Spatial distribution and the possible source of CDOM for inland water in summer in the Northeast China

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Abstract: Colored Dissolved Organic Matter (CDOM) is one of the major light absorbing constituents in natural water with the strongest absorption in the ultraviolet region and almost zero in the red region (Stedmon *et al*., 2000). Because of its solar radiation consumption, CDOM is generated from photoreactions of various biogeochemical cycles in natural waters, and also the river inputs and drainage, especially in inland waters (Sieburth et al., 1969; Zhang et al., 2007).

On the basis of sampling data form 4 different inland waters in summer in Jilin province, spatial distribution and the possible source of CDOM were discussed in this paper. Specific absorption coefficient of CDOM at 375nm ($a_{CDOM}(375)$) which is the indicator of concentration of CDOM was used to analyze spatial distribution of CDOM for different waters and relationship with other parameters. Means of $a_{CDOM}(375)$ varied in different inland waters, the maximum of which was 28.59±13.81m^{-1} in Chagan Lake. The differences were not significant among other three waters and the mean of $a_{CDOM}(375)$ is 5.31±1.47m^{-1} in Nanhu Lake, 3.99±1.58m^{-1} in Shitoukoumen Reservoir and 4.72±0.88m^{-1} in Songhua Lake. Spatial differences for different sampling data in the 4 waters witch were denoted with variation coefficients showed that, evident spatial variation was in Chagan Lake with the maximum 0.48. However, the minimum was 0.19 in Songhua Lake, and 0.39 in Shitoukoumen Reservoir and 0.28 in Nanhu Lake.

The property of CDOM in the range of 350-650nm can be modeled by Equation 1 (Bricaud et al., 1981).

$$a(\lambda)=a(\lambda_0)e^{S(\lambda 0-\lambda)} \quad (1)$$

where $a(\lambda)$ is the absorption coefficient at a certain wavelength (λ); $a(\lambda_0)$ is the absorption coefficient at a reference wavelength (λ_0) always at 440nm. S is the exponential slope coefficient and is a measure of how the absorption decreases with respect to wavelength.

Spectral slopes S were calculated through the least-square fitting method which varied in

different waters and for different samples. A consistent negative relationship between S and $a_{CDOM}(375)$ was observed (R^2=0.654, N=75, P<0.01). S varies with the components of CDOM but is uncorrelated to its concentration which illustrates the distribution portion of fulvic acid and humic acid (Carder *et al*., 1981). And S is in direct proportion to contribution of fulvic acid in contrast with that of humic acid. Fulvic acid is primary contribution for CDOM absorption in Songhua Lake and Shitoukoumen Reservoir with the S-values 19.94±0.97μm^{-1} and 19.70±4.98μm^{-1} respectively. Mean of S for Nanhu Lake is 16.40±2.60μm^{-1} and for Chagan Lake 14.48±4.72μm^{-1}, which indicated the greater portion of humic acid for CDOM absorption. Generally, CDOM originates from river inputs and production through various biological processes, such as bacterial degradation and decomposition, especially for inland water, such as lakes, reservoir and estuarine. Different sources of CDOM were estimated from the relationships between CDOM and total suspended mater concentration (R_{TSS}) and chlorophyll-a concentration ($R_{CHL\text{-}a}$) respectively. The results showed that the correlation coefficients $R_{CHL\text{-}a}$ were superior to R_{TSS} which demonstrated the biological processes source for Nanhu Lake, Shitoukoumen Reservoir and Chagan Lake. But for Songhua Lake, the dominating source is from river inputs as the R_{TSS} was higher than $R_{CHL\text{-}a}$, but biological process was also an important portion for CDOM concentration.

Key words: CDOM; spectral slope; inland water

Tab. 1 The information of sampling data

Location	Sampling Date	Samples
Nanhu Lake	2009-06-25	10
Shitoukoumen Reservoir	2009-07-27	22
Chagan Lake	2009-07-15	20
Songhua Lake	2008-07-25	26

Tab. 2 The depictive statistics of TSS concentration (C_{TSS}), chlorophyll-a concentration ($C_{CHL\text{-}a}$), $a_{CDOM}(375)$, and spectral slopes S.

Location	C_{TSS}(mg/L)		$C_{CHL\text{-}a}$(μg/L)		$a_{CDOM}(375)$(m^{-1})		S(μm^{-1})	
	mean	C.V	mean	C.V	mean	C.V	mean	C.V
Nanhu Lake	9.20±1.14	0.12	6.77±1.57	0.23	5.31±1.47	0.28	16.40±2.60	0.16
Shitoukoumen Reservoir	14.51±5.15	0.35	6.99±2.25	0.32	3.99±1.58	0.39	19.70±4.98	0.25
Chagan Lake	19.21±20.45	0.11	14.32±4.09	0.29	28.59±13.80	0.18	14.48±4.72	0.33
Songhua Lake	3.32±4.10	1.23	6.35±7.00	1.10	4.72±0.88	0.19	19.94±0.97	0.05

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