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Stable isotope compositions of precipitation in China

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Outline

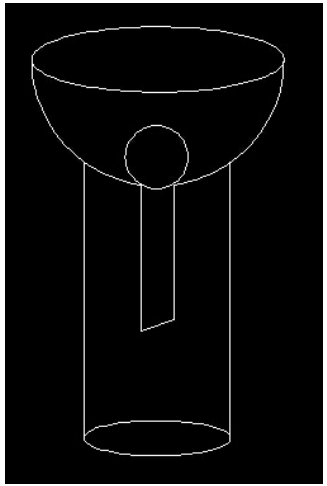
- Introduction
- Material and methods
- Results and conclusion
  - ✓ The CHNIP stations' isotopic characteristics.
  - ✓ Seasonal variations
  - ✓ Local MWL
  - ✓ Correlations between $\delta^{18}O$ and environmental variables (Temperature, meteorological and geographical)
- Conclusions

Introduction

- Stable isotopes are ideal tracers of water.
- The begin observations stable isotopic compositions of precipitation in China was in the mid-1980s (participated in the GNIP), but most were suspended after the mid-1990s.
- In 2004, CHNIP was established beacuse of the palaeoclimatologists.

Material and methods

- Methods
  - Placed the equipment outside
  - After each rainfall event, rainwater is collected and stored indoors below 4 ^{o}C.
  - A pail was using collected snow, and after the event snow samples melt at room temperature.
  - The end of the month, all collected water is mixed.
  - Using a Finnigan MAT253 mass spectrometer and TC/EA method for ^{18}O and D content.



(NE:northeast NW:northwest TP:Tibetan NC:north China SC:south China)

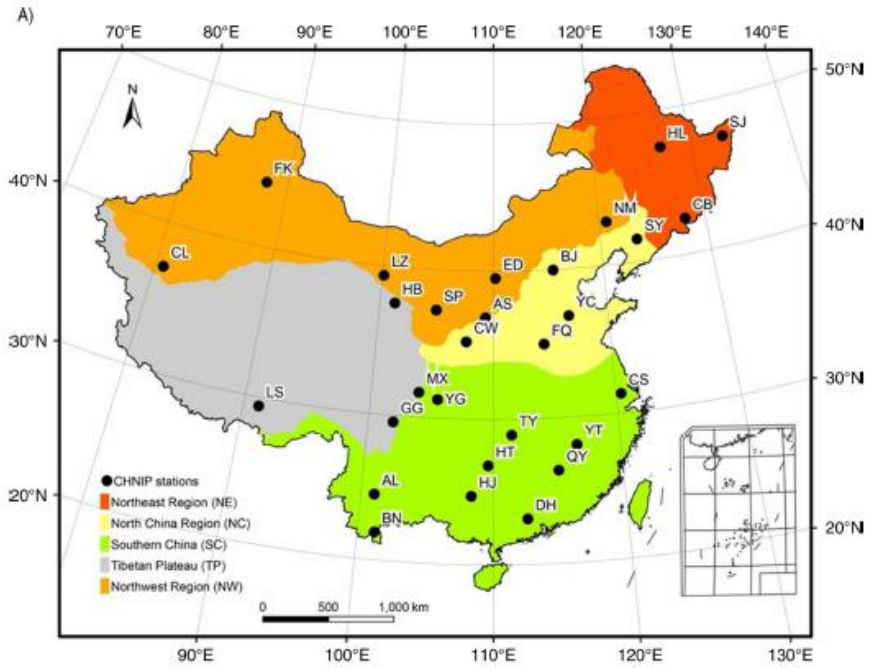
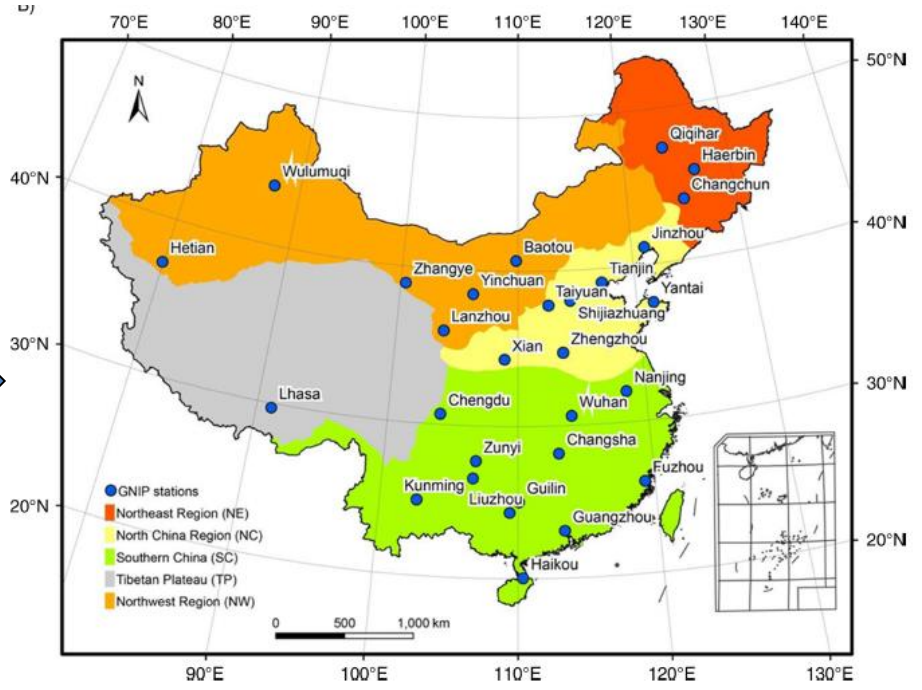


Fig . 1 . The section of CHNIP and the section of GNIP



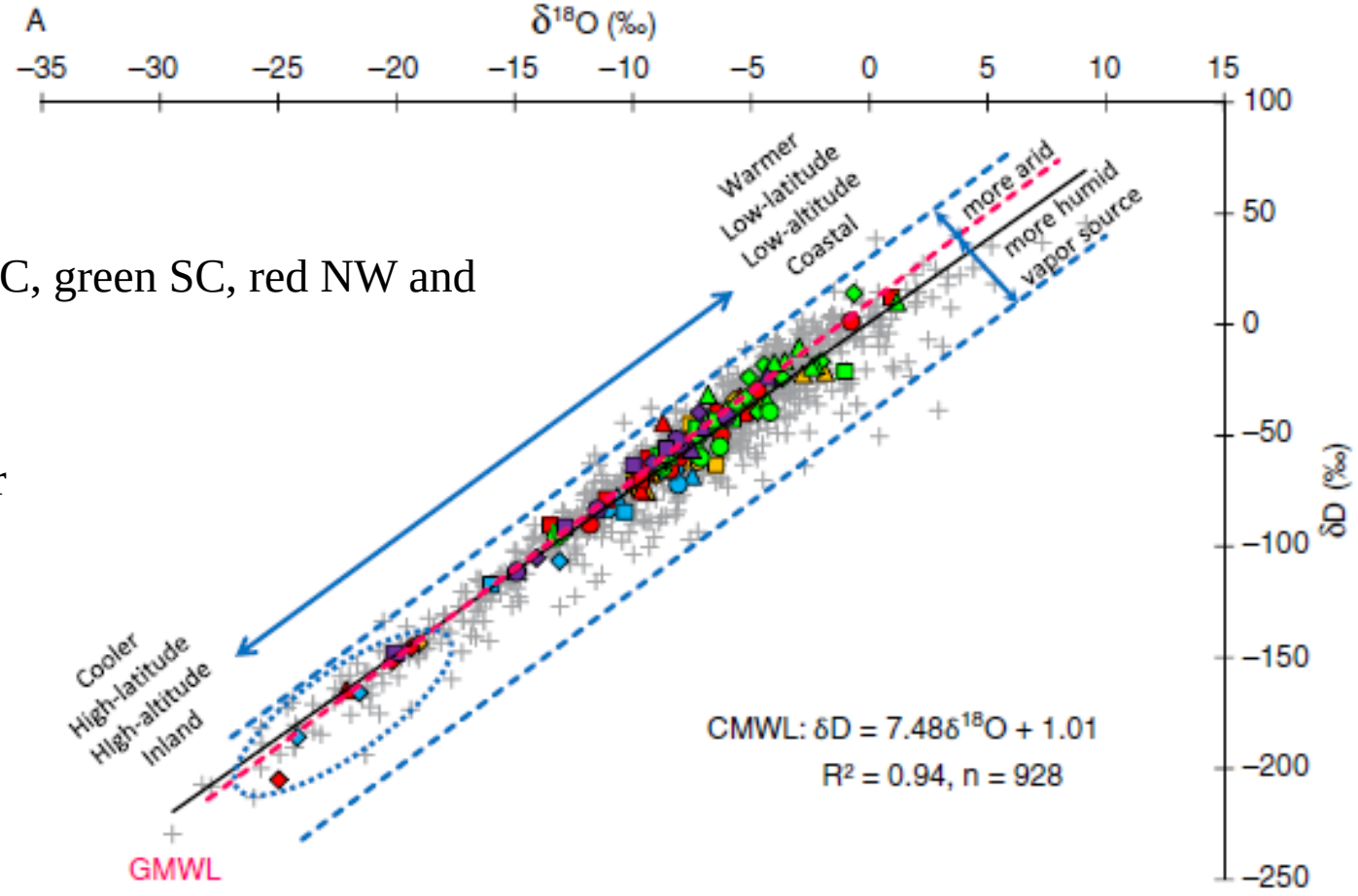
Results

- Fundamental isotopic characteristics of the CHNIP stations.
  - The ranges of δD and δ^{18}O NE > NW > TP > NC > SC（Time scale）
  - The weighted δD and δ^{18}O values in precipitation. SC > NW > NC > TP > NE （Space scale）

Linear δD-δ^{18}O relationships based on all the CHINP from 2005 to 2010.

