

Curriculum Vitae

Zhaohua Wu

Earth, Ocean, and Atmospheric Science
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EDUCATION

- 1998 Ph.D., University of Washington, Seattle, WA. Major: Atmospheric Sciences. Supervisor: Edward S. Sarachik and David S. Battisti.
- 1991 1988-1991, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China. Major: Graduate Study. Supervisor: Congbin Fu.
- 1988 B.S., Department of Atmospheric Sciences, Nanjing University, Nanjing, China. Major: Atmospheric Sciences.

WORK EXPERIENCE

- 2009–present Assistant, Associate, and Full Professor, Earth, Ocean, and Atmospheric Science, Florida State University.
- 2002–2008 Research Scientist, Center for Ocean-Land-Atmosphere Studies, Calverton, MD.
- 2001–2005 Lecturer, Department of Computer Sciences, Southeastern University, Washington, DC.
- 2000–2001 Postdoctoral Research Scientist, Center for Ocean-Land-Atmosphere Studies, Calverton, MD. Advisors: Edwin K. Schneider and Benjamin P. Kirtman.
- 1999 Research Associate, Joint Institute for the Study of the Atmosphere and Ocean. Advisor: Edward S. Sarachik.
- 1991–1998 Graduate Research Assistant, Department of Atmospheric Sciences, University of Washington, Seattle, WA.
- 1988–1991 Graduate Research Assistant, Institute of Atmospheric Physics, Chinese Academy of Sciences, P. R. China.

HONORS, AWARDS, PRIZES

Hilbert-Huang Transform Outstanding Contribution Award, Third International Conference on Hilbert-Huang Transform: Theory and Applications (2011).

NASA Technology Awards (category: NASA Patent Application Award), Center for Ocean-Land-Atmosphere Studies (2007).

NASA Technology Awards (category: NASA Patent Application Award), Center for Ocean-Land-Atmosphere Studies (2006).

MAJOR ACADEMIC COMMUNITY SERVICES

2015–present Executive Editor, *Climate Dynamics*

2007–present Founding Editor, *Advances in Adaptive Data Analysis*

2012–2018 Editor, *Journal of the Atmospheric Sciences*

2011–2012 Associate editor, *Journal of the Atmospheric Sciences*

TEACHING

Course Taught

Advanced Data Analysis (MET6155)

Meteorological Computations (Fortran-based) (MET3220C)

Meteorological Computation (Python-based) (MET 3220)

Dynamics of Large-Scale Climate Variability and Change (MET 6308)

Advanced Tropical Atmospheric Dynamics (MET6155)

Advanced Dynamic Meteorology I (MET5311)

Atmospheric Dynamics I (MET4301)

Physical Analysis of Data (MET 6155-2)

Doctoral Seminar (MET6930)

Directed Individual Study (MET5905)

Directed Individual Study (MET6906)

Advanced Tropical Atmospheric Dynamics [Nanjing University, Nanjing, China]

Advanced Tropical Atmospheric Dynamics [The First Institute of Oceanography, Qingdao, China]

Physical Analysis of Data [The First Institute of Oceanography, State Oceanic

Administration of China, Qingdao, China]

Short Course: The Hilbert-Huang Transform [The First Institute of Oceanography, State Oceanic Administration of China, Qingdao, China]

Short Course: Physical Time-Frequency Analysis [Nanjing University, Nanjing, China]

Short Course: The Hilbert-Huang Transform [Sun Yat-Sen (Zhongshan) University, Guangzhou China]

Short Course: Physical Time-Frequency Analysis [Center for Ocean-Land-Atmosphere Studies, Calverton, MD]

Wu, Z., Cavaleri, L., Yang, S., Yang, K., Bracco, A., & Stammer, D. (2015). *UNESCO/IOC-ODC TRAINING COURSE ON CLIMATE CHANGE / WESTPAC TRAINING COURSE ON CLIMATE CHANGE*. UNESCO/IOC Regional Training and Research Center on Ocean Dynamics and Climate (UNESCO/IOC-ODC). http://www.fio.org.cn/english/training_center/news/2015.09.07-18.htm.

Wu, Z., Li, T., Murtugudde, R., Qiao, F., & Guan, C. (2013). *UNESCO/IOC-ODC TRAINING COURSE ON AIR-SEA INTERACTION AND MODELING*. UNESCO/IOC Regional Training and Research Center on Ocean Dynamics and Climate (UNESCO/IOC-ODC). http://www.fio.org.cn/english/training_center/training_courses/training.htm.

Problem Solving Using Higher Level Languages [Southeastern University, Washington, DC] (COSC 502)

Calculus II [Southeastern University, Washington, DC] (MATH 302)

Students Supervised

Doctoral Committee Chair: Liu, Q. (2021), Liu, Y. (2019), Sun, J., (2017), Ji, F. (2015), Feng, J., (2015), Qian, C. (2009), Yang, F.

