Ray Nassar

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EDUCATION

- **Ph.D.,** Physical Chemistry, University of Waterloo, Waterloo, Ontario, 2006
- **Bachelor of Science**, Honours Chemistry co-op, University of Waterloo, Waterloo, Ontario, 1998
- **Bachelor of Education,** Intermediate-Senior Chemistry and Physics Teaching, Queen's University, Kingston, Ontario, 1998

SCIENTIFIC RESEARCH EXPERIENCE

- **Environment Canada, Climate Research Division, Toronto, Ontario**
  ***Research Scientist – Climate Chemistry Measurements and Research (CCMR)*, 2010-present**

  Global modeling of atmospheric CO_2 and CH_4 and their sources/sinks (natural and anthropogenic). Application of satellite measurements of CO_2 and CH_4 in an advanced data assimilation system. Observing System Simulation Experiments (OSSEs) to evaluate proposed satellite observing systems.

- **University of Toronto, Departments of Physics and Geography, Toronto, Ontario**
  ***Postdoctoral Fellow – Centre for Global Change Science*, 2008-2010**

  Development of a major update to the atmospheric CO_2 simulation in the GEOS-Chem model. Inverse modeling of CO_2 sources and sinks combining satellite and ground-based measurements.

- **Harvard University, School of Engineering & Applied Sciences, Cambridge, Massachusetts**
  ***Postdoctoral Fellow – Atmospheric Chemistry Modeling Group*, 2006-2008**

  Validation/analysis of data from the Tropospheric Emission Spectrometer (TES) satellite instrument. Chemical transport modeling of tropospheric ozone, carbon monoxide, nitrogen oxides, etc.

- **University of Waterloo, Department of Chemistry, Waterloo, Ontario**
  ***Doctoral Researcher – Atmospheric Chemistry Experiment (ACE)*, 2000-2006**

  Lab spectroscopy, participation in ACE-FTS satellite instrument testing and retrieval development. Analyzed ACE-FTS measurements of chlorine and fluorine species, CH_4 and water vapor (H_2O and HDO) to investigate chemical and physical processes in the stratosphere and upper troposphere.

- **Alcan International Limited, Research and Development Centre, Kingston, Ontario**
  ***Research Assistant – Primary Materials Research Group*, 1998-1999**

  Research on extraction of alumina from bauxite using lab instrumentation and bench chemistry.

- **University of Waterloo, Department of Chemistry, Waterloo, Ontario**
  ***Undergraduate Researcher – Lab spectroscopy for astrophysical applications*, 1997-1998**

  Experimental high resolution infrared Fourier transform spectroscopy of hot H_2O for analysis of extraterrestrial atmospheres (sunspots, cool stars, exoplanets).

TEACHING EXPERIENCE

- **University of Waterloo, Department of Chemistry: Undergraduate Teaching Assistant**
  Introductory Spectroscopy (2003-2005), 3rd Year Physical Chemistry Laboratory (2000-2004), 1st Year General Chemistry Laboratory (2001-2002)
- **Iroquois Falls Secondary School, Iroquois Falls, Ontario: Secondary School Teacher**
  Grade 9 General Science, Grade 10 General Science, Grade 12 General Math (1997)
- **Gananoque Secondary School, Gananoque Ontario: Secondary School Teaching Assistant**
  OAC (Grade 13) Physics and Grade 9 Advanced Science (1996)

STUDENT SUPERVISION

- **Environment Canada, Climate Research Division**

  3rd year undergraduate co-op Physics student from University of Waterloo (UW), 2012 Sep-Dec
  Validation of satellite CO_2 measurements with aircraft data

  3rd year undergraduate co-op Mathematical Physics student from UW, 2012 May-Aug
  Comparison of model simulations with satellite XCO_2 retrievals and aircraft CO_2 measurements

