

Shixian ZHAI

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Employment

07/2022 – present: Research Associate, Harvard University

07/2019 – 06/2022: Postdoc, Harvard University

Education

03/2018 - 06/2019: Joint Ph.D. in Atmospheric Chemistry, Harvard University

09/2015 - 06/2019: Ph.D. in Atmospheric Physics and Atmospheric Environment, Nanjing University of Information Science and Technology

09/2012 - 06/2015: Master in Atmospheric Sciences, Chinese Academy of Meteorological Sciences (CAMS); Credit courses are taken at the University of Chinese Academy of Sciences

09/2008 - 06/2012: Bachelor in Lightning Protection Science and Technology, Nanjing University of Information Science and Technology

Publications

Manuscript in preparation:

Zhai, S., Jacob, D. J. et al: Rising transpacific transport of peroxyacetyl nitrate (PAN) from 2008-2019: IASI satellite measurements and GEOS-Chem model simulation, poster presentation, 2022 GEMS satellite workshop at Seoul.

Submitted:

Brewer, J. F., Jacob, D. J., ..., **Zhai, S.**, et al: A scheme for representing aromatic secondary organic aerosols in chemical transport models: application to source attribution of organic aerosols over South Korea during the KORUS-AQ campaign, *J. Geophys. Res.*, submitted.

Published:

Zhai, S., Jacob, D. J., Wang, X., Liu, Z., Wen, T., Shah, V., Li, K., Moch, J. M., Bates, K. H., Song, S., Shen, L., Zhang, Y., Luo, G., Yu, F., Sun, Y., Wang, L., Qi, M., Tao, J., Gui, K., Xu, H., Zhang, Q., Zhao, T., Wang, Y., Lee, H. C., Choi, H., and Liao, H.: Control of particulate nitrate air pollution in China, *Nature Geoscience*, <https://doi.org/10.1038/s41561-021-00726-z>, 2021. (Highly cited paper, top 1% cited in geoscience; Top journal, ranking top 1% in Earth and Planetary Sciences)

Zhai, S., Jacob, D. J., Wang, X., Shen, L., Li, K., Zhang, Y., Gui, K., Zhao, T., and Liao, H.: Fine particulate matter ($PM_{2.5}$) trends in China, 2013-2018: separating contributions from anthropogenic emissions and meteorology, *Atmos. Chem. Phys.*, 19, 11031-11041 <https://doi.org/10.5194/acp-19-11031-2019>, 2019. (Hot paper, top 0.1% cited in geoscience; Top journal, ranking top 3% in Earth and Planetary Sciences)

Zhai, S., Jacob, D. J., Brewer, J. F., Li, K., Moch, J. M., Kim, J., Lee, S., Lim, H., Lee, H. C., Kuk, S. K., Park, R. J., Jeong, J. I., Wang, X., Liu, P., Luo, G., Yu, F., Meng, J., Martin, R. V., Travis, K. R., Hair, J. W., Anderson, B. E., Dibb, J. E., Jimenez, J. L., Campuzano-Jost, P., Nault, B. A., Woo, J. H., Kim, Y., Zhang, Q., and Liao, H.: Relating geostationary satellite measurements of aerosol optical depth (AOD) over East Asia to fine particulate matter ($PM_{2.5}$): insights from the KORUS-AQ aircraft campaign and GEOS-Chem model simulations, *Atmos. Chem. Phys.*, 21, 16775-16791, 10.5194/acp-21-16775-2021,

2021. ([Top journal](#), ranking top 3% in Earth and Planetary Sciences)

Zhai, S., An, X., Zhao, T., Sun, Z., Wang, W., Hou, Q., Guo, Z., and Wang, C.: Detection of critical PM_{2.5} emission sources and their contributions to a heavy haze episode in Beijing, China, using an adjoint model, *Atmos. Chem. Phys.*, 18, 6241-6258, 10.5194/acp-18-6241-2018, 2018. ([Top journal](#), ranking top 3% in Earth and Planetary Sciences)

Zhai, S., Jacob, D. J., Pendergrass, D. C., Colombi, N. K., Shah, V., Yang, L. H., Zhang, Q., Wang, S., Kim, H., Sun, Y., Choi, J. S., Park, J. S., Luo, G., Yu, F., Woo, J. H., Kim, Y., Dibb, J. E., Lee, T., Han, J. S., Anderson, B. E., Li, K., and Liao, H.: Coarse particulate matter air quality in East Asia: implications for fine particulate nitrate, *EGUphere*, 2023, 1-18, 10.5194/egusphere-2022-1485, 2023.

