

Curriculum Vitae

Zhaohua Wu

August 29, 2013

General Information

University address: Earth, Ocean, and Atmospheric Science
College of Arts and Sciences
Love Building 0422
Florida State University
Tallahassee, Florida 32306-4520

E-mail address: zwu@fsu.edu

Professional Preparation

1998 Ph.D., University of Washington, Seattle, WA. Major: Atmospheric Sciences.
Supervisor: Edward S. Sarachik and David S. Battisti.

Wu, Z. (1998). *Thermally Driven Surface Winds in the Tropics*. (Doctoral dissertation, University of Washington, Seattle, WA). Retrieved from Thesis (Ph. D.)--University of Washington, 1998., http://alliance-primo.hosted.exlibrisgroup.com/primo_library/libweb/action/dlSearch.do?dsent=0&onCampus=true&query=any%2Ccontains%2CZhaohua+wu&displayMode=full&dstmp=1377721089390&highlight=true&searc, OCLC Number: 42778555.

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.

Professional Experience

2009–present Assistant Professor, Earth, Ocean & Atmospheric Science, Florida State University, Tallahassee, FL.

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.
- 1991–1998 Graduate Research Assistant, Institute of Atmospheric Physics, Chinese Academy of Sciences, P. R. China.

Language Proficiency

Chinese - native in speaking, reading, and writing.
English - fluent in speaking, reading, and writing.

Visiting Professorship(s)

- 2008–present Visiting Adjunct Professor, Research Center for Adaptive Data Analysis, National Central University, Taiwan.

Honors, Awards, and 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 (2007).

Current Membership in Professional Organizations

American Geophysical Union
American Meteorological Society

Teaching

Courses Taught

Meteorological Computations (MET3220)

Atmospheric Dynamics I (MET4301)

Advanced Dynamic Meteorology I (MET5311)

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]

Advanced Topics in Climatology (MET6155)

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]

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

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

Doctoral Committee Chair

Dai, Z., doctoral student.

Feng, J., doctoral student.

Sun, J., doctoral student.

Doctoral Committee Cochair

Fei, J., doctoral student. (2013). [Fei Ji is a visiting student from Lanzhou University of China, who will earn his degree from Lanzhou University]

Qian, C., doctoral student. (2009). *Climate variability and change in China in the reference frame of the modulated annual cycle*. [Dr. Qian was a student in Chinese Academy of Sciences; and he earned his Ph.D. there]

Doctoral Committee Member

Michael, John-Paul, doctoral candidate.

Sejas, S. A., doctoral candidate.

Selman, C. M., doctoral candidate.

Honeyager, R. E., doctoral student.

Master's Committee Chair

Feng, J., graduate. (2012).
Strazzo, S. E., graduate. (2011).

Master's Committee Member

Selman, C. M., graduate. (2012).
West, R. R., graduate. (2012).
Sejas, S. A., graduate. (2011).
Duncan, J. B., student.

International training course

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).

Research and Original Creative Work

Zhaohua's research is characterized by two interwoven threads: studying atmospheric/climate dynamics and developing mathematical/physical analysis methods.

Program of Research and/or Focus of Original Creative Work

Zhaohua is particularly interest in understanding the evolutions of atmospheric/climate phenomena. The mathematical methods he has developed provide new capability of revealing new insights into these evolutions. In addition to that, his developed analysis methods have found numerous applications in scientific, engineering and medical sciences.

Publications

Invited Journal Articles

Huang, N. E., & Wu, Z. (2008). A review on Hilbert-Huang transform: method and its applications to geophysical studies. *Reviews of Geophysics*, 46, RG2006. Retrieved from <http://onlinelibrary.wiley.com/doi/10.1029/2007RG000228/pdf>
doi:10.1029/2007RG000228

