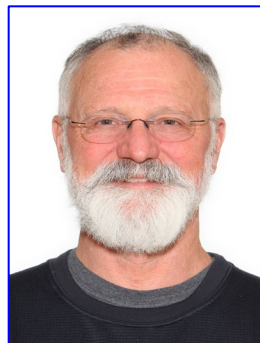


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EDUCATION/TRAINING

Ph.D. in Environmental Science and Engineering, 2004, University of North Carolina, Chapel Hill, NC
M.S. in Physics, 1979, Southern Illinois University, Carbondale, IL
B.S. in Physics, 1976, Southern Illinois University, Carbondale, IL
B.S. in Mathematics, 1976, Southern Illinois University, Carbondale, IL

PROFESSIONAL EXPERIENCE

Professor (adjunct) Department of Environmental Sciences and Engineering, Gillings School of Public Health, University of North Carolina, 2012-present.

Editor-in-Chief Institute of Physics Journal of Breath Research, Bristol, UK, 2015 to present

Core Faculty Occupational and Environmental Exposure Science (OEES) Program, University of North Carolina, 2010 to present

Forensic Chemist (consultant) NASA Engineering Safety Center, Langley, VA, 2012 to present

Research Physical Scientist (GS-15, retired), U.S. Environmental Protection Agency, Research Triangle Park, NC, 1987- Dec.31, 2019

Associate Professor (adjunct) and Graduate Faculty appointments, Environmental Science and Engineering Dept., School of Public Health, University of North Carolina, 1994-2012.

Senior Research Scientist; Northrop Corporation, Research Triangle Park, NC, 1979-1987.

SELECTED AWARDS AND HONORS

NASA Group Achievement Award, "*F/A-18 Fleet Physiological Events Assessment Team*", 2018.

U.S. EPA National Exposure Research Laboratory, Excellence in Mentorship Award, 2015

NASA Engineering Achievement Award, "*F-22 life Support System Independent Analysis Team*", 2012.

U.S. EPA, ORD, Bronze Medal for Exhaled Breath Condensate Research, 2007

U.S. EPA, ORD, Bronze Medal for World Trade Center exposure assessment, 2006.

U.S. EPA, ORD, Two NERL Special Achievement Awards, 2006.

ORD Administrator's award for support of World Trade Center Experts Panel, 2005.

U.S. EPA, eleven EPA Scientific and Technological Achievement Awards (STAA) for Research Publications, 1990, 1993, 1994, 2004, 2006, 2007, 2008(2), 2010(2), and 2012.

EPA Special Achievement Awards, 1989 and 1991.

National EPA Award: Speciner Award: "Outstanding Contribution by a Professional Employee", 1989.

U.S. Patent #5,447,556, 14 technical claims - "Sample Injection Apparatus and Method"; Sept.5, 1995;

EPA Exclusive License agreement (1996) with Graseby-Nutech Corp. for "Valveless injection cryogenic GC-MS interface"; Awarded four EPA Co-operative Research and Development Agreements (CRADA) with industrial partners under the Federal Technologies Transfer Act (FTTA)

Science activities:

Editor-in-Chief: Institute of Physics: *Journal of Breath Research* (2015-present)

Journal editorial board: Taylor and Francis: *Biomarkers* (2005-present)

Founding and serving member of scientific board of *International Society of Breath Research (IABR)* (2005-present)

Legacy Member and serving on scientific board of International Navies Group: *Submarine Air Monitoring and Air Purification (SAMAP)* (1994-present)

Member of *NASA F-22 Life Support System Independent Analysis Team* (2012-2013)

Member of *NASA F/A-18 Physiological Events Independent Analysis Team* (2016-2017)

Member of **NASA F/A-15, -18, -35 Pilot Breathing Assessment Team** (2018-2020)
Member of **NASA Pilot Human Systems Engineering Team** (2020-2021)
Member of **NASA Spacesuit Evaluation Team** (2021-present)

Other past/current memberships:

Air Pollution Control Association (APCA)
Society of Toxicology (SOT)
Society of Risk Assessment (SRA)
Association for the Advancement of Science (AAAS)
American Chemical Society (ACS)
International Society of Exposure Science (ISES)
American Society for Testing and Materials (ASTM)

RESEARCH

Develop field sampling and extraction methods for organic compounds in biological and environmental media. Develop sample concentration and analysis laboratory methods for measuring and identifying patterns of endogenous and chemical biomarkers in human biological fluids including blood, breath, exhaled breath condensate, bronchial lavage fluid, and urine using gas chromatography – mass spectrometry (GC-MS) and immunochemistry platforms. Construct mathematical, statistical, and systems biology approaches to interpret the absorption, distribution, metabolism and elimination of human exposures to environmental stressors. Develop non-targeted high-resolution-MS analytical workflow methods for disease diagnostics. Mentor Ph.D. students and post-doctoral fellows and teach Environmental Exposure Assessment at UNC School of Public Health.

HIGHLIGHTS

Peer-reviewed publications and oral presentations on various technical topics (listed below).

Forensic chemist for NASA Engineering Safety Center (NESC)

Editor-in-Chief of *Journal for Breath Research* starting 2015 after serving 8 years on editorial board; published by Institute of Physics, London, UK.

Founding signatory member of the International Association for Breath Analysis (IABR) headquartered in Valduz, Liechtenstein; currently serving on IABR Governing Board.

Technical contact for “Memorandum of Understanding (MOU) between University of North Carolina, School of Public Health and U.S. Environmental Protection Agency, Office of Research and Development.

Adjunct Professor at University of North Carolina, Chapel Hill, NC; taught “Sampling and Analysis of Organic Air Pollutants” (4 yrs) and “Environmental Exposure Assessment” (10 yrs); serve on Ph.D. student committees; mentor graduate students under Student Services Agreements, training grants and practicum experience.

Scientific Chair, International Association of Breath Research (IABR) Meeting, Zurich Switzerland, Sept. 2016.

Member of International Scientific Organizing Committees for 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016 breath research meetings (Dortmund, Germany; Cleveland, Ohio; Prague Czech Republic, Barga, Italy; Parma, Italy; Saarbrücken, Germany, Torun Poland, Vienna Austria, Zurich Switzerland), and for 2009, 2011 Submarine Air Monitoring and Air Purification (SAMAP) meetings, (San Diego, CA; Taranto, Italy)

Developed series of analytical (GC-MS) methods for volatile organic compounds in ambient air (TO-14) and for biomarkers in human exhaled breath, exhaled breath condensate, plasma, whole blood, and urine.

