

Supplement of Biogeosciences, 12, 921–932, 2015
<http://www.biogeosciences.net/12/921/2015/>
doi:10.5194/bg-12-921-2015-supplement
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Supplement of

Long-term spatial and temporal variation of CO₂ partial pressure in the Yellow River, China

L. Ran et al.

Correspondence to: X. X. Lu (geoluxx@nus.edu.sg)

Table S1. Total alkalinity (TAlk) and $p\text{CO}_2$ in the Yellow River basin (arithmetic mean \pm standard deviation).

River	Station	Coordinates		Temperature	pH	TAlk	$p\text{CO}_2$
		Longitude	Latitude	°C		$\mu\text{mol/l}$	μatm
Yellow River	Xiliugou	103.58	36.13	14.69 \pm 6.78	8.08 \pm 0.18	3250 \pm 815	1613 \pm 631
Yellow River	Lanzhou	103.82	36.07	12.19 \pm 6.42	8.56 \pm 0.19	3026 \pm 456	510 \pm 308
Yellow River	Xiaheyan	105.05	37.45	12.42 \pm 7.02	8.29 \pm 0.26	3276 \pm 347	1139 \pm 814
Yellow River	Qingtongxia	105.99	37.90	11.02 \pm 8.53	8.01 \pm 0.26	3318 \pm 783	2145 \pm 1797
Yellow River	Shizuishan	106.78	39.25	12.61 \pm 8.45	8.37 \pm 0.23	3374 \pm 419	930 \pm 587
Yellow River	Zhaojunfen	109.68	40.48	13.04 \pm 9.60	8.11 \pm 0.09	3349 \pm 916	1499 \pm 485
Yellow River	Wubao	110.72	37.45	15.28 \pm 9.63	8.06 \pm 0.22	3132 \pm 732	1766 \pm 1105
Yellow River	Longmen	110.58	35.67	17.76 \pm 9.35	7.98 \pm 0.31	3944 \pm 850	3246 \pm 2965
Yellow River	Sanmenxia	111.37	34.82	18.01 \pm 9.24	8.01 \pm 0.26	3874 \pm 805	2846 \pm 2027
Yellow River	Huayuankou	113.67	34.91	19.14 \pm 8.38	8.05 \pm 0.31	3467 \pm 636	2565 \pm 1550
Yellow River	Luokou	116.98	36.73	16.19 \pm 9.61	7.94 \pm 0.23	3337 \pm 726	2614 \pm 2483
Yellow River	Xiaolangdi	112.37	34.93	18.42 \pm 8.97	7.96 \pm 0.22	3220 \pm 785	2372 \pm 1995
