Supplementary Materials

Table S1. LMWL slope of the δ^2H–$\delta^{18}O$ linear relationship (in permille/permille) using multiple approaches for each sampling site during 2011–2014.

Station	$a + \sigma_a$					
	OLSR	**RMA**	**MA**	**PWLSR**	**PWRMA**	**PWMA**
Anning	7.19 ± 0.11	7.36 ± 0.11	7.53 ± 0.12	7.46 ± 0.10	7.58 ± 0.10	7.70 ± 0.10
Yuzhong	7.50 ± 0.09	7.63 ± 0.09	7.76 ± 0.10	7.62 ± 0.09	7.74 ± 0.09	7.85 ± 0.09
Gaolan	7.47 ± 0.17	7.95 ± 0.17	8.44 ± 0.18	7.63 ± 0.16	8.06 ± 0.16	8.51 ± 0.17
Yongdneg	7.14 ± 0.11	7.35 ± 0.11	7.57 ± 0.11	7.56 ± 0.10	7.75 ± 0.10	7.94 ± 0.10
This study	7.27 ± 0.06	7.51 ± 0.06	7.73 ± 0.06	7.55 ± 0.05	7.73 ± 0.05	7.91 ± 0.05

Table S2. LMWL intercept of the δ^2H–$\delta^{18}O$ linear relationship (in permille) using multiple approaches for each sampling site during 2011–2014.

Station	$(b + \sigma_b)$/‰					
	OLSR	**RMA**	**MA**	**PWLSR**	**PWRMA**	**PWMA**
Anning	1.54 ± 0.83	2.38 ± 0.83	3.20 ± 0.85	6.15 ± 0.76	6.89 ± 0.76	7.61 ± 0.77
Yuzhong	7.20 ± 0.87	8.19 ± 0.87	9.16 ± 0.89	8.91 ± 0.84	9.87 ± 0.85	10.81 ± 0.85
Gaolan	5.94 ± 1.17	8.75 ± 1.17	11.65 ± 1.25	8.07 ± 1.19	10.79 ± 1.21	13.58 ± 1.26
Yongdneg	4.96 ± 0.72	6.05 ± 0.72	7.12 ± 0.74	8.29 ± 0.78	9.54 ± 0.79	10.77 ± 0.80
This study	4.56 ± 0.44	6.03 ± 0.45	7.32 ± 0.46	7.87 ± 0.44	9.10 ± 0.44	10.32 ± 0.45

Table S3. Values of rmSSEav using multiple approaches for each sampling site during 2011–2014.

Station	$\mathbf{rmSSE_{av}}$					
	OLSR	**RMA**	**MA**	**PWLSR**	**PWRMA**	**PWMA**
Anning	1.0095	1.0037	1.0094*	1.0000	1.0105*	1.0254**
Yuzhong	1.0070	1.0028	1.0069	1.0014	1.0049*	1.0149**
Gaolan	1.0261	1.0100*	1.0258	1.0138	1.0101*	1.0308**
Yongdeng	1.0122	1.0048	1.0121**	1.0000**	1.0214**	1.0522**
This study	1.0123	1.0048**	1.0121**	1.0006**	1.0105**	1.0288**

Note: *Passed the significance test of0.05 level, **Passed the significance test of 0.01 level.

Table S4. LMWL slope of the δ^2H–$\delta^{18}O$ linear relationship (in permille/permille) using multiple approaches for each sampling site based on monthly samples during 2011–2014.

Station	$a + \sigma_a$					
	OLSR	**RMA**	**MA**	**PWLSR**	**PWRMA**	**PWMA**
Anning	7.60 ± 0.21	7.69 ± 0.20	7.78 ± 0.21	7.42 ± 0.21	7.51 ± 0.21	7.60 ± 0.21
Yuzhong	7.51 ± 0.22	7.62 ± 0.21	7.72 ± 0.22	7.71 ± 0.16	7.77 ± 0.16	7.82 ± 0.16
Gaolan	8.05 ± 0.67	8.80 ± 0.65	9.60 ± 0.73	7.92 ± 0.70	8.75 ± 0.72	9.63 ± 0.76
Yongdneg	7.30 ± 0.29	7.50 ± 0.28	7.70 ± 0.30	7.58 ± 0.32	7.81 ± 0.32	8.04 ± 0.33
This study	7.06 ± 0.37	7.38 ± 0.36	7.70 ± 0.39	7.01 ± 0.34	7.27 ± 0.34	7.53 ± 0.3

Table S5. LMWL intercept of the δ^2H–$\delta^{18}O$ linear relationship (in permille) using multiple approaches for each sampling site based on monthly samples during 2011–2014.

