

# Sen Zhao, Ph.D.

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## Research Interests

- 📌 Climate Variability, Dynamics and Predictability
- 📌 Wave Dynamics in Atmosphere and Ocean, Atmospheric Teleconnections
- 📌 El Niño–Southern Oscillation (ENSO), Indian Ocean Dipole (IOD), Pacific Decadal Oscillation (PDO)
- 📌 Paleoclimate, Global Warming and Climate Change

## Employment (post Ph.D.)

2016.10 – present 📌 **Postdoctoral Fellow.** Department of Atmospheric Sciences, SOEST, University of Hawaii at Mānoa

## Education

- 2011.09 – 2016.07 📌 **Ph.D., Meteorology, Institute of Atmospheric Physics, Chinese Academy of Sciences, China.**  
Thesis: *Theory of Cross-Equatorial Propagation of Planetary Wave in Horizontally Non-Uniform Basic Flow and Its Applications in Atmospheric Teleconnections*
- 2007.09 – 2011.07 📌 **B.S., College of Atmospheric Sciences, and LONGJI Class in School of Mathematics and Statistics, Lanzhou University, China.**  
Thesis: *Evaluation of WRF microphysics and cumulus schemes in simulating Hurricane Katrina*

## Publications

### Journal Articles (Lead Author)

- 1 Zhao, S., F.-F. Jin, and M. F. Stuecker (2019): Improved Predictability of the Indian Ocean Dipole Using Seasonally Modulated ENSO Forcing Forecasts. *Geophysical Research Letters*, 46(16), 9980–9990. doi: 10.1029/2019GL084196.
- 2 Zhao, S., J. Li, Y. Li, F.-F. Jin, and J. Zheng (2019): Interhemispheric Influence of Indo-Pacific Convection Oscillation on Southern Hemisphere Rainfall through Southward Propagation of Rossby Waves. *Climate Dynamics*, 52(5), 3203–3221. doi: 10.1007/s00382-018-4324-y.
- 3 Shi, F., S. Zhao, Z. Guo, H. Goosse, and Q. Yin (2017): Multi-proxy reconstructions of May–September precipitation field in China over the past 500 years. *Climate of the Past*, 13(12), 1919–1938. doi: 10.5194/cp-13-1919-2017.
- 4 Li, J., S. Zhao, Y. Li, L. Wang, and C. Sun (2016): On the role of perturbation potential energy in variability of the East Asian summer monsoon: Current status and prospects (in Chinese). *Advances in Earth Science*, 31(2), 115–125. doi: 10.11867/j.issn.1001-8166.2016.02.0115.
- 5 Zhao, S., J. Li, and C. Sun (2016): Decadal Variability in the Occurrence of Wintertime Haze in Central Eastern China Tied to the Pacific Decadal Oscillation. *Scientific Reports*, 6, 27424. doi: 10.1038/srep27424.
- 6 Zhao, S., J. Li, and Y. Li (2015): Dynamics of an Interhemispheric Teleconnection across the Critical Latitude through a Southerly Duct during Boreal Winter. *Journal of Climate*, 28(19), 7437–7456. doi: 10.1175/JCLI-D-14-00425.1.

### Journal Articles (Co-Author)

- 1 Feng, J., J. Li, F.-F. Jin, Z. Liu, and S. Zhao (2019): Effect of El Niño on the Response Ratio of Hadley Circulation to Different SST Meridional Structures. *Climate Dynamics*, online. doi: 10.1007/s00382-019-04756-7.
- 2 Wang, Q., J. Li, Y. Li, J. Xue, S. Zhao, Y. Xu, Y. Wang, Y. Zhang, D. Dong, and J. Zhang (2019): Modulation of tropical cyclone tracks over the western North Pacific by intra-seasonal Indo-western Pacific convection oscillation during the boreal extended summer. *Climate Dynamics*, 52(1-2), 913–927. doi: 10.1007/s00382-018-4264-6.
- 3 Feng, J., J. Li, F. Jin, S. Zhao, and J. Zhu (2018): Relationship between the Hadley circulation and different tropical meridional SST structures during boreal summer. *Journal of Climate*, 31(16), 6575–6590. doi: 10.1175/JCLI-D-18-0095.1.

