Apr 5th, 11:30 AM - 1:30 PM

Dissolved Cu concentrations in the Strait of Georgia: trends, speciation, and accumulation by local calanoid copepods

Bertha Iselle Flores Ruiz
Univ. of British Columbia, Canada, iflores@eoas.ubc.ca

Jack Anthony
Univ. of British Columbia, Canada, jack@minimove.ca

Lori-Jon C. Waugh
Univ. of British Columbia, Canada, lori_waugh@outlook.com

Cheng Kuang
Univ. of British Columbia, Canada, ckuang@eoas.ubc.ca

Roger Francois
Univ. of British Columbia, Canada, rfrancoi@eoas.ubc.ca

See next page for additional authors

Speaker
Bertha Iselle Flores Ruiz, Jack Anthony, Lori-Jon C. Waugh, Cheng Kuang, Roger Francois, and Maria T. Maldonado

Dissolved Cu in the Strait of Georgia: preliminary observations

Bertha Iselle Flores Ruiz[1], Jack Anthony[1], Lori-Jon C. Waugh[1], Cheng Kuang[1], Roger Francois[1], and Maria T. Maldonado[1].

Department of Earth, Ocean, and Atmospheric Sciences. University of British Columbia. Vancouver, Canada.[1]

1. Introduction

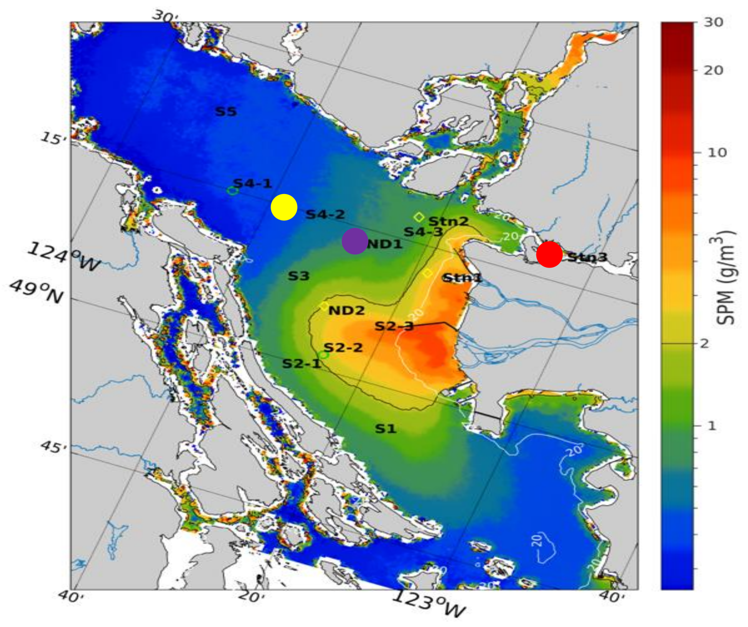

Fig.1 *Map of the Strait of Georgia from Pawlowicz et al. (2017). The suspended particulate matter (SPM) metric is shown as a proxy for the Fraser River plume location. The added circles represent previous (purple and red) and current (yellow) dissolved Cu sampling sites.*

Dissolved Cu (dCu) can range between 2 to 40 nM in coastal Northeast Pacific waters (Buck and Bruland, 2005).

Potential for dCu to be bioaccumulated and biomagnified. (Cardwell et al., 2013; DeForest et al., 2007).

More than 99% of dCu is bound to organic ligands which play an important role in its toxicity (Buck et al., 2007).

Determine baseline dCu concentrations, speciation, and sources into the Strait of Georgia (SoG), and provide insight of current levels into effects on lower trophic organisms.

2. Methods

Dissolved Cu concentrations

Collected depth profiles at stations ND1 and Burrard Inlet (2016) and S4-1.5 (2017-2018) and measured them in a FIA-CL.

Measured dCu speciation through CLE-ACSV, using SA as the competitive ligand.

