

Shaw Chen Liu

Distinguished Research Fellow
Founding Director, Research Center for Environmental Changes
Academia Sinica
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PERSONAL DATA

Born April 26, 1944, Hopeh, China

EDUCATION

BS (Physics), National Cheng Kung University, Taiwan, 1966
PhD (Physics), University of Pittsburgh, 1972

EMPLOYMENT

Distinguished Research Fellow and Director, Research Center for Environmental Changes, Academia Sinica, 2004-Date
Distinguished Research Fellow, Institute of Earth Sciences, Academia Sinica, November 1999-Date.
Chief, Environmental Change Research Project, Institute of Earth Sciences, Academia Sinica, November 1999-Date.
Chinese Meteorological Academy, Laboratory of Atmospheric Chemistry and Climate Changes, Co-Chair 2003-Date.
Peking University, School of Environmental Sciences, Visiting Professor 2001-Date.
National Central University, Department of Atmospheric Sciences, Adjunct Professor 2000-Date.
National Taiwan University, Dept. of Atmospheric Sciences, Adjunct Professor 2000-Date.
Georgia Power/ Georgia Research Alliance Eminent Scholar Chair and Professor, School of Earth and Atmospheric Sciences, Georgia Institute of Technology, March 1996-November 1999
Program Chief and Supervisory Research Physicist, Theoretical Aeronomy, Aeronomy Lab., NOAA, September 1980-March 1996
Research Physicist, Theoretical Aeronomy, Aeronomy Lab., NOAA, December 1977-August 1980
Associate Research Scientist, Space Physics Research Lab., University of Michigan, August 1976-July 1977
Assistant Research Scientist, Space Physics Research Lab., University of Michigan, July 1974-July 1976
Post-Doctoral Fellow, University of Pittsburgh, January 1973-June 1974

RESEARCH INTEREST

Atmospheric chemistry, air quality, budgets of trace gases and aerosols, biogeochemical cycles, and climate change.

AWARDS, HONORS

Academician, Academia Sinica, inducted in 2012.
ISI Highly Cited Researcher, total citations: >6200, average citations per item:57, h-index: 47.
CTCI Science and Technology Award (Environmental Sciences), 2005
Fellow, Chinese Meteorological Society, inducted in 2004
Chinese Meteorological Society, Dr. Shiah-Shen Huang Outstanding Paper Award, 2003
Fellow, American Geophysical Union, inducted in 1994
NOAA Administrator Award - 1993
NOAA, Three ERL Outstanding Paper Awards - 1981, 1989, and 1990

PROFESSIONAL ACTIVITIES

Member, American Geophysical Union
Member, American Physics Society
NSF Panel on Tropospheric Chemistry, 1981-1982
NAS Panel on Global Tropospheric Chemistry, 1982-1983.

International Ozone Commission, 1990-1997.
 NRC Committee to Assess the North American Research Strategy for Tropospheric Ozone (NARSTO) Program, 1997-2000.
 Advisory Board of the Chinese National Climate Center, 1996-date.
 Co-mission scientist, Western Pacific Tropospheric Chemistry Experiments, 1990-1996
 Steering Committee, NASA Global Tropospheric Experiments (GTE), 1988-date.
 Executive Committee, IGBP-IGAC-APARE, 1989-1998
 Co-convener, NSF/NOAA Stratosphere-Troposphere Experiments: Radiation, Aerosols, and Ozone (STERA0), 1995-1997.
 Editor-in-Chief, Journal of Geophysical Research (Atmospheres), 1988-1991.
 Editorial Board, Geophysical Abstracts, 1990-1997
 Associate Editor, Acta Meteorological Sinica, 1989-date
 Scientific Steering Committee, IGBP-IGAC, 2001-date.
 Executive Committee, Chinese Geophysical Association, Taiwan, ROC, 2000-date.
 Executive Committee, Chinese Atmospheric Association, Taiwan, ROC, 2000-date.
 Executive Committee, Chinese IGBP, Taiwan, ROC, 2000-date.
 President, Chinese Geosciences Union, Taipei, Taiwan ROC, 2003-2004
 Co-chair, IGBP/IGAC (International Global Atmospheric Chemistry Program), 2003-2005
 President, IUGG-Taiwan, 2007-present.
 Executive Secretary, **The Academy of Sciences Located in Taipei** 2007-present.

