High Speed, High Precision Laser Monitors for N_2O, CH_4, COS, NH_3, CO_2 Isotopes and More

Abstract:

We will present recent results using Aerodyne laser trace gas monitors to address important measurement challenges in trace gas exchange between the atmosphere and the Earth’s surface. Aerodyne sensors are designed for fast time response (0.1 seconds when required) and for extremely high measurements precision for a wide variety of greenhouse gases and particle precursor gases.

These capabilities enable sensitive and specific gas flux measurements using a variety of techniques: eddy covariance, surface chamber and gradient fluxmethods, for example. These flux measurements are critical for understanding biosphere-atmosphere interactions and for studying air pollution generated by human activities. We will present recent results involving a wide variety of molecules: N_2O, CH_4, CO, COS, NH_3, HCHO, NO, $NO_2$and the isotopes of carbon dioxide. We will also discuss a variety of measurement techniques including automated sampling systems that use one laser monitor to perform several tasks. For example, one trace gas monitor can perform tower profile measurements, surface chamber flux measurements and eddy flux measurements on an automated, but intelligent and flexible schedule.

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部分文献目录 Partial Publication List – David D. Nelson

Dynamics of canopy stomatal conductance, transpiration, and evaporation in a temperate deciduous forest, validated by carbonyl sulfide uptake, Wehr, Richard, Róisín Commane, J. William Munger, J. Barry McManus, David D. Nelson, Mark S. Zahniser, Scott R. Saleska, and Steven C. Wofsy. *Biogeosciences* 14, no. 2 (2017): 389.

Seasonality of temperate forest photosynthesis and daytime respiration, Wehr, R., J. W. Munger, J. B. McManus, D. D. Nelson, M. S. Zahniser, E. A. Davidson, S. C. Wofsy, and S. R. Saleska Nature 534, no. 7609 (2016): 680-683.

.**Continuous and high-precision atmospheric concentration measurements of COS, CO 2, CO and H 2 O using a quantum cascade laser spectrometer (QCLS)**,Kooijmans, Linda MJ, Nelly AM Uitslag, Mark S. Zahniser, David D. Nelson, Stephen A. Montzka, and Huilin ChenAtmospheric Measurement Techniques 9, no. 11 (2016): 5293-5314.

Surface–atmosphere exchange of ammonia over peatland using QCL-based eddy-covariance measurements and inferential modeling, Zöll, Undine, Christian Brümmer, Frederik Schrader, Christof Ammann, Andreas Ibrom, Christophe R. Flechard, David D. Nelson,

Mark Zahniser, and Werner L. Kutsch. Atmospheric Chemistry and Physics 16, no. 17 (2016): 11283-11299.

Dynamics of Ammonia Volatilisation Measured by Eddy Covariance During Slurry Spreading in North Italy, Rossana Monica Ferrara, Marco Carozzi, Paul Di Tommasi, David D. Nelson, Gerardo Fratini, Teresa Bertolini, Vincenzo Magliulo, Marco Acutis, Gianfranco Rana, Agriculture, Ecosystems & Environment, 219, 1-13, 2016.

New Approaches to Measuring Sticky Molecules: Improvement of Instrumental Response Times Using Active Passivation, J. R. Roscioli, M. S. Zahniser, D. D. Nelson, S. C. Herndon, C. E. Kolb, J. Phys. Chem. A, (Web): June 24, 2015.

Recent progress in laser-based trace gas instruments: performance and noise analysis, J. B. McManus, M. S. Zahniser, D. D. Nelson, J. H. Shorter, S. C. Herndon, D. Jervis, M. Agnese, R. McGovern, T. I. Yacovitch, J. R.Roscioli, Appl. Phys. B: Lasers Opt., 119, 203-218, 2015.

Design and performance of a dual-laser instrument for multiple isotopologues of carbon dioxide and water, J. B. McManus, D. D. Nelson, M. S. Zahniser, Opt. Express, 23, 6569-6586, 2015.

