

Curriculum Vitae

Penny M. Rowe

Research Scientist
Northwest Research Associates
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Education Ph.D., Physical Chemistry, University of Washington (2004)
 B.S., Chemistry, with honors (minor in mathematics),
 University of Puget Sound (1997)

Research History

Research Scientist: NorthWest Research Associates (2016 - present)
Research Affiliate: University of Santiago, Physics Dept., (2014 – present).
Research Affiliate: University of Idaho, Dept. of Geography (2014-2015).
Postdoctoral Research: University of Idaho, Dept. of Geography (2004 - 2014).
Graduate Research Assistant: University of Washington, Dept. of Chemistry (1999-2004).
Participated in Surface Heat Budget of the Arctic (SHEBA) program (Summer 1998).

Refereed Publications

2022

Cordero, R.R., Sepúlveda, E., Feron, S., Damiani, A., Fernandoy, F., Neshyba, S., Rowe, P.M., Asencio, V., Carrasco, J., Alfonso, J.A. and Llanillo, P. (2022). Black carbon footprint of human presence in Antarctica. *Nature communications*, 13(1), pp.1-11.

Cordero, R.R., Sepúlveda, E., Feron, S., Wang, C., Damiani, A., Fernandoy, F., Neshyba, S., Rowe, P.M., Asencio, V., Carrasco, J. and Alfonso, J.A., (2022). Black carbon in the Southern Andean snowpack. *Environmental Research Letters*, 17(4), p.044042.

Richter, P., Palm, M., Weinzierl, C., Griesche, H., Rowe, P. M., & Notholt, J. (2022). A dataset of microphysical cloud parameters, retrieved from Fourier-transform infrared (FTIR) emission spectra measured in Arctic summer 2017. *Earth System Science Data*, 14(6), 2767-2784.

Cordero, R.R., Feron, S., Damiani, A., Redondas, A., Carrasco, J., Sepúlveda, E., Jorquera, J., Fernandoy, F., Llanillo, P., Rowe, P.M. and Seckmeyer, G., (2022). Persistent extreme ultraviolet irradiance in Antarctica despite the ozone recovery onset. *Scientific reports*, 12(1), pp.1-10.

2021

Rowe, P.M., Walden, V.P., Brandt, R.E., Town, M.S., Hudson, S.R., and Neshyba, S. (2021). Evaluation of Temperature-Dependent Complex Refractive Indices of Supercooled Liquid Water Using Downwelling Radiance and In-Situ Cloud Measurements at South Pole, *Journal of Geophysical Research: Atmospheres*, 127, e2021JD035182. <https://doi.org/10.1029/2021JD035182>.

Chyhareva, A., Gorodetskaya, I., Krakovska, S., Pishniak, D., & Rowe, P. (2021). Precipitation phase transition in austral summer over the Antarctic Peninsula. *Ukrainian Antarctic journal*, (1), 32-46.

Pizarro, J., Vergara, P. M., Cerda, S., Cordero, R. R., Castillo, X., Rowe, P. M., ... & Neshyba, S. (2021). Contaminant emissions as indicators of chemical elements in the snow along a latitudinal gradient in southern Andes. *Scientific reports*, 11(1), 1-10.

Rowe P.M., Fortmann, L., Guasco, T.L., Wright, A., Ryken, A., Sevier, E., Stokes, G., Mifflin, A., Wade, R., Cheng, H., Pfalzgraff, W., Beaudoin, J., Rajbhandari, I., Fox-Dobbs, K., and Neshyba, S. (2021). Integrating polar research into undergraduate curricula using computational guided inquiry. *Journal of Geoscience Education*, 69(2), 178-191.

Sepúlveda, E., Cordero, R. R., Damiani, A., Feron, S., Pizarro, J., Zamorano, F., ... & Rowe, P. M. (2021). Evaluation of Antarctic Ozone Profiles derived from OMPS-LP by using Balloon-borne Ozonesondes. *Scientific reports*, 11(1), 1-11.

Bromwich, D.H., et al. (2020). The Year of Polar Prediction in the Southern Hemisphere (YOPP-SH). *BAMS* 101.10: E1653-E1676.

2020

Bromwich, D.H., et al. (2020). The Year of Polar Prediction in the Southern Hemisphere (YOPP-SH). *BAMS* 101.10: E1653-E1676.

Fortmann, L., Beaudoin, J., Rajbhandari, I., Wright, A., Neshyba, S., and Rowe, P. (2020). Teaching Modules for Estimating Climate Change Impacts in Economics Courses using Computational Guided Inquiry. *J. Econ. Educ.* DOI: [10.1080/00220485.2020.1731383](https://doi.org/10.1080/00220485.2020.1731383).