Five representative publications:

- Liu, S. C.**, M. Trainer, F. C. Fehsenfeld, D.D. Parrish, E.J. Williams, D.W. Fahey, G. Hubler, and P.C. Murphy, Ozone Production in the rural troposphere and the implications for regional and global ozone distributions, *Journal of Geophysical Research*, 92, 4194-4207, 1987.
- Liu, S. C.**, C-H Wang, C-J Shiu, H-W Chang, C-K Hsiao and S-H Liaw, Reduction in Sunshine Duration over Taiwan: Causes and Implications, *Terrestrial, Atmospheric and Oceanic Sciences*, 13, 523-546, 2002.
- Liu, S. C.**, Congbin Fu, Chein-Jung Shiu, Jen-Ping Chen, and Futing Wu. Temperature dependence of global precipitation extremes, *Geophysical Research Letters*, VOL. 36, L17702, doi:10.1029/2009GL040218, 2009.
- Shiu, C.-J., **S. C. Liu**^{*}, C. Fu, A. Dai, and Y. Sun (2012), How much do precipitation extremes change in a warming climate?, *Geophys. Res. Lett.*, 39, L17707, doi:10.1029/2012GL052762.
- Liu, R., S. C. Liu, R. J. Cicerone, C.-J. Shiu, J. Li, J. L. Wang, and Y. H. Zhang, 2015: Trends of extreme precipitation in eastern China and their possible causes. *Adv. Atmos. Sci.*, 32(8), 000-000, doi: 10.1007/s00376-015-5002-1.

List of Publications

- Liu, R., S. C. Liu, R. J. Cicerone, C.-J. Shiu, J. Li, J. L. Wang, and Y. H. Zhang, 2015: Trends of extreme precipitation in eastern China and their possible causes. *Adv. Atmos. Sci.*, **32**(8), 000-000, doi: 10.1007/s00376-015-5002-1.
- J. Huang, H. Liu, J. H. Crawford, C. Chan, D. B. Considine, Y. Zhang, X. Zheng, C. Zhao, V. Thouret, S. J. Oltmans, S. C. Liu, D. B. A. Jones, S. D. Steenrod, and M. R. Damon, 2015 Origin of springtime ozone enhancements in the lower troposphere over Beijing: In situ measurements and model analysis, *ATMOSPHERIC CHEMISTRY AND PHYSICS*, 15. (SCI)
- Anoop Mishra, and Shaw Chen Liu, 2014, “hanges in precipitation pattern and risk of drought over India in the context of global warming”, *JOURNAL OF GEOPHYSICAL RESEARCH*, 119(13), 7833-7841.
- Shih-Chieh Hsu, Celine Siu Lan Lee, Chih-An Huh, Robina Shaheen, Fei-Jan Lin, Shaw Chen Liu, Mao-Chang Liang and Jun Tao, 2014, “Ammonium deficiency caused by heterogeneous reactions during a super Asian dust episode”, *JOURNAL OF GEOPHYSICAL RESEARCH-ATMOSPHERES*, 119(11), 6803-6817.

Q. Zhang, B. Yuan, M. Shao, X. Wang, S. Lu, K. Lu, M. Wang, L. Chen, C.-C. Chang, and S. C. Liu, 2014, "Variations of ground-level O₃ and its precursors in Beijing in summertime between 2005 and 2011", *ATMOSPHERIC CHEMISTRY AND PHYSICS*, 14, 6089-6101. (SCI)

Ying Li, Alexis K. H. Lau, Jimmy C. H. Fung, Junyu Zheng and Shawchen Liu, Importance of NO_x control for peak ozone reduction in the Pearl River Delta region, *Journal of Geophysical Research: Atmospheres*, 118, 9428–9443, 2013.

Z. Liu, Y. Wang, D. Gu, C. Zhao, L. G. Huey, R. Stickel, J. Liao, M. Shao, T. Zhu, L. Zeng, A. Amoroso, F. Costabile, C.-C. Chang, and S.-C. Liu, Summertime photochemistry during CAREBeijing-2007: RO_x budgets and O₃ formation, *Atmos. Chem. Phys.*, 12, 7737–7752, 2012.

Shiu, C.-J., S. C. Liu, C. Fu, A. Dai, and Y. Sun (2012), How much do precipitation extremes change in a warming climate?, *Geophys. Res. Lett.*, 39, L17707, doi:10.1029/2012GL052762.