Station	$(b + \sigma_b)$/‰					
	OLSR	**RMA**	**MA**	**PWLSR**	**PWRMA**	**PWMA**
Anning	4.88 ± 1.74	5.52 ± 1.70	6.15 ± 1.77	5.34 ± 1.40	5.87 ± 1.41	6.40 ± 1.42
Yuzhong	7.40 ± 2.00	8.25 ± 1.95	9.09 ± 2.03	9.74 ± 1.42	10.18 ± 1.42	10.62 ± 1.43
Gaolan	12.68 ± 4.49	17.37 ± 4.35	22.39 ± 4.90	10.17 ± 4.58	15.25 ± 4.69	20.71 ± 5.04
Yongdeng	6.08 ± 2.45	7.53 ± 2.38	8.96 ± 2.51	8.36 ± 2.19	9.82 ± 2.21	11.27 ± 2.26
This study	5.29 ± 2.26	7.16 ± 2.49	9.03 ± 2.67	6.27 ± 2.30	7.92 ± 2.33	9.56 ± 2.39

Table S6. Values of rmSSEav using multiple approaches for each sampling site based on monthly samples during 2011–2014.

Station	$rmSSE_{av}$					
	OLSR	**RMA**	**MA**	**PWLSR**	**PWRMA**	**PWMA**
Anning	1.0049	1.0019	1.0049	1.0353	1.0143	1
Yuzhong	1.0057	1.0023	1.0056	1	1.0041	1.0097
Gaolan	1.0378	1.0143	1.0375	1.0465	1.0149	1.0384
Yongdeng	1.0111	1.0044	1.011	1.0003	1.0141	1.0432
This study	1.018	1.007	1.0178	1.0183	1.0069	1.0104

Table S7. Meteoric water line slopes of the δ^2H–$\delta^{18}O$ linear relationship (in permille/permille) for different seasons and sub regions using multiple approaches based on event-based samples during 2011–2014.

Station	Season	$a + \sigma_a$					
		OLSR	**RMA**	**MA**	**PWLSR**	**PWRMA**	**PWMA**
Anning	Spring	6.78 ± 0.27	6.93 ± 0.26	7.07 ± 0.27	7.27 ± 0.30	7.45 ± 0.30	7.62 ± 0.31
	Summer	6.92 ± 0.17	7.12 ± 0.17	7.32 ± 0.17	7.35 ± 0.14	7.48 ± 0.14	7.61 ± 0.14
	Autumn	7.59 ± 0.26	7.80 ± 0.26	8.00 ± 0.27	7.94 ± 0.18	8.03 ± 0.18	8.12 ± 0.18
	Winter	9.70 ± 0.48	9.77 ± 0.41	9.84 ± 0.48	9.58 ± 0.58	9.69 ± 0.58	9.79 ± 0.59
Yuzhong	Spring	7.20 ± 0.34	7.49 ± 0.33	7.79 ± 0.36	7.57 ± 0.26	7.74 ± 0.26	7.90 ± 0.27
	Summer	7.31 ± 0.15	7.46 ± 0.15	7.61 ± 0.16	7.48 ± 0.16	7.63 ± 0.16	7.79 ± 0.16
	Autumn	7.65 ± 0.14	7.74 ± 0.14	7.82 ± 0.14	7.68 ± 0.13	7.76 ± 0.13	7.83 ± 0.13
	Winter	7.52 ± 0.28	7.60 ± 0.26	7.68 ± 0.28	8.01 ± 0.25	8.07 ± 0.25	8.13 ± 0.25
Gaolan	Spring	8.31 ± 0.27	8.60 ± 0.26	8.88 ± 0.28	8.55 ± 0.32	8.95 ± 0.33	9.36 ± 0.34
	Summer	7.30 ± 0.24	7.81 ± 0.24	8.33 ± 0.26	7.47 ± 0.24	7.94 ± 0.24	8.44 ± 0.25
	Autumn	6.80 ± 0.33	7.15 ± 0.33	7.50 ± 0.35	7.63 ± 0.25	7.81 ± 0.25	7.99 ± 0.26
	Winter	1.20 ± 0.10	1.25 ± 0.10	1.26 ± 0.11	1.23 ± 0.07	1.25 ± 0.07	1.25 ± 0.07
Yongdneg	Spring	6.78 ± 0.34	7.20 ± 0.33	7.63 ± 0.36	6.64 ± 0.33	7.03 ± 0.33	7.43 ± 0.34
	Summer	7.18 ± 0.13	7.36 ± 0.13	7.54 ± 0.13	7.71 ± 0.11	7.83 ± 0.11	7.95 ± 0.12
	Autumn	7.61 ± 0.18	7.75 ± 0.17	7.89 ± 0.18	7.74 ± 0.17	7.87 ± 0.17	8.01 ± 0.18
	Winter	10.34 ± 1.48	10.75 ± 1.21	11.18 ± 1.54	10.83 ± 1.19	11.09 ± 1.20	11.35 ± 1.22
This study	Spring	7.28 ± 0.16	7.61 ± 0.16	7.95 ± 0.17	7.31 ± 0.15	7.59 ± 0.15	7.88 ± 0.16
	Summer	7.11 ± 0.09	7.35 ± 0.09	7.59 ± 0.09	7.48 ± 0.08	7.67 ± 0.08	7.86 ± 0.08
	Autumn	7.59 ± 0.10	7.76 ± 0.10	7.92 ± 0.11	7.82 ± 0.09	7.93 ± 0.09	8.04 ± 0.09
	Winter	7.64 ± 0.26	7.83 ± 0.25	8.02 ± 0.27	7.67 ± 0.30	7.93 ± 0.30	8.18 ± 0.31

Table S8. Meteoric water line intercepts of the δ^2H–$\delta^{18}O$ linear relationship (in permille) for different seasons and sub regions using multiple approaches based on event-based samples during 2011–2014.