  3rd year undergraduate co-op Physics student from UW, 2011 Sep-Dec
  Development of spatial/temporal scale factors for high resolution global fossil fuel CO_2 emission data
- **University of Waterloo, Department of Chemistry**
  Mentorship/co-supervision of junior students in the group of Prof. Peter Bernath, 2002-2006

SELECTED RESEARCH PROPOSALS

- Collaborator on "Satellite Composition Data: Towards improvements in climate, weather and air quality forecasting in the next decade", NSERC Climate Change and Atmospheric Research (CCAR), PI: John C. McConnell (York University), submitted 2012 October
- Collaborator on "Observational Constraints on Carbon Exchange at Regional and Local Scales (OCCERLS)", NSERC-CCAR, PI: Jennifer Murphy (University of Toronto), submitted 2012 October
- Collaborator on "Probing the Atmosphere of the High Arctic (PAHA)", NSERC-CCAR, PI: James Drummond (Dalhousie University), submitted 2012 October
- Principal Investigator (PI) for the successful proposal "Assimilation of GOSAT observations in the Environment Canada Carbon Assimilation System (EC-CAS) and complementary systems", 3rd Greenhouse Gases Observing Satellite (GOSAT) research announcement, 2011-present
- Project member in the successful Memorandum of Understanding (MOU) "Verifying Carbon Fluxes from Data Assimilation of atmospheric CO_2 measurements" between Environment Canada and the Canadian Space Agency (CSA), 2011-present
- Co-investigator for the successful proposal "Quantifying the Impact of OCO-2 Measurement Precision and Observing Strategy in the Context of Atmospheric Model Errors on CO_2 Flux Inversions" for Orbiting Carbon Observatory 2 (OCO-2) science team membership, 2011-present

SELECTED AWARDS

- Centre for Global Change Science Postdoctoral Fellowship, University of Toronto, (declined), 2008-2010
- Natural Sciences and Engineering Research Council (NSERC) Postdoctoral Fellowship, 2008-2010
- President's Graduate Scholarship, University of Waterloo, 2005
- NSERC Postgraduate Scholarship, 2003-2005
- Canadian Space Agency (CSA), Space Science (Atmospheric) Supplement to NSERC, 2003-2005
- Graduate Incentive Award, University of Waterloo, 2003-2005
- H.G. McLeod Scholarship, Guelph-Waterloo Centre for Graduate Work in Chemistry, 2004
- Ontario Graduate Scholarship in Science and Technology (OGSST), 2003
- Distinguished Teaching Assistant Award, Faculty of Science, University of Waterloo, 2001

PROFESSIONAL MEMBERSHIPS

- European Geosciences Union (EGU), 2011-present
- Canadian Meteorological and Oceanographic Society (CMOS), 2008-present
- American Geophysical Union (AGU), 2004-present

REVIEWING ACTIVITIES

- Intergovernmental Panel on Climate Change (IPCC), 5th Assessment Report, Working Group I, The Physical Science Basis, Chapter 6: Carbon and Biogeochemical Cycles
- NASA Research Opportunities in Space and Earth Sciences (ROSES) proposals and member of the Atmospheric Carbon Observations from Space (ACOS) review panel, Washington, D.C., 2010
- NOAA Climate Program, Earth System Science Global Carbon Cycle proposals, 2010 and 2011
- Manuscripts in the journals: Atmospheric Chemistry and Physics (4), Journal of Geophysical Research (2), Nature Climate Change (1), Geophysical Research Letters (1), Atmospheric Measurement Techniques (1), Biogeosciences (1), Atmosphere-Ocean (1), Journal of Quantitative Spectroscopy and Radiative Transfer (1), IEEE Journal of Selected Topics in Earth Observation and Remote Sensing (1)