Shih-Chieh Hsu, Chih-An Huh, Chuen-Yu Chan, Shuen-Hsin Lin, Fei-Jan Lin, and Shaw Chen Liu (2012), Hemispheric dispersion of radioactive plume laced with fission nuclides from the Fukushima nuclear event, *GEOPHYSICAL RESEARCH LETTERS*, VOL. 39, doi:10.1029/2011GL049986.

Hsu, H.-M., C.-Y. Lin, A. Guenther, J. J. Tribbia, and **S. C. Liu** (2011), Air-chemistry "turbulence": power-law scaling and statistical regularity *Atmos. Chem. Phys.*, 11, 8395-8413.

Chang, Tzu-Yin, Yuei-An Liou, Chuan-Yao Lin, **Shaw-Chen Liu**, Yi-Chen Wang (2010), Evaluation of surface heat fluxes in Chiayi plain of Taiwan by remotely sensed data, *International Journal of Remote Sensing*, 31(14), 3885-3898

Zhu, Chong-Shu, Cheng-Chieh Chen, Jun-Ji Cao, Chuen-Jinn Tsai, Charles C.-K. Chou, **Shaw-Chen Liu** and Gwo-Dong Roam (2010), Characterization of carbon fractions for atmospheric fine particles and nanoparticles in a highway tunnel, *Atmospheric Environment*, 44(23), 2668-2673

Lu, Keding, Yuanhang Zhang, Hang Su, Theo Brauers, Charles C. Chou, Andreas Hofzumahaus, **Shaw C. Liu**, Kazuyuki Kita, Joerg Kleffmann, Yutaka Kondo, Min Shao, Andreas Wahner, Jialin Wang, Xuesong Wang, Peter Wiesen, Tong Zhu (2010), Oxidant (O₃+NO₂) production processes and formation regimes in Beijing, *J. Geophys. Res.*, 115, D10306, doi:10.1029/2010JD014394

Lin, Chuan-Yao, C.-C. Chang, C.Y. Chan, C.H. Kuo, W.-C. Chen, D. Allen Chu and **Shaw C. Liu** (2010), Characteristics of springtime profiles and sources of ozone in the low troposphere over northern Taiwan, *ATMOSPHERIC ENVIRONMENT*, 44(2), 182-193.

Liu, S. C., C. Fu, C.-J. Shiu, J.-P. Chen, and F. Wu, 2009. Temperature dependence of global precipitation extremes, *Geophysical Research Letters*, 36, L17702, doi:10.1029/2009GL040218.

Shiu, C.-J., **S. C. Liu**, and J.-P., Chen, 2009. Diurnally asymmetric trends of temperature, humidity and precipitation in Taiwan, *Journal of Climate*, 22, doi:10.1175/2009JCLI2514.1, No. 21, 5635–5649.

Chang, C. C., L. L. Wang, S. C. C. Lung, **S. C. Liu**, and C. J. Shiu. 2009. Source characterization of ozone precursors by complementary approaches of vehicular indicator and principal component analysis. *Atmospheric Environment* 43 (10):1771-1778.

Yuan, Z. B., A. K. H. Lau, M. Shao, P. K. K. Louie, **S. C. Liu**, and T. Zhu. 2009. Source analysis of volatile organic compounds by positive matrix factorization in urban and rural environments in Beijing. *Journal of Geophysical Research-Atmospheres* 114. DOI 10.1029/2008jd011190.

Tang, J. H., L. Y. Chan, C. C. Chang, **S. Liu**, and Y. S. Li. 2009. Characteristics and sources of non-methane hydrocarbons in background atmospheres of eastern, southwestern, and southern China. *Journal of Geophysical Research-Atmospheres* 114. DOI 10.1029/2008jd010333.

Chou, C. C. K., C. Y. Tsai, C. J. Shiu, **S. C. Liu**, and T. Zhu. 2009. Measurement of NO_y during Campaign of Air Quality Research in Beijing 2006 (CAREBeijing-2006): Implications for the ozone production efficiency of NO_x. *Journal of Geophysical Research-Atmospheres* 114. DOI 10.1029/2008jd010446.