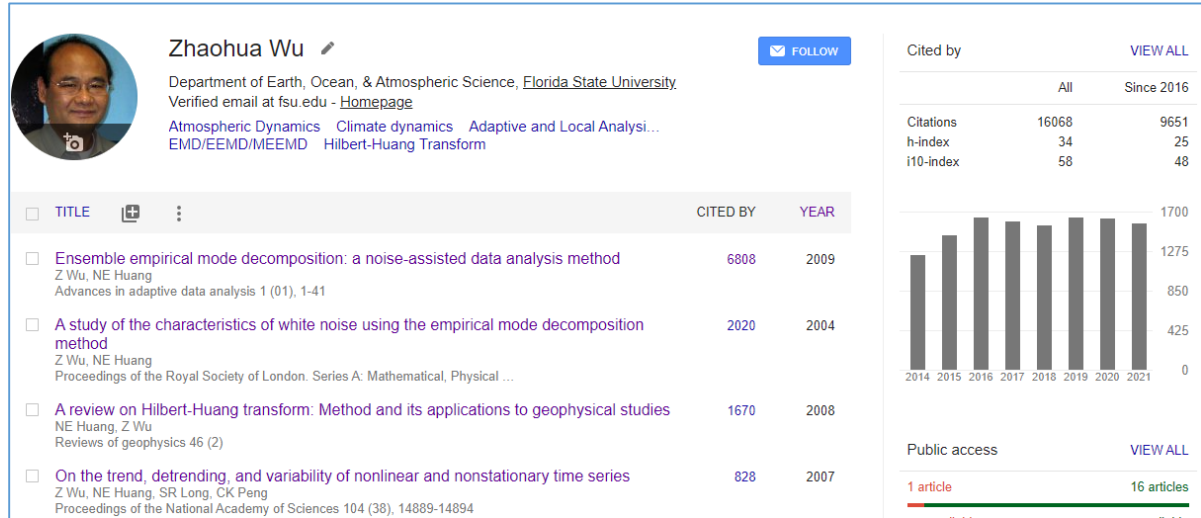
Doctoral Committee Member: Shi, S., Xue, S., Secor, M., Jiao, B., May, J. C., Ataie, I. (2020), West, R. R. (2020), Hong, Y. (2017), Honeyager, R. E. (2017), Selman, C. M. (2015), Sejas, S. A. (2014), Michael, J. P. (2014).

Master's Committee Chair: Buczek, C. (2020), Secor, M. (2020), Yang, F. (2020), Mau, A. (2020), Sun, J. (2014), Feng, J. (2012), Strazzo, S. E. (2011).

Master's Committee Member: WhitField, R. W. (2021), Shi, S. (2020), Xue, S. (2020), Roman-Stork, H. L. (2018), Belles, J. (2015), Chen, H. (2015), Lefran, D. (2015), Yin, M. (2015), Hussein, A. A. (2014), Navarro, M. (2014), Shi, Q. (2014), Tian, X. (2014), Liang, Z. (2013), Duncan, J. B. (2013), Honeyager, R. E. (2013), Sejas, S. A. (2011).

RESEARCH AND ORIGINAL CREATIVE WORK

Summary



Publications

Invited Journal Articles

1. Wu, Z., Feng, J., Qiao, F., & Tan, Z.-M. (2016). Fast Multi-dimensional Ensemble Empirical Mode Decomposition for the analysis of Big Spatiotemporal Data Sets. *Philosophical Transactions of the Royal Society of London*, **A374**, 20150197.
2. Huang, N., Hu, K., Yang, A., Chang, H.-S., Deng, J., Liang, W.-K., Yeh, J.-R., Kao, C.-H., Juan, C.-H., Peng, C.-K., Meijer, J., Wang, Y.-H., Long, S., & Wu, Z. (2016). On Holo-Hilbert spectral analysis: a full informational spectral representation for nonlinear and non-stationary data. *Philosophical Transactions of the Royal Society of London*, **A374**, 20150206.
3. Mandic, D., Rehman, N., Wu, Z., & Huang, N. (2013). Empirical Mode Decomposition-Based Time-Frequency Analysis of Multivariate Signals: The Power of Adaptive Data Analysis. *IEEE Signal Processing Magazine*, **30(6)**, 74-86.
4. Huang, N. E., & Wu, Z. (2008). A review on Hilbert-Huang transform: method and its applications to geophysical studies. *Reviews of Geophysics*, **46**, RG2006.

Refereed Journal Articles

5. Liu, Y., Tan, Z.-M., & Wu, Z., 2021. Enhanced feedback between shallow convection and low-level moisture convergence leads to improved simulation of MJO eastward propagation. *Journal of Climate*, (early online release, <https://doi.org/10.1175/JCLI-D-20-0894.1>)