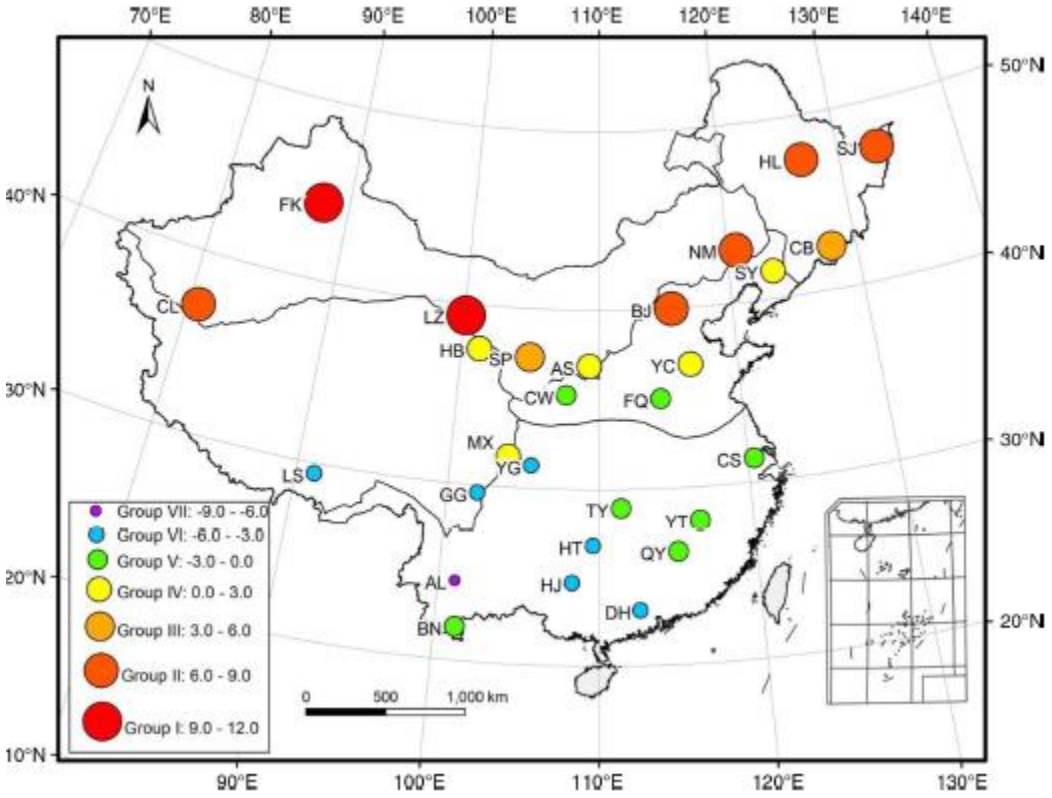
(blue NE, yellow NC, green SC, red NW and purple TP)

Triangle - spring
Circle - summer
Rectangle -autumn
Diamond -winter)



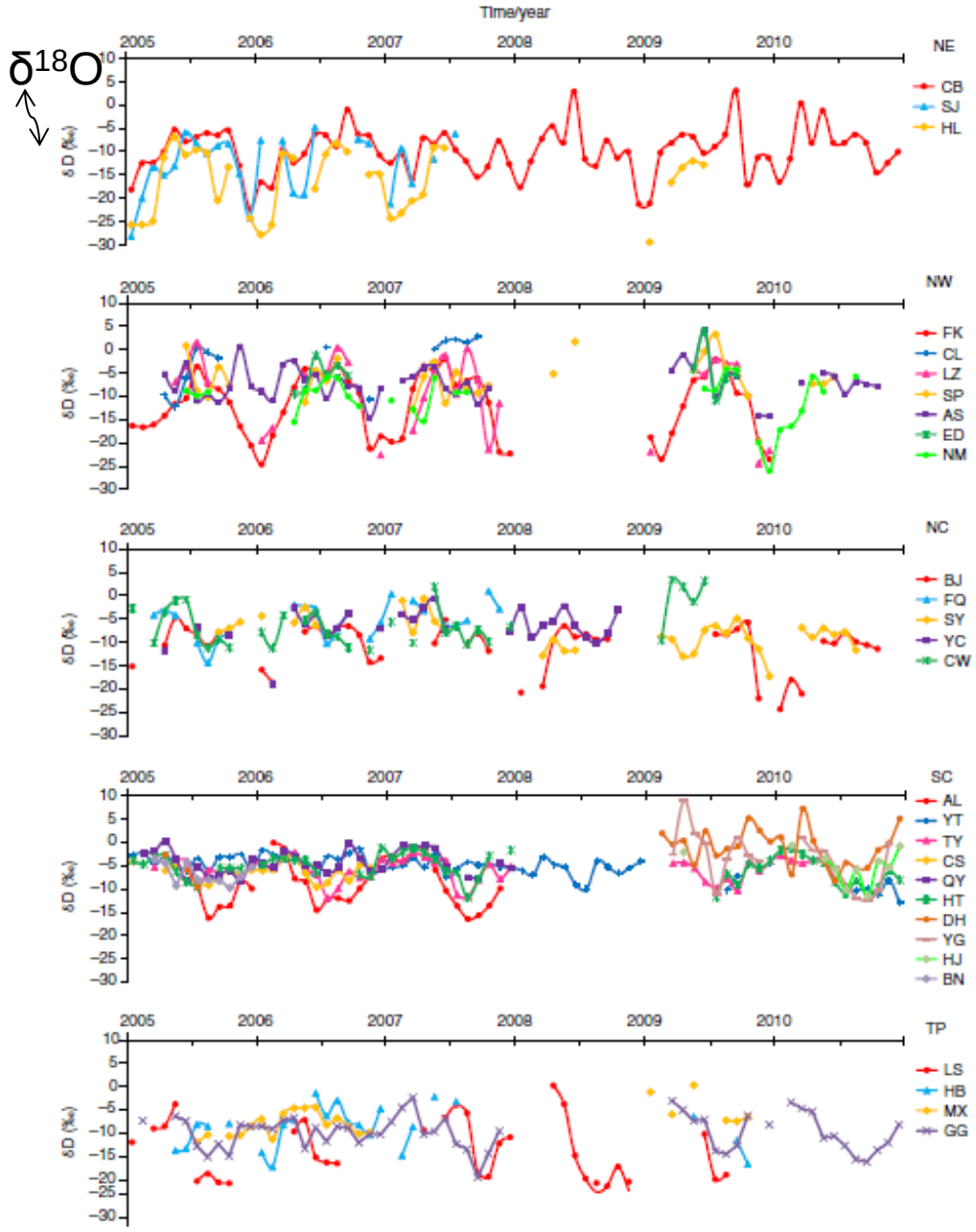
◆The weighted δD and δ^{18}O values in precipitation. SC > NW > NC > TP > NE

Seasonal variations of the precipitation isotopes.



- I , II and III($3 < (\delta_s - \delta_w) < 12$) major temperature contribution.
- Group IV main concentrated in the north of our country.
- The value of δ in SC winter are higher.

Fig. 3. Distributions of δ_s -δ_w. δ_s and δ_w denote the un-weighted mean summer and winter.



- Large, small and mediate seasonal fluctuations of $\delta^{18}O$ are found in the northern (NW and NE), southern (SC) and NC regions, respectively.
- A 'V'-shaped $\delta^{18}O$ pattern is found at SC, while a reverse 'V'-shaped pattern is found at NE and NW.
- The ranges of δD and $\delta^{18}O$ NE > NW > TP > NC > SC

Table 1. Descriptive statistics of precipitation isotope values of CHNIP stations