Development and field testing of a rapid and ultra-stable atmospheric carbon dioxide spectrometer,
B. Xiang, D. D. Nelson, J. B. McManus, M. S. Zahniser, R. A. Wehr, S. C. Wofsy, Atmos. Meas. Tech., 7, 4445-4453, 2014.

Feasibility and Potential Utility of Multicomponent Exhaled Breath Analysis for Predicting Development of Radiation Pneumonitis after Stereotactic Ablative Radiotherapy, J. M. Moré, N. C.W. Eclov, M. P. Chung, J. F. Wynne, J. H. Shorter, D. D. Nelson, A. L. Hanlon, R. Burmeister, P. Banos, P. G. Maxim, B. W. Jr Loo, M. Diehn, J. Thorac. Oncol., 9, 957-964, 2014.

Demonstration of an Ethane Spectrometer for Methane Source Identification, T. I. Yacovitch, S. C. Herndon, J. R. Roscioli, C. Floerchinger, R. M. McGovern, M. Agnese, G. Pétron, J. Kofler, C. Sweeney, A. Karion, S. A. Conley, E. A. Kort, L. Nähle, M. Fischer, L. Hildebrandt, J. Koeth, J. B. McManus, D. D. Nelson, M. S. Zahniser, C. E. Kolb, Environ. Sci. Technol., 48, 8028-8034, 2014.

Measurement of a doubly substituted methane isotopologue, $^{13}CH_3D$, by tunable infrared laser direct absorption spectroscopy, S. Ono, D. T. Wang, D. S. Gruen, B. S. Lollar, M. S. Zahniser, B. J. McManus, D. D. Nelson, Anal. Chem., 86, 6487–6494, 2014.

Greenhouse gas budget (CO_2, CH_4 and N_2O) of intensively managed grassland following restoration, L. Merbold, W. Eugster, J. Stieger, M. Zahniser, D. Nelson, N. Buchmann, Global Change Biol., 20, 1913–1928, 2014.

Evaluation of the airborne quantum cascade laser spectrometer (QCLS) measurements of the carbon and greenhouse gas suite – CO_2, CH_4, N_2O, and CO – during the CalNex and

HIPPO campaigns, G. W. Santoni, B. C. Daube, E. A. Kort, R. Jiménez, S. Park, J. V. Pittman, E. Gottlieb, B. Xiang, M. S. Zahniser, D. D. Nelson, J. B. McManus, J. Peischl, T. B. Ryerson, J. S. Holloway, A. E. Andrews, C. Sweeney, B. Hall, E. J. Hintsa, F. L. Moore, J. W. Elkins, D. F. Hurst, B. B. Stephens, J. Bent, and S. C. Wofsy, Atmos. Meas. Tech., 7, 1509-1526, 2014.

Measurement of a doubly substituted methane isotopologue, $^{13}CH_3D$, by tunable infrared laser direct absorption spectroscopy, S. Ono, D. T. Wang, D. S. Gruen, B. S. Lollar, M. S. Zahniser, B. J. McManus, D. D. Nelson, Anal.Chem, (Web): June 4, 2014.

Development of a Spectroscopic Technique for Continuous Online Monitoring of Oxygen and Site-Specific Nitrogen Isotopic Composition of Atmospheric Nitrous Oxide, E. Harris, D. D. Nelson, W. Olszewski, M. Zahniser, K. E. Potter, B. J. McManus, A. Whitehill, R. G. Prinn, S. Ono, Anal. Chem., 86, 1726–1734, 2014.

Urban measurements of atmospheric nitrous acid: A caveat on the interpretation of the HONO photostationary state, B. H. Lee, E. C. Wood, S. C. Herndon, B. L. Lefer, W. T. Luke, W. H. Brune, D. D. Nelson, M. S. Zahniser, J. W. Munger, J. Geophys. Res. Atmos., 118, 12,274–12,281, doi:10.1002/2013JD020341 2013.