Zhai, S., An, X., Liu, Z., Sun, Z., and Hou, Q.: Model assessment of atmospheric pollution control schemes for critical emission regions, *Atmos. Environ.*, 124, 367-377, <https://doi.org/10.1016/j.atmosenv.2015.08.093>, 2016. ([Top journal](#), ranking top 9% in Environmental Science)

An, X. Q., **Zhai, S.**, Jin, M., Gong, S., and Wang, Y.: Development of an adjoint model of GRAPES-CUACE and its application in tracking influential haze source areas in north China, *Geosci. Model Dev.*, 9, 2153-2165, 10.5194/gmd-9-2153-2016, 2016. ([Shixian is the leading developer of the adjoint model and the main contributor to this paper](#); Top journal, ranking top 2% in Earth and Planetary Sciences)

Zhai, S., An, X., Liu, J., Wu, Q., Li, N., Zhang, X.: Effects of emission-sources reduction at different time points on PM_{2.5} concentration over Beijing Municipality, *China Environmental Science*, 2014.

Zhai, S., An, X., Sun, Z., Liu, J.: Effects of emission-sources reduction time and ratios on PM_{2.5} concentration over Beijing Municipality, *China Environmental Science*, 2015.

Pendergrass, D. C., **Zhai, S.**, Kim, J., Koo, J. H., Lee, S., Bae, M., Kim, S., Liao, H., and Jacob, D. J.: Continuous mapping of fine particulate matter (PM_{2.5}) air quality in East Asia at daily 6 x 6 km² resolution by application of a random forest algorithm to 2011–2019 GOFCI geostationary satellite data, *Atmos. Meas. Tech.*, 15, 1075-1091, 10.5194/amt-15-1075-2022, 2022. ([Top journal](#))

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, *Proc. Natl. Acad. Sci. USA*, 118, e2015797118, 10.1073/pnas.2015797118, 2021.

Li, K., Jacob, D. J., Liao, H., Zhu, J., Shah, V., Shen, L., Bates, K. H., Zhang, Q., and **Zhai, S.**: A two-pollutant strategy for improving ozone and particulate air quality in China, *Nature Geoscience*, 12, 906-910, 10.1038/s41561-019-0464-x, 2019.

Colombi, N. K., Jacob, D. J., Yang, L. H., **Zhai, S.**, et al.: Why is ozone in South Korea and the Seoul Metropolitan Area so high and increasing?, *EGUphere*, 2022, 1-21, 10.5194/egusphere-2022-1366, 2022.

Yang, L. H., Jacob, D. J., Colombi, N. K., **Zhai, S.** et al.: Tropospheric NO₂ vertical profiles over South Korea and their relation to oxidant chemistry: Implications for geostationary satellite retrievals and the observation of NO₂ diurnal variation from space, *EGUphere*, 2022, 1-30, 10.5194/egusphere-2022-1309, 2022.

Zhu, H., Martin, R., Croft, B., **Zhai, S.**, Li, C., Bindle, L., Pierce, J., Chang, R., Anderson, B., Ziembka, L., Hair, J., Ferrare, R., Hostetler, C., Singh, I., Chatterjee, D., Jimenez, J., Campuzano-Jost, P., Nault, B., Dibb, J., Schwarz, J., and Weinheimer, A.: Parameterization of Size of Organic and Secondary Inorganic Aerosol

