

MICHAELA IMELDA HEGGLIN

born on 28 April 1975 in Zug, Switzerland

Department of Physics
University of Toronto
60 St. George St.
Toronto, ON
Canada M5S 1A7

Phone: +1 416 978 2661
michaela@atmosph.physics.utoronto.ca

DEGREES

- Ph.D. (Dr. Sc. ETH), Institute for Atmospheric and Climate Science, ETH Zurich, Switzerland (May 2004)
- M.Sc. in Environmental Sciences (Dipl. Umwelt-Natw. ETH), ETH Zurich, Switzerland (October 2000)

EMPLOYMENT

Jul 2006 – present	Research Associate, Department of Physics, University of Toronto, Toronto, ON, Canada (working with Prof. Theodore G. Shepherd and Prof. Dylan B. A. Jones)
Sep 2005 – Jun 2006	Postdoctoral Fellow, Department of Physics, University of Toronto, Toronto, ON, Canada (working with Prof. Theodore G. Shepherd)
Jun 2004 – Jul 2005	Postdoctoral Fellow, Institute for Atmospheric and Climate Science, ETH Zurich, Switzerland (working with Prof. Thomas Peter)
May 2001 – May 2004	Ph.D. student, Institute for Atmospheric and Climate Science, ETH Zurich, Switzerland (Supervisors: Dr. Dominik Brunner, Prof. Johannes Staehelin, Prof. Thomas Peter)
Feb 2001 – Apr 2001	Visiting Scientist, Max-Planck-Institute for Chemistry Department of Atmospheric Chemistry, Mainz, Germany (working with Dr. Horst Fischer and Prof. Jos Lelieveld)
Sep 2000 – Dec 2000	Research Assistant, Institute for Atmospheric and Climate Science, ETH Zurich, Switzerland (working with Dr. Ulrich Krieger, Dr. Thomas Koop, and Prof. Thomas Peter)

LANGUAGES

Swiss German and Romansch (native languages); German, French, English (fluent); Latin (proficient); Italian, Spanish (basic knowledge)

PROFESSIONAL MEMBERSHIPS

AGU (American Geophysical Union); AMS (American Meteorological Society)

TEACHING AND SUPERVISION

At University of Toronto, Canada:

- Supervision of summer students (Sarah Nickerson, 2006; Ming Fu, 2008; Rafael Krichevsky, 2009)

At ETH Zurich, Switzerland:

- Teaching assistant in *Tropospheric Chemistry* (SS 2003, in German)
- Teaching assistant in *Stratospheric Chemistry* (WS 2002/03, in German)
- Substitute during lectures in *Environment III* and *Introduction to Meteorology, Atmospheric Physics and Chemistry* (WS 2002 and 2003, in German)

SIGNIFICANT RESPONSIBILITIES

- Co-lead of SPARC Data Initiative (with Susann Tegtmeier, IFM-GEOMAR, from Oct 2009)
- Co-lead of joint IGAC/SPARC AC&C Activity II ‘Processes controlling aerosols and chemical tracers in the upper troposphere’ (with Céline Mari, CNRS, and Mary Barth, NCAR, from Oct 2009)
- Member of the PREMIER mission advisory group (MAG) during Phase A of the European Space Agency (ESA) Earth Explorer satellite selection procedure (from May 2009)
- Coordinating lead author (CLA) of the ‘Twenty Questions’ chapter of the 2010 WMO/UNEP Ozone Assessment (with David Fahey, NOAA, 2009-2011)
- Co-lead author (with Andrew Gettelman, NCAR) of chapter 7 ‘The UTLS’ of the SPARC CCMVal Report (Chemistry-Climate Model Validation, Eds.: V. Eyring, T. G. Shepherd, D. Waugh, 2007-2010)

OTHER RELEVANT EXPERIENCE

- Science team member of a new UTLS satellite mission proposal to NASA’s Venture program (PI: William J. Randel, from May 2011)
- Co-convenor (with Michelle Santee, John Daniel, and Phil Rasch) of the poster session ‘Atmospheric composition and forcings’ at the WCRP Open Science conference in Denver (October, 2011)
- Co-Investigator, ‘UTLS Transport in the Climate System’ (ROSES-2010 AST call for proposals, PI: G. L. Manney, ongoing)
- Co-convenor (with Mark Baldwin, NWRA) of the session ‘Stratospheric Ozone and Climate’ at the AGU Meeting of the Americas, Foz de Iguacu, Brazil (2-6 Aug, 2010)
- Member of the Canadian Space Agency’s CASS mission definition team (from July 2010)
- Co-author of chapter 2 ‘Stratospheric ozone and surface ultraviolet radiation’ of the 2010 WMO/UNEP Ozone Assessment (2009-2010)