EPA Principal investigator and originator of series of Cooperative Research and Development Agreements (CRADAs) with industrial partners: (1) Developed gas chromatographic sample injection systems for commercial market (Patent and exclusive license agreement issued), (2) Developed specialty surface coatings for chemical deactivation of metal surfaces based on vapor deposition of fused silica, (3) Developed miniaturized micro-environmental whole air samplers, (4) Developed novel approaches environmental application of tandem mass spectrometry.

Developed methodology for retrospective assay of archived PM 2.5 samples for carcinogenic polycyclic aromatic hydrocarbons; application to World Trade Center (WTC) risk assessment. Developed analytical methods for discriminating residual WTC indoor contamination. Member of National Institutes of Environmental Health Sciences (NIEHS) Workgroup on WTC research. Advisor to WTC expert panel subcommittee on source signature development

Invited speaker at international conferences: Germany, Russia, Canada, Australia, Czech Republic, Austria, Italy, Japan, Netherlands, New Zealand; at domestic conferences: AWMA, ACS, ASTM, ISES, PittCon, SAMAP, Superfund, SAMAP, IABR, SOT, etc.; at U.S. Agencies: EPA, NIOSH, NIEHS, CDC; and at various industrial, and technical scientific functions.

Invited speaker/lecturer at University meetings, symposia, and work-shops including Harvard, Penn State, U. of Illinois, U. of North Carolina, NC State U., San Francisco State, UCLA, LSU, Notre Dame, Johns Hopkins, U. Colorado, Northwestern U., Princeton U., Dartmouth College, Fraunhofer Institute, Germany, Medical University of Innsbruck, Austria, J. Heyrovský Institute, Prague, Czech Rep., and U. of Pisa, Italy. Advisor/collaborator regarding environmental exposure: National Aeronautics and Space Administration (NASA), U.S. Department of Energy (DoE), North East States Coordinated Air Management (NESCAUM), EPA Offices of Radiation Programs (ORP), Air Quality and Planning Standards (OAQPS), Toxic Substances (OTS), Solid Waste (OSW), Indoor Air Division (IAD), U.S. Naval Undersea Medical Institute (NUMI), Air Force Office of Scientific Research (AFOSR), Centers for Disease Control (CDC), and the National Institute of Occupational Safety and Health (NIOSH).

Advisor to various branches of U.S. Military: U.S. Navy (and NATO) on artificial atmospheres contamination measurements onboard nuclear submarine fleet; U.S. Navy on impact of industrial incineration on Atsugi Naval Air Station, Japan, U.S. Marine Corps on groundwater and soil contamination, U.S. Air Force on Jet Fuel and halocarbon exposures.

Peer Review Panel member for American Institute for Biological Sciences, Army Gulf War Syndrome Research, NIH Heart, Lung, Blood Institute (NHLBI), EPA grants reviews, NIOSH program reviews, EPA technical contracts, and EPA promotion boards.

Journal peer reviewer for Environmental Health Perspectives, Journal of American Waste Management Association, Annals of Occupational Hygiene, Journal of Exposure Science & Environmental Epidemiology, Environmental Science and Technology, Journal of Chromatography A, Journal of Chromatography B, Biomarkers, Analytical and Bioanalytical Chemistry, Journal of Breath Research, Environmental Health, and Chemosphere.

Organizer and chairman of technical program sessions for AWMA, ASTM, EPA, IABR, SAMAP, PittCon, SOT, and ACS conferences.

PUBLICATIONS AND PRESENTATIONS

BOOKS

Breathborne Biomarkers and the Human Volatilome, Eds. C. Davis, J. Beauchamp, and **J. Pleil**, 2020. Elsevier, Amsterdam, Netherlands

Evaluation of dermal exposure to polycyclic aromatic hydrocarbons in fire fighters, 2013. Fent KW, Eisenberg J, Evans D, Sammons D, Robertson S, Striley C, Snawder J, Mueller C, Kochenderfer V, **Pleil J**, Stiegel M. US Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health No. 2010-0156-3196, Cincinnati OH USA

Biomonitoring—An Exposure Science Tool for Exposure and Risk Assessment, 2012. Tan YM, Dary CC, Chang EM, Ulrich JM, Van Emon JM, Xue J, **Pleil JD**, Kenneke JF, Sobus J, Sheldon LS, Morgan MK. US Environmental Protection Agency: EPA/600/R-12/039 |Washington, DC, USA.

BOOK CHAPTERS

Pleil JD, Stiegel MA, and Beauchamp JD, 2020. Breath biomarkers and the exposome, Chap. 1, *Breathborne Biomarkers and the Human Volatilome*, Eds. C. Davis, J. Beauchamp, and J. Pleil, 2020. Elsevier, Amsterdam, Netherlands

Nylander-French LA, Beauchamp JD, and **Pleil JD**, 2020. Volatile emissions from skin, Chap. 25, *Breathborne Biomarkers and the Human Volatilome*, Eds. C. Davis, J. Beauchamp, and J. Pleil, 2020. Elsevier, Amsterdam, Netherlands

Pleil JD and Egeghy PP, 2020. Mathematical interpretation of targeted exhaled breath measurement data, Chap. 33, *Breathborne Biomarkers and the Human Volatilome*, Eds. C. Davis, J. Beauchamp, and J. Pleil, 2020. Elsevier, Amsterdam, Netherlands

Beauchamp JD and **Pleil JD**, 2015. "Breath: an often overlooked medium in biomarker discovery", in *Biomarker Validation: Technological, Clinical and Commercial Aspects* (Eds. H Seitz & S Schumacher) Wiley-VCH, Weinheim, Germany, ISBN: 978-3-527-33719-4.

Pleil JD and Sobus JR, 2013. "Mathematical and statistical approaches for interpreting exhaled breath measurements of organic compounds", Chap. 1: *Volatile biomarkers: non-invasive diagnosis in physiology and medicine*, Elsevier B.V., Amsterdam, eds. Amann A and Smith D.

Amann A, Miekisch W, Schubert J, **Pleil J**, and Risby T, 2010. "Methodological issues of sample collection and analysis of exhaled breath", Chap. 7: *European Respiratory Society Monograph Series: Exhaled Biomarkers*, Vol. 49, eds. I Horvath and JC Jongsted.

Sobus JR, Morgan MK, **Pleil JD**, and Barr DB, 2010. "Biomonitoring: Current Tools and Approaches for Assessing Human Exposure to Pesticides", Chap. 45: *Hayes Handbook of Pesticide Toxicology*, Elsevier Ltd. Oxford, UK, ed. R Krieger.