Station	*Lon* (°)	*Lat* (°)	*Alt* (m)	P[a] (mm)	T[a] (°C)	δD (‰)				$\delta^{18}O$ (‰)				r		LMWL		
						δD_p[b]	Min	Max	SD	$\delta^{18}O$[b]	Min	Max	SD	$r_{\delta\text{-}T}$	$r_{\delta\text{-}P}$	Slope	Intercept	S_T
Northeastern region (NE)																		
SJ (Sanjiang)	133.3	47.35	55	463	2.8	−80.1	−207.3	−38.3	47.13	−10.42	−28.21	−4.74	6.36	0.588**	0.425	7.29	−6.71	8.79
HL (Hailun)	126.93	47.45	236	469	2.5	−92.8	−229.6	−50.1	52.92	−12.52	−29.47	−6.85	6.83	0.781**	0.418*	7.71	2.58	8.70
CB (Changbaishan)	128.11	42.4	738.1	703	3.8	−74.7	−193.8	−9.7	35.02	−8.56	−22.33	3.10	5.02	0.542**	0.265*	6.40	−22.04	8.78
North China (NC)																		
SY (Shenyang)	123.37	41.52	49	554	8.5	−62.7	−120.4	−13.0	24.35	−8.95	−17.23	−0.53	3.53	0.230	−0.204	6.25	−5.76	8.70
BJ (Beijing)	115.43	39.96	1248	467	5.3	−69.6	−190.5	−30.6	40.39	−9.16	−24.33	−4.63	4.92	0.814**	0.501**	7.94	3.92	8.77
YC (Yucheng)	116.57	36.83	22	536	13.3	−54.2	−150.8	−6.3	28.78	−6.36	−19.07	−0.51	3.71	0.110	0.018	7.53	−6.56	8.54
CW (Changwu)	107.68	35.24	1200	457	10.3	−55.9	−91.7	17.6	31.04	−7.35	−11.68	3.45	4.62	0.137	−0.291	6.50	−6.68	8.67
FQ (Fengqiu)	114.33	35.01	67.5	515	14.0	−57.3	−103.4	−9.9	24.74	−7.37	−14.38	1.05	3.78	−0.280	−0.442	6.24	−9.19	8.50
Southern China (SC)																		
CS (Changshu)	120.42	31.33	3.1	944	17.0	−45.0	−75.0	−10.6	17.78	−6.75	−9.58	−3.01	1.89	−0.623**	−0.295	8.77	13.96	8.48
TY (Taoyuan)	111.44	28.93	106	1382	17.3	−34.7	−86.8	1.8	22.99	−5.93	−11.87	−2.12	2.56	−0.045	−0.609**	8.63	17.10	8.55
YT (Yingtan)	116.56	28.12	45	1736	18.4	−45.0	−103.5	−6.7	20.98	−5.59	−12.90	−1.32	5.60	−0.148	−0.098	6.41	−8.25	8.41
HT (Huitong)	109.61	26.85	541	968	16.7	−36.9	−93.3	14.8	25.31	−5.88	−11.86	−1.14	2.96	−0.212	−0.650**	8.08	11.47	8.55
QY (Qianyanzhou)	115.03	26.44	76.4	1383	17.9	−35.4	−74.4	−1.1	20.04	−4.54	−8.35	0.38	2.48	−0.299	−0.171	7.34	−1.98	8.50
HJ (Huanjiang)	108.33	24.74	400	1417	19.3	−38.7	−81.4	16.1	32.43	−6.16	−11.42	−0.58	3.63	−0.679*	−0.365	8.89	17.31	8.43
DH (Dinghushan)	112.55	23.16	90	1805	22.2	−25.9	−65.8	36.7	28.84	−2.75	−9.56	7.33	4.25	−0.523*	−0.558*	6.53	−8.35	8.39
YG (Yanting)	105.46	31.27	420	841	16.6	−42.6	−91.0	45.4	40.55	−5.55	−12.36	9.15	5.68	−0.360	−0.350	6.77	−2.30	8.50
AL (Ailaoshan)	101.03	24.55	2481	1484	11.6	−86.9	−123.3	4.1	40.11	−12.19	−16.41	−0.02	4.93	−0.620**	−0.632**	8.09	11.94	8.37
BN (Xishuangbanna)	101.26	21.93	560	1371	22.4	−45.0	−68.4	−21.8	16.74	−6.94	−9.74	−3.44	2.27	−0.367	−0.136	7.82	7.00	8.25
Northwestern China (NW)																		
FK (Fukang)	87.93	44.29	460	167	7.5	−67.6	−183.4	−15.1	54.07	−9.87	−24.64	−2.06	6.79	0.891**	0.310*	7.83	8.86	8.70
CL (Cele)	80.73	37.02	1306	51	12.9	−4.2	−87.4	27.3	40.37	−1.47	−12.20	2.80	5.31	0.674*	0.257	7.54	6.87	8.97
LZ (Linze)	100.13	39.35	1375	127	9.0	−36.1	−175.8	1.8	63.15	−6.21	−24.42	1.60	8.15	0.910**	0.346	7.51	2.76	8.90
SP (Shapotou)	105	37.28	1350	126	10.9	−52.6	−90.7	21.8	28.18	−7.16	−12.84	3.32	4.04	0.397*	−0.330	7.11	−1.16	8.67
AS (Ansai)	109.32	36.86	1083	460	10.1	−58.2	−106.8	25.2	27.42	−8.11	−14.81	4.41	3.73	0.202	−0.307*	7.06	−0.62	8.66
ED (Erdos)	80.73	37.02	1306	279	6.9	−43.8	−85.5	22.0	29.54	−6.06	−10.87	3.81	4.05	0.353	−0.410	7.12	−0.23	8.92
NM (Naiman)	120.7	42.93	37.28	289	7.1	−67.1	−213.0	−34.5	39.39	−8.65	−26.04	−4.25	5.03	0.772**	0.362	7.71	−1.28	8.71
Tibetan Plateau (TP)																		
LS (Lhasa)	91.21	29.41	3688	407	8.5	−110.9	−169.9	38.5	53.20	−15.02	−22.65	0.26	6.52	−0.287	−0.254	8.04	10.86	8.30
HB (Haibei)	101.31	37.56	3280	458	−0.1	−56.2	−133.3	−6.9	35.38	−8.10	−17.20	−1.40	4.52	0.430*	0.209	7.62	4.65	9.12
MX (Maoxian)	103.9	31.7	1826	719	9.7	−49.5	−83.3	8.5	24.37	−7.77	−11.98	0.31	3.16	−0.088	−0.201	7.56	8.19	8.76
GG (Gonggashan)	102	29.58	2950	1704	5.1	−76.5	−147.8	1.4	30.86	−10.82	−19.50	−2.35	3.73	−0.496**	−0.424**	8.10	12.56	8.73

[a]Mean precipitation (P) and temperature (T) values during respective observation periods.
[b]δ-values are averaged by monthly precipitation amount, using the equation $\overline{\delta_p} = \sum_{i=1}^{n} \delta \times P_i / \sum_{i=1}^{n} P_i$.
* or ** stand for significance at 0.05 or 0.01 level, respectively.

LMWL (Local Meteoric Water Line)

Based on the 928 groups of precipitation, CMWL is established as $\delta D = 7.48 * \delta^{18}O + 1.01$

LMWLs generally can be grouped into four types.

- Slope ≈ 8, most of these samples are distributed in SC.
- 7 < slope < 8, all of the NW and TP stations. The wider δ-ranges are caused by seasonal temperature variations and relatively low condensation temperature.
- Slope < 7
  - YT and DH stations, which located at the southeastern coast. The net evaporation is too high.
  - Stations are located at the 30^{o}-45^{o}N continental inlands.
- Slope > 8, three SC stations are belong to this type.

- The theoretical slope of LMWL (ST) can be calculated based on the condensation temperature, which is usually represented by the surface temperature (*Criss, 1999*):

$$s_T=(\alpha_2-1)(1000+\delta D)/(\alpha_{18}-1)(1000+\delta^{18}O)$$

Where α_2 and $\alpha_{18}$are temperature dependent((*Friedman and O’ Neil, 1977; Criss, 1999*):

$$\ln\alpha_2=0.052612-76.248(1/T)+224844(1/T^2)$$

$$\ln\alpha_{18}=-0.0020667-0.4156(1/T)+1137(1/T^2)$$

- The measured slopes are generally lower than the theoretical slope.

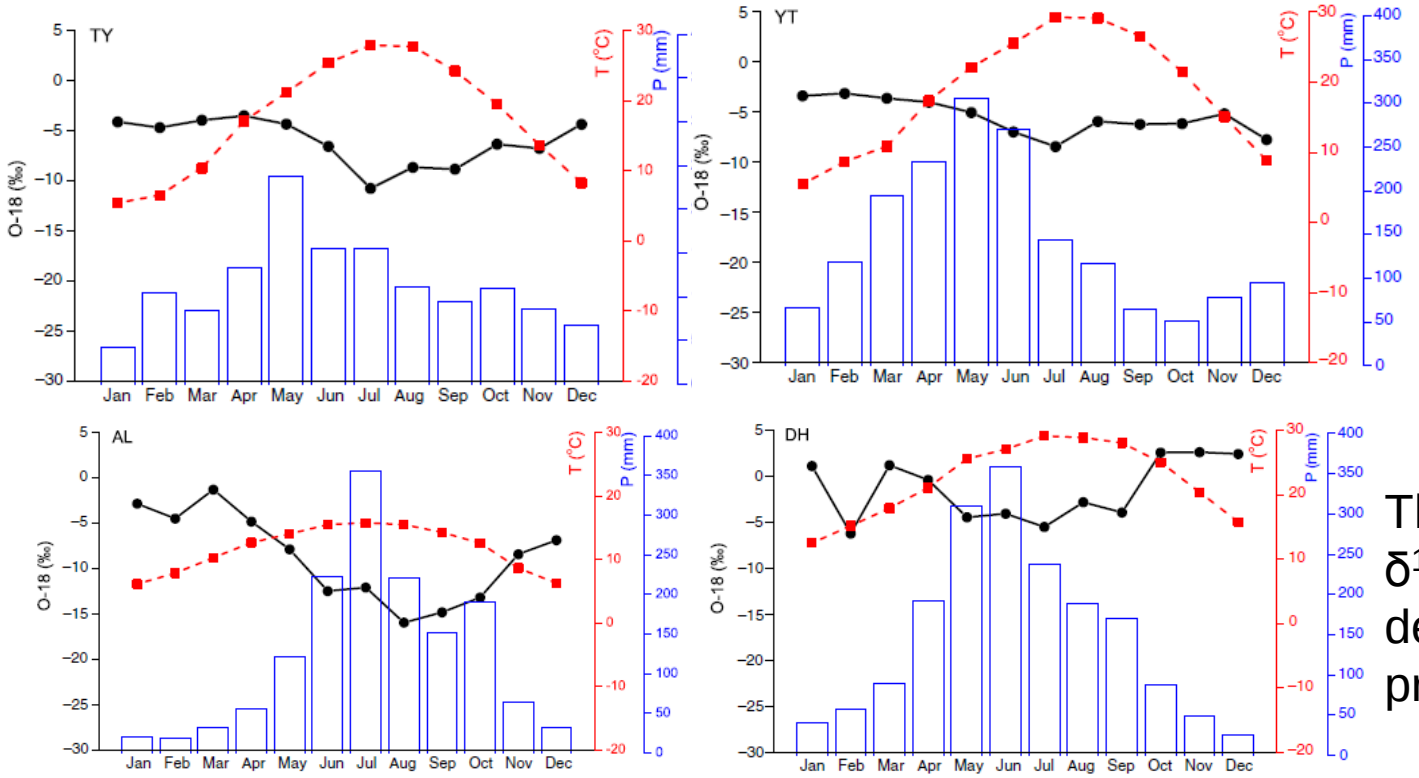
- Reason : Most of the precipitation has undergone raindrop evaporation effect.

