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Wisconsin Eawag
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(2004) Rodionov

Rodionov . PDO

(2005) and Overland

Bering

Argyilan and Forman

Huron/Michigan

(2003)

Ghanbari, Namdar and Bravo

Superior, Michigan, Erie (2008)

PDO, TNI, Trans-Nino Index Ontario

NAM/AO, Northern Pacific Decadal Oscillation

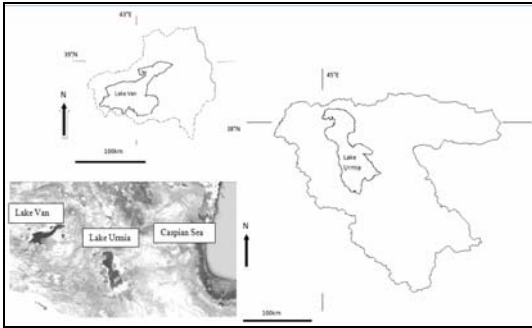
PNA, Annular Mode/ Arctic Oscillation Index

Pacific/North American PNA pattern

)

(2004) Changnon

(



Pasquini et al.

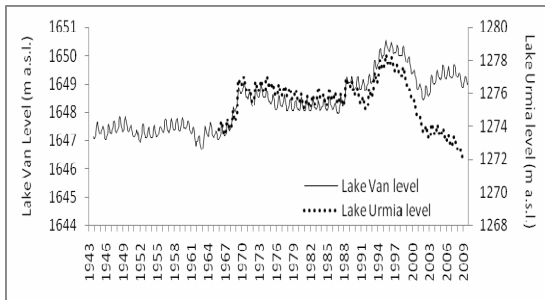
(2008)

SOI(Southern Oscillation Index)

ENSO

Michigan/ Huron

(2009) Hanrahan



$$(P) \quad x_n \quad .x_1$$

$$x_i \quad x_j \quad (x_i, x_j; j > 1)$$

$$(i=1, j=2, \quad (i,j)$$

$$P \quad .(i=N-1, j=N) \quad \dots \quad (i=2, j=3, \dots, N) \quad 3, \dots, N)$$

$$(P=(N-1)N/2)$$

$$(P=0)$$

(Kempe et al., 1978)

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(M)

(Kendall, 1975)

(37°36'N, 45°16'E)

(Tatvan)

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Kadioglu (38°31'N, 42°18'E)

t-student

(2004) Rodionov

$$\Phi_{xy}(\omega) = \tan^{-1} \left[\frac{\text{Im}f(\omega)}{\text{Re}f(\omega)} \right] \quad ()$$

$$(\quad^\circ) 2\pi \quad (\quad^\circ) -2\pi$$

$$(\quad)$$

x y

$$(\quad)$$

(

$$(\quad)$$

Ref(ω)
(Storch and Zwiers, 2003)

$$f_{xy}(\omega) = \text{Re}f(\omega) + i \text{Im}f(\omega), \quad i^2 = -1 \quad ()$$

$$|f_{xy}(\omega)| = \sqrt{\text{Re}f(\omega)^2 + \text{Im}f(\omega)^2} \quad ()$$

y_t x_t

$$\omega f_{yy}() \quad \omega f_{xx}()$$

$$: \quad ()$$

$$W(\omega) = \frac{|f_{xy}(\omega)|^2}{f_{xx}(\omega)f_{yy}(\omega)} \quad ()$$

$$(2, d-2)$$

F

d .

$$(\quad)$$

t-student

$$(\quad)$$

(Emery and

:Thomson, 2001)

