

## CURRICULUM VITAE

### PAUL BRADFORD SHEPSON

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#### I. **General Information:**

##### **A. Education:**

**B.S.** 1978 S.U.N.Y. College at Cortland (Chemistry)

**Ph.D.** 1982 Pennsylvania State University (Analytical/Atmospheric Chemistry)

##### **B. and C. Professional Career:**

1982 Research Chemist, Mobil Research and Development Corp., Motor Gasoline Group, Paulsboro, N.J.

1982-1987 Research Chemist, Northrop Services, Inc. (on-site Contractor U.S. EPA, Atmospheric Sciences Research Laboratory, Research Triangle Park, N.C.)

1987-1991 Assistant Professor, Department of Chemistry, York University, Toronto, Ontario.

1988-1993 Acting Director, Centre for Atmospheric Chemistry (CAC), York University

1991-1994 Associate Professor (with tenure), York University, Toronto, Ontario.

1994-2006 Adjunct Professor, Department of Chemistry, York University

1994- Professor, Departments of Chemistry, and Earth and Atmospheric Sciences, Purdue University, West Lafayette, IN

2000 Visiting Scientist, Pacific Northwest National Labs, Environmental Molecular Sciences Laboratory, Richland, WA

2001; 2008 Visiting Professor, University of Innsbruck, Institute for Ion Physics, Austria

2003-2006 Head, Analytical Chemistry Division, Dept. of Chem., Purdue University

2004-2006 Founding and Interim Director of the Purdue Climate Change Research Center

2006-2008 Director, Purdue Climate Change Research Center

2008-2013 Head, Department of Chemistry, Purdue University

##### **D. Awards**

Ontario Ministry of Environment and Energy 1994 Excellence in Research and Technology Development Award

AGU 1999 Editor's Citation for Excellence in Refereeing

AGU 2006 Editors' Citation for Excellence in Refereeing for JGR-Atmospheres

Fellow of the American Association for the Advancement of Science, elected 2010

Fellow of the American Geophysical Union, elected 2011

2012 Purdue College of Science Graduate Student Mentoring Award

Walter Orr Roberts Lecturer in Interdisciplinary Sciences Award (American Meteorological Society (2015))

##### **E. Professional Associations:**

American Chemical Society

American Geophysical Union

European Geophysical Union

Air and Waste Management Association

American Society for Mass Spectrometry

American Association for the Advancement of Science

**F. Areas of Expertise:**

- Climate and Earth System Science
- Funding and organizing large scale international collaborative environmental science research projects
- Atmospheric Chemistry
- Atmospheric Chemistry and Analytical Chemistry Education
- Atmospheric Photochemistry and Free Radical Reaction Kinetics and Mechanisms
- Analytical Methods Development
- Aviation, and Aircraft Instrumentation Development
- Smog Chamber Studies
- Computer Modelling of Atmospheric Processes
- Atmospheric Pollutant Measurements
- Gas, Liquid, and Ion Chromatographic Techniques
- Quadrupole and Ion Trap mass spectrometry
- Atmospheric Mutagenesis
- Use of in-vitro and in-vivo Bioassay Techniques for Identification of Atmospheric Mutagens
- Snow chemistry/Arctic Chemistry
- Climate Change and Atmospheric Chemistry
- Commercial, Multi-Engine and Instrument-Rated Pilot (1700+ hrs)

**II. Learning**

**A. Teaching Assignments**

Semester & Year	Course Number, Credit Hour & Type	Title of Course	# of Students	Student Classification
Fall 2013	EAPS 521/CHM 581	Atmospheric Chemistry	40	Graduate
Fall/Spring 2012-2013	CHM 499	Undergraduate Research	2	Undergraduate
Fall/Spring 2011-2012	CHM 499	Undergraduate Research	2	Undergraduate
Fall/Spring 2010-2011	CHM 499	Undergraduate Research	2	Undergraduate
Fall/Spring 2009-2010	CHM 499	Undergraduate Research	2	Undergraduate

Teaching evaluation, Fall 2013, CHM581/EAPS521 ("Atmospheric Chemistry"):

Q5 Overall, I would rate this course as 4.0/5.0

Q6 Overall, I would rate this instructor as 4.1/5.0

**III. Teaching History: (Other contributions)**

**Undergraduate (York U.)**

Fall 1987	SC/CHEM 3110.08	Analytical Chemistry
Fall/Winter 1987/88	SC/CHEM 4100.06	Research Project (Les Toth)
Summer 1988	SC/CHEM 4100	Research Project (Leslie Topham)
Fall 1988	SC/CHEM 3110.08	Analytical Chemistry
Fall 1989	SC/CHEM 3110.04	Analytical Chemistry
Winter 1989	SC/NATS 1770.06B	Science and the Environment
Winter 1990	SC/NATS 1770.06B	Science and the Environment
	SC/CHEM 3120.04	Instrumental Methods of Chemical Analyses

	SC/CHEM 4100.03	Research Project (Talbir Singh)
	SC/CHEM 4060.03	Selected Topics in Chemistry (Talbir Singh)
Fall 1990	SC/CHEM 3160.03/ EATS 3130.03	Introductory Atmospheric Chemistry
	SC/CHEM 4060.03	Selected Topics in Chemistry (Norman Dean)
Winter 1991	SC/CHEM 2110.05	Analytical Chemistry
	SC/CHEM 4100	Research Project (Anna Sirju)
Winter/Spring 1991	SC/NATS 1770.06	Science and the Environment
Fall 1991	SC/CHEM 3160.03/ EATS 3130.03	Introductory Atmospheric Chemistry
	SC/CHEM 4100.06	Research Project (Jason O'Brien)
Winter 1992	SC/CHEM 2110.05	Analytical Chemistry
Fall 1992	SC/CHEM 3160.03/ EATS 3130.03	Introductory Atmospheric Chemistry
	SC/CHEM 4100.06	Research Project (Liz Frankford)
Winter 1993	SC/CHEM 2110.05	Analytical Chemistry
	SC/NATS 1820.06	Chemistry in Modern Living
Fall/Winter 1993/94	SC/CHEM 4100.06	Research Project (Mary Boseovski; Kok Zhi Khoo; Craig Stroud)
Winter 1994	SC/CHEM 3130.04	Atmospheric Chemistry Measurements

### Undergraduate (Purdue)

Spring 1995	CHM490A	Atmospheric Chemistry
Spring 1995	CHM 499	Undergraduate Research (Kim Pollins, Charlie Shonn Stanley)
Snyder,		
Fall 1995	CHM481	Environmental Chemistry
Fall 1995	CHM 499	Undergraduate Research (Kim Pollins, Jeff Hardy, Megan McMahon)
Summer 1996	CHM 499	Undergraduate Research (Steve Yontz)
Fall/Spring 96/97	CHM 499	Undergraduate Research (Chris Bowman, Megan McMahon, Kim Pollins, Jaime Ursta)
Spring 1997	CHM 481	Environmental Chemistry
Fall/Spring 97/98	CHM 499	Undergraduate Research (Stormy Ratajczak, Ralph Holler)
Spring 1998	CHM481	Environmental Chemistry
Fall/Spring '98/'99	CHM 499	Undergraduate Research (Stormy Ratajczak, Ralph Holler)
Fall/Spring '99/'00	CHM 499	Undergraduate research (Stormy Ratajczak)
Spring 1999	CHM481	Environmental Chemistry
Spring 2000	CHM 481	Environmental Chemistry
Spring 2001	CHM481	Environmental Chemistry
Spring 2002	CHM481	Environmental Chemistry
Summer 2002	CHM115	General Chemistry
Spring 2003, 2004, 2006	CHM481	Environmental Chemistry
Spring 2007	CHM599	Carbon Neutrality at Purdue
Spring 2007	CHM499	Undergraduate Research (Ben Nault; Megan Williams)

Fall/spring 2008	CHM499	Undergraduate research (Ben Nault; Tennie Renkens; Arisa Iwasaki)
Fall/spring 2009/2010	CHM499	Undergraduate research (Ben Nault; Tennie Renkens; Greg Hopkinson; Cyrus Baker)
Fall/Spring 2010/2011	CHM499	Undergraduate Research (Ben Nault; Cyrus Baker)
Fall/Spring 2011/2012	CHM499	Undergraduate Research (Cyrus Baker; Rachel Svetanov)
Fall/Spring 2013/2014	CHM499	Undergraduate Research (Ye Xuan Gan)
Fall/Spring 2013/2014	CHM499	Undergraduate Research (Hao Zong)
Fall 2013	EAPS521	CHM581 Atmospheric Chemistry
Spring 2014	CHM499	Undergraduate Research (Leigh Anderson)

### Graduate (York U.)

Summer 1988	SC/CHEM 6010.03	Review Essay
Winter 1989	SC/CHEM 5610.03	Special Topics in Atmospheric Chemistry
Fall 1990	SC/ESS 5300.03	Introductory Atmospheric Chemistry
Fall 1991	SC/CHEM 5710.03	Recent Advances in Atmospheric Chemistry
Fall 1992	SC/CHEM 5170.03	Special Topics in Chemical Physics

### Graduate (Purdue)

Spring 1995	ATMS 591	Atmospheric Chemistry
Fall 1995	CHM 695A	Seminar in Analytical Chemistry
Spring 1996	ATMS591/CHM599	Atmospheric Chemistry
Spring 1996	CHM695A	Seminar in Analytical Chemistry
Fall 1996	ATMS551/CHM599	Atmospheric Chemistry
Fall >96/Spring >97	CHM 695A	Seminar in Analytical Chemistry
Fall 1997	CHM581/ATMS551	Atmospheric Chemistry
Fall '97/Spring '98	CHM 695A	Seminar in Analytical Chemistry
Fall 1998	CHM581/ATMS551	Atmospheric Chemistry
Fall '98/Spring '99	CHM 695A	Seminar in Analytical Chemistry
Fall '99/Spring00	CHM 695A	Seminar in Analytical Chemistry
Fall '99	CHM581/ATMS551	Atmospheric Chemistry
Fall '01	CHM581/EAS521	Atmospheric Chemistry
Fall '02	CHM599C/EAS591C	Atmosphere-Surface Chemical Interactions
Fall '03, '05, '06, '07, '13	CHM581/EAS521	Atmospheric Chemistry

### External

Summer 1989/ Summer 1990	CIRAC Summer Course - Lectures on Chemical Kinetics and Smog Chamber Studies
Summer 1991, 1992 1993, 1994	CIRAC Summer Course - Course Organizer

### Creative Endeavor, Research

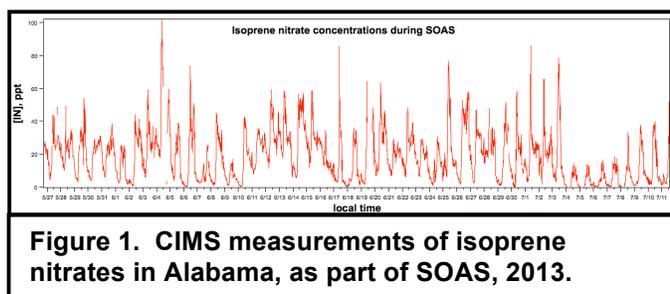
#### A. Description of Research

Paul Shepson's research addresses pressing problems in analytical chemistry, and atmospheric chemistry and climate change, leading research efforts in three areas, namely biosphere-atmosphere interactions in forest environments, cryosphere-atmosphere interactions in the Shepson Full CV, Revised November 2013

Arctic, and greenhouse gas flux measurements. These are discussed in more detail below, focusing on recent activities and accomplishments.