Carbonyl sulfide in the planetary boundary layer: Coastal and continental influences, R. Commane, S. C. Herndon, M. S. Zahniser, B. M. Lerner, J. B. McManus, J. W. Munger, D. D. Nelson, S. C. Wofsy, JGR, Atmos. 118, Issue 14, 8001–8009, DOI:10.1002/jgrd.5058, *2013.*

Long-term eddy covariance measurements of the isotopic composition of the ecosystem–atmosphere exchange of CO_2 in a temperate forest, R. Wehr, J. W. Munger, D. D. Nelson, J. B. McManus, M. S. Zahniser, S. C. Wofsy, S. R. Saleska, Agric. For. Meteorol., 181, 69-84, 2013.

Towards a stable and absolute atmospheric carbon dioxide instrument using spectroscopic null method, B. Xiang, D. D. Nelson, J. B. McManus, M. S. Zahniser, S. C. Wofsy, Atmos. Meas. Meas. Tech., 6, 1611-1621, 2013.

Selective measurements of NO, NO2 and NOy in the free troposphere using quantum cascade laser spectroscopy, B. Tuzson, K. Zeyer, M. Steinbacher, J. B. McManus, D. D. Nelson, M. S. Zahniser, L. Emmenegger, Atmos. Meas. Tech. Discuss., 5, 8969–8993, 2012.

Application of the carbon balance method to flare emissions characteristics, S. C. Herndon, D. D. Nelson, Jr., E. C. Wood, W. B. Knighton, C. E. Kolb, Z. Kodesh, V. M. Torres, D. T. Allen, Ind. Eng. Chem. Res., 51, 12577-12585, 2012.

Mass fluxes and isofluxes of methane (CH4) at a New Hampshire fen measured by a continuous wave quantum cascade laser spectrometer. G. W. Santoni, B. H. Lee, J. P. Goodrich, R. K. Varner, P. M. Crill, J. Barry McManus, D. D. Nelson, M. S. Zahniser, S. C. Wolfsy, JGR 117, D10301, doi:10.1029/2011JD016960, 15pp., 2012.

Monomer, clusters, liquid: an integrated spectroscopic study of methanol condensation, H. Laksmono, S.Tanimura, H. C. Allen, G. Wilemski, M. S. Zahniser, J. H. Shorter, D. D. Nelson, J. B. McManus, B. E. Wyslouzil, Phys. Chem. Chem. Phys., 13, 5855-5871, 2011.

Dual quantum cascade laser trace gas instrument with astigmatic Herriott cell at high pass number, J. B. McManus, M. S. Zahniser, D. D. Nelson, Appl. Opt., 50, A74-A84, 2011.

Application of quantum cascade lasers to high-precision atmospheric trace gas measurements, J. B. McManus, M. S. Zahniser, D. D. Nelson Jr., J. H. Shorter, S. Herndon, E. Wood, F. Wehr, Opt. Eng. 49, 111124, 2010.

Multicomponent breath analysis with infrared absorption using room-temperature quantum cascade lasers, J. H. Shorter, D. D. Nelson, J. Barry McManus, M. S. Zahniser, D. K. Milton, IEEE Sensors J., 10, 76-84, 2010.

Long-term continuous sampling of $^{12}CO_2$, $^{13}CO_2$ and $^{12}C^{18}O^{16}O$ in ambient air with a quantum cascade laser spectrometer, J. B. McManus, D. D. Nelson, M. S. Zahniser, Isot. Environ. Health Stu. 46, 49-63, 2010.

High precision measurements of atmospheric concentrations and plant exchange rates of carbonyl sulfide using mid-IR quantum cascade laser, K. Stimler, D. Nelson, D. Yakir, Glob. Change Biol. 16, 2496-2503, 2010.

Comparison of emissions from on-road sources using a mobile laboratory under various driving and operational sampling modes, M. Zavala, S. C. Herndon, E. C. Wood, J. T. Jayne, D. D. Nelson, A. M. Trimborn, E. Dunlea, W. B. Knighton, A. Mendoza, D. T. Allen, C. E. Kolb, M. J. Molina, and L. T. Molina, Atmos. Chem. Phys., 9, 1-14, 2009.