Pleil JD, Kim D, Prah JD, Ashley DL, and Rappaport SM, 2005. "The Unique value of Breath Biomarkers for Estimating Pharmacokinetic Rate Constants and Body Burden from Environmental Exposures", Chap. 24: *Breath Analysis for Diagnosis and Therapeutic Monitoring*, World Scientific Publishing Co., Singapore, eds. A. Amann and D. Smith

Lindstrom AB and **Pleil JD**, 2002. "Volatile organic compounds as exposure biomarkers", Sec. 3, Chap. 1: *Disease Markers in Exhaled Breath (Basic Mechanisms and Clinical Applications)*; IOS Press, Amsterdam, Berlin, Oxford, Tokyo, Washington, DC; eds. N. Marczin and M.H. Yacoub.

NASA Reports

- International Space Station (ISS):** NASA Combustion Products Report: Integrated Panelists Comments and Recommendations, NASA Johnson Space Center, Houston, TX Dec. 2010.
- F-22 Life Support System (LSS) Independent Analysis:** NASA Engineering and Safety Center (NESC), Technical Assessment Report NESC-RP-12-00792, NASA Langley Research Center, Langley, VA Aug. 2012.
- F/A-18 and E/A-18 Fleet Physiological Episodes:** NASA Engineering and Safety Center (NESC), Technical Assessment Report NESC-RP-17-01205, NASA Langley Research Center, Langley, VA Sept. 2017.
- Pilot Breathing Assessment (PBA)** Volumes 1 & 2, NASA Engineering and Safety Center, Technical Assessment Report NESC-RP-18-01320, NASA Langley Research Center, Langley, VA Nov. 2020.
- Pilot Breathing Assessment Systems Engineering (PiBASE):** Understanding Pilot Breathing – A case Study in Systems Engineering, NASA Engineering and Safety Center (NESC), Position Paper: NESC-NPP-18-01320, NASA Langley Research Center, Langley, VA June 2021.

JOURNAL PUBLICATIONS

- Pleil JD**, Shelton M, Sobus JR, and Richards WL, 2022. In-flight pilot breathing performance and needs in high-performance jet aircraft: Summary data from the NASA Pilot Breathing, *Journal of Breath Research* (in preparation).
- Pleil JD**, Wallace MAG, Strynar M, and Egeghy PP, 2022. Interpreting community level measurements of perfluorinated compounds (PFCs) in human plasma within the context of the NHANES statistical baseline, *Journal TBN*, (in preparation)
- Schmidt AJ, Salman D, **Pleil JD**, Thomas CP, Davis CE, 2022. IABR Symposium 2021 Meeting Report: Breath standardization, sampling, and testing in a time of COVID-19. *Journal of Breath Research*. **16** 010201
- Pleil JD**, Wallace MAG, Davis MD, and Matty CM, 2021. The physics of human breathing: flow, timing, volume and pressure parameters for normal, on-demand, and ventilator respiration, *Perspective, Journal of Breath Research*. 15(4) 042002
- Pleil JD** and Christensen LE, 2021. Tunable diode laser (TDL) technology for real-time carbon dioxide monitoring (capnography) in human breath, *Journal of Breath Research* 15(4) 040201
- Pleil JD**, Lowe C, Wallace A, Williams A, 2021. Using the US EPA CompTox Chemicals Dashboard to interpret targeted and non-targeted GC-MS analyses from human breath and other biological media. *Journal of Breath Research*. 15(2) 025001
- Pleil JD**, Beauchamp JD, Dweik RA, Risby TH. 2020. A special issue: Flow, pressure, volume and time as dependent variables in breath analysis. *Journal of breath research*. 15(1):010201.
- Fent KW, Toennis C, Sammons D, Robertson S, Bertke S, Calafat AM, **Pleil JD**, Wallace MA, Kerber S, Smith D, Horn GP, 2020. Firefighters' absorption of PAHs and VOCs during controlled residential fires by job assignment and fire attack tactic. *Journal of exposure science & environmental epidemiology* 30(2):338-49.
- Pleil JD**, Beauchamp JD, Dweik RA, Risby TH, 2020. Breath research in times of a global pandemic and beyond: the game changer. *Journal of breath research* 14(4):040202.
- Davis MD, Winters BR, Madden MC, **Pleil JD**, Sessler CN, Wallace MAG, Ward-Caviness CK, Montpetit AJ, 2020. Exhaled breath condensate biomarkers in critically ill, mechanically ventilated patients, *Journal of Breath Research* 15(1):016011.
- Pleil JD**, Beauchamp JD, Risby TH, and Dweik RA, 2020. The scientific rationale for the use of simple masks or improvised face coverings to trap exhaled aerosols and possibly reduce the breathborne spread of COVID-19, *Journal of Breath Research*, 14(3):030201.
- Fent KW, Toennis C, Sammons D, Robertson S, Bertke S, Calafat AM, **Pleil JD**, Wallace MAG, Kerber S, Smith DL, and Horn GP, 2020. Firefighters' absorption of PAHs and VOCs during controlled

residential fires by job assignment and fire attack tactic. *Journal of Exposure Science and Environmental Epidemiology*, 30(2):338-49. ORD-027665.