1. **Biosphere-atmosphere interactions in forest environments.** The Shepson Group studies the impact of biogenic volatile organic compound (BVOC) fluxes on the composition of the atmosphere, in particular, their impact on the production of ozone and aerosols, and the interactions between anthropogenic and biogenic pollutants. They have also been focused on studies of the distribution of atmospheric nitrogen species, and the impact of deposition of those species on carbon cycling in forest ecosystems. This work is supported by analytical method development, e.g. their recent development of the Proton Transfer Reaction Linear Ion Trap (PTRLIT; Mielke et al., *Anal. Chem.*, 2008). Dr. Shepson's group has been a part of the recent revolution in atmospheric chemistry measurements that has been enabled by developments in mass spectrometry. Examples will be discussed below.

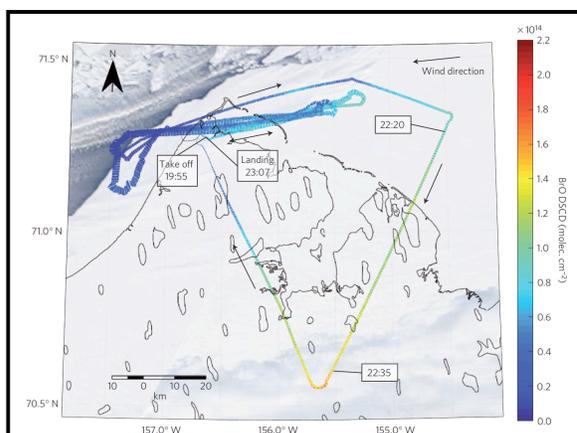
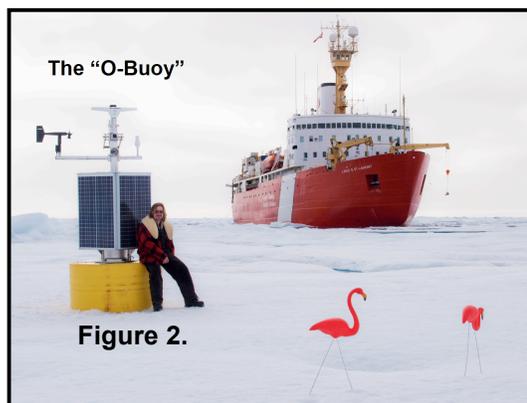
An important hot topic for geoscientists is the nature of the "terrestrial carbon sink", i.e. the current terrestrial vegetation sink for about 20% of all CO<sub>2</sub> emitted into the atmosphere. Dr. Shepson's group has partly focused on the extent to which deposition of anthropogenic nitrogen species to North American forests may impact primary productivity and thus CO<sub>2</sub> uptake in those forests. In 2011 his group published a paper (Costa et al., *Geophys. Res. Lett.*, 2011) in which they used measurements of the stable isotopes <sup>17</sup>O and <sup>18</sup>O in nitrate ions (working with researchers in EAPS at Purdue and others at U. Washington) in cloud water, rainwater, and forest soil cores to show that on the order of 20-30% of the nitrogen needed for forest growth is derived from dry and wet deposition of atmospheric nitrogen, mostly in the form of ammonium and nitrate. However, some of the nitrogen that deposits is organic nitrogen. For the past two (+) decades, Shepson's group has been studying the production of atmospheric organic nitrates, that are produced via atmospheric oxidation of volatile organic compounds (VOCs) in the presence of nitric oxide (emitted mostly from combustion). A particularly important VOC is isoprene, which is a volatile organic compound emitted by trees as a natural thermoregulator and antioxidant. Shepson's group was the first to show that organic nitrates from OH radical reaction with alkenes (e.g. propene (Shepson et al., *ES&T*, 1985) and isoprene (Chen et al., *JGR*, 1998; O'Brien et al., *JGR*, 1995, *J. Phys. Chem.*, 1998)) are important sinks for atmospheric NO<sub>x</sub>. Shepson's group (Grossenbacher et al., *JGR*, 2001) was the first to conduct quantitative ambient measurements of the atmospheric nitrates produced from isoprene oxidation (the "isoprene nitrates") and show that they can be an important component of atmospheric nitrogen. His graduate student Amanda Lockwood showed (Lockwood et al., *GRL*, 2008) that growing trees can uptake organic nitrates through the stomata, and utilize that nitrogen in the production of amino acids and proteins. His group also synthesized and determined the relative yields of the 8 isomeric isoprene nitrates (Lockwood et al., *Atmos. Chem. Phys.*, 2010) so that rational decisions could be made about which species are important for further study. His group also conducted a 1D computer model study of organic nitrate production in a northern Michigan forest (Pratt et al., *Atmos. Chem. Phys.*, 2012) that showed that isoprene nitrates represented about 90% of organic nitrate production, but that the nitrate radical (NO<sub>3</sub>) is a very important organic nitrate precursor, both at nighttime, and in the daytime. The latter has been a significant surprise to the atmospheric chemistry community. The ability to conduct high time resolution measurements of isoprene nitrates, and other hydroxynitrates, via I<sup>-</sup> chemical ionization mass spectrometry, was just demonstrated by Shepson Group members at the Southern Oxidants and Aerosol Study (SOAS) in rural Alabama, in June/July of 2013. The full data set is shown in Figure 1, at right. For Shepson's group, that is the culmination of over 20 years of work.



Recently, in the process of studying the forms of nitrogen in cloud water (using Shepson's airplane, the Airborne Laboratory for Atmospheric Research, ALAR; <http://science.purdue.edu/shepson/research/bai/alar.html>) and precipitation in North American forests, the Shepson group discovered that warm summertime cumulus clouds contain a large concentration of bacteria, up to 300,000 cells per ml of cloud water (Hill et al., *JGR*, 2007). Then, working with researchers in the Purdue Biology Department, they were able to determine the bacterial species present in the cloud water, using PCR techniques. They found (Kourtev et al., *Atmos. Environ.*, 2011) that cloud water is dominated by cyanobacteria, proteobacteria, actinobacteria, and firmicutes (and that the bacteria were mostly active and replicating in-cloud).

2. **Cryosphere-atmosphere interactions in the Arctic.** For the past couple decades the Shepson Group has been studying halogen chemistry in the Arctic, specifically halogen-mediated destruction of ozone and mercury in the lower part of the atmosphere above the frozen ocean. Their group discovered some of the most important examples of photochemical production of reactive gases that evade from the sea ice/snowpack, to significantly impact the composition of the polar troposphere. This work has also involved various developments of analytical methods that enabled important new measurements in the Arctic. In the late 1990s, his group, in collaboration with others (Finlayson-Pitts, and Honrath), discovered that sunlit snowpacks are photochemically active, leading to emission of photochemically active and important pollutants such as nitrogen oxides (Honrath et al., *GRL*, 1999), molecular halogen species (e.g. Br<sub>2</sub> (Foster et al., *Science*, 2001)), and carbonyl compounds such as formaldehyde (Sumner and Shepson, *Nature*, 1999) and acetaldehyde (Grannas et al., *Atmos. Environ.*, 2002). In 2003, he created the internationally collaborative project OASIS ("Ocean-Atmosphere-Sea Ice-Snowpack") to study these processes. He organized an important OASIS campaign at Barrow, AK in 2009, involving researchers from the U.S., Canada, the UK, Germany, and France. During this campaign, Shepson's group collaborated on two studies of bromine chemistry above the snowpack at Barrow during which an unprecedented array of bromine species was measured (Br<sub>2</sub>, BrCl, BrO, and HOBr; Liao et al., *JGR* 2011; 2012), and Paul's graduate student, Chelsea Stephens, conducted an analysis that showed that bromine atoms are the dominant reactant responsible for the oxidation of elemental mercury in the Arctic (Stephens et al., *JGR*, 2012). He was also part of the project that led to the discovery of large Cl<sub>2</sub> concentrations above the snowpack at Barrow (Liao et al., *Nature Geosci.*, 2013). As part of OASIS, in 2009 his group helped create the "O-Buoy" project, which is a unique and large scale collaborative effort aimed at conducting first-ever year-round measurements of ozone, CO<sub>2</sub>, and BrO around the Arctic Ocean surface, from autonomous instrumented buoys (see a deployed O-Buoy on the Arctic Ocean in Figure 2, above right) tethered by the sea ice (<http://www.o-buoy.org/>). A recent Shepson graduate student, Travis Knepp, published the first O-Buoy paper (Knepp et al., *Atmos. Meas. Tech.*, 2010).

Shepson group discoveries about snowpack and halogen chemistry in the Arctic, Shepson Full CV, Revised November 2013



**Figure 3. Measurements from Shepson's aircraft of BrO over the tundra at Barrow, AK.**



studies of emission and uptake of the important greenhouse gases ozone (O<sub>3</sub>), carbon dioxide (CO<sub>2</sub>) and methane (CH<sub>4</sub>). In 2009 his group published a paper showing that ALAR could be flown in Lagrangian mode (i.e. following the air mass flow), while measuring the total amount of CO<sub>2</sub> in the atmospheric boundary layer, to enable measurement of the rate of uptake of CO<sub>2</sub> by the surface (in the corn belt; Martins et al., *Ag. Forest Meteorol.*, 2009). They have also used their aircraft measurements to enable inverse modeling approaches for determination of regional scale CO<sub>2</sub> fluxes (Lauvaux et al., *Atmos. Chem. Phys.*, 2012). They then used their aircraft to develop a method (the Mass Balance Method) for measurement of the urban area-wide emission rate of CO<sub>2</sub> and CH<sub>4</sub> from the city of Indianapolis (Mays et al., *ES&T*, 2009). The work of Mays et al. enabled Shepson to pull together collaborators from around the country to develop a multi-agency effort on measurement of urban scale greenhouse gas emissions, called the "Indianapolis Flux Experiment" (INFLUX), funded by NIST. More recently, he and ALAR have been focused on studies of the impact of shale gas development on emissions of methane into the atmosphere. Shown in Figure 6 above is an example of a mass balance measurement of CH<sub>4</sub> from a well pad in the Marcellus shale region. The measured methane flux, 34g/s, is 2-3 orders of magnitude larger than the values assumed in the EPA inventory for such wells, that are in the drilling phase. ALAR has become an important resource for studying the impact of this important development in U.S. energy management.