Gladich, I., Berrens, M. L., Rowe, P. M., Pereyra, R. G., & Neshyba, S. (2020). Solvation and Stabilization of Single-Strand RNA at the Air/Ice Interface Support a Primordial RNA World on Ice. *The Journal of Physical Chemistry C*, 124(34), 18587-18594.

Lubin, D., Zhang, D., Silber, I., Scott, R. C., Kalogeras, P., Battaglia, A., et al. (2020). AWARE: The Atmospheric Radiation Measurement (ARM) West Antarctic Radiation Experiment. *Bulletin of the American Meteorological Society*, BAMS-D-18-0278.1. <http://doi.org/10.1175/BAMS-D-18-0278.1>

Rowe, P. M., Fergoda, M., and Neshyba, S. (2020). Temperature-Dependent Optical Properties of Liquid Water From 240 to 298 K. *Journal of Geophysical Research: Atmospheres*, 125(17), e2020JD032624. <http://doi.org/10.1175/BAMS-D-18-0278.1>

2019

Alfonso, J. A., Cordero, R., Rowe, P. M., Neshyba, S., Casassa, G., Carrasco, J., et al., 2019: Elemental and Mineralogical Composition of the Western Andean Snow (18°S–41°S). *Scientific Reports*, 9(1), 1–13. <http://doi.org/10.1038/s41598-019-44516-5>.

Perro, C., Duck, T. J., Lesins, G., Strong, K., Rowe, P. M., Drummond, J. R., & Sica, R. J. (2019). Pan-Arctic measurements of wintertime water vapour column using a satellite-borne microwave radiometer. *Atmospheric Measurement Techniques Discussions*, 1-25.

Rowe, P. M., Cordero, R., Warren, S. G., Stewart, E., Doherty, S. J., Pankow, A., et al., 2019: Black carbon and other light-absorbing impurities in snow in the Chilean Andes. *Scientific Reports*, 9(1), 4008. <http://doi.org/10.1038/s41598-019-39312-0>.

Rowe, P. M., Cox, C., Neshyba, S., & Walden, V. P. (2019). Toward autonomous surface-based infrared remote sensing of polar clouds: retrievals of cloud optical and microphysical properties. *Atmos. Meas. Tech.*, 12(9), 5071–5086. <http://doi.org/10.5194/amt-12-5071-2019>

2018 and Prior

Rowe, P. M., Cheng, H., Fortmann, L., Wright, A., & Neshyba, S., 2018: Teaching image processing in an upper level CS undergraduate class using computational guided inquiry and polar data. *Journal of Computing Sciences in Colleges*, 34(1), 171–179. <http://doi.org/10.5555/3280489.3280517>

Butterfield, N., Rowe, P. M., Stewart, E., Roesel, D., & Neshyba, S., 2017: Quantitative three-dimensional ice roughness from scanning electron microscopy. *Journal of Geophysical Research: Atmospheres*, 122(5), 3023–3041.

Weaver, D., Strong, K., Schneider, M., Rowe, P. M., Sioris, C., Walker, K. A., et al., 2017: Intercomparison of atmospheric water vapour measurements at a Canadian High Arctic site. *Atmospheric Measurement Techniques*, 10, 2851–2880.

Rowe, P. M., Cox, C., & Walden, V. P., 2016: Toward autonomous surface-based infrared remote sensing of polar clouds: Cloud height retrievals. *Atmospheric Measurement Techniques*, 9, 3641–3659. <http://doi.org/10.5194/amt-9-3641-2016>.

Cox, C., Rowe, P. M., Neshyba, S., & Walden, V. P., 2016: A synthetic data set of high-spectral resolution infrared spectra for the Arctic atmosphere. *Earth System Science Data Discussions*, 1–29. <http://doi.org/10.5194/essd-2015-40>.

Cordero, R. R., Damiani, A., Seckmeyer, G., Jorquera, J., Caballero, M., Rowe, P. M., et al., 2016: The Solar Spectrum in the Atacama Desert. *Scientific Reports*, 6. <http://doi.org/10.1038/srep22457>.

Gladich, I., A. Oswald, N. Bowens, S. Naatz, P. Rowe, M. Roeselova and S. Neshyba, 2015: Mechanism of Anisotropic Surface Self-Diffusivity at the Prismatic Ice-Vapor Interface, *Physical Chemistry Chemical Physics*, 2015, **17**, 22947 – 22958, DOI: 10.1039/C5CP01330E.

