18	0.2001	3.26	909.1	0.1158
14.33	0.05	0.0841	1.79	0.01	0.0427
14.04	196.13	0.0982	1.76	196.08	0.0483
13.64	476.24	0.1202	1.71	476.2	0.0694
13.39	654.25	0.1261	1.67	654.21	0.0837
13.02	909.14	0.151	1.63	909.1	0.1074
7.16	0.03	0.0552			
7.02	196.1	0.071			
6.82	476.21	0.0934			
6.69	654.23	0.102			
6.51	909.11	0.1219			

Organic greenhouse: Database was obtained by analyzing water samples extracted from the soil, and was then used to form the nitrate calibration equation.

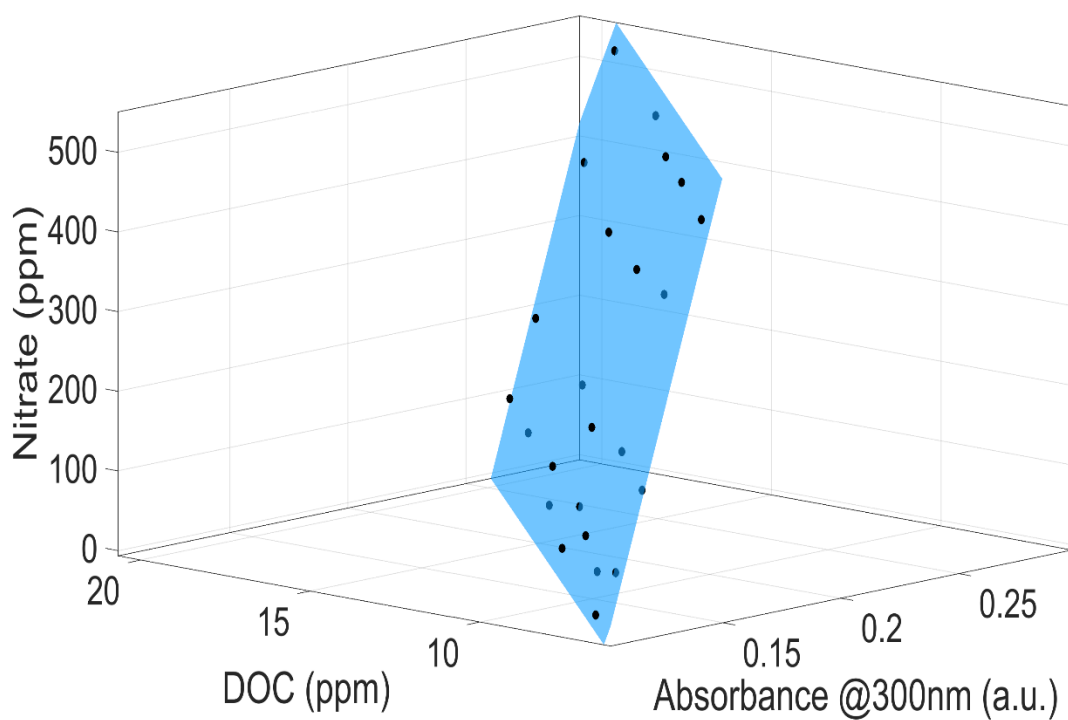
Concentration (ppm)			Concentration (ppm)		
DOC	Nitrate	Absorption at 300 nm (a.u.)	DOC	Nitrate	Absorption at 300 nm (a.u.)
12.50	2.63	0.14	36.06	46.03	0.33
12.02	40.99	0.14	34.72	81.37	0.32
11.57	76.50	0.14	31.25	173.23	0.30
10.42	168.85	0.14	26.79	291.34	0.28
8.93	287.59	0.13	20.83	448.82	0.26
6.94	445.90	0.14	14.42	618.41	0.22
4.81	616.39	0.13	50.00	10.50	0.45
25.00	5.25	0.24	48.08	48.56	0.43
24.04	43.51	0.23	46.30	83.80	0.41
23.15	78.94	0.23	41.67	175.42	0.40
20.83	171.04	0.22	35.71	293.21	0.36
17.86	289.46	0.21	27.78	450.28	0.31
13.89	447.36	0.20	19.23	619.42	0.28
9.62	617.40	0.17			
37.50	7.88	0.33			

Open crop field, coastal plain: Database was obtained by analyzing water samples extracted from the soil, and was then used to form the nitrate calibration equation.

