

Dr. Aronne Merrelli

Assistant Research Scientist
Climate and Space Sciences and Engineering
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Dr. Merrelli has extensive experience in sensor characterization, radiative transfer, and retrieval algorithm development in passive remote sensing and applications to atmospheric sciences and exoplanet astronomy. His research has focused on the utilization of spectral measurements of both reflected solar and terrestrial thermally emitted radiation. He is currently member of the science and algorithm teams for the NASA Orbiting Carbon Observatory-2 and -3, and Co-I on the NASA Polar Radiant Energy in the Far InfraRed Experiment.

Education:

2012 Ph.D., Atmospheric and Oceanic Sciences, University of Wisconsin–Madison.
Advised by David D. Turner.
2008 M.S., Electro Optics, University of Dayton
1998 B.S., Physics with minor in Mathematics, Carnegie Mellon University

Professional Experience:

2022 – present: Assistant Research Scientist, Climate and Space Sciences and Engineering, University of Michigan, Ann Arbor, MI.
2021 – 2022: Scientist I, Space Science and Engineering Center, Madison WI.
2016 – 2021: Assoc. Researcher, Space Science and Engineering Center, Madison WI.
2014 – 2016: Asst. Researcher, Space Science and Engineering Center, Madison WI.
2013 – 2014: Research Associate, Space Science and Engineering Center, Madison WI.
Postdoctoral position, *advised by Ralf Bennartz.*
2008 – 2012: Graduate Research Assistant, Cooperative Institute for Meteorological Satellite Studies, and Space Science and Engineering Center, Madison WI.
2003 – 2008: Engineer/Scientist, Ball Aerospace & Technologies Corp., Fairborn OH.
2001 – 2003: Systems Engineer, Raytheon Missile Systems, Tucson, AZ.

Peer Reviewed Publications:

Underlined and bolded first authors indicate a supervised graduate student; underlined, bolded and starred first authors indicate undergraduate student.

Jacobs, N., O'Dell, C. W., Taylor, T. E., Logan, T., Byrne, D. et al. (2023) The importance of digital elevation model accuracy in XCO₂ retrievals: improving the OCO-2 ACOS v11 product (in review).

Taylor, T. E., O'Dell, C. W., Baker, D., Bruegge, C., Chang, A. et al. (2023) Evaluating the consistency between OCO-2 and OCO-3 XCO₂ estimates derived from the NASA ACOS

version 10 retrieval algorithm. *Atmospheric Measurement Techniques Discussions*. (in press)
<https://doi.org/10.5194/amt-2022-329>

