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A. Full CV

Education

- **Ph.D**., 2008: Institute of Atmospheric Sciences, National Taiwan University, Taipei, Taiwan
- **M.S.**, 1997: Institute of Environmental Engineering, National Chung-Hsing University, Taichung, Taiwan
- **B.E.**, 1995: Department of Environmental Engineering, National Chung-Hsing University, Taichung, Taiwan

Appointments

- Assistant Research Specialist, Research Center for Environmental Changes, Academia Sinica, Taiwan (2012/11~present)
- Postdoctoral Fellow, Laboratory of Climate Change Research, Consortium for Climate Change Study, Ministry of Science and Technology, Taiwan (2012/01~2012/11)
- Postdoctoral Fellow, Research Center for Environmental Changes, Academia Sinica, Taiwan (2008/02~2012/01)
- Research Associate, Earth System Science Interdisciplinary Center, University of Maryland at College Park, Maryland, USA (2009/11~2011/10)
- Visitor, Mesoscale Atmospheric Processes Laboratory (in Dr. Wei-Kuo Tao's group), Goddard Space Flight Center, NASA, USA (2009/11~2011/10)
- Part-time Research Assistant and PhD Student, Research Center for Environmental Changes, Academia Sinica, Taiwan (2000/09~2008/01)
- Research Assistant, Environmental Changes Research Project Office, Institute of Earth Science, Academia Sinica, Taiwan (1999/07~2000/08)

Publications

1. Shiu, C.-J*. et al., 2022: Examining climatic impacts of the four fast-physics parameterizations of TaiESM1, Technical Report, RCEC, Academia Sinica.

2. Shiu, C.-J.*, Y.-C. Wang, W.-T. Chen, H.-L. Pan, R. Sun, Y.-H. Chen, H.-H. Hsu, and C.-A. Chen, 2021: GTS v1.0: A Macrophysics Scheme for Climate Models Based on a Probability Density Function, Geosci. Model Dev., 14, 177-204, https://doi.org/10.5194/gmd-14-177-2021.

3. Dutta, U., A. Hazra, H. S. Chaudhari, S. K. Saha, S. Pokhrel, C.-J. Shiu, and J.-P. Chen, 2021: Role of microphysics and convective auto-conversion for the better simulation of Tropical

Intraseasonal Oscillations (MISO and MJO), Journal of Advances in Modeling Earth Systems, https://doi.org/10.1029/2021MS002540.

4. Wang, Y.-C., H.-H. Hsu, C.-A. Chen, W.-L. Tseng, P.-C. Hsu, C.-W. Lin, Y.-L. Chen, L.-C. Jiang, Y.-C. Lee, H.-C. Liang, L. Chang, W.-L. Lee, and C.-J. Shiu, 2021: Performance of the Taiwan Earth System Model in simulating climate variability compared with observations and CMIP6 model simulations. Journal of Advances in Modeling Earth Systems, 13, e2020MS002353. https://doi.org/10.1029/2020MS002353.

5. Chou, M.-D., K.-T. Lee, I.-S. Zo, W.-L. Lee, C.-J. Shiu, and J.-B. Jee, 2021: A New k-Distribution Scheme for Clear-Sky Radiative Transfer Calculations in Earth's Atmosphere. Part II: Solar (Shortwave) Heating due to H2O and CO2, Journal of Atmospheric Sciences, 78, 2657–2675, doi: 10.1175/JAS-D-20-0278.1.

6. Lee, W.-L., Wang, Y.-C., Shiu, C.-J., Tsai, I., Tu, C.-Y., Lan, Y.-Y., Chen, J.-P., Pan, H.-L., and H.-H. Hsu, (2020). Taiwan Earth System Model Version 1: description and evaluation of mean state, Geosci. Model Dev., 13, 3887-3904, https://doi.org/10.5194/gmd-13-3887-2020.

7. Chou, M.-D., J. C.-C. Yu, W.-L. Lee, C.-J. Shiu, K.-T. Lee, I.-S. Zo, J.-B. Jee, and B.-Y. Kim, (2020). A New k-Distribution Scheme for Clear-Sky Radiative Transfer Calculations in Earth's Atmosphere. Part I: Thermal Infrared (Longwave) Radiation, Journal of Atmospheric Sciences, https://doi.org/10.1175/JAS-D-19-0088.1.

8. Wang, X., S. C. Liu, R. Liu, C.-J. Shiu, C. He, and X. Zhong, (2019). Observed changes in precipitation extremes and effects of tropical cyclones in South China during 1955-2013. Int. J. Climatol., 1-8. https://doi.org/10.1002/joc.5980.

9. Shiu, C.-J.* et. al., 2018: Modifying Cloud-Related Physical Parameterizations for TaiESM, Technical Report, RCEC, Academia Sinica.

10. Liu, R., Su, H., Liou, K.-N., Jiang, J. H., Gu, Y., Liu, S. C., and C.-J. Shiu, (2018). An assessment of tropospheric water vapor feedback using radiative kernels. J. Geophys. Res.: Atmospheres, 123, 1499-1509. https:// doi.org/10.1002/2017JD027512.

