

Xiao Lu (卢骁)

Postdoctoral Research Fellow

John A. Paulson School of Engineering and Applied Sciences, Harvard University

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ACADEMIC APPOINTMENT

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| 2019/10- | Postdoctoral Research Fellow, Harvard University <ul style="list-style-type: none">Atmospheric Chemistry Modeling Group (Advisor: Prof. Daniel Jacob) |
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EDUCATION

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|-----------------|---|
| 2014/09-2019/06 | Ph.D., Peking University <ul style="list-style-type: none">Air Quality Modeling Group (Advisor: Prof. Lin Zhang)Ph.D. Thesis: Tropospheric Ozone Interacts with Weather and Climate: Mechanisms and Model Development |
| 2010/09-2014/06 | B.S., Sun Yat-sen University |

RESEARCH INTERESTS

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- Source, chemistry, transport, and sink of greenhouse gas and air pollutants
 - Large-scale chemistry-climate interactions
 - Climate-chemistry model development

RESEARCH EXPERIENCE

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| 2019/10-present | Postdoctoral research assistant, Harvard University |
| 2016/09-2017/09 | Visiting Ph.D. student, Harvard University |
| 2016/07-2016/09 | Collaborating research assistant, National Climate Center of China |
| 2014/09-2019/10 | Graduate Research Assistant/Research associate, Peking University |

HONORS AND AWARDS (Selected)

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| 2020 | <ul style="list-style-type: none">IOP trusted reviewer award (for exceptionally high level of peer review competencies) |
| 2019 | <ul style="list-style-type: none">Outstanding Ph.D. Thesis Award of Peking University 北京大学优秀博士论文Excellent graduate of Beijing, Excellent graduate of Peking University 北京市优秀毕业生, 北京大学优秀毕业生Tang Lixin Scholarship 唐立新奖学金 |
| 2018 | <ul style="list-style-type: none">“Xie Yibing” Youth Meteorological Science and Technology Award (<i>Awarded to six young scientists nationwide per year</i>) 谢义炳青年气象科技奖National Scholarship (Rank #1 of the Department) 博士研究生国家奖学金Outstanding Thesis Award of the 24th Chinese Atmospheric Environment Science and Technology Conference 第24届中国环境学会大气环境分会优秀报告奖Consolidated Award of the 12th National Environmental Conference of Doctoral Students |

第 12 届全国环境博士生学术会议综合优秀奖

- 2017 • Graduate Scholarship of Peking University 北京大学研究生专项奖学金
- 2016 • **State Scholarship Fund from the Chinese Scholarship Council 国家留学基金委奖学金**
• Award for Contribution in Student Organization of Peking University 北京大学社会工作奖
- 2015 • **Presidential Fellowship of Peking University (Rank #1 of the Grade) 北京大学校长奖学金**
• Outstanding Thesis Award of the 32th Chinese Meteorological Society Conference
第 32 届中国气象学会年会优秀论文

