

## RESEARCH EXPERTISE

biogeochemical tracers, chemical oceanography, dissolved gases, isotope geochemistry, groundwater chemistry, mass spectrometry, biogeochemical instrument development, earth observation science

## EDUCATION

- PhD, Chemical Oceanography** 2016  
- Massachusetts Institute of Technology/Woods Hole Oceanographic Institution Joint Program in Oceanography  
- **Thesis:** Insight into chemical, biological, and physical processes in coastal waters from dissolved oxygen and inert gas tracers. <https://doi.org/10.1575/1912/8589>
- BSc, Combined Honors, Chemistry and Earth and Ocean Sciences** (with distinction) 2010  
- University of Victoria, Canada  
- **Thesis:** Investigation of the nitrous oxide cycle within an anoxic coastal pond in Cape Cod, MA

## EXPERIENCE

- Earth Observation Scientist**, Plymouth Marine Laboratory 2020–present  
- Using biogeochemical Argo data to study the ocean carbon pumps and ocean deoxygenation
- NSERC Postdoctoral Research and Teaching Fellow**, University of British Columbia 2017–2020  
- Investigated greenhouse gas cycling in the Canadian Arctic and groundwater geochemistry in British Columbia. Co-instructor for Field Methods in Groundwater Hydrology. *Publications 8-10, 12-21.*
- Graduate Research Assistant**, Woods Hole Oceanographic Institution 2011–2016  
- Developed a gas equilibration mass spectrometer for on-site measurement of dissolved noble gases in water. Participated in three field experiments to quantify air-sea gas exchange (from inert gases) and biological productivity (from the triple oxygen isotope composition of O<sub>2</sub>). *Publications 4-7, 11.*
- Research Assistant**, University of Victoria 2010–2011  
- Contributed to development of novel mass spectrometer-based techniques for real-time reaction monitoring. Applied techniques to study mechanisms of palladium-catalyzed cross-coupling reactions. *Publication 2.*
- Summer Student Fellow**, Woods Hole Oceanographic Institution 2009  
- Studied N cycling in an anthropogenically-influenced anoxic lake by measuring the concentration and isotopic composition of N<sub>2</sub>O and nutrients. Investigated biological pathways to N<sub>2</sub>O production through incubations.
- Research Assistant**, University of Victoria 2008  
- Quantified denitrification rates in a seasonally-anoxic estuary by interpreting an annual time series of O<sub>2</sub> concentration and O<sub>2</sub>/N<sub>2</sub>/Ar ratio data. *Publications 1 and 3.*

## PEER-REVIEWED PUBLICATIONS

You can also view my publications on [Google Scholar](#). Open access links are available through my [website](#).

20) [Technical note: Effects of iron\(II\) on fluorescence properties of dissolved organic matter at circumneutral pH](#)  
K Jia, **CCM Manning**, A Jollymore, and RD Beckie (2021)  
*Hydrology and Earth System Sciences*, in press, <https://doi.org/10.5194/hess-2020-150>

19) [ΔO<sub>2</sub>/N<sub>2</sub>' as a new tracer of marine net community production: Application and evaluation in the Subarctic Northeast Pacific and Canadian Arctic Ocean](#)  
RW Izett, RC Hamme, C McNeil, **CCM Manning**, A Bourbonnais, and PD Tortell (2021)

18) [Rapid advances in mobile mass spectrometry enhance tracer hydrology and water management](#)

AL Popp\*, **CCM Manning\***, and JLA Knapp\* (2021)

\*All authors contributed equally

*Water Resources Research*, in press, <https://doi.org/10.1029/2021WR029890>

17) [First estimation of the diffusive methane flux and concentrations from Lake Winnipeg, a large, shallow and eutrophic lake](#)

R Mandryk, DW Capelle, **CCM Manning**, PD Tortell, RD McCulloch, and T Papakyriakou (2020)