Refereed Journal Articles

- Mandic, D., Rehman, N., Wu, Z., & Huang, N. (in press). Data-driven time-frequency analysis of multivariate signals. *IEEE Signal Processing Magazine*.
- 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, 1489–1504. Retrieved from <http://journals.ametsoc.org/doi/abs/10.1175/JAS-D-12-0213.1>
doi:10.1175/JAS-D-12-0213.1
- 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*, unknown yet, unknown yet. Retrieved from <http://link.springer.com/article/10.1007/s00382-012-1554-2>
doi:10.1007/s00382-012-1554-2
- Misra, V., Li, H., Wu, Z., & DiNapoli, S. (2013). Global seasonal climate predictability in a two tiered forecast system: part I: boreal summer and fall seasons. *Climate Dynamics*, Unknown yet, Unknown yet. Retrieved from <http://link.springer.com/content/pdf/10.1007%2Fs00382-013-1812-y.pdf>
doi:10.1007/s00382-013-1812-y
- 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, 1-23. Retrieved from http://download.springer.com/static/pdf/21/art%253A10.1007%252Fs00382-011-1250-7.pdf?auth66=1365199195_8756ed9f135477a440e987e58ec834c0&ext=.pdf doi:DOI 10.1007/s00382-011-1250-7
- 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, 25-43. Retrieved from http://download.springer.com/static/pdf/599/art%253A10.1007%252Fs00382-011-1073-6.pdf?auth66=1365199149_5a194f8dc5ab2efbdd6c765cbb9c435d&ext=.pdf
doi:10.1007/s00382-011-1073-6
- 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, 531-555. Retrieved from http://download.springer.com/static/pdf/266/art%253A10.1007%252Fs00382-011-1258-z.pdf?auth66=1365198935_2ceddc1fd56114fece32f63f25f19705&ext=.pdf
doi:10.1007/s00382-011-1258-z

- 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, 3583-3598. Retrieved from <http://journals.ametsoc.org/doi/pdf/10.1175/JCLI-D-11-00364.1>
doi:10.1175/JCLI-D-11-00364.1
- 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, 291-307. Retrieved from <http://www.worldscientific.com/doi/pdfplus/10.1142/S1793536911000866>
doi:10.1142/S1793536911000866
- 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, 1400-1406. Retrieved from <http://link.springer.com/article/10.1007%2Fs11430-011-4235-9?LI=true>
doi:10.1007/s11430-011-4235-9
- 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, 63-93. Retrieved from <http://www.worldscientific.com/doi/pdfplus/10.1142/S1793536911000659>
doi:10.1142/S1793536911000659
- 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, 5292-5302. Retrieved from <http://journals.ametsoc.org/doi/abs/10.1175/JCLI-D-11-00006.1>
doi:10.1175/JCLI-D-11-00006.1
- 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, 284-296. Retrieved from <http://link.springer.com/article/10.1007%2Fs00376-010-9221-1?LI=true>
doi:10.1007/s00376-010-9221-1
- 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, 6486-6500. Retrieved from <http://journals.ametsoc.org/doi/pdf/10.1175/JCLI-D-10-05012.1>
doi:10.1175/JCLI-D-10-05012.1
- 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, 297-309. Retrieved from <http://link.springer.com/article/10.1007%2Fs00376-010-9242-9?LI=true#page-1>
doi:10.1007/s00376-010-9242-9

- Wu, Z., Huang, N. E., & Chen, X. (2011). Some considerations on physical analysis of data. *Advances in Adaptive Data Analysis*, 3, 95-113. Retrieved from <http://www.worldscientific.com/doi/pdfplus/10.1142/S1793536911000660> doi:I:10.1142/S1793536911000660
- 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, 759-773. Retrieved from <http://link.springer.com/article/10.1007%2Fs00382-011-1128-8?LI=true> doi:10.1007/s00382-011-1128-8
- 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, 415-428. Retrieved from <http://www.worldscientific.com/doi/pdfplus/10.1142/S1793536910000550> doi:10.1142/S1793536910000562
- 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, 233-265. Retrieved from <http://www.worldscientific.com/doi/pdfplus/10.1142/S1793536910000471> doi:10.1142/S1793536910000471
- 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, 1169-1182. Retrieved from <http://link.springer.com/article/10.1007%2Fs00376-009-9121-4?LI=true> doi:10.1007/s00376-009-9121-4
- Wang, G., Chen, X., Qiap, F., Wu, Z., & Huang, N. E. (2010). On intrinsic mode function. *Advances in Adaptive Data Analysis*, 2, 277-293. Retrieved from <http://www.worldscientific.com/doi/pdfplus/10.1142/S1793536910000549> doi:10.1142/S1793536910000549
- Wu, Z., & Huang, N. E. (2010). On the Filtering Properties of the Empirical Mode Decomposition. *Advances in Adaptive Data Analysis*, 2, 397-414. Retrieved from <http://www.worldscientific.com/doi/pdfplus/10.1142/S1793536910000604> doi:10.1142/S1793536910000604
- 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, 463-508. Retrieved from <http://www.worldscientific.com/doi/pdfplus/10.1142/S1793536910000586> doi:10.1142/S1793536910000586
- 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, 483-516. Retrieved from