**B. Peer-Reviewed Publications:** (G= Shepson Grad. student, U= Undergrad.,  
P= Postdoc)

165. Liao, J., L. G. Huey, Z. Liu, D. J. Tanner, C. A. Cantrell, J. J. Orlando, F. M. Flocke, P. B. Shepson, A. J. Weinheimer, S. R. Hall, H. J. Beine, Y. Wang, E. D. Ingall, C. R. Stephens<sup>G</sup>, R. S. Hornbrook, E. Apel, A. Fried, L. Mauldin, J. N. Smith, R. M. Staebler, J.A. Neuman, J.B. Nowak, Observations of very high levels of molecular chlorine at Barrow, AK, *Nature Geoscience*, (2014) doi:10.1038/ngeo2046.
164. Son V. Nghiem, Pablo Clemente-Colón, Thomas Douglas, Christopher Moore, Daniel Obrist, Donald K. Perovich, Kerri A. Pratt<sup>P</sup>, Ignatius G. Rigor, William Simpson, Paul B. Shepson, Alexandra Steffen, and John Woods, Studying Bromine, Ozone, and Mercury Chemistry in the Arctic, *EoS Trans., Feature Article*, 94, 289-291, Aug. 13, 2013.
163. Cambaliza, M. O.<sup>P</sup>, P. B. Shepson, D. Caulton<sup>G</sup>, B. Stirm, D. Samarov, A. Possolo, J. Turnbull, T. Lauvaux, K. Davis, K. Mays<sup>G</sup>, C. Sweeney, J. Whetstone, A. Karion, K. Gurney, J. Huang, I. Razlivanov, N. Miles, S. Richardson, B. Moser<sup>U</sup>, A. Hendricks<sup>U</sup>, Assessment of uncertainties of the aircraft-based mass-balance approach for quantifying urban greenhouse gas emissions, *Atmos. Chem. Phys. Discussions*, 13, 29895–29945, 2013.
162. Kerri A. Pratt<sup>P</sup>, Kyle Custard<sup>G</sup>, Paul B. Shepson, Thomas A. Douglas, Denis Pöhler, Johannes Zielcke, Stephan General, Ulrich Platt, William Simpson, Mark Carlsen, David J. Tanner, L. Gregory Huey, Brian H. Stirm, Photochemical Production of Molecular Bromine in Arctic Surface Snowpacks, *Nature Geosciences*, DOI: 10.1038/NGEO1779, 2013.
161. Kerri A. Pratt<sup>P</sup>, Marc N. Fiddler<sup>G</sup>, Paul B. Shepson, Annmarie G. Carlton, and Jason D. Surratt, Cloud water chemistry above the Ozarks' isoprene source region, *Atmos. Environ.*, 77, 231-238, 2013.

160. Griffith, S., R. Hansen, S. Dusanter, P. S. Stevens, M. Alaghmand<sup>P</sup>, S. Bertman, M. Carroll, M. Erickson, M. Galloway, N. Grossberg, J. Hottle, J. Hou, T. Jobson, A. Kammrath, F. Keutsch, B. Lefer, L. Mielke<sup>G</sup>, A. O'Brien, P. B. Shepson, M. Thurlow, W. Wallace, N. Zhang, X. Zhou, OH and HO<sub>2</sub> Radical Chemistry during PROPHET 2008 and CABINEX 2009 – Part 1: Measurements and Model Comparison, *Atmos. Chem. Phys.*, 13, 5403-5423, 2013.
159. Helmig, D., P. Boylan, B. Johnson, S. Oltmans, C. Fairall, R. Staebler, A. Weinheimer, J. Orlando, D. J. Knapp, D. D. Montzka, F. Flocke, U. Frieß, H. Sihler, and P. B. Shepson, Ozone Dynamics and Snow-Atmosphere Exchanges During Ozone Depletion Events at Barrow, AK, *J. Geophys. Res.*, 117, D20303, doi:10.1029/2012JD017531, 2012.
158. J. P. D. Abbatt, J. L. Thomas, K. Abrahamsson, C. Boxe, A. Granfors, A. E. Jones, M. King, A. Saiz-Lopez, P. B. Shepson, J. Sodeau, D. Toohey, C. Toubin, R. von Glasow, S. Wren, and X. Yang, Halogen Activation via Interactions with Environmental Ice and Snow, *Atmos. Chem. Phys.*, 12, 6237-6271, 2012.
157. Paul B. Shepson, Parisa A. Ariya, Clara Deal, D. James Donaldson, Thomas A. Douglas, Brice Loose, Ted Maksym, Patricia A. Matrai, Ocean-Atmosphere-Sea Ice-Snowpack Interactions, Changes, and Feedbacks in Polar Regions: A Scientific Challenge for the 21<sup>st</sup> Century, *EoS Transactions*, American Geophysical Union Feature Article, 93, No. 11, Page 117, 2012 doi:10.1029/2012EO110001, 2012.
156. A. M. Bryan, R. Forkel, S. B. Bertman, M. A. Carroll, S. Dusanter, G. D. Edwards<sup>P</sup>, S. Griffith, A. B. Guenther, R. F. Hansen, D. Helmig, T. Jobson, F. N. Keutsch, B. L. Lefer, S. N. Pressley, P. B. Shepson, P. S. Stevens, and A. L. Steiner, In-canopy gas-phase chemistry during the 2009 CABINEX field campaign: Sensitivity to isoprene chemistry and vertical mixing, *Atmos. Chem. Phys.*, 12, 8829-8849, 2012.
155. N. Zhang, X. Zhou, S. Bertman, M. Alaghmand<sup>P</sup>, P. B. Shepson, and M. A. Carroll, Measurements of Ambient HONO and Vertical HONO Flux Above a Northern Michigan Forest Canopy, submitted, *Atmos. Chem. Phys.*, 12, 8285–8296, 2012.
154. K. A. Pratt<sup>P</sup>, L. H. Mielke<sup>G</sup>, P. B. Shepson, A. M. Bryan, A. L. Steiner, J. Ortega, D. Helmig, C. S. Vogel, S. Griffith, S. Dusanter, P. S. Stevens, M. Alaghmand<sup>P</sup>, Contributions of individual biogenic volatile organic compounds to organic nitrate formation above a mixed forest, *Atmos. Chem. Phys.*, 12, 10125–10143, 2012.
153. J. Liao, L. G. Huey, D. J. Tanner, F. M. Flocke, J. J. Orlando, J. A. Neuman, J. B. Nowak, A. J. Weinheimer, S. R. Hall, J. N. Smith, A. Fried, R. M. Staebler, Y. Wang, J.-H. Koo, C. A. Cantrell, P. Weibring, J. Walega, D. J. Knapp, P. B. Shepson, and C. R. Stephens<sup>G</sup>, Observed and modeled inorganic bromine (HOBr, BrO, and Br<sub>2</sub>) speciation at Barrow, AK in spring 2009, *J. Geophys. Res.*, 117, D00R16, doi:10.1029/2011JD016641.
152. G. D. Edwards<sup>P</sup>, D. K. Martins<sup>G</sup>, T. K. Starn, K. A. Pratt<sup>P</sup>, and P. B. Shepson, A disjunct eddy accumulation system for the measurement of BVOC fluxes: Lab characterizations and Field deployment, *Atmos. Meas. Tech.* 5, 2115-2132, 2012.
151. T. Lauvaux, A. E. Schuh, M. Uliasz, S. Richardson, N. Miles, L. I. Diaz, D. Martins<sup>G</sup>, P. B. Shepson, and K. J. Davis, Constraining the CO<sub>2</sub> budget of the Corn Belt: Exploring

Uncertainties from the Assumptions in a Mesoscale Inverse System, *Atmos. Chem. Phys.*, *12*, 337–354, 2012.

150. A. W. Costa<sup>G</sup>, G. Michalski, B. Alexander, and P. B. Shepson, Analysis of Atmospheric Inputs of Nitrate to a Temperate Forest Ecosystem from  $\Delta^{17}\text{O}$  Isotope Ratio Measurements, *Geophys. Res. Lett.*, *38*, L15805, doi:10.1029/2011GL047539, 2011.
149. C. R. Stephens<sup>G</sup>, P. B. Shepson, A. Steffen, J. W. Bottenheim, J. Liao, L. G. Huey, E. Apel, A. Weinheimer, S. V. Nghiem, and S. R. Hall, The relative importance of chlorine and bromine radicals in the oxidation of atmospheric mercury at Barrow, Alaska, *J. Geophys. Res.*, *117*, D00R11, doi:10.1029/2011JD016649.
148. M. M. Galloway, J. P. DiGangi, J. R. Hottle, A. J. Huisman, L. H. Mielke<sup>G</sup>, M. Alaghmand<sup>P</sup>, P. B. Shepson, J. Weremijewicz, H. Klavon, F. M. McNeal, M. A. Carroll, S. Griffith, R. F. Hansen, P. S. Stevens, S. B. Bertman, and F. N. Keutsch, Observations and Modeling of Formaldehyde at the PROPHET Mixed Hardwood Forest Site in 2008, *Atmos. Environ.*, *49*, 403–410, 2012.
147. Son V. Nghiem, Ignatius G. Rigor, Andreas Richter, John P. Burrows, Paul B. Shepson, Jan Bottenheim, David G. Barber, Alexandra Steffen, Jeff Latonas, Feiyue Wang, Garry Stern, Pablo Clemente-Colón, Seelye Martin, Dorothy K. Hall, Philip Tackett<sup>G</sup>, Gregory Neumann, and Matthew Asplin, Field and satellite observations of the formation and distribution of Arctic atmospheric bromine above a rejuvenated sea ice cover, in press, *J. Geophys. Res.* *117*, D00S05, doi:10.1029/2011JD016268, 2012.
146. M. Alaghmand<sup>P</sup>, P. B. Shepson, T. K. Starn, B. T. Jobson, W. Wallace, M. A. Carroll, S. B. Bertman, B. Lamb, S. Edburg, X. Zhou, E. Apel, D. Riemer, P. Stevens, and F. Keutsch, The Morning  $\text{NO}_x$  Maximum in the Forest Atmosphere Boundary Layer, *Atmos. Chem. Phys. Discuss.*, *11*, 29251–29282, 2011.
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**Submitted:**