OTHER PROFESSIONAL ACTIVITIES

- Committee on Earth Observation Satellites (CEOS), Carbon Task Force (CTF) member, 2011-present
- GOSAT international science team member (3rd Research Announcement PI), 2011-present
- Orbiting Carbon Observatory 2 (OCO-2) 'Competed Science Team' member, 2011-present
- GEOS-Chem Steering Committee, co-chair of Carbon Gases & Organics Working Group, 2011-2015
- Science team member for the Weather, Climate and Air quality (WCA) instrument suite proposed for Canada's Polar Communications and Weather (PCW) satellite mission, 2010-present
- Chaired discussion session on lidar CO_2 measurement requirements for anthropogenic emissions monitoring, NASA ASCENDS satellite workshop, Ann Arbor, Michigan, 2008
- Participant in Orbiting Carbon Observatory (OCO) science team telecons/meetings, 2007-2011
- NASA Aura and Tropospheric Emission Spectrometer (TES) science team member, 2006-present
- Science team member for Atmospheric Chemistry Experiment (ACE) satellite mission, 2000-present

JOURNAL PUBLICATIONS

1. **R. Nassar**, L. Napier-Linton, K.R. Gurney, R.J. Andres, T. Oda, F.R. Vogel, F. Deng, Scale factors to improve the temporal and spatial distributions of CO_2 emissions from global fossil fuel emission inventories, *in revision, Journal of Geophysical Research Atmospheres, doi:10.1029/012JD018196.*

2. S.S. Kulawik, J.R. Worden, S.C. Wofsy, S.C. Biraud, **R. Nassar**, D.B.A. Jones, E.T. Olsen, Greg B. Osterman and the TES and HIPPO Teams (2012), Comparison of improved Aura Tropospheric Emission Spectrometer (TES) CO_2 with HIPPO and SGP aircraft profile measurements, *Atmospheric Chemistry and Physics Discussions*, 12, 6283-6329.

3. C. Shim, **R. Nassar**, J. Kim (2011), Comparison of model-simulated atmospheric carbon dioxide with GOSAT retrievals, *Asian Journal of Atmospheric Environment, 5, 263-277.*

4. **R. Nassar**, D.B.A. Jones, S.S. Kulawik, J.R. Worden, K.W. Bowman, R.J. Andres, P. Suntharalingam, J.M. Chen, C.A.M. Brenninkmeijer, T.J. Schuck, T.J. Conway, D.E. Worthy (2011), Inverse modeling of CO_2 sources and sinks using satellite observations of CO_2 from TES and surface flask measurements, *Atmospheric Chemistry and Physics*, 11, 6029-6047.

5. S.C. Wofsy, B.C. Daube, R. Jimenez, E. Kort, J.V. Pittman, S. Park, R. Commane, B. Xiang, G. Santoni, D. Jacob, J. Fisher, C. Pickett-Heaps, H. Wang, K. Wecht, Q.-Q. Wang, B.B. Stephens, S. Shertz, P. Romashkin, T. Campos, J. Haggerty, W.A. Cooper, D. Rogers, S. Beaton, R. Hendershot, J.W. Elkins, D.W. Fahey, R.S. Gao, F. Moore, S.A. Montzka, J.P. Schwarz, D. Hurst, B. Miller, C. Sweeney, S. Oltmans, D. Nance, E. Hintsa, G. Dutton, L.A. Watts, J.R. Spackman, K.H. Rosenlof, E.A. Ray, B. Hall, M.A. Zondlo, M. Diao, R. Keeling, J. Bent, E.L. Atlas, R. Lueb, M.J. Mahoney, M. Chahine, E. Olsen, P. Patra, K. Ishijima, R. Engelen, J. Flemming, **R. Nassar**, D.B.A. Jones, S.E. Mikaloff-Fletcher (2011), HIAPER Pole-to-Pole Observations (HIPPO): fine grained, global scale measurements of climatically important atmospheric gases and aerosols, *Philosophical Transactions of the Royal Society A*, 369, 2073-2086.