6. Xue, L., Ding, A., Cooper, O., Huang, X., Wang, W., Zhou, D., Wu, Z., McClure-Begley, A., Petropavlovskikh, I., Andreae, M.O. and Fu, C., 2020. ENSO and Southeast Asian biomass burning modulate subtropical trans-Pacific ozone transport. *National Science Review*. doi: 10.1093/nsr/nwaa132 (online version published)
7. Zou, M., Xiong, X., Wu, Z., & Yu, C. (2020). Ozone trends during 1979-2019 over Tibetan Plateau derived from satellite observations. *Frontiers in Earth Science*, **8**, 432.
8. Liu, Q., Tan, Z.-M., Sun, J., Hou, Y., Fu, C., & Wu, Z. (2020). Changing rapid weather variability increases influenza epidemic risk in a warming climate. *Environmental Research Letters*, **15**, 044004.
9. Sun, J., & Wu, Z. (2020). Isolating spatiotemporally local mixed Rossby-gravity waves using multi-dimensional ensemble empirical mode decomposition. *Climate Dynamics*, **54**, 1383.
10. Deng, J., Wu, Z., Zhang, M., Huang, N. E., Wang, S., & Qiao, F. (2019). Data concerning statistical relation between obliquity and Dansgaard–Oeschger events. *Data in Brief*, **23**, 103727.
11. Zou, M., Xiong, X., Wu, Z., Li, S., Zhang, Y., & Chen, L. (2019). Increase of atmospheric methane observed from space-borne and ground-based measurements. *Remote Sensing*, **11**, 964.
12. Liu, Y., Tan, Z.-M., & Wu, Z. (2019). Non-instantaneous Wave-CISK for the Interaction between convective heating and low-level moisture convergence in the Tropics. *Journal of the Atmospheric Sciences*, **76**, 2083-2101.
13. Zhang, M., Wu, Z., & Qiao, F. (2018). Deep Atlantic Ocean warming facilitated by the deep western boundary current and equatorial Kelvin waves. *Journal of Climate*, **31**, 8541.
14. Hu, X., Cai, M., Yang, S., & Wu, Z. (2018). Delineation of thermodynamic and dynamic responses to sea surface temperature forcing associated with El Niño. *Climate Dynamics*, **51**, 4329.
15. Zhang, M., Zhang, Y., Shu, Q., Zhao, C., Wang, G., Wu, Z., & Qiao, F. (2018). Spatiotemporal evolution of the chlorophyll a trend in the North Atlantic Ocean. *Science of The Total Environment*, **612**, 1141.
16. Liu, M., Lin, J., Wang, Y., Sun, Y., Zheng, B., Shao, J., Chen, L., Zheng, Y., Chen, J., Fu, T.-M., Yan, Y., Zhang, Q., & Wu, Z. (2018). Spatiotemporal variability of NO₂ and PM_{2.5} over Eastern China: Observational and model analyses with a novel statistical method. *Atmospheric Chemistry and Physics*, **18**, 12933.
17. McGlynn, D. F., Mao, H., Wu, Z., Sive, B. C., & Sharac, T. (2018). Understanding long-term variations in surface ozone in United States (U.S.) national parks. *Atmosphere*, **9**, 125.
18. Deng, J., Wu, Z., Zhang, M., Huang, N. E., Wang, S., & Qiao, F. (2018). Using Holo-Hilbert spectral analysis to quantify the modulation of Dansgaard-Oeschger events by obliquity. *Quaternary Science Reviews*, **192**, 282.
19. Wdowinski, S., Bray, R., Kirtman, B. P., & Wu, Z. (2016). Increasing flooding hazard

- in coastal communities due to rising sea level: Case study of Miami Beach, Florida. *Ocean & Coastal Management*, **126**, 1.
20. Wu, Z., Huang, N. E., & Wallace, J. M. (2014). Adaptive and local analysis of climate data. *Engineering*, **1(1)**, 41-45.
 21. Ji, F., Wu, Z., Huang, J., & Chassignet, E. (2014). Evolution of land surface air temperature trend. *Nature Climate Change*, **4**, 462–466.
 22. Feng, J., Wu, Z., & Liu, G. (2014). Fast multidimensional ensemble empirical mode decomposition using a data compression technique. *Journal of Climate*, **27**, 3492.
 23. Misra, V., Li, H., Wu, Z., & DiNapoli, S. (2014). Global seasonal climate predictability in a two tiered forecast system: part I: boreal summer and fall seasons. *Climate Dynamics*, **42**, 1425.
 24. Wu, Z., Chassignet, E. P., Ji, F., & Huang, J. (2014). Reply to 'Spatiotemporal patterns of warming'. *Nature Climate Change*, **4(10)**, 846.
 25. Feng, J., Wu, Z., & Zou, X. (2014). Sea Surface Temperature Anomalies off Baja California: A Possible Precursor of ENSO. *Journal of the Atmospheric Sciences*, **71**, 1529.
 26. Chen, X., Wang, M., Zhang, Y., Feng, Y., Wu, Z., & Huang, N. E. (2013). Detecting Signal from Data with Red Noise: Theory and Applications. *Journal of the Atmospheric Sciences*, **70**, 1489.
 27. Chen, X., Zhang, Y., Zhang, M., Feng, Y., Wu, Z., Qiao, F., & Huang, N. E. (2013). Intercomparison between Observed and Simulated Variability in Global Heat Content using Empirical Mode Decomposition, Part I: Modulated Annual Cycle. *Climate Dynamics*, **41**, 2797.
 28. Huang, B., Hu, Z.-Z., Kinter, J. L., III, Wu, Z., & Kumar, A. (2012). Connection of stratospheric QBO with global atmospheric general circulation and tropical SST. Part I: Methodology and composite life cycle. *Climate Dynamics*, **38**, 1.
 29. Huang, B., Hu, Z.-Z., Kinter, J. L., III, Wu, Z., & Kumar, A. (2012). Connection of the stratospheric QBO with global atmospheric general circulation and tropical SST. Part II: Interdecadal variations. *Climate Dynamics*, **38**, 25.
 30. Huang, B., Hu, Z.-Z., Schneider, E. K., Wu, Z., Xue, Y., & Klinger, B. (2012). Influences of subtropical air-sea interaction on the multidecadal AMOC variability in the NCEP climate forecast system. *Climate Dynamics*, **39**, 531.
 31. Huang, B., Hu, Z.-Z., Schneider, E. K., Wu, Z., Xue, Y., & Klinger, B. (2012). Influences of tropical-extratropical interaction on the multidecadal AMOC variability in the NCEP climate forecast system. *Climate Dynamics*, **39(3)**, 531.
 32. Zhu, J., Huang, B., & Wu, Z. (2012). The role of ocean dynamics in the interaction between the Atlantic meridional and equatorial modes. *Journal of Climate*, **25**, 3583.
 33. Bao, S., Pietrafesa, L. J., Huang, N. E., Wu, Z., Dickey, D. A., Gayes, P. T., & Yan, T. (2011). An empirical study of tropical cyclone activity in the Atlantic and Pacific Oceans: 1851-2005. *Advances in Adaptive Data Analysis*, **3**, 291.