Uptake rate experiments

Collected local adult *Metridia pacifica* in three instances in 2017

Novel approach: Used ^{64}Cu as a radiotracer

Trace metal sampling and handling

Tracing dCu with a box model

Used Wang (2015)'s Salish Sea box model with inputs for:

- Fraser River: 17.1 nM (Government of Canada)
- Pacific waters at station P12 200-300 m : 2.6 nM (Posacka et al. 2017)
- Constant tracer input at average concentrations (10.1 nM)

3. Preliminary Results and Discussion

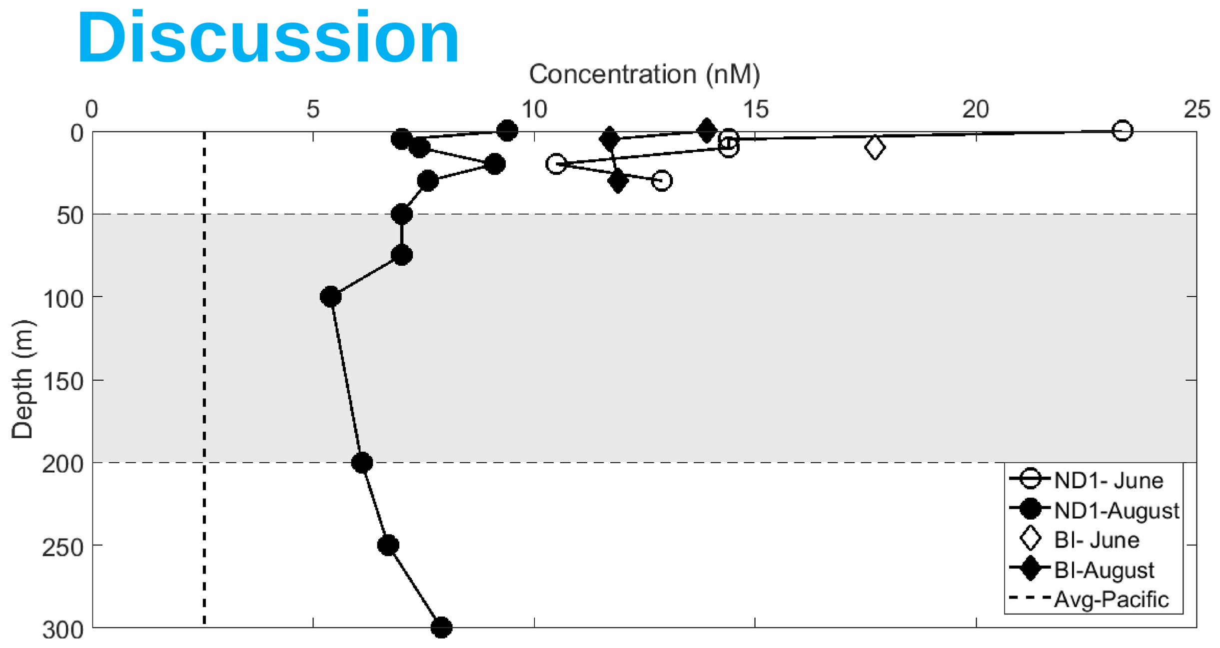

Fig. 2 *Dissolved Cu profile at stations ND1 and BI in 2016 (average). Average dCu levels in upwelled Pacific waters shown in the dashed line. ND1 samples range from 9.7 to 23.7 nM in June, and 5.1 to 10.1 nM in August. BI samples ranged from 18.8 to 19.6 nM, and 11.5 to 14.1 nM in June and August respectively.*

Depth (m)	Sample Date	$[Cu_{amb}]$ (nM)	$[L_1]$ (nM)	Log K_{L1}^{cond} (M^{-1})	pCu^{2+}_{free}
0	Sept 11, 2017	9*	19.9 ± 2.7	14.1±0.2	14.72
100	Sept 12, 2017	3*	4.0 ± 0.7	14.9±0.3	14.86
Buck and Bruland 2005	2003 SF Bay	17.9 - 49.6	22 - 265	12.9 -14.3	15.5 -13.3
Jacquot et al. 2014	2011-2012 Puget Sound	4 - 6	2.98 -7.23	12.9 – 14.7	15 -12

Table 1. *Comparison between 0 and 100 m estimated ligand concentrations in the SoG and other coastal waters. Cu in the SoG is bound to strong organic ligands that are also in excess at the surface. Concentrations of toxic Cu ions are low, and measurements in the Strait and other waters are similar. $[Cu_{amb}]$ with * are estimates.*