*Journal of Great Lakes Research*, in press, <https://doi.org/10.1016/j.jglr.2021.03.011>

16) [Characterization of marine microbial communities around an Arctic seabed hydrocarbon seep at Scott Inlet, Baffin Bay](#)

MA Cramm, B de Moura Neves, **CCM Manning**, TB Oldenburg, P Archambault, A Chakraborty, A Cyr-Parent, EN Edinger, A Jaggi, A Mort, PD Tortell, and CR Hubert (2021)

*Science of the Total Environment*, 762, 143961, <https://doi.org/10.1016/j.scitotenv.2020.143961>

15) [Ideas and perspectives: A strategic assessment of methane and nitrous oxide measurements in the marine environment](#)

ST Wilson and 35 others including **CC Manning** (2020)

*Biogeosciences*, 17, 5809-5828, <https://doi.org/10.5194/bg-17-5809-2020>

14) [Oxygen and triple oxygen isotope measurements provide different insights into gross oxygen production in a shallow salt marsh pond](#)

EM Howard, AC Spivak, JS Karolewski, KM Gosselin, ZO Sandwith, **CC Manning**, RHR Stanley (2020)

*Estuaries and Coasts*, 43, 1908-1922, <http://doi.org/10.1007/s12237-020-00757-6>

13) [River inflow dominates methane emissions in an Arctic coastal system](#)

**CC Manning**, VL Preston, SF Jones, APM Michel, DP Nicholson, PJ Duke, M Ahmed, K Manganini, BGT Else, and PD Tortell (2020)

*Geophysical Research Letters*, 47, e2020GL087669, <https://doi.org/10.1029/2020GL087669>

**Software:** <https://doi.org/10.5281/zenodo.3785893>

**Data:** <https://doi.org/10.1594/PANGAEA.907159>

12) [A new method for tracing denitrification in riparian groundwater](#)

A Popp, **CC Manning**, M Brennwald, and R Kipfer (2020)

*Environmental Science & Technology*, 54(3), 1562-1572, <https://doi.org/10.1021/acs.est.9b05393>

11) [Changes in gross oxygen production, net oxygen production, and air-water gas exchange during seasonal ice melt in Whycocomagh Bay, a Canadian estuary in the Bras d'Or Lake system](#)

**CC Manning**, RHR Stanley, DP Nicholson, B Loose, A Lovely, P Schlosser, and BG Hatcher (2019)

*Biogeosciences*, 17, 3351-3376, <https://doi.org/10.5194/bg-16-3351-2019>

10) [Advancing knowledge of gas migration and fugitive gas from energy wells in northeast British Columbia, Canada](#)

AG Cahill, R Beckie, B Ladd, E Sandl, M Goetz, J Chao, J Soares, **C Manning**, C Chopra, N Finke, I Hawthorne, A Black, KU Mayer, S Crowe, T Cary, R Lauer, B Mayer, A Allen, D Kirste, L Welch (2019)

*Greenhouse Gases: Science and Technology*, 9, 134-151, <https://doi.org/10.1002/ghg.1856>

9) [An intercomparison of oceanic methane and nitrous oxide measurements](#)

ST Wilson and 31 others including **CC Manning** (2018)

