Dr. Robert R. Nelson

Algorithm Scientist
Jet Propulsion Laboratory, California Institute of Technology
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RELEVANT EXPERIENCE

Dr. Nelson is an algorithm scientist in the JPL Tropospheric Composition group and on the Orbiting Carbon Observatories (OCO-2/3) and Multi-angle Imaging SpectroRadiometer (MISR) Science Teams. He spent his graduate career and postdoctoral fellowship investigating ways to improve the accuracy and precision of near-infrared carbon dioxide retrievals from space-based instruments, with a focus on the impact of clouds and aerosols. His research objectives include improving atmospheric gas and aerosol retrieval algorithms, detecting and quantifying small-scale greenhouse gas sources, and developing novel products from space-based measurements. He leads CO_2 algorithm development within the JPL OCO-3 team and is a key member of the OCO-2 algorithm team, and helped lead the development of versions 10 and 11 of the OCO-2/3 ACOS XCO_2 retrieval algorithm.

EDUCATION

• **Ph.D.**, Atmospheric Science (Colorado State University, Fort Collins, CO)	4.00 GPA	2019
• **M.S.**, Atmospheric Science (Colorado State University, Fort Collins, CO)	3.98 GPA	2015
• **B.S.**, Meteorology (Iowa State University, Ames, IA)	3.92 GPA	2012

RESEARCH AND PROFESSIONAL EXPERIENCE

Algorithm Scientist, NASA Jet Propulsion Laboratory 2021-Present
- Contributing to the development of the OCO-2 and OCO-3 carbon dioxide and MISR aerosol retrieval algorithms as a member of the Tropospheric Composition group.

Postdoctoral Researcher, NASA Jet Propulsion Laboratory 2019-2021
- Helped advance the OCO-2 and OCO-3 carbon dioxide and MISR aerosol retrieval algorithms working under the guidance of Dr. Annmarie Eldering.

Graduate Research Assistant, Colorado State University 2012–2019
- Worked under Dr. Christopher O'Dell on the development and improvement of carbon dioxide retrieval algorithms. Took Ph.D. level courses, primarily on radiative transfer and remote sensing topics.

American Meteorological Society Local Chapter Treasurer & Webmaster 2014–2016
- Various responsibilities as an elected officer of FORT Collins Atmospheric ScientisTs (FORTCAST).

Senior Thesis, Iowa State University Fall 2011
- Analyzed the presence of the Madden-Julian Oscillation in the Iowa State University Global Climate Model using a variety of analytic techniques.

Research Intern, University of Oklahoma Summer 2011
- Compared cloud climatologies from MODIS imagery to mesoscale models to assess systematic differences in cloudiness.

American Meteorological Society Student Chapter President, Iowa State University May 2011–2012

- Led our chapter of the AMS through the 2011-2012 academic year. Responsibilities included organizing educational outreach, fundraising, and promoting both our local and the national AMS chapters.

Research Intern, University of Michigan Summer 2010
- Researched synoptic and mesoscale influences on mercury wet deposition.

Honors Mentor Program, Iowa State University Fall 2008
- Created self-organizing maps from North American Regional Climate Change Assessment Program (NARCCAP) data.

TECHNICAL EXPERTISE

- Python, Git, LaTeX, Unix, Adobe Photoshop, Microsoft Office. Experience with IDL, MATLAB, FORTRAN, and NCL.

RECOGNITION

- JPL Team Award (OCO-3/EMIT Power Plant Study Team) 2025
- JPL Team Award (Earth Science Senior Review Team) 2023
- JPL Team Award (OCO-3 Geolocation Team) 2023
- JPL Voyager Award (OCO-3 SAMs) 2022
- JPL Team Award (OCO-2 & OCO-3 B10 Development) 2020
- JPL Voyager Award (OCO-3 IOC) 2019
- American Meteorological Society Graduate Fellowship Recipient 2012–2013
- Phi Beta Kappa Honors Society, Iowa State University 2011–2012
- Ernest F. Hollings Scholar, NOAA 2010–2012
- University Honors Program, Iowa State University 2008–2012

TEACHING

Summer School for Inverse Modeling of Greenhouse Gases (SSIM-GHG) June 2024
- Co-instructor for trace gas retrievals

Colorado State University Atmospheric Radiation Teaching Assistant Spring 2015
- Assisted Dr. Chris O'Dell in teaching Atmospheric Radiation by grading assignments, creating homework and test questions and modules, and helping students succeed.

Colorado State University Programming Teaching Assistant Spring 2014
- Assisted students with programming problems in multiple languages including MATLAB, IDL, Python, FORTRAN, and NCL.

Iowa State University Freshman Honors Program Leader Fall 2009
- Led a diverse group of students toward completing common goals. Learned how to effectively prepare syllabi, manage class time, and successfully motivate students.

