

Dr. Robert R. Nelson
Algorithm Scientist
Jet Propulsion Laboratory, California Institute of Technology
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RELEVANT EXPERIENCE

Rob is an algorithm scientist in the JPL Tropospheric Composition group and on the Orbiting Carbon Observatory (OCO-2/3) and Multi-angle Imaging SpectroRadiometer (MISR) Science Teams. He spent his graduate career and post doc 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 helped lead the development of versions 10 and 11 of the OCO-2/3 ACOS XCO₂ retrieval algorithm.

EDUCATION

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| • 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 |
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RESEARCH AND PROFESSIONAL EXPERIENCE

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| 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 (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

SELECT PRESENTATIONS

- “OCO-3 Snapshot Area Mapping Mode: Early Results”, EGU General Assembly, Virtual 2020
- “Exploring Improvements to the Aerosol Parameterization in the OCO-2 X_{CO_2} Retrieval Algorithm”, AGU Fall Meeting, Washington D.C., USA 2018
- “Using GEOS-5 Aerosols to Inform the OCO-2 CO_2 Retrieval”, IWGGMS, FMI, Helsinki, Finland 2017
- “A Comparison of Aerosol Measurements from OCO-2 and MODIS”, AGU Fall Meeting, San Francisco, CA, USA 2016
- “Total Column Water Vapor from OCO-2”, IWGGMS, Kyoto University, Kyoto, Japan 2016
- “A Comparison of Cloud and Aerosol Measurements from OCO-2 and CALIPSO”, AGU Fall Meeting, San Francisco, CA, USA 2015
- “Aerosol First Guess Sensitivity in the ACOS X_{CO_2} Retrieval Algorithm”, AGU Fall Meeting, San Francisco, CA, USA 2014
- “The Potential of Clear Sky Carbon Dioxide Satellite Retrievals”, IWGGMS, ESA-ESTEC, Noordwijk, Netherlands 2014

- “Comparison of High Resolution Cloud Climatologies From MODIS Imagery and Mesoscale Models”, AMS Annual Meeting, New Orleans, LA, USA 2012
- “The MJO Impact on Global Precipitation: A Comparison Study between ISU GCM and Observation”, Iowa State University Senior Thesis Symposium, Ames, IA, USA 2011

TEACHING

- 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.**, Eldering, A., Kulawik, S. S., O’Dell, C., McDuffie, J.: Reduced OCO-2 XCO₂ errors from the retrieval of additional temperature and water vapor parameters, in prep., 2023.
- 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 XCO₂ 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., Moeni, O., Mastrogiacomo, J. P., O’Dell, C. W., **Nelson, R. R.**, Kiel, M., Chatterjee, A., Eldering, A. and Crisp, D.: Tracking CO₂ 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 XCO₂ 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) XCO₂ and SIF retrievals, *Remote Sens. Environ.*, 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 XCO₂: 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.
- O'Dell, C. W., Eldering, A., Wennberg, P. O., Crisp, D., Gunson, M. R., Fisher, B., Frankenberg, C., Kiel, M., Lindqvist, H., Mandrake, L., Merrelli, A., Natraj, V., **Nelson, R. R.**, Osterman, G. B., Payne, V. H., Taylor, T. E., Wunch, D., Drouin, B. J., Oyafuso, F., Chang, A., McDuffie, J., Smyth, M., Baker, D. F., Basu, S., Chevallier, F., Crowell, S. M. R., Feng, L., Palmer, P. I., Dubey, M., García, O. E., Griffith, D. W. T., Hase, F., Iraci, L. T., Kivi, R., Morino, I., Notholt, J., Ohyama, H., Petri, C., Roehl, C. M., Sha, M. K., Strong, K., Sussmann, R., Te, Y., Uchino, O., and Velazco, V. A.: Improved retrievals of carbon dioxide from Orbiting Carbon Observatory-2 with the version 8 ACOS algorithm, *Atmos. Meas. Tech.*, 11, 6539–6576, doi:10.5194/amt-11-6539-2018, 2018.
- 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.

Nelson, R. R.: The impact of aerosols on space-based retrievals of carbon dioxide, master's thesis, Colorado State University, Libraries, 2015.

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