

# Xiao Lu (卢骁)

## Associate Professor

### School of Atmospheric Sciences, Sun Yat-sen University

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## ACADEMIC APPOINTMENT

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| 2021/05-        | <b>Associate Professor, Sun Yat-sen University</b> <ul style="list-style-type: none"><li>Department of Atmospheric Physics and Chemistry, School of Atmospheric Sciences</li></ul> |
| 2019/10-2021/04 | <b>Postdoctoral Research Fellow, Harvard University</b> <ul style="list-style-type: none"><li>Atmospheric Chemistry Modeling Group (Advisor: Prof. Daniel Jacob)</li></ul>         |

## EDUCATION

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

## 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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| 2019/10-2021/05 | 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"><li>IOP trusted reviewer award (for exceptionally high level of peer review competencies in Environmental Research Letters)</li></ul>   |
| 2019 | <ul style="list-style-type: none"><li><b>Outstanding Ph.D. Thesis Award of Peking University</b> 北京大学优秀博士论文</li><li><b>Excellent graduate of Beijing, Excellent graduate of Peking University</b> 北京市优秀毕业生, 北京大学优秀毕业生</li><li>Tang Lixin Scholarship 唐立新奖学金</li></ul>   |
| 2018 | <ul style="list-style-type: none"><li><b>“Xie Yibing” Youth Meteorological Science and Technology Award</b> (<i>Awarded to six young scientists nationwide per year</i>) 谢义炳青年气象科技奖</li><li><b>National Scholarship (Rank #1 of the Department)</b> 博士研究生国家奖学金</li><li>Outstanding Thesis Award of the 24<sup>th</sup> Chinese Atmospheric Environment Science and Technology</li></ul> |

- 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 12<sup>th</sup> 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 32<sup>th</sup> 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., Boesch, 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*, 21, 4637–4657, 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*, 21, 6365–6387, 2021.
16. Wang, X., Fu, T.-M., Zhang, L., Cao, H., Zhang, Q., Ma, H., Shen, L., Evans, M. J., Ivatt, P. D., **Lu, X.**, Chen, Y., Zhang, L., Feng, X., Yang, X., Zhu, L., and Henze, D. K.: Sensitivities of Ozone Air Pollution in the Beijing–Tianjin–Hebei Area to Local and Upwind Precursor Emissions Using Adjoint Modeling, *Environmental Science & Technology*, 55, 5752–5762, 2021.
17. Shen, L., Zavala-Araiza, D., Gautam, R., Omara, M., Scarpelli, T., Sheng, J., Sulprizio, M. P., Zhuang, J., Zhang, Y., Qu, Z., **Lu, X.**, Hamburg, S. P., and Jacob, D. J.: Unravelling a large methane emission discrepancy in Mexico using satellite observations, *Remote Sensing of Environment*, 260, 112461, <http://doi.org/10.1016/j.rse.2021.112461>, 2021.
18. 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.
19. 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
20. 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.
21. 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
22. 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
23. 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
24. 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
25. 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]**
26. 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 NO<sub>2</sub> over Hefei, China, and comparisons with OMI and GEOS-Chem model data, *Optics Express*, 27, A1225, 2019.
  27. 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
  28. 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
  29. 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<sub>2.5</sub> pollution and human health in China and India, *Environmental International*, 121, 250-259, 2018.
  30. 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.
  31. 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

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

## INVITED TALK

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

## CONFERENCE & PRESENTATION (Selected)

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| <b>2020/12</b> | <b>American Geosciences Union 2020 (AGU)</b> (remote)<br><i>Oral: Global methane budget and trend, 2010-2017: complementarity of inverse analyses using in situ (GLOBALVIEWplus CH<sub>4</sub> ObsPack) and satellite (GOSAT) observations</i>   |
| <b>2019/05</b> | <b>The 9<sup>th</sup> International GEOS-Chem Meeting (IGC9)</b> , Cambridge, MA, US<br><i>Oral: Development of the China National Climate Center Climate Chemistry Model (BCC-GEOS-Chem): Model description and evaluation</i>  |
| <b>2018/12</b> | <b>American Geosciences Union 2018 (AGU)</b> , Washington D.C., US<br><i>Poster: Tropospheric and surface ozone in China and India: present-day status and interannual variability</i>   |
| <b>2018/11</b> | <b>The 24<sup>th</sup> Chinese Atmospheric Environment Science and Technology Conference</b> , Qingdao, China<br><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> |
| <b>2018/06</b> | <b>The 15<sup>th</sup> Annual Meeting Asia Oceania Geosciences Society (AOGS)</b> , 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 13<sup>th</sup> 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 7<sup>th</sup> International GEOS-Chem Meeting (IGC7)**, Cambridge, MA, US

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

## TEACHING EXPERIENCE

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

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

## ACTIVITIES AND SERVICES

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- **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, Air Quality Atmosphere & Health, Atmosphere, Atmospheric Pollution Research, 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, Nature Communications, Remote Sensing, Science of the Total Environment*