34. Qian, C., Fu, C., & Wu, Z. (2011). Changes in the amplitude of the temperature annual cycle in China and their implication for climate change research. *Journal of Climate*, **24**, 5292.
35. Hu, Z.-Z., Huang, B., Kinter III, J. L., Wu, Z., & Kumar, A. (2011). Connection of the stratospheric QBO with global atmospheric general circulation and tropical SST. Part II: interdecadal variations. *Climate Dynamics*, **38(1-2)**, 25.
36. Qian, C., Wu, Z., Fu, C., & Wang, D. (2011). On changing El Nino: A view from time-varying annual cycle, interannual variability and mean state. *Journal of Climate*, **24**, 6486.
37. Huang, N. E., Chen, X., Lo, M.-T., & Wu, Z. (2011). On Hilbert spectral representation: a true time-frequency representation for nonlinear and nonstationary data. *Advances in Adaptive Data Analysis*, **3**, 63.
38. Wu, Z., Huang, N. E., Wallace, J. M., Smoliak, B. V., & Chen, X. (2011). On the time-varying trend in global-mean surface temperature. *Climate Dynamics*, **37**, 759.
39. Fu, C., Qian, C., & Wu, Z. (2011). Projection of global mean surface air temperature changes in next 40 years: Uncertainties of climate models and an alternative approach. *Science China - Earth Sciences*, **54**, 1400.
40. Wu, Z., Huang, N. E., & Chen, X. (2011). Some considerations on physical analysis of data. *Advances in Adaptive Data Analysis*, **3**, 95.
41. Qian, C., Fu, C., Wu, Z., & Yan, Z. (2011). The role of changes in the annual cycle in earlier onset of climatic spring in northern China. *Advances in Atmospheric Sciences*, **28**, 284.
42. Qian, C., Yan, Z., Wu, Z., Fu, C., & Tu, K. (2011). Trends in temperature extremes in association with weather-intraseasonal fluctuations in eastern China. *Advances in Atmospheric Sciences*, **28**, 297.
43. Chang, Y.-M., Wu, Z., Chang, J., & Huang, N. E. (2010). Model validation based on ensemble empirical mode decomposition. *Advances in Adaptive Data Analysis*, **2**, 415.
44. Yan, T., Pietrafesa, L. J., Dickey, D. A., Bao, S., Huang, N. E., & Wu, Z. (2010). North Atlantic ocean basin tropical cyclone activity as related to climate factors for the 2010 hurricane season. *Advances in Adaptive Data Analysis*, **2**, 463.
45. Wang, G., Chen, X., Qiao, F., Wu, Z., & Huang, N. E. (2010). On intrinsic mode function. *Advances in Adaptive Data Analysis*, **2**, 277.
46. Qian, C., Wu, Z., Fu, C., & Zhou, T. (2010). On multi-timescale variability of temperature in China in modulated annual cycle reference frame. *Advances in Atmospheric Sciences*, **27**, 1169.
47. Wu, Z., & Huang, N. E. (2010). On the Filtering Properties of the Empirical Mode Decomposition. *Advances in Adaptive Data Analysis*, **2**, 397.
48. Chen, X., Wu, Z., & Huang, N. E. (2010). The time-dependent intrinsic correlation based on the empirical mode decomposition. *Advances in Adaptive Data Analysis*, **2**, 233.