Station	Season	$(b + \sigma_b)$/‰					
		OLSR	**RMA**	**MA**	**PWLSR**	**PWRMA**	**PWMA**
Anning	Spring	1.67 ± 1.74	2.47 ± 1.68	3.26 ± 1.77	7.10 ± 1.73	7.95 ± 1.74	8.80 ± 1.77
	Summer	-0.03 ± 1.02	0.59 ± 1.01	1.22 ± 1.05	4.66 ± 1.04	5.35 ± 1.05	6.03 ± 1.06
	Autumn	4.58 ± 2.10	5.96 ± 2.06	7.33 ± 2.15	10.39 ± 1.67	11.16 ± 1.67	11.91 ± 1.68
	Winter	35.01 ± 7.27	36.02 ± 6.30	37.02 ± 7.32	33.24 ± 7.56	34.55 ± 7.58	35.84 ± 7.64
Yuzhong	Spring	7.81 ± 2.76	9.95 ± 2.69	12.09 ± 2.87	10.67 ± 2.27	11.98 ± 2.28	13.28 ± 2.31
	Summer	6.14 ± 1.27	7.10 ± 1.26	8.05 ± 1.29	8.10 ± 1.32	9.19 ± 1.33	10.27 ± 1.35
	Autumn	7.90 ± 1.39	8.60 ± 1.37	9.28 ± 1.40	8.15 ± 1.40	8.84 ± 1.41	9.51 ± 1.42
	Winter	4.87 ± 3.84	5.86 ± 3.63	6.82 ± 3.88	11.50 ± 3.95	12.40 ± 3.95	13.28 ± 3.98
Gaolan	Spring	11.83 ± 1.58	13.20 ± 1.56	14.58 ± 1.63	12.94 ± 1.90	14.96 ± 1.92	17.02 ± 1.98
	Summer	2.94 ± 1.76	5.97 ± 1.76	9.11 ± 1.88	5.82 ± 1.84	8.94 ± 1.87	12.16 ± 1.96
	Autumn	5.95 ± 2.30	8.14 ± 2.26	10.35 ± 2.42	11.73 ± 2.10	13.08 ± 2.11	14.43 ± 2.15
	Winter	-50.44 ± 0.88	-50.00 ± 0.82	-49.90 ± 0.90	-50.26 ± 0.54	-50.09 ± 0.54	-50.05 ± 0.54
Yongdeng	Spring	5.63 ± 2.22	7.75 ± 2.19	9.92 ± 2.35	6.07 ± 2.46	8.80 ± 2.49	11.59 ± 2.60
	Summer	2.75 ± 0.76	3.44 ± 0.76	4.12 ± 0.78	6.67 ± 0.83	7.43 ± 0.84	8.17 ± 0.85
	Autumn	11.72 ± 1.40	12.67 ± 1.38	13.60 ± 1.43	12.53 ± 1.40	13.48 ± 1.40	14.42 ± 1.42
	Winter	44.88 ± 21.28	50.82 ± 17.38	56.91 ± 22.13	50.41 ± 17.82	54.25 ± 17.92	58.13 ± 18.24
This study	Spring	7.11 ± 1.07	8.92 ± 1.07	10.75 ± 1.12	8.49 ± 1.07	10.29 ± 1.09	12.11 ± 1.12
	Summer	2.38 ± 0.58	3.54 ± 0.58	4.70 ± 0.60	6.26 ± 0.60	7.46 ± 0.60	8.64 ± 0.62

	Autumn	8.83 ± 0.88	10.00 ± 0.87	11.15 ± 0.90	11.26 ± 0.80	12.14 ± 0.80	13.01 ± 0.81
	Winter	5.22 ± 3.34	7.47 ± 3.27	9.71 ± 3.42	4.55 ± 4.15	7.86 ± 4.18	11.18 ± 4.28

Table S9. Values of rmSSEav for different seasons and sub regions using multiple approaches based on event-based samples during 2011–2014.

