LEI ZHU, Ph.D.

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SCHOLARLY PROFILE

My research goal is to better understand processes governing the distributions of atmospheric species, and their implications for air quality, public health, and climate. My research program combines **remote sensing**, **modeling**, and **data assimilation** techniques.

My **research interests** include: atmospheric chemistry and its implications, modeling of atmospheric chemistry, and observing trace gases from space.

PROFESSIONAL EXPERIENCE

2019.12 – Present	Assistant Professor, Southern University of Science and Technology
2019.07 – 2019.12	Research Scholar, Harvard-Smithsonian Center for Astrophysics
2017.01 – 2019.07	Post-doctoral Fellow, Harvard University

EDUCATION

2016.12	Ph.D. in Environmental Science and Engineering, Harvard University
	Advisor: Prof. Daniel J. Jacob
2011.06	MSci. in Environmental Science, Peking University
	Advisor: Prof. Yu Song
2008.06	B.S. in Environmental Science, Nankai University

PUBLICATIONS

First or corresponding author (*)

Sun, W., **L. Zhu***, I. De Smedt *et al*: Global Significant Changes in Formaldehyde (HCHO) Columns Observed from Space at the Early Stage of the COVID-19 Pandemic, submitted to *Geophys. Res. Lett*, 2020.

Zhu, L.*, G. González Abad, C. R. Nowlan *et al*.: Validation of satellite formaldehyde (HCHO) retrievals using observations from 12 aircraft campaigns, *Atmos. Chem. Phys.*, 20, 12329–12345, 2020.

Zhu, L.*, Jacob, D. J., Eastham, S. D. *et al*.: Effect of sea salt aerosol on tropospheric bromine chemistry, *Atmos. Chem. Phys.*, 19, 6497-6507, 2019.

Zhu, L.*, L. J. Mickley, D. J. Jacob *et al*.: Long-term (2005–2014) trends in formaldehyde (HCHO) columns across North America as seen by the OMI satellite instrument: Evidence of changing emissions of volatile organic compounds, *Geophys. Res. Lett*., 44, 7079–7086, 2017.

Zhu, L.*, D. J. Jacob, F. N. Keutsch *et al*.: Formaldehyde (HCHO) as a Hazardous Air Pollutant: Mapping surface air concentrations from satellite and inferring cancer risks in the United States, *Environ. Sci. Technol*., 51, 5650–5657, 2017.

Zhu, L.*, D. J. Jacob, P. S. Kim *et al*.: Observing atmospheric formaldehyde (HCHO) from space: validation and intercomparison of six retrievals from four satellites (OMI, GOME2A, GOME2B, OMPS) with SEAC^{4}RS aircraft observations over the southeast US, *Atmos. Chem. Phys*., 16, 13477–13490, 2016.

Zhu, L.*, D. J. Jacob, L. J. Mickley *et al*.: Anthropogenic emissions of highly reactive volatile organic compounds in eastern Texas inferred from oversampling of satellite (OMI) measurements of HCHO columns, *Environ. Res. Lett*., 9, 114004, 2014.

Zhu, L., X. Huang, H. Shi *et al*.: Transport pathways and potential sources of PM_{10} in Beijing, *Atmos.*

Environ., 45, 594–604, 2011.

Co-authorship

Wang, X. *et al*. including **L. Zhu**: Direct links between hygroscopicity and mixing state of ambient aerosols: estimating particle hygroscopicity from their single-particle mass spectra, *Atmos. Chem. Phys.,* 20, 6273–6290, 2020.

Souri, A. *et al*. including **L. Zhu**: An Inversion of NOx and NMVOC Emissions using Satellite Observations during the KORUS-AQ Campaign and Implications for Surface Ozone over East Asia, *Atmos. Chem. Phys.*, 20, 9837–9854, 2020.

Lu, X. *et al*. including **L. Zhu**: Development of the global atmospheric general circulation-chemistry model BCC-GEOS-Chem v1.0: model description and evaluation, *Geosci. Model Dev.*, 13, 3817–3838, 2020.