ACRP Report 7: Aircraft and Airport-Related Hazardous Air Pollutants: Research Needs and Analysis, E. Wood, S. Herndon, R. C. Miake-Lye, D. Nelson, M. Seeley, 65p. (2008). Airport Cooperative Research Program, Transportation Research Board, Washington, DC

High precision and continuous field measurements of $\delta^{13}C$ and $\delta^{18}O$ in carbon dioxide with a cryogen-free QCLAS, B. Tuzson, J. Mohn, M. J. Zeeman, R. A. Werner, W. Eugster, M. S. Zahniser, D. D. Nelson, J. B. McManus, L. Emmenegger, Appl. Phys. B, DOI: 10.1007/s00340-008-3085-4, 2008.

Pulsed quantum cascade laser instrument with compact design for rapid, high sensitivity measurements of trace gases in air, J. B. McManus, J. H. Shorter, D. D. Nelson, M. S. Zahniser, D. E. Glenn, R. M. McGovern, Appl. Phys. B., 92, 387-392, 2008.

New method for isotopic ratio measurements of atmospheric carbon dioxide using a 4.3 μm pulsed quantum cascade laser, D. D. Nelson, J. B. McManus, S. C. Herndon, M. S. Zahniser, B. Tuzson, L. Emmenegger, Appl. Phys. B, 90, 301-310, 2008. Special Issue: 6th International Conference on tunable laser spectroscopy.

Tunable diode laser absorption spectroscopy study of CH_3CH_2OD/D_2O binary condensation in a supersonic Laval nozzle, S. Tanimura, B. E. Wyslouzil, M. S. Zahniser, J. H. Shorter, D. D. Nelson, J. B. McManus, J. Chem.Phys. 127, 034305 (13), 2007.

Towards realization of reactive gas amount of substance standards through spectroscopic measurements, P. M. Chu, D. D. Nelson, Jr., M. S. Zahniser, J. B. McManus, Q. Shi, J. C. Travis, IEEE T. Instrum. Meas., 56, 305-308, 2007.

Evaluation of nitrogen dioxide chemiluminescence monitors in a polluted urban environment, E. J. Dunlea, S. C. Herndon, D. D. Nelson, R. M. Volkamer, F. San Martini, P. M. Sheehy, M. S. Zahniser, J. H. Shorter, J. C. Wormhoudt, B. K. Lamb, E. J. Allwine, J. S. Gaffney, N. A. Marley, M. Grutter, C. Marquez, S. Blanco, B. Cardenas, A. Retama, C. R. Ramos Villegas, C. E. Kolb, L. T. Molina1, M. J. Molina, Atmos. Chem. Phys., 7, 2691–2704, 2007.

Airborne measurements of HCHO and HCOOH during the New England Air Quality Study 2004 using a pulsed quantum cascade laser spectrometer, S.C. Herndon, M.S. Zahniser, D.D. Nelson Jr., J. Shorter, J.B. McManus, R. Jiménez, C. Warneke, J.A. DeGouw, J. Geophys. Res., 112, D10S03, doi:10.1029/2006JD007600, 2007.

Comparison of cw and pulsed operation with a TE-cooled quantum cascade infrared laser for detection of nitric oxide at 1900cm^{-1}, J.B. McManus, D.D. Nelson, S.C. Herndon, J.H. Shorter, M.S. Zahniser, S. Blaser, L. Hvozdara, A. Muller, M. Giovannini, J. Faist, Appl. Phys B, 85, 235-241, 2006.

Characterization of a near-room-temperature, continuous-wave quantum cascade laser for long-term, unattended monitoring of nitric oxide in the atmosphere, DD. Nelson, J.B. McManus, S.C. Herndon, J.H. Shorter, M.S. Zahniser, S. Blaser, L. Hvozdara, A. Muller, M. Giovannini, J. Faist, Opt. Lett., 31, 2012, 2006.