Station	Season	$rmSSE_{av}$					
		OLSR	RMA	MA	PWLSR	PWRMA	PWMA
Aning	Spring	1.0089	1.0035	1.0088	1.0000	1.0168	1.0428
	Summer	1.0118	1.0046	1.0116	1.0000	1.0203*	1.0446*
	Autumn	1.0111	1.0043	1.0109	1.0000	1.0116	1.0248
	Winter	1.0029	1.0012	1.0029	1.0103	1.0014	1.0024
Yuzhong	Spring	1.0167	1.0065	1.0165	1.0014	1.0078	1.0197
	Summer	1.0082	1.0032	1.0081	1.0008	1.0084	1.0256*
	Autumn	1.0046	1.0018	1.0045	1.0024	1.0017	1.0050
	Winter	1.0044	1.0017	1.0043	1.0000	1.0191	1.0397
Gaolan	Spring	1.0138	1.0054	1.0137	1.0033	1.0160	1.0583*
	Summer	1.0282	1.0108	1.0279**	1.0141	1.0112	1.0366**
	Autumn	1.0207	1.0080	1.0205	1.0000	1.0206*	1.0461*
	Winter	1.0089	1.0037	1.0055	1.0015	1.0025	1.0032
Yongdeng	Spring	1.0251	1.0096	1.0248	1.0232	1.0085	1.0252
	Summer	1.0100	1.0039	1.0099*	1.0000**	1.0250**	1.0540**
	Autumn	1.0076	1.0030	1.0075	1.0017	1.0050	1.0160
	Winter	1.0166	1.0065	1.0165	1.0081	1.0052	1.0101
This study	Spring	1.0184	1.0071	1.0182**	1.0122	1.0070	1.0186*
	Summer	1.0137	1.0053*	1.0135**	1.0000**	1.0171**	1.0426**
	Autumn	1.0089	1.0035	1.0088*	1.0000	1.0067*	1.0174**
	Winter	1.0103	1.0040	1.0101	1.0095	1.0034	1.0194

Note: *Passed the significance test of 0.05 level, **Passed the significance test of 0.01 level.

Table S10. Meteoric water line slopes of the δ^2H–$\delta^{18}O$ linear relationship (in permille/permille) for different seasons and sub regions using multiple approaches based on monthly samples during 2011–2014.

Station	Season	$a + \sigma_a$					
		OLSR	RMA	MA	PWLSR	PWRMA	PWMA
Anning	Spring	7.68 ± 0.62	7.86 ± 0.55	8.03 ± 0.63	7.76 ± 0.52	7.87 ± 0.52	7.99 ± 0.52
	Summer	7.28 ± 0.41	7.38 ± 0.37	7.48 ± 0.41	7.16 ± 0.41	7.27 ± 0.41	7.37 ± 0.41
	Autumn	6.66 ± 0.69	6.91 ± 0.61	7.16 ± 0.72	8.23 ± 0.43	8.31 ± 0.42	8.31 ± 0.42
	Winter	8.61 ± 0.45	8.66 ± 0.37	8.70 ± 0.45	8.40 ± 0.37	8.43 ± 0.37	8.46 ± 0.37
Yuzhong	Spring	7.51 ± 0.45	7.57 ± 0.38	7.64 ± 0.45	7.43 ± 0.57	7.53 ± 0.56	7.63 ± 0.56
	Summer	7.61 ± 0.29	7.66 ± 0.27	7.72 ± 0.30	7.54 ± 0.25	7.58 ± 0.25	7.62 ± 0.25
	Autumn	7.71 ± 0.38	7.80 ± 0.34	7.88 ± 0.38	7.71 ± 0.29	7.76 ± 0.29	7.81 ± 0.30
	Winter	6.78 ± 0.31	6.80 ± 0.22	6.81 ± 0.31	6.83 ± 0.39	6.86 ± 0.39	6.88 ± 0.39
Gaolan	Spring	8.10 ± 1.03	8.51 ± 0.91	9.00 ± 1.09	7.73 ± 1.21	8.37 ± 1.24	9.05 ± 1.31
	Summer	8.21 ± 1.06	8.87 ± 0.97	9.56 ± 1.14	8.34 ± 1.23	9.07 ± 1.15	9.85 ± 1.22
	Autumn	7.82 ± 4.81	10.36 ± 3.40	13.68 ± 6.35	10.56 ± 3.37	11.59 ± 3.44	12.70 ± 3.69
	Winter	0.99 ± 0.28	1.03 ± 0.15	1.03 ± 0.26	1.11 ± 0.08	1.11 ± 0.08	1.11 ± 0.08
Yongdneg	Spring	6.63 ± 0.78	6.99 ± 0.70	7.35 ± 0.82	5.99 ± 0.81	6.42 ± 0.83	6.85 ± 0.87
	Summer	7.92 ± 0.61	8.15 ± 0.55	8.37 ± 0.62	8.08 ± 0.46	8.21 ± 0.46	8.34 ± 0.46
	Autumn	7.84 ± 0.31	7.90 ± 0.28	7.95 ± 0.31	7.74 ± 0.38	7.83 ± 0.38	7.91 ± 0.39
	Winter	10.97 ± 1.03	11.12 ± 0.80	11.26 ± 1.04	11.61 ± 0.73	11.68 ± 0.74	11.75 ± 0.74
This study	Spring	7.06 ± 0.37	7.38 ± 0.36	7.70 ± 0.49	7.01 ± 0.34	7.27 ± 0.34	7.53 ± 0.35
	Summer	7.49 ± 0.29	7.74 ± 0.28	7.98 ± 0.30	7.52 ± 0.25	7.70 ± 0.25	7.88 ± 0.25
	Autumn	7.59 ± 0.28	7.76 ± 0.27	7.92 ± 0.28	8.01 ± 0.19	8.08 ± 0.19	8.15 ± 0.19
	Winter	7.76 ± 0.36	7.90 ± 0.34	8.03 ± 0.37	7.55 ± 0.33	7.67 ± 0.34	7.78 ± 0.3