<http://www.worldscientific.com/doi/pdfplus/10.1142/S179353690900031X>
doi:10.1142/S179353690900031X

- 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*, 177-299. Retrieved from <http://www.worldscientific.com/doi/pdfplus/10.1142/S1793536909000096>
doi:10.1142/S1793536909000096
- 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*, 447-460. Retrieved from <http://www.worldscientific.com/doi/pdfplus/10.1142/S1793536909000151>
doi:10.1142/S1793536909000151
- Qian, C., Fu, C., & Wu, Z. (2009). On the secular change of spring onset at Stockholm. *Geophysical Research Letters, 36*, L12706. Retrieved from <http://onlinelibrary.wiley.com/doi/10.1029/2009GL038617/pdf>
doi:10.1029/2009GL038617
- 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*, 2055-2068. Retrieved from <http://cat.inist.fr/?aModele=afficheN&cpsidt=22252569>
- Wu, Z., & Huang, N. E. (2009). Ensemble Empirical Mode Decomposition: a noise-assisted data analysis method. *Advances in Adaptive Data Analysis, 1*, 1-41. Retrieved from <http://www.worldscientific.com/doi/pdfplus/10.1142/S1793536909000047>
doi:10.1142/S1793536909000047
- Wu, Z., Huang, N. E., & Chen, X. (2009). The multi-dimensional Ensemble Empirical Mode Decomposition method. *Advances in Adaptive Data Analysis, 1*, 339-372. Retrieved from <http://www.worldscientific.com/doi/pdfplus/10.1142/S1793536909000187>
doi:10.1142/S1793536909000187
- 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*, 2279-2292. Retrieved from <http://www.sciencedirect.com/science/article/pii/S0378437107012605>
doi:hysa.2010.1016/j.p07.11.052
- 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*, 823-841. Retrieved from

<http://link.springer.com/article/10.1007%2Fs00382-008-0437-z?LI=true#page-1>
doi:10.1007/s00382-008-0437-z

- 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. Retrieved from 10.1088/1742-6596/96/1/012153
doi:10.1088/1742-6596/96/1/012153
- 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. Retrieved from <http://iopscience.iop.org/0295-5075/77/6/68008> doi:10.1209/0295-5075/77/68008
- 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), 24-30.
- 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*, 14889-14894. Retrieved from <http://www.pnas.org/content/104/38/14889.short> doi:10.1073/pnas.0701020104
- Hu, Z.-Z., & Wu, Z. (2004). The Intensification and shift of the annual North Atlantic Oscillation in a global warming scenario simulation. *Tellus*, *52A*, 112-124. Retrieved from <http://onlinelibrary.wiley.com/doi/10.1111/j.1600-0870.2004.00050.x/full>
doi:10.1111/j.1600-0870.2004.00050.x
- Wu, Z., & Hunag, 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*, 1597-1611. Retrieved from <http://rspa.royalsocietypublishing.org/content/460/2046/1597.short>
doi:10.1098/rspa.2003.1221
- 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*, 769-774. Retrieved from <http://journals.ametsoc.org/doi/abs/10.1175/1520-0469%282004%29061%3C0769%3ATCOEOT%3E2.0.CO%3B2> doi:10.1175/1520-046(2004)061
- 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. Retrieved from <http://onlinelibrary.wiley.com/doi/10.1029/2004GL019548/abstract>
doi:1029/2004GL019548
- 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*, 377-392. Retrieved from