- Massie, S. T., Cronk, H., Merrelli, A., Schmidt, K. S., & Mauceri, S. (2023) Insights into 3D cloud radiative transfer effects for the Orbiting Carbon Observatory. *Atmospheric Measurement Techniques*. <https://doi.org/10.5194/amt-16-2145-2023>
- Miller, N. B., Merrelli, A., L'Ecuyer, T. S., & Drouin, B. J. (2023). Simulated clear-sky water vapor and temperature retrievals from PREFIRE measurements. *Journal of Atmospheric and Oceanic Technology*. <https://doi.org/10.1175/JTECH-D-22-0128.1>
- Bertossa, C.**, L'Ecuyer, T. S., Merrelli, A., Huang, X., & Chen, X. (2023). A neural-network based cloud mask for PREFIRE and evaluation with simulated observations. *Journal of Atmospheric and Oceanic Technology*. <https://doi.org/10.1175/JTECH-D-22-0023.1>
- Bell, E., O'Dell, C. W., Taylor, T. E., Merrelli, A., Nelson, R. R., Kiel, M., Eldering, A., Rosenberg, R., and Fisher, B. (2023). Exploring bias in the OCO-3 snapshot area mapping mode via geometry, surface, and aerosol effects. *Atmospheric Measurement Techniques*. Volume 16, Issue 1, pp.109-133. <https://doi.org/10.5194/amt-16-109-2023>
- Keller G. R., Rosenberg, R. A., Spiers, G. D., Yu, S., Merrelli, A. et al. (2022). Inflight Radiometric Calibration and Performance of the Orbiting Carbon Observatory 3 for Version 10 Products. *IEEE Transactions on Geoscience and Remote Sensing*, vol. 60, pp. 1-18, 2022, Art no. 5413518, <https://doi.org/10.1109/TGRS.2022.3216825>
- Taylor, T. E., O'Dell, C. W., Crisp, D., Kuze, A., Lindqvist, et al. (2022). An eleven year record of XCO₂ estimates derived from GOSAT measurements using the NASA ACOS version 9 retrieval algorithm. *Earth System Science Data*, Volume 14, Issue 1, pp.325-360. <https://doi.org/10.5194/essd-2021-247>
- He, F., Merrelli, A., L'Ecuyer, T. S., and Turnbull, M. C. (2022) Climate Outcomes of Earth-similar Worlds as a Function of Obliquity and Rotation Rate. *Astrophysical Journal*, Volume 933, 1, 62. <http://doi.org/10.3847/1538-4357/ac6951>
- Miller, N. B., Gunshor, M. M., Merrelli, A. J., L'Ecuyer, T. S., Schmit, T. J. et al. (2022) Imaging Considerations From a Geostationary Orbit Using the Short Wavelength Side of the Mid-Infrared Water Vapor Absorption Band. *Earth and Space Science*, Volume 9, Issue 1. <https://doi.org/10.1029/2021EA002080>
- L'Ecuyer, T. S., Drouin, B. J., Anheuser, J., Grames, M., Henderson, D., et al. (2021). The Polar Radiant Energy in the Far InfraRed Experiment: A New Perspective on Polar Longwave Energy Exchanges. *Bulletin of the American Meteorological Society* Volume 102, Issue 7, p.E1431-E1449. <https://doi.org/10.1175/BAMS-D-20-0155.1>
- Kulie, M. S., Pettersen, C., Merrelli, A. J., Wagner, T. J., Wood, N. B., et al. (2021) Snowfall in the Northern Great Lakes: Lessons Learned from a Multi-Sensor Observatory. *Bulletin of the American Meteorological Society* 1–61, <https://doi.org/10.1175/BAMS-D-19-0128.1>
- Massie, S. T., Cronk, H., Merrelli, A., O'Dell, C., Schmidt, K. S., et al. (2021) Analysis of 3D cloud effects in OCO-2 XCO₂ retrievals. *Atmospheric Measurement Techniques* 14, 1475–1499. <https://doi.org/10.5194/amt-14-1475-2021>