49. Hou, T. Y., Yan, M. P., & Wu, Z. (2009). A variant of the EMD method for multi-scale data. *Advances in Adaptive Data Analysis*, **1**, 483.
50. Wu, Z., & Huang, N. E. (2009). Ensemble Empirical Mode Decomposition: a noise-assisted data analysis method. *Advances in Adaptive Data Analysis*, **1**, 1.
51. Huang, N. E., Wu, Z., Long, S. R., Arnold, K. C., Chen, X., & Blank, K. (2009). On instantaneous frequency. *Advances in Adaptive Data Analysis*, **1**, 177.
52. Qian, C., Fu, C., & Wu, Z. (2009). On the secular change of spring onset at Stockholm. *Geophysical Research Letters*, **36**, L12706.
53. Huang, N. E., Wu, Z., Pinzón, J. E., Parkinson, C. L., Long, A. R., Blank, K., Gloersen, P., & Chen, X. (2009). Reductions of noise and uncertainty in annual global surface temperature anomaly data. *Advances in Adaptive Data Analysis*, **1**, 447.
54. Wu, Z., Huang, N. E., & Chen, X. (2009). The multi-dimensional Ensemble Empirical Mode Decomposition method. *Advances in Adaptive Data Analysis*, **1**, 339.
55. Tsui, P. H., Chang, C. C., Ho, M. C., Lee, Y. H., Chen, Y. S., Chang, C. C., Huang, N. E., Wu, Z., & Zhang, K. J. (2009). Use of Nakagami statistics and empirical mode decomposition for ultrasound tissue characterization by a nonfocused transducer. *Ultrasound in medicine & biology*, **35**, 2055.
56. Hu, K., Peng, C. K., Huang, N. E., Wu, Z., Goldberger, A. L., Lipsitz, L. A., & Novak, V. (2008). Altered phase interactions between spontaneous blood pressure and flow fluctuations in type 2 diabetes mellitus: nonlinear assessment of cerebral autoregulation. *Physica A: Statistical Mechanics and its Applications*, **387**, 2279.
57. Yeh, J.-H., Lim, T.-Y., Shieh, J.-S., Huang, N. E., Wu, Z., & Peng, C.-K. (2008). Investigating complex patterns of blocked intestinal artery blood pressure signals by empirical mode decomposition and linguistic analysis. *Journal of Physics: Conference Series*, **96**, 012153.
58. Wu, Z., Schneider, E. K., Kirtman, B. P., Sarachik, E. S., Huang, N. E., & Tucker, C. J. (2008). The modulated annual cycle: an alternative reference frame for climate anomalies. *Climate Dynamics*, **31**, 823.
59. Costa, M., Priplata, A. A., Lipsitz, L. A., Goldberger, A. L., Huang, N. E., Wu, Z., & Peng, C. K. (2007). Noise and poise: enhancement of postural complexity in the elderly with a stochastic resonance-based therapy. *Europhysics letters*, **77**, EPL 68008.
60. Wu, Z., Huang, N. E., Long, S. R., & Peng, C. K. (2007). On the trend, detrending, and variability of nonlinear and nonstationary time series. *Proceedings of the National Academy of Sciences of the United States of America*, **104**, 14889.
61. Li, H., Wang, C., Xu, Y., & Wu, Z. (2007). Time-frequency analysis of the vertical dynamics of the track-vehicle system using EEMD. *Chinese Railway Science*, **28(5)**, 24.
62. Wu, Z., & Huang, N. E. (2004). A study of the characteristics of white noise using the Empirical Mode Decomposition method. *Proceeding of the Royal Society A: Mathematical, Physical, and Engineering Sciences*, **460**, 1597.

63. Wu, Z., Schneider, E. K., & Kirtman, B. P. (2004). Causes of low frequency North Atlantic SST variability in a coupled GCM. *Geophysical Review Letters*, **31**, L09210.
64. Wu, Z., & Moore, D. W. (2004). The completeness of eigenfunctions of the tidal equation on an equatorial beta plane. *Journal of the Atmospheric Sciences*, **61**, 769.
65. Hu, Z.-Z., & Wu, Z. (2004). The Intensification and shift of the annual North Atlantic Oscillation in a global warming scenario simulation. *Tellus*, **52A**, 112.
66. Wu, Z. (2003). A shallow CISK, deep equilibrium mechanism for the interaction between large-scale convection and large-scale circulations in the tropics. *Journal of the Atmospheric Sciences*, **60**(2), 377.
67. Wu, Z., Sarachik, E. S., & Battisti, D. S. (2001). Thermally driven tropical circulations under Rayleigh friction and Newtonian cooling: Analytic solutions. *Journal of the Atmospheric Sciences*, **58**(7), 724.
68. Wu, Z., Battisti, D. S., & Sarachik, E. S. (2000). Rayleigh friction, Newtonian cooling, and the linear response to steady tropical heating. *Journal of the Atmospheric Sciences*, **57**, 1937.
69. Wu, Z., Sarachik, E. S., & Battisti, D. S. (2000). Vertical structure of convective heating and the three-dimensional structure of the forced circulation on an equatorial beta plane. *Journal of the Atmospheric Sciences*, **57**, 2169.
70. Wu, Z., Sarachik, E. S., & Battisti, D. S. (1999). Thermally forced Surface winds on an equatorial beta plane. *Journal of the Atmospheric Sciences*, **56**, 2029.
71. Chen, X., Gao, G., & Wu, Z. (1991). The long wave radiation budget in the atmosphere over the North Pacific. *Journal of Nanjing University (Natural Sciences Edition)*, **27**, 623.

Invited Book Chapters

72. Wu, Z. (2014). Ensemble empirical mode decomposition and its multi-dimensional extensions. In Norden. E. Huang, & Samuel. S. P. Shen (Ed.), *Hilbert-Huang Transform: Introduction and Applications (2nd edition)* (pp. 27-46). World Scientific.
73. Wu, Z., & Huang, N. (2014). Statistical Significance Test of Intrinsic Mode Functions. In Huang, N. and, & Shen, S. (Eds.), *Hilbert Huang Transform and Its Applications (2nd Edition)* (pp. 149-170). World Scientific. Retrieved from <http://www.worldscientific.com/worldscibooks/10.1142/8804>
74. Shen, S. P., Shu, T., Huang, N. E., Wu, Z., North, G. R., Carl, T. R., & Easterling, D. R. (2005). HHT analysis of the nonlinear and non-stationary annual cycle of daily surface air temperature data. In N. E. Huang, & S. S. P. Shen (Eds.), *Hilbert-Huang Transform: Introduction and Applications* (pp. 187-210). Singapore: World Scientific.
75. Wu, Z., & Huang, N. E. (2005). Statistical significance test of intrinsic mode functions. In N. E. Huang, & S. S. P. Shen (Eds.), *Hilbert-Huang Transform: Introduction and Applications* (pp. 125-148). Singapore: World Scientific.