Technical note: Evaluation of standard ultraviolet absorption ozone monitors in a polluted urban environment, E.J. Dunlea, S.C. Herndon, D.D. Nelson, R.M. Volkamer, B.K. Lamb, E.J. Allwine, M. Grutter, C.R. Ramos Villegas, C. Marquez, S. Blanco, B. Cardenas, C.E. Kolb, L.T. Molina, M.J. Molina, Atmos. Chem. Phys., 6, 3163-3180, 2006.

Measurement of nitrogen dioxide in cigarette smoke using quantum cascade tunable infrared laser differential absorption spectroscopy (TILDAS), J.H. Shorter, D.D. Nelson, M.S. Zahniser, M.E. Parrish, D.R. Crawford, D.L. Gee, Spectrochem. Acta A, 63, 994-1001, 2006.

What are the instrumentation requirements for measuring the isotopic composition of net ecosystem exchange of CO_2 using eddy covariance methods?, S.R. Saleska, J.H. Shorter, S. Herndon, R. Jiménez, J.B. McManus, J.W. Munger, D.D. Nelson, MS. Zahniser, Isot. Environ. Health Studies, 42, 115-133, 2006.

Characterization of a near-room-temperature, continuous-wave quantum cascade laser for long-term, unattended monitoring of nitric oxide in the atmosphere, D.D. Nelson, J.B. McManus, S.C. Herndon, J.H. Shorter, M.S. Zahniser, S.Blaser, L.Hvozdara, A.Muller, M.Giovannini, and J.Faist, Opt. Lett. 31, 2012-2014, 2006.

Atmospheric reactive nitrogen concentration and flux budgets at a Northeastern U.S. forest site, C.V. Horii, J.W. Munger, S.C. Wofsy, M. Zahniser, D. Nelson, J.B. McManus, Agr. Forest Meteorol., 133, 210-225, 2005.

A high precision pulsed quantum cascade laser spectrometer for measurements of stable isotopes of carbon dioxide, J.B. McManus, D.D. Nelson, J.H. Shorter, R. Jimenez, S. Herndon, S. Saleska, M. Zahniser, J. Mod. Optics, 52, 2309-2321, 2005.

Real-time measurements of SO_2 H_2CO, and CH_4 emissions from in-use curbside passenger buses in New York City using a chase vehicle, S.C. Herndon, J.H. Shorter, M.S. Zahniser, J. Wormhoudt, D.D. Nelson, K.L. Demerjian, C.E. Kolb, Environ. Sci. Technol. 39, 7984-7990, 2005.

Real-time measurements of nitrogen oxide emissions from in-use New York City transit buses using a chase vehicle, J.H. Shorter, S. Herndon, M.S. Zahniser, D.D. Nelson, J. Wormhoudt, K.L. Demerjian, C.E. Kolb, Environ. Sci. Technol. 39, 7991-8000, 2005.

Characterization of urban pollutant emission fluxes and ambient concentration distributions using a mobile laboratory with rapid response instrumentation, S.C. Herndon, J.T. Jayne, M.S. Zahniser, D.R. Worsnop, B. Knighton, E. Alwine, B.K. Lamb, M. Zavala, D.D. Nelson, J.B. McManus, J.H. Shorter, M.R. Canagaratna, T.B. Onasch, C.E. Kolb, Faraday Discuss., 130, 327-339, 2005.

Temperature and gas-phase composition measurements in supersonic flows using tunable diode laser absorption spectroscopy: The effect of condensation on the boundary-layer thickness, S. Tanimura, Y. Zvinevich, B.E. Wyslouzil, M.S. Zahniser, J.H. Shorter, D.D. Nelson, J.B. McManus, J. Chem. Phys., 122, 194304 (11 pages), 2005.