6. **R. Nassar**, D.B.A. Jones, P. Suntharalingam, J.M. Chen, R.J. Andres, K.J. Wecht, R.M. Yantosca, S.S. Kulawik, K.W. Bowman, J.R. Worden, T. Machida and H. Matsueda (2010), Modeling global atmospheric CO_2 with improved emission inventories and CO_2 production from the oxidation of other carbon species, Geoscientific Model Development, 3, 689-716.

7. M. Luo, C. Boxe, J. Jiang, **R. Nassar**, N. Livesey (2010), Interpretation of Aura satellite observations of CO and aerosol index related to the December 2006 Australia fires, Remote Sensing of Environment, 114, 2853-2862 and also *Atmospheric Chemistry and Physics Discussions*, 9, 23665-23693.

8. S.S. Kulawik, D.B.A. Jones, **R. Nassar**, F.W. Irion, J.R. Worden, K.W. Bowman, T. Machida, H. Matsueda, Y. Sawa, S. Biraud, M. Fisher, A. Jacobson (2009), Characterization of Tropospheric Emission Spectrometer (TES) CO_2 for carbon cycle science, *Atmospheric Chemistry and Physics*, 10, 5601-5623.

9. H. Wang, D.J. Jacob, M. Kopacz, D.B.A. Jones, P. Suntharalingam, J.A. Fisher, **R. Nassar**, S. Pawson, J.E. Nielsen (2009), Error correlation between CO_2 and CO as constraint for CO_2 flux inversions using satellite data, *Atmospheric Chemistry and Physics*, 9, 7313-7323.

10. **R. Nassar,** J.A. Logan, I.A. Megretskaia, L.T. Murray, L. Zhang, D.B.A. Jones (2009), Analysis of tropical tropospheric ozone, carbon monoxide and water vapor during the 2006 El Niño using TES

observations and the GEOS-Chem model, *Journal of Geophysical Research*, 114, D17304, doi:10.1029/2009JD011760.

11. V.H. Payne, S.A. Clough, M.W. Shephard, **R. Nassar**, J.A. Logan (2009), Information-centered representation of retrievals with limited degrees of freedom for signal: Application to methane from the Tropospheric Emission Spectrometer, *Journal of Geophysical Research*, 114, D10307, doi:10.1029/2008JD010155.

12. E. Mahieu, P. Duchatelet, P. Demoulin, K.A. Walker, E. Dupuy, L. Froidevaux, C. Randall, V. Catoire, K. Strong, C.D. Boone, P.F. Bernath, J.-F. Blavier, T. Blumenstock, M. Coffey, M. De Mazière, D. Griffith, J. Hannigan, F. Hase, N. Jones, K.W. Jucks, A. Kagawa, Y. Kasai, Y. Mebarki, S. Mikuteit, **R. Nassar**, J. Notholt, C.P. Rinsland, C. Robert, O. Schrems, C. Senten, D. Smale, J. Taylor, C. Tétard, G.C. Toon, T. Warneke, S.W. Wood, R. Zander, C. Servais (2008), Validation of ACE-FTS v2.2 measurements of HCl, HF, CCl_3F and CCl_2F_2 using space-, balloon- and ground-based instrument observations, *Atmospheric Chemistry and Physics*, 8, 6199-6221.

13. **R. Nassar,** J.A. Logan, H.M. Worden, I.A. Megretskaia, K.W. Bowman, G.B. Osterman, A.M. Thompson, D.W. Tarasick, S. Austin, H. Claude, M.K. Dubey, W.K. Hocking, B.J. Johnson, E. Joseph, J. Merrill, G.A. Morris, M. Newchurch, S.J. Oltmans, F. Posny, F.J. Schmidlin, H. Vömel, D.N. Whiteman, J.C. Witte (2008), Validation of Tropospheric Emission Spectrometer (TES) Nadir Ozone Profiles Using Ozonesonde Measurements, *Journal of Geophysical Research*, 113, D15S17, doi:10.1029/2007JD008819.