Invited Encyclopedia Entries

76. Huang, N. E., Wu, Z., & Long, S. R. (2008). Hilbert Huang Transform. In Editor-in-chief, & Dr. Eugene Izhikevich (Eds.), *Scholarpedia* (Vol. 3(7)). http://www.scholarpedia.org/article/Hilbert-Huang_transform.

Nonrefereed Proceedings

77. Wu, Z. (2004). Statistical significance test of Intrinsic Mode Functions. In *The 25th IUGG International Meeting on Mathematical Geophysics: Frontiers in Theoretical Earth Science* (pp. 89). IUGG.
78. Wu, Z. (2001). The role of shallow heating in driving tropical atmospheric circulations. In *13th Conference on Atmospheric and Oceanic Fluid Dynamics* (pp. 104-108). American Meteorological Society.
79. Wu, Z. (1999). The structure of the thermally forced circulations under different combinations of linear damping. In *12th Conference on Atmospheric and Oceanic Fluid Dynamics* (pp. 66-70). American Meteorological Society.
80. Wu, Z. (1999). Vertical structure of heating and the 3D structure of the forced circulations in the tropics. In *12th Conference on Atmospheric and Oceanic Fluid Dynamics* (pp. 152-156). American Meteorological Society.
81. Wu, Z., Sarachick, E. S., & Battisti, D. S. (1997). Forced planetary waves on an equatorial beta-plane. In *11th Conference on Atmospheric and Oceanic Fluid Dynamics* (pp. 6-10). American Meteorological Society.

Nonrefereed Summaries

82. Saravanan, R., Vimont, D. J., & Wu, Z. (2000). Summary of *Exotic mechanisms for coupled ocean-atmosphere variability in mid-latitudes*. Lecture notes for 2000 NCAR ASP on Decadal and Centennial Climate Variability. Retrieved from <http://www.asp.ucar.edu/colloquium/2000/Lectures/saravanan.html>
83. Hurrell, J. W., Wu, Z., & Vimont, D. J. (2000). Summary of *Observations of extratropical variability*. Lecture notes for 2000 NCAR ASP on Decadal and Centennial Climate Variability. Retrieved from <http://www.asp.ucar.edu/colloquium/2000/Lectures/hurrell1.html>

Nonrefereed Reports

84. Wu, Z., Kirtman, B. P., Schneider, E. K., Sarachik, E. S., Huang, N. E., & Tucker, J. (2007). *Amplitude-frequency modulated annual cycle: an alternative reference frame for climate anomaly* (COLA Technical Report 244). Institute of Global Environment and Society. Retrieved from <http://www.iges.org/pubs/tech.html>
85. Wu, Z., & Huang, N. E. (2005). *Ensemble Empirical Mode Decomposition: a noise-assisted data analysis method* (COLA Technical Report 193). Institute of Global Environment and Society. Retrieved from <http://www.iges.org/pubs/tech.html>

86. Wu, Z., Schneider, E. K., & Kirtman, B. P. (2004). *Causes of low frequency North Atlantic SST variability in a coupled GCM* (COLA Technical Report 160). Institute of Global Environment and Society. Retrieved from <http://www.iges.org/pubs/tech.html>
87. Wu, Z., & Huang, N. E. (2003). *A study of the characteristic of white noise using the Empirical Mode Decomposition method* (COLA Technical Report 133). Institute of Global Environment and Society. Retrieved from <http://www.iges.org/pubs/tech.html>
88. Wu, Z., & Moore, D. W. (2002). *On the completeness of meridional eigenfunctions of tidal equation on an equatorial β -plane* (COLA Technical Report 118). Institute of Global Environment and Society. Retrieved from <http://www.iges.org/pubs/tech.html>
89. Hu, Z.-Z., & Wu, Z. (2002). *The Intensification and shift of the North Atlantic Oscillation in a global warming scenario simulation* (COLA Technical Report 127). Institute of Global Environment and Society. Retrieved from <http://www.iges.org/pubs/tech.html>
90. Wu, Z. (2001). *A Shallow-CISK-Deep-Equilibrium mechanism for the interaction between large-scale convection and large-scale circulation in the tropics* (COLA Technical Report 104). Institute of Global Environment and Society. Retrieved from <http://www.iges.org/pubs/tech.html>
91. Wu, Z., Schneider, E. K., Hu, Z.-Z., & Cao, L. (2001). *The impact of global warming on ENSO variability in climate records* (COLA Technical Report 110). Institute of Global Environment and Society. Retrieved from <http://www.iges.org/pubs/tech.html>

