Lu Hu

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RESEARCH INTERESTS

Air quality and atmospheric chemistry; Biosphere-atmosphere interactions; Volatile organic compounds (VOCs); Ozone; Aerosol; Source attribution of air toxics; Chemical transport modeling at regional and global scales; Long-term field observations; Mass spectrometry

EDUCATION

Ph.D. **Land & Atmospheric Science**, University of Minnesota – Twin Cities 2014
Dissertation: *"Constraints on the sources and impacts of volatile organic compounds (VOCs) over North America from tall tower measurements"*

M.S. **Geochemistry**, Chinese Academy of Sciences, Beijing 2008

B.S. **Materials Chemistry**, China University of Geosciences, Beijing 2005

RESEARCH EXPERIENCE

Harvard University, School of Engineering and Applied Science, Cambridge, MA
Postdoctoral Fellow with Daniel Jacob: 2014 – present

- Improving understanding of global tropospheric ozone by integrating recent model developments in isoprene chemistry, tropospheric halogen chemistry, lightning, and convection; Evaluating the model using an ensemble of sonde, aircraft, and satellite data.
- Modeling global ozone at an unprecedented ~12×12 km^2 resolution for applications of ozone climate forcing and intercontinental transport of pollution.
- Investigating factors controlling the variability and trend of tropospheric ozone and OH radical over the last 30 years using the NASA Global Modeling Initiative (GMI) and GEOS-Chem chemical transport models.

University of Minnesota, Department of Soil, Water, and Climate, St. Paul, MN
Graduate Research Assistant with Dylan Millet: 2008 – 2014

- Designed, developed, and validated online in situ instrumentation to measure organic compounds in the atmosphere.
- Developed and implemented forward and inverse numerical 3D modeling to apportion biogenic and anthropogenic sources of organic carbon, estimate emission budgets, and assess atmospheric implications over North America.
- Successfully led field measurements campaigns:
  - Created the first in situ long-term record of high-frequency VOC measurements from a tall tower to study the seasonality and sources of atmospheric organics (St. Paul, MN).
  - Co-led instrument installments and measurements for speciated VOCs in an extensive campaign to study ozone and secondary aerosol formation (St. Louis, MO).

Chinese Academy of Sciences, Institute of Geochemistry, Guiyang/Beijing, China
Graduate Research Assistant with Xinqing Lee: 2005 – 2008

- Designed instruments for measuring land-atmosphere exchange of greenhouse gases.
- Investigated geochemical records in lake sediments for paleoclimate study.

RESEARCH GRANTS

- Co-principal investigator (resubmitted): *Biogenic Volatile Organic Compounds and Their Atmospheric Chemistry In the Changing Arctic*, National Science Foundation (NSF), with D. Hemig (PI) and D. Millet (co-I), 2016 – 2018
  - To study the oxidative chemistry and ozone budget in the Arctic tundra region and how they are influenced by natural emissions invoked by changing climate.
- Principal investigator: *The Influence of Ozone from Outside States: Towards Cleaner Air in Minnesota*, Consortium on Law and Values in Health, Environment & the Life Sciences, UofMN, 2013– 2014, **$9,934**
  - Utilized a combination of regulatory monitoring data and model experiments to estimate the magnitude of local versus transported pollutants and their impact on a state scale.

TEACHING AND MENTORING EXPERIENCE

Guest Lecturer for Graduate and Undergraduate Courses

- ESPM 3000: The Fracking Debate, UofMN, Spring 2014 (undergraduate level, 89 students)
- LAAS 5480: Atmospheric Processes II - Radiation, Chemistry, & Climate, UofMN, Spring 2014 (graduate level, 7 students)
- ESPM 3000: Climate change – Myths, Mysteries, & Uncertainties, UofMN, Fall 2013 (undergraduate level, 45 students)
- ESPM 3000: Atmospheric Composition and Chemistry, UofMN, Spring 2013 (undergraduate level, 12 students)

Mentor for Graduate/Undergraduate Students

- Mentored two graduate students. Motivated, encouraged and helped them through academic research (Harvard, 2014 – present).
- Supervised a visiting undergraduate from Harvard-PKU summer research program. Advised the student in project planning, IDL programing, GEOS-Chem modeling, data visualization and interpretation. Guided the student in preparation and presentation of the research findings at departmental seminar and at GEIA Conference (Harvard, 2015 Jul. – Sept.).
- Supervised an undergraduate to design and develop a fully automatic and simple air pollution measurement instrument (UofMN, 2013 Apr. – Sept.).
- Supervised an undergraduate from the Undergraduate Research Opportunities Program of UofMN. Guided the student in a field campaign for long term pollutant observations; mentored the student in preparation and presentation of the research finding at the IGAC Conference (UofMN, 2009 – 2010).