Meteorological controls of $\delta^{18}O$

- In the SC, F_v is the main control factor.

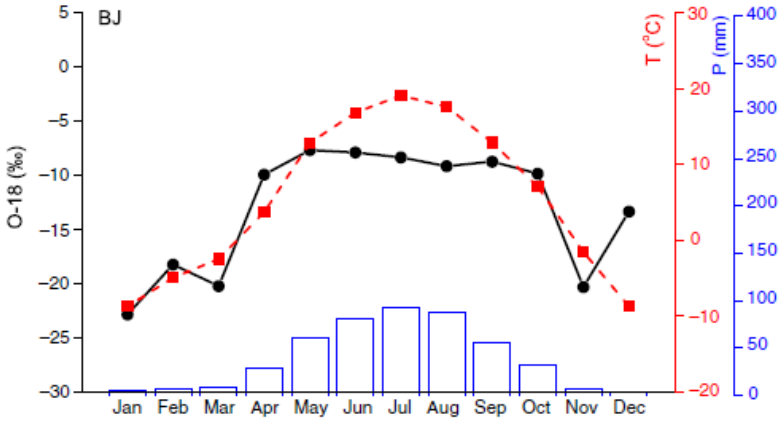
$\delta_C = \alpha/\alpha_0 * F_v^{(\alpha_m - 1)} - 1$ (*Dansgaatd,1961*)

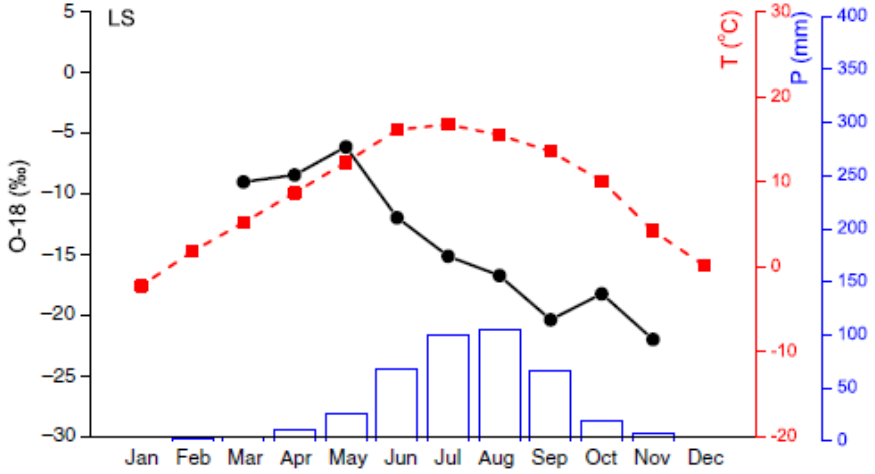
F_v is remaining fraction of the vapour phase.α α_0 α_m refer to condensation t, initial t_o and $(t+t_o)/2$

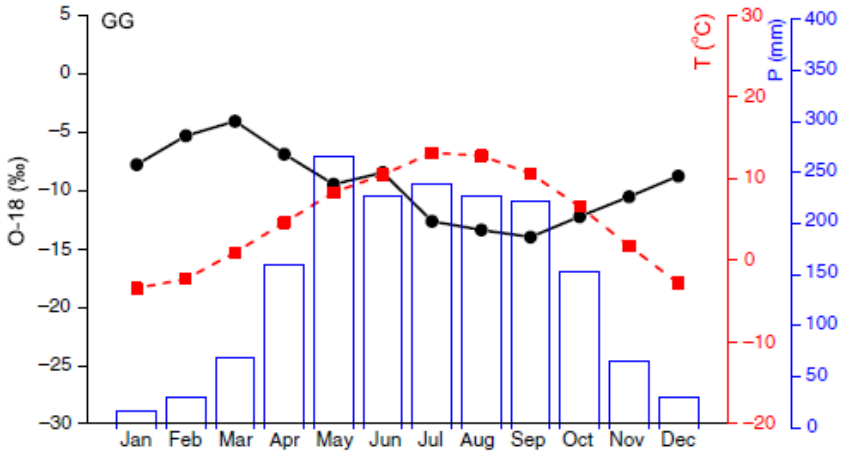


The variation of $\delta^{18}O$ show a strong dependence on precipitation.

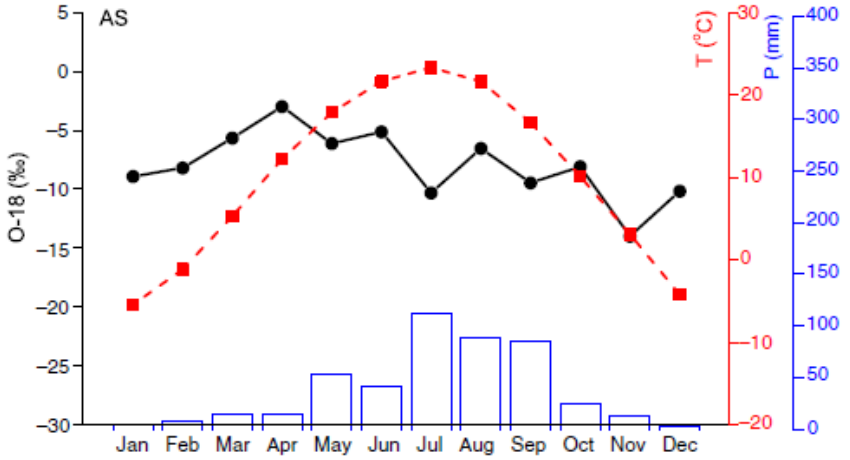
- In NC, correlation coefficients seem to be low. Except T and P, evaporation of the falling raindrops cause the high value of $\delta^{18}O$.
- In TP, the equations are formed by different variables, just like the NC.

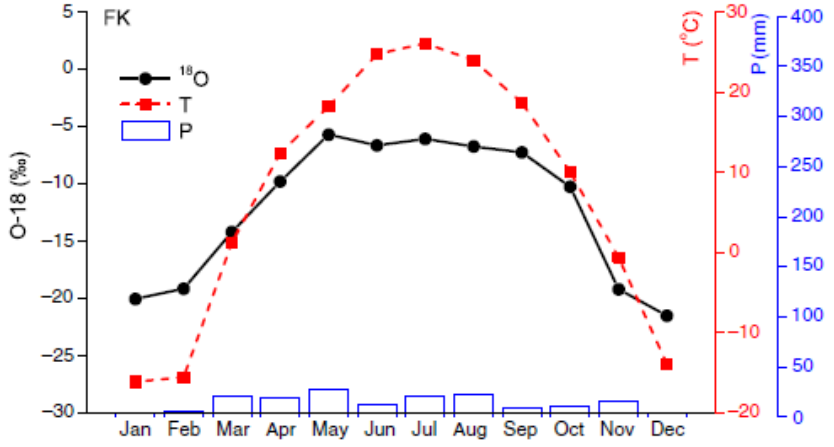






- In the NE and NW regions, T as a dominant control factor of $\delta^{18}O$. Except T, some other factors such as RH, Vp, Wd, and P are found to be critically influential for NW regions