<http://journals.ametsoc.org/doi/pdf/10.1175/1520-0469%282003%29060%3C0377%3AA%3CDEM%3E2.0.CO%3B2> doi:10.1175/1520-0469(2003)060

- Wu, Z., Sarachik, E. S., & Battisti, D. S. (2001). Thermally driven tropical circulations under Rayleigh friction and Newtonian cooling: analytical solutions. *Journal of the Atmospheric Sciences*, 58, 724-741. Retrieved from <http://journals.ametsoc.org/doi/abs/10.1175/1520-0469%282001%29058%3C0724%3ATDTCUR%3E2.0.CO%3B2> doi:10.1175/1520-0469(2001)058
- 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, 1937-1957. Retrieved from <http://journals.ametsoc.org/doi/abs/10.1175/1520-0469%282000%29057%3C1937%3ARFNCAT%3E2.0.CO%3B2>
- 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, 2169-2187. Retrieved from <http://journals.ametsoc.org/doi/abs/10.1175/1520-0469%282000%29057%3C2169%3AVSOCHA%3E2.0.CO%3B2>
- Wu, Z., Sarachik, E. S., & Battisti, D. S. (1999). Thermally forced Surface winds on an equatorial beta plane. *Journal of the Atmospheric Sciences*, 56, 2029-2037. Retrieved from <http://journals.ametsoc.org/doi/pdf/10.1175/1520-0469%281999%29056%3C2029%3ATFSWOA%3E2.0.CO%3B2>
- 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, 623-629.

Invited Book Chapters

- 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.
- 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

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

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.

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.

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.

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.

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

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>

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>

Nonrefereed Reports

- 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>
- 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>
- 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>
- 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>
- 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>
- 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>
- 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>
- 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

- Wu, Z. (presented 2013, January). *Ensemble Empirical Mode Decomposition*. 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. (International)

- 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. (International)
- 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. (International)
- 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. (International)
- 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. (International)
- 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. (International)
- 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. (International)
- 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. (International)

Invited Keynote and Plenary Presentations at Symposia

- 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. (International)

Invited Presentations at Conferences

- Wu, Z. (presented 2008, January). *The connection between the Empirical Mode Decomposition and the Fourier Transform*. Presentation at Joint Mathematics Meetings, American Mathematical Society. (National)
- Wu, Z. (presented 2006, March). *Signal Processing: Beyond Wavelets*. Presentation at the meeting of The Chinese Association for Science Technology USA, Fairfax, VA. (National)
- 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. (International)
- 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. (International)
- 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. (National)
- 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. (National)

Invited Workshops

- 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. (International)

Invited Lectures and Readings of Original Work

- Wu, Z. (2011, June). *On the varying trend of the global mean surface temperature*. Delivered at Nanjing University. (International)
- Wu, Z. (2011, March). *On the varying trend of the global mean surface temperature*. Delivered at NOAA/CPC, Camp Spring, MD. (International)
- Wu, Z. (2011, March). *On the varying trend of the global mean surface temperature*. Delivered at Department of Atmospheric and Oceanic Sciences, Peking University. (International)