- Collaborator, ‘Modelling and Climate Implications of Stratopause and Tropopause Evolution’ (Aura Science Team element of NASA’s ROSES-2007 call for proposals, PI: G. L. Manney, 2007-2009)
- Collaborator, STEP mission concept study (Stratosphere-Troposphere Exchange Processes, Canadian Space Agency, PI: D. Degenstein, 2007-2009)
- Member of the Organizing Committee, Community Workshop ‘Science from Suborbital Vehicles (Balloons, Aircraft, Sounding Rockets)’, Toronto, ON, Canada, sponsored by the Canadian Space Agency (Feb 2007)
- Science team member of SPURT aircraft campaign (trace gas transport in the tropopause region, an AFO2000 research project funded by the German Federal Ministry of Education and Research (BMBF), 2001-2004)
- Reviewer for *Atmospheric Chemistry and Physics*, *Journal of Geophysical Research*, *Journal of the Atmospheric Sciences*, *Geophysical Research Letters*, *Journal of the Meteorological Society of Japan*, and the UNEP EEAP 2010 assessment report

GRANTS AND CONTRACTS

- International Space Science Institute (ISSI) International Teams Program, ‘Atmospheric Trace Gas Data Set Inter-Comparison Project’ (approx. 20’000 CHF; 2010, ongoing)
- European Space Agency (ESA) ITT Call, ‘PREMIER impact study: Impact on Climate predictions (42’000 Euro; 2010, ongoing)

PUBLICATIONS

In Preparation or Submitted:

- Fujiwara, M., J. Suzuki, A. Gettelman, **M. I. Hegglin**, H. Akiyoshi, and K. Shibata, Wave activity in the tropical tropopause layer in reanalysis and chemistry climate model data, *J. Geophys. Res.*, in preparation.
- **Hegglin, M. I.**, I. Wohltmann, K. Rosenlof, G. Bodeker, and CCMVal model PIs, Climate-change induced changes in stratosphere-to-troposphere ozone fluxes: a multi-model assessment, in preparation.
- Manney, G. L., **M. I. Hegglin**, W. H., Daffer, S., Pawson, M. J., Schwartz, Climatology and variability of upper tropospheric/lower stratospheric (UTLS) jet from MERRA reanalysis, in preparation.
- Manney, G. L., **M. I. Hegglin**, W. H., Daffer, M. L., Santee, E. A., Ray, S., Pawson, M. J., Schwartz, C. D., Boone, L., Froidevaux, Livesey, N. J., Read, W. G., and Walker, K. A.: Jet characterization in the upper troposphere/lower stratosphere (UTLS): applications to climatology and transport studies, *Atmos. Chem. Phys. Discuss.*, **11**, 1835-1889, doi:10.5194/acpd-11-1835-2011, 2011.

Peer-Reviewed Journal Publications:

- Gettelman, A., P. Hoor, L. L. Pan, W. J. Randel, **M. I. Hegglin**, and T. Birner, The extra tropical upper troposphere and lower stratosphere, *Rev. Geophys.*, in press, 2011.