PUBLICATIONS

1. **Lu, X.**, Jacob, D. J., Zhang, Y., Maasakkers, J. D., Sulprizio, M. P., Shen, L., Qu, Z., Scarpelli, T. R., Nesser, H., Yantosca, R. M., Sheng, J., Andrews, A., Parker, R. J., Boech, H., Bloom, A. A., and Ma, S.: Global methane budget and trend, 2010–2017: complementarity of inverse analyses using in situ (GLOBALVIEWplus CH₄ ObsPack) and satellite (GOSAT) observations, *Atmospheric Chemistry and Physics*, in press, 2021.
2. **Lu, X.**, Zhang, L., Wu, T., Long, M., Wang, J., Jacob, D., Zhang F., Zhang, J., Eastham, S., Hu, L., Zhu, L., Liu, X., and Wei, M.: Development of the global atmospheric general circulation-chemistry model BCC-GEOS-Chem v1.0: model description and evaluation, *Geoscientific Model Development*, 13, 3817–3838, 2020
3. **Lu, X.**, Zhang, L., Wang, X., Gao, M., Li, K., Zhang, Y., Yue, X., and Zhang, Y.: Rapid increases in warm-season surface ozone and resulting health impact over China since 2013, *Environmental Science & Technology Letters*, 7, 240–247, 2020
4. **Lu, X.**, Zhang, L., Chen, Y., Zhou, M., Zheng, B., Li, K., Liu, Y., Lin, J., Fu, T.-M., and Zhang, Q.: Exploring 2016–2017 surface ozone pollution over China: source contributions and meteorological influences, *Atmospheric Chemistry and Physics*, 19, 8339–8361, 2019 **[ESI 1% Highly Cited Paper]**
5. **Lu X.**, Zhang, L., Zhao, Y., Jacob, D., Hu, Y., Hu, L., Gao, M., Liu, X., Petropavlovskikh, I., McClure-Begley, A., and Querel R.: Surface and tropospheric ozone trends in the Southern Hemisphere since 1990: possible linkages to poleward expansion of the Hadley Circulation, *Science Bulletin*, 64, 400–409, 2019 **[Journal Highlight Article]**
6. **Lu X.**, Zhang, L., Shen, L.: Meteorology and Climate Influences on Tropospheric Ozone: a Review of Natural Sources, Chemistry, and Transport Patterns, *Current Pollution Reports*, 5, 238–260, 2019
7. **Lu, X.**, Hong, J., Zhang, L., Cooper, O. R., Schultz, M. G., Xu, X., Wang, T., Gao, M., Zhao, Y., and Zhang, Y.: Severe Surface Ozone Pollution in China: A Global Perspective, *Environmental Science & Technology Letters*, 5, 487–494, 2018. **[ESI 0.1% Hot Paper] [ESI 1% Highly Cited Paper]**
8. **Lu, X.**, Zhang, L., Liu, X., Gao, M., Zhao, Y., and Shao, J.: Lower tropospheric ozone over India and its linkage to the South Asian monsoon, *Atmospheric Chemistry and Physics*, 18, 3101–3118, 2018.
9. **Lu, X.**, Zhang, L., Yue, X., Zhang, J., Jaffe, D. A., Stohl, A., Zhao, Y., and Shao, J.: Wildfire influences on the variability and trend of summer surface ozone in the mountainous western United States, *Atmospheric Chemistry and Physics*, 16, 14687–14702, 2016.
10. Li, K., Jacob, D. J., Liao, H., Qiu, Y., Shen, L., Zhai, S., Bates, K. H., Sulprizio, M. P., Song, S., **Lu, X.**, Zhang, Q., Zheng, B., Zhang, Y., Zhang, J., Lee, H. C., and Kuk, S. K.: Ozone pollution in the North China Plain spreading into the late-winter haze season, *Proceedings of the National Academy of Sciences*, 118, e2015797118, 2021.
11. DeLang, M. N., Becker, J. S., Chang, K.-L., Serre, M. L., Cooper, O. R., Schultz, M. G., Schröder, S., **Lu, X.**, Zhang, L., Deushi, M., Josse, B., Keller, C. A., Lamarque, J.-F., Lin, M., Liu, J., Marécal, V., Strode, S. A., Sudo, K., Tilmes, S., Zhang, L., Cleland, S. E., Collins, E. L., Brauer, M., and West, J. J.: Mapping Yearly Fine Resolution Global Surface Ozone through the Bayesian Maximum Entropy Data Fusion of Observations and Model Output for 1990–2017, *Environmental Science & Technology*, 2021.
12. Maasakkers, J. D., Jacob, D. J., Sulprizio, M. P., Scarpelli, T. R., Nesser, H., Sheng, J., Zhang, Y., **Lu, X.**, Bloom, A. A., Bowman, K. W., Worden, J. R., and Parker, R. J.: 2010–2015 North American methane emissions, sectoral contributions,