Table S11. Meteoric water line intercepts the δ^2H–$\delta^{18}O$ linear relationship (in permille) for different seasons and sub regions using multiple approaches based on monthly samples during 2011–2014.

Station	Season	$(b + \sigma_b)$/‰					
		OLSR	RMA	MA	PWLSR	PWRMA	PWMA
Anning	Spring	6.13 ± 3.49	6.97 ± 3.08	7.80 ± 3.56	8.66 ± 2.85	9.23 ± 2.86	9.79 ± 2.90
	Summer	2.19 ± 2.62	2.70 ± 2.37	3.20 ± 2.65	3.22 ± 2.50	3.71 ± 2.50	4.19 ± 2.53
	Autumn	-1.41 ± 5.49	0.39 ± 4.84	2.19 ± 5.68	12.38 ± 3.71	13.02 ± 3.72	13.64 ± 3.74
	Winter	18.27 ± 6.32	18.89 ± 5.16	19.49 ± 6.35	16.75 ± 5.35	17.20 ± 5.36	17.63 ± 5.37
Yuzhong	Spring	9.94 ± 3.40	10.40 ± 2.88	10.86 ± 3.43	9.48 ± 4.66	10.31 ± 4.68	11.12 ± 4.72
	Summer	9.84 ± 2.30	10.24 ± 2.10	10.63 ± 2.32	8.76 ± 2.00	9.06 ± 2.01	9.36 ± 2.02
	Autumn	9.27 ± 3.99	10.06 ± 3.61	10.83 ± 4.04	7.72 ± 3.20	8.22 ± 3.21	8.71 ± 3.22
	Winter	-8.36 ± 3.96	-8.19 ± 2.80	-8.03 ± 3.97	-8.28 ± 6.06	-7.95 ± 6.06	-7.62 ± 6.08
Gaolan	Spring	13.65 ± 6.08	16.11 ± 5.37	18.64 ± 6.40	8.68 ± 6.81	12.06 ± 6.94	15.62 ± 7.36
	Summer	10.66 ± 6.95	14.57 ± 6.36	18.68 ± 7.49	10.99 ± 7.48	15.51 ± 7.64	20.31 ± 8.12
	Autumn	16.51 ± 33.09	33.94 ± 23.41	56.69 ± 43.70	33.92 ± 25.58	41.68 ± 26.16	50.07 ± 28.02
	Winter	-52.06 ± 2.18	-51.78 ± 1.26	-51.77 ± 2.18	-51.19 ± 0.66	-51.16 ± 0.65	-51.16 ± 0.65
Yongdneg	Spring	0.89 ± 6.36	3.23 ± 5.68	5.59 ± 6.65	1.10 ± 5.92	4.07 ± 6.02	7.11 ± 6.33
	Summer	7.61 ± 3.26	8.72 ± 2.98	9.83 ± 3.35	9.01 ± 2.89	9.75 ± 2.90	10.48 ± 2.93
	Autumn	14.94 ± 2.72	14.38 ± 2.46	14.82 ± 2.73	11.86 ± 2.78	12.44 ± 2.79	13.01 ± 2.81
	Winter	54.07 ± 14.16	56.04 ± 10.97	58.00 ± 14.34	62.35 ± 10.88	63.38 ± 10.90	64.39 ± 10.94
This study	Spring	5.29 ± 2.56	7.16 ± 2.49	9.03 ± 2.67	6.27 ± 2.31	7.92 ± 2.33	9.56 ± 2.39
	Summer	6.09 ± 1.92	7.52 ± 1.88	8.94 ± 1.98	6.50 ± 1.69	7.59 ± 1.70	8.66 ± 1.73
	Autumn	9.37 ± 2.50	10.73 ± 2.43	12.08 ± 2.55	12.27 ± 1.67	12.87 ± 1.67	13.46 ± 1.68
	Winter	6.77 ± 4.65	8.39 ± 4.38	9.98 ± 4.73	2.27 ± 4.62	3.82 ± 4.63	5.34 ± 4.68

Table S12. Values of rmSSEav for different seasons and sub regions using multiple approaches based on monthly samples during 2011–2014.