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3. Joel D. Rindelaub<sup>G</sup>, Kevin M. McAvey<sup>G</sup>, and Paul B. Shepson, The Variable Yields of α-

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5. Caulton, Dana R.<sup>G</sup>, Paul B. Shepson, Renee L. Santoro, Jed P. Sparks, Robert W. Howarth, Anthony Ingraffea, Maria O. Cambaliza<sup>P</sup>, Colm Sweeney, Anna Karion, Kenneth J. Davis, Brian H. Stirm, Stephen A. Montzka, and Ben Miller, Quantification of Methane Emission from Shale Gas Development, *Proc. Nat. Acad. Sci.*, under review, 2013.
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#### **To be Submitted:**

1. Jocelyn Turnbull, Colm Sweeney, Anna Karion, Timothy Newberger, Pieter Tans, Scott Lehman, Kenneth Davis, Natasha Miles, Scott Richardson, Thomas Lauvaux, Maria Obiminda Cambaliza<sup>P</sup>, Paul Shepson, Kevin Gurney, Yang Song, and Igor Razlivanov, Effects of sampling location and choice of background in atmospheric measurements of fossil fuel CO<sub>2</sub> and trace gas emissions from an urban area, in preparation for submission to *Atmos. Chem. Phys.*, 2013.
2. Cambaliza, M. O.<sup>P</sup>, P. B. Shepson, D. Caulton<sup>G</sup>, B. Stirm, J. Bogner, K. Spokas, O. Salmon, T. Lavoie, B. Moser, C. Miller, A. Hendricks, C. Obermeyer, J. Turnbull, T. Lauvaux, K. Davis, C. Sweeney, J. Whetstone, K. Prasad, E. Crosson, N. Miles, and S. Richardson, "Quantification and Source Apportionment of the Methane Flux from the City of Indianapolis", in preparation for submission to *Atmos. Chem. Phys.*, 2013.
3. Stephens, C. R.<sup>G</sup>, P. B. Shepson, J. Liao, L. G. Huey, and C. Cantrell, Bromine atom production and chain propagation during springtime Arctic ozone depletion events in Barrow, Alaska, *Atmos. Chem. Phys.*, in preparation for submission, 2013.

#### **Other non-peer-reviewed publications**

Annamarie G. Carlton, Eleana Little, Michael Moeller, Stella Odoyo, and Paul B. Shepson, The Data Gap: Can a Lack of Monitors Obscure Loss of Clean Air Act Benefits in Fracking Areas? *Environmental Science & Technology*, December 23, 2013.

#### **C. Invited Presentations:**

1. "The Atmospheric Chemistry and Toxicology of Peroxyacetyl Nitrates (PAN)", York U. Chemistry Department Seminar, November 1989.
2. "Is the Chemistry and Composition of the Atmosphere Changing?" CHEMED '89. Queens University, Kingston, Ontario. August 16, 1989

3. "Measurements of Carbonyl Compounds During EMEFS", Atmospheric Environment Service, Downsview, Ontario, March 1989.
4. "Mechanisms for the Atmospheric Production of Peroxyacetyl Nitrate (PAN)", Atmospheric Environment Service, Downsview, Ontario, February 1988.
5. "Photochemical Smog and Air Pollution", Invited Lectures, Department of Chemistry, Queens University, Queen University, Kingston, Ontario, November 1987.
6. P.B. Shepson. "Are we Changing the Composition of the Atmosphere?" Science Teachers Association of Ontario Conference, Toronto, November 1-3, 1990.
7. "Atmospheric Chemistry at the Dorset Site", Ontario Ministry of the Environment - Technology Transfer Conference, Toronto, Ontario, November 25, 1991.
8. "PAN and Oxidant Chemistry", CIRAC/AWMA Joint International Conference on Atmospheric Chemistry - The Role of Models in Understanding Atmospheric Chemistry. Toronto, Ontario, Jan. 27, 1992.
9. "Mutagenicity of PAN *in vivo*", Workshop on the Genotoxicity and Dosimetry of Atmospheric Transformation Products, U.S. EPA, RTP, N.C., May 28, 29, 1992.
10. "Global Atmospheric Change" Science Teachers Association of Ontario Meeting, Toronto, November 5, 1992.
11. "Global Atmospheric Change and Odd-Nitrogen Chemistry", Purdue University, Dept. of Earth and Atmos. Sci., April 13, 1993.
12. "Uncovering a Hole in our Understanding of Arctic Ozone Chemistry", Clarkson University, Department of Chemistry, September 2, 1993
13. "Investigations of Arctic Tropospheric Ozone, and the Possible Role of Halogen Atom Chemistry", Purdue University, Dept. of Earth and Atmos. Sci., February 1994.
14. "The Impact of Natural Hydrocarbons on Ozone Production in an Urban Environment", Purdue University, Analytical Division Seminar, October 4, 1994.
15. "Surface Ozone Depletion in the Arctic, and the Possible Role of Halogen Atom Chemistry", University of Western Michigan, Department of Chemistry, November 24, 1994.
16. "Alkyl Nitrates, and Their Relationship to Halogen Atom Chemistry in the Arctic at Polar Sunrise", American Chemical Society National Meeting, Chicago, IL, August 20, 1995.
17. "Evidence for the Importance of Halogen Atom Chemistry in the Troposphere", Purdue University, Physical Chemistry Seminar, September 20, 1995.
18. "Trace Analysis in Atmospheric Chemistry", Purdue University, Industrial Associates Meeting, October 12, 1996.
19. "Evidence for Halogen Atom Chemistry in the Arctic Troposphere", U.C. - Irvine, Department of Chemistry, October 29, 1996.

20. "Evidence for Halogen Atom Chemistry in the Arctic Troposphere", U.C. - Riverside, Department of Chemistry, October 30, 1996.
21. "PROPHET: Program for Research on Oxidants: Photochemistry, Emissions, and Transport", U.S. Environmental Protection Agency, Research Triangle Park, N. C., Nov. 25, 1996.
22. "Studies of the Role of Biogenic Hydrocarbons in Production of Ozone in the Troposphere", Oak Ridge National Labs, Oak Ridge, TN, Dec. 5, 1996.
23. "The Role of Biogenic Hydrocarbons in Tropospheric Ozone Production", Indiana State University, Dept. of Chemistry, Feb. 11, 1997.
24. "Bromine Chemistry in the Arctic Troposphere", Great Lakes Chemical Co., West Lafayette, IN, Feb. 13, 1997.
25. "Surface Ozone Depletion in the Arctic, and the Possible Role of Halogen Atom Chemistry", Indiana University, Dept. of Geography, Bloomington, IN, Feb. 28, 1997
26. "Field Intensive Preliminary Results as part of the Program for Research on Oxidants: Photochemistry, Emission, and Transport (PROPHET), 20<sup>th</sup> Annual Midwest Environmental Chemistry Workshop, Indiana University, November 9, 1997.
27. "Evidence for Halogen Atom Chemistry During Polar Sunrise", U. C. Davis, Dept. of Earth and Atmospheric Sciences, November 10, 1997.
28. "The Role of Isoprene in Tropospheric Ozone Production and the Sequestration of NO<sub>x</sub>", U. C. Davis, Dept. of Chemistry, November 11, 1997.
29. "The Role of Biogenic Hydrocarbons in the Production of Ground Level Ozone", Northeastern Illinois University, Department of Chemistry, January 29, 1998.
30. "Development of a Fast Time Response Method for Isoprene Measurement Using Ion Trap MS/MS", National Center for Atmospheric Research, March 2, 1998.
31. "Studies of the Role of Halogen Atom Chemistry in the Destruction of Marine Boundary Layer Ozone at Polar Sunrise", Harvard University, Department of Earth, Atmospheric, and Space Science, March 30, 1998.
32. "Tropospheric Chemistry at the Air-Ice Interface", Telluride Summer Workshop, "Recent Advances in Tropospheric Chemistry", Telluride, CO, Aug. 6, 1998.
33. "Recent developments in the analytical chemistry of isoprene and its oxidation products", York University, Department of Chemistry, Toronto, Ontario, Oct. 2, 1998.
34. "Studies of Multi-Phase Chemistry in the Arctic", University of Michigan, Department of Chemistry, Ann Arbor, MI, February 19, 1999.
35. "Sustainable Atmosphere", panel presentation, University of Michigan, Business School, Ann Arbor, MI, February 22, 1999.
36. "Studies of Multi-Phase Chemistry in the Arctic", University of Illinois, Atmospheric

- Science Department, Champaign-Urbana, IL, February 24, 1999.
37. “Studies of Multi-Phase Chemistry in the Arctic”, New York State Department of Health, Wadsworth Center, Albany, N. Y., March 4, 1999.
  38. “Studies of Multi-Phase Chemistry in the Arctic”, Purdue University, Department of Earth and Atmospheric Sciences, March 8, 1999.
  39. “Development of Quadrupole Ion trap Methods for Determination of Atmospheric Volatile Organic Compounds”, American Chemical Society Meeting, Symposium on Quadrupole Ion Trap Mass Spectrometric Analysis in the Environment, March 22, 1999, Anaheim, CA.
  40. “Studies of Multi-Phase Chemistry in the Arctic”, West Chester University, Department of Chemistry, April 5, 1999.
  41. “Air/Snow Interactions of Atmospheric Carbonyl Compounds”, 9<sup>th</sup> Annual Goldschmidt Conference, Harvard University, Aug. 23, 1999.
  42. “Interactions of Carbonyl Compounds with the Snowpack”, Pacific Northwest National Laboratories, Richland, WA, Oct. 5, 1999.
  43. “Arctic Tropospheric Chemistry: Evidence for Photochemistry in the Snowpack”, University of California, Berkeley, Oct. 26, 1999.
  44. “Polar Tropospheric Chemistry: The Importance of Snow Phase Photochemistry”, Environment Canada, 10/28/99, presented remotely from Purdue’s Distance Learning Lab.
  45. “Atmospheric Chemistry at the Air-Snow Interface”, Ohio Wesleyan University, Interdisciplinary Science Series, 11/4/99.
  46. “Atmospheric Chemistry at the Air-Snow Interface”, Bradley University, Department of Chemistry, 11/10/99.
  47. “Dry and Wet Deposition of Atmospheric Organic Nitrates”, presented at the Society of Environmental Toxicology and Chemistry Annual Meeting, Philadelphia, PA, Nov. 17, 1999.
  48. “Polar Tropospheric Chemistry: Evidence for Photochemistry in the Snowpack”, McGill University, Dept. of Chemistry, Dec. 2, 1999.
  49. Paul B. Shepson, Ann Louise Sumner, Amanda M. Grannas, Christophe Guimbaud, Kevin Ford, Terra Dassau, Tara L. Couch, and Richard Honrath “Studies of the Interaction of Carbonyl Compounds Between the Atmosphere and the Snowpack”, Pacific Northwest National Laboratories, June 23, 2000.
  50. “PROPHET: the Forest and the Trees”, University of Michigan Biological Station, Pellston, MI, 7/12/00.