PUBLICATIONS

Nelson, R. R., Kulawik, S. S., O'Dell, C., McDuffie, J., and Eldering, A.: Improving OCO-2 XCO_2 retrievals through the scaling of singular value decomposition-based temperature and water vapor profiles, *Earth Space Sci.*, 12, e2024EA003975, doi:10.1029/2024EA003975, 2025.

Virtanen, T. H., Sundström, A.-M., Suhonen, E., Lipponen, A., Arola, A., O'Dell, C., **Nelson, R. R.**, and Lindqvist, H.: A global perspective on CO2 satellite observations in high AOD conditions, *Atmos. Meas. Tech.*, 18, 929–952, doi:10.5194/amt-18-929-2025, 2025.

Moeini, O., Nassar, R., Mastrogiacomo, J.-P., Dawson, M., O'Dell, C. W., **Nelson, R. R.**, Chatterjee, A.: Quantifying CO2 emissions from smaller anthropogenic point sources using OCO-2 target and OCO-3 snapshot area mapping mode observations, *J. Geophys. Res. Atmos.*, 130, doi:10.1029/2024JD042333, 2025.

Nelson, R. R., Cusworth, D. H., Thorpe, A. K., Kim, J., Elder, C. D., Nassar, R., and Mastrogiacomo, J.-P.: Comparing point source CO_2 emission rate estimates from near-simultaneous OCO-3 and EMIT observations, *Geophys. Res. Lett.*, 51, doi:10.1029/2024GL113002, 2024.

Cusworth, D. H., Thorpe, A. K., Miller, C. E., Ayasse, A. K., Jiorle, R., Duren, R. M., Nassar, R., Mastrogiacomo, J.-P., and **Nelson, R. R.**: Two years of satellite-based carbon dioxide emission quantification at the world's largest coal-fired power plants, *Atmos. Chem. Phys.*, 23, 14577–14591, doi:10.5194/acp-23-14577-2023, 2023.

Nelson, R. R., Witek, M. L., Garay, M. J., Bull, M. A., Limbacher, J. A., Kahn, R. A., Diner, D. A.: Improving the coverage of MISR aerosol retrievals over shallow, turbid, and eutrophic waters, *Atmos. Meas. Tech.*, 16, 4947–4960, doi:10.5194/amt-16-4947-2023, 2023.

Taylor, T. E., O'Dell, C. W., Baker, D., Bruegge, C., Chang, A., Chapsky, L., Chatterjee, A., Cheng, C., Chevallier, F., Crisp, D., Dang, L., Drouin, B., Eldering, A., Feng, L., Fisher, B., Fu, D., Gunson, M., Haemmerle, V., Keller, G. R., Kiel, M., Kuai, L., Kurosu, T., Lambert, A., Laughner, J., Lee, R., Liu, J., Mandrake, L., Marchetti, Y., McGarragh, G., Merrelli, A., **Nelson, R. R.**, Osterman, G., Oyafuso, F., Palmer, P. I., Payne, V. H., Rosenberg, R., Somkuti, P., Spiers, G., To, C., Wennberg, P. O., Yu, S., Zong J.: Evaluating the consistency between OCO-2 and OCO-3 XCO_2 estimates derived from the NASA ACOS version 10 retrieval algorithm, *Atmos. Meas. Tech.*, 16, 3173–3209, doi:10.5194/amt-16-3173-2023, 2023.

Bell, E., O'Dell, C. W., Taylor, T. E., Merrelli, A., **Nelson, R. R.**, Kiel, M., Eldering, A., Rosenberg, R., Fisher, B.: Exploring bias in OCO-3 Snapshot Area Mapping mode via geometry, surface, and aerosol effects, *Atmos. Meas. Tech.*, 16, 109–133, doi:10.5194/amt-2022-241, 2023.

Nassar, R., Moeini, O., Mastrogiacomo, J. P., O'Dell, C. W., **Nelson, R. R.**, Kiel, M., Chatterjee, A., Eldering, A. and Crisp, D.: Tracking CO_2 emission reductions from space: A case study at Europe's largest fossil fuel power plant, *Front. Remote Sens.*, 3, 98, doi:10.3389/frsen.2022.1028240, 2022.

Wu, D., Liu, J., Wennberg, P. O., Palmer, P. I., **Nelson, R. R.**, Kiel, M., Eldering, A.: Towards sector-based attribution using intra-city variations in satellite-based emission ratios between CO2 and CO, *Atmos. Chem. Phys.*, 22, 14547–14570, doi:10.5194/acp-2021-1029, 2022.