Concentration (ppm)		Absorption at 300 nm (a.u.)
DOC	Nitrate	
12.50	81.70	1.26
12.02	276.18	1.25
11.57	554.00	1.23
10.42	730.56	1.23
8.93	983.36	1.22
6.94	40.85	0.66
4.81	236.13	0.68
25.00	515.10	0.66
24.04	692.38	0.66
23.15	946.23	0.66
20.83	20.43	0.34
17.86	216.10	0.35
13.89	495.64	0.38
9.62	673.29	0.37
37.50	927.66	0.40

Concentration (ppm)		Absorption at 300 nm (a.u.)
DOC	Nitrate	
7.46	10.21	0.18
7.32	206.09	0.20
7.11	485.92	0.22
6.97	663.75	0.23
6.78	918.38	0.25
3.73	5.11	0.11
3.66	201.08	0.12
3.55	481.05	0.14
3.49	658.98	0.16
3.39	913.73	0.18

Citrus orchard: Database obtained by analyzing water samples extracted from the soil, and was then

Concentration (ppm)		Absorption at 300 nm (a.u.)	Concentration (ppm)		Absorption at 300 nm (a.u.)
DOC	Nitrate		DOC	Nitrate	
24.95	2.02	0.09	83.17	173.39	0.24
49.90	4.04	0.15	17.82	287.16	0.10
74.85	6.05	0.19	35.64	288.60	0.14
99.80	8.07	0.26	53.46	290.04	0.18
23.99	40.40	0.09	71.29	291.48	0.22
47.98	42.34	0.14	13.86	445.57	0.12
71.97	44.28	0.28	27.72	446.69	0.15
95.96	46.22	0.26	41.58	447.81	0.17
23.10	75.94	0.11	55.44	448.93	0.21
46.20	77.81	0.14	9.60	616.16	0.12
69.31	79.68	0.19	19.19	616.94	0.14
92.41	81.55	0.25	28.79	617.71	0.16
20.79	168.35	0.10	38.38	618.49	0.18
41.58	170.03	0.18			
62.38	171.71	0.19			

used to form the nitrate calibration equation.

Hummus and soil mixture extract: Database was obtained by analyzing water samples extracted from the soil, and was then used to form the nitrate calibration equation.

Concentration (ppm)		Absorption at 300 nm (a.u.)	Concentration (ppm)		Absorption at 300 nm (a.u.)
DOC	Nitrate		DOC	Nitrate	
7.2	18.53	0.1115	14.9	88.16	0.2039
7.1	68.19	0.1185	14.7	185.82	0.2137
7	166.04	0.1283	14.4	375.46	0.2205
6.8	493.84	0.1505	14.2	512.96	0.2375
10	25.74	0.1524	20	51.47	0.2669
9.9	75.36	0.1461	19.9	100.97	0.2577
9.8	173.14	0.16	19.7	198.49	0.2657
9.6	363.03	0.175	19.3	387.9	0.2805
9.5	500.7	0.181	19	525.21	0.2892
12	30.88	0.1663			
11.9	80.48	0.1722			
11.8	178.21	0.176			
11.6	368	0.1921			
11.4	505.6	0.2015			
15	38.6	0.2039			

References

Dahan, O., A. Babad, N. Lazarovitch, E.E. Russak, and D. Kurtzman. 2014. Nitrate leaching from intensive organic farms to groundwater. Hydrol. Earth Syst. Sci. 18(1): 333–341. doi: 10.5194/hess-18-333-2014.

Dahan, O., R. Talby, Y. Yechieli, E. Adar, Y. Enzel, N. Lazarovitch, Y. Enzel, N. Lazarovitch, and Y. Enzel. 2009. In Situ Monitoring of Water Percolation and Solute Transport Using a Vadose Zone Monitoring System. Vadose Zo. J. 8(4): 916. doi: 10.2136/vzj2008.0134.

Rimon, Y., O. Dahan, R. Nativ, and S. Geyer. 2007. Water percolation through the deep vadose zone and groundwater recharge: Preliminary results based on a new vadose zone monitoring system. Water Resour. Res. 43(5): 1–12. doi: 10.1029/2006WR004855.

Rimon, Y., R. Nativ, and O. Dahan. 2011. Physical and Chemical Evidence for Pore-Scale Dual-Domain Flow in the Vadose Zone. Vadose Zo. J. 10(1): 322–331. doi: 10.2136/vzj2009.0113.

Turkeltaub, T., O. Dahan, and D. Kurtzman. 2014. Investigation of Groundwater Recharge under Agricultural Fields Using Transient Deep Vadose Zone Data. Vadose Zo. J. 13(4). doi: 10.2136/vzj2013.10.0176.

Turkeltaub, T., D. Kurtzman, and O. Dahan. 2016. Real-time monitoring of nitrate transport in deep vadose zone under a crop field – implications for groundwater protection. Hydrol. Earth Syst. Sci. Discuss. (February): 1–31. doi: 10.5194/hess-2016-63.

Turkeltaub, T., D. Kurtzman, E.E. Russak, and O. Dahan. 2015. Impact of switching crop type on water and solute fluxes in deep vadose zone. Water Resour. Res. 51(3): 9828– 9842. doi: 10.1002/2015WR017612.