Cox, C., Walden, V. P., Rowe, P. M., & Shupe, M., 2015: Humidity trends imply increased sensitivity to clouds in a warming Arctic. *Nature Communications*, 6, 10117.

Lubin, D., B.H. Kahn, M.A. Lazzara, P.M. Rowe, and V.P. Walden, 2015: Variability in AIRS-retrieved cloud amount and thermodynamic phase over west versus east Antarctica influenced by the SAM, *Geophys. Res. Lett.*, 42, doi:10.1002/2014GL062285.

Cox, C., V. Walden, G.P. Compo, P.M. Rowe, M. Shupe, and K. Steffen, 2014: Downwelling longwave flux over Summit, Greenland, 2010–2012: Analysis of surface-based observations and evaluation of ERA-Interim using wavelets, *J. Geophys. Res. Atmos.*, 119(21), 12317–12337, doi:10.1002/2014JD021975.

Cox, C.J., D.D. Turner, P.M. Rowe, M.D. Shupe, and V.P. Walden, 2014: Cloud microphysical properties retrieved from downwelling infrared radiance measurements made at Eureka, Nunavut, Canada (2006-2009), *J. Appl. Meteor. Climatol.*, doi: 10.1175/JAMC-D-13-0113.1.

Rowe, P.M., S. Neshyba, and V.P. Walden, 2013: Radiative consequences of low-temperature infrared refractive indices for supercooled water clouds, *Atmos. Chem. Phys.*, 13, 11925-11933, doi: 10.5194/acp-13-11925-2013.

Neshyba, S.P., B. Lowen, M. Benning, A. Lawson, and P.M. Rowe, 2013: Roughness metrics of prismatic facets of ice. *J. Geophys. Res.* (Accepted Jan. 2013, Marked for “Editor Highlight” on the *J. Geophys. Res.* homepage and listed in the Special Research Spotlight of EOS).

Shupe, M., Turner, D. D., Walden, V. P., Bennartz, R., Cadeddu, M. P., Castellani, B. B., Cox, C., D.R. Hudak, M.S. Kulie, N.B. Miller, R.R. Neely, W. Neff, P.M. Rowe, 2013: High and Dry: New Observations of Tropospheric and Cloud Properties above the Greenland Ice Sheet, *B. Am. Meteorol. Soc.*, 169-186, DOI 10.1175/BAMS-

D-11-00249.1.

Cox, C.J., V.P. Walden, and P.M. Rowe, 2012: A comparison of the atmospheric conditions at Eureka, Canada and Barrow, Alaska (2006-2008), *J. Geophys. Res.*, 117, D12204 doi: 10.1029/2011JD017164.

Mariani, Z, K. Strong, M. Wolff, P. Rowe, V. Walden, P.F. Fogal, T. Duck, G. Lesins, D.S. Turner, C. Cox, E. Eloranta, J.R. Drummond, C. Roy, D.D. Turner, D. Hudak, and I.A. Lindenmaier, 2012: Infrared measurements in the Arctic using two Atmospheric Emitted Radiance Interferometers, *Atmos. Meas. Tech.*, 5, 329-344; doi:10.5194/amt-5-329-2012.

Rowe, P.M., S. Neshyba, and V.P. Walden, 2011: Responsivity-based criterion for accurate calibration of FTIR emission spectra: Theoretical development and bandwidth estimation, *Optics Express*, 19 (7), 5930-5941; doi:10.1364/OE.19.005930. (See www.opticsinfobase.org/abstract.cfm?uri=oe-19-7-5930.)

Rowe, P.M., S. Neshyba, C.J. Cox, and V.P. Walden, 2011: A responsivity-based criterion for low noise in FTIR emission spectra: Identification of in-band low-responsivity wavenumbers, *Optics Express*, 19 (6), 5451-5463; doi: 10.1364/OE.19.005451. (See www.opticsinfobase.org/abstract.cfm?uri=oe-19-6-5451.)

Walden, V.P., R.L. Tanamachi, P.M. Rowe, H.E. Revercomb, D.C. Tobin, and S.A. Ackerman, 2010: Improvements in the data quality of the Interferometric Monitor of Greenhouse Gases, *Appl. Opt.*, 49, 520-528, doi: 10.1364/AO.49.000520.

Rowe, P., and V.P. Walden, 2009: Improved measurements of the foreign-broadened continuum of water vapor in the 6.3 mm band at -30°C, *Appl. Opt.*, 48, 1358-1365, doi: 10.1364/AO.48.001358.