Lin, C. C., K. L. Huang, S. J. Chen, **S. C. Liu**, J. H. Tsai, Y. C. Lin, and W. Y. Lin. 2009. NH₄⁺, NO₃⁻, and SO₄²⁻ in roadside and rural size-resolved particles and transformation of NO₂/SO₂ to nanoparticle-bound NO₃⁻/SO₄²⁻. *Atmospheric Environment* 43 (17):2731-2736.

Hsu, S. C., **S. C. Liu**, R. Arimoto, T. H. Liu, Y. T. Huang, F. J. Tsai, F. J. Lin, and S. J. Kao. 2009. Dust deposition to the East China Sea and its biogeochemical implications. *Journal of Geophysical Research-Atmospheres* 114. DOI 10.1029/2008jd011223.

Hsu, S. C., **S. C. Liu**, Y. T. Huang, C. C. K. Chou, S. C. C. Lung, T. H. Liu, J. Y. Tu, and F. J. Tsai. 2009. Long-range southeastward transport of Asian biomass pollution: Signature detected by aerosol potassium in Northern Taiwan. *Journal of Geophysical Research Atmospheres* 114. DOI 10.1029/2009jd011725.

Liu, S. C., (2008): A review of ozone formation in megacities of East Asia and its potential impact on ozone trends, In: *Recent Progress in Atmospheric Sciences: Applications to the Asia-Pacific Region*. P438-457. edited by K. N. Liou and M.-D. Chou., Published by World Scientific Publishing Co. Pte. Ltd.

Chou, C. C. K., C. T. Lee, C. S. Yuan, W. C. Hsu, C. Y. Lin, S. C. Hsu, and **S. C. Liu**. 2008. Implications of the chemical transformation of Asian outflow aerosols for the long-range transport of inorganic nitrogen species. *Atmospheric Environment* 42 (32):7508-7519.

Hsu, S. C., **S. C. Liu**, Y. T. Huang, S. C. C. Lung, F. J. Tsai, J. Y. Tu, and S. J. Kao. 2008. A criterion for identifying Asian dust events based on Al concentration data collected from northern Taiwan between 2002 and early 2007. *Journal of Geophysical Research Atmospheres* 113 (D18). DOI 10.1029/2007jd009574.

Lin, C. Y., F. Chen, J. C. Huang, W. C. Chen, Y. A. Liou, W. N. Chen, and **S. C. Liu**. 2008. Urban heat island effect and its impact on boundary layer development and land-sea circulation over northern Taiwan. *Atmospheric Environment* 42 (22):5635-5649.

Lin, C. Y., W. C. Chen, **S. C. Liu**, Y. A. Liou, G. R. Liu, and T. H. Lin. 2008. Numerical study of the impact of urbanization on the precipitation over Taiwan. *Atmospheric Environment* 42 (13):2934-2947.

Wang, J. L., C. H. Wang, C. H. Lai, C. C. Chang, Y. Liu, Y. H. Zhang, **S. Liu**, and M. Shao. 2008. Characterization of ozone precursors in the Pearl River Delta by time series observation of non-methane hydrocarbons. *Atmospheric Environment* 42 (25):6233-6246.

Zhang, Y. H., M. Hu, **S. C. Liu**, and A. Wiedensohler. 2008. The special issue on PRIDE-PRD2004 campaign. *Atmospheric Environment* 42 (25):6155-6156.

Zhang, Y. H., M. Hu, L. J. Zhong, A. Wiedensohler, **S. C. Liu**, M. O. Andreae, W. Wang, and S. J. Fan. 2008. Regional Integrated Experiments on Air Quality over Pearl River Delta 2004 (PRIDE-PRD2004): Overview. *Atmospheric Environment* 42 (25):6157-6173.

Chan, C. Y., Y. S. Li, J. H. Tang, Y. K. Leung, M. C. Wu, L. Y. Chan, C. C. Chang, and **S. C. Liu**. 2007. An analysis on abnormally low ozone in the upper troposphere over subtropical East Asia in spring 2004. *Atmospheric Environment* 41 (17):3556-3564.

Chang, S. Y., C. T. Lee, C. C. K. Chou, **S. C. Liu**, and T. X. Wen. 2007. The continuous field measurements of soluble aerosol compositions at the Taipei Aerosol Supersite, Taiwan. *Atmospheric Environment* 41 (9):1936-1949.

