Dr. Robert R. Nelson

Algorithm Scientist
Jet Propulsion Laboratory, California Institute of Technology
4800 Oak Grove Drive, m/s: 233-300, Pasadena, CA 91109, USA
(763) 354-8411, Robert.R.Nelson@jpl.nasa.gov

RELEVANT EXPERIENCE

Robert 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.

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, some experience with IDL, MATLAB, FORTRAN, and NCL

RECOGNITION

- JPL Team Award (OCO-2, OCO-3)   2020
- JPL Voyager Award (OCO-2, OCO-3)   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_{CO2} 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_{CO2} 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.: Reduced OCO-2 XCO_2 errors from the retrieval of additional temperature and water vapor parameters, in prep., 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*, 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.*, 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.*, 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.*, 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.*, 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.*, 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., O'Dell, C. W.: The Impact of Improved Aerosol Priors on Near-Infrared Measurements of Carbon Dioxide, *Atmos. Meas. Tech.*, 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, https://doi.org/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