14. J.A. Logan, I.A. Megretskaia, **R. Nassar**, L.T. Murray, L. Zhang, K.W. Bowman, H.M. Worden, M. Luo (2008), Effects of the 2006 El Niño on tropospheric composition as revealed by data from the Tropospheric Emission Spectrometer (TES), *Geophysical Research Letters*, 38, L03816, doi:10.1029/2007GL031698.

15. **R. Nassar**, P.F. Bernath, C.D. Boone, A. Gettelman, S.D. McLeod, C.P. Rinsland (2007), Variability in HDO/H_2O abundance ratios in the tropical tropopause layer, *Journal of Geophysical Research*, 112, D21305, doi:10.1029/2007JD008417.

16. D. Fu, C.D. Boone, P.F. Bernath, K.A. Walker, **R. Nassar**, G.L. Manney, S.D. McLeod (2007), Global phosgene observations from the Atmospheric Chemistry Experiment (ACE) mission, *Geophysical Research Letters*, 34, L17815, doi:10.1029/2007GL029942.

17. C.P. Rinsland, **R. Nassar**, C.D. Boone, P. Bernath, L. Chiou, D.K. Weisenstein, E. Mahieu, R. Zander (2007), Spectroscopic detection of COClF in the tropical and mid-latitude lower stratosphere, *Journal of Quantitative Spectroscopy and Radiative Transfer*, 105, 467-475.

18. L. Froidevaux, N.J. Livesey, W.G. Read, R.J. Salawitch, J.W. Waters, B. Drouin, I.A. MacKenzie, H.C. Pumphrey, P. Bernath, C. Boone, **R. Nassar**, S. Montzka, J. Elkins, D. Cunnold, D. Waugh (2006), Temporal Decrease in Upper Atmospheric Chlorine, *Geophysical Research Letters*, 33, L23812, doi:10.1029/2006GL027600.

19. **R. Nassar**, P.F. Bernath, C.D. Boone, C. Clerbaux, P.F. Coheur, G. Dufour, L. Froidevaux, E. Mahieu, J.C. McConnell, S.D. McLeod, D.P. Murtagh, C.P. Rinsland, K. Semeniuk, R. Skelton, K.A. Walker, R. Zander (2006), A global inventory of stratospheric chlorine in 2004, *Journal of Geophysical Research*, 111, D22312, doi:10.1029/2006JD007073.

20. **R. Nassar**, P.F. Bernath, C.D. Boone, S.D. McLeod, R. Skelton, K.A. Walker, C.P. Rinsland, P. Duchatelet (2006), A global inventory of stratospheric fluorine in 2004 based on ACE-FTS measurements, *Journal of Geophysical Research*, 111, D22313, doi:10.1029/2006JD007395.

21. J.J. Jin, K. Semeniuk, G.L. Manney, A.I. Jonsson, S.R. Beagley, J.C. McConnell, G. Dufour, **R. Nassar**, C.D. Boone, K.A. Walker, P.F. Bernath, C.P. Rinsland (2006), Severe Arctic ozone loss in the winter 2004/2005: observations from ACE-FTS, *Geophysical Research Letters*, 33, L15801, doi:10.1029/2006GL026752.

22. G. Dufour, **R. Nassar**, C.D. Boone, R. Skelton, K.A. Walker, P.F. Bernath, C.P. Rinsland, K. Semeniuk, J.J. Jin, J.C. McConnell, G.L. Manney (2006), Partitioning between the inorganic chlorine reservoirs, HCl and $ClONO_2$, during the Arctic winter 2005 from the ACE-FTS, *Atmospheric Chemistry and Physics*, 6, 2355-2366.

23. C.P. Rinsland, E. Mahieu, R. Zander, **R. Nassar**, P. Bernath, C. Boone, L.S. Chiou (2006), Long-Term Stratospheric Carbon Tetrafluoride (CF_4) Increase from 1985-2004 Infrared Space-based Solar Occultation Measurements, *Geophysical Research Letters*, 33, L02808, doi:10.1029/2005GL024709.