Atmospheric Trace Gas Measurements Using a Dual Quantum-Cascade Laser Mid-Infrared Absorption Spectrometer, R. Jimenez, S. Herndon, J.H. Shorter, D.D. Nelson, J.B. McManus, M.S. Zahniser, Proceedings of SPIE V.5738, 318-330: Novel in-Plane Semiconductor Lasers IV, ed. by C. Mermelstein, D.P. Bour, 2005.

Quad Quantum Cascade Laser Spectrometer With Dual Gas Cells for the Simultaneous Analysis of Mainstream and Sidestream Cigarette Smoke, R.E. Baren, M.E. Parrish, K.H. Shafer, C.N. Harward, Q. Shi, D.D. Nelson, J.B. McManus, M.S. Zahniser, Spectrochimica Acta A, 60, 3437-3447, 2004.

High Precision Measurements of Atmospheric Nitrous Oxide and Methane Using Thermoelectrically Cooled Mid-Infrared Quantum Cascade Lasers and Detectors, D.D.

Nelson, B. McManus, S. Urbanski, S. Herndon, M.S. Zahniser, Spectrochimica Acta A, 60, 3325-3335, 2004.

Spatially Resolved Gas Phase Composition Measurements in Supersonic Flows Using Tunable Diode Laser Absorption Spectroscopy, P. Paci, Y. Zvinevich, S. Tanimura, B.E. Wyslouzil, M.S. Zahniser, J. Shorter, D. Nelson, B. McManus, J. Chem. Phys. 121, 9964- 9970, 2004.

NO and NO_2 Emission Ratios Measured from In-Use Commercial Aircraft during Taxi and Takeoff, S.C. Herndon, J.H. Shorter, M.S. Zahniser, D.D. Nelson, J.T. Jayne, R.C. Brown, R.C. Miake-Lye, I. Waitz, P. Silva, T. Lanni, K. Demerjian, C.E. Kolb, Environ. Sci. Technol., 38, 6078-6084, 2004.

Mobile Laboratory with Rapid Response Instruments for Real-Time Measurements of Urban and Regional Trace Gas and Particulate Distributions and Emission Source Characteristics, C.E. Kolb, S.C. Herndon, J.B. McManus, J.H. Shorter, M.S. Zahniser, D.D. Nelson, J.T. Jayne, M.R. Canagaratna, D.R. Worsnop, Environ. Sci. Technol., 38, 5694-5703, 2004.

Determination of Line Strengths for Selected Transitions in the v2 Band Relative to the v1 and v5 Bands of H_2CO, S.C. Herndon, D.D. Nelson Jr., Y. Li, M.S. Zahniser, J. Quant. Spect. & Rad. Transfer, 90, 207-216, 2005.

Environmental Monitoring with Pulsed Quantum Cascade Lasers: Seeking Sensitivity and Stability, D.D. Nelson Jr., J. B. McManus, J. Shorter, Q. Shi, M. Zahniser, B. Wyslouzil, Proceedings of the Laser Applications to Chemical and Environmental Analysis Conference, Annapolis MD, February 9-11, 2004.

Utilization of Tunable Infrared Laser Sensors for Cross-Road Mobile Source Emissions Characterization and Quantification, D.D. Nelson, M.S. Zahniser, J.B. McManus, C.E. Kolb, Proc. of A&WMA's 97th Annual Conference & Exhibition Sustainable Development: Gearing Up for the Challenge! June 22-25, 2004, Indianapolis, IN

Fluxes of Nitrogen Oxides Over a Temperate Deciduous Forest, C.V. Horii, J.W. Munger, S.C. Wofsy, M. Zahniser, D.Nelson, J.B. McManus, J. Geophys. Res., 109, D08305,doi:1029/2003JD004326, 2004.

Measurement of Formaldehyde, Nitrogen Dioxide, and Sulfur Dioxide at Whiteface Mountain Using a Dual Tunable Diode Laser System, Y.Q. Li, K.L. Damerjian, M.S.Zahniser, D.D. Nelson, J.B. McManus S.C. Herndon, J. Geophy. Res., 109, D16S08, doi:1029/2003JD004091, 2004.