Station	Season	$rmSSE_{av}$					
		OLSR	RMA	MA	PWLSR	PWRMA	PWMA
Anning	Spring	1.0091	1.0036	1.009	1.0073	1.0035	1.0041
	Summer	1.0056	1.0022	1.0055	1.0203	1.0067	1.0001
	Autumn	1.015	1.0058	1.0148	1	1.0175	1.035
	Winter	1.0022	1.0009	1.0022	1.0145	1.0066	1
Yuzhong	Spring	1.0036	1.0014	1.0036	1.0088	1.0009	1.0047
	Summer	1.003	1.0012	1.003	1.0089	1.0034	1
	Autumn	1.0043	1.0017	1.0043	1.0062	1.0023	1.0004
	Winter	1.0008	1.0003	1.0008	1.0016	1	1.0018
Gaolan	Spring	1.0224	1.0087	1.0222	1.0445	1.011	1.0244
	Summer	1.0326	1.0124	1.0323	1.024	1.0125	1.0484
	Autumn	1.1323	1.0445	1.1323	1.0389	1.017	1.0384
	Winter	1.0054	1.0027	1.0029	1	1.0086	1.0094
Yongdneg	Spring	1.0216	1.0083	1.0213	1.0923	1.0288	1.0022
	Summer	1.0117	1.0046	1.0116	1.0013	1.0051	1.0135
	Autumn	1.0029	1.0011	1.0028	1.0016	1.0021	1.0098
	Winter	1.0054	1.0021	1.0054	1	1.0068	1.0152
This study	Spring	1.018	1.007	1.0178	1.0183	1.0069	1.010
	Summer	1.018	1.007	1.0178	1.0183	1.0069	1.0104
	Autumn	1.0134	1.0052	1.0133	1.0102	1.0048	1.0079
	Winter	1.0089	1.0035	1.0088	1	1.0074	1.0162

Table S13. LMWL slope of the δ^2H–$\delta^{18}O$ linear relationship (in permille/permille) ($a + \sigma_a$) under the precipitation amount (P in mm) condition using six regressions based on event-based samples in the Lanzhou city from 2011 to 2014.

***P* (mm)**	**Slope (permille/permille)**						**n**
	OLSR	**RMA**	**MA**	**PWLSR**	**PWRMA**	**PWMA**	
$0 < P < 0.5$	7.13 ± 0.13	7.38 ± 0.13	7.62 ± 0.14*	7.14 ± 0.14	7.42 ± 0.14	7.71 ± 0.15**	207
$0.5 \le P < 1$	7.17 ± 0.16	7.38 ± 0.15	7.58 ± 0.16	7.16 ± 0.15	7.36 ± 0.15	7.56 ± 0.16	126
$1 \le P < 2$	7.21 ± 0.15	7.48 ± 0.15	7.75 ± 0.15*	7.29 ± 0.14	7.54 ± 0.14	7.78 ± 0.14**	187
$2 \le P < 5$	7.37 ± 0.11	7.56 ± 0.11	7.75 ± 0.11*	7.35 ± 0.11	7.53 ± 0.11	7.70 ± 0.11*	233
$P \ge 5$	7.80 ± 0.12	7.98 ± 0.12	8.16 ± 0.12*	7.81 ± 0.11	7.98 ± 0.11	8.14 ± 0.12*	207

Note: *Passed the significance test of0.05 level, **Passed the significance test of 0.01 level.

Table S14. LMWL slope of the δ^2H–$\delta^{18}O$ linear relationship (in permille/permille) ($a + \sigma_a$) under the air temperature (T in °C) condition using six regressions based on event-based samples in the Lanzhou city from 2011 to 2014.

***T* (°C)**	**Slope (permille/permille)**						**n**
	OLSR	**RMA**	**MA**	**PWLSR**	**PWRMA**	**PWMA**	
$T < 0$	7.62 ± 0.16	7.78 ± 0.15	7.95 ± 0.16	7.72 ± 0.14	7.86 ± 0.14	7.99 ± 0.15	107
$0 \le T < 10$	7.01 ± 0.16	7.30 ± 0.16	7.60 ± 0.16*	7.23 ± 0.13	7.44 ± 0.14	7.64 ± 0.14**	173
$10 \le T < 20$	7.38 ± 0.07	7.58 ± 0.07**	7.78 ± 0.07**	7.69 ± 0.07**	7.87 ± 0.07**	8.07 ± 0.07**	569
$T \ge 20$	7.10 ± 0.21	7.40 ± 0.21	7.71 ± 0.22*	7.26 ± 0.14	7.39 ± 0.14	7.51 ± 0.14	102

Note: *Passed the significance test of 0.05 level, **Passed the significance test of 0.01 level.

Table S15. LMWL slope of the δ^2H–$\delta^{18}O$ linear relationship (in permille/permille) ($a + \sigma_a$) under the relative humidity (RH in %) condition using six regressions based on event-based samples in the Lanzhou city from 2011 to 2014.