- 4 Li, Y., J. Feng, J. Li, and S. Zhao (2018): The Circle Diagram in the Group Velocity Domain for Rossby Wave under the Horizontally Non-Uniform Flow. *SOLA*, 14, 121–125. doi: 10.2151/sola.2018-021.
- 5 Li, Y., J. Li, F. Kucharski, J. Feng, S. Zhao, and J. Zheng (2018): Two Leading Modes of the Interannual Variability in South American Surface Air Temperature during Austral Winter. *Climate Dynamics*, 51(5-6), 2141–2156. doi: 10.1007/s00382-017-4004-3.
- 6 Liu, T., J. Li, Y. Li, S. Zhao, F. Zheng, J. Zheng, and Z. Yao (2018): Influence of the May Southern Annular Mode on the South China Sea Summer Monsoon. *Climate Dynamics*, 51(11-12), 4095–4107. doi: 10.1007/s00382-017-3753-3.
- 7 Stuecker, M. F., C. M. Bitz, K. C. Armour, C. Proistosescu, S. M. Kang, S.-P. Xie, D. Kim, S. McGregor, W. Zhang, S. Zhao, W. Cai, Y. Dong, and F.-F. Jin (2018): Polar Amplification Dominated by Local Forcing and Feedbacks. *Nature Climate Change*, 8(12), 1076–1081. doi: 10.1038/s41558-018-0339-y.
- 8 Xue, J., J. Li, C. Sun, S. Zhao, J. Mao, D. Dong, Y. Li, and J. Feng (2018): Decadal-Scale Teleconnection between South Atlantic SST and Southeast Australia Surface Air Temperature in Austral Summer. *Climate Dynamics*, 50(7-8), 2687–2703. doi: 10.1007/s00382-017-3764-0.
- 9 Zhou, X., J. Li, F. Xie, R. Ding, Y. Li, S. Zhao, J. Zhang, and Y. Li (2018): The Effects of the Indo-Pacific Warm Pool on the Stratosphere. *Climate Dynamics*, 51(11-12), 4043–4064. doi: 10.1007/s00382-017-3584-2.
- 10 Feng, J., J. Li, F. Jin, S. Zhao, and F. Xie (2017): The responses of the Hadley circulation to different meridional SST structures in the seasonal cycle. *Journal of Geophysical Research: Atmospheres*, 122(15), 7785–7799. doi: 10.1002/2017JD026953.
- 11 Huyan, L., J. Li, S. Zhao, C. Sun, D. Dong, T. Liu, and Y. Zhao (2017): The Impact of Layer Perturbation Potential Energy on the East Asian Summer Monsoon. *Journal of Climate*, 30(17), 7087–7103. doi: 10.1175/JCLI-D-16-0729.1.
- 12 Qin, J., R. Ding, Z. Wu, J. Li, and S. Zhao (2017): Relationships between the extratropical ENSO precursor and leading modes of atmospheric variability in the Southern Hemisphere. *Advances in Atmospheric Sciences*, 34(3), 360–370. doi: 10.1007/s00376-016-6016-z.
- 13 Stuecker, M. F., A. Timmermann, F.-F. Jin, Y. Chikamoto, W. Zhang, A. T. Wittenberg, E. Widiasih, and S. Zhao (2017): Revisiting ENSO/Indian Ocean Dipole Phase Relationships. *Geophysical Research Letters*, 44(5), 2481–2492. doi: 10.1002/2016GL072308.
- 14 Tian, W., Y. Li, F. Xie, J. Zhang, M. P. Chipperfield, W. Feng, Y. Hu, S. Zhao, X. Zhou, Y. Yang, and X. Ma (2017): The relationship between lower-stratospheric ozone at southern high latitudes and sea surface temperature in the East Asian marginal seas in austral spring. *Atmospheric Chemistry and Physics*, 17(11), 6705–6722. doi: 10.5194/acp-17-6705-2017.
- 15 Xie, F., J. Li, J. Zhang, W. Tian, Y. Hu, S. Zhao, C. Sun, R. Ding, J. Feng, and Y. Yang (2017): Variations in North Pacific Sea Surface Temperature Caused by Arctic Stratospheric Ozone Anomalies. *Environmental Research Letters*, 12(11), 114023. doi: 10.1088/1748-9326/aa9005.
- 16 Ding, R., J. Li, Y.-h. Tseng, K.-J. Ha, S. Zhao, and J.-Y. Lee (2016): Interdecadal change in the lagged relationship between the Pacific–South American pattern and ENSO. *Climate Dynamics*, 47(9-10), 2867–2884. doi: 10.1007/s00382-016-3002-1.
- 17 Kazmi, D. H., J. Li, C. Ruan, S. Zhao, and Y. Li (2016): A Statistical Downscaling Model for Summer Rainfall over Pakistan. *Climate Dynamics*, 47(7–8), 2653–2666. doi: 10.1007/s00382-016-2990-1.
- 18 Lou, P., J. Li, J. Feng, S. Zhao, and Y. Li (2016a): Does a monsoon circulation exist in the upper troposphere over the central and eastern tropical Pacific? *Atmospheric and Oceanic Science Letters*, 9(6), 458–464. doi: 10.1080/16742834.2016.1234330.
- 19 Lou, P., J. Li, J. Feng, S. Zhao, and Y. Li (2016b): Wind rotation characteristics of the upper tropospheric monsoon over the central and eastern tropical Pacific. *Atmospheric and Oceanic Science Letters*, 9(6), 479–486. doi: 10.1080/16742834.2016.1235464.
- 20 Yang, F., N. Wang, F. Shi, F. C. Ljungqvist, S. Zhao, and T. Liu (2016): The spatial distribution of precipitation over the West Qinling region, China, AD 1470–2000. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 443, 278–285. doi: 10.1016/j.palaeo.2015.12.003.