- Ray, E. A., F. L. Moore, K. H. Rosenlof, et al., Evidence for changes in stratospheric transport and mixing over the past three decades based on multiple data sets and tropical leaky pipe analysis, *J. Geophys. Res.*, **115**, D21304, doi:10.1029/2010JD014206, 2010.
- Hoor, P., H. Wernli, **M. I. Hegglin**, and H. Bönisch, Transport timescales and tracer properties in the extratropical UTLS, *Atmos. Chem. Phys.*, **10**, 7929-7944, doi:10.5194/acp-10-7929-2010, 2010.
- **Hegglin, M. I.**, A. Gettelman, P. Hoor et al., Multi-model assessment of the upper troposphere and lower stratosphere: extra-tropics, *J. Geophys. Res.*, **115**, D00M09, doi:10.1029/2010JD013884, 2010.
- Gettelman, A., **M. I. Hegglin**, M. Fujiwara et al., Multi-model assessment in the upper troposphere and lower stratosphere: tropics and trends, *J. Geophys. Res.*, **115**, D00M08, doi:10.1029/2009JD013638, 2010.
- Morgenstern, O., M. A. Giorgetta, K. Shibata et al., Review of present-generation stratospheric chemistry-climate models and associated external forcings, *J. Geophys. Res.*, doi:10.1029/2009JD013728, 2010.
- **Hegglin, M. I.**, and T. G. Shepherd, Large climate-induced changes in UV index and stratosphere-to-troposphere ozone flux, *Nature Geoscience* **2**, 687-691, 2009.
This paper was highlighted by Nature [461:148, 2009] and featured in Nature Geoscience 'News&Views' [D. S. Stevenson, 2:677, 2009] and Frontiers in Ecology and Environment 'Dispatches' [J. Bradbury, 8:401, 2009]
- Manney, G. L., R. S. Harwood, I. A. MacKenzie, K. Minschwaner, D. R. Allen, M. L. Santee, K. A. Walker, **M. I. Hegglin**, A. J. Lambert, H. C. Pumphrey, P. F. Bernath, C. D. Boone, and W. H. Daffer, Satellite observations and modelling of transport during the 2006 major stratospheric sudden warming, *Atmos. Chem. Phys.*, **9**, 4775-4795, 2009.
- **Hegglin, M. I.**, C. D. Boone, G. L. Manney, K. A. Walker, A global view of the extratropical tropopause transition layer from Atmospheric Chemistry Experiment Fourier Transform Spectrometer O₃, H₂O, and CO, *J. Geophys. Res.*, **114**, D00B11, doi:10.1029/2008JD009984, 2009.
- **Hegglin, M. I.**, C. D. Boone, G. L. Manney, T. G. Shepherd, K. A. Walker, P. F. Bernath, W. H. Daffer, P. Hoor, and C. Schiller, Validation of ACE-FTS satellite data in the upper troposphere/lower stratosphere (UTLS) using non-coincident measurements, *Atmos. Chem. Phys.*, **8**, 1483-1499, 2008.
- **Hegglin, M. I.**, and T. G. Shepherd, O₃-N₂O correlations from the Atmospheric Chemistry Experiment: Revisiting a diagnostic of transport and chemistry in the stratosphere, *J. Geophys. Res.*, **112**, D19301, doi:10.1029/2006JD008281, 2007.
- Paetz, H. W., A. Volz-Thomas, **M. I. Hegglin**, D. Brunner, H. Fischer, and U. Schmidt, In-situ comparison of the NO_y instruments flown in MOZAIC and SPURT, *Atmos. Chem. Phys.*, **6**, 2401-2410, 2006.

- **Hegglin, M. I.**, D. Brunner, Th. Peter, P. Hoor, H. Fischer, J. Staehelin, M. Krebsbach, C. Schiller, U. Parchatka, and U. Weers, Measurements of NO, NO_y, N₂O, and O₃ during SPURT: Implications for transport and chemistry in the lowermost stratosphere, *Atmos. Chem. Phys.*, **6**, 1331-1350, 2006.
- Krebsbach M., C. Schiller, D. Brunner, G. Günther, **M. I. Hegglin**, D. Mottaghy, M. Riese, N. Spelten, and H. Wernli, Seasonal cycles and variability of O₃ and H₂O in the UT/LMS during SPURT, *Atmos. Chem. Phys.*, **6**, 109-125, 2006.
- Engel, A., H. Bönisch, D. Brunner, H. Fischer, H. Franke, G. Günther, C. Gurk, **M. Hegglin**, P. Hoor, R. Königstedt, M. Krebsbach, R. Maser, U. Parchatka, Th. Peter, D. Schell, C. Schiller, U. Schmidt, N. Spelten, T. Szabo, U. Weers, H. Wernli, Th. Wetter, and V. Wirth, Highly resolved observations of trace gases in the lowermost stratosphere and upper troposphere from the SPURT project: An overview, *Atmos. Chem. Phys.*, **6**, 283-301, 2006.
- Fischer H., M. Lawrence, Ch. Gurk, P. Hoor, J. Lelieveld, **M. I. Hegglin**, and D. Brunner, Model simulations and aircraft measurements of vertical, seasonal and latitudinal O₃ and CO distributions over Europe, *Atmos. Chem. Phys.*, **6**, 339-348, 2006.
- **Hegglin, M. I.**, D. Brunner, Th. Peter, J. Staehelin, V. Wirth, P. Hoor, and H. Fischer: Determination of eddy-diffusivity in the lowermost stratosphere, *Geophys. Res. Lett.*, **32**, L13812, doi:10.1029/2005GL022495, 2005.
- Hoor, P., C. Gurk, D. Brunner, **M. I. Hegglin**, H. Wernli, and H. Fischer: Seasonality and extent of extratropical TST derived from in-situ CO measurements during SPURT, *Atmos. Chem. Phys.*, **4**, 1427-1442, 2004.
- **Hegglin, M. I.**, D. Brunner, H. Wernli, C. Schwierz, O. Martius, M. Krebsbach, C. Schiller, N. Spelten, P. Hoor, H. Fischer, U. Parchatka, U. Weers, J. Staehelin, and Th. Peter, Tracing troposphere to stratosphere transport within a mid-latitude deep convective system. *Atmos. Chem. Phys.*, **4**, 741-756, 2004.
- **Hegglin, M. I.**, U. K. Krieger, T. Koop, and T. Peter, Technical Note: Organics-induced fluorescence in Raman studies of sulfuric acid aerosols, *Aerosol Science and Technology*, **36**, 510-512, 2001.