Yellow River	Toudaoguai	111.07	40.27	10.83 \pm 9.16	7.95 \pm 0.32	3837 \pm 729	3132 \pm 2500
Yellow River	Lijin	118.30	37.52	15.03 \pm 9.65	8.17 \pm 0.15	3390 \pm 629	1389 \pm 548
Daxiahe	Chaiqiao	103.27	35.63	11.23 \pm 4.99	8.12 \pm 0.32	3289 \pm 421	1797 \pm 1730
Daxiahe	Xiahe	102.52	35.20	4.51 \pm 4.10	8.20 \pm 0.29	4049 \pm 468	1556 \pm 1015
Daxiahe	Shuangcheng	103.05	35.48	8.01 \pm 4.96	8.11 \pm 0.55	3462 \pm 823	3575 \pm 1709
Taohe	Luqu	102.42	34.63	7.24 \pm 4.95	7.95 \pm 0.25	3955 \pm 405	2792 \pm 2289
Taohe	Xiabagou	103.02	34.70	9.08 \pm 5.70	7.98 \pm 0.41	3676 \pm 551	3546 \pm 1721
Taohe	Lijiacun	103.82	35.27	9.46 \pm 5.91	8.05 \pm 0.30	3426 \pm 560	2222 \pm 2082
Taohe	Hongqi	103.57	35.80	11.89 \pm 6.31	7.94 \pm 0.41	3291 \pm 477	3351 \pm 2360
Dayugou	Duoba	103.58	34.57	5.71 \pm 3.99	8.11 \pm 0.39	2718 \pm 361	1499 \pm 1191
Guangtonghe	Sanjiaji	103.73	35.55	9.39 \pm 6.37	7.84 \pm 0.37	3095 \pm 413	3311 \pm 2512
Huangshui	Haiyan	101.02	36.90	5.30 \pm 4.98	8.23 \pm 0.26	3514 \pm 435	1333 \pm 1301
Huangshui	Shiyazhuang	101.35	36.67	7.11 \pm 6.20	8.29 \pm 0.24	3310 \pm 518	1049 \pm 875
Huangshui	Xining	101.78	36.63	8.85 \pm 6.22	8.19 \pm 0.25	3115 \pm 642	1289 \pm 973
Huangshui	Xiangtang	102.83	36.35	8.97 \pm 6.89	8.10 \pm 0.19	3288 \pm 557	1573 \pm 915
Huangshui	Minhe	102.80	36.33	9.47 \pm 7.17	8.20 \pm 0.32	3459 \pm 779	1678 \pm 1154
Halijianhe	Haiyan	101.02	36.90	4.46 \pm 4.35	8.18 \pm 0.19	2820 \pm 784	1038 \pm 769
Beichuanhe	Qiaotou	101.68	36.93	6.22 \pm 5.12	8.26 \pm 0.21	2414 \pm 457	779 \pm 497
Mapisihe	Haiyan	101.02	36.90	3.99 \pm 3.68	8.27 \pm 0.19	3547 \pm 284	1082 \pm 702
Dongyugou	Lintao	103.87	35.40	11.34 \pm 5.94	7.96 \pm 0.40	3488 \pm 1416	2773 \pm 2107