Rowe, P., L.M. Miloshevich, D.D. Turner, and V.P. Walden 2008: Dry bias in radiosonde humidity profiles over Antarctica, *J. Atmos. Ocean. Tech.*, 25, 1529-1541, doi: 10.1175/2008JTECHA1009.1

Rowe, P., V.P. Walden, and S.G. Warren, 2006: Measurements of the foreign-broadened continuum of water vapor in the 6.3- μm band at -30 C, *Appl. Opt.*, 45 (18), 4366-4382, doi: 10.1364/AO.45.004366.

Rowe, P. M., 2004: Measurements of the Foreign-Broadened Continuum of Water Vapor in the 6.3 micron band at -30 Celsius. University of Washington, Seattle, Washington, 278 pp.

Rathke, C, S. Neshyba, M. D. Shupe, P. Rowe, and A. Rivers, 2002: Radiative and microphysical properties of Arctic stratus clouds from multiangle downwelling infrared

radiances, *J. Geophys. Res. A.* 107(D23), 4703, doi:10.1029/2001JD001545 (2002).

Educational Materials

- Polar ENgagement through GUIded INquiry (PENGUIN) modules that use Jupyter Notebooks or Excel Worksheets to give undergraduate students hands-on experience obtaining and working with polar research and data: <https://serc.carleton.edu/penguin>
- PENGUIN modules for the High School level: https://people.nwra.com/rowe/penguin_high_general.shtml
- Modelling the spread of COVID-19: <https://www.kaggle.com/pennyrowe/modeling-spread-covid-19>
- Numerous other computational modules: <https://www.kaggle.com/pennyrowe/notebooks>
- Educational module illustrating cloud-property inverse retrievals from infrared spectra: <https://bitbucket.org/cgigroup/greybodyretrieval>.

Contributed Datasets and Computer code

- Code for calling the Discrete Ordinates Radiative Transfer (DISORT) program:
Python: https://bitbucket.org/clarragroup/rundisort_py
Matlab/Octave: https://bitbucket.org/clarragroup/rundisort_mat
- Code for computing cloudy-sky downwelling infrared radiances using LBLRTM and DISORT: https://bitbucket.org/clarragroup/run_lblrtm_disort/ https://bitbucket.org/clarragroup/rundisort_py
- Temperature-dependent refractive indices of liquid water: https://people.nwra.com/rowe/refractive_indices.shtml
- Temperature-dependent single-scattering properties of liquid water: https://people.nwra.com/rowe/single_scatter.shtml
- Simulated line-by-line clear and cloudy sky infrared radiances for atmospheric profiles characteristic of the Arctic (available on request).

Research Mentoring Experience

Danielle Dolan and Anna Van Boven: Developed a module applying statistics to ice core data for the project Polar ENgagement through GUIded INquiry (PENGUIN). Summer 2021.

Led one of the first virtual summer research experience for undergraduate (REU) programs of the National Science Foundation, with 14 students. Mentored Isabella Hedly, Anoushka Adhav, Augustin Kalytiak-Davis, Reid O'Brien, Cameron Markovsky, Jodie McClennan, and Lydia Gilbert. Summer 2020.

Katie Gray and Emma Sevier: Computational Guided Inquiry for bringing polar data into undergraduate classrooms. Summer 2018.

Mathew Fergoda: Infrared radiance of Antarctic Clouds. Summers 2017 and 2018.

Connor Krill: Infrared radiance of Antarctic Clouds. Summer 2017.

Aedin M. Wright: Temperature inversions in radiosoundings and Computational Guided Inquiry for bringing polar data into undergraduate classrooms. October 2016 – August 2018.

Edgardo Sepulveda: Clouds and atmospheric structure over King George Island, Antarctica. March 2016 – current.

U.S. and Chilean graduate and undergraduate students: Snow sampling and filtering for black carbon in the Chilean Andes, Austral winters 2015, 2017. U.S. students include Alec Pankow and Emily Stewart of the University of Puget Sound.

Alessio Spassiani: NSERCE CREATE Undergraduate Summer Internship, June - August 2011.

Public Outreach

STEM Career fair panelist at Sammamish High School, Bellevue, WA, (2017, 2018, and 2019).

Organized and implemented Spanish language translation for High-Adventure Science online educational module (HAS.concord.org; “What is the Future of Earth’s Climate?”) (Completed 2018).