***RH* (%)**	**Slope (permille/permille)**						**n**
	OLSR	**RMA**	**MA**	**PWLSR**	**PWRMA**	**PWMA**	
$0 < RH < 60$	6.88 ± 0.17	7.18 ± 0.17	7.48 ± 0.18*	6.92 ± 0.14	7.12 ± 0.14	7.32 ± 0.15	143
$60 \le RH < 70$	6.90 ± 0.18	7.20 ± 0.18	7.50 ± 0.19*	7.08 ± 0.19	7.38 ± 0.19	7.69 ± 0.19**	129
$70 \le RH < 80$	7.34 ± 0.11	7.55 ± 0.12	7.76 ± 0.12*	7.67 ± 0.11	7.82 ± 0.11**	7.07 ± 0.11**	234
$80 \le RH < 90$	7.73 ± 0.09	7.90 ± 0.09	8.06 ± 0.10*	7.76 ± 0.11	7.94 ± 0.10	8.11 ± 0.10**	298
$90 \le RH < 100$	7.51 ± 0.16	7.77 ± 0.16	8.04 ± 0.17*	7.74 ± 0.13	7.91 ± 0.13	8.08 ± 0.13*	155

Note: *Passed the significance test of 0.05 level, **Passed the significance test of 0.01 level.

Table S16. LMWL slope of the δ^2H–$\delta^{18}O$ linear relationship (in permille/permille) ($a + \sigma_a$) under the water vapor pressure (e in %) condition using six regressions based on event-based samples in the Lanzhou city from 2011 to 2014.

***e* (%)**	**Slope (permille/permille)**						**n**
	OLSR	**RMA**	**MA**	**PWLSR**	**PWRMA**	**PWMA**	
$0 < e < 5$	7.77 ± 0.17	7.94 ± 0.17	8.11 ± 0.18*	7.67 ± 0.16	7.81 ± 0.16	7.96 ± 0.17	88
$5 \le e < 10$	7.09 ± 0.16	7.43 ± 0.15	7.77 ± 0.16**	6.95 ± 0.15	7.29 ± 0.15	7.63 ± 0.16*	209
$10 \le e < 15$	7.20 ± 0.09	7.41 ± 0.09	7.62 ± 0.09**	7.49 ± 0.08*	7.66 ± 0.08**	7.83 ± 0.09**	383
$15 \le e < 25$	7.24 ± 0.12	7.50 ± 0.12	7.76 ± 0.13**	7.80 ± 0.09*	7.95 ± 0.09**	8.10 ± 0.10**	265

Note: *Passed the significance test of 0.05 level, **Passed the significance test of 0.01 level.

Table S17. LMWL slope of the δ^2H–$\delta^{18}O$ linear relationship (in permille/permille) ($a + \sigma_a$) under the dew point temperature (T_d in °C) condition using six regressions based on event-based samples in the Lanzhou city from 2011 to 2014.

***T*d (°C)**	**Slope (permille/permille)**						**n**
	OLSR	**RMA**	**MA**	**PWLSR**	**PWRMA**	**PWMA**	
$T_d < 0$	7.79 ± 0.17	7.98 ± 0.17	8.18 ± 0.17	7.64 ± 0.16	7.84 ± 0.17	8.03 ± 0.17	112
$0 \le T_d < 10$	7.79 ± 0.11	7.47 ± 0.11	7.75 ± 0.12**	7.44 ± 0.10	7.67 ± 0.09**	7.89 ± 0.09	329
$10 \le T_d < 20$	7.15 ± 0.09	7.35 ± 0.09	7.54 ± 0.09**	7.54 ± 0.08**	7.69 ± 0.08**	7.83 ± 0.08**	392
$T_d > 20$	7.21 ± 0.19	7.46 ± 0.19	7.71 ± 0.20	7.65 ± 0.17	7.83 ± 0.17*	8.01 ± 0.17**	101

Note: *Passed the significance test of 0.05 level, **Passed the significance test of 0.01 level.

Table S18. LMWL slope of the δ^2H–$\delta^{18}O$ linear relationship (in permille/permille) ($a + \sigma_a$) under the depression of the dew point (ΔT_d in ℃) condition using six regressions based on event-based samples in the Lanzhou city from 2011 to 2014.

ΔT_d (℃)	Slope (permille/permille)						n
	OLSR	RMA	MA	PWLSR	PWRMA	PWMA	
$\Delta T_d < 2$	7.67 ± 0.14	7.90 ± 0.14	8.13 ± 0.14*	7.82 ± 0.10	7.95 ± 0.10	8.07 ± 0.10*	193
$2 \le \Delta T_d < 4$	7.67 ± 0.09	7.83 ± 0.09	7.98 ± 0.09*	7.77 ± 0.09	7.92 ± 0.09	8.07 ± 0.09**	310
$4 \le \Delta T_d < 6$	7.16 ± 0.65	7.43 ± 0.15	7.71 ± 0.15*	7.57 ± 0.15	7.83 ± 0.14**	8.10 ± 0.14**	186
$\Delta T_d \ge 6$	6.96 ± 0.13	7.25 ± 0.13	7.55 ± 0.13**	7.18 ± 0.11	7.40 ± 0.11*	7.62 ± 0.12**	258

Note: *Passed the significance test of 0.05 level, **Passed the significance test of 0.01 level.