- Pleil JD**, Wallace MAG, McCord J, Madden MC, Strynar MJ, Sobus JR, and Ferguson G, 2019. How do cancer-sniffing dogs sort biological samples? Exploring case-control samples with non-targeted LC-Orbitrap, GC-MS, and immunochemistry methods, *Journal of Breath Research* 14(1):016006 ORD-030436
- Fent KW, Toennis C, Sammons D, Robertson S, Bertke S, Calafat AM, **Pleil JD**, Wallace MAG, Kerber S, Smith DL, and Horn GP, 2019. Firefighters' and instructors' absorption of PAHs and benzene during training exercises. *International Journal of Hygiene and Environmental Health* 222(7):991-1000 ORD-028786.
- Pleil JD** and Williams A, 2019. Centralized resource for chemicals from the human volatilome in an interactive open-sourced database, *Journal of Breath Research* 13:040201 (Aug) ORD-031464
- Wallace MAG, **Pleil JD**, and Madden MC, 2019. Identifying organic compounds in exhaled breath aerosol: non-invasive sampling from respirator surfaces and disposable hospital masks, *Journal of Aerosol Science* 137:105444 ORD- 030870.
- Pleil JD**, Hanzel A and Beauchamp JD, 2019. Advances in proton transfer reaction mass spectrometry (PTR-MS): applications in exhaled breath analysis, food science, and atmospheric chemistry, *Journal of Breath Research* 13 039002 (June) ORD-030984
- Pleil JD**, Wallace MAG, Miekisch W, and DiFrancesco F, 2019. Contemporary human breath related topics: aerosols, saliva, and HR-MS bioinformatics from Pittcon 2019. *Journal of Breath Research* 13 039001 (June) ORD-030740
- Wallace MAG, **Pleil JD**, Whitaker DA and Oliver KD, 2019. Recovery and reactivity of polycyclic aromatic hydrocarbons collected on selected sorbent tubes and analyzed by thermal desorption-gas chromatography/mass spectrometry. *Journal of Chromatography A*, 1602:19-29 ORD-029841
- Wallace, MAG, **Pleil JD**, Oliver KD, Whitaker DA, Mentese S, Fent KW and Horn GP, 2019. Targeted GC-MS analysis of firefighters' exhaled breath: Exploring biomarker response at the individual level to assess the quality of protective gear. *Journal of Occupational and Environmental Hygiene*, 16(5):355-366. (April) ORD-026386
- Wallace MAG, **Pleil JD**, Oliver KD, Whitaker DA, Mentese S, Fent KW, and Horn GP, 2019. Non-targeted GC-MS analysis of exhaled breath samples: Exploring human biomarkers of exogenous exposure and endogenous response from professional firefighting activity. *Journal of Toxicology and Environmental Health, Part A* 82(4): 244-260. (March) ORD-025476
- O'Lenick C, **Pleil JD**, Stiegel MA, Sobus JR, and Wallace MAG, 2019. Detection and Analysis of Endogenous Polar Volatile Organic Compounds (PVOCs) in Urine: Building the Human Exposome, *Biomarkers* 24(3):240-248 (May) ORD-026439
- Pleil JD**, Wallace MAG, McCord J, 2018. Beyond mono-isotopic accurate mass spectrometry: Ancillary techniques for identifying unknown features in non-targeted discovery analysis, *Journal of Breath Research* 13(10):012001 (Nov.) ORD 027044
- Wallace MAG, **Pleil JD**, 2018. Evolution of Clinical and Environmental Health Applications of Exhaled Breath Research: Review of Methods and Instrumentation for Gas-phase, Condensate, and Aerosols, *Analytica Chimica Acta* 1024:18-38 (Sept.) ORD-022964
- Winters BR, **Pleil JD**, Boyer J, Nylander-French L, Wallace MAG, Madden MC, 2018. Review: Endogenously-Produced Volatiles for in vitro Toxicity Testing using Cell Lines, *Applied in vitro Toxicology* 4(2):129-38 (June) ORD-024548
- Wallace MAG, and **Pleil JD**, 2018. Dataset of breath research manuscripts curated using PubMed search strings from 1995-2016, *Data in Brief*, (June) 18:1711-1724 ORD-024520
- Pleil JD** and Wallace MAG, 2018. New breath related topics: Sample collection for exhaled breath condensate and aerosol, development of real-time medical alerts, measurement of artificial atmospheres, and analysis of legalized cannabis product, *Journal of Breath Research*, (May) 12(3):039001 ORD-026145
- Pleil JD**, Stiegel MA, Wallace MAG, and Funk WE, 2018. Human biomarker interpretation: the importance of intra-class correlation coefficients (ICC) and their calculations based on mixed models, ANOVA, and variance estimates. *Journal of Toxicology and Environmental Health B, Critical Reviews* (April) 21(3):161-180 (ORD-025407)

Pleil JD, Wallace MAG, Madden MC, 2018. Exhaled breath aerosol (EBA): the simplest non-invasive medium for public health and occupational exposure biomonitoring, *Journal of Breath Research* 12(2): 027110 (Feb) ORD-023073

Pleil JD, 2018. Tenth Anniversary Special Issue of *Journal of Breath Research: Looking Forward*, *Journal of Breath Research* 12:010201 (Jan) ORD-024302

Reyes JM, Hubbard H, Stiegel MA, **Pleil JD**, Serre ML, 2018. Incorporating mass fraction of polycyclic aromatic hydrocarbons into Bayesian Maximum Entropy Framework across North Carolina, *Journal of Exposure Science and Environmental Epidemiology* 28:381–391 (Jan) ORD-019418

Winters BR, **Pleil JD**, Angrish MM, Stiegel MA, Risby TH, and Madden MC, 2017. Standardization of exhaled breath condensate (EBC) and exhaled breath aerosol (EBA) collection using a feedback regulated sampling device, *Journal of Breath Research* 11(4): 047107 (Nov) ORD-018528

Wallace MAG, **Pleil JD**, Mentese S, Oliver KD, Whitaker DA, Fent KW, 2017. Calibration and performance of synchronous SIM/scan mode for simultaneous targeted and discovery (non-targeted) analysis of exhaled breath samples from firefighters. *Journal of Chromatography A* 1516:114-124 (Sept) ORD-021351

Pleil, JD and R Giese, 2017. Integrating exhaled breath diagnostics by disease-sniffing dogs with instrumental laboratory analysis, *Journal of Breath Analysis* 11:032001 (Sept) ORD-020302

Pleil JD, Beauchamp JD, and Miekisch W, 2017. Cellular Respiration, Metabolomics and the Search for Illicit Drug Biomarkers in Breath: Report from PittCon 2017, *Journal of Breath Research* 11:039001 (Aug) ORD-021222

Stiegel MA and **Pleil JD**, Sobus JR, Stevens T, and Madden MC, 2017. Linking physiological parameters to perturbations in the human exposome: environmental exposures modify blood pressure and lung function via inflammatory cytokine pathway, *Journal of Toxicology and Environmental Health A* 80(9):485-501 (June) ORD-019961

Hackner K and **Pleil JD**, 2017. Canine olfaction as an alternative to analytical instruments for disease diagnosis: understanding “dog personality” to achieve reproducible results, *Journal of Breath Research* 11:012001 (January) ORD-018980

Wallace MA, Kormos TM, and **Pleil JD**, 2016. Blood-borne Biomarkers and Bioindicators for Linking Exposure to Health Effects in Environmental Health Science, *Journal of Toxicology and Environmental Health, Part B. Critical Reviews* 19(8):380-409 (Nov.) ORD-016285