$$d = \frac{8}{3} \left(\frac{n}{M} \right) \quad ()$$

$$(\quad) \quad T$$

$$T = \frac{2F}{d - 2 + 2F} \quad ()$$

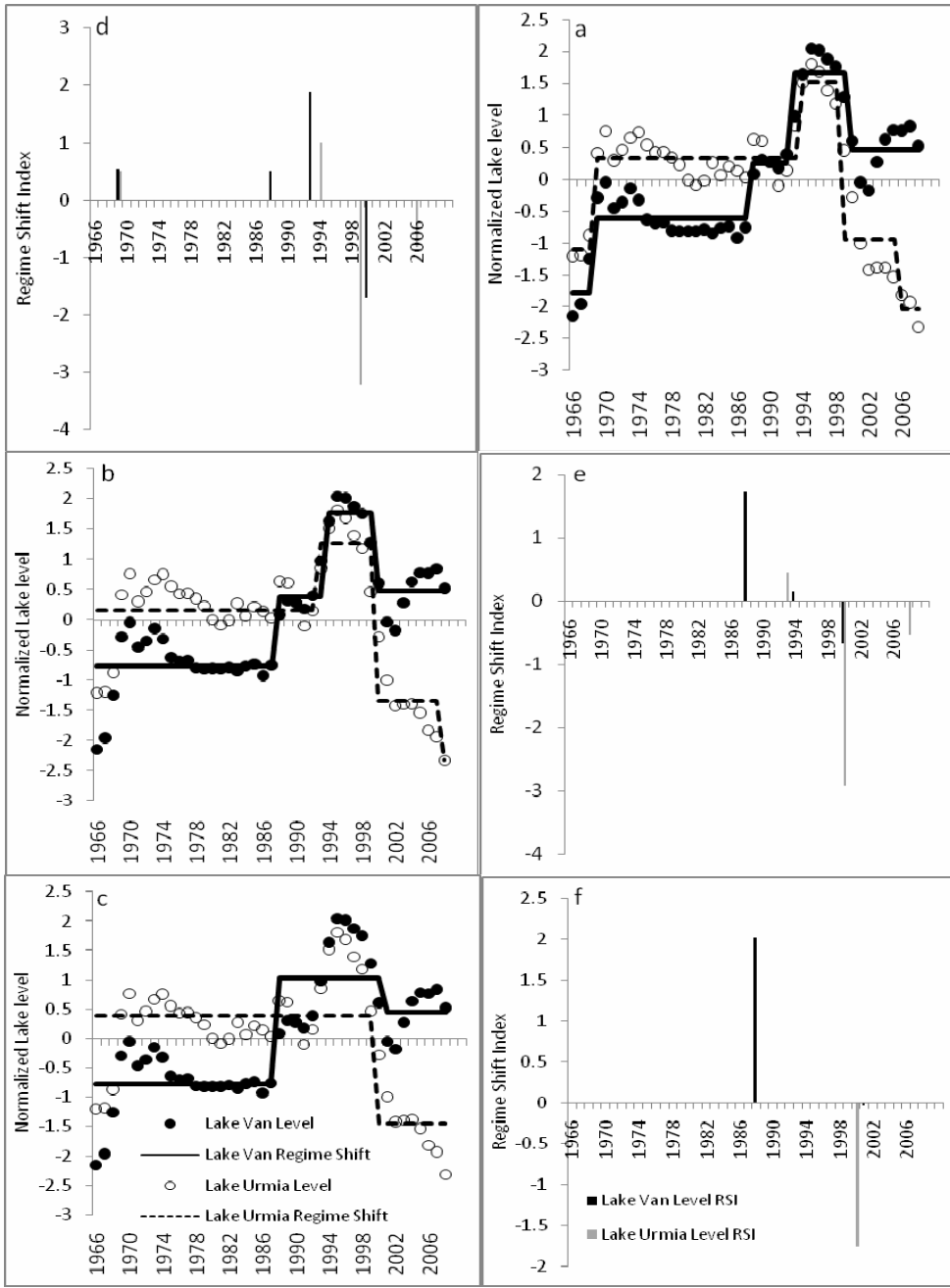
$$W(\omega) > T$$

(ρ	M	
سری زمانی	M	ρ	نوع روند
تراز دریاچه ارومیه	-۶/۶۵۹۲	۰/۰۰۱	نزولی
تراز دریاچه وان	-۱۵/۸۸۰۹	۰/۰۰۱	صعودی
بارندگی حوضه دریاچه ارومیه	-۴/۴۶۰۹	۰/۰۰۱	نزولی
بارندگی حوضه دریاچه وان	-۰/۲۳۸۷	۰/۱	فاقد روند