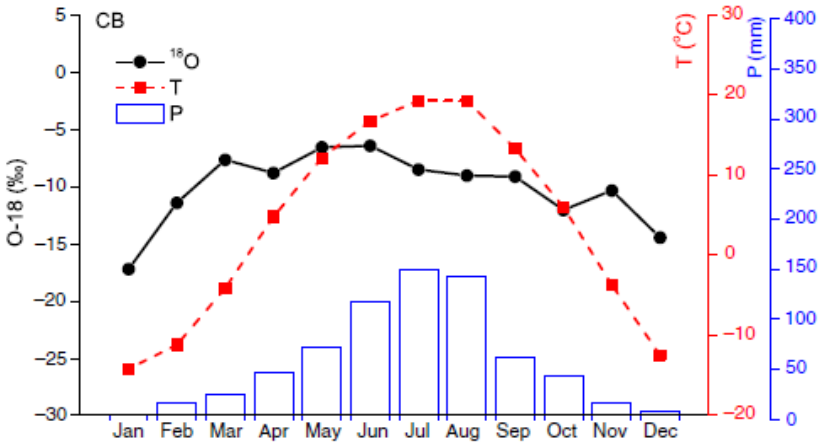


Table 2. Stepwise regression models for CHNIP stations

Region	Station	Non-linear stepwise regression models	Adjusted R^2	p
NE	SJ	$\delta^{18}O = -13.379 + 0.239T$	0.311	0.005
	HL	$\delta^{18}O = -16.876 + 0.331T$	0.596	0.000
	CB	$\delta^{18}O = -7.559 + 0.469T - 0.549Wp$	0.349	0.006
NC	SY	$\delta^{18}O = -99.930 - 0.003Wd^2 + 0.986Wd$	0.210	0.015
	BJ	$\delta^{18}O = -10.417 + 0.747T - 0.025Wp^2 - 0.035S$	0.707	0.050
	YC	$\delta^{18}O = -20.479 + 0.084Wd$	0.231	0.007
	CW	$\delta^{18}O = 253.076 - 0.002RH^2 - 0.285Vp$	0.530	0.029
	FQ	$\delta^{18}O = 2.552 - 0.001RH^2$	0.183	0.055
SC	CS	$\delta^{18}O = -7.564 - 0.006T^2 + 0.023S$	0.586	0.011
	TY	$\delta^{18}O = 2045.727 - 681.929\log Vp - 0.013Wp^2$	0.586	0.001
	YT	$\delta^{18}O = -4.138 - 0.018S + 1.963Ws^2 - 0.008P$	0.158	0.027
	HT	$\delta^{18}O = 1848.366 - 0.015Wp^2 - 620.738\log Vp$	0.541	0.028
	QY	$\delta^{18}O = 3170.993 - 0.015Wp^2 - 1055.79\log Vp$	0.288	0.012
	HJ	$\delta^{18}O = 2.783 - 0.059S$	0.519	0.017
	DH	$\delta^{18}O = -3629.392 + 1209.223\log Vp$	0.352	0.002
	YG	$\delta^{18}O = -3.218 + 0.06T^2 - 0.065Wp^2$	0.419	0.025
	AL	$\delta^{18}O = -12.074 - 0.518Wp + 0.035Wd + 0.031S$	0.751	0.040
	BN	$\delta^{18}O = -11.788 + 0.0002Wd^2$	0.345	0.043
NW	FK	$\delta^{18}O = -8.805 + 0.220T - 0.001RH^2$	0.810	0.016
	CL	$\delta^{18}O = -1252.324 + 0.037T^2 + 1.436Vp - (9.133 \times 10^{-5})Wd^2$	0.895	0.016
	LZ	$\delta^{18}O = -16.841 + 0.609T$	0.822	0.000
	SP	$\delta^{18}O = -16.582 + 10.146\log T - 0.092P$	0.328	0.014
	AS	$\delta^{18}O = -1.991 - 0.033P + 0.226T - 0.107RH$	0.425	0.013
	NM	$\delta^{18}O = -14.175 + 0.303T$	0.559	0.000
TP	LS	$\delta^{18}O = -38.857 + 18.078Ws$	0.368	0.000
	HB	$\delta^{18}O = -9.355 + 0.243T$	0.146	0.040
	MX	$\delta^{18}O = 36.879 - 0.090Wd - 0.455RH + 0.530T - 0.029Wp^2$	0.726	0.010
	GG	$\delta^{18}O = 23.482 - 0.027Wp^2 - 0.343RH$	0.403	0.007

P, precipitation (mm); T, surface air temperature (°C); Vp, vapour pressure (hPa); RH, relative humidity (%); Wp, water pressure (hPa); S, sunshine duration (h); Ws, wind speed (m/s); Wd, wind direction (°).

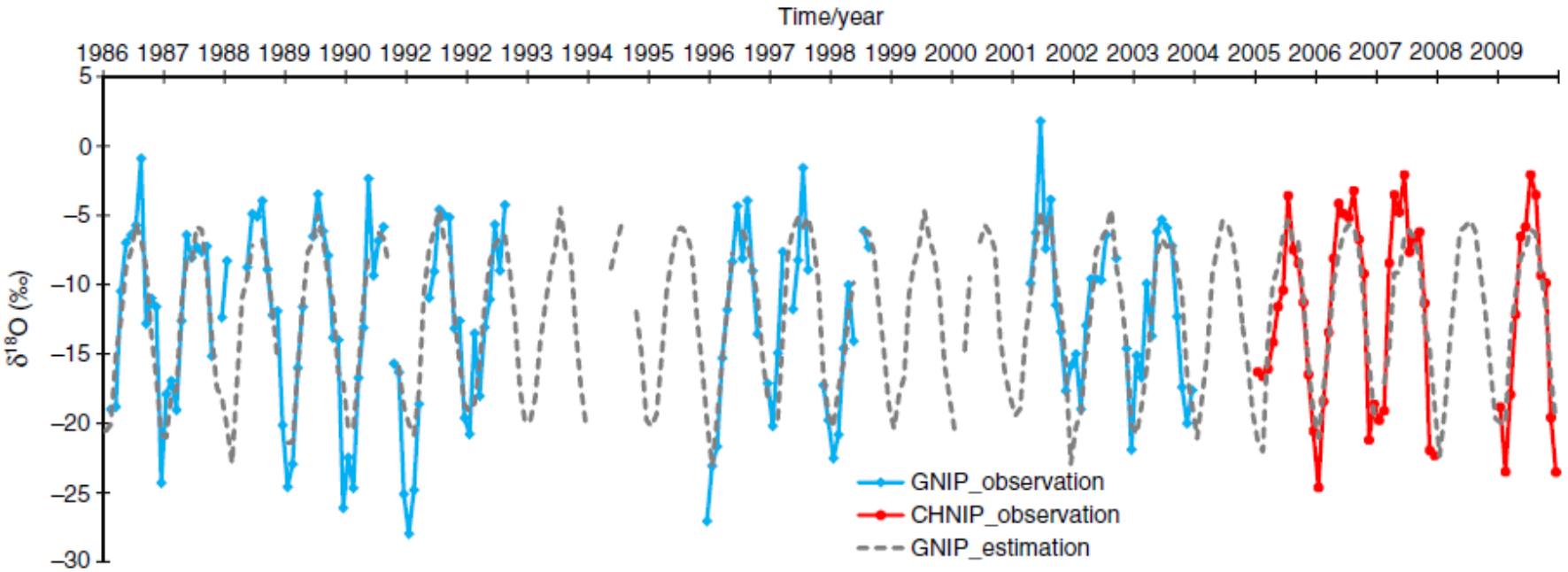


Fig. 5 Reconstruct time 1986-2009, based on Wulumuqi station.
$\delta^{18}O$=-14.101+0.428T-0.146Wd

- Geographical controls on $\delta^{18}O$

CHNIP

①Latitude 20N and 50N.

②Longitude 80E and 140E.

③Altitudes range from less than 10 m on the eastern plain to over 3000 m on the TP.

On the whole-country scale, $\delta^{18}O$ is expressed as :

$\delta^{18}O$ =8.892-0.041Lon-0.312Lat-0.002Alt

Conclusions

- The inner continental and coastal stations have larger or smaller δ-ranges, respectively, and the weight follow the SC > NW > NC > TP > NE.

- CMWL: $\delta D = 7.48\delta^{18}O + 1.01$, SC or TP, NW and NE samples upper or lower end of the line.

- Transformation is closely related to the stable isotope values and environmental variables.

The current work

- The Taihu Lake includes 32 sampling points that represent all the geographical and environment characteristics（Fig. 1a）. We divided Lake Taihu to seven sections: northern, northwestern, western, center, eastern, southwestern, and southeastern respectively(Fig. 1b)

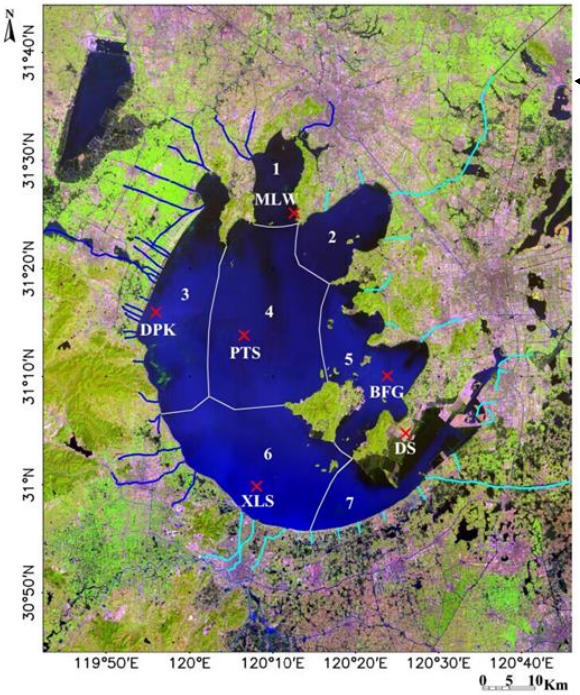
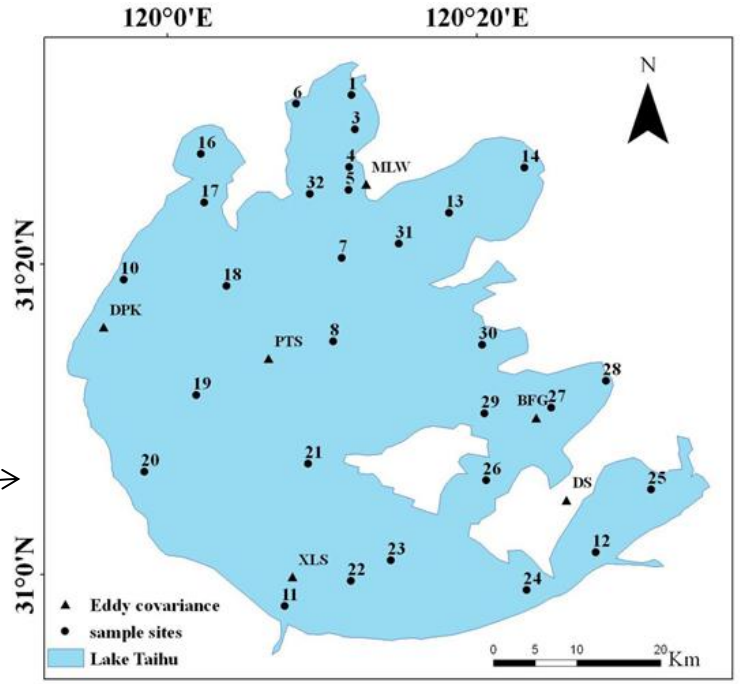