Non-Peer Reviewed:

- Hoor, P., H. Bönisch, D. Brunner, A. Engel, H. Fischer, C. Gurk, G. Gnther, **M. I. Hegglin**, M. Krebsbach, R. Maser, Th. Peter, C. Schiller, U. Schmidt, N. Spelten, H. Wernli and V. Wirth, New insights into upward transport across the extratropical tropopause derived from extensive in situ measurements during the SPURT project, *SPARC Newsletter*, **22**, 29-31, 2004.

Reports:

- Fahey, D. W., and **M. I. Hegglin** (Coordinating Lead Authors), Twenty Questions and Answers About the Ozone Layer: 2010 Update, Scientific Assessment of Ozone Depletion: 2010, 72 pp., World Meteorological Organization, Geneva, Switzerland, 2011.

- **Coauthor** to Douglass, A. and V. Fioletov (Coordinating Lead Authors), Stratospheric ozone and surface ultraviolet radiation. Chapter 2 of Scientific Assessment of Ozone Depletion: 2010, Global Ozone Research and Monitoring Project–Report No. 52, 516 pp., World Meteorological Organization, Geneva, Switzerland, 2011.
- **Coauthor** to Baldwin, M. P. and N. P. Gillett (Lead Authors), Effects of the stratosphere on the troposphere. Chapter 10 of SPARC Report on the Evaluation of Chemistry-Climate Models, V. Eyring, T. G. Shepherd, D. W. Waugh (Eds.), SPARC Report No. 5, WCRP-132, WMO/TD-No. 1526, <http://www.atmos.physics.utoronto.ca/SPARC>, 2010.
- Gettelman, A. and **M. I. Hegglin** (Lead Authors), Upper Troposphere and Lower Stratosphere. Chapter 7 of SPARC Report on the Evaluation of Chemistry-Climate Models, V. Eyring, T. G. Shepherd, D. W. Waugh (Eds.), SPARC Report No. 5, WCRP-132, WMO/TD-No. 1526, <http://www.atmos.physics.utoronto.ca/SPARC>, 2010.

PhD and Diploma Thesis:

- **Hegglin, M. I.**, 2004. Airborne NO_y-, NO-, and O₃-measurements during SPURT: Implications for atmospheric transport. Ph.D. thesis No. 15553, ETH Zurich, Switzerland.
- **Hegglin, M. I.**, 2000. Fluoreszenz an Schwefelsäuretröpfchen. Diploma thesis at IACETH, ETH, Zurich, Switzerland.