Taylor, T. E., O'Dell, C. W., Crisp, D., Kuze, A., Lindqvist, H., Wennberg, P. O., Chatterjee, A., Gunson, M., Eldering, A., Fisher, B., Kiel, M., **Nelson, R. R.**, Merrelli, A., Osterman, G., Chevallier, F., Palmer, P. I., Feng, L., Deutscher, N. M., Dubey, M. K., Feist, D. G., García, O. E., Griffith, D. W. T., Hase, F., Iraci, L. T., Kivi, R., Liu, C., de Mazière, M., Morino, I., Notholt, J., Oh, Y.-S., Ohyama, H., Pollard, D. F., Rettinger, M., Roehl, C. M., Schneider, M., Sha, M. K., Shiomi, K., Strong, K., Sussmann, R., Té, Y., Velazco, V. A., Vrekoussis, M., Warneke, T., Wunch, D.: An eleven year record of XCO_2 estimates derived from GOSAT measurements using the NASA ACOS version 9 retrieval algorithm, *Earth Syst. Sci. Data*, 14, 325–360, doi:10.5194/essd-14-325-2022, 2022.

Nelson, R. R., Eldering, A., Crisp, D., Merrelli, A. J., O'Dell., C. W.: Retrieved wind speed from the Orbiting Carbon Observatory-2, *Atmos. Meas. Tech.*, 13, 6889-6899, doi:10.5194/amt-13-6889-2020, 2020.

Johnson, M. S., Schwandner, F. M., Potter, C. S., Nguyen, H. M., Bell, E., **Nelson, R. R.**, Philip, S., O'Dell, C. W.: Carbon dioxide emissions during the 2018 Kilauea volcano eruption estimated using OCO-2 satellite retrievals, *Geophys. Res. Lett.*, 47, e2020GL090507, doi:10.1029/2020GL090507, 2020.

Taylor, T. E., Eldering, A., Merrelli, A., Kiel, M., Somkuti, P., Cheng C., Rosenberg, R., Fisher, B., Crisp, D., Basilio, R., Bennett, M., Cervantes, D., Chang, A., Dang, L., Frankenberg, C., Haemmerle, V. R., Keller, G. R., Kurosu, T., Laughner, J. L., Lee, R., Marchetti, Y., **Nelson, R. R.**, O'Dell, C. W., Osterman, G., Pavlick, R., Roehl, C., Schneider, R., Spiers, G., To, C., Wells, C., Wennberg, P. O., Yelamanchili, A., Yu, S.: OCO-3 early mission operations and initial (vEarly) XCO_2 and SIF retrievals, *Remote Sens. Enviro.*, 251, 112032, doi:10.1016/j.rse.2020.112032, 2020.

Sanghavi, S., **Nelson, R.**, Frankenberg, C., Gunson, M.: Aerosols in OCO-2/GOSAT retrievals of XCO_2: an information content and error analysis, *Remote Sens. Environ.*, 251, 112053, doi:10.1016/j.rse.2020.112053, 2020.

Kulawik, S. S., O'Dell, C., **Nelson, R. R.**, and Taylor, T. E.: Validation of OCO-2 error analysis using simulated retrievals, *Atmos. Meas. Tech.*, 12, 5317–5334, doi:10.5194/amt-2018-368, 2019.

Nelson, R. R.: Aerosol parameterizations in space-based near-infrared retrievals of carbon dioxide, doctoral dissertation, Colorado State University, Libraries, 2019.

Nelson, R. R. and O'Dell, C. W.: The Impact of Improved Aerosol Priors on Near-Infrared Measurements of Carbon Dioxide, *Atmos. Meas. Tech.*, 12, 1495–1512, doi:10.5194/amt-12-1495-2019, 2019.

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Nelson, R. R., Crisp, D., Ott, L. E., O'Dell, C. W.: High-accuracy measurements of total column water vapor from the Orbiting Carbon Observatory-2, *Geophys. Res. Lett.*, 43, 12261–12269, doi:10.1002/2016GL071200, 2016.

Nelson, R. R., O'Dell, C. W., Taylor, T. E., Mandrake, L., and Smyth, M.: The potential of clear-sky carbon dioxide satellite retrievals, *Atmos. Meas. Tech.*, 8, 1671–1684, doi:10.5194/amt-9-1671-2016, 2016.

Taylor, T. E., O'Dell, C. W., Frankenberg, C., Partain, P. T., Cronk, H. Q., Savtchenko, A., **Nelson, R. R.**, Rosenthal, E. J., Chang, A. Y., Fisher, B., Osterman, G. B., Pollock, R. H., Crisp, D., Eldering, A., and Gunson, M. R.: Orbiting Carbon Observatory-2 (OCO-2) cloud screening algorithms: validation against collocated MODIS and CALIOP data, *Atmos. Meas. Tech.*, 9, 973–989, doi:10.5194/amt-9-973-2016, 2016.

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Nelson, R. R.: Measuring atmospheric carbon dioxide from space, *Physics Today*, doi:10.1063/PT.5.4006, 2014.