- Taylor, T. E., Eldering, A., Merrelli, A. J., Kiel, M., Somkuti, P. et al. (2020) OCO-3 early mission operations and initial (vEarly) XCO₂ and SIF retrievals. *Remote Sensing of Environment* 251, 112032. <https://doi.org/10.1016/j.rse.2020.112032>
- Payne, V. H., Drouin, B. J., Oyafuso, F., Kuai, L., Fisher, B. M. et al. (2020) Absorption coefficient (ABSCO) tables for the Orbiting Carbon Observatories: Version 5.1. *Journal of Quantitative Spectroscopy and Radiative Transfer* 255, 107217 <https://doi.org/10.1016/j.jqsrt.2020.107217>
- Zeng, Z.-C., Chen, S., Natraj, V., Le, T., Xu, F. et al. (2020) Constraining the vertical distribution of coastal dust aerosol using OCO-2 O₂ A-band measurements. *Remote Sensing of Environment* 236, 111494 <https://doi.org/10.1016/j.rse.2019.111494>
- Pettersen, C., Kulie, M. S., Bliven, L. F., Merrelli, A. J., Petersen, W. A., et al. (2020) A Composite Analysis of Snowfall Modes from Four Winter Seasons in Marquette, Michigan. *Journal of Applied Meteorology and Climatology* 59, 103–124 <https://doi.org/10.1175/JAMC-D-19-0099.1>
- Nelson, R. R., Eldering, A., Crisp, D., Merrelli, A. J. & O'Dell, C. W. (2020) Retrieved wind speed from the Orbiting Carbon Observatory-2. *Atmospheric Measurement Techniques* 13, 6889–6899. <https://doi.org/10.5194/amt-13-6889-2020>
- Merrelli, A., Turnbull, M. C. & L'Ecuyer, T. S. Terran World Spectral Simulator. (2019) *Publications of the Astronomical Society of the Pacific* 131, 054502 <https://doi.org/10.1088/1538-3873/ab0480>
- Pettersen, C., Bennartz, R., Merrelli, A. J., Shupe, M. D., Turner, D. D., Walden, V. P. (2018) Precipitation regimes over central Greenland inferred from 5 years of ICECAPS observations. *Atmospheric Chemistry and Physics*, 18, 4715–4735 <https://doi.org/10.5194/acp-18-4715-2018>
- O'Dell, C. W., Eldering, A., Wennberg, P. O., Crisp, D., Gunson, M. R., et al. (2018) Improved retrievals of carbon dioxide from Orbiting Carbon Observatory-2 with the version 8 ACOS algorithm. *Atmospheric Measurement Techniques* 11, 6539–6576 <https://doi.org/10.5194/amt-11-6539-2018>
- Pettersen, C., Bennartz, R., Kulie, M. S., Merrelli, A. J., Shupe, M. D., and Turner, D. D. (2016) Microwave signatures of ice hydrometeors from ground-based observations above Summit, Greenland. *Atmospheric Chemistry and Physics*, 16, 4743-4756, <https://doi.org/10.5194/acp-16-4743-2016>
- Merrelli, A., R. Bennartz, C. W. O'Dell, T. E. Taylor: Estimating bias errors in the OCO-2 retrieval algorithm caused by 3D radiation scattering from unresolved boundary layer clouds. (2015) *Atmospheric Measurement Techniques* 8, 1641-1656, <https://doi.org/10.5194/amt-8-1641-2015>
- Baum, B. A., P. Yang, A. J. Heymsfield, A. Bansemmer, A. Merrelli, C. Schmitt, and C. Wang (2014) Ice cloud bulk single-scattering property models with the full phase matrix at wavelengths from 0.2 to 100 μm . *Journal of Quantitative Spectroscopy and Radiative Transfer*, 146, 123-139, <https://doi.org/10.1016/j.jqsrt.2014.02.029>
- Turner, D.D., Merrelli, A., Vimont, D. & Mlawer, E.J. (2012) Impact of modifying the longwave water vapor continuum absorption model on community Earth system model simulations,