11. Liu, R., S. C. Liu, C.-J. Shiu, J. Li, and Y. H. Zhang, (2016): Trends of regional precipitation and their control mechanisms during 1979-2013. Adv. Atmos. Sci., 33 (2), 164-174, doi: 10.1007/s00376-015-5117-4.

12. Liu, R., S. C. Liu, R. J. Cicerone, C.-J. Shiu, J. Li, J. L. Wang, and Y. H. Zhang, (2015): Trends of extreme precipitation in eastern China and their possible causes. Adv. Atmos. Sci., 32 (8), 1027-1037, doi: 10.1007/s00376-015-5002-1.

13. Shiu, C.-J.* (2014), Implementation of a two-moment cloud microphysics parameterization for convective and stratiform clouds of NCAR CESM, Technical Report, RCEC, Academia Sinica.

14. Shiu, C.-J.* (2012), Improving clouds and precipitation simulations in global climate models, Technical Report, RCEC, Academia Sinica.

15. Shiu, C.-J., Shaw Chen Liu, Congbin Fu, Aiguo Dai and Ying Sun (2012): How Much do Precipitation Extremes Change in a Warming Climate? Geophys. Res. Lett., 39, L17707, doi:10.1029/ 2012GL052762.

16. Liu, Shaw Chen, Congbin Fu, C.-J. Shiu, Jen-Ping Chen, Futing Wu, (2009): Temperature Dependence of Global Precipitation Extremes, Geophys. Res. Lett., 36, L17702, doi:10.1029/2009GL040218.

17. Shiu, C.-J., S. C. Liu, and J.-P. Chen, (2009): Diurnally asymmetric trends of temperature, humidity and precipitation in Taiwan, J. Climate, 22, 5635-5649.

18. Chang, Chih-Chung, Jia-Lin Wang, Shih-Chun Candice Lung, Shaw Chen Liu, C.-J. Shiu, (2009): Source characterization of ozone precursors by complementary approaches of vehicular indicator and principal component analysis. Atmos. Environ., 43, 1771-1778.

19. Liu, Tsun-Hsien, Fujung Tsai, Shih-Chieh Hsu, C.-J. Shiu, Wei-Nei Chen, Jien-Yi Tu, Guan-Ru Chen, Yu-Ling Chuang, (2009): Southeastward Transport of Asian Dust and its Contributions to Northern Taiwan. Atmos. Environ, 43, 458-467.

20. Chou, C. C.-K., C.-Y. Tsai, C.-J. Shiu, S. C. Liu, T. Zhu, (2009): Measurement of NOy during CAREBEIJING-2006: Implications for the ozone production efficiency of NOx. J. Geophys. Res. 114, Issue D7, CiteID D00G01.

21. Tan, Pei-Hua, Chia Chou, Jing-Yi Liang, Charles C.-K. Chou, C.-J. Shiu, (2009): Air pollution "holiday effect" resulting from the Chinese New Year. Atmos. Environ. 43, 2114-2124.

22. Chen, J-.P., A. Hazra, C.-J. Shiu, I-C. Tsai, and H.-H. Lee, (2008): Interaction between Aerosols and Clouds: Current Understanding, In: Recent Progress in Atmospheric Sciences: Applications to the Asia-Pacific Region. p231-281. Edited by K. N. Liou and M.-D. Chou., Published by World Scientific Publishing Co. Pte. Ltd.

23. Shiu, C.-J. (2008): Radiative Effects of Aerosols on the Environment in Taiwan. Ph.D. Dissertation, 208pp. National Taiwan University (in English).

24. Shiu, C.-J., S. C. Liu, C.-C. Chang, J.-P. Chen, C. C. K. Chou, C.-Y. Lin, and C.-Y. Young, (2007): "Photochemical Production of Ozone and Control Strategy for Southern Taiwan", Atmos. Environ., 41, 9324-9340.

25. Chou, C. C. K., S. C. Liu, C.-Y. Lin, C.-J. Shiu, and K.-H. Chang, (2006): "The trends of surface ozone in Taipei, Taiwan, and its causes: Implications for ozone control strategies", Atmos. Environ., 40, 3898-3908.

26. Lin, C.-Y., S. C. Liu, C. C. K. Chou, T. H. Liu, C.-T. Lee, C.-S. Yuan, C.-J. Shiu, and C.-Y. Young, (2004): "Long-Range Transport of Asian Dust and Air Pollutants to Taiwan", Terrest. Atmos. Ocean. (TAO), 15, 759-784.

27. Liu, S. C., C.-H. Wang, C.-J. Shiu, H.-W. Chang, C.-K. Hsiao and S.-H. Liaw, (2002): "Reduction in Sunshine Duration over Taiwan: Causes and Implications", Terrest. Atmos. Ocean. (TAO), 13, 523-545.

28. Liu, S. C. and C.-J. Shiu, (2001): "Asian Dust Storms and Their Impact on the Air Quality of Taiwan", Aerosol and Air Quality Research, Vol. 1, No. 1, 1-8.