- 21 Zheng, F., J. Li, Y. Li, S. Zhao, and D. Deng (2016): Influence of the Summer NAO on the Spring-NAO-Based Predictability of the East Asian Summer Monsoon. *Journal of Applied Meteorology and Climatology*, 55(7), 1459–1476. doi: 10.1175/JAMC-D-15-0199.1.
- 22 Zheng, J., Q. Wu, Y. Guo, and S. Zhao (2016): The Impact of Summertime North Indian Ocean SST on Tropical Cyclone Genesis over the Western North Pacific. *SOLA*, 12, 242–246. doi: 10.2151/sola.2016-048.
- 23 Li, Y., J. Li, F. F. Jin, and S. Zhao (2015): Interhemispheric Propagation of Stationary Rossby Waves in a Horizontally Nonuniform Background Flow. *Journal of the Atmospheric Sciences*, 72(8), 3233–3256. doi: 10.1175/JAS-D-14-0239.1.
- 24 Shi, F., Q. Ge, B. Yang, J. Li, F. Yang, F. C. Ljungqvist, O. Solomina, T. Nakatsuka, N. Wang, S. Zhao, C. Xu, K. Fang, M. Sano, G. Chu, Z. Fan, N. P. Gaire, and M. U. Zafar (2015): A Multi-Proxy Reconstruction of Spatial and Temporal Variations in Asian Summer Temperatures over the Last Millennium. *Climatic Change*, 131(4), 663–676. doi: 10.1007/s10584-015-1413-3.
- 25 Sun, C., J. Li, and S. Zhao (2015): Remote Influence of Atlantic Multidecadal Variability on Siberian Warm Season Precipitation. *Scientific Reports*, 5, 16853. doi: 10.1038/srep16853.
- 26 Zhu, G., W. Lin, S. Zhao, and Y. Cao (2015): Spatial and temporal variation characteristics of ocean waves in the South China Sea during the boreal winter. *Acta Oceanologica Sinica*, 34(1), 23–28. doi: 10.1007/s13131-015-0592-0.
- 27 Shi, F., B. Yang, S. Zhao, and F. Yang (2014): Spatial pattern reconstruction of typical centennial warm periods of global temperature over the past millennium (in Chinese). *Quaternary Sciences*, 34(6), 1125–1135. doi: 10.3969/j.issn.1001-7410.2014.06.01.

### Books and Chapters (peer-reviewed)

- 1 Jin, F.-F., H.-C. Chen, S. Zhao, M. Hayashi, C. Karamperidou, M. F. Stuecker, and R. Xie (2019): Simple ENSO Models. In: *ENSO in a Changing Climate*. Ed. by A. Santos, W. Cai, and M. J. McPhaden.