51. “Studies of Photochemistry in the Snowpack in the Arctic”, Washington State University, Pullman, WA, September 25, 2000.
52. “Studies of the Role of the Snowpack in Determining the Concentration of Carbonyl Compounds in the Arctic Boundary Layer”, at the “Reactivity on the surface of ice: Application to the Environment and Interstellar Space conference at Porquerrolles, France, Sept. 25 – 29, 2000.
53. “Air-Surface Interactions and New Challenges in Analytical Atmospheric Chemistry”, Pacific Northwest National Laboratory, Richland, WA, October 17, 2000.
54. “Recent Developments in Measurements of Atmospheric Nitrogen Species, and the Search for the Missing  $\text{NO}_y$ ”, Eastern Analytical Symposium, Atlantic City, N.J., Oct. 31, 2000.
55. “Ice and Snow Chemistry: Unearthing the Secrets”, presented at the New Horizons in Science Briefing of the Council for the Advancement of Science Writing, Nov. 2, 2000, Houston, TX.
56. “The Role of Snowpack Processes in Determining Carbonyl Compound Concentrations in the Arctic”, NOAA-Aeronomy Laboratory, November 14, 2000, Boulder, CO.
57. “Freezing Salty Water – NMR Studies”, Pacific Northwest National Laboratory, Richland, WA, 12/13/00.
58. “Canadian Ice and NMR Spectroscopy”, Antioch University, Yellow Springs, OH, March 30, 2001.
59. “Evidence for Photochemistry in the Snowpack, and its Impact on the Composition of the Atmosphere”, University of Virginia, Dept. of Environmental Sciences, Charlottesville, VA, April 5, 2001.
60. “Evidence for Photochemistry in the Snowpack, and its Impact on the Composition of the Atmosphere”, University of Innsbruck, Institut für Ionenphysik, May 14, 2001.
61. “Studies of the Role of Biogenic Volatile Organic Compounds (VOCs) and Their Role in Atmospheric Nitrogen Cycling at the PROPHET Site”, Keynote presentation, Great Lakes Regional ACS meeting, Grand Rapids, MI, June 13, 2001.
62. “Studies of the Interaction of Carbonyl Compounds with Snow, and the Impact on Arctic Boundary Layer Photochemistry”, Atmospheric Chemistry Gordon Conference, Salve Regina U., Newport, RI, June 21, 2001.
63. “Chemistry on the Quasi-Liquid Layer on the Surface of Ice”, Analytical Chemistry Gordon Conference, Connecticut College, New London, CT, June 28, 2001.
64. “Studies Of Snowpack Processes And Their Role In Determining The Concentration Of Formaldehyde And Acetaldehyde In The Arctic Atmospheric Boundary Layer”, International Association of Meteorology and Atmospheric Sciences 11 July 2001 (session convenor).

Innsbruck, Austria .

65. "Chemistry on the Surface of Ice and Snow", Industrial Associates Meeting, Purdue University, Department of Chemistry, October 5, 2001.
66. "Challenges for the Quantitative Determination of Atmospheric Trace Level Pollutants Using Ion Trap Mass Spectrometry", Federation of Analytical Chemistry and Spectroscopy Societies meeting, Detroit, MI, October 8, 2001
67. "Flux Measurements of Atmospheric Pollutants, on the Fly", Asilomar meeting of the American Society for Mass Spectrometry - Real World Challenges and New Developments in Environmental Mass Spectrometric Measurements, Pacific Grove, CA, October 19-23, 2001 (Conference co-Chair, with Kim Prather).
68. "Planning for a Future Ocean-Ice-Atmosphere Research Program in the Arctic", NSF OAI All Hands Meeting, Salt Lake City, UT, Nov. 14, 2001.
69. "Chemistry on the Surface of Ice and Snow", Eastern Illinois University, Dept. of Chemistry, 11/5/01.
70. "Chemistry on the Surface of Ice and Snow, and its Impact on Atmospheric Chemistry", Ohio State University, Dept. of Chemistry, 11/20/01
71. "Snowpack Photochemistry and its Impact on the Arctic Boundary Layer Atmosphere", Georgia Institute of Technology, Dept. of Earth and Atmospheric Science, 11/30/01.
72. "Atmospheric Chemistry at the Air-Snow Interface", Indiana University-NW, Merrillville, IN, February 27, 2002.
73. "Studies of the production of organic nitrates for OH oxidation of biogenic VOCs", ACS Award symposium for Roger Atkinson, ACS National Meeting, Orlando, FL, April 9, 2002.
74. "The Biosphere, Inverse Micelles, Carbonyl Compounds, Organic Nitrates, Particulate Matter, and the Biosphere", Telluride Atmospheric Chemistry Workshop, Telluride, CO, Aug. 5, 2002.
75. "Studies of Biogeochemical Cycling of Carbon and Nitrogen in a Forest Environment as Part of PROPHET", ACS National Meeting, Boston, MA, August 19, 2002.
76. "Studies of the Interactions of the Carbon and Nitrogen Cycles in Forest Environments", Department of Agronomy, Purdue University, Oct. 14, 2002.
77. Atmosphere-Forest Exchange: Important Questions Regarding the Atmosphere's Role in the Delivery of Nutrient Nitrogen and Impacts on Nitrogen and Carbon Cycling, M. Carroll, P. B. Shepson, S. B. Bertman, J. P. Sparks, and E. Holland, American Geophysical Union Fall Meeting, Dec. 6, 2002.
78. "Biosphere-Atmosphere Interactions and Global Climate Change", Biology Dept., Purdue University, Eco-Lunch Seminar, Sept. 3, 2003,

79. “What we Think We Might Possibly Know About VOC Structure and Organic Nitrate Yields, and Why we Should Care”, American Physical Society Meeting, March 22, 2004, Montreal, Canada.
80. “Missing Carbon, Missing Nitrates, and Biosphere-Atmosphere Interactions”, U.C. Irvine, Dept. of Earth Systems Science, April 28, 2004, Irvine, CA.
81. “New Developments in studies of photochemistry on the surface of ice and snow”, American Chemical Society National Meeting, Philadelphia, PA, August 25, 2004.
82. “Development of an Aircraft-Based Platform for Study of Coupling Between the Carbon and Nitrogen Cycles”, School of Public and Environmental Affairs, Indiana University, October 21, 2004.
83. “Climate Change and Air-Snow Interactions”, The Ukpeagvik Iñupiat Corporation (UIC) Science Center, Barrow, AK, Feb. 5, 2005.
84. “Atmospheric Chemistry and Climate Change in the Arctic”, Indiana University-Purdue University-Fort Wayne, Fort Wayne, IN, Sept. 30, 2005.
85. “Cloud and canopy processes in the processing of atmospheric nitrogen”, Berkeley Atmospheric Sciences Center Symposium, U.C. Berkeley, October 14, 2005.
86. “Studies of Halogen Atom Chemistry in the Arctic”, Georgia Institute of Technology, Departments of Earth and Atmospheric Sciences, and Chemistry, October 21, 2005.
87. “Atmospheric Chemistry and Climate Change in the Arctic”, Reed College, Department of Chemistry, Portland, OR, Dec. 1, 2005.
88. “The ALAR Program: Studies of Coupling Between the Carbon and Nitrogen Cycles”, NOAA GMD, Boulder, CO, Dec. 19, 2005.
89. “Atmospheric Radiation and Photochemistry”, European Research Course on Atmospheres, University Joseph Fourier of Grenoble, Grenoble, France, January 9, 2006.
90. “Chemical Kinetics and Atmospheric Lifetimes”, European Research Course on Atmospheres, University Joseph Fourier of Grenoble, Grenoble, France, January 10, 2006.
91. “Photochemistry of Organic Compounds in Ice”, Conference on The routes for organics oxidation in the atmosphere and its implications to the atmosphere, Alpe d’Huez, France, January 8, 2006.
92. “Climate Change, Feedbacks, and the Future in the Arctic”, The First Undergraduate Conference on Extreme Weather and Climate Change Impacts, Purdue University, April 21, 2006.
93. “State of the Fundamentals of Snowpack Photochemical Production of Important Stuff” Co-organizer (with Eric Wolff and Florent Domine) of the Air-Ice Chemical Interaction (AICI; an IGAC project) Workshop in Grenoble, Fr., May 29-Jun1, 2006.

94. “Coupling Between Forests, the Atmosphere, and Climate Change: the Big and Little Pictures”, Purdue Climate Change Research Center, Purdue University, West Lafayette, IN, August 24, 2006.
95. “Coupling Between Climate Change, Atmospheric Chemistry, and Human Impacts in the Arctic”, Michigan Technological University, Department of Civil and Environmental Engineering, October 9, 2006.
96. “Coupling Between Climate Change, Atmospheric Chemistry, and Human Impacts in the Arctic”, Kalamazoo College, Department of Chemistry, November 6, 2006.
97. “Climate change and air-snow interactions in the Arctic”, January 10, 2007, Grandes Conférences Des Sciences De L’univers Grenoble, Grenoble, France.
98. “Atmospheric Radiation and Photochemistry”, January 11, 2007, European Research Course on Atmospheres, Université Joseph Fourier, Grenoble, France.
99. “Chemical kinetics, sources and sinks of atmospheric chemical species, and atmospheric lifetimes”, January 11, 2007, European Research Course on Atmospheres, Université Joseph Fourier, Grenoble, France.
100. “Climate Change and Atmospheric Chemistry in the Arctic”, January 12, 2007, European Research Course on Atmospheres, Université Joseph Fourier, Grenoble, France.
101. “A Case for NCAR involvement in OASIS”, National Center for Atmospheric Research, Atmospheric Chemistry Division, Jan. 26, 2007.
102. “Quantitative Determination of Isobaric Volatile Organic Compounds using Proton Transfer Reaction – Linear Ion Trap (PTR-LIT) mass spectrometry”, L. H. Mielke, P. B. Shepson, S. McIluckey, D. Erickson, A. Hansel, and A. Wisthaler, Biogenic Hydrocarbons and the Atmosphere Gordon Conference, Ventura, CA, Feb. 28, 2007.
103. “Arctic Halogen Chemistry, Climate Change, and the Future”, NCAR ACD seminar, Boulder, CO, April 9, 2007.
104. “Atmospheric Chemistry and Climate Change in the Arctic”, Department of Chemistry, Juniata College, Huntingdon, PA, Sept. 18, 2007.
105. “Atmospheric Chemistry and Climate Change in the Arctic”, Department of Chemistry, Wabash College, Crawfordsville, IN, Sept. 27, 2007.
106. “Connections between biogenic volatile organic compound emissions and the fate of atmospheric NO<sub>x</sub>”, Texas A&M, Department of Atmospheric Sciences, College Station, TX, October 9, 2007.
107. “Connections between atmospheric nitrogen deposition and net ecosystem exchange of carbon”, University of Iowa, Department of Chemical and Biological Engineering, Iowa City, Iowa, Nov. 1, 2007
108. “Climate Change, and Atmosphere-Surface Interactions in the Arctic”, the 17<sup>th</sup> Annual Harold I. Schiff Lecture, York University, Toronto, Ontario, Canada, Nov. 27, 2007.