Fig. 1a The Taihu lake Ecological zoning

Fig. 1b sampling points



Source: *Lee et al., 2014*

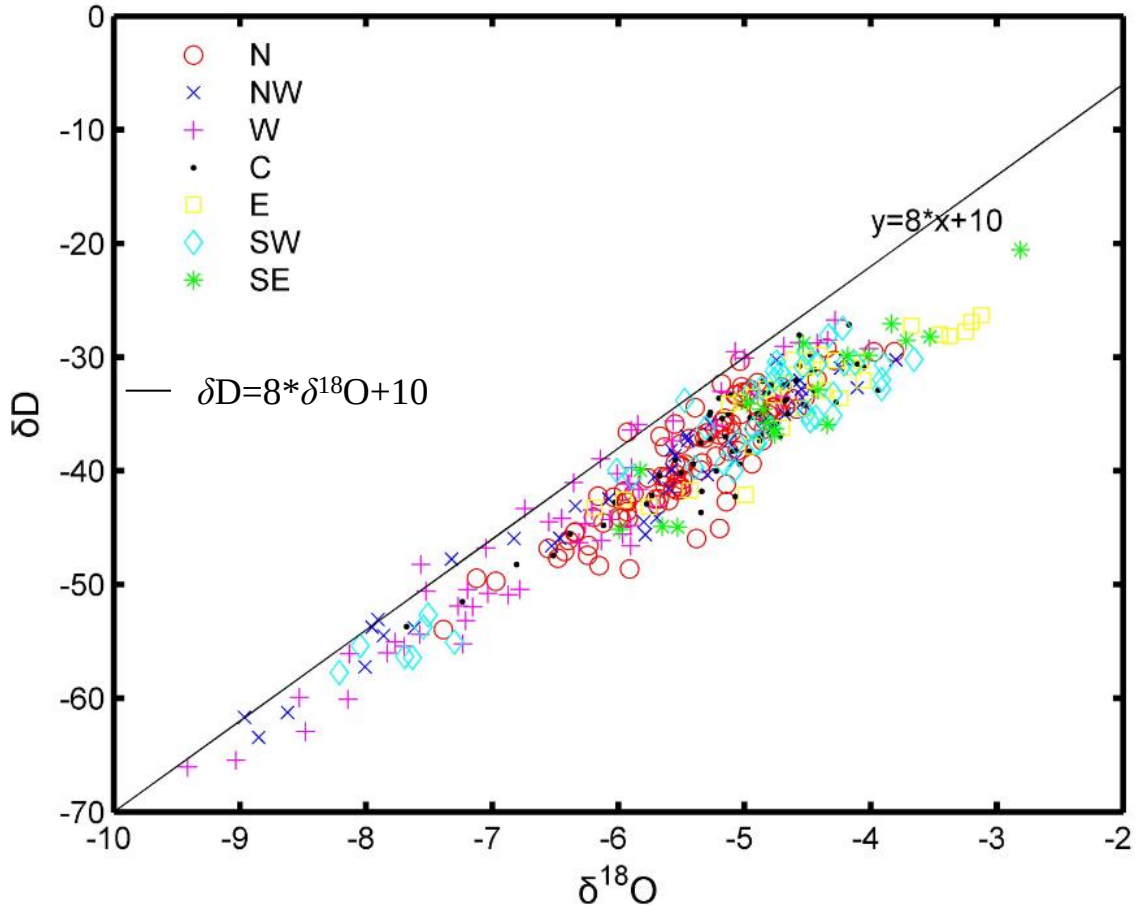
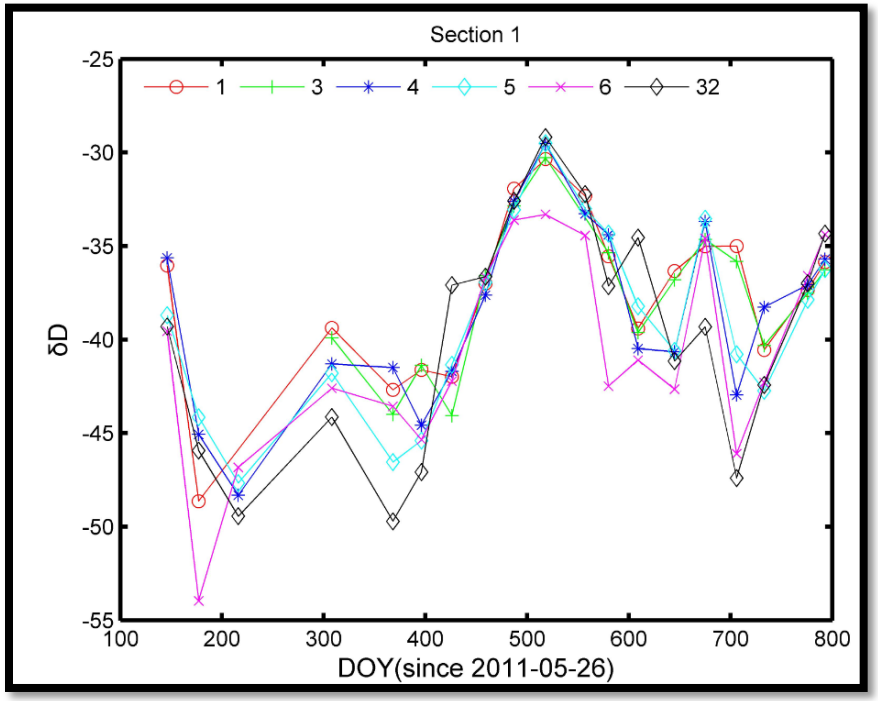
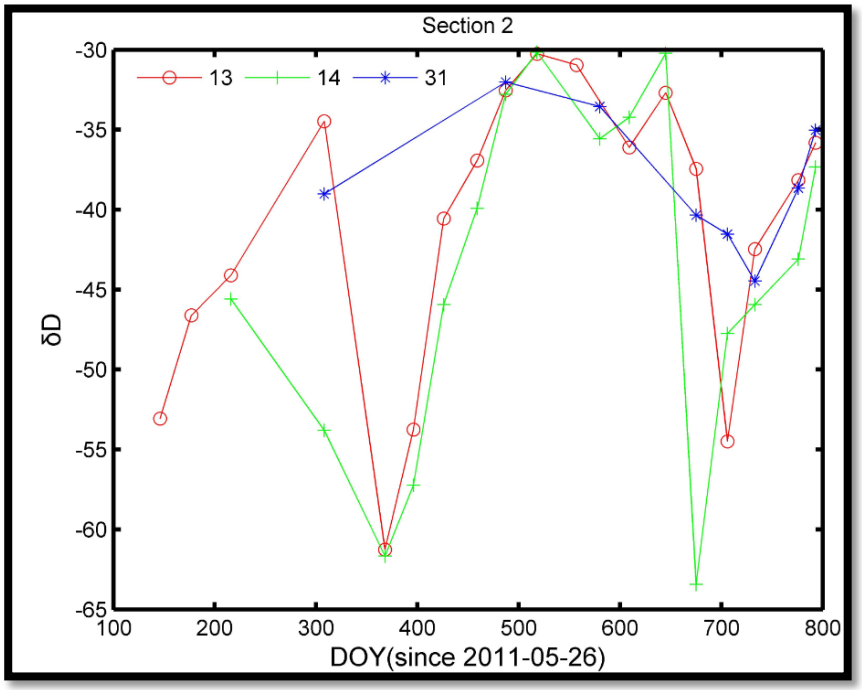
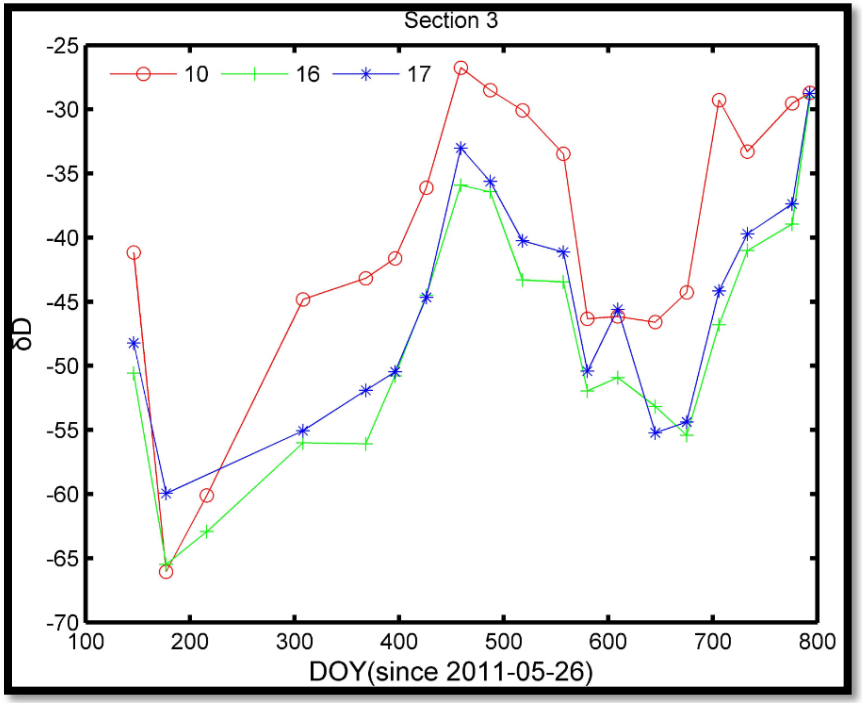