- and trends: a high-resolution inversion of GOSAT satellite observations of atmospheric methane, *Atmospheric Chemistry and Physics*, 21, 4339-4356, 2021.
13. Jiang, Z., Li, J., **Lu, X.**, Gong, C., Zhang, L., and Liao, H.: Impact of Western Pacific Subtropical High on Ozone Pollution over Eastern China, *Atmospheric Chemistry and Physics*, 21, 2601-2613, 2021.
 14. Zhang, Y., Jacob, D. J., **Lu, X.**, Maasakkers, J. D., Scarpelli, T. R., Sheng, J.-X., Shen, L., Qu, Z., Sulprizio, M. P., Chang, J., Bloom, A. A., Ma, S., Worden, J., Parker, R. J., and Boesch, H.: Attribution of the accelerating increase in atmospheric methane during 2010–2018 by inverse analysis of GOSAT observations, *Atmospheric Chemistry and Physics*, 21, 3643-3666, 2021.
 15. Sun, Y., Yin, H., Liu, C., Zhang, L., Cheng, Y., Palm, M., Notholt, J., **Lu, X.**, Vigouroux, C., Zheng, B., Wang, W., Jones, N., Shan, C., Tian, Y., Hu, Q., and Liu, J.: Mapping the drivers of formaldehyde (HCHO) variability from 2015–2019 over eastern China: insights from FTIR observation and GEOS-Chem model simulation, *Atmospheric Chemistry and Physics*, in press, 2021.
 16. Sun, Y., Yin, H., Cheng, Y., Zhang, Q., Zheng, B., Notholt, J., **Lu, X.**, Liu, C., Tian, Y., and Liu, J.: Quantifying variability, source, and transport of CO over the Himalayas and Tibetan Plateau, *Atmospheric Chemistry and Physics Discussions*, 2020.
 17. Gao, M., Yang, Y., Liao, H., Zhu, B., Zhang, Y., Liu, Z., **Lu, X.**, Wang, C., Zhou, Q., Wang, Y., Zhang, Q., Carmichael, G. R., and Hu, J.: Reduced light absorption of black carbon (BC) and its influence on BC-boundary-layer interactions during APEC Blue, *Atmospheric Chemistry and Physics Discussions*, 2021.
 18. Sun, Y., Yin, H., Liu, C., Mahieu, E., Notholt, J., Té, Y., **Lu, X.**, Palm, M., Wang, W., Shan, C., Hu, Q., Qin, M., Tian, Y., and Zheng, B.: Reduction in C₂H₆ from 2015 to 2020 over Hefei, eastern China points to air quality improvement in China, *Atmospheric Chemistry and Physics Discussions*, 2021.
 19. Li, K., Jacob, D. J., Shen, L., **Lu, X.**, De Smedt, I., and Liao, H.: Increases in surface ozone pollution in China from 2013 to 2019: anthropogenic and meteorological influences, *Atmospheric Chemistry and Physics*, 20, 11423-11433, 2020.
 20. Lin, H., Feng, X., Fu, T.-M., Tian, H., Ma, Y., Zhang, L., Jacob, D. J., Yantosca, R. M., Sulprizio, M. P., Lundgren, E. W., Zhuang, J., Zhang, Q., **Lu, X.**, Zhang, L., Shen, L., Guo, J., Eastham, S. D., and Keller, C. A.: WRF-GC: online coupling of WRF and GEOS-Chem for regional atmospheric chemistry modeling, Part 1: description of the one-way model (v1.0), *Geoscientific Model Development*, 2020.
 21. Cooper, O. R., Schultz, M. G., Schroeder, S., Chang, K.-L., Gaudel, A., Benítez, G. C., Cuevas, E., Fröhlich, M., Galbally, I. E., Molloy, S., Kubistin, D., **Lu, X.**, McClure-Begley, A., Nédélec, P., O'Brien, J., Oltmans, S. J., Petropavlovskikh, I., Ries, L., Senik, I., Sjöberg, K., Solberg, S., Spain, G. T., Spangl, W., Steinbacher, M., Tarasick, D., Thouret, V., and Xu, X.: Multi-decadal surface ozone trends at globally distributed remote locations, *Elementa-Science of the Anthropocene*, 8, 23, 2020.
 22. Gao, M., Gao, J., Zhu, B., Kumar, R., **Lu, X.**, Song, S., Zhang, Y., Wang, P., Beig, G., Hu, J., Ying, Q., Zhang, H., Sherman, P., and McElroy, M. B.: Ozone Pollution over China and India: Seasonality and Sources, *Atmospheric Chemistry and Physics*, 2020.
 23. Wu, T., Zhang, F., Zhang, J., Jie, W., Zhang, Y., Wu, F., Li, L., Yan, J., Liu, X., **Lu, X.**, Tan, H., Zhang, L., Wang, J., and Hu, A.: Beijing Climate Center Earth System Model version 1 (BCC-ESM1): model description and evaluation of aerosol simulations, *Geoscientific Model Development*, 13, 977-1005, 2020.
 24. Yin, H., Sun, Y., Liu, C., **Lu, X.**, Smale, D., Blumenstock, T., Nagahama, T., Wang, W., Tian, Y., Hu, Q., Shan, C., Zhang, H., and Liu, J.: Ground-based FTIR observation of hydrogen chloride (HCl) over Hefei, China, and comparisons with GEOS-Chem model data and other ground-based FTIR stations data, *Optics Express*, 28, 8041, 2020.
 25. Zhao, Y., Zhang, L., Zhou, M., Chen, D., **Lu, X.**, Tao, W., Liu, J., Tian, H., Ma, Y., and Fu, T.-M.: Influences of planetary boundary layer mixing parameterization on summertime surface ozone concentration and dry deposition over North China, *Atmospheric Environment*, 218, 116950, 2019.
 26. Shao, J., Chen, Q., Wang, Y., **Lu, X.**, He, P., Sun, Y., Shah, V., Martin, R. V., Philip, S., Song, S., Zhao, Y., Xie, Z., Zhang, L., and Alexander, B.: Heterogeneous sulfate aerosol formation mechanisms during wintertime Chinese haze events: Air