PRESENTATIONS

(Only first-authored contributions are listed)

Conference talks

- Aug 2010 **(Invited)** The extra-tropical UTLS from space-based instruments, AGU meeting of the Americas, Foz do Iguacu, Brazil.
- Aug 2010 Climate-induced changes in UV, AGU meeting of the Americas, Foz do Iguacu, Brazil.
- Jun 2010 **(Invited)** Climate-change induced changes in UV radiation and stratospheric ozone fluxes into the troposphere, CMOS, Ottawa, Canada.
- Jun 2010 Simulating the Past, Present and Future of the Upper Troposphere and Lower Stratosphere (UTLS), CMOS, Ottawa, Canada.
- Jun 2010 PREMIER, CMOS, Ottawa, Canada.
- Oct 2009 PREMIER, SPARC SSG meeting, Kyoto, Japan.
- Oct 2009 **(Invited)** CCMVal overview: The extra-tropical UTLS in chemistry-climate models (co-authored by Andrew Gettelman), Extratropical UTLS Workshop, NCAR, Boulder, CO, USA.
- Oct 2009 First global view of the Extratropical Tropopause Transition Layer (ExTL) from the ACE-FTS, Extratropical UTLS Workshop, NCAR, Boulder, CO, USA.

- Jul 2009 Climate-induced changes in UTLS ozone and their impacts on the troposphere, IAMAS/MOCA, Montreal, QB, Canada.
- Jul 2009 A global view on the extratropical tropopause transition layer from the ACE-FTS, IAMAS/MOCA, Montreal, QB, Canada.
- Jun 2009 Trends in stratospheric ozone fluxes into the troposphere in a changing climate, Middle Atmosphere Meeting, AMS, Stowe, VT, USA.
- Mar 2009 Needs of the Chemistry-Climate Modelling community regarding H₂O measurements, SPARC Water Vapour Workshop, Toronto, Canada.
- Oct 2008 Validation of chemistry-climate models in the upper troposphere/lower stratosphere using solar occultation observations from the ACE-FTS, CEOS Atmospheric Composition Constellation Workshop, GISS, New York, USA.
- Sep 2008 **(Invited)** Toward a global view of extratropical UTLS tracer distributions, SPARC General Assembly, Bologna, Italy.
- Jul 2008 Validation of ACE-FTS ozone in the upper troposphere/lower stratosphere using non-coincident measurements, Quadrennial Ozone Symposium, Tromsø, Norway.
- Sep 2007 The benefits of in-line advection – Assessing the transport characteristics of the CMAM-DAS, SPARC Data Assimilation Working Group Workshop, Toronto, ON, Canada.
- Aug 2007 The Extratropical Tropopause Transition Layer (ExTL) as seen from ACE, Middle Atmosphere Meeting, AMS, Portland, OR, United States.
- Jul 2007 O₃-N₂O correlations: Revisiting a diagnostic of transport and chemistry in the stratosphere, IUGG, Perugia, Italy.
- Jul 2007 Validating ACE-FTS in the upper troposphere/lower stratosphere (UTLS), IUGG, Perugia, Italy.
- Jun 2007 O₃-N₂O correlations: Revisiting a diagnostic of transport and chemistry in the stratosphere, SPARC CCMVal Workshop, Leeds, United Kingdom.
- Jun 2007 Validation of Chemistry Climate Models in the upper troposphere/lower stratosphere (UTLS) using ACE satellite data, Canadian Association of Physicists (CAP), Saskatoon, SK, Canada.
- Feb 2007 The dream of a Canadian high-altitude research aircraft, CSA Suborbital Workshop, Toronto, ON, Canada.
- May 2006 O₃-N₂O correlations from satellite measurements as validation diagnostic for Chemistry-Climate Models, CMOS Congress, Toronto, ON, Canada.
- May 2006 **(Invited)** La région de la TS/SI de la perspective de mesures en avion, ACFAS colloque sur la moyenne atmosphère, Montréal, QC, Canada.
- Sep 2005 Monitoring the UTLS – meeting a challenge? CSA, Niche Mission Workshop, Montreal, QC, Canada.
- Apr 2002 Deep convective injection into the LMS at mid-latitudes, EGU, Nice, France.

Project Workshop talks

- Dec 2010 O₃-fluxes from CCMVal - a multi-model comparison, C-SPARC workshop, Toronto, ON, Canada.