Presentations

Invited Keynote and Plenary Presentations at Conferences

1. Wu, Z. (presented 2020). *Spectral Analysis of a Time Series: from Additive perspective to Multiplicative perspective*. Keynote presentation at 2020 BASC Symposium, Berkeley Atmospheric Sciences Center, Berkeley, California.
2. Wu, Z. (presented 2018). *Spectral Analysis of a Time Series: from Additive Perspective to Multiplicative Perspective*. Keynote presentation at Second ADAPT Symposium on Advanced Understanding, Monitoring and Prediction of Weather, Climate and Environmental systems, ADAPT Center, Penn State University, Penn State University.
3. Wu, Z. (presented 2015, March). *Fast Multidimensional Ensemble Empirical Mode Decomposition Using a Data Compression Technique*. Keynote presentation at International Conference on Optimization, Sparsity, and Adaptive Data Analysis, Morningside Center of Mathematics, Chinese Academy of Sciences, Beijing.
4. Wu, Z. (presented 2013, January). *Modulated Annual Cycle - An Alternative Reference Frame for Climate Anomaly*. Plenary presentation at Adaptive Data Analysis and Sparsity, Institute for Pure and Applied Mathematics, University of California at Los Angeles, University of California at Los Angeles.
5. Wu, Z. (presented 2012, September). *The Eccentricity of the Earth's Orbit and Glacial*

- Cycles: Role of Ocean as a Heat Storage*. Plenary presentation at WCRP/CLIVAR Workshop on Decadal and Multi-decadal Variability in Pacific and Indian Ocean, WCRP/CLIVAR, Qingdao, China.
6. Wu, Z. (presented 2011, September). *On the Time-Varying Trend of the Global Mean Surface Temperature*. Plenary presentation at Hot Topics Workshop: Instantaneous Frequencies and Trends for Nonstationary Nonlinear Data, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN.
 7. Wu, Z. (presented 2011, June). *Ensemble Empirical Mode Decomposition*. Keynote presentation at The Third International Conference on the Advances of Hilbert-Huang Transform and Its Applications, The first Institute of Oceanography, China Oceanic Administration, Qingdao, China.
 8. Wu, Z. (presented 2009, December). *Ensemble Empirical Mode Decomposition*. Keynote presentation at International Conference on Sparse Representation of Multiscale Data and Images: Theory and Applications, Institute of Advanced Studies, Nanyang Technological University, Singapore, Singapore.
 9. Wu, Z. (presented 2008, December). *The connection between the Empirical Mode Decomposition and the Fourier Transform*. Plenary presentation at The Second International Conference on the Advances of Hilbert-Huang Transform and Its Applications, Sun Yat-Sen University, China, Guangzhou, China.
 10. Wu, Z. (presented 2006, June). *Time-frequency analysis: beyond wavelets*. Plenary presentation at International Conference on Applied Harmonic Analysis: Approximation and Computation, Chinese Academy of Sciences, Beijing, China.
 11. Wu, Z. (presented 2006, March). *Ensemble Empirical Mode Decomposition: a noise-assisted data analysis method*. Plenary presentation at The First International Conference on the Advances of Hilbert-Huang Transform and Its Applications, National Central University, Chung-Li, Taiwan.
 12. Wu, Z. (presented 2004, April). *Causes of low frequency North Atlantic SST variability in a coupled GCM*. Plenary presentation in CLIVAR Workshop on Atlantic Climate Predictability and Prediction (White Paper). Symposium conducted at the meeting of CLIVAR and University of Reading, Reading, United Kingdom

Invited Presentations at Conferences

13. Wu, Z. (presented 2008, January). *The connection between the Empirical Mode Decomposition and the Fourier Transform*. Presentation at Joint Mathematics Meetings, American Mathematical Society.
14. Wu, Z. (presented 2006, March). *Signal Processing: Beyond Wavelets*. Presentation at the meeting of The Chinese Association for Science Technology USA, Fairfax, VA.
15. Wu, Z. (presented 2004, June). *Significance Test of Intrinsic Mode Functions*. Presentation at International Ocean-Atmosphere Conference, Chinese-American Ocean and Atmospheric Association, Beijing, China.
16. Wu, Z. (presented 2003, June). *A Study of the Characteristics of White Noise using*

the Empirical Mode Decomposition. Presentation at The First Joint Annual Meeting, Canadian Applied and Industrial Mathematics Society (CAIMS) & Society for Industrial and Applied Mathematics (SIAM), Montreal, Canada.

17. Wu, Z. (presented 2000, July). *A Shallow CISK, deep equilibrium thinking*. Presentation at Summer Colloquium on the Dynamics of Decadal to Centennial Climate Variability, NCAR/ASP, Boulder, CO.
18. Wu, Z. (presented 1999, March). *Vertical structure of heating and the structure of thermally driven circulations in the tropics*. Presentation at Meeting, Equatorial Theoretical Panel, Honolulu, HI.

Invited Workshops

19. Wu, Z. (2011, March). *The Scientific Workshop on the Role of Ocean in Climate Change*. Workshop delivered at State Oceanic Administration of China, Beijing, China.

Invited Seminars (only host institutions listed, some multiples times)

California Institute of Technology, Chinese Academy of Railway Sciences, Columbia University, Chinese Academy of Sciences, Chinese Meteorological Administration, Florida State University, Fudan University, Harvard University, Lanzhou University, Nanjing University, NASA/GSFC, National Central University, National Science Foundation, National Taiwan University, NOAA/CPC, Peking University, NOAA/Geophysical Fluid Dynamics Laboratory, Peking University, Princeton University, Shanghai Typhoon Institute, Sun Yat-sen University, The First Institute of Oceanography, Tsinghua University, UC Berkeley, University of Alberta, University of Delaware, University of Hawaii, University of Maryland, University of Nebraska, University of Pennsylvania, University of Washington, Zhejiang University .