*Biogeosciences*, 15, 5891-5907, <https://doi.org/10.5194/bg-15-5891-2018>

- 8) Refined estimates of net community production in the Subarctic Northeast Pacific derived from  $\Delta\text{O}_2/\text{Ar}$  measurements with  $\text{N}_2\text{O}$ -based corrections for vertical mixing  
RW Izett, **CC Manning**, RC Hamme, and PD Tortell (2018)  
*Global Biogeochemical Cycles*, 32, 326-350, <http://doi.org/10.1002/2017GB005792>
- 7) Revising estimates of aquatic gross oxygen production by the triple oxygen isotope method to incorporate the local isotopic composition of water  
**CC Manning**, EM Howard, DP Nicholson, B Ji, ZO Sandwith, and RHR Stanley (2017)  
*Geophysical Research Letters*, 44, 10511-10519, <http://doi.org/10.1002/2017GL074375>.  
**Software:** <http://doi.org/10.5281/zenodo.376786>
- 6) Impact of recently upwelled water on productivity investigated using in situ and incubation-based methods  
**CC Manning**, RHR Stanley, DP Nicholson, JM Smith, JT Pennington, MR Fewings, ME Squibb, and FP Chavez (2017)  
*Journal of Geophysical Research: Oceans*, 122, <http://doi.org/10.1002/2016JC012306>
- 5) Quantifying air-sea gas exchange using noble gases in a coastal upwelling zone  
**CC Manning**, RHR Stanley, DP Nicholson, and ME Squibb (2016)  
*IOP Conference Series: Earth and Environmental Science*. 35, 012017, 13 pages, <https://doi.org/10.1088/1755-1315/35/1/012017>.  
**Software:** <http://doi.org/10.5281/zenodo.594531>
- 4) Continuous measurements of dissolved Ne, Ar, Kr, and Xe with a field-deployable gas equilibration mass spectrometer  
**CC Manning**, RHR Stanley, and DE Lott (2016).  
*Analytical Chemistry* 88, 3040–3048, <http://doi.org/10.1021/acs.analchem.5b03102>
- 3) Nitrate elimination and regeneration as evidenced by dissolved inorganic nitrogen isotopes in Saanich Inlet, a seasonally anoxic fjord  
A Bourbonnais, MF Lehmann, RC Hamme, **CC Manning**, and SK Juniper (2013)  
*Marine Chemistry* 157, 194-207, <http://doi.org/10.1016/j.marchem.2013.09.006>
- 2) Powerful insight into catalytic mechanisms through simultaneous monitoring of reactant, products and intermediates  
KL Vikse, Z Ahmadi, **CC Manning**, DA Harrington, and JS McIndoe (2011)  
*Angewandte Chemie International Edition* 50(36), 8304-8306, <http://doi.org/10.1002/anie.201102630>
- 1) Impact of deep-water renewal events on fixed nitrogen loss from seasonally-anoxic Saanich Inlet  
**CC Manning**, RC Hamme, and A Bourbonnais (2010)  
*Marine Chemistry* 122, 1-10, <http://doi.org/10.1016/j.marchem.2010.08.002>

## SUBMITTED MANUSCRIPTS

- 22) Interannual variability in methane and nitrous oxide concentrations and sea-air fluxes across the North American Arctic Ocean (2015–2019)  
**CCM Manning**, Z Zheng, L Fenwick, R McCulloch, E Damm, RW Izett, WJ Williams, S Zimmermann, S Vaigle, and PD Tortell (2021)  
Submitted to *Global Biogeochemical Cycles*, manuscript ID 2021GB007185. Preprint on *EarthArXiv*, <https://doi.org/10.31223/X53G86>
- 21) Standard protocols for  $\text{N}_2\text{O}$  and  $\text{CH}_4$  data reporting and archiving  
A Kock, **CCM Manning**, and T Steinhoff (2020)  
In revision for *IODE/IOC Ocean Best Practices Repository*, <https://www.oceanbestpractices.org/>

## TECHNICAL REPORTS

### 26) Assessment of fugitive natural gas on near-surface groundwater quality

B Ladd, CJC Van De Ven, J Chao, J Soares, T Cary, N Finke, **C Manning**, AL Popp, C Chopra, AG Cahill, KU Mayer, A Black, R Lauer, C van Geloven, L Welch, S Crowe, B Mayer, RD Beckie  
Geoscience BC Project 2016-043 Final Report, Geoscience BC Report 2021-10, p. 1-20. [Open access link.](#)

### 25) Controlled natural gas release experiment in a confined aquifer, northeastern British Columbia (NTS 094A/04): Activity report 2019-2020