Datonghe	Xiangtang	102.83	36.35	8.09 ±6.15	8.21 ±0.19	3600 ±717	1257 ±582
Datonghe	Tiantang	102.50	36.95	11.34 ±6.23	7.99 ±0.27	3060 ±650	1940 ±1057
Datonghe	Liancheng	102.82	36.60	10.69 ±4.92	8.03 ±0.45	2984 ±498	2373 ±2316
Zhuanglanghe	Wushengyi	103.18	36.87	8.61 ±6.10	7.78 ±0.28	3548 ±514	3758 ±2660
Zhuanglanghe	Hongyazi	103.43	36.18	10.62 ±7.39	7.99 ±0.37	3634 ±898	2648 ±2089
Zulihe	Huining	105.08	35.72	12.90 ±5.67	7.82 ±0.49	2943 ±774	4674 ±3857
Zulihe	Guochengyi	104.88	36.22	14.25 ±5.71	7.38 ±0.49	2645 ±1037	9659 ±8248
Zulihe	Jingyuan	104.67	36.55	14.29 ±7.50	7.42 ±0.42	2763 ±709	8431 ±7582
Guanchuanhe	Chankou	104.55	35.68	11.46 ±5.64	7.59 ±0.47	3224 ±1231	8308 ±5865
Qingshuihe	Shilipu	106.75	36.00	6.89 ±6.24	7.89 ±0.46	5457 ±932	6079 ±4266
Qingshuihe	Guyuan	106.30	36.02	11.64 ±7.07	7.82 ±0.47	4933 ±1209	7058 ±6144
Qingshuihe	Hanfuwan	106.15	36.60	12.39 ±8.92	7.53 ±0.42	3786 ±1256	8693 ±8027
Qingshuihe	Quanyanshan	105.55	37.47	11.57 ±8.17	7.62 ±0.42	3449 ±1241	6333 ±5830
Nanhezi	Nanhezi	105.87	37.57	8.87 ±7.84	7.87 ±0.35	5276 ±2353	5242 ±3575
Hongliugou	Mingshazhou	105.88	37.57	10.19 ±8.31	7.67 ±0.45	4129 ±1520	7653 ±6409
Qingshuihou	Xinhuaqiao	106.23	37.98	9.60 ±7.52	7.81 ±0.40	6996 ±2930	8796 ±4674
Kushuihe	Guojiaqiao	106.25	37.98	10.18 ±8.36	7.83 ±0.37	5587 ±2598	5851 ±5000
Xiaohe	Xiaoquan	106.58	37.43	8.81 ±7.68	7.92 ±0.36	5720 ±1762	5126 ±2504
Wuliangshuai	Xishanzui	108.70	40.78	12.01 ±7.78	8.82 ±0.37	8633 ±1466	819 ±647
Sanchuanhe	Houdacheng	110.75	37.42	14.42 ±8.32	7.98 ±0.65	3557 ±869	2367 ±1671
Wudinghe	Baijiachuan	110.42	37.23	16.68 ±9.50	8.02 ±0.31	3730 ±797	2677 ±2374
Dalihe	Suide	110.23	37.50	15.76 ±9.47	8.24 ±0.31	4664 ±1307	1804 ±1222
Yanshui	Ansai	109.32	36.87	13.52 ±7.76	8.13 ±0.26	3814 ±1793	1664 ±1040
Yanshui	Ganguyi	109.80	36.70	14.69 ±8.81	8.12 ±0.34	4831 ±1604	2795 ±2082
Jindihe	Puyang	115.02	35.50	20.38 ±9.32	7.72 ±0.33	3475 ±1380	4980 ±3633
Dawenhe	Laiwu	117.63	36.20	16.11 ±9.29	7.45 ±0.26	2446 ±954	5818 ±4702
Dawenhe	Beiwang	117.18	36.07	16.53 ±10.48	7.60 ±0.29	2807 ±1324	4641 ±3558
Dawenhe	Linwen	116.98	35.95	17.23 ±9.95	7.63 ±0.29	2385 ±677	3860 ±2707
Dawenhe	Daicunba	116.45	35.90	17.16 ±10.67	7.71 ±0.26	2367 ±1040	2867 ±1856
Dawenhe	Dongzhou dam	117.80	35.90	16.03 ±9.54	7.67 ±0.24	1971 ±478	2813 ±1710
Dawenhe	Guli dam	117.55	35.92	14.38 ±9.08	7.58 ±0.29	3060 ±1672	5175 ±3924
Dongpinghu	Chenshankou	116.20	36.12	16.04 ±11.00	8.05 ±0.21	2600 ±635	1503 ±814
Yingwenhe	Xueye dam	117.58	36.40	15.92 ±9.26	7.76 ±0.26	2158 ±587	2430 ±1399
Shiwenhe	Huangqian dam	117.23	36.30	18.26 ±9.41	7.59 ±0.31	1617 ±641	3010 ±2045
Guangminghe	Guangming dam	117.60	35.88	17.84 ±9.77	7.70 ±0.23	2275 ±527	3132 ±2120