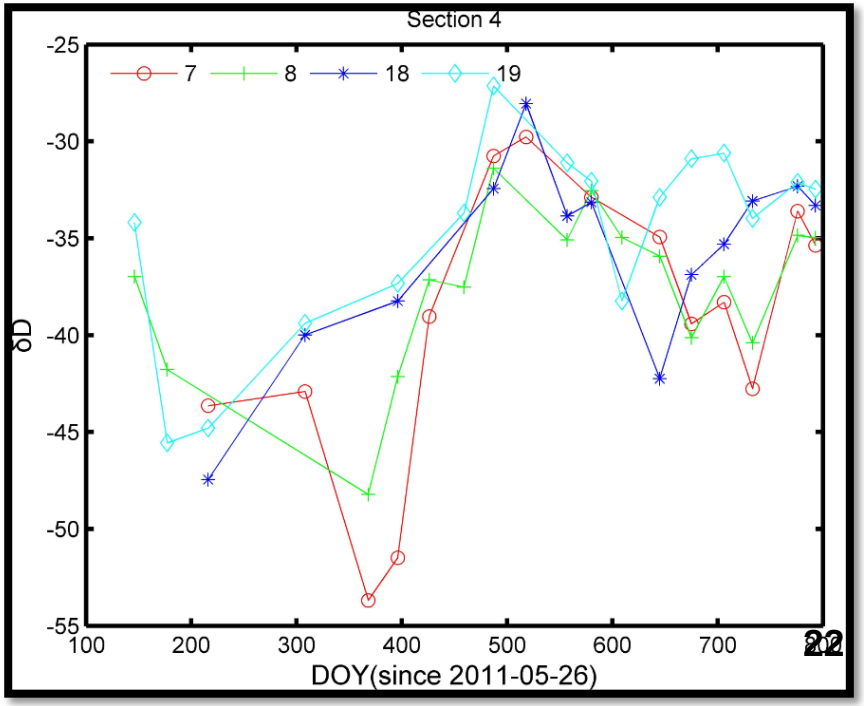
Fig 2. The correlation between $\delta^{18}O$ and δD. GMWL : $\delta D = 8*\delta^{18}O+10$

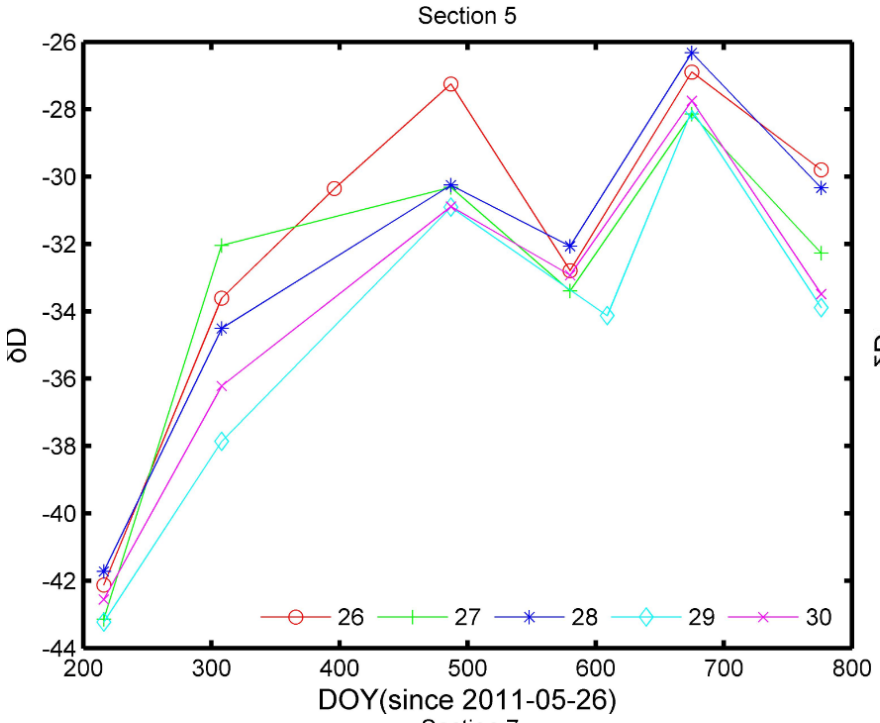
•The value range of δD and $\delta^{18}O$ generally follow the pattern: western > northwestern > southwestern > center > northern > southeastern > eastern , which indicates that the western lake section has the larger δ value range than the eastern lake section.

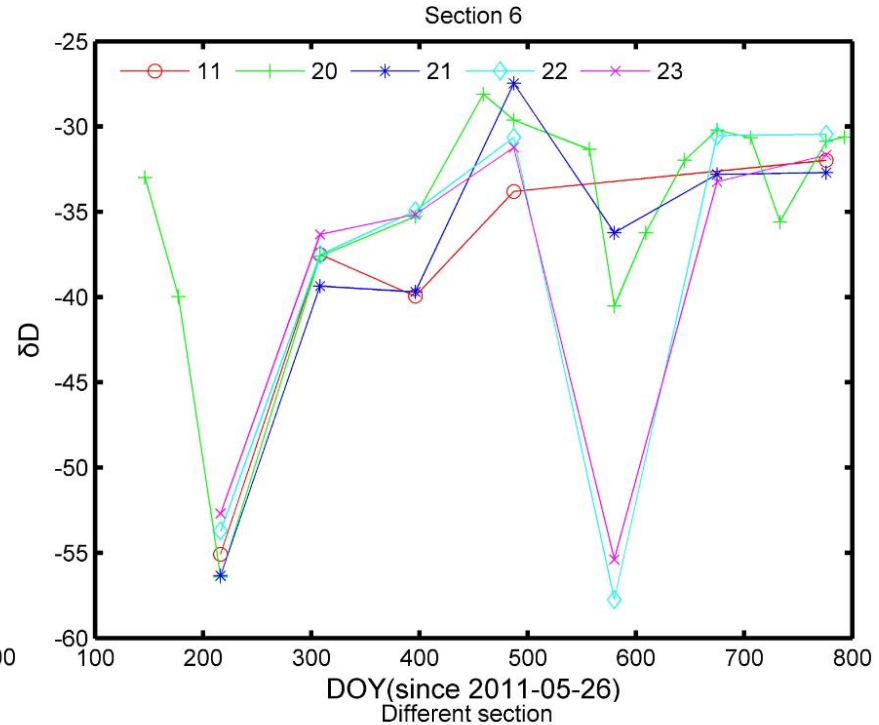

Section 1
1
3
4
5
6
32
δD
DOY(since 2011-05-26)

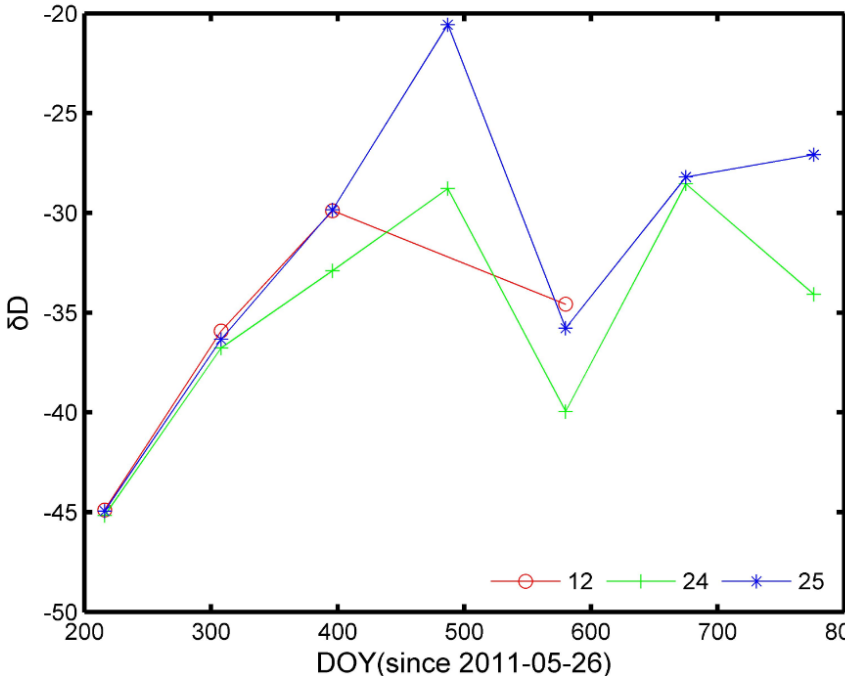

Section 2
13
14
31
δD
DOY(since 2011-05-26)


Section 3
10
16
17
δD
DOY(since 2011-05-26)


Section 4
7
8
18
19
δD
DOY(since 2011-05-26)