- for Efficient Representation of Global Aerosol Optical Properties, EGUsphere, 2022, 1-31, 10.5194/egusphere-2022-1292, 2022.
- Shah, V., Jacob, D. J., Moch, J. M., Wang, X., and **Zhai, S.**: Global modeling of cloud water acidity, precipitation acidity, and acid inputs to ecosystems, *Atmos. Chem. Phys.*, 20, 12223-12245, <https://doi.org/10.5194/acp-20-12223-2020>, 2020.
- Shah, V., Jacob, D. J., Li, K., Silvern, R. F., **Zhai, S.**, Liu, M., Lin, J., and Zhang, Q.: Effect of changing NO_x lifetime on the seasonality and long-term trends of satellite-observed tropospheric NO₂ columns over China, *Atmos. Chem. Phys.*, 20, 1483-1495, 10.5194/acp-20-1483-2020, 2020.
- Song, S., Ma, T., Zhang, Y., Shen, L., Liu, P., Li, K., **Zhai, S.**, Zheng, H., Gao, M., Moch, J. M., Duan, F., He, K., and McElroy, M. B.: Global modeling of heterogeneous hydroxymethanesulfonate chemistry, *Atmos. Chem. Phys.*, 21, 457-481, 10.5194/acp-21-457-2021, 2021.
- Travis, K. R., Crawford, J. H., Chen, G., Jordan, C. E., Nault, B. A., Kim, H., Jimenez, J. L., Campuzano-Jost, P., Dibb, J. E., Woo, J. H., Kim, Y., **Zhai, S.**, Wang, X., McDuffie, E. E., Luo, G., Yu, F., Kim, S., Simpson, I. J., Blake, D. R., Chang, L., and Kim, M. J.: Limitations in representation of physical processes prevent successful simulation of PM_{2.5} during KORUS-AQ, *Atmos. Chem. Phys.*, 22, 7933-7958, 10.5194/acp-22-7933-2022, 2022.
- Gui, K., Che, H., Zeng, Z., Wang, Y., **Zhai, S.**, Wang, Z., Luo, M., Zhang, L., Liao, T., Zhao, H., Li, L., Zheng, Y., and Zhang, X.: Construction of a virtual PM_{2.5} observation network in China based on high-density surface meteorological observations using the Extreme Gradient Boosting model, *Environ. Int.*, 141, 105801, <https://doi.org/10.1016/j.envint.2020.105801>, 2020.
- An, X., Hou, Q., Li, N., and **Zhai, S.**: Assessment of human exposure level to PM₁₀ in China, *Atmos. Environ.*, 70, 376-386, <https://doi.org/10.1016/j.atmosenv.2013.01.017>, 2013.
- Wang, C., An, X., **Zhai, S.**, Hou, Q., and Sun, Z.: Tracking sensitive source areas of different weather pollution types using GRAPES-CUACE adjoint model, *Atmos. Environ.*, 175, 154-166, <https://doi.org/10.1016/j.atmosenv.2017.11.041>, 2018.
- Wang, C., An, X., **Zhai, S.**, and Sun, Z.: Tracking a Severe Pollution Event in Beijing in December 2016 with the GRAPES-CUACE Adjoint Model, *J. Meteorol. Res.*, 32, 49-59, 10.1007/s13351-018-7062-5, 2018.
- Wang, C., An, X., **Zhai, S.**, Sun, Z.: The application of an adjoint model in tracking influential haze source areas of pollution episodes, *China Environmental Science*, 2017.
- Liu, J., An, X., Zhu, T., **Zhai, S.**, Li, N.: Evaluation of PM_{2.5} decrease in Beijing after emission restrictions in the Beijing-Tianjin-Hebei and surrounding regions, *China Environmental Science*, 2014.
- An, X., Yao, B., Li, Y., Zhou, L., Liu, Z., **Zhai, S.**: Estimating emission of SF₆ in China by atmospheric observation data and inverse modeling, *Acta Scientiae Circumstantiae*, 2014.
- Moch, J. M., Mickley, L. J., Keller, C. A., Bian, H., Lundgren, E. W., **Zhai, S.**, and Jacob, D. J.: Aerosol-Radiation Interactions in China in Winter: Competing Effects of Reduced Shortwave Radiation and Cloud-Snowfall-Albedo Feedbacks Under Rapidly Changing Emissions, *J. Geophys. Res. Atmos.*, 127, e2021JD035442, <https://doi.org/10.1029/2021JD035442>, 2022.
- Zeng, Z., Gui, K., Wang, Z., Luo, M., Geng, H., Ge, E., An, J., Song, X., Ning, G., **Zhai, S.**, and Liu, H.: Estimating hourly surface PM_{2.5} concentrations across China from high-density meteorological observations by machine learning, *Atmos. Res.*, 254, 105516, <https://doi.org/10.1016/j.atmosres.2021.105516>, 2021.
- Xiang, S., Li, Y., **Zhai, S.**, and Peng, J.: Comparative analysis of precipitation structures in two Southwest China Vortex events over eastern Sichuan Basin by TRMM, *J. Atmos. Sol.-Terr. Phys.*, 221, 105691, <https://doi.org/10.1016/j.jastp.2021.105691>, 2021.

