

Supplement of The Cryosphere, 13, 157–175, 2019
<https://doi.org/10.5194/tc-13-157-2019-supplement>
© Author(s) 2019. This work is distributed under
the Creative Commons Attribution 4.0 License.



Supplement of

The optical characteristics and sources of chromophoric dissolved organic matter (CDOM) in seasonal snow of northwestern China

Yue Zhou et al.

Correspondence to: Xin Wang (wxin@lzu.edu.cn) and Qingcai Chen (chenqingcai666@163.com)

The copyright of individual parts of the supplement might differ from the CC BY 4.0 License.

S1 Brief descriptions of some terms in PARAFAC method

S1.1 Components and excitation/emission loadings

To explain the terms “component” and “loading”, we should go back to the theory of this method. PARAFAC decomposes a three-way dataset into a set of trilinear terms and a residual array:

$$x_{ijk} = \sum_{f=1}^F a_{if} b_{jf} c_{kf} + \varepsilon_{ijk}, \quad (\text{S1})$$
$$i = 1, \dots, I; j = 1, \dots, J; k = 1, \dots, K.$$

In Eq. (S1), x is the original data set, i is the sample number, j and k are the excitation and emission wavelengths; f corresponds to the fluorescent component, ε is the residual containing noise and other unmodeled variations. Parameters a , b , and c represent the concentration, emission and excitation spectra of each fluorophore, respectively, and comprise each “component” as shown in Fig. 4. The “loadings” appeared in Fig. S2 are the values of b and c calculated from the model, these two parameters show the basic information of fluorescent components. Details can be found in Stedmon and Bro (2008).

S1.2 F_{\max}

F_{\max} represents the max fluorescence intensity of each component, which is calculated by parameters a , b , and c in Eq. (S1) and with the same unit of the original EEM. F_{\max} is proportional to the concentration of corresponding composition. However, the intensity of fluorescence does not only dependent on the concentration, but also the molar absorptivity and fluorescence quantum efficiency. In other words, if species A

has higher F_{\max} than species B, we cannot conclude that A is more abundant than B.

If certain PARAFAC component can be identified as any known chemical species, then quantification can be performed. Nonetheless, the changes of F_{\max} for a certain component and the ratios between components can be used to investigate the differences among samples qualitatively and quantitatively. Details can be seen in Stedmon and Bro (2008) and Murphy et al. (2013).