24. C.D. Boone, **R. Nassar**, K.A. Walker, Y. Rochon, S.D. McLeod, C.P. Rinsland, P.F. Bernath (2005), Retrievals for the Atmospheric Chemistry Experiment Fourier Transform Spectrometer, *Applied Optics*, 44 (33), 7218-7231.

25. C.P. Rinsland, C. Boone, **R. Nassar**, K. Walker, P. Bernath, J.C. McConnell, L. Chiou (2005), Atmospheric Chemistry Experiment (ACE) Arctic Stratospheric Measurements of NO_x during February and March 2004: Impact of Intense Solar Flares, *Geophysical Research Letters*, 32, L16S05, doi:10.1029/2005GL022425.

26. C.P. Rinsland, C. Boone, **R. Nassar**, K. Walker, P. Bernath, E. Mahieu, R. Zander, J.C. McConnell, L. Chiou (2005), Trends of HF, HCl, CCl_2F_2, CCl_3F, $CHClF_2$ (HCFC-22), and SF_6 in the lower stratosphere from Atmospheric Chemistry Experiment (ACE) and Atmospheric Trace Molecule Spectroscopy (ATMOS) measurements near 30ºN latitude, *Geophysical Research Letters*, 32, L16S03, doi:10.1029/2005GL022415.

27. **R. Nassar**, P.F. Bernath, C.D. Boone, G.L. Manney, S.D. McLeod, C.P. Rinsland, R. Skelton, K.A. Walker (2005), ACE-FTS measurements across the edge of the winter 2004 Arctic vortex, *Geophysical Research Letters*, 32, L15S05, doi:10.1029/2005GL022671.

28. **R. Nassar**, P.F. Bernath, C.D. Boone, G.L. Manney, S.D. McLeod, C.P. Rinsland, R. Skelton, K.A. Walker (2005), Stratospheric abundances of water and methane based on ACE-FTS measurements, *Geophysical Research Letters*, 32, L15S04, doi:10.1029/2005GL022383.

29. P.F. Bernath, C.T. McElroy, M.C. Abrams, C.D. Boone, M. Butler, C. Camy-Peyret, M. Carleer, C. Clerbaux, P.-F. Coheur, R. Colin, P. DeCola, M. De Mazière, J.R. Drummond, D. Dufour, W.F.J. Evans, H. Fast, D. Fussen, K. Gilbert, D.E. Jennings, E.J. Llewellyn, R.P. Lowe, E. Mahieu, J.C. McConnell, M. McHugh, S.D. McLeod, D. Michelangeli, C. Midwinter, **R. Nassar**, F. Nichitiu, C. Nowlan, C.P. Rinsland, Y.J. Rochon, N. Rowlands, K. Semeniuk, P. Simon, R. Skelton, J.J. Sloan, M.-A. Soucy, K. Strong, P. Tremblay, D. Turnbull, K.A. Walker, I. Walkty, D.A. Wardle, V. Wehrle, R. Zander, J. Zou (2005), Atmospheric Chemistry Experiment (ACE): mission overview, *Geophysical Research Letters*, 32, L15S01, doi:10.1029/2005GL022386.

30. A.E. Haddrell, X. Feng, **R. Nassar**, M.J. Bogan, G. Agnes (2005), Offline LDI-TOF-MS monitoring of simultaneous inorganic and organic reactions on particles levitated in a laboratory environment, *Journal of Aerosol Science*, 36: 521-533, doi:10.1016/j.jaerosci.2004.10.015.

31. **R. Nassar**, P. Bernath (2003), Hot Methane Spectra for Astrophysical Applications, *Journal of Quantitative Spectroscopy & Radiative Transfer*, 82:279-292, doi:10.1016/S0022-4073(03)00158-4.

32. N.F. Zobov, O.L. Polyansky, J. Tennyson, S.V. Shirin, **R. Nassar**, T. Hirao, T. Imajo, P.F. Bernath, L. Wallace (2000), Using Laboratory Spectroscopy to Identify Lines in the K- and L-band Spectrum of Water in a Sunspot, *The Astrophysical Journal*, 530: 994-998.