109. "Snow and Ice Photochemistry in Polar Regions, and Interactions With a Changing Climate", American Geophysical Union Fall Meeting, Dec. 13, 2007, San Francisco, CA.
110. "Introduction to Atmospheric Chemistry", European Research Course on Atmospheres", U. Josef Fourier, Grenoble, Fr., January 7, 2008.
111. "Tropospheric Ozone and the Future", European Research Course on Atmospheres", U. Josef Fourier, Grenoble, Fr., January 8, 2008.
112. "Atmospheric Chemistry and Climate Change in the Arctic", European Research Course on Atmospheres", U. Josef Fourier, Grenoble, Fr., January 9, 2008.
113. "Climate Change, and Atmosphere-Cryosphere Chemical Interactions in the Arctic", University of Innsbruck, Institut fur Ionenphysik, Innsbruck, Austria, January 17, 2008.
114. "Atmospheric chemistry and climate change in the Arctic", Circumpolar Flaw Lead Study, on board the Canadian Coast Guard Icebreaker, The Amundsen, Feb. 5, 2008.
115. "Atmospheric chemistry and climate change in the Arctic", Department of Chemistry, Transylvania University, Lexington, KY, March 4, 2008.
116. "A connection between arctic haze and halogen chemistry?", American Physical Society Meeting, March 12, 2008, New Orleans, LA.
117. "Climate Change, and Atmosphere-Cryosphere Interactions in the Arctic", ACS National Meeting, April 10, 2008, New Orleans, LA.
118. "Climate Change: Realities, Impacts, and Opportunities", Fort Wayne Rotary Club World Affairs Conference, Indiana U. Purdue U.-Fort Wayne Campus, March 11, 2008.
119. "Climate Change: Fundamentals, Impacts, and Opportunities", Department of Physics Colloquium, Purdue University, West Lafayette, IN, March 27, 2008.
120. "Climate Change and Ecosystem Impacts", University of Michigan Biological Station, All-Camp Lecture, July 2, 2008.
121. "Photochemistry in and above ice and snow, and the impact on the atmosphere", International Global Atmospheric Chemistry Conference, Sept. 11, 2008, Annecy, France.
122. "Chemistry, Climate Change, Energy Management, and Politics: Why these things are exciting", Eastern Illinois University, Charleston, IL, Oct. 1, 2008.
123. "New Insights on Halogen Chemistry and Air-Surface Interactions in the Arctic", Harvard University, Dept. of Earth and Planetary Sciences, April 3, 2009.
124. "Determination of the Carbon Footprint of the City of Indianapolis Using an Aircraft-Based Mass-Balance Approach", Loyola University (Chicago), May 4, 2009.

125. "Climate Change: A Global Scale Challenge with Regional Scale Impacts and Opportunities", University of Notre Dame, Mendoza College of Business, June 25, 2009.
126. "Air-Snowpack-Sea Ice Chemical Interactions in the Arctic", University of Toronto, Department of Chemistry, November 10, 2009.
127. "Halogen Atom Chemistry in the Arctic in the Context of Climate Change" Howard University, Dept. of Chemistry, Feb. 26, 2010.
128. "Studies of Halogen Chemistry in the Arctic and Connections to Climate Change", Penn State University, Dept. of Meteorology, March 31, 2010.
129. "The INFLUX Project: Toward Improved Capabilities in Urban-Area Scale Greenhouse Gas Flux Measurements", NOAA, Boulder, CO, May 18, 2010.
130. "Climate Change and Atmospheric Chemistry in the Arctic", Plenary Lecture, 41st Central Regional Meeting of the American Chemical Society, June 18, 2010, Dayton, OH.
131. "Climate Change, Atmospheric Chemistry, and Arctic Sea Ice", Purdue University, Physical Chemistry Seminar, Oct. 20, 2010.
132. "Halogen Chemistry on the Surface of Ice", University of Alaska at Fairbanks, department of Chemistry, February 22, 2011.
133. "Atmospheric Chemistry and Climate Change in the Arctic", Villanova University, Dept. of Chemistry, April 12, 2011, Philadelphia, PA.
134. "Working Toward an Improved Ability to Quantitatively Determine Urban Area-Wide Fluxes of Greenhouse Gases, or, Going to the Dump", Atmospheric Chemistry Gordon Conference, Mt. Snow, Vt., July 26, 2011.
135. "Arctic Haze and Air Pollution", Arctic Climate Summer Course, U.of Stockholm research station at Abisko, Sweden, August 2, 2011.
136. "Tropospheric Ozone", Arctic Climate Summer Course, U.of Stockholm research station at Abisko, Sweden, August 2, 2011.
137. "Arctic Climate Change Impacts, and Going to the Dump", Purdue University, Earth and Atmospheric Sciences Departmental seminar, West Lafayette, IN, Sept. 8, 2011.
138. "Climate Change Impacts in the Arctic, and Going to the Dump", Atmospheric Sciences Research Center, SUNY-Albany, Albany, NY, September 12, 2011.
139. "Measuring Greenhouse Gas Fluxes in Indianapolis: Going to the Dump", Purdue University Dept. of Biology, Ecolunch Seminar Series, West Lafayette, IN, Sept. 21, 2011.
140. "Climate change and sea-ice-atmospheric chemistry-CCN-cloud cover feedbacks", Purdue Climate Change Research Center Water and Climate Seminar Series, West Lafayette, IN, Sept. 23, 2011.

141. "Climate change impacts and chemistry in the Arctic, and, Going to the dump", University of Illinois, Department of Chemistry, Urbana-Champaign, IL, October 21, 2001.
143. "Climate Change and Impacts on Atmospheric Chemical Composition in the Arctic", American Geophysical Union Fall Meeting, San Francisco, CA, Dec. 7, 2011.
144. "Climate Change and the Future of Ice at the Poles", Endurance Lecture Series, Indiana State Museum, Indianapolis, IN, January 19, 2012.
145. "INFLUX: Moving Toward the Ability to Conduct Regional and Global Scale Accounting of Greenhouse Gases", University of Madison, WI, Weston Roundtable Series, Nelson Institute Center for Sustainability and the Global Environment, Madison, WI, February 9, 2012.
146. "Assessment of uncertainties of aircraft based measurement of urban greenhouse gas emissions. Preliminary results from the Indianapolis Flux Experiment (INFLUX)", meeting of the Network of Airborne Environmental Research Scientists (NAERS), Garmisch-Partenkirchen, Germany, February 14, 2012.
147. "The latest on climate change and halogen chemistry in the Arctic troposphere", U. C. Irvine, Dept. of Chemistry, Irvine, CA, May 22, 2012.
148. "Interactions between atmospheric nitrogen chemistry, air quality, and the health of the biosphere", ACS National Meeting, Kinetics and Mechanism in the Atmosphere, August 21, 2012.
149. "Studies of the propagation of bromine chemistry in the Arctic: from the sea ice to open leads and across the tundra", IGAC, Beijing, China, September 18, 2012.
150. "Toward the Development of Integrated Approaches for the Measurement of Greenhouse Gas Emission Rates for Megacities", National Institute of Metrology, Beijing, China, September 20, 2012.
151. "Measurements of Urban Area-Wide CO<sub>2</sub> and CH<sub>4</sub> Fluxes as part of the Indianapolis Flux Experiment (INFLUX)", American Geophysical Union Fall Meeting, Dec. 7, 2012, San Francisco, CA.
152. "Airborne Measurements of Surface Fluxes of Greenhouse Gases", Cornell University, Dept. of Ecology and Evolutionary Biology, Ithaca, N.Y., January 25, 2013.
153. "Aircraft-Based Studies of Atmosphere-Surface Chemical Interactions: from Sea Ice to Shale Gas", University of Michigan, Dept. of Atmospheric, Oceanic and Space Sciences, Ann Arbor, MI, Feb. 21, 2013.
154. "Aircraft-based Studies of Methane Emission from Shale Gas Drilling Operations in the Bakken and Marcellus Formations", Purdue University Center for the Environment, March 1, 2013.
155. "37 Years of Research About Organic Nitrates and Their Impact on Atmospheric Nitrogen, Ozone and Aerosols", 30th Informal Symposium on Kinetics and

Photochemical Processes in the Atmosphere, Caltech, Pasadena, CA, March 8, 2013.

156. "Visions and Musings", Dept. of Meteorology, Penn State University, University Park, PA, Sept. 9, 2013
157. "Climate Change, and Quantification of Sources and Sinks of Greenhouse Gases Using an Aircraft Platform", Bradley University Dept. of Chemistry, Peoria IL, Oct. 3, 2013.
158. "Understanding climate change, and its impacts, while emitting a lot of CO<sub>2</sub> myself", University of Dubuque, Dubuque, IA, Oct. 4, 2013.
159. "Aircraft-based measurements of fluxes of greenhouse gases: from forest uptake to urban area-wide and shale gas basin scale emissions", University of Maryland, Dept. of Atmospheric and Oceanic Sciences, College Park, MD, November 7, 2013.

**D. Technical Reports:**

1. T.E. Kleindienst, P.B. Shepson and E.O. Edney, "Mutagenic Activities of Wood Smoke Photooxidation Products", EPA/600/S3-86/049 (1986).
2. P.B. Shepson, T.E. Kleindienst and E.O. Edney, "The Production of Mutagenic Compounds as a Result of Urban Photochemistry", EPA/600/S3-87/020, (1987).
3. L.T. Cupitt, L.D. Claxton, P.B. Shepson, and T.E. Kleindienst, "IACP (Integrated Air Cancer Project) Emissions: Transformations and Fate", EPA Report (1987).