Journal of Geophysical Research, Atmospheres, vol. 117

<https://doi.org/10.1029/2011JD016440>

- Merrelli, A. & Turner, D.D. (2012) Comparing Information Content of Upwelling Far-Infrared and Midinfrared Radiance Spectra for Clear Atmosphere Profiling", *Journal of Atmospheric and Oceanic Technology*, vol. 29, no. 4, pp. 510-526 <https://doi.org/10.1175/JTECH-D-11-00113.1>
- Tucker, D. L., Kent, S., Richmond, M. W., Annis, J., Smith, J. A., et al. (2006) The Sloan Digital Sky Survey monitor telescope pipeline. *Astronomische Nachrichten* 327, 821-843 <http://dx.doi.org/10.1002/asna.200610655> (2006).
- Zehavi, I., Blanton, M.R., Frieman, J.A., Weinberg, D.H., Mo, H.J., et al., (2002) Galaxy Clustering in Early Sloan Digital Sky Survey Redshift Data. *The Astrophysical Journal* 571, 172. <https://doi.org/10.1086/339893>
- Richards, G.T., Fan, X., Schneider, D.P., Berk, D.E.V., Strauss, M.A., et al., (2001) Colors of 2625 Quasars at $0 < z < 5$ Measured in the Sloan Digital Sky Survey Photometric System. *The Astronomical Journal* 121, 2308. <https://doi.org/10.1086/320392>
- Castander, F. J., Nichol, R. C., Merrelli, A., and the SDSS collaboration (2001) The First Hour of Extragalactic Data of the Sloan Digital Sky Survey Spectroscopic Commissioning: The Coma Cluster. *The Astronomical Journal*, Vol. 121, Issue 5, pp 2331 - 2357 <https://doi.org/10.1086/320384>
- Romer, A. K., Nichol, R. C., Holden, B. P., Ulmer, M. P., Pildis, R. A., Merrelli, A. J., Adami, C., Burke, D. J., Collins, C. A., Metevier A. J., Kron, R. G. and Commons, K. (2000) The Bright SHARC Survey: The Cluster Catalog. *The Astrophysical Journal Supplement Series* 126, 209 <https://doi.org/10.1086/313302>
- Nichol, R. C., Romer, A. K., Holden, B. P., Ulmer, M. P., Pildis, R. A., Adami, C., Merrelli, A. J., Burke, D. J., and Collins, C. A. (1999) The Bright SHARC Survey: *The X-Ray Cluster Luminosity Function*. *The Astrophysical Journal Letters* 521, L21 <https://doi.org/10.1086/312167>

Conference Papers

- “Orbital Trade Study for the PREFIRE Mission”, Drouin, B.J., Kahn, B., Lim, B., Merrelli, A., Nelson, E., Quinn, G., Nagle, F., L’Ecuyer, T., in 2022 IEEE Aerospace Conference (AERO). pp. 1–7. <https://doi.org/10.1109/AERO53065.2022.9843312>
- “Using CALIOP Retrieved Aerosol Parameters to Improve OCO-2 Version 8 Retrievals”, Merrelli, A., Bennartz, R., O’Dell, C., Taylor, T. E. & Cronk, H. American Meteorological Society, 15th Conference on Atmospheric Radiation, Vancouver, Canada (2018).
- “Information content for cloud ice microphysics in the far-infrared radiance spectrum”, A. Merrelli & D. D. Turner: International Radiation Symposium 2012 conference proceedings, Berlin, Germany (2012).

Selected Conference Presentations and Posters

- “Planetary Albedo Partitioning of Earth-Like Exoplanets with Variations in Rotation Periods and Obliquity”, **Tarin-Olivas R.**,* Turnbull, M. C., Colose, C., L’Ecuyer, T., Kane, S., He, F., and Merrelli, A. J. in AGU Fall Meeting Abstracts 2022 P45C-2497 (2022).
- “Photometric variability of Earth, as an Exoplanet Proxy: Insights from DSCOVR and TSS Simulations”, Merrelli, A., Turnbull, M. & L’Ecuyer, T., in American Astronomical Society Meeting Abstracts #233 vol. 233 140.31 (2019).
- “Evaluating XCO₂ Retrievals from OCO-2 with CALIOP-Derived Aerosol Priors”, Merrelli, A. J., Bennartz, R. & O’Dell, C. in AGU Fall Meeting Abstracts vol. 2017 A33G-2467 (2017).
- “Improving XCO₂ Retrievals from OCO₂ by using CALIOP-derived Aerosol Priors”, Aronne Merrelli, R. Bennartz, and C. O’Dell. Poster presentation A41F-0127 at 2016 Fall Meeting, AGU, San Francisco, Calif., (2016).
- “The VIIRS Fast Radiative Transfer Model (VFRTM)”, Aronne Merrelli; B. Baum; P. Yang; and Y. Ding. Poster presentation at the 21st Conference on Satellite Meteorology, American Meteorological Society, Madison, WI. (2016).
- “True Ringing Artifacts in Unapodized FTS Measurements”, Merrelli, Aronne; Tobin, David; Knuteson, Robert; Greenwald, Thomas; Revercomb, Hank. Poster Presentation at International TOVS Study Conference XX, Lake Geneva, Wisconsin (2015).
- “Comparing Cross-track Infrared Sounder Observations with Forward Model Calculations”, Merrelli, Aronne; Tobin, David; Knuteson, Robert; Greenwald, Thomas; Revercomb, Hank. Poster presentation IN13C-3656 at 2014 Fall Meeting, AGU, San Francisco, Calif. (2014).

