# 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

## Professional Experience (post Ph.D.)

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

## Education

2011 – 2016 **Ph.D. Meteorology, Institute of Atmospheric Physics, Chinese Academy of Sciences**
Dissertation: *Theory of Cross-Equatorial Propagation of Planetary Wave in Horizontally Non-Uniform Basic Flow and Its Applications in Atmospheric Teleconnections* (Dissertation adviser: Jianping Li)

2007 – 2011 **B.S., College of Atmospheric Sciences, and Longji Class in School of Mathematics and Statistics, Lanzhou University**, Thesis: *Evaluation of WRF microphysics and cumulus schemes in simulating Hurricane Katrina* (Thesis adviser: Shuwen Zhang)

## Publications

***Articles in Preparation or Submitted***

3 **Zhao, S.** and F.-F. Jin (2020a): *A Robust Assessment of the Bjerknes-Wyrtki-Jin Indices for ENSO Linear Stability and Periodicity.* in prepagation.

2 **Zhao, S.** and F.-F. Jin (2020b): *ENSO Periodicity and Predictibility.* in prepagation.

1 **Zhao, S.**, J. Li, F.-F. Jin, J. Feng, and Y. Li (2020): *Rossby Wave Ray and Phase Tracing on a Horizontally Non-Uniform Flow with Application to the Pacific-Japan Teleconnection.* in prepagation.

**Total 37 peer-reviewed papers and 1 book chapter, of which 6 are either as first author or with adviser as first author.**
***Google Scholar total citations are 487, h-index is 13; Publons SCI citations are 374, h-index is 11 (as of May 6, 2020)***

***Journal Articles As Lead Author***

6 **Zhao, S.**, M. F. Stuecker, F.-F. Jin, J. Feng, H. Ren, W. Zhang, and J. Li (2020): Improved Predictability of the Indian Ocean Dipole using a Stochastic-Dynamical Model compared to the North American Multi-model Ensemble Forecast. ***Wea. Forecasting***, *35*(2), 379–399. doi: 10.1175/WAF-D-19-0184.1.

5 **Zhao, S.**, F.-F. Jin, and M. F. Stuecker (2019): Improved Predictability of the Indian Ocean Dipole Using Seasonally Modulated ENSO Forcing Forecasts. ***Geophys. Res. Lett.***, *46*(16), 9980–9990. doi: 10.1029/2019GL084196.

4 **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. ***Clim. Dyn.***, *52*(5), 3203–3221. doi: 10.1007/s00382-018-4324-y.

3 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.

2 **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. ***Sci. Rep.***, *6*, 27424. doi: 10.1038/srep27424.

1 **Zhao, S.**, J. Li, and Y. Li (2015): Dynamics of an Interhemispheric Teleconnection across the Critical Latitude through a Southerly Duct during Boreal Winter. ***J. Climate***, *28*(19), 7437–7456. doi: 10.1175/JCLI-D-14-00425.1.

***Journal Articles As Co-Author***

31 Tseng, Y., R. Ding, **S. Zhao**, Y. Kuo, and Y. Liang (2020): Could the North Pacific Oscillation Be Modified by the Initiation of East Asian Winter Monsoon? ***J. Climate***, *33,* 2389–2406. doi: 10.1175/JCLI-D-19-0112.1.

30 Xue, A., F.-F. Jin, W. Zhang, J. Boucharel, **S. Zhao**, and X. Yuan (2020): Delineating the Seasonally Modulated Nonlinear Feedback Onto ENSO From Tropical Instability Waves. ***Geophys. Res. Lett.***, *47*(7), e2019GL085863. doi: 10.1029/2019GL085863.

29 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. ***Clim. Dyn.***, *53,* 3877–3891. doi: 10.1007/s00382-019-04756-7.

28 Shi, F., H. Goosse, F. Klein, **S. Zhao**, T. Liu, and Z. Guo (2019): Monopole mode of precipitation in East Asia modulated by the South China Sea over the last four centuries. ***Geophys. Res. Lett.***, *46*(24), 14713–14722. doi: 10.1029/2019GL085320.

27 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. ***Clim. Dyn.***, *52*(1-2), 913–927. doi: 10.1007/s00382-018-4264-6.

26 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. ***J. Climate***, *31*(16), 6575–6590. doi: 10.1175/JCLI-D-18-0095.1.

25 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.

24 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. ***Clim. Dyn.***, *51*(5-6), 2141–2156. doi: 10.1007/s00382-017-4004-3.

23 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. ***Clim. Dyn.***, *51*(11-12), 4095–4107. doi: 10.1007/s00382-017-3753-3.

22 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.

21 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. ***Clim. Dyn.***, *50*(7-8), 2687–2703. doi: 10.1007/s00382-017-3764-0.

20 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. ***Clim. Dyn.***, *51*(11-12), 4043–4064. doi: 10.1007/s00382-017-3584-2.

19 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. ***J. Geophys. Res.: Atmos.***, *122*(15), 7785–7799. doi: 10.1002/2017JD026953.

18 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. ***J. Climate***, *30*(17), 7087–7103. doi: 10.1175/JCLI-D-16-0729.1.

17 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. ***Adv. Atmos. Sci.***, *34*(3), 360–370. doi: 10.1007/s00376-016-6016-z.

16 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. ***Clim. Past***, *13*(12), 1919–1938. doi: 10.5194/cp-13-1919-2017.

15 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. ***Geophys. Res. Lett.***, *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. ***Atmos. Chem. Phys.***, *17*(11), 6705–6722. doi: 10.5194/acp-17-6705-2017.