Chance, K. *et al*. including **L. Zhu**: TEMPO Green Paper; Chemistry, physics, and meteorology experiments with the Tropospheric Emissions: Monitoring of Pollution instrument, *Proc. SPIE 11151, Sensors, Systems, and Next-Generation Satellites XXIII*, 111510B (10 October 2019).

Shen, L., D. J. Jacob, **L. Zhu** *et al*.: The 2005–2016 Trends of Formaldehyde Columns Over China Observed by Satellites: Increasing Anthropogenic Emissions of Volatile Organic Compounds and Decreasing Agricultural Fire Emissions, *Geophys. Res. Lett.*, 46, 4468–4475, 2019.

Zhang, Y. *et al*. including **L. Zhu**: Satellite-Observed Changes in Mexico's Offshore Gas Flaring Activity Linked to Oil/Gas Regulations, *Geophys. Res. Lett.*, 46, 1879–1888, 2019.

Wang, X. *et al*. including **L. Zhu**: The role of chlorine in tropospheric chemistry, *Atmos. Chem. Phys.*, 19, 3981–4003, 2019.

Song, S. *et al*. including **L. Zhu**: Possible heterogeneous chemistry of hydroxymethanesulfonate (HMS) in northern China winter haze, *Atmos. Chem. Phys*., 19, 1357–1371, 2019.

Sun, K., **Zhu, L**., K. Cady-Pereira *et al*.: A physics-based approach to oversample multi-satellite, multispecies observations to a common grid, *Atmos. Meas. Tech.*, 11, 6679–6701, 2018.

Kaiser, J., D. J. Jacob, **L. Zhu** *et al*.: High-resolution inversion of OMI formaldehyde columns to quantify isoprene emission on ecosystem-relevant scales: application to the southeast US, *Atmos. Chem. Phys.*, 18, 5483–5497, 2018.

Miller, C. C. *et al*. including **L. Zhu**: Glyoxal yield from isoprene oxidation and relation to formaldehyde: chemical mechanism, constraints from SENEX aircraft observations, and interpretation of OMI satellite data, *Atmos. Chem. Phys.*, 17, 8725–8738, 2017.

Travis, K. R. *et al*. including **L. Zhu**: Why do models overestimate surface ozone in the Southeast United States?, *Atmos. Chem. Phys.*, 16, 13561–13577, 2016.

Fisher, J. A. *et al*. including **L. Zhu**: Organic nitrate chemistry and its implications for nitrogen budgets in an isoprene- and monoterpene-rich atmosphere: constraints from aircraft (SEAC⁴RS) and ground-based (SOAS) observations in the Southeast US, *Atmos. Chem. Phys.*, 16, 5969–5991, 2016.

Yu, K. *et al*. including **L. Zhu**: Sensitivity to grid resolution in the ability of a chemical transport model to simulate observed oxidant chemistry under high-isoprene conditions, *Atmos. Chem. Phys.*, 16, 4369–4378, 2016.

Marais, E. A. *et al*. including **L. Zhu**: Aqueous-phase mechanism for secondary organic aerosol formation from isoprene: application to the southeast United States and co-benefit of SO_2 emission controls, *Atmos. Chem. Phys.*, 16, 1603–1618, 2016.

Kim, P. S. *et al*. including **L. Zhu**: Sources, seasonality, and trends of southeast US aerosol: an integrated analysis of surface, aircraft, and satellite observations with the GEOS-Chem chemical transport model, *Atmos. Chem. Phys.*, 15, 10411–10433, 2015.

Li, M., X. Huang, **L. Zhu** *et al*.: Analysis of the transport pathways and potential sources of PM_{10} in Shanghai based on three methods, *Sci. Tot. Environ.*, 414, 525–534, 2012.

Huang, X. et al. including **L. Zhu**: Mercury Emissions from Biomass Burning in China, *Environ. Sci. Technol.*, 45, 5650–5657, 2011.

Song, Y. *et al*. including **L. Zhu**: A new emission inventory for nonagricultural open fires in Asia from

2000 to 2009, *Environ. Res. Lett*., 5, 014014, 2011.

Wang, B., **L. Zhu**, Z. Gong *et al*.: Introduction to the methods of parameter estimation for environmental monitoring data set with truncated data below a detection limit, *Acta Science Circumstantiae*., 29, 1345–1350, 2009.