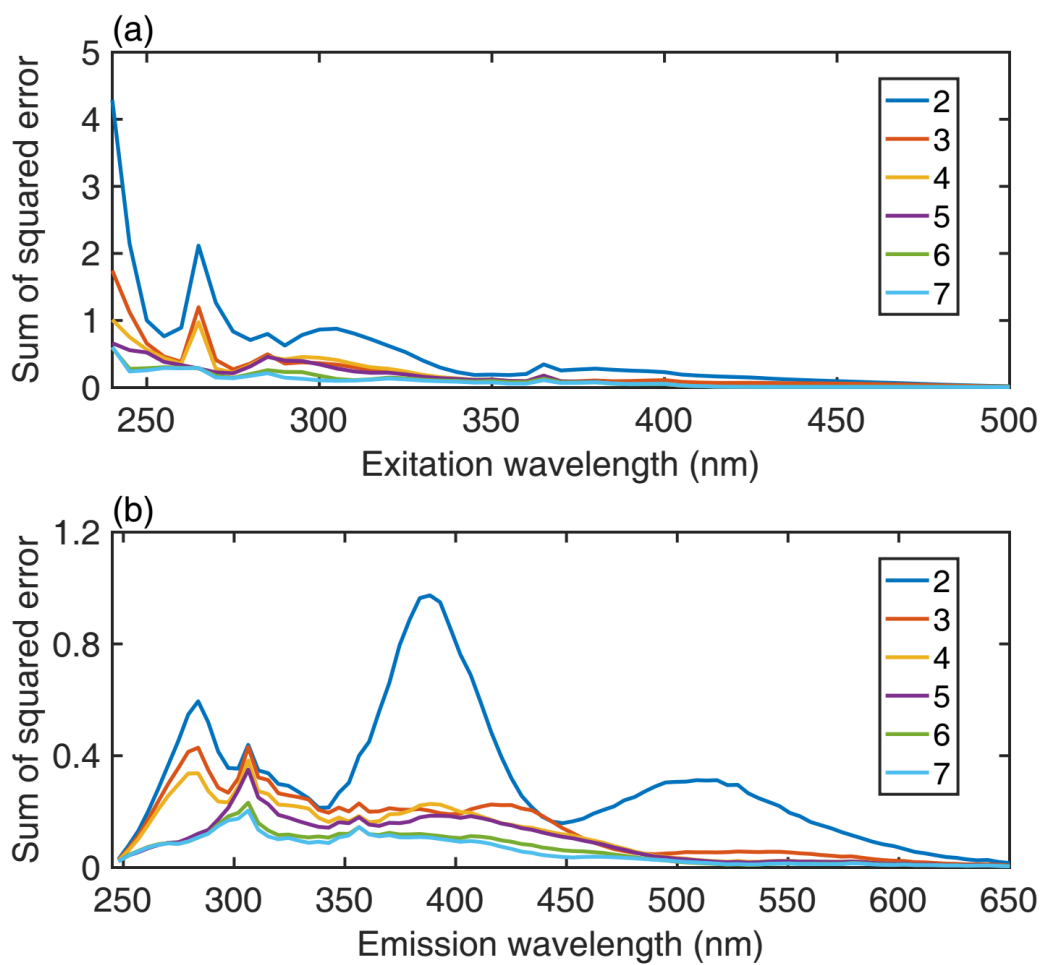


Figure S1. Residual analysis of 2- to 7-component PARAFAC models for (a) excitation wavelength and (b) emission wavelength.

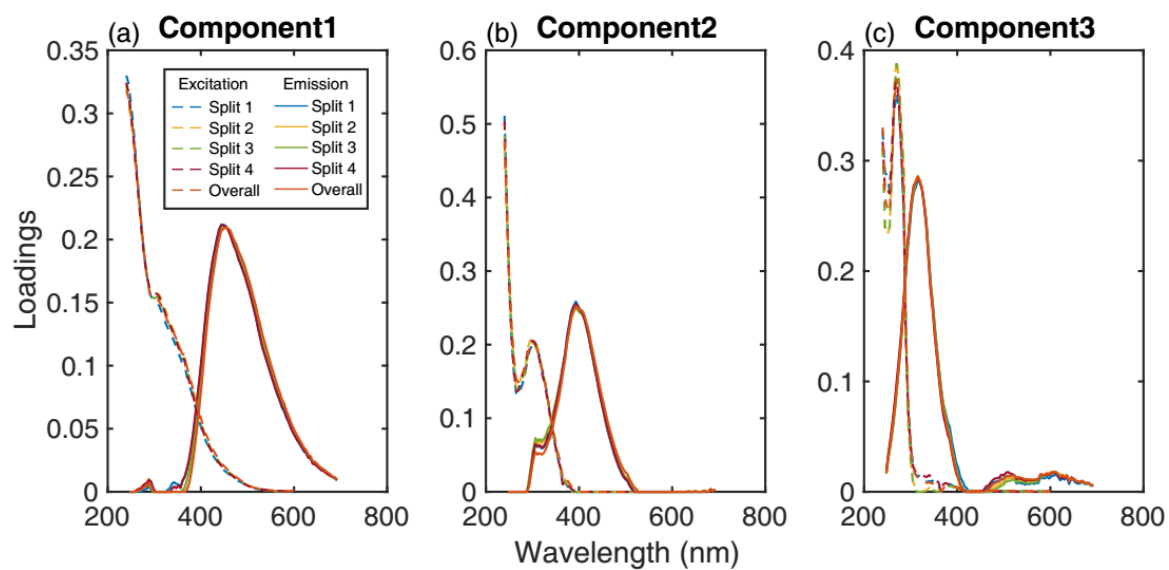


Figure S2. Split half analysis of 3-component PARAFAC model with the split style of $S_4C_4T_2$. The dashed lines indicate the excitation loadings and the solid lines indicate the emission loadings. The results of different splits and the overall dataset are in different colors as shown in the legend.