$$(a)$$

$$(c)$$

$$(e)$$



e, d, f

c, b, a

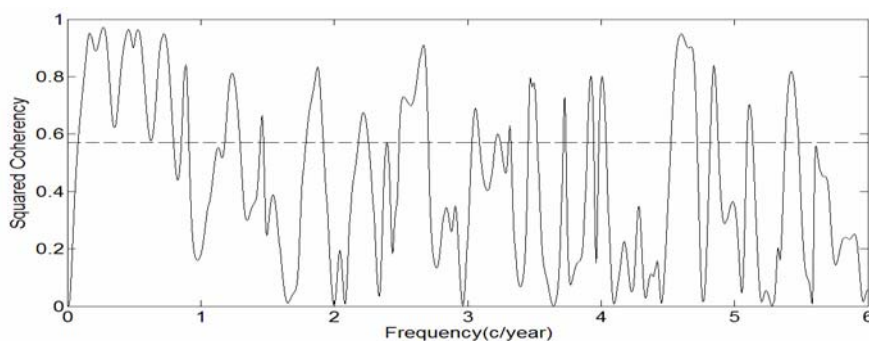
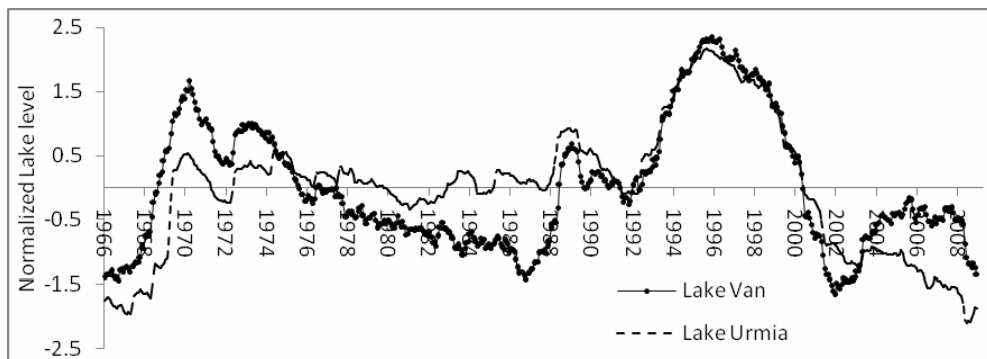
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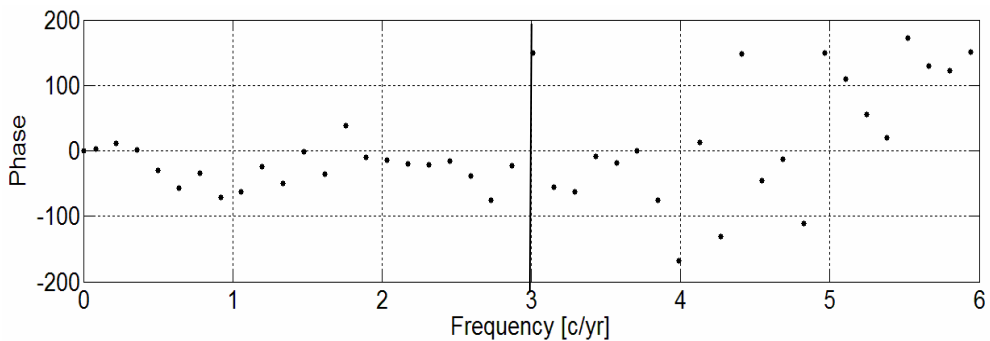
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فرکانس (دور در سال)	سال	ماه	وابستگی	فرکانس (دور در سال)	سال	ماه	وابستگی
0.08203	12.19	146.29	0.58	3.31055	0.30	3.62	0.60
0.79102	1.26	15.17	0.61	3.32227	0.30	3.61	0.61
0.86133	1.16	13.93	0.62	3.45703	0.29	3.47	0.64
0.90820	1.10	13.21	0.59	3.52148	0.28	3.41	0.61
1.18359	0.84	10.14	0.58	3.71484	0.27	3.23	0.60
1.28906	0.78	9.31	0.60	3.73242	0.27	3.22	0.62
1.44727	0.69	8.29	0.61	3.89648	0.26	3.08	0.61
1.46484	0.68	8.19	0.64	3.94336	0.25	3.04	0.59
1.78711	0.56	6.71	0.58	3.98438	0.25	3.01	0.60
1.91602	0.52	6.26	0.61	4.03711	0.25	2.97	0.61
2.18555	0.46	5.49	0.59	4.52930	0.22	2.65	0.62
2.25586	0.44	5.32	0.58	4.71680	0.21	2.54	0.64
2.48438	0.40	4.83	0.58	4.81641	0.21	2.49	0.59
2.70117	0.37	4.44	0.63	4.87500	0.21	2.46	0.61
3.03516	0.33	3.95	0.61	5.09766	0.20	2.35	0.62
3.08789	0.32	3.89	0.57	5.13281	0.19	2.34	0.59
3.21094	0.31	3.74	0.58	5.37891	0.19	2.23	0.58
3.24023	0.31	3.70	0.58	5.47266	0.18	2.19	0.62



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