Beauchamp JD, Pleil JD, Risby TR, and Dweik R, 2016. Meeting Report: IABR Breath Summit 2016 in Zurich, Switzerland, *Journal of Breath Research* 10(4):049001 (Nov.) ORD-018978

Pleil JD, 2016. Imputing defensible values for left-censored “below level of quantitation” (LoQ) biomarker measurements, *Journal of Breath Research* 10(4):045001 (Oct.) ORD-017468

Pleil JD, 2016. Breath biomarkers in toxicology, invited Review Article, *Archives of Toxicology*, 90:2669-2682. (Oct.) ORD-017222

Pleil JD and Sobus JR, 2016. Estimating central tendency from a single spot measure: A closed-form solution for lognormally distributed biomarker data for risk assessment at the individual level, *Journal of Toxicology and Environmental Health, Part A* 79(18):837-847. (Sept.) ORD-016063

Pleil JD, 2016. QQ-plots for assessing distributions of biomarker measurements and generating defensible summary statistics, *Journal of Breath Research* (Aug.) 10:035001. ORD-016627

Williams J and **Pleil JD**, 2016. Crowd-based Breath Analysis: Assessing Behavior, Activity, Exposures, and Emotional Response of People in Groups, *Journal of Breath Analysis* 10:032001. (June) ORD-016555

Pleil JD, Risby TH and Herbig J, 2016. Breath Biomonitoring in National Security Assessment, Forensic THC Testing, Biomedical Technology and Quality Assurance Applications: Report from PittCon 2016, *Journal of Breath Research* 10:029001. (May) ORD-016183

Stiegel MA, **Pleil JD**, Sobus JR, and Madden MC, 2016. Inflammatory Cytokines and White Blood Cell Counts Response to Environmental Levels of Diesel Exhaust and Ozone Inhalation Exposures, *PLoS ONE* 11(4):e0152458. (April) ORD-013864

Pleil JD, 2016. Cellular Respiration: recreating *in vivo* systems biology for *in vitro* exploration of human exposome and microbiome biomarkers, *Journal of Breath Research*, 10:010201. (Mar) ORD-015303

Pleil JD and Isaacs KK, 2016. High-resolution mass spectrometry: basic principles for using exact mass and mass defect for discovery analysis of organic molecules in blood, breath, urine and environmental media, *Journal of Breath Research*, 10:012001. (March) ORD-015049

- Angrish MM, **Pleil JD**, Stiegel MA, Madden MC, Moser VC, Herr DW, 2016. Taxonomic applicability of inflammatory cytokines in adverse outcome pathway (AOP) development. *Journal of Toxicology and Environmental Health, Part A*. 79(4):184-196. (March) ORD-012234
- Beauchamp JD, **Pleil JD**, Dweik RA, Herbig J, Risby TH. 2016. International Association of Breath Research 10th anniversary conference at the Schoenbrunn Palace in Vienna, Austria. *Journal of Breath Research*, 10(1):019001. (February) ORD-015040
- Pleil JD**, 2016. Comparing biomarker measurements to a normal range: when to use standard error of the mean (SEM) or standard deviation (SD) confidence intervals tests, *Biomarkers* 21(3):195-199. (Jan) ORD-012549
- Pleil JD**, Angrish MM, and Madden MC, 2015. Immunochemistry for high-throughput screening of human exhaled breath condensate (EBC) media: implementation of automated Quanterix SIMOA instrumentation, *Journal of Breath Research* 9:047108 (Dec.)
- Stiegel MA, **Pleil JD**, Angrish MM, Sobus JR, and Morgan MK, 2015. Kidney injury biomarkers and urinary creatinine variability in nominally healthy adults, *Biomarkers* 20(6-7):436-452. (Nov.)
- Funk WE, **Pleil JD**, Sauter DJ, McDade DW, and Holl JL, 2015. Use of Dried Blood Spots for Estimating Children's Exposures to Heavy Metals in Epidemiological Research, *Journal of Environmental and Analytical Toxicology* S7: 002. (July)
- Pleil JD**, 2015. The next chapter for the *Journal of Breath Research*, (editorial), *Journal of Breath Research* 9:030201.
- Pleil JD**, 2015. Understanding new "exploratory" biomarker data: a first look at observed concentrations and associated detection limits, *Biomarkers* 20(2):168-169.
- Pleil JD**, Miekisch W, Beauchamp JD, and Funk WE, 2015. Adapting biomarker technologies to adverse outcome pathways (AOPs) research: Current thoughts on using *in vivo* discovery for developing *in vitro* target methods, *Journal of Breath Research* 9:039001.
- Harper M, Weiss C, **Pleil JD**, Blount B, Miller A, Hoover MD, and Jahn S, 2015. Commentary on a More Comprehensive Vision and Strategy for the Discipline of Exposure Science, *Journal of Exposure Science and Environmental Epidemiology* 25(4):381-387
- Angrish MM, Madden MC and **Pleil JD**, 2015. Probe molecules (PrM) approach in adverse outcome pathway (AOP) based high throughput screening (HTS): *in vivo* discovery for developing *in vitro* target methods, *Chemical Research in Toxicology* 28(4):551-559.
- Bean HD, **Pleil JD**, and Hill, JE, 2015. Report: New analytical and statistical approaches for interpreting the relationships among environmental stressors and biomarkers, *Biomarkers* 20(1):1-4.
- Stiegel MA, **Pleil JD**, Sobus JR, Morgan MK, and Madden MC, 2015. "Analysis of inflammatory cytokines in human blood, breath condensate, and urine using a multiplex immunoassay platform", *Biomarkers*, 20(1): 35-46.
- Fent KW, Evans DE, Booher D, **Pleil JD**, Stiegel MA, Horn GP, and Dalton J, 2015. "Volatile organic compounds off-gassing from firefighters' personal protective equipment ensembles after use", *Journal of Occupational and Environmental Hygiene* 12(6):404-414).
- Sobus JR, Dewoskin RS, Tan YM, **Pleil JD**, Phillips MB, George BJ, Christensen KY, Schreinemachers DM, Williams MA, Cohen-Hubal EA, and Edwards SW, 2015. "Uses of NHANES biomarker data for chemical risk assessment: Trends, challenges and opportunities", *Environmental Health Perspectives* 123:919-927.
- Pleil JD**, Sobus JR, Stiegel MA, Hu D, Oliver KD, Olenick C, Strynar MJ, Clark M, Madden MC, and Funk WE, 2014. Estimating common parameters of log-normally distributed environmental and biomonitoring data: harmonizing disparate statistics from publications, *Journal of Toxicology and Environmental Health, Part B. Critical Reviews* 17:341-368.
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PRESENTATIONS (2020 - 2005)