**E. Grants:**

November 1987 - NSERC Strategic Grant "Atmospheric Chemistry and Toxicology of Peroxyacyl October 1990, Nitrates" with H. Schiff, H. Niki, D.R. Hastie and J.A. Heddle \$101,120/year.

April 1988 AES Science Subvention "Development and Application of Techniques for Measurement of Atmospheric Carbonyl Compound Concentrations \$7,000.

March 1989 AES Contract "Development of a Technique for Measurement of Atmospheric Nitrogen Dioxide" \$7,000.

April 1989 AES Science Subvention "Development of Measurement Techniques for Peroxyacyl Nitrates and Organic Nitrates \$10,000.

April 1988 - March 1990 NSERC Operating Grant "Atmospheric Mutagenesis Involving Volatile Organo-Chlorine Compounds" \$25,300/yr.

March 1990 AES Contract "Development of a Technique for Measurement of Atmospheric Nitrogen Dioxide" \$10,000.

April 1990 NSERC Equipment Grant - High Performance Liquid Chromatograph (with D.R. Hastie) \$34,772.

April 1990- AES/NSERC Science Subvention "Atmospheric Measurements of Shepson Full CV, Revised November 2013

March 1990	Organic Nitrates and PANs" \$20,000.
April 1990-March 1992	NSERC Operating Grant "Atmospheric Photochemistry and Mutagenesis involving Volatile Organo-Chlorine Compounds" \$26,000/yr.
Sep. 1990-Aug. 1991	OME Contract "PAN Measurement and Data Analysis for two Sites in Ontario" \$23,100
October 1990	AES Contract "Measurements of PAN during the Intercomparison of NO <sub>2</sub> Measurement Methods" \$4,212
November 1990	AES Contract to Plan, Conduct and Report on a Workshop entitled, "Atmospheric Processes of Organic Toxic Pollutants and their Role in Current Environmental Problems" \$25,000
April 1991	OME Grant, Environment Technologies Program "Development of a Nitrogen-Specific GC/Detector for Measurement of Atmospheric Nitrates" (with D.R. Hastie) \$248,980 (3 years).
April 1991	OME Grant "Studies of Oxidant Formations in Rural Areas of Ontario" \$346,825 (3 years).
April 1991	NSERC Major Equipment Grant, GC/MS, (with Leznoff, Aspinall, Lee-Ruff, Lever, Potvin, Niki) \$252,619
May 1991	AES/NSERC Science Subvention "Atmospheric Measurements of Organic Nitrates" \$19,760
February 1992	AES Contract - Construction of a Flow Mode Reaction Chamber. \$36,668.90
April 1992	NSERC Operating Grant. "Studies of Oxidant Chemistry in Sensitive Canadian Environments" \$92,000 (4 years).
May 1992	AES/NSERC Science Subvention "Development and Application of a Gas Chromatographic Technique for Measurement of Atmospheric Carbonyl Compounds" \$21,000
May 1992	York University, President's NSERC Fund. "Computer Control and Data System for the CIRAC Air Toxics Research Project". \$2,500
November 1992	AES Strategic Grant. "Development of an Automated Cryo-Concentration/GC/MSD method for Routine Measurements of Atmospheric Oxidation Products" \$50,000
January 1993	OME Contract. "Measurement of Peroxyacetyl Nitrate at Urban and Rural Sites in Ontario" \$36,500
April 1993	NSERC Equipment Grant. "Automated Sample Acquisition/Gas Chromatograph/Mass Selective Detector for Atmospheric Pollutant

Measurements" \$62,292

- April 1993 York University, President's NSERC Fund. "Development of a Method for Measurement of Atmospheric Cl<sub>2</sub>" \$1,000.
- June 1993 AES/NSERC Science Subvention. "Measurements of Hydrocarbon Oxidation Products in Canadian Atmospheric Environments" \$63,000 (three years).
- June 1994 Ontario Ministry of Environment and Energy. "Studies of Oxidant Formation in Southern Ontario" \$87,000
- June 1994 AES/NSERC Strategic Grant. "Photochemical Reaction Chamber Hydrocarbon Oxidation Product Measurement System" \$35,607
- May 1995 EPA subcontract (GIT). "Carbonyl Compound Measurements During the Nashville 1995 Summer Intensive of the Southern Oxidants Study", \$31,700
- July 1995 Showalter Foundation, Purdue University. Proposal for Purchase of Instrumentation for Measurement of Vertical Profiles of Atmospheric Ozone, \$49,462.
- January 1996 National Science Foundation, "Arctic Outflow Campaign: A Measurement Study to Characterize the Composition and Photochemistry of Arctic Air Transported Southward During Spring", \$7,802 (in collaboration with Michigan Technical University).
- January 1996 National Science Foundation, "A Study of the Importance of Organic Nitrates as Sinks for Atmospheric Nitrogen Oxides", \$350,000 (3 years).
- May 1996 NOAA contract, AAEROCE Ozone Vertical Profile Measurements at Purdue, \$5,525
- October 1996 US EPA, ADevelopment, Evaluation, and Application of a Fast Time-Response Mass Spectrometric Method for Quantitative Monitoring Oxidant Precursors, \$485,262 (3 years)
- September 1996 BASF - Industrial Associates Program, \$20,000
- Feb. 1997 NSF, "Investigations of the Importance of Halogen Atom Chemistry in the Arctic Troposphere", \$649,817 (three years; with co-PIs Sun, Francisco, and Margerum).
- May 1997 PRF Research Grant. "Studies of the Contribution of Isoprene and its Oxidation Products to Ozone Formation in the Troposphere", \$11,666.
- May 1997 Supplement to "A Study of the Importance of Organic Nitrates as Sinks for Atmospheric Nitrogen Oxides", \$21,336.

September 1997 BASF - Industrial Associates Program, \$20,000  
January 1998 – NSF – Air-Snow Exchange of Reactive Nitrogen Oxides at Summit, Greenland,

Dec. 2000 co-PI with J. Dibb, U.-N.H., \$255,692

January 1998 PRF Research Grant. “Studies of Formaldehyde Photochemistry in the Arctic at Polar Sunrise”, \$11,666.

May 1998 Chemical Manufacturers Assoc., “Studies of Organic Nitrate Formation from Atmospheric Oxidation of Glycol Ethers”, \$35,325.

February 1999 Albemarle Corp., “Studies of the Organic Nitrate Yield from OH Reaction with 1-Bromopropane”, \$39,348.

March 1999 NSF, (Office of Polar Programs), “Studies of the Role of Sea Ice in Arctic Tropospheric Ozone Chemistry”, 3 years, 397,394.

March 1999 NSF (Atmospheric Chemistry), “A Study of the Role of Organic Nitrate Formation in the Removal of Tropospheric NO<sub>x</sub>”, 3 years, \$360,000.

March 1999 NOAA, “Measurements of Biogenic VOCs During the Southern Oxidants Study 1999”, \$56,000, 3/99-2/00.

Sept. 1999 NSF, OPP “Investigation of Photochemical Transformations within Snow and Their Effect on Snow and the Atmospheric Composition”. Years 1&2 - \$190,179

Sept. 2001 NSF, Biocomplexity Program, “Development of Instrumentation for Measurement of Biosphere-Atmosphere Fluxes of Carbon and Nitrogen”, 4 years, \$588,474  
(Collaborative grant with B. Lamb, H. Westberg (WSU), A. Guenther (NCAR), and P. Curtis (OSU); total award was \$1.7M)

May 2002 NSF, (Office of Polar Programs), “Studies of the Role of Sea Ice in Arctic Tropospheric Ozone Chemistry”, Supplement, \$22,865

July 2002 The Showalter Foundation, “Studies of the Impact of Atmospheric Nitrogen Deposition on the Sequestration of Carbon Dioxide by North American Forests, \$100,000

April 2002 NSF (Atmospheric Chemistry), “A Study of the Role of Organic Nitrate Formation in the Removal of Tropospheric NO<sub>x</sub>”, supplement, \$30,191.

August 2002 NSF (Office of Polar Programs), “Changing Environmental Controls on Coupled Chemical Exchange Between the Ocean, Ice, and Atmosphere in the Arctic – A Workshop Request”, \$81,191

January 2003 NSF (Atmospheric Chemistry), “Studies of the Fluxes of Atmospheric Organic Nitrogen Compounds to a Forest Environment”, \$360,000

June 2003 NSF (Polar Programs), “Studies of the Impact of Emission of Reactive Gases from Arctic Snowpacks and Sea Ice”, \$399,959.

June 2003 NSF (Analytical Chemistry), “Development of a Proton Transfer Reaction Linear Ion Trap for Fast Atmospheric Pollutant Detection”, \$535,000

April 2003 NSF-IGERT, via U. Mich., (BART), “The Development of a Light-Aircraft Flux Measurement System for Determinations of Fluxes of CO<sub>2</sub> and Odd-Nitrogen Compounds”, \$55,000.

July 2003 Purdue Research Foundation, “Studies Of The Impact Of Frost Flowers On Tropospheric Ozone”, 2 years, \$13,263/yr.

December 2003 NSF, SBIR Phase I grant, with Aerodyne Corp. (Boston), “Innovative Aerosol Collector for On-line Analysis of Organics”, \$15,000.

August 2004 21<sup>st</sup> Century Fund, \$120,566.

September 2004 Budget for the 2004/2005 Academic Yr. for the Purdue Climate Change Research Center, \$122,000

December 2004 Purdue Research Foundation, International Travel Grant, “OASIS Implementation Plan Workshop”, \$1,000.

August 2005 Budget for the 2005/2006 Academic Yr. for the Purdue Climate Change Research Center, \$212,275

July 2005 Supplement to "Studies of the Impact of Emission of Reactive Gases from Arctic Snowpacks and Sea Ice.", NSF, Office of Polar Programs, \$43,320.

August 2005 Supplement to “Studies of the Fluxes of Atmospheric Organic Nitrogen Compounds to a Forest Environment”, \$37,151

September 2005 Supplement to “Development of Instrumentation for Measurement of Biosphere-Atmosphere Fluxes of Carbon and Nitrogen”, \$53,443

January 2006 A Multiphase Study of the Nature, Sources, and Fate of Atmospheric Organic Nitrogen, NSF-ATM, \$689,869 (4 yrs).

February 2006 Purdue Research Foundation, “Halogen Atom Measurements as part of the International Polar Year”, \$14,040, 1 Year Graduate Fellowship.