Formal Training in Teaching

- Harvard Mentoring Workshops, 2015
- GRAD 8101 Teaching in Higher Education, Preparing Future Faculty, UofMN, 2012

SKILLS

- MODELING: 3D chemical transport modeling (GEOS-Chem; Lagrangian particle dispersion model STILT); inverse modeling
- ANALYTICAL: Atmospheric composition monitoring; data acquisition; datalogger programing; proton transfer reaction-mass spectrometry (PTR-MS)
- COMPUTER: R/FORTRAN/IDL programming; UNIX system
- BUSINESS: Leadership and Teambuilding; Project Management; Grant Writing; Event Planning

HONORS AND AWARDS

- Best Student Poster Award, Air and Waste Management Association (A&WMA) 107th Annual Conference & Exhibition, 2014
- Outstanding Student Paper Award, American Geophysical Union (AGU) Fall Meeting, 2013: *Awarded to the top 3-5% of presenters in each section/focus group*
- Doctoral Dissertation Fellowship, UofMN, 2013: *For the most accomplished Ph.D candidates*
- Consortium Student Scholar, UofMN, 2013: *One in nine research awards to projects related to the societal implications of environment problems*
- Baker Travel Scholarship, UofMN, 2009, 2011, 2012
- Excellent Student Scholarship, Chinese Academy of Sciences, 2007
- Best Academic Report Award of Geosciences, Chinese Academy of Sciences, 2006
- Geochemistry Scholarship, Chinese Academy of Sciences, 2006
- Outstanding Graduate Award in Beijing, Beijing Municipal Education Commission, 2005: *Awarded to the top 5% graduates in more than 100 universities in Beijing*
- Outstanding Graduate Award, China Univ. of Geosciences, 2005
- Excellent Student Scholarship, China Univ. of Geosciences, 2002, 2004, 2005

LEADERSHIP, PROFESSIONAL ACTIVITIES AND SERVICES

- Journal reviewer: J. *Geophys. Res.*; *Atmos. Chem. Phys.*; *Bull. Amer. Meteor. Soc.*; *Atmos. Environ.*; *Atmos. Res.*; J. *Atmos. Ocean Tech.*
- Grant reviewer: *NOAA AC4 Program*
- Chair, Harvard Atmospheric Science Seminar Committee, 2015 – 2016
- Contributor, Tropospheric Ozone Assessment Report (TOAR): Global metrics for climate change, human health and crop/ecosystem research, the International Global Atmospheric Chemistry Project (IGAC), 2015
- Session chair, "Ozone Monitoring and Modeling", A&WMA 107th Annual Conference & Exhibition, Long Beach, CA, June 2014
- Technical Coordinating Committee Member for the Measurement, Monitoring, Emission Inventory and Application (AA-2), A&WMA, 2013 – 2014
- Co-founder and Board Member, Joint UMN-China Coalition for Clean Energy, 2013
- Coordinator: Departmental Centennial Seminar Series Committee, UofMN, 2012 – 2013
- Organizer, Career Symposium Series for Young Scientists, UofMN, 2012
- Judge, Twin Cities Regional State Science Fairs, 2012, 2013
- Vice President, Departmental Graduate Student Association, UofMN, 2010

PUBLICATIONS

In Preparation

Hu, L., D.J. Jacob, Y. Zhang, X. Liu, and L. Zhang, Factors controlling global tropospheric ozone: roles of isoprene chemistry, tropospheric halogen chemistry, convection, and lightning NO_x sources, in preparation, 2016

In Press

Schmidt, J. A., D. J. Jacob, H. Horowitz, **L. Hu**, T. Sherwen, M. Evans, Q. Liang, R. Suleiman, D. Oram, M. Le Breton, C. Parcival, S. Wang, B. Dix, and R. Volkamer, Modeling the observed tropospheric BrO background: Importance of multiphase chemistry and implications for ozone, OH, and mercury, submitted to *J. Geophys. Res.*

Refereed (14 peer-reviewed publications with 5 as the lead author to date)

Millet, D. B., M. Baasandorj. **L. Hu**, D. Mitroo, J. Turner, B. J. Williams, Nighttime chemistry and morning isoprene drive daytime ozone downwind of a major deciduous forest, Environ. Sci. & Technol., 50, 4335-4342

Yan, Y.-Y., J.-T. Lin, J. Chen, **L. Hu (**2016), Improved simulation of tropospheric ozone by a global-multi-regional two-way coupling model system, *Atmos. Chem. Phys*., 16, 2381-2400