Yangliuhe	Ruiguzhuang	117.52	35.97	17.38±8.72	7.29±0.35	2103±913	6894±3877
Kangwanghe	Bailou	116.62	36.17	18.76±9.78	7.63±0.32	4032±1749	6190±2784
Yufuhe	Wohushan dam	116.97	36.50	16.20±9.76	7.92±0.31	3074±350	2801±2644
Yiluohe	Heishiguan	112.93	34.72	19.08±7.86	7.93±0.32	3612±1090	3551±2750
Qinhe	Runcheng	112.52	35.47	18.22±6.70	7.94±0.15	2986±997	2160±987
Qinhe	Wulongkou	112.68	35.15	16.51±8.91	7.95±0.29	3422±653	2739±2386
Qingjianghe	Yimenzhen	107.10	34.33	10.93±6.43	7.30±0.36	1368±639	4405±3384
Qianhe	Qianyang	107.13	34.63	13.15±7.33	7.85±0.29	3973±986	3651±2400
Qishuihe	Haoshihe	108.05	34.60	13.28±8.43	7.92±0.32	4284±771	3844±3282
Bahe	Maduwang	109.15	34.23	14.60±7.03	7.84±0.30	2449±990	2243±1579
Jinghe	Tuliping	106.52	35.53	10.43±6.24	8.18±0.48	3172±658	2044±1927
Jinghe	Pingliang	106.63	35.57	12.35±9.12	8.30±0.45	3554±779	1636±1259
Jinghe	Zhangjiashan	108.60	34.63	17.71±7.08	7.92±0.22	4366±1199	3457±2133
Jinghe	Yangjiaping	107.73	35.33	13.29±8.19	8.17±0.25	3882±823	1707±1160
Daluhe	Jiaofengtou	106.92	35.48	11.07±7.61	8.05±0.54	4356±1787	4622±2101
Ruihe	Ankou	106.83	35.25	12.56±7.10	8.14±0.40	3298±734	2062±1787
Shibaozihe	Huating	106.68	35.22	10.85±7.35	8.18±0.49	3549±771	2278±1893
Xiaohe	Huangjiahe	106.48	35.98	11.62±6.06	7.82±0.33	4254±1325	4075±2628
Ruhe	Pengyang	106.65	35.83	13.24±6.65	7.69±0.48	3885±1996	6629±5448
Ruhe	Kaibian	107.07	35.77	11.93±7.20	8.10±0.34	4116±941	2412±1950
Malianhe	Yuluoping	107.88	35.33	15.39±8.03	7.93±0.36	4121±1115	3620±2984
Daxihe	Baili	107.38	35.02	10.52±8.77	8.01±0.44	4181±1060	3160±3047
Beiluohe	Jiaokou	109.35	35.65	15.83±8.85	8.16±0.27	4346±1365	2026±1728
Beiluohe	Zhuangtou	109.01	35.05	20.50±6.09	7.91±0.21	4638±1225	4049±3497
Zhouhe	Zhidan	108.77	36.82	14.06±8.40	8.24±0.25	3973±1202	1534±1262
Yinchuanhe	Yinchuan	103.07	35.68	11.84±7.04	8.28±0.67	2384±292	1651±1550
Weihe	Linjiachun	107.05	34.38	13.03±7.81	7.91±0.16	3335±738	2488±1136
Weihe	Weijiabao	107.70	34.30	14.70±7.69	7.79±0.24	3670±1155	3776±2169
Weihe	Xianyang	108.70	34.32	14.61±8.74	7.97±0.17	3244±737	2107±1009
Weihe	Huaxian	109.77	34.58	18.01±7.25	7.92±0.32	4063±1392	3716±3475
Huluhe	Qin'an	105.67	34.90	10.31±7.65	8.09±0.22	4287±1058	2095±1206
Huluhe	Beixia	105.75	35.57	12.10±6.87	8.02±0.44	4185±1279	3242±3164
Nanhe	Renda	105.75	35.17	11.49±7.14	8.06±0.34	4057±1056	2633±2116
Wujiahe	Shagaibulong	108.73	41.07	13.74±7.40	7.83±0.41	3060±802	4098±2240
Beihezi	Beihezi	106.15	36.97	9.31±7.40	7.76±0.38	5009±1487	6218±5538