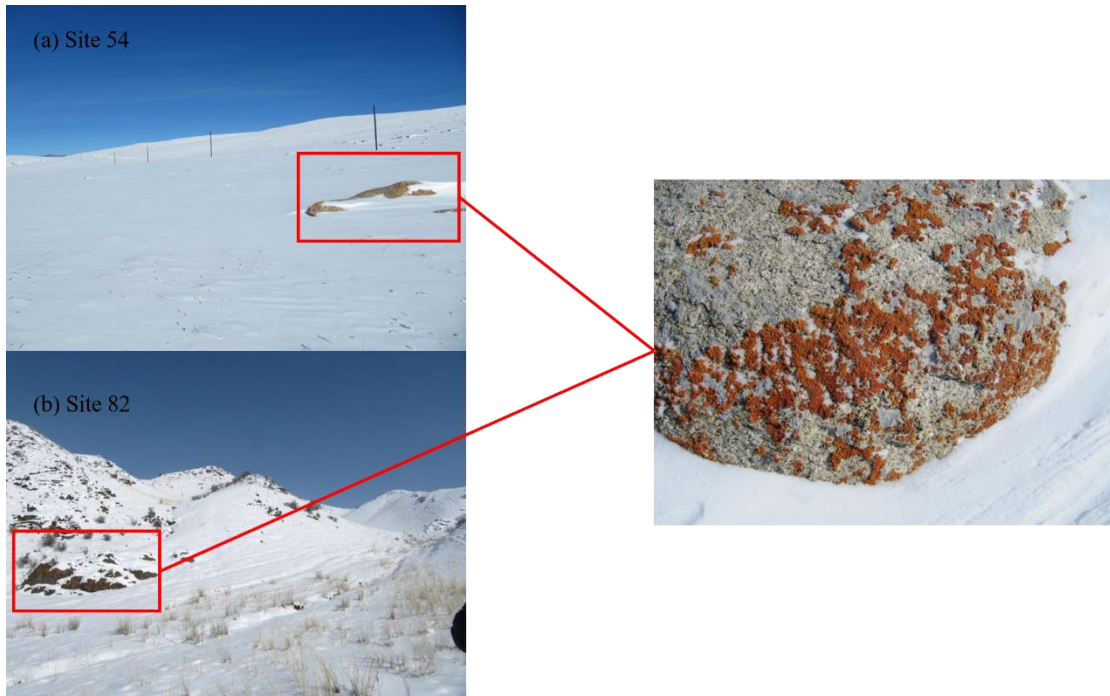


Figure S3. Pictures of lichens growing on rocks near sites **(a)** 54 and **(b)** 82.