Hu, L., D.B. Millet, M. Baasandorj, T.J. Griffis, K.R. Travis, C. Tessum, J. Marshall, W.F. Reinhart, T. Mikoviny, M. Müller, A. Wisthaler, M. Graus, C. Warneke, and J. de Gouw (2015a), Emissions of C_6-C_8 aromatic compounds in the United States: Constraints from tall tower and aircraft measurements, *J. Geophys. Res.*, 120, 826-842. [**Highlighted on the cover of the JGR-Atmosphere**]

Hu, L., D.B. Millet, M. Baasandorj, T.J. Griffis, P. Turner, D. Helmig, A.J. Curtis, J. Hueber (2015b), Isoprene emissions and impacts over an ecological transition region in the US Upper Midwest inferred from tall tower measurements, *J. Geophys. Res.,* 120, 3553-3571

Baasandorj, M., D.B. Millet, **L. Hu**, D. Mitroo, and B.J. Williams (2015), Measuring acetic and formic acid by Proton Transfer Reaction-Mass Spectrometry: Sensitivity, humidity dependence, and quantifying interferences, *Atmos. Meas. Tech.*, 8, 1301-1321.

Millet, D.B., M. Baasandorj, D.K. Farmer, J.A. Thornton, K. Baumann, P. Brophy, S. Chaliyakunnel, J.A. de Gouw, M. Graus, **L. Hu**, A. Koss, B.H. Lee, F.D. Lopez-Hilfiker, J.A. Neuman, F. Paulot, J. Peischl, I.B. Pollack, T.B. Ryerson, C. Warneke, B.J. Williams, and J. Xu (2015), A large and ubiquitous source of atmospheric formic acid, *Atmos. Chem. Phys.*, 15, 6283-6304.

Hu, L., D.B. Millet, S. Kim, K. C. Wells, T. J. Griffis, E.V. Fischer, D. Helmig, J. Hueber, and A. J. Curtis (2013), North American acetone sources determined from tall tower measurements and inverse modeling, *Atmos. Chem. Phys.*, 13, 3379-3392

Kim, S.Y., D.B. Millet, **L. Hu**, M. Mohr, T. J. Griffis, D. Wen, J. Lin, S. Miller, and M. Longo (2013), Constraints on carbon monoxide emissions based on tall tower measurements in the US Upper Midwest, *Environ. Sci. & Technol.*, 47, 8316-8324

Wells, K.C., D.B. Millet, **L. Hu**, K.E. Cady-Pereira, Y. Xiao, M.W. Shephard, C.L. Clerbaux, L. Clarisse, P.-F. Coheur, E.C. Apel, J. de Gouw, C. Warneke, H.B. Singh, A.H. Goldstein, and B.C. Sive (2012), Tropospheric methanol observations from space: Retrieval evaluation and constraints on the seasonality of biogenic emissions, *Atmos. Chem. Phys.*, 12, 5897-5912

Hu, L., D.B. Millet, M.J. Mohr, K.C. Wells, T.J. Griffis, and D. Helmig (2011), Sources and seasonality of atmospheric methanol based on tall tower measurements in the US Upper Midwest, *Atmos. Chem. Phys.*, 11, 11145-11156

Hu, L., X. Lee, D. Huang, and J. Cheng (2008), Ammonium nitrogen in the surface soil of arid and semiarid Central East Asia. *Geochimica.*, 37(6), 572-580

Cheng J., X. Lee, Z. Lin, **L. Hu**, and D. Huang (2008), Spatial variation of C and N contents of plant communities in the steppe of north China: Implication for the abnormal C/N ratio in the surface soil. *Geochimica.*, 37(3), 265-274

Jiang, W., X. Lee, D. Huang, H. Zhou**, L. Hu**, Y. Peng, Z. Hong, Y. Lin, and Y. Xing. (2008), Thermodynamics equilibrium calculation method for contribution of organic acids to free acidity of precipitation, *Environ. Chem.*, 27(4), 416-421

Lee, X., D. Huang, Y. Zhang, W. Jiang, N. An, **L. Hu**, and G. Xu (2008), Measurements of stable carbon isotopic compositions of formic and acetic acids in aqueous solution by needle trap coupled with GC-IRMS. Geochimica., 37(6), 549-555

Extended Conference Abstract

Luan, Y., **L. Hu**, K.C. Wells, The influence of ozone from outside state: Towards cleaner air in Minnesota, Extended Abstract # 33368 for the *Air & Waste Management Association (A&WMA)'s 107th Annual Conference and Exhibition*, Long Beach, CA, June, 2014