Tunable Infrared Laser Differential Absorption Spectroscopy (TILDAS) Sensors for Combustion Exhaust Pollutant Quantification, M.S. Zahniser, D.D. Nelson, and C.E. Kolb, Applied Combustion Diagnostics, K.K. Hoeinghaus and J. B. Jeffries, ed, 648-668, Taylor & Francis (2002).

Infrared Line strengths and Pressure Broadening Coefficients in the n_{12} Vibrational Band of Hydrazine Measured by Infrared Tunable Diode Laser Spectroscopy, S.E. Plunkett, M.S. Zahniser, M.E. Parrish, D.D. Nelson, J.H. Shorter, J. Wormhoudt, and K.H. Shafer, J. Mol. Spec., 211, 241-247 (2002).

Infrared Laser Spectrometer with Balanced Absorption for Measurement of Isotopic Ratios of Carbon Gases, J.B. McManus, M.S. Zahniser, D.D. Nelson, L.R. Williams, and C.E. Kolb, Spectrochim. Acta 58, 2465-2479 (2002).

Hydrazine Detection Limits in the Cigarette Smoke Matrix Using Infrared Tunable Diode Laser Absorption Spectroscopy, S. Plunkett, M.E. Parrish, K.H. Shafer, J.H. Shorter, D.D. Nelson and M.S. Zahniser, Spectrochim. Acta 58, 2505-2517 (2002).

Sub-Part-Per-Billion Detection of Nitric Oxide in Air Using a Thermoelectrically Cooled Mid-Infrared Quantum Cascade Laser Spectrometer, D.D. Nelson, J.H. Shorter, J.B. McManus and M.S. Zahniser, Appl. Phys. B., 75, 343-350 (2002).

Quantum Cascade Lasers for Open- and Closed-Path Measurement of Atmospheric Trace Gases, J.B. McManus, D.D. Nelson, J.H. Shorter and M.S. Zahniser, Diode Lasers and Applications in Atmospheric Sensing, SPIE Proceedings, 4817, 22-33 (2002).

Characterization of Heavy-Duty Vehicle Exhaust in Dense Urban Environments, J.H. Shorter, S.C. Herndon, M.S. Zahniser, D.D. Nelson, J.T. Jayne, and C.E. Kolb, Proceedings of the 10th International Symposium "Transport and Air Pollution", 33-40 (2001).

Rate Constant Measurements for the Reaction of HO_2 with O_3 from 200 to 300 K Using a Turbulent Flow Reactor, S.C. Herndon, P.W. Villalta, D.D. Nelson, J.T. Jayne, and M.S. Zahniser, J. Phys. Chem. A, 105, 1583-1591 (2001).

Time-resolved analysis of cigarette combustion gases using a dual infrared tunable diode laser system, S. Plunkett, M.E. Parrish, K.H. Shafer, D. Nelson, J. Shorter, and M. Zahniser, Vibrational Spectroscopy, 27, 53-63 (2001).

Remote Sensing of NO and NO_2 Emissions from Heavy-Duty Diesel Trucks Using Tunable Diode Lasers, J.L. Jimenez, G.J. McRae, D.D. Nelson, M.S. Zahniser, and C.E. Kolb, Environ. Sci & Technol., 2380-2387 (2000).

IRMA: A tunable infrared multi-component acquisition system for plasma diagnostics, J. Röpcke, L. Mechold, M. Käning, J. Anders, F.G. Wienhold, D. Nelson, and M. Zahniser, Rev. Sci. Instru., 71, 3706-3710 (2000).

IRMA: A Tunable Infrared Multi-Component Acquisition System for Plasma Diagnostics, J. Röpcke, L. Mechold, J. Anders, F.G. Wienhold, D. Nelson, M. Zahniser, and J. Wormhoudt, Symposium on "Laser Applications to Chemical and Environmental Analysis", 88-90 (2000).