AWARDS & GRANTS

Academic Recognition

American Meteorological Society Special Award for OMI	2020
Recognized reviewer for *Atmospheric Pollution Research*	2019
NASA/DOI William T. Pecora Team Award for OMI	2018
Outstanding reviewer for *Atmospheric Environment*	2017
NASA Group Achievement Award for SEAC^{4}RS	2015
Graduate with honors, Nankai University	2008
Excellent All-round Student, Nankai University	2005 – 2007

Teaching

Harvard University Certificate of Distinction in Teaching	2013

Fellowships

Smithsonian Astrophysical Observatory Visiting Scientist Fellowship	2019
Harvard Graduate Consortium on Energy and Environment Fellowship	2014 – 2016
Graduate Scholarship, Peking University	2008 – 2010
Novozymes Fellowship	2007
China National Educational Opportunity Grant	2007
Undergraduate scholarship, Nankai University	2005 – 2006

PRESENTATIONS

Talks

Satellite remote sensing of trace gases: principles, methods, and applications for air quality studies, Nankai University, Tianjin, China, 2020 **(invited)**.

Validation of satellite formaldehyde (HCHO) retrievals using observations from 12 aircraft campaigns, *AGU Fall Meeting*, 2019, San Francisco, CA, USA.

Satellite remote sensing of trace gases: principles, methods, and applications for air quality studies, *Atmospheric Chemistry Forum* (online), November 30, 2019 (**invited**).

Satellite remote sensing for air quality applications, with a focus on formaldehyde (HCHO), University of Illinois at Urbana–Champaign, Champaign, IL, 2019 **(invited)**.

Satellite remote sensing for air quality applications, with a focus on formaldehyde (HCHO), Institute of Atmospheric Physics Chinese Academy of Sciences, Beijing, China, 2019 **(invited)**.

Satellite remote sensing for air quality applications, with a focus on formaldehyde (HCHO), Peking University, Beijing, China, 2019 **(invited)**.

Satellite remote sensing for air quality applications, with a focus on formaldehyde (HCHO), Southern University of Science and Technology, Shenzhen, China, 2019 **(invited)**.

Modeling of tropospheric halogen (Cl-Br-I) chemistry: cycling, debromination, and impact, *The 1st Regional GEOS-Chem Asia Meeting*, Nanjing, China, 2018.

Mapping surface air concentrations from OMI and inferring cancer risks: implications for TEMPO, *TEMPO Science Meeting*, Cambridge, MA, 2017 **(invited)**.

Observing atmospheric formaldehyde from space: validation, intercomparison, trend analysis and public health implications, *AGU Fall Meeting*, San Francisco, CA, 2016.

Observing atmospheric formaldehyde from space: Validation, intercomparison, trend analysis and public health implications, *Aura Science Meeting*, Rotterdam, The Netherlands, 2016.

Mapping of surface formaldehyde (HCHO) from space for air quality management, *The 9th NASA Air Quality Applied Sciences Team Meeting*, St. Louis University, St. Louis, MO, 2015.

Indirect validation of new OMI, GOME-2B and OMPS formaldehyde retrievals using SEAC^{4}RS data, *The 7th International Conference of GEOS-Chem*, Harvard University, Cambridge, MA, 2015.

Validation of satellite HCHO observations (OMI, GOME-2B, OMPS) using SEAC^{4}RS data, *SEAC^{4}RS Science Meeting*, Caltech, Pasadena, CA, 2015.

Anthropogenic emissions of highly reactive volatile organic compounds inferred from oversampling of OMI HCHO columns, *EOS Aura Science Team Meeting 10th year anniversary celebration*, College Park, MD, 2014.

Anthropogenic emissions of highly reactive VOCs (HRVOCs) inferred from oversampling of OMI formaldehyde columns, *The 6th NASA Air Quality Applied Sciences Team Meeting*, Rice University, Houston, TX, 2014.

Math in Nature: finding order in chaos, at Harvard Medical School, *Science in News*, Boston, MA, 2013 **(invited)**.

Variability of HCHO over the United States: Implications for VOCs Emissions, *The 5th NASA Air Quality Applied Sciences Team Meeting*, University of Maryland, College Park, MD, 2013.