- Wu, Z. (2011, March). *Some considerations of physical analysis of data*. Delivered at Institute of Atmospheric Physics, Chinese Academy of Sciences. (International)
- Wu, Z. (2009, June). *Amplitude-frequency modulated annual cycle – an alternative reference frame for climate anomaly*. Delivered at Peking University, Department of Atmospheric Sciences, Beijing, China. (International)
- Wu, Z. (2009, June). *On the global warming trend*. Delivered at Chinese Academy of Sciences, Institute of Atmospheric Physics, Beijing, China. (International)
- Wu, Z. (2009, June). *On the global warming trend*. Delivered at Nanjing University, School of Atmospheric Sciences, Nanjing, China. (International)
- Wu, Z. (2009, March). *Amplitude-frequency modulated annual cycle – an alternative reference frame for climate anomaly*. Delivered at NOAA Geophysical Fluid Dynamics Laboratory, Princeton, NJ. (National)
- Wu, Z. (2009, March). *The Empirical Mode Decomposition: the method, its progress, and open questions*. Delivered at Princeton University, Program in Applied and Computational Mathematics (Colloquium), Princeton, NJ. (National)
- Wu, Z. (2009, February). *The Empirical Mode Decomposition: the method, its progress, and open questions*. Delivered at Florida State University, Department of Mathematics, Tallahassee, FL. (Local)
- Wu, Z. (2008, December). *Ten years of the Hilbert-Huang Transform*. Delivered at The First Institute of Oceanography, China Oceanography Administration, Qingdao, China. (International)
- Wu, Z. (2008, August). *Amplitude-frequency modulated annual cycle – an alternative reference frame for climate anomaly*. Delivered at Columbia University, International Research Institute for Climate and Society, Palisades, NY. (National)
- Wu, Z. (2008, August). *Ensemble Empirical Mode Decomposition*. Delivered at Columbia University, International Research Institute for Climate and Society, Palisades, NY. (National)
- Wu, Z. (2008, May). *Amplitude-frequency modulated annual cycle – an alternative reference frame for climate anomaly*. Delivered at Shanghai Typhoon Institute, Shanghai, China, Beijing, China. (International)
- Wu, Z. (2008, May). *Ensemble Empirical Mode Decomposition*. Delivered at Shanghai Typhoon Institute, Shanghai, China, Beijing, China. (International)

- Wu, Z. (2008, May). *Ensemble Empirical Mode Decomposition*. Delivered at The National Science Foundation, Arlington, VA. (National)
- Wu, Z. (2008, April). *Amplitude-frequency modulated annual cycle – an alternative reference frame for climate anomaly*. Delivered at Florida State University, Department of Meteorology, Tallahassee, FL. (Local)
- Wu, Z. (2008, January). *Climate Test Bed Seminar Series: Annual cycle and the prediction of interannual variability*. Delivered at NOAA, Camp Spring, MD. (National)
- Wu, Z. (2008, January). *Ensemble Empirical Mode Decomposition*. Delivered at California Institute of Technology, Division of Geological and Planetary Sciences, Pasadena CA. (National)
- Wu, Z. (2007, November). *The selection of a reference frame: the starting point for scientific analysis*. Delivered at National Central University, School of Engineering, Taiwan, R.O.C. (International)
- Wu, Z. (2007, September). *Time-frequency analysis: beyond wavelets (with applications to climate sciences)*. Delivered at University of Delaware, Center for Remote Sensing, Newark, DE. (National)
- Wu, Z. (2007, July). *Recent Advances in Hilbert-Huang Transform*. Delivered at Chinese Academy of Sciences, Institute of Atmospheric Physics, Beijing, China. (International)
- Wu, Z. (2007, July). *Amplitude-frequency modulated annual cycle – an alternative reference frame for climate anomaly*. Delivered at Chinese Academy of Sciences, Institute of Atmospheric Physics, Beijing, China. (International)
- Wu, Z. (2007, May). *Amplitude-frequency modulated annual cycle – an alternative reference frame for climate anomaly*. Delivered at NOAA/CPC, Camp Spring, MD. (National)
- Wu, Z. (2007, January). *Amplitude-frequency modulated annual cycle – an alternative reference frame for climate anomaly*. Delivered at University of Washington, Department of Atmospheric Sciences, Seattle, WA. (National)
- Wu, Z. (2007, January). *Time-frequency analysis: beyond wavelets (with applications to climate sciences)*. Delivered at University of Washington, Department of Atmospheric Sciences, Seattle, Wa. (National)
- Wu, Z. (2006, December). *Amplitude-frequency modulated annual cycle – an alternative reference frame for climate anomaly*. Delivered at University of California, Berkeley, Center for Atmospheric Sciences, Berkeley, CA. (National)