PRESENTATIONS

Invited Talks

MIT Atmospheric Chemistry Seminar, Cambridge, MA: "Factors controlling global tropospheric ozone", May 2016

University of Montana, Chemistry Seminar: "Tropospheric ozone and related organic trace gases: sources and chemistry", Feb. 2016

City University of Hong Kong, Energy and Environment Seminar: "Tropospheric ozone and related organic trace gases: sources and chemistry", Feb. 2016

Harvard Environmental Chemistry Seminar, Cambridge, MA: "Isoprene emissions and chemical impacts over an ecological transition region", Nov. 2015

UofMN Doctoral Research Showcase, Minneapolis, MN: "Reconciling the differences between top-down and bottom-up estimates of VOC emissions using tall tower measurements", Apr. 2014

Pacific Northwest National Laboratory (PNNL) Atmospheric Science Seminar, Richland, WA: "Constraints on North American VOC sources from tall tower measurements", Feb. 2014

Harvard University Environmental Science and Engineering Seminar, Cambridge, MA: "Constraints on the sources and chemical impacts of volatile organic compounds (VOCs) over North America using tall tower measurements", Feb. 2014

UofMN Doctoral Dissertation Fellows Seminar, Minneapolis, MN: "Tall tower-based constraints on the sources of organic compounds in the atmosphere", Jan. 2014

The Flint Hills Resources Pine Bend Refinery, Rosemount, MN: "Constraints on regional VOC sources from tall tower measurements", Jun. 2013

Institute of Geochemistry, Chinese Academy of Sciences, Guiyang, Guizhou, China: "Tall Tower-based constraints on natural and anthropogenic acetone sources in North America", Sept. 2012

Conferences

"Processes influencing global tropospheric ozone: insights from OMI ozone observations", Aura Science Meeting, Rotterdam, The Netherlands, Aug. 2016 (talk)

"Factors controlling global tropospheric ozone: roles of isoprene chemistry, tropospheric halogen chemistry, convection, and lightning NO_x sources", AGU Fall Meeting, San Francisco, CA, Dec. 2015 (talk)

"Improved understanding of global tropospheric ozone integrating recent model developments", 7th International GEOS-Chem Meeting, Cambridge, MA, May 2015 (talk)

"Isoprene emissions and impacts over an ecological transition region", 7th International GEOS-Chem Conference, Cambridge, MA, May 2015 (poster)

"Isoprene emissions and impacts over an ecological transition region in the US Upper Midwest", AGU Fall Meeting, San Francisco, CA, Dec. 2014 (poster)

"The influence of ozone from outside states: Towards cleaner air in Minnesota", A&WMA Annual Conference, Long Beach, CA, Jun. 2014 (talk)

"Top-down estimates of aromatic hydrocarbon emissions in the United States from tall tower measurements", A&WMA Annual Conference, Long Beach, CA, Jun. 2014 (poster)

"Aromatic hydrocarbon emissions in the United States deduced from tall tower measurements", AGU Fall Meeting, San Francisco, CA, Dec. 2013 (talk)

"The influence of cross-state surface ozone in Minnesota", 28th Annual Conference on the Environment, St. Paul, MN, Nov. 2013 (poster)

"Carbon monoxide in East St. Louis", St. Louis Air Quality Regional Study Summer 2013 science meeting, St. Louis, MO, Aug. 2013 (talk)

"Constraints on biogenic VOC emissions from tall tower measurements", 6th International GEOS-Chem Meeting, Cambridge, MA, May 2013 (talk)

"New constraints on North American acetone sources from tall tower measurements and inverse modeling", AGU Fall Meeting, San Francisco, CA, Dec. 2012 (poster)

"New constraints on North American acetone sources from tall tower measurements and inverse modeling", 12th International Global Atmospheric Chemistry (IGAC) Conference, Beijing, China, Sep. 2012 (poster)

"Sources and seasonality of atmospheric methanol based on tall tower measurements in the US Upper Midwest", AGU Fall Meeting, San Francisco, CA, Dec. 2011 (poster)

"Seasonal & diurnal variations of volatile organic compounds from tall tower measurements in the Upper Midwest, 11th IGAC Conference, Halifax, Canada, Jul. 2010 (poster)

"Constraints on regional sources of volatile organic compounds from tall tower measurements in the Upper Midwest", AGU Fall Meeting, San Francisco, CA, Dec. 2009 (talk)

"Geographic distribution of ammonium-nitrogen in surface soil of central East Asia", 11th Annual Conference of Chinese Society for Mineralogy, Petrology and Geochemistry, Beijing, China, Apr. 2007 (talk)

REFERENCES

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