Patented Inventions

1. Huang, N. E., & Wu, Z. (2011). *Noise-assisted data analysis method, system and program product therefore*. US Patent No: US7941298.
2. Huang, N. E., Lo, M.-T., Wu, Z., & Chen X. (2013). *Method for quantifying and modeling degree of nonlinearity, combined nonlinearity, and nonstationarity*. Taiwan Patent No.: TW101104424.
3. Huang, N. E., Wu, Z., & Chen X. (2014). *Data decomposition method and computer system therefrom*. Taiwan Patent No.: TWI432975B.

Contracts and Grants Funded

1. Wu, Z. (Jul 2017–Jun 2021). *Spatiotemporal Inhomogeneity of Tropical Waves*. Funded by National Science Foundation. Total award \$540,812.

2. Wu, Z. (May 2012–Apr 2015). *Integration of the NASA CAMVis and Multiscale Analysis Package (CAMVis-MAP) for Tropical Cyclone Climate Study*. Funded by National Aeronautics and Space Administration. Total award \$266,028.
3. Wu, Zhaohua (PI). (Jan 2012–Dec 2015). *Tempora-Spatial Evolutions of Low-Frequency Climate Variability and Warming Trend*. Funded by National Science Foundation. (1139479). Total award \$396,805.
4. Wu, Z. (Jan 2009–Apr 2011). *Collaborative Research: Understanding Observed Low-Frequency Variability of SST in the North Atlantic*. Funded by National Science Foundation. Total award \$90,026.
5. Wu, Z. (May 2007–Dec 2008). *Collaborative Research: Understanding Observed Low-Frequency Variability of SST in the North Atlantic*. Funded by National Science Foundation. (ATM-0653136). Total award \$493,014.
6. Schneider, E. K., Kirtman, B. P., & Wu, Z. (Feb 2004–Jan 2007). *Variability of the Climate System: Understanding Observed Low Frequency Variability of SST in the North Atlantic*. Funded by National Science Foundation. (ATM-0342104). Total award \$479,494.

SERVICE

Florida State University

2020–present	Member, EOAS Graduate Committee
2018–present	Director, FSU Meteorological Graduate Program (2018–present).
2015–present	Member, EOAS Colloquium Committee
2015–present	Chair, MET Seminar Committee
2013–2015	Member, Computer Sub-Committee
2011–present	Member, FSU Meteorological Program Admission Committee.

The Profession

Guest Reviewer for Refereed Journals

Acta Oceanologica Sinica (English edition)
Advances in Adaptive Data Analysis
Advances in Atmospheric Sciences
AIAA Journal
American Mathematical Monthly
Annales Geophysicae
Applied and Computational Harmonic Analysis
Atmosphere-Ocean

Australian Physical & Engineering Sciences in Medicine
Biomedical Engineering-Applications, Basis and Communications
Climate Dynamics
Climatic Change
Climatic Research
Communications on Pure and Applied Analysis
Dynamics of Atmospheres and Oceans
EURASIP Journal on Advances in Signal Processing
Geophysical Research Letters
IEEE Signal Processing Letters
IEEE Transactions on Biomedical Engineering
IEEE Transactions on Image Processing
IEEE Transactions on Signal Processing
IET Image Processing
International Journal of Climatology
International Journal of Computational Methods
Journal of Applied Meteorology and Climatology
Journal of the Atmospheric Sciences
Journal of Climate
Journal of Geophysical Research-Ocean
Journal of Marine Research
Journal of Vibration and Control
Mathematical Medicine and Biology
Mechanical Systems and Signal Processing
Monthly Weather Review
Nature
Nature Climate Change
New Astronomy
Philosophical Transactions of the Royal Society of London, A
Physica A
Proceeding of the National Academy of Sciences, USA
Proceeding of the Royal Society of London, A
Quarterly Journal of the Royal Meteorological Society
SIAM Journal on Multiscale Modeling and Simulation
Science
Scientific Report
Smart Materials and Structures
Studies in Nonlinear Dynamics & Econometrics
Terrestrial, Atmospheric and Oceanic Sciences
Theoretical and Applied Climatology

Reviewer or Panelist for Grant Applications

Natural Environment Research Council, UK (2015–present).

National Aeronautics and Space Administration (2010–present).

National Oceanic and Atmospheric Administration, USA (2008–present).

National Science Foundation, USA (2008–present).

Juror for a Performance

AGU Outstanding Student Paper Awards (multiple years).

Chair of a Symposium

Wu, Z., Grapenthin, R., & McKenna, S. A. (Chair). (2017, December). *A52G: Novel Methods for Combining Physical Simulation, Machine Learning, and Data-Driven Analysis in Climate Studies and Geophysical Sciences I*. Symposium conducted at the meeting of American Geophysical Union, New Orleans.

Service to Professional Associations

Member, The key Laboratory of the Data Analysis and Applications of the State Oceanic Administration of China, Scientific Advisory Committee (2010–present).

Member, The Third International Conference on the Advances of Hilbert-Huang Transform and Its Applications, Qingdao, P. R. China, Scientific Advisory Committee (2011).

Its Applications, National Central University, Chung-Li, Taiwan, Organizing Committee (2006).

Service to Other Institutions

Scientific Advisory Committee Member, *The key Laboratory of the Data Analysis and Applications* (2010–present).

Visiting (Adjunct) Professor, *National Central University* (2007–2018).

CURRENT MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS

American Geophysical Union

American Meteorological Society