- Wu, Z. (2006, December). *Tao of data analysis*. Delivered at National Central University, Taiwan, R.O.C. (International)
- Wu, Z. (2006, December). *Time-frequency analysis: beyond wavelets (with applications to black hole merge)*. Delivered at National Central University, Department of Physics, Taiwan, R.O.C. (National)
- Wu, Z. (2006, December). *Time-frequency analysis: beyond wavelets (with applications to fluid mechanics)*. Delivered at National Taiwan University, Institute of Applied Mechanics, Taiwan, R.O.C. (National)
- Wu, Z. (2006, November). *Amplitude-frequency modulated annual cycle – an alternative reference frame for climate anomaly*. Delivered at University of Maryland, Earth System Science Interdisciplinary Center (ESSIC), College Park, MD. (National)
- Wu, Z. (2006, September). *Time-frequency analysis: beyond wavelets (with applications to physiological data)*. Delivered at University of Pennsylvania, School of Medicine, Philadelphia, PA. (National)
- Wu, Z. (2006, June). *Time-frequency analysis: beyond wavelets (with applications to bridge damage detection)*. Delivered at Zhejiang University, School of Civil Engineering, Hangzhou, China. (International)
- Wu, Z. (2006, June). *Time-frequency analysis: beyond wavelets (with applications to bridge damage detection)*. Delivered at Chinese Academy of Railway Sciences, Beijing, China. (International)
- Wu, Z. (2006, June). *Time-frequency analysis: beyond wavelets (with applications to climate sciences)*. Delivered at Chinese Academy of Sciences, Institute of Atmospheric Physics, Beijing, China. (International)
- Wu, Z. (2006, June). *Time-frequency analysis: beyond wavelets (with applications to climate sciences)*. Delivered at Chinese Academy of Sciences, Institute of Atmospheric Physics, Beijing, China. (International)
- Wu, Z. (2006, February). *Time-frequency analysis: beyond wavelets (with applications to climate sciences)*. Delivered at Harvard University, Department of Earth and Planetary Sciences, Cambridge, MA. (International)
- Wu, Z. (2006, January). *Ensemble Empirical Mode Decomposition: a noise-assisted data analysis method*. Delivered at NOAA/CPC, Camp Spring, MD. (National)
- Wu, Z. (2004, August). *The impact of ENSO on NAO variability*. Delivered at NOAA/EMC, Camp Spring, MD. (National)

- Wu, Z. (2004, May). *The impact of ENSO on NAO variability*. Delivered at University of Maryland, Earth System Science Interdisciplinary Center (ESSIC), College Park, MD. (National)
- Wu, Z. (2004, March). *Statistical significance test of Intrinsic Mode Functions of geophysical data*. Delivered at University of Alberta, Institute for Geophysical Research, Edmonton, Canada. (National)
- Wu, Z. (2003, September). *A Shallow CISK, deep equilibrium thinking*. Delivered at NASA/GSFC, Greenbelt, MD. (National)
- Wu, Z. (2002, April). *A Shallow CISK, deep equilibrium thinking*. Delivered at University of Nebraska, Department of Geosciences, Lincoln, NE. (National)
- Wu, Z. (2002, April). *The impact of global warming on ENSO variability*. Delivered at George Mason University, School of Computational Sciences, Fairfax, VA. (National)
- Wu, Z. (2002, April). *The impact of global warming on ENSO variability*. Delivered at University of Maryland, Earth System Science Interdisciplinary Center (ESSIC), College Park, MD. (National)
- Wu, Z. (2001, November). *A Shallow CISK, deep equilibrium thinking*. Delivered at NOAA/CPC, Camp Spring, MD. (International)
- Wu, Z. (2001, October). *The impact of global warming on ENSO variability*. Delivered at University of Washington, Department of Atmospheric Sciences and Joint Institute for the Study of Atmosphere and Ocean (JISAO), Seattle, WA. (National)
- Wu, Z. (2001, February). *A Shallow CISK, deep equilibrium thinking*. Delivered at University of Maryland, Department of Meteorology, College Park, MD. (Local)
- Wu, Z. (1999, December). *A Shallow CISK, deep equilibrium thinking*. Delivered at Chinese Academy of Sciences, Institute of Atmospheric Physics, Beijing, China. (International)
- Wu, Z. (1999, December). *A Shallow CISK, deep equilibrium thinking*. Delivered at Nanjing University, Department of Atmospheric Sciences, Nanjing, China. (International)
- Wu, Z. (1999, September). *Thermally driven surface winds in the Tropics*. Delivered at Center for Ocean-Land-Atmosphere Studies, IGES, Distinguished Visiting Series, Calverton, MD. (National)
- Wu, Z. (1999, July). *Thermally driven surface winds in the Tropics*. Delivered at University of Hawaii, Department of Meteorology, Honolulu, HI. (National)