Cross road and mobile tunable infrared laser measurements of nitrous oxide emissions from motor vehicles, J.L. Jimenez, J.B. McManus, J.H. Shorter, D.D. Nelson, M.S. Zahniser, M. Koplow, G.J. McRae, and C.E. Kolb, Chemosphere - Global Change Science, 2, 397-412 (1999).

Characterization of On-Road Vehicle NO Emissions by a TILDAS Remote Sensor, J.L. Jimenez, M.D. Koplow, D.D. Nelson, M.S. Zahniser and S.E. Schmidt, J. Air & Waste Manage. Asso., 49, 463-470 (1999).

Nitric Acid and Nitrogen Dioxide Flux Measurements: A New Application of Tunable diode Laser Absorption Spectroscopy, C.V. Horii, M.S. Zahniser, D.D. Nelson, J.B. McManus and S.C. Wofsy, Application of Tunable Diode and Other Infrared Sources for Atmospheric Studies and Industrial Process Monitoring, SPIE Proceedings, V. 3758, 152-161 (1999).

A Tunable Diode Laser System for the Remote Sensing of On-Road Vehicle Emissions, D.D. Nelson, M.S. Zahniser, J. B. McManus, C.E. Kolb, and J.L. Jimenez, Appl. Phys. B, 67, 433-441, (1998).

Air-broadened Linewidth Measurements in the O2 Vibrational Band of HOCl, J.H. Shorter, D.D. Nelson, and M.S. Zahniser. J. Chem. Soc. Faraday. Trans., 93, 2933-2935 (1997).

Measurement of Trace Gas Fluxes Using Tunable Diode Laser Spectroscopy, M.S. Zahniser, D.D. Nelson, J.B. McManus and P.L. Kebabian. Phil. Trans. Roy. Soc. Lond. A., 351, 371-382 (1995).

A Mechanistic Study of the Reaction of HO_2 Radical with Ozone, D.D. Nelson, Jr. and M.S. Zahniser. J. Phys. Chem., 98, 2101 (1994).

Air-Broadened Linewidth Measurements in the O_2 Vibrational Band of the Hydroperoxyl Radical, D.D. Nelson, Jr. and M.S. Zahniser., J. Mol. Spec., 166, 273 (1994).

OH Reaction Kinetics and Atmospheric Lifetimes of CF_3CFHCF_3 and CF_3CH_2Br, D.D. Nelson, Jr., M.S. Zahniser, and C.E. Kolb. Geophys. Res. Lett., 20, 197-200 (1993).

Quantum Yields for OH Production From 193 nm and 248 nm Photolysis of HNO_3 and H_2O_2, A. Schiffman, D.D. Nelson, Jr., and D.J. Nesbitt. J. Chem. Phys., 98, 6935 (1993).

Chemical Kinetics of the Reactions of OH Radicals with CF_3CFHCF_3 and CF_3CH_2Br, D.D. Nelson, Jr., M.S. Zahniser, and C.E. Kolb, Geophys. Res. Lett. 20, 197-200 (1993).

Chemical Kinetic Studies of Atmospheric Reactions Using Tunable Diode Laser Spectroscopy, D.R.Worsnop, D.D. Nelson, and M.S. Zahniser, Proceedings of the SPIE Conference on Optical Methods in Atmospheric Chemistry, SPIE 1715, 18-33 (1992).

Chemical Kinetics of the Reactions of OH Radical with Several Propane Based HCFCs, D.D. Nelson, Jr., M.S. Zahniser, and C.E. Kolb, J. Phys. Chem., 96, 249-253 (1992).

Diode Laser Spectroscopy of the O_3 Vibration of the HO_2 Radical, D.D. Nelson and M.S. Zahniser, J. Mol. Spectrosc., 150, 527-534 (1991).

High Resolution Infrared Flash Kinetic Spectroscopy of OH Radicals, A. Schiffman, D.D. Nelson Jr., M.S. Robinson, and D.J. Nesbit, J. Chem. Phys., 95, 2629 (1991).