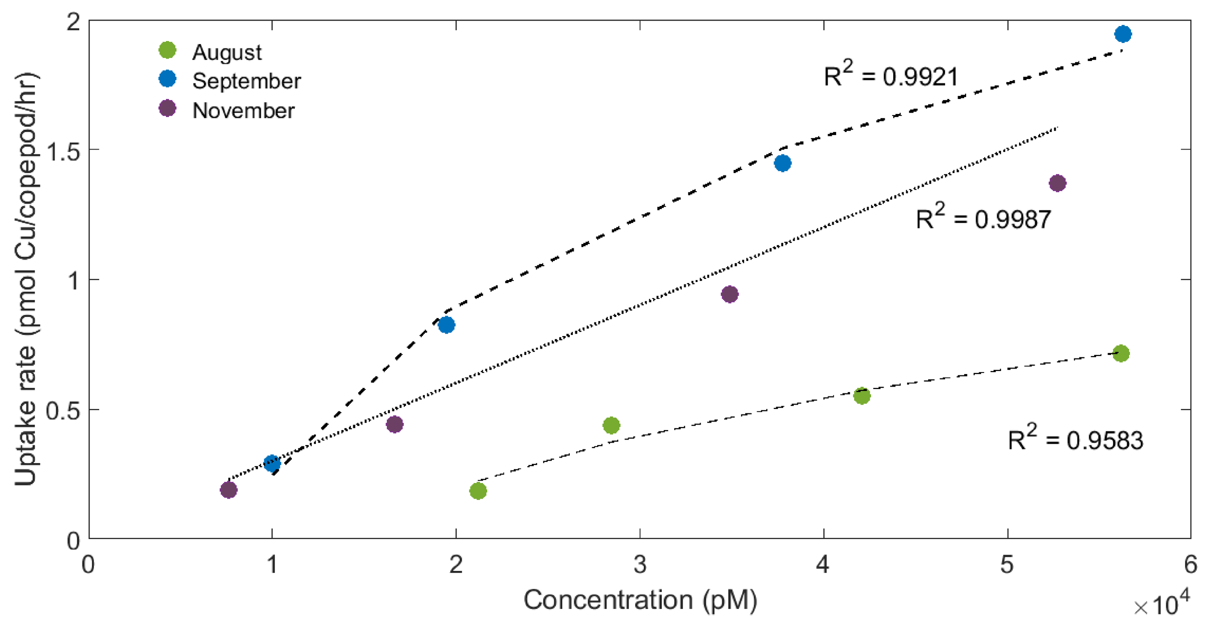

Fig. 3 *Dissolved Cu uptake rate experiments in 2017 with* M. pacifica *exposed at different plausible dCu levels. The general trend suggest s that copepods did not become saturated at the exposed concentrations. The uptake rate constants average was 4.6 L gDW⁻¹ d ⁻¹. These results are similar to Chang and Reinfelder (2000)'s.*