January 2006 Purdue Research Foundation International Travel Grant – AICI Workshop, \$1,000

March 2007 The Collaborative O-Buoy Project: Deployment of a Network of Arctic Ocean Chemical Sensors for the IPY and Beyond, 3 years, \$462,843

June 2007 Aircraft-Based Measurements of CO<sub>2</sub> as Part of the Mid-Continent Intensive, NOAA, \$19,825

July 2007 Showalter Trust (co-PI with lead PI Kevin Gurney), "The Hestia Project: Supporting Climate Science, Policy and Planning at Purdue", \$74,591

July 2007 Health Research, Inc., Aircraft-based HONO measurements, with PI Xianliang Zhou, \$11,742

May 2007 U. Mich. IGERT, "Secondary organic aerosol formation from biogenic VOC's and feedbacks to the climate system" (BART), \$31,500

Sept. 2007 IPY: Halogen Chemistry and Ocean-Atmosphere-Sea Ice-Snowpack (OASIS) Chemical Exchange During IPY, NSF-OPP, \$469,513

Nov. 2007 Production of Secondary Organic Aerosol from Multiphase Terpene Photooxidation, U.S. EPA STAR Grant, \$333,397

June 2008 Purdue Research Foundation Fellowship, \$12,000

July 2009 "Collaborative Research: Program for Research on Oxidants – Photochemistry Emissions & Transport (PROPHET) 2009 – Community Atmosphere-Biosphere INteractions Experiment (CABINEX)", 2 years, \$116,836

January 2009 "Computational & Laboratory Studies of Arctic Sea Ice Halogen Chemistry", The Camille and Henry Dreyfus Foundation Inc., two years, \$120,000

July 2009 "The Canadian Obuoy Project", Environment Canada/Bigelow Labs, 1 year, \$42,128

August 2009 Supplement to: IPY: Halogen Chemistry and Ocean-Atmosphere-Sea Ice-Snowpack (OASIS) Chemical Exchange During IPY, NSF-OPP, \$74,148

August 2009 Supplement to: The Collaborative O-Buoy Project: Deployment of a Network of Arctic Ocean Chemical Sensors for the IPY and Beyond, \$44,676

August 2009 Supplement to: A Multiphase Study of the Nature, Sources, and Fate of Atmospheric Organic Nitrogen, NSF-ATM, \$61,148.

January 2010 "Development, Improvement, & Assessment of the Accuracy of Aircraft-Based Mass Balance Measurements of Integrated Urban Emission Fluxes of Greenhouse Gases", NIST, 3 years, \$1,500,000

April 2010 "Implications of Arctic Sea Ice Reduction of Tropospheric Bromine, Ozone, and Mercury Chemical Processes, Transport, and Distribution" NASA, IDS, 3 years, \$269,451

September 2010 "Collaborative Research: The O-Buoy Network of Chemical Sensors in the Arctic Ocean", NSF, OPP, 5 years, \$1,041,211 (Purdue component)

December 2010 "Airborne Microwave Observatory of Subcanopy and Subsurface (AirMOSS)", 5 years, \$586,958 (Purdue component of NASA Earth Venture-1 Project).

July 2011 "Studies of the Production of Molecular Halogens in Arctic Snowpacks and on Sea Ice Surfaces", NSF, OPP, 3 years, \$526,971.

August 2011 "Collaborative Research: Biogenic Volatile Organic Compounds and their Impacts in a Changing Temperate Forest", NSF, ATM, 2 years, \$162,743.

May 2012 Gift in support of the Shepson Atmospheric Chemistry Research Group, Clean Air Task Force, \$23,100.

August 2012 "Studies of the Impact of Organic Nitrates on Nitrogen Cycling and Aerosol Production", NSF-GEO, 3 years, \$526,971

October 2012 "Aircraft-Based Assessment of the Individual Source Contributions to the Total Greenhouse Gas Emissions from an Urban Environment, National Institute of Standards and Technology, 1 year, \$268,000.

May 2013 "The Role of Oxidation of BVOCs in SOA Production in the Southeastern U.S.", EPA, 1 year, \$105,000.

September 2013 "Improvement and Application of Aircraft and Ground-Based Measurements of the Emission of Greenhouse Gases from the City of Indianapolis", 1 year, \$258,169.

October 2013 "Quantitative Aircraft Mass Balance Measurements of the Flux of Methane from Specific Sources Related to Shale Gas Operations in the Barnett Shale Formation Region", Environmental Defense Fund, \$78,300.

February 2014 "Gift in support of the Shepson Atmospheric Chemistry Research Group, Clean Air Task Force, \$38,000.

### **Graduate Supervision:**

#### **Current students**

Kevin McAvey (Nov. '09 -; Ph.D.)  
 Joel Rindelaub (Jun. '09 -; Ph.D.)  
 Fulizi Xiong (Nov. '10 -; Ph.D.)  
 Kyle Custard (Nov. '10 -; Ph.D.)  
 Dana Caulton (Nov. '10 -; Ph.D.)  
 Wes Halfacre (Nov. '10 -; Ph.D.)  
 Carlos Rivera Vasquez (Nov. '11 -; M.S.)  
 Chris Groff (Nov '12;- M.S.)  
 Chris Wirth (Nov '12-; Ph.D.)  
 Angela Raso (Nov '12-; Ph.D.)  
 Tegan Lavoie (Nov. '13-; Ph.D.)  
 Olivia Salmon (Nov. '13-; Ph.D.)

## **Former students**

Ning Gao (September 1989 -1990; Ph.D.(transferred))  
Kathleen Hedley (September 1989 - 1991; M.Sc.)  
Pierrette Blanchard (September 1988 - 1993; Ph.D.)  
Anna-Pearl Sirju (January 1992 - 1993 ; M.Sc.)  
David Plummer (September 1992-1995 ; M.Sc.)  
Meghan Jones (Oct. 95 - May '96)  
T. Walker (Nov. 96 - May 97; transferred)  
Tom Biesenthal (York U., September 1992-May 1997 ;Ph.D.)  
Gary Impey (York U., September 1993- Dec. 1998;Ph.D.)  
Orlando Herrera-Gomez (Nov. 96 – Dec. 98; M.S.)  
Bradley Campbell (Nov. '97 – Dec. 1999; M.S.)  
Brian Michalowski (Sept. '97 – June 1999; M.S.)  
Bryan Splawn (June 1995 – August 1999; M.S.)  
David Hulbert (Oct. 96 – Dec. '98; M.S.)  
Jason O'Brien (York U., September 1992-1998 ;Ph.D.)  
John Grossenbacher (Oct. 95 -; 2001, Ph.D.)  
Ann Louise Sumner (Nov. 96 -; 2001, Ph.D.)  
Dennis Barket (Nov. 96 - 2001; Ph.D.)  
Julia Hurst (Nov. 96 - 2001; Ph.D.)  
Kevin Ford (Nov. '98 - 2001 M.S.)  
Amanda Grannas (Nov. '98- Dec. 2002; Ph.D.)  
Cynthia Espada (Nov. '97 - Dec. 2003; Ph.D.)  
Pete Giacobelli (Nov. '00 - Dec. 2003; M.S.)  
Rose Ravelo (Nov. 2001 -2004; withdrew)  
Terra Dassau (Nov. '98- 2005; Ph.D.)  
Adam Keil (Nov. 2000 – Nov. 2005; Ph.D.)  
Cory Moffatt (Nov. '02 -; Aug. '06; M.S.)  
Kimberly Hill (Sept. '02 – April 06; Ph.D.)  
Amanda Lockwood (Nov. 2001 – Dec. 2008; Ph.D.)  
Aubrey Cavender (Nov. 2001- June 2008; Ph.D.)  
Phil Tackett (Nov. '03 – Dec. 2008; Ph.D.)  
Marc Fiddler (Jan. '07 – Jan. '09; Ph.D.)  
Karl Garman (Jan. 2002 - ; Dec. 2009; Ph. D.)  
Doug Martins (Sept. '02 -; May '09; Ph.D.)  
Kelly Mays (Sept. '07 – May '09; M.S.)  
Jonathan Slade (Nov. '07 – Dec. '09; M.S.)  
Levi Mielke (Nov. '04 – Dec. '09; Ph.D.)  
Travis Knepp (Nov. '04 - Apr. '10; Ph.D.)  
Jade Jones (Nov. '08 - May 2011; M. S.)  
Allyson Costa (Nov. '04 - Aug. '11; Ph.D.)  
Nick Veselka (Nov. '09 - Dec. '11; M.S.)  
Chelsea Stephens (Nov. '07 - Dec. '12); Ph.D.)

## **Post-Doctoral Fellows:**

### York U.:

Kirk Gladstone (January - July 1989)  
Kayambu Muthuramu (February 1991 - May 1994)  
J. Zhang (May 1991 - December 1991)  
Cunshing Hao (May 1992 - April 1994)  
Quanji Wu (February 1993 - March 1994)



2003 Mass Spectrometry  
Air-Ice Chemical Interactions Co-Chair (IGAC project)

2003-2007 NSF OPP External Advisory Panel

2003 NCAR ACD External Advisory Panel

2003 Created the Ocean-Atmosphere-Sea Ice-Snowpack (OASIS) project

2004 Co-Chair, IGAC project Air-Ice Chemical Interactions

2008-2010 NSF Geosciences Directorate External Advisory Panel

2008-2009 Organized OASIS2009 international field campaign

2013 - Inaugural Associate Editor (Atmospheric Sciences) for the online Journal  
*Elementa*

**Consulting:**

1990 Ontario Ministry of Labour  
NSI - Environment Sciences  
Unisearch Associates.

1991 CIRAC

1992 CIRAC

1993 CIRAC  
Atmospheric Environment Service

1994 CIRAC  
Atmospheric Environment Service  
U.S. EPA (Peer Review)

1995 U.S. EPA (Peer Review)

1997 Dept. of Energy

1997 Albemarle Corp.

1998 NSF "Committee of Visitors"

1999 EPA (Peer Review)

2004 EPA Senior Scientist Promotions Review

**Book Chapters:**

P. B. Shepson, Organic Nitrates, in "Volatile Organic Compounds In The Atmosphere", Ralf Koppmann, Ed., Blackwell Publishing, Ltd., Oxford, UK, 2007.

**Presentations at Schools and/or outreach presentations**

1990 Unionville High School

1990 Milliken Mills High School

1991 Glen Forest Secondary School

1991 Bowmanville High School

1991 Markham Secondary School

1991 City School

1992 St. Andrews Collegiate  
(All the above in the Toronto area)

2003 Cumberland Elementary School, "Climate Change"

2005 Barrow High School, Barrow, AK

- 2005 West Lafayette High School
- 2006 Happy Hollow Elementary School, West Lafayette, IN
- 2011 West Lafayette, IN High School Convocation, February 17, 2011, "Donuts, Fire, Ice, and Saving the World".
- 2011 Elderhostel Group, Purdue University, June 13, 2011, "Climate Change - Exciting??"