Participated in the Pacific Science Center Polar Science Weekend with an exhibit “Where is the Polar Front?” Seattle, WA (2015)

Participated in the University of Puget Sound Art+Science salon hosted by the Tacoma Art Museum, Tacoma, WA (2013)

Judge for the Bryant Middle School Science Fair (2011, 2012, 2014, 2015)

Guest Lectures

- Applying Statistics to Polar Research, University of Puget Sound (Undergraduate), Tacoma, WA, 6 talks over two weeks in 2 classes, 2021.
- “Evaluating an Environmental Impact Statement: the Tacoma LNG Plant”, University of Puget Sound (Undergraduate), Tacoma, WA, 2020, 2021.
- “The Greenhouse Effect and Climate Change,” Seabury Middle School, Tacoma, WA, Oct. 11, 2016.
- “Climate Change and Atmospheric Science in the Cryosphere,” Colegio Aleman de Valparaiso (High School), Vina del Mar, Chile, June 20, 2016.
- “Infrared Spectra of Clouds and Greenhouse Gases”, Sammamish High School (High School chemistry class), Bellevue, WA, 2013.
- “Infrared Spectra of Clouds and Greenhouse Gases”, University of Puget Sound (Undergraduate chemistry class), Tacoma, WA, 2013.
- “Cloud in a jar,” Bryant Elementary (elementary class), Tacoma, WA, 2012.

Invited Science Talks

- Cloud property retrievals from downwelling infrared radiances from polar atmospheres, Seminar on Physics and Chemistry of the Atmosphere, SoSe 2021, Institute of Environmental Physics (IUP) Bremen, Germany, May 218, 2021.
- Retrievals of polar cloud properties from infrared radiance spectra, Thompson Hall Science and Mathematics Seminars, University of Puget Sound, September 19, 2013.
- Importance of new Temperature-Dependent Refractive Indices of Water for Simulated Thermal Emission from Super-Cooled Liquid Water Clouds, Noble Seminar Series. Reginald and Murial Noble Fund, University of Toronto Atmospheric Physics Group, November 5, 2012.

In the Media

- Twitter feed for NorthWest Research Associates: https://twitter.com/NWRA_science
- Twitter feed for Antarctic Research Group of the University of Santiago: <https://twitter.com/Antarcticacl>.
- Article in the Chilean Antarctic Bulletin special edition “Women of Antarctic Climate Change” (Spanish): Olas de Calor en la Antártica?, Feron, S. and Rowe, P.M. (2021) 40(2), 29-31.
- Year of Polar Prediction (YOPP) PolarPredict News Newsletter #4: Describes YOPP-endorsed project: Characterization of Low Clouds and the Atmosphere over the Antarctic Peninsula and West Antarctic Ice Sheet (CAALC): https://www.polarprediction.net/fileadmin/user_upload/www.polarprediction.net/Home/News/PolarPredictNews/PolarPredictNews04_final.pdf, Nov 2017.
- Sampling black carbon in the Chilean Andes: Chilean articles about campaigns sampling soot in snow in the Chilean Andes:
 - Primer diagnóstico sobre efecto de la contaminación en la nieve de la Cordillera de Los Andes, in Centro de Estudios Avanzados en zonas aridas (<http://www.ceaza.cl/2018/04/30/primer-diagnostico-efecto-la-contaminacion-la-nieve-la-cordillera-los-andes/>), 30 April 2018.
 - Incluida la Región de Coquimbo: Científicos estudian niveles de carbón presentes en la nieve de la Cordillera de Los Andes, in Centro de Estudios Avanzados en zonas aridas (Ceaza.cl), 21 July 2015.
- Antarctic research at King George Island near the northern end of the Antarctic Peninsula
 - Participation in the Chilean Antarctic School Trip in 2018 (in Spanish): EXPEDICIÓN ANTÁRTICA ESCOLAR: UNA EXPERIENCIA ÚNICA (<https://www.radiofestival.cl/expedicion-antartica-escolar-una-experiencia-unica/> and http://www.radiopolar.com/noticia_146739.html), Dec 2018.
 - Article with a picture of research student Edgardo Sepulveda: La información que entregan las nubes de la península antártica en isla Rey Jorge, in La Prensa Austral, <https://laprensaaustral.cl/ciencia/la-informacion-que-entregan-las-nubes-de-la-peninsula-antartica-en-isla-rey-jorge/>, Jan 2018.

- Article with interview of research student Edgardo Sepulveda: Explorando la Antártica: las investigaciones que ayudan a entender el cambio climático, in El Definido (<https://www.eldefinido.cl/actualidad/pais/9459/Explorando-la-Antartica-las-investigaciones-que-ayudan-a-entender-el-cambio-climatico/>), Jan 2018.