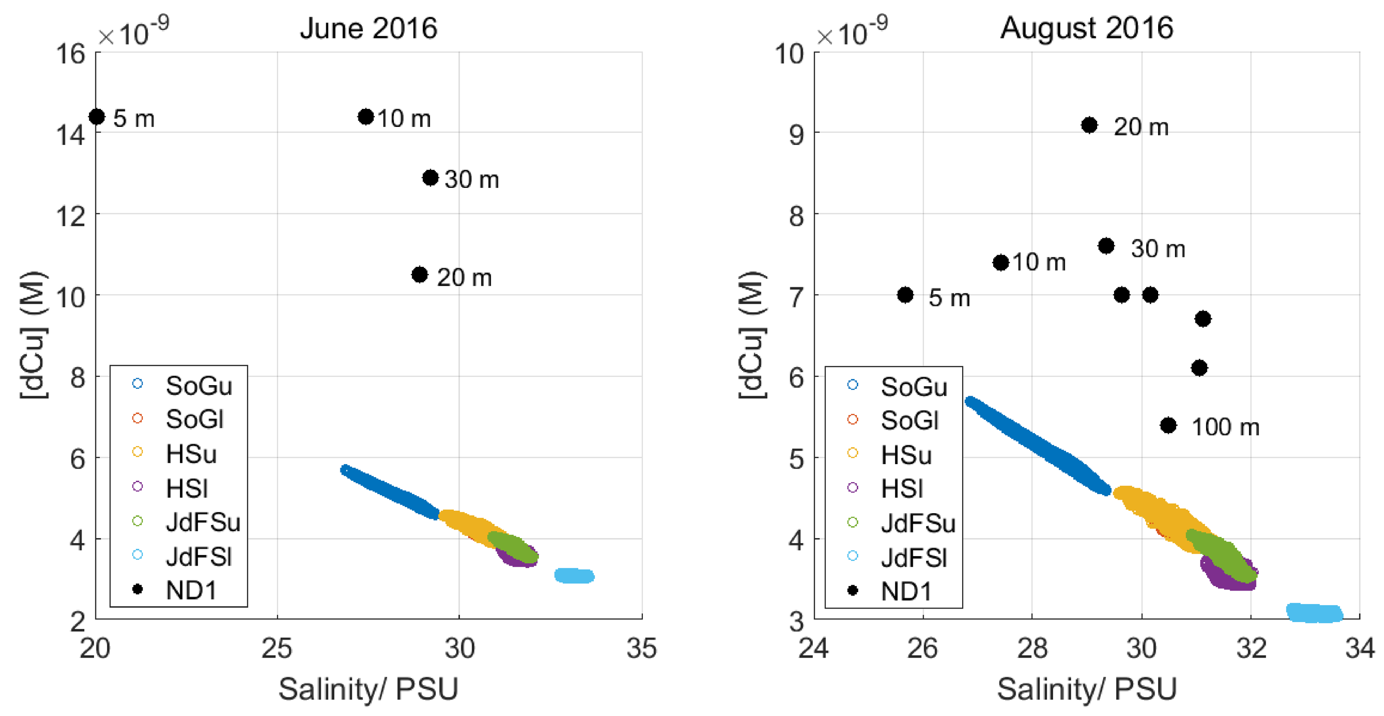

Fig. 4 *Output salinity vs dCu levels from the Salish Sea model. ND1 samples are plotted along with theoretical dCu levels found throughout the water column. Sample measurements were more than double the expected dCu levels in June, and at least about 20% higher in August. This suggests at least one or more unaccounted dCu sources in surface waters of the SoG.*

4. Conclusion

- **Dissolved Cu concentrations in the SoG seem to vary temporally, geographically, and within the water column.**
- **dCu is bound to high-affinity organic ligands.**
- **Model zooplankton dCu uptake rates are not saturated at plausible environmental concentrations.**

References.

Buck, K. N. and K. W. Bruland. *Marine Chemistry*. **2005**. *96*(12), 185 – 198.
Buck, K. N., Ross, J. R. , Flegal, A. R. , and Bruland , K. W. *Environmental Research*. **2007**.*105*(1),5–19.
Cardwell, R. D., DeForest, D. K. , Brix, K. V. , and Adams, W. J. **2013 .** pp. 101–122. New York, NY.
Chang, S. I. and J. R. Reinfelder. *Marine Ecology Progress Series.* **2002.** *231*, 179–186.
DeForest, D. K., Brix, K. V. , and Adams, W. J. *Aquatic Toxicology* . **2007.** *84*(2), 236 – 246.
Government of Canada. Online. **2017**.
Jacquot, J. E., Horak, R. E., Amin, S. A. ,. Devol, A. H, Ingalls, A. E. , Armbrust, E. V. , Stahl, D. A. and Moffett, J. W. *Marine Chemistry.* **2014**. *162*, 37–49.
Pawlowicz, R., Di Costanzo, R., Halverson, M., Devred, E., and Johannessen, S. *Atmosphere-Ocean*. **2017**. 1480-9214.
Posacka, A.M., Semeniuk, D.M., Whitby, H., van den Berg, C. M.G., Cullen, J.T., Orians, K., and Maldonado, M.T. *Marine Chemistry.* **2017**. *196*, 47-61.
Wang, C.Ph. D. thesis, University of British Columbia. **2015**.

Acknowledgement

We would like to thank the captains and crew of the CCGH Siyay, M. Soon, Y. J. Sun, R. Gan, A. Rommel ,C. Payne, and L. Pakhomova for their help sampling. Thank you to J. Guo, Stevens, and R. Pawlowicz for their insights and help with the experiments and model.