Curriculum Vitae

Yilun Han

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Professional Affiliation:

2024—Present	Postdoc Employee, Scripps Institution of Oceanography, University of California, San Diego, CA, USA
2022—2024	Research Associate, Department of Earth System Science, Tsinghua University, China

Education:

Ph.D.	2016—2022, Department of Earth System Science, Tsinghua University, China
B. Sc.	2012—2016, School of Atmospheric Science, Nanjing University, China

Research Interests and Experiences:

Primary Research Interest: Data-Driven Moist Physics Parameterization

Pioneered the integration of deep learning into climate modeling, having developed the first stable, AI-based convection parameterization for real-geography Global Climate Models (GCMs). My research trajectory, from initial 1D ResNet development validated offline against a high-fidelity Superparameterized GCM and integrated into a single-column model against field data (Han et al., 2020) to a full 3D model coupling (Wang et al., 2022; Han et al., 2023), has resulted in robust hybrid models that accurately simulate heavy rainfall and MJO dynamics. Participating in the U.S. Department of Energy's (DOE's) Scientific Discovery through Advanced Computing (SciDAC) program, my recent work (Han et al., 2025) demonstrated that a hybrid model can generate well in an unseen warm climate (+4K SST) and decadal simulations. This represents a key advancement for climate projection. Then, multiple strategies to reduce climatological biases at high latitudes in hybrid models are identified (Han et al., 2026a). Building on this, we developed another network for cloud cover and numbers, formed the model HyCAM, and refined the radiative heating, resulting in greatly improved performance, especially for precipitation (Han et al., 2026b). Later, HyCAM shows a realistic Madden-Julian Oscillation that matches observations, using historical SST in a 15-year simulation (Han et al., 2026c).

Secondary Research Interest: Subgrid Surface-Atmosphere Coupling

In-depth investigations were conducted to incorporate inhomogeneous land characteristics into atmospheric physics, specifically by implementing stochastic subgrid sensible and latent heat fluxes derived from land-type statistics (Sun et al., 2021; Yin et al., 2023). Additionally, a novel two-way explicit subgrid surface-atmosphere coupling framework was developed, spanning land units, ocean, and ice components. This framework proved essential for simulating scale-dependent processes, including urban rainfall intensification (Liu & Han et al., 2024) and low-level cloud enhancement over Arctic open water (Ma & Han et al., 2026).

Research Skills:

Experienced in running, code modifications, and new module development for climate models: CESM1&2, SPCAM, and E3SMv3. Use Fortran and Python for model development and TensorFlow, PyTorch, and scikit-learn for data-driven projects; additionally, use Python, NCL, and Matlab for analysis.

Refereed Publications and Manuscripts Under Review:

Han, Y., Zhang, G. J., & Wang, Y. (2026a). Exploring Ways to Reduce Biases in a Hybrid Global Climate Model With Machine-Learned Moist Physics. Journal of Advances in Modeling Earth Systems, 18(5), e2025MS005522.

Han, Y., Zhang, G. J., Song, X., Wang, Y., & Wan, H. (2026b). Enhancing Deep Learning Cloud Parameterization to Improve Hybrid GCM Simulation. Journal of Advances in Modeling Earth Systems, in review.

Han, Y., Zhang, G. J., Song, X., Wang, Y., & Wan, H. (2026c). Machine-learned convection produces a realistic simulation of Madden-Julian Oscillation in a hybrid global circulation model. Geophysical Research Letters. submitted.

Ma, Q., **Han, Y. (co-first)**, Lei, R., Liu, J., Yu Y,. Song, M., Xu S., Zhang, G. J., Zhang, R., Wang, Y. (2026). Improved simulation of seasonal variation of Arctic low clouds by resolving subgrid open water fluxes to the atmosphere in CESM2. Geophysical Research Letters, 53, e2025GL119467.

Han, Y., Zhang, G. J., Wang, Y., & Wan, H. (2025). A decadal hybrid GCM simulation using deep-learning-based cloud and convection parameterization generalized to a warm climate. *Journal of Advances in Modeling Earth Systems*, 17, e2025MS005231.

Wang, Y., Xia, W., **Han, Y.**, & Zhang, G. J. (2025). Progress and Perspective of Convection and Cloud Parameterizations in Numerical Models. *J Meteorol Res* 39, 593–607

Liu, S., **Han, Y. (co-first)**, Wang, P., Zhang, G. J., Wang, B., & Wang, Y. (2024). More heavy precipitation in World urban regions captured through a two-way subgrid land-atmosphere coupling framework in the NCAR CESM2. *Geophysical Research Letters*, 51, e2024GL108747.

Yu, S., Hannah, W., Peng, L., Lin, J., Bhouri, M. A., Gupta, R.,..., **Han, Y.**,... & Pritchard, M. (2024). ClimSim: A large multi-scale dataset for hybrid physics-ML climate emulation. *Advances in Neural Information Processing Systems*, 36.

Han, Y., Zhang, G. J., & Wang, Y. (2023). An ensemble of neural networks for moist physics processes, its generalizability and stable integration. *Journal of Advances in Modeling Earth Systems*, 15, e2022MS003508.

Yin, M., **Han, Y.**, Wang, Y., Sun, W., Deng, J., Wei, D., Kong, Y., & Wang, B. (2023). Climate impacts of parameterizing subgrid variation and partitioning of land surface heat fluxes to the atmosphere with the NCAR CESM1.2. Geosci. Model Dev., 16(1), 135-156.

Wang, X., **Han, Y. (co-corresponding)**, Xue, W., Yang, G., & Zhang, G. J. (2022). Stable climate simulations using a realistic general circulation model with neural network parameterizations for atmospheric moist physics and radiation processes. Geosci. Model Dev., 15(9), 3923-3940.

Sun, W., Wang, B., Wang, Y., Zhang, G. J., **Han, Y.**, Wang, X., & Yang, M. (2021). Parameterizing Subgrid Variations of Land Surface Heat Fluxes to the Atmosphere Improves Boreal Summer Land Precipitation Simulation With the NCAR CESM1.2. Geophysical Research Letters, 48(1), e2020GL090715.

Han, Y., Zhang, G. J., Huang, X., & Wang, Y. (2020). A Moist Physics Parameterization Based on Deep Learning. Journal of Advances in Modeling Earth Systems, 12(9), e2020MS002076.

International Conference:

Poster Presentation, American Geophysical Union (AGU) Fall Meeting, 2025; Oral Presentation, the 20th Asia Oceania Geosciences Society, 2023; Oral Presentation, the 14th International Conference on Mesoscale Convective Systems and High-Impact Weather in East Asia, 2021