### Articles in Preparation or Submitted

- 1 Zhao, S. and F.-F. Jin (2019): *A Robust Assessment of the Bjerknes-Wyrtki-Jin Indices for ENSO Linear Stability and Periodicity*. in prepagation.
- 2 Zhao, S., F.-F. Jin, and H.-C. Chen (2019): *ENSO Periodicity and Predictibility*. in prepagation.
- 3 Zhao, S., J. Li, F.-F. Jin, J. Feng, and Y. Li (2019): *Rossby Wave Ray and Phase Tracing on a Horizontally Non-Uniform Flow with Application to the Pacific-Japan Teleconnection*. in prepagation.
- 4 Zhao, S., M. F. Stuecker, F.-F. Jin, J. Feng, H. Ren, W. Zhang, and J. Li (2019): *Improved Predictability of the Indian Ocean Dipole using a Stochastic-Dynamical Model compared to the North American Multi-model Ensemble Forecast*. submitted.

### Presentations

- Improved Predictability of the Indian Ocean Dipole Using Seasonally Modulated ENSO Forcing, *AOGS 15th Annual Meeting*, Honolulu, USA, June 03–08, 2018 (oral)
- Decadal Variability in the Occurrence of Wintertime Haze in Central Eastern China Tied to the Pacific Decadal Oscillation, *AOGS 15th Annual Meeting*, Honolulu, USA, June 03–08, 2018 (oral)
- Interhemispheric influence of the Indo-Pacific convection oscillation on Southern Hemisphere rainfall, *AOGS 13th Annual Meeting*, Beijing, China, July 31–August 5, 2016 (poster)
- Interhemispheric influence of the Indo-Pacific convection oscillation on Southern Hemisphere rainfall, *The 13th General Circulation Model Simulations of the East Asian Climate (EAC) workshop*, Beijing, China, March 24–25, 2016 (poster)
- Dynamics of an interhemispheric teleconnection across the critical latitude through a southerly duct during boreal winter, *LASG Annual Meeting*, Beijing, China, December 24–25, 2014 (poster)
- The Hemispheric Propagation of Stationary waves in Atmosphere, *EGU General Assembly 2013*, Vienna, Austria, April 7–12, 2013 (poster)
- The Hemispheric Propagation of Stationary waves in Atmosphere, *ICDM Workshop 2012*, Kunming, China, August 6–9, 2012 (poster)

## Teaching

- Co-Instructor ■ “Dynamics of El Niño–Southern Oscillation Phenomenon” (ATMO 752), UH Mānoa spring semester 2019, USA, Instructor: Fei-Fei Jin
- Guest Lecturer ■ “Applied Atmospheric Dynamics” (ATMO 402), UH Mānoa spring semester 2019, USA, Instructor: Fei-Fei Jin

## Skills

- Languages ■ Strong reading, writing and speaking competencies for English and Mandarin Chinese
- Coding ■ Fortran, Python, CDO, NCO, Ferret, NCL, Matlab, Gnuplot, GrADS, R, Linux Shells, L<sup>A</sup>T<sub>E</sub>X
- Numerical Models ■ Coupled General Circulation Models (CESM1, CM2.1, and CM3), WRF
- Simple Models ■ Linear Baroclinic Models (LBM), Zebiak-Cane ENSO Model, Shallow Water Model for Global Ocean, Linear Primitive Models, Barotropic Model, Recharge Oscillator Model, Gill-Matsuno Model
- Self-Developed Tools ■ Rossby wave ray and phase tracing, IOD prediction model
- Misc. ■ Academic research, teaching, training, consultation, and publishing.

## Honors, Awards, and Scholarships

- 2013 ■ Postgraduate National Scholarship, Institute of Atmospheric Physics, Chinese Academy of Sciences.
- 2012–2014 ■ Outstanding Student Leader, University of the Chinese Academy of Sciences.
- 2012–2015 ■ Merit Student, University of the Chinese Academy of Sciences.
- 2011 ■ Outstanding Graduate, Lanzhou University, China.

## Miscellaneous Experiences

### Journal Referee

- Journal of Climate, Climate Dynamics, Scientific Reports, Theoretical and Applied Climatology

### Scientific Societies

- American Geophysical Union (AGU), Asia Oceania Geosciences Society (AOGS), European Geosciences Union (EGU)

### Other Academic Training

- Participant: Joint US-Japan Workshop on Climate Change and Variability, Honolulu, USA, 03/2019
- Participant: International Symposium on Tropical Ocean and Climate, Qingdao, China, 06/2015
- Participant: The International Commission on Climate (ICCL) Expert Assessment Workshop on “Decadal Climate Variability and Cross-Scale Interactions”, Beijing, China, 04/2013

## Referees

### Prof. Fei-Fei Jin

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