Table S19. Meteoric water line of monthly-weighted samples for four seasons in Lanzhou City during 2011–2014. The monthly isotopic data during 1985–1987 and 1996–1999 was provided by IAEA/WMO (2017), and the event-based data during 2011–2014 were precipitation-weighted to monthly series.

	OLSR	RMA	MA	PWLSR	PWRMA	PWMA
$a+\sigma_a$	7.40 ± 0.13	7.60 ± 0.13	7.80 ± 0.49	7.40 ± 0.15	7.67 ± 0.57	7.94 ± 0.59
$(b+\sigma_b)$/‰	5.94 ± 1.11	7.39 ± 1.11	8.84 ± 4.14	6.05 ± 1.11	7.82 ± 4.11	9.59 ± 4.36
$rmSSE_{av}$	1	1.0155	1.0311	1	1.0209	1.042

Table S20. Inter-annual variation of slope of the δ^2H–$\delta^{18}O$ linear relationship (in permille/permille) using the six regression methods, precipitation amount (P in mm) and air temperature (T in °C) based on event-based samples at Yuzhong in summer from 2011 to 2014.

Year	Summer Slope (permille/permille)							
	OLSR	RMA	MA	PWLSR	PWRMA	PWMA	P (mm)	T (°C)
2011	7.77 ± 0.21	7.84 ± 0.21	7.91 ± 0.22	7.50 ± 0.21	7.56 ± 0.21	7.63 ± 0.21	105	17.80
2012	7.87 ± 0.29	8.00 ± 0.28	8.12 ± 0.29	7.82 ± 0.34	7.99 ± 0.34	8.17 ± 0.35	187.60	18.20
2013	6.44 ± 0.52	6.94 ± 0.50	7.45 ± 0.55	6.71 ± 0.60	7.36 ± 0.62	8.04 ± 0.66	115.60	16.88
2014	6.79 ± 0.63	7.21 ± 0.59	7.65 ± 0.67	7.97 ± 0.60	8.30 ± 0.61	8.64 ± 0.62	133.10	16.05

Table S21. Inter-annual variation of slope of the δ^2H–$\delta^{18}O$ linear relationship (in permille/permille) using the six regression methods, precipitation amount (P in mm) and air temperature (T in °C) based on event-based samples at Gaolan in summer from 2011 to 2014.

Year	Summer Slope (permille/permille)							
	OLSR	RMA	MA	PWLSR	PWRMA	PWMA	P (mm)	T (°C)
2011	7.81 ± 0.54	8.12 ± 0.51	8.44 ± 0.56	8.56 ± 0.39	8.71 ± 0.39	8.85 ± 0.40	60.80	17.98
2012	7.87 ± 0.32	7.29 ± 0.31	7.69 ± 0.33	7.31 ± 0.31	7.65 ± 0.40	8.00 ± 0.46*	112.80	20.08
2013	7.46 ± 0.38	7.77 ± 0.36	8.07 ± 0.39	7.21 ± 0.47	7.70 ± 0.48	8.21 ± 0.50	80.40	18.93
2014	7.22 ± 0.53	7.58 ± 0.51	7.95 ± 0.56	7.28 ± 0.65	7.82 ± 0.67	8.38 ± 0.70	51.60	18.36

Table S22. Inter-annual variation of slope of the δ^2H–$\delta^{18}O$ linear relationship (in permille/permille) using the six regression methods, precipitation amount (P in mm) and air temperature (T in °C) based on event-based samples at Yongdeng in summer from 2011 to 2014.

Year	Summer Slope (permille/permille)							
	OLSR	RMA	MA	PWLSR	PWRMA	PWMA	P (mm)	T (°C)
2011	6.88 ± 0.33	7.04 ± 0.23	7.19 ± 0.24	7.16 ± 0.19	7.26 ± 0.19	7.36 ± 0.20	158.10	15.66
2012	7.18 ± 0.41	7.47 ± 0.39	7.76 ± 0.43	7.56 ± 0.31	7.72 ± 0.31	7.88 ± 0.32	187.20	16.81
2013	7.39 ± 0.28	7.51 ± 0.27	7.63 ± 0.28	7.67 ± 0.22	7.74 ± 0.22	7.81 ± 0.22	142.80	16.20
2014	6.91 ± 0.21	7.07 ± 0.20	7.23 ± 0.21	7.31 ± 0.22	7.50 ± 0.23	7.68 ± 0.23*	166.10	15.30