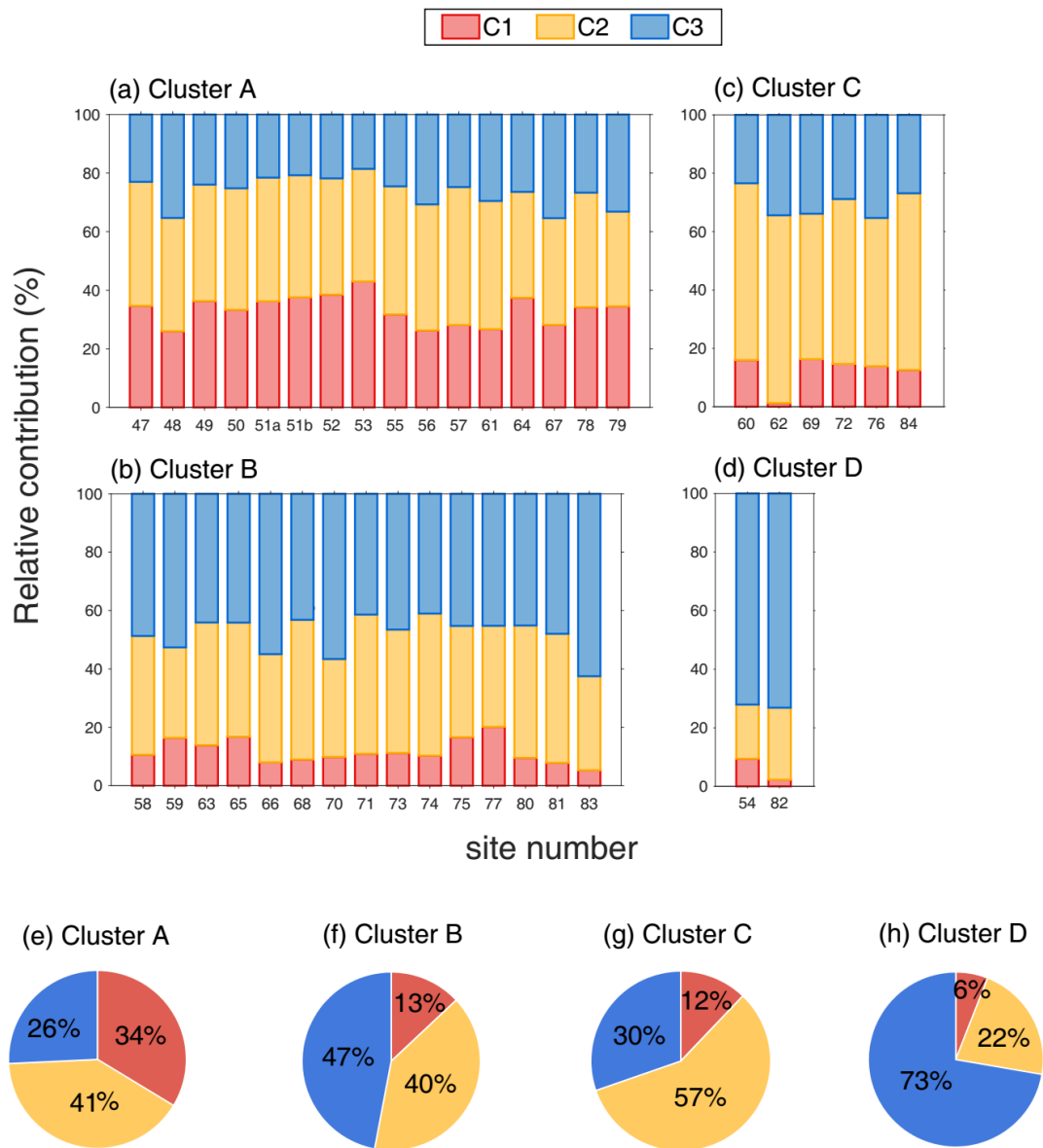


Figure S4. (a–d) The results of cluster analysis, and (e–h) the averages of %C1-%C3 in each cluster.

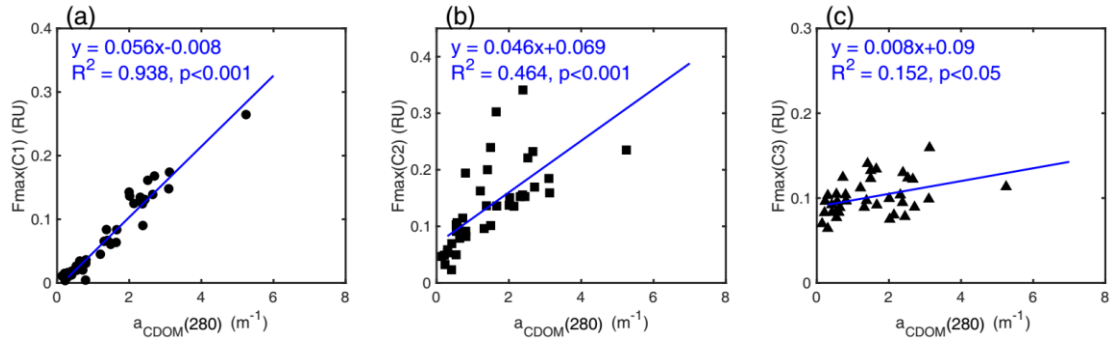


Figure S5. The relationships between $a_{\text{CDOM}}(280)$ and the intensities of (a) C1, (b) C2, and (c) C3.