- Pleil JD**, 2020. Exhaled breath aerosols: Thoughts on sampling, analysis and safety in the era of COVID-19, Plenary lecture: Breath Biopsy Conference 2020, Owlstone Medical, Cambridge UK, Nov.10-11.
- Williams A and **Pleil JD**, 2019. Utilizing the US-EPA CompTox Chemicals Dashboard to deliver public access to a human volatilome subset of data, International Association of Breath Research, Leicestershire, UK Sept. 8-11.
- Pleil JD** and Herbig J. 2019. Human Exhaled Breath Aerosol (EBA): Sampling and Analysis Applications for Clinical Diagnostics and Environmental Exposure Studies, PittCon 2019, Philadelphia, PA, March 16-21.
- Pleil JD**, Wallace MA, and Beauchamp JD, 2019. Non-targeted analysis: Implementing high-resolution mass spectrometry to improve identification of analytical features in biomonitoring studies, 8th International PTR-MS Conference, Innsbruck, Austria, Feb. 2-8.
- Pleil JD, Wallace MAG, Winters BR, Davis M, Montpetit A, and Madden MC, 2018. Plenary Lecture: Linking medical investigations with analytical chemistry: from bed to bench, International Association of Breath Research, Maastricht Netherlands, June 16-20.
- Pleil JD, Wallace MA, 2018. Are dogs or instruments better at sniffing out cancer? The jury's still out, but the arguments flourish, Lecture: ENVR 400, University of North Carolina, School of Public Health, Chapel Hill NC, March 21.
- Pleil JD, Wallace MA, Madden MC, 2018. The "priming" effect: Previous exposures and activities may impact current responses to environmental stressors in certain individuals, PittCon 2018, Orlando FL, Feb. 26 - March 1.
- Wallace MA, Pleil JD, Winters BR, Grossman J, Madden MC, 2018. Analytical methods development for exogenous and endogenous compounds in Exhaled Breath Aerosol (EBA) and Exhaled Breath Condensate (EBC), PittCon 2018, Orlando FL, Feb. 26 - March 1.
- Pleil JD, Wallace MA, Madden MC, 2017. Artificial atmosphere environments influence cardio-pulmonary parameters at the individual level via inflammatory cytokine pathways, SAMAP International Meeting (US Navy), Uncasville, CT, USA, Nov. 12-16.
- Pleil JD, Wallace MA, Madden MC, and Winters B, 2017. Breath biomarkers: non-targeted (discovery) measurements for environmental and clinical applications, PittCon 2017, Chicago, IL, March 6-10.
- Pleil JD, 2017. Overview of *in vitro* cellular respiration (gas-phase) analysis as a complement to systemic *in vivo* human metabolome discovery, PittCon 2017, Chicago, IL, March 6-10.
- Pleil JD and Funk WE, 2016. Human biomonitoring and *in vitro* toxicity testing applications for covert threat analysis and security applications, invited symposium lecture, PittCon 2016, Atlanta, GA, March 6-10.
- Winters BR, Pleil JD, and Beauchamp JD, 2016. Exhaled breath diagnostics: potential applications for real-time analysis at organism (*in vivo*) and cellular (*in vitro*) levels of organization, plenary lecture, 7th International PTR-MS Conference, Obergurgl, Austria, Feb. 14-19.
- Pleil JD, 2015 Exposure Science at US EPA: Linking environmental measurements to *in vivo* and *in vitro* biomonitoring data, invited lecture, Thayer School of Engineering, Dartmouth College, Hanover NH Oct. 9.
- Pleil JD, 2015. Publish or perish: improving your chances with the journal's editor, lecture ENVR 400, Oct. 7.
- Pleil, JD, 2015. Human exhaled breath condensate (EBC) media: Implementation of automated Quanterix SIMOA immunochemistry platform, plenary lecture, International Association of Breath Research, Vienna, Austria, Sept. 12-18.
- Pleil JD, 2015. The human exposome and systems biology: Ongoing empirical measurement studies and biomarker interpretation, HERCULES Workshop, Georgia Tech, Atlanta GA, May 26-28, 2015.
- Pleil JD, 2015. Human exposure science: linking environmental and biomonitoring data, invited lecture, Northwestern University, Evanston, IL, April 16, 2015.
- Pleil JD, 2015. Human exposure science: new research areas for medical and public health applications, invited lecture, Feinberg School of Medicine, Northwestern University, Chicago, IL, April 16, 2015.
- Pleil JD, Angrish MM, Madden MC, 2015. Adverse outcome pathways (AOPs) in human systems biology: Gas-phase probes for assessing *in vitro* enzyme system perturbations, invited symposium lecture, PittCon 2015, New Orleans, LA, March 8-12.

Angrish MM, Madden MC, Pleil JD, 2014. "Gas phase probe molecules for assessing *in vitro* metabolism to infer an *in vivo* response." *ToxCast Data Summit*, US EPA, September 29–30.

Pleil, JD. 2014. "Breath-borne Biomarkers: a) Timing and exposure reconstruction b) Implementing aerosols sampling and analysis", invited subject matter expert presentation, JASON Committee Meeting, FBI Weapons of Mass Destruction Directorate, San Diego, CA, June 26.

Pleil JD and Miekisch W, 2014. "Analysis of microbiome contributions to the human biomarker metabolome", invited symposium, PittCon 2014, Chicago, IL, March 4.

Pleil, JD, 2014. "Introduction to using breath-borne biomarkers in exposure assessment research: invited lecture, ENVR 770 Biological Monitoring, University of North Carolina, Chapel Hill, NC, Feb. 19.

Pleil JD, 2014. "High-throughput toxicity testing of environmental chemicals: Potential mid-infrared applications for *in vitro* assessments", invited lecture, Princeton University, NJ, Feb. 17.

Pleil JD, 2014. "Quantitative exposure science: using *in vivo* biological measurements for discovery and target analyses", invited lecture, Northwestern University, Evanston, IL, Feb. 11.

Pleil JD, Stiegel MA, Kormos TM, and Sobus JR, 2013. "Identifying potential confounders from the pulmonary microbiome in suites of nominally endogenous human metabolites in exhaled breath", *Breath Summit 2013*, Saarbrücken Germany, June 8-13.