29. Shiu, C.-J. (1997): The Modeling Development of Atmospheric Particle Dry Deposition in Taichung Area. MS Thesis, 141pp. National Chung-Hsing University (in Chinese)

Other Activities

- Journal and project proposal reviewer:
  Journal: Geoscientific Model Development, Climate Dynamics, Journal of Climate, Geophysical Research Letter, Journal of Geophysical Research (Atmosphere), Quarterly Journal of Royal Meteorological Society, International Journal of Climatology, Journal of hydrometeorology, Journal of Atmospheric and Solar-Terrestrial Physics, Theoretical and Applied Climatology, Atmospheric Research, Terrestrial Ocean and Atmosphere, Terrestrial, Atmospheric, and Oceanic Sciences, Advances in Atmospheric Sciences, Atmosphere (MDPI), Aerosol and Air Quality Research, Journal of Marine Science and Technology
  Project proposal: National Science Council and the Ministry of science and Technology (Taiwan)
- Professional societies and organizations:
  American Geophysical Union, Asia Oceania Geosciences Society
- International atmospheric and oceanic field campaigns and research projects:
  Taiwan Earth System Model (TaiESM) has been enrolled in the CMIP6. I am responsible for all the three tier sets of simulations requested by the Cloud Feedback Model Intercomparison Project (CFMIP) and served as the corresponding person.

B. Major Achievements and Contributions (2016-present)

✓ **Development of Taiwan Earth System Model (TaiESM)**

For the past five years or so, I have been devoted to modeling works related to building a new earth system model i.e., the Taiwan Earth System Model (TaiESM) which is developed and modified

based on the Community Earth System Model (CESM version 1.2.2) of NCAR. These model development works include (a) tuning of TaiESM; (b) using TaiESM for participating CFMIP of CMIP6; (c) implementation of GTS cloud macrophysics into TaiESM; (d) implementation of warm cloud microphysics for convective clouds of TaiESM; (e) implementation of a full two-moment cloud microphysics for stratiform clouds of TaiESM; (f) unifying cloud macrophysics and cloud microphysics scheme of TaiESM; and (g) implementation of NASA Goddard radiative transfer scheme into TaiESM. The ultimate goal is to develop a General Circulation Model (GCM) capable of simulating more realistic aerosol-cloud-radiation interaction.

✓ **Collaborating with Principle Investigators of climate group of RCEC for scientific studies**

These studies include (a) development of a new parameterization for cross-tropopause water vapor transport in GCM; (b) investigating specific impacts resulted from individual changes in the physical parameterizations of TaiESM; (c) evaluation of a new K-Distribution scheme for CLIRAD radiative transfer scheme.; (d) examining diurnal cloud cycle simulated by TaiESM and NCAR CESM; (e) investigating changes in monsoon evolution resulted from changes in physical parameterizations of GCM and anthropogenic and natural external forcings; (f) developing a consistent framework of physical parameterization for simulating aerosol-cloud interactions in convective and stratiform clouds of GCMs; and (g) extreme precipitation changes under global warming.

✓ **Development of a synergy of different scale models for understanding cloud microphysical processes of climate model**

I have developed a synergy of different scale models with the same cloud and aerosol microphysical schemes to understand and evaluate how cloud microphysical processes can be influenced by different microphysical schemes and their interactions with aerosols and radiation. These models include Kinematic Driver (KiD), Single Column Model of Community Atmosphere Model (SCAM), Large Eddy Simulation (LES), and GCM model. Simulation results from these models will be further validated and compared to either field campaigns or satellite observations depending on the scale of the individual models. We have done a comparison of three different sets of warm cloud processes parameterization in KiD, SCAM and GCM and noticed that the synergetic models are useful for understanding features of individual microphysical parameterizations. Such type of synergy of models can be very useful for improvement, development and evaluation of physical parameterizations for global climate prediction and weather forecast in the near future especially for processes related to cloud macrophysics and microphysics.

✓ **Buildup of technical tools for evaluation of cloud and precipitation simulations**

I have been devoted to using satellite simulators for cloud comparisons and an innovated way of data analysis for understanding the spatial patterns of cloud fields associated with the moist processes. In addition to application of satellite simulators for cloud comparisons including in-line and off-line CFMIP Observation Simulator Package (COSP) and off-line Joint simulator called Joint-Simulator (Hashino et al., 2013), regime-dependent diagnosis of cloud fields and tendency terms of moist

processes against large-scale parameters are used to insight the relationship between cloud fields and various moist processes.

C. Future Plan

My near-future plans include (a) continuing developing the Unified Aerosol-Cloud-Convection-Precipitation parameterization (UACCP) for TaiESM; (b) refined calculation between the UACCP and radiative transfer scheme; (c) development of machine learning (or AI) approach for model tuning of TaiESM; (d) applications of the UACCP in TaiESM for various scientific topics; (e) contribution to the developments of Unified Model for multi-scale purposes; (f) contribution to understanding aerosol-cloud interactions in TaiESM; (g) contribution to disentangling the hot model issue of TaiESM; (h) contribution to climate and monsoon change studies; (i) contribution to climate downscaling studies; (j) contribution to establishment of global observational cloud datasets.