Hsu, S. C., **S. C. Liu**, S. J. Kao, W. L. Jeng, Y. T. Huang, C. M. Tseng, F. Tsai, J. Y. Tu, and Y. Yang. 2007. Water-soluble species in the marine aerosol from the northern South China Sea: High chloride depletion related to air pollution. *Journal of Geophysical Research-Atmospheres* 112 (D19). DOI 10.1029/2007jd008844.

Lin, C. Y., Z. F. Wang, C. C. K. Chou, C. C. Chang, and **S. C. Liu**, 2007. A numerical study of an autumn high ozone episode over southwestern Taiwan. *Atmospheric Environment* 41 (17):3684-3701.

Shiu, C. J., **S. C. Liu**, C. C. Chang, J. P. Chen, C. C. K. Chou, C. Y. Lin, and C. Y. Young. 2007. Photochemical production of ozone and control strategy for Southern Taiwan. *Atmospheric Environment* 41 (40):9324-9340.

Tang, J. H., L. Y. Chan, C. Y. Chan, Y. S. Li, C. C. Chang, **S. C. Liu**, and Y. D. Li. 2007. Nonmethane hydrocarbons in the transported and local air masses at a clean remote site on Hainan Island, south China. *Journal of Geophysical Research-Atmospheres* 112 (D14). DOI 10.1029/2006jd007796.

Tang, J. H., L. Y. Chan, C. Y. Chan, Y. S. Li, C. C. Chang, **S. C. Liu**, D. Wu, and Y. D. Li. 2007. Characteristics and diurnal variations of NMHCs at urban, suburban, and rural sites in the Pearl River Delta and a remote site in South China. *Atmospheric Environment* 41 (38):8620-8632.

Chang, Chih-Chung, Wang, Jia-Lin, **Liu, S. C.** and Lung, Shih-Chun (2006). Assessment of vehicular and non-vehicular contributions to hydrocarbons using exclusive vehicular indicators. *Atmospheric Environment*, 40, pp.6349-6361.

Chou, C. C-K, **Liu, S. C.**, Lin, C-Y, Shiu, C-J and Chang, K-H (2006). The trend of surface ozone in Taipei, Taiwan, and its causes: implications for ozone control strategies. *Atmospheric Environment*, 40, pp.3898-3908.

Hsu SC, **Liu SC**, Jeng WL, et al. (2006): Lead isotope ratios in ambient aerosols from Taipei, Taiwan: Identifying long-range transport of airborne Pb from the Yangtze Delta, *Atmospheric Environment*, 40 (28): 5393-5404.

Hsu SC, **Liu SC**, Jeng WL, et al. (2005) Variations of Cd/Pb and Zn/Pb ratios in Taipei aerosols reflecting long-range transport or local pollution emissions., *SCIENCE OF THE TOTAL ENVIRONMENT*, 347 (1-3): 111-121.

Lin, C.-Y., **S. C. Liu**, Charles C.-K. Chou, Saint-Jer Huang, Chung-Ming Liu, Ching-Huei, Kuo, and Chea-Yuan Young, 2005: Long-range transport of aerosols and their impact on the air quality of Taiwan. *Atmospheric Environment*, 39, 6066-6076.

Chang, C. C., Chen, T. Y., Chuan-Yao Lin, Chung-Shin Yuan, **S. C. Liu**, 2005. "Effects of Reactive Hydrocarbon on Ozone Formation in Southern Taiwan" *Atmospheric Environment* 39, 2867-2878.

Chang C. C, T-Y Chen, C Chou and **SC Liu**. Assessment of traffic contribution of hydrocarbons by using 2,2-dimethylbutane as a vehicular indicator. *Terrestrial, Atmospheric and Oceanic Sciences*. 15. 697-711, 2004.

Chou CCK, CY Lin, TK Chen, SC Hsu, SC Lung, **SC Liu** and CY Young. Influence of long-range transported dust particles on local air quality: A case study on the Asian dust episodes in Taipei during the spring of 2002. *Terrestrial, Atmospheric and Oceanic Sciences*, 15, 881-900, 2004.

Lin CY, **SC Liu**, CCK Chou, TH Liu, CT Lee, CS Yuan, CJ Shiu and CY Young. Long-range transport of Asian dust and air pollutants to Taiwan. *Terrestrial, Atmospheric and Oceanic Sciences*, 15, 759-784, 2004.

Lung SCC, CH Liu, SY Huang, TJ Lin, CCK Chou and **SC Liu**. Water-soluble ions of aerosols in Taipei in spring 2002. *Terrestrial, Atmospheric and Oceanic Sciences*, 15, 901-924, 2004.