CJC Van De Ven, AG Cahill, B Ladd, J Chao, J Soares, T Cary, N Finke, **C Manning**, AL Popp, C Chopra, KU Mayer, A Black, R Lauer, C van Geloven, L Welch, S Crowe, B Mayer, RD Beckie  
*Geoscience BC Summary of Activities 2020: Energy and Water*, Geoscience BC Report 2021-02, p. 135-144.  
[Open access link.](#)

### 24) Controlled natural gas release experiment in a confined aquifer, northeastern British Columbia: Activity report 2018-2019

AG Cahill, B Ladd, J Chao, J Soares, T Cary, N Finke, **C Manning**, AL Popp, C Chopra, KU Mayer, A Black, R Lauer, C van Geloven, L Welch, S Crowe, B Mayer and RD Beckie (2020)  
*Geoscience BC Summary of Activities 2019: Energy and Water*, Geoscience BC Report 2020-02, p. 145-160.  
[Open access link.](#)

### 23) Implementation and operation of a multidisciplinary field investigation involving a subsurface controlled natural gas release, northeastern British Columbia

AG Cahill, B Ladd, J Chao, J Soares, T Cary, N Finke, **C Manning**, C Chopra I Hawthorne, ON Forde, KU Mayer, A Black, S Crowe, B Mayer, R Lauer, C van Geloven, C., L Welch, and RD Beckie (2019)  
*Geoscience BC Summary of Activities 2018: Energy and Water*, Geoscience BC Report 2019-2, p. 95–104. [Open access link.](#)

## SELECTED GRANTS, SCHOLARSHIPS, AND FELLOWSHIPS

2018–2020	NSERC Postdoctoral Fellowship (\$90 000)
2014	WHOI Ocean Ventures Fund for graduate student research (\$6000)
2014	WHOI Coastal Ocean Institute award for graduate student research (\$1294)
2012–2015	NSERC Post-Graduate Scholarship D (\$63 000)
2012–2014	Canadian Meteorological and Oceanographic Society scholarship (\$10 000)
2011–2012	NSERC Post-Graduate Scholarship M (\$17 300)
2009	Woods Hole Oceanographic Institution Summer Student Fellowship (\$8000)
2008	NSERC Undergraduate Student Research Award (\$4500)

## OTHER ACTIVITIES

2021–	Member of Ocean Observatories Initiative Biogeochemical Sensor Working Group
2021–	Submission moderator for EarthArXiv (Earth Science preprint server)
2019, 2020	Co-instructor for Field Methods in Groundwater Hydrology (UBC undergrad and graduate course)
2019	Canadian Arctic research cruise on CCGS Amundsen (22 days)
2018	Canadian Arctic research cruise on CCGS Amundsen (21 days)
2018	Coastal fieldwork in Cambridge Bay, Nunavut (10 days)
2018	Hydrogeological fieldwork in Hudson's Hope, BC (15 days)
2018	UBC Instructional Skills Workshop, run by the the Centre for Teaching, Learning and Technology
2018	Mitacs Foundations of Project Management workshop
2017	Canadian Arctic research cruise on CCGS Amundsen (42 days)
2015–2017	Developed open access policies for scientific publications at WHOI and MIT

- 2015 9<sup>th</sup> Annual Graduate Climate Conference, program designer and biogeochemistry session chair
- 2015 MIT/Imperial College London Global Fellows Program
- 2014 Communicating Ocean Sciences (semester long course on teaching methods at WHOI)
- 2014–2016 WHOI Women’s Committee, member and webmaster
- 2012– Reviewer for US National Science Foundation (1), Leverhulme Foundation (1), Global Biogeochemical Cycles (2), Geophysical Research Letters (2), Journal of Geophysical Research (2), Marine Chemistry (2), Environmental Science and Technology (2), ACS Earth and Space Chemistry (1), and Biogeosciences (1)
- 2008– Seventeen presentations as first author at research conferences, and nine departmental seminars