Yuanhe	Yuanhe	105.43	36.57	9.72 ±6.87	8.14 ±0.39	3996 ±614	2090 ±1407
Xianmahe	Xianmahe dam	106.03	36.38	9.31 ±7.29	7.70 ±0.55	2877 ±1418	5820 ±2106
Daheihe	Qixiaying	112.12	40.97	5.53 ±4.41	8.01 ±0.10	4872 ±229	2521 ±541
Tianshuihe	Weizhou	106.48	37.28	8.29 ±7.44	7.78 ±0.32	4155 ±2081	4961 ±4188
Kuyehe	Wenjiachuan	110.75	38.43	14.93 ±9.08	8.20 ±0.10	3330 ±816	1212 ±357
Qiushuihe	Linjiaping	110.87	37.70	13.98 ±9.47	8.06 ±0.26	3587 ±1370	1917 ±1168
Pianguanhe	Pianguan	111.48	39.43	9.88 ±7.96	8.17 ±0.34	3167 ±804	1529 ±635
Luhe	Hengshan	109.28	37.97	12.41 ±8.75	8.20 ±0.17	4706 ±880	1747 ±626
Qingjianhe	Yanchuan	110.18	36.88	14.28 ±8.59	8.11 ±0.31	4782 ±1493	2533 ±1827
Xiaohe	Lujiazhuang	113.05	37.73	12.81 ±8.65	8.32 ±0.44	3309 ±774	1718 ±1323
Fenhe	Yitang	111.86	37.05	14.40 ±9.45	8.24 ±0.26	3950 ±994	1568 ±1074
Fenhe	Jingle	111.92	38.33	14.81 ±8.42	8.08 ±0.29	3930 ±1312	2201 ±1265
Fenhe	Lanchun	112.45	37.99	12.86 ±5.19	8.27 ±0.19	3436 ±725	1101 ±469
Fenhe	Dongmuzhuang	112.38	37.60	14.58 ±9.97	7.78 ±0.24	3824 ±600	4136 ±2285
Fenhe	Shitan	111.68	36.45	15.73 ±6.02	8.01 ±0.42	3502 ±654	2988 ±2292
Fenhe	Hejin	110.80	35.57	17.56 ±9.06	7.86 ±0.32	4809 ±1444	4989 ±3673
Wenyuhe	Wenyuhe dam	112.02	37.50	12.86 ±6.65	8.37 ±0.33	3063 ±450	967 ±833
Sushuihe	Zhangliuzhuang	110.32	34.83	15.50 ±9.23	8.52 ±0.20	7641 ±989	1452 ±660
Yiluohe	Luhun	112.18	34.20	15.73 ±7.09	7.82 ±0.25	3046 ±608	3290 ±2330
Yihe	Longmenzhen	112.47	34.55	16.97 ±7.67	7.83 ±0.23	3137 ±991	3088 ±1903
Luohe	Yiyang	112.17	34.52	16.05 ±8.29	7.96 ±0.22	3152 ±483	2230 ±1357
Luohe	Baimashi	112.58	34.72	17.72 ±7.68	7.84 ±0.21	3006 ±802	2796 ±1716
Runhe	Xin'an	112.15	34.72	13.38 ±10.10	7.87 ±0.23	3487 ±851	2765 ±1108
Danhe	Shanluping	112.92	35.24	17.28 ±5.62	7.82 ±0.25	3814 ±695	3705 ±1710
Ruihe	Jingchuan	107.35	35.33	12.67 ±7.95	8.01 ±0.23	3388 ±713	2189 ±1491
Puhe	Bajiazhui	107.50	35.68	13.63 ±8.31	8.17 ±0.24	4057 ±989	1775 ±1338
Xichuan	Qingyang	107.88	36.00	14.83 ±8.79	8.18 ±0.25	3959 ±1285	1693 ±1259
Yellow River ^a	Madoi	98.18	34.88	2.8	8.89	3327	211
Yellow River ^a	LB trib.	99.86	35.59	6.6	8.84	2228	165
Yellow River ^a	Tangnag	100.20	35.60	11.7	8.83	2489	199
Yellow River ^a	RB trib.	103.11	35.51	9.9	8.94	2808	170
Yellow River ^a	Lanzhou #1	103.82	36.07	13.1	8.60	3044	423
Yellow River ^a	Lanzhou #2	103.82	36.07	19.5	8.33	2889	813
Kachu ^a	Tangku	102.46	33.47	11	8.27	891	261
Mochu ^a	Ruoergai	102.81	33.63	10.4	8.22	1128	368