Stiegel MA, Pleil JD, Kormos TM and Sobus JR, 2013. "Methods development for inflammatory markers in exhaled breath condensate samples and exhaled aerosols", *International Association for Breath Research: Breath Analysis Summit 2013*, Saarbrücken, Germany, June 8-13.

Madden MC, Stevens T, Case M, Sobus JR, Stiegel MA, Diaz-Sanchez D, Cascio W, Devlin RB, and Pleil JD, 2013. "Controlled exposures of human volunteers to diesel engine exhaust: Biomarkers of exposure and health outcomes", *International Society for Aerosols in Medicine*, University of North Carolina, Chapel Hill, NC, April 6-10.

Pleil JD, Stiegel MA, Wolfgang MC, Council S, Sobus JR, Kormos TM, and Madden MC, 2013. "Breath biomarkers from viable pulmonary aerosols: discovery of human micro-biome contributions", *Society of Toxicology: 52nd Annual Meeting and ToxExpo*, San Antonio, TX, March 8-13.

Pleil JD, 2013. "Exploring the human exposome: Linking *in vivo* human studies to *in vitro* toxicity testing", *Society of Toxicology, RTP Regional Meeting*, Research Triangle Park, NC, February 21.

Pleil JD, 2013. "Quantitative Exposure Science: Linking environmental measurements to *in vivo* human biomonitoring data", *Program in Public Health (PPH 303)*, Northwestern University, Evanston, IL, February 12.

Pleil JD, Stiegel MA, Kormos TM and Madden MC, 2012 "Environmental health applications for exhaled breath aerosols: Investigations of inflammatory proteins and opportunistic infections", plenary lecture: *International Breath Analysis Meeting*, Sonoma, CA, October 28-November 1.

Pleil JD, 2012. "Collaborative Efforts between EPA Regions and HEASD/NERL: Focus on Methods Development and Applications", *US EPA Superfund Regional Managers Meeting*, Research Triangle Park, NC, October 25.

Pleil JD, 2012 "Preliminary chemical investigation of used coalescer "socks" from F-22 aircraft", *NASA F-22 Life Support Systems Independent Analysis Team*, Johnson Spaceflight Center, Houston TX, August 6.

Pleil JD, 2012 "Pulmonary function changes from controlled inhalation exposures to ozone and diesel exhaust", *NASA F-22 Life Support Systems Independent Analysis Team*, NASA Langley Research Center, Langley, VA, May 23.

Pleil JD, 2012. "New CSS biomonitoring projects for linking *in vivo* human studies to *in vitro* toxicity testing", *Human Exposure and Atmospheric Sciences Work in Progress Lecture Series*, US EPA, Research Triangle Park, NC, April 18.

Pleil JD, 2012. "Breath Biomarkers in Environmental Health Science: Decoding the Human Exposome", invited symposium lecture, *PittCon 2012*, Orlando, FL, March 12.

Pleil JD, 2011. "Urban exposure science: from environmental media measurements of the 2001 WTC disaster forward to health assessments based on human biomarker methodology", invited lecture, *University of Chicago's 6th Chicago Core Conference on "Biosocial and technology based approaches to urban health and aging"*, Chicago, IL, Oct. 25, 2011.

Stiegel MA, Pleil JD, Sobus JR, Kormos TM, Mazurek W, Gan TH, De Nola G, and Hanhela PJ, 2011. "Human blood biomarker measurements from chemical exposures onboard an Australian *Collins* class diesel submarine", *Air Independent Propulsion (AIP) and Related Atmosphere Control Technologies, Submarine Air Monitoring and Air Purification (SAMAP)*, Taranto, Italy, Oct. 9 -15.

- Pleil JD, Stiegel MA, and Sobus JR, 2011. "Breath Biomarkers in Environmental Health Science: Exploring Patterns in the Human Exposome", Breath Analysis Summit 2011: International Conference on Breath Research, Parma Italy, Sept. 11-14, 2011.
- Pleil JD, 2011. "Using human biomarker measurements to link environmental exposure to internal dose", invited lecture, NIOSH Research Center, Morgantown, WV, March 29.
- Pleil JD, Stiegel MA, Madden MC, Sobus JR, 2011. "Dealing with analytical results from breath analysis: What is real, what is background, and what is random?", invited lecture, PittCon 2011, Atlanta, GA, March 14.
- Pleil JD, Stiegel MA, Madden MC, and Sobus JR, 2010. "Heat Map Visualization of Complex Breath Biomarker Measurements for Environmental and Intelligence Applications", invited lecture, Exhaled Breath Analysis: from Sensors to Devices to Applications, Engineering Conferences International, Barga Italy, Oct. 24-30.
- Pleil JD, 2010. "Systems Biology Approaches for Environmental Exposure Science at the Individual Level", invited lecture, Environmental Sciences and Engineering Dept. University of North Carolina, March 16.
- Pleil JD, 2010. "Breath Tests in Medicine: How do we deal with inspired air and other external environmental exposures?", invited lecture, PittCon 2010, Orlando, FL, March 2.
- Pleil JD, 2009. "Overview of EPA biomarker research for Environmental Exposure Science", invited seminar, Mechanical Engineering Dept., University of Colorado, Boulder, CO, Nov. 2.
- Pleil JD, Stiegel MA, Sobus JR, Tabucchi S, Ghio AJ, and Madden MC, 2009. "Human blood and plasma analysis for trace-level polycyclic aromatic hydrocarbons (PAHs)", invited speaker, International Submarine Air Monitoring and Purification Conference, San Diego, CA, Oct. 18-22.
- Pleil JD, 2009. "Interpreting environmental exposures using human biomarker measurements and a systems biology approach", work in progress seminar series, Human exposure and Atmospheric Sciences Division, U.S. EPA, RTP, NC, Sept. 16.
- Pleil JD, 2009. "Overview of interpreting environmental influences on the assessment of exhaled breath measurements", invited plenary lecture, International Association for Breath Research (IABR), Dortmund, Germany, April 26-30.
- Pleil JD, 2008. "Evidentiary breath analysis for alcohol: chemical interferences and toxicokinetics related to environmental co-exposures", ENVR 400 seminar, School of Public Health, University of North Carolina, Chapel Hill, NC. Sept. 24.
- Pleil JD, 2008. "Exhaled Breath Analysis for Environmental Exposure Assessment", invited speaker, Mid-infrared Technologies for Health and Environment (MIRTHE) workshop, Johns Hopkins University, Baltimore, MD. Aug. 8.
- Pleil JD, 2008. "Environmental Exposure Assessment", invited lecture series, Dept. of Chemistry and Industrial Chemistry, University of Pisa, and Institute of Clinical Physiology, National Research Council, Italy, July 19 – Aug. 1.
- Pleil JD, 2008. "Interpretation of human biomarkers for exposure reconstruction", invited speaker, workshop for exposure assessment, University of California, Los Angeles (UCLA), CA. July 9-11.
- Pleil JD, 2008. "Non-traditional Biometrics for Threat Assessment", invited speaker and panelist, Air Force Office of Scientific Research (AFOSR), Arlington, VA. May 20-21.
- Pleil JD, 2008. "Diacyetyl methods evaluation", invited reviewer and panelist, National Institute of Occupational Safety and Health (NIOSH), Cincinnati, OH. April 1 -2.
- Pleil JD, 2008. "Blood Biomonitoring", Invited panelist and speaker, InQTel meeting for Intelligence (CIA, NSA, DHS) Technology, San Francisco, CA, Jan 29-31.
- Pleil JD, 2007. "Role of exhaled breath biomarkers in environmental health science", Invited plenary speaker; Breath Summit, International Association of Breath Research (IABR), Cleveland Clinic Foundation, Cleveland OH, Nov. 1-4.
- Pleil JD, Madden MC, Sobus JR, Hubbard HF, 2007. "Biomarker Study of Controlled Human Exposures to Diesel Exhaust: Calibrating the Metabolic Response to Well Characterized Environmental Pollutant Levels", Conference of the International Society of Exposure Analysis (ISEA), Durham, NC Oct. 14-18.
- Pleil JD, Sobus JR, and Madden MC, 2007. "Environmental and biomarker measurements of polycyclic aromatic hydrocarbons as indicators of human diesel exhaust exposure using controlled chamber studies", invited lecture, Submarine Atmospheres Monitoring and Purification (SAMAP), Amsterdam, Netherlands, Oct. 6-11.
- Pleil JD and Glover PL, 2007. "Chemical and toxicokinetic evaluation of environmental exposures to solvents and fuels as potential interferences on evidentiary breath alcohol analyzers", invited plenary