- Nov 2009 Climate-induced changes in ultraviolet index and stratosphere-to-troposphere ozone flux, C-SPARC workshop, Toronto, ON, Canada.
- Nov 2008 Validation of Chemistry Climate Models in the upper troposphere/lower stratosphere within CCMVal, C-SPARC workshop, Toronto, ON, Canada.
- Nov 2008 ACE-FTS observations in the UTLS and their use for Chemistry Climate Model validation, ACE Workshop, Waterloo, ON, Canada.
- Dec 2007 The Extratropical Tropopause Transition Layer (ExTL) seen from ACE and in CMAM, C-SPARC Workshop, Toronto, ON, Canada.
- Nov 2007 An Update on the Validation of the ACE-FTS in the UTLS, ACE Workshop, Waterloo, ON, Canada.
- May 2007 Validating ACE-FTS in the UTLS, ACE Workshop, Waterloo, ON, Canada.
- Dec 2006 O₃-N₂O correlations: A reanimated test of stratospheric transport and chemistry in CCMs, C-SPARC Workshop, Toronto, ON, Canada.
- Oct 2006 Tracer-tracer correlations from ACE: Exploring transport and chemistry in the stratosphere and in the CMAM, ACE Workshop, Waterloo, ON, Canada.
- Dec 2005 Validation of UTLS tracer distributions in CMAM with SPURT aircraft measurements, Global Chemistry for Climate (GCC) Workshop, Toronto, ON, Canada.
- Dec 2004 Tracer-tracer correlations in the UTLS region observed during the SPURT project, GCC Workshop, University of Toronto, Department of Physics, Toronto, ON, Canada.

Seminars

- Feb 2011 Ozone in the upper troposphere/lower stratosphere (UTLS) – Why do we care?, NIWA, Christchurch, New Zealand.
- Feb 2011 Ozone in the upper troposphere/lower stratosphere (UTLS) – Why do we care?, NIWA, Lauder, New Zealand.
- Dec 2010 Climate change and the ozone layer: Connections and surface impacts, Department of Earth, Atmospheric and Planetary Sciences, MIT, Cambridge, MA, USA.
- Oct 2010 Ozone in the upper troposphere/lower stratosphere (UTLS) – Why do we care?, FZJ, Jülich, Germany.
- Sep 2010 Ozone in the upper troposphere/lower stratosphere (UTLS) – Why do we care?, IAC, ETH Zurich, Switzerland.
- Sep 2010 Climate change and the ozone layer: connections and surface impacts, IFM GEOMAR, Kiel, Germany.
- May 2010 Climate change and the ozone layer: Connections and surface impacts, Department of Physical and Environmental Sciences, University of Toronto Scarborough, Toronto, Canada.
- Jul 2009 Characterization of the tropopause region using in-situ and remote measurements, University of Mainz, Mainz, Germany.

- Nov 2008 Toward a global perspective on extratropical upper troposphere/lower stratosphere tracer distributions, Department of Physics, New Mexico Tech, NM, USA.
- Jan 2008 A global perspective on the extratropical tropopause transition layer from the ACE-FTS satellite data, Max-Planck-Institute for Chemistry Department of Atmospheric Chemistry, Mainz, Germany.
- Jan 2008 Validation of satellite data in the upper troposphere/lower stratosphere using non-coincident measurements, Research Institute, Karlsruhe, Germany.
- Nov 2006 The extratropical UTLS: New perspectives from aircraft and satellite measurements, NCAR, Boulder, CO, USA.
- Nov 2005 How trace gas measurements tell stories about dynamical processes, Environment Canada, Toronto, ON, Canada.
- Nov 2004 NO, NO_y, and O₃ measurements during SPURT: Implications for transport and chemistry, Max-Planck-Institute for Chemistry Department of Atmospheric Chemistry, Mainz, Germany.

Poster contributions

- Dec 2010 Multi-model prediction of climate-induced changes in ozone and reactive nitrogen fluxes into the troposphere, AGU, San Francisco, USA.
- Jun 2007 Validation of the global UTLS in CCMs using ACE satellite data, CCMVal Workshop, Leeds, United Kingdom.
- Nov 2005 Validation of UTLS tracer distributions in the Canadian Middle Atmosphere Model with SPURT aircraft measurements, CCMVal Workshop, Boulder, Colorado, USA.
- Aug 2004 A new 2D advection-diffusion model simulating trace gas distributions in the lowermost stratosphere, SPARC General Assembly, Victoria, BC, Canada.
- Aug 2004 Troposphere-to-stratosphere transport and its impact on lowermost stratospheric NO_y and O₃, SPARC General Assembly, Victoria, BC, Canada.
- Apr 2003 Tracing troposphere-to-stratosphere transport processes above a convective system at mid-latitudes, EGU, Nice, France.

REFERENCES

Available upon request.