13 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. ***Environ. Res. Lett.***, *12*(11), 114023. doi: 10.1088/1748-9326/aa9005.

12 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. ***Clim. Dyn.***, *47*(9-10), 2867–2884. doi: 10.1007/s00382-016-3002-1.

11 Kazmi, D. H., J. Li, C. Ruan, **S. Zhao**, and Y. Li (2016): A Statistical Downscaling Model for Summer Rainfall over Pakistan. ***Clim. Dyn.***, *47*(7–8), 2653–2666. doi: 10.1007/s00382-016-2990-1.

10 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? ***Atmos. Oceanic Sci. Lett.***, *9*(6), 458–464. doi: 10.1080/16742834.2016.1234330.

9 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. ***Atmos. Oceanic Sci. Lett.***, *9*(6), 479–486. doi: 10.1080/16742834.2016.1235464.

8 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. ***Palaeogeogr. Palaeoclimatol. Palaeoecol.***, *443,* 278–285. doi: 10.1016/j.palaeo.2015.12.003.

7 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. ***J. Appl. Meteor. Climatol.***, *55*(7), 1459–1476. doi: 10.1175/JAMC-D-15-0199.1.

6 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.

5 Li, Y., J. Li, F. F. Jin, and **S. Zhao** (2015): Interhemispheric Propagation of Stationary Rossby Waves in a Horizontally Nonuniform Background Flow. ***J. Atmos. Sci.***, *72*(8), 3233–3256. doi: 10.1175/JAS-D-14-0239.1.

4 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.

3 Sun, C., J. Li, and **S. Zhao** (2015): Remote Influence of Atlantic Multidecadal Variability on Siberian Warm Season Precipitation. ***Sci. Rep.***, *5,* 16853. doi: 10.1038/srep16853.

2 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 Oceanol. Sin.***, *34*(1), 23–28. doi: 10.1007/s13131-015-0592-0.

1 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.

***Book and Chapters (peer-reviewed)***

1 Jin, F.-F., H.-C. Chen, **S. Zhao**, M. Hayashi, C. Karamperidou, M. F. Stuecker, R. Xie, and L. Geng (2020): Simple ENSO Models. In: *El Niño Southern Oscillation in a Changing Climate.* Ed. by A. Santoso, W. Cai, and M. J. McPhaden.

## Presentations

***Oral***

- Improved Predictability of the Indian Ocean Dipole Using Seasonally Modulated ENSO Forcing, *AOGS 15th Annual Meeting*, Honolulu, USA, June 03–08, 2018
- 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

***Poster***

- A robust assessment of the Bjerknes-Wyrtki-Jin indices for ENSO growth rate and periodicity, *AGU Fall Meeting 2019*, San Francisco, USA, December 9–13, 2019
- Interhemispheric influence of the Indo-Pacific convection oscillation on Southern Hemisphere rainfall, *AOGS 13th Annual Meeting*, Beijing, China, July 31–August 5, 2016

## Presentations (continued)

- 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
- 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
- The Hemispheric Propagation of Stationary waves in Atmosphere, *EGU General Assembly 2013*, Vienna, Austria, April 7–12, 2013
- The Hemispheric Propagation of Stationary waves in Atmosphere, *ICDM Workshop 2012*, Kunming, China, August 6–9, 2012

## Teaching

Guest Lecturer
- "Applied Atmospheric Dynamics" (ATMO 402), Instructor: Fei-Fei Jin, UH Mānoa spring semester 2020

Co-Instructor
- "Dynamics of El Niño–Southern Oscillation Phenomenon" (ATMO 752), Instructor: Fei-Fei Jin, UH Mānoa spring semester 2019

Guest Lecturer
- "Applied Atmospheric Dynamics" (ATMO 402), Instructor: Fei-Fei Jin, UH Mānoa spring semester 2019

## 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.

## Skills

Languages — Strong reading, writing and speaking competencies for English and Mandarin Chinese

Coding — Fortan, Python, CDO, NCO, Ferret, NCL, Matlab, Gnuplot, GrADS, R, Linux Shells, LaTeX

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

Misc. — Academic research, teaching, training, consultation, and publishing.

## Self-Development Toolkit

**Rossby Wave Ray and Phase Tracing** — A software package for investigating the Rossby wave propagation and its phase evolution in a **horizontally non-uniform basic flow** (includes both U and V)

**Simple IOD Prediction System** — A simple stochastic-dynamical prediction model (SDM) for IOD with dynamical evolution of SST determined by seasonal modulated Indian Ocean feedbacks and seasonal modulated ENSO forcing as well as stochastic forcing. **The SDM exhibits generally higher skill and longer lead times for predicting IOD events than current operational forecast systems**

**iTAO Climate Model** — A intermediate Tropical Atmosphere and Ocean coupled model (iTAO) with a Gill-type atmospheric model and a linear continuously stratified dynamical ocean model embedded with a mixed layer SST anomaly model. **This is a improved version of Zebiak-Cane type model in global ocean with consideration of vertical structure of ocean**

## Miscellaneous Experience

***Professional Service***

- Review for Journals: *Journal of Climate, Climate Dynamics, Scientific Reports, Atmosphere, Theoretical and Applied Climatology*

***Scientific Societies***

- American Geophysical Union (AGU)

## Miscellaneous Experience (continued)

- European Geosciences Union (EGU)
- Asia Oceania Geosciences Society (AOGS)

***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

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