- speaker, 20th Annual Meeting of the International Association for Chemical Testing (IACT), Wilmington, NC, May 6-10.
- Pleil JD, Sobus JR, Hubbard HF, and Madden MC, 2007. "Sample extraction and GC-MS analysis for water soluble volatile organic compounds in liquid biological media", Invited presentation, EnviroAnalysis 2007, Wellington, New Zealand, February 6-9.
- Pleil JD and Sobus JR, 2006. "Measurement method for volatile organic biomarkers in exhaled breath condensate", Invited presentation, International Scientific Meeting on Breath Analysis in Physiology and Medicine, sponsored by International Association for Breath Research, Prague, Czech Republic, Sept. 4-5.
- Smith JP, Olsen CR, Gontz AM, Benedict LA, Bopp RF, Pleil JD, Funk WE, and Rappaport SM, 2006. "Conducting Environmental Forensics in Dynamic Highly Urbanized Estuarine Systems: Lessons Learned from Investigating the Impact of the World Trade Center Attack on the Sediments of New York Harbor", Geological Society of America, Northeast Section – 41st Annual Meeting, Harrisburg, PA March 20-22.
- Sheldon LS, Morgan M, and Pleil JD, 2006. "Biomonitoring: Interpretation and Uses", International Life Sciences Institute (ILSI) Annual Meeting, San Juan, Puerto Rico, Jan. 16.
- Pleil JD, 2005. "Human Biomonitoring to Link Environmental Exposure to Biologically Relevant Dose", Invited presentation, International Life Sciences Institute Meeting (ILSI), Research Triangle Park, NC, Dec. 15-16.
- Kim D, Nylander-French L, Pleil JD, Prah JD, and Ashley DL, 2005. "Development of a Physiologically-Based Pharmacokinetic Model for Dermal Absorption and Penetration of Methyl *Tertiary* Butyl Ether in Humans", International Conference Occupational and Environmental Exposures of Skin to Chemicals (OEESC-2005) Karolinska Institute, Stockholm, Sweden, June 12 – 15.
- Pleil JD, Chao E, Egeghy PP, Nylander-French L, and Rappaport SM, 2005. "Exhaled Human Breath Measurement of Jet Fuel Constituents: Distinguishing between Inhalation and Dermal Exposure Routes", Invited plenary lecture, International Conference of Breath Analysis for Medical Diagnosis and Therapeutic Monitoring", University of Innsbruck, Austria, May 26-28.
- Pleil JD, 2005. "Assessing Carcinogenic Polycyclic Aromatic Hydrocarbons (PAH) Levels in the Aftermath of the New York World Trade Center Disaster", Invited Seminar, Louisiana State University Medical Center, New Orleans, March 8.

NARRATIVE

Over the past 40+ years, I have worked with many aspects of environmental science especially in analytical methods and instrument development. Using laboratory results from our field and applied studies with human subjects, I have also developed stochastic and classical pharmacokinetic models for the uptake, metabolism and eventual disposition of various organic carcinogens (or suspected carcinogens) including vinyl chloride, benzene, chloroform, MTBE, trichloroethene, tetrachloroethene and diesel exhaust constituents. Currently, there are a number of my analytical methods based on cryogenic focusing (air/breath), liquid-liquid (and solid-liquid) extraction for blood, urine and dust in use for trace analysis at the Agency and other institutions. Over the years I have worked in collaboration with most branches of the military, as well as DoD, NASA, NATO, NIOSH, CDC, AFOSR, and DoE. I have provided Agency expertise to the U.S. Navy's Undersea Medical Institute, have trained Marine Corps personnel in Okinawa, and participated in the U.S. Air Force's inter-services military Jet Fuel exposure study as the senior Government scientist. Since 2001, I have been involved with the World Trade Center (WTC) disaster and its environmental/health aftermath. In my most recent position, I developed laboratory methods for measuring and identifying patterns of endogenous and chemical biomarkers, constructed mathematical, statistical, and systems biology approaches to interpret exposures to environmental stressors, and, as an adjunct Professor, continue to teach "Environmental Exposure Assessment" for graduate students in the Gillings School of Public Health of the University of North Carolina, Chapel Hill. I retired from Federal Service Dec. 31, 2019. I continue to serve as peer reviewer for various government agencies, technical advisor to NASA Engineering Safety Center (NESC), Editor-in-Chief of JBR, and adjunct Professor at UNC.

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