Presentations

- Zhai, S.**, Coarse particulate matter air quality in East Asia: implications for fine particulate nitrate, AGU 2022 (poster presentation), Chicago, December 13, 2022.
- Zhai, S.**, Air Quality over East Asia: Trends and Broader Impacts, CUHK ([invited talk](#)), 14 November 2022.
- Zhai, S.**, Coarse particulate matter air quality in East Asia: implications for fine particulate nitrate, The 10th International GEOS-Chem conference (oral, in-person), Washington University in St. Louis, June 7, 2022.
- Zhai, S.**, Factors Controlling Peroxyacetyl Nitrate (PAN) in Polluted and Remote Atmospheres: Insights from the KORUS-AQ and ATom Campaigns, the American Meteorological Society (AMS) 102nd Annual Meeting (oral, online), January 27, 2022.
- Zhai, S.**, Fine Particulate Matter ($PM_{2.5}$) in East Asia: Trends and Geostationary Satellite Monitoring, School of Environment Science and Engineering, Nanjing University of Information Science and Technology ([invited talk](#)), January 6, 2022.
- Zhai, S.**, Fine Particulate Matter ($PM_{2.5}$) in East Asia: Trends and Geostationary Satellite Monitoring, School of Earth Sciences, Zhejiang University ([invited talk](#)), December 27, 2021.
- Zhai, S.**, Fine Particulate Matter ($PM_{2.5}$) in East Asia: Trends, Control, and Geostationary Satellite Monitoring, School of Environmental Science & Engineering, Southern University of Science and Technology ([invited talk](#)), Oct. 14, 2021.
- Zhai, S.**, Air Quality in the Urban Environment – Research Methods and Recent Findings, Physics and Chemistry of Particulate Matter, Guest Lecture EH 515 Air Quality in the Urban Environment, Rollins School of Public Health, Emory University ([invited talk](#), remote), Feb. 9, 2021.
- Zhai, S.**, Sources and seasonality of $PM_{2.5}$ over North China and South Korea, 101st American Meteorological Society (AMS) meeting (oral, remote), Jan. 14, 2021.
- Zhai, S.**, Controlling particulate nitrate pollution in China, 2020 AGU Fall Meeting (oral, remote), Dec. 15, 2020.
- Zhai, S.**, Sources and seasonality of $PM_{2.5}$ over East Asia, the 11th International GEMS workshop (oral, remote), Nov. 25, 2020.
- Zhai, S.**, $PM_{2.5}$ and its composition changes in China: 2013-2018, Environmental Statistics seminar by Biostatistics Department at Harvard School of Public Health ([invited talk](#)), Feb. 21, 2020.
- Zhai, S.**, $PM_{2.5}$ trends in China, 2013-2017: contributions from different components, 2019 AGU Fall Meeting (poster), San Francisco, Dec. 9-13, 2019.
- Zhai, S.**, $PM_{2.5}$ trends in eastern China, 2013-2017: contributions from emission controls and meteorology, 2018 AGU Fall Meeting (poster), Washington, D.C, Dec. 2018.
- Zhai, S.**, Detecting critical $PM_{2.5}$ emission sources and their contributions to a heavy haze episode in Beijing, China by using an adjoint model, 22nd seminar of Chinese atmospheric environment science & technology, ([excellent oral presentation](#)), Shanghai, Oct. 22, 2016.
- Zhai, S.**, Adjoint sensitive analysis of a Nov. 2012 haze episode over Beijing, 8th technical seminar of fine and superfine particles, $PM_{2.5}$ source spectra symposium (oral), Huangshi City, Hubei Province, Nov. 23, 2015.
- Zhai, S.**, Effects of emission-sources reduction at different time points on $PM_{2.5}$ concentration over Beijing Municipality, 30th Chinese Meteorological Society Annual Conference (oral), Nanjing City, Jiangsu Province, Oct. 25, 2013.

Professional Activities

Air quality subgroup leader at the Harvard Atmospheric Chemistry Modeling Group.

Journal reviewer for *Atmospheric Environment*, *Frontiers in Environmental Science*, and *Science Bulletin*.
Judge of Outstanding Student Presentation Awards (OSPA) for the AGU FALL Meeting 2022.

Hosted project

Assessment of human health and economic loss from primary and secondary PM_{2.5} sources: applications of an adjoint model, Jiangsu Province Graduate Research and Practice Innovation Program, 2016-2017.

Selected Honors

Ph.D.: New-student First Prize Award (2015); Excellent Doctoral Dissertation (2020).

Master: First Class Scholarship (2013); Outstanding Student Leader (2013); Merit Student, UCAS (2013); Outstanding Student Leader, UCAS (2013).

Bachelor: Outstanding Graduate (2012); First Class Scholarship (2008~2009、2010~2011); Outstanding Student Leader (2008~2009、2009~2010); Merit Student (2008~2009、2009~2010、2010~2011、2011~2012); Mary English Scholarship (2008~2009, one of the two winners in the department); First Prize in English Speaking Contest (2009); Excellent Volunteer at Campus Sports Culture Festival (2009) & NUIST 50th Anniversary (2010).