Review Service

- 2022 – Advances in Atmospheric Sciences, Atmospheric Measurement Techniques
- 2021 – Earth System Science Data
- 2020 – Panelist for NASA review panel (2), AGU JGR-Atmospheres (2)
- 2019 – AGU JGR-Atmospheres
- 2018 – IEEE Transactions on Geoscience and Remote Sensing, AMS Journal of Atmospheric and Oceanic Technology
- 2017 – Panelist for NASA review panel, external reviewer for NASA review panel, Remote Sensing (3), AGU JGR-Atmospheres (2)
- 2016 – AGU JGR-Atmospheres (2)
- 2015 – International Journal of Remote Sensing
- 2014 – PNAS, AMS: Journal of Atmospheric and Oceanic Technology

Technical Experience:

Radiative Transfer Models: VLIDORT, SHDOM, LBLRTM, PCRTM, CRTM, OCO-2 operational model; Co-maintainer of LBLDIS with Dave Turner.

Proficient scientific programming skills in python (primary), MATLAB, IDL
Knowledgeable in FORTRAN, C, Cython

Research Funding

Pending competitive proposals:

2023: Assessing and Mitigating Impacts of Inelastic Scattering on OCO XCO₂ retrievals (PI). Proposal submitted to NASA ROSES element, “Science team for OCO missions”. \$285K, \$234K to PI institution.

2023: Reducing Satellite-measured XCO₂ biases via Optimization of Aerosol Schemes in Physics-based Retrievals. (Co-I, PI: Chris O’Dell, Colorado State University). Proposal submitted to NASA ROSES element, “Science team for OCO missions”. \$55K to Co-I institution.

Current competitive proposals:

2021 – 2024: Library of Terran Worlds: Quantifying Atmospheric and Surface Signatures of Potentially Habitable Earth-Similar Planets Among Nearby Suns (Co-I, PI: Margaret Turnbull, SETI Institute). \$97K to Co-I institution.

2021 – 2024: Reducing Geometry-Dependent OCO XCO₂ Biases to Better Inform SAM-Based Fossil Fuel Flux Inversions, NASA ROSES 2020 (Co-I, PI: Chris O’Dell, Colorado State University). \$98K to Co-I institution.

2019 – 2024: Polar Radiant Energy in the Far InfraRed Experiment, NASA EVI-4 (Co-I, PI: Tristan L’Ecuyer, University of Wisconsin–Madison). \$188K to Co-I institution.

Past competitive proposals:

2018 – 2022: Partial Column XCO₂ and Cloud Property Retrievals for OCO-2 (PI), NASA ROSES 2017. \$360K total budget, \$260K to PI institution.

2015 – 2018: Enhancing OCO-2’s observational capabilities under partly and fully cloudy conditions, NASA ROSES 2014 (Co-I, PI: Ralf Bennartz, University of Wisconsin–Madison). \$489K total budget, \$392 to PI institution.

Current Directed funding:

2020 – 2023 OCO-2/OCO-3 Assess the performance of L2 algorithms, subcontract to NASA JPL, \$150K.

Past Directed funding:

2016 – 2021 Roman Space Telescope (Formerly Wide-Field Infrared Survey Telescope, WFIRST) Coronagraph Science Investigation Team (PI: Maggie Turnbull, SETI Institute), \$514K.

2017 – 2020 OCO-2 Assess the performance of L2 algorithms, subcontract to NASA JPL, \$120K.