Hsu SC, SC Liu, CY Lin, RT Hsu, YT Huang and YW Chen. Metal Compositions and Characterizations of PM₁₀ and PM_{2.5} Aerosols in Taipei during the Springtime, 2002. *Terrestrial, Atmospheric and Oceanic Sciences*. 15, 925-948, 2004.

Wang CC, CT Lee, **SC Liu**, and JP Chen. Aerosol characterization at Taiwan's northern tip during ACE-Asia, *Terrestrial, Atmospheric and Oceanic Sciences*, 15, 839-856, 2004.

Davis, D. D., et al. (2003), An assessment of western North Pacific ozone photochemistry based on springtime observations from NASA's PEM-West B (1994) and TRACE-P (2001) field studies, *J. Geophys. Res.*, 108(D21), 8829, JD003232.

Tsai, F., T.-H. Liu, **S. C. Liu**, T.-Y. Chen, T. L. Anderson, S. J. Masonis, Model Simulation and Analysis of Coarse and Fine Particle Distributions During ACE-Asia, *J. Geophys. Res.*, 109, D19S20, doi: 10.1029/2003JD003665.

Chou, C. C.-K., T. Chen, S. Huang, and **S. C. Liu** (2003), Radiative Absorption Capability of Asian Dust with Black Carbon Contamination, *Geophys. Res. Lett.*, 30(12), 1616, doi:10.1029/2003GL017076.

Ko, M. et al., Photochemical Ozone Budget during the BIBLE-A and B Campaign, *J. Geophys. Res.*, 108 (D3), 8404, 2003.

Koike et al., Reactive nitrogen over the tropical Western Pacific: Influence from lightning and biomass burning during BIBLE-A, *J. Geophys. Res.*, 108 (D3), 8403, 2003.

Kondo et al., Effects of biomass burning, lightning and convection on O₃, CO, and NO_y over the tropical Pacific and Australia in August-October 1998-1999, *J. Geophys. Res.*, 108 (D3), 8402, 2003.

DiNunno, B., D. Davis, G. Chen, J. Crawford, J. Olson, and **S. Liu** (2003), An assessment of ozone photochemistry in the central/eastern North Pacific as determined from multiyear airborne field studies, *J. Geophys. Res.*, 108(D2), 8237, doi:10.1029/2001JD001468.

Liu, S. C., Chung-Ho Wang, Chein-Jung Shiu, Hsiu-Wu Chang, Chang-Keng Hsiao and Shuh-Haung Liaw, Reduction in Sunshine Duration over Taiwan: Causes and Implications, *Terrestrial, Atmospheric and Oceanic Sciences*, 13, 523-546, 2002.

Yu, H., **S. C. Liu**, and R. E. Dickinson, Radiative effects of aerosols on the evolution of the atmospheric boundary layer, *J. Geophys. Res.*, 107(D12), 10.1029/2001JD000754, 2002.

Liu, S.C., and C-J Shiu, Asian Dust Storms and Their Impact on the Air Quality of Taiwan, *Aerosol and Air Quality Research*, 1, 1-8, 2001

Wang, Y., **S. C. Liu** et al., Factors controlling tropospheric O₃, OH, NO_x, and SO₂ over the tropical Pacific during PEM-Tropics B, *J. Geophys. Res.*, 106, 32733-32747, 2001.

Davis D., G. Grodzinsky, P. Kasibhatla, J. Crawford, G. Chen, **S. Liu**, A. Bandy, D. Thornton, H. Guan, and S. Sandholm, Impact of ship Emissions on marine boundary layer NO_x and SO₂ Distributions over the Pacific Basin, *Geophys. Res. Lett.*, 28, 235-238, 2001.

Wang, Y., **S. C. Liu**, H. Yu, S. T. Sandholm, D. R. Blake, and T. Chen, Influence of convection and biomass burning outflow on tropospheric chemistry over the tropical Pacific, *J. Geophys. Res.*, 105, 9321-9333, 2000.

Wang, Y., **S. C. Liu**, B. E. Anderson, G. W. Sachse, S. A. Vay, Y. Kondo, A. Thompson, and H. Singh Evidence of convection of a dominant source of condensation nuclei in the northern mid-latitude upper troposphere, *Geophys. Res. Letters*, 27, 369-372, 2000.