Weihe ^a	Wushan	104.88	34.73	16.8	8.54	3062	511
Taohe ^a	Headwaters	102.69	34.50	6.8	8.86	2459	174
Taohe ^a	LB trib.	103.00	34.70	6.5	8.92	2396	147
Taohe ^a	Mianxian	104.02	34.43	18.1	8.93	3085	209
Taohe ^a	Lintao	103.85	35.42	23.7	8.25	3016	1080
Datonghe ^a	Minhe #1	102.83	36.35	14.1	8.73	3183	330
Datonghe ^a	Minhe #2	102.83	36.35	18.3	8.47	3011	603
Huangshui ^a	Huangyuan	101.24	36.69	9.2	8.71	3493	360
Huangshui ^a	Minhe	102.79	36.36	21.7	8.20	3015	1180
Yellow River ^b	Toudaoguai	111.07	40.27	13.75 ±8.63	8.14 ±0.19	3664 ±399	1624 ±778
Yellow River ^b	Tongguan	110.33	34.61	14.42 ±8.74	7.80 ±0.28	4075 ±796	4770 ±3470
Yellow River ^b	Lijin	118.30	37.52	17.17 ±9.28	8.25 ±0.17	3622 ±292	1348 ±689

^a from Wu et al. (2005) for the upper Yellow River; sampled in May and June of 1999 and 2000.

^b for the Yellow River mainstem during the period 2011–2012 based on weekly sampling.

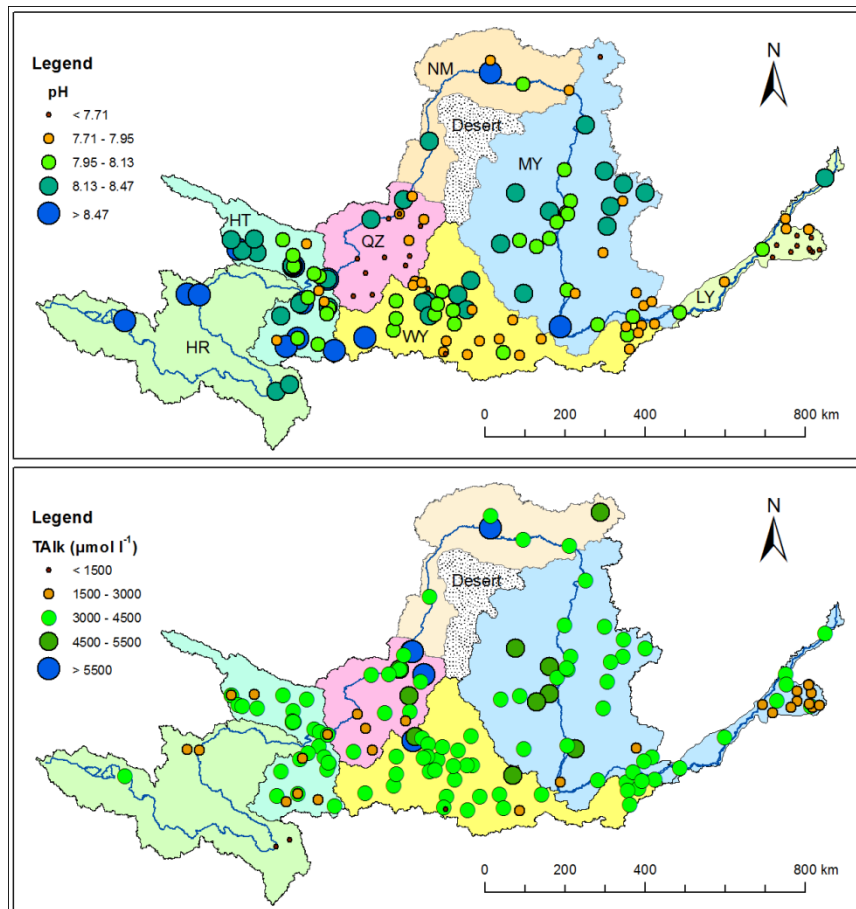


Fig. S1. Spatial variations in pH (top) and TAlk (bottom) within the Yellow River watershed. High TAlk values coincides with low pH, such as in the QZ sub-basin, while low TAlk values are mostly measured at sampling sites with high pH, such as in the HR sub-basin.