CONFERENCE PROCEEDINGS

- J. McConnell, C.T. McElroy, B. Solheim, C. Sioris, W. Evans, H. Buijs, M. Roux, P. Rahnama, K. Walker, D. Jones, L. Garand, **R. Nassar**, R. Martin, N. O'Neill, M. Bergeron, and the PCW/PHEMOS Science Team (2011), A Quasi-Geostationary View of the Arctic and Environs: PCW/PHEMOS For Arctic Weather, Climate and Air Quality, EUMETSAT Meteorological Satellite Conference, 2011 September 5-9, Oslo, Norway, ISBN 978-92-9110-093-4.

- C.P. Rinsland, P.F. Bernath, C. Boone, **R. Nassar**, G. Dufour, C. Clerbaux (2007), Atmospheric Chemistry Experiment (ACE) Measurements of the Upper Troposphere and Stratosphere, Proceedings of the ENVISAT Symposium, 2007 April 23-27, Montreux, Switzerland (ESA SP-636).

- C. Boone, **R. Nassar**, S. McLeod, K. Walker, P. Bernath (2004), *SCISAT-1 Retrieval Results*, Proceedings of SPIE, Vol. 5542, Earth Observing Systems IX, edited by W.L. Barnes and J.J. Butler (SPIE, Bellingham, WA) pp 184-194.

- **R. Nassar**, K.A. Walker, C. Boone, S.D. McLeod, P.F. Bernath (2003), *SCISAT-1: Retrieval Algorithms, ACE-FTS Testing and the ACE Database*, Proceedings of SPIE, Vol. 5151 Earth Observing Systems VII, edited by W. L. Barnes (SPIE, Bellingham, WA) pp 173-183.

- **R. Nassar**, P. Bernath (2003), *Temperature profiles for the ACE forward model.* 2003 Optical Remote Sensing Technical Digest, Proceedings of the conference Optical Remote Sensing, Quebec City, Quebec, 2003 Feb 3-5 (Optical Society of America, Washington D.C.) pp 34-36.

- **R. Nassar**, P. Bernath (2003), *Laboratory Spectra of Hot Water and Methane for Modeling Late-Type Stars and Brown Dwarfs*, Proceedings of the Conference "Chemistry as a Diagnostic of Star Formation" University of Waterloo (NRC Research Press, Ottawa) pp 366-367.

CHAPTERS IN REPORTS

- D.M. Cunnold, C. Clerbaux, J. Anderson, A. Engel, P.J. Fraser, E. Mahieu, A. Manning, J. Miller, S.A. Montzka, **R. Nassar**, R. Prinn, S. Reimann, C.P. Rinsland, P. Simmonds, D. Verdonik, R. Weiss, D. Wuebbles, Y. Yokouchi (2007), Chapter 1: Long-Lived Substances, in *Scientific Assessment of Ozone Depletion: 2006*, World Meteorological Organization, Geneva, Switzerland.

- K.S. Law, W.T Sturges, D.R. Blake, N.J. Blake, J.B. Burkholder, J.H. Butler, R.A. Cox, P.H. Haynes, M.K.W. Ko, K. Kreher, C. Mari, K. Pfeilsticker, J.M.C. Plane, R.J. Salawitch, C. Schiller, B.-M. Sinnhuber, R. von Glasow, N.J. Warwick, D.J. Wuebbles, S.A. Yvon-Lewis (2007), Chapter 2: Halogenated Very Short-Lived Substances, in *Scientific Assessment of Ozone Depletion: 2006*, World Meteorological Organization, Geneva, Switzerland. **Listed Contributors:** A. Butz, D.B. Considine, M. Dorf, L. Froidevaux, L.J. Kovalenko, N.J. Livesey, **R. Nassar**, C.E. Sioris, D.K. Weisenstein.