Section 5
δD
DOY(since 2011-05-26)
26
27
28
29
30


Section 6
δD
DOY(since 2011-05-26)
11
20
21
22
23


Section 7
δD
DOY(since 2011-05-26)
12
24
25

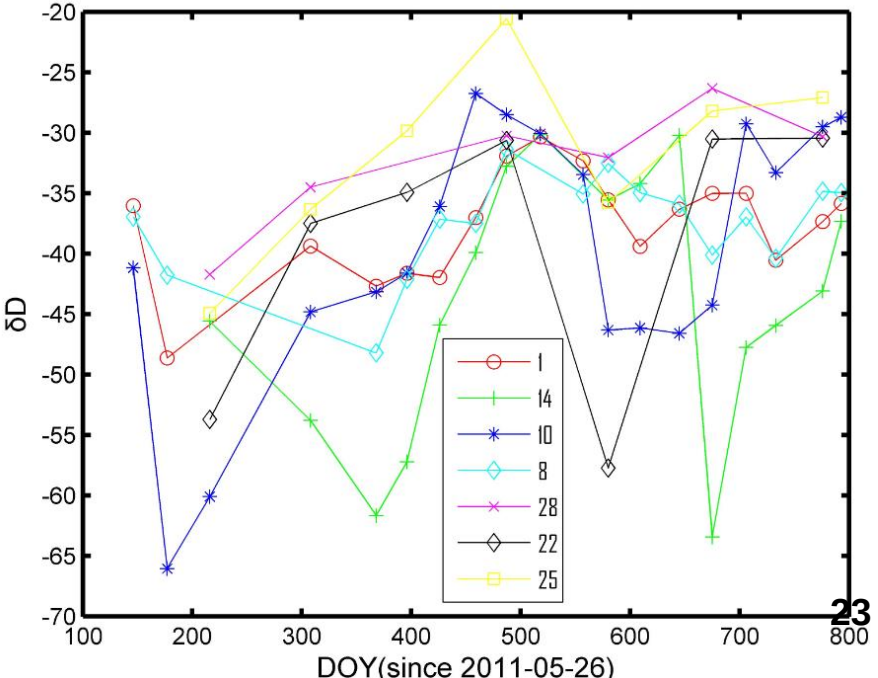

Different section
δD
DOY(since 2011-05-26)
1
14
10
8
28
22
25

Table 1. Descriptive statistics of isotope values of sampling points

Station	Lon	Lat	T	δD(%)				δ18O				D-excess	LMWL		
	(o)	(o)	(oC)	δDp(%)	Min	Max	SD	δ18Op	Min	Max	SD		Slope	Intercept	R^2
Section 1(Northern)															
1	120.191500	31.513000		-37.61233321	-48.635516	-30.347999	4.44421	-4.925555	-5.912227	-4.425053	0.3991222	3.771703	7.6735	2.2837	0.4749
3	120.194330	31.476330		-37.69942057	-44.067664	-30.282048	3.875109	-5.26367158	-6.196631	-4.291381	1.1664935	4.40995209	7.993	4.3733	0.0909
4	120.188500	31.447333		-38.65065401	-48.320109	-29.530642	4.904621	-5.262672	-6.154355	-3.813138	2.331029	3.450725	7.7177	1.9652	0.7753
5	120.187500	31.411500		-39.0812702	-47.668937	-29.513294	5.049796	-5.441423	-6.479141	-3.974530	1.8985665	4.450111	7.0906	-0.4984	0.873
6	120.130339	31.451444		-40.64853912	-53.968535	-33.312748	5.4979152	-5.752185	-7.387564	-4.742512	2.0967699	5.368944	7.6596	3.4106	0.8562
32	120.132167	31.505167		-39.82715604	-49.715960	-29.178077	6.1433172	-5.523444	-7.126451	-4.349312	2.6452552	4.360395	7.5248	1.7355	0.8179
Section 2 (Northwestern)															
13	120.295500	31.386500		-41.2045056	-61.260162	-30.250506	9.1756087	-5.829389	-8.623559	-4.238486	2.8821941	5.430604	6.4415	-3.6546	39574
14	120.376910	31.435110		-44.04371285	-63.442753	-30.158620	10.713398	-6.19669076	-8.964826	-3.802401	3.1568365	5.5298132	6.4631	-3.9941	0.9679
31	120.241540	31.353400		-38.07909812	-44.471653	-32.023906	4.2348751	-5.13867573	-5.799060	-4.544557	1.436096	3.03030772	7.9836	2.946	0.885
Section 3(Western)															
10	119.945500	31.314500		-39.790508	-66.05443	-26.755144	10.850864	-5.656002	-9.413696	-4.014286	2.7659066	5.457508	7.9618	5.2416	0.935
16	120.043511	31.456386		-48.042684	-65.482565	-29.075941	9.436828	-6.971242	-9.031613	-4.687790	2.3087737	7.727252	8.9372	14.261	0.9506
17	120.020808	31.369573		-45.330916	-59.944205	-28.770157	8.580584	-6.508271	-8.527456	-4.422348	2.334234	6.735251	7.8563	5.7999	0.9263
Section 4(Center)															
7	120.180833	31.339333		-39.18263832	-53.687362	-29.774731	7.1912852	4.68392141	-7.680521	-4.449252	2.4474229	4.68392141	7.0885	-0.3141	0.899
8	120.170820	31.248160		-37.565040	-48.223608	-31.388980	4.1703969	-5.243713	-6.807201	-4.479077	2.0156886	4.384663	6.6876	-2.4974	0.7971
18	120.056120	31.308100		-35.87023459	-47.450880	-28.053930	5.0834522	-5.01377375	-6.516238	-4.568265	2.6655986	4.23995541	8.8594	8.5486	0.7319
19	120.023330	31.190550		-34.778313	-45.563203	-27.142498	5.0748748	-4.740999	-6.382904	-3.940242	2.2832448	3.149677	6.7312	-2.8656	0.827

Station	Lon	Lat	T	δD(%)				δ18O				D-excess	LMWL		
	(o)	(o)	(oC)	δDp(%)	Min	Max	SD	δ18Op	Min	Max	SD		Slope	Intercept	R^2
Section 5(Eastern)															
26	120.328556	31.085806		-31.83185334	-42.124827	-26.892992	5.1919332	-4.20041012	-4.988825	-3.201925	3.072764	1.77142762	6.8165	-3.1998	0.6699
27	120.405963	31.176834		-33.21870191	-43.145123	-28.138562	5.1976065	-4.48926538	-5.759664	-3.374136	2.5442689	2.69542113	6.0034	-6.2677	0.8549
28	120.464785	31.205650		-32.53591653	-41.726863	-26.324729	5.238712	-4.43515526	-5.431136	-3.123231	2.8759883	2.94532556	6.1734	-5.1559	0.7656
29	120.333610	31.171142		-34.6770965	-43.231036	-28.031769	5.3403299	-4.81176554	-6.189238	-3.449786	3.0659804	3.81702784	5.3709	-8.8335	0.8816
30	120.331493	31.244820		-33.97177702	-42.554828	-27.750001	5.0645949	-4.62361095	-5.958355	-3.249314	2.9924661	3.01711056	5.3528	-9.2225	0.8616
Section 6(Southwestern)															
11	120.118667	30.963667		-39.66282481	-55.081255	-31.983308	9.1618735	-5.69202248	-7.300293	-4.905511	3.3863808	5.87335504	8.3005	7.5839	0.8645
20	119.967306	31.107889		-34.873749	-56.432665	-28.098831	6.8538933	-4.746876	-7.631890	-3.656595	2.9399693	3.101259	6.7347	-2.9051	-0.8459
21	120.143856	31.116508		-37.80000636	-56.349660	-27.468412	9.22214	-5.22400337	-7.695034	-3.913497	2.9332332	3.99202059	7.1875	-0.2524	0.9105
22	120.189882	30.991044		-39.36388448	-57.751021	-30.448215	11.55242	-5.51751973	-8.213594	-4.123562	2.6877659	4.77627339	6.8941	-1.3252	0.9708
23	120.232706	31.012612		-39.38514278	-52.688973	-31.226455	10.20079	-5.50638879	-8.047560	-4.298268	3.5733695	4.66596756	6.2937	-4.7296	0.9469
Section 7(Southeastern)															
12	120.453830	31.021670		-36.31746927	-44.883635	-29.887461	6.2690929	-4.75791203	-5.651829	-4.181065	2.5859168	1.74582699	8.6608	4.8898	0.8347
24	120.379090	30.980910		-35.17258393	-45.170025	-28.547314	6.0046201	-4.88944738	-5.989956	-3.718447	2.6246	3.94299508	6.8504	-1.6778	0.8324
25	120.513290	31.089410		-31.8259258	-44.949630	-20.567103	7.9005008	-4.18695567	-5.531998	-2.812436	1.5027961	1.66971956	8.4988	3.7581	0.9671

- The largest range of δD (-66.05443- -26.755144) and δ^{18}O (-7.300293- -4.905511) are located at the sampling point 10 and 11，which is belong to western and southwestern section, respectively.
- The sampling point 3 have minimum standard deviation of δD(-44.067664- -30.282048), while point 31 have the minimum Std of δ^{18}O(-5.799060- -4.544557) .
- In total, the eastern section have the maximum of δD and δ^{18}O, and the minimum of δD and δ^{18}O occur at the northwestern section.

- Except some points in the western region, the δ values of most points were lower than the GMWL.
- The maximum of d-excess was located at the western section of Lake Taihu and the minimum value was found in the southeastern section.

  The reasons are probably below:

- Stable isotopic values of input rivers and output rivers are not the same.
- The eastern lake is much shallower than the west. So under the same evaporation situation, the water in the east is more enriched than the west.
- Meteorology also plays a necessary role.

Thanks