Patented Inventions

Huang, N. E., & Wu, Z. (2011). *Noise-assisted data analysis method, system and program product therefore*. US Patent No.: 7,941,298. Retrieved from <http://www.google.com/patents/US7941298>

Contracts and Grants

Contracts and Grants Funded

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.

Wu, Z. (Jan 2012–Dec 2014). *Tempora-Spatial Evolutions of Low-Frequency Climate variability and warming trend*. Funded by National Science Foundation. Total award \$396,805.

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.

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.

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

FSU Department Service

Review and make suggestions of computational need of meteorology program, Computer Sub-Committee (2013–present).

Contribute to all aspects of improving meteorological graduate program, Meteorology Graduate Program Committee (2011–present).

The Profession

Editor for Refereed Journals

Editor, *Journal of the Atmospheric Sciences* (2012–present).

Editor, *Advances in Adaptive Data Analysis* (2007–present).

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

Guest Reviewer for Refereed Journals

Nature (2012–present).

Science (2012–present).

AIAA Journal (2011–present).

Climatic Change (2011–present).

International Journal of Climatology (2011–present).

International Journal of Computational Methods (2011–present).

Annales Geophysicae (2010–present).

Atmosphere-Ocean (2010–present).

Communications on Pure and Applied Analysis (2010–present).

IEEE Transactions on Biomedical Engineering (2010–present).

New Astronomy (2010–present).

Theoretical and Applied Climatology (2010–present).

Acta Oceanologica Sinica (English edition) (2009–present).

IET Image Processing (2009–present).

Journal of Geophysical Research-Ocean (2009–present).

IEEE Signal Processing Letters (2008–present).

IEEE Transactions on Image Processing (2008–present).

Journal of Vibration and Control (2008–present).

Mechanical Systems and Signal Processing (2008–present).

Advances in Adaptive Data Analysis (2007–present).

Advances in Atmospheric Sciences (2007–present).

Biomedical Engineering-Applications, Basis and Communications (2007–present).

IEEE Transactions on Signal Processing (2007–present).

Studies in Nonlinear Dynamics & Econometrics (2007–present).

EURASIP Journal on Advances in Signal Processing (2006–present).

Mathematical Medicine and Biology (2006–present).

Physica A (2006–present).

Smart Materials and Structures (2006–present).

Dynamics of Atmospheres and Oceans (2005–present).

Journal of Applied Meteorology and Climatology (2005–present).

Journal of Marine Research (2005–present).

Geophysical Research Letters (2003–present).

Monthly Weather Review (2003–present).

Climate Dynamics (2002–present).

Quarterly Journal of the Royal Meteorological Society (2002–present).

Journal of Climate (2001–present).

Journal of the Atmospheric Sciences (1997–present).

Juror for a Performance

AGU Fall Meeting 2010 Outstanding Student Paper Awards. San Francisco: American Geophysical Union (2010–present).

Reviewer or Panelist for Grant Applications

National Science Foundation (2008–present).

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).

Member, The First International Conference on the Advances of Hilbert-Huang Transform and Its Applications, National Central University, Chung-Li, Taiwan, Organizing Committee (2006).

Service to Other Universities

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