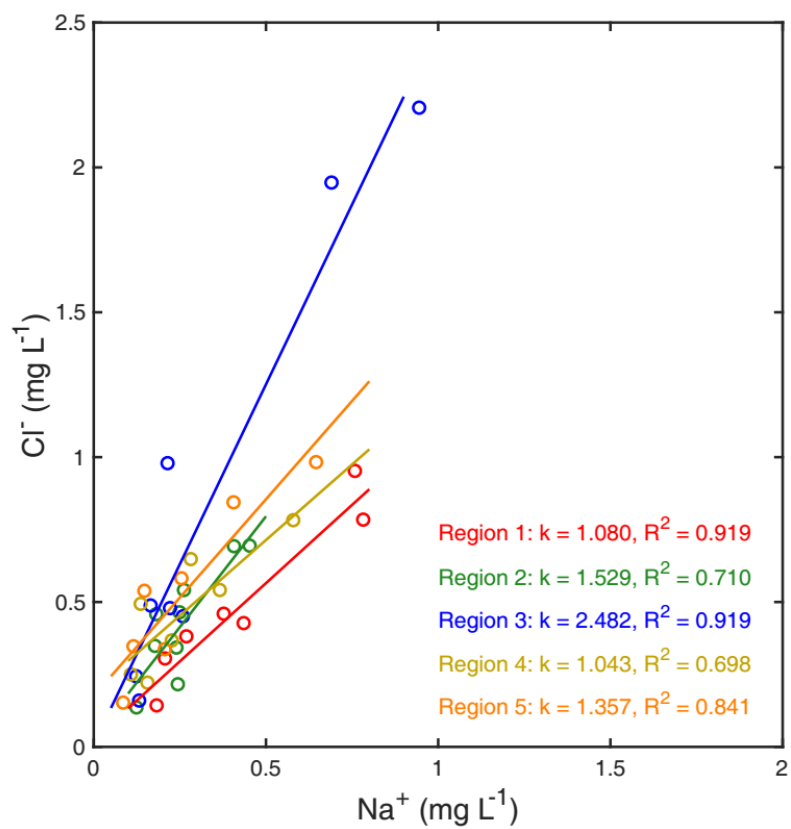


Figure S6. Mass ratios of Cl^- and Na^+ for the surface snow samples in each region.

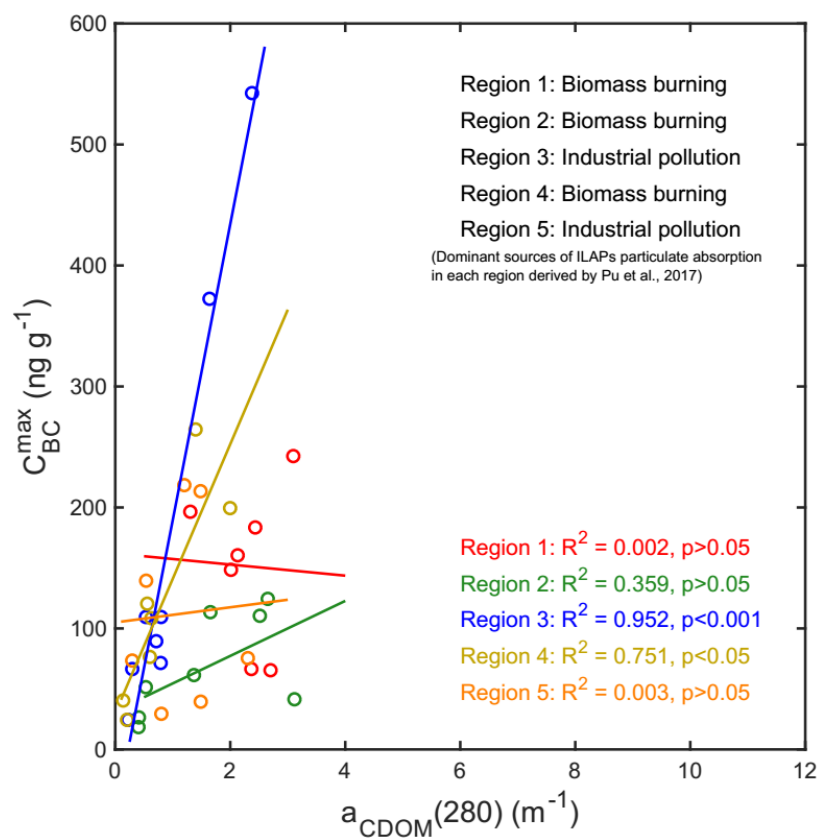


Figure S7. The relationships between particulate absorption of ILAPs (C_{BC}^{\max}) and $a_{CDOM}(280)$ in regions 1–5. Note that the dominant sources of C_{BC}^{\max} in each region are also presented, which were derived from Table 5 in Pu et al. (2017).

References

Pu, W., Wang, X., Wei, H. L., Zhou, Y., Shi, J. S., Hu, Z. Y., Jin, H. C., and Chen, Q. L.:

Properties of black carbon and other insoluble light-absorbing particles in seasonal snow of northwestern China, *The Cryosphere*, 11, 1213-1233, 2017.

Murphy, K. R., Stedmon, C. A., Graeber, D., and Bro, R.: Fluorescence spectroscopy and multi-way techniques. PARAFAC, *Anal. Methods-Uk.*, 5, 6557-6566, 2013.

Stedmon, C. A., and Bro, R.: Characterizing dissolved organic matter fluorescence with parallel factor analysis: a tutorial, *Limnol. Oceanogr.-Meth.*, 6, 572-579, 2008.