A spike in electricity demand due to severe summer heatwaves: Increase of SO_2 emissions detected from space, *The 18th Seminar of JSPS-MOE Core University Program*, Beijing, China, 2010.

Estimating of fire emissions in Boreal Siberia by satellite data sets, *The 6th Seminar of Environment Modeling and Pollution Controlling*, Beijing, China, 2009.

Posters

Validation of satellite formaldehyde (HCHO) retrievals using aircraft observations and implication for TEMPO, *TEMPO Science Meeting*, University of Wisconsin–Madison, WI, 2019.

Effect of sea-salt aerosol on tropospheric bromine chemistry, *The 9th International Conference of GEOS-Chem*, Harvard University, Cambridge, MA, 2019.

Effect of sea-salt aerosol on tropospheric bromine chemistry, *AGU Fall Meeting*, Washington, D.C., 2018.

Observing atmospheric formaldehyde from space: trend analysis and public health implications, *The 8th International GEOS-Chem Meeting*, Cambridge, MA, 2017.

Validation of satellite HCHO retrievals with aircraft (SEAC^{4}RS) observations, *Atmospheric Radiation Workshop*, NCAR, Boulder, CO, 2016.

Anthropogenic emissions of highly reactive volatile organic compounds inferred from oversampling of OMI HCHO columns, *AGU Fall Meeting*, San Francisco, CA, 2014.

Indirect validation of GOME-2/MetOp-A and B formaldehyde retrievals using SEAC^{4}RS data: Preliminary results, *The 7th NASA Air Quality Applied Sciences Team Meeting*, Harvard University, Cambridge, MA, 2014.

Indirect Validation of GOME-2/MetOp-A and B and New OMI formaldehyde (HCHO) retrievals using SEAC^{4}RS data: Preliminary results, *SEAC^{4}RS Science Meeting*, NIST, Boulder, CO, 2014.

Variability of HCHO over the Southeastern United States observed from space: Implications for VOC emissions, *AGU Fall Meeting*, San Francisco, CA, 2012.

Spikes in electricity demand during severe summer heat waves: Increased SO_2 emissions detected from space, *AGU Fall Meeting*, San Francisco, CA, 2010.

TEACHING EXPERIENCE

Instructor
- o *Computing and Programming for Environmental Research*, Graduate course, SUSTech, 26 students, 2020.

Teaching Assistant
Lab demonstrations/tutoring, grading, exam grading, offering weekly sections
- o *Atmospheric Chemistry and Physics*, Graduate course, Harvard University, 12 students, 2017.

    o *The Fluid Earth: Oceans, Atmosphere, and Climate*, Undergraduate course, Harvard University, 50 students, 2013.

ADVISING EXPERIENCE

Postdoc
Lei Shu 2020–, Dakang Wang 2020–

Research Assistant
Bin Bai 2020–, Wenfu Sun 2020–

Graduate Student
PhD student: Dongchuan Pu 2020–, Yuyang Chen 2020–
Graduate mentoring program at Harvard: Tianjia Liu 2017–2019, Natasha Goss 2014–2015

Undergraduate Student
Liqian Tan 2020–, Yuyang Chen 2019–2020

PROFESSIONAL SERVICE

Committee Experience

GEMS Science Team Member	2019 –
OMPS (NPP and NOAA-20) Science Team Member	2018 –
TEMPO Science Team Member	2017 –
NASA Aura Science Team Member	2016 –
Chair of weekly Harvard Atmospheric Sciences seminar series	2016 – 2017
NASA SEAC[4]RS Flight Campaign Science Team Member	2012 – 2015
NASA Air Quality Applied Sciences Team Member	2011 – 2015

Guest Editor
Remote Sensing

Peer Review Journals
Atmosphere, *Atmospheric Environment*, *Atmospheric Chemistry and Physics*, *Atmospheric Measurement Techniques*, *Atmospheric Pollution Research*, *Environmental Science & Technology*, *Geophysical Research Letters*, *Journal of Geophysical Research*, *Nature Climate Change*, *Remote Sensing*

Proposal Reviewer
NASA proposal review panels

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