INVITED TALKS

- **R. Nassar**. *Benefits and challenges associated with the use of satellite observations of CO_2 for estimating CO_2 surface sources and sinks*, American Geophysical Union Fall Meeting, San Francisco, California, 2011 December 5-9.
- **R. Nassar**. *Application of satellite and in situ observations of CO_2 for quantifying CO_2 sources and sinks*, University of Toronto, Carbon Cycle Research Group, Toronto, Canada, 2011 April 7.
- **R. Nassar**. *Application of greenhouse gas satellite observations at Environment Canada*, NOAA-NASA-EUMETSAT Satellite Hyperspectral Workshop, Miami, Florida, 2011 March 30.
- **R. Nassar**. *Inverse Modeling of CO_2 sources and sinks using a combination of satellite and flask observations*, Earth Observation Group, University of Leicester, Leicester, United Kingdom, 2010 September 10.
- **R. Nassar**. *Using TES CO_2 observations to improve inverse modeling estimates of CO_2 fluxes*, Air Quality Research Division, Environment Canada, Toronto, 2010 February 18.
- **R. Nassar**. *Using Satellite Observations of CO_2 from TES for Source/Sink Inversions*, Meteorological Institute of the Netherlands (KNMI), Utrecht, Netherlands, 2009 September 29.
- **R. Nassar**. *Chlorine, Fluorine and Water in the Stratosphere: Chemistry, Transport and Trends based on ACE-FTS measurements*, Meteorological Institute of Stockholm University, Stockholm, Sweden, 2006 June 1.
- **R. Nassar**. *Chlorine and Water in the Stratosphere: Chemistry, Transport and Trends based on ACE-FTS measurements*, Harvard University, Cambridge, Massachusetts, 2005 December 19.
- **R. Nassar**, P.F. Bernath, C.D. Boone, S.D. McLeod, R. Skelton, K.A. Walker. *ACE-FTS Measurements of Water and Methane Isotopologues*, International Workshop on Submillimeter Wave Earth Observation, Kyoto, Japan, 2005 November 14-15.

SELECTED ORAL PRESENTATIONS

- **R. Nassar**, D.B.A. Jones, C. Sioris, J.C. McConnell, K.A. Walker, H. Buijs, Northern Greenhouse Gas Observations from a Highly Elliptical Orbit (HEO) Mission, 8th International Workshop on Greenhouse Gas Measurements from Space (IWGGMS-8), Pasadena, CA, 2012 June 18-20.
- **R. Nassar**, L. Napier-Linton, K.R. Gurney, R.J. Andres, T. Oda, F.R. Vogel, F. Deng, Improving the temporal and spatial distribution of CO_2 emissions from global fossil fuel emission inventories for source/sink inversions, Atmospheric Tracer Transport Intercomparison (TransCom) Project Meeting, Nanjing, China, 2012 June 4-8.
- **R. Nassar**, D.B.A. Jones, H. Buijs, C. Sioris, J.C. McConnell, Northern High Latitude Greenhouse Gas Observations from Space, Group on Earth Observations (GEO) Carbon Conference "Carbon in a Changing World", United Nations Food and Agriculture Organization (UN FAO), Rome, Italy, 2011 October 28.
- **R. Nassar**, D.B.A. Jones, S.S. Kulawik, J.M. Chen, P. Suntharalingam, R.J. Andres, Inverse Modeling of CO_2 sources/sinks using Tropospheric Emission Spectrometer (TES) CO_2 observations, International Global Atmospheric Chemistry Conference (IGAC), Halifax, 2010 July 11-16.

- **R. Nassar,** D.B.A. Jones, S.S. Kulawik, J.M. Chen, R.J. Andres, P. Suntharalingam, Using Tropospheric Emission Spectrometer (TES) CO_2 observations to improve inverse modeling estimates of carbon fluxes, American Geophysical Union Fall Meeting, San Francisco, California, 2009 December 14-18.
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