Koike M., Y. Kondo, H. Ikeda, B. E. Anderson, G. W. Sachse, D. Blake, **S. C. Liu**, H. B. Singh, A. Thompson, K. Kita, Y. Zhao, T. Sugita, R. E. Shetter, and N. Toriyama, Impact of aircraft emissions on reactive nitrogen over the North Atlantic Flight Corridor region, *J. Geophys. Res.*, 105, 3665-3677, 2000

Bradshaw, J., D. D. Davis, G. Grodzinsky, S. Smyth, R. E. Newell, S. Sandholm and **S. C. Liu**, Observed distributions of nitrogen oxides in the remote free troposphere from NASA GTE Programs, *Review of Geophysics*, 38, 61-116, 2000.

Crawford, J., D. Davis, J. Olson, G. Chen, **S. Liu**, H. Fuelberg, J. Hannan, Y. Kondo, B. Anderson, G. Gregory, G. Sachse, R. Talbot, A. Viggiano, B. Heikes, J. Snow, H. Singh, and D. Blake, Evolution and chemical consequences of lightning produced NO_x observed in the N. Atlantic upper troposphere, *J. Geophys. Res.*, Vol. 105, pp. 19,795 - 19,805, 2000.

Chameides W. L., H. Yu, **S. C. Liu**, M. Bergin, X. Zhou, L. Mearns, G. Wang, C. S. Kiang, R. D. Saylor, C. Luo, Y. Huang, A. Steiner, and F. Giorgi: Case study of the effects of atmospheric aerosols and regional haze on agriculture: An opportunity to enhance crop yields in China through emission controls? *Proceedings of National Academy Sciences*, Nov 23 1999; 96: 13626-13633.

Kondo Y., M. Koike, H. Ikeda, B. E. Anderson, K. E. Brunke, Y. Zhao, K. Kita, T. Sugita, H. B. Singh, **S. C. Liu**, L. Jeagle, A. Thompson, G. L. Gregory, R. E. Shetter, G. W. Sachse, E. V. Browell, and M. J. Mahoney, Impact of aircraft emissions on NO_x in the lowermost stratosphere at northern midlatitudes, *Geophys. Res. Letters*, 26, 3065-3068, 1999.

Liu, S. C., H. Yu, B. Ridley, Y. Wang, D. D. Davis, Y. Kondo, M. Koike, B. E. Anderson, G. W. Sachse, S. A. Vay, G. L. Gregory, H. Fuelberg, A. Thompson, and H. Singh, Sources of Reactive Nitrogen in the Upper Troposphere During SONEX, *Geophys. Res. Letters*, 26, 2441-2444, 1999.

Liu, C. M., H. W. Chang, and **S. C. Liu**, An analysis of Lanyu baseline measurement data, *Atmospheric Sciences*, 27, 99-130, 1999.

Smyth, S., S. Sandholm, B. Shumaker, W. Mitch, A. Kanvinde, J. Bradshaw, **S. C. Liu**, S.A. McKeen, G.L. Gregory, B. Anderson, R. Talbot, D. Blake, M. Fenn, J. Merrill, S. Bachmeier, G.W. Sachse, and J. Collins, Characterization of the Chemical Signatures of Air Masses Observed During the PEM Experiments Over the Western Pacific, *J. Geophys. Res.*, 104, 16243-16254, 1999.

Crawford, J., D. Davis, J. Olson, G. Chen, S. Sandholm, **S. C. Liu**, G. Gregory, G. Sachse, J. Barrick, D. Blake, R. and H. Singh, Assessment of upper tropospheric HO_x sources over the tropical Pacific based on NASA GTE/PEM data: Net effect on OH and other photochemical parameters, *Journal of Geophysical Research*, 104, 16255-16274, 1999.

Chameides, W. L., X. Li, X. Tang, X. Zhou, C. Luo, C. S. Kiang, J. St. John, R. D. Saylor, **S. C. Liu**, K. S. Lam, T. Wang, F. Giorgi, Possible effects of ozone pollution on crop yield in China, *Geophys. Res. Letters*, 26, 867-870, 1999.

Liu, S. C., and H. B. Yu, Modelling the vertical distributions of non-methane hydrocarbons and their potential impact on the background atmosphere, in NATO Report V-102, KFA, Juelich, Germany, 1999.

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