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- quality model assessment using observations of sulfate oxygen isotopes in Beijing, *Atmospheric Chemistry and Physics*, 19, 6107-6123, 2019. **[Journal Highlight Article] [ESI 1% Highly Cited Paper]**
27. Yin, H., Sun, Y., Liu, C., Zhang, L., **Lu, X.**, Wang, W., Shan, C., Hu, Q., Tian, Y., Zhang, C., Su, W., Zhang, H., Palm, M., Notholt, J., and Liu, J.: FTIR time series of stratospheric NO₂ over Hefei, China, and comparisons with OMI and GEOS-Chem model data, *Optics Express*, 27, A1225, 2019.
 28. Zhou, M., Zhang, L., Chen, D., Gu, Y., Fu, T.-M., Gao, M., Zhao, Y., **Lu, X.**, and Zhao, B., The impact of aerosol-radiation interactions on the effectiveness of emission control measures, *Environmental Research Letters*, 14, 024002, 2019
 29. Gao, M., Ding, Y., Song, S., **Lu, X.**, Chen, X., and McElroy, M. B.: Secular decrease of wind power potential in India associated with warming Indian Ocean, *Science Advances*, 4, eaat5256, 2018
 30. Gao, M., Beig, G., Song, S., Zhang, H., Hu, J., Ying, Q., Liang, F., Liu, Y., Wang, H., **Lu, X.**, Zhu, T., Carmichael, G. R., Nielsen, C. P., and McElroy, M. B.: The impact of power generation emissions on ambient PM_{2.5} pollution and human health in China and India, *Environmental International*, 121, 250-259, 2018.
 31. Gao, M., Liu, Z., Wang, Y., **Lu, X.**, Ji, D., Wang, L., Li, M., Wang, Z., Zhang, Q., and Carmichael, G. R.: Distinguishing the roles of meteorology, emission control measures, regional transport, and co-benefits of reduced aerosol feedbacks in “APEC Blue”, *Atmospheric Environment*, 167, 476-486, 2017.
 32. Zhang, L., Shao, J., **Lu, X.**, Zhao, Y., Hu, Y., Henze, D. K., Liao, H., Gong, S., and Zhang, Q.: Sources and Processes Affecting Fine Particulate Matter Pollution over North China: An Adjoint Analysis of the Beijing APEC Period, *Environmental Science & Technology*, 50, 8731-8740, 2016.

BOOK CONTRIBUTION

Lu X., Zhang, L., Shen, L.: Tropospheric ozone interacts with meteorology and climate, Chapter in Air Pollution, Climate and Health, Elsevier (in press)

INVITED TALK

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| 2020/06 | NOAA Global Monitoring Laboratory Virtual Global Monitoring Annual Conference (eGMAC)
Global methane budget and trend in 2010-2017: comparative and joint inversions of suborbital (ObsPack) and satellite (GOSAT) observations |
| 2019/10 | School of Atmospheric Sciences, Sun Yat-sen University, Guangzhou, China
Tropospheric ozone interacts with weather and climate: mechanisms and model development |

CONFERENCE & PRESENTATION (Selected)

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| 2020/12 | American Geosciences Union 2020 (AGU) (remote)
<i>Oral: Global methane budget and trend, 2010-2017: complementarity of inverse analyses using in situ (GLOBALVIEWplus CH₄ ObsPack) and satellite (GOSAT) observations</i> |
| 2019/05 | The 9th International GEOS-Chem Meeting (IGC9) , Cambridge, MA, US
<i>Oral: Development of the China National Climate Center Climate Chemistry Model (BCC-GEOS-Chem): Model description and evaluation</i> |
| 2018/12 | American Geosciences Union 2018 (AGU) , Washington D.C., US
<i>Poster: Tropospheric and surface ozone in China and India: present-day status and interannual variability</i> |
| 2018/11 | The 24th Chinese Atmospheric Environment Science and Technology Conference , Qingdao, China
<i>Oral: Tropospheric and surface ozone in China and India: present-day status, interannual variability, and linkages to changes of precursor emissions and climate</i> |
| 2018/06 | The 15th Annual Meeting Asia Oceania Geosciences Society (AOGS) , Honolulu, Hawaii, US |

Poster: Development of the China National Climate Center Climate Chemistry Model (BCC-GEOS-Chem): Model description and evaluation

2017/12 **American Geosciences Union 2017 (AGU)**, New Orleans, LA, US

Oral: Increasing tropospheric ozone in the Southern Hemisphere driven by poleward expansion of the Hadley circulation: ozone as a climate feedback agent

2016/08 **The 13th Annual Meeting Asia Oceania Geosciences Society (AOGS)**, Beijing, China

Oral: Wildfire influences on the variability and trend of summer surface ozone in the US Intermountain West

2015/05 **The 7th International GEOS-Chem Meeting (IGC7)**, Cambridge, MA, US

Poster: Influences of wildfires on summer surface ozone in the US Intermountain West

TEACHING EXPERIENCE

- **Teaching Assistant (2016/02-2016/07)**

Atmospheric measurements techniques (Course for graduate students), Department of Atmospheric and Oceanic Sciences, Peking University

ACTIVITIES AND SERVICES

- **Co-chair of the East Asia Focus Working Group of the Tropospheric Ozone Assessment Report (TOAR II)**

- **Editor**

Atmosphere (topic editor, 2020-)

- **Journal Reviewer**

Advances of Atmospheric Sciences, Atmosphere, Chemosphere, Environmental Pollution, Environmental Research Letters, Environmental Science & Policy, Environmental Science & Technology, Environmental Science & Technology Letters, Geophysical Research Letters, Journal of Atmospheric and Solar-